

Project Special Provisions
Structure

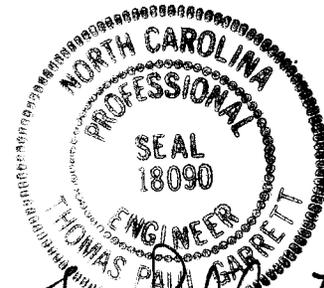
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Roy M. Giroulami
2-12-07

*except for sand lightweight concrete,
Shipping steel Structural Members &
Pier Protection Fendering*



Thomas Paul Garrett
2-9-07
*Excluding Drilled Piers &
Pier Protection Fendering*

PROJECT SPECIAL PROVISIONS
STRUCTURES

SECURING OF VESSELS

(10-12-01)

Secure vessels in accordance with Section 107 of the Standard Specifications and the following provision.

When utilizing barges, tugboats or other vessels, take all necessary precautions to ensure that such vessels are securely anchored or moored when not in active operation. Take all necessary measures to ensure that the vessels are operated in a manner that avoids damage to or unnecessary contact with bridges and other highway structures and attachments. If severe weather conditions are anticipated, or should be anticipated through reasonable monitoring of weather forecasts, take additional measures to protect bridges and other highway structures and attachments from extreme conditions. The Contractor is strictly liable for damages to any bridge or other highway structure or attachment caused by a vessel owned or controlled by the Contractor. The Contractor is also liable to third parties for property damages and loss of revenue caused by vessels under the Contractor's control.

DRILLED PIERS

(SPECIAL)

1.0 GENERAL

A. Description

This special provision governs the construction of Drilled Piers, also known as "Drilled Shafts" and "Caissons". Drilled piers are a reinforced concrete section, cast-in-place against in situ material or permanent steel casing. Drilled piers are a straight shaft type and vertical. Construct drilled piers in accordance with the details and dimensions shown on the plans and this provision.

B. Prequalification and Experience Requirements

Use a Drilled Pier Contractor prequalified by the Contractual Services Unit of the Department for drilled pier work (work code 3090).

Submit documentation that the Drilled Pier Contractor has successfully completed at least 5 drilled pier projects within the last 3 years with diameters, lengths and subsurface conditions similar to those anticipated for this project. Documentation should include the General Contractor and Owner's name and current contact information with descriptions of each past project. Also, submit documentation of experience with the use of slurry.

Provide a list of the Drilling Superintendent, Drill Rig Operators and Project Manager that will be assigned to this project. Submit documentation for these personnel verifying employment with the Drilled Pier Contractor and a minimum of 5 years experience in drilled pier construction with past projects of scope and complexity

similar to that anticipated for this project. Documentation should include resumes, references, certifications, project lists, experience descriptions and details, etc. Perform work with the personnel submitted and accepted. If personnel changes are required during construction, suspend drilled pier construction until replacement personnel are submitted and accepted.

C. Construction Sequence Plan

Submit two hard copies and an electronic copy (pdf or jpeg format on CD or DVD) of a drilled pier construction sequence plan for all the drilled piers 30 days before beginning drilled pier construction. Provide detailed project specific information in this plan including:

1. Experience documentation in accordance with Section 1.0, Item B
2. List and size of equipment including: cranes, kelly bars, drill rigs, vibratory hammers, augers, core barrels, cleanout buckets, airlifts and/or submersible pumps, tremies and/or concrete pumps, casing (diameters, thicknesses and lengths), desanding equipment, etc.
3. Order of drilled pier construction
4. Casing installation, drilled pier excavation and bottom cleaning methods
5. Reinforcement placement methods including how the cage will be supported and centered in the excavation
6. Concrete placement procedures including how the tremie or pump will be controlled and what type of discharge control will be used to prevent concrete contamination when the tremie or pump is initially placed in the excavation
7. Concrete mix design in accordance with Section 1000 of the Standard Specifications
8. Slurry details including intended purpose, product information, manufacturer's recommendations for use, slurry equipment information and written approval from the slurry supplier that the mixing water is acceptable
9. Procedures for handling drilling spoils and slurry overflow including environmental controls to prevent the loss of concrete, slurry and spoils
10. Methods of how the slurry level will be maintained above the highest piezometric head
11. Crosshole sonic logging (CSL) submittals in accordance with the Crosshole Sonic Logging Special Provision
12. Other information shown on the plans or requested by the Engineer

Do not begin drilled pier construction until the construction sequence plan is accepted. If alternate drilled pier construction procedures are proposed or necessary, a revised submittal may be required. If the work deviates from the accepted submittal without prior approval, the Engineer may suspend drilled pier construction until a revised drilled pier construction sequence plan is submitted and accepted.

D. Preconstruction Meeting

Conduct a drilled pier preconstruction meeting with the Project Manager, Drilling Superintendent, the Resident or Bridge Maintenance Engineer and/or his or her representatives, the Bridge Construction Engineer and the Geotechnical Operations Engineer to discuss construction and inspection of the drilled piers. This meeting should occur after the Drilled Pier Contractor has mobilized to the site and the construction sequence plan has been reviewed and accepted.

2.0 EXCAVATION

Perform the excavations required for the drilled piers to the dimensions and elevations shown on the plans or otherwise required by the Engineer, including any miscellaneous grading or excavation to install the pier.

Excavate with a drill rig of adequate capacity. Use a rig that is capable of drilling through soil, cemented sands, weathered rock, boulders, timbers, man-made objects and any other materials encountered.

Use a drill rig capable of drilling a minimum of 25% deeper than the deepest drilled pier shown on the plans. Use drilling tools equipped with vents designed to stabilize the hydrostatic pressure above and below the tool during extraction from the excavation. Monitor the rate at which the drilling tools are inserted and extracted so as to minimize sidewall suction action in the excavation. Drilling below the tip elevations shown on the plans may be required to achieve adequate bearing.

A drilling log signed by the Drilled Pier Contractor that includes material descriptions and depths and drilling times and tools used for each material is required for each pier.

Dispose of drilling spoils in accordance with Section 802 of the Standard Specifications and as directed by the Engineer. Drilling spoils consist of all excavated material including water removed from the excavation either by pumping or drilling tools. Construct drilled piers at the locations shown on the plans and within the tolerances specified herein. If tolerances are exceeded, the Engineer may require corrective measures to meet the tolerances specified. Construct the drilled piers such that the axis at the top of the piers is no more than 3 in (75 mm) in any direction from the position shown in the plans. Build drilled piers within 2% of the plumb deviation for the total length of the piers. Verify the plumbness of the drilled pier excavations by an accurate procedure, such as an inclinometer on the kelly bar or other approved techniques. Unless a plan note requires the construction joint to be moved below the ground line, construct the finished top of pier elevation between 1 in (25 mm) above and 3 in (75 mm) below the top of pier elevation shown on the plans.

When drilling from a barge, use a fixed template that maintains pier position and alignment during all excavation and concrete placement operations. Floating templates (attached to a barge) are not allowed.

Stabilize all drilled pier excavations with steel casing and slurry. Stabilize excavations at all times from the beginning of drilling through concrete placement.

The minimum diameter of an excavation may be 2 in (50 mm) less than the design drilled pier diameter shown on the plans. In order to remove a casing and substitute a larger diameter or longer casing through unstable or caving material, either backfill the excavation, stabilize the excavation with slurry before removing the casing to be replaced or insert the larger casing around the casing to be replaced before removal.

A. Permanent Steel Casing

Use permanent steel casings as directed by the Engineer and/or as required by a note on plans. Use permanent casings that are clean smooth non-corrugated watertight steel of ample strength to withstand handling and driving stresses and the pressures imposed by concrete, earth or backfill. Provide permanent steel casings conforming to ASTM A252, Grade 2 and the following minimum wall thickness requirements.

CASING WALL THICKNESS

Casing Diameter	Minimum Wall Thickness
Less than or equal to 48 in (1220 mm)	3/8 in (9 mm)
Greater than 48 in (1220 mm) and less than or equal to 78 in (1982 mm)	1/2 in (12 mm)
Greater than 78 in (1982 mm)	5/8 in (16 mm)

Provide permanent casings with an outside diameter not less than the specified size of the drilled pier. If approved by the Engineer, a permanent casing larger in diameter than the drilled pier design diameter is permitted. However, no payment will be made for any costs associated with larger permanent casings. Extend the permanent casings from the top of pier elevation or top of permanent casing elevation, if shown on the plans, to a depth no deeper than the permanent casing tip elevation shown on the plans or the revised permanent casing tip elevation approved by the Engineer. Do not extend permanent casings below the permanent casing tip elevation shown on the plans without prior approval from the Engineer. Additional drilled pier length and reinforcement may be required if permanent casings are extended below the permanent casing tip elevation shown on the plans. No payment will be made for the resulting additional drilled pier length, reinforcement and permanent casing unless the Engineer approves the revised permanent casing tip elevation. Install permanent casings in one continuous unit. If splices are necessary for the casing, use an approved method of splicing. Splices are considered incidental and no additional compensation will be made.

Remove any portion of the permanent steel casing that extends above the top of the drilled pier after the Drilled Pier Concrete has achieved a compressive strength of 4500 psi (31.0 MPa). The cost of casing removal will be considered incidental to the cost of the permanent steel casing.

B. Slurry

The use of polymer slurry may either be required or prohibited as noted on the plans. If polymer slurry use is not noted on the plans, polymer slurry use is an option.

If polymer slurry is required or an option, use one of the following polymers listed in the table below:

PRODUCT	MANUFACTURER
SlurryPro CDP	KB Technologies Ltd. 3648 FM 1960 West, Suite 107 Houston, TX 77068 (800) 525-5237
Super Mud	PDS Company 105 West Sharp Street El Dorado, AR 71730 (800) 243-7455
Shore Pac GCV	CETCO Drilling Products Group 1500 West Shure Drive Arlington Heights, IL 60004 (800) 527-9948
Novagel Polymer	Geo-Tech Drilling Fluids 220 North Zapata Hwy, Suite 11A Laredo, TX 78043 (210) 587-4758

Use polymer slurry and associated additives in accordance with the manufacturer’s guidelines and recommendations unless otherwise approved by the Engineer. The Drilled Pier Contractor should be aware that polymer slurry might not be appropriate for a given site. Polymer slurry should not be used for excavations in soft or loose soils as determined by the Engineer. When using polymer slurry, a representative of the manufacturer must be on-site to assist and guide the Contractor during the construction of the first three drilled piers unless otherwise approved by the Engineer. This representative must also be available for on-site assistance to the Contractor if problems are encountered during the construction of the remaining drilled piers as requested by the Engineer. The cost of all on-site assistance and representation will be considered incidental to the cost of the drilled piers.

If mineral slurry is required or an option, use mineral slurry composed of bentonite having a mineral grain size that remains in suspension and sufficient viscosity and gel

characteristics to transport excavated material to a suitable screening system to minimize bottom sedimentation. Provide bentonite slurry to maintain the stability of the excavation and allow for proper concrete placement. The Drilled Pier Contractor should be aware that salt water with salt concentrations in excess of 500 ppm may adversely affect bentonite slurry.

If permanent steel casing is not required, use temporary steel casing at the top of the excavation. Provide temporary casing a minimum of 10 ft (3m) long with a minimum wall thickness of 3/8 in (9 mm) and an outside diameter not less than the specified size of the drilled pier. Maintain the top of the temporary casing a minimum of 1 ft (300 mm) above the ground surface surrounding the casing.

Maintain the slurry in the pier excavation at a level not less than 5 ft (1.5 m) or the drilled pier diameter (whichever is greater) above the highest piezometric head along the depth of the pier. It is anticipated that the highest piezometric head is the static water or groundwater elevation (elevation head). However, the Drilled Pier Contractor is responsible for determining the highest piezometric head. The use of steel casing to maintain the required slurry level is permitted; however, no payment will be made for casing that is used for this purpose. If the slurry level in the excavation suddenly changes or cannot be practically maintained, or the slurry construction method does not produce the desired result, stop the pier construction until an alternate construction procedure is accepted by the Engineer.

Thoroughly premix the slurry with water in tanks before introducing the slurry into the excavation. Submit written approval from the slurry supplier that the mixing water is acceptable. Allow bentonite slurry to hydrate 24 hours in tanks before use. Slurry tanks of adequate capacity are required for slurry circulation, storage and treatment. Excavated slurry pits are not allowed in lieu of slurry tanks without prior approval from the Engineer. Take all steps necessary to prevent the slurry from "setting up" in the excavation. Such methods include, but are not limited to agitation, circulation and/or adjusting the properties of the slurry. Perform desanding operations as necessary to achieve the acceptable sand contents before placing reinforcing steel.

1. Time

Adjust the excavation operations so that the maximum time the slurry is in contact with the sidewalls of the uncased portions of the drilled pier excavation (from time of drilling to concrete placement) does not exceed 36 hours. Do not work on more than two drilled piers per drill rig below the steel casing at any time.

Agitate bentonite slurry in the drilled pier excavations a minimum of every 4 hours. If the bentonite slurry is not agitated a minimum of every 4 hours or the 36 hour time limit is exceeded, the Engineer may require the excavation to be overreamed beneath the steel casing a minimum of 1 in (25 mm) and a maximum of 3 in (75 mm) before performing any other operations in the excavation. Overream with a grooving tool, overreaming bucket or other approved equipment at a minimum spacing of 12 in (300 mm). All costs associated with both overreaming and the

resulting additional concrete placement will be considered incidental to the cost of the drilled piers.

If concrete placement is not completed within three days of beginning drilling, enlarge the design drilled pier diameter by a minimum of 6 in (150 mm), or as required by the Engineer, the entire length of the pier at no additional cost to the Department. Enlarging the drilled pier includes replacing the steel casing with steel casing the same size to which the drilled pier is enlarged at no additional cost to the Department.

2. Sampling

Collect all slurry samples using an approved sampling tool. Test slurry samples to determine density, viscosity, pH and sand content to establish an acceptable working pattern during slurry use. Test a minimum of 4 samples during each 8 hours of slurry use for each drilled pier. Take the first sample for the first 8 hours from the slurry tank before introducing slurry into the excavation. Collect the remaining samples from the bottom of the pier excavation. When the test results are acceptable and consistent, a decrease in the testing frequency to one sample per 4 hours of slurry use is permitted.

Before placing reinforcing steel in the drilled pier excavation, extract slurry samples from the bottom of each excavation and at intervals not exceeding 10 ft (3 m) up the excavation, until two consecutive samples produce acceptable values for density, viscosity, pH and sand content.

3. Testing

Have qualified personnel conduct slurry tests to determine density, viscosity, pH and sand content. The following tables show the acceptable range of values for the slurry properties:

BENTONITE SLURRY
Sodium Montmorillonite (Commercial Bentonite)
Acceptable Range of Values

Property (units)	At Time of Slurry Introduction	In Excavation Immediately Before Concrete Placement	Test Method
Density, pcf (kg/m ³)	64.3 – 69.1 (1030-1107)	64.3 – 75.0 (1030-1201)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	28 – 45	28 – 45	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8 – 11	8 – 11	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 4	Less than or equal to 2	Sand API 13B-1 Section 5

Notes:

1. Perform tests when the slurry temperature is above 40°F (4.4°C).
2. Increase density by 2 pcf (32 kg/m³) in saltwater.

SLURRYPRO CDP
KB Technologies Ltd.
Acceptable Range of Values

Property (units)	At Time of Slurry Introduction	In Excavation Immediately Before Concrete Placement	Test Method
Density, pcf (kg/m ³)	Less than or equal to 67 (1073)	Less than or equal to 64 (1025)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	50 – 120	Less than or equal to 70	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	6 – 11.5	6 – 11.5	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 0.5	Less than or equal to 0.5	Sand API 13B-1 Section 5

Notes:

1. Perform tests when the slurry temperature is above 40°F (4.4°C).
2. Increase density by 2 pcf (32 kg/m³) in saltwater.

SUPER MUD PDS Company Acceptable Range of Values			
Property (units)	At Time of Slurry Introduction	In Excavation Immediately Before Concrete Placement	Test Method
Density, pcf (kg/m ³)	Less than or equal to 64 (1025)	Less than or equal to 64 (1025)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	32 – 60	Less than or equal to 60	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8 – 10	8 – 10	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 0.5	Less than or equal to 0.5	Sand API 13B-1 Section 5
Notes:			
1. Perform tests when the slurry temperature is above 40°F (4.4°C). 2. Increase density by 2 pcf (32 kg/m ³) in saltwater.			

SHORE PAC GCV
CETCO Drilling Products Group
Acceptable Range of Values

Property (units)	At Time of Slurry Introduction	In Excavation Immediately Before Concrete Placement	Test Method
Density, pcf (kg/m ³)	Less than or equal to 64 (1025)	Less than or equal to 64 (1025)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	33 – 74	Less than or equal to 57	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8 – 11	8 – 11	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 0.5	Less than or equal to 0.5	Sand API 13B-1 Section 5

Notes:

1. Perform tests when the slurry temperature is above 40°F (4.4°C).
2. Increase density by 2 pcf (32 kg/m³) in saltwater.

NOVAGEL POLYMER Geo-Tech Drilling Fluids Acceptable Range of Values			
Property (units)	At Time of Slurry Introduction	In Excavation Immediately Before Concrete Placement	Test Method
Density, pcf (kg/m ³)	Less than or equal to 67 (1073)	Less than or equal to 64 (1025)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	45 – 104	Less than or equal to 104	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	6.5 – 11.5	6.5 – 11.5	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 0.5	Less than or equal to 0.5	Sand API 13B-1 Section 5
Notes:			
1. Perform tests when the slurry temperature is above 40°F (4.4°C).			
2. Increase density by 2 pcf (32 kg/m ³) in saltwater.			

When any slurry samples are found to be unacceptable, take whatever action is necessary to bring the slurry within specification requirements. Do not place reinforcement steel until resampling and testing produce acceptable results.

Sign and submit reports of all slurry tests required above to the Engineer upon completion of each drilled pier. The Department reserves the right to perform comparison slurry tests at any time.

4. Slurry Disposal

Comply with all applicable local, state and federal regulations, as well as with the environmental permits of the project when disposing of excavated materials contaminated with slurry. Keep all excavated materials, spoils from the desanding unit and slurry out of the water and contain them at all times. The cost of the containment, removal and disposal of excavated materials contaminated with slurry, as well as the slurry itself, is incidental to the cost of the drilled piers.

3.0 CLEANING

Excavate the bottom of the drilled pier to a level plane or stepped with a maximum step height of 12 in (300 mm). Clean the bottom of the excavation of loose material using a technique accepted in the construction sequence plan. At a minimum, clean the bottom of the excavation with a cleanout bucket and an airlift or submersible pump.

4.0 INSPECTION METHODS AND REQUIREMENTS

After the drilled pier excavation is complete and immediately before placing reinforcing steel and concrete, demonstrate the proper condition of the drilled pier excavation to the Engineer. Provide weighted tape measures, steel probes, personnel and all assistance required for the Engineer to inspect the drilled pier excavations.

A. Bearing Capacity

If the required end bearing capacity is not satisfied, increase the drilled pier length as directed by the Engineer. Payment for the additional drilled pier length to achieve adequate bearing will be made per the drilled pier pay items.

A standard penetration test (SPT) may be required to verify the conditions and continuity of the bearing material before placing reinforcing steel. When noted on the plans that a SPT is required, drive a split barrel sampler a minimum of 18 in (450 mm) below the drilled pier tip elevation or to refusal in accordance with ASTM D1586, "Penetration Test and Split-Barrel Sampling of Soils". Complete the SPT using NW rods through casing or another stabilizing method as approved by the Engineer. Extend the SPT rods from the top of the drilled pier excavation to the drilled pier tip elevation. Firmly support the SPT casing at the top of the drilled pier excavation and rest it on the bottom of the excavation. Conduct the SPT a minimum of 12 in (300 mm) away from the sidewalls of the excavation and be sure not to scrape the sidewalls of the excavation

while inserting or withdrawing the SPT equipment. Have the SPT device on-site before reaching the drilled pier tip elevation. Report the number of blows for each 6 in (150 mm) increment driven and a description of the recovered soil sample to the Engineer. The Engineer determines the number of blows required for bearing.

B. Bottom Cleanliness

The pier excavation bottom is considered clean if a minimum of 50% of the bottom area has less than 1/2 in (13 mm) of sediment and no portion of the bottom area has more than 1-1/2 in (38 mm) of sediment as determined by the Engineer.

One or more of the following inspection procedures may be used to inspect the cleanliness of the pier excavation bottom before placing the reinforcing steel and concrete.

1. Steel Probe

Lower a steel probe to the bottom of the drilled pier excavation to ensure that cleaning has been satisfactorily completed. Supply a steel probe that is 2 ft (0.6 m) long with a flat tip on the sounding end, weighs approximately 9 lbs, #10 rebar (4 kg, #32 rebar), and is suspended from the opposite end with a non-stretch cable.

2. Shaft Inspection Device (SID)

The Department may use the SID to take sediment measurements and observe the bottom conditions of the drilled pier excavation at a minimum of five locations selected by the Engineer. The SID is a remotely operated camera capable of observing bottom conditions and measuring sediment underwater and slurry. Each SID inspection (including all 5 locations) takes approximately 1 hour after the equipment has been set up. The Engineer provides the SID and the personnel to operate the device. Notify the Engineer a minimum of 2 days before beginning the drilled pier excavation so the Engineer can arrange for the transportation of the SID to the site and the personnel to perform the inspections. SID inspections are required until the cleanliness of the drilled pier excavation bottom is acceptable in accordance with Section 4.0, Item B of this provision. Do not conduct operations that interfere with the SID inspections. Remove all cleaning and drilling equipment from the drilled pier excavation during any SID inspection. Provide a working area large enough for the SID equipment and within reach of the cabling supplied and clear sight distance of the drilled pier excavation. Assist the Engineer in the transportation and handling of the SID and all the associated equipment and in supporting the electric hoist and/or hoisting tripod for the SID. If required, provide a safe and secure location to park the trailer for the SID while it is unattended on the project site. If any of the SID equipment is damaged due to the Contractor's negligence, then replace the equipment at no additional cost to the Department. Provide replacement equipment that exactly matches the damaged equipment as directed by the Engineer. All costs involved with the initial SID inspection of each drilled pier excavation will be made per the SID pay item. No additional payment

will be made for subsequent or repeated SID inspections of the same drilled pier excavation. No claims for either lost time or actual expense of any SID inspections that do not find the cleanliness of the drilled pier excavation bottom in compliance with this provision will be paid.

5.0 REINFORCING STEEL

Reinforcing steel shall conform to Section 1070 of the Standard Specifications. Completely assemble a cage of reinforcing steel, consisting of longitudinal and spiral bars and place it in the drilled pier excavation as a unit immediately after the proper condition of the excavation is demonstrated to the Engineer. When concrete placement does not follow immediately after cage placement, remove the steel from the pier excavation unless the Engineer directs otherwise. If the cage is removed, recheck pier excavation cleanliness in accordance with this provision before reinstalling the cage.

A. Construction, Placement, Support and Alignment

If it is determined in the field that the drilled pier must be longer, adequate reinforcement may be required in the extended length as directed by the Engineer. Lift the cage so racking and cage distortion does not occur. Keep the cage plumb during concrete operations and casing extraction. Check the position of the cage before and after placing the concrete. Position the splice length of the drilled pier cage so that the column or footing has the minimum concrete cover shown on the plans.

Securely cross-tie the vertical and spiral reinforcement at each intersection with double wire. Support or hold down the cage so that the vertical displacement during concrete placement and casing extraction does not exceed 6 in (150 mm).

B. Bolsters and Spacers

Set the rebar cage directly on the bottom of the drilled pier excavation with plastic bolsters under each vertical reinforcing bar. Ensure that spacers are tall enough to raise the rebar cage off the bottom of the drilled pier excavation a minimum of 3 in (75 mm). If approved by the Engineer, the rebar cage may be hung in the excavation provided the mechanisms supporting the cage are left in place until the Drilled Pier Concrete strength has achieved 3000 psi (20.7 MPa).

In order to ensure the minimum required concrete cover and achieve concentric spacing of the cage within the pier, attach plastic spacer wheels at five points around the cage perimeter. Use spacer wheels that provide a minimum of 2 in (50 mm) "blocking" from the outside face of the spiral bars to the outermost surface of the drilled pier. Tie spacer wheels that snap together with wire and allow them to rotate. Use spacer wheels that span at least two adjacent vertical bars. Start placing spacer wheels at the bottom of the cage and continue up along its length at maximum 10 ft (3 m) intervals.

6.0 CONCRETE

Drilled Pier Concrete shall conform to Section 1000 of the Standard Specifications. Begin concrete placement immediately after inserting reinforcing steel into the drilled pier excavation.

A. Concrete Mix

As an option, use Type IP blended cement with a minimum cement content of 665 lbs/yd³ (395 kg/m³) and a maximum cement content of 833 lbs/yd³ (494 kg/m³). Use No. 78M coarse aggregate in the mix.

Use an approved water-reducer, water-reducing retarder, high-range water-reducer or high-range water-reducing retarder to facilitate placement of the concrete if necessary. Do not use a stabilizing admixture as a retarder in Drilled Pier Concrete without approval of the Engineer. Use admixtures that satisfy AASHTO M194 and add them at the concrete plant when the mixing water is introduced into the concrete. Redosing of admixtures is not permitted.

B. Concrete Placement

Place concrete such that the drilled pier is a monolithic structure. Vibration is only permitted, if needed, in the top 10 ft (3 m) of the drilled pier. Remove any contaminated concrete from the top of the drilled pier at the time of concrete placement. Contain and remove all wasted concrete that spills over the casing.

Maintain a static slurry level in the excavation before placing concrete underwater. Pump concrete in accordance with Article 420-5 of the Standard Specifications. Use a steel tremie with a minimum diameter of 10 in (250 mm) and watertight joints or a pump pipe to place concrete. Use a discharge control to prevent concrete contamination when the tremie tube or pump pipe is initially placed in the excavation. Extend the tremie tube or pump pipe into the concrete a minimum of 5 ft (1.5 m) at all times except when the concrete is initially introduced into the pier excavation. If the tremie tube or pump pipe pulls out of the concrete for any reason after the initial concrete is placed, restart concrete placement with a steel capped tremie tube or pump pipe.

Place concrete within the time frames specified in Table 1000-2 of the Standard Specifications for Class AA concrete. Do not place concrete so fast as to trap air, slurry, water, fluids, soil or any other deleterious materials in the vicinity of the reinforcing steel and the annular zone between the rebar cage and the excavation walls.

Keep a record of the volume of concrete placed in each drilled pier excavation and make it available to the Engineer. Record a graphical plot of the depth versus theoretical concrete volume and actual measured concrete volume for each drilled pier and provide it to the Engineer when finished placing concrete.

7.0 SCHEDULING AND RESTRICTIONS

If caving or sloughing occurs, compensation will not be provided for additional concrete to fill the resulting voids.

For the first 16 hours after a drilled pier has achieved its initial concrete set (as determined by the Engineer), do not drill adjacent piers, do not install adjacent piles, and do not allow any equipment wheel loads or "excessive" vibrations within 20 ft (6 m) of the drilled pier.

In the event that the procedures described herein are performed unsatisfactorily, the Engineer may suspend drilled pier construction in accordance with Article 108-7 of the Standard Specifications. If the integrity of the drilled pier is in question, the Engineer reserves the right to reject the drilled piers and require remediation. Remedial measures are proposed by the Contractor and require approval of the Engineer. No compensation will be paid for losses or damage due to remedial work or any investigation of drilled piers found defective or not in accordance with this provision or the plans.

8.0 MEASUREMENT AND PAYMENT

A. Method of Measurement

1. Drilled Piers

The quantity of "Drilled Piers" to be paid for will be the linear feet (meters) of the drilled piers computed from elevations and dimensions as shown on the plans or from revised dimensions authorized by the Engineer.

2. Permanent Steel Casing

The quantity of "Permanent Steel Casing" to be paid for will be the linear feet (meters) of permanent steel casing as directed or required to be used. The length to be paid for will be measured along the permanent casing from the top of the casing elevation or top of the pier elevation, whichever is lower, to the permanent casing tip elevation. The Department will also pay for up to an additional 3 ft (1 m) of permanent casing cut off if the casing can not be installed to the permanent casing tip elevation shown on the plans. Permanent casing will be paid for only when permanent casing is authorized or when the Engineer directs the Contractor to leave a casing in place such that it becomes a permanent part of the pier.

3. Shaft Inspection Device (SID)

The quantity of "SID Inspection" to be paid for will be per drilled pier as noted on the plans and/or directed by the Engineer. SID inspections are performed until the bottom cleanliness of the drilled pier excavation is acceptable by this provision; however, payment will only be made for the initial SID inspection of each drilled pier excavation.

4. Standard Penetration Test (SPT)

The quantity of "SPT Testing" to be paid for will be the actual number of SPT tests performed as noted on the plans and/or directed by the Engineer.

B. Basis of Payment

1. Drilled Piers

Payment will be made at the contract unit price per linear foot (meter) for "____ Dia. Drilled Piers". Such payment will include, but is not limited to, furnishing all labor, tools, equipment, materials including concrete complete and in place and all incidentals necessary to excavate the drilled piers through any material encountered and complete the work as described in this provision. No additional payment will be made for any miscellaneous grading or excavation to install the drilled pier. "Reinforcing Steel" and "Spiral Column Reinforcing Steel" will be paid for separately and will not be part of the unit bid price for "Drilled Piers".

2. Permanent Steel Casing

Payment will be made at the contract unit price per linear foot (meter) for "Permanent Steel Casing for ____ Dia. Drilled Pier". Such payment will include, but is not limited to, furnishing all material, labor, tools, equipment and all incidentals necessary to install the casing in the pier excavation.

3. Shaft Inspection Device (SID)

Payment for SID will be at the contract unit price per each for "SID Inspection". Such payment will include, but is not limited to, furnishing all materials, labor, tools, equipment and all incidentals necessary to complete the SID inspection as described in this provision.

4. Standard Penetration Test (SPT)

Payment for SPT will be at the contract unit price per each for "SPT Testing". Such payment will include, but is not limited to, furnishing all materials, labor, tools, equipment and all incidentals necessary to complete the SPT at each test location.

CROSSHOLE SONIC LOGGING

(7-18-06)

1.0 GENERAL

Use the non-destructive testing method called Crosshole Sonic Logging (CSL) to verify the integrity of the drilled pier and the quality of the concrete. The Engineer will determine the number of CSL tests and which drilled piers will be CSL tested. Drilled piers are referred to as piers in this special provision.

The CSL test measures the time for an ultrasonic pulse to travel from a signal source in one access tube to a receiver in another access tube. In uniform, good quality concrete, the travel time between equidistant tubes should yield relatively consistent arrival times and correspond to a reasonable pulse velocity, signal amplitude and energy from the bottom to the top of the pier. Longer travel times, decrease in pulse velocity and lower amplitude/energy signals indicate the presence of irregularities such as poor quality concrete, voids, honeycombing, cracking and soil intrusions. The signal may be completely lost by the receiver and CSL recording system for severe defects such as voids and soil intrusions.

The CSL Consultant shall have a minimum 3 years experience of CSL testing and have a Registered North Carolina Professional Engineer supervising the testing and interpretation of results. Submit the proposed CSL Consultant for approval 30 days before beginning drilled pier construction. The following evidence of qualification is required, unless the Department previously approved the consultant and no changes have occurred since previous submittal:

- Written evidence of successful completion of CSL tests, brief descriptions and reference's phone numbers for three recent CSL projects.
- Personnel qualifications
- Equipment description
- Example report

Make all necessary arrangements with the CSL Consultant to have the CSL tests satisfactorily performed on the selected drilled piers in accordance with this provision. The CSL Consultant shall supply the Contractor with technical instruction and guidance in preconstruction activities and on-site technical assistance and guidance during set up and performance of the CSL tests. Provide suitable access to the site and to the top of piers to be tested. Follow instructions from the CSL Consultant unless directed otherwise by the Engineer.

Place CSL tubes in all drilled piers. Perform CSL testing only on drilled piers selected by the Engineer a minimum 7 days after concrete placement and after concrete achieves a minimum compressive strength of 3000 psi (20.7 MPa), but within 30 days after concrete placement. After CSL test results have been reviewed and the Engineer has accepted the drilled pier, dewater the tubes and core holes, if any, and fill with an approved grout. If the Engineer elects not to CSL test a pier, obtain approval from the Engineer to dewater the tubes and fill them with an approved grout. Provide, mix and place grout in accordance with the Grout for Structures Special Provision.

2.0 PREPARATION FOR CSL

Submit the grout mix design or packaged grout type, the CSL tube size, manufacturer's certificate of compliance, cap details, couplings, any joint details and the proposed method of attaching the tubes in accordance with the Drilled Piers Special Provision.

Install four tubes in each drilled pier with a diameter of 5 ft (1524 mm) or less and six tubes in each pier with a diameter of greater than 5 ft (1524 mm). Provide 2 in (50 mm) inside diameter Schedule 40 steel pipe conforming to ASTM A53, Grade A or B, Type E, F, or S. The tubes shall have a round, regular internal diameter free of defects or obstructions, including any at tube joints, in order to permit the free, unobstructed passage of source and receiver probes. The tubes shall provide a good bond with the concrete and be watertight.

Fit the tubes with a watertight threaded cap on the bottom and a removable threaded cap on the top. Securely attach the tubes to the interior of the reinforcement cage. Install the tubes in each drilled pier in a regular, symmetric pattern such that each tube is equally spaced from the others around the perimeter of the cage. Place tubes such that large vertical reinforcing bars do not block the direct line between adjacent tubes. The tubes are typically wire-tied to the reinforcing cage every 3 ft (1 m) or otherwise secured such that the tubes remain in position during placement of the rebar cage and the concrete. Install tubes as near to vertical and as parallel as possible, **as non-vertical tubes can adversely affect data analysis**. Extend the tubes from 6 in (150 mm) above the pier tip to at least 3 ft (1 m) above the top of the pier. If the pier top elevation is below ground elevation, extend tubes at least 2 ft (610 mm) above ground surface. If the drilled pier tip elevation is excavated more than 1 ft (305 mm) below the tip elevation shown on the plans, extend the tubes using proper threaded mechanical couplings to within 6 in (150 mm) of the revised pier tip elevation.

Before placement of the reinforcement cage into the drilled pier, record the tube lengths and tube positions along the length of the cage. After concrete placement, measure the stickup of the tubes above the top of the drilled piers and verify tube spacing.

After placement of the reinforcement cage and before concrete placement, fill the CSL tubes with clean water and cap them to keep out debris. CSL tubes that are not filled with water and capped will be rejected. When removing the caps, use care not to apply excess torque, force or stress, which could break the bond between the tubes and the concrete.

Verify that unobstructed passage of the probes is achievable before the CSL Consultant arrives on site. If testing equipment will not pass through the entire length of the CSL tube, core a 2 in (50 mm) diameter hole through the concrete the full length of the drilled pier at no cost to the Department. Locate the core hole approximately 9 in (230 mm) inside the pier reinforcement from obstructed tube or as determined by the Engineer. Fill core hole with clean water and cover to keep out debris.

3.0 CSL EQUIPMENT

The minimum requirements of the CSL equipment are as follows:

- A microprocessor based CSL system for display of individual CSL records, analog-digital conversion and recording of CSL data, analysis of receiver responses and printing of report quality CSL logs
- Ultrasonic source and receiver probes which can travel through 2 in (50 mm) I.D. steel pipe

- An ultrasonic voltage pulser to excite the source with a synchronized triggering system to start the recording system
- A depth measurement device to electronically measure and record the source and receiver depths associated with each CSL signal
- Appropriate filter/amplification and cable systems for CSL testing
- An acquisition system that stores each log in digital format, with drilled pier identification, date, time and test details, including the source and receiver gain. Display arrival time data graphically during data acquisition.
- 3D tomographic imaging software, or source for completing the work

4.0 CSL TEST PROCEDURE

Provide the Engineer and CSL Consultant with the following:

- Tube lengths and positions
- Record of the drilled pier construction information including the pier bottom and top elevations
- Construction dates before CSL testing

Conduct CSL tests between each perimeter pair and major principal diameter and log, unless directed otherwise by the Engineer.

Perform the CSL testing with the source and receiver probes in the same horizontal plane unless test results indicate defects or poor concrete zones, in which case, further evaluate the defect zones with angle tests (source and receiver vertically offset at greater than 1.5 ft (460 mm) in the tubes). Report any defects indicated by decreased signal velocity and lower amplitude/energy signals at the time of testing and conduct angle tests in the zones of the defects as defined by the Concrete Condition Rating Criteria (CCRC) in Section 5.0 of this provision. Make CSL measurements at depth intervals of 2.5 in (65 mm) or less from the bottom of the tubes to the top of each pier. Pull the probes simultaneously, starting from the bottom of the tubes, using a depth-measuring device to electronically measure and record the depths associated with each CSL signal. Remove any slack from the cables before pulling to provide for accurate depth measurements of the CSL records. In the event defects are detected, conduct additional logs, as needed, at no additional cost to the Department. The Department will not accept any claims for either lost time or the actual expense of further investigation of defects.

If steel tube debonding occurs, then core drill a 2 in (50 mm) diameter hole to the depth of debonding for each debonded tube in order to perform the CSL logs at no additional cost to the Department.

5.0 CSL RESULTS AND REPORTING

Submit the CSL test results in both electronic and hard copy form including two original copies of CSL report within 5 working days of completion of CSL testing. The CSL report should include but not limited to the following:

- Project identification
- Dates of testing
- Table and a plan view of each pier tested with accurate identification of tube coordinates and tubes referenced to the site
- Tube collar elevation
- Names of personnel that performed the tests/interpretation and their affiliation
- Equipment used
- Interpretation, analysis and results

Include CSL logs for each tube pair tested with analysis of the initial pulse arrival time, velocity, relative pulse energy/amplitude and stacked waveform plotted versus depth. List all zones defined by the Concrete Condition Rating Criteria (CCRC) in a tabular format including the percent velocity reduction and the velocity values used from the nearby zone of good quality concrete. Discuss each zone defined by the CCRC in the CSL report as appropriate. Base the results on the percent reduction in velocity value from a nearby zone of good quality concrete with good signal amplitude and energy as correlated to the following:

Concrete Condition Rating Criteria (CCRC)			
CCRC	Rating Symbol	Velocity Reduction	Indicative Results
Good	G	≤ 10 %	Good quality concrete
Questionable Defect	Q	>10 % & < 20 %	Minor concrete contamination or intrusion. Questionable quality concrete.
Poor	P/D	≥ 20 %	Defects exist, possible water/slurry contamination, soil intrusion and/or poor quality concrete.
No Signal	NS	No Signal received	Soil intrusion or other severe defect absorbed the signal (assumes good bond of the tube-concrete interface).
Water	W	V = 4750 fps (1450 mps) to 5000 fps (1525 mps)	Water intrusion or water filled gravel intrusion with few or no fines present.

The following are a few examples of types and causes of defects:

- Necking or arching of the concrete on withdrawal of the temporary casing.
- Necking or contamination of the concrete due to collapse of the side walls.
- Soft toe due to incomplete cleaning or collapse of the side walls.
- Horizontal lenses of silt\mud\slurry due to the tremie pipe rising above the concrete.
- Voids due to the use of low-slump concrete.
- Honeycombing due to washout of fines.
- Trapping of contaminants due to pumping concrete to fast.

Provide the original pulse signal data files and ASCII format of the picks with a header (identifying the pier tested, tube coordinates and each data column) in an electronic file. The Engineer will require 5 working days to evaluate the CSL test results and determine whether or not the drilled pier is acceptable. Evaluation of CSL test results, with ratings other than good (G) per the Concrete Condition Rating Criteria (CCRC) may require further investigation and additional time for review and analysis of the data. Do not grout the CSL tubes or perform any further work on the CSL tested drilled pier until the Engineer determines whether the drilled pier is acceptable. Perform tomography in order to further investigate and delineate the boundaries of any defective/unconsolidated zones with 20% or more reduction in velocity value as correlated to the CCRC. Process CSL data to construct easy to understand 2D/3D (2D cross-sections between tubes and 3D volumetric images for the entire pier) *color-coded* tomographic images indicating velocity variations along the

pier. Identify the location and geometry of defective/unconsolidated zones in 3D color images with detailed discussion in the CSL report. Any further tests deemed necessary by the Engineer in order to determine the acceptability of the drilled pier will be determined after reviewing the CSL report. Additional test or analysis options include 3D tomographic imaging, single-hole sonic testing, sonic echo or impact response tests and concrete coring.

The Engineer determines the depth, location, diameter (PQ or NQ size) and number of core holes when concrete coring is required. If the Engineer is concerned about concrete strength or requires the use of a borehole camera for inspection, large diameter cores (PQ size) are required. Drill a minimum of two core holes to intercept the suspected defect zones. Use a coring method that provides maximum core recovery and minimizes abrasion and erosion. Provide concrete cores properly marked in a wooden crate labeled with the drilled pier depth at each interval of core recovery to the NCDOT Materials and Test Unit for evaluation and testing. Submit coring records, signed by the Contractor that include NCDOT project number, name of the Drilling Contractor, date cored and percent core recovery. Allow 5 working days after submitting the core records for the Department's review.

6.0 CORRECTION OF UNACCEPTABLE DRILLED PIER

When the Engineer determines a drilled pier is unacceptable, submit remedial measures to the Department for approval. No compensation will be made for remedial work or losses or damage due to remedial work of drilled piers found defective or not in accordance with the Drilled Piers Special Provision or the plans. Modifications to the drilled pier design or any load transfer mechanisms required by the remedial action shall be designed by a Registered North Carolina Professional Engineer. Include supporting calculations and drawings sealed by a Registered North Carolina Professional Engineer for all foundation elements affected. Do not begin remedial action work until the Department has reviewed and accepted the remedial action plan. Allow 5 working days after submitting the remedial work plan for the Department's review and acceptance. Furnish all materials and work necessary to correct defective drilled piers.

7.0 MEASUREMENT AND PAYMENT

The complete and accepted CSL will be paid for at the unit bid price for "Crosshole Sonic Logging" per each. The Department will only pay for the initial CSL test on a drilled pier; no additional payment will be made for subsequent CSL tests performed on the same drilled pier. Include in this unit bid price all costs incurred for procurements, conducting the CSL testing, reporting of results and incidentals necessary to complete the work including any other test required to determine the acceptability of the drilled pier.

Include the cost of the crosshole sonic logging tubes in the unit bid price for drilled piers. No separate payment will be made for the CSL tubes. The unit bid price for the drilled piers will include full compensation for furnishing, installing, extending tubes, dewatering and grouting of all CSL tubes and core holes, if applicable, and all materials, labor, tools, equipment and incidentals necessary to complete the work.

THERMAL SPRAYED COATINGS (METALLIZATION)**(SPECIAL)****1.0 DESCRIPTION**

Apply a thermal sprayed coating (TSC) and sealer to metal surfaces as specified herein when called for on the plans or by other Special Provisions, or when otherwise approved by the Engineer in accordance with the SSPC-CS 23.00/AWS C2.23/NACE No. 12 Specification. Only Arc Sprayed application methods are used to apply TSC coatings, the Engineer must approve other methods of application.

2.0 QUALIFICATIONS

Only use NCDOT approved TSC Contractors meeting the following requirements:

1. Who have the capability of blast cleaning steel surfaces to SSPC SP-5 and SP-10 Finishes.
2. Who employ a Spray Operator(s) qualified in accordance with AWS C.16/C2.16M2002 and a Quality Control Inspector(s) who have documented training in the applicable test procedures of ASTM D-3276 and SSPC-CS 23.00.

A summary of the contractor's related work experience and the documents verifying each Spray Operator's and Quality Control Inspector's qualifications are submitted to the Engineer before any work is performed.

3.0 MATERIALS

Provide wire in accordance with the metallizing equipment manufacturer's recommendations. Use the wire alloy specified on the plans which meets the requirements in Annex C of the SSPC-CS 23.00 Specification. Have the contractor provide a certified analysis (NCDOT Type 2 Certification) for each lot of wire material.

Apply an approved sealer to all metallized surfaces in accordance with Section 9 of SSPC-CS 23. The sealer must either meet SSPC Paint 27 or is an alternate approved by the Engineer.

4.0 SURFACE PREPARATION AND TSC APPLICATION

Grind flame cut edges to remove the carbonized surface prior to blasting. Bevel all flame cut edges in accordance with Article 442-10(D) regardless of included angle. Blast clean surfaces to be metallized with grit or mineral abrasive in accordance with Steel Structures Painting Council SSPC SP-5/10(as specified) to impart an angular surface profile of 2.5 - 4.0 mils (0.063 - 0.100 mm). Surface preparation hold times are in accordance with Section 7.32 of SSPC-CS 23. If flash rusting occurs prior to metallizing, blast clean the metal surface again. Apply the thermal sprayed coating only when the surface temperature of the steel is at least 5°F (3°C) above the dew point.

At the beginning of each work period or shift, conduct bend tests in accordance with Section 6.5 of SSPC-CS 23.00. Any disbonding or delamination of the coating that exposes the substrate requires corrective action, additional testing, and the Engineer's approval before resuming the metallizing process.

Apply TSC with the alloy to the thickness specified on the plans or as provided in the table below. All spot results (the average of 3 to 5 readings) must meet the minimum requirement. No additional tolerance (as allowed by SSPC PA-2) is permitted. (For Steel Beams: For pieces with less than 200 ft² (18.6m²) measure 2 spots/surface per piece and for pieces greater than 200 ft² (18.6m²) add 1 additional spots/surface for each 500 ft² (46.5m²)).

Application	Thickness	Alloy	Seal Coat
Pot Bearings	8 mil	85/15 Zinc (W-Zn-Al-2)	0.5 mil
Deck Joint Seals	8 mil	99.99% Zn (W-Zn-1)	0.5 mil
Optional Disc Bearings	8 mil	85/15 Zinc (W-Zn-Al-2)	0.5 mil
Intermediate Diaphragms	8 mil	85/15 Zinc (W-Zn-Al-2)	0.5 mil
Permanent Steel Casings	8 mil	99.5% Aluminum (W-Al-1350)	0.5 mil

When noted on the plans or as specified in the above chart, apply the sealer to all metallized surfaces in accordance with the manufacturer's recommendations and these provisions. Apply the seal coat only when the air temperature is above 40°F (4°C) and the surface temperature of the steel is at least 5°F (3°C) above the dew point. If the sealer is not applied within eight hours after the final application of TSC, the applicator verifies acceptable TSC surfaces and obtains approval from the Engineer before applying the sealer.

5.0 INSPECTION FREQUENCY

The TSC Contractor must conduct the following tests at the specified frequency and the results documented in a format approved by the Engineer.

Test/Standard	Location	Frequency	Specification
Ambient Conditions	Site	Each Process	5°F (3°C) above the dew point
Abrasive Properties	Site	Each Day	Size, angularity, cleanliness
Surface Cleanliness SSPC Vis 1	All Surfaces	Visual All Surfaces	SSPC-SP-10 Atmospheric Service SSPC-SP - 5 Immersion Service
Surface Profile ASTM D-4417 Method C	Random Surfaces	3 per 500 ft ²	2.5 - 4.0 mils
Bend Test SSPC-CS 23.00	Site	5 per shift	Pass Visual
Thickness SSPC PA-2R SSPC-CS 23.00	Each Surface	Use the method in PA-2 Appendix 3 for Girders and Appendix 4 for frames and miscellaneous steel. See Note 1.	Zn - 8 mils minimum Al - 8 mils minimum Zn Al - 8 mils minimum Areas with more than twice the minimum thickness are inspected for compliance to the adhesion and cut testing requirements of this provision.
Adhesion ASTM 4541	Random Surfaces Splice Areas	1 set of 3 per 500 ft ²	Zn > 500 psi Al > 1000 psi Zn Al > 750 psi
Cut Test - SSPC-CS 23.00	Random Surfaces	3 sets of 3 per 500 ft ²	No peeling or delamination
Job Reference Std. SSPC-CS 23.00	Site	1 per job	Meets all the above requirements

6.0 REPAIRS

All Repairs are to be performed in accordance with the procedures below, depending on whether the repair surface is hidden or exposed. As an exception to the following, field welded splices on joint angles and field welding bearing plates to girders may be repaired in accordance with the procedures for hidden surfaces.

For hidden surfaces (including but not limited to interior girders, interior faces of exterior girders, and below-grade sections of piles):

1. Welding of metallized surfaces may be performed only if specifically permitted by the Engineer. Remove metallizing at the location of field welds by blast cleaning (SSPC SP-6 finish), or hand (SSPC SP-2 finish) or power tool cleaning (SSPC SP-3 finish) just prior to welding. Clean sufficiently to prevent contamination of the weld. All repairs to welded connections are metallized in accordance with SSPC CS 23.00.
2. Minor areas less than or equal to 0.1 ft² (9300mm²) exposing the substrate are metallized in accordance with SSPC CS 23.00 or painted in accordance with ASTM A780, "Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings."
3. Large areas greater than 0.1 ft² (9300mm²) exposing the substrate are metallized in accordance with SSPC CS 23.00.
4. Damaged (burnished) areas not exposing the substrate with less than the specified coating thickness are metallized in accordance with SSPC CS 23.00 or painted in accordance with ASTM A780, "Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings."
5. Damaged (burnished) areas not exposing the substrate with more than the specified coating thickness are not repaired.
6. Defective coating is repaired by either method 2 or 3 depending on the area of the defect.

For Exposed Surfaces (including but not limited to exterior faces of exterior girders and above-grade sections of piles):

1. Welding of metallized surfaces may be performed only if specifically permitted by the Engineer. Remove metallization at the location of field welds by blast cleaning (SSPC SP-6 finish), or hand (SSPC SP-2 finish) or power tool cleaning (SSPC SP-3 finish) just prior to welding. Clean sufficiently to prevent contamination of the weld. All repairs to welded connections are metallized in accordance with SSPC CS 23.00.
2. All areas exposing the substrate are metallized in accordance with SSPC CS 23.00
3. Defective coating is repaired by either method 2 or 3 depending on the area of the defect.

7.0 TWELVE MONTH OBSERVATION PERIOD

The contractor maintains responsibility for the coating system for a twelve (12) month observation period beginning upon the satisfactory completion of all the work required in the plans or as directed by the engineer. The contractor must guarantee the coating system under the payment and performance bond (refer to article 109-10). To successfully complete the observation period, the coating system must meet the following requirements after twelve(12) months service:

- No visible rust, contamination or application defect is observed in any coated area.
- Painted surfaces have a uniform color and gloss.
- Surfaces have an adhesion of no less than 500 psi (3.45 MPa) when tested in accordance with ASTM D-4541.

8.0 BASIS OF PAYMENT

The contract price bid for the bridge component to which the coating is applied will be full compensation for the thermal sprayed coating.

SAND LIGHTWEIGHT CONCRETE

(7-18-06)

Use sand lightweight concrete, as noted on the plans, that meets the requirements of this Special Provision.

Sand lightweight concrete is composed of portland cement, fine aggregate, lightweight coarse aggregate, water, and admixtures. Provide sand lightweight concrete that complies with the applicable requirements of Sections 420, 1000, and 1024 of the Standard Specifications and the additional requirements herein.

Submit a mix design from a testing laboratory approved by the NC Division of Highways for approval at least 35 days prior to the proposed use. Provide a mix meeting Table 1000-1 of the Standard Specifications and the following design criteria:

TEST	TEST METHOD	REQUIREMENT
Max. Unit Weight, plastic, lbs/ft ³ (kg/m ³)	AASHTO T121	120 (1925)
Max. Unit Weight, dry, lbs/ft ³ (kg/m ³)	ASTM C567 using equilibrium air dried unit weight	115 (1845)
Min. Relative Dynamic Modulus, (percent)	AASHTO T161 Procedure A	80

When submitting the mix design, include the source of the aggregates, cement, and admixtures and the gradation, specific gravity and fineness modulus (fine aggregate only) of the aggregates. Submit test results showing the mix design conforms to the criteria, including the 28 day compressive strength of a minimum of six cylinders. Provide a mix design that produces an average compressive strength sufficient to ensure that a minimum strength of 4500 psi (31.0 MPa) is achieved in the field.

Produce an additional mix in accordance with AASHTO M195 to determine the drying shrinkage. The maximum drying shrinkage for this mix is 0.07%.

For lightweight aggregate, use expanded shale or slate that meets the requirements of AASHTO M195. Grade the lightweight aggregate in accordance with 1014-2(E)(6).

Determine the soundness in accordance with AASHTO T104. Loss of more than 10% of the lightweight aggregate in five cycles of the accelerated soundness test using sodium sulfate is not permitted.

Ensure the lightweight aggregate is in a saturated surface-dry condition when it is proportioned and incorporated into the mix.

EVAZOTE JOINT SEALS

(8-13-04)

1.0 SEALS

Use preformed seals compatible with concrete and resistant to abrasion, oxidation, oils, gasoline, salt and other materials that are spilled on or applied to the surface. Use a low-density closed cell, cross-linked ethylene vinyl acetate polyethylene copolymer nitrogen blown material for the seal.

Use seals manufactured with grooves 1/8" (3 mm) ± wide by 1/8" (3 mm) ± deep and spaced between 1/4 (6 mm) and 1/2 inch (13 mm) apart along the bond surface running the length of the joint. Use seals sized so that the depth of the seal meets the manufacturer's recommendation, but is not less than 70% of the uncompressed width. Provide a seal designed so that, when compressed, the center portion of the top does not extend upward above the original height of the seal by more than 1/4 inch (6 mm). Splice the seal using the heat welding method by placing the joint material ends against a teflon heating iron of 350°F (177°C) for 7 - 10 seconds, then pressing the ends together tightly. Do not test the welding until the material has completely cooled. Use material that resists weathering and ultraviolet rays. Provide a seal that has a working range of 30% tension and 60% compression and is watertight along its entire length including the ends.

Provide seals that meet the requirements given below.

TEST	TEST METHOD	REQUIREMENT
Elongation at break	ASTM D3575	210 ± 15%
Tensile strength, psi (kPa)	ASTM D3575	110 ± 15 (755 ± 100)
Compression Recovery (% of original width)	AASHTO T42 50% compr. for 22 hr. @ 73°F (23°C) 1/2 hr. recovery	87 ± 3
Weather/Deterioration	AASHTO T42 Accelerated Weathering	No deterioration for 10 years min.
Compression/Deflection	@ 50% deflection of original width @ 50% deflection of original width	10 psi (69 kPa) min. 60 psi (414 kPa) max.
Tear Strength, psi (kPa)	ASTM D624	16 ± 3 (110 ± 20)
Density	ASTM D545	2.8 to 3.4
Water Absorption (% vol/vol)	ASTM D3575 Total immersion for 3 months	3

Have the top of the evazote seal clearly shop marked. Inspect the evazote seals upon receipt to ensure that the marks are clearly visible upon installation.

2.0 ADHESIVES

Use a two component, 100% solid, modified epoxy adhesive with the seal that meets the requirements of ASTM C881, Type 1, Grade 3, Class B & C and has the following physical properties:

Tensile strength.....	3500 psi (24.1 MPa) min.
Compressive strength.....	7000 psi (48.3 MPa) min.
Shore D Hardness	75 psi (0.5 MPa) min.
Water Absorption.....	0.25% by weight

Use an adhesive that is workable to 40°F (4°C). When installing in temperatures below 40°F (4°C) or for application on moist, difficult to dry concrete surfaces, use an adhesive specified by the manufacturer of the joint material.

3.0 SAWING THE JOINTS

When the plans call for sawing the joints, the joints shall be initially formed to a width as shown on the plans including the blockout for the elastomeric concrete. Complete placement of the elastomeric concrete after the reinforced concrete deck slab has cured for seven full days and reached a minimum strength of 3000 psi (20.7 Mpa).

Cure the elastomeric concrete for a minimum of 2 days prior to sawing the elastomeric concrete to the final width and depth as specified in the plans.

When sawing the joint to receive the evazote seal, always use a rigid guide to control the saw in the desired direction. To control the saw and to produce a straight line as indicated on the plans, anchor and positively connect a template or a track to the bridge deck. Do not saw the joint by visual means such as a chalk line. Fill the holes used for holding the template or track to the deck with an approved, flowable non-shrink, non-metallic grout.

Saw cut to the desired width and depth in one or two passes of the saw by placing and spacing two metal blades on the saw shaft to the desired width for compression seals.

The desired depth is the depth of the seal plus 1/4 inch (6 mm) above the top of the seal plus approximately 1 inch (25 mm) below the bottom of the seal. An irregular bottom of sawed joint is permitted as indicated on the plans. Grind exposed corners on saw cut edges to a 1/4" (6 mm) chamfer.

Remove any staining or deposited material resulting from sawing with a wet blade to the satisfaction of the Engineer.

Use extreme care to saw the joint straight to the desired width and to prevent any chipping or damage to sawed edges of the joint.

4.0 PREPARATIONS FOR SAWED JOINTS

When the plans call for sawing the joint, the Engineer thoroughly inspects the sawed joint opening for spalls, popouts, cracks, etc. Make all necessary repairs prior to blast cleaning and installing the seal.

Immediately before sealing, clean the joints by sandblasting with clean dry sand. Sandblast to provide a firm, clean joint surface free of curing compound, loose material and any foreign matter. Sandblast without causing pitting or uneven surfaces. The aggregate in the elastomeric concrete may be exposed after sandblasting.

After blasting, either brush the surface with clean brushes made of hair, bristle or fiber, blow the surface with compressed air, or vacuum the surface until all traces of blast products and abrasives are removed from the surface, pockets, and corners.

If nozzle blasting, use compressed air that does not contain detrimental amounts of water or oil.

Examine the blast cleaned surface and remove any traces of oil, grease or smudge deposited in the cleaning operations.

Bond the seal to the blast cleaned surface on the same day the surface is blast cleaned.

5.0 PREPARATIONS FOR ARMORED JOINTS

When the plans call for armored joints, form the joint and blockout openings in accordance with the plans. If preferred, wrap the temporary form with polyethylene sheets to allow for easier removal. Do not use form release agents.

A. Submittals

Submitting detailed working drawings is not required; however, submitting catalog cuts of the proposed material is required. In addition, direct the joint supplier to provide an angle segment placing plan.

B. Surface Preparation

Prepare the surface within the 48 hours prior to placing the elastomeric concrete. Do not place the elastomeric concrete until the surface preparation is completed and approved.

1. Angle Assembly

Clean and free metallized steel of all foreign contaminants and blast the non-metallized steel surfaces to SSPC SP-10. Blast-cleaning anchor studs is not required.

2. Concrete

Prior to placing the elastomeric concrete, thoroughly clean and dry all concrete surfaces. Sandblast the concrete surface in the blockout and clear the surface of all loose debris.

C. Elastomeric Concrete Placement

Make sure that a manufacturer's representative is present when placing elastomeric concrete. Do not place elastomeric concrete if the ambient air temperature is below 45°F (7°C).

Prepare and apply a primer, as per manufacturer's recommendations, to all vertical concrete faces, all steel components to be in contact with elastomeric concrete, and to areas specified by the manufacturer. Align the angles with the joint opening.

Prepare, batch, and place the elastomeric concrete in accordance with the manufacturer's instructions. Place the elastomeric concrete in the areas specified on the plans while the primer is still tacky and within 2 hours after applying the primer. Pay careful attention to properly consolidate the concrete around the steel and anchors. Trowel the elastomeric concrete to a smooth finish.

D. Joint Preparation

Prior to installing the seal, the Engineer thoroughly inspects the armored joint opening for proper alignment and full consolidation of elastomeric concrete under the angle assemblies. Make all necessary repairs prior to cleaning the joint opening and installing the seal.

Clean the armored joint opening with a pressure washer rated at 3000 psi (20.7 MPa) minimum at least 24 hours after placing the elastomeric concrete. Dry the cleaned surface prior to installing the seal.

Examine the cleaned surface and remove traces of oil, grease or smudge deposited during the cleaning operations.

Bond the seal to the cleaned surface on the same day the surface is cleaned.

6.0 SEAL INSTALLATION

Install the joint seal according to the manufacturer's procedures and recommendations and as recommended below. Do not install the joint seal if the ambient air temperature is below 45°F (7°C). Have a manufacturer's representative present during the installation of the first seal of the project.

Begin installation at the low end of the joint after applying the mixed epoxy to the sides of both the joint material and both sides of the joint, making certain to completely fill the grooves with epoxy. With gloved hands, compress the material and with the help of a blunt probe, push it down into the joint until it is recessed approximately 1/4 inch (6 mm) below the surface. Do not push the seal at an angle that would stretch the material. Once work on a joint begins, do not stop until it is completed. Clean the excess epoxy off the surface of the joint material *quickly* and *thoroughly*. Do not use solvents to remove excess epoxy. Remove excess epoxy in accordance with the joint manufacturer's recommendations.

Install the seal so that it is watertight. Testing of the joint seal is not required, but it is observed until final inspection.

7.0 BASIS OF PAYMENT

Payment for all evazote joint seals will be at the lump sum contract price bid for "Evazote Joint Seals" which prices and payment will be full compensation for furnishing all material, including elastomeric concrete when required, labor, tools and equipment necessary for installing these units in place and accepted.

ELASTOMERIC CONCRETE

(10-12-01)

1.0 DESCRIPTION

Elastomeric concrete is a mixture of a two-part polymer consisting of polyurethane and/or epoxy, and kiln-dried aggregate. Have the manufacturer supply it as a unit. Use the concrete in the blocked out areas on both sides of the bridge deck joints as indicated on the plans.

2.0 MATERIALS

Provide materials that comply with the following minimum requirements at 14 days.

CONCRETE PROPERTIES	TEST METHOD	MINIMUM REQUIREMENT
Bond Strength to Concrete, psi (MPa)	ASTM D638 (D638M)	450 (3.1)
Brittleness by Impact, ft-lb (kg-m)	Ball Drop	7 (0.97)
Compressive Strength, psi (MPa)	ASTM D695 (D695M)	2800 (19.3)

BINDER PROPERTIES (without aggregate)	TEST METHOD	MINIMUM REQUIREMENT
Tensile Strength, psi (MPa)	ASTM D638 (D638M)	800 (5.5)
Ultimate Elongation	ASTM D638 (D638M)	150%
Tear Resistance, lb/in (kN/m)	ASTM D624	90 (15.7)

In addition to the requirements above, use elastomeric concrete that also resists water, chemical, UV, and ozone exposure and withstands extreme temperature (freeze-thaw) changes.

Furnish a manufacturer's certification verifying that the materials satisfy the above requirements. Provide samples of elastomeric concrete to the Engineer, if requested, to independently verify conformance with the above requirements.

Require a manufacturer's representative to be present on site during the installation of the elastomeric concrete.

3.0 BASIS OF PAYMENT

No separate payment will be made for elastomeric concrete. The lump sum contract price bid for "Evazote Joint Seals" will be full compensation for furnishing and placing the Elastomeric Concrete.

FALSEWORK AND FORMWORK

(7-18-06)

1.0 DESCRIPTION

Use this Special Provision as a guide to develop temporary works submittals required by the Standard Specifications or other provisions; no additional submittals are required herein. Such temporary works include, but are not limited to, falsework and formwork.

Falsework is any temporary construction used to support the permanent structure until it becomes self-supporting. Formwork is the temporary structure or mold used to retain plastic or fluid concrete in its designated shape until it hardens. Access scaffolding is a temporary structure that functions as a work platform that supports construction personnel, materials, and tools, but is not intended to support the structure. Scaffolding systems that are used to temporarily support permanent structures (as opposed to functioning as work platforms) are considered to be falsework under the definitions given. Shoring is a component of falsework such as horizontal, vertical, or inclined support members. Where the term "temporary works" is used, it includes all of the temporary facilities used in bridge construction that do not become part of the permanent structure.

Design and construct safe and adequate temporary works that will support all loads imposed and provide the necessary rigidity to achieve the lines and grades shown on the plans in the final structure.

2.0 MATERIALS

Select materials suitable for temporary works; however, select materials that also ensure the safety and quality required by the design assumptions. The Engineer has authority to reject material on the basis of its condition, inappropriate use, safety, or nonconformance with the plans. Clearly identify allowable loads or stresses for all materials or manufactured devices on the plans. Revise the plan and notify the Engineer if any change to materials or material strengths is required.

3.0 DESIGN REQUIREMENTS

A. Working Drawings

Provide working drawings for items as specified in the contract, or as required by the Engineer, with design calculations and supporting data in sufficient detail to permit a structural and safety review of the proposed design of the temporary work.

When concrete placement is involved, include data such as the drawings of proposed sequence, rate of placement, direction of placement, and location of all construction joints. Submit the number of copies as called for by the contract.

When required, have the drawings and calculations prepared under the guidance of, and sealed by, a North Carolina Registered Professional Engineer who is knowledgeable in temporary works design.

Design falsework and formwork requiring submittals in accordance with the 1995 AASHTO *Guide Design Specifications for Bridge Temporary Works* except as noted herein.

1. Wind Loads

Table 2.2 of Article 2.2.5.1 is modified to include wind velocities up to 110 mph (177 km/hr). In addition, Table 2.2A is included to provide the maximum wind speeds by county in North Carolina.

Table 2.2 - Wind Pressure Values

Height Zone feet (m) above ground	Pressure, lb/ft ² (kPa) for Indicated Wind Velocity, mph (km/hr)				
	70 (112.7)	80 (128.7)	90 (144.8)	100 (160.9)	110 (177.0)
0 to 30 (0 to 9.1)	15 (0.72)	20 (0.96)	25 (1.20)	30 (1.44)	35 (1.68)
30 to 50 (9.1 to 15.2)	20 (0.96)	25 (1.20)	30 (1.44)	35 (1.68)	40 (1.92)
50 to 100 (15.2 to 30.5)	25 (1.20)	30 (1.44)	35 (1.68)	40 (1.92)	45 (2.15)
over 100 (30.5)	30 (1.44)	35 (1.68)	40 (1.92)	45 (2.15)	50 (2.39)

2. Time of Removal

The following requirements replace those of Article 3.4.8.2.

Do not remove forms until the concrete has attained strengths required in Article 420-16 of the Standard Specifications and these Special Provisions.

Do not remove forms until the concrete has sufficient strength to prevent damage to the surface.

Table 2.2A - Steady State Maximum Wind Speeds by Counties in North Carolina

COUNTY	25 YR (mph) (km/hr)	COUNTY	25 YR (mph) (km/hr)	COUNTY	25 YR (mph) (km/hr)
Alamance	70 (112.7)	Franklin	70 (112.7)	Pamlico	100 (160.9)
Alexander	70 (112.7)	Gaston	70 (112.7)	Pasquotank	100 (160.9)
Alleghany	70 (112.7)	Gates	90 (144.8)	Pender	100 (160.9)
Anson	70 (112.7)	Graham	80 (128.7)	Perquimans	100 (160.9)
Ashe	70 (112.7)	Granville	70 (112.7)	Person	70 (112.7)
Avery	70 (112.7)	Greene	80 (128.7)	Pitt	90 (144.8)
Beaufort	100 (160.9)	Guilford	70 (112.7)	Polk	80 (128.7)
Bertie	90 (144.8)	Halifax	80 (128.7)	Randolph	70 (112.7)
Bladen	90 (144.8)	Harnett	70 (112.7)	Richmond	70 (112.7)
Brunswick	100 (160.9)	Haywood	80 (128.7)	Robeson	80 (128.7)
Buncombe	80 (128.7)	Henderson	80 (128.7)	Rockingham	70 (112.7)
Burke	70 (112.7)	Hertford	90 (144.8)	Rowan	70 (112.7)
Cabarrus	70 (112.7)	Hoke	70 (112.7)	Rutherford	70 (112.7)
Caldwell	70 (112.7)	Hyde	110 (177.0)	Sampson	90 (144.8)
Camden	100 (160.9)	Iredell	70 (112.7)	Scotland	70 (112.7)
Carteret	110 (177.0)	Jackson	80 (128.7)	Stanley	70 (112.7)
Caswell	70 (112.7)	Johnston	80 (128.7)	Stokes	70 (112.7)
Catawba	70 (112.7)	Jones	100 (160.9)	Surry	70 (112.7)
Cherokee	80 (128.7)	Lee	70 (112.7)	Swain	80 (128.7)
Chatham	70 (112.7)	Lenoir	90 (144.8)	Transylvania	80 (128.7)
Chowan	90 (144.8)	Lincoln	70 (112.7)	Tyrell	100 (160.9)
Clay	80 (128.7)	Macon	80 (128.7)	Union	70 (112.7)
Cleveland	70 (112.7)	Madison	80 (128.7)	Vance	70 (112.7)
Columbus	90 (144.8)	Martin	90 (144.8)	Wake	70 (112.7)
Craven	100 (160.9)	McDowell	70 (112.7)	Warren	70 (112.7)
Cumberland	80 (128.7)	Mecklenburg	70 (112.7)	Washington	100 (160.9)
Currituck	100 (160.9)	Mitchell	70 (112.7)	Watauga	70 (112.7)
Dare	110 (177.0)	Montgomery	70(112.7)	Wayne	80 (128.7)
Davidson	70 (112.7)	Moore	70 (112.7)	Wilkes	70 (112.7)
Davie	70 (112.7)	Nash	80 (128.7)	Wilson	80 (128.7)
Duplin	90 (144.8)	New Hanover	100 (160.9)	Yadkin	70 (112.7)
Durham	70 (112.7)	Northampton	80 (128.7)	Yancey	70 (112.7)
Edgecombe	80 (128.7)	Onslow	100 (160.9)		
Forsyth	70 (112.7)	Orange	70 (112.7)		

Note on the working drawings any anchorages, connectors, inserts, steel sleeves or other such devices used as part of the falsework or formwork that remains in the permanent structure. If the plan notes indicate that the structure contains the necessary corrosion protection required for a Corrosive Site, epoxy coat, galvanize, metallize or otherwise protect these devices as directed by the Engineer. Any coating required by the Engineer will be considered incidental to the various pay items requiring temporary works.

B. Review and Approval

The Engineer is responsible for the review and approval of temporary works' drawings.

Submit the working drawings sufficiently in advance of proposed use to allow for their review, revision (if needed), and approval without delay to the work.

Do not start construction of any temporary work for which working drawings are required until the drawings have been approved. Such approval does not relieve the Contractor of the responsibility for the accuracy and adequacy of the working drawings.

The time period for review of the working drawings does not begin until complete drawings and design calculations, when required, are received by the Engineer.

On the drawings, show all information necessary to allow the design of any component to be checked independently as determined by the Engineer.

If requested by the Engineer, submit with the working drawings manufacturer's catalog data listing the weight of all construction equipment that will be supported on the temporary work. Show anticipated total settlements and/or deflections of falsework and forms on the working drawings. Include falsework footing settlements, joint take-up, and deflection of beams or girders. Falsework hangers that support concentrated loads and are installed at the edge of thin top flange concrete girders (such as bulb tee girders) shall be spaced so as not to exceed 75% of the manufacturer's stated safe working load. Use of dual leg hangers (such as Meadow Burke HF-42 and HF-43) are not allowed. Design the falsework and forms supporting deck slabs and overhangs on girder bridges so that there will be no differential settlement between the girders and the deck forms during placement of deck concrete.

4.0 CONSTRUCTION REQUIREMENTS

All requirements of Section 420 of the Standard Specifications apply.

Construct temporary works in conformance with the approved working drawings. Ensure that the quality of materials and workmanship employed is consistent with that assumed in the design of the temporary works. Do not weld falsework members to any portion of the permanent structure unless approved. Show any welding to the permanent structure on the approved construction drawings.

Provide tell-tales attached to the forms and extending to the ground, or other means, for accurate measurement of falsework settlement. Make sure that the anticipated compressive settlement and/or deflection of falsework does not exceed 1 inch (25 mm). For cast-in-place concrete structures, make sure that the calculated deflection of falsework flexural members does not exceed 1/240 of their span regardless of whether or not the deflection is compensated by camber strips.

A. Maintenance and Inspection

Inspect and maintain the temporary work in an acceptable condition throughout the period of its use. Certify that the manufactured devices have been maintained in a condition to allow them to safely carry their rated loads. Clearly mark each piece so that its capacity can be readily determined at the job site.

Perform an in-depth inspection of an applicable portion(s) of the temporary works, in the presence of the Engineer, not more than 24 hours prior to the beginning of each concrete placement. Inspect other temporary works at least once a month to ensure that they are functioning properly. Have a North Carolina Registered Professional Engineer inspect the cofferdams, shoring, sheathing, support of excavation structures, and support systems for load tests prior to loading.

B. Foundations

Determine the safe bearing capacity of the foundation material on which the supports for temporary works rest. If required by the Engineer, conduct load tests to verify proposed bearing capacity values that are marginal or in other high-risk situations.

The use of the foundation support values shown on the contract plans of the permanent structure is permitted if the foundations are on the same level and on the same soil as those of the permanent structure.

Allow for adequate site drainage or soil protection to prevent soil saturation and washout of the soil supporting the temporary works supports.

If piles are used, the estimation of capacities and later confirmation during construction using standard procedures based on the driving characteristics of the pile is permitted. If preferred, use load tests to confirm the estimated capacities; or, if required by the Engineer conduct load tests to verify bearing capacity values that are marginal or in other high risk situations.

The Engineer reviews and approves the proposed pile and soil bearing capacities.

5.0 REMOVAL

Unless otherwise permitted, remove and keep all temporary works upon completion of the work. Do not disturb or otherwise damage the finished work.

Remove temporary works in conformance with the contract documents. Remove them in such a manner as to permit the structure to uniformly and gradually take the stresses due to its own weight.

6.0 METHOD OF MEASUREMENT

Unless otherwise specified, temporary works will not be directly measured.

7.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items requiring temporary works will be full compensation for the above falsework and formwork.

SUBMITTAL OF WORKING DRAWINGS

7-18-06

1.0 GENERAL

Submit working drawings in accordance with Article 105-2 of the Standard Specifications and the requirements of this special provision. For the purposes of this provision, "submittals" refers to only those listed in this provision. The list of submittals contained herein does not represent a list of required submittals for this project. Submittals are only necessary for those items as required by the Standard Specifications, other Special Provisions or contract plans. Make submittals that are not specifically noted in this Special Provision directly to the Resident Engineer. Either the Structure Design Unit or the Geotechnical Engineering Unit or both units will jointly review submittals.

If a submittal contains variations from plan details or specifications or significantly affects project cost, field construction or operations, discuss the submittal with and submit all copies to the Resident Engineer. State the reason for the proposed variation in the submittal. To minimize review time, make sure all submittals are complete when initially submitted. Provide a contact name and information with each submittal. Direct any questions regarding submittal requirements to the Resident Engineer, Structure Design Unit contacts or the Geotechnical Engineering Unit contacts noted below.

In order to facilitate in-plant inspection by NCDOT and approval of working drawings, provide the name, address and telephone number of the facility where fabrication will actually be done if different than shown on the title block of the submitted working drawings. This includes, but is not limited to, precast concrete items, prestressed concrete items and fabricated steel or aluminum items.

2.0 ADDRESSES AND CONTACTS

For submittals to the Structure Design Unit, use the following addresses:

Via US mail:

Mr. G. R. Perfetti, P. E.
State Bridge Design Engineer
North Carolina Department
of Transportation
Structure Design Unit
1581 Mail Service Center
Raleigh, NC 27699-1581
Attention: Mr. P. D. Lambert, P. E.

Via other delivery service:

Mr. G. R. Perfetti, P. E.
State Bridge Design Engineer
North Carolina Department
of Transportation
Structure Design Unit
1000 Birch Ridge Drive
Raleigh, NC 27610
Attention: Mr. P. D. Lambert, P. E.

For submittals to the Geotechnical Engineering Unit, use the following addresses:

For projects in Divisions 1-7, use the following Eastern Regional Office address:

Via US mail:

Mr. K. J. Kim, Ph. D., P. E.
Eastern Regional Geotechnical
Manager
North Carolina Department
of Transportation
Geotechnical Engineering Unit
Eastern Regional Office
1570 Mail Service Center
Raleigh, NC 27699-1570

Via other delivery service:

Mr. K. J. Kim, Ph. D., P. E.
Eastern Regional Geotechnical
Manager
North Carolina Department
of Transportation
Geotechnical Engineering Unit
Eastern Regional Office
3301 Jones Sausage Road, Suite 100
Garner, NC 27529

For projects in Divisions 8-14, use the following Western Regional Office address:

Via US mail:

Mr. John Pilipchuk, L. G., P. E.
Western Regional Geotechnical
Manager
North Carolina Department
of Transportation
Geotechnical Engineering Unit
Western Regional Office
5253 Z Max Boulevard
Harrisburg, NC 28075

Via other delivery service:

Mr. John Pilipchuk, L. G., P. E.
Western Region Geotechnical
Manager
North Carolina Department
of Transportation
Geotechnical Engineering Unit
Western Regional Office
5253 Z Max Boulevard
Harrisburg, NC 28075

Direct any questions concerning submittal review status, review comments or drawing markups to the following contacts:

Primary Structures Contact:

Paul Lambert
(919) 250 – 4041
(919) 250 – 4082 facsimile
plambert@dot.state.nc.us

Secondary Structures Contacts:

James Gaither
(919) 250 – 4042
Man-Pan Hui
(919) 250 – 4044

Eastern Regional Geotechnical Contact (Divisions 1-7):

K. J. Kim
(919) 662 – 4710
(919) 662 – 3095 facsimile
kkim@dot.state.nc.us

Western Regional Geotechnical Contact (Divisions 8-14):

John Pilipchuk
(704) 455 – 8902
(704) 455 – 8912 facsimile
jpilipchuk@dot.state.nc.us

3.0 SUBMITTAL COPIES

Furnish one complete copy of each submittal, including all attachments, to the Resident Engineer. At the same time, submit the number of hard copies shown below of the same complete submittal directly to the Structure Design Unit and/or the Geotechnical Engineering Unit.

The first table below covers “Structure Submittals”. The Resident Engineer will receive review comments and drawing markups for these submittals from the Structure Design Unit. The second table in this section covers “Geotechnical Submittals”. The Resident Engineer will receive review comments and drawing markups for these submittals from the Geotechnical Engineering Unit.

Unless otherwise required, submit one set of supporting calculations to either the Structure Design Unit or the Geotechnical Engineering Unit unless both units require submittal copies in which case submit a set of supporting calculations to each unit. Provide additional copies of any submittal as directed by the Engineer.

STRUCTURE SUBMITTALS

Submittal	Copies Required by Structure Design Unit	Copies Required by Geotechnical Engineering Unit	Contract Reference Requiring Submittal ¹
Arch Culvert Falsework	5	0	Plan Note, SN Sheet & "Falsework and Formwork"
Box Culvert Falsework ⁷	5	0	Plan Note, SN Sheet & "Falsework and Formwork"
Cofferdams	6	2	Article 410-4
Evazote Joint Seals ⁶	9	0	"Evazote Joint Seals"
Expansion Joint Seals (hold down plate type with base angle)	9	0	"Expansion Joint Seals"
Expansion Joint Seals (modular)	2, then 9	0	"Modular Expansion Joint Seals"
Expansion Joint Seals (strip seals)	9	0	"Strip Seals"
Falsework & Forms ² (substructure)	8	0	Article 420-3 & "Falsework and Formwork"
Falsework & Forms (superstructure)	8	0	Article 420-3 & "Falsework and Formwork"
Girder Erection over Railroad	5	0	Railroad Special Provisions
Maintenance and Protection of Traffic Beneath Proposed Structure	8	0	"Maintenance and Protection of Traffic Beneath Proposed Structure at Station ____"
Metal Bridge Railing	8	0	Plan Note
Metal Stay-in-Place Forms	8	0	Article 420-3
Metalwork for Elastomeric	7	0	Article 1072-10

Bearings ^{4,5}			
Miscellaneous Metalwork ^{4,5}	7	0	Article 1072-10
Optional Disc Bearings ⁴	8	0	“Optional Disc Bearings”
Overhead Signs	13	0	Article 903-3(C) & Applicable Project Special Provisions
Pile Splicer	7	2	Subarticle 450-7(C)
Placement of Equipment on Structures (cranes, etc.)	7	0	Article 420-20
Pot Bearings ⁴	8	0	“Pot Bearings”
Precast Concrete Box Culverts	2, then 1 reproducible	0	“Optional Precast Reinforced Concrete Box Culvert at Station ____”
Precast Retaining Wall Panels	10	1	Article 1077-2
Prestressed Concrete Cored Slab (detensioning sequences) ³	6	0	Article 1078-11
Prestressed Concrete Deck Panels	6 and 1 reproducible	0	Article 420-3
Prestressed Concrete Girder (strand elongation and detensioning sequences)	6	0	Articles 1078-8 and 1078- 11
Removal of Existing Structure over Railroad	5	0	Railroad Special Provisions
Revised Bridge Deck Plans (adaptation to prestressed deck panels)	2, then 1 reproducible	0	Article 420-3
Revised Bridge Deck Plans (adaptation to modular expansion joint seals)	2, then 1 reproducible	0	“Modular Expansion Joint Seals”
Sound Barrier Wall Casting Plans	10	0	Article 1077-2 & “Sound Barrier Wall”
Sound Barrier Wall Steel Fabrication Plans ⁵	7	0	Article 1072-10 & “Sound Barrier Wall”
Structural Steel ⁴	2, then 7	0	Article 1072-10

Temporary Detour Structures	10	2	Article 400-3 & “Construction, Maintenance and Removal of Temporary Structure at Station ____”
Temporary Shoring	6	2	“Temporary Shoring”
TFE Expansion Bearings ⁴	8	0	Article 1072-10

FOOTNOTES

1. References are provided to help locate the part of the contract where the submittals are required. References in quotes refer to the Project Special Provision by that name. Articles or subarticles refer to the Standard Specifications.
2. Submittals for these items are necessary only when required by a note on plans.
3. Submittals for these items may not be required. A list of pre-approved sequences is available from the producer or the Materials and Tests Unit.
4. The fabricator may submit these items directly to the Structure Design Unit.
5. The two sets of preliminary submittals required by Article 1072-10 of the Standard Specifications are not required for these items.
6. Submittals for Fabrication Drawings are not required. Submittals for Catalogue Cuts of Proposed Material are required. See Section 5.A of the referenced Project Special Provision.
7. Submittals are necessary only when the top slab thickness is 18 inches or greater.

GEOTECHNICAL SUBMITTALS

Submittal	Copies Required by Geotechnical Engineering Unit	Copies Required by Structure Design Unit	Contract Reference Requiring Submittal ¹
Crosshole Sonic Logging (CSL) Reports ²	1	0	“Crosshole Sonic Logging”
Drilled Pier Construction Sequence Plans	1	0	“Drilled Piers”
Mechanically Stabilized Earth (MSE) Retaining Walls	8	2	“MSE Retaining Walls”
Pile Driving Analyzer (PDA) Reports ²	2	0	“Pile Driving Analyzer”
Pile Driving Equipment Data ³	1	0	Article 450-5
Proprietary Retaining Walls	8	2	Applicable Project Special Provision
Permanent Anchored Tieback Retaining Walls	8	2	Applicable Project Special Provision
Soil Nail Retaining Walls	8	2	Applicable Project Special Provision
Temporary Mechanically Stabilized (MSE) Earth Wall	2	0	Applicable Project Special Provision

FOOTNOTES

- References are provided to help locate the part of the contract where the working drawing submittals are required. References in quotes refer to the Project Special Provision by that name. Articles refer to the Standard Specifications.
- Hard and electronic copies of submittals are required. See referenced Project Special Provision.
- Download Pile Driving Equipment Data Form from following link:

<http://www.ncdot.org/doh/preconstruct/highway/geotech/formprovdet/>

Submit one hard copy of the completed form to the Resident Engineer. Submit a second copy of the completed form electronically, by facsimile or via US Mail or other delivery service to the Geotechnical Engineering Unit. Electronic submission is preferred. See second page of form for submittal instructions.

**CONSTRUCTION, MAINTENANCE AND REMOVAL
OF TEMPORARY ACCESS AT STATION 31+21.29 -L-**

(11-17-06)

1.0 GENERAL

Construct, maintain, and remove the temporary access required to provide the working area necessary for construction of the new bridge, construction of the temporary detour structure, or for the removal of an existing bridge, as applicable. Temporary access may include other methods than those outlined in this Special Provision; however, all types of temporary access are required to meet the requirements of all permits, the Standard Specifications, and this Special Provision.

2.0 TEMPORARY WORK BRIDGE

Construction of a temporary work bridge is permitted as shown on the plans. The temporary work bridge shall have a minimum span length of 20 feet. Submit details of the temporary work bridge to the Engineer prior to constructing the work bridge to ensure conformance with the plans and all permits. Completely remove the temporary bridge prior to final acceptance or as otherwise required by the permits.

3.0 BASIS OF PAYMENT

The lump sum price bid for "Construction, Maintenance and Removal of Temporary Access at Station 31+21.29 -L-" will be full compensation for the above work, or other methods of access, including all material, work bridge components, equipment, tools, labor, disposal, and incidentals necessary to complete the work.

CRANE SAFETY

(8-15-05)

Comply with the manufacturer specifications and limitations applicable to the operation of any and all cranes and derricks. Prime contractors, sub-contractors, and fully operated rental companies shall comply with the current Occupational Safety and Health Administration regulations (OSHA).

Submit all items listed below to the Engineer prior to beginning crane operations involving critical lifts. A critical lift is defined as any lift that exceeds 75 percent of the manufacturer's crane chart capacity for the radius at which the load will be lifted or requires the use of more than one crane. Changes in personnel or equipment must be reported to the Engineer and all applicable items listed below must be updated and submitted prior to continuing with crane operations.

CRANE SAFETY SUBMITTAL LIST

- A. **Competent Person:** Provide the name and qualifications of the “Competent Person” responsible for crane safety and lifting operations. The named competent person will have the responsibility and authority to stop any work activity due to safety concerns.
- B. **Riggers:** Provide the qualifications and experience of the persons responsible for rigging operations. Qualifications and experience should include, but not be limited to, weight calculations, center of gravity determinations, selection and inspection of sling and rigging equipment, and safe rigging practices.
- C. **Crane Inspections:** Inspection records for all cranes shall be current and readily accessible for review upon request.
- D. **Certifications:** **By July 1, 2006**, crane operators performing critical lifts shall be certified by NC CCO (National Commission for the Certification of Crane Operators), or satisfactorily complete the Carolinas AGC’s Professional Crane Operator’s Proficiency Program. Other approved nationally accredited programs will be considered upon request. All crane operators shall also have a current CDL medical card. Submit a list of anticipated critical lifts and corresponding crane operator(s). Include current certification for the type of crane operated (small hydraulic, large hydraulic, small lattice, large lattice) and medical evaluations for each operator.

PILE DRIVING ANALYZER**(7-18-06)****1.0 GENERAL**

This special provision governs driving piles with a pile dynamic analyzer (PDA) in accordance with the plans and as directed by the Engineer. The PDA test method is described in ASTM D 4945-00, “Standard Test Method for High-Strain Dynamic Testing of Piles”. Install piles in accordance with Section 450 of the Standard Specifications and this provision.

Submit the proposed pile driving methods and equipment in accordance with the Standard Specifications. The Engineer will respond with preliminary approval or rejection of the proposed pile driving methods and equipment within ten (10) calendar days. Preliminary approval is required before driving piles with a PDA. Notify the Engineer of the pile driving schedule a minimum of fourteen (14) calendar days in advance.

Either an approved PDA Consultant or the NCDOT Geotechnical Engineering Unit, as directed by the Engineer, shall perform PDA testing and CAPWAP analysis. If required, retain a PDA Consultant to provide PDA testing. Contact the Geotechnical Engineering Unit Contract Administrator for a list of approved PDA Consultants.

The Engineer will determine the number of piles and which piles to be tested with the PDA based upon the subsurface conditions and the pile installation sequence and progress.

The Engineer will complete the review of the proposed pile driving methods and equipment and provide the required driving resistance within ten (10) calendar days after the Engineer receives the complete PDA report or the Geotechnical Engineering Unit completes the PDA testing. A PDA report for PDA testing on multiple piles may be required as directed by the Engineer before the 10 day time period begins.

2.0 PREPARATION FOR PDA TESTING

Provide piles for PDA testing that are 5 ft (1.5 m) longer, or as directed by the Engineer, than the estimated pile lengths shown on the plans. Supply 110 V, 60 Hz, 30 Amp of AC electrical power to operate the PDA equipment. Direct current welders or non-constant power sources are unacceptable.

Provide a suitable shelter to protect the PDA equipment and operator from conditions of sun, water, wind and temperature. The shelter should have a minimum floor size of 6 ft x 6 ft (2 m x 2 m) and a minimum roof height of 8 ft (2.5 m). If necessary, heat or cool the shelter to maintain a temperature between 50 and 85 degrees F (10 and 30 degrees C). Place the shelter within 75 ft (23 m) of the pile such that the PDA cables reach the computer and the operator can clearly observe the pile. The Engineer may waive the shelter requirement if weather conditions allow.

Drill up to a total of sixteen (16) bolt holes in either two or four sides of the pile, as directed by the PDA Consultant or the Engineer, at an approximate distance equal to three (3) times the pile diameter below the head of the pile. If the PDA Consultant or the Engineer choose to drill the bolt holes, provide the necessary equipment, tools and assistance to do so. A hammer drill is required for concrete piles and up to two (2) hours may be required to drill the holes.

Lift, align and rotate the pile to be tested with the PDA as directed by the PDA Consultant or the Engineer. Place the pile in the leads and template so that the PDA instruments and their accompanying wires will not be damaged.

The PDA Consultant or the Engineer will furnish the PDA measuring instruments and materials for installing the instruments. Attach the PDA instruments as directed by the PDA Consultant or the Engineer after the pile is placed in the leads and the template.

3.0 PDA TESTING

Use only the preliminarily approved pile driving methods and equipment to drive piles with the PDA instruments attached. Drive the pile as directed by the PDA Consultant or the Engineer in order to measure the wavespeed of the pile.

Drive the pile to the required bearing capacity and specified tip elevation, if applicable, as shown on the plans or as directed by the PDA Consultant or the Engineer. During pile driving, the PDA will be used to evaluate, including but not limited to, the following:

hammer performance, bearing capacity, distribution of soil resistance, pile driving stresses, energy transfer, pile integrity and various soil parameters such as quake and damping.

The PDA Consultant or the Engineer may require the Contractor to modify the pile installation procedure during driving as follows:

- Reduce the hammer energy
- Drive deeper or shallower because of variations in the subsurface conditions
- Readjust the transducers
- Realign the pile

The Contractor is responsible in terms of both actual expense and time delays for any damage to the PDA instruments and supporting equipment due to the Contractor's fault or negligence. Replace any damaged equipment at no additional cost to the Department.

4.0 REDRIVING PILES

When directed by the Engineer, reattach the PDA instruments and restrike or redrive the pile in accordance with Section 3.0 above and Subarticle 450-7(E) of the Standard Specifications. Obtain the required stroke and penetration (at least 6 in or 150 mm) or as directed by the PDA Consultant or the Engineer. The PDA Consultant or the Engineer will record dynamic measurements during restriking and redriving. The Engineer may require restriking and redriving more than once on the same pile. The Engineer will determine when PDA testing has been satisfactorily completed.

5.0 CAPWAP ANALYSIS AND PDA REPORT

The PDA Consultant shall perform analysis of the PDA raw data with the Case Pile Wave Analysis Program (CAPWAP). At a minimum, analysis is required for a hammer blow near the end of initial drive and for each restrike and redrive. Additional CAPWAP analysis may be required as determined by the PDA Consultant or the Engineer.

Submit the PDA report to the Engineer in both electronic and hard copy form, including three (3) original hard copies, within seven (7) calendar days after the field testing is completed. The PDA report shall include but not be limited to the following:

A. Title Sheet

- NCDOT TIP number and WBS element number
- Project description
- County
- Bridge station number
- Pile location

- Personnel
- Report date
- B. Introduction
- C. Site and Subsurface Conditions (including water table elevation)
- D. Pile Details
 - Pile type and length
 - Required bearing capacity and factor of safety
 - Concrete compressive strength and/or steel pile yield strength
 - Pile splice type and locations
 - Pile batter
 - Installation methods including use of jetting, preaugering, spudding, vibratory hammer, template, barge, etc.
- E. Driving Details
 - Hammer make, model and type
 - Hammer and pile cushion type and thickness
 - Pile helmet weight
 - Hammer efficiency and operation data including fuel settings, bounce chamber pressure, blows per minute, equipment volume and pressure
 - Ground or mud line elevation and template reference elevation at the time of driving
 - Final pile tip elevation
 - Driving resistance (ram stroke, blows per foot (0.3 meter) and set for last ten hammer blows)
 - Restrike and redrive information
- F. PDA field work details
- G. CAPWAP analysis results
 - Table showing percent skin and tip, skin and toe damping, skin and toe quake and match quality
- H. Summary/Conclusions
- I. Attachments
 - Boring log(s)
 - Pile driving equipment data form (from Contractor)
 - Field pile driving inspection data (from project inspector)

- Accelerometer and strain gauge locations
- Accelerometer and strain gauge serial numbers and calibration information
- PDA hardware model and CAPWAP software version information
- Electronic copy of all PDA raw data and executable CAPWAP input and output files

6.0 MEASUREMENT AND PAYMENT

The complete and accepted PDA testing will be paid for at the unit bid price for “PDA Testing” per each. Include in the unit bid price for “PDA Testing” all costs for providing the PDA, PDA instruments and materials for installing the instruments and recording the dynamic measurements the first time the pile is tested with the PDA. Costs for providing these items for the same pile after the pile is initially tested with the PDA will be considered incidental to the unit bid price for “Pile Redrives”. Also include in the unit bid price for “PDA Testing” all costs for performing the CAPWAP analysis on data collected during initial drive, restrikes and redrives and preparing and submitting the PDA report. No payment for “PDA Testing” will be made if the PDA report submitted is incomplete as described in Section 5.0. No payment for “PDA Testing” will be made if the Department performs PDA testing. If the Department does not perform PDA testing, the number of “PDA Testing” per pile will be equal to one.

The complete and accepted PDA assistance will be paid for at the unit bid price for “PDA Assistance” per each. Include in the unit bid price for “PDA Assistance” all costs for PDA preparation and support including all materials, labor, tools, equipment, mobilization and incidentals necessary to complete the work described in this provision excluding the costs for the PDA testing described above. Costs for PDA preparation and support for restrikes and redrives will not be paid for separately. The number of “PDA Assistance” per pile will be equal to one for each pile tested with the PDA.

The cost of the pile and the installation including driving, restriking and redriving will be paid for separately in accordance with the Standard Specifications and will not be part of these PDA pay items.

CRACK REPAIR OF PRESTRESSED CONCRETE GIRDERS

(7-18-06)

The following shall be added to 1078-15 Final Finish of the Standard Specifications:

All cracks that are 0.010 inches (0.25mm) or greater shall be repaired by means of epoxy injection in accordance with the Standard Specifications and as approved by the Engineer. Any crack less than 0.010 inches (0.25mm) need not be repaired, except that cracks greater than 0.007 inches (0.18mm) and less than 0.010 inches (0.18mm) on any member containing Calcium Nitrite corrosion inhibitor shall be coated with epoxy paint.

All material and operations concerning the epoxy injection repair process shall be in accordance with the Standard Specifications and approved by the Engineer.

SHIPPING STEEL STRUCTURAL MEMBERS

(7-18-06)

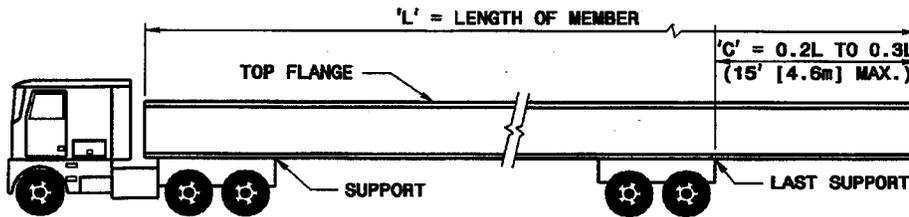
Section 1072-23 Marking and Shipping

Add the following paragraphs after the third paragraph of the Section.

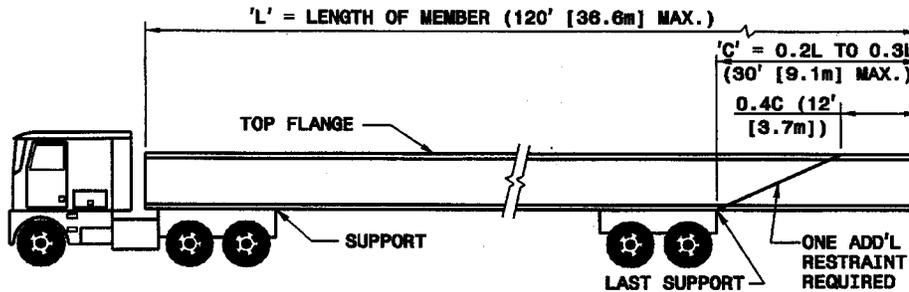
Load and ship steel beams and girders in accordance with the Figure below for all types of transportation.

Below is the sketches provided to Materials and Tests Unit on May 8, 1991. When the contractor wishes to place members on trucks not in accordance with these limits, to ship by rail, to attach shipping restraints to the members, to ship horizontally curved steel members, or to invert members, he shall submit a shipping plan prior to shipping. See also Article 1072-11.

LIMITS FOR PLACEMENT OF BEAMS AND GIRDERS DURING SHIPMENT



WHEN 'C' = 15' (4.6m) OR LESS



WHEN 'C' = OVER 15' (4.6m) THRU 30' (9.1m)

L	MIN. 'C'	MAX 'C'
75 (22.9m)	15 (4.6m)	22½ (6.9m)
80 (24.4m)	16 (4.9m)	24 (7.3m)
85 (25.9m)	17 (5.2m)	25½ (7.8m)
90 (27.4m)	18 (5.5m)	27 (8.2m)
95 (29.0m)	19 (5.8m)	28½ (8.7m)
100 (30.5m)	20 (6.1m)	30 (9.1m)
105 (32.0m)	21 (6.4m)	30 (9.1m)
110 (33.5m)	22 (6.7m)	30 (9.1m)
115 (35.1m)	23 (7.0m)	30 (9.1m)
120 (36.6m)	24 (7.3m)	30 (9.1m)

NOTES: ALL DIMENSIONS ARE IN FEET (METERS).
 TRUCK LOADING SHOWN FOR SIMPLICITY
 DIMENSIONS APPLY TO ALL TYPES OF SHIPMENTS.

GROUT FOR STRUCTURES

(7-18-06)

1.0 DESCRIPTION

This special provision addresses grout to be used in structures, including continuous flight auger (CFA) piles, micropiles, soil nail and permanent anchor tieback retaining walls and backfilling crosshole sonic logging (CSL) tubes or grout pockets, shear keys, dowel holes and recesses for cored slabs and box beams. Provide grout composed of portland cement, water, fine aggregate and, at the Contractor’s option, pozzolan. If necessary, use set controlling admixtures. Proportion, mix and place grout in accordance with the plans, the applicable section of the Standard Specifications or special provision for the structure and this provision as directed by the Engineer.

2.0 MATERIALS

Refer to Division 10 of the Standard Specifications:

Item	Article
Portland Cement	1024-1
Water	1024-4
Fine Aggregate	1014-1
Fly Ash	1024-5
Ground Granulated Blast Furnace Slag	1024-6
Admixtures	1024-3

At the Contractor’s option, use an approved packaged grout in lieu of the materials above with the exception of the water. Contact the Materials and Tests (M&T) Unit for a list of approved packaged grouts. Consult the manufacturer to determine if the packaged grout selected is suitable for the application and meets the compressive strength and shrinkage requirements.

3.0 REQUIREMENTS

If no compressive strength or shrinkage is specified on the plans or in the applicable section of the Standard Specifications or special provision for the structure, provide non-metallic, non-shrink grout with minimum compressive strengths and shrinkage in the vertical direction as follows:

Property	Requirement
Compressive Strength @ 3 days	2500 psi (17.2 Mpa)
Compressive Strength @ 28 days	4500 psi (31.0 Mpa)
Shrinkage	<0.15%

Unless using packaged grout, submit grout mix designs in terms of saturated surface dry weights on M&T Form 312U in accordance with the applicable section of the Standard Specifications or special provision for the structure. A testing laboratory approved by the Department shall determine the grout mix proportions. Adjust proportions to compensate

for surface moisture contained in the aggregates at the time of mixing. Changes in the saturated surface dry mix proportions will not be permitted unless a revised grout mix design submittal has been accepted.

When submitting grout mix designs, provide laboratory test results for aggregate gradation, shrinkage, compressive strength and fluidity with each mix design. Submit compressive strength for at least two 2 in (50 mm) cube specimens at the age of 3, 7, 14 and 28 days for a total of at least eight cube specimens tested. Perform laboratory tests in accordance with the following:

Property	Test Method
Aggregate Gradation	AASHTO T27
Shrinkage	ASTM C1090
Compressive Strength	AASHTO T106
Fluidity	ASTM C939 (as modified below)

When testing grout for fluidity in accordance with ASTM C939, modify the flow cone outlet diameter from ½ to ¾ in (13 to 19 mm).

Unless otherwise required in the Contract or by the Engineer, a grout mix design submittal is not required when using an approved packaged grout. When grout mix designs are submitted, the Engineer will review the mix designs and notify the Contractor as to their acceptability. Do not use grout mix designs until written acceptance has been received. Acceptance of grout mix designs or use of approved packaged grouts does not relieve the Contractor of responsibility to furnish a product that meets the Contract requirements.

Upon written request from the Contractor, a grout mix design accepted and used satisfactorily on a Department project may be accepted for use on other projects.

4.0 SAMPLING AND PLACEMENT

The applicable section of the Standard Specifications or special provision for the structure and the Engineer will determine the locations to sample grout and the number and type of samples collected for field and laboratory testing. The compressive strength of the grout will be considered the average compressive strength test results of two cube specimens at 28 days.

Do not place grout if the grout temperature is less than 50°F (10°C) or more than 95°F (35°C) or if the air temperature measured at the location of the grouting operation in the shade away from artificial heat is below 35°F (2°C).

Provide grout at a rate that permits proper handling, placing and finishing in accordance with the manufacturer’s recommendations unless directed otherwise by the Engineer. Control grout delivery so the interval between placing batches in the same component does not exceed 20 minutes. Solids in the grout shall remain in suspension without excessive bleed-water. Place grout before the time between adding the mixing water and placing the grout exceeds that in the table below.

**ELAPSED TIME FOR PLACING GROUT
(with continuous agitation)**

Air or Grout Temperature Whichever is Higher	Maximum Elapsed Time	
	No Set Retarding Admixture Used	Set Retarding Admixture Used
90°F (31°C) or above	30 minutes	1 hr. 15 minutes
80°F (27°C) through 89°F (31°C)	45 minutes	1 hr. 30 minutes
79°F (26°C) or below	60 minutes	1 hr. 45 minutes

5.0 MISCELLANEOUS

Comply with Articles 1000-9 through 1000-12 of the Standard Specifications to the extent applicable for grout in lieu of concrete.

PEDESTRIAN RAILING

(SPECIAL)

1.0 DESCRIPTION

Furnish and erect pedestrian railing in conformity with the details shown on the plans and at locations shown in the plans and in accordance with this specification.

Provide railing that matches the existing pedestrian railing in the adjacent City of New Bern property. Railing shall be "Contemporary with Rings" as manufactured by:

Sterling Dula Architectural Products
2250 Powell Avenue
Erie, PA 16505
Telephone (814) 838 7731

2.0 MATERIALS

Submit a five foot (5') section of railing and eight (8) copies of catalog cuts and/or drawings for all proposed materials for the Engineer's review and approval. Include the stock number, description, size, manufacturing specification, and applicable contract item number(s) on each submittal. Allow forty (40) days for submittal review. The Engineer will advise the Contractor of reasons for rejected submittals and will return approved submittals to the Contractor. Do not deliver material to the project prior to submittal approval.

3.0 INSTALLATION

Set fence posts and provide sleeves in accordance with Section 866 of the Standard Specifications or submit fence post anchor plate details. After the posts have been set, fill sleeves with grout.

Attach rail to classic concrete rail pilaster in accordance with manufacturer's recommendations.

4.0 BASIS OF PAYMENT

Pedestrian railing will be measured and paid for as the actual number of linear feet of completed and accepted railing. The price and payment will be full compensation for all items required to provide the pedestrian railing but not limited to those items contained in this special provision.

Payment will be made under:

Pedestrian Railing Linear Feet

REMOVAL OF EXISTING STRUCTURE AT STATION 31+21.29 -L- (SPECIAL)

Remove the existing bridge in accordance with Section 402 of the Standard Specifications and this Special Provision.

The following items are to be salvaged by the Department of Transportation:

- | | |
|-------------------------------------|--|
| 1. Control Desk from upstairs | 7. Ring gear |
| 2. Control cabinets from downstairs | 8. Controls in bridge tender's house |
| 3. Two (2) roll out barriers | 9. Commission plate |
| 4. New gate at Northeast off going | 10. Bridge tender's house and contents |
| 5. All navigation lights | |
| 6. Emergency generator | |

The salvaged items will be collected and stored by the New Bern Bridge Maintenance office.

Payment for the above work will be included in the lump sum price bid for "Removal of Existing Structure at Station 31+21.29 -L-".

EXISTING PEDESTRIAN BRIDGE: (SPECIAL)

The existing pedestrian bridge located near the North End of the bridge shall be protected from damage during construction. The Contractor may remove and later replace portions of the bridge as necessary. The Contractor shall repair any damage done to the bridge as a result of construction as directed by the Engineer.

The bridge shall be restored to its original condition or better after the completion of construction activities in its vicinity.

No separate payment will be made for any work necessary to protect, repair, remove, replace or restore the existing pedestrian bridge. All costs associated with this work shall be paid for in the various pay items.

PIER PROTECTION FENDERING

(SPECIAL)

1.0 Description

This work consist of furnishing and installing structural plastic (SP) components including fiberglass reinforced plastic lumber (FRPL) and fiberglass reinforced plastic piles (FRPP).

2.0 Materials

Use plastic consisting of a mixture of one or more of the following recycled post consumer or post industrial thermoplastics: high-density polyethylene, medium-density polyethylene, low-density polyethylene. Mix the plastic with appropriate colorants, UV inhibitors, hindered amine light stabilizers and antioxidants so that the resulting product meets the material property requirements specified in Table 1. SP products must not absorb moisture, corrode, rot, warp, splinter or crack. The outer skin of both the FRPL and FRPP must be smooth and light gray in color unless otherwise specified in the Contract Documents.

Manufacture FRPL and FRPP as one continuous piece with no joints or splices to the dimensions and tolerances in accordance with Table 2 and consisting of a dense outer skin surrounding a less dense core. Interior voids shall not exceed $\frac{3}{4}$ inch [19.1 mm] in diameter. FRPL and FRPP shall be free of twist and curvature. Reinforce 6"x12" FRPL with glass filament. Reinforce 12"x12" FRPL with glass filament and a minimum of four 1-1/2 inch (38.0 mm) reinforcing rods placed in the corners of the section. Reinforce 16" OD (400 mm) FRPP with glass filament and a minimum of sixteen 1-1/2 inch [38.0 mm] fiberglass reinforcing rods. Space the fiberglass reinforcing rods evenly around the inside perimeter of the pile. Reinforcing rods must be continuous and offer a minimum flexural strength of 70 ksi [482 MPa] when tested in accordance with ASTM D 4476 and a minimum compressive strength of 40 ksi [275 MPa] when tested in accordance with ASTM D 695. Steel reinforcement of either FRPL or FRPP is not permitted.

Add a minimum of 15% (by weight) glass filament to the polyethylene used for FRPL with the following exception: the glass filament is not required for the 8"x8"x12" FRPL blocking unless indicated otherwise by the manufacturer. Add a minimum of 5% (by weight) glass filament to the polyethylene used for FRPP.

12"x12" FRPL must meet the minimum structural properties listed in Table 3. 8"x8"x12" and 6"x12" FRPL must meet the minimum structural properties listed in Table 4. 16" OD FRPP must meet the minimum structural properties listed in Table 5.

Density ASTM D 792	Skin	55-63pcf [881-1009 kg/m ³]
Density ASTM E 12	Core	34-48 pcf [545-769 kg/m ³]
Water Absorption ASTM D 570	Skin	2 hrs: <1.0% weight. increase 24 hrs: <3.0% weight. increase
Brittleness ASTM D 746	Skin	No break at -40°F[-40°C]
Impact Resistance ASTM D 746 Modified	Skin	Greater than 4 ft-lbs/inch [213.5 N.m/m]
Hardness ASTM D 2240	Skin	44-75 (Shore D)
Abrasion ASTM D 4060	Skin	Weight Loss: < 0.02 oz [0.5g] Wear Index: 2.5 to 3.0 Cycles = 10,000 Wheel = CS17 Load - 2.2 lb [1 kg]
Chemical Resistance ASTM D 543	Skin Sea Water Gasoline No. 2 Diesel	<1.5% weight increase <7.5% weight increase <6.0% weight increase
Tensile Properties ASTM D 638	Skin/Core	Minimum 500 psi [3.447 MPa] at break
Compressive Modulus ASTM D 695	Skin/Core	Minimum 40 ksi [275.8 MPa]
Coefficient of Friction ASTM F 489	Skin	Maximum 0.25, wet or dry
Nail Pull-Out ASTM D 1761	Skin/Core	Minimum 60 lb [267 N]

FRPL	Dimension	Tolerance
Length	Per order (80 ft [24.3 m] maximum)	+6 -0 in [+150 mm / -0mm]
Width	See Contract Plans	± ¼ in [± 6.4 mm]
Height	See Contract Plans	± ¼ in [± 6.4 mm]
Corner Radius – FRPL (w/ rebar)	1 3/4 in [44.5 mm]	± ¼ in [± 6.4 mm]
- FRPL (w/o rebar)	¼ in [6.4 mm]	± 1/16 in [± 1.6 mm]
Outer Skin Thickness –	3/16 in [4.7 mm]	± 1/8 in [± 3.2 mm]
Distance from outer surface to rebar elements (FRPL)	1 1/2 in [38.1 mm]	± 5/8 in [± 15.8 mm]
Straightness (gap, bend or bulge while lying on a flat surface)		<1 ½ in per 10 feet [<38.1 mm per 3.05 m length]

Table 3 Structural Properties for 12"x12" FRPL reinforced w/ (4) - 1.50" rebar	
Member Size	12 in x 12 in [300 x 300 mm]
Modulus of Elasticity as derived below	405 ksi [2,797 MPa]
Stiffness, E.I.	6.58E+08 lb-in ² [1,889 kN·m ²]
Yield Stress in Bending	4.4 ksi [30.4 MPa]
Weight	42-51 lb/ft [62-76 kg/m]

Determine the Modulus of Elasticity of a full size specimen by conducting a three point bend test with a load applied in the center of a simply supported fourteen foot span [4.27 m], at a deflection rate of 0.25 inches per minute. The Modulus is to be taken at a strain of 0.01 inches per inch, where strain equals $(6) \times (\text{depth of cross section}) \times (\text{deflection}) / (\text{span length squared})$ and where Modulus of Elasticity equals $(\text{load}) \times (\text{span length cubed}) / [(48) \times (\text{deflection}) \times (\text{moment of inertia})]$.

Table 4 Structural Properties for 8"x8"x12" and 6"x12" FRPL reinforced w/ glass filament	
Modulus of Elasticity (ASTM D6109)	175,000 psi
Flexural Strength (ASTM D6109)	No fracture at 1,800 psi
Compressive Strength (ASTM D6108)	1,500 psi
Screw Withdrawal (ASTM D6117)	350 lbs

Table 5 Structural Properties for 16" OD FRPP reinforced w/ (16) - 1.50" rebar	
Member Size	16" O.D. [400 mm]
Modulus of Elasticity as derived below	1,145 ksi [7,900 Mpa]
Stiffness, E.I.	3.69E+09 lb-in ² [10,584 kN·m ²]
Yield Stress in Bending	9,068 ksi [62.6 Mpa]
Weight	68-83 lb/ft [101-124 kg/m]

Determine the modulus of elasticity for composite piles using the following test. Place a 54 foot long plastic composite marine fender piling of manufacturer's standard commercial type horizontally in a clamping device so that 6 feet of the piling will be firmly fixed and unable to move and the other end simply supported. Gradually apply a vertical (downward) load to a point 12 feet from the simply-supported end. Measure the deflection along the length of the piling at the load point, and 3 equidistant locations. Use the load and deflection data to calculate the flexural modulus of elasticity, maximum outer fiber stress, stiffness (EI), and the bending stress. The flexural modulus of elasticity is calculated by dividing EI by the moment of inertia of the cross section of the product.

Calculate the properties in Table 5 utilizing standard elastic beam flexure formulas (as found in references such as Machinery's Handbook; and Formulas for Stress and Strain, by Roark and Young). Report the Stiffness (EI) as the average of the stiffness at all measurement locations, between zero load and half the load corresponding to the specification yield stress. The specified minimum yield stress in bending shall be reached before failure of the product. Calculate the stress at the load point, on the tension side of the plastic composite marine piling.

As stated, conduct the tests on a full-scale product of the specified OD. The results of these tests may be extended through engineering calculations to a product that has a smaller cross section than the tested product. Do not use smaller cross sections to predict the performance of larger cross sections.

FRPP shall exhibit recoverable deflection. FRPP shall not exhibit more than a 5% reduction in bending stiffness (EI) when cyclically load tested. Cyclical load testing shall be conducted on either a 13"O.D. or 16"O.D. FRPP. The test shall be for a minimum of 200 load cycles. The test shall be a four point load condition with a minimum 30.5' clear span and a minimum 15' shear span. The applied load shall produce a minimum of 40% of the CP's bending moment at yield. The bending moment at yield shall be determined by the formula $M = f(I / c)$ where:

M = bending moment at yield (in·lbs)

f = yield stress in bending (lb/in²)

I = moment of inertia of cross-section (in⁴)

c = distance from neutral axis to point where stress is desired (inches)

3.0 Acceptance

The contractor shall submit the following information to the resident engineer at least 60 days prior to installing any SP products.

- Copies of the SP manufacturer's standards and most recent brochure for the FRPP & FRPL products covered by these Specifications.
- Independent test lab report confirming the SP products meet the Plastic Material properties found in Table 1.
- Independent test lab report confirming the submitted FRPP & FRPL products meet the minimum structural property requirements found in Table 3 (FRPL) and Table 5 (FRPP).
- Independent test lab report (cyclical load test) confirming FRPP meets the recoverable deflection requirements found in this specification.
- Written certification from the SP manufacturer that the submitted FRPL and FRPP products satisfy the requirements of this specification and have been in service for a minimum of five (5) years on at least three (3) other bridge pier protection applications in the U.S. This written certification shall include project owner information, project names, locations, contacts and phone numbers.

4.0 Construction Details

Protect materials at all times against exposure to extreme heat or impact. Transport SP in a manner that will minimize scratching or damage to the outer surfaces, stack on dunnage above ground so that it may be easily inspected and store in a manner that will avoid damage. Handle and lift SP with nylon slings. Do not use sharp instruments in handling the product. SP damaged in shipping or handling will be rejected.

Cut, bevel, drill, countersink, and otherwise fabricate SP in accordance with the manufacturer's recommendations Set all material accurately to required levels and lines, with members plumb and true and accurately cut and fitted. Securely attach all composite lumber to substrate by anchoring and fastening as shown on plans. Perform all cutting and drilling in a manner that allows for the collection of all debris and dispose of properly.

After driving, cut off piles at the elevation shown on the plans using sawing or other means as approved by the Engineer to provide a smooth level cut.

5.0 Basis of Payment

The lump sum price bid for "Pier Protection Fendering" will be full compensation for the above work including all material, labor, equipment, tools, disposal, fasteners, and other necessary items required for completing the work. No separate payment will be made for plates, bolts, screws or other hardware necessary to complete the work.

MASS CONCRETE

(SPECIAL)

This special provision applies to the bascule pier fender system bent caps.

The Contractor shall provide an analysis of the anticipated thermal developments in the mass concrete elements using his proposed mix design, casting procedures, and materials. Additionally, the Contractor shall describe the measures and procedures he intends to use to limit the temperature differential to 35°F or less between the interior and exterior of the designated mass concrete elements during curing. The proposed plan to control the temperature differential shall be submitted to the Department for review and comments at the time approval is requested for the mass concrete mix design.

Maintenance of the specified thermal differential may be accomplished through a combination of the following:

- A. Selection of concrete ingredients to minimize the heat generated by hydration of the cement.
- B. Cooling component materials to reduce the temperature of the concrete while in its plastic state.
- C. Controlling the rate of placing the concrete.
- D. Insulating the surface of the concrete to prevent heat loss.
- E. Providing supplemental heat at the surface of the concrete to prevent heat loss.
- F. Other acceptable methods which may be developed by the Contractor.

Mass concrete shall be Class AA, vibrated, air-entrained, and shall contain an approved set-retarding, water-reducing admixture, and 30% flyash and 5% microsilica by weight of the total cementitious material. The total cementitious material shall not exceed 690 lbs. per cubic yard of concrete. The maximum water-cementitious material ratio shall be 0.366 for rounded aggregate and 0.410 for angular aggregate. The slump of the concrete shall not exceed three inches. The Contractor shall submit compressive strength results, the average of at least three

cylinders made in the laboratory, of his proposed mix design. These cylinders shall show a minimum strength of 5000 psi at 28 days.

Minimum compressive strength at 28 days of field placed concrete shall be 4500 psi.

At the discretion of the Engineer, all temperature monitoring requirements may be waived provided the Contractor has proven to the satisfaction of the Engineer that he can limit the temperature differential to 35° F or less between the interior and exterior of the footing.

The Contractor shall provide and install a minimum of six temperature sensing devices in each mass concrete pour to monitor temperature differentials between the interior and exterior of the pour unless otherwise directed by the Engineer. These devices shall be accurate within $\pm 2^{\circ}\text{F}$ within the temperature range of 40°F to 180°F. One temperature sensing probe shall be placed near the center of mass of the pour, and another temperature sensing probe shall be placed at approximately two inches clear from the surface of the concrete furthest from the center of mass. The Engineer shall approve the locations of the other temperature sensing probes.

The monitoring devices shall be read and readings recorded at one-hour intervals, beginning when casting is complete and continuing until the maximum temperature is reached and two consecutive readings indicate a temperature differential decrease between the interior and exterior of the element. At the option of the Contractor, an approved strip-chart recorder furnished by the Contractor may record the temperature. If monitoring indicates the 35°F differential has been exceeded, the Contractor shall make the necessary revisions to the approved plan to reduce the differential on any remaining placements to 35°F or less. The Department must approve any revisions to the plan prior to implementation.

Flyash and microsilica used in the mass concrete mix shall meet the requirements of Articles 1024-5 and 1024-7 of the Standard Specifications. Portland Cement shall meet the requirements of AASHTO M85 for Portland Cement Type II. The temperature of mass concrete at the time of placement shall not be less than 40°F nor more than 75°F.

The placement of the mass concrete shall be continuous until the work is completed and the resulting structures shall be monolithic and homogeneous.

The entire cost of this work shall be included in the unit contract price bid for Class AA Concrete.

**NAVIGATIONAL CLEARANCE VERIFICATION & WATERWAY
INSPECTION**

(SPECIAL)

The Contractor is responsible for the following requirements:

Upon removal of the existing bridge and all temporary work bridges, inspect the waterway bottom to insure that all construction waste materials have been completely removed. Remove any bridge-related debris discovered during this survey. Provide a certification in writing by a licensed engineer or licensed surveyor in the State of North Carolina that the waterway has not been impaired and all construction related debris has been cleared from it. The certification shall include the actual method used to conduct the inspection.

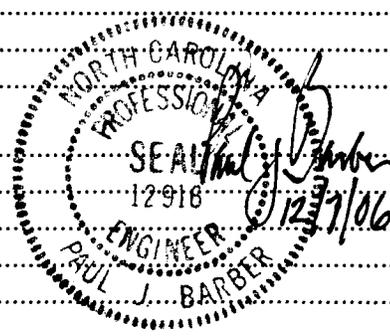
Upon completion of the proposed bridge, verify as-built clearances for the navigational channel and provide a certification by a licensed surveyor or registered professional engineer in the State of North Carolina attesting to the correctness of the clearances.

No separate payment or compensation will be made for this work. Include all costs for performing this work in the various pay items.

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PROJECT SPECIFIC SPECIAL PROVISIONS**BASCULE SPAN CONCRETE**

Modifies/supplements Standard Specification Section 420 - Concrete Structures.

420-1 DESCRIPTION

THE FOLLOWING IS ADDED:

This work shall also include cast-in-place construction using lightweight concrete in the bridge deck and sidewalks of the movable bascule spans, classic concrete bridge rail along the west fascia of the bascule spans composite floor deck at the control house control room level and heavy weight concrete construction for the counterweight.

This work shall also include construction of Portland cement white concrete at the control house with the fine aggregates for white concrete conforming to Article 1024.

420-2 MATERIALS

THE FOLLOWING IS ADDED:

Item

Sand lightweight concrete conforming to Sand Lightweight Concrete Special Provisions.

Sand lightweight concrete shall consist of lightweight coarse aggregate and natural sand fine aggregate in accordance with Sand Lightweight Concrete Special Provisions.

420-3 FALSEWORK AND FORMS

D. Forms for Concrete Bridge Decks

THE FOLLOWING IS ADDED:

Permanent steel bridge deck forms shall not be used in the construction of the deck on the movable bascule spans and the concrete floor slabs of the control house, except on the control room level where composite floor metal deck is used.

420-4 PLACING CONCRETE

THE FOLLOWING IS ADDED:

Refer to the plans for sequencing the placement of concrete on the movable span.

Counterweight Concrete:

Heavy weight concrete to be used in the counterweight shall be Class B modified as described in the following paragraphs. Heavy weight concrete shall have 3 percent minimum air

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B-2532****Project Specific Special Provisions
PSSP**

entrainment. The matrix shall contain steel punchings, scrap metal, billet steel, or other approved materials to achieve the average 28-day air dry unit weight specified on the plans or modified by the Contractor's balance calculations. The size of steel punchings shall be 5/8-in minimum diameter and 3/8-in thick.

The Contractor shall prepare calculations showing required dimensions and weight of the counterweight based on center of gravity calculations as specified in the Span Balancing Special Provision. The calculations shall be submitted to the Engineer for review. The calculations shall include summarized tabulations showing for each material the total quantity, estimated unit weight, and total weight. These estimates shall be revised based on the shipping weights of the steel. The supplemental summarized tabulations shall be submitted to the Engineer.

Before he prepares the balance calculations, the Contractor shall cast 5 test blocks of materials to be used in the counter- weights. These blocks shall be carefully measured and weighed immediately after casting and again 28 days later. From these measurements, he shall carefully estimate the density. Test blocks shall be made and cured as specified for permanent concrete.

The density of concrete actually placed in the counterweight shall be verified by means of other test blocks made at intervals during the placement of the concrete for the counterweight. Each block shall be weighed promptly after being made and the weight compared to the original test blocks to estimate the resulting density when seasoned, and the need for adjusting the total volume of concrete to be placed in the counterweight.

Counterweight calculations shall assume that the pockets are partially filled (approximately 4 percent of counterweight weight) in the balanced state.

Lightweight Concrete:

In addition to the requirements set forth in the Special Provision, "Sand Lightweight Concrete" and the standard specification, lightweight concrete in the bascule span shall meet the criteria set forth in the following paragraphs. The Contractor shall be responsible for designing the concrete mixture and determining the proportions of cement, fine aggregate, coarse aggregate, water and air-entraining admixture which will produce a workable sand-lightweight concrete mix.

The lightweight concrete density is critical for span balancing calculations. Contractor shall take the necessary precautions to ensure the maximum dry (placed) unit weight does not exceed 115 pounds per cubic foot. If, as a result of cylinder testing, initial batches indicate a unit weight in excess of the maximum permitted, concrete pours shall be halted and a new design mix shall be formulated immediately. All test results shall be reported to Department field personnel and the appropriate Contractor personnel in a timely manner.

All sand-lightweight concrete shall have good workability and other properties such that proper placement, consolidation, and finishing are obtained. Lightweight aggregates and sand shall be batched by weight.

The manufacturer of the lightweight aggregate shall supply a technical representative at the site for the first day of lightweight concrete placement operations. The representative shall be responsible to assist the Contractor and the Engineer in the control of lightweight concrete mixing and placement operations.

A technical report shall be submitted to the Engineer, by the lightweight aggregate manufacturer, regarding any observations or test results relative to the concreting practices at the work site.

Class S Concrete (Seal):

Class S concrete shall be non-vibrated and non air-entrained, shall contain an approved set-retarding water-reducing admixture, and shall contain flyash in the amount of 25-30 percent by weight of the total cementitious material (Portland cement plus flyash). The total cementitious material shall not exceed 640 lbs. per cubic yard of concrete. The maximum water/cementitious material ratio shall be 0.550 for rounded aggregate and 0.594 for angular aggregate. Slump shall be a minimum of 6 inches and a maximum of 8 inches. Minimum compressive strength at 28 days shall be 3000psi. The laboratory test results of compressive strength at 28 days shall be at least 4000 psi for laboratory trial batches. If the combination of concrete materials proposed for use will not provide the required laboratory compressive strength, the total cementitious material may be increased not to exceed 640 lbs. per cubic yard with the approval of the engineer at no cost to the Department. Measurement of air content may also be performed by the Chace indicator, AASHTO T199, in which case sufficient tests will be made in accordance with AASHTO T152, T121, or T196 to establish correlation with the Chace indicator. Concrete for structures will not be rejected based on tests made in accordance with AASHTO T199.

For Class S concrete, the concrete temperature at the time of placing shall be not less than 40 degrees F nor more than 75 degree F. Class S concrete shall not be deposited under water when the water temperature at the surface is less than 35 degrees F.

Class S concrete shall contain an approved set retarding mixture. Maximum elapsed time for placing concrete shall be one hour and forty-five minutes. Granulated blast furnace slag shall not be used in Class S concrete.

420-21 MEASUREMENT AND PAYMENT

THE FOLLOWING IS ADDED TO THE PAY ITEM LIST:

Pay Item	Pay Unit
Class AA Concrete	cubic yard
Class AA Concrete, White	cubic yard
Class S Concrete (Seal)	cubic yard
Counterweight Concrete, Heavy Weight	cubic yard

FABRICATING AND PLACING REINFORCEMENT

Modifies/supplements Standard Specification Section 425 – Fabricating and Placing Reinforcement.

425-4 PLACING AND FASTENING

THE FOLLOWING IS ADDED:

Core Drilling and Grouting:

Holes shall be drilled with approved core drilling equipment at locations, size and depth shown in the plans. At the discretion of the Engineer, locations may be adjusted locally to avoid striking existing reinforcement. Holes shall be partially filled with non-shrinking type grout conforming to Section 1081.

The grout shall be first thoroughly brushed into all surfaces of the hole and then shall be placed to a depth sufficient to insure complete filling of the hole after insertion of the reinforcing bar.

Reinforcing bars shall be clean and dry prior to insertion into the grouted hole. Bars shall be inserted into the holes to the depth prescribed on the plans and shall be manipulated to insure complete coverage by the grout. After the insertion of the reinforcing bar, all excess grout shall be struck off flush with the concrete face. If the grout fails to fill the hole after reinforcing bar insertion, additional grout shall be added to the hole to allow a flush strike-off.

If the reinforcing bar is inserted in a hole which has an axis predominantly horizontal to the ground surface, care shall be taken to prevent the reinforcing bar from changing position prior to the setting of the grout, and to prevent the grout from running down the face of the concrete.

The Contractor and adhesive anchor manufacturer shall certify that the anchors supplied shall, when tested for tensile strength in accordance with ASTM E-488 for the specified anchor embedment depth and bolt or rebar grade and diameter, fail in yielding of the steel not a failure of the concrete in which they are embedded or an adhesion failure of the adhesive anchors.

The Contractor and/or adhesive anchor manufacturer shall perform proof loading of the adhesive anchors on each concrete element (i.e., deck slab, parapet, pier) no sooner than 24 hours after installation, in accordance with ASTM E-488 to 90% of the yield strength of the bolts or rebar used without failure of the anchors. A minimum of 10% of the first 50 anchors installed on each concrete element shall be randomly selected and proof loaded to 90% of the yield strength of the bolts or rebar prior to installing additional anchors, using confined tests on the concrete element in the presence of the Engineer. Any spalls or cracks caused by such testing shall be repaired. After acceptable results of all these preliminary tests, the remaining anchors shall be installed. The cube root of the remainder of the anchors installed on each concrete element shall be randomly selected and proof tested to 90% of the yield strength of the bolts or rebar, not sooner than 24 hours after installation, using confined testing, in the presence of the resident Engineer of construction, or his representative, without failures. Calibration certificates shall be provided for the device used for testing. Testing shall occur at locations approved by the Engineer.

The adhesive anchors used shall be acceptable based on satisfactory proof testing and certification as outlined above for each concrete element that the adhesive anchors are installed on. Any failure to comply with these requirements shall be considered cause for rejection of the adhesive anchors supplied. Failure of the adhesive anchoring system to meet the proof load requirements shall cause the Contractor to install detailed, tested and approved adhesive anchors of alternate size, embedment depth, or reduced spacing to supply satisfactory performance.

The embedment of the anchors in the concrete shall be based on a maximum presumptive ultimate concrete compressive strength, f'_c of 3,000 psi.

Should failure of the adhesive anchors to meet the proof load requirements as specified above be alleged by the Contractor and/or the adhesive anchor manufacturer to be attributable to insitu concrete compressive strengths less than 3,000 psi, the Contractor shall increase the anchor embedment depth, or reduce the anchor spacing.

The required embedment of the adhesive anchors, as shown on shop drawings to be submitted for approval, shall be into the existing concrete. Sufficient adhesive shall be placed in

each drill hole to insure that the annular space between the anchor and the hole is fully filled for the entire depth of the hole, both through the leveling course and into the existing concrete.

All material specifications for adhesive, anchors, rebar, washers and nuts shall be indicated on shop drawings to be submitted for approval.

Holes shall be drilled to the diameter in accordance with the manufacturer's instructions for the system used and shall be thoroughly cleaned and dry before installation.

Drills used to make anchor holes shall not spall the opposite side on the concrete element.

When air drills are used, and rebar is encountered which prohibits advancing the hole, the Contractor shall either core drill through the bar and then continue to air drill the remainder of the hole, or shall angle the hole with the air drill, if feasible, to bypass the bar.

STEEL STRUCTURES

Modifies/supplements Standard Specification Section 440 - Steel Structures.

440-1 DESCRIPTION

THE FOLLOWING IS ADDED:

This work shall also include furnishing, fabricating, and erecting bascule girders/stringers, floorbeams, trunnion columns/beams and lateral bracing frames for the movable bascule span; fabricating the cast iron balance blocks which are to be placed within the counterweight or stored in the bascule piers; and performing calculations, tests, and adjustments to provide the final balance for the movable bascule spans.

The counterweights shall be steel boxes filled with heavy weight concrete with pockets provided therein for balance blocks to be used for future adjustment and for securing an initial balance between the lift span and the counterweights. With the span in the closed position, the span will have a total positive reaction on the two live load shoes of 20,000 pounds total. For future adjustment of the counterweights, the Contractor shall provide additional balance blocks over and above those required for the initial balance as indicated on the Plans. These blocks shall be stored at the site at locations designated by the Engineer.

This work shall also consist of the furnishing, fabrication, and erection of pier access ways including all hatches, walkway grating, ladders, railings, and connecting hardware, including supports, which are comprised of structural steel shapes and plates, all in accordance with the details shown on the plans or as directed by the Engineer. Also included, as part of this work will be the furnishing of a manually operated adjustable maintenance platform for access to the counterweight pockets along with manual hoist to lift balance blocks to counterweight pockets.

440-2 MATERIALS AND FABRICATION

THE FOLLOWING IS ADDED:

All structural steel shall conform to AASHTO M270, Grade 50, except as otherwise noted on the Plans.

Cast iron for balance blocks shall conform to AASHTO M105, Class 30.

Pipe railing shall be in accordance with ASTM A53 Grade B, Schedule 40, galvanized per AASHTO M111.

Steel grid grating shall be ASTM A569, galvanized per AASHTO M111. Grating shall be welded Type 1W/B with 1-inch by 1/4-inch bearing bars at 1-3/16-inch centers with cross bars at 4-inch centers.

Adjustable maintenance platform shall be a manually operated, adjustable height lift with a cantilevered working platform. The platform shall be 25 1/2-inch long and 29-inch wide with 42-inch high handrails, midrails and 4-inch high toeboards. The platform will provide a 9-foot to 15-foot length. The lift will be a quickly elevated to the desired working height with a hand crank winch, and then the user climbs a ladder to the platform. The platform shall be constructed of steel with two 8-inch lockable swivel casters, two 8-inch rigid casters, and four adjustable height stabilizing jacks that work as outriggers. The platform shall be in compliance with ANSI A 92.3 and shall be Model No. ML-15W as furnished by the Cotterman Company or an approved equal. Two platforms are required one per bascule leaf.

Each platform shall come with a steel body hand chain hoist with 20-foot lifting height and 1000-pound capacity and shall be series LHH as furnished by Coffing Hoists and Little Mule Products or an approved equal. A center pull hoist ring with 1000-pound rated capacity shall be mounted directly above each vertical line of counterweight pockets.

Pier access and maintenance hatches shall be as specified on the Plans.

440-10 MEASUREMENT AND PAYMENT

THE FOLLOWING IS ADDED:

Pier access ways will not be measured and payment will be made on a lump sum basis.

Cast iron balance blocks will be measured by the unit basis.

THE FOLLOWING IS ADDED:

Pay Item	Pay Unit
Pier Access Ways	Lump Sum
Balance Blocks, Cast Iron	Unit

Separate payment will not be made for furnishing, fabricating and bascule girders/stringers, floorbeams, trunnion columns and beams, and lateral bracing frames, but all costs shall be included in the bid price for the Pay Item "Structural Steel".

Separate payment will not be made for furnishing, fabricating and erecting the pier access ways including all hatches, walkway grating, ladders, railings, and connecting hardware, including supports, which are comprised of structural steel shapes and plates, as well as furnishing and erecting the cantilevered adjustable maintenance platform for access to the counterweight pockets, but all costs shall be included in the bid price for the Pay Item "Pier Access Ways".

Separate payment will not be made for furnishing and erecting the maintenance platform at the center of the movable bascule spans, but all costs shall be included in the bid price for the Pay Item "Pier Access Ways".

Separate payment will be made for furnishing, fabricating and erecting the toe and tail span locks with all costs to be included in the bid price for Pay Item "Span Lock Machinery" as described in Section Span Lock Machinery of the Special Provisions.

Separate payment will be made for furnishing, fabricating and erecting the trunnion assembly which includes the trunnion bearing, trunnion and hubs with all costs to be included in the bid price for Pay Item "Trunnion Assemblies" as described in Section Trunnion Assemblies of the Special Provisions.

BASCULE SPAN – ADDITIONAL CONSTRUCTION REQUIREMENTS

Special attention is called to the necessity for the correct alignment of the center and rear break details. The bascule girders, stringers, and floorbeams shall be cambered for dead load and vertical curvature as specified on the Plans. Each bascule leaf shall be assembled as a unit in the shop in its cambered position. Proper alignment of machinery bearings or other casings shall be verified.

The setting of all members and other parts, which serve as supports or connections of the movable parts or machinery, shall be set to the tolerances shown on the Plans or as called for in the Special Provisions. In no case shall concrete be placed around such parts before they are firmly held in place by proper temporary bracing and before the accuracy of the setting has been checked. Prior to the setting of critical members, the Contractor shall submit an erection procedure to the Engineer for review and approval. This erection procedure shall show estimated displacements and deflections of steel work while portions of the structure are erected and concrete placed.

A suggested concrete placement sequence for the deck and the counterweight is indicated on the Plans. During the placement of the concrete slab it will be necessary to monitor the deflection of the bascule girders.

Fabrication. The flange plates, which support the trunnion bearings, shall be so accurately welded to the web plates that not less than the designated thickness of metal will remain after finishing. Flange plates are to be square with the web. These plates shall be ordered with extra thickness to allow for finishing and tolerances. The flange plates shall be planed throughout the length as shown on the Plans to provide a true plane for attaching the trunnion bearings.

Special attention is called to the alignment of trunnions. See Special Provisions Section Trunnion Assemblies for additional requirements.

Counterweight. The Contractor shall prepare the shop counterweight calculations and the shop counterweight drawings as part of this work. See Special Provisions Section Span Balancing for calculation instructions.

Stainless Steel Shims. Wherever shims are required, the nominal, or theoretical, thickness "t" shall be indicated. The actual shim pack furnished shall have a thickness equal to 2 times the nominal thickness indicated and shall be composed of the following material thickness: t, t/2, t/4, t/8, t/16, etc. The thickness of the material furnished shall be such that the total shim pack thickness can be adjusted in increments of 1/32nd inch for machinery bases and structural parts that have machined surfaces, or 1/16th inch for structural steel connections for parts not having machined surfaces.

BASCULE SPAN ERECTION

The bascule leaves shall be erected and constructed in the closed position, one leaf at a time. See Suggested Sequence of Construction on the Plans.

During periods when the bascule leaves are unbalanced, the Contractor must provide positive, sturdy supports, shoring, and /or falsework to support the unbalanced loads. The Contractor shall secure the services of an engineer, registered in the State of North Carolina, to design these supports to the entire unbalanced loads plus all additional loads resulting from wind forces, temporary erection forces, accumulations of snow, ice or dirt, etc. The Contractor shall submit proposed shoring methods, sealed by the Contractor's engineer, to the Engineer for review and approval. It will remain the Contractor's responsibility to ensure that the bascule leaves are adequately shored in a safe manner.

The Contractor shall submit erection procedures of his proposed stages of construction, means of control, and motive power to the Engineer for review and approval. The Contractor shall keep ready at a convenient nearby location sufficient counterweight material to balance the bridge leaves during the erection and completion. It will remain the Contractor's responsibility to assure that the bascule leaves are opened and closed in a safe manner.

Clearances. The first time the bascule leaf is slowly moved, a check shall be made of all points of minimal clearance or possible interference between the fixed and movable parts of the structure or as otherwise specified on the Plans.

Breaks in Roadway Floor. Particular care must be taken to insure that the breaks in floor are adjusted for smooth joints, proper alignments and clearances.

Metal Work Set in Concrete. All metal work set in concrete shall be placed and maintained with care in exact alignment at the proper elevation. Where a grout bed is required, the metal parts shall be adjusted and supported by means of leveling bolts. The grout bed shall be made with an approved self-leveling, high strength non-shrink and non-staining grout. All metal work shall be adjusted to the satisfaction of the Engineer before being set in concrete or mortar.

Placing Span in Operation Condition. The span shall be placed in an operating condition, to the satisfaction of the Engineer, upon its final completion. The Span shall be operated sufficiently to enable the Engineer to inspect its operation to their satisfaction. Faulty and defective work shall be repaired or replaced at no additional cost to the Owner.

Operating Machinery Work. The furnishing, fabricating, installing and /or erecting, painting, adjusting, and the placing in operation of all related items shall be as specified in the Section Span Drive Machinery, Section Span Lock Machinery, and Section Trunnion Assemblies of the Special Provision.

SPAN BALANCING

I. DESCRIPTION

This work shall consist of the Contractor developing calculations and testing the operation of the bascule span to ensure its balance.

II. CALCULATION PROCEDURES

During the shop drawing development, the Contractor shall prepare complete and thorough center of gravity calculations for the bascule span. These center of gravity calculations shall be obtained by using weight take-off from approved shop drawings for the structural steel, concrete, bridge railing, bar lists for the concrete deck, sidewalk and parapets, test blocks for all types of concrete to be used on the bascule span and estimation of the weight of paint on the structural steel along with incidentals such as navigation lighting, conduits, wiring, span locks, platforms, etc.

Weights for structural steel shall be computed on the basis of the net finished parts as shown on the shop drawings deducting for cope, cuts, clips and all open holes; but including weights of bolts, nuts, washers and welds.

The Contractor shall compute the weights of individual components to two decimal places and summarize to the nearest whole number. Calculations shall be furnished showing the development of these weights.

The center of gravity of each component shall be located both horizontally and vertically and if not symmetrical located transversely. The center of gravity distances shall all be dimensioned to the centerline of trunnion as reference. All dimensions shall be in feet and to two decimal places.

Positive (+) distances will be for elements forward and above the centerline of trunnion, while negative (-) distances will be for elements having centers of gravity behind or below the centerline of trunnion.

The Contractor shall submit center of gravity calculations in a tabulated form showing the component's weight, distances from center of roll to the components center of gravity (both horizontally, vertically and transversely, where necessary), the product of the weights and arms and the net summation for the quantity take-off. This tabulation shall be developed for each bascule leaf, each counterweight and the complete structure, which is the combination of both.

These calculations shall be utilized by the Contractor in developing the required information for the counterweight calculations, which are further explained under Subarticle 420-4.

No construction shall proceed on the counterweight until the balance calculations have been reviewed and approved by the Engineer. The balance calculations shall be prepared, signed and sealed by a Professional Engineer registered to practice in the State of North Carolina and familiar with movable bridges.

Balance calculations shall be prepared and balance adjustments performed such that, in the calculations, the bascule span is balanced. It is desired to have a slight unbalanced condition, which will be specified in the ensuing paragraphs and adjusted for, in the field.

Throughout the whole construction the Contractor shall maintain a copy of the balance tabulation on site and correct the calculations to reflect any adjustments required for field installation of the components.

III. BALANCING PROCEDURES (TO BE PERFORMED ON EACH LEAF INDIVIDUALLY)

After the concrete counterweight and slabs, sidewalks and curbs, railings are constructed and the counterweight adjusted for the predetermined balance by installing some of the balance blocks, the Contractor shall take a preliminary balance reading of the bascule span. This preliminary reading shall be performed by jacking the span using pressure readings from hydraulic jacks placed under the live load shoe. No extraneous loads shall be on the span during the jacking. The Contractor shall place a hydraulic jack under each bascule girder live load bearing shoe and apply sufficient load to unseat the span from their bearings. Pressure readings at each jack shall be taken to determine the unbalanced moments. The Contractor shall also place hydraulic jacks under each bascule girder at the counterweight and apply sufficient load to close the span. Pressure readings at each jack shall be taken to determine the unbalanced moments. These pressure readings shall also be used to estimate the trunnion friction. An unbalanced moment no greater than 200 kip-ft in the direction towards the channel (span heavy) will be considered suitable. If a greater moment exists, the Contractor shall rebalance and re-jack the span until this moment is attained. At no time will a moment in the direction of the counterweight (tail heavy) be acceptable. The Contractor shall repeat this procedure until the unbalanced moment is acceptable.

Once this initial balancing has been performed, the Contractor shall operate the bascule span utilizing the mechanical gear drive system. The operation of the span shall occur with no extraneous loads on the span and when the weather and wind conditions impose no additional loading on the span. Operation shall only be performed after the mechanical gear drive system alignment has been accepted and approved.

Strain gages shall be installed on the rack pinion shafts. The strain gauges shall be wired to calibrated apparatus capable of simultaneously recording the strain on the two rack pinion shafts of one leaf during the full opening and closing cycle of the leaves. Strain gauge measurements shall be repeated on the two rack pinion shafts for the other leaf.

Normal openings for river traffic shall be utilized for determining span balance, unless previously approved otherwise by the Engineer. Balancing shall not extend the time that the span is normally opened for the normal river traffic when both leaves are being tested simultaneously.

Prior to performing any balance readings, the Contractor shall take a complete inventory of all balance blocks in the counterweights of both leaves. This inventory shall include description of material, weight, quantity and location in the counterweights.

The span shall be raised and lowered for a minimum of two cycles. Strain gage readings will be taken continuously and simultaneously for the full operating cycle of raising and lowering the span. With this information, the Contractor shall record the readings as compared to the angle of span opening and develop a graph of span unbalance.

From this information, the Contractor shall calculate the magnitude of unbalance and recommend a placement of balance blocks to obtain the prescribed state of balance to the Engineer for review and approval.

The Contractor shall prepare a report on the basis of the strain gauge measurements. The following describes the balance report that the Contractor shall submit for the bridge. The report shall include the following information for each leaf of the bascule span:

- 1) Relationship between measured strain and actual operating torque.
- 2) Relationship between measured strain and angle of opening. This shall include all derived formulas.
- 3) Location of existing center of gravity.
- 4) Location of desired center of gravity.
- 5) Recommended balance block shifts and removal to achieve desired center of gravity.
- 6) Recommended balance plate installation to achieve desired center of gravity.
- 7) Present capacity of existing counterweight pockets for both leaves. This shall include inventory of the number and location of balance material presently on the counterweights.
- 8) Raw data in a usable format.

Five (5) copies of the report shall be furnished to the Engineer. Upon approval of the recommended balance block shifts and balance block installation, if any, by the Engineer, the Contractor shall shift the actual blocks and install balance blocks as required. This work may involve removing or shifting blocks from one pocket to another.

After completion of balance block shifts and balance plate installation, the balance of each leaf shall again be checked by means of data from resistance strain gauges. If additional block shifts and/or additional balance block installation is required, based on the new data, the Contractor shall perform such shifts and/or additions as required. If deemed necessary by the Engineer, the Contractor shall take a third set of strain gauge readings of the span balance after the balance block shift and balance plate installation to verify the span balance.

After the balance blocks have been placed, a second test operation will be run and recorded as previously mentioned. If the operation indicates a need to further refine the balance, the Contractor shall make the adjustments in balance block placements. This procedure shall be repeated until the desired span balance is obtained.

The desired state of balance for this bascule span is to have a downward reaction at the two live load shoes on each bascule leaf of approximately 20 kips total with 10.5 kips and 9.5 kips at the west and east bascule girders respectively.

The Contractor may submit for review and approval an alternate method of span balance. Rejection of alternate method shall at no time be considered extra cost to the Owner.

As part of this work, the Contractor shall generate a Schedule of Work. The intent of the Schedule of Work is to maintain the balance of the bascule span during all phases of work.

The Schedule of Work shall be submitted to the Engineer for review and approval. The Schedule of Work shall be a balance table recording the weight and center of gravity in relation to the trunnion centerline (in the horizontal, vertical, and transverse directions) of all material removed from or added to the bascule leaves. All weights utilized in the balance table shall be based on final shop drawing weights. The Schedule of Work shall be prepared and sealed by a Professional Engineer currently licensed and registered by the State of North Carolina.

Review of the Schedule of Work, including reviewing the number of balance blocks and balance blocks, does not relieve the Contractor of the entire responsibility for securing such balance and damage that may result from improper balance.

The Contractor shall plan and schedule the work on the bascule leaves in such a manner that the temporary unbalanced condition is equal on each bascule girder of one leaf. The maximum span-heavy imbalance of one bascule leaf due to the Contractor's operations and any imbalance shall not exceed 200 kip-feet (100 kip-feet per girder). Span-light conditions (span weight less than counterweight) will not be permitted at any time.

The Schedule of Work shall be updated prior to the removal or addition of weight to the bascule leaves under any phase of the work. The Schedule of Work shall be kept current by the Contractor at all times and shall be furnished to the Engineer at least monthly. The Contractor shall keep a current Schedule of Work at the site at all times and it shall be made available for review by the Engineer immediately upon request.

The Engineer shall have the right to request additional verification of span balance at any time during the construction if the Engineer deems necessary at no additional cost to the Department.

After completion of major phases of work such as span lock installation, the Contractor shall check the final span balance for both bascule leaves by the resistance strain gage method. The check shall include making any adjustments as required and ordered by the Engineer to rebalance both leaves. If block adjustment and block installation is required for final balancing, the Contractor shall once again take readings of the final balance condition and furnish five (5) copies of the final balance report to the Engineer for approval.

IV. BASIS OF PAYMENT

Separate payment will not be made for any of the work as described in Section Span Balancing but the costs for all balance calculations, including all work required to develop the calculations, strain gage balance checks, as well as the placement of the cast iron balance blocks to obtain the desired balance shall be included in the lump sum bid price for Pay Item "Approximately _____ Pounds Structural Steel".

Separate payment will be made for fabricating and furnishing the cast iron balance blocks with all costs to be included in the bid price for Pay Item "Balance Blocks, Cast Iron" as previously described herein.

MAINTENANCE AND PROTECTION OF NAVIGATION TRAFFIC BENEATH PROPOSED STRUCTURE AT STATION 31+21.29

I. GENERAL

Maintain navigational traffic on the Trent River as shown on the Construction Staging Plans and as directed by the Engineer.

Provide a minimum temporary horizontal clearance of 50'-0" with unlimited vertical clearance at all times during construction.

Submit plans and calculations for review and approval for protecting traffic and bracing girders, as described herein, at the above station before beginning work at this location. Have the drawings and design calculations prepared, signed, and sealed by a North Carolina Registered Professional Engineer. The approval of the Engineer will not relieve the Contractor of the responsibility for the safety of the method or equipment.

II. PROTECTION OF TRAFFIC

Protect traffic from any operation that affords the opportunity for construction materials, equipment, tools, etc. to be dropped into the path of traffic beneath the structure. Based on Contractor means and methods determine and clearly define all dead and live loads for this system, which, at a minimum, shall be installed between beams or girders over any navigation area where vessel traffic is maintained. Install the protective system before beginning any construction operations over traffic. In addition, for these same areas, keep the overhang falsework in place until after the rails have been poured.

III. BRACING GIRDERS

Brace girders to resist wind forces, weight of forms and other temporary loads, especially those eccentric to the vertical axis of the member during all stages of erection and construction. Before casting of intermediate diaphragms, decks, or connecting steel diaphragms do not allow the horizontal movement of girders to exceed ½ inch (13mm).

IV. BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items will be full compensation for the above work.

PREFORMED COMPRESSION JOINT SEALS

I. SEALS

Provide preformed seals manufactured from elastic polychloroprene material. Provide seals that are compatible with concrete and resistant to abrasion, oxidation, oils, gasoline, salt and other materials that are spilled on or applied to the surface. Splicing is not permitted.

Choose the appropriate seal design and cross-section so that it is substantially solid when fully compressed. A middle vertical rib in the seal cross-section is required. Use a seal with closure, defined as the point at which the seal is fully compressed, in the range of 50-70% of the original seal width. Provide a seal that, when compressed, the center portion of the top surfaces does not extend upward above the original height of the seal. Install the compression seal so that it is watertight along its entire length including the ends.

Provide seals that meet the requirements given below.

<p style="text-align: center;">TEST SPECIFICATIONS FOR PREFORMED COMPRESSION JOINT SEALS</p>

TEST	REQUIREMENT	TEST METHOD
Min. Tensile Strength, psi (MPa)	2000 (13.8)	ASTM D412
Elongation at Break, %min.	250	ASTM D412
Hardness, Type A Durometer	55 ± 5	ASTM D2240
Oven Aging, 70 hrs. @ 212°F (100°C) Tensile strength, % change, max. Elongation, % change max. Hardness, points change, max.	-20 -20 0 to ± 10	ASTM D573
Ozone Resistance 20% strain, 300 pphm in air, 70 hrs. @ 104°F (40°C) (Wipe with solvent to remove surface contamination)	No cracks	ASTM D1149
High Temperature Recovery 70 hrs. @ 212°F (100°C), under 50% deflection, % min.	85	AASHTO M220
Low Temperature Recovery 22 hrs. @ -20°F (-29°C), under 50% deflection, % min. 72 hrs. @ 14°F (-10°C), under 50% deflection, % min.	83 88	AASHTO M220
Compression-Deflection Test P = Force per square inch (sq. mm) @ 15% deflection of minimum seal width @ 50% deflection of minimum seal width	3 psi (20.7 kPa) min. 15 psi (103.4 kPa) max.	

Have the top of the compression seal clearly shop marked. Inspect the compression seals upon receipt to ensure that the marks are clearly visible upon installation.

II. BON-LASTIC ADHESIVE

Provide bon-lastic adhesive that is one-part moisture polyurethane and hydrocarbon solvent mixture with the following physical properties:

Average weight per gallon (liter) 8.00 lbs (3.6 kg) = 10%

Solid content 72 - 74% by weight

Adhesive to remain fluid from 5°F (-15°C) to 120°F (49°C)

Film strength (ASTM D412) 1200 psi (8.3 MPa)

Elongation 350%

Submit to the Engineer the manufacturer's affidavit that all materials furnished by the manufacturer are in conformance with this Special Provision. Submit these affidavits for each separate project and clearly state the project number.

III. SAWING THE JOINTS

Where the plans call for sawing the joints, initially form the joints to the width shown on the plans.

Allow the concrete slab to cure for at least 2 days prior to sawing the concrete joint to its final specified width and depth.

When sawing the joint to receive the compression seal, always use a rigid guide to control the saw in the desired direction. To control the saw and to produce a straight line as indicated on the plans, anchor and positively connect a template or a track to the bridge deck. Do not saw the joint by visual means such as a chalk line. Fill the holes used for holding the template or track to the deck with an approved, flowable non-shrink, non-metallic grout.

Saw cut to the desired width and depth in one or two passes of the saw by placing and spacing two metal blades on the saw shaft to the desired width for the compression seals.

The desired depth is the depth of the compression seal plus 1/4 inch (6 mm) above the top of the seal plus approximately 3/4 inch (19 mm) below the bottom of the seal. An irregular bottom of sawed joint is permitted as indicated on the plans. Grind exposed corners on saw cut edges to a 1/4" (6 mm) chamfer.

Remove any staining or deposited material resulting from sawing with a wet blade to the satisfaction of the Engineer.

Use extreme care to saw the joint straight to the desired width and to prevent any chipping or damage to sawed edges of the joint.

IV. PREPARATION OF SAWED JOINT

The Engineer thoroughly inspects the sawed joint opening for spalls, popouts, cracks, etc. Make all necessary repairs prior to blast cleaning and installing the sealer. The installed compression seal is required to be watertight.

Immediately before sealing, clean the joints by sandblasting. Sandblast to provide a firm, clean joint surface free of curing compound, loose material and any foreign matter. Sandblast without causing pitting or uneven surfaces.

Dry blast cleaning is required. Use clean dry sand for the abrasive when blast cleaning.

After blasting, either brush the surface with clean brushes made of hair, bristle or fiber, blow the surface with compressed air, or vacuum the surface until all traces of blast products and abrasives are removed from the surface, pockets, and corners.

If nozzle blasting, use compressed air that does not contain detrimental amounts of water or oil.

Examine the blast cleaned surface and remove any traces of oil, grease or smudge deposited in the cleaning operations.

Bond the seal to the blast cleaned surface on the same day the surface is blast cleaned.

V. BASIS OF PAYMENT

Payment for all compression sealing assemblies shall be considered incidental to the construction of the bridge and included in the several pay items.

BIRD PROTECTION

I. GENERAL

This work shall also include furnishing and erecting a bird repellent system to prevent bird access to any areas where birds roost, nest or land and to prevent damage caused by droppings or nesting materials.

II. MATERIALS AND FABRICATION

Bird repellent netting shall have openings no larger than $\frac{3}{4}$ " x $\frac{3}{4}$ ", manufactured by Nixalite of America Inc.; Bird-B-Gone Inc., Fly-Bye or an approved equal.

Bird repellent netting shall be attached to the structure using tensioned steel wires in accordance with the manufacturer's recommendations.

Bird spikes shall be stainless steel, manufactured by Nixalite of America Inc.; Bird-B-Gone Inc.; Bird-X Inc. or an approved equal.

All stitching and connection hardware shall be stainless steel or other corrosion resistant material as recommended by the manufacturer.

III. MEASUREMENT AND PAYMENT

Bird netting and spikes, including all work and hardware associated with furnishing and installing these items shall not be measured and payment will be made on a lump sum basis.

Pay Item
Bird Protection

Pay Unit
Lump Sum

VERTICAL CLEARANCE GAUGES

I. GENERAL

Vertical clearance gauges will be required over the navigational channel of the main bridge. Gauges will be furnished and installed by Division Bridge Maintenance forces within thirty days prior to completion of the main bridge.

The contractor shall be responsible for notifying, coordinating, and arranging access for Division Bridge Maintenance personnel to complete the work.

II. MEASUREMENT AND PAYMENT

No separate measurement will be made of the above work. Payment will be considered as incidental to the construction of the project.

CLASSIC CONCRETE BRIDGE RAILS

I. GENERAL

The "Classic Concrete Bridge Rail" and "Classic Concrete Bridge Rail, (Sand Lightweight)" shall be in accordance with applicable parts of the Standard Specifications, the details shown on the plans and as outlined in these special provisions. Plans for the bridge rails are detailed for cast in place concrete and must be placed using conventional forms.

II. CONCRETE MIX

Concrete for the normal weight bridge rail shall meet the requirements for class AA concrete and concrete for the sand lightweight bridge rail shall meet the requirements for sand lightweight concrete. The following exceptions apply to all classic bridge railing:

The maximum size coarse aggregate used in the concrete mix shall be #78M. The slump shall be within the range of 5" to 8" when tested in accordance with AASHTO T119. A high range water

reducer shall be used. The quantity of high range water reducer per pound of cement shall be within the range recommended on the current list of approved admixtures issued by M&T Unit.

III. CONSTRUCTION

The bridge rails shall be placed to the established shape, line, grade and dimensions shown on the plans.

Joints in the rails shall be constructed at the locations and of the type specified on the plans.

IV. FINISHING

All exposed surfaces which are not satisfactory to the Engineer as to uniformity of color and texture or because of excessive patching shall be corrected as required by the Engineer. All surfaces of the bridge rails shall be given a Class I surface finish in accordance with the Standard Specifications unless directed otherwise by the Engineer.

V. MEASUREMENT

The quantity to be paid for under this item shall be the actual number of linear feet of "Classic Concrete Bridge Rail" or "Classic Concrete Bridge Rail (Sand Lightweight)", complete in place and accepted, measured continuously along the top surface of completed rail from end to end without deductions for spaces between sections.

VI. PAYMENT

The quantity to be paid for under this item shall be the actual number of linear feet of "Classic Concrete Bridge Rail" and "Classic Concrete Bridge Rail (Sand Lightweight)", complete in place and accepted, measured continuously along the top surface of completed rail from end to end without deductions for spaces between sections.

BRIDGE ELECTRICAL - GENERAL

I. GENERAL PROJECT DESCRIPTION

The provisions of this section apply to the furnishing, installation, and testing of the complete bridge electrical system for control and operation of the bascule leaves and all control house and pier electrical facilities, including roadway lighting, electric service, cable television service, telephone service, traffic control equipment, navigational lighting, communications equipment, alarm equipment, and bridge control equipment, complete, exclusive of water and sewer utilities to the structure. The provisions of this section also apply to the furnishing, installation and testing of conduit and wiring to electrical equipment provided under other sections of these provisions such as to sump pump equipment and heating, ventilating and air conditioning equipment.

II. COMMON PROVISIONS

The information provided in this section relates to work materials, construction methods, and standards, which may be common to all areas of electrical work throughout construction. Consequently, these items are to be included for payment within the various pay items to which they apply, as indicated elsewhere.

The electrical work specified herein shall be coordinated, as required, with the work of all other disciplines, sections of the specifications, and the plans, so that all installations are properly staged and shall operate as designed.

Any apparatus, device, circuit, appliance, material, or labor not herein specifically mentioned or included, but that may be found necessary to complete or perfect the installation and equipment of the equipment that is included in a manner acceptable to the Engineer, shall be furnished by the Contractor as if specifically included in these specifications, and without additional cost to the NCDOT.

All labor, material, equipment, and services shall be provided by the Contractor to perform operations required for the complete installation and related work as specified in the subsections that follow. All pay items shall be complete with all accessories as specified herein and as shown on the plans. Any such work included in any other section of these specifications that is not specifically described therein shall comply with the requirements of this section.

A. Standards and Codes

Portions or all of certain recognized industry or association standards referred to herein as being a requirement of these specifications shall be considered as binding as though reproduced in full herein unless supplemented and/or modified by more stringent requirements in this specification. Unless otherwise stated, the reference standard shall be the standard, which is current as of the date of issuance of these specifications. Reference may be made to standards either by full name or, for the sake of brevity, by letter designation as follows:

AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute, Inc.
ASME	American Society of Mechanical Engineers
AWG	American Wire Gauge
ASTM	American Society for Testing and Materials
EPA	Environmental Protection Agency of the United States Government
FHWA	Federal Highway Administration
IES	Illuminating Engineering Society
ICEA	Insulated Cable Engineer's Association
IMSA	International Municipal Signal Association
IPCEA	International Power Cable Engineers Association
JIC	Joint Industrial Council
NEC	National Electric Code
NEMA	National Electric Manufacturers Association
NFPA	National Fire Protection Association
NJDEP	New Jersey Department of Environmental Protection
MUTCD	Manual on Uniform Traffic Control Devices
OSHA	Occupational Safety and Health Administration
UL	Underwriters' Laboratories, Inc.

Omissions from the drawings and specifications, or the misdescription of details of work which are evidently necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omissions and details or work, but they shall be performed as if fully and correctly set forth and described in the drawings and specifications. In any case of discrepancy in figures, catalog numbers, or descriptions in the drawings or in the specifications, the matter shall be properly submitted to the Engineer who shall promptly make determination in writing. Any adjustment in the plans by the Contractor without written approval shall be at the Contractor's own risk and expense.

B. Equipment Locations

The layout drawings show, in general, the arrangements and locations of all equipment. This shall be considered as illustrative and subject to the approval of the Engineer; the Contractor shall modify it as necessary, for complete and proper construction and operation. The locations of the conduits, boxes, and equipment shown on the plans are diagrammatic only, and may be subject to slight shifting as required or as the Engineer may direct in order to conform to local conditions. The design drawings may be utilized in the preparation of the shop or working drawings showing the permanent construction as actually made.

C. Schedules

Specification and data sheets for all of the bridge control circuits and raceways are included in the plans in tabular format. These schedules are intended to assist the Contractor during installation of cable and conduit. Actual circuits and conduits may vary due to field alterations. Therefore, the schedules are to serve only as a guideline to the Contractor.

The schedules are included as an aid to the contractor to assist with control system wiring. Raceways and circuits used solely for lighting, general purpose receptacles, and other non-control system items such as the alarm systems, intercom system, lighting circuits and CCTV system are not included in the schedules for clarity. These raceways, not shown in the schedules or on the Plans, shall be furnished and installed by the Contractor as though fully described in the Plans and/or specifications. The Contractor shall bear full responsibility for assuring that conduit sizes and conduit fills are in compliance with the National Electrical Code. The Contractor shall consider all conduit and wiring required for installation of all of the equipment described in the Plans and Specifications. No additional payment for conduit and wiring for this equipment shall be made.

The raceway schedule is keyed to the raceway numbers as they appear on the plan sheets. The schedule gives the raceway type (fiberglass reinforced conduit, cable tray, etc.), minimum trade size (nominal inside dimension), and a list of the enclosed circuits. As these schedules concentrate primarily on control circuits and conductor cross sections can vary between manufacturers, the Contractor shall bear full responsibility for providing all required raceways and maintaining conductor fill within NEC limitations. The routings shown are suggestions which may be altered with the Engineer's approval.

The circuit schedules give the origin and destination of each described circuit, the number of cables in the circuit, the description of each cable in the circuit (size in AWG, type per data sheets in this specification, and number of conductors in each cable), and a listing of all the raceways that the circuit is routed through.

D. Wiring Devices

General use, single pole, or 3-way switches shall be Arrow-Hart 1991 or 1993, Bryant 4901 or 4903, General Electric 5951-1 or 5953-1, or Hubbel 1221 or 1223.

General use, duplex receptacles shall be Arrow-Hart 5262, Bryant 5262, General Electric 4065-1, or Hubbel 5262. GFCI Protection must be available for all receptacles either through use of GFCI receptacles or GFCI circuit breakers.

Devices installed indoors shall be brown color. Devices installed outdoors shall be corrosion-resistant, with gray fiberglass weatherproof covers.

Cover plate for flush installations shall be .040 inch thick satin finished type 302 stainless steel.

Cover plates for indoor surface installation shall be cast aluminum or cadmium-plated cast-iron. Covers shall fit type FS or FD boxes without overlapping edges or corners.

E. Panelboards

Provide and install all panelboards as shown in the Plans. The short circuit interrupting capacity for the distribution panels shall be 22,000 amps.

Branch circuits shall be changeable without additional machining, drilling or tapping. Branch circuit connections shall provide sequence phasing, with connections permanently identified on the face of the front of the panel interior.

Mains shall be equipped with automatic circuit breakers for branch circuit protection and shall have ratings as indicated. All single pole branches shall be rated 20 ampere, unless indicated otherwise.

Buses shall be rigid copper or copper alloy, installed to provide consecutive phasing. Solid neutral bus shall have solderless connectors, shall be insulated from the cabinet and shall have an ampacity equal to the ampacity of the phase buses. Equipment grounding bus shall be bonded to the cabinet, shall have solderless connectors and a main lug. All copper parts shall be plated to prevent corrosion.

Branches. Circuit breakers shall be of the indicating type, providing distinctive "ON", "OFF" and "tripped" positions of the operating handle. All multi-pole breakers shall be so designed that an overload in any one pole automatically causes all poles to open. Multi-pole breakers shall have a single operating handle. Single pole 15 and 20 ampere branch breakers shall be UL listed for switching duty.

Breakers shall be thermal magnetic type having inverse time delay thermal trip on overloads and instantaneous magnetic trip on short circuit. Circuit breakers shall be quick-break, quick-make on manual, as well as automatic operation. Each circuit breaker shall be independently removable without disturbing adjacent units or other bus connections and shall be fastened to the main bus bars with a bolt-on connection. All copper parts shall be plated to prevent corrosion. Circuit breakers for smoke detectors and navigation light power circuits shall be equipped with a lockout feature. GFCI protection shall be provided for receptacles either through GFCI type circuit breakers or GFCI type receptacles.

All 100-ampere frame breakers shall have an interrupting rating of 22,000 amperes AC. All larger frame size breakers shall have an interrupting rating of 30,000 amperes.

All panelboards shall be factory assembled, UL listed, as manufactured by the approved MCC manufacturer

F. Nameplates

Nameplates shall be provided for all major pieces of equipment named on the drawings, for all devices on the control desk and in panels, and shall be made of triple laminated Micarta or Textolite with chamfered edges, and shall be engraved to show black letters on a white background. They shall be mounted with Monel or stainless steel screws. Nameplates for devices shall show the device designation used on the schematic wiring diagram. Fuse nameplates shall show the type, ampere, and voltage rating of the fuses.

G. Installations

The electrical equipment and its installation shall be in accordance with regulations of the NEC and shall conform to division ii, group b of the latest revision, for movable bridges of the American Association of State Highway and Transportation officials except as otherwise provided herein.

All materials and equipment furnished under these specifications shall be new and, to the extent possible, standard products of the various manufacturers. Where more than one of any specific item is required, all shall be of the same type and manufacturer. Items of equipment or material, which are not specifically defined herein, shall conform to the general standard of quality established herein.

Each piece of electrical equipment and apparatus shall have a permanent type corrosion-resisting metal nameplate on which is stamped the name of the manufacturer, the catalog or model number, and the rating or capacity of the equipment or apparatus.

All electrical devices, printed circuit boards, including their components, and any other electrical or electronic parts, shall be completely identified in such a way as to be easily procured from a supplier of that device. All prints and drawings of it shall show complete circuitry and identify all components as to their specific use and function in the circuit.

The Contractor shall retain the services of a qualified control system vendor who shall have complete system responsibility for the detailed integration of all system components, in order to ensure a complete operating system is furnished and installed in accordance with specified requirements of this project. The control system vendor shall be responsible for ensuring total compatibility of all equipment and devices furnished and installed and shall provide supervisory assistance in the selection, installation and integration of all bridge span drive and associated equipment. Components associated with bridge span drive operations include but shall not be limited to span drive control, limit switches, motor controls, motor control center, control desk and associated devices.

The control system vendor shall be responsible for the review of shop drawings, prior to submission to the Engineer, to ensure that all components of the bridge operating system submitted for use are compatible in every respect and that all components meet or exceed the specific requirements and intent of the project. The total bridge operating system shall be subject to the approval of the Engineer, based on the specified project requirements.

The control system vendor shall ensure maximum reliability and ease of maintenance for all components of the operating system and shall be responsible for all training of the bridge operator staff and for the supervision of all trial operations.

The control system vendor must have demonstrable competence in providing electrical control systems for movable bridges of various types, particularly bascule type, but including vertical lift and swing type bridges utilizing programmable logic controllers. Such competence shall be demonstrated by identifying a minimum of (3) three movable bridges for which the control system vendor has provided complete systems within the past five years.

The control system vendor shall make available a field service staff with the capability of providing services for field coordination of construction and final adjustments to the drive system to the satisfaction of the Engineer. Field staff shall be capable of responding, at the site, to an emergency within 24 hours.

Name and written qualifications of the proposed system vendor shall be included in the bid proposal and shall be subject to approval by the NCDOT Engineering Department.

The Contractor shall be responsible for coordinating all aspects of equipment installation including matters of construction staging and methods of bringing equipment into the spaces where it is to be installed.

All ferrous metal work shall be hot-dip galvanized in accordance with ASTM A123 or ASTM A153, whichever is applicable. If any galvanizing is damaged, the metal work shall be refinished by cleaning and painting, with two coats of approved galvanizing repair paint, or approved zinc spelter paint.

Lock washers shall be provided on all mechanical fastenings. In order to prevent deterioration due to corrosion, all bolts, nuts, studs, washers, pins, terminals, springs, hangers, cap screws, set screws, tap bolts, brackets, and other hardware fastenings and fittings shall be of an approved corrosion-resisting material such as silicon bronze, or stainless steel. Hot-dip galvanizing, per ASTM specification A153, will be considered approved treatment for all non-moving ferrous hardware.

Reference to a particular product by manufacturer, trade name, or catalog number establishes the quality standards of material and equipment required for this installation and is not intended to exclude products equal in quality and similar in design.

Equipment for which an acceptable manufacturer is not specifically named, or named equipment for which substitution is proposed, shall be manufactured by a company which has had a minimum of ten years of experience in the manufacture of similar equipment and which, in the Engineer's opinion, has demonstrated its proficiency in the manufacture of such equipment. All equipment will be subject to the Engineer's approval.

Each circuit, as shown in the circuit schedule on the plans, shall be identified at both ends with a heat shrinkable sleeve. Identification shall be permanent and waterproof. Once installed, the identifying sleeve shall not be removable except by cutting it loose from the cable.

H. Fire Stopping

Fire stopping material, including forming, packing and other accessory materials, shall be installed around plumbing, mechanical and electrical services penetrating floors and walls to

provide fire-stops with fire resistance ratings for the floor or wall assembly in which penetration occurs complying with installation requirements established by testing and local inspecting agencies having jurisdiction.

Surfaces to which fire-stopping material is to be applied shall be prepared with appropriate cleaners to enhance the proper adhesion of the sealer to the substrate. The cleaners used shall not be harmful to substrates and adjacent materials and shall not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.

Polyethylene tape or other plastic tape as recommended by the sealant manufacturer shall be installed to prevent sealant from adhering to rigid, inflexible surfaces where such adhesion would result in sealant failure.

The fire-stopping sealants used shall be appropriate for the various locations and installation conditions in which they are used. The Contractor shall be responsible for furnishing and installing fire-stopping sealants which are fully compatible with the openings into which they are applied. The sealants shall also have a fire-resistance rating equal to or greater than the assembly into which they are installed. Sealants shall be capable of maintaining their rated fire-resistant seal without failure due to normal expansion and contraction of the assembly into which they are installed.

Different sealants may be used as appropriate for varying areas into which they are installed. All sealants used, however, shall be the product of a single manufacturer. The sealants must be UL listed or FM approved.

Protect joint sealers during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of substantial completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealer immediately and reseal joints with new materials to produce joint sealer installation with repaired areas indistinguishable from original work at no additional cost to owner.

I. Painting

All interior and exterior surfaces of fabricated steel, including surface of any remaining existing structure, shall be blast cleaned and primed and painted in accordance with AASHTO specifications. For more information interior painting, see architectural specifications.

J. Submittals

A. Catalog Cuts

The Contractor shall submit for the Engineer's approval catalog cuts and/or shop drawings for materials and/or equipment he proposes to use on the project. Forty days shall be allowed for the Engineer's review of each submittal. Materials which have not been approved shall not be delivered to the project. Eight copies of each catalog cut and/or drawing shall be submitted and each shall show the material description, brand name, stock-number, size, rating, manufacturing specification and the use for which it is intended. Procurement and/or installation of materials and/or equipment shall not be done without prior shop drawing review and approval of the Engineer.

The Contractor shall carefully coordinate the selection of materials and equipment to assure that the materials and equipment will physically fit together where installed as a complete assembly. Space is tight in many areas limiting the selection of items which will fit.

All components of each contract item shall be represented with a catalog cut or drawing. The submittals shall be neatly presented and arranged in the same order as the contract bid items.

B. As-Built Plans

The contractor shall furnish 2 complete full size sets of final as-built plans upon completion of the work including all electrical schematics, wiring diagrams, terminal listings, panel layout, conduit layout and control desk and panels.

These as-built plans shall include the title, index, summary of quantities, and all of the layout and detail sheets of the project with all changes indicated. After review by the Engineer, one set of these as-built plans shall be placed in a waterproof envelope and filed by the Contractor in each Control Panel.

One set of as-built plans shall be submitted to the Design Services Unit.

The light standard foundations that are relocated by permission of the Engineer shall be shown on the as-built plans in their final locations.

The Contractor shall keep a daily record of the location of all items in order to ensure the accuracy of the as-built plans.

C. Warranties

Warranties from each manufacturer of electrical materials and equipment pertinent to the complete and satisfactory operation of the system shall be turned over to the Engineer prior to the acceptance of the project. Each warranty so furnished shall indicate its expiration date and shall not be less than those provided as a customary trade practice.

III. MEASUREMENT AND PAYMENT

No Measurement or Payment will be made for, Bridge Electrical – General. All measurement and payment will be made under pay items described in sections which follow.

RACEWAY AND WIRING

I. DESCRIPTION

This work shall consist of furnishing and installing all electrical messenger cable systems, junction boxes, conduits and underground and bridge mounted wiring shown in the plans. Included in this work shall be installation of the messenger cable systems and wiring to the gates, gongs, electrical service and telephone service, cable television service, traffic signal controllers, traffic signal heads, CCTV cameras, and roadway lighting as shown on the plans. Included in this work shall be electric service conduit, wiring to the service transformer, and installation of the utility meter socket, with all pertinent connectors, grounding, and assemblies within the junction boxes. All bridge wiring shall be brought to and routed through the control house and terminated at the appropriate system terminals within the control house. This item includes all

raceway and wiring work within the piers and control house as well as on the approaches. This item includes electrical service wiring, telephone service wiring, and cable TV service wiring as well as wiring to sump pumps, bathroom exhaust fan, and HVAC equipment (both indoor and outdoor). Thermostat wiring is not included under this item but will be part of the HVAC provisions.

The Contractor shall also supply the structural Contractor with all concrete inserts for carrying the messenger cable system. The Contractor shall coordinate the installation of these inserts with the structural Contractor.

Electrical service wiring shall be terminated at the new main disconnect switch within the control house.

II. MATERIALS

A. Messenger Cable System Hardware

Messenger cable shall be wire stainless steel strand messenger cable conforming to ASTM A475, extra-high-strength grade, unless otherwise noted on the Plans.

Concrete inserts shall be of an approved stainless steel type having a minimum load tension capacity of 4 kN (to accommodate 19 mm diameter eyebolts) and threads to match the threaded eyebolts to be used. The inserts shall be designed so as to provide a method of fastening or securing the base of the inserts to the deck forms to avoid movement while concrete is being poured.

All conduits shall be of the material called for in the plans. All conduits shall be free from blisters, cracks, or injurious defects.

Raceway sizes shall be as shown on the plans or as approved by the Engineer. Any lengths or raceway fill amounts shown or implied on the plans, are included solely as a convenience to the Contractor, and are not guaranteed to be accurate or correct, and will not be used as a basis for payment.

Any apparatus, device, circuit, appliance, material, or labor not herein specifically mentioned or included, but that may be found necessary to complete or perfect the installation and equipment in a manner acceptable to the engineer, shall be furnished by the Contractor as if specifically included in these specifications, and without additional cost to the Department.

B. Messenger Cable System Wiring

All conductors shall be stranded copper unless specifically noted otherwise on the plans or these special provisions. Wire and cable shall conform to IPCEA specifications and shall have marks for identification (manufacturer's name, type insulation, and gauge of conductor) and the UL label.

All wire insulation shall be rated at 600 VAC or greater. All cable shall be UL Type SOW-A suitable for sunlight resistance and outdoor use within a messenger cable system.

Closed circuit television wiring installed shall meet the requirements of the manufacturer of the closed circuit television system equipment and shall be rated for sunlight resistance and outdoor use within a messenger cable system.

The grounding electrode conductor shall be #6 AWG unless noted larger on the plans.

All power limited circuits shall be routed separately in accordance with the provisions of the National Electrical Code (NEC).

C. Cable Trays

Cable trays shall be galvanized steel and shall conform to NEMA standards for cable trays. Tray of the ladder type shall be of the size outlined on the plans, 9 inch rung spacing, and shall sustain a minimum of 50 pounds per linear foot load on a 12 foot span with a safety factor of 2.

Trays shall be provided at the elevation and locations shown on the plans. The interconnections of the sections, fittings, and other components shall provide a rigid mechanical assembly with splice plates properly installed to avoid structural weakness. Tray splices shall be located within 1/4 span of the supports

Trays shall run parallel or perpendicular to the main structural lines of the building. Drilling or welding of building steel members will not be permitted. Trays shall be mechanically connected at joints, fittings, and terminations, and shall provide a continuous ground path. Each section of the tray shall be bonded and connected to the main grounding grid, as shown on the plans.

Cable trays shall be supported as shown on the drawings and at the midpoint of each horizontal bend.

Where cable trays pass through floors or where conductors are required through floors for access to electrical equipment as shown on the plans, the openings shall be filled and caulked with a fire proofing sealant after all conductors are installed. Where conductors pass through floors without the use of a cable tray, escutcheon plates shall be provided. Sealants shall be manufactured by Carborundum, Dow Corning, Nelson fire stop products, or approved equal.

D. Wireways

All closed wireways shall protect electrical wiring in areas which may be subject to being hosed down or may otherwise wet or subject to serious corrosion problems. All closed wireways shall have the following properties:

- NEMA 4X construction
- 16 gauge Type 304 stainless steel covers and bodies
- 10 gauge Type 304 stainless steel flanges
- Seams continuously welded and ground smooth, no holes or knockouts
- Smooth, rounded edges on all sections and fittings to prevent damage to insulation
- Heavy butt hinges and external screw clamps to assure complete seal between covers and bodies

- Screw clamps which are quick and easy to operate
- Oil-resistant gaskets and adhesive
- Solid oil-resistant gasket positioned between flanges when sections and fittings are bolted together

All open lay-in type wireways shall have the following properties:

- 16 gauge Type 304 stainless steel covers and bodies
- Seams continuously welded and ground smooth
- Smooth, rounded edges on all sections and fittings to prevent damage to insulation
- Removable covers held closed with stainless steel fasteners

E. Conduits

All conduits shall be of the material called for in the plans. All conduits shall be free from blisters, cracks, or injurious defects. Conduit sizes shall be as shown on the plans or as approved by the Engineer and shall be 3/4" minimum trade size. Any lengths shown on the raceway schedule or in the plans, are included solely as a convenience to the Engineer, and are not guaranteed to be accurate or correct, and will not be used as a basis for payment. Conduits that are visible outside of the piers or control house shall be manufactured (not painted) to match with the architectural colors of the bridge structure.

Conduits installed in heated spaces within the Control House shall be galvanized rigid steel. All conduits, which are subjected to the outside environment or are installed in spaces which are not heated, shall be fiberglass reinforced epoxy conduits. Any area not served by HVAC equipment shall be treated as exterior areas. Fittings for use with all fiberglass reinforced epoxy conduits shall be compatible products produced by the same manufacturer producing the conduits. Flexible metal conduits shall be liquid-tight type. Use of PVC conduit shall not be permitted for surface mounted or exposed conduit installations.

Conduits cast in concrete shall be PVC schedule 80 coupled to stainless steel conduit fittings where the conduits enter or exit the concrete. The PVC conduits are intended to provide rust free service where protected from impact and the stainless steel fittings are intended to provide rust resistant impact protection where the PVC may otherwise be subject to damage.

Conduits shall be installed so as to be continuous and watertight between boxes or equipment. Conduits shall be protected at all times from the entrance of water and other foreign matter by being capped or well plugged overnight and when the work is temporarily suspended.

All conduits shall be installed so that they will drain properly and drainage tees shall be provided at low points where required, and as directed by the Engineer.

All field bends shall be in accordance with the NEC and shall be long sweep, free from kinks, and of such easy curvatures as to facilitate the drawing in of conductors without injury. Conduit runs shall be made with as few couplings as standard lengths will permit, and the total angle of all bends between any two boxes shall not exceed 360 degrees. Long running threads will not be permitted.

Pull boxes shall be used wherever necessary to facilitate the installation of the conductors. Condulets shall not be used for pulling more than ten conductors or for making such turns in conduit runs or for branching conductors, except for indoor wiring to lighting fixtures and receptacles.

Conduits and/or wiring in the Control Room shall, wherever practical, be concealed in the walls, ceiling, or floor. Where conduits pass through the floors or walls of the control house, galvanized rigid conduit sleeves shall be provided for free passage of the conduits. After the conduits are installed, the openings shall be filled and caulked with a fireproofing sealant and escutcheon plates provided on the interior walls, ceilings, and floors for airtight fits.

Exposed raceway runs, whether or not described in the Plans and/or specifications, shall be straight and shall be parallel or at right angles to the general structure lines. Attachment to steel or concrete shall be by stainless steel hardware. Routing shall be approved by the Engineer. Concrete inserts for raceway support shall be Unistrut, B-line, Midland Ross, or approved equal, fabricated from stainless steel.

Conduits mounted exteriorly on parts of the steel work shall be set not less than 2 inches clear from the supporting structure to prevent accumulation of dirt, and they shall be securely clamped to the steel work to prevent rattling and wear. The clamps, in general, shall consist of stainless steel u-bolts attached to stainless steel angle or channel supports bolted to the members. The spacing of the clamps shall not exceed 6 feet on centers.

Supports for electrical work which are fabricated from structural plates or shapes welded or bolted to structural members and which are shown or requested to be included on the steel drawings, will be paid for under the items shown on the plans. Additional alterations and supports not shown or requested, but that are found necessary after completion of steel fabrication plans, shall be included for payment and additional compensation will not be considered.

At any point where a conduit crosses an expansion joint, or where movement between adjacent sections of conduit can be expected, expansion fittings shall be installed.

All conduits shall be carefully cleaned, both before and after installation using methods as recommended by the conduit manufacturer. The conduit manufacturer's recommended methods shall be submitted along with shop drawings for review by the Engineer.

Both ends of each conduit run shall be provided with a brass tag having a number stamped thereon in accordance with the final conduit schedules. These tags shall be securely and permanently fastened to the conduit ends with bare copper wire. Conduits pertaining to circuits which are not part of the bridge control system such as for lighting, general purpose receptacles, fire alarm system, intercom system and CCTV system shall also be tagged beginning with the next numerical raceway after the highest number bridge system raceway given in the schedules. Additional bridge system raceways may be added or inserted where required, but no less than the number of raceways shown on the plans and in the schedules. The Contractor may renumber these as necessary due to modifications, but shall provide detailed as-built schedules at the conclusion of construction.

Galvanized Rigid Steel Conduit

The conduit shall be UL listed and shall comply with the requirements of ANSI standard C80.1 "Specifications for Rigid Steel Conduit (Zinc-Coated)". Manufacturers shall be Allied, Steel Duct, Triangle, Youngstown, Wheatland or approved equal.

All rigid steel conduit fittings shall be hot-dip galvanized after fabrication in accordance with ASTM-A153. Manufacturer shall be Appleton Electric, Crouse-Hinds, O.Z./ Gedney, Pyle-National, Russell & Stroll, Thomas & Betts, or approved equal.

All steel conduit, after field threading, shall be re-galvanized with "Zinc Rich", "Zincilate 810", or "Galvanizing Powder M-321". This material shall be applied in the field, immediately after the conduit is threaded and cleaned.

The use of galvanized rigid steel conduit shall be limited as described in the preceding sections.

Fiberglass Reinforced Epoxy Conduit

All conduits exposed to the outdoor environment and those indicated as FRE shall be fiberglass reinforced epoxy conduit.

The conduit shall bear UL listing #E53373 and shall comply with the latest applicable UL and NEMA requirements.

All conduits shall be manufactured from E or E-CR glass and epoxy resin with no fillers and shall have a resin content of 32%, plus or minus 3%. All joints shall be inside tapered bell end and of even socket depth throughout the raceway. Conduits shall be equipped with one-piece injection molded push-fit integral bell and spigot. All conduits shall be installed using the manufacturer's recommended installation methods and materials. The manufacturer's installation instructions shall be included in the Contractor's shop drawing submittals for review by the Engineer.

Liquid-Tight Flexible Nonmetallic Conduit.

Liquid-tight, flexible nonmetallic conduit shall have a smooth inner surface with integral reinforcement within the conduit wall and be designated as a Type LFNC-B (for FNMC-B). Liquidtight flexible nonmetallic Conduit shall be listed to UL standard UL1660. Liquidtight flexible nonmetallic Conduit shall be flame resistant and when used with listed fittings, shall be approved for the installation of electrical conductors.

Liquid-tight flexible Nonmetallic Conduit shall be installed in accordance with Article 351, Part B of the National Electrical Code (NEC) and other applicable sections of the NEC and/or local electrical codes.

Liquidtight Flexible Nonmetallic Conduit shall be marked OUTDOOR for outdoor applications exposed to sunlight and weathering conditions. Liquidtight Flexible Nonmetallic Conduit shall be marked for DIRECT BURIAL for direct burial applications.

Liquid-tight Flexible Nonmetallic Conduit shall be evaluated by the National Evaluation Service, Inc. for the installation within a three hour or less fire-resistive floor/ceiling and two hour fire-resistive wall construction.

Liquid-tight Fittings shall be listed for the use with liquidtight flexible nonmetallic conduit and shall be marked LFNC-B (FNMC-B). Liquidtight fittings used for direct burial applications shall be listed for wet locations.

Flexible liquid-tight nonmetallic conduit shall be used for all motor connections. Use of flexible conduit is allowed only for the connection of motors, limit switches, and other devices that must be periodically adjusted in position. Connections between the rigid conduit system and all movable motors, and movable limit switches shall be made with flexible conduit with couplings and threaded terminal fittings. The flexible conduit shall be fully interlocked and shall be type RT-6 as made by the Flexonics Corporation, type UA -or as Anaconda's Sealtite, Carflex by Carlon, or approved equal. Flexible conduit extensions shall not exceed 24 inches in length and shall be equipped with bonding jumpers.

F. Boxes

The Contractor shall furnish and install junction and pull boxes, reducers, and other fittings as required by these specifications or where required by the NEC, or where required to facilitate pulling, whether shown on plans or not.

All exterior surface mounted pull, junction, splice, and terminal boxes shall be 14 gauge stainless steel, NEMA 4X, and shall be provided with hinged, overlapping covers of the same material, with pad-lock provisions and shall be equal to bulletin A4 as made by Hoffman Engineering Company, U.S. Electrical Products, or approved equal. Exterior boxes mounted on the bridge steelwork shall be primed and painted the same color as the bridge. Wall-mounted boxes installed in the new control house shall be NEMA 12. Junction boxes and terminal cabinets mounted in piers shall be NEMA 4X, 14-gauge stainless steel as described above.

Drain holes shall be provided in the boxes. All boxes shall be provided with mounting lugs and shall be securely fastened to the structure with not less than four stainless steel metal through-bolts. Sheet metal enclosures shall be drilled to receive the conduit ends, which shall be secured with insulated hub connectors. The conduit ends projecting into all boxes and enclosures shall be equipped with insulated bushings. No box or enclosure shall be drilled for more conduits than actually enter it.

Boxes for surface or exterior mounted wiring devices shall be cast-iron, hot-dipped galvanized, type FS, FD, or approved equal.

Boxes for flush-mounted devices in finished areas shall be stamped galvanized steel.

Framework for supporting boxes, switches, and other externally mounted electrical devices shall be fabricated stainless steel.

All mounting bolts, nuts, washers, and other hardware used for fastening boxes, disconnect switches, devices, lighting outlet boxes, conduit clamps, and similar devices shall be stainless steel. Bolt heads and nuts shall be hexagonal, and bolts smaller than 3/8 inch in diameter shall not be used except as may be necessary to fit the mounting holes in small devices, outlet boxes, and similar standard equipment.

Standard galvanized steel outlet boxes shall be furnished and installed at all flush outlets for lighting fixtures, switches, and receptacles where these devices are proposed on the plans for installation. Exposed outlet boxes mounted on the surface shall be weatherproof cast allow type with threaded hubs and suitable matching covers for switches and receptacles.

Galvanized steel outlet boxes and covers shall not be less than 1/16 inch thick and shall be of such form and dimension as to be adapted to its specific use, location and kind of fixture to be used and the number, size and arrangement of conduits connecting thereto. There shall be no holes in boxes that are not used for conduits.

G. Conductors

Insulated conductors and conductor accessories shall be furnished in sufficient quantities for a complete installation. Installation shall be in accordance with the National Electrical Code, and shall include placement, splicing, terminating, identification, testing, and verification of each circuit and conductor.

Cable types, as shown on the plans, shall be as shown on the cable data sheets. The "type" as shown on the circuit schedules in the plans is the "type" referenced to at the top of each cable specification sheet.

Extra flexible cable shall be installed in a loop in the pit pier area between the stationary and movable conduits serving the navigation lights, lighting and receptacle circuits, and the span locks mounted on the movable span.

The "outside diameter" is the nominal diameter used to calculate the required conduit size. If actual cables used are of larger diameter, the Contractor shall increase the size of the affected conduits, as required by the NEC, at no additional cost to the owner. Determination of correct cable lengths and conduit size is the responsibility of the Contractor.

Acceptable manufacturers for type B, C, D, G, and H are Okonite, Boston insulated wire and cable, Rome cable or approved equal. Acceptable manufacturers for type E are Okonite, American insulated wire, Rockbestos or approved equal.

Durable marking shall be provided on the outer surface of all cables or conductors at intervals not exceeding 24 inches.

Marking shall include manufacturer's name, insulating material, conductor size, and voltage class.

Each conductor, of power, control and signal wiring, shall be color coded with colored insulation. Color coding of power wiring shall be as shown below.

Color-coding of power conductors shall be as follows:

<u>120/240 Volts</u>	
Line 1	Red
Line 2	Black
Neutral	White
Ground	Green

<u>120/208 Volts</u>	
Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground	Green

<u>277/480 Volts</u>	
Phase A	Brown
Phase B	Orange
Phase C	Yellow
Neutral	White
Ground	Green

The drawing of wire and cables into conduits shall be done without injury to the wires or their insulation or covering.

All cables shall be installed as recommended by the manufacturer. The manufacturer's recommended maximum pulling tension and minimum bending radius shall be adhered to during installation. The Contractor shall use the necessary guides, pulleys, sleeves, and pulling aids to prevent abrasion and damage to the cables during installation. Lubricants recommended by the cable manufacturer and acceptable to the Engineer shall be used for the pulling of conductors or cables. Both ends of every single length of conductor shall be permanently and clearly tagged with approved tags marked in accordance with the same number and designation shown on the wiring diagrams. All outgoing wires no. 8 AWG or smaller in the control desk, on the switchboards and panels and in terminal cabinets shall be connected to terminal blocks.

Spare conductors of a multi-conductor cable shall be left at their maximum lengths for possible replacement of any other conductors in the cable. Each spare conductor shall be coiled and then taped to the conductors being used.

Twisted shielded pair conductors or instrument conductors shall not be terminated at any point except at point of origin or point of finish. Twisted shielded wires shall be grounded only at signal receiving point. Where instrument conductors are required to connect to other instrument conductors, such as within the submarine cable, the individual conductors and shielding shall be spliced in accordance with the manufacturer instructions. The splice connections shall then be taped and wrapped to ensure adequate seal from noise and environment in accordance with the manufacturer's instructions.

Conductors inside terminal boxes and at the control panels and control desk shall be installed in plastic wire ways or shall be neatly formed into bundles and strapped with nylon cable ties. These conductors shall be looped to allow not less than 3 inches of free conductor when disconnected from terminal strips. These formed cables shall be held securely away from the terminals and from contact with the cabinet by means of approved insulating supports. Wiring duct meeting JIC standards will be acceptable.

All terminal strips shall be provided with approved permanent terminal markings for each connected conductor in service. The marking shall be placed on a material, which will not be affected by age or moisture.

Splicing of conductors will not be permitted except for wiring to service lighting fixtures and receptacles.

All splices, T-taps, and free ends of 600-volt cables shall be insulated. General use cables shall be insulated with No. 33 tape. High ambient cable shall be insulated with No. 70 tape.

Wherever it becomes necessary to terminate, joint, or branch conductors, terminal blocks in boxes shall be used.

Cable connections for No. 8 and smaller, for making terminations and splices shall be with high-pressure indent type pressure connectors. Connectors shall be copper and as manufactured by Buchanan products, Burndy, Thomas & Betts, or approved equal.

Cable connections for no. 6 and larger for making terminations, T-taps, and splices shall be with a high compression or bolted type pressure connector. Compression connectors shall be Thomas & Betts series 54000, Burndy, or approved equal, using manufacturer's recommended tooling for installation. Bolted connectors shall have a non-rotating pressure cap and as manufactured by Burndy, O.Z. Electric, Buchanan, or approved equal.

Type-B Cable.

600 Volt flame-resistant SINGLE CONDUCTOR POWER CABLE.

Reference: ICEA S-66-524
 Conductor: Class B stranding, 90 degrees C, standard round uncoated copper
 Insulation: Flame resistant thermosetting chemically cross linked polyethylene
 Jacket: None
 UL listing: XHHW-2
 Tests: Flame test requirements per IEEE 383, using a gas burner flame source.

Details:

Size (AWG)	Number of Strands	Insulation Thickness in Mils	Outer Diameter in Inches
14	7	30	0.14
12	7	30	0.16
10	7	30	0.18
8	7	45	0.24
6	7	45	0.28
4	7	45	0.32
2	7	45	0.38
1	19	55	0.44
1/0	19	55	0.48
2/0	19	55	0.52
3/0	19	55	0.58
4/0	19	55	0.63
250	37	65	0.70
350	37	65	0.80
500	37	65	0.93

Type C Cable.

Type C cable shall be used as indicated on the Plans for the Droop Cable connection between the stationery structure and the movable span. Cable must be capable of supporting its own weight over the length required. Cable shall be based on BIW Cables All-Temp Industrite type SOW-A Control Cable with features as follows:

Reference: ASTM B-33, ASTM B-174, UL-62
 Conductor: Extra-flexible stranding (Class K), soft-drawn tinned copper
 Separator: Paper
 Insulation: Color coded Thermoset (EPDM) insulation per UL-62 and ICEA S-68-516
 Cabling: Conductors are cabled (maximum of two layers) with non-wicking, non-hygroscopic fillers with an overall binder of rubberized fabric tape

Jacket: Black, oil and flame-resistant, reinforced thermoset (neoprene) jacket; per UL-62 and ICEA S-68-516

Special Construction: Shall be manufactured as a 12 conductor, 10 AWG cable.

Type D Cable.

600 Volt Flame Retardant Multiconductor Control Tray Cable (Okonite FMR Okoseal 210):

Conductor: Tin coated copper per ASTM B-33, Class B stranded per ASTM B-8.

Grounding Conductor: Where indicated, bare stranded copper per ASTM B-8, Class B, and NEC Table 250-95.

Insulation: Okonite-FMR meets or exceeds requirements of UL 1581 and ICEA S-95-658 NEMA/WC70 Type II insulation.

Overall Jacket: Complies with UL 1277. The Okoseal compound meets or exceeds the requirements of UL 1581. UL Listed as Type TC cable with a sunlight resistant jacket and for direct burial.

Assembly: Conductors cabled in accordance with UL 1277 using fillers, as necessary, with a cable tape overall.

Color Coding: Base colors and tracers as shown on reverse of Data Sheet or black conductors with surface printing of numbers per ICEA 73-532 NEMA/WC57 Method 4.

Details:

Conductor Size: No. 10 AWG
Conductor Strand No.: 7

Number of Conductors in Cable	Overall jacket Thickness in Mils	Approximate Outside Diameter in Inches
4	60	0.58
5	60	0.63
7	60	0.68
9	60	0.79
12	80	0.93

Conductor Size: No. 12 AWG
Conductor Strand No.: 7

Number of Conductors in Cable	Overall jacket Thickness in Mils	Approximate Outside Diameter in Inches
4	45	0.49
5	45	0.53
7	60	0.61
9	60	0.71

12	60	0.79
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Conductor Size: No. 14 AWG
Conductor Strand No.: 7

Number of Conductors in Cable	Overall jacket Thickness in Mils	Approximate Outside Diameter in Inches
4	45	.045
5	45	.050
7	45	0.53
9	60	0.64
12	60	0.72

Type F Cable.

600 Volt, water and oil resistant SOW-A MULTI-CONDUCTOR WEATHER CABLE:

Type F cable shall be used as indicated on the Plans for fender navigation lighting and for messenger cable circuits. Cable must be capable of supporting its own weight over the length required. Cable shall be based on BIW Cables All-Temp Industrite type SOW-A Control Cable with features as follows:

- Reference: ICEA S-68-516, UL-62
- Conductor: Bare, annealed copper per ASTM B-3. Flexible, bunch-stranded per UL-62
- Insulation: Color coded synthetic oil, ozone and water resistant rubber (EPDM) UL-62
- Jacket: Oil resistant thermoset, CPE (black or yellow) UL-62
- UL Listing: File no. E7362
- Tests: ASTM D-470, ASTM D-2240, ASTM D-573, ASTM D- 471, UL1581, CSA C22.2 NO 0.3, ASTM D-2863, ASTM D-573, MSHA

Details:

Phase Conductor Size (AWG or MCM)	Number of Conductors	Strand	Conductor Insulation Thickness (Inches)	Jacket Assembly Thickness (Inches)	Overall Diameter (Inches)
18	2	41x34	.030	.060	.340
18	3	41x34	.030	.060	.360
18	4	41x34	.030	.060	.385
16	2	65x34	.030	.060	.365
16	3	65x34	.030	.060	.385

16	4	65x34	.030	.060	.415
14	2	41x30	.045	.080	.500
14	3	41x30	.045	.080	.524
14	4	41x30	.045	.080	.567
12	2	65x30	.045	.095	.574
12	3	65x30	.045	.095	.600
12	4	65x30	.045	.095	.650
10	2	104x30	.045	.095	.623
10	3	104x30	.045	.095	.655
10	4	104x30	.045	.095	.710

Type G Cable.

Bare Copper Grounding Wire

- Conductor: Conforming to ASTM B-3 for Soft or Annealed Copper Wire
 Conforming to ASTM B-8 for Concentric-Lay Stranded Copper
 Conforming to Federal Standard QQ-W-343
- Insulation: None (except if in contact with aluminum; then the grounding wire shall have a green PVC jacket).

Details:

Conductor Size (AWG)	Number of Strands	Diameter in Inches
8	7	.146
6	7	.184
4	7	.232
2	7	.292
1/0	19	.373
2/0	19	.419
3/0	19	.470
4/0	19	.528
250	37	.575
350	37	.681
500	37	.813

Type H Cable.

600 Volt, Flame Retardant, 3-Conductor with Ground Conductor - Power Tray Cable (Okonite FMR Okoseal 210):

- Conductor: Tin coated copper per ASTM B-33, Class B stranded per ASTM B-8.
- Grounding Conductor: Where indicated, bare stranded copper per ASTM B-8, Class B, and NEC Table 250-95.
- Insulation: Okonite-FMR meets or exceeds requirements of UL 1581 and ICEA S-95-658 NEMA/WC70

- Overall Jacket: Type II insulation. Complies with UL 1277. The Okoseal compound meets or exceeds the requirements of UL 1581. UL Listed as Type TC cable with a sunlight resistant jacket and for direct burial.
- Assembly: Conductors cabled in accordance with UL 1277 using fillers, as necessary, with a cable tape overall.
- Color Coding: Conductor colors shall be Brown, Orange, Yellow and Green.

Details:

Phase Conductor Size (AWG or MCM)	Ground Conductor Size (AWG)	Overall Jacket Assembly Thickness (mills)	Overall Diameter (Inches)
10	10	60	0.58
8	10	60	0.66
6	8	60	0.76
4	8	60	0.89
2	6	80	1.05
2/0	6	80	1.32
4/0	4	80	1.55

Type I Cable.

Type RG6U coaxial cable with a PVC (polyvinylchloride) jacket, aluminum foil shield, solid 18 AWG copper covered steel conductor.

Type J Cable.

600 Volt, Flame Retardant, 2-Conductor with Ground Conductor - Power Tray Cable (Okonite FMR Okoseal 210):

- Conductor: Tin coated copper per ASTM B-33, Class B stranded per ASTM B-8.
- Grounding Conductor: Where indicated, bare stranded copper per ASTM B-8, Class B, and NEC Table 250-95.
- Insulation: Okonite-FMR meets or exceeds requirements of UL 1581 and ICEA S-95-658 NEMA/WC70 Type II insulation.
- Overall Jacket: Complies with UL 1277. The Okoseal compound meets or exceeds the requirements of UL 1581. UL Listed as Type TC cable with a sunlight resistant jacket and for direct burial.
- Assembly: Conductors cabled in accordance with UL 1277 using fillers, as necessary, with a cable tape overall.

Color Coding Conductor colors shall be Black, White and Green.

Details:

Phase Conductor Size (AWG or MCM)	Ground Conductor Size (AWG)	Overall Jacket Assembly Thickness (mills)	Overall Diameter (Inches)
10	10	60	0.50
8	8	60	1.52
6	6	60	1.52
4	4	60	1.52
2	2	80	2.03
2/0	2/0	80	2.03
4/0	4/0	80	2.03

H. Terminal Blocks

Wherever it becomes necessary to terminate, join, or branch conductors, terminal blocks in boxes or cabinets shall be used. Terminal blocks shall be provided for conductors requiring connection to circuits external to the specified equipment, for internal circuits crossing shipping splits, and where equipment parts replacement and maintenance will be facilitated.

Terminal blocks shall be grouped for easy accessibility unrestricted by interference from structural members and instruments. Sufficient space shall be provided on each side of each terminal block to allow an orderly arrangement of all leads to be terminated on the block. Provide a minimum of 10 percent spare terminal points in each cabinet, box, console or enclosure.

Terminal blocks shall be provided with corrosion resistant plating on non-ferrous hardware and shall be provided with approved lock washers and terminal connectors for all external wiring.

All terminal blocks shall be provided with approved permanent terminal markings for each connected conductor in service and shall be marked to agree with the wiring diagram. The marking shall be placed on a material which will not be affected by age or moisture and shall be given two applications of a clear protective substance compatible with the terminal material and the marking material after the markings are placed thereon.

Terminal blocks shall be appropriate for the size of wire being terminated. The arrangements of terminal blocks shall be as recommended in the plans. Terminal blocks must be CE marked, CSA Certified, and UL listed.

III. SUBMITTALS

A. Catalog Cuts

The Contractor shall submit for the Engineer's approval catalog cuts and/or shop drawings for materials he proposes to use on the project. Forty days shall be allowed for the Engineer's review of each submittal. Materials which have not been approved shall not be delivered to the

project. Eight copies of each catalog cut and/or drawing shall be submitted and each shall show the material description, brand name, stock-number, size, rating, manufacturing specification and the use for which it is intended.

All components of each contract item shall be represented with a catalog cut or drawing. The submittals shall be neatly presented and arranged in the same order as the contract bid items.

B. As-Built Plans

The contractor shall furnish 2 complete full size sets of final as-built plans upon completion of the work including all electrical schematics, wiring diagrams, terminal listings, panel layout, conduit layout and control desk and panels.

These as-built plans shall include the title (No. 1), index (No. 1A), summary of quantities (No. 3), and all of the layout and detail (E) sheets of the project with all changes indicated. After review by the Engineer, one set of these as-built plans shall be placed in a waterproof envelope and filed by the Contractor in each Control Panel.

One set of as-built plans shall be submitted to the Design Services Unit.

The light standard foundations that are relocated by permission of the Engineer shall be shown on the as-built plans in their final locations.

The Contractor shall keep a daily record of the location of all items in order to ensure the accuracy of the as-built plans.

C. Warranties

Warranties from each manufacturer of electrical materials and equipment pertinent to the complete and satisfactory operation of the system shall be turned over to the Engineer prior to the acceptance of the project. Each warranty so furnished shall indicate its expiration date and shall not be less than those provided as a customary trade practice.

IV. CONSTRUCTION METHODS

A. General

All construction and installation shall be made by workmen skilled in this type of work and under the supervision of an experienced and qualified electrical supervisor. In addition, the approved control system vendor shall provide supervisory assistance to the electrical Contractor as specified herein before. All work shall be executed in a neat and workmanlike manner and shall present a neat and mechanical appearance when completed. Upon completion of the contract, the Contractor shall deliver to the Engineer a corrected plan showing in detail all changes on construction from the original plans, especially location and sizes of conduits, complete schematic circuit diagrams and the like.

The electrical installation shall comply with all applicable laws and ordinances in effect at the construction site, with applicable regulations of the NEC, and with regulations of the utility companies furnishing power, cable and telephone services to the site.

The electrical wiring to this equipment shall be installed with approved sizes and types of wire terminals and splice fittings.

B. Raceway

Conduit sections shall be connected to each other with screw couplings, made up so that the end of both conduits will butt squarely against each other inside the coupling. Conduits shall be installed so as to be continuous and watertight between boxes or equipment. Conduits shall be protected at all times from the entrance of water and other foreign matter by being capped or well plugged overnight and when the work is temporarily suspended.

All conduits shall be installed so that they will drain properly and drainage tees shall be provided at low points where required, and as directed by the engineer.

All field bends shall be in accordance with the NEC and shall be long sweep, free from kinks, and of such easy curvatures as to facilitate the drawing in of conductors without damage or injury. Conduit runs shall be made with as few couplings as standard lengths will permit, and the total angle of all bends between any two boxes shall not exceed 360 degrees. Long running threads will not be permitted.

Pull boxes shall be used wherever necessary to facilitate the installation of the conductors. Condulets shall not be used for pulling more than ten conductors or for making such turns in conduit runs or for branching conductors, except for indoor wiring to lighting fixtures and receptacles.

Conduits in the control room shall, wherever practical, be neatly installed along the surface of the walls or ceiling. Where conduits pass through the floors or walls of the control house, PVC-coated galvanized rigid conduit sleeves shall be provided for free passage of the conduits. After the conduits are installed, the openings shall be filled and caulked with a waterproofing sealant for airtight fits.

Exposed raceway runs shall be straight and shall be parallel or at right angles to the general structure lines. Attachment to steel or concrete shall be by galvanized straps, or hangers held at not less than two points by galvanized bolts or lag screws. Concrete inserts shall be Unistrut, B-Line, Midland Ross, or approved equal, fabricated from stainless steel.

At any point where a conduit crosses an expansion joint, or where movement between adjacent sections of conduit can be expected, bronze or alloy expansion fittings shall be installed equal to type AX as made by the O.Z. Electrical Manufacturing Company, Inc., or equivalent by Hope or Spring City.

All conduits shall be carefully cleaned, both before and after installation. Upon completion of the conduit installation, the contractor shall clear each conduit with a tube cleaner equipped with a mandrel of a diameter not less than 80 percent of the nominal inside diameter of the conduit, and shall then draw in the conductors.

The Contractor shall provide detailed as-built schedules at the conclusion of construction, as required. Conduits shall be as manufactured by Wheatland Tube Company, Triangle PWC, Inc., Carlon, Steelduct Products, Inc., or approved equal.

C. Wiring Methods

The drawing of wire and cables into conduits shall be done without injury to the wires or their insulation or covering.

All cables shall be installed as recommended by the manufacturer. The manufacturer's recommended maximum pulling tension and minimum bending radius shall be adhered to during installation. The contractor shall use the necessary guides, pulleys, sleeves, and pulling aids to prevent abrasion and damage to the cables during installation. Lubricants recommended by the cable manufacturer and acceptable to the engineer shall be used for the pulling of conductors or cables. All outgoing wires no. 8 AWG or smaller, in the control desk, on the switchboards and panels and in terminal cabinets shall be connected to terminal blocks.

Both ends of every single length of conductor shall be permanently and clearly identified with pre-printed heat shrink sleeves marked in accordance with the same number and designation shown in the final wiring diagrams. The marking shall be done on a sleeve not less than 1/2 inch long. The inside diameter of the sleeve shall be such that it will slip snugly over the insulated wire. Each sleeve shall be marked so that the identification shall be permanent and waterproof. Adhesive type labels are not acceptable.

Spare conductors of a multi-conductor cable shall be left at their maximum lengths for possible replacement of any other conductors in the cable. Each spare conductor shall be coiled and then taped to the conductors being used.

Conductors inside terminal boxes and at the control panels and control desk shall be installed in plastic wire ways or shall be neatly formed into cables and bound using approved plastic wire ties, with the individual conductors leaving the cable at their respective terminal points. These conductors shall be looped to allow not less than 3 inches of free conductor when disconnected. These formed cables shall be held securely away from the terminals and from contact with the cabinet by means of approved insulating supports. Wiring duct meeting JIC standards will be acceptable.

All conductors shall be color coded per the NEC (grounded neutral- WHITE; grounding - BARE or GREEN) and phase conductors shall be BLACK, RED and BLUE. Approved marking tape, paint, or sleeves may be used in lieu of continuous colored conductors for No. 8 AWG and larger. A white conductor in a cable assembly shall not be marked any other color. However, a white, red, or black conductor may be stripped at all accessible points and used as a bare equipment grounding conductor.

Joints, taps, and splices will only be permitted at locations indicated on the plans and by the following methods.

Locations in junction boxes and bases of standards:

- (1) Cut and remove the insulation only as far as necessary to make a secure mechanical and electrical connection. The connector shall be a removable type (split-bolt, set screw, wire nut, etc.) and shall be covered with self-vulcanizing rubber tape applied in half-lap layers, to give a smooth covering of not less than 2 times the thickness of the original insulation. Over the rubber tape, at least two layers of vinyl plastic tape shall be applied half-lap. The rubber tape shall be a self-fusing type putty in tape form that can be wrapped, stretched, or molded around irregular shapes for smooth insulation build-up. The vinyl plastic tape shall be 0.178 millimeter (O-100 degrees C) ultraviolet, abrasion, moisture, alkali, acid and corrosion resistant.
- (2) Install a manufactured mechanical or compression connector with factory made waterproof insulating boots in accordance with procedures and using tools as specified by the manufacturer.

After all wiring has been installed and connected in the proposed permanent manner, but prior to the above operation period, each circuit conductor shall be given an insulation resistance test by the Engineer. The insulation resistance for each conductor shall exceed 5 megohms after charging for 30 seconds at 500 VDC or 1000 VDC.

If the insulation resistance test of any conductor indicates a value of less than 5 megohms, the Contractor shall locate the fault. If the fault is in a conductor between terminal connections, the conductor shall be replaced. If the fault is at a terminal connection, the terminal device shall be replaced or repaired as directed by the Engineer.

V. MEASUREMENT AND PAYMENT

The work covered by this section will be paid for at the contract lump sum price for "Raceway and Wiring". Such price and payment will be full compensation for all work covered by this section including but not limited to installing, wiring and testing all electrical equipment and components and related equipment, materials, equipment, and all other hardware necessary.

Payment will be made under:

Raceway and Wiring.....Lump Sum

BRIDGE ELECTRICAL UTILITIES

I. DESCRIPTION

This work shall consist of furnishing, installing, and coordinating bridge incoming electrical service, telephone service and cable television service, including all material and equipment required to provide permanent service connections from the utility point of service to the control house, complete and operational, with the exception of the conduits for this work which shall be installed and paid for under the item "Raceway and Wiring".

Commercial electric power for operation of the bridge and its auxiliaries shall be supplied by the local utility company at 480 volts nominal, 3-phase, 4-wire, grounded wye, 60-hertz from a pad mounted transformer.

The utility meter, metering equipment and bridge service transformer(s) will be provided and installed by the power company. The Contractor shall be responsible for the concrete transformer pad, all coordination with the utility company, and all conduit and wiring from the service transformer to the Control House.

Terminals of grounding system shall be solderless type, secured by means of hexagonal head, copper plated steel machine bolts with lock washers. Grounding system conductors shall be continuous unspliced connections between terminal lugs.

Structure grounding shall consist of furnishing and installing a complete control house grounding system for the control house. Grounds shall be complete and continuous so as to ground the incoming service and the Bridge Control System.

II. UTILITY LOCATIONS AND CONTRACTORS RESPONSIBILITY

The best available information for the location, size, and type of material for all existing utilities is shown on the plans. The Contractor will be responsible for making investigations for determining the exact location, size, and type material of the existing facilities necessary for the construction of the proposed utilities and to avoid damage to existing facilities. Any damage incurred to existing facilities is the responsibility of the Contractor and shall be repaired to the original or better condition at no additional cost to the Department. Utility coordination was initiated by the NCDOT. The Contractor is responsible for all remaining coordination required to establish the required services at the control house.

III. MATERIALS AND EQUIPMENT

A. Service Grounding

Terminals of grounding system shall be solderless type, secured by means of hexagonal head, copper plated steel machine bolts with lock washers. Grounding system conductors shall be continuous unspliced connections between terminal lugs.

B. Service Disconnect

A new fusible disconnect switch shall be furnished and installed where shown on the Plans. Disconnect enclosure shall be NEMA 4X rated. Fuses shall be Class K 5 dual element type and sized as shown on the Plans. Disconnects shall be provided inside the control house as well as at the transformer pad.

IV. CONSTRUCTION METHODS

A. Service Grounding

Incoming service electrical power system shall be solidly grounded to the grounding assembly at the transformer pad.

Wiring, conduits and all related work shall be installed as indicated under common provisions.

The contractor shall be responsible for all utility bills (Telephone and Electric Service) from start of construction to final acceptance.

V. SUBMITTALS

A. Catalog Cuts

The Contractor shall submit for the Engineer's approval catalog cuts and/or shop drawings for materials he proposes to use on the project. Forty days shall be allowed for the Engineer's review of each submittal. Materials which have not been approved shall not be delivered to the project. Eight copies of each catalog cut and/or drawing shall be submitted and each shall show the material description, brand name, stock-number, size, rating, manufacturing specification and the use for which it is intended.

All components of each contract item shall be represented with a catalog cut or drawing. The submittals shall be neatly presented and arranged in the same order as the contract bid items.

B. As-Built Plans

The contractor shall furnish 2 complete full size sets of final as-built plans upon completion of the work including all electrical schematics, wiring diagrams, terminal listings, panel layout, conduit layout and control desk and panels.

These as-built plans shall include the title (No. 1), index (No. 1A), summary of quantities (No. 3), and all of the layout and detail (E) sheets of the project with all changes indicated. After review by the Engineer, one set of these as-built plans shall be placed in a waterproof envelope and filed by the Contractor in each Control Panel.

One set of as-built plans shall be submitted to the Design Services Unit.

The light standard foundations that are relocated by permission of the Engineer shall be shown on the as-built plans in their final locations.

The Contractor shall keep a daily record of the location of all items in order to ensure the accuracy of the as-built plans.

C. Warranties

Warranties from each manufacturer of electrical materials and equipment pertinent to the complete and satisfactory operation of the system shall be turned over to the Engineer prior to the acceptance of the project. Each warranty so furnished shall indicate its expiration date and shall not be less than those provided as a customary trade practice.

VI. MEASUREMENT AND PAYMENT

Payment at the contract prices for the various items covered by this section will be full compensation for all work covered by this section.

Such prices and payments will be full compensation for all work covered by this section including but not limited to furnishing and installing all electrical equipment and components, service poles and related service equipment, wire, and all other hardware.

Payment will be made under:

Bridge Electrical UtilitiesLump Sum

STANDBY GENERATOR

I. DESCRIPTION

This work shall consist of furnishing, installing, and placing in permanent operating condition an engine-generator set complete with radiator, radiator fan, exhaust system, water circulating system, and an electric starter with battery, battery heater and battery charger. Also included in this item of work shall be the furnishing and installation of the generator control panel, automatic transfer switch, fuel pad and piping installation, load bank, ducting, belly mounted fuel tank,

remote annunciator, and motorized louvers, including all affiliated wiring. Conduits installed within the control house shall be paid for under separate pay items as indicated in these specifications.

II. MATERIALS AND EQUIPMENT

A. Automatic Transfer Switch (ATS)

Automatic start/automatic transfer switch shall be rated at 600 amps. Each contact pole of the main transfer device shall be double-throw design, with solid silver cadmium contacts, capable of handling both non-inductive and inductive loads and allow for inrush currents of 20 times the continuous rating. Contact pressure shall be maintained by a coil spring, not a part of the current-carrying path. The ampere rating of the transfer switch shall be sufficient to handle the capacity of the plant and loads being transferred. The transfer switch enclosure shall be NEMA 1 gasketed.

The transfer switch shall provide the following functions using solid state logic control:

- (1) Time delay on transfer from normal to emergency: adjustable
- (2) Time delay on transfer from emergency to normal: adjustable
- (3) Time delay on engine cooldown: adjustable
- (4) Frequency/voltage monitor of emergency source
- (5) Four position selector switch (test, auto start, off, and local start)
- (6) Relay contacts for normal and emergency power
- (7) Frequency meter mounted in enclosure door
- (8) Voltmeter, ammeter and selector switch mounted in enclosure door
- (9) Plant exerciser with two-position selector switch for load / no load

B. Engine-Generator

The engine-generator shall be the product of a manufacturer regularly engaged in the manufacture of generator plants. The generator set and all controls shall be built and tested by this same manufacturer, precluding divided responsibility. The generator shall be tested at the manufacturer's facilities. Certified test reports of the complete assembly shall be available from the manufacturer showing the plant's power rating, voltage, and frequency regulation, and other pertinent data. Detailed operation and maintenance manuals with parts lists shall be provided. The engine-generator set shall be sized as indicated on the plans and elsewhere in these specifications.

C. Rating

The installation of the engine and electric generating system shall include an electric plant rated for standby service as shown in the Plans.

The rated output shall mean the set full continuous derated output under the climatic conditions shown below. The set shall also be capable of carrying a load of 10 percent above the full derated output for two hours under conditions shown below, at rated speed, without undue heating of the engine or alternator.

The engine shall be derated for the following ambient conditions:

Altitude: 50 feet above sea level

Outside ambient design temperature:

-5 deg f. Minimum

+88 deg f. Maximum

D. Assembly Details

Engine features - the engine shall be a heavy duty, diesel fueled, water cooled with unit mounted radiator, multi-cylinder, 4 stroke, designed for cold quick start, capable of delivering full load output at all ambient temperature conditions. Speed shall not exceed 1,800 rpm. Engine shall have not less than 1.5 brake horsepower per kW of generator requirements, in excess of the power required for engine accessories such as radiator fan, and auxiliary water pumps, if required. Provide set with a block heater to maintain jacket water temperature at a minimum of 50 deg f. The engine shall be naturally aspired. No external water supply is available. The engine-generator set shall be equipped standard with a sound attenuated enclosure to provide a sound level no greater than 68 dB (a). This sound level will represent the average measurement taken at eight points set equidistant, 23 feet from the set, operating at full load.

The system shall be a package of new and current equipment consisting of:

- (a) A diesel engine-driven electric plant to provide standby electrical power.
- (b) Engine-mounted start-stop control system (with provisions for a remote control).
- (c) Fuel filters and electric fuel shut-off valve.
- (d) Isochronous governor capable of 0.25 percent steady strip frequency regulation.
- (e) Automatic battery charging alternator with solid state voltage regulation.
- (f) Replaceable cylinder liners of the wet sleeve type.
- (g) Replaceable valve seat inserts.

E. Starting System

The remote-controlled engine starting shall be by means of 24 volt starting motors. Batteries of sufficient capacity for five, 15-second consecutive crank periods shall be furnished. The battery voltage shall be 24-volt DC. Provide four series-connected 6-volt batteries. Provide battery rack with corrosion-resistant battery trays.

F. Fuel System

Unit shall operate on diesel fuel stored in a belly mounted tank. Furnish fuel shut-off valve, fuel filters and all accessories as required. Appropriate leak protection shall be provided. So as to comply with fire codes, the maximum fuel storage capacity shall not exceed 175 gallons.

G. Battery Charger

A standby, adjustable, fully automatic, constant voltage, current limited, charging device with rheostat and ammeter shall be furnished by the supplier to maintain the battery in full operating condition at all times. A battery heater shall be provided to maintain battery function.

H. Cooling System

The cooling system shall insure that the maximum cooling water temperature is safely within the normal working temperature range when the set is operating continuously at full load at maximum ambient temperature when the air intake temperature of the engine room may rise to 120 degrees F. The engine outlet water temperature under such conditions shall not exceed 200 degrees F.

The generator set shall be provided with self-contained cooling system of ample capacity comprising heavy duty design radiator multiple v-belt driven radiator fan and gear driven centrifugal pump for water circulation. Radiator fan blades should be of heavy gauge sheet metal well protected against corrosion or of cast anti-corrosion metal. Provision should be made for fan belt adjustment without interference with the cowl. The radiator assembly shall include a core guard and an air duct flange and exhaust air out.

I. Lubrication System

A pressure type lubricating system with gear type oil pump and a full flow filter shall be fitted to the engine. The lube oil system shall have full flow filters of sufficient capacity. The lube oil filter elements shall be of the replaceable element type.

J. Intake and Exhaust System

Air is to be induced to the engine manifold through an air cleaner with reusable elements.

The exhaust system shall include a residential type silencer, a condensation trap and drain cock, a flexible connection near the engine, a metal thimble where the exhaust line passes through the wall and a rain hood over exhaust pipe end. The metal thimble shall have a diameter 6 inches larger than the exhaust line. The exhaust line shall be the size recommended by the engine manufacturer.

The exhaust system shall be provided with all necessary piping, clamps, silencer, wall flashings and other item required for proper installation.

The exhaust system shall be completely insulated from the flex connection at the engine and silencer to the exhaust outlet outside the control house. The exhaust silencer shall be wrapped completely. Insulation shall be removal blanket type as manufactured by Firrwin Corp. or ATP or Fibrex or engineered approved equal. The completed insulation system shall be wrapped with stainless steel sheets held in place with stainless steel bands. Sheets shall have 1" overlap and be prevented from slipping by installing 3# 8x1/2 long stainless steel sheet metal screws equally spaced around the circumference at each joint.

K. Governing System

The engine shall run steadily at any load within its rating at its rated speed, and the changes in speed at a steady load shall not exceed 0.5 percent when all transients have decayed.

The maximum speed variation upon applying a 50 percent 0.8 power factor load change shall not exceed 5 percent.

The governor shall be gear driven, and shall have provisions for remote adjustment of speed. The governor shall be of the electronic type and shall be capable of close speed regulation with in + or - 0.25 percent.

L. Safety Switches

The engine shall be equipped with automatic safety switches to stop the engine in the following cases:

- (a) Water temperature exceeds a preset safe working limit.
- (b) Lubricating oil pressure lower than a preset safe working limit.
- (c) Speeds exceeding 110 percent of rated speed.

M. Control System

Engine controls shall include complete engine start controls, which operate on closing contact, and stop control, which operates opening contact. A cranking time delay relay shall be provided to open the starting circuit in approximately 45 to 90 seconds if the plant is not started within that time. The electric plant controls shall include a weekly exerciser timer to permit exercising under load, running time meter, and run-stop-remote selector-switch. High water temperature, overspeed shutdown, and low oil pressure shutdown with signal light and alarm terminals shall be provided. A remote annunciator shall be provided with both audible and visual indications of low oil pressure, overcrank, low water temperature, high water temperature and overspeed. Visual indications only shall be provided for low battery voltage, high battery voltage and generator power on. Remote annunciator shall be capable of being located up to 1000 feet from the generator set and shall be located as shown on the plans.

The complete control shall be designed, built, and tested by the manufacturer of the alternator. It shall include the necessary relays and component parts together with UL listed and tested electrically and mechanically interlocked contactor, and shall provide the transfer functions indicated for the specific units.

N. Engine Instrument Panel

An engine-mounted instrument panel shall be equipped with gauges for water temperature, oil pressure, oil temperature, battery charge rate ammeter, and intake manifold vacuum.

O. Alternator

The alternator shall be salient-pole, reconnectable 12-lead, self-ventilated of drip-proof construction with amortisseur rotor windings and skewed for smooth voltage wave form. The insulation material shall meet the NEMA standard (mg-22.40 and 16.40) for class H and be vacuum impregnated with epoxy varnish to be fungus resistant per mil I-24092. Temperature rise of the rotor and stator shall be limited to NEMA class F. The excitation system shall be of brushless construction controlled by a solid-state voltage regulator with adjustable volts-per-hertz operation capable of maintaining voltage within + or - 2 percent at any constant load from 0 to 100 percent of rating. The regulator must be sealed from the environment and isolated from the load to prevent tracking when connected to SCR loads. The generator must be 'K' rated. That is to say that it must be capable of being connected to SCR variable speed drives.

On application of any load up to the rated load, the instantaneous voltage dip shall not exceed 10 percent and shall recover to + or - 2 percent of rated voltage within one second. The maximum transient frequency dip shall be no more than 2 percent below rated on application of any motor load surge.

The generator shall be capable of sustaining approx. 300 percent of rated current for at least 10 seconds under a 3 phase symmetrical short by inherent design or by the addition of an optional current boost system.

A resettable line current sensing circuit breaker with inverse time versus current response shall be furnished and shall not automatically reset preventing restoration of voltage if maintenance is being performed. This breaker shall protect the generator from damage due to its own high current capability and shall not trip within the 10 seconds specified above to allow selective tripping of down-stream fuses or circuit breakers under a fault condition.

The alternator instrument panel shall be wired, tested, and shock-mounted on the electric plant by the manufacturer of the alternator. It shall contain manual reset overload protection, running time meter, ac voltmeter with phase selector switch, AC ammeter with phase transfer switch, voltage adjusting rheostat, and panel lights.

P. Load Bank

A radiator mounted resistive load bank shall be provided to facilitate routine testing of the engine-generator under load. The unit shall be constructed of aluminized steel according to the NEMA 3R standard and mounted directly to the radiator. Control power shall be 120 VAC, single phase, and 60 hertz. Provision shall be provided for remote load dump from a normally closed set of contacts in the automatic transfer switch. In the event of a utility failure, all loads should be removed. The load bank shall be rated not less than 75kw at 480v, 3 phase, 60 hertz and shall be rated at least 50 percent of the generator set full load rating. Load bank shall be Avtron model K711/K711A, Loadtech model ODL2, or approved equal by Caterpillar, Cummins, Onan, or Kohler.

Q. Supplier

The engine generator set shall be supplied by the manufacturer as a complete factory assembled generator set to include the engine, generator, radiator, control panel, and all accessories specified mounted on a single steel grid base. The supplier shall have been regularly engaged in the manufacture of such equipment for the past ten years and who has parts and service facilities locally available so there is one source of supply and responsibility.

All accessories needed for the proper operation of the plant shall be furnished. These shall include a muffler, exhaust pipe, radio shielding, safety alarms, plant weekly exerciser timer, running time meter, flexible exhaust connection, starting batteries, battery cables, battery rack, fuel filter, solenoid, crankcase heater, thermostat, primary regulator, flexible fuel connections, shut-off valve, and detailed operation and maintenance manuals with parts list.

Each piece of equipment and apparatus shall have a stainless steel, brass or bronze nameplate on which is stamped the name of the manufacturer and the rating or capacity of the equipment or apparatus.

Manufacturers shall be Onan, Caterpillar, Cummins or Kohler or approved equal.

R. Louvers

Furnish and install where shown on plans, electrically operated, adjustable type intake and exhaust louvers for the Generator Room. Frame and blade material to be 6063-T5 aluminum alloy. Frame shall contain integral caulking slots. Louver shall have vinyl blade seals and compressible metal jamb seals. Blades shall pivot on plated steel hex axles with stainless steel sleeve bearings. Each adjustable section shall include concealed (exposed optional) manual operating quadrant (electric operator also to be supplied). Louvers shall be provided with insect screens of 14 x 18 bronze wire cloth, backed by a screen of 19-gauge wire in 1/2" mesh. Screen shall be contained within a removable frame.

Design shall incorporate structural supports required to withstand a wind load of 20 pounds per sp. Ft. (.96 kPa).

Published performance data must be submitted for approval prior to fabrication and must demonstrate pressure drop and water penetration equal to or less than the model specified. Louver shall receive a Kynar 500 finish. Size shall be as shown on the plans.

The louvers shall be provided with electric operators which return to the normal position upon power interruption. The operator shall use a two-wire circuit. The actuator shaft shall rotate cw 180 degrees when power is applied. A spring shall return the actuator shaft ccw to the original position when actuator is de-energized. An auxiliary end SPDT end switch shall make or break the circuit at the powered end of stroke. Ambient operating temperature range shall be at least -30 to +130 degrees F.

Adequate generator exhaust airflow (as per generator manufacturer's requirements) must be maintained. Actual exhaust louver wall opening shall be large enough to allow entry and exit of the generator set (see Architectural and Structural Plans).

Color of louver shall be custom to match terracotta clay tile color.

Entry of the generator into the generator room is expected to be via the generator room louvers. The Contractor shall coordinate the louver opening size with the generator size to assure that the louver opening will provide generator entry as well as required air flow.

S. Fuel Storage and Delivery System

Provide a delivery piping system for supply of fuel to the belly mounted fuel tank described above. The delivery system shall be complete in all respects in order to allow filling of the belly mounted fuel tank from the roadway level.

The enclosure for the fuel delivery system shall include an integral drip pan/sump to contain any leak from the pump, plumbing, valves, etc. The sump shall include a drain plug. A leak detector switch located in the sump shall activate the "rupture" alarm detailed below.

The fuel delivery piping system shall be designed and supplied as an engineered system by the manufacturer. The system shall include any devices that are required by code and/or good engineering practice to interconnect the roadway level filling area to the day tank and to provide for external vents as per local codes and UL 142, NFPA 31 and NFPA37.

The system shall be for use with fuel oil as described by NFPA 321, "Basic Classification of Flammable and Combustible Liquids." As defined by this standard, the Fuel Supply System shall

be for use with "combustible liquids," those having a flash point at or above 100°F and further defined as class II or class III liquids. In no case shall a liquid defined as "flammable," or as "class I" or as having a flash point less than 100°F be used. In every case, the system shall not be used or applied at a temperature in excess of the flash point of the contents. Electrical equipment used in the system shall be in accordance with NFPA 30, section 5-7, wherein it states "For areas where class II or class III liquids only are stored or handled at a temperature below their flash points, the electrical equipment may be installed in accordance with provisions of NFPA 70, National Electric Code, for ordinary locations..."

The system shall be designed and installed in accordance with applicable sections of NFPA 30, NFPA 31, NFPA 37, UL 80 and UL 142.

The complete Fuel Storage and Delivery System described above, shall be designed and manufactured by a single supplier and be a standard product in serial production.

III. CONSTRUCTION REQUIREMENTS

The emergency generator shall be brought into the house through the lower opening in the sidewall. Partial assembly may be required. The generator manufacturer's technical representative shall be present during installation and at startup to insure that the installation is proper and the warranty is not voided. All components of the generator system, including the generator control panel, remote annunciator, and louver operation shall be coordinated and as per the manufacturer's recommendations.

The main fuel tank and delivery system shall be installed in the pier area adjacent to the Control House as shown in the Plans. Anchor the tank to the concrete pad. Contractor shall coordinate equipment sizing and layout to allow equipment entry and installation in the pier area. Take into consideration the space constraints in the pier area including the path of the moving bridge counterweight.

Provide schedule 40, ASTM A 53, black iron pipe for all supply and return piping between the belly mounted fuel tank and the fuel filling area on the sidewalk. Pipe shall be sized as per generator manufacturer's recommendations. Make all connections to fixed installed pipe with pipe unions to facilitate tank service/removal.

Fuel vent sizes shall be as required by local codes and by UL 142, NFPA 31 and NFPA 37 specifications

IV. MEASUREMENT AND PAYMENT

Payment at the contract prices for the various items covered by this section will be full compensation for all work covered by this section.

Such prices and payments will be full compensation for all work covered by this section including but not limited to furnishing and installing all electrical equipment and components, service poles and related service equipment, wire, and all other hardware.

Payment will be made under:

Standby GeneratorLump Sum

I. DESCRIPTION

This work shall consist of furnishing and installing all roadway lighting standard assemblies, all conduits, junction boxes, and other items as necessary to make the roadway lighting fully operational in accordance with the plans.

II. MATERIALS AND EQUIPMENT

A. Roadway Lighting

The Contractor shall furnish all roadway lighting fixtures, lighting equipment, and components shown on the plans, listed on the fixture schedule and all labor and materials to install the specified equipment in the manner indicated. All fixtures and lighting equipment shall be delivered with accessories, hangers, canopies, hickey, casings, end plates, sockets, fixture wires, holders, reflectors, globes, glass, guards, ballasts, diffusing louvers, recessing boxes, etc. All wired and assembled as indicated.

The Contractor shall furnish and install all lamps and accessory wiring. Entire fixtures and all component electrical parts shall be listed by UL. The Engineer reserves the right to require colors and finishes to meet special requirement on the building and on the bridge. The roadway lighting equipment shall be furnished and installed as required by the following schedule:

Type D: Pedestrian walkway type fixture with post. The fixture shall be 15" dia. x 35" tall with clear, textured, polycarbonate, acorn type globe, with a cast aluminum base. The fixture shall be provided with 175W Metal-Halide lamp and high intensity discharge ballast, for 120V operation and socket assembly, a borosilicate glass refractor with an IES type 3 distribution. The post shall be of cast iron tapered and fluted with (2) 24" long banner arms mounted 4" below top of donut @ 90degree of the access door, (1) 120V weather proof receptacle mounted 6" below top donut directly above access door, two heavy duty eye bolts mounted 36" below banner arms with same orientation as arms, a GFI mounted inside base, and an integral 3" tenon for luminaire or crossarm mounting. Door located in base for anchorage and wiring access. The height of the post shall be 9'-2" with a base diameter of 17". The luminaire and post color paint most match the City of New Bern green finish and shall be manufactured by Antique Street Lamps Inc.(no substitution, must match City of New Bern Standard).

Luminaire: cat. # AT23-W-175M-MOG- PCT-GR3-120-ANBK

Pole: cat. #PI-C17-9-ANBK

Type E: Roadway type luminaire with steel pole. The luminaire housing shall be of heavy duty die cast aluminum with one-piece cast aluminum lens frame attached to the housing by a zinc plated cold rolled steel hinge with a stainless steel pin. Closure is by four self-retained stainless steel screws. A stainless steel self-locking stop arm shall be provided to hold the lens frame in the open position while servicing. The arm mounting shall be of one piece extruded aluminum with internal bolt guides and fully radiused top and bottom. Luminaire to pole attachment shall be by internal draw bolts, and shall include a pole reinforcing plate with wire strain relief. Arm shall be circular cut to mate with specified round pole. The reflector module shall be Specular Alzak optical segments rigidly mounted within the die-cast aluminum enclosure that attaches to the housing as a one piece module. The socket shall be factory prewired with a quick-disconnect

plug for the ballast module. Wire penetration to the socket shall be sealed by a silicone gasket to create a totally sealed optical chamber. All electrical components shall be UL and CSA recognized, mounted on a single plate and factory prewired with quick-disconnect plugs. The fixture shall be provided with a 400W Metal-Halide lamp and the ballast shall be of the high power factor with starting temperature of -20 degree F for 120V operation. The fixture shall be finished with Super TGIC thermoset polyester powder coat paint applied over a Titanated Zirconium conversion coating. The luminaire shall be of the arm mounting as manufactured by Kim Lighting cat # 1A-CCS25A2-400MH120-BL-P. The pole shall be 30ft high and of one piece tapered round shaft of high tensile carbon steel (55,000 psi minimum yield), welded to the base. The base shall be of two pieces steel full cover secured by stainless steel screw. A handhole shall be provided 18" up from base, with a gasketed cover and ground lug. Four galvanized anchor bolt shall be provided complete with eight nuts, eight flat washers, and a presswood template. The pole shall have a Super TGIC thermoset polyester powder coat paint (City of New Bern green finish) applied over a chromate conversion coating. The pole and luminaire shall be as manufactured by Kim Lighting (no substitution, must match City of New Bern standard)

Luminaire: cat #1A-CC25A2-400MH-120-BL-P

Pole: cat. #PTRS30-75120-A-BL-P

Type E1: Same as Type E except luminaire shall be provided with 250W Metal-Halide lamp.

Luminaire: cat #1A-CC25A2-250MH-120-BL-P

Pole: cat. #PTRS30-75120-A-BL-P

Lighting fixtures on movable spans or where vibration may be a hazard to lamp life shall be installed with shock absorbing lamp receptacles.

Ballasts shall be furnished and installed as required for all lighting fixtures. Ballasts shall meet the requirements specified herein and shall be designed to meet applicable certified ballast manufacturers and/or American Standard association and underwriter's laboratories specification. Ballasts furnished must provide lamp watts within 90 percent minimum of lamp manufacturer's published ratings. All ballasts shall be sound rated "A". The Contractor shall replace any ballasts which do not operate quietly. Ballasts shall be applied such that the ballast case temperature will remain below 90 degrees C, for full ballast life. The ballast shall supply an open circuit voltage which, at the minimum supply voltage limit, will meet requirements of the lamp manufacturer, and shall be guaranteed to start at least 90 percent of seasoned hid lamps at the minimum supply voltage limit in -20 degree F. Ambient. All ballasts shall be equipped with either internal, non-resetting thermal protection devices adjacent to the coils and in the power capacitor or each ballast shall be provided with dual-element, inline, and slow blowing external fuse. All ballasts shall be of the high power factor type, with 120 V primaries. Radio-frequency interference suppressers shall be provided.

B. Wiring

All other materials and equipment for this work shall be as indicated under Raceway and Wiring.

III. CONSTRUCTION REQUIREMENTS

The construction requirements for Roadway Lighting shall be as indicated under common provisions.

IV. MEASUREMENT AND PAYMENT

Payment at the contract prices for the various items covered by this section will be full compensation for all work covered by this section.

Such prices and payments will be full compensation for all work covered by this section including but not limited to furnishing and installing all electrical equipment and components, service poles and related service equipment, wire, and all other hardware.

Payment will be made under:

Roadway Lighting.....Lump Sum

TRAFFIC SIGNAL ASSEMBLIES

I. DESCRIPTION

This work shall consist of furnishing and installing traffic signal assemblies complete with all components and wiring from the signal fixture to the base of the pole, as required, exclusive of conduits and wiring to the assembly which shall be as described under "Raceway and Wiring".

II. MATERIALS AND EQUIPMENT

Materials and equipment required for a complete traffic signal assembly. Each traffic signal assembly shall be as shown in the plans and shall consist of approved materials in compliance with the provisions of the NCDOT standard drawings and specifications section 1700.

Foundations shall be as shown in the Structural Plans.

III. CONSTRUCTION REQUIREMENTS

Each traffic signal assembly shall be mounted in the locations shown on the plans.

No separate measurement will be made of the above work. Payment will be considered as incidental to the construction of the project.

No separate measurement will be made of the above work. Payment will be considered as incidental to the construction of the project.

IV. MEASUREMENT AND PAYMENT

Payment at the contract prices for the various items covered by this section will be full compensation for all work covered by this section.

Such prices and payments will be full compensation for all work covered by this section including but not limited to furnishing and installing all electrical equipment and components, service poles and related service equipment, wire, and all other hardware.

Payment will be made under:

Traffic Signal Assemblies.....Lump Sum

I. DESCRIPTION

This work shall consist of furnishing and installing Drawbridge Ahead signs with flashing signal assemblies complete with all components and wiring from the signal fixture to the base of the pole, as required, exclusive of conduits and wiring to the assembly which shall be as described under "Raceway and Wiring".

II. MATERIALS AND EQUIPMENT

A diamond shaped, "Drawbridge Ahead" sign, sized 36" by 36", with two yellow flashing warning beacons shall be provided as shown on the plans (one require on each bridge approach – two total assemblies). The sign shall be furnished, fabricated and erected as per NCDOT standard drawings and specifications for type "E" signs, section 900 (General requirements for signing).

III. CONSTRUCTION REQUIREMENTS

Each sign and signal assembly shall be mounted in the locations shown on the plans.

IV. MEASUREMENT AND PAYMENT

Payment at the contract prices for the various items covered by this section will be full compensation for all work covered by this section.

Such prices and payments will be full compensation for all work covered by this section including but not limited to furnishing and installing all electrical equipment and components, service poles and related service equipment, wire, and all other hardware.

Payment will be made under:

Drawbridge Ahead SignsLump Sum

WARNING GATES

I. DESCRIPTION

This work shall consist of furnishing and installing traffic warning gates completely assembled with all components and wiring provided by the manufacturer. This work shall include installation of the gate cabinet including pedestal support, anchoring, gate arm with gate arm lights, flashers, gongs, wiring from the flashers and gongs to the cabinet, and cam limit switch adjustments. Conduits and wiring to the warning gates are not included here, but shall be as described under "Raceway and Wiring". The warning gates shall be installed on the bridge approaches in the locations shown on the plans. All of the work described in this subsection shall be as shown on the plans and specified herein and shall be paid for under the item "Warning Gate".

II. MATERIALS AND EQUIPMENT

Warning gates shall be provided and installed as indicated in the plans. The warning gates shall be Model VW-4, as manufactured by B&B Roadway, LLC, (888) 560-2060 or equivalent by Automatic Power, or Federal Signal.

The operating mechanism and main control components shall be contained in a weatherproof housing. The housing shall be constructed of .188" (4.8mm) carbon steel, hot dip galvanized after fabrication. Exterior surfaces shall be painted aluminum. All fasteners shall be corrosion resistant. Arm shaft openings shall incorporate O-ring seals.

Front and rear access doors shall be mounted on full cross bronze straps. Hinges shall be of the slip-off type and shall have stainless steel pins. Door latches, two per door, shall use a vise action to compress a neoprene bulb-type gasket to seal the door openings. A padlockable strap shall be provided suitable for heavy duty standard padlocks, provided by others.

Gate arm shall be of a lightweight rectangular aluminum and fiberglass construction with diagonal red and white striping on the arm faces, 120vac alternating red flashing lights and a flasher. The Contractor shall verify gate arm length. One warning gong per roadway approach shall also be provided. Actual gate arm length shall be verified by the Contractor so as to cover one-half of the full width of the roadway. All hardware on the gate arms shall be stainless steel. Gate cabinets shall be of special construction such that access to the cabinet interiors and components can be achieved on the roadway side only. Access to the side of the cabinet opposite the roadway side will not be possible due to limited platform clearance and OSHA requirements.

All gate arms shall come furnished with a spring loaded shock absorber which operates when the arm is parallel to the roadway elevation. Shock absorbers shall pivot to the vertical position when the gate is raised.

The gate shall be fixed to a suitable foundation, as specified by the project engineer, using four 3/4" (20mm) diameter minimum anchor bolts. The gate housing base shall provide four 1.00" (25mm) holes on a 20 1/4" (514mm) square pattern. (Mounting holes in standard base shall be slotted to allow for a 19 1/2" x 20 1/4" (495mm x 514mm) mounting pattern to accommodate some existing bolt patterns.) ARM: The gate arm shall be 4" (102mm) square, 6005-T5 aluminum extruded tubing. Maximum arm length shall be 40' (12m) from the centerline of the housing. Stainless steel truss cables and a damping type bumper rod shall be furnished with longer arms at the discretion of the manufacturer. Front and rear arm surfaces shall be covered with alternating red and white pre-stripped diamond grade reflective sheeting. Stripes shall be 6" (152mm) wide, and shall slope at 45 degrees down toward the arm tip. Remaining exposed surfaces shall be painted white.

The arm base shall be designed with a shear pin mechanism to minimize damage to the gate and vehicle in the event of a collision. In the event of an impact, the shear pin shall break, allowing the arm to swing approximately 75 to 80 degrees. At the full open position, a spring-loaded latch shall engage, preventing the arm from swinging back into traffic. Arm shall be easily reset by manually releasing the latch, rotating the arm back into position and replacing the shear pin.

A pair of carbon steel channels, hot dip galvanized, painted aluminum, shall be rigidly affixed to the ends of the main arm shaft. The channels and a steel crossmember shall provide a sturdy mount for the arm, arm base assembly and counterweights.

At the rear end of the side arm channels, hot dip galvanized counterweights shall be mounted to balance the arm. Counterweights shall be sectional and shall permit at least 10% adjustment.

The main arm shaft shall be of 2" (51mm) diameter AISI 4150 with a minimum tensile strength of 140,000 psi. The shaft shall be mounted in heavy duty relubricable ball bearings.

The warning arm shall pivot in the vertical plane via a mechanical 4-bar linkage. The linkage shall utilize cranks keyed to the main arm shaft and transmission shaft and an adjustable connecting rod between a pair of self-aligning spherical rod ends. The connecting rod shall be of 1" (25mm) diameter AISI 4150. The linkage shall be driven by a fully enclosed, double reduction, worm gear speed reducer. Gear ratio used shall produce an operation time of 11 seconds.

The motor voltage and phase shall be as shown in the Plans. The motor shall be 1/2 hp, except when a greater rating is recommended by the gate manufacturer to handle exceptionally heavy applications and is approved by the customer. The motor shall be a C-face design and shall be mounted directly to the transmission. The motor shall be instantly reversing and overload protected.

The motor shall be equipped with a solenoid-release, automatic brake. The brake shall have a manual release lever to permit manual operation of the gate during emergencies or setup.

A handcrank and drillcrank shall be provided with each gate to facilitate manual operation of the gate.

The gate limit switch assembly shall be a self-contained unit. The assembly shall provide 8 independent SPDT control switches. Switches shall be rated for 15 amps at 480 VAC. Switches shall be controlled by individually adjustable cams. The limit switch assembly design shall permit adjustment of all cams with the gate in any position. The limit switch assembly shall have a removable cover to help prevent accidental contact with switch terminals. Shaft, cams, bushings and housing pieces shall be of non-ferrous corrosion resistant materials.

A manual disconnect switch shall be provided, pre-wired at the factory to break the main motor leads, to protect personnel during service. A handcrank safety switch shall be provided to prevent powered actuation of the gate during manual operation. Safety switches shall also be installed and set at the factory to break the control circuit when either access door is opened. Door safety switches shall have a pull-to-override feature for test operation and shall automatically reset when doors are closed. Control components and terminal blocks shall be mounted inside an electrical enclosure mounted facing the roadway side access opening, except where custom components required by the customer prevent this arrangement. Pressure-type, modular terminal blocks shall be fully labeled and clearly coded to wiring diagrams. All control wiring shall be clearly coded to wiring diagrams and shall terminate at the terminal block. Connections to screw-type terminals shall have lugs. Conductors shall be #16 AWG stranded, minimum. Wiring shall be run in conduit where practical.

A 2 year warranty shall cover the gate and related equipment against defective material and components. Manufacturer shall furnish replacement parts for a minimum of 5 years. Replacement parts for standard components shall normally be available within 1 working day. Lamps, fuses and other components designed for a life less than 2 years shall be covered for the rated life of the component or the warranty period of the component manufacturer.

The housing of the gate arm lights shall be of high impact plastic. Assembly shall be double-faced. Light assembly shall be mounted to warning gate arm or barrier using an aluminum adapter plate. Lenses shall be red Fresnel plastic, approximately 4" diameter. Lamp shall be 5W, 120V, clear, rated 9 candle power. The number of warning lights on the new warning gate arms shall be as indicated on the plans. The lights shall be connected so adjacent units will flash alternately.

The warning gong housing shall be of heavy duty, cast aluminum construction. Gong assembly shall be equipped with an aluminum mounting adapter for mounting to the top of warning gate housing. Mounting shall be designed to enclose all wiring. A hinged and gasketed rear door shall provide service access. A cast aluminum guard above the shell shall provide weather protection.

Gong shall operate on 120V power. Current draw is .45 FLA. Gong shell shall be pressed steel.

III. CONSTRUCTION REQUIREMENTS

Each warning gate shall be mounted on the bridge approaches at the locations shown on the plans.

The Contractor shall furnish and install anchor bolts into the pedestals based on the actual mounting hole arrangement of the approved gate. Anchor bolt size and quantity will as per the manufacturer's requirements. Gate cabinets shall have an open bottom and are to be installed over the conduit stub and wiring which is to serve power and control to the gate.

IV. MEASUREMENT AND PAYMENT

Payment at the contract prices for the various items covered by this section will be full compensation for all work covered by this section.

Such prices and payments will be full compensation for all work covered by this section including but not limited to furnishing and installing all electrical equipment and components, service poles and related service equipment, wire, and all other hardware.

Payment will be made under:

Warning GatesLump Sum

BARRIER GATES

I. DESCRIPTION

This work shall consist of furnishing and installing barrier gates completely assembled with all components and wiring provided by the manufacturer. This work shall include installation of the gate cabinet including anchoring, gate arm, flashers, wiring from the flashers to the cabinet, and cam limit switch adjustments. Conduits and wiring to the barrier gates are not included here, but shall be as described under "Raceway and Wiring". The barrier gates shall be installed on the east and west roadway approaches in the locations shown on the plans. All of the work described in this subsection shall be as shown on the plans and specified herein and shall be paid for under the item "Barrier Gate".

II. MATERIALS AND EQUIPMENT

Barrier gates shall be provided and installed as indicated in the plans. The barrier gates shall be Model VR-6, as manufactured by B&B Roadway, LLC (phone: 888-560-2060), or equivalent by Automatic Power or Federal Signal.

Each barrier gate shall contain a double aluminum tube arm and shall be furnished with 120 VAC arm lights and a flasher. Actual gate arm lengths shall be verified by the Contractor so as to cover one-half of the full width of the roadway. All hardware on the gate arms shall be stainless steel. Gate cabinets shall be of special construction such that access to the cabinet interiors and components can be achieved on the roadway side only. Access to the side of the cabinet opposite the roadway side will not be possible due to limited platform clearance and OSHA requirements.

The barrier shall be designed for use as a penetration resistance barrier and shall be suitable for use as a warning barrier for wide spans. The barrier shall be explicitly designed for traffic control on movable bridges, as required by AASHTO's current Standard Specifications for Movable Highway Bridges, and shall be suitable for similar applications as well.

The operating mechanism and main control components shall be contained in a weatherproof housing. The housing shall be constructed of .375" (9.5mm) carbon steel, hot dip galvanized after fabrication. Exterior surfaces shall be painted aluminum. All external fasteners ½" and under shall be stainless steel. Fasteners over ½" shall be stainless steel, hot dip galvanized or mechanically galvanized. Arm shaft openings shall incorporate O-ring seals.

Front and rear access doors shall be mounted on full cross straps. Hinges shall be of the slip-off type and shall have stainless steel pins. A stop shall be mounted inside the door to secure the door from being raised off the hinges in the closed position. Door latches, two per door, shall use a vise action to compress a neoprene bulb-type gasket to seal the door openings. A stainless steel strap shall extend across each door and fit over a heavy hasp to permit use of a padlock. Strap and hasp shall be designed to fit both standard style heavy-duty padlocks and high security shackleless ("hockey puck" style) padlocks. Padlocks shall be provided by others, keyed alike.

The barrier shall be fixed to a suitable foundation, as specified by the project engineer, using eight 1" (25mm) diameter anchor bolts. The barrier housing base shall provide 1.25" (32mm) mounting holes.

The barrier arm design shall be one of the following: double rail aluminum tube (maximum 60'), tapered aluminum pole (maximum 40'), or trussed tri-rail (maximum 40'). Maximum arm length shall be measured from the centerline of the housing. Stainless steel truss cables and a damping type bumper rod shall be furnished with longer arms at the discretion of the manufacturer. Front and rear arm surfaces shall be covered with pre-stripped alternating red and white diamond grade reflective sheeting. Stripes shall be 6" (150mm) wide and shall slope at 45 degrees down toward the arm tip. Remaining exposed surfaces shall be painted white.

The barrier shall utilize 6x25 construction, 300-series stainless steel, annealed energy absorption cables to assist in diffusing the kinetic energy of an impacting vehicle. Cables shall be annealed in a coil not less than 42" diameter. The barrier shall typically be capable of absorbing the energy of a 5,000 pound vehicle traveling up to 50 mph. Actual capacity shall necessarily depend on individual barrier configuration. • Double rail aluminum tube arms shall have two or three .50" (12mm) cables, one inside each tube, and one along the center of the arm if three cables are used.

- Tapered pole arms shall use three .375" (9.5mm) cables, one inside the pole and one above and one below the pole.
- Tri-rail arms shall use three .5" (12mm) cables, one inside each tube.

The energy absorption cables shall be anchored at both ends of the span in the closed to traffic position. At the housing, heavy duty side arm latches shall be mechanically linked to the operating mechanism to automatically engage a shaft through the side arm tubes when the arm is lowered, to assist in transferring the impact load into the housing in the event of an impact.

The energy absorption cables shall be anchored at the tip end of the arm in the closed to traffic position. The on-coming barrier shall be fitted with a bar and anchor nut while off-going barrier shall be fitted with a yoke. On-coming barriers shall be sequenced to close first and open last. Yoke on the off-going traffic barrier shall fit over the anchor nut in the closed to traffic position. End latch system shall be designed so that the yoke will engage the anchor nut in a collision to connect the two barriers into a continuous unit. End latches shall not require powered actuation for proper engagement.

A pair of carbon steel rectangular tubes, hot dip galvanized, painted aluminum, shall be rigidly affixed to the ends of the main arm shaft. The tubes shall be offset to locate the arm centerline at the height specified above the housing base. The channels and a steel crossmember shall provide a sturdy mount for the arm and counterweights.

At the rear end of the side arm tubes, hot dip galvanized counterweights shall be mounted to balance the arm. Counterweights shall be sectional and shall be balanced at the factory.

The main arm shaft shall be of 2.25" (57mm) diameter AISI 4150 with a minimum tensile strength of 140,000 psi. The shaft shall be mounted in heavy duty relubricable ball bearings.

The gate arm shall pivot in the vertical plane via a mechanical 4-bar linkage. The linkage shall utilize cranks keyed to the main arm shaft and transmission shaft and an adjustable connecting rod between a pair of self-aligning spherical rod ends. The connecting rod shall be of AISI 4150. The linkage shall be driven by a fully enclosed, double reduction, worm gear speed reducer. Gear ratio used shall produce an operation time of 16 seconds. An auxiliary crank shall be used, paired with the transmission crank, to reduce the load on the transmission and to better balance and stabilize the load on the housing and mounting structure. The auxiliary crank shall be mounted in a permanently lubricated bronze bearing. The velocity of the arm shall follow a sinusoidal pattern to provide smooth operation. The arm shall begin and end its full motion path with zero velocity and accelerate smoothly to maximum velocity at mid-travel.

The motor voltage and phase shall be as shown in the Plans. The motor horsepower shall be as recommended by the barrier manufacturer to suit the installation, typically 1hp. The motor shall be a C-face design and shall be mounted directly to the transmission. The motor shall be instantly reversing and overload protected.

The motor shall be equipped with a solenoid-release, automatic brake. The brake shall have a manual release lever to permit manual operation of the barrier during emergencies or setup.

A handcrank and drillcrank shall be provided with each barrier to facilitate manual operation of the barrier.

The barrier limit switch assembly shall be a self-contained unit. The assembly shall provide 8 independent SPDT control switches. Switches shall be rated for 15 amps, 480 VAC. Switches shall be controlled by individually adjustable cams. The limit switch assembly design shall

permit adjustment of all cams with the barrier in any position. The limit switch assembly shall have a removable cover to help prevent accidental contact with switch terminals. Shaft, cams, bushings and housing pieces shall be of non-ferrous corrosion resistant materials.

A manual disconnect switch shall be provided, pre-wired at the factory to break the main motor leads, to protect personnel during service. A handcrank safety switch shall be provided to prevent automatic actuation of the barrier during manual operation. Safety switches shall also be installed and set at the factory to break the control circuit when either access door is opened. Door safety switches shall have a pull-to-override feature for test operation and shall automatically reset when doors are closed. Control components and terminal blocks shall be mounted inside an electrical enclosure mounted facing the roadway side access opening, except where custom components required by the customer prevent this arrangement. Pressure-type, modular terminal blocks shall be fully labeled and clearly coded to wiring diagrams. All control wiring shall be clearly coded to wiring diagrams and shall terminate at the terminal block. Connections to screw-type terminals shall have lugs. Conductors shall be #16 AWG stranded, minimum. Wiring shall be run in conduit where practical.

A 2 year warranty shall cover the barrier and related equipment against defective material and components. Manufacturer shall furnish replacement parts for a minimum of 5 years. Replacement parts for standard components shall normally be available within 1 working day. Lamps, fuses and other components designed for a life less than 2 years shall be covered for the rated life of the component or the warranty period of the component manufacturer.

The gate arm warning light housing shall be of high impact plastic. Assembly shall provide 360 degree visibility to provide warning capability at all stages of rotation. Light assembly may use an aluminum junction box or be wired directly through the base into the gate arm or barrier beam, at the discretion of the manufacturer, depending upon the suitability of the construction style of the gate arm or barrier beam.

Lens shall be red fresnel plastic, approximately 4 ½" in diameter, and shall be of a slightly tapered cylindrical shape.

Lamp shall be 120V, 15W, clear, with a rating of 9 candle power.

III. CONSTRUCTION REQUIREMENTS

Each barrier gate shall be mounted on the bridge approaches in the locations shown on the plans. Structural support shall be as shown in the Structural Plans. Structural work shall be paid for under a separate pay item.

The Contractor shall furnish and install anchor bolts to secure the gate onto the cantilevers based on the actual mounting hole arrangement of the approved gate. Gate cabinets shall have an open bottom and are to be installed over the conduit stub and wiring which is to serve power and control to the gate.

IV. MEASUREMENT AND PAYMENT

Payment at the contract prices for the various items covered by this section will be full compensation for all work covered by this section.

Such prices and payments will be full compensation for all work covered by this section including but not limited to furnishing and installing all electrical equipment and components, service poles and related service equipment, wire, and all other hardware.

Payment will be made under:

Barrier GatesLump Sum

CONTROL HOUSE AND PIER ELECTRICAL WORK

I. DESCRIPTION

This work shall consist of furnishing, installing, and placing in permanent operating condition all control house lighting, receptacles, wall jacks (for cable TV and telephone), heat trace circuits, telephone service for three separate lines, cable TV service, fax machine, telephone, intercom system, fire alarm system, closed circuit TV system, marine band radio, lighting panelboard, junction boxes, terminal cabinets, and conduits and wiring associated with these facilities and other facilities as described in this section.

II. MATERIALS AND EQUIPMENT

A. Lighting Fixtures

The Contractor shall furnish all fixtures, lighting equipment, and components shown on the plans, listed on the fixture schedule and all labor and materials to install the specified equipment in the manner indicated. All fixtures and lighting equipment shall be delivered with accessories, hangers, canopies, hickey, casings, end plates, sockets, fixture wires, holders, reflectors, globes, glass, guards, ballasts, diffusing louvers, recessing boxes, etc. All wired and assembled as indicated.

The Contractor shall furnish and install all lamps and accessory wiring. Entire fixtures and all component electrical parts shall be listed by UL. The Engineer reserves the right to require colors and finishes to meet special requirement on the building and on the bridge. The lighting fixtures shall be furnished and installed as required by the following schedule:

Type A: 2'x2' recessed fluorescent fixture with 20ga steel housing and 24ga steel reflector. The housing shall be arched with elegantly contoured perforated lamp diffusers and louver. The fixture should have no visible lamps, fasteners, hardware, or glaring reflectors, just soft, diffused, and comfortable lighting. The fixture shall be baked on low gloss white powder coated polyester finish. The shielding assembly shall consist of perforated metal shielding panels backed by a white acrylic diffuser and center blade baffle. The unit shall be provided with 3-40 compact fluorescent lamps and electronic ballast for 120V operation. The unit shall be as manufactured by Cooper Lighting Fenestra series cat. #232R-3BX40W-ETG-1EB-SI or approved equal.

Type B: 1'x4' pendant mounted industrial fluorescent fixture with wraparound. The housing shall be of cold rolled steel painted before fabrication with white polyester powder coat finish with a minimum total reflectance of 93%. The optic shall be of premium grade injection molded clear acrylic lenses. The unit shall be provided with 2-32W fluorescent lamp with electronic ballast for 120V operation. The fixture shall be as manufactured by Holophane Line HW-Medium Channel cat. # HW-S-M-4-D-S-H71-042-EP1-1 or approved equal.

Type C: Roadway mounted enclosed and gasketed incandescent fixture with glass globe, steel guard and 100W lamp. Appleton no. JBW10G-M, or approved equal.

Type F: Pier Lighting-hazardous, marine, heavy-duty floodlight, 175W Metal Halide, 120 VAC. The unit shall be provided with all necessary hardware to be mounted on the wall and it shall be dust tight and ignition proof with corrosion resistant construction including stainless steel hardware. Classification shall be UL 1572, 40 degree C, wet location as manufactured by Holophane: Predator type no. PD-175MH-12-K-W-5-G or approved equal.

Type EM: Self contained emergency lighting unit consisting of: Housing- constructed of NEMA 1 heavy gauge steel in dark bronze enamel finish. Top cover of unit shall be hinged to provide easy access to battery and electronics. Light source- shall be provided by two 7.2 watt PAR 36 sealed beam incandescent lamps housed in fully directional, high impact thermoplastic lamphead assemblies. Battery-12 volt maintenance-free lead acid battery completely sealed. Electronics- shall include a solid state charger with regulated charge voltage and short circuit protection. A low voltage disconnect and AC lockout shall also be included. Full battery charger shall occur in compliance with UL 924. The unit shall be provided with CVS (Continuous Verification System) self-testing electronics. The unit shall be rated for 120V, 60 Hz and shall supply the rated load for a minimum of 90 minutes to not less than 87% of the rated battery voltage. The unit shall be as manufactured by Dual-Lite and capable to be mounted directly to the wall by means of two keyhole slots. Dual-Lite cat. No. AS180CVS-12V or approved equal.

Type Exit: universal mounting exit sign constructed of high-strength cast aluminum with textured white face finish. Exit legend shall consist of 6" high letter (red) on high contrast background with $\frac{3}{4}$ " stroke and break-out chevron type directional arrows. The unit shall be suitable for 120V operation and illumination shall be provided by 4-red high output LED lamps. The exit sign shall be of the single face type with factory installed fully automatic emergency operation module with long life Nickel-Cadmium battery. The unit shall be provided with a manual test switch and AC indicator light and with a self-testing/self-diagnostic electronics. The unit shall be as manufactured by Dual-Lite Sempra Series or approved equal.

Provide Control Room lighting with dimmable ballasts. Lights shall be dimmable from the Control Console and shall be controlled by 3-way switches in the Control Console and at the entry to the Control Room.

Lighting fixtures on movable spans or where vibration may be a hazard to lamp life shall be installed with shock absorbing lamp receptacles.

Catalog cuts of fixtures with complete photometric data, where different from those indicated, shall be submitted to the Engineer for approval.

Fluorescent fixtures shall be internally wired with no. 16, type SFF-2, insulated fixture wire in accordance with the latest requirements in the current edition of the NEC.

Fixtures with incandescent medium-base sockets shall be internally wired with no smaller than no. 16 and mogul sockets no smaller than no. 14 type SFF-2.

Ballasts shall be furnished and installed as required for all lighting fixtures. Ballasts shall meet the requirements specified herein and shall be designed to meet applicable certified ballast manufacturers and/or American Standard association and underwriter's laboratories specification. Ballasts furnished must provide lamp watts within 90 percent minimum of lamp manufacturer's published ratings. All ballasts shall be sound rated "A". The Contractor shall replace any

ballasts which do not operate quietly. Ballasts shall be applied such that the ballast case temperature will remain below 90 degrees C, for full ballast life. The ballast shall supply an open circuit voltage which, at the minimum supply voltage limit, will meet requirements of the lamp manufacturer, and shall be guaranteed to start at least 90 percent of seasoned hid lamps at the minimum supply voltage limit in -20 degree F. Ambient. All ballasts shall be equipped with either internal, non-resetting thermal protection devices adjacent to the coils and in the power capacitor or each ballast shall be provided with dual-element, inline, and slow blowing external fuse. All ballasts shall be of the high power factor type, with 120 V primaries. Radio-frequency interference suppressers shall be provided.

B. Occupancy Sensor

Supply for control house lavatory. Single gang switch box mounted infrared occupancy sensor which switches lights and fan ON when movement is detected and automatically switches the lights and fan OFF after the room is vacated for a preset (adjustable from 30 seconds to 30 minutes) length of time.

C. Lighting Transformer

The bridge lighting transformer shall be dry-type, 480-120/208V, 3-Phase and installed in the location as shown on the plans. These transformers will feed the "NLP" and the "SLP" panelboards. The transformer shall be class AA. The temperature rating shall be 150 Deg C rise above ambient, and shall be Square D class 7400. Dimensions of the transformer shall be no greater than the specified model so as to ensure installation room during construction. Lighting transformers shall be provided on each side of the channel in the quantities and locations as shown in the plans.

The transformer shall be provided with electrostatic shields, a NEMA 3R enclosure and stainless steel mounting hardware for an installation as shown on the plans.

The transformer shall have a rated sound level of 55 decibels or below when measured in accordance with NEMA standards.

Appropriate mounting hardware, especially designed to accommodate the transformers according to the style of mounting shown on the plans, shall be furnished with all transformers.

The transformer shall be thoroughly cleaned, then given a rust resisting primer coat and two or more finish coats of paint or enamel. The transformer shall be finished with ANSI G1 light gray indoor paint.

Submit manufacturer's data on power/distribution transformers, including certification of transformer performance efficiency at indicated loads, percentage regulation at 100 percent and 80 percent power factor, no-load and full-load losses in watts, percent impedance at 75 degrees C, hot-spot and average temperature rise above 40 degrees C ambient, sound level in decibels, and standard published data.

D. Panelboards

Provide and install the Lighting Panelboards and the Bridge Control Panelboard (BCP) as shown in the Plans. Panelboards shall meet requirements stated in Common Provisions

E. Fire Alarm System

Smoke detectors shall have ionization chambers capable of detecting products of combustion. Power requirements shall be 120 VAC. Interface for a contact operated alarm system shall be provided. The master alarm panel shall be furnished and installed with a telephone dialer and shall be located on the upper floor of the control house as shown on the plans. Heat detectors shall be furnished and installed in the Generator Room. The smoke and heat detectors shall be installed in the locations shown on the plans, and they shall be connected to the master panel to sound and activate the bells and horns shown on the plans. The system shall be as manufactured by Simplex, or approved equal and shall meet all of the requirements of NFPA 74.

F. Toxic and Combustible Gas Detectors

Toxic and Combustible Gas Detectors shall be furnished and installed on all three levels of the control house to detect combustible and toxic gases. Monitor unit shall be located in the control room. Monitor unit shall have a minimum 6-channel capability for connection to 6 separate remote sensing units. Unit shall have dual alarm level (Hi-Lo) capability and provide auxiliary contacts for interlocking dampers on low level alarms and full line shut off on the level alarms. Power requirements shall be 120 VAC and enclosure shall be NEMA 12. Monitor shall have a meter display for % LEL plus audio and visual alarms.

Detected and alarmed gases must include propane, natural gas and carbon monoxide.

Each remote sensing unit shall use a gas sensitive metal oxide semiconductor (MOS) sensor mounted in an explosion proof sensor enclosure.

Shop drawings shall show proposed locations and methods of installation for all equipment

G. Intercom System

In order to provide means of intercommunication throughout the bridge structure a single-circuit page/party type communication system shall be furnished and installed by the Contractor in accordance with the Intercom System Block Diagram as shown in the Plans.

The equipment to be furnished shall include all necessary handsets, headsets, amplifiers, and cable, plus any other equipment required for a complete, satisfactorily-operating system free from induced hum or noise signals.

All materials used in the construction of the apparatus shall be new and selected as the best available for the intended purpose, considering long life and best engineering practices. Safety factors shall be used throughout the design. Only heavy-duty industrial components rated to operate within the following environmental conditions shall be used:

- High noise areas, up to 115 dB sound pressure level.
- Ambient temperature range of 158°F (70°C), maximum to -22°F (-30°C), minimum.
- High humidity and oily locations.
- Dusty and smoky locations, including dirt and fly ash.
- Hazardous areas (Division 1 and 2, Class I, II, and III).
- Outdoor locations.
- Locations subject to constant vibration.

The system shall utilize a distributed amplifier arrangement. When an amplifier fails or is removed, only the associated speaker shall be rendered inoperable. All station amplifiers shall be electronically paralleled allowing future extension of cabling for the addition of amplifier stations.

All Outdoor Wall Station Units shall be enclosed in NEMA 4X glass reinforced polyester enclosures. The handset shall remain protected inside the enclosure and shall be immediately ready for use when the enclosure is opened. A drill template shall be provided for use by the installing contractor to facilitate the installation of conduits. The speaker amplifier shall be integral to the handset enclosure and shall include controls for adjustment of speaker volume, microphone gain, receiver volume and sidetone.

The indoor stations shall be provided with all of the features of the outdoor station except that the handset shall be accessible on the front face of the unit without the need to open an enclosure. The indoor stations shall be housed in 16-gauge cold-rolled steel enclosures finished with textured polyester paint.

All indoor and outdoor station handsets shall include the following:

- Noise canceling dynamic microphone.
- Dynamic, hearing aid compatible (per VCC, part 68) receiver.
- 6 foot extended PVC retractile cable.
- Material: gray ABS.

All indoor and outdoor station handset amplifier circuits shall include the following:

- Output Level: 1.5 Vrms nominal into 33 ohm load.
- Output Limiter: 1.5 Vrms nominal.
- Gain: 55dB, nominal (below limiter level); adjustable from 40 to 63 dB.
- Frequency Response: 250-4,000 Hz. +/- 1.5 dB.
- Distortion: 1.5% maximum THD @ 1 kHz.
- Controls: Microphone gain, receiver volume, sidetone adjustment (user access provided).

All speaker amplifier circuits shall include the following:

- Output Level: 12 watts minimum, with nominal supply voltage \leq 1% THD.
- Amplifier Sensitivity: 0.5 VAC, at rated output.
- Frequency Response: 250-4,000 Hz. +/- 3 dB ref @ 1 kHz.
- Distortion: 1% maximum THD ref. @ 1 kHz, 12 watts.
- Input Impedance: 50,000 ohms, nominal.
- Controls: Speaker volume.

All speakers and accessory items installed in the system shall be rated for outdoor use.

The wide angle loudspeakers shall include the following:

- Frequency Response: 450 Hz-8,000 Hz +/- 5 dB.
- Low Frequency Cutoff: -10 dB (350 Hz).
- High Frequency Cutoff: -10 dB (12 kHz.).
- Coverage Angle: 120 degrees horizontal; 60 degrees vertical; nominal.

- dB Level: 113 to 119 dB @ 12 watts.
- Horn Body Material: High impact, injection molded, glass reinforced polyester.
- Mounting Hardware Material: Passivated 304 stainless steel.
- Temperature Range: -40C to 70C.

Indoor Speakers shall include the following:

- Speaker Size: 12 inches.
- Efficient Frequency Range: 150-7,000 Hz.
- Power: 10 watt.
- Impedance: 8 Ohms.

The outdoor speaker shall be equipped with driver and stainless steel mounting hardware and shall include the following:

- ABS construction for corrosion and weather resistance and durability.
- Stainless steel mounting bracket.
- Compact integral 8 ohm driver with 15 watt rating.
- Low Frequency Cutoff: 315 Hz.
- Dispersion @ 1250 Hz: 110 degrees.
- Sound Pressure Level: 116 dB.
- Efficient Frequency Range: 470-7,600 Hz.
- Air Column Length: 1.5 feet (0.45 meters).

Any other equipment required to make this system operational as described herein shall also be supplied.

The wide-range paging speaker shall be CS-64 direct radiator design suitable for paging, public announcement, background music and tone signaling distribution. The speaker component shall be a 4.72" (12 cm) cone-type dynamic speaker, treated for weather-resistance. The paging speaker shall include a matching transformer to accommodate 70.7V and 100V lines.

The speakers shall be installed at 4 locations shown on the plans. The paging speaker shall be UL listed under category UL 1480 and include external "UL Listed" labeling. The paging speaker shall comply with the IEC IP-64 standard for dust and moisture-resistance and operate within a temperature range from -20C to 55C. The material and finish of the horn/cover shall be fire-resistant ABS resin and coated with polyurethane resin paint. The color of the speaker shall match the street light poles as shown on plans and specified.

The contractor shall give priority in staging construction to install and put into operation the intercom system so as to make this system usable to facilitate communication throughout the construction period.

H. Telephone

Three new telephone lines shall be furnished and installed from the telephone network boxes, up to, and into the control house to the Control Room level. All new telephone lines shall be terminated at separate RJ11 type wall jacks in the locations shown on the plans. A wall type telephone provided for the upper level of the control house. The second telephone line shall be dedicated for a fax machine, also to be furnished and installed under this pay item. The third

telephone line shall dedicated for a PLC dial-up modem. The modem shall be furnished and installed under a separate pay item.

The wall telephone shall be equipped with characteristics as follow:

- The telephone shall operate on a standard analog phone line. It shall be solely powered from the phone line and not require a battery or external power source. A shall be initiated by lifting the handset and using the keypad to dial. The telephone shall use tone dialing.
- The phone housing shall be constructed of high-impact, anti-corrosive polyester resistant to thermal degradation and immune to chemicals, solvents and salts and rated NEMA 3. The cover (containing the handset and keypad) shall be removable from the rear section of the housing for accessing the phone electronics and telephone line connection. The housing shall be approximately 9.5"x 8"x 6.9" (HxWxD) and gray in color. The phone shall weigh approximately 6 pounds.
- The handset shall provide a volume control and noise canceling microphone. The 6' cord shall be constructed of Hytrel® for added durability. The receiver shall be hearing aid compatible.
- The handset cradle shall be heavy-duty, with a non-movable, magnetic type hook-switch. The keypad shall be sealed. The phone shall contain a ringer with REN of 1.3.
- The phone shall have an operating temperature range of -40°C to +60°C and relative humidity to 95% non-condensing.
- Phone shall be registered under FCC Regulations, Part 68 and shall comply with UL1459.
- Telephone manufacturer shall be ISO 9001 Certified.

The Contractor shall coordinate with the local telephone utility to arrange for the necessary telephone service and installation of the network interface boxes as required.

I. Cable Television

Cable television service shall be furnished and installed from the system interface boxes, up to, and into the control house to the Control Room level. The new cable television line shall be terminated at a wall jack in the control room.

The Contractor shall coordinate with the local cable television utility to arrange for the necessary service and installation of the system interface boxes as required.

J. Fax Machine

A fax machine and supporting wiring shall be furnished and installed in the Control Room. The fax machine shall include an 18 sheet automatic document feeder, 16 level halftone control, 15 second transmission speed, automatic fax/phone changeover with answering machine connectability and a 50 number autodialer for phone and fax calls.

K. Closed Circuit Television System (CCTV)

A closed circuit television system shall be installed as shown on the plans and shall consist of nine cameras, three monitors, video switcher, connecting cables, conduit, mounting hardware,

and all necessary hardware to install a complete CCTV System as shown in the plans and described herein.

The intent of the installed system is to allow the Bridge Operator to have a general, overall view of all areas from the near side warning gates to the far side warning gates, simultaneously on the installed monitors, without the need to use pan, tilt, zoom, or monitor switching controls. Due to the safety hazards associated with pedestrians on a movable bridge, the CCTV system must allow the Operator to determine, without exception, that all pedestrians are out of the areas between the near and far warning gates. The intent of the pan, tilt and zoom controls to be installed on all cameras is to allow the Operator to select an enhanced view for closer examination or to substitute one camera view for another during a failure of a camera.

The Work shall consist of furnishing all labor, materials and equipment to install, connect, adjust, program and test a complete operational closed-circuit color television (CCTV) system as shown on the plans and hereinafter described.

The color CCTV system vendor shall assume complete system responsibility for the integrated functioning of all components to provide a satisfactory assembled system operating in accordance with specified requirements. The color CCTV system vendor shall be responsible for the detailed design of the total system to ensure compatibility of equipment and suitability for the intended system functioning. The vendor shall provide on-call warranty service for a period of 1 year upon final acceptance of the bridge.

Cameras shall be powered by 120 VAC and be capable of operating in temperature range of -10C to 50C.

The camera dedicated to viewing the control house entry door shall be installed recessed into the control house soffit so as to preserve the aesthetics of the control house.

Images from each camera shall be displayed continuously; screen shall be adjusted to achieve optimum size on monitor. Monitor shall be 19" flat panel type.

The monitor shall be mounted within easy view of the Operator when standing in front of the control console and shall be 6 ft minimum from the floor. The monitor bracket may be either ceiling or wall mount type as approved.

Cameras and monitors shall be manufactured by Axis communications, Panasonic, Sony, or approved equal (Axis communications, the preferred manufacturer for CCTV equipment) as listed in the plans. Manufacturer specific equipment is referenced for the purpose of assuring compatibility with equipment. Locations are as shown on the plans.

L. Heat Tracing

Heat tracing for the water service shall be 120volt self regulating rapid trace type SLR-C rated for 3 watts per foot as manufactured by Chromalox Industrial Heating Products, Trasor or Tyco. A second, spare heat trace cable shall be installed along with the primary cable. Only the primary cable shall be wired to the controller. This installation shall allow the controller wiring to be swapped from the primary to the secondary cable in the event of failure of the primary cable.

No heat tracing is required for the sewer piping.

M. Marine Band Radio

The Contractor shall furnish one portable transmitter- receiver for FM maritime band communication. The transceiver shall be capable of transmitting on 108 channels and shall be capable of receiving 118 channels and shall have a minimum output of 5 watts. The transceiver shall also be equipped with flexible antennas, rechargeable batteries, battery charger/transceiver holder, carrying case and AC powered adapter.

III. CONSTRUCTION REQUIREMENTS

The construction requirements for control house and pit pier electrical work shall be as indicated under common provisions.

IV. MEASUREMENT AND PAYMENT

Payment at the contract prices for the various items covered by this section will be full compensation for all work covered by this section.

Such prices and payments will be full compensation for all work covered by this section including but not limited to furnishing and installing all electrical equipment and components, service poles and related service equipment, wire, and all other hardware.

Payment will be made under:

Control House and Pier Electrical WorkLump Sum

BRIDGE CONTROL SYSTEM

I. DESCRIPTION

This work shall consist of furnishing, installing, and placing in permanent operating condition the entire bridge control system. Included with this item shall be furnishing and installing the motor controls, relay control circuits, control consoles and electrical cabinets, bridge PLC system with all programming, lighting transformers, distribution equipment, panelboards, conduits, bascule span navigation lights fixtures, air horn and air horn compressor, junction boxes, terminal cabinets, grounding connections and all other items listed in this section. Also included in this work shall be installation of the wiring to the lock assemblies. The furnishing and installation of the lock assemblies are not included as part of this work but shall be furnished and installed as described elsewhere in these specifications.

II. MATERIALS AND EQUIPMENT

A. Power and Distribution

One (1) Automatic Trip/Reset circuit breaker shall be installed within the new control house in the location shown on the plans. This circuit breaker enclosure shall be NEMA 4X rated. The circuit breaker rating shall be the same as bus bracing for panelboards and must qualify as a service disconnect device. The handle shall be pad-lockable.

Ground cables shall be interconnected or bonded to structural steel or ground rods or plates by exothermic welds. Two coats of insulating varnish shall be applied over all exothermic welds and exposed cables. Ground cable shall be Type-G cable as described elsewhere in these specifications. Ground cable shall be sized in accordance with NEC requirements based on varying phase conductor sizes and circuit breaker protection sizes as necessary.

B. Lighting Transformer

The bridge lighting transformer shall be dry-type, 480-120/208V, 3-Phase and installed in the location as shown on the plans. These transformers will feed the "LP" and the "PP" panelboards. The transformer shall be class AA. The temperature rating shall be 150 Deg C rise above ambient, and shall be Square D class 7400 or GE or Cutler Hammer or approved equal. Dimensions of the transformer shall be no greater than the specified model so as to ensure installation room during construction. Lighting transformers shall be provided on each side of the channel in the quantities and locations as shown in the plans.

The transformer shall be provided with electrostatic shields, a NEMA 3R enclosure and stainless steel mounting hardware for an installation as shown on the plans.

The transformer shall have a rated sound level of 55 decibels or below when measured in accordance with NEMA standards.

Appropriate mounting hardware, especially designed to accommodate the transformers according to the style of mounting shown on the plans, shall be furnished with all transformers.

The transformer shall be thoroughly cleaned, then given a rust resisting primer coat and two or more finish coats of paint or enamel. The transformer shall be finished with ANSI G1 light gray indoor paint.

Submit manufacturer's data on power/distribution transformers, including certification of transformer performance efficiency at indicated loads, percentage regulation at 100 percent and 80 percent power factor, no-load and full-load losses in watts, percent impedance at 75 degrees C, hot-spot and average temperature rise above 40 degrees C ambient, sound level in decibels, and standard published data.

C. Motors (General)

Motors shall be built in accordance with NEMA standards. All exposed metal surfaces shall be protected with a moisture- proof corrosion-resistant polyester paint or coating. Exposed unpainted and uncoated metal surfaces shall be of a heavy-duty corrosion-resistant material. The rotors shall be balanced mechanically and electrically. All windings shall be provided with special insulation to retard decrease in insulation resistance due to excessive moisture. Each motor shall have class B insulation unless otherwise indicated.

Each motor, except the main span drive motors, having a horsepower of 1/2 hp or larger shall be 480 volt, 3-phase, 60-hertz, totally enclosed, non-ventilated, 30-minute rated, squirrel cage induction motor.

Auxiliary and main span motors shall be installed by machinery contractor.

D. Auxiliary Drive Clutch

An electric clutch with minimum requirements shown on the plans shall be furnished as part of the span drive system. The clutch shall be designed to be normally open and electrically engaged. The driven portion of the clutch shall be connected to the reducer's input shaft and the driving portion of the clutch shall be connected to the auxiliary drive. The clutch hub and shaft fits and finishes shall meet the requirements of AASHTO Article 2.5.17 for hubs on shafts.

Each clutch shall be a high torque, low inertia, electro-magnetic clutch. The clutch shall be equipped with friction linings, on the driven end only, which can be replaced without disturbing related equipment on either side of the clutch. A spring lock pin shall be provided to adjust the air gap. A space heater shall also be provided.

The driven portion of the clutch will be turning at approximately 900 RPM whenever the main drive motor is being used to operate the bridge. The clutch shall be dynamically balanced for operation at these speeds.

Each clutch shall also come furnished with a three-piece enclosure conforming to the requirements of the AASHTO specifications or OSHA. The enclosures shall be a minimum of 12 gage galvanized sheet metal or other suitable material approved by the Engineer. The enclosure shall be split type with minimum three sections per assembly for easy removal and handling by one person. Consideration of the use of corrosion resisting hinges and corrosion resisting draw latches with joints such as joggle lap type to provide a dust-tight and drip-proof enclosure for this purpose is recommended.

The Contractor shall coordinate, verify, and incorporate proper clearance between the enclosure, brake assembly and adjacent machinery components. All pieces of the guard assembly shall be easily removable and replaceable as required for maintenance purposes.

E. Auxiliary Gearmotor

The auxiliary drive, brake-gear motor, shall be furnished with a double reduction unit and an integral 20/6.67 HP two-speed motor with dual windings and marine environment coating. The brake-gear motor shall have a minimum output torque rating as shown on the Plans and shall have not less than a AGMA Class II rating. The efficiency of the unit shall not be less than 97 percent.

F. Main Span Drive Motor

The main span drive motor shall be a DC motor rated for use with static adjustable speed DC converters and shall meet the following criteria:

1. Foot Mounting
2. 60-minute duty cycle
3. Totally Enclosed Non-Ventilated Enclosure
4. Class F Insulation - 90 degree C Rise
5. Normally Closed Thermal Guard
6. 500 Volt Armature, 300 Volt Field
7. Maximum Capacity Ball Bearings (Drive End)
8. Equipped with an accessory shaft and coupling (as needed) which will accommodate the specified tachometer/overspeed switch assembly

9. Other characteristics shall be as defined in the Machinery Schedule in the Mechanical Drawings.
10. 115 VAC motor space heater.

The span drive motor shall be supplied with a shaft extension with a diameter as necessary to accommodate the tachometer/overspeed switch unit being furnished.

Flexible couplings for the main drive motors are to be furnished as part of the mechanical provisions. The coupling halves at the motors shall be shipped to the supplier of the motors and shall be fitted and installed on the motor shafts as part of the work of Bridge Control System work.

Motor horsepower and speed ratings shall be as shown on the drawings.

Where motors are supplied as an integral part of another item, the motors shall be of a NEMA design and horsepower and speed compatible with that item.

G. DC Regenerative Drive Controller

The main span drive motor shall be controlled by a DC regenerative drive controller. The span drive controllers shall be configured to provide basic single drive / two motor load sharing (series operation - armatures wired in series and separate field controls provided). The span drive controllers shall be installed in NEMA 1 gasketed dust-resistant enclosures mounted on shock and vibration resistant bases. The drive shall be equipped with all features required for operation of movable bridges and shall include:

1. Solid state, 3-phase, SCR controller.
2. Incoming line circuit disconnect switch with external operating handle.
3. Forward/reverse control.
4. Tachometer Feedback.
5. Tachometer loss protection.
6. Phase loss protection.
7. Field loss protection.
8. Undervoltage Protection.
9. Circuit checker.
10. Fault Indicators with Memory.
11. Blown Armature Fuse Detection.
12. Armature shunt, 50 mv, with 4-1/2" meter, and a transducer with +ma output for remote meter.
13. Emergency stop control by current limit.
14. Motor/controller failure light and relay for remote.
15. Annunciation "ready" light.
16. Motor Overheat Protection.
17. Motor space heater control.
18. Nameplate.
19. Speed indicator in rpm.
20. Speed Feedback Loss Protection.
21. % load indicator.
22. Regenerative capability in both forward and reverse.
23. Cooling fans.
24. Current (torque) limit adjustment, set at 150% rated motor current.

25. Proof of Torque Circuit.
26. Reduced torque mode for seating.
27. During periods of idle use, the drive motor field winding shall be de-energized as an energy saving feature.
28. Five Level Speed Control.
29. Interface to Control Circuits as shown in Electrical Schematic Drawings.

The bridge control system shall be interfaced to the generators and/or transfer switches so that the operation of the DC regenerative drive controllers is locked out during generator operation. The generators have only been sized for operation of the span while using the auxiliary drive system.

H. Drive Isolation Transformer

A three phase, motor drive isolation transformer shall be furnished and installed as indicated on the plans. The isolation transformer shall be provided by the main drive controller manufacturer and will provide isolation between the incoming line and the drive circuitry.

I. Tachometer-Overspeed Switch Assembly

A Tachometer-Overspeed switch assembly in a stainless steel NEMA 3R enclosure shall be furnished and installed as indicated on the plans. The tachometer shall generate 100 volts DC per 100 rpm. The overspeed switch shall be initially set as shown in the mechanical plans but shall be field adjustable. The assembly integrating tachometer and overspeed switch must be a standard integrated product of a single manufacturer. The design was developed around the Hubbell tachometer overspeed switch. Care must be taken with proposed substitutions as space is tight where the unit is to be installed.

J. Motor Disconnect Switch

All AC motors shall be equipped with "In-sight" disconnect switches. These shall be Allen Bradley 1494F type disconnect switches (or approved equal by Square D or Cutler Hammer) in NEMA 4X stainless steel enclosures.

K. Motor and Machinery Brakes

Electrically operated thruster brakes shall be furnished as part of the span drive system and shall be installed by qualified millwrights as indicated on the plans. Brakes shall be spring-set, thruster-released, shoe type brakes of open construction with corrosion resisting fittings. Brake size and manufacturer shall be as shown on the mechanical plans. Brakes shall be equipped with a hand release which will not change the torque setting or require removable levers or wrenches. Each hand release shall be provided with a lever type limit switch for interlocking purposes. It shall not be possible to release the hand release of the brake without tripping this switch. Two (2) additional lever type limit switches shall also be furnished with each brake. One switch shall be activated when the brake is fully engaged and the other switch shall be activated when the brake is fully disengaged.

Each brake shall also come furnished with a three-piece enclosure conforming to the requirements of the AASHTO specifications or OSHA. The enclosures shall be a minimum of 12 gage galvanized sheet metal or other suitable material approved by the Engineer. The guards

shall be split type with minimum three sections (top section and two halves that cover the entire brake assembly) per assembly for easy removal, handling and reassembly by one person. The use of corrosion resisting hinges and corrosion resisting draw latches with joints such as joggle lap type to provide a drip-proof enclosure for this purpose is recommended. The hand release shall be able to be operated without removal of this cover. Phenolic nameplates as specified and described elsewhere in these specifications shall be installed on the brake cover to denote the SET / RELEASE position of the hand lever.

Each brake shall come furnished with a space heater (mounted to the brake frame) wired from the panelboard.

The contractor shall coordinate, verify, and incorporate proper clearance between the enclosure, brake assembly and adjacent machinery components. All pieces of the guard assembly shall be easily removable and replaceable as required for maintenance purposes.

L. Motor Control Centers

Motor control centers and motor starters shall be by Allen Bradley or Square D or Siemens.

Extra sections shall be provided for installation of relay and PLC controls as described in the schematic diagrams. Distribution of PLC and relay equipment at both MCC's and the Control Console is intended to facilitate maintenance and trouble-shooting and decrease field wiring.

The motor control centers shall conform to NEMA standard "A- C General Purpose Motor Control Centers" part ICS 2-322, U. L. Standard no. 845, and to the NEC. Exposed metal parts shall be primed and painted with ASA61 light gray. The MCC's shall be mounted on vibration dampening mounts. Space heaters shall be provided in MCC sections.

The vertical sections shall be nominally 90 inches high, 20 inches wide, 15-21 inches deep and of NEMA 1 construction. Each section shall have a horizontal wire trough located at both top and bottom, and shall be connected by a vertical wire trough. Each unit shall have an individual front door for access. Construction details shall be as indicated in the MCC construction data.

The starters shall be 3-pole, 480-volt, full voltage, magnetic combination type, with trip indicating motor circuit protectors. Connection to the bus shall be by stab-type contacts. Quantities shall be as shown on the drawings. Internal connections and accessories shall be as shown on the motor starter wiring diagrams.

Circuit breakers shall be 3-pole, heavy duty, 600v, quick- make, quick-break. Quantities shall be as shown on the drawings.

An incoming line surge protector shall be provided and installed on the side of the incoming line section of the MCC. The surge protector shall be as recommended by national Lightning Protection.

Incoming line metering accessories shall be added to the metering sections in the MCC as follows:

Watt Transducer: 1% accuracy, with an output of + or 1.0 MA DC, and a range of + or 400 KW, and 3 150/5 ampere CT's shall be provided and connected as shown in the plans. Existing 120VAC PT's shall be utilized as required.

Phase reversal relay: Relay shall be similar to Time-Mark type A269, and shall have a normally closed contact wired to terminal blocks. This contact shall close upon phase under voltage, loss of phase, or reverse incoming phases.

MCC construction data:

Wiring: Class 1, Type B.

System: 600 volts 3-phase, 4-wire.

Enclosure: NEMA 12.

Bus Bracing: 22,000 Amps (sym).

Standard 20-inch wide compartments.

Insulated/isolated power bus.

Copper vertical ground bus.

Plug-in units with advance/retract operator mechanisms.

Stab assemblies which are solidly bussed to the unit disconnects.

Pull-apart terminal blocks.

Internal vertical and horizontal wireways.

Captive splice bar assembly.

Engraved laminated nameplates for each unit compartment.

600A main bus.

300A vertical bus.

300A bare ground bus.

Bare ground 1/4"x1"

Control Voltage: 120 VAC from starter control transformer.

External connections to incoming line feeders: cable.

Incoming line connections: top

Load feeders connections: top

Control cables connections: top

All internal wire and cable to be insulated for 600 volts. Wiring and connections shall be as shown on the plans.

M. Limit Switches

Rotary Type Limit Switches.

Rotary cam type limit switches shall be furnished and installed for detection of span position on each leaf. The Span Position rotary cam limit switches shall provide 12 circuits. Switch contacts shall be rated 10 amps or better at 120 volts. Enclosure shall be rated NEMA 4X and shall also house an integral resolver. The cams shall be individually adjustable and adjustment tools shall be provided. Rotary limit switch circuits shall be configured and adjusted as shown on the Plans. All limit switches shall be mounted so as to allow sufficient range for adjustment without compromising the reliability of each adjustment.

The Contractor shall coordinate the shaft size on the cam limit switch with the connection to the inner trunnion in the machinery areas. A speed increase with a 1:4 ratio shall be supplied (increases 71 degrees of span opening to 284 degrees of cam limit switch rotation). A right angle adapter shall also be provided to allow positioning of the cam limit switch so that it will fit next to the trunnion.

The rotary cam limit switch shall also include the following features:

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- Precisions cam adjustment at any angular position of the cam shaft.
- Speeds from 0 to 500 rpm in either direction.
- No special cams required for any contact setting from 4 degrees to 356 degrees.
- No tools required to adjust cam setting.
- Accurate repeatability.
- Rugged duty precision snap action switches capable of providing millions of trouble free operations. Switch contact arrangements shall be single pole double throw as shown in the Schematic Diagrams.
- Lifetime sealed ball bearings.
- No minimum speed.
- Dimensions compatible with mounting arrangement as shown in the Plans.

A resolver shall be furnished as an integral part of each Rotary CAM limit switch assembly. The resolver shall provide span position information which shall be fed to a resolver decoder span position display on the Control Console. The cable shield shall be connected to ground at the location of the resolver and the cam limit switch housing and left unconnected at the control console end. The rotary cam limit switch and resolver combination shall be a standard factory integrated unit of a manufacturer with at least 10 years of experience in the manufacturing of such units rather than a custom built unit.

Proximity Type Limit Switches.

Four (4) UL approved magnetic proximity type limit switches (2 per leaf) shall be furnished and installed as indicated on the plans. The proximity type limit switch shall be used for Fully Seated span leaf indication and mounted as shown in the plans. The proximity type limit switch shall be of NEMA 4X construction with a stainless steel housing. Switches shall be double pole double throw (two form C's).

Lever Type Limit Switches.

Lever type limit switches shall be used on all brakes and within span lock housings for their operation, interlocking and indication. These switches shall be installed by the brake or span lock manufacturer.

N. Temporary Navigation Lights

Temporary navigation lights shall be furnished and installed and maintained in the temporary channel during construction. Piles or other suitable mounting provisions shall be installed, as required, to support the light fixtures. Fixtures shall be a type PL-SP, solar powered fixture from B & B Roadway, or equivalent from Federal Signal or Automatic Power. The Contractor shall submit proposed mounting details with shop drawing submittals for review and approval by the Engineer.

O. Span Navigation Lights

Four span navigation lights shall be furnished and installed as indicated on the plans. The navigation lights shall be model BS as manufactured by Roadway Manufacturing of Russelville, Alabama; type CC7305 as manufactured by B & B Electromatic of Norwood, Louisiana; or an

approved equal by Federal Signal or Automatic Power. The lights shall be provided with a cast aluminum housing and a marine junction box, which mounts between the mounting flange and the mounting structure. The housing shall have all joints sealed with weather proof gaskets. Lenses shall be of a rigid, heat resistant glass. The navigation lights shall be equipped with pull chains to assist in light bulb changing. The light bulbs shall be rated for a 5 year life span.

The navigation lights shall be mounted so as to be accessible for maintenance from the span railing by maintenance personnel standing on the sidewalk.

The bascule span lights shall also be equipped with dual 120v lamps and a transfer relay. Upon failure of the primary lamp, the transfer relay will transfer current to the secondary lamp and will indicate the failure of the primary lamp on the control console. The transfer relay with built-in lamp-out indicator circuit, shall be prewired and installed in a relay box supplied in the same material as the fixture.

P. Fender Navigation Lights

Six fender lights shall be furnished and installed as indicated on the plans. The fender lights shall be model PL as manufactured by Roadway manufacturing of Russelville, Alabama, type CC7301 as manufactured by B & B Electromatic of Norwood, Louisiana, or an approved equal by Automatic Power or Federal Signal. The lights shall be provided with a cast aluminum housing and a marine junction box, which mounts between the mounting flange and the mounting structure. The housing shall have all joints sealed with weather proof gaskets. Lenses shall be of a rigid, heat resistant glass. The light bulbs shall be rated for a 5 year life span.

The fender lights shall also be equipped with dual 120v lamps and a transfer relay. Upon failure of the primary lamp, the transfer relay will transfer current to the secondary lamp and will indicate the failure of the primary lamp on the control console. The transfer relay with built-in lamp-out indicator circuit shall be prewired and installed in a relay box supplied in the same material as the fixture.

The fender lights shall be mounted along the top of the fender. The lights shall be mounted so as to be protected from damage from collision with marine traffic but shall be mounted so as to remain visible to marine traffic.

Q. Air Horn

The Contractor shall furnish and install a complete self contained air horn signaling system consisting of air compressor, duplex air horn, piping and all hardware required as shown on the plans.

The duplex air horn shall be capable of 120 DB discharge intensity at 10 feet at 50 psi discharge pressure. The horn shall be of weatherproof construction made of polished zinc, die cast.

The compressor shall be the oscillating diaphragm type, quick in response and directly connected to the motor, signal shall be capable of being instantly actuated the moment current is applied.

The compressor motor shall be standard speed, 1 hp motor, equipped with lifetime lubricated sealed ball bearing. Motor shall operate at 120 volts ac, 60 hertz.

Air horn system shall be B & B Electromatic Corp. Model 55-50 or an approved equal by Automatic Power or Federal Signal.

R. PLC Based Control System

The PLC and all components in the PLC system shall be manufactured by a single source. The manufacturer shall have a minimum of five (5) years experience in the manufacture and service of this type of control equipment.

The PLC system shall include all inputs, outputs and functionality as defined in the schematics. In addition, the system shall provide a capacity for expansion of the system by 25 percent and shall have four (4) installed spare cards of each type of input or output used in the system. These spares shall be provided at each main or remote location of inputs or outputs in the system.

The PLC memory shall be of a non-volatile type which does not rely on battery backup for retention of memory.

The PLC system shall be of a modular design utilizing plug-in modules in a compatible rack. The system shall be capable of satisfactory operation in the environment it is to be installed in.

Hardware and software shall be provided to support the following functions of the PLC:

1. Bridge Control
2. Alarm Evaluation And Annunciation

An uninterruptible power supply shall be furnished and installed to backup power to the PLC and the annunciator for a period no less than 15 minutes upon failure of the utility power.

The PLC shall have a minimum of a 64K memory minimum processor board. The PLC shall be an Allen Bradley model SLC 5/04, a General Electric / Fanuc 90-30, or an equivalent by Siemens.

S. Control Console

All functions required to control, interlock, and coordinate the span drive system and associated auxiliary systems shall be performed by the control system as shown in the schematic diagrams.

Machine Tool Relays: Provide machine tool relays where indicated in the plans. Machine Tool relays shall be Square D type X class 8501 with contact blocks as needed or equal by Square D, General Electric or Westinghouse.

All control relays shall be Allen Bradley type HB (catalog no. 700-HB33A1) or equal by Square D, General Electric or Westinghouse, with normally open and normally closed power poles as shown in the plans. The relay shall be a 3PDT relay with a 10 amp contact rating and 120 VAC coil rating.

All On-Delay time delay relays shall be Allen Bradley type HS (catalog no. 700-HS12AA1 for 0.1 to 10 second delay or catalog no. 700-HS12BA1 for 1 to 180 second delay) or equal by Square D, General Electric or Westinghouse, with normally open and normally closed power poles as shown in the plans. Pneumatic time delay relays shall not be used. The relay shall be a DPDT relay with a 12 amp contact rating and 120 VAC coil rating.

All Off-Delay time delay relays shall be Allen Bradley type HS (catalog no. 700-HS22AA1 for 0.1 to 10 second delay or catalog no. 700-HS22BA1 for 1 to 180 second delay) or equal by Square D, General Electric or Westinghouse, with normally open and normally closed power

poles as shown in the plans. Pneumatic time delay relays shall not be used. The relay shall be a DPDT relay with a 12 amp contact rating and 120 VAC coil rating.

All adjustable timing relays shall be replaced with fixed timing relays near the completion of field start up.

All fixed On-Delay time delay relays shall be Allen Bradley type HS (catalog no. 700-HSF12FxxA1) or equal by Square D, General Electric or Westinghouse, with normally open and normally closed power poles as shown in the plans. Pneumatic time delay relays shall not be used. The relay shall be a DPDT relay with a 12 amp contact rating and 120 VAC coil rating.

All fixed Off-Delay time delay relays shall be Allen Bradley type HS (catalog no. 700-HSF22FxxA1) or equal by Square D, General Electric or Westinghouse, with normally open and normally closed power poles as shown in the plans. Pneumatic time delay relays shall not be used. The relay shall be a DPDT relay with a 12 amp contact rating and 120 VAC coil rating.

All magnetic latching relays shall be Allen Bradley type HJ (catalog no. 700-HJ32A1) or equal by Square D, General Electric or Westinghouse, with normally open and normally closed power poles as shown in the plans. The relay shall be a DPDT relay with a 10 amp contact rating and 120 VAC coil rating.

All cabinets and the control console sections shall be of the freestanding type. The construction shall be of neat, substantial construction, arranged as shown on the plans. The panels and control console shall be fabricated from not less than no. 10 gauge type 304 stainless steel properly formed, and suitably reinforced by stainless steel members joined by electrical welding to ensure true surfaces and adequate support for the instruments mounted thereon. All mating members shall be neatly fitted up with close joints.

All cabinets in the control house (including control console) shall be lockable. This pertains to ALL cabinets and enclosures – not just those within the control room.

All welds on the exposed surfaces and all rough edges or corners shall be ground off smooth and all projecting edges rounded off. Finished surfaces shall be free from waves, bellies or other imperfections. Exterior surfaces shall be ground smooth, filled, primed, sanded and carefully cleaned of all dirt, moisture, rust, scale, lubricants and other substances. Lubricants shall be removed by suitable solvents..

Unless specified otherwise, doors shall be hinged and shall have turned-back edges and additional bracing where required to assure rigidity. Hinges shall be of the piano or concealed type. Door latches shall be of the three-point type to assure tight closing. All metal hardware shall be of substantial construction, and shall have a satin finish. All equipment mounting screws and bolts shall be stainless steel.

The stainless steel exteriors shall remain unpainted and shall be treated to provide a number 4 satin finish. Special care shall be taken throughout the construction to insure that the stainless steel exterior surfaces are completely protected from damage or defacement at all times.

Stainless steel filler panels shall be furnished and installed at the control console and wherever else needed to provide a continuous appearance to the front faces of the cabinets and control console throughout the control room. The filler panels shall be of the same material and finish as the front faces of the cabinets and control console.

A hard neoprene gasket of 1/8 inch minimum thickness shall be installed between the concrete floor and the enclosure bottom flange.

Nomenclature for labeling of all devices within the control cabinets shall use initials to provide information on north/south/east/west orientation, function and operation. For example, P-NSL = "Pull North Span Lock." Wherever such nomenclature has been already used in the schematic diagrams to describe devices, this same nomenclature shall be used in the cabinets.

Incoming line metering accessories shall be added as follows:

CT's and PT's:	Three 400/5 ampere CT's and three 480-120 volt PT's shall be provided and connected as shown on the one-line diagram.
Potential transformers:	480v primary to 120v secondary, 3 required.
Phase reversal relay:	Relay shall be similar to Time-Mark type A269, and shall have a normally closed contact wired to terminal blocks. This contact shall close upon phase under voltage, loss of phase, or reverse incoming phases. Settings for this relay shall be 430 Low and 520 High with a 5 sec. delay trip.

Interconnecting wiring shall be provided between all electrical devices mounted in the cabinets and enclosures. If the devices are to be connected to external equipment (field devices or other cabinets), they shall be connected to terminal blocks. Conductors shall be UL listed, extra-flexible Type THWN-MTW, machine-tool wiring. Minimum size shall be no. 12 AWG minimum.

All interior wiring shall be installed neatly and carefully, and shall be terminated at suitable terminal blocks. All wire terminations shall be made with ring tongue nylon self-insulating wire terminals, equal to Thomas & Betts Company Stakon terminals. Wire terminals shall be installed using a high compression indenting crimping tool that assures a full crimp by releasing the terminal only when the crimp is complete. All control and instrument wiring used within the panels shall conform to NEC and NEMA standards and shall be installed and tested at the factory.

Internal wiring in factory pre-wired electronic system cabinets may be installed according to the manufacturer's standard as to wire size, insulation, and method of termination on internal equipment.

Internal illumination shall be provided in all panels and enclosures using 18" fluorescent strip fixtures. A lighting switch shall be installed beside the access door inside the panels and enclosures.

A system of convenience outlets shall be provided in each panel and enclosure for use with power tools, portable lamps, and other similar equipment. Thermostatically controlled strip heaters shall be furnished and installed in the interior of each panel.

There shall be furnished in each enclosure and the control desk 120 volt ac circuits to feed the interior lighting and convenience outlets. Convenience outlets shall be fed separately from lighting circuits.

The control power for motor control shall be provided from supplies as described in the electrical drawings.

Wiring diagrams shall be prepared on sheets approximately 22 inches by 36 inches. Where interconnecting wiring from different items of equipment or sectional wiring diagrams of the same item of equipment appear on different wiring diagram sheets, all interconnections shall be clearly identified.

Information indicated on the Contractor's drawings shall include wiring of the individual panel items as they actually will appear in the panel, contact arrangements of switches, and internal wiring of relays and instruments.

Elementary diagrams shall be cross-referenced to terminal markings on the connection and interconnection diagrams, but need not show complete details of circuits external to the panels. Each item of panel mounted equipment indicated on the diagrams shall be identified by item number and name.

All control panels shall be factory tested for circuit continuity and operation.

The control console sections shall be furnished for installation in the control house where indicated on the plans, for operation of the bascule span and its auxiliaries. On the console sections shall be mounted all devices necessary for the electrical control of the bridge.

The control console shall be of neat, substantial construction, arranged as shown on the plans. It shall be fabricated from not less than no. 10 gauge type 304 stainless steel properly formed, and suitably reinforced by steel angles to provide adequate strength. The top and front slope shall be of non-reflecting finish.

Control Console mounted devices shall be furnished as mounted as described in the Control Console Device List and shall be mounted as shown on the Control Console layout drawing. All devices shall provide the functionality indicated in the electrical schematic drawings and described within this specification.

All indicating lamps on the panels shall be 120 volt, powered directly from the control circuits.

All instrument cutouts, mounting studs, and support brackets shall be located accurately.

Special care shall be taken throughout the construction to insure that the stainless steel desk top and the equipment mounted thereon are completely protected from damage or defacement at all times.

Control Console legend plates shall be custom made and shall be made of a hot-polished, laminated phenolic compound not less than 3/16 inch thick. The compound shall have a black surface 1/32 inch thick, and intermediate white layer 1/32 inch thick and a black back 1/8 inch thick. All corners shall be rounded, and the edges of the plates shall be chamfered. All engraving shall be upper case, standard gothic characters, cut through the surface into the intermediate layer to show white letters on a black background.

All control console device legend information shall be provided on the custom legend plates. No legends shall be put on pilot light lenses.

The wiring within the control desk shall be insulated switchboard wire conforming to the requirements herein before specified for wiring on the control panels. The wiring shall be arranged systematically so that all circuits can be readily traced. All conductors shall be terminated on easily accessible terminal blocks mounted inside the desk. Spare terminals totaling at least 10 percent of those actually used shall be provided. Wiring shall be identified at

equipment terminals by clearly marking the adjacent area to correspond to conductor designations appearing on the Contractor's wiring diagrams.

Wiring to each control switch shall be individually bundled and shall be installed with a "drop loop" of sufficient length to allow its removal from the panel for maintenance without disconnecting the wiring.

Indicating lights shall be mounted on the control desk to show that the various steps in the sequence of operation have taken place so that the operator may proceed to subsequent steps at the proper time. The functions to be indicated and the color of the lenses shall be as shown on the plans. Each lens shall be provided with an engraved legend, as indicated on the plans, which shall be readily visible when the lamp is energized. Each indicating light shall be similar to type shown and it shall be suitable for mounting on the desk top provided.

The Span Fully Closed pilot lights on the control console shall be provided with green rather than red lenses and lamps.

The pilot light lenses shall not be provided with any engraved legend. All legends shall be on the custom legend plates rather than on the lenses.

The Control System vendor shall take measures as necessary to assure that the above pilot lights are not partially illuminated (due to inductive and/or other leakage currents) when the control logic indicates that the pilot light should be in an Off state.

A miniature lamp with an integral switch shall be installed on the control console aiming down for nighttime operation. The ceiling lights within the new control room shall be controlled by a slide type dimmer switch located on the control console as shown on the plans. This switch shall work in conjunction with one to be located at the entrance door to the room. All switches shall be of the types and sizes as shown on the plans.

The key for the Control Power keyswitch shall only be removable in the OFF position. The key shall not be removable in the ON position.

The span position indicator, ammeters, and voltmeter on the control console shall have faces arranged to eliminate glare as far as practical. All equipment shown in the electrical equipment list for installation in and on the desk and additional devices as required for the specified functions shall be conveniently and neatly arranged, assembled, and completely wired at the manufacturer's plant. External wiring and metal raceways shall enter at the bottom of the control desk.

T. Annunciator Console.

The annunciator console shall be furnished for installation in the control room where indicated on the plans, for monitoring of the bascule span and its auxiliaries.

The annunciator console shall be of neat, substantial construction, arranged as shown on the plans. It shall be fabricated from not less than no. 10 gauge type 304 stainless steel properly formed, and suitably reinforced by steel angles to provide adequate strength. The top and front slope shall be of non-reflecting finish.

Annunciator Console mounted devices shall be furnished as mounted as described in the Annunciator Console Device List and shall be mounted as shown on the Control Console layout

drawing. All devices shall provide the functionality indicated in the electrical schematic drawings and described within this specification.

All indicating lamps on the panels shall be 120 volt, powered directly from the control circuits.

All instrument cutouts, mounting studs, and support brackets shall be located accurately.

Special care shall be taken throughout the construction to insure that the stainless steel cabinet and the equipment mounted thereon are completely protected from damage or defacement at all times.

The legend plates of all console-mounted devices shall be provided as indicated in the Device List.

The wiring within the console shall be insulated switchboard wire conforming to the requirements herein before specified for wiring on the control panels. The wiring shall be arranged systematically so that all circuits can be readily traced. All conductors shall be terminated on easily accessible terminal blocks mounted inside the desk. Spare terminals totaling at least 10 percent of those actually used shall be provided. Wiring shall be identified at equipment terminals by clearly marking the adjacent area to correspond to conductor designations appearing on the Contractor's wiring diagrams.

Wiring to each console device shall be individually bundled and shall be installed with a "drop loop" of sufficient length to allow its removal from the panel for maintenance without disconnecting the wiring.

The span position indicator, ammeters, and voltmeter on the control console shall have faces arranged to eliminate glare as far as practical. All equipment shown in the electrical equipment list for installation in and on the desk and additional devices as required for the specified functions shall be conveniently and neatly arranged, assembled, and completely wired at the manufacturer's plant. External wiring and metal raceways shall enter at the bottom of the control desk.

The position of the span shall be shown by a PLC encoder module with display mounted on the sloping section of the control console in the operator's house. The indicator shall have an LED digital display. Numerical indications shall display 3 digits, with a decimal point at the tenths position. The position monitor shall be driven by a resolver input and shall feed a PLC input.

The annunciator lamp cabinets shall be flush mounted, with 120 vac lamps and shall be provided with a lamp test option. Window engraving shall accommodate 3 lines of 13 characters per line. Actual engraving shall be as shown in the plans. Window arrangements shall be 2 rows high x 2 columns wide, dimensions as shown on the plans. Cabinets shall be furnished complete with lamps and terminal strips, and shall be installed as shown on the plans. The pullout bezel color shall be black. The lamp cabinet unit used shall be compatible with the control console layout as shown in the Plans.

The generator alarm annunciators installed in the Annunciator Console shall be by the same manufacturer that provides the generators. The Contractor shall coordinate with the Control System Vendor to assure that the supplied generator annunciator will fit within the Annunciator Console as shown in the Plans.

U. Control Console Power Meters

The meter shall be UL listed and CE marked.

Power meter shall be designed for Multifunction Electrical Measurement on 3 phase power systems.

- (1) Meter shall support 3 element wye, 2.5 element wye, 2 element delta, 4 wire delta systems.
- (2) The meter shall accept universal voltage input.
- (3) Surge withstand shall conform to IEEE C37.90.1
- (4) The meter shall be user programmable for voltage range to any PT ratio.
- (5) Meter shall accept a burden of up to .36VA per phase, Max at 600V, 0.014VA at 120 Volts.
- (6) The meter shall accept a voltage input range of up to 416 Volts Line to Neutral, and a range of up to 721 Volts Line to Line.
- (7) Meter shall accept a current reading of up to 11 amps continuous.

Power meter shall use a dual input method for current inputs. Method one shall allow the CT to pass directly through the meter without any physical termination on the meter, ensuring the meter cannot be a point of failure on the CT circuit. The second method shall provide additional termination pass-through bars, allowing the CT leads to be terminated on the meter. The meter must support both termination methods.

- (1) Fault Current Withstand shall be 100 Amps for 10 seconds, 300 Amps for 3 seconds, and 500 Amps for 1 second.
- (2) Meter shall be programmable for current to any CT ratio. DIP switches or other fixed ratios shall not be acceptable
- (3) Meter shall accept burden of 0.005VA per phase, Max at 11 Amps.
- (4) Meter shall begin reading at a 5mA pickup current.
- (5) Pass through wire gauge dimension of 0.177" / 4.5 mm shall be available.
- (6) All inputs and outputs shall be galvanically isolated to 2500 Volts AC.
- (7) The meter shall accept current inputs of class 10: (0 to 11) A, 5 Amp Nominal, and class 2 (0 to 2) A, 1A Nominal Secondary.

The meter shall have an accuracy of +/- 0.1% or better for volts and amps, and 0.2% for power and energy functions. The meter shall meet the accuracy requirements of IEC687 (class 0.2%) and ANSI C12.201(Class 0.2%).

- (1) The meter shall provide true RMS measurements of voltage, phase to neutral and phase to phase; current, per phase and neutral.
- (2) The meter shall provide sampling at 400+ samples per cycle on all channels measured readings simultaneously.
- (3) The meter shall utilize 24 bit Analog to Digital conversion.
- (4) Meter shall provide Harmonics %THD (% of total Harmonic Distortion).

The meter shall include a three line, bright red, .56" LED display.

- (1) The meter shall fit in both DIN 92mm and ANSI C39.1 Round cut-outs.
- (2) The meter must display a % of Load Bar on the front panel to provide an analog feel. The % Load bar shall have not less than 10 segments.

The meter shall support power supply of 90 to 265 Volts AC and 100 to 370 Volts DC. Universal AC/DC Supply shall be available.

- (1) Meter power supply shall accept burden of 10VA max.
- (2) Meter shall provide upgrade rate of 100msec for Watts, Var and VA. All other parameters shall be 1 second.

The meter shall have a standard 4-year warranty.

Power meter shall be able to be stored in (-40 to +85) degrees C.

- (1) Operating temperature shall be (-30 to +70) degrees C.
- (2) NEMA 12 faceplate rating shall be available for the power meter.

Acceptable product is Electro Industries/GaugeTech, Model Shark 100 or equivalent by General Electric or Yokogawa.

V. Droop Cable Box

Droop Cable Boxes shall be 10 gauge NEMA 4X, stainless steel and manufactured to dimensions no less than those shown on the plans. Cabinets shall be wide enough to house the equipment to be installed within. Cabinets shall have a single hinged door. Cabinets shall be provided for both, the movable and the stationary, ends of the droop cables.

The entrance to the cabinet shall be reinforced for additional cable support integrity. The droop cables shall enter the cabinet through sealing fittings. The cabinet vendor shall coordinate with the Contractor on the making of holes in the cabinet which will accept the sealing fittings which will be installed by the Contractor.

W. Submarine Cable Terminal Cabinet

Terminal Cabinets used for submarine cable terminations shall be 10 gauge NEMA 4X, stainless steel and manufactured to the dimensions shown on the plans. Cabinets wider than 36 inches used for submarine cables and/or submarine ducts shall have double-doors with a 3-point handle latching mechanism and neoprene gasketed seal all around. Cabinets 36 inches or less wide used for the submarine cables and/or submarine ducts shall be 10 gauge NEMA 4X, stainless steel and shall have a single door. Likewise, this cabinet shall also have a 3-point latching handle mechanism and neoprene gasket all around. Door handles shall be lockable and of stainless steel hardware.

The submarine cable entrance to the box shall be double walled at the bottom for additional cable support integrity. The box shall be floor mounted on legs as shown in the plans. The submarine cable shall enter the submarine cable box through a sealing bushing as described and specified elsewhere in these specifications. The cabinet vendor shall coordinate with the Contractor on the making of holes in the bottom of the cabinet which will accept the sealing bushings which will be installed by the Contractor.

Terminal blocks in the submarine cable cabinets shall allow circuit isolation (Allen Bradley 1492-CE9 or equal by Thomas and Betts or General Electric).

III. CONSTRUCTION REQUIREMENTS

All construction and installation shall be made by workmen skilled in this type of work and under the supervision of an experienced and qualified electrical supervisor. In addition, the approved control system vendor shall provide supervisory assistance to the electrical Contractor as specified herein before. All work shall be executed in a neat and workmanlike manner and shall present a neat and mechanical appearance when completed. Upon completion of the contract, the Contractor shall deliver to the engineer a corrected plan showing in detail all changes on construction from the original plans, especially location and sizes of conduits, complete schematic circuit diagrams and the like.

The electrical installation shall comply with all applicable laws and ordinances in effect at the construction site, with applicable regulations of the NEC, and with regulations of the utility companies furnishing power, cable television and telephone services to the site.

The Contractor shall obtain approval from the coast guard for any temporary construction navigation lighting required.

The Contractor shall file with the engineer a certificate of final electrical inspection and acceptance by the Board of Fire Underwriters or an approved inspection agency.

A. Motors

The motors shall be wired with approved sizes and types of wire terminals and splice fittings for the connection of the motors to the circuit wiring.

B. Service Grounding

Incoming service electrical power system shall be solidly grounded to the grounding grid assembly at the electric utility transformer pad.

Terminal lugs and the metal framing and enclosures of all electrical equipment such as control panels, control console, panelboards, motors, metal doors and window frames, metal stairs, and other apparatus shall be bonded to the grounding grid assembly.

C. Powerweld Connections

These specifications cover powerweld exothermic welding system for use in making electrical connections of copper to copper or copper to steel.

The Powerweld system shall include weld metal, molds, and accessories.

National standards - The Powerweld welding system furnished under these specifications shall meet the applicable requirements of IEEE-80, chapter 9, section of conductors and joints. Powerweld exothermic connections are approved in NEC 250-113 and 250-115.

Applications - two styles of powerweld welding connections shall be available: "Smokeless/Sparkless" for indoor and the other for outdoor usage.

Welded connections to be used outdoors shall be suitable for exposure to the elements or direct burial without degradation over the lifetime of the grounding system.

"Smokeless/Sparkless" connections to be used indoor shall be of the low smoke, low emission type - but shall be metallurgically similar to the above connection.

Material - molds shall be made from graphite material with standing high temperatures and shall be designed to provide an average usage life of not less than 50 separate exothermic welds before degrading.

Starting material shall consist of aluminum and copper oxides.

Weld metal used for grounding connections shall contain copper oxide, aluminum, and not more than 1 percent tin. Weld metal used for cathodic connections shall not contain tin or vanadium.

Marking: Molds shall bear the permanent marking indicating the name of the manufacturer, the mold model, the type and size of welding mixture compatible with the welding process, and the size of the cable or bus connection. Instructions detailing general safety information, connection preparation and welding procedures shall be provided with each mold.

Weld metal packages shall be identified as to the part no. (size) and type of metals to be connected, such as copper to copper or copper to steel.

Weld metal packages for cathodic connections shall be so identified. Weld metal packages shall be clearly marked to indicate whether they are for standard (for outdoor), or NLP smokeless/sparkless (low emission) applications.

Weld metal shall be controlled at the factory and subjected to routine and rigid quality control inspection procedures. The batch control numbers shall be packaged with the product prior to shipment for the factory.

Manufacturer must be able to certify that all material of his manufacture, can be safely and satisfactorily interchanged with competitive product or products.

Packaging and shipping: containers for weld metal shall be moisture resistant and shall be packaged to prevent damage or spillage during shipping.

Weld metal and starting material (if used) shall be measured and packaged together in a non-absorbing container. The starting material shall be at the bottom of the container to allow the starting material to be dispersed uniformly over the top of the welding mixture when placed in the crucible for a more uniform ignition and exothermic welding process.

The local distributor and local sales personnel shall have provision for responding to field calls within 24 hours, as well as providing training for construction forces on the proper techniques for making powerweld connections.

D. Ground Resistance

Ground resistance shall have a value of 5 ohms or less after connection to the service equipment and shall be measured with an approved ground tester.

Ground resistance measurements shall be taken as follows:

1. The resistance of each individual ground rod shall be measured at the time of installation and before connection to the ground bus. If the resistance is greater than 25 ohms, sections of rod shall be added to the rod being tested until the desired resistance is

- achieved. If after 2 sections have been added (total 30') and the resistance has not been achieved, call the engineer for a determination.
2. The resistance of the ground bus shall be measured, with all rods connected to the bus prior to connection to the service equipment.
 3. The resistance of the ground bus shall be measured with all rods connected to the bus after connection to the service equipment.
 4. A report of the test shall be forwarded to the engineer.
 5. It is preferable that all ground rods have approximately like resistances so that when paralleled all rods will carry very nearly the same current. In those instances where a wide variance of resistance is encountered, additional sectional rods shall be added to those already installed that have the high resistance.
 6. Letters of certification: upon request, a letter of certification shall be furnished by the manufacturer or distributor with each shipment.

E. Shop Tests

The control system shall be pre-tested at the factory (factories) to ensure that all functions operate in accordance with the plans and the speed- time-position curves contained herein. The supplier shall test each motor controller and control circuit as an interconnected system at the factory, and shall provide certified test results to the engineer.

The control system inputs and outputs shall be connected to devices simulating the field mounted devices.

The control console described in these specifications, or a test panel shall be provided to derive the control signals and indicators required to simulate span operation.

The timed acceleration, transition and timed deceleration functions shall be demonstrated.

It shall be demonstrated that the speeds will decrease in accordance with the speed-position curves.

The engineer shall be notified 30 days prior to the tests so that he can arrange for a witness to these tests.

The supplier's costs (if any) of debugging the schematics or adapting the program to his hardware, both at the shop and on the project site after installation, shall be included as incidental to the contract.

The equipment shall also be shown to be operational when connected to the movable span at the site.

Shop test - The units of the engine-generator set, with all accessories connected and in place, shall be subjected to full- load test runs at the manufacturer's plant, as hereinafter specified.

The engine shall be run continuously for not less than four hours without stoppage, and shall include at least one hour of operation at 50 to 75 percent, and two hours of operation at 100 percent of rated load. A record shall be kept of the water temperature in the engine head until a stabilized temperature is reached. When the engine is stopped, the temperature of the water shall rise to not more than 200 degrees f.

The tests shall include complete performance tests of the entire generator set to show that the generator voltage regulator and the engine governor perform properly to meet all specified requirements.

The generator and exciter shall be subjected to a full load heat run, and the test results shall be reported on the standard performance specification forms of the National Electrical Manufacturers Association.

Six (6) certified copies of the results of the above tests shall be submitted to the engineer. The units of the engine generator set shall not be shipped from the plant of the manufacturer until certified tests therefore have been approved by the engineer.

F. Preliminary Field Checkout

Appropriate representatives of the bridge electrical control equipment shall arrange to be on site.

These representatives shall be capable of making adjustments to the equipment, of locating faults or defects and correcting them if possible, and of obtaining from the manufacturers without delay, new parts for replacement of apparatus which, in the opinion of the engineer, do not perform satisfactorily.

Field inspections of the lightning protection system shall include:

1. Inspection of down conductors prior to being covered by interior, exterior, or other installations.
2. Inspection of lightning protection system ground prior to burial.

The services of Edison Testing Laboratories (ETL) shall be obtained to provide the certification of the lightning protection system. Obtain the ETL label and attach it to the structure at the location specified by the owner. At the time of application for lightning protection insurance, a copy of the application shall be sent to an owner representative.

Certifications of the lightning protection system shall include:

1. Certification that surge protection with a minimum of 160ka per phase surge capacity is installed on each of the main electrical services.
2. Certification that surge suppression is installed on antenna, telephone, radio and telephone lead wires.

All insulated conductors shall be electrically tested after placement. All circuits, including lighting circuits, shall be tested with the circuit complete except for connections to equipment. All splices shall be complete prior to testing. Any circuit failing to test satisfactorily shall be replaced, or repaired and retested as directed by the engineer. All equipment and labor required for testing shall be provided by the Contractor.

All insulated conductors shall be tested for continuity and conductor identification. In addition, all insulated conductors of multi-conductor cable shall be tested for short circuits. Contractor shall furnish portable, battery powered, ring testers, and other test equipment as required to conduct these tests.

1. Continuity tests shall include all tests necessary to confirm that each conductor is continuous throughout its entire length.

- 2. Identification tests shall include all tests necessary to confirm that the conductor being investigated originated and terminates at the locations designed in the circuit list or indicated on the drawings.
- 3. Short circuit tests shall include all tests necessary to confirm that no conductor of a multi-conductor cable is short circuited to another conductor in that cable.
- 4. Power And Control Cable Rated Below 2,000 v. - All insulated conductors, except instrumentation cable, rated less than 2,000 v. Shall be tested with a 1,000 v. Megger or an equivalent testing device. Insulation resistance measurements shall be made between each conductor and ground and between each conductor and all other conductors of the same circuit. Minimum acceptable resistance values shall be in excess of 100 megohms.
- 5. Instrumentation Cable - All insulated conductors of supervisory and communication cable shall be tested with a 500 v. Megger or an equivalent testing device. Insulation resistance measurements shall be made between each conductor and the cable shielding tape and between the two conductors in each pair. Minimum acceptable resistance values shall be 50 megohms divided by the actual cable length in miles.

G. Field Operational Testing

After the span is operating to the satisfaction of the engineer, Contractor and its manufacturers' representatives, an operational test period of not less than one week shall begin, during which time all aspects of the span will be tested and observed by the engineer. During this period, the Contractor shall make any repairs necessary as a result of equipment failure due to faulty equipment or workmanship. Should preliminary checks or operational tests show that any piece of equipment furnished by the Contractor, in the judgment of the engineer, is defective or functions improperly, such adjustments and/or replacements shall be made by the Contractor as to make the installation completely acceptable to the engineer, and at no extra cost to the owner.

Field testing shall also include complete operating tests to show that the entire engine-generator and all components operate satisfactorily to sustain the loads imposed during operation of the movable span.

During routine testing of the standby generator, the generator shall be loaded up to 60 percent of its nameplate rated load to avoid carbon build-up in the diesel engine.

IV. MEASUREMENT AND PAYMENT

Payment at the contract prices for the various items covered by this section will be full compensation for all work covered by this section.

Such prices and payments will be full compensation for all work covered by this section including but not limited to furnishing and installing all electrical equipment and components, service poles and related service equipment, wire, and all other hardware.

Payment will be made under:

Bridge Control System.....Lump Sum

SUBMARINE CABLES

I. DESCRIPTION

This specification pertains to multi-conductor cables used in underwater installations.

This work shall consist of furnishing and installing submarine cables across the movable bridge channel and terminating the submarine cable conductors as indicated in the plans. Included with this work shall be all related mounting and support hardware for the cables and cabinets, core drilling and concrete sealing (as needed) to allow safe cable entry into the Submarine Cable Cabinet areas. All of the work described in this subsection shall be as shown on the plans and specified herein and shall be paid for under the pay item "Submarine Cables".

The submarine cables shall be manufactured in accordance with ANSI/ICEA S-95-658 / NEMA WC70, ASTM B-3, ASTM B-8, and IEEE 45 standards. Submarine cables shall be designated (depending on composition) as Power, Control or Instrumentation Submarine cables.

II. MATERIALS AND EQUIPMENT

A. Submarine Cable

Provide two (2) Power submarine cables and three (3) Control submarine cables installed and routed as described in the Plans. Nominal outer diameter of each cable shall be approximately 4 inches. Actual lengths of submarine cables required shall be as determined in the field by the Contractor, based on the actual routing.

Cable construction shall be as noted in this cable specification. The submarine cable conductors shall be supplied in a quantity sufficient to accommodate the required bridge system and general lighting conductors plus 30 percent spares for each type of conductor. The minimum conductor size shall be No. 10 AWG (except for shielded conductors). The Contractor shall coordinate submarine cable ordering with the Control System Vendor so as to accommodate all conductors needed for the control system. The Contractor shall also consider all conductors for all systems and general lighting (these are not shown in the cable schedules). These systems include, but are not limited to, fire alarm, toxic gas detection, PLC communications, intercom communications, and CCTV.

Cables shall be as manufactured by Boston Insulated Wire Corp. (BIW of N. Dighton, MA - 508-822-5444), Okonite, Kerite, or L. F. Gaubert (represented by Transit-Tech. Inc. of Peoria, IL - 800-447-0124).

Prior to manufacturing, the Contractor shall submit to the Engineer, for review, drawings showing the actual cross-section and makeup of each required cable together with a detailed description of each component.

Fillers: Supply additional spare conductors as fillers where possible. Use additional polypropylene fillers as necessary to produce a circular cross-section.

Power and Control Conductors: Quantities of conductors shall be as required to support the system in the plans. Wire shall be annealed uncoated copper in accordance with ASTM B-3. Conductors shall be stranded in accordance with ASTM B-8, class "B" stranding. Insulation shall be rated at 600 volts. A separator shall be employed between the conductor and the

insulation. Number coding of the conductors shall be accomplished by permanently printed legends of numbers and corresponding words in accordance with IEEE-45 standards. The conductors shall be cabled in a tight and concentric configuration and filled as necessary to give the completed cable a circular cross section. Filler material outlined in previous subsection.

Conductors shall be reserved in each submarine cable for use as dedicated ground wires.

Minimum conductors for the Power Submarine Cables shall be as follows:

- 4/C, #350 MCM
- 4/C, #6 AWG
- 1/C, #1/0 ground

Minimum conductors for the Control Submarine Cables shall be as follows:

- 50/C, #10 AWG
- 4, Twisted Shielded Pairs, #16 AWG (for intercom)
- 3, four twisted pairs, #24 AWG, Cat5 (for resolver)
- 6 SM fiber optic (for PLC communications)

Binder: The conductor cable assembly shall be wrapped with a 0.002" polyester binder tape applied helically with a minimum overlap of 25 percent.

Internal Jacket: The conductor cable assembly jacket shall be high density polyethylene and shall be both ultraviolet and weather resistant. The wall thickness shall be a minimum point thickness of 0.188"

Armor Wire: The armor shall consist of strand of #6 AWG galvanized steel wire and each strand shall have a minimum point thickness of 0.030" high density polyethylene coating. The coated armor wire shall be helically applied at a left lay angle of 17 to 25 degrees.

External Jacket: The overall assembly shall be provided with a high density polyethylene jacket. The jacket shall be both a minimum point thickness of 0.188". The external jacket shall be permanently printed with a sequential footage marking every three feet maximum beginning at the footage number required descending to zero with the cable end at the reel center marked zero.

Internal Shielded Duct: Within all of the Control Submarine Cables shall be a 0.75 to 1.00 inch foil shielded polyethylene inner duct to allow for future communication control cable installation. A pull cord shall be installed to assist with future wire installations.

B. Submarine Cable Testing

The completed cable conductors shall withstand an RMS voltage in accordance with standards between each conductor and all other conductors, armor included.

The completed cable conductors shall have the insulation resistance measured after completion of the voltage test and the values shall be in accordance with standards.

A laboratory test shall be conducted and the values of the following shall be recorded:

1. Original tensile strength and elongation for jackets and insulation per ICEA.
2. Air oven aging for insulation per ICEA.

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3. Measured thickness of jackets, conductor insulation and armor strand coating thickness.

Pre-Delivery Instructions: Before the cable is installed on the shipping reel, cut a six (6) inch sample from each end of the completed cable. Submit samples, certificate of compliance, voltage test, insulation measurements and laboratory test to the Owner for approval. Sample submittal shall be made within 120 calendar days after receipt of the Purchase Order.

C. Cable Supports

The armored submarine cables shall be supported as shown in the plans.

D. Cabinet Sealing Bushings

The inner jacket of the submarine cables and submarine ducts shall be routed through a galvanized sealing bushing at the entry of the cables and ducts into the Submarine Cable Cabinets as shown in the plans.

III. CONSTRUCTION REQUIREMENTS

Submarine cables shall be buried 7 feet below the existing bottom of the channel or 7 feet below the depth projected by the Army Corps of Engineers, whichever is deeper. Routing shall be laid out as closely as possible to that shown in the plans. The cables shall be routed outside of the fender system so as to protect the cables from damage when new piles may be driven during fender system repairs. The actual routing shall be as so determined in the field taking into account actual field conditions. For this reason, the actual lengths of the cables needed shall be determined by the Contractor and approved by the Engineer. Installation shall be as shown in the plans.

The Contractor shall provide all appropriate equipment for installation of the cables and shall furnish a diver and the necessary diving equipment for use of the Engineer or his representative in making inspections of the cable installation. The Contractor shall operate the equipment when being used by the Engineer or his representative. All cable bends shall be of large easy curvature well within that recommended by its manufacturer so as not to damage or over stress the cable or its insulation.

Installation of a cable chase or sleeves during concrete pouring shall be performed to provide a safe path for the cables to be routed to the terminal box areas.

The cables shall enter the pier area and shall be supported by the wire armor at cable supports as shown in the plans. The wire armor shall be removed from the submarine cable above the support clamps. An electrical bond shall be made between the cable support hardware and the submarine cable armor for each location such that the measured resistance between support hardware and armor is not more than 10 ohms.

The cables shall be terminated in Submarine Cable Terminal Cabinets as described in the plans. The cables shall enter the cabinets through the cabinet sealing glands.

IV.MEASUREMENT AND PAYMENT

Payment at the contract prices for the various items covered by this section will be full compensation for all work covered by this section.

Such prices and payments will be full compensation for all work covered by this section including but not limited to furnishing and installing all electrical equipment and components, service poles and related service equipment, wire, and all other hardware.

Payment will be made under:

Submarine CablesLump Sum

LIGHTNING PROTECTION SYSTEM

I. DESCRIPTION

This work shall consist of furnishing, installing, and placing in permanent operating condition an Early Streamer Emission (ESE) lightning protection system.

Provide all labor, material, equipment, and services to perform operations required for the complete installation and related work as specified.

Any such work included in any other section of these specifications that is not specifically described therein shall comply with the requirements of this section.

The following items of work are specifically included in, but not limited to the generality implied by these specifications:

- 1. ESE lightning protection air terminal
- 2. Complete mast, base, and supports.
- 3. Down conductors.
- 4. Grounding terminations.
- 5. Transient voltage surge suppression.
- 6. Flag pole (without flag hardware).

This section also describes the material and installation for transient voltage surge suppressors (TVSS) for the protection of all AC circuits from the effects of lightning induced current, substation switching transients, and internally generated transients resulting from inductive and/or capacitive load switching.

Related work specified:

- 1. General electrical requirements.
- 2. Raceways, boxes, and fittings.
- 3. Wire and cables.
- 4. Grounding.
- 5. Lightning protection.

II. MATERIALS AND EQUIPMENT

A. ESE Air Terminal

Complete ESE air terminal assembly:

1. Stainless Steel 5/8" diameter air terminal
2. Sensing mechanism.
3. Early streamer initiator
4. Triggering mechanism
5. Sealed stainless steel housing
6. Threaded base for connection to mast.

Plate indicating name and phone number of the ESE air terminal manufacturer.

Air terminal shall be made in USA.

B. Conductors

Copper conductors shall be 28 strands of 14 gauge copper wire in a rope lay configuration with a net weight of 380 lbs. per 1,000 ft. minimum. Copper strip of equivalent capacity may be substituted.

The structural steel may be utilized as the main down conductor.

1. Structural steel shall be electrically continuous or made so.
2. Every other column shall be grounded or at intervals not exceeding an average of 60 feet on center.

All conductors shall be securely fastened to the structure at every 36" on center utilizing fasteners with corrosion resistance equal to that of the conductor.

All metal objects of induction situated within 15' 0" of a lightning protection conductor or bonded metal body shall be interconnected to the lightning protection system.

1. Grounded metal bodies shall be interconnected to the lightning protection system via a main size conductor.
2. Ungrounded metal bodies shall be interconnected to the lightning protection system via a secondary conductor no smaller than #6 AWG copper.

No copper materials shall be installed upon a dissimilar metal. Tin coated copper and bronze equipment shall be installed where these conditions exist.

Tin or lead coated copper and bronze equipment shall be utilized where corrosive atmospheres are present.

Lightning protection conductors shall maintain a downward or horizontal path to ground avoiding "U" and "V" pockets with the following exception:

1. A conductor may rise no more than 3" for every 12" of run.

No bend of conductor shall form a final included angle of less than 90 degrees nor shall have a radius of less than 8 inches. Exceptions are thru roof, thru wall, and "T" connections

Each ESE air terminal shall be provide with two (2) paths to ground from the base plate of the mast, with the exception of an elevated mast that may have a single conductor run for a maximum of 16 feet (4.8 meters) before two (2) down conductors are implemented.

C. Lightning Protection Mast

Aluminum mast:

1. Height as required by application.
2. Threaded connection for acceptance of ESE air terminal.
3. Bonding plate for cable connection.
4. Mast shall be Structured as required by wind and safety factors inherent to the geographic location of the installation.

Base support: Flag pole.

Certified or accepted by the ESE system manufacturer.

D. Grounding System

The Contractor shall coordinate the construction of the pier foundations with the requirements of the Lightning Protection System. Grounding shall be installed as shown in the Plans. The down conductor from the Precvectron air terminal shall be tied in with the pier grounding system as shown in the Plans.

The ground system shall have no more than 10 ohms of resistance.

Ground terminations:

1. 10' copper-clad ground rods (3 per down lead)
2. gauge copper ground plates 2 sq. ft in area (3 per down lead). Connections to ground plates shall be achieved via a bond plate with 8 sq. in. of contact.
3. Electrolytic ground electrodes (per down lead) may be used in lieu of or in combination with ground rods, and plates to achieve the 10 ohm resistance requirement.

A ground loop may be substituted for ground rods, plates, or electrolytic grounds. All ground loop conductors shall be equal to the main lightning protection conductor in weight, size, and conductivity. The ground loop shall comply with the 10 ohms requirement.

All ground connections shall be accomplished via Powerweld exothermic welding.

Connections to ground rods, ground plates, electrolytic ground electrodes, or ground loop conductors shall be made at a point not less than 24 inches away form foundation walls and 18 inches below grade.

Ground terminations shall be spaced as evenly as possible about the building perimeter.

All grounded systems shall be bonded together via main size conductor to achieve equal potential of all grounded systems. All such connections shall be accomplished via Powerweld exothermic welding where possible.

E. Connectors, Fasteners, and Hardware

Provide all connectors, fittings, fasteners, clamps, guards, lugs, exothermic connections, etc.. as required to install all parts of the lightning protection system. All material should be listed where applicable. All equipment shall be fabricated from copper and/or bronze material for the use intended.

All connections between dissimilar metals shall be executed with tinned copper or bronze equipment.

F. Transient Voltage Surge Suppression

Provide surge suppression for the electrical, telephone and TV lead wires.

Main electrical panel surge suppression.

1. Industrial grade 160 kA per phase capacity
2. Redundant replaceable modules
3. Independently fused modules
4. Status indicator LED's
5. Audible alarm
6. UL 1449 listed
7. UL listed disconnect
8. Disconnect without power shut down capability.

Main telephone service surge suppression:

1. Industrial grade meeting telephone system manufacturer's or carriers standards.
2. Replaceable modules.
3. One (1) nanosecond or less reaction time.

Antenna and TV lead wire surge suppression:

1. Industrial grade suitable for the conductor, coax or hard wire installation
2. One (1) nanosecond or less reaction time.
3. Installed as close to antenna or TV camera as possible.

Suppressors shall be listed in accordance with UL 1449, safety standards for Transient Voltage Surge Suppressors and UL 1283 Electromagnetic Interference filters.

Suppressors shall be independently tested with the category C3 high exposure waveform (20 kV - 1.2/50 microseconds, 10 kA - 8/20 microseconds) per ANSI/IEEE C62.41-1991.

Suppressors shall incorporate copper bus bars (electrical grade copper 1.5" wide x 0.25" thick) for the surge current path. Small round wiring or plug-in connections shall not be used in the path for surge current diversion. Surge current diversion modules shall use bolted connections to the bus bars for reliable low impedance connections.

Suppressors shall be constructed using surge current modules (MOV based). Each module shall be fused with user replaceable 200,000 AIC rated fuses. The status of each module shall be monitored on the front of the suppressors enclosure, as well as on the module.

For three phase, four wire configurations, suppressors shall provide suppression elements between all phases and the system neutral except for the delta configuration. The delta

configuration shall provide elements between each phase conductor. For three phase, five wire configurations, suppressors shall provide suppression elements between all phases and the system neutral. Redundant suppression modules shall provide the following paths: line to neutral and line to ground.

Suppressors shall be equipped with an audible alarm which activates when any one of the surge current modules have failed. An alarm on/off switch shall be provided to silence the alarm and an alarm "push to test" switch shall be provided to test the alarm. The switches and alarm shall be located on the front cover of the suppressors' enclosure.

Suppressors shall meet or exceed the following criteria:

1. Minimum single impulse current rating (L-N): 160 kA per phase (8/20 microseconds wave form).
2. Pulse life test: Capable of protecting against and surviving 5000 ANSI/IEEE C62.41 category C transients without failure or degradation of UL 1449 clamp voltage by more than 10%.
3. The UL 1449 clamping voltage shall not exceed the following:

<u>VOLTAGE</u>	<u>L-N</u>	<u>N-G</u>
120/208	400	400
277/480	800	800

4. The ANSI/IEEE C62.41- 1991 category C3 clamping voltage shall not exceed the following.

<u>VOLTAGE</u>	<u>L-N</u>	<u>N-G</u>
120/208	675	675
277/480	1250	1250

5. The suppressor shall have a response time no greater than 5 nanoseconds for any of the individual protection modes.

Suppressors shall be designed to withstand a maximum continuous operating voltage (MOV) of not less than 115% of normal RMS voltage.

Visible indication or proper suppressor connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable.

Terminals shall be provided for all the necessary power and ground connections. Each terminal shall accommodate wire sizes of #8 to #1 AWG.

Suppressor manufacturer shall provide certified test data confirming a "fail-short" failure mode.

Suppressor shall be manufactured in the United States of America. All major components shall also be of American manufacture.

Suppressors shall be equipped with the following items:

1. A transient voltage surge counter shall be located on the front cover of the suppressor.
2. The suppressor shall include a UL listed internal disconnect switch.

G. Flag Pole

A vertical flag pole and associated hardware shall be furnished and installed where indicated on the plans, complete with features as indicated. Flagpole shall have an overall length as shown in the Plans and a receptacle with set screw for ESE air terminal. No flag will be mounted on this pole. No flag mounting hardware is required.

Anchor bolts shall be installed to accommodate the bolt pattern of the approved flagpole. The Contractor shall coordinate this with the flagpole supplier and the electrical and concrete work.

Flag pole features shall be as follows:

1. MATERIAL - Alloy 6063-T6 aluminum tubing
2. FINISH - Directional satin ground
3. ANCHORAGE - As shown in the Plans.

H. Acceptable Suppliers

Acceptable ESE terminals and system suppliers include:

- Prevelectron- National Lightning Protection Corp. (800-628-2816).
- Helita Pulasar – Lightning Master.
- Interceptor– Erico.
- Triple C 405-235-5456.

Written requests for substitution shall be made a minimum of ten (10) days prior to bid date for consideration.

1. A sample of all parts to be used in the lightning protection system shall be submitted for evaluation. Samples will not be returned.
2. Test data showing the ESE air terminals characteristics and advantages.
3. Calculations showing the air terminals protection zones using the current characteristics of the air terminal based upon the test data.
4. Submit copy of manufacturers warranty.
5. Submit copy of lightning protection insurance policy for minimum of \$6,000,000 coverage.
6. Submit a list of twenty (20) verifiable installations utilizing the ESE terminal with names, addresses, and phone numbers of the completed installations.

III. METHOD OF CONSTRUCTION

Verify that all surfaces are ready to receive work.

Verify and compare dimensions and measurements shown on shop drawings with field conditions.

Verify that all systems that may influence the lightning protection system design are included or referenced on the shop drawings.

Install ESE lightning protection system in accordance with manufacturer's instructions.

Installation shall be accomplished in a neat and orderly manner by an installer approved or certified by the ESE system manufacturer.

All work inside the building shall be concealed.

All wall, roof, and other penetrations shall be sealed as required and performed by the appropriate trade.

All structural applications shall be coordinated with the project structural engineer and all other applicable trades.

Protect elements under other sections from damage or disfiguration during work under this section.

All adhesive lightning protection components shall be installed with an adhesive approved by the roof manufacturer.

All work installed in accessible areas shall be properly guarded and protected from damage.

All material shall be installed in a manner to protect against electrolytic couple in the presence of moisture.

Install one primary suppressor at each utility service entrance to the facility, according to manufacturer's recommendations.

The suppressor shall be installed on the load side of the service entrance.

Conductors between suppressor and point of attachment shall be kept short and straight.

The suppressor's ground shall be bonded to the service entrance ground.

IV. MEASUREMENT AND PAYMENT

Payment at the contract prices for the various items covered by this section will be full compensation for all work covered by this section.

Such prices and payments will be full compensation for all work covered by this section including but not limited to furnishing and installing all electrical equipment and components, service poles and related service equipment, wire, and all other hardware.

Payment will be made under:

Lightning Protection System.....Lump Sum

STARTUP SERVICES

The Contractor shall arrange for and provide all the necessary field tests, as indicated herein and as directed by the Engineer, to demonstrate that the entire electrical system is in proper working order and is in accordance with the plans and specifications.

The Contractor shall be responsible for operation and maintenance, including all costs thereof, for systems or equipment temporarily placed in operation for testing and adjusting purposes or for the convenience or necessity of the Contractor, prior to final acceptance by the Engineer.

The owner's operating personnel shall be instructed by the Contractor in the operation of equipment during test runs and prior to acceptance. This training session shall be video taped and given to the owner at the completion of the training session.

I. SHOP TESTS

The control system shall be pre-tested at the factory to ensure that all functions operate in accordance with the plans and the speed- time-position curves contained herein. The supplier shall test each motor and drive controller and control circuit as an interconnected system at the factory, and shall provide certified test results to the Engineer.

The control system inputs and outputs shall be connected to devices simulating the field mounted devices.

The control console described in these specifications, or a test panel shall be provided to derive the control signals and indicators required to simulate span operation.

The timed acceleration, transition and timed deceleration functions shall be demonstrated.

It shall be demonstrated that the speeds will decrease in accordance with the speed-position curves.

The Engineer shall be notified 30 days prior to the tests so that he can arrange for a witness to these tests.

The supplier's costs (if any) of debugging the schematics or adapting the program to his hardware, both at the shop and on the project site after installation, shall be included as incidental to the contract.

The equipment shall also be shown to be operational when connected to the bascule leaves at the site.

Generator Shop Test - The engine-generator set, with all accessories connected and in place, shall be subjected to full- load test runs at the generator manufacturer's plant, as hereinafter specified.

The engine shall be run continuously for not less than four hours without stoppage, and shall include at least one hour of operation at 50 to 75 percent, and two hours of operation at 100 percent of rated load. A record shall be kept of the water temperature in the engine head until a stabilized temperature is reached. When the engine is stopped, the temperature of the water shall rise to not more than 200 degrees f.

The tests shall include complete performance tests of the entire generator set to show that the generator voltage regulator and the engine governor perform properly to meet all specified requirements.

The generator and exciter shall be subjected to a full load heat run, and the test results shall be reported on the standard performance specification forms of the national electrical manufacturers association.

The Fuel Storage and Delivery System shall be provided with a tank pressure and leakage test, an operational test of the fuel delivery control system. Testing on the pumps shall include vacuum, flow, pressure, leakage, and current testing.

Six (6) certified copies of the results of the above tests shall be submitted to the Engineer. The units of the engine generator set shall not be shipped from the plant of the manufacturer until certified tests therefore have been approved by the Engineer.

II. PRELIMINARY FIELD CHECKOUT

Appropriate representatives of the bridge electrical control equipment shall arrange to be on site.

These representatives shall be capable of making adjustments to the equipment, of locating faults or defects and correcting them if possible, and of obtaining from the manufacturers without delay, new parts for replacement of apparatus which, in the opinion of the Engineer, do not perform satisfactorily.

Field inspections of the lightning protection system shall include:

1. Inspection of down conductors prior to being covered by interior, exterior, or other installations.
2. Inspection of lightning protection system ground prior to burial.

The services of Edison Testing Laboratories (ETL) shall be obtained to provide the certification of the lightning protection system. Obtain the ETL label and attach it to the structure at the location specified by the owner. At the time of application for lightning protection insurance, a copy of the application shall be sent to an owner representative.

Certifications of the lightning protection system shall include:

1. Certification that surge protection with a minimum of 160ka per phase surge capacity is installed on each of the main electrical services.
2. Certification that surge suppression is installed on antenna, telephone, radio and telephone lead wires.

All insulated conductors shall be electrically tested after placement. All circuits, including lighting circuits, shall be tested with the circuit complete except for connections to equipment. All splices shall be complete prior to testing. Any circuit failing to test satisfactorily shall be replaced, or repaired and retest as directed by the Engineer. The Contractor shall provide all equipment and labor required for testing.

All insulated conductors shall be tested for continuity and conductor identification. In addition, all insulated conductors of multi-conductor cable shall be tested for short circuits. Contractor shall furnish portable, battery powered, ring testers, and other test equipment as required to conduct these tests.

- (3) Continuity tests shall include all tests necessary to confirm that each conductor is continuous throughout its entire length.
- (4) Identification tests shall include all tests necessary to confirm that the conductor being investigated originated and terminates at the locations designed in the circuit list or indicated on the drawings.
- (5) Short circuit tests shall include all tests necessary to confirm that no conductor of a multi-conductor cable is short circuited to another conductor in that cable.
- (6) Power and control cable rated below 2,000 v. - all insulated conductors, except instrumentation cable, rated less than 2,000 v. Shall be tested with a 1,000 v. Megger or an equivalent testing device. Insulation resistance measurements shall be made between

each conductor and ground and between each conductor and all other conductors of the same circuit. Minimum acceptable resistance values shall be in excess of 100 megohms.

- (7) Instrumentation cable - all insulated conductors of supervisory and communication cable shall be tested with a 500 v. Megger or an equivalent testing device. Insulation resistance measurements shall be made between each conductor and the cable shielding tape and between the two conductors in each pair. Minimum acceptable resistance values shall be 50 megohms divided by the actual cable length in miles.

III. FIELD OPERATIONAL TESTING

After the span is operating to the satisfaction of the Engineer, Contractor and its manufacturers' representatives, an operational test period of not less than one week shall begin, during which time all aspects of the bascule span will be tested and observed by the Engineer. During this period, the Contractor shall make any repairs necessary as a result of equipment failure due to faulty equipment or workmanship. Should preliminary checks or operational tests show that any piece of equipment furnished by the Contractor, in the judgment of the Engineer, is defective or functions improperly, such adjustments and/or replacements shall be made by the Contractor as to make the installation completely acceptable to the Engineer, and at no extra cost to the owner.

Field testing shall also include complete operating tests to show that the entire engine-generator and all components operate satisfactorily to sustain the loads imposed during operation of the bascule span.

During routine testing of the emergency generator, the generator shall be loaded up to 60 percent of its nameplate rated load to avoid carbon build-up in the diesel engine.

IV. SPARE PARTS

The Contractor shall furnish the following spare parts:

- (a) One circuit breaker of each kind and size installed.
- (b) A quantity of 10 percent (1 minimum) of the total for each type and size of control, timing, or overload relay installed.
- (c) A quantity of 30 percent (3 minimum) of the total for each size and type of thermal overload relay installed.
- (d) Provide spare drive controller components as follows:
 - (1) One each of every type circuit card, module, contactor, fuse, relay, or transformer installed.
- (e) For the control desk lights:
 - (1) 12 indicating lamps for each type installed
 - (2) 1 color cap of each color and legend

Spare parts shall be provided in sealed, uniform-sized cartons, with typed and clearly varnished labels to indicate their contents. The Contractor shall also provide a directory of permanent type describing the parts. The directory shall state the name of each part, the manufacturer's number therefore, and the rating of the device for which the part is a spare. The spare parts shall also be marked to correspond with their respective item numbers as indicated on the elementary wiring diagram. Each circuit card requiring adjustments shall be adjusted at the bridge prior to final 100% Submittal October 3, 2006

delivery to the NCDOT. A lockable steel cabinet shall be provided for storage of the spare parts and instruction manual, as shown on the plans. Minimum size shall be 48" w x 16" d x 72" h.

V. MEASUREMENT AND PAYMENT

Payment at the contract prices for the various items covered by this section will be full compensation for all work covered by this section.

Such prices and payments will be full compensation for all work covered by this section including but not limited to furnishing and installing all electrical equipment and components, service poles and related service equipment, wire, and all other hardware.

Payment will be made under:

Startup ServicesLump Sum

METHOD OF MEASUREMENT

Traffic signal assemblies, drawbridge ahead signs, warning gates, and barrier gates will be measured by the number of each. All other electrical items will be measured on a lump sum basis.

BASIS OF PAYMENT

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Raceway and Wiring	Lump Sum
Bridge Electrical Service	Lump Sum
Emergency Generator	Lump Sum
Roadway Lighting	Lump Sum
Traffic Signal Assembly	Unit
Drawbridge Ahead Sign	Unit
Warning Gate	Unit
Barrier Gate	Unit
Control House and Pier Electrical Work	Lump Sum
Bridge Electrical Control and Operating System	Lump Sum
Submarine Cables	Lump Sum
Lightning Protection System	Lump Sum
Startup Services	Lump Sum

BRIDGE HVAC

I. DESCRIPTION

The work under this Section shall consist of furnishing all labor, equipment, and materials (including spare parts) and performing all work necessary for the installation, testing, and balancing of the Bridge HVAC system as shown on the plans and specified herein.

II. ABBREVIATIONS

Portions or all of certain recognized industry or association standards referred to herein as being a requirement of these Specifications shall be considered as binding as though reproduced in full herein, unless supplemented or modified by more stringent requirements of the Contract Documents. Unless otherwise stated, the reference standard shall be the standard that is current as of the date of issuance of these specifications. Reference may be made to standards either by full name or, for the sake of brevity, by letter designation as follows:

- AMCA..... Air Movement and Control Association, Inc.
- ANSI..... American National Standards Institute
- ARI..... Air-Conditioning and Refrigeration Institute
- ASHRAE..... American Society of Heating, Refrigeration Architects & Engineers
- ASTM..... ASTM International (Formerly, American Society for Testing & Materials)
- ETL..... Electrical Testing Laboratories
- HVI..... Heating and Ventilation Institute
- ISO..... International Organization for Standardization
- MIL..... Military Specification
- MSS..... Manufacturers Standardization Society
- NEC..... National Electrical Code of NFPA
- NEMA..... National Electrical Manufacturer’s Association
- UL..... Underwriters’ Laboratories, Inc.

III. SHOP DRAWING SUBMITTAL

The Contractor shall prepare and submit for review working drawings and catalogs for the new heating, ventilation and air conditioning system and miscellaneous components. Working drawings shall conform to the requirements of Section 105-2 of the Standard Specifications and shall include the following:

HVAC configuration in plan and elevation showing its relation to the structure, control house and other work including structural, electrical, architectural, and other mechanical.

Details showing all steel support for piping and of the HVAC equipment to structure members.

Equipment details, catalog and data sheets of standard components, and a tabulation giving the name of the part, description, function, manufacturer, rating, type, model, and catalog and serial number of each component including installation and maintenance instructions.

Each component shall be identified by an item number and complete assembly layout drawings shall be furnished identifying each component by the item number.

Piping layout showing routing, location, position, and support relative to other work including electrical, structural, and architectural.

IV. MATERIAL AND FABRICATION

Provide products which are compatible with other products of the HVAC work, and with other work requiring interface with HVAC work, including mechanical/electrical connections and control devices.

A. General

The heat pump and/or air conditioning system shall consist of ductless split systems as shown on the plans. The system shall consist of a recessed-ceiling, ceiling-mounted or wall-mounted evaporator section with wired control and floor-mounted outdoor unit. Required ratings are as shown on the Plans and specified herein. These systems shall include horizontal discharge, single phase outdoor units.

All HVAC work, piping, and its installation shall conform to the requirements of the North Carolina Building Code 2002. All units shall be rated as per ARI Standards 210/240, and shall be certified by UL.

All equipment and materials shall be new. All equipment, materials and workmanship shall be first class in every particular, and shall be manufactured and installed to the satisfaction of the Engineer.

B. Indoor Units

(1) General

Indoor units shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, control circuit board and fan motor. Each unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dry air instead of refrigerant before shipment from the factory.

(2) Capacities

The unit HP-1 shall be a recessed ceiling, split-type heat pump air conditioning system. The cooling and heating capacities of the unit are as shown on the Plans.

The unit HP-2 shall be a recessed ceiling, split-type, ductless heat pump air conditioning system. The cooling and heating capacities of the unit are as shown on the Plans.

The unit HP-3 shall be a recessed ceiling, split-type, ductless heat pump air conditioning system. The cooling and heating capacities of the unit are as shown on the Plans.

The unit HP-4 shall be a wall mounted, split-type, ductless heat pump air conditioning system. The cooling and heating capacities of the unit are as shown on the Plans.

The unit HP-5 shall be a wall mounted, split-type, ductless heat pump air conditioning system. The cooling and heating capacities of the unit are as shown on the Plans.

All unit ratings are based on indoor and outdoor temperatures as follow:

Cooling Indoor 80°F DB, 67°F WB and cooling outdoor 95°F DB
Heating Indoor 70°F DB and heating outdoor 47°F DB, 43°F WB

(3) Unit Cabinet

The casing shall have a white finish.

The rear cabinet panel shall have provisions for a field installed filtered outside air intake. (Ceiling-mounted units only)

Cabinet shall have filter tracks and cleanable filters which shall be accessible from below with a ¼-turn fastener. Adjacent room cooling to be provided by a simple knockout in the cabinet side panel, and cabinet shall have provisions to accommodate a limited amount of ductwork, if desired.

Grilles with fully insulated discharge and inlet shall have a white finish and be attractively styled. Unit shall fit a standard 2 ft x 2 ft ceiling grid.

(4) Fan

The evaporator fans shall be high performance, double inlet, forward curve sirocco fans driven by a single motor.

The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.

Fan shall be 3-speed centrifugal, direct drive blower type with air intake in center of the unit and discharge on the perimeter. Air louvers shall be adjustable for 2, 3, or 4-way discharge.

(5) Filter

Unit shall have filter track with factory-supplied cleanable filters, which will be easily accessible and removable.

(6) Coil

The evaporator coil shall be of nonferrous construction with smooth plate fins on copper tubing. Fins shall be bonded to the tubes by mechanical expansion.

The coils shall be pressure tested at the factory.

A drip pan under the coil shall have a factory-installed condensate pump and drain connection for hose attachment to remove condensate.

(7) Electrical

Units shall be equipped with factory-mounted electric heaters. Minimum protections shall include over current and high temperature condition. Unit shall operate on 208/230 v, 60 Hz power supply. Power and control connections shall have terminal block connections.

(8) Control

This unit shall have a wired controller to perform input functions necessary to operate the system.

The fan coil units shall have a terminal board which controls system operation in response to the room thermostat. The user may manually select any one of 3 fan speeds and an auto mode for unit operation.

The controller shall be 24v and consist of an On-Off switch, Cool/Dry-Fan selector, Thermostat setting, Timer Mode, High-Low fan speed, Test Run switching and Check Mode switching.

Temperature changes shall be by 2°F increments with a range of 65 - 87°F.

Wiring shall run direct from the indoor unit to the controller with no splices.

Manufacturer shall provide conductors of adequate size as per N.E.C for connection to remote controller.

The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and controlling the outdoor unit.

The refrigerant shall be controlled with a piston-type refrigerant metering device and evaporative coil freeze protection shall be provided.

Normal operation of the remote controller shall provide individual system control in which one remote controller and one indoor unit are installed in the same room.

The system shall be capable of automatic restart when power is restored after power interruption.

The system shall include self-diagnostics including total hours of compressor run time.

The microprocessor within the wall mounted remote controller shall provide automatic cooling and heating, display set point and room temperature, a timer function to provide a minimum 24 hour timer cycle for system, and diagnostics shall provide continuous checks of unit operation and warn of possible malfunction.

Control system shall control the continued operation of the air sweep louvers, as well as provide on/off and system/mode function switching.

(9) Seasonal Energy Efficiency Ratio

The Seasonal Energy Efficiency Ratio (SEER) of the units shall be a minimum of 10.0.

(10) Additional Features

Fresh Air Intake Kit shall include filter and duct connections to provide for outdoor ventilation air (must be used with power ventilation kit.) Kit must be used with the accessory fresh air kit when fresh air must be ducted in. The kit will overcome duct static to provide a constant supply of ventilation air. Kit shall consist of booster fan and adjustable speed control to properly balance fan to achieve required airflow rate.

C. Outdoor Unit

(1) General

The outdoor unit shall be designed specifically for use with the indoor units. The units CU-1, CU-2, CU-3, CU-4, and CU-5 shall be condensing units for indoor units HP-1, HP-2, HP-

3, HP-4, and HP-5 respectively. These units shall be equipped with a circuit board that interfaces to the indoor unit and performs all functions necessary for operation. The unit shall have a baked enamel finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.

(2) Unit Cabinet

Unit cabinet shall be constructed of galvanized steel, bonded and coated with a baked enamel finish. Compressor compartment shall be isolated and have an acoustic lining to assure quiet operation.

(3) Fan

Condenser fans shall be direct-drive propeller type, shall discharge air horizontally, and shall blow air through the outdoor coil.

Condenser fan motors shall be totally enclosed, single-phase motors with class B insulation and permanently lubricated sleeve bearings. Motor shall be protected by internal thermal overload protection.

Shaft shall have inherent corrosion resistance. Fan blades shall be corrosion resistant and shall be statically and dynamically balanced.

Condenser fan openings shall be equipped with PVC-coated protection grille over fan and coil.

(4) Coil

The condenser coil shall be of nonferrous construction with smooth plate fins on copper tubing. Fins shall be bonded to the tubes by mechanical expansion.

The coil shall be protected with an integral metal guard.

Refrigerant flow from the condenser shall be controlled by means of a metering orifice.

(5) Compressor

Compressor shall be a fully hermetic. It shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature and over-current.

Motor shall be NEMA rated class F, suitable for operating in a refrigerant atmosphere.

Compressor assembly shall be installed on rubber vibration isolators and shall have internal spring isolation.

Compressors shall be single or three-phase as specified on Electrical Plans and Specifications.

(6) Electrical

Unit shall operate on 208/230 v, 60 Hz power supply as specified on the equipment schedule.

Power and control connections shall have terminal block connections.

Unit electrical power shall be a single point connection.

Unit control voltage to the indoor fan coil shall be 24-v. All power and control wiring shall be installed per NEC and all local building codes.

(7) Additional Features

For units with line lengths over 50 feet, such as CU-1 and CU-2, a crank case heater shall be added to the compressor to help prevent refrigerant migration to the compressor during the off cycle

D. Unit Heater

Furnish Manufacturer and Model number as shown on the drawings, including all accessories such as wall brackets or ceiling hangers for a complete installation of the unit heater.

Unit heater shall be furnished with thermostat kit, fan only operation (summer fan switch) kit and power disconnect kit.

The thermostat controlling the unit shall be installed at a height of 54" above the finished floor in the locations indicated on the Plans or as directed by the Engineer. All associated wiring for the thermostat and unit heater shall conform to the latest edition of the National Electrical Code.

E. Ventilation Fan

A ventilation fan shall be furnished and installed in the restroom of the control house. Fan shall be as shown on the Plans. Ventilation fan shall come with ductwork to vent to the outside and be controlled from the restroom by a separate wall switch having a motion-activated timer for 30-minute operation unless turned off. The discharge of the fan shall not affect the appearance of the roof exterior.

The thermostat controlling the unit shall be installed at a height of 54" above the finished floor in the locations indicated on the Plans or as directed by the Engineer. All associated wiring for the thermostat and ventilation fan shall conform to the latest edition of the National Electrical Code.

Ventilation fans shall come equipped with galvanized mounting collar, galvanized bird screen, backdraft damper, motorside fan guard, thermostat and all other accessories necessary for installation such as bolts, caulking, and etc. Fan shall be ducted to the bottom of the roof overhang (soffit) section through a round ductwork.

Blower assembly shall be removable, have a high pressure centrifugal-type blower wheel and a permanently lubricated motor designed for continuous operation, and shall be mounted with resilient anti-vibration mounts.

All air and sound ratings shall be certified by HVI. Unit shall be U.L. Listed.

F. Refrigerant Piping Insulation and Joint Sealer

Minimum thickness for flexible foam pipe insulation as listed below or refer to manufacturer's specifications for recommended insulation requirements.

½ inch for one inch outside diameter and smaller pipe.

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¾ inch for 1-1/8 through 2 inch outside diameter pipe.

One inch for 2-1/8 inches outside diameter and larger pipe (two layers of ½ inch).

One inch sheet for fittings as recommended by manufacturer.

K-factor of 0.25 Btu-in/hr-ft²-°F at 75°F mean temperature or less.

G. Joint Sealer

An air-drying contact adhesive that is compatible for joining seams and butt joints of pipe and sheet insulations for line temperatures up to 250°F (120°C). The adhesive shall also be capable for use in the application of sheet insulation to flat or curved metal surfaces and suitable for operation at temperatures up to 180°F (82°C).

Joint sealer shall meet or exceed requirements of Military Specification MIL-A-24179A and Amend-2 as Type II, Class 1

Dried film shall also meet 25/50 flammability and smoke development classification requirements of codes and specifications when tested by ASTM E 84 Method.

H. Sealing Materials

Joint and Seam Sealants, General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.

Joint and Seam Tape shall be 2 inches wide, glass fiber fabric reinforced.

Joint and Seam Sealant shall be one part, nonsag, solvent release curing, polymerized butyl sealant complying with FS TT S 001657, Type I; formulated with a minimum of 75 percent solids.

I. Fire Stopping

Fire Resistant Sealant: Two part, foamed in place, fire stopping silicone sealant formulated for use in a through penetration fire stop system for filling openings around pipe penetrations through walls and floors shall be provided. Material shall have fire resistance ratings indicated as established by testing identical assemblies per ASTM E 814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops, Underwriters Laboratory Inc., or other testing and inspecting agency acceptable to authorities having jurisdiction.

J. Instrumentation

Contractor shall provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.

Provide only those instruments, which have the maximum field measuring accuracy and are best suited to the function being measured.

K. Miscellaneous

Outside air intake for the control level indoor unit shall be ducted to the roof soffit using the fresh air intake kit provided by the manufacturer.

V. CONSTRUCTION DETAILS

A. General

The Contractor shall prepare and submit for review working drawings and catalogs for the new piping and miscellaneous components. Working drawings shall conform to the requirements of Section 105-2 of the Standard Specifications and as noted in III Shop Drawing Submittal of this Section.

B. Quality Assurance

All wiring shall be in accordance with the National Electrical Code (N.E.C.).

The units shall be rated in accordance with ARI Standard 210, 240, and 270 and bear the ARI label.

The units shall be manufactured in a facility registered to ISO 9001 and ISO14001, to environmental protection set by the International Standard Organization (ISO).

A full charge of refrigerant for the entire length of refrigerant tubing shall be provided in the condensing unit.

A dry air holding charge shall be provided in the evaporator.

System efficiency shall meet or exceed 10.0 SEER.

C. Warranty

As part of this section the contractor shall warrant all products and associated hardware to be free of defects in material and workmanship for a period of one (1) year and five (5) years for compressor from the date of final acceptance of the completed bridge contract. Final Acceptance shall be in accordance to Section 105-17 of the Standard Specifications. Any defect within this period shall be repaired or replaced by the Manufacturer or Vendor, at total cost to the Manufacturer or Vendor, including labor, parts, and transportation. The Contractor shall provide letters to the suppliers with copies to the Engineer, identifying the scheduled date of final acceptance of the bridge and therefore the date the warranty shall begin. If the date of final acceptance is extended, it shall be the Contractors responsibility to extend the commencement of the warranties from the suppliers at no cost to the Department.

Manufacturer shall have fifteen years experience in the U.S. market.

D. Delivery, Storage and Handling

Units shall be stored and handled according to the manufacturer's recommendation.

The wired controller shall be shipped inside the carton with the indoor unit and able to withstand 105° F storage temperatures and 95% relative humidity.

E. Installation

Install HVAC units in accordance with the drawings and manufacturer's standards and recommendations. Contractor shall mount indoor units from ceiling and/or walls using new

stainless steel anchor bolts. The Contractor shall field verify all locations where the indoor and outdoor units and the piping and wiring are to be installed to ensure piping and wiring will maintain as straight a line as possible at the shortest distance as possible.

Before beginning construction of any portion of the work involving the HVAC system, the Contractor shall determine the exact locations of all structure, pipes, utilities, and other features to ensure there are no conflicts.

Condensate piping from each unit shall be installed, with proper slope, to drain into the sump pit.

All supports for vertical portions of piping shall be directly fastened to the piping prior to the installation of the insulation. The Contractor shall include additional supports as required to accommodate thrust loads at all elbows and turns. Additional extraneous loads on the piping such as valves shall be properly supported.

The Contractor shall install insulation on all portions of the refrigerant piping including the condensate piping. Insulation shall be as recommended by the manufacturer or as specified herein. Insulation shall not be installed over any fittings or joints until that section of piping has been tested and accepted.

Install all piping in finish areas before installation of final finish materials to prevent damage to these materials. Do not install pipe insulation until all piping is tested and proven tight. All insulation shall be interrupted through wall and ceiling openings to minimize opening size. Openings through floors and ceilings must be fire stopped with and approved fire stop material. Hangers, supports, anchors, etc., that are secured directly to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation. All laps and butt strips shall be adhered with vapor barrier adhesive. Ends of pipe insulation shall be sealed with vapor barrier coatings at fittings, wall and ceiling interruptions and at intervals of not more than 21 feet on straight runs of pipe.

The thermostat controlling the units shall be installed at a height of approximately 60" above the finished floor in the locations indicated on the Plans or as directed by the Engineer. All associated wiring for the thermostats and air conditioners shall conform to the latest edition of the National Electrical Code.

F. Grounding

Positive equipment ground shall be provided for unit components.

G. Condensing Unit

Condensing units shall be installed in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

Pre charged refrigerant tubing shall be connected to unit's quick connect fittings. Run tubing so as not to interfere with access to unit.

Install furnished accessories.

H. Testing

All fittings shall be connected and tested for leaks with appropriate test equipment. Air must be expelled and the refrigerant charge checked and adjusted. Test run shall be performed for each unit as recommended by the manufacturer. All malfunctions shall be recorded and corrected, and the units retested to the satisfaction of the Engineer.

VI. MEASUREMENT AND PAYMENT

No measurement will be made for the Pay Item Bridge HVAC. Bridge HVAC payment will be made on a lump sum basis.

The lump sum price for the Pay Item Bridge HVAC shall include the cost of furnishing all labor, equipment, and materials required to complete the work as shown on the Plans and specified herein. This includes furnishing and installing all piping inside the control house and bascule pier including drain piping, fittings, valves, unions, insulation, pipe supports, as well as testing and charging of the units.

Payment for electrical work associated with providing the power and making the electrical connection to the units is not part of this item, but is paid for under PSSP Section Control House and Pier Electrical Work.

Payment will be made under:

Pay Item	Pay Unit
Bridge HVAC	Lump Sum

OPERATION AND MAINTENANCE MANUALS LUBRICATION CHART AND TRAINING

I. DESCRIPTION

The work under this Section shall consist of the Contractor furnishing operation and maintenance manuals and lubricating charts for all portions of the mechanical and electrical systems. This shall include, but not be limited to the trunnion assemblies, span operating machinery, span locks, electrical system, gates, signals, lightning protection system, instrument drive and mechanical and electrical related items pertaining to the control houses including, but not limited to; the heating, ventilating and air conditioning, water and sewer, sump pumps, communication systems, lighting, smoke detectors and heat tracing. Also included in this Section shall be the Operator and Maintenance Training for the new mechanical and electrical systems along with confined space training and purchasing of confined space equipment.

II. MATERIALS AND CONSTRUCTION DETAILS

A. Operation and Maintenance Manuals

Each section shall be bound in a heavy-duty nickel-plated three-hole binder with three trigger positions: lock, unlock and open. Binder shall allow sheets to lie flat when booklet is open.

Covers for binder shall be stiff, heavy-duty board type covered by a heavy-duty plastic or other approved material. Each binder shall be approximately 9 inches by 12 inches and thickness will depend on amount of material contained within, but booklet thickness shall not exceed 5 inches. Each binder shall be neatly entitled with a descriptive title, the name of the project, the location, year of installation, owner, name of structure, manufacturer, contractor and engineer on both the cover and the spine of binder.

All printed matter, text, data and any other material within each section shall be clearly and easily legible, accurate and distinct and be in black on white background. Page size shall be 8-1/2 inches by 11 inches, while fold out material shall not be greater than 12 inches by 18 inches. Where reduced size drawings are not legible, full size drawings shall be provided only as directed by the Engineer.

The method of binding, materials to be included and the text shall be submitted to and approved by the Engineer.

Manuals shall be submitted concurrently with the working drawings for approvals. A minimum of three (3) copies of the manuals for each structure shall be submitted for review. In case of correction or rejection, the Contractor shall resubmit the required number of manuals until the manuals are approved and such procedure shall not be considered a reason for delay. The binder volumes shall be completed and made available at the bridge site for use during the field testing periods of the new span drive operating machinery, electrical and span lock systems. Any corrections resulting from the field tests and training sessions shall be incorporated into the booklets for the final volumes.

A separate binder shall be provided for each of the following sections:

- Section 1 - Operator Instructions, Operator and Maintenance Trouble Shooting Guides
- Section 2 - New Trunnions and Operating Machinery
- Section 3 - Bridge Electrical Operating System
- Section 4 - Span Locks, Gates and Signals
- Section 5 - Control House Electrical and Mechanical Systems (including HVAC, communication, lighting, sump pump, water and sewer, etc.)

(1) Section 1:

This section shall consist of divisions pertaining to the operation, maintenance and trouble shooting of the complete mechanical and electrical systems.

The first division shall entail Operator's instructions and trouble shooting guide, which shall cover in full the step by step sequence of operation of the mechanical and electrical systems and its auxiliaries, and shall note all precautions for correct operation. The step by step sequence shall be for the normal operation and the emergency operation.

The second division shall entail maintenance trouble shooting flow diagrams listing all possible faults and problems with causes and recommended corrective measures or minor repairs. This division shall have a master trouble shooting flow diagram that covers all aspects of the bridge operating systems encompassing signals, gates, locks, span drive and the electrical systems that control them. The master flow diagram may reference the specific faults pertaining to a system that can be detailed in that specific trouble shooting chart as listed below, if the master flow diagram becomes too large.

The remaining divisions shall detail the complete trouble shooting flow diagrams for the major items of the systems. It can be divided into multiple divisions for each specific system. These can include, but are not be limited to the gates and signals, span locks, span drive and the electrical controls. The flow diagrams shall cover all aspects of the system it pertains to and clearly state recommended repairs and/or corrective measures.

(2) Sections 2 through 5:

Each remaining section shall as a minimum be separated into divisions to include the following:

Table of contents, in numerical page order and index, in alphabetical order, each unique to that specific section.

Detailed manufacturer's recommended preventive maintenance schedules.

The complete spare parts list, including local representatives' and suppliers' phone numbers and addresses.

A set of manuals, catalog cuts, descriptive leaflets, breakdowns, part lists, maintenance instructions for maintaining, adjusting and lubricating the systems, bulletins and drawings covering all items of equipment and accessories that make up or are part of the systems. Catalog cuts shall have the part being utilized clearly marked (not highlighted) and any other components on the page crossed out so that no confusion on which part is being utilized. The catalog numbers of each and every component shall be included in case it becomes necessary to order replacement parts from the manufacturer.

A complete set of shop drawings provided at the end of the project reflecting all as-built conditions, including all schematics, wiring diagrams, panel layout, conduit layout, control desk and panels, fits and finishes and component detail drawings.

Where applicable, include drawings accurately recording the actual location of all lightning protection system equipment including air terminals, bonding/grounding equipment and conductors.

Copies of all warranties on all equipment supplied to the project and letter identifying start of warranty period (to be added at end of project as mentioned elsewhere in the specifications).

These sections shall be divided into specific divisions pertaining to the major components. Each division shall have all the necessary details for that specific component.

Sections may consist of multiple binders, only as required and approved by the Engineer, to maintain the maximum size of each binder as previously mentioned.

Once the complete set has been approved and placed in final form, the Contractor shall furnish ten (10) copies of the manuals to the Engineer for distribution.

B. Lubrication Chart

The Contractor shall furnish three (3) copies on mylar and ten (10) copies full size (22 inches by 36 inches) as well as reduced sized for inclusion in the previously mentioned manuals of a lubrication chart. The lubrication chart shall show the location of all lubrication fittings and other points of lubrication for the new mechanical and electrical equipment, which will require lubrication of any kind. The chart shall show the kind of lubricant to be used at each point and

the frequency of lubrication. A full size print of the chart shall be framed under Lexan in a neat wooden frame with backing and shall be placed as directed by the Engineer within the control house.

Lubrication chart shall be submitted to the Engineer for review and approval as a working drawing in accordance to Subsection 105-2 of the Standard Specifications. Final lubrication chart shall not be made until chart has been approved by the Engineer.

Standardization of the lubrication for the mechanical and electrical systems is required. The Contractor shall coordinate with all the system suppliers to ensure that the type of lubricant supplied shall be kept to as few as possible.

C. Maintenance Training

The Contractor shall provide a minimum of two (2) eighty four (84) hour (21 - 8 hours sessions) of classroom and field operation, maintenance and trouble shooting instruction. There will be ten (10) attendees per training session. Provide each attendee the Operation and Maintenance Manuals for the course as well as Confined Space Entry Manuals. The final approved manuals shall be furnished to the attendees no later than two (2) weeks prior to the training session so that they may become familiar with the system.

The Contractor shall obtain a conference room located in the vicinity of the bridge (not to exceed five miles away) for the purpose of holding the training sessions.

Two (2) of the eight (8) hour sessions shall cover the mechanical portion and the course shall consist of the following; plus any additional subjects required:

1. Mechanical Drive Basics
2. Mechanical System Configuration specific to the project
3. Mechanical Component Layout and Location
4. Preventive Maintenance Procedures
5. Trouble Shooting, Minor Repairs and Emergency Operations
6. Mechanical Operation of the Bridge

Four (4) of the eight (8) hour sessions shall cover the electrical portion and will have a similar course outline as follows; plus any additional subjects required:

1. Electrical Power Basics
2. PLC Familiarization and Programming Fundamentals specifically for this project
3. Electrical Control System Configuration
4. Electrical Control System Component Locations
5. Preventive Maintenance Procedures
6. Trouble Shooting, Minor Repairs and Emergency Operations
7. Electrical Operation of the Bridge

Two (2) of the eight (8) hour sessions shall cover the confined space entry portion for both bridges and the course shall consist of the following; plus any additional subjects required:

1. Confined Space Entry Basics
2. Continuous Voice Communication Practices
3. Safety Equipment Usage, including Head, Eye, Ear, Body and Respirator Protection
4. Ventilation and Air Monitoring Techniques
5. Use of Safe Power Tools and Equipment and Lighting

6. Emergency Response Plans, including Entrant Self-Evacuation, Attendant-Ordered Evacuation and Unresponsive Entrant Rescue
7. Confined Space Entry Procedures

Two (2) eight (8) hour sessions shall cover the new span lock machinery, gates and signals and control house components including the water and sewer, HVAC and lighting for both bridges.

Two (2) eight (8) hour sessions will be for on site instruction for the electrical group and two (2) eight (8) hour sessions for each of the remaining groups related to the topics covered in the classroom except for the confined space entry group. Faults will be introduced into the systems, which the students will diagnose and correct. These faults will include the most common failures, which are likely to be encountered in the operations of the bridge.

As part of the training, the Contractor shall have the major system suppliers (reducers, locks and electrical control system) provide a qualified engineer as a representative to train the Department's personnel on the components that are being furnished. The system representatives shall be required to perform one detailed training session as described above to familiarize the Department on the systems and their operating characteristics. This training shall consist of two (2) eight (8) hour training sessions for each of the major systems.

The Contractor shall submit to the Engineer for approval the qualifications of the system supplier's representatives who will be doing the training. These qualifications shall include the representative's name, company they work for and a breakdown of the representative's specific experience to the portion of the project they will be covering.

D. Operator Training

The Contractor shall provide a minimum of two (2) sixteen (16) hour (4 - 8 hour) training sessions for the bridge operators prior to operating the bridge using the new electrical/mechanical systems. This training shall detail in step by step sequence the new systems and procedures, the operators will be required to follow. Training shall be performed in the new control house with equipment in place, but prior to utilization. Operator training shall not be scheduled until the new systems are operating to the satisfaction of the Engineer.

E. Confined Space Entry Equipment

The Contractor shall furnish for each bascule pier confined space entry equipment specified herein or as specified on the Plans. All equipment and materials furnished for confined space entry shall be brand new.

The confined space atmosphere monitor shall be an Industrial Scientific's portable ATX612 multi-gas instrument with automatic data logging functions or approved equal. Accompanying the monitor shall be a docking station for battery recharging.

The confined space ventilation unit shall be a Homelite blower or approved equal. Ventilation time shall be a minimum of two air changes per hour for each bascule pit pier.

Two (2) sets of Cseem harness and accompanying recovery line; two (2) MSA hard hat for head protection; and six (6) ISI Van Guard five-minute emergency escape respirator pack shall be provided.

All confined space entry equipment shall be stored as directed by the Engineer.

III. MEASUREMENT AND PAYMENT

Payment for Pay Item Operation and Maintenance Manuals, Lubrication Chart, and Training will be made on a lump sum basis.

The lump sum price bid for the Pay Item Operation and Maintenance Manuals, Lubrication Chart and Training shall include the costs of furnishing all labor, material, equipment and incidentals required to complete the work in accordance with these Special Provisions.

Payment will be made under:

Pay Item	Pay Unit
Operation and Maintenance Manuals, Lubrication Chart, and Training	Lump Sum

SPAN DRIVE MACHINERY

I. DESCRIPTION

The work under this Section shall consist of furnishing all labor, equipment and materials (including spare parts) as shown on the Plans and specified herein. The work also includes removal of existing components; installing, adjusting, painting, lubricating and testing to place in correct, satisfactory operating condition the new span drive operating machinery for the trunnion bascule bridge.

All apparatus for controlling the operation of the span drives and all conduits, boxes, wiring, cables and other equipment required to extend the necessary circuits from the control house to the respective components shall be furnished and installed under PSSP Section Bridge Electrical.

II. ABBREVIATIONS

Portions or all of certain recognized industry or association standards or specifications referred to herein as being a requirement of these Special Provisions shall be considered as binding as though reproduced in full herein unless supplemented and/or modified by more stringent requirements of the Contract Documents. Unless otherwise stated the reference standard or specification which is current as of the date of issuance of these Special Provisions. The following abbreviations will be used herein and on the plans to designate standard specifications for material and workmanship:

- American Association of State Highway and Transportation Officials..... AASHTO
- American Gear Manufacturers Association..... AGMA
- American Iron and Steel Institute AISI
- American National Standard Institute..... ANSI
- American Society of Mechanical Engineers..... ASME
- American Society of Testing Materials ASTM
- American Welding Society AWS
- National Electrical Manufacturers Association NEMA
- National Lubricating Grease Institute..... NLGI

Occupational Safety and Health Act.....OSHA
 Society of Automotive Engineers SAE
 Steel Structure Painting Council..... SSPC

III. MATERIALS AND FABRICATION

Refer to Division 10:

Item	Section
Structural Steel	1072
Anchor Bolts	1072-6
High Strength Bolt, Nuts, Washers, and Direct Tension Indicators	1072-8
Holes for Bolts and Other Fasteners	1072-18
Organic Zinc Primer Paint	1080-9

A. General

The materials shall meet the minimum requirements specified herein or as specified on the plans, if plan requirements are more stringent. The plans show equipment schedules listing the minimum design requirements for the new equipment. Working drawings, catalog cuts and certifications shall be submitted for approval according to the requirements of Subsection 105-10 of the Standard Specifications for all mechanical equipment proposed for purchase or being fabricated.

All equipment and materials furnished under the items specified herein shall be brand-new. All new equipment, materials and workmanship shall be first class in every particular, and shall be manufactured and installed to the satisfaction of the Engineer.

The design, workmanship and erection of all machinery components shall meet the applicable requirements of AASHTO 1988 Standard Specifications for Movable Highway Bridges, hereinafter referred to as the AASHTO Specifications, except as otherwise specified herein or as shown on the plans.

B. Steel Castings

All steel castings shall be fully annealed. Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects in positions affecting their strength and value for the service intended. All castings shall be sandblasted or otherwise effectively cleaned of scale and sand, to present a smooth, clean, and uniform surface. All unfinished edges of castings shall be neatly cast with rounded corners, and all inside angles shall have ample fillets. All surfaces requiring finish shall have adequate material allowance for machining to finish dimensions. Machined bosses shall be provided on cast steel machinery parts to give proper seats for bolt heads and nuts.

Blow holes appearing upon finished castings shall be so located that a straight line laid in any direction will not cut a total length of cavity greater than one inch in any one foot, nor shall any single blow hole exceed one inch in any dimension or have an area greater than one half square inch. Blow holes shall not have a depth injuriously affecting the strength of the casting. Minor defects, which do not impair the strength, may with the approval of the Engineer, be welded by an approved process and be inspected by magnetic particle examination. The defects shall be

removed to solid metal by chipping, drilling, or other satisfactory method, and, after welding, the castings shall be annealed, if required by the Engineer. Castings, which have been welded without the Engineer's permission, will be rejected.

C. Steel Forgings

The main rack, rack pinion shafts and floating shafts shall conform to the requirements of ASTM A668 Class as shown on the Plans.

All forged shafts shall be reduced to size from a single bloom or ingot until perfect homogeneity is secured. The blooms or ingots, from which shafts are to be made, shall have a cross-sectional area at least three times that required after finishing. No forging shall be done at less than a red heat. Forged rounds for shafts shall be true, straight, and free from all injurious flaws, seams, or cracks. Forging shall provide adequate material allowance for machining to finish dimensions. All forging shall be thoroughly annealed before being machined.

D. Structural Steel Supports

Structural steel for machinery base supports shall conform to the requirements of Section 1702 of the Standard Specification, ASTM A709 of the grade where shown on the plans. Steel components of manufactured items shall conform to the materials recommended by the manufacturer.

The plans indicate minimum requirements for machinery base supports for the new machinery components. The Contractor shall provide suitable supports structurally adequate. The material thickness shown on the plans are to be considered the minimum acceptable and should be increased if appropriate for the application.

Top surfaces of all new supports shall be milled after fabrication to provide a uniform surface. All surfaces requiring milling shall have adequate material allowance for milling to the minimum finish dimensions as required by AASHTO section 2.5.17 "Fits and Surface Finishes", or as shown on the plans.

Weldments for machinery base supports shall be neat and shall have all exposed sharp corners and edges removed. Mounting surfaces of the frames shall be straight and flat such that full contact with the equipment being supported or retained is obtained.

All welding required herein or called for on the plans shall be done in accordance with the requirements of AWS D1.5 and Subsection 1072-20 of the Standard Specification. Weldments shall be stress relieved by heat prior to final machining. The fitting up and welding procedure shall be such that distortion of the work will be a minimum. If necessary to obtain this result, suitable welding fixtures shall be used. The Contractor shall submit welding procedures, together with the working drawings for the parts to the Engineer for approval.

All fillet welds and partial penetration groove welds shall be tested by the magnetic-particle method in accordance with the requirements of Section 6 of AASHTO/AWS D1.5. Radiographic testing shall be used for examination of complete joint penetration groove welds in butt joints and for complete penetration groove welds in T-joints and corner joints shall be tested by ultrasonic testing. All complete joint penetration welds shall be tested in accordance with the requirements of Section 6 of AASHTO/AWS D1.5 for each size and type weld. Inspection and

testing of welds and basis of acceptance shall be in accordance with the requirements of Section 6 of AASHTO/AWS D1.5.

All field welds shall be stress relieved by peening unless otherwise indicated within these Special Provisions or within the plans or unless specific written permission is granted to omit the peening process for each particular weld. The Contractor shall submit his proposed weld procedures for all field welds. Proposed peening procedures will be required to be included in the weld procedures before approval will be granted. No field welding shall begin until the approved weld procedures are available. All field welding shall be in accordance with Subsection 1072-20 of the Standard Specifications.

E. Open Gears

All open gears shall conform to the requirements of AASHTO Specifications and the requirements for accuracy of the AGMA Standard 390.02, AGMA Gear Classification Manual, except as otherwise provided herein or on the plans. The AGMA quality number shall be stated on the applicable shop drawings. The open gears shall conform to AGMA Quality No. 6 or better.

Quantity of backlash on the new pinions may be reduced to ensure that once the new pinions are aligned with their respective racks the correct amount of backlash as called for in AGMA Standard 390.02 is furnished. Tolerances for misalignment shall be taken as one half (1/2) that permitted for new gearing.

The rack pinion material hardness shall be 30 to 40 BHN higher than the rack material.

F. Gearbox Speed Reducers

Speed reducers with minimum requirements as shown on the plans shall conform to the requirements of AASHTO Specification 2.5.22 and shall also conform with AGMA Product Standard 6001-D97 Design and Selection of Components for Enclosed Gear Drives, Standard 6010-F97 Standard for Spur, Helical, Herringbone, and Bevel Enclosed Drives, and shall carry the AGMA symbol on the nameplate.

Gears and shafts shall be heat-treated alloy steel suitable for the intended service. Gearing in enclosed reducers shall conform to AGMA Quality No. 8 or higher.

Housings shall be of cast steel or welded plate construction. An inspection cover shall be provided to permit inspection of the gearing inside.

Provisions shall be made for filling, draining, and ventilating the housings; and a sight gauge shall be mounted on each unit to read the recommended lubricant level. Ventilation opening shall come equipped with a moisture (hygroscopic) and particle filtration unit.

The drain provisions shall include a shut-off valve between a drain pipe cap and the reducer. A hose bibb or other device suitable for connecting a 1" drain hose shall be provided for the reducer.

A drain hose shall be provided for use when oil must be drained from the reducer. The hose shall be a minimum of 50 feet long. The hose shall be provided with a storage reel and shall be permanently stored where directed by the Engineer.

The inside of the housings shall be sandblast cleaned prior to assembly and be protected from rusting.

As shown on the plans, the primary speed reducer shall be a parallel-shaft single-reduction differential unit with double input/output shafts and the secondary speed reducer shall be a parallel shaft, triple reduction unit with a single input/output shaft. The input shafts of the primary unit shall be extended to accommodate the clutch and brake to provide suitable clearances. The efficiency of the units shall not be less than 97 percent and 96 percent respectively.

New speed reducers shall be provided with continuous oil bath lubrication for variable speed. The lubricant level shall be such that all shaft bearings are submerged or to such higher level as recommended by the reducer manufacturer. The reducer shall be provided with effective seals to retain the lubricant.

The reducers shall be rated for a service factor of 1.0 at 150% horsepower rating of the main motor. The AASHTO requirements for peak or breakdown torque shall be construed to mean that the stress levels may be a maximum of 50 percent higher than normal. Pitting resistance requirements shall be ignored when considering peak or breakdown torque.

The auxiliary drive, brake-gear motor, with minimum requirements as shown on the Plans shall be furnished under PSSP Section Bridge Control System, but installed by qualified millwrights under this Section.

G. Auxiliary Drive Clutch

An electric clutch with minimum requirements shown on the Plans shall be furnished under PSSSP Section Bridge Control System, but installed by qualified millwrights under this Section.

H. Shafts

Shafts shall be of the type and size as shown on the plans and as specified herein.

Forged rounds for shafts shall be true, straight, and free from all injurious flaws, seams, or cracks. Forging shall provide adequate material allowance for machining to finish dimensions. All forging shall be thoroughly annealed before being machined.

All shafts shall be accurately finished, round, smooth, and straight; and when turned to different diameters, they shall have rounded fillets at shoulders and chamfers at shaft ends. All journal-bearing areas on shafts and pins shall be accurately turned, ground, and polished with no trace of tool marks or scratches on the journal surface or adjoining shoulder fillets. Journal diameters shall be finished to the limits specified in AASHTO Article 2.5.17 for shaft journals.

I. Couplings

Couplings shall be of the type and size as shown on the plans and shall include grid type, gear type, jaw type, and others as noted.

All couplings and shaft fits and finishes shall meet the requirements of AASHTO Article 2.5.17 for hubs on shafts. Couplings shall, in general, be finish-bored and have keyways cut by the Coupling Manufacturer to dimensions and tolerances established on the working drawings and then shipped to the manufacturers of the various components for shop installation on the shafts.

The couplings shall have provisions for lubricating all contact surfaces and the housings shall be oil-tight under all operating conditions. Gap discs shall be provided in each coupling to center the floating assembly and rack pinion shaft. Couplings shall have the provision to overcome shaft angular and offset misalignments.

J. Bearings and Bushings

Bearings and bushings shall be of the type and size as shown on the plans and as specified herein. All bearing and bushing fits and finishes shall be in accordance with ANSI B4.1, Preferred Limits and Fits for Cylindrical Parts and ANSI B46.1, Surface Texture.

New span drive bearings housings shall be annealed, stress relieved, ASTM A709, Grade 36 weldments. Two-piece split construction for accurate cap and base registration. Cap bolts shall be secured with double hex nuts and base bolts are sub-drilled in the shop 0.030-inch under bolt shank diameter to permit field reaming. The cap shall be equipped with an Alemite large button head lubrication fitting.

The new bushings for the span drive split bearings shall be finished bored with the caps in place. Each bearing shall be furnished with ¼-inch thick brass liners and ½-inch thick shims. Each set of shims shall conform to Subsection M of this Section. The brass liners shall consist of one solid piece 0.125-inch +0.002”/-0.000” thick and one piece 0.125-inch +0.002”/-0.000” thick in 0.003-inch laminations and ½-inch thick shims with pre-drilled bolt holes. The edges of the liners shall be cut square and flush with the bushing flange. Except for a short distance from each end, the inside edges of the liners shall be cut back to form a grease groove along the shaft. All bolt holes shall be drilled through the liners with sufficient clearance.

Bronze for bushings shall conform to the requirements for ASTM B22 Alloy UNS C93700 unless otherwise noted. All grease grooves shall be machine cut and smooth. The sides of all grease grooves shall be rounded to a radius of half the width of the groove.

K. Keys and Keyways

Keys and keyways shall be provided between open gears, couplings, clutches and their respective shafts. Keys and keyways shall conform to the dimensions and tolerances for square and flat keys of ANSI B17.1. All keys shall be effectively held in place, preferably by setting them into closed-end keyways milled into the shaft. The ends of all such keys shall be rounded to a half circle equal to the width of the key. Subject to the Engineer’s approval, keys that are not set into the closed-end keyways shall be held by safety set screws, or other effective means. Keyways shall not extend into any bearing.

Keys provided between couplings, clutches and their respective shafts shall conform to the minimum requirements of ASTM A668, Class D, unless otherwise noted and as shown on the plans.

L. Collars

Shaft collar shall be a steel two-piece heavy-duty clamp type collar for shaft diameters as shown on the plans. Material for shaft collars shall be C1117 hot-rolled bar with heat treated alloy steel socket cap and set screws conforming to ANSI B18.3.

The face of collars adjacent to bearings shall be machined and polished to 63 micro-finish.

M. Shims

Where shown on the plans and required for leveling and alignment of equipment, machinery shims shall be neatly trimmed to the dimensions of the assembled parts and drilled for all bolts that pass through the shims. Holes for bolts shall be oversized by 1/16-inch. In general, sufficient thickness shall be furnished to secure 1/64-inch variations of the shim allowance plus one shim equal to the full allowance. Shimming of equipment shall be performed with the least amount of shims needed to fill space. No more than five (5) shims shall be used unless approved by the Engineer. Shims shall conform to Section 1072 of the Standard Specification, ASTM A709, Grade 36, except that thickness less than 1/4-inch shall be stainless steel. Corrosion resistant precision thickness shims will be permitted if desired by the Contractor.

Shims with open side or U-shaped holes for bolts will not be permitted for final alignment. No shims shall have less than two holes for bolts unless approved by the Engineer.

N. Fasteners

The following requirements for bolts, nuts, studs, cap screws, and lock washers, shall apply, except where otherwise called for herein or on the plans.

All bolts for connecting machinery parts to each other or to supporting members shall be either high-strength bolts or turned bolts as shown on the plans.

Turned bolts shall be quenched and tempered steel conforming to the requirements of ASTM Specifications A449 or A325. Turned bolts shall have the diameter of the shank 1/16-inch larger than the diameter of the threads. Hexagonal heads and nuts shall be in accordance with the heavy series and finished. Two nuts or one nut and a lock-washer shall be used on turned bolts. Lock washers will only be permitted if approved by the Engineer. All bolt heads and nuts shall bear on seats square with the axis of the bolt. On castings, except where recessed, the bearing shall be on finished bosses or spot-faced seats. Bolt heads, which are recessed in castings, shall be square. Turned bolts in finished holes shall meet the requirements of AASHTO Article 2.5.17. Turned bolts shall conform to the requirements of Section 2.6.18 Fasteners and Section 3.3.15 Bolt Holes and Bolts, of the AASHTO Specifications.

High-strength steel bolts, nuts and hardened washers shall conform to the requirements of ASTM Specification A325. Connections using high-strength bolts shall conform to the "Specification for Structural Joints using ASTM A325 or A490 Bolts," approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.

Anchor bolts fastening new machinery supports to concrete shall be stainless steel threaded rods conforming to the requirements of ASTM F593 with heavy hex nuts and washers, diameter as shown on the plans. Nuts shall conform to the requirements of ASTM Specification A563. Threads shall be the Coarse Thread Series as specified in the latest issue of ANSI B1.1, having a Class 2A tolerance. Double nuts shall be used on all anchor bolts. Anchor bolt adhesive shall meet the requirements of Section 1081 of the Standard Specification for Type 3A adhesive.

The dimensions of socket-head cap screws, socket flat-head cap screws, and socket-set screws shall conform to ANSI B18.3; and the screws shall be made of heat-treated alloy steel, cadmium-plated and furnished with a self-locking nylon pellet embedded in the threaded section. Unless otherwise called for on the plans or specified herein, set screws shall be of the headless, safety type; shall have threads of the coarse thread series; and shall have cut points. Set screws shall

neither be used to transmit torque nor as the fastening or stop for any equipment that contributes to the stability or operation of the bridge.

All threads for bolts, nuts, and cap screws shall conform to the coarse thread series and shall have a Class 2 tolerance for bolts and nuts or Class 2A tolerance for bolts and Class 2B tolerance for nuts in accordance with the ANSI B1.1, "Unified Screw Threads."

All bolt holes through unfinished surfaces shall be spot-faced for the head and nut, square with the axis of the bolts.

Positive locks shall be furnished for all nuts. If double nuts are used, they shall be of standard thickness. Double nuts shall be used for all connections requiring occasional opening or adjustment. If lock washers are used for securing screws or nuts, they shall be made of tempered steel and shall conform to the SAE regular dimensions. The material shall meet the SAE tests for temper and toughness.

O. Machinery Guards and Shields

The Contractor or manufacturer shall furnish suitable guards for equipment being installed as required in order to conform to the requirements of the AASHTO Specifications or OSHA. The guards shall be a minimum of 12 gage galvanized sheet metal or other suitable material and as indicated on the plans. All guards shall be easily removable and replaceable as required for maintenance purposes. Consideration of the use of hinges and retaining bolts using wing nuts for this purpose is recommended.

P. Concrete Grouting Material

The material shall be a non-metallic, non-shrink grout which, when mixed with water, will harden rapidly to produce a permanent anchoring bond. It shall contain no metals nor rust or corrosion promoting agents. The grout shall meet the requirements of Section 1081 of the Standard Specification.

The material when prepared in accordance with the manufacturers' instructions shall be of a trowelable consistency. It shall also have the following properties.

- a. The material shall exhibit no shrinkage on setting, but may exhibit slight expansion of no more than 0.40%.
- b. Compressive Strength - Two-inch cubes of this material when cured as shown shall have the following minimum compressive strengths:

Cure	Strength
24 hour air cure @ 75°F	4000 PSI Min.
7 day air cure @ 75°F	6000 PSI Min.
- c. The material shall have a minimum initial set of 30 minutes.

Q. Maintenance and Operation Manual

The Contractor shall furnish maintenance and operation manuals giving complete instructions relative to assembly, installation, operation, adjustment, alignment, lubrication, maintenance, disassembly and carrying complete parts lists and assembly drawings for the span drive machinery installed. The manuals, under a separate section, shall be part of a general

maintenance and operation manual as specified in Project Specific Special Provisions (PSSP) - Operation and Maintenance Manuals, Lubrication Chart, and Training. Manuals shall be furnished concurrently with working drawings for review and approval by the Engineer.

R. Lubrication, Lubricants and Charts

All bearings shall be fitted for a pressure system of lubrication using 1/4-inch pipe-size giant button head fittings. Fittings shall be as manufactured by Stewart-Warner Alemite Corporation.

All grease fittings shall be conveniently located for greasing, and they shall be connected to the points requiring lubrication from convenient lubrication stations as shown on the plans by 3/8-inch galvanized steel piping with a minimum bursting pressure of 12,000 psi. All pipes shall be securely supported and located so that it shall be protected from injury and excessive vibration. Maximum spacing of supports shall not exceed four feet. All lubricating equipment shall be installed in perfect working condition. Where multiple lubrication fittings are tied into one station each fitting shall identify its point of lubrication by being labeled. No grease fitting will lubricate more than one point of lubrication. Labels shall be made of brass tags with a number or nomenclature stamped on the tag which coincides with the lubrication chart being provided. They shall be mounted with stainless steel screws or 16-gage stainless steel wires. Location of the lubrication manifolds to be as ordered by the Engineer.

The Contractor shall lubricate and maintain the new span drive machinery throughout the construction period. The Contractor shall supply all equipment and materials necessary for this operation.

The Contractor shall furnish sufficient lubricant to provide for the initial lubrication of each component on the structure requiring lubrication and such additional lubricant for normal maintenance requirements for a period of at least two years. Maintenance lubricants shall not be required for synthetic reducer oil, which will have an indefinite service life.

All synthetic oils purchased for use on the bridge shall be provided by a manufacturer, which has facilities for annual testing of the oil furnished. The manufacturer shall furnish evidence that annual testing of the oils will be at no cost to the owner of the bridge, for the life of the bridge. The lubricants shall conform to the recommendations of the manufacturers of the units and shall be coordinated with the products normally stocked by the Department.

The Contractor shall furnish all equipment necessary for routine maintenance lubrication of the equipment on the bridge. Each grade or class of grease shall be provided with its own separate grease guns or other equipment normally used for application of the lubricant. The Contractor shall coordinate the grease requirements with the various suppliers to attempt to limit the number of different greases. Contractor shall also furnish two grease guns suitable for the furnished lubrication fittings for each bridge. Each grease gun shall be provided with a fitting suitable for the grease fitting installed. If more than one type of grease fitting is used for the same lubricant, grease applicators shall be provided for each type of fitting. Each device shall have a permanently attached nameplate listing the specific lubricant within.

Maintenance lubricants shall be stored where specified by the Engineer.

The Contractor shall furnish a lubrication chart as specified under PSSP - Operation and Maintenance Manuals, Lubrication Chart, and Training. The chart shall show the location of all

lubrication fittings and other points of mechanical and electrical equipment the require lubrication of any kind.

S. Paint

ALL SURFACES OF THE SPAN DRIVE MACHINERY SHALL BE PAINTED USING A PAINT SYSTEM CONFORMING TO ALL REQUIREMENTS STATED IN DIVISION 4 SECTION 442, STEEL STRUCTURES, EXCEPT FOR THE FOLLOWING:

All unfinished machinery surfaces shall be made free of all chips, dirt, rust, scale, sand, grease, and other foreign matter by sandblasting, or other approved means as stated elsewhere, except that sandblasting will not be permitted after machining of any surface.

After proper surface preparation, all unfinished machinery surfaces, except for those inside housing, shall be given one (1) shop coat of primer prepared in accordance with the requirements given under Section 440, Steel Structures.

After installation is complete, all machinery surfaces remaining exposed, except rubbing surfaces, shall be thoroughly cleaned and given field coats of paint prepared as specified elsewhere for intermediate and finish coat.

After completion of the operating tests and final acceptance of the project, all accumulated oil, grease, dirt, and other foreign matter shall be solvent cleaned in accordance with SSPC-SP1 from exposed machinery surfaces, except rubbing surfaces. Paint shall be touched up as required to the satisfaction of the Engineer.

Nameplates on all manufacturers' components shall be readable, clean and free of all paint before acceptance of the machinery.

T. Spare Parts

The Contractor shall furnish the following spare parts for the new span drive machinery.

- 2 Complete set of friction discs for the electric clutch (CL)
- 2 Steelflex grid for the motor brake wheel coupling (C-4)
- 2 Complete set of seals and gaskets for the motor brake wheel coupling (C-4)
- 4 Complete set of seals and gaskets for coupling (C-3)
- 4 Complete set of seals and gaskets for the machinery brake wheel coupling (C-2)
- 4 Complete set of seals and gaskets for the secondary output coupling (C-1)
- 6 Hygroscopic breathers for every reducer supplied on the project.
- 2 Bronze insert for jaw type coupling (limit switch coupling)

Spare parts shall be provided in sealed, uniform sized cartons with typed and clearly varnished labels to indicate their contents, and they shall be stored where ordered by the Engineer. The spare parts shall also be marked to correspond with their respective item numbers, as indicated on the shop drawings.

Spare parts shall be delivered to the site and stored at the location ordered by the Engineer.

U. Tools

For each bridge the Contractor shall provide one set of wrenches suitable for machinery maintenance and to fit all nuts and bolt heads in the machinery installation. In addition, a full set of flat head and Phillips head screwdrivers shall be furnished which will fit all machinery and electrical components and an assortment of allen keys, punches, files, chisels and a ball peen hammer.

For emergency operation of the span locks and traffic gates, a minimum 18V 1/2" cordless drill/driver set shall be furnished, which will accommodate the shaft extension of the span locks and the use of drill cranks provided for the traffic gates. The set shall include a two-speed drill/driver with maximum rated torque of 450 in-lbs, (2) chargers, (4) compact battery pack and heavy-duty carrying case.

The miscellaneous tools, grease, and grease guns shall be stored in a location approved by the Engineer in a cabinet or toolbox made of galvanized steel and having provisions for a padlock.

V. Warranty and Quality Control

All manufacturers shall warrant all products and associated hardware to be free of defects in material and workmanship for a period of one (1) year from the date of final acceptance of the completed bridge contract. Final Acceptance shall be in accordance to Subsection 105-17 of the Standard Specifications. Any defect within this period shall be repaired or replaced by the Manufacturer or Vendor, at total cost to the Manufacturer or Vendor, including labor, parts, and transportation. The Contractor shall provide letters to the suppliers with copies to the Engineer, identifying the scheduled date of final acceptance of the bridge and therefore the date the warranty shall begin. If the date of final acceptance gets extended, it shall be the Contractors responsibility to extend the commencement of the warranties from the suppliers at no cost to the Department.

IV. CONSTRUCTION DETAILS

A. General

The new machinery specified and as approved on the shop drawings and related electrical equipment shall be installed according to best millwright practice. Millwrights shall provide information that they have performed installations on heavy machinery of a similar character to that required within this project. The millwright foreman shall have successfully installed movable bridge machinery on a previous project.

In addition to the mechanical equipment included within this Project Specific Special Provision (PSSP) and as shown on the plans, electrical equipment including the main drive motors, brakes, limit switches, clutches, and the auxiliary motors shall be installed as a part of this PSSP. The Contractor shall coordinate the work with subcontractors to provide for the necessary shop assembly and field installation of all of the equipment.

Machinery manufacture and installation shall conform to all applicable requirements in AASHTO Specifications and all applicable requirements with special requirements and additions as specified herein or as specified on the plans

B. Field Measurements

It shall be the Contractor's responsibility to verify all dimensions relating to the new span machinery and machinery supports.

Contractor shall verify, by field measurements, the pertinent dimensions of all members and components, which will be connected to or installed with the span drive machinery. Such field measurements shall be clearly indicated on the working drawings for the span drive machinery.

C. Working Drawings

Preparation and submission of working drawings shall conform to the requirements of Subsection 105-2 of the Standard Specifications.

Working drawings shall show all parts completely detailed and dimensioned. The grade and extent of finish machining, with all tolerances and allowances, shall be stated for each part for which a specific fit is required. Finished surfaces shall be as defined by the ANSI B46.1, Surface Texture; and fits shall be as defined by the ANSI B4.1, Preferred Limits and Fits for Cylindrical Parts, unless otherwise stated herein or on the plans. ANSI B4.1 shall also apply to fits for non-cylindrical parts.

Manufactured components shall be shown in outline on the drawings, with sufficient dimensions and data to determine the clearances required for installation and operation. Manufacturer's certified dimension prints shall state the name of the job; pertinent ratings of the equipment; and shall indicate, where applicable, the provisions for adding, draining, and checking the level of lubricant; the method of lubrication and type of fittings; and the location of inspection openings.

The Contractor shall furnish complete data regarding the design and construction of all manufactured items to be furnished as part of the machinery under this Contract, including material specifications, cross-sectional assembly drawings, detailed drawings of component parts, and the dimensions of principal elements.

Complete shop bills of materials shall be made for all machinery parts. If the bills are not shown on the working drawings, prints of the bills shall be furnished for review in the same manner as specified for the drawings.

Working drawings shall give identifying marks and essential dimensions for locating each part or assembled unit with respect to the bridge or foundation.

The Contractor shall submit to the Engineer for review the required number of prints of all working drawings. In case of correction or rejection, the Contractor shall resubmit the required number of prints of working drawings until drawings are approved and such procedure shall not be considered a cause for delay. All corrections and revisions to details or dimensions shall be clearly marked on the working drawings by respective revision marks. The Contractor shall bear all costs for damages, which may result from the ordering of any materials prior to the approval of the working drawings; and no work shall be done until the working drawings have been reviewed and approved by the Engineer. The Contractor shall supply the Engineer with as many prints of the approved drawings as may be ordered.

Approval of the working drawings by the Engineer shall not relieve the Contractor from full responsibility for the satisfactory construction and operation of the machinery.

D. Inspection and Testing

The Contractor shall give two weeks notice to the Engineer prior to the beginning of work at the foundries, forge, and machine shops so that inspection may be provided. No materials shall be cast, forged, or machined before the Engineer has been notified where the orders have been placed.

The Contractor shall furnish all facilities for the inspection of material and workmanship in the foundries, forge, and machine shops; and the Engineer shall be allowed free access to necessary parts of the premises. Work done while the Inspector has been refused access will automatically be rejected.

The Inspector shall have the power to reject materials or workmanship, which do not fulfill the requirements of these Specifications.

Inspection at the foundries, forge and machine shops is intended as a means of facilitating the work and avoiding errors; and it is expressly understood that it will not relieve the Contractor from any responsibility in regard to imperfect material or workmanship and the necessity for replacing the defective materials or workmanship.

The Contractor shall furnish the Engineer with as many copies of orders covering work as the Engineer may direct.

Unless otherwise provided, the Contractor shall furnish test specimens, as specified herein, and all labor, testing machines, tools, and equipment necessary to prepare the specimens and to make the physical tests and chemical analyses. Copies of all test reports and chemical analyses shall be furnished to the Engineer.

The acceptance of any material or finished parts by the Engineer shall not bar their subsequent rejection if found defective. Rejected material and workmanship shall be replaced or corrected by the Contractor in a manner satisfactory to the Engineer at no additional cost to the Department.

The reducer manufacturer shall shop test each reducer by running it at the normal operating speed at no load for at least four hours and at 150% full load torque of the main motor for 1 hour in the presence of the Engineer or his duly appointed representative. These tests shall be run with the reducer filled to the recommended mark with new oil of the viscosity the manufacturer recommends on his lubrication chart for normal operation. Half of the run shall be in one direction and the other half in the opposite direction. Immediately before the start of the test, at half-hour intervals for no load and at ten-minute intervals for 150% full-load motor torque thereafter, the following measurements shall be made and recorded and the records shall be submitted with the Certificate of Compliance:

1. Temperature of ambient air
2. Temperature of oil near bottom of crankcase (not to exceed 135°F)
3. Surface temperature of each shaft extension adjacent to shaft seal
4. Sound level at point above and 60 inches distant from center of unit

During testing, each reducer shall be checked for unusual noise (thumping or any non-uniformity), excessive bearing clearance and any other unusual operating characteristics. The units shall operate smoothly, and without excessive vibration or temperature rise. All malfunctions shall be recorded and corrected, and the units retested, if necessary, before release

from the manufacturer's shop. After the unit has passed the test, a Certificate of Compliance shall be submitted by the Contractor to the Engineer.

The proper operation of the lubricating system shall be demonstrated during the shop test. In addition to the test specified above, the proper distribution of load on the gear teeth shall be demonstrated by the application of tooth contact tape or other medium approved by the Engineer applied to each gear and these tapes shall be preserved in the records to be submitted with the Certificate of Compliance.

E. Protection for Shipment

All finished metal surfaces and unpainted metal surfaces that might be damaged by corrosion shall be coated as soon as practicable after disassembly or finishing with a corrosive-preventative compound. This coating shall be removed from all surfaces prior to assembly and painting after installation.

All machinery parts shall be completely protected from weather, dirt and all other injurious conditions during disassembly, manufacture, shipment, and while awaiting erection.

All shaft journals that are shipped disassembled from their bearings shall be protected during shipment and before erection by a packing of oil-soaked fabric secured in place by burlap or rust preventative spray such as Cosmoline and covered with heavy metal thimbles or heavy timber lagging securely attached. Every precaution shall be taken to ensure that the bearing surfaces will not be damaged and that all parts shall arrive at their destination in satisfactory condition.

Assembled units shall be mounted on skids or otherwise crated for protection during handling and shipment.

F. Installation and Field Testing

Prior to any work being performed on the machinery, the Contractor shall submit to the Engineer for approval a detailed mechanical work procedure. This procedure shall give in detail methods for providing alignment and measurements for gear teeth, bearings, and turned bolts; detailed explanation for match marking, and installation and testing of new machinery. Procedures shall include duration of time involved with the work and shall show coordination with structural, electrical and architectural work, which will be coinciding with the mechanical work.

All parts of the machinery shall be installed in accordance with installation marks and match marks. Before final drilling or reaming, all parts shall be adjusted to exact alignment by means of shims furnished for each part. After final alignment and bolting, all parts shall operate smoothly.

Bolt holes in structural steel for connecting machinery shall, in general, be drilled from the solid after final alignment of the machinery. Sufficient installation holes, sub-drilled ¼-inch undersize for undersize temporary bolts, may be used for installation and alignment of the machinery. After the machinery has been aligned in its final position, full-size holes for the remaining bolts shall be drilled or sub-drilled and reamed, the full-size bolts installed, and the temporary bolts removed. The undersize holes used for temporary bolts shall then be reamed full-size and full-size bolts installed.

The machinery shall be installed and adjusted by competent millwrights skilled in the type of work involved. They shall be provided with all necessary measuring and leveling instruments, as

may be required including but not limited to dial indicators and laser alignment equipment. Contractor shall provide all necessary equipment and methods to the Engineer to verify proper alignment of all machinery has been obtained to the satisfaction of the Engineer.

The span drive machinery shall be installed with the utmost care in the field. Ropes, slings or other equipment used for installation shall be carefully placed to prevent scratches, abrasions or other damage. The reducers shall be placed as indicated on the plans.

During installation of the main rack pinion on the bridge, the pinion shall be aligned to match the alignment of the rack gear teeth. Records of tooth alignment, contact widths, cross bearing, backlash, and root clearances shall be recorded and furnished to the Engineer for review and approval. Tolerances for misalignment shall be taken as one half (1/2) that permitted for the new gearing. The Contractor shall not grind or otherwise modify the contact face of the gear teeth. The Contractor shall take whatever measures deemed necessary and as approved by the Engineer to obtain the needed accuracy of the alignment specified.

Prior to the installation of the reducers, the Contractor shall bolt up and align the new main rack pinion assembly to the rack segments. All open gearing shall be aligned such that backlash is within tolerance and at least 75% of the effective face width of each pair of meshing teeth is in contact. The cross mesh shall not exceed 0.01 inch per 6 inch face width. All open gear measurements shall include backlash, cross mesh alignment, tooth valley gap and face contact. Alignment of each rack and rack pinion shall be verified by bluing of the teeth and operating the rack and rack pinions under normal load condition. Sub-drilled holes at the secondary reducers and rack pinion bearings may be used with high strength bolts during alignment checks. Contractor shall submit calculations for the size of fasteners and sub-drilled holes required to the Engineer for review. Final reaming will be performed after rack and pinion alignments have been approved by the Engineer. The type of bluing or medium used for face contact shall be submitted to the Engineer for approval prior to any measurements. The measurements shall be performed at a minimum of eight (8) equally spaced span positions ranging from fully open to fully closed. Contractor shall submit in writing the alignment for review and approval by the Engineer.

All parts of the machinery shall be match marked for proper assembly and correct orientation. Before final drilling or reaming, all parts shall be adjusted to exact alignment by means of shims. Tapered shims shall be provided at no additional cost only if required.

Once the pinion alignment has been approved by the Engineer, the Contractor may continue with the installation of the secondary and primary reducers and the remaining mechanical equipment.

The main drive motors, brakes and auxiliary drive machinery shall be precisely aligned with the respective input shaft of the reducer as shown on the plans.

The span shall not be operated by the operating machinery until all components are installed in final alignment and bolted as approved by the Engineer. Once the span machinery has been final installed and tested, the contractor shall check the tooth contact between the rack and rack pinion through a full span opening cycle.

The alignment of all components shall be checked by the use of laser alignment tools, dial indicators and/or feeler gages both before and after final bolting up of the machinery in the presence of the Engineer. Installation tolerances furnished by the coupling manufacturer shall be considered to be a maximum value and the installation shall be such that the installed tolerances

are no more than one-half those recommended unless otherwise approved by the Engineer. Any re-adjustment after final bolting required by the Engineer in order to conform to this requirement shall be made by the Contractor at no additional cost to the Department.

After installation is complete, the Contractor shall make a thorough inspection to insure that all gears are clean and free of obstruction, that all parts are aligned and adjusted as closely as practicable without actual operation, and that all bolts are properly tightened. All gear housings shall be filled with lubricant to the proper level, and all rotating and sliding parts shall be supplied with lubricants recommended by the suppliers of the units. Typical lubricants for the various locations are as follows:

- Sleeve Bearings: NLGI Grade #2 Grease
- Open Gears: NLGI Grade #2 Grease
- Gear Reducers: Petroleum Based Rust and Oxidation Inhibited Gear-oil
AGMA Viscosity Gr. 4 or manufacturer's recommendation
- Gear Couplings: NLGI Grade #0 Grease
- Grid Couplings: NLGI Grade #1 – Falk Long Term Grease (LTG)

Synthetic oils used on the bridge shall be provided by a manufacturer, which has facilities for annual testing of the oil furnished. The manufacturer shall furnish evidence that annual testing of the oils will be at no cost to the owner of the bridge, for the life of the bridge.

The lubricants listed on the lubrication charts shall conform to the recommendations of the manufacturers of the units and shall be coordinated with the products normally stocked by the North Carolina Department of Transportation. Information required from the Maintenance Department shall be obtained through the Engineer.

When the equipment is ready for testing, the operating machinery shall be operated through not less than five complete cycles in the presence of the Engineer.

During the foregoing test runs, all parts shall be inspected to detect overheating, misalignment, or incorrect adjustment. All such defects shall be corrected at no cost to the Department before final acceptance.

V. MEASUREMENT AND PAYMENT

No measurement will be made for the Pay Item Span Drive Machinery as payment will be made on a lump sum basis.

The lump sum price bid for the Pay Item Span Drive Machinery shall cover the cost manufacturing, furnishing, and installing new span drive components. The cost shall include painting the operating machinery along with all materials; bolts, shims, keys, guards, shields, lubricants; labor; equipment; tools and all other work; including adjusting and aligning, required to properly execute and place in complete working order the span drive in accordance with the plans, Standard Specifications, PSP and PSSP. The cost shall also include the adjusting and aligning of related electrical equipment including motors, brakes, clutches, and span control equipment.

Payment for furnishing electrical work associated with the new span drive including motors, brakes, clutches, and limit switches is not part of this item, but is paid for under PSSP Section Bridge Control System.

Progress payments will be made. Prior to the beginning of any work, the Contractor shall submit to the Engineer a detailed schedule of work operation. This schedule shall be complete and include the expected percentage of work to be completed within specific time frames. The Engineer will use the schedule to authorize progress payments in accordance with actual work completed. The Engineer may at any time require the preparation and submittal of an updated work schedule. Failure by the Contractor to submit an updated schedule upon request will cause the progress payment procedure to terminate immediately.

Payment will be made under:

Pay Item	Pay Unit
Span Drive Machinery	Lump Sum

SPAN LOCK MACHINERY

I. DESCRIPTION

The work under this Section shall consist of furnishing all labor, equipment and materials (including spare parts) as shown on the plans and specified herein. The work also includes installing, adjusting, painting, lubricating and testing to place in correct, satisfactory operating condition the new lock bar operators (tail and toe), lock bars, guide sockets, receiving sockets, and supports as well as having the lock machinery representative on site for installation verification.

II. ABBREVIATIONS

Portions or all of certain recognized industry or association standards or specifications referred to herein as being a requirement of these Special Provisions be considered as binding as though reproduced in full herein unless supplemented and/or modified by more stringent requirements of the Contract Documents. Unless otherwise stated the reference standard or specification which is current as of the date of issuance of these Special Provisions. The following abbreviations will be used herein and on the plans to designate standard specifications for material and workmanship:

- American Association of State Highway and Transportation Officials..... AASHTO
- American Gear Manufacturers Association..... AGMA
- American Iron and Steel Institute AISI
- American National Standard Institute..... ANSI
- American Society of Mechanical Engineers..... ASME
- American Society of Testing Materials ASTM
- American Welding SocietyAWS
- National Electrical Manufacturers AssociationNEMA
- National Lubricating Grease Institute.....NLGI
- Occupational Safety and Health Act..... OSHA
- Society of Automotive Engineers SAE
- Steel Structure Painting Council..... SSPC

III. MATERIALS AND FABRICATION

Refer to Division 10:

Item	Section
Structural Steel	1072
Anchor Bolts	1072-6
High Strength Bolt, Nuts, Washers, and Direct Tension Indicators	1072-8
Holes for Bolts and Other Fasteners	1072-18
Organic Zinc Primer Paint	1080-9

A. General

The materials shall meet the minimum requirements specified herein or as specified on the plans. Working drawings, catalog cuts, operation and maintenance manuals and certifications shall be submitted for approval in accordance with Article 105-2 of the Standard Specifications and the requirements of the Standard Project Special Provisions (PSP) for all mechanical equipment proposed for purchase or being fabricated.

All equipment and materials furnished under this item shall be brand new. All new equipment, materials and workmanship shall be first class in every particular, and shall be manufactured and installed to the satisfaction of the Engineer.

The design, workmanship and erection of all machinery components shall meet the applicable requirements of AASHTO 1988 Standard Specifications for Movable Highway Bridges, hereinafter referred to as the AASHTO Specifications, except as otherwise specified herein or as shown on the plans.

B. Span Locks

Span locks shall be provided at the bascule span and shall conform to the minimum requirements as shown on the plans and as specified herein. The new lock bar operators shall be Earle Type EG-3 as manufactured by the Steward Machine Company, Inc or approved equal. The lock bar operator shall include a motor and brake, reduction gearing and limit switches in one weatherproof, self-contained assembly.

The unit shall be provided with a removable hand crank for manual operation and a removable protective cover for the shaft end. The hand crank shall be stored in a stainless steel weatherproof enclosure near the lock bar operator as directed by the Engineer.

The operator shall be designed to deliver a thrust of 8,800 pounds to the lock bar at 50% of the stall torque of the motor. Operator components shall be so designed and detailed that stalling the motor shall not result in any physical damage to the lock bar operator mechanical components.

The motor shall be high starting torque, induction type, totally enclosed non-ventilated, severe duty, NEMA design D, 3 phase, dual voltage 480/240 volt, 60 hertz and have a 30 minute duty rating in which temperature rise is not to exceed 55°C. Motor-mounted disc brake shall be spring set, electrically released and shall be provided with a manual release. Brake housing shall be rated dust tight and weatherproof. Motor shall come furnished with a safety interlock switch that prevents the energizing of the motor as long as the hand crank is connected to the shaft extension.

The materials of the span lock components shall be as indicated on the plans and as specified herein.

Lock bars shall be forged alloy steel and shall also conform to the requirements of ASTM Specification A668 of the Class shown on the Plans. The lock bars shall be integral with the cylindrical stems and shall have an RC6 fit (running clearance) in the guide and receiving sockets as shown on the Plans and as approved by the Engineer.

Forgings shall provide adequate material allowance for machining to finish dimensions. All forgings shall be thoroughly annealed before being machined.

C. Structural Steel Supports

Structural steel for lock machinery support and sockets shall conform to the requirements of Section 1702 of the Standard Specification, ASTM A709, Grade 50. Steel components of manufactured items shall conform to the materials recommended by the manufacturer.

Top surfaces of all new supports shall be milled after fabrication to provide a uniform surface. All surfaces requiring milling shall have adequate material allowance for milling to the minimum finish dimensions as shown on the Plans.

Weldments for machinery base supports shall be neat and shall have all exposed sharp corners and edges removed. Mounting surfaces of the frames shall be straight and flat such that full contact with the equipment being supported or retained is obtained.

All welding required herein or called for on the plans shall be done in accordance with the requirements of AWS D1.5 and Subsection 1072-20 of the Standard Specifications. Weldments shall be stress relieved by heat prior to final machining. The fitting up and welding procedure shall be such that distortion of the work will be a minimum. If necessary to obtain this result, suitable welding fixtures shall be used. The Contractor shall submit welding procedures, together with the working drawings for the parts to the Engineer for approval.

All fillet welds and partial penetration groove welds shall be tested by the magnetic-particle method in accordance to the requirements of Section 6 of AASHTO/AWS D1.5. Radiographic testing shall be used for examination of complete joint penetration groove welds in butt joints. Complete penetration groove welds in T-joints and corner joints shall be tested by ultrasonic testing. All complete joint penetration welds shall be tested in accordance with requirements of Section 6 of AASHTO/AWS D1.5 for each size and type weld. Inspection and testing of welds and basis of acceptance shall be in accordance with the requirements of Section 6 of AASHTO/AWS D1.5.

All field welds shall be stress relieved by peening unless otherwise indicated within these Special Provisions or within the plans or unless specific written permission is granted to omit the peening process for each particular weld. The Contractor shall submit his proposed weld procedures for all field welds. Proposed peening procedures will be required to be included in the weld procedures before approval will be granted. No field welding shall begin until the approved weld procedures are available. All field welding shall be in accordance with Subsection 1072.20 of the Standard Specifications.

D. Shims

Where shown on the plans and required for leveling and alignment of equipment, machinery shims shall be full width and neatly trimmed to the dimensions of the assembled parts and drilled for all bolts that pass through the shims. Holes for bolts shall be oversized by 1/16-inch. In general, sufficient thickness shall be furnished to secure 1/64-inch variations of the shim allowance plus one shim equal to the full allowance. Shimming of equipment shall be performed with the least amount of shims needed to fill the space. No more than five (5) shims shall be used unless approved by the Engineer. Shims shall conform to Section 1072 of the Standard Specification, ASTM A709, Grade 36 except that thickness less than 1/4-inch shall be stainless steel. Corrosion resistant precision thickness shims will be permitted if desired by the Contractor.

Shims with open side or U-shaped holes for bolts will not be permitted for final alignment. No shims shall have less than two holes for bolts unless approved by the Engineer.

E. Fasteners

Turned bolts shall be quenched and tempered steel conforming to the requirements of ASTM Specifications A449 or A325. Turned bolts shall have the diameter of the shank 1/16-inch larger than the diameter of the threads. Hexagonal heads and nuts shall be in accordance with the heavy series and finished. Two nuts and washers on both sides of the hole shall be used on turned bolts. Lock washers will only be permitted if approved by the Engineer. All bolt heads and nuts shall bear on seats square with the axis of the bolt. On castings, except where recessed, the bearing shall be on finished bosses or spot-faced seats. Bolt heads that are recessed in castings shall be square.

High-strength steel bolts, nuts and hardened washers shall be galvanized and conform to the requirements of ASTM Specification A325. Connections using high-strength bolts shall conform to the "Specification for Structural Joints using ASTM A325 or A490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.

Anchor bolts fastening sockets and machinery supports to concrete shall be stainless steel threaded rods conforming to the requirements of ASTM F593 with heavy hex nuts and washers, diameter as shown on the plans. Nuts shall conform to the requirements of ASTM Specification A563. Threads shall be the Coarse Thread Series as specified in the latest issue of ANSI B1.1, having a Class 2A tolerance. Double nuts shall be used on all anchor bolts. Anchor bolt adhesive shall meet the requirements of Section 1081 of the Standard Specification for Type 3A adhesive.

Hex head cap screws shall conform to the requirements of ASTM Specification A193.

All threads for bolts, nuts, and cap screws shall conform to the coarse thread series and shall have a Class 2 tolerance for bolts and nuts or Class 2A tolerance for bolts and Class 2B tolerance for nuts in accordance with the ANSI B1.1, "Unified Screw Threads."

All bolt holes through unfinished surfaces shall be spot-faced for the head and nut, square with the axis of the bolts.

Positive locks shall be furnished for all nuts. If double nuts are used, they shall be of heavy hex nut thickness. Double nuts shall be used for all connections requiring occasional opening or adjustment. If lock washers are used for securing screws or nuts, they shall be made of tempered

steel and shall conform to the SAE heavy dimensions. The material shall meet the SAE tests for temper and toughness.

F. Lock Machinery Shielding

The Contractor shall furnish suitable shields for the new span locks being installed as shown on the plans. The shields shall be a minimum of 12-gage stainless steel sheet metal or other suitable material and as indicated on the plans. All guards shall be easily removable and replaceable as required for maintenance purposes.

G. Maintenance and Operation Manuals

The Contractor shall furnish maintenance and operation manuals giving complete instructions relative to assembly, installation, operation, adjustment, alignment, lubrication, maintenance, disassembly and carrying complete parts lists and assembly drawings for the new span locks installed. The manuals, under a separate section, shall be part of a general maintenance and operation manual as specified in PSSP - Operation and Maintenance Manuals, Lubrication Chart, and Training. Manuals shall be furnished concurrently with working drawings for review and approval by the Engineer.

H. Lubrication, Lubricants and Charts

All elements of the new span locks, which require lubrication including lock sockets shall be fitted for a pressure system of lubrication using 1/4-inch pipe-size giant button head fittings. Fittings shall be as manufactured by Stewart-Warner Alemite Corporation or approved equal.

All grease fittings shall be conveniently located for greasing, and they shall be connected to the points requiring lubrication from convenient lubrication stations as shown on the plans by 3/8-inch galvanized steel piping with a minimum bursting pressure of 12,000 psi. All pipes shall be securely supported and located so that it shall be protected from injury and excessive vibration. Maximum spacing of supports shall not exceed four feet. All lubricating equipment shall be installed in perfect working condition. Where multiple lubrication fittings are tied into one station each fitting shall identify its point of lubrication by being labeled. No grease fitting will lubricate more than one point of lubrication. Labels shall be made of brass tags with a number or nomenclature stamped on the tag which coincides with the lubrication chart being provided. They shall be mounted with stainless steel screws or 16-gage stainless steel wires. Location of the lubrication manifolds to be as directed by the Engineer.

The Contractor shall lubricate and maintain the new span lock machinery throughout the construction period. The Contractor shall supply all equipment and materials necessary for this operation.

The Contractor shall furnish sufficient lubricant to provide for the lubrication of the lock bar operators, locks and sockets requiring lubrication from installation until final acceptance and such additional lubricant for normal maintenance requirements for a period of at least two years.

Maintenance lubricants shall be stored where specified by the Engineer.

The Contractor shall furnish a lubrication chart as specified under PSSP - Operation and Maintenance Manuals, Lubrication Chart, and Training. The chart shall show the location of all

lubrication fittings and other points of mechanical and electrical equipment the require lubrication of any kind.

I. Paint

ALL SURFACES OF THE SPAN LOCK MACHINERY SHALL BE PAINTED USING A PAINT SYSTEM CONFORMING TO ALL REQUIREMENTS STATED IN DIVISION 4 SECTION 442, STEEL STRUCTURES, EXCEPT FOR THE FOLLOWING:

All unfinished machinery surfaces shall be made free of all chips, dirt, rust, scale, sand, grease, and other foreign matter by sandblasting or other approved means as stated elsewhere, except that sandblasting will not be permitted after machining of any surface.

After proper surface preparation, all unfinished machinery surfaces, except for those inside housing, shall be given one shop coat of primer prepared in accordance with the requirements given under Section 440, steel Structures.

After installation is complete, all machinery surfaces remaining exposed, except rubbing surfaces, shall be thoroughly cleaned and given field coats of paint prepared as specified elsewhere for intermediate and finish coat.

After completion of the operating tests and final acceptance of the project, all accumulated oil, grease, dirt, and other foreign matter shall be solvent cleaned in accordance with SSPC-SP1 from exposed machinery surfaces, except rubbing surfaces. Paint shall be touched up as required to the satisfaction of the Engineer.

Nameplates on all manufacturers' components shall be readable, clean and free of all paint before acceptance of the machinery.

J. Spare Parts

The Contractor shall furnish the following spare parts for the new span lock machinery system:

- 2 Complete sets of wear shoes of each type A, B and C including shims and cap screws.
- 2 Span lock motor with integral disc brake and safety interlock with hand crank.

Spare parts shall be provided in sealed, uniform sized cartons with typed and clearly varnished labels to indicate their contents and to the respective bridge, and they shall be stored where ordered by the Engineer. The spare parts shall also be marked to correspond with their respective item numbers.

K. Warranty and Quality Control

All manufacturers shall warrant all products and associated hardware to be free of defects in material and workmanship for a period of one (1) year from the date of final acceptance of the completed bridge contract. Final Acceptance shall be in accordance to Subsection 105-17 of the Standard Specifications. Any defect within this period shall be repaired or replaced by the Manufacturer or Vendor, at total cost to the Manufacturer or Vendor, including labor, parts, and transportation. The Contractor shall provide letters to the suppliers with copies to the Engineer, identifying the scheduled date of final acceptance of the bridge and therefore the date the warranty shall begin. If the date of final acceptance gets extended, it shall be the Contractors

responsibility to extend the commencement of the warranties from the suppliers at no cost to the Department.

IV. CONSTRUCTION DETAILS

A. General

The span lock machinery specified and as approved on the shop drawings and related electrical equipment shall be installed according to best millwright practice. Millwrights shall provide information that they have performed installations on heavy machinery of a similar character to that required within this project. The millwright foreman shall have successfully installed movable bridge machinery on previous projects.

The Contractor shall coordinate the work with subcontractors to provide for the necessary shop assembly and field installation of all of the equipment.

B. System Supplier

As part of this item, the Contractor shall be required to have the new span lock machinery system supplier be present on the site during system installation and train the Department's personnel. Training shall be in accordance to the requirements specified under PSSP - Operation and Maintenance Manuals, Lubrication Chart, and Training.

C. Working Drawings

Working drawings shall show all parts completely detailed and dimensioned. The grade and extent of finish machining, with all tolerances and allowances, shall be stated for each part for which a specific fit is required. Finished surfaces shall be as defined by the ANSI B46.1, Surface Texture; and fits shall be as defined by the ANSI B4.1, Preferred Limits and Fits for Cylindrical Parts, unless otherwise stated herein or on the plans. ANSI B4.1 shall also apply to fits for non-cylindrical parts.

Manufactured components shall be shown in outline on the drawings, with sufficient dimensions and data to determine the clearances required for installation and operation. Manufacturer's certified dimension prints shall state the name of the job; pertinent ratings of the equipment; and shall indicate, where applicable, the provisions for adding, draining, and checking the level of lubricant; the method of lubrication and type of fittings; and the location of inspection openings.

The Contractor shall furnish complete data regarding the design and construction of all manufactured items to be furnished as part of the machinery under this Contract, including material specifications, tolerances, finishes, cross-sectional assembly drawings, detail drawings of component parts, and the dimensions of principal elements. This information to be furnished concurrently with the working drawings.

Complete shop bills of materials shall be made for all machinery parts. If the bills are not shown on the working drawings, prints of the bills shall be furnished for review in the same manner as specified for the drawings. This information to be furnished concurrently with the working drawings.

Working drawings shall give identifying marks and essential dimensions for locating each part or assembled unit with respect to the bridge.

The Contractor shall submit to the Engineer for review the required number of prints of all working drawings. In case of correction or rejection, the Contractor shall resubmit the required number of prints of working drawings until drawings are approved and such procedure shall not be considered a cause for delay. All corrections and revisions to details or dimensions shall be clearly marked on the working drawings by respective revision marks. The Contractor shall bear all costs for damages, which may result from the ordering of any materials prior to the approval of the working drawings; and no work shall be done until the working drawings have been reviewed and approved by the Engineer.

Approval of the working drawings by the Engineer shall not relieve the Contractor from full responsibility for the satisfactory construction and operation of the machinery.

V. INSPECTION AND TESTING

The Contractor shall furnish all facilities for the inspection of material and workmanship in the foundries, forge, and machine shops; and the Engineer shall be allowed free access to necessary parts of the premises. Work done while the Inspector has been refused access will automatically be rejected.

The Inspector shall have the power to reject materials or workmanship, which do not fulfill the requirements of these Specifications.

Inspection at the foundries, forge and machine shops is intended as a means of facilitating the work and avoiding errors; and it is expressly understood that it will not relieve the Contractor from any responsibility in regard to imperfect material or workmanship and the necessity for replacing the defective materials or workmanship.

The acceptance of any material or finished parts by the Engineer shall not bar their subsequent rejection if found defective. Rejected material and workmanship shall be replaced or corrected by the Contractor in a manner satisfactory to the Engineer at no additional cost to the Department.

The lock bar operator manufacturer shall shop test each unit with the respective sockets by operating it at the normal running speed in the orientation it will be installed in the field. Each lock bar operator shall be tested for 15 cycles (extend and retract = 1 cycle). During this testing motor amperages shall be measured and recorded. During testing, each operator shall be checked for unusual noise (thumping or any non-uniformity) and any other unusual operating characteristics. The units shall operate smoothly, and without excessive vibration or temperature rise. All malfunctions shall be recorded and corrected, and the units retested, if necessary, before release from the manufacturer's shop. After the unit has passed the test, a Certificate of Compliance shall be submitted by the Contractor to the Engineer. After the testing, each unit shall have lubricant drained and inspected and new lubricant installed. Prior to testing, the Contractor shall notify the Engineer three (3) weeks in advance for the ability to witness the components during testing. No testing shall be performed without the presence of the Engineer or Engineer's representative unless the Contractor has been otherwise directed, in writing, by the Engineer.

Assemblies shall be match-marked to ensure reassembly in the field with the same components.

VI. PROTECTION FOR SHIPMENT

All finished metal surfaces and unpainted metal surfaces that might be damaged by corrosion shall be coated as soon as practicable after disassembly or finishing with a corrosive-preventative compound. This coating shall be removed from all surfaces prior to assembly and painting after installation.

All machinery parts shall be completely protected from weather, dirt and all other injurious conditions during disassembly, manufacture, shipment, and while awaiting erection.

Every precaution shall be taken to ensure that the bearing surfaces will not be damaged and that all parts shall arrive at their destination in satisfactory condition.

Assembled units shall be mounted on skids or otherwise crated for protection during handling and shipment.

VII. INSTALLATION AND FIELD TESTING

Prior to any work being performed on the machinery, the Contractor shall submit to the Engineer for approval a detailed installation procedure. This procedure shall give in detail explanation for match marking and installation and testing of new machinery. Procedures shall include duration of time involved with the work and shall show coordination with structural, electrical and architectural repairs, which will be coinciding with the mechanical work.

All parts of the machinery shall be installed in accordance with installation marks and match marks. Before final drilling or reaming, all parts shall be adjusted to exact alignment by means of shims furnished for each part. After final alignment and bolting, all parts shall operate smoothly.

Bolt holes in structural steel for connecting machinery shall, in general, be drilled from the solid after final alignment of the machinery. Sufficient installation holes, sub-drilled 1/4-inch undersize for undersize temporary bolts, may be used for installation and alignment of the machinery. After the machinery has been aligned in its final position, full-size holes for the remaining bolts shall be drilled or sub-drilled and reamed, the full-size bolts installed, and the temporary bolts removed. The undersize holes used for temporary bolts shall then be reamed full-size and full-size bolts installed.

The machinery shall be installed and adjusted by competent millwrights skilled in the type of work involved. They shall be provided with all necessary measuring and leveling instruments, as may be required including but not limited to laser alignment equipment, dial indicators, and feeler gages. Contractor shall provide all necessary equipment and methods to the Engineer to verify proper alignment of all machinery has been obtained to the satisfaction of the Engineer.

Prior to placing any of the new span locks in operation, the Contractor shall have the system supplier representative be on site to inspect the installation of the new span locks to ensure it is installed to the supplier's requirements and tolerances. System Supplier Representative shall furnish a letter to the Engineer after the inspection certifying that the installation is acceptable and in conformance to the requirements of the lock machinery supplier.

The span lock machinery shall be installed with the utmost care in the field. Ropes, slings or other equipment used for installation shall be carefully placed to prevent scratches, abrasions or other damage. The lock bar operators and sockets shall be placed as indicated on the plans.

To install the new span lock machinery, the Contractor shall first vertically align the bascule leaves at the centerline of the bascule span by adjusting the front live load shoes. The support for the lock bar operators shall then be installed and the operators, with lock bars, temporarily attached with undersized bolts. Holes for these bolts in the operator shall be sub-drilled in the field after the operators have been roughly aligned. The receiving and guide sockets shall likewise be attached with undersized bolts through new holes, finished to the size of the weldments, in the structural steel. Holes for these bolts in the socket weldments shall be sub-drilled in the field after the sockets have been roughly aligned. If necessary, angular alignment of the sockets shall be adjusted with beveled shims placed between the sockets and the structural steel. The lock bars shall then be operated through several cycles by manual cranking and adjustments made to the location of the sockets and lock bar operators as required to align all elements of the span locks. Holes shall then be reamed for turned bolts to permanently fasten the lock bar operators and sockets.

The millwrights responsible for the installation of the lock bar mechanism shall be responsible for proper installation of the sockets. Any additional requirements necessary to provide assurance that the receiver will be installed to the degree of accuracy necessary for proper functioning of the receiver shall be made at no additional cost to the Department. Any re-adjustment and/or re-machining of the receiver necessary to eliminate any cross bearing between the wear plates and the lock bar shall be at no additional cost to the Department.

The lock bar operator shall be precisely aligned with the lock bar after final installation of the lock bar guide and receiving sockets. The centerline of the operator shall be collinear to the lock bar. The operator shall be shimmed vertically as shown on the plans at the location of the operator.

All adjusting, aligning and testing of the new span lock machinery shall be done with no extraneous loads upon the bascule spans.

All gear housings shall be filled with lubricant to the proper level, and all rotating and sliding parts shall have their surfaces applied with lubricants recommended by the suppliers of the units.

The lubricants listed on the lubrication charts shall conform to the recommendations of the Manufacturer of the units and shall be coordinated with the other components on this project to minimize the amount of lubricants to be furnished.

After completion of electrical and mechanical work for span lock installation, and after greasing all lock machinery components as described above, the Contractor shall demonstrate satisfactory operation of the span lock machinery by having them driven and pulled in the presence of the Engineer. The span locks shall be operated electrically and by the hand crank with which each unit is equipped. The leaves shall be raised between each cycle to simulate a regular opening of the bridge. The number of such operating cycles for demonstration purposes shall be as requested by the Engineer, and shall be sufficient to verify proper adjustment and functioning of the span lock system.

During the foregoing test runs, all parts shall be inspected to detect overheating, misalignment, or incorrect adjustment. All such defects shall be corrected at no cost to the Department before final acceptance.

VIII. MEASUREMENT AND PAYMENT

Payment for Pay Item Span Lock Machinery will be made on a lump sum basis.

The lump sum price bid for the Pay Item Span Lock Machinery shall include the cost of furnishing all labor, material, equipment and any incidentals required to complete the work which includes furnishing and installing the new span locks consisting of the lock bar operator (tail and toe), sockets, bolts, lubrication fittings and lubricants, shims, supports and any incidentals required to properly execute and place in complete working order the new span locks in accordance with the Plans, Standard Specifications, Standard PSP and PSSP. Cost shall also include having the span lock machinery representative on site for installation acceptance.

Payment for the span lock representative performing the training is not part of this item, but is paid for under PSSP - Operation and Maintenance Manuals, Lubrication Chart, and Training.

Payment for furnishing electrical work associated with the new span lock machinery including wiring to motors, brakes and limit switches is not part of this item, but is paid for under PSSP Bridge Control System.

Progress payments will be made. Prior to the beginning of any work, the Contractor shall submit to the Engineer a detailed schedule of work operation. This schedule shall be complete and include the expected percentage of work to be completed within specific time frames. The Engineer will use the schedule to authorize progress payments in accordance with actual work completed. The Engineer may at any time require the preparation and submittal of an updated work schedule. Failure by the Contractor to submit an updated schedule upon request will cause the progress payment procedure to terminate immediately.

Payment will be made under:

Pay Item	Pay Unit
Span Lock Machinery	Lump Sum

SUMP PUMP SYSTEMS

I. DESCRIPTION

The work under this Section shall consist of furnishing all labor, equipment and materials (including spare parts) and performing all work necessary to install, test and place in correct, satisfactory operating condition new sump pumps, piping, floats switches and controls. Work shall also include the removal and disposal of the existing sump pump systems along with the associated piping and electrical wiring.

II. MATERIALS AND FABRICATION

Sump Pumps shall be Model 1601, 2 inch discharge with 1 HP, 1750 RPM, 3 phase, 460 volts motor as manufactured by the Weil Pump Company, Inc. or approved equal. Pumps shall be capable of pumping 80 gallons per minute maximum with a minimum of 28 feet of head.

Both primary and secondary stage pumping system shall be powered and controlled through a duplex alternating control panel with single pole switch assembly (refer to electrical specifications for additional detail). The control panel shall come furnished with all necessary electrical components for a complete and independent operation and alternating of the two pumps, including but not limited to motor contactors, overload protection, circuit breakers, control transformers, level controllers, terminal blocks, test-off-auto selector switches, red pilot lights and NEMA 4X cabinets. The level switches for the duplex system shall operate the sump pumps independently and shall consist of tethered float switches. The level switches shall control the sump pumps and shall be mounted as shown on the Plans. The duplex pump system shall have four micro switches for control, which shall consist of a pump off, lead pump on, lag pump on, and high water alarm.

The Duplex alternating panel shall be able to alternate which pump is primary (lead) pump after each use.

Power and control wiring length shall be field measured, but as a minimum, the length of wire shall be 50 feet to allow a continuous length from the pumps and switches to the control panels.

Piping shall be polyvinyl chloride (PVC) plastic pipe conforming to ASTM D2665.

Fittings for PVC pipe shall be polyvinyl chloride (PVC) conforming to ASTM D2665.

Check valves installed in piping shall be PVC ball check valve capable of being mounted in any position with a pressure rating of 150 psi. Size shall be equal to the size of the pipe on which it is installed.

Drain spigot shall be 1 inch PVC Drum Faucet with ball valve with threaded end capable of connection to hose on outlet.

Pipe supports shall be heavy wrought pipe clamp with galvanized finish as manufactured by Anvil International or approved equal.

Piping supports consisting of structural steel hangers, U-bolts, rods, and wear shields shall be galvanized and conform to Section 1076 Galvanizing of the Standard Specifications unless otherwise specified.

Anchors for pipe supports shall be Stainless Steel Kwik-Bolt II rod coupling as manufactured by Hilti or approved equal.

III. CONSTRUCTION DETAILS

A. Submittals

The Contractor shall prepare and submit for review working drawings and catalogs for the new sump pump including piping and miscellaneous components. Working drawings shall conform to the requirements of Section 105 of the Standard Specifications and shall include the following:

- (1) Pump and piping configuration in plan and elevation showing its relation to the structure and other work including structural, electrical, architectural, and other mechanical.
- (2) Details showing all steel support for piping and connection to existing structure.
- (3) Manufacturer's catalog information and data for pumps, control panels, piping, fittings, piping supports including installation and maintenance instructions.

B. Warranty and Quality Control

All manufacturers furnished as part of this section shall warrant all products and associated hardware to be free of defects in material and workmanship for a period of one (1) year from the date of final acceptance of the completed bridge contract. Final Acceptance shall be in accordance to Subsection 105-17 of the Standard Specifications. Any defect within this period shall be repaired or replaced by the Manufacturer or Vendor, at total cost to the Manufacturer or Vendor, including labor, parts, and transportation. The Contractor shall provide letters to the suppliers with copies to the Engineer, identifying the scheduled date of final acceptance of the bridge and therefore the date the warranty shall begin. If the date of final acceptance gets extended, it shall be the Contractors responsibility to extend the commencement of the warranties from the suppliers at no cost to the Department.

C. Spare Parts

The contractor shall furnish the following spare parts for the Sump Pump System for each bascule pier:

- 2 complete sets of fuses and pilot lights for the duplex control system.
- 1 set of four tethered float switches.

D. Installation

The Contractor shall field verify all locations where the sump pumps, control panels and piping are to be installed to ensure no conflicts with the structure or other portion of work.

Contractor shall follow manufacturer's literature for proper installation of the sump pumps.

PVC piping shall be stored prior to installation on racks to provide continuous support to prevent sagging. No sharp edges or heavy objects shall come into contact with the piping or fittings. Piping shall not be subjected to excessive heat prior to or during installation.

PVC piping shall be installed and joined as per the pipe manufacturer's specifications and as specified herein for PVC joints using solvent cement.

Where flanges on PVC pipe are required, the Contractor shall install flanges using solvent cement and shall use full-face flat-type gaskets between flanges.

Cutting of PVC pipe shall be square cuts at pipe ends, the inside diameter shall be deburred and the outside diameter for the PVC pipe shall be beveled to the manufacturer's requirements.

Prior to placing the system into operation, the piping to and from the pumps shall be hydrostatically testing to ensure proper water tightness of system. The test shall be in accordance to Section 312 of the International Plumbing Code. Under no circumstance shall a vacuum be created.

Upon completion of the pressure testing and prior to placing system in operation, the Contractor shall, in the presence of the Engineer, place each system through an operation test. This test shall show proper operation of the switches, pumps, check valves, and drains. If any portion of the system does not function, the Contractor shall retest the system until the Engineer is completely satisfied.

IV. MEASUREMENT AND PAYMENT

No measurement will be made for the Pay Item Sump Pumps Systems for the payment will be made on a lump sum basis.

The lump sum price for the Pay Item Sump Pump Systems shall include the cost of furnishing all labor, equipment, and materials required to complete the work as shown on the plans and specified herein which includes furnishing and installation of pumps, control panels, piping, fittings, valves, pipe supports, as well as testing of the piping and the system.

Payment for electrical work associated with providing the power and making the electrical connection to the electrical panels is not part of this item, but is paid for under PSSP Section Control House and Pier Electrical Work.

Payment will be made under:

Pay Item	Pay Unit
Sump Pump Systems	Lump Sum

TRUNNION ASSEMBLIES

I. DESCRIPTION

The work under this Section shall consist of furnishing all labor, equipment and materials as shown on the Plans and specified herein. The work under this Section requires the Contractor to furnish and install the trunnions, hubs, keys with keyways, trunnion bearings, instrument drive shaft extension/coupling, fasteners, and all materials and work incidental to these activities.

II. ABBREVIATIONS

Portions or all of certain recognized industry or association standards or specifications referred to herein as being a requirement of these Special Provisions shall be considered as binding as though reproduced in full herein unless supplemented and/or modified by more stringent requirements of the Contract Documents. Unless otherwise stated, the referenced standard or specification current as of the date of issuance of these Special Provisions shall be used. The following abbreviations will be used herein and on the Plans to designate standard specifications for material and workmanship:

- American Association of State Highway and Transportation Officials..... AASHTO
- American Gear Manufacturers Association..... AGMA
- American Iron and Steel Institute AISI
- American National Standard Institute..... ANSI
- American Society of Mechanical Engineers..... ASME

American Society of Testing Materials	ASTM
American Welding Society	AWS
National Electrical Manufacturers Association	NEMA
National Lubricating Grease Institute.....	NLGI
Occupational Safety and Health Act.....	OSHA
Society of Automotive Engineers	SAE
Steel Structure Painting Council.....	SSPC

III. MATERIALS AND FABRICATION

Refer to Division 10:

Item	Section
Structural Steel	1072
Anchor Bolts	1072-6
High Strength Bolt, Nuts, Washers, and Direct Tension Indicators	1072-7
Holes for Bolts and Other Fasteners	1072-18
Organic Zinc Primer Paint	1080-9
Epoxy and Adhesives	1081

A. General

The materials shall meet the minimum requirements specified herein or as specified on the Plans. Working drawings, catalog cuts, operation and maintenance manuals and certifications shall be submitted for approval in accordance with Article 105-2 of the Standard Specifications and the requirements of the Standard Project Special Provisions (Standard PSP) for all mechanical equipment proposed for purchase or being fabricated.

All equipment and materials furnished under this item shall be brand new. All new equipment, materials and workmanship shall be first class in every particular, and shall be manufactured and installed to the satisfaction of the Engineer.

The design, workmanship and erection of all machinery components shall meet the applicable requirements of AASHTO 1988 Standard Specifications for Movable Highway Bridges, hereinafter referred to as the AASHTO Specifications, except as otherwise specified herein or as shown on the Plans.

B. Forgings

All forgings shall conform to the requirements of ASTM A668 of the Class as shown on the plans.

Forged carbon steel components shall be fully annealed. Heavy shafts forged directly from ingots shall be bottom poured, and particular care shall be taken to prevent air pockets and shrinkage spots in these ingots.

Shafts, forged in pairs, shall be separated before being annealed.

A shaft forging more than three (3) inches in diameter shall have an extension sufficient in length from which a standard sized specimen may be obtained by means of a core drill or rim cutter. Each shaft and each test specimen shall be marked with a designation number. Complete records

of all tests shall be kept. When shafts are forged in pairs, provisions for the specimens for each shaft of such pair shall be made.

Test specimens from a once annealed forging not meeting the specifications will require a second annealing. This is permissible, but the same forging shall in no case be subjected to more than three (3) annealings; that is, the initial annealing and the two subsequent annealings.

The inspection holes required in heavy forgings, to determine their interior soundness shall preferably be forged at the forge shop. The Contractor shall inform the Engineer before starting this work, to arrange for inspection and tests. A copy of shipping invoices shall list each unit individually giving the designating number and weight of each shaft forging and mailed to the Engineer for his use.

Original metal shall be used in the composition base material. No scrap material is permitted.

Forgings shall provide adequate material allowance for machining to finish dimensions. All forgings shall be thoroughly annealed before being machined.

C. Castings

Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended. The test projections shall be such that they can be turned down and planed to specimens of standard size and shape which do not effect the finished dimensions of component or its structural integrity.

Each casting shall have a coupon cut in the form of a cube or cylinder, which can be cut or finished to one (1) inch square in section and one (1) inch high. This coupon shall be uniform with the casting in every respect.

Castings weighing over 500 lbs. shall be suspended and hammered all over. If cracks, flaws, defects or weaknesses are evident, either audibly during the hammering or visually after such treatment, they may be cause for rejection. The Engineer reserves the right to subject these portions to additional non-destructive tests.

Prior to the test, all castings shall be sandblasted or otherwise effectively cleaned of scale and sand, to present a smooth, clean and uniform surface. No sharp, unfilleted angles or corners shall be allowed in a casting.

The effects of annealing and re-annealing shall be determined. At least one tension test shall be made from each melt in each annealing charge and from each casting weighing over 500 lbs. Suitable projections shall be provided on casting at different points in a way that will enable the Engineer to verify the uniform and proper annealing of the casting. Three (3) annealings will be permitted, therefore, sufficient projections shall be provided to ascertain the effect of each successive annealing. These specimens shall show a fracture having a silky and fine granular structure throughout. Projections used for testing shall be broken off only in the presence of the Engineer, or his representative. He will stamp the piece or pieces broken off for identification if the grain is found to be refined.

After the inspection and tests are completed satisfactorily, all projections, fins from sink heads, runners and annealing scale shall be removed. Surfaces which are to be machined may be left untouched, but such surfaces must be distinctly marked on the shop drawings.

During the casting and annealing process the metal shall not be overheated excessively or otherwise injured. Appropriate temperature indicating devices shall be used.

Blow holes appearing on finished castings shall be so located that a straight line laid in any direction will not reveal a cavity longer than one (1) inch in any one (1) foot, nor any simple blow hole exceed one (1) inch in any dimension or have an area greater than one-half (1/2) square inch. Blow holes shall not have a depth adversely affecting the strength of the casting. Minor defects which do not impair the strength may, with the approval of the Engineer, be welded by an approved process. The defects shall be removed to solid metal by chipping, drilling or other satisfactory method, and after welding, the castings shall be annealed, if required and as directed by the Engineer. Castings which have been welded without the Engineer's approval will be rejected.

Steel castings shall conform to ASTM A27 Grade 70-36, unless otherwise noted. Steel castings noted as ASTM A148 shall be tested in accordance with Supplemental Specification S9.

Before any work is started, the Contractor shall notify the Engineer to arrange for inspection and tests. Invoices for each casting shipped, giving the number and weights, shall be sent to the Engineer.

D. Magnetic Particle Examination

All castings shall be magnetic particle examined 100% in accordance with ASTM Specification E 709.

The test procedure shall be multidirectional magnetization whereby the magnetic field is induced in the casting by passing a current through the piece to be tested.

The current used shall be such that a magnetic field of sufficient strength to produce interpretable indications is developed. Adequacy of field strength shall be verified by the use of a magnetic field indicator.

The part shall be examined using fluorescent, wet magnetic particle and black light procedures.

After inspection, the castings shall be demagnetized by current reversal to a degree that any residual field will not create problems during the machine operations.

The Engineer shall be notified not less than three weeks prior to testing so that his representative may be present at the time of testing.

E. Structural Steel

Structural steel shall conform to the requirements of Section 1072 Structural Steel, ASTM A709, Grade 50. Steel components of manufactured items shall conform to the materials recommended by the manufacturer.

Mounting surfaces of all new supports shall be milled after fabrication to provide a uniform surface. All surfaces requiring milling shall have adequate material allowance for milling to the minimum finish dimensions as shown on the Plans.

F. Welding

Weldments for machinery and supports shall be neat and shall have all exposed sharp corners and edges removed. Mounting surfaces of the frames shall be straight and flat such that full contact with the equipment being supported or retained is obtained.

All welding required herein or called for on the Plans shall be done in accordance with the requirements of AWS D1.5 and Subsection 1072-20. Weldments shall be stress relieved by heat prior to final machining. The fitting up and welding procedure shall be such that distortion of the work will be a minimum. If necessary to obtain this result, suitable welding fixtures shall be used. The Contractor shall submit welding procedures, stress relief procedures, together with the working drawings for the parts to the Engineer for approval.

All fillet welds and partial penetration groove welds shall be tested by the magnetic-particle method in accordance with the requirements of Section 6 of AASHTO/AWS D1.5. Radiographic testing shall be used for examination of complete joint penetration groove welds in butt joints and for complete penetration groove welds in T-joints and corner joints shall be tested by ultrasonic testing. All complete joint penetration welds shall be tested in accordance with the requirements of Section 6 of AASHTO/AWS D1.5 for each size and type weld. Inspection and testing of welds and basis of acceptance shall be in accordance with the requirements of Section 6 of AASHTO/AWS D1.5.

G. Trunnion Assemblies

Trunnion assemblies shall be provided for the bascule span and shall conform to the minimum requirements as shown on the Plans and as specified herein. The trunnion shafts, hubs, trunnion bearings, keys and keyways, and instrument drive shaft/coupling (where noted on the Plans) shall be furnished, installed and aligned as specified herein. Cam switch support shall be furnished and installed under Section 440 Steel Structures. Cam switch shall be furnished, installed, aligned, and wired under the Project Specific special Provisions (PSSP), Bridge Control System.

Trunnion shafts shall be furnished in accord with the requirements for materials and providing the configuration and details shown on the Plans. The trunnion shafts shall be forged to conform to the requirements of ASTM specification A668 of the class shown on the Plans. Trunnion shafts shall have an FN3 (interference) fit with the hubs and bascule girders, and shall have the fits and finishes required with the trunnion bearings by the AASHTO Specifications.

H. Trunnion Hubs (Spider)

Trunnion hubs shall be weldments of structural steel conforming to the requirements for the material shown on the Plans, and shall be fabricated and machined to the dimensions shown on the Plans. A pair shall be mounted to each of the bascule girders using turned bolts. Epoxy (Devcon 10-Minute Epoxy Black, or equal) shall be used to coat the back of the hub and the mounting surface of the girder web, and fill any imperfections between each hub and the girder web. Each trunnion shall be installed with an FN3 fit between the trunnion and the hubs and bascule girder, and shall be located at the centerline of rotation shown on the Plans, absolutely perpendicular to the girder web.

I. Pillow Block Bearings

Trunnion bearings shall be bronze bushed pillow block assemblies as shown on the plans. Pillow block bearings for the trunnions shall be constructed of cast steel conforming to the requirements of ASTM A27 Grade 70-36. The Contractor has the option to substitute using structural steel conforming to the requirements ASTM A36 or ASTM A709 Grade 36. The pillow blocks shall be cast or fabricated and machined to the dimensions shown on the Plans. They shall be fitted with bronze bushings meeting the requirements specified in this Section and as shown on the Plans.

Each pillow block shall be machined to the fits and finishes required by the AASHTO Specifications. Bores and grease grooves shall be provided in the pillow blocks in the locations shown to effectively lubricate the bearings and trunnion shafts. Turned studs shall secure the cap to the base of the pillow block. Brass shims (liners) shall be used to attain the required clearance between the trunnion shaft and the base and cap bushings.

Bushings shall conform to AASHTO Designation M 107 (ASTM B-22), Alloy UNS No. C91100.

The new bushings for the span drive split bearings shall be finished bored with the caps in place. Each bearing shall be furnished with 3/4-inch thick brass liners and 1/2-inch thick shims. Each set of shims shall conform to Subsection L of this Section. The brass liners shall consist of two solid piece 0.25-inch +0.002"/-0.000" thick, one solid piece 0.125-inch +0.0002"/-0.000" thick, and one piece 0.125-inch +0.002"/-0.000" thick in 0.003-inch laminations and 1/2-inch thick shims with pre-drilled bolt holes. The edges of the liners shall be cut square and flush with the bushing flange. Except for a short distance from each end, the inside edges of the liners shall be cut back to form a grease groove along the shaft. All bolt holes shall be drilled through the liners with sufficient clearance.

Pillow blocks shall be mounted to the trunnion support using turned bolts. Shims shall be used to carefully align the trunnions by the means of alignment described under Section IV Construction Details.

J. Turned Bolts

Turned bolts shall be quenched and tempered steel conforming to the requirements of ASTM Specifications A449 or A325. Turned bolts shall have the diameter of the shank 1/16-inch larger than the diameter of the threads. Hexagonal heads and nuts shall be in accordance with the heavy series and finished. Two nuts or one nut and a lock-washer shall be used on turned bolts. Lock washers will only be permitted if approved by the Engineer. All bolt heads and nuts shall bear on seats square with the axis of the bolt. On castings, except where recessed, the bearing shall be on finished bosses or spot-faced seats. Bolt heads, which are recessed in castings, shall be square. Turned bolts in finished holes shall meet the requirements of AASHTO Article 2.5.17. Turned bolts shall conform to the requirements of Section 2.6.18 Fasteners and Section 3.3.15 Bolt Holes and Bolts, of the AASHTO Specifications.

K. Keys and Keyways

Keys and keyways shall be provided between the hubs and trunnion shafts. Keys and keyways shall conform to the dimensions and tolerances for square and flat keys of ANSI B17.1. All keys

shall be effectively held in place by setting them into closed-end keyways milled into the shaft. The ends of all such keys shall be rounded to a half circle equal to the width of the key.

L. Shims

Machinery shims under the trunnion bearings shall be neatly trimmed to the dimensions of the assembled parts and drilled for all bolts that pass through the shims. Holes for bolts shall be oversized by 1/16-inch. In general, sufficient thickness shall be furnished to secure 1/64-inch variations of the shim allowance plus one shim equal to the full allowance. Shimming of equipment shall be performed with the least amount of shims needed to fill space. No more than five (5) shims shall be used unless approved by the Engineer. Shims shall conform to the requirements of ASTM A709, Grade 36, except that thickness less than 1/4-inch shall be stainless steel.

M. Maintenance and Operation Manuals

The Contractor shall furnish maintenance and operation manuals giving complete instructions relative to assembly, installation, operation, adjustment, alignment, lubrication, maintenance, disassembly and carrying complete parts lists and assembly drawings for the trunnion assemblies. The manuals, under a separate section, shall be part of a general maintenance and operation manual as specified elsewhere in these Special Provisions under PSSP - Operation and Maintenance Manuals, Lubrication Chart, and Training. Manuals shall be furnished concurrently with working drawings for review and approval by the Engineer.

N. Lubrication, Lubricants and Charts

The trunnion bearings shall be fitted for a pressure system of lubrication using 1/4 inch pipe-size giant button head fittings, or as otherwise shown on the Plans. Fittings shall be as manufactured by Stewart-Warner Alemite Corporation or approved equal.

All grease fittings shall be conveniently located for greasing, or shall be connected to the points requiring lubrication from convenient lubrication stations by 3/8 inch galvanized steel piping with a minimum bursting pressure of 12,000 psi. All pipe shall be securely supported and located so that it shall be protected from injury and excessive vibration. Maximum spacing of supports shall not exceed four feet. All lubricating equipment shall be installed in perfect working condition. Where multiple lubrication fittings are tied into one station each fitting shall identify its point of lubrication by being labeled. No grease fitting will lubricate more than one point of lubrication. Labels shall be made of brass tags with a number or nomenclature stamped on the tag which coincides with the lubrication chart being provided under the requirements of PSSP - Operation and Maintenance Manuals, Lubrication Chart, and Training. They shall be mounted with stainless steel screws or 16 ga. stainless steel wire. Location of the lubrication manifolds to be as directed by the Engineer.

The Contractor shall furnish sufficient lubricant to provide for the lubrication of trunnion bearings until final acceptance and such additional lubricant for normal maintenance requirements for a period of at least two (2) years.

Maintenance lubricants shall be stored where specified by the Engineer.

The Contractor shall place the lubrication points of the trunnion assemblies on the lubrication chart as specified under PSSP - Operation and Maintenance Manuals, Lubrication Chart, and Training.

O. Protection of Machinery

All finished metal surfaces and unpainted metal surfaces that might be damaged by corrosion shall be coated as soon as practicable after disassembly or finishing with a corrosive-preventative compound. This coating shall be removed from all surfaces prior to assembly and painting after installation.

All machinery parts shall be completely protected from weather, dirt and all other injurious conditions during disassembly, manufacture, shipment, and while awaiting erection.

All shaft journals that are shipped disassembled from their bearings shall be protected during shipment and before erection by a packing of oil-soaked fabric secured in place by burlap or rust preventative spray such as Cosmoline and covered with heavy metal thimbles or heavy timber lagging securely attached. Every precaution shall be taken to ensure that the bearing surfaces will not be damaged and that all parts shall arrive at their destination in satisfactory condition.

Assembled units shall be mounted on skids or otherwise crated for protection during handling and shipment.

P. Paint

ALL SURFACES OF THE TRUNNION ASSEMBLIES SHALL BE PAINTED USING A PAINT SYSTEM CONFORMING TO ALL REQUIREMENTS STATED IN DIVISION 4 SECTION 442, STEEL STRUCTURES, EXCEPT FOR THE FOLLOWING:

All unfinished machinery surfaces shall be made free of all chips, dirt, rust, scale, sand, grease, and other foreign matter by sandblasting, or other approved means as stated elsewhere, except that sandblasting will not be permitted after machining of any surface.

After proper surface preparation, all unfinished machinery surfaces, except for those inside housing, shall be given one (1) shop coat of primer prepared in accordance with the requirements given under Section 440, Steel Structures.

After installation is complete, all machinery surfaces remaining exposed, except rubbing surfaces, shall be thoroughly cleaned and given field coats of paint prepared as specified elsewhere.

After completion of the operating tests and final acceptance of the project, all accumulated oil, grease, dirt, and other foreign matter shall be solvent cleaned in accordance with SSPC-SP1 from exposed machinery surfaces, except rubbing surfaces. Paint shall be touched up as required to the satisfaction of the Engineer.

Q. Warranty and Quality Control

All manufacturers shall warrant all products and associated hardware to be free of defects in material and workmanship for a period of one (1) year from the date of final acceptance of the completed bridge contract. Final Acceptance shall be in accordance with the Standard Specifications. Any defect within this period shall be repaired or replaced by the Manufacturer

or Vendor, at total cost to the Manufacturer or Vendor, including labor, parts, and transportation. The Contractor shall provide letters to the suppliers with copies to the Engineer, identifying the scheduled date of final acceptance of the bridge and therefore the date the warranty shall begin. If the date of final acceptance gets extended, it shall be the Contractor's responsibility to extend the commencement of the warranties from the suppliers at no cost to the Department.

The Department reserves the right to receive on demand a test report from an independent laboratory certifying that the equipment furnished meets these specifications, at no cost to the Department.

The Department reserves the right to reject an entire shipment of material covered by this specification if an item or items are found to be defective within a 30-day period following receipt of materials.

IV. CONSTRUCTION DETAILS

A. General

The machinery specified and as approved on the shop drawings and related electrical equipment shall be installed according to best millwright practice. Millwrights shall provide documentation that they have performed installations on heavy machinery of a similar character to that required within this project. The millwright foreman shall have successfully installed movable bridge machinery on a previous project.

Machinery manufacture and installation shall conform to all applicable requirements in AASHTO Specifications and all applicable requirements with special requirements and additions as specified herein or as specified on the Plans

B. Field Assembly and Alignment

Each trunnion shall be surveyed for level, elevation, offset and angular alignment. Relationship between pairs of trunnions for each leaf shall be compared together. Each trunnion shall have measurements taken at the outside face of the trunnion shaft at centerline, the inside face of trunnion, at centerline and the top four (4) corners of the trunnion bearing base to verify the location of the hubs, the bearings, and the bore through the trunnion shaft.

The alignment of trunnions to each other on the same leaf shall be performed utilizing a laser beam with electronic targets having computerized digital readouts and all other equipment or tools necessary to utilize the laser beam system. The Contractor may propose alternate procedures and/or methods subject to the approval of the Engineer. Accuracy of the measurements shall be within 1/100th of an inch over 100 feet.

The trunnion bearing alignment shall not be completed until the final weight of each bascule leaf has been applied, the leaves have been aligned, and the trunnions on each leaf have been fully aligned with each other to within the accuracy stated above.

The Contractor shall submit his proposed list of equipment and installation methods to the Engineer for review.

Five (5) copies of the alignment report shall be furnished to the Engineer. The report shall include the location of the reference point utilized and diagrammatic layout of the trunnions for

both leaves showing all alignment relations. The report shall include the procedure on how the alignment measurements were performed, equipment utilized, accuracy/calibration of equipment and recommendations for improvement of alignment (if necessary).

Once the trunnion bearings have been installed at all four (4) trunnions on both leaves, the Contractor shall survey the trunnion alignment again utilizing the same points and submit a final trunnion alignment report. Any corrections to the trunnion alignment at any time during construction shall be at Contractor expense.

C. Trunnion Bearings and Installation

Prior to the trunnion installation into the bearings, the Contractor shall lubricate the journal of the trunnion. Both the interior of the bearing cap and the top surface of the trunnion journal shall be cleaned of all protective coatings using new clean non-abrasive cloths as part of the procedure. Once the bearing cap is installed, the Contractor shall lubricate the trunnion until grease flows out both sides of the bearing.

Working drawings as called for in Subsection 105-2 of the Standard Specifications are required to be submitted to the Engineer for approval for the trunnion bearings.

Fits and surface finishes for the new trunnion bearings shall be in accordance to Article 2.17.4 of the AASHTO Standard Specifications.

D. Installation of Electrical Equipment

Electrical apparatus to be attached to the trunnions shall be furnished and installed as shown on the Plans. The flanged trunnion extension shafts shall be completely concentric to the centerlines of trunnions, and shall be carefully aligned with the shaft extensions of the electrical cam switch assembly in accord with the requirements of the coupling manufacturer. Wiring of the electrical equipment shall be in accordance with Bridge Control System requirements, and will be paid for under PSSP Section Bridge Control System. The Contractor shall furnish and install the supports with all necessary connection material under Section 440, Steel Structures.

V. MEASUREMENT AND PAYMENT

Trunnion Assemblies shall be paid for on a Lump Sum basis. The price bid for the Pay Item Trunnion Assemblies shall include the cost of furnishing all labor, material, equipment and any incidental required to complete the work. The work includes furnishing, installing, aligning, and lubrication of the trunnion assemblies, complete as shown on the Plans.

Payment will be made under:

Pay Item
Trunnion Assemblies

Pay Unit
Lump Sum

I. DESCRIPTION

The work under this Section shall consist of furnishing all labor, equipment and materials (including spare parts) and performing all work necessary to install, test and place in correct, satisfactory operating condition a new water supply and sewage system in the bascule pier. The work shall be coordinated with other work on the approach spans to bring water lines to the bascule piers and providing sewer lines from the bascule piers to existing sewer manholes described elsewhere in these Special Provisions and Standard Specifications.

II. ABBREVIATIONS

Portions or all of certain recognized industry or association standards referred to herein as being a requirement of these Special Provisions shall be considered as binding as though reproduced in full herein, unless supplemented or modified by more stringent requirements of the Contract Documents. Unless otherwise stated, the reference standard shall be the standard that is current as of the date of issuance of these specifications. Reference may be made to standards either by full name or, for the sake of brevity, by letter designation as follows:

- ANSI American National Standards Institute
- ASSE.....American Society of Sanitary Engineering
- ASTMASTM International (Formerly American Society for Testing & Materials)
- AWWA American Water Works Association
- MSS..... Manufacturers Standardization Society of the Valve and Fitting Industry, Inc.
- NFPA National Fire Protection Association
- NSFS..... National Sanitation Foundation Standard
- UL Underwriters’ Laboratories, Inc.

III. MATERIALS AND FABRICATION

Refer to Division 10:

Item	Section
Sanitary Sewer Pipe and Fittings	1034
Water Pipe and Fittings	1036
Miscellaneous Metals and Hardware	1074
Galvanizing	1076
Epoxy and Adhesives	1081

Refer to Project Specific Special Provisions Section 499:

Item	Section
Plumbing Fixtures	499.27
Plumbing	499.28

A. General

All piping and its installation shall conform to the requirements of the North Carolina Plumbing Code by the International Code Council, New Bern Commissioners of Public Works or the Authority having jurisdiction.

All equipment and materials shall be new. All equipment, materials and workmanship shall be first class in every particular, and shall be manufactured and installed to the satisfaction of the Engineer.

B. Piping and Fittings

The water supply piping shall meet the requirements of the NSFS number 61 and shall be seamless copper tubing conforming to ASTM B88, Type K

Fittings for copper water supply pipe shall conform to ANSI B16.22. Solder filler metal shall conform to ASTM B32. Solder and fluxes shall be lead-free for joining water supply piping.

The sewer piping shall be polyvinyl chloride (PVC) plastic pipe conforming to ASTM D2665.

Fittings for PVC pipe shall be polyvinyl chloride (PVC) conforming to ASTM D2665.

C. Valves

Ball valves for copper piping shall be two piece construction with bronze body conforming to ASTM B62, having standard porting and solder ends. Valve shall include chrome plated ball, replaceable teflon seats and seals, blow proof stem and vinyl covered handle. Valves shall be rated for 600 psi working pressure. Size shall be equal to the size of the pipe on which it is installed.

D. Unions

Unions for the instantaneous water heater shall be two piece construction with bronze body conforming to ASTM B62, having standard porting and solder ends. Union shall be rated for 600 psi working pressure. Size shall be equal to the size of the pipe on which it is installed.

E. Insulation

Pipe and fitting insulation shall be AP-T jacketed Micro-lok fiberglass pipe insulation as manufactured by Manville Corporation. Thickness as shown on the Plans. Insulation at pipe supports shall be Hydrous Calcium Silicate as manufactured by Manville Corporation.

Insulation shall be covered over pipe and fittings with Zestron 2000 PVC covers, 20 mils thick, as manufactured by Manville Corporation or approved equal. PVC covers shall be secured using stainless steel clamps. A wear shield as shown on the Plans, shall be placed between each support and the PVC insulation jacket. The wear shield shall be secured to the PVC jacket.

F. Miscellaneous

Heat trace for water piping shall be self-regulating rapid trace 240 Volt Type SRL rated for 3 watts per foot as manufactured by Chromalox Industrial Heating Products or approved equal. Heat trace shall be secured with fiberglass tape. Include all necessary accessories required by the

manufacturer to provide the self-regulating capabilities for the heat trace for the above ground portion of the waterline. Thermostat control to shutoff if temperature is above 40 degrees F.

The bascule pier water line expansion compensator (joint) shall be Model HPFF as manufactured by the Metraflex Company or approved equal. Compensator shall have stainless steel housing with copper sweat ends. The compensator shall be secured utilizing pipe ring and socket as manufactured by ITT Grinnell or approved equal.

The bascule pier sewer line expansion compensator (joint) shall be polyvinyl chloride (PVC) plastic pipe type DWV with EPDM O-ring Model S119-40 as manufactured by Spears or approved equal.

For hot water heaters, water hammer arrestor, and wall hydrant, see Subsection 499.28 plumbing in control house.

Pipe supports shall utilize heavy wrought pipe clamp with galvanized finish as manufactured by ITT Grinnell or approved equal.

Piping supports consisting of structural steel hangers, U-bolts, rods, and wear shields shall be galvanized and conform to Section 1076 of the Standard Specifications unless otherwise specified.

Anchors for pipe supports shall be Stainless Steel Kwik-Bolt II rod coupling as manufactured by Hilti or approved equal.

Excluded Work:

The plumbing work excludes the following:

- (1) Electrical connecting of devices.
- (2) Furnishing and installation of heating cables for exterior piping.
- (3) Water and sewer lines outside the bascule piers are covered elsewhere in these Project Specific Special Provisions.

IV. CONSTRUCTION DETAILS

Refer to Division 15:

Item	Section
General Utility Requirements	1500
Waterline Installation	1510
Sanitary Sewer Installation	1520

A. Submittals

The Contractor shall prepare and submit for review working drawings and catalogs for the new piping and miscellaneous components. Working drawings shall conform to the requirements of Section 105-2 of the Standard Specifications and shall include the following:

- (1) Piping configuration in plan and elevation showing its relation to the structure, control house and other work including structural, electrical, architectural, and other mechanical.

- (2) Details showing all steel support for piping and the steel connection to existing structure members.
- (3) Manufacturer's catalog information and data for piping, fittings, expansion joints, insulation and covers, heat trace, piping supports including installation and maintenance instructions.

B. Warranty and Quality Control

All manufacturers furnish as part of this section shall warrant all products and associated hardware to be free of defects in material and workmanship for a period of one (1) year from the date of final acceptance of the completed bridge contract. Final Acceptance shall be in accordance to Subsection 105-17 of the Standard Specifications. Any defect within this period shall be repaired or replaced by the Manufacturer or Vendor, at total cost to the Manufacturer or Vendor, including labor, parts, and transportation. The Contractor shall provide letters to the suppliers with copies to the Engineer, identifying the scheduled date of final acceptance of the bridge and therefore the date the warranty shall begin. If the date of final acceptance gets extended, it shall be the Contractors responsibility to extend the commencement of the warranties from the suppliers at no cost to the Department.

C. Installation

The Contractor shall field verify all locations where the water and sewer piping are to be installed to ensure piping will maintain as straight a line as possible.

PVC piping shall be stored prior to installation on racks to provide continuous support to prevent sagging. No sharp edges or heavy objects shall come into contact with the piping or fittings. Piping shall not be subjected to excessive heat prior to or during installation.

PVC piping shall be installed and joined as per the pipe manufacturer's specifications and as specified herein for PVC joints using solvent cement.

Where flanges on PVC pipe are required, the Contractor shall install flanges using solvent cement and shall use full face flat-type gaskets between flanges.

Cutting of PVC pipe shall be square cuts at pipe ends, the inside diameter shall be deburred and the outside diameter for the PVC pipe shall be beveled to the manufacturer's requirements.

All horizontal portions of above ground piping shall be supported using reinforced insulation as previously specified so that the weight of the pipe will not crush the insulation at the supports. A wear shield, as shown on the Plans, shall be placed between each horizontal support and the PVC insulation jacket. The wear shield shall be secured to the jacket utilizing stainless steel clamps.

All supports for vertical portions of piping shall be directly fastened to the piping prior to the installation of the insulation. The Contractor shall include additional supports as required to accommodate thrust loads at all elbows and turns. Additional extraneous loads on the piping such as cleanouts and valves shall be properly supported.

Prior to the installation of the insulation, the Contractor shall install and secure the two heat trace lines to the water piping. The heat trace shall be loosely wrapped around the pipe expansion joints to ensure free movement of the joints.

The Contractor shall install insulation on all portions of the water and sewer piping except for the vent piping and cleanout extensions which may remain exposed. Insulation shall not be installed over any fittings or joints until that section of piping has been tested and accepted.

D. Tests and Disinfection

The Contractor shall not enclose, cover or put into operation the water or sewer piping systems until it has been inspected, disinfected (water only), and approved by the Engineer or other duly authorized representative. The Contractor shall give two (2) weeks notice to the Engineer prior to performing any tests.

Testing of the water, waste and vent line shall be in accordance with the procedures of the authority having jurisdiction or, in the absence of a published procedure in accordance to Section 312 of the North Carolina Plumbing Code.

Prior to the water being placed in-service it shall be cleaned and disinfected in accordance with Section 610 of the North Carolina Plumbing Code or the authority having jurisdiction or, in case a method is not prescribed by the authority, the procedure described in AWWA C651. Upon completion of the disinfection samples shall be taken, delivered to and analyzed by an approved laboratory. Test reports shall be submitted to the Engineer.

The Contractor shall furnish all labor, materials and equipment necessary to perform the above pressure testing and disinfection.

V. MEASUREMENT AND PAYMENT

No measurement will be made for the Pay Item Bascule Span Water and Sewer payment will be made on a lump sum basis.

The lump sum price for the Pay Item Bascule Span Water and Sewer shall include the cost of furnishing all labor, equipment, and materials required to complete the work as shown on the Plans and specified herein which includes furnishing and installation of all piping inside the control house including vent piping, fittings, valves, unions, insulation, heat trace, pipe supports, toilet and seat, instantaneous hot water heater, and lavatory, as well as testing and disinfecting of the sewer, vent, and water lines.

Payment will be made under:

Pay Item	Pay Unit
Bascule Pier Water and Sewer	Lump Sum

Payment for electrical work associated with providing the power and making the electrical connection to the heat trace and hot water heater is not part of this item, but is paid for under Bridge Electrical Work.

499 CONTROL HOUSE & ELECTRICAL ROOM GENERAL CONSTRUCTION

499.01 - DESCRIPTION

The provisions of this section apply to the construction of the control house and machinery room, complete, excluding reinforced cast-in-place concrete (Section 420); structural steel (Section 440), electrical work; heating, ventilating and air conditioning.

The following subsections comprise this Section:

Cast-in-Place Architectural Concrete	499.02
Terracotta Rainscreen & Baguette System	499.03
Cold Form Steel Framing	499.04
Miscellaneous Metals	499.05
Metal Stair & Ladders	499.06
Building Insulation	499.07
Standing Seam Metal Roof & Soffit	499.08
Joint Sealer	499.09
Steel Doors and Frames	499.10
Access Doors and Frames	499.11
Flush Roof & Floor Hatch and Safety Railing	499.12
Finish Hardware	499.13
Curtain Wall System	499.14
Glazing	499.15
Gypsum Board Assemblies	499.16
Interior Architectural Woodwork	499.17
Resilient Tile Flooring	499.18
Painting	499.19
Hi Performance Coatings	499.20
Ceramic Tile	499.21
Signs	499.22
Metal Lockers	499.23
Toilet Accessories	499.24
Roller Shades	499.25
Furnishings	499.26
Plumbing Fixtures	499.27
Plumbing	499.28
Steel Decking	499.29
Measurement and Payment	499.30

499.02 - CAST-IN-PLACE ARCHITECTURAL CONCRETE

PART 1 - GENERAL

A. This Subsection includes

1. Concrete finish and color requirements for the complete North and South Bascule Piers including the Control House and Machinery Room.

2. All other requirements for Cast-in-Place Concrete and Architectural Cast-in-Place Concrete not listed in this section shall comply with Section 420.
3. Payment for all Cast-in-Place Concrete and Architectural Cast-in-Place Concrete will be made under Section 420.

B. Submittals:

1. Product Data: For each manufactured material and product indicated.
2. Design Mixes: For each concrete mix.
3. Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie location and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.
4. Samples: For each of the following:
 - a. Form-facing panel
 - b. Form ties
 - c. Cement
 - d. Coarse and fine aggregate gradations
 - e. Chamfers
5. Samples for verifications: Architectural concrete samples, cast vertically. Approximately 18 by 18 by 2 inches, of finishes, colors, and textures to match design reference. Include Sample sets showing the full range of variations expected in these characteristics.

C. Quality Assurance

1. Installer Qualifications: A qualified contractor who has specialized in installing cast-in-place architectural concrete similar in material, design, and extent to that indicated for this Project.
2. Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
3. ACI Standards: Comply with ACI 303.1, "Specification for Cast-in-Place Architectural Concrete"; ACI 301, "Specification for Structural Concrete"; and ACI 117, "Specifications for Tolerances for Concrete Construction and Materials," unless more stringent provisions are indicated.
4. Mockups (Sample Panels): Before casting architectural concrete, produce a minimum of 3 sets of full-scale sample panels to verify selections made under sample Submittals. Mock Ups shall be cast vertically, approximately 48 by 48 by 6 inches (1200 by 1200 by 150 mm) minimum, to demonstrate the expected range of finish, color, and texture variations.
 - a. Notify Engineer 7 days in advance of date and time when mock ups will be constructed.
 - b. Obtain Engineers approval of mockups before casting architectural concrete.
 - c. Maintain mock ups in an undisturbed condition as a standard for judging completed work.
 - d. Demolish and remove mockups when directed.

PART 2 - PRODUCTS

A. Smooth Form-Facing Panels

1. Steel, glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that will provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
2. Contractor may use plywood for Architectural Concrete Finish No. 2, Gray Concrete only.

B. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch minimum; nonstaining.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.

E. Concrete Materials for Color variation as indicated on architectural drawings: Use materials from same source for entire Project, as follows:

1. Portland Cement:

- a. **Architectural Concrete Finish No. 1, White Concrete** –as indicated on architectural drawings
 - 9) ASTM C 150, Type I/II white color
- b. **Architectural Concrete Finish No. 2, Gray Concrete** –as indicated on architectural drawings.
 - 1) ASTM C 150, Type I/II gray color

2. Normal Weight Aggregate: ASTM C 33, Uniformly graded and as follows

- a. Architectural Concrete Finish No. 1, White Concrete
 - 2) Nominal Maximum Aggregate Size 3/4 inch
- b. Architectural Concrete Finish No. 2, Gray Concrete
 - 3) Comply with Section 420.

A. Finishes:

1. **Architectural Concrete Finish No. 1, White Concrete**

- a. Smooth-Formed Finish with Smooth Rubbed Finish
- b. As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.
- c. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

2. **Architectural Concrete Finish No. 2, Gray Concrete**

- a. Smooth-Formed Finish
- b. As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.
- c. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, or painting.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

C. Formwork: Comply with Section 420

D. Reinforcements and Inserts: Comply with Section 420

E. Removing and Reusing Forms:

1. Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete.
 - a. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.
2. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved 28-day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

3. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for architectural concrete surfaces.

F. Repairs, Protection and Cleaning

1. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.
 - a. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.
2. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.

499.03 - TERRACOTTA RAINSCREEN & BAGUETTE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: The Work of this Section shall include but not be limited to the following:
 1. Aluminum clip and sub-girts system.
 2. Extruded hollow clay tiles panels.
 3. Extruded hollow clay baguettes.
 4. Flashing, weather-seals, cover plates and formed metal trim.
 5. Miscellaneous anchors, fasteners, adhesives, insulation, vapor barrier, sealants, and related accessories.

1.2 SYSTEM DESCRIPTION

- A. A complete, pre-engineered aluminum clip and sub-girt system, with aluminum stud framing, insulation where indicated, closure pieces, trim and flashing. The system is to be composed of double-leaf clay (terra-cotta) tiles and baguettes, which can only be removed on purpose, tiles hung on aluminum clips, at head grooves and base channels, fastened to horizontal aluminum sub-frame. The sub-frame is attached to vertical aluminum "L" profile which are attached with aluminum clip angles to the structure. The baguette system shall be attached to the structure as shown on the drawings.
- B. Design system to allow for all movements within structure, and to support loads transferred from the adjacent construction and to fit within the space allotted without projections into the finished space as shown on the Drawings.
- C. The system is to have between each two tiles a continuous vertical aluminum spacer which will have the following functions:

1. Vertical spacer profile which will keep the uniformed joint dimension and align the tiles vertically.
2. Will prevent the tiles from rattling in the wind and will assure perfectly flat façade.
3. Integral drainage to direct condensation and water infiltration within the wall to weeping points.

D. Design Criteria:

1. Strength: Design system to withstand loadings as required by applicable codes, but not less than following minimum loadings.
 - a. Wind: Uniform pressure of 50 psf inward and outward wind pressures.
 - b. Seismic: Conform with applicable codes. Allow for interstory drift during seismic event. Interstory drift at upper floors is calculated as 0.5" during a major seismic event.
 - c. Terracotta Rainscreen & Baguette Sunscreen System to conform to 2002 Edition North Carolina Building Code debris-impact requirements with a minimum impact resistance rating of 120 MPH.
 - d. Teracotta Rainscreen & Baguette Sunscreen Supporting system and materials shall be intended for installation in a saltwater environment.
2. Condensation: System shall accommodate positive drainage for moisture entering or condensation occurring within panel system
3. Flatness: System shall be flat with no noticeable warpage, buckling, deflections or other surface irregularities.
4. The drawings indicate sizes, profiles, finishes, and dimensional requirements of the exterior wall system required and are based on specific types and models specified. With no less than 10 days prior to the bid, exterior wall system components by other manufacturers may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as solely judged by the Architect. The burden of proof of equality is on the proposer.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Design, fabricate and install components so that the completed exterior wall system will withstand live loads, the inward and outward pressures specified, and loads stipulated by the Building Code in effect for this Project.
 1. The system shall have a design load of positive and negative pressures up to 50 psf.
 2. Deflections within the system are to be limited to L/360 or less when tested in accordance with positive and negative pressures and as required to prevent cracking or damage to tile facing.
 3. The exterior wall system shall be designed to meet all specified performance requirements. Where performance requirements result in more than one load or pressure, the load or pressure which produces the greatest stress shall govern.
 4. Live Load: Live load is defined as a 7.5 psf force acting normal to wall at mid-height, cumulative to outward force.

- B. Movement: Design, fabricate and install system to withstand building, seismic and thermal movements including loading deflections, temperature change without buckling, distortion, joint failure, glass breakage, or undue stress on system components, anchors, or permanent deformation of any kind.
 - 1. Provide for thermal movement over an ambient temperature range of 120 deg. F. and a surface temperature range of 180 deg F.

1.4 SUBMITTALS

- A. Shop Drawings: Complete shop drawings shall be submitted for approval prior to fabrication, including elevations, and sections of each condition. Such drawings shall also include metal thickness, finish, methods of installation, anchorage and expansion joints, width, bow, camber and squareness tolerances necessary to accommodate thermal movement.
- B. Shop Drawings of Mock-Up: Submit shop drawings of exterior wall system mock-up showing details. Include detailed description of each test procedure to be preformed.
- C. Calculations: Submit calculations for the design of the exterior wall system, including deflections, in place stresses, negative pull-off loads and capacity of fasteners. Calculations shall be signed and sealed by a Professional Engineer registered in the State of North Carolina.
- D. Product Data: Manufacturer's latest published literature describing each product selection.
- E. Samples: Submit 3 sets of the following samples in the selected finishes and color for Architect approval.
 - 1. Each type and composition of tile and baguette and for each color and texture required, at least 24 inches square.
 - 2. 12 inch long by full profile sample of each type sheet metal trim and closure pieces.

1.5 QUALITY ASSURANCE

- A. Performance Test Standards: Provide exterior wall system which has been tested and certified by manufacturer to provide specified resistance to air and water infiltration when installed as indicated and when tested in accordance with AAMA 501, "Methods of Test for Metal Curtain Walls."
- B. Field Test: Provide suitable small sample area for field testing by Owner testing consultant for resistance to air infiltration and water penetration of a small representative sampling of installed clay tile cladding assemblies and adjacent perimeter construction per requirements of AAMA 501.901 Test Method B.
 - 1. Resistance to air infiltration using static air pressure difference: ASTM E 783-Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.

2. Resistance to water penetration using static air pressure difference: ASTM E 1105- field Determination of Water Penetration and Installed Exterior Windows, Curtain walls and Doors by Uniform and Cyclic Static Air Pressure Difference.
- C. Manufacturer's Qualifications: Provide exterior wall system manufactured by a firm experienced in manufacturing systems that are similar to those indicated for this project and have a record of successful in-service performance.
- D. Qualifications of Installers:
1. The cladding installer shall be approved by the manufacturer of the cladding.
 2. The installer will have experience with 100,000 Sq. Ft. of rainscreen installation and 20,000 sq. ft. of terra-cotta rainscreen and baguette installation.
 3. For actual installation of cladding, use only competent and skilled mechanics completely familiar with the products and the manufacturer's currently recommended methods of installation.
- E. Source Responsibility:
1. The rainscreen system, including the tiles and the hanging system, will be manufactured by the same company.
 2. The entire terracotta rainscreen system, with all its components, will have been used for at least 5 years and in more than 10 projects.
- F. Field Measurements: Prior to fabrication of exterior wall system, take field measurements of structure and substrates to receive wall system.
- G. Mock-Up:
1. Provide a completely assembled, typical wall areas installed with all related accessories, in composite configurations designed to fulfill the performance criteria, and representative of the design as shown on the Drawings.
 2. Extent of mock-up shall be the same as that which will be provided in the final work.
 3. Mock-up shall be installed simulating actual construction conditions, including actual structural supports and connections. Use means, methods and techniques proposed for final installation.
 4. Locate mock-up in location as directed by the Architect.
 5. Personnel assembling mock-up shall be the same personnel that will perform the actual final units of work at the project site.
 6. Mock-up shall be subjected to testing criteria specified for final installation.

1.6 PRE-INSTALLATION COORDINATION

- A. Pre-Installation Conference: Prior to start of cladding work, and at Contractor's direction, meet at site and review installation procedures and coordinate with other work.
1. Meeting shall include Contractor, Architect, major material manufacturers, and subcontractors whose work must be coordinated with cladding work including the curtain wall installer.

- B. Installer shall examine parts of supporting structure and conditions under which cladding work is installed.
- C. Notify Contractor in writing of conditions detrimental to proper and timely completion of work.
- D. Do not proceed until unsatisfactory conditions have been corrected in manner acceptable to Installer.

1.7 SITE CONDITIONS

- A. Do not install materials when temperature is below 50 degrees F prior to and during completion of cladding masonry work.
- B. During freezing weather, provide adequate equipment or cover to protect clay tile work completed or in progress.
- C. At the end of each work day and when weather threatens provide water cut-offs that are proven effective in providing weather-tight seals and in preventing moisture penetration.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver exterior wall system components packaged to comply with manufacturer's/fabricator's requirements and adequately protected from damage during shipment.
- B. Protect components from adverse job conditions prior to installation.
- C. Protect components from other trades after installation.
- D. Stack exterior wall system components on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store components so that water accumulations will drain freely.
 - 1. Do not store exterior wall system components in contact with other materials that might cause staining, denting, surface damage, or other deleterious effect.

1.9 SPECIAL WARRANTY

- A. Warrant the material of this Section for a period of 10 years from date of Substantial Completion against defects in it.
- B. Warrant the workmanship of this Section for a period of 2 years from date of Substantial Completion against defects in workmanship.
- C. The warranty shall provide that exterior wall system will remain weathertight during the warranty period and that if any leaks occur, that the system will be repaired or replaced as required to render the system weathertight, at no cost to the Owner. The warranty shall cover labor and materials.

PART 2 - PRODUCTS

2.1 EXTERIOR WALL SYSTEMS

- A. Basis of Design Product by Moeding. Provide Named product or approved equal.

MOEDING "ALPHATON®" system

Represented by: SHILDAN USA INC.
130 Pratt Oval,
Glen Cove, NY 11542
(516)-656-0019

2.2 MATERIALS

- A. Hollow Clay Tile Units complying with the following requirements:

1. Finish: Standard
2. Size: Refer to drawings
3. Color: Pastel Red
4. The tiles should be in (1.18)" (30 mm) thickness and should have double-leaf (as shown in the drawings).
5. Tiles should have deep penetration sealer in order to prevent dirt from staying on them
6. The color should be inherited in clay tile body and not only on the surface.

- B. Hollow Clay Baguette Units complying with the following requirements:

1. Finish: Standard
2. Size: Refer to drawings
3. Color: Pastel Red
4. The baguettes shall be in 2.36" (60 mm) thickness (as shown in the drawings).
5. Baguettes shall have deep penetration sealer in order to prevent dirt from staying on them.
6. The color should be inherited in clay tile body and not only on the surface.

- C. Fasteners, Clips, and Anchor Channels:

1. Supplied in accordance with manufacturer's recommendations to meet load requirements specified.
2. The clips will be painted with a polyester paint to match tiles color.

- D. Vertical spacers:

1. Supplied in accordance with manufacturer's recommendations to maintain a water-tight installation.
2. No sealants, gaskets or other materials which can deteriorate over time or may be flammable may be incorporated in to the system.
3. The spacer will be painted with a polyester paint to match tiles color.

E. Accessories:

1. Corrosion resistant type capable of supporting cladding system and superimposed design loads; design to allow adjustments of system prior to being permanently fastened in place.

F. Bituminous Paint:

1. Cold-applied mastic, SSPC Paint 12, compounded for 30 mil thickness per coat.

G. Supporting system; Fastening method: A complete, pre-engineered aluminum clip and sub-girt system, complying with the following requirements:

1. The tiles are fastened at head grooves and base channels using aluminum clips.
2. To ensure proper structural performance, the clips should be located at appoint equal to 20% of the length of the tile from the edge of the tile. For example for a tile length of 20" the clip location will be 4" for the edge.
3. To ensure the structural integrity between the tile and the clip, the clip must engage the upper lip of the tile by a minimum width of 0.71" (18mm) and a minimum vertical dimension of 0.51" (13mm).
4. The aluminum clips must be fastened to horizontal aluminum sub-frame in order to maintain an accurate horizontal gap.
5. Tiles must be capable of easy and fast assembly
6. The replacement of damaged tiles, particularly in the middle sections, must be possible using simple methods and should not require special tools.
7. Under no circumstances shall it be possible to remove individual tiles unless they are first destroyed.
8. The aluminum clips and vertical spacer will be colored to match the tile color.
9. Supporting system shall be intended for installation in a saltwater environment.

2.3 PRECONSTRUCTION TESTING OF TERRA-COTTA TILES

- A. Absorption: Test according to ASTM C 67 using 24 hour submersion and 5 hours boiling (separate sets of specimens, minimum 5 specimens each). Absorption by submersion shall not exceed 5 percent average, 7 percent individual specimen. Absorption by boiling shall not exceed: 8 percent average, 9 percent individual specimen.
- B. Freezing and Thawing: Test according to ASTM C 67 for 100 cycles requiring minimum of 50 days (minimum 5 specimens). No specimen shall lose more than 3 percent of its original dry weight. No specimen shall crack, crumble or fracture. Specimens shall conform to approved color range samples before and after testing.
- C. Breaking Load: Test according to modified ASTM C 67 (minimum 5 specimens). Supports shall be actual hardware used for this project. Apply load at mid-span between supports. Report shall include breaking load, calculated section modules at mid-span, and calculated breaking stress.
- D. Separate sets of specimens are required to be tested for each combination of color and texture. For a given color and texture combination, the most common size tile for the

project shall be tested, except for breaking load, where tile size corresponding to maximum span shall be tested. If multiple widths occur to maximum span, test width shall be selected by Architect.

2.4 ACCESSORIES

- A. Touch-up Material: As furnished by exterior wall system manufacturer.
- B. Bituminous Paint: As recommended by exterior wall system manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Supply metal anchors to be built in to other trades for placement. Provide insufficient quantity and direct placement.
- B. Ensure items built in by other trades for this work are properly located and sized.
- C. Establish lines, levels and shims as required. Protect from disturbance.
- D. Do not install broken, chipped or cracked units.

3.2 INSTALLATION

- A. Install anchor channels and clips as indicated and in accordance with manufacturer's instructions.
- B. Install sufficient anchorage devices to securely and rigidly fasten system to building. Fasteners to be concealed.
- C. Provide anchors to be installed in other work, and setting details, in time for proper installation by trades concerned; verify correct placement.
- D. Lay clay tile units on mounting clips properly jointed with other work.
 - 1. Place clay tile units in accordance with lines and levels indicated, in strict accordance with manufacturer's instructions.
 - 2. Take care to prevent damage to clay tile units.
 - 3. Install system to allow adequate clearances around perimeter and to enable proper installation; allow for thermal movement within cladding assembly.
- E. Assemble and anchor various components to allow for expansion and contraction, maintaining watertight condition.
- F. Ensure assembly is plumb, level and free of warp or twist; maintain dimensional tolerances and alignment with adjacent work.
- G. Allow moisture entering joints and condensation occurring within cavity to drain to exterior.

1. Design drainage system to hold maximum anticipated moisture for 100 year rain cycle without overflowing.
- H. Apply coat of bituminous paint on concealed aluminum surfaces to be in contact with steel, cementitious, or dissimilar materials.
- I. Set clay tile units in stack bond unless otherwise indicated.
- J. Tolerance: Accurately align and locate components to column lines and floor levels; adjust work to conform with following tolerances.
1. Plumb: 1/8" in 10' -0"; 1/4" in 40' -0"; non-cumulative.
 2. Level: 1/8" in 20' -0"; 1/4" in 40' -0"; non-cumulative.
 3. Alignment: limit offset to 1/6" where surfaces are flush or less than 1/2" out of flush, and separated by less than 2" (by reveal or protruding work); otherwise limit offsets to 1/8".
 4. Location: 3/8" maximum deviation from measured theoretical location (any member, and location).
- K. Built-In Work:
1. As work progresses, build in anchor bolts, flashing and other items supplied by other trades.
 2. Install items plumb and true.
 3. Do not build in organic materials subject to rot or deterioration.
 4. Remove protective film from finished aluminum surfaces.
- L. Cutting:
1. When field cutting is undertaken, care shall be exercised to ensure that cuttings do not remain on exposed surfaces.
- 3.3 CLEANING
- A. Clean soiled surfaces using materials which will not harm clay tile units or adjacent materials.
- B. Consult clay tile manufacturer for acceptable cleaners. Use non-metallic tools in cleaning operations.
- C. Upon completion of installation, remove protective coatings or coverings and clean aluminum surfaces, exercising care to avoid damage of finish.
- D. Remove excess sealant compounds, dirt or other foreign substances.
- E. Remove and replace clay tile units that are broken, chipped, cracked, abraded or damaged during construction period. Reinstall in accordance with manufacturer's instructions.

1.1 GENERAL

A. This Subsection includes the following:

1. Roof Rafter Framing.

B. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads without deflections greater than the following:

1. Design Loads: As follows:

- | | |
|----------------------|--------|
| a. Roof Dead Loads: | 20 psf |
| b. Roof Snow Loads | 20 psf |
| c. Wind Loads | 50 psf |
| d. Wind Uplift Loads | 50 psf |

2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

a. Roof Rafter Framing: Horizontal deflection of 1/360 of the horizontally projected span.

3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).

C. Submittals: In addition to Product Data, submit the following:

1. Shop Drawings showing layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
3. Mill certificates signed by steel sheet producer or test reports from a qualified independent testing agency.
4. Welder certificates.
5. Research/Evaluation Reports: Evidence of cold-formed metal framing's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

D. Quality Assurance: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members" for calculating structural characteristics of cold-formed metal framing.

1. Engineering Responsibility: Engage a qualified professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is

experienced in providing engineering services of the kind indicated to prepare design calculations, Shop Drawings, and other structural data.

2. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

1.2 PRODUCTS

- A. Steel Sheet: ASTM A 653, structural steel, G60 (Z180) zinc coating, Grade 33 (230) for minimum uncoated steel thickness of 0.0428 inch and less; 50 (340) for minimum uncoated steel thickness of 0.0538 inch and greater.
- B. Steel Roof Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, complying with ASTM C 955, and as follows:
 1. Minimum Uncoated-Steel Thickness: 0.0538 inch
 2. Flange Width: 1-5/8 inches minimum.
 3. Section Properties:
 - a. Minimum $A = 0.553 \text{ in}^2$, $S(x) = 1.147 \text{ in}^3$, $I(x) = 3.442 \text{ in}^4$
- C. Built-up Members: Built-up members of manufacturer's standard C-shaped steel section, with stiffened flanges, nested into a U-shaped steel section joist track, with unstiffened flanges; unpunched; of web depths indicated; complying with ASTM C 955, and as follows:
 1. Minimum Uncoated-Steel Thickness: Matching steel rafters.
 2. Flange Width: 1-5/8 inches Minimum
- D. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi (230 MPa), of manufacturer's standard thickness and configuration, unless otherwise indicated.
 1. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - a. Supplementary framing.
 - b. Bracing, bridging, and solid blocking.
 - c. Web stiffeners.
 - d. End clips.
 - e. Gusset plates.
 - f. End closures.
 - g. Hole reinforcing plates.
- E. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123.
- F. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a

load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

- G. Mechanical Fasteners: Corrosion-resistant-coated, self-drilling, self-threading steel drill screws.
- H. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.

1.3 EXECUTION

- A. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to ASTM C 1007, manufacturer's written recommendations, and requirements in this Section.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
 - 3. Install framing members in one-piece lengths.
 - 4. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed.
 - 5. Install insulation in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
 - 6. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- B. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
- C. Joist Installation: Install, align, and securely anchor perimeter joist track sized to match joists as indicated on Shop Drawings. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten to both flanges of joist track.
- D. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

499.05 - MISCELLANEOUS METALS

PART 1 - GENERAL

- A. This Subsection includes the Fabrication and Erection of miscellaneous metals work, as shown on drawings including schedules, notes, and details showing size and location of

members, typical connections, and types of steel and other metal fabrications as required for complete and functional building assemblies and systems.

B. This Section includes, but is not limited to:

1. Steel ladders
2. Steel Pipe Guardrails
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Miscellaneous metal trim
5. Loose Bearing and Leveling Plates

C. Codes and Standards: comply with provisions of following, except as otherwise indicated:

1. North Carolina Building Code, 2002
2. The OSHA Code of Federal Regulations.
3. Codes and standards referenced on the plans

D. Submittals: In addition to Product Data, submit the following:

1. Shop Drawings detailing fabrication and erection.
2. Templates for anchor bolts.
3. Certification that work meets the requirements of the North Carolina Building Code, 2002
4. Certification that work meets the requirements of the OSHA Code of Federal regulations.

PART 2 - PRODUCTS

A. General: Provide materials with smooth, flat surfaces without blemishes.

B. Ferrous Metals: As follows:

1. Steel Plates, Shapes, and Bars: ASTM A 36
2. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.
3. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless otherwise indicated.
4. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153.

C. Aluminum: As follows:

1. Extrusions: ASTM B 221 alloy 6063-T6.

D. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664 and compatible with finish paint systems indicated.

- E. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- F. Fasteners: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.
- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.
- H. Fabrication, General: Use connections that maintain structural value of joined pieces. Shear and punch metals cleanly and accurately. Remove burrs.
 - 1. Weld corners and seams continuously. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish exposed welds smooth and blended.
 - 2. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes.
 - 3. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
- I. Steel Ladders: Comply with ANSI A14.3 and as follows:
 - 1. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, spaced 18 inches apart.
 - 2. Bar Rungs: 3/4-inch-diameter steel bars, spaced 12 inches o.c.
 - 3. Fit rungs in centerline of side rails; plug-weld and grind smooth.
 - 4. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.
 - 5. Galvanize exterior ladders
 - 6. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
- J. Loose Bearing and Leveling Plates: Provide for steel items bearing on masonry or concrete. Drill plates to receive anchor bolts.
 - 1. Galvanize plates.
- K. Exterior Guard Rail:
 - 1. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless otherwise indicated. Sizes of Pipe are indicated on Drawings.
 - 2. Provide Guardrail system where no opening in system is more than 3 1/2" and no space in between guardrail system and adjacent surface is no more than 3 1/2" as well.
 - 3. Toe Kick: Provide OSHA compliant 4" high Toe Kick welded to pipe.
 - 4. Gate: Provide swing gate and latch.
 - 5. Finish of guardrail to match Bridge Railing.

- L. Miscellaneous Framing and Supports: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work. Fabricate from structural steel of welded construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.
1. Where indicated to be cast into concrete equip with integrally welded anchors at 24 inches (600 mm) o.c.
- M. Miscellaneous Steel Trim: Fabricate units with continuously welded joints and smooth exposed edges. Miter corners and use concealed splices where possible. Provide cutouts, fittings, and anchorages; coordinate assembly and installation with other work.
- N. Finish metal fabrications after assembly. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Shop prime ferrous-metal items not indicated to be galvanized.
1. Hot-dip galvanize items indicated to be galvanized to comply with ASTM A 123 or ASTM A 153 as applicable.

PART 3 - EXECUTION

- A. Installation, General: Provide anchorage devices and fasteners for securing metal fabrications to in-place construction. Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, with edges and surfaces level, plumb, and true.
1. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, or similar construction.
 2. Fit exposed connections accurately together. Weld connections, unless otherwise indicated. Do not weld, cut, or abrade galvanized surfaces.
 3. Provide items to be set in reinforced concrete including all Sleeves for openings, anchorages, inserts, etc. in ample time to maintain project schedule.
- B. Set bearing and leveling plates on cleaned surfaces using wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts and pack with nonshrink, nonmetallic grout.
- C. Touch up shop paint after erection. Clean field welds, bolted connections, and abraded areas and paint with the same material as used for shop painting.
- D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

499.06 - METAL STAIRS & LADDERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Steel stairs with cast abrasive aluminum treads.
2. Steel tube railings attached to metal stairs and to walls adjacent to metal stairs.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance of Stairs: Provide metal stairs capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

B. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
3. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.

- C. Seismic Performance: Provide metal stairs capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

1.3 SUBMITTALS

- A. Product Data: For metal stairs.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 COORDINATION

- A. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500 (cold formed)
- D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Wire Rod for Grating Crossbars: ASTM A 510 (ASTM A 510M).
- F. Iron Castings: Either gray iron, ASTM A 48/A 48M, Class 30, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

- G. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205).
- H. Expanded Metal, Carbon Steel: ASTM F 1267, Class 1 (uncoated).
- I. Woven-Wire Mesh: Intermediate-crimp, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A 510 (ASTM A 510M).
- J. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

2.3 MISCELLANEOUS MATERIALS

- A. Cast abrasive aluminum treads: Structural aluminum treads and landings – Basis of design: type 105 as manufactured by Wooster products.
 - 1. Manufacturers:
 - a. Wooster Products Inc.
 - b. American Safety Tread Co., Inc.
 - c. Amstep Products.
 - d. Armstrong Products, Inc.
 - e. Balco Inc.
 - f. Granite State Casting Co.
- B. Fasteners: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
- D. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape.
- E. Where aluminum will contact concrete, protect against corrosion by painting contact surfaces with bituminous paint.

2.4 FABRICATION

- A. Manufacturers:
 - 1. Alfab, Inc.
 - 2. American Stair, Inc.
 - 3. Sharon Companies Ltd. (The).
- B. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, treads, risers and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding, unless otherwise indicated. Use materials and methods that minimize distortion and develop strength and corrosion resistance of

- base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. At exposed connections, finish exposed welds smooth and blended.
2. Use connections that maintain structural value of joined pieces.
 3. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
 4. Form bent-metal corners to smallest radius possible without impairing work.
 5. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
- C. Stair Framing: Fabricate stringers of steel **channels**. Construct platforms of steel **channel** headers and miscellaneous framing members.
1. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
 2. Where stairs are enclosed by gypsum-board **shaft-wall** assemblies, provide hanger rods or struts to support landings from floor construction above or below.
 3. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish metal stairs after assembly.
- B. Hot-dip galvanize items indicated to be galvanized. Comply with ASTM A 123/A 123M or ASTM A 153/A 153M as applicable.
- C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below for environmental exposure conditions of installed products:
 1. Interior Stairs (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- D. Apply shop primer to uncoated surfaces of metal stair components. Comply with SSPC-PA 1, "Paint Application Specification No.1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- B. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete, unless otherwise indicated.

- C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- D. Attach handrails to wall with wall brackets or to guardrail as shown on drawings.
 - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
- E. Adjusting and Cleaning:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting.
 - 2. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

499.07 - BUILDING INSULATION

PART 1 - GENERAL

- A. This Subsection includes Building Insulation in Rigid and Batt forms.
- B. Submittals: Product Data for each type of insulation indicated, including Material Safety Data Sheets (MSDS).
- C. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84 for surface-burning characteristics and test methods indicated with product by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
- D. Single-source responsibility for insulation products: Obtain each type of building insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the work.

PART 2 - PRODUCTS

- A. General: Provide insulating materials that comply with requirements and with referenced standards for preformed units, provide sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths. Manufacturers include but are not limited to:
 - 1. Certainteed Corp.
 - 2. Knauf Fiber Glass GMBH
 - 3. Owens/Corning's Fiberglass Corp
 - 4. United States Gypsum Company

5. Dow Buildings Materials
 - B. Foil-Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type I, Class 1 or 2 with maximum flame-spread and smoke-developed indices of 75 and 450, respectively, based on tests performed on unfaced core on thicknesses up to 4 inches.
 - C. Mineral-fiber blanket insulation consisting of fibers manufactured from glass, slag wool, or rock wool.
 1. Unfaced Mineral-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
 2. Faced Mineral-Fiber Blanket Insulation: ASTM C 665, Type III, Class A; Category 1, faced with foil-scrim-kraft, foil-scrim, or foil-scrim-polyethylene vapor-retarder membrane on one face.
 - D. Vapor Retarders:
 1. Fire Retardent, Reinforced Polyethylene Vapor Retarder: ASTM D 4397, 6 mils thick, with maximum permeance rating of 0.13 perm
 2. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
 - E. Insulation Fasteners: Adhesively Attached, Spindle-Type Anchors with Washers: Angle formed from perforated galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square; welded to projecting steel spindle with a diameter of 0.105 inch and length capable of holding insulation of thickness indicated securely in position with self-locking washers complying with the following:
 1. Washers formed from 0.016-inch- thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
 2. Where anchors are located in service level areas provide capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap.

PART 3 - EXECUTION

- A. Installation of General Building Insulation: Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units. Seal joints caused by pipes, conduits, electrical boxes, And similar items penetrating vapor retarders with tape of type recommended by vapor retarder manufacturer to create an airtight seal between penetrating objects and vapor retarder. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors.
- B. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles. Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates.

499.08 - STANDING SEAM METAL ROOF & SOFFIT

PART 1 - GENERAL

- A. Submittals: In addition to Product Data, submit Shop Drawings, installation instructions, color samples, and general recommendations, as applicable to materials and finishes for each component.
- B. Contractor shall furnish and install a Standing Seam 20 oz Copper Roof complete with the following:
 - 1. Rosin Paper Slip Sheet.
 - 2. Self Adhering high temperature resistant Underlayment.
 - 3. Plywood Sheathing
 - 4. Rigid Polyisocyanurate Insulation
 - 5. Metal flashing matching roofing material.
 - 6. Pitch pockets matching roof materials
 - 7. Copper Soffit
 - 8. Copper Soffit Vents & perforated panels.
 - 9. Adhesives.
 - 10. Fasteners compatible with Roof materials.
 - 11. Accessories for roof penetrations.
 - 12. Sealants
 - 13. Solder
 - 14. Wood Blocking.
 - 15. Snow Guards
 - 16. Miscellaneous Accessories.
- C. All of the above shall be in accordance with the Contract Drawings and Specifications and in accordance with the Metal Roof material manufacturer's, the Copper Development Association Inc's, and the Sheet Metal and Air Conditioning Contractors National Association, Inc's (SMACNA) written instructions and recommendations.
- D. Quality Assurance:
 - 1. Design Criteria Reference
 - a. North Carolina Building Code, 2002
 - b. American Society for Testing Materials (ASTM).
 - c. Factory Mutual Engineering Corporation (FM) Class 1
 - d. Fire Resistance and I-60/90.
 - e. American National Standard Institute (ANSI) wind design.
 - f. Wind uplift specifications and loss prevention bulletins (1-28, 1-29s, 1-49).
 - g. Underwriters Laboratories inc. (UL).
 - h. Copper Development Association Inc. (CDA)
 - i. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).

2. Wind load resistance: the Metal Roof System shall withstand both positive and negative pressures of constant and intermittent winds of at least 120 miles per hour and be fully warranted for same by the Metal Roof Manufacturer and Installer.
3. Installation: Installation shall be by a roofing applicator with at least five years experience with Standing Seam Metal Roofs similar to this one. The applicator must be authorized in writing by the Metal Roof manufacturer to install this type of roof system. Installation shall not deviate from the contract Documents except where the Engineer has approved the use of the metal roof manufacturer's standard and/or special details, Specifications, installation instructions, etc. through the written submittals procedure.
4. Submittals: the contractor shall submit roof layout drawings, insulation layout Drawings for each layer of insulation, detail drawings (both Standard and special) as shop drawings to the engineer for Approval in a timely manner as approved by the Metal Roof Manufacturer and Installer.
5. In addition, all metal roof manufacturer product Specifications, product data, material safety data sheets (MSDS), installation instructions, certifications, etc.; including all related underlayment, Rosin Paper Slip Sheets, Insulation, flashing metal soffits Fascias, Metal Soffits, Metal Trim, Metal Closures, Fasteners, wood blocking and battans, accessories data showing locations, sizes, adjacent work, compatibility of elements, etc, shall be submitted to the Engineer for approval in a timely manner and as approved by the Metal Roof Manufacturer and Installer.
6. Warranty: The metal roof manufacturer shall issue a Warranty upon satisfactory completion of the installation following substantial completion of the work and upon the Manufacturer's factory representative's approval of the installation. The warranty shall cover all labor and materials of the entire metal roof system for a period of not less than 25 years.

PART 2 - PRODUCTS

- A. The Metal Roof Manufacturer and the installer for the Roof System indicated on the Contract Drawings and specified herein shall approve all components.
 1. The Standing Seam Metal Roof Shall be of a type and configuration noted on the Contract Drawings and specified herein. All copper shall be 20oz.
 2. Manufacturers: Subject to compliance with requirements, provide panels by one of the following:
 - a. Revere Copper Products Inc.
 - b. Hussey Copper Ltd.
 - c. Outokumpu American Brass Company
- B. Polyethylene Underlayment: Minimum 6-mil- thick polyethylene sheeting complying with ASTM D 4397.
- C. Self-Adhering, Polymer-Modified, Bituminous Sheet Underlayment: ASTM D 1970, minimum of 40 mils thick. Provide primer when recommended by underlayment manufacturer.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. WinterGuard; CertainTeed Corporation.
 - b. Nordshield Ice and WaterGuard; Nord Bitumi US, Inc.
 - c. Polyguard Deck Guard; Polyguard Products, Inc.
 - d. Moisture Guard; Tamko Asphalt Products, Inc.

- D. Building Paper: Minimum 5 lb/100 sq. ft., rosin sized.

- E. Soffit Panels: 1 1/2" deep roll formed concealed fastener copper panel by Morin Corporation or equal. Model Number A-12-0.

- F. Felt Underlayment: ASTM D 226, Type II (No.30), asphalt-saturated organic felts.

- G. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.

- H. Closure Strips: Closed-cell, self-extinguishing, expanded, cellular, rubber or cross-linked, polyolefin-foam strips.

- I. Sealing Tape: Pressure-sensitive, polyisobutylene tape with release paper backing.

- J. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat.

- K. Snow Guards: Prefabricated, non-corrosive units designed to be installed without penetrating roof and complete with adhesive anchoring as per the manufacturer's instructions.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Berger Building Products Corp.
 - b. Sieger Snow Guards, Inc.
 - c. Zaleski Snow-Guard and Roofing Specialties Inc

PART 3 - EXECUTION

- A. Examination: Examine substrates and conditions for compliance with requirements indicated for conditions affecting performance of metal panel roofing. Examine roof framing to verify that purlins, angles, channels, and other secondary structural panel support members and anchorage have been installed according to written instructions of panel manufacturer. Do not proceed with roof panel installation until unsatisfactory conditions have been corrected.

- B. Installation: Comply with panel manufacturer's written instructions and recommendations for installation. Anchor panels securely in place, with provisions for thermal and structural movement. The roof installation, including roof fascia, from start to finish must, be completed In one day to Ensure that no water flows under any of the roof metal. The metal roof soffit may be installed on another day. Separate dissimilar

metals with a bituminous coating, rubberized-asphalt underlayment, or by other means recommended by manufacturers of dissimilar metals.

1. Mechanically attach rigid insulation with the Manufacturer's approved fasteners at the rates, patterns, Roof Deck Penetrations, etc. recommended by the metal roof manufacturer. Install the insulation to the deck after installing the wood blocking continuously at the roof perimeter and at roof openings per the metal roof manufacturer's recommendations.
 2. Mechanically attach the plywood sheathing through the insulation with the metal roof manufacturer's approved fasteners at the rates, patterns, roof deck penetrations, etc. recommended by the metal roof manufacturer.
 3. Install felt underlayment and building-paper slip sheet on roof deck under metal panels, unless otherwise recommended by panel manufacturer. Apply from eave to ridge in shingle fashion and lap joints a minimum of 2".
 4. Accessories: Install standing seams; finials; flashing, soffits and fascia's at roof perimeter; roof penetrations; etc. shall all be installed per the metal roof manufacturer's recommendations to provide a completely watertight system.
 5. Snow Guards: Install according to written installation instructions and recommendations of manufacturer and NRCA's "Steep Roofing Manual."
- C. Damaged Units: Replace panels and other components of the Work that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- D. Water Tightness Test: the Contractor shall perform a roof water tightness test by use of a garden hose water stream directed at the top of each metal pan for at least 5 minutes in the presence of the Engineer. No leaks of any kind shall occur to pass this Test.

499.09 - JOINT SEALER

PART 1 - GENERAL

A. This Subsection includes the following:

1. Exterior joints in vertical surfaces and nontraffic horizontal surfaces.
2. Exterior joints in horizontal traffic surfaces.
3. Control and expansion joints.
4. Perimeter joints between metals and reinforced concrete such as frames of door and windows.
5. Interior joints in vertical surfaces and horizontal non-vehicular traffic surfaces.
6. Perimeter joints of exterior openings where indicated.
7. Perimeter joints between interior wall surfaces and exterior walls, ceilings, floors, frames of interior doors and windows.
8. Perimeter joints of toilet fixtures.
9. Other joints as indicated.
10. Firestopping and smoke stopping at perimeters of conduits, wiring, piping and other penetrations of fire resistance rated wall, roof, ceiling, partition and floor assemblies

- B. System performances: Provide joint sealers or sealant systems that have been produced and installed to establish and maintain watertight and airtight continuous seals.
- C. Submittals: In addition to Product Data, submit the following:
 - 1. Samples of each type and color of joint sealant required.
 - 2. Test reports for joint sealants evidencing compliance with requirements.
 - 3. Product data from manufacturers for each joint sealer product required, including instructions for joint preparation and joint sealer application, as well as material safety data sheets (MSDS).
 - 4. Material safety data sheets for each sealer, primer, Cleaner, etc

PART 2 - PRODUCTS

- A. Sealant Manufacturers: Subject to compliance with requirements, provide sealants by one of the following:
 - 1. Dow Corning.
 - 2. United States Gypsum
 - 3. Pecora Corporation.
 - 4. 3M
 - 5. National Gypsum Corp.
 - 6. Sonneborn Building Products Div., ChemRex Inc.
 - 7. Tremco.
- B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by testing and field experience.
- C. Colors: Provide colors indicated for exposed joint sealants or, if not indicated, as selected by Engineer from manufacturer's full range for this characteristic.
- D. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant of base polymer specified below:
 - 1. One Part Nonacid Curing Silicone Sealant: Type S, Grade NS, Class 25, and complying with the following requirements for uses and additional joint movement capability. Uses NT, M, G, A, and O.
 - 2. Mildew-Resistant Silicone Sealant: Type S; Grade NS; Class 25; Uses NT, G, A, and O; formulated with fungicide; intended for sealing interior joints with nonporous substrates exposed to high humidity and temperature extremes.
 - 3. Pourable Silicone Sealant: Type M or S, and Grade P; Class 25; Uses T, NT, M, G, A, and O; with the additional capability, when tested per ASTM C 719, to withstand 100 percent movement in extension and 25 percent movement in compression for a total of 125 percent movement and still comply with other requirements of ASTM C 920.
- E. Fire-resistant Joint Sealers: Provide manufacturer's standard fire-stopping with accessory materials, having fire-resistance ratings indicated as established by testing identical

assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to Authority having jurisdiction.

1. Manufacturers
 - a. Hilti, Inc
 - b. 3M Fire Protection Products
 - c. United States Gypsum Company

- F. Acrylic-Based Solvent-Release Sealant: ASTM C 1311.

- G. Latex Sealant: ASTM C 834.

- H. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834.

- I. Preformed Silicone-Sealant System: Manufacturer's standard system consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.

- J. Preformed Foam Sealant: Manufacturer's standard preformed, precompressed, impregnated, open-cell foam sealant manufactured from high-density urethane foam impregnated with a nondrying, water-repellent agent; in precompressed sizes and in roll or stick form to fit joint widths indicated, and as follows:
 1. Impregnating Agent: Manufacturer's standard.
 2. Density: Manufacturer's standard.
 3. Backing: Pressure-sensitive adhesive, factory applied to one side with protective wrapping.

- K. Sealant Backings, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

- L. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 1. Type C: Closed-cell material with a surface skin.
 2. Type O: Open-cell material.

- M. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C).

- N. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint.

- O. Primer: As recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

- A. General: Comply with joint sealant manufacturer's instructions for products and applications indicated.
- B. Sealant Installation Standard: Comply with ASTM C 1193.
- C. Preparation surface cleaning of Joints: clean out joints immediately before installing joint sealers to comply with recommendations of Joint sealer manufacturers and the following requirements:
 - 1. Remove all foreign material from joint substrates which may interfere with adhesion of joint sealer, including dust; paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; old joint sealers; oil; grease; waterproofing; water repellants; water; surface dirt; and frost.
 - 2. Clean concrete, and similar porous joint substrate surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealers.
 - 3. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealer manufacturer based on pre-construction joint sealer-substrate tests or prior experience. Apply primer to comply with joint sealer manufacturer's recommendations. Confine primers to areas of joint sealer bond, do not allow Spillage or migration onto adjoining surfaces.
 - 4. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning. Methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.
- D. Installation of Joint Sealers: Comply with joint sealer manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - 1. Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 962.
 - 2. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919.
 - 3. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
 - a. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths which allow optimum sealant movement capability.
 - b. Remove absorbent joint fillers which have become wet prior to sealant application and replace with dry material. Install bond breaker tape between sealants and joint fillers, compression seals, or back of joints where adhesion of sealant to surfaces at back of joints would result in sealant failure.

E. Installation of Fire-stopping Sealant: Install sealant, including forming, packing, and other accessory materials to fill openings around mechanical and electrical services penetrating floors and walls to provide fire-stops with fire resistance ratings indicated for roof, floor or wall assembly in which penetration occurs or one (1) hour fire resistance rated assemblies if not shown otherwise. Comply with installation requirements established by testing and inspecting agency.

1. Install fire-stopping sealant in accordance with Underwriters Laboratories (UL) design numbers per the following:
 - a. System types use a system listed below that best matches the wall, roof and floor construction.
 - 4) Single Metal Pipe/Conduit Penetrations – UL Designations: C-AJ-1065, C-AJ-1029, C-AJ-1144 and C-AJ-1179, W-L-1051.
 - 5) Multiple Metal Pipe Conduit Penetrations – UL Designations: C-AJ-1047, W-J-1012, W-L-1020.
 - 6) Insulated Metal Pipe Penetrations - UL Designations: C-AJ-5052, C-AJ-5067, C-AJ-5072, C-AJ-5068, C-AJ-5071, F-A-5003, W-L-5043.
 - 7) Cable Penetrations - UL Designations: W-L-3043, W-L-3050 C-AJ-3068, W-L-3044, C-AJ-3022, C-AJ-3036, W-L-3017, W-L-3018.
 - 8) Cable Tray Penetrations - UL Designations: C-AJ-4018, W-J-4005, C-AJ-4007.
 - 9) Blank Openings - UL Designations: C-AJ-0026, C-AJ-0011.
 - 10) Fire-Rated Joints - UL Designations: U-900A, U-900B, U-900C, J-900Z006, U-900Z014, J-900Z005, U-900Z013.
 - 11) Mixed Items - UL Designations: C-AJ-8034
 - 12) Bus Ducts - UL Designations: C-AJ-6007

F. Sealant Schedule

<u>Type number</u>	<u>Description</u>
1	DOW Corning 791 silicone sealant
2	DOW Corning 795 silicone sealant
3	DOW Corning Trademate Silicone Paintable Glazing Sealant
4	United States Gypsum Sheetrock Acoustical Sealant
5	3M 2000 Firestop sealant or Tremco Fire Stop sealant systems

Locations for use of each type of sealant are as follows:

Type 1: use on exterior of buildings, in unheated spaces which will not require painting of the sealant, and where shown on the contract drawings.

Type 2: use for full setting bed at door saddles and thresholds, and where shown on the contract drawings.

Type 3: use on interior of buildings, in unheated spaces which will require painting of sealant, and where shown on the contract drawings.

Type 4: use acoustical sealant as a smokestop sealant at edges of gypsum board partitions.

Type 5: use sealant at penetrations of floor slabs, partitions, roof slabs and walls as smoke stop and Firestop sealant.

499.10 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

A. This Subsection includes

1. Steel Doors
2. Steel Door Frames
3. Fire Rated Steel Door and Frame Assemblies

B. Submittals:

1. Product Data and Shop Drawings for each type of door and frame indicated.
2. Door Schedule using same reference designations indicated on Drawings in preparing schedule for doors and frames.

C. Quality Assurance:

1. Comply with ANSI A 250.8, unless more stringent requirements are indicated.
2. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

PART 2 - PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Steel Doors and Frames:
 - a. Benchmark Commercial Doors; a division of General Products Co., Inc.
 - b. Deansteel Manufacturing, Inc.
 - c. Kewanee Corporation (The).
 - d. Steelcraft; a division of Ingersoll-Rand.

B. Materials:

1. Cold-Rolled Steel Sheets: ASTM A 366, Commercial Steel (CS), or ASTM A 620, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.

C. Exterior and Interior Doors: Doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2, Seamless.
- D. Flush Vision Lite Systems: Manufacturers standard kits consisting of glass like moldings to accommodate glass thickness and size of vision lite indicated on contract drawings.
- E. Frames: Provide steel frames that comply with ANSI A250.8 and with steel sheet thickness as indicated for door level selected below:
1. For Level 3 steel doors, 0.067 inch.
 2. Supports and Anchors: Not less than 0.042-inch thick, zinc-coated steel sheet.
 3. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153, Class C or D as applicable.
- F. Fabricate steel door and frame units to comply with ANSI A250.8 and to be free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant.
1. Doors and Frames: Fabricate from metallic-coated steel sheet. Close top and bottom edges of doors flush.
 2. Core Construction: Manufacturer's standard core construction that produces a door complying with SDI standards.
 3. Tolerances: Comply with SDI 117.
 4. Prepare doors and frames to receive hardware. Reinforce doors and frames to receive surface-applied hardware. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.
 5. Fabricate knock-down frames with mitered or coped corners, for field assembly.
 6. Fabricate knock-down, drywall slip-on frames for in-place gypsum board partitions.
 7. Provide terminated stops unless otherwise noted.
 8. Provide non-removable glazing stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
 9. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.
- G. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 - EXECUTION

- A. Install doors and frames according to Shop Drawings and manufacturer's data.
1. Frames: Install steel frames for doors and other openings, of size and profile indicated.
 - a. Set masonry anchorage devices where required for securing frames to in-place concrete construction.
 - b. Provide at least three wall anchors per jamb.

- c. For in-place gypsum board partitions, install knock-down, drywall slip-on frames.
 - d. Install fire-rated frames according to NFPA 80.
 - e. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
2. Doors: Install to comply with ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
 - a. Jambs and Head: 1/8 inch.
 - b. Meeting Edges, Pairs of Doors: 1/4 inch.
 - c. Bottom: 3/4 inch.
 3. Fire-Rated Doors: Install within clearances specified in NFPA 80.
 4. Smoke-Control Doors: Install according to NFPA 105.

B. Adjusting and Cleaning:

1. Prime-Coat Touchup: Sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
2. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

499.11 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

- A. This Subsection includes
 1. Ceiling Access Doors and Frames
 2. Fire Rated Floor Doors and Frames
- B. Product Data: For each access door and frame and floor door and frame indicated.
- C. Schedule: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.
- D. Coordination Drawings: Reflected ceiling plans coordinating framing, suspension systems, piping, ductwork, and other concealed construction with ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim. Show method of attaching door frames to surrounding construction.

E. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are labeled and listed by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 or UL 10B for vertical access doors.

PART 2 - PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Access Doors:
 - a. Larsen's Manufacturing Company.
 - b. Nystrom Building Products Co.
 - c. Precision Plumbing Products, Inc.
 - d. Cierra Products
2. Floor Doors:
 - a. Access Manufacturing, Inc.
 - b. Bilco Company (The).
 - c. Nystrom Building Products Co.

B. Materials:

1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher leveled. Electrolytic zinc-coated steel sheet may be substituted at fabricator's option.
3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with A60 (ZF180) zinc-iron-alloy (galvannealed) coating or G60 (Z180) mill-phosphatized zinc coating; stretcher leveled.
4. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
5. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

C. Flush Access Doors and Frames: Fabricated from steel sheet with continuous piano hinge and screwdriver-operated cam latch.

1. Door: Minimum 0.060-inch thick sheet metal, set flush with surrounding finish surfaces.
2. Frame: Minimum 0.060-inch- thick sheet metal with drywall bead.
3. Provide in Gypsum Board Ceiling as indicated on drawings and as directed by the Engineer. Provide 1 Ceiling Door in Control Room, Stair Tower, and Toilet Room as directed by Engineer.
4. Cierra Products Model C-NW Series – Flush for Drywall.

D. Insulated Fire Rated Floor door, Nystrom Model FCR or approved equal.

1. Steel Floor Door: Galvanized structural-steel angle frame with 1/4-inch-thick, diamond-pattern, galvanized structural-steel tread plate door; nonwatertight; loading capacity to support 300-lbf/sq. ft. pedestrian live load.
 - a. Equip each door with adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with red vinyl grip that allows for one-handed closure, and recessed lift handle.
 - b. Door: Fabricated from 3/16" reinforced steel diamond plate. Door must contain 4" of fire rated insulation for thermal rating.
 - c. Frame: Fabricate from 3/16" steel ready for mounting concrete.
 - d. Hinge: Stainless steel continuous piano hinge.
 - e. Spring: Gas cylinder lift assist, which restrains door in 90-degree open position.
 - f. Latch: Stainless steel slam latch with removable key handle.
 - g. Label: Floor door to have label by independent testing laboratory for a two-hour fire test. Tested to the following standards: ASTM E119, NFPA252, UL10(b).

2. Floor Hatch Safety Railing: Kee Guard or approved equal.
 - a. Railing shall be removable.
 - b. Use ground socket fittings installed flush to Floor Finish. Kee Guard Type 66.
 - c. Pipe shall be 1 1/2" Galvanized.

PART 3 - EXECUTION

- A. Comply with manufacturer's written instructions for installing access doors and frames and floor doors and frames. Prior to installation, verify adequacy of work by other trades including but not limited to reinforced concrete. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces. Install access doors with trim-less frames and floor doors flush with adjacent finish surfaces or recessed to receive finish material. Adjust doors and hardware after installation for proper operation. Remove and replace doors or frames that are warped, bowed, or otherwise damaged. Adjust hardware and lubricate to provide unencumbered operation.

499.12 - FLUSH ROOF AND FLOOR HATCH AND SAFETY RAILING

PART 1 - GENERAL

- A. Submittals: For each type of product indicated, submit the following:
 1. Product Data.

2. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures. Also show conditions of reinforced concrete roof slab, and flashing, ladder, etc.
3. Coordination Drawings showing other items on roof.
4. Finish Samples.

B. Quality Assurance

1. Provide units listed by Underwriters Laboratories, Inc.
2. OSHA compliant roof hatch safety railing system as required by OSHA Standard 1910.23 and 1910.27.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Basis of Design: Nystrom Products model FGA and model FCRM
 - a. Roof Hatches:
 1. Nystrom Products Co.
 2. Bilco Company
 3. Babcock-Davis Hatchways, Inc.
 2. Performance Requirements:
 - a. Fabricate floor hatch assemblies to support the following loads:
Live load: 300 pounds per square foot minimum
Concentrated load: 300 pounds minimum
 - b. Design requirements specified herein are in addition to applicable building code requirements. The more stringent requirements will govern.
3. Product Data: Manufacturer's technical data for each type of access door and panel assembly, including setting drawings, templates, fire-resistive characteristics, finish requirements, and details of anchorage devices. Include complete schedule, types, locations, construction details, finishes, latching or locking provisions, and other pertinent data.
4. Manufacturer's Installation Instructions: Indicate installation requirements and rough-in dimensions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Diamond Tread Plate: ASTM B632-02, 1/4 inch 6061-T6 aluminum with mill finish.
- B. Aluminum Extrusion: 6061-T6 aluminum with protective paint finish to safeguard effects of concrete.

- C. Anodized Aluminum: AAMA 611-92 clear and colored.
- D. Steel Diamond Tread Plate: ASTM A786 with baked on rust-inhibitive gray prime finish.
- E. Steel Angle: ASTM A36-94 steel frame with baked on rust-inhibitive gray prime finish.
- F. Stainless Steel Diamond Tread Plate: ASTM A793 stainless steel, No. 304 finish.
- G. Stainless Steel Angle: ASTM A276 stainless steel, No. 304 finish.
- H. Stainless Steel Smooth Plate: ASTM A240 smooth plate stainless steel, type No. 316 for highly corrosive installations.
- I. Compression Springs: ASTM 213, type No. 316 stainless steel.
- J. Fasteners: Type No. 316 stainless steel. ASTM F593 for bolts and ASTM F594 for nuts.
- K. Epoxy Paint: Manufacturer's standard applied epoxy paint.

2.2 GUTTER/CHANNEL FRAME FLOOR HATCHES

A. Aluminum Doors and Frames:

- 1. Doors: 1/4 inch reinforced aluminum diamond plate.
- 2. Frame: Extruded aluminum gutter frame with integral masonry flange and 1-1/2 inch drainage coupling for attachment to drainage system.
 - a. Apply 1 coat of epoxy paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.3 FIRE RATED FLOOR DOORS

A. Aluminum Insulated Fire Rated Floor Door

- 1. Door: 1/4 inch aluminum diamond tread plate
- 2. Insulation: 3 layers of 3M E-Mat, and 3" thick Duct Wrap blanket
- 3. Frame: 1/4 inch extruded aluminum angle frame with integral masonry flange
 - a. Optional: Mounting holes for existing opening installation.
- 4. Finish: Mill finish. Frames provided with protective epoxy coating at areas that contact concrete.
- 5. Label: Provide floor doors with Intertek/Warnock-Hersey fire-rating label for 2-hour fire test, tested to the following standards: NFPA 288, NFPA 252, and IBC standards, subjected to hose stream test in floor/ceiling assembly.

- B. Floodtight Well Hatches: Hatch designed for water-tightness to 10 foot (3.05m) water column.

1. Door: 1/4 inch reinforced aluminum diamond plate, reinforced to support 625 pounds per square foot (10 foot water column) live load capacity.
2. Frame: 2 inch by 3 inch by 1/4 aluminum angle.

2.4 HARDWARE

- A. Latch: Type 316 stainless steel slam latch with inside lever handle and outside removable "L" handle fastened to door tamper-resistant stainless steel bolts.
- B. Latch for FCRM: Type 316 stainless steel 2-point latch with inside handle release and outside removable "L" handle fastened to door with tamper-resistant stainless steel bolts.

2.5 LOCKING/LATCHING OPTIONS

- A. Mortise cylinder preparation to receive special mortise cylinder lock.
- B. Hinge: 3 inch by 3 inch type 316 stainless steel, heavy-duty butt hinge with stainless steel pin fastened to door with stainless steel carriage bolts. Provide hinges with slotted bolt holes for on-site adjustment.
- C. Springs: Type 316 stainless steel compression lift springs designed to counterbalance door weight and resist downward pressure when closing door. Design springs to not exceed 30 pounds of force to operate.
- D. Springs for FCRM: Type 316 stainless steel gas springs designed to counterbalance door weight and resist downward pressure when closing door. Design springs to not exceed 30 pounds of force to operate.
 1. Self-closing mechanism to automatically close door in the even of a fire.
- E. Hold-Open Arm: 3/8 inch type 316 stainless steel arm that automatically locks when door is opened to 90 degrees. Provide release handle with red vinyl grip that releases door and allows for 1-handed closure.

2.6 FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Aluminum: Epoxy Paint: Manufacturer's standard applied epoxy paint.
- D. Hatch Safety Railing System:
 1. Description: Top rail, mid rail, and chain or swinging gate, with the hatch curb acting as the toe plate.
 - a. Test load: 200 pounds.
 - b. Height: Minimum 42 inches above finished roof deck.

- c. Pipe: Galvanized, 1-1/4 inch ID, A53 Grade B seamed pipe or galvanized, 1-5/8 inch OD A500 seamed tube.
 - d. Flat bar: 2 x 3/8 inch thickness A36 mild steel.
 - e. Chain system: 3/16 inch proof coil ASTM specification, zinc plated with quick link on fixed end.
 - f. Pipe ends and tops: Covered or plugged with weather and light resistant material.
 - g. Bolts and washers: 3/8 x 2-1/2 inch grade Z, zinc plated.
 - h. Sealant: As recommended by manufacturer.
 - i. Factory finish: Hot dipped galvanized.
- E. Galvanized Steel Sheet Finishes: Clean surfaces and apply a conversion coating. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint to comply with ASTM A 780.
- 1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
 - 2. Shop Primer: Exterior galvanized metal primer per Subsection 523.12 – PAINTING.

PART 3 - EXECUTION

- A. Examination: Verification of Conditions: Check openings for correct size and irregularities. Do not proceed until unsatisfactory conditions have been corrected.
- B. Installation: Comply with Manufacturer's written instructions. Coordinate with other roof construction, and anchor roof accessories securely. Set units plumb, level, and true to line without warp or rack. Set railing brackets in sealant.
- C. Separation: Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.
- D. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.
- E. Cap Flashing: Install cap flashing to overlap roofing or roof flashing (as counterflashing), and seal overlap with mastic sealant.
- F. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.
- G. Cleaning and Protection: Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

499.13 - FINISH HARDWARE

PART 1 - GENERAL

- A. Door hardware required is indicated in hardware schedule at the end of this Subsection.
- B. It is the intent that all doors be equipped with operable hardware unless noted otherwise. The hardware supplier shall provide all standard options and incidental accessories reasonable for items listed, which are required to provide the buildings with complete, necessary and proper hardware.
- C. Submittals: In addition to Product Data for each item specified, submit the following:
 - 1. Samples: For each type of exposed finish.
 - 2. Door Hardware Schedule: Organize into door hardware sets indicating type, style, function, size, label, hand, manufacturer, fasteners, location, and finish of each door hardware item. Locations of hardware set shall be cross-referenced to indications on drawings both on floor plans and in door and frame schedule
 - 3. Keying Schedule: Supplier shall meet with the Engineer to finalize keying requirements and obtain final instruction in writing.
 - 4. Product Certificates: Certifying that door hardware complies with listed fire door assemblies.
- D. Supplier Qualifications: Door hardware supplier who is or employs a qualified DHI Architectural Hardware Consultant.
- E. Manufacturer: obtain each type of hardware (lock sets, latch sets, hinges, closers, etc.) From a single manufacturer, although several may be indicated as offering products complying with requirements except as noted in the hardware schedule.
- F. Fire-rated openings: Provide hardware for fire-rated openings in compliance with NFPA standard no. 80 and local building code requirements. Provide only hardware which has been tested and listed by UL or FM for types and sizes of doors and which complies with requirements of UL labels and shall bear the appropriate UL labels and "Fire Exit Hardware" markings.
- G. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into final keying schedule.
- H. Deliver keys to Owner by registered mail.
- I. Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. Upon request, check shop drawing of such other work, to confirm that adequate provisions are made for proper location and installation of hardware.

PART 2 - PRODUCTS

- A. Provide door hardware for each door to comply with requirements in this Section, door hardware sets indicated in door and frame schedule, and the Door Hardware Schedule.
1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
 2. Designations: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- B. Basis-of-Design Product: Product named for each door hardware item indicated in Door Hardware Sets establishes the basis of design. Provide either the named product or a comparable product by one of the manufacturers specified for each type of hardware item. Products submitted as substitutions shall be reviewed by the Engineer and be equal to those specified.
- C. Standards: Comply with BHMA A156 series standards - Grade 1.
- D. Certified Products: Provide door hardware that is listed in one of BHMA's directories of certified products.
- E. PIVOTS AND HINGES
1. Manufacturers:
 - a. Baldwin Hardware Corporation (BH).
 - b. Hager Companies (HAG).
 - c. Stanley Commercial Hardware; Div. of The Stanley Works (STH)
 2. Hinges for Fire-Rated Assemblies: Stainless steel, with stainless-steel pin.
 3. Interior and Exterior Hinges: Stainless steel, with stainless-steel pin.
 4. Nonremovable Pins: Provide set screw in hinge barrel that prevents removal of pin while door is closed; for outswinging exterior doors.
 5. Metal Doors and Frames: Machine screws (drilled and tapped holes).
 6. Number of hinges: Number indicated in schedule or; minimum of 3 hinges for door leaf for doors 90" or less in height; one additional hinge for each 30" of additional height.
- F. MECHANICAL LOCKSETS AND LATCHES
1. Manufacturers:
 - a. Corbin Russwin Architectural Hardware; Div. of Yale Security Inc. (CR).
 - b. Hager Companies (HAG).
 - c. Schlage Lock Company; an Ingersoll-Rand Company (SCH).
 2. Bored Lockset Design: As scheduled.
 3. Lock Throw: Comply with door requirements.
 4. Backset: 2-3/4 inches.

5. Entrance locksets shall meet ANSI series 1000-F13 requirements.
6. Hand of door: Drawings indicate direction of swing or hand of each door leaf. Supplier is responsible for determining door handedness and ordering handed items correctly.

G. BOLTS

1. Manufacturers:
 - a. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
 - b. Hager Companies (HAG).
 - c. Rixson-Firemark, Inc.; Div. of Yale Security Inc. (RIX).
2. Surface Bolts: Flush bolt heads of minimum 1/2-inch-diameter rods of brass, bronze, or stainless steel with minimum 12-inch-long rod.
3. Flush Bolts: BHMA Grade 1 designed for mortising into door edge.
4. Bolts: Comply with labeled fire door requirements where required.

H. CLOSERS – Surface Mounted

1. Manufacturers:
 - a. Corbin Russwin Architectural Hardware; Div. of Yale Security Inc. (CR).
 - b. DORMA Door Controls Inc.; Member of The DORMA Group (DC).
 - c. Yale Security Inc.; Div. of Williams Holdings (YAL).

I. STOPS AND HOLDERS

1. Stops and Holders: Provide floor stops for doors, unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.
2. Manufacturers:
 - a. Baldwin Hardware Corporation (BH).
 - b. DORMA Door Controls Inc.; Member of The DORMA Group (DC).
 - c. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
3. Silencers for Door Frames: Neoprene or rubber.

J. DOOR GASKETING, DOOR BOTTOMS AND THRESHOLDS

1. Door Gasketing: Provide continuous weather-strip gasketing doors. Attach with non-corrosive fasteners.
2. Manufacturers:
 - a. Pemko Manufacturing Co., Inc. (PEM).
 - b. Reese Enterprises, Inc. (RE).
 - c. Zero International, Inc. (ZRO).

3. Air Leakage: Not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.
4. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled, based on testing according to UL 1784.
5. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled, based on testing according to UL 10B or NFPA 252.
6. Sound-Rated Gasketing: Assemblies that are listed and labeled, based on testing according to ASTM E 1408.
7. Gasketing Materials: Comply with ASTM D 2000 and AAMA 701/702.
8. Thresholds: as required for each application.

K. CYLINDERS, KEYING, AND STRIKES

1. Cylinders: Cylinders shall be removable core type similar to Best Lock Co. In satin chrome Model LE74-626 with cam for mortise lock installation, in US 26 (ANSI/BHMA 626) finish. See keying below

L. KEYING SYSTEM: Masterkeying: Factory Key, Masterkey, Grand-Masterkey, and Great-Grand-Masterkey all locks and cylinders to the existing system as directed.

1. Keys: Provide nickel-silver keys permanently inscribed with a visual key control number and "DO NOT DUPLICATE" notation.
2. Number of Keys: Furnish three (3) keys for each lock, twelve (12) masterkeys for each set, three (3) grand-masterkeys and three (3) great-grand-masterkeys.
3. Key Control System: Include key-holding hooks, labels, key tags with self-locking key holders, envelopes, and markers. Contain system in wall-mounted type metal cabinet with baked-enamel finish. Include cross-index system set up by key control manufacturer, with card index.

M. Strikes: Manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware sets.

N. Fabrication:

1. Base Metals: Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18 for finishes. Do not furnish manufacturer's standard materials if different from specified standard.
2. Fasteners: Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated. Provide steel machine or wood screws or steel through bolts for fire-rated applications.
3. Manufacturer's Name Plate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable name-plates), except in conjunction with required ul labels and as otherwise acceptable to the engineer. Manufacturer's identification will be permitted on rim of lock cylinders only.

PART 3 - EXECUTION

- A. Examine doors and frames for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- B. Steel Door and Frame Preparation: Comply with DHI A115 series. Drill and tap doors and frames for surface-applied hardware according to SDI 107.
- C. Mounting Heights: Comply with DHI requirements, unless otherwise indicated.
- D. Installation: Comply with manufacturer's written instructions. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
 - 1. Thresholds: Set thresholds for all doors in sealant as specified in Subsection 499.09 – JOINT SEALERS.
- E. Adjust and check each operating item of door hardware and each door to ensure proper operation or function. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with accessibility requirements. Clean operating items as necessary to restore proper function and finish.
- F. Door Hardware Schedule: As follows:

Door Hardware Set No. 1

Each to have the following:

*	Hinges	FBB199 4-1/2" x 4 1/2 630	Stanley	BHMA 630 Stainless Steel
1	Lock Set	Mortise lockset ML 2265-LWM Lustra Lever Escutcheon trim both sides	Corbin/Russwin	BHMA 630 Stainless Steel
1	Weather Striping	319CN	Pemko	Alum. (C)
1	Closing Devices	DC2210	Corbin/Russwin	BHMA 689
1	Stops and Holders	As required	Corbin/Russwin	Stainless Steel
1	Threshold	254X4AFG (7 1/8")	Pemko	Alum. (A)
1	Door Drop Bottom	4131CRL	Pemko	Alum. (C)

- 1 Door Silencers 1/2" Rubber Door Silencers Hagar
307D
- * Number of hinges, as specified.

Door Hardware Set No. 2
Each to have the following:

- * Hinges FBB199 Stanley BHMA 630
4-1/2" x 4 1/2 630 Stainless Steel
- 1 Lock Set Mortise lockset Corbin/Russwin BHMA 630
ML 2265-LWM Stainless Steel
Lustra Lever
Escutcheon trim both sides
- 1 Closing Devices DC2210 Corbin/Russwin BHMA 689
- 1 Stops and Holders As required Corbin/Russwin Stainless Steel
- 1 Threshold 253X3AFG (6 1/8") Pemko Alum. (A)
- 1 Door Drop Bottom 4131CRL Pemko Alum. (C)
- 1 Door Silencers 1/2" Rubber Door Silencers Hagar
307D
- * Number of hinges, as specified.

499.14 - CURTAIN WALL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes conventionally glazed aluminum curtain walls installed as stick systems.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide glazed aluminum curtain-wall systems, including anchorage, capable of withstanding, without failure, the effects of the following:
 - 1. Structural loads.
 - 2. Thermal movements
 - 3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.

4. Dimensional tolerances of building frame and other adjacent construction.
5. Required Impact resistance.
6. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferred to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.

B. Structural Loads:

1. Wind Loads: 50 psf (Architectural Cladding & Components)
2. Seismic Loads: $2 \times (A_v = 0.04) \times W$ (self weight)

C. Curtain wall system to conform to 2002 Edition North Carolina Building Code debris-impact requirements with a minimum impact resistance rating of 120 MPH

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) 1/4 inch or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller [amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm)].
3. Cantilever Deflection: Where framing members overhang an anchor point, limited to 2 times the length of cantilevered member, divided by 175.

E. Temperature Change (Range): Systems accommodate 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

F. Air Infiltration: For systems, maximum air leakage of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

G. Water Penetration Under Static Pressure: Systems do not evidence water penetration when tested according to ASTM E 331 at a minimum differential static pressure of 20 percent of positive design wind load, but not less than 10 lbf/sq. ft. (479 Pa)

H. Condensation Resistance: For systems, condensation-resistance factor (CRF) of not less than 55 when tested according to AAMA 1503.

I. Average Thermal Conductance: For systems, average U-factor of not more than 0.66 Btu/sq. ft. x h x deg F (3.75 W/sq. m x K) when tested according to AAMA 1503.

1.3 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Prepared by the Curtain Wall Manufacturer, under the supervision of a qualified professional engineer detailing fabrication and assembly of glazed aluminum curtain-wall systems.
 - 1. Include structural analysis data signed and sealed by the qualified professional engineer licensed in North Carolina responsible for their preparation.
- C. Samples: For each exposed finish.
 - 1. One 12" long section of each mullion profile
- D. Product test reports.
- E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Acceptable to manufacturer and capable of preparing data for glazed aluminum curtain-wall systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of glazed aluminum curtain-wall systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals and other materials beyond normal weathering.
 - d. Water leakage.
 - e. Failure of operating components to function normally.
 - 2. Warranty Period: **10** ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for glazed aluminum curtain-wall systems is based on Kawneer 1600 -1. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. Vistawall Architectural Products.
2. YKK AP America Inc.

2.2 FRAMING SYSTEMS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 611.
3. Hot-Rolled Sheet and Strip: ASTM A 570/A 570M.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads.
4. Finish exposed portions to match framing system.
5. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.

E. Anchors: Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

F. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials

G. Framing Gaskets: As recommended by manufacturer for joint type.

H. Framing Sealants: As recommended by manufacturer for joint type.

2.3 GLAZING SYSTEMS

A. Glazing: As specified in 499.15 "Glazing."

- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer for joint type.

2.4 ACCESSORY MATERIALS

- A. Perimeter Fire-Containment Systems (Safing Insulation): Specified in 499.09 Joint Sealers
- B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.5 FABRICATION

- A. Form aluminum shapes before finishing.
- B. Fabricate components that, when assembled, have the following characteristics:
 - 1. Sharp profiles, straight and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to prevent glazing-to-glazing contact and to maintain required glazing edge clearances.
 - 6. Provisions for reglazing from interior.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: Class I, clear anodic coating complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Fit joints to produce hairline joints free of burrs and distortion.
 - 2. Rigidly secure nonmovement joints.
 - 3. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 4. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
 - 5. Seal joints watertight, unless otherwise indicated.
- B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install glazing as specified in 499.15 "Glazing."
- F. Install sealants as specified in 499.09 "Joint Sealers."
- G. Install perimeter fire-containment systems (safing insulation) as specified in 499.09 Joint Sealers Section.
- H. Erection Tolerances: Install glazed aluminum curtain-wall systems to comply with the following maximum tolerances:
1. Plumb: 1/8 inch in 10 feet (3 mm in 3 m); 1/4 inch in 40 feet (6 mm in 12 m).
 2. Level: 1/8 inch in 20 feet (3 mm in 6 m); 1/4 inch in 40 feet (6 mm in 12 m).
 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (13 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (13 to 25 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of 1 inch (25 mm) wide or greater, limit offset from true alignment to 1/4 inch (6 mm).
 4. Location: Limit variation from plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/2 inch (12.7 mm) over total length.

3.2 FIELD QUALITY CONTROL

- A. Water Spray Test: After the installation of minimum area of 40-feet- (23-m-) by-2-story glazed aluminum curtain-wall system has been completed but before installation of interior finishes has begun, test a 2-bay area of system designated by Architect according to AAMA 501.2.
1. Repair or remove work where test results indicate water penetration of systems.
 2. Perform additional testing to determine resistance to water penetration of replaced or additional work.

PART 1 - GENERAL

A. This Subsection includes

1. Glazing for
 - a. Aluminum Curtain Wall
 - b. Hollow Metal Doors

B. Performance Requirements: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

1. Glass Design: Glass thicknesses indicated are minimums and are for detailing only. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 - a. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - 13) Specified Design Wind Loads: 45 psf
 - 14) Specified Design Snow Loads: 20 psf
 - 15) Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
 - 16) Minimum Impact Resistance: 120 MPH
2. Thermal and Optical Performance Properties: As determined according to procedures indicated below:
 - a. Center-of-Glass U-Values: NFRC 100 methodology using LBL-35298 WINDOW 4.1 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 - b. Center-of-Glass Solar Heat Gain Coefficient: NFRC 200 methodology using LBL-35298 WINDOW 4.1 computer program.
 - c. Solar Optical Properties: NFRC 300.

C. Submittals: In addition to Product Data for each glass product and glazing material, submit the following:

1. Samples: In the form of 12-inch-square Samples for each type of glass, including fire rated laminated glazing. Provide Sample of fire rated frame 12-inches long.
2. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

3. Glazing sealant test reports indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.
 4. Shop Drawings for Fire Rated Glass and Framing Systems – Show Doors, frames, hardware and steel frame components and attachment to adjacent work.
- D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252. Door Hardware shall comply with the requirements of NFPA 101.
- E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated.
1. GANA Publications: GANA'S "Glazing Manual" and "Laminated Glass Design Guide."
 2. SIGMA Publications: SIGMA TM-3000, "Vertical Glazing Guidelines," and SIGMA TB-3001, "Sloped Glazing Guidelines."
- F. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following inspecting and testing agency:
1. Insulating Glass Certification Council.

PART 2 - PRODUCTS

- A. Products: Subject to compliance with requirements, provide one of the products indicated in schedules.
- B. Wired Glass: ASTM C 1036, Type II, Class 1, Quality q8; 6.4 mm thick; of form and mesh pattern indicated below:
1. Patterned Wired Glass: Form 2, Mesh m1
- C. Insulating-Glass Units for Curtain Wall (Basis of Design Product)
1. Storm Glass as manufactured by Old Castle Glass: Preassembled units consisting of dual-sealed lites of ¼” clear tempered glass separated by a dehydrated ½” interspace, and a 9/16” glass laminated with .090 PVB inner layer meeting at least a 120 MPH impact resistance rating with a minimum “U” value of .47 for use with the specified curtain wall system.
 2. Glazing Tape and Sealant for Fire-Resistive Glazing Products: Identical to product used in test assembly to obtain fire-protection rating.
 3. Setting Blocks: Hardwood, glass width by 4 inches by 3/16 inch thick.
 4. Spacers: Neoprene, tested for compatibility with specified glazing compound.
 5. For Door Hardware Schedule of Fire Rated Glass Door See 523.13 Door Hardware.

- D. Elastomeric Glazing Sealants: Products complying with ASTM C 920 and other requirements specified in the Glazing Sealant Schedule, in colors indicated, compatible with one another and with other materials they will contact.
- E. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
- F. Expanded Cellular Glazing Tape: Closed-cell, PVC foam tape; complying with AAMA 800 for the following types:
 - 1. Type 1, for glazing applications in which tape acts as the primary sealant.
 - 2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.
- G. Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
 - 1. Neoprene.
 - 2. EPDM.
 - 3. Silicone.
 - 4. Thermoplastic polyolefin rubber.
 - 5. Any material indicated above.
- H. Miscellaneous Glazing Materials: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- I. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

PART 3 - EXECUTION

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. Remove and replace glass that is broken, chipped, cracked,

abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.

- C. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

499.16 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

- A. This Subsection includes
 - 1. Interior Gypsum Wall Boards
 - 2. Non-Load Bearing Stud Framing
- B. Furnish and Install Gypsum Wall Boards and Accessories where indicated on the plans.
- C. Submittals: Product Data for each type of product indicated.
- D. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

PART 2 - PRODUCTS

- A. Steel Partition Framing: Comply with ASTM C 754, ASTM C 1002, and ASTM C 1003 for conditions indicated.
 - 1. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized.
 - 2. Steel Studs and Runners: ASTM C 645, in depth indicated.
 - a. Minimum Base Metal Thickness:
 - 17) 0.043 inch (18 Gauge)
 - 18) 0.0312 (20 Gauge)
 - 19) as indicated on drawings
 - 3. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch-deep flanges.
 - 4. Proprietary Firestop Track: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

- a. Available Product: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 20) Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
 - 21) Metal-Lite, Inc.; The System.
 5. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - a. Minimum Base Metal Thickness: 18 Gauge and 20 Gauge as indicated on drawings
 6. Cold-Rolled Channel Bridging: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange, and in depth indicated.
 - a. Clip Angle: 1-1/2 by 1-1/2 inch 0.068-inch- thick, galvanized steel.
 7. Hat-Shaped, Rigid Furring Channels: ASTM C 645, in depth indicated.
 - a. Minimum Base Metal Thickness:
 - 22) 0.043 inch (18 Gauge)
 - 23) 0.0312 (20 Gauge)
 - 24) as indicated on drawings
 8. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission. Asymmetrical or hat shaped, with face attached to single flange by a slotted leg (web) or attached to two flanges by slotted or expanded metal legs.
 9. Cold-Rolled Furring Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange, and in depth indicated.
 - a. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch.
 - b. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.
 10. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare metal thickness of 0.0312 (20 Gauge), and depth required to fit insulation thickness indicated.
 11. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Gypsum Wallboard: ASTM C 36.
1. Type WRX: In thickness indicated and with long edges tapered.
- C. Panel Size, General: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

- D. Proprietary, Special Fire-Resistive Type: ASTM C 36, having improved fire resistance over standard Type X, complying with requirements of fire-resistance-rated assemblies indicated, in thickness indicated, and with long edge tapered.
- E. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178, with core type and in thickness indicated. This board shall be fire rated where required and indicated on drawings.
1. Available Product: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, "Dens-Shield Tile Backer" manufactured by G-P Gypsum Corp.
- F. Interior Trim: ASTM C 1047.
1. Cornerbead: Use at outside corners, unless otherwise indicated.
 2. LC-Bead (J-Bead): Use at exposed panel edges.
 3. L-Bead: Use where indicated or as required
 4. U-Bead: Use where indicated or as required
 5. Expansion (Control) Joint: Use where indicated or as required
 6. Curved-Edge Cornerbead: With notched or flexible flanges; use at curved openings.
 7. Reveals: F-Series, by Gordon Interior Specialties division of equal. F- Series reveals shall be primed and painted to match interior paint color. F-Reveals are used under solid surface window sill in Control Room only.
 8. Reveal Base: by Fry Reglet, Architectural Materials or equal. Alum. Reveal base is used in Control Room only. Do not paint metal reveal base.
- G. Joint Tape:
1. Interior Gypsum Wallboard: Paper.
 2. Tile Backing Panels: As recommended by panel manufacturer.
- H. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, rounded or beveled panel edges and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, flanges of trim accessories, and fasteners, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
- I. Joint Compound for Tile Backing Panels: As recommended by manufacturer.
- J. Acoustical Sealant: See Section 499.09 Joint Sealers.

- K. Auxiliary Materials: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
1. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - a. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. Isolation Strip at Exterior Walls:
 - a. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No.15 asphalt felt), nonperforated.
 - b. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.
 3. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - a. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

PART 3 - EXECUTION

- A. Installing Steel Framing, General: Comply with ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
- B. Installing Steel Partition Framing:
1. Where studs are installed directly against exterior walls, install isolation strip between studs and wall.
 2. Extend partition framing full height to structural supports or substrates above ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
 3. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb.
 - b. Extend jamb studs to underside of floor or roof structure above.
 4. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- C. Z-Furring Members: Erect insulation vertically and hold in place with Z-furring members. Provide custom bent J tracks at top and bottom of Z furring and at framed openings as indicated on drawings.

1. Until gypsum board is installed, hold insulation in place with 10-inch staples fabricated from 0.0625-inch-diameter, tie wire and inserted through slot in web of member.
- D. Gypsum Board Application: Comply with ASTM C 840 and GA-216.
1. Space screws a maximum of 12 inches o.c. for vertical applications.
 2. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.
 3. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 4. On partitions/walls, apply gypsum panels horizontally perpendicular to framing, unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 5. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 6. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
 7. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.
 8. Glass-Mat, Water-Resistant Backing Panel: Install with 1/4-inch gap where panels abut other construction or penetrations.
- E. Installing Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- F. Finishing Gypsum Board Assemblies: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
1. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
 - a. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges to panel surfaces that will be exposed to view, unless otherwise indicated.
 2. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

499.17 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

- A. This Subsection includes
1. Plastic laminate cabinets at Control Room
 2. Plastic laminate vanity for Toilet Room

3. Solid surface countertop, back and side splashes.
 4. Solid surface interior window sill
- B. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips, unless concealed within other construction before woodwork installation.
- C. Submittals: In addition to Product Data, submit the following:
1. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 2. Provide plastic laminated manufacturers full range of standard color and textures for selection by Engineer. Include solid and wood grain.
 3. Samples of plastic-laminate-clad panel products, for each type, color, pattern, and surface finish.
 4. Sample of solid surface material in finish indicated. Sample shall be 1" thick, 7" wide and 12" long.
- D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.
1. Provide AWI Quality Certification Program labels or certificate indicating that woodwork complies with requirements of grades specified.

PART 2 - PRODUCTS

- A. Fabricators: Subject to compliance with requirements, provide interior architectural woodwork by one of the following:
- B. Wood Products: Comply with the following:
1. Hardboard: AHA A135.4.
 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD-Exterior Glue.
 3. Particleboard: ANSI A208.1, Grade [M-2-Exterior Glue.
 4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 5. Hardwood Plywood and Face Veneers: HPVA HP-1.
- C. Thermoset Decorative Overlay: Particleboard or medium-density fiberboard with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1
- D. High-Pressure Decorative Laminate: NEMA LD 3.
1. Available Manufacturers: Subject to the requirements, provide products by one of the following:
 - a. Formica Corporation
 - b. Wilsonart International
 - c. Laminart

- E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avonite; Avonite, Inc.
 - b. Corian; DuPont Polymers.
 - c. Formica Corporation
- F. Fire-Retardant-Treated Materials: Where indicated, use materials impregnated with fire-retardant chemical formulations to comply with AWWA C20 (lumber) and AWWA C27 (plywood), Exterior Type or Interior Type A. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Kiln-dry material after treatment.
- G. Fire-Retardant Particleboard: Panels made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread rating of 25 or less and smoke-developed rating of 25 or less per ASTM E 84.
- H. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread rating of 25 or less and smoke-developed rating of 200 or less per ASTM E 84.
- I. Cabinet Hardware and Accessories: Provide cabinet hardware and accessory materials associated with architectural cabinets.
1. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, self-closing.
 2. Wire Pulls: Nickel Plated Matt. Hafele No. 116.24.623
 3. Catches: Magnetic catches, BHMA A156.9, B03141.
 4. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
 5. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:
 - a. Box Drawer Slides: 100 lbf
 - b. File Drawer Slides: 150 lbf
 6. Door Locks: BHMA A156.11, E07121.
 7. Drawer Locks: BHMA A156.11, E07041.
 - a. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652
- J. Fabrication, General: Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Interior Woodwork Grade: Provide Custom grade interior woodwork complying with the referenced quality standard.
2. Shop cut openings to maximum extent possible.
3. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
4. Assemble casings in plant except where limitations of access to place of installation require field assembly.

K. Plastic-Laminate Cabinets: As follows:

1. AWI Type of Cabinet Construction: Flush overlay
2. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements.
3. Materials for Semiexposed Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
 - a. Drawer Sides and Backs: Solid-hardwood lumber
 - b. Drawer Bottoms: Hardwood plywood
4. Colors, Patterns, and Finishes:
 - a. Provide Engineer's selections from laminate manufacturer's full range of colors and finishes.

L. Solid-Surfacing-Material Countertops: As follows:

1. Solid-Surfacing-Material Thickness: as indicated on Contract Drawings
2. Sealant: Manufacturer's standard mildew-resistant, FDA, UL listed silicone sealant in colors matching components.
3. Foming Joints: Using manufacturer's standard joint adhesive; without conspicuous joints.
4. Edges: Clean, sharp returns. Rout cutouts, radii and contours to template. Smooth edges. Repair or reject defective and inaccurate work.
5. Color: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
 - a. Color shall be: Nocturne
6. Finish: Provide surfaces with a uniform finish. Matte Finish shall have a standard gloss range of 5-20.
7. Installation: Adhere to tops using manufacturer's standard color matched silicone sealant.
8. Fabricate tops in one piece with shop-applied backsplashes and edges, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
9. Joints in Solid Surface window sills shall be at centerlines of steel tubes.

M. Shop Finishing: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling.
 - a. Grade: Custom
 - b. AWI Finish System TR-4: Conversion varnish.
 - c. AWI Finish System TR-5: Catalyzed vinyl lacquer.
 - d. Staining: -None required
 - e. Sheen: Satin, 30-50

PART 3 - EXECUTION

- A. Condition woodwork to average prevailing humidity conditions in installation areas and examine and complete work as required, including removal of packing and backpriming before installation.
- B. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in this Section for type of woodwork involved.
- C. Install woodwork level, plumb, true, and straight to a tolerance of 1/8 inch in 96 inches. Shim as required with concealed shims. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- D. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
- E. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Calk space between backsplash and wall with sealant specified.

499.18 - RESILIENT TILE FLOORING

PART 1 - GENERAL

- A. This Subsection includes
 1. Vinyl Composition Floor Tile for the Control Room.
- B. Single-source responsibility for floor tile and resilient wall base: obtain each type, color, and pattern of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the work.
- C. Fire performance characteristics: Provide resilient floor tile with the following fire performance characteristics as determined by testing products per ASTM test method

indicated blow by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

D. Store flooring materials in dry spaces protected from the weather with ambient temperatures maintained between 50 deg F. and 90 deg. F.

E. Submittals: As follows:

1. Product Data: For each type of product specified.
2. Certification by tile manufacturer that products supplied for tile installation comply with local regulations controlling use of volatile organic compounds (VOC's).
3. Color Samples: Provide a full range of standard color samples from manufacturer for selection by Engineer. Provide full size tiles if requested by Engineer.

PART 2 - PRODUCTS

A. Products: Subject to compliance with requirements, furnish and install VCT from one of the following manufacturers

1. Armstrong World Industries
2. Azrock industries, Inc
3. Flexco Co.

B. Vinyl Composition Floor Tile: Products complying with ASTM F 1066.

C. Concrete slab primer: non-staining type as recommended by flooring manufacturer.

D. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

E. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.

1. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer.

B. Preparation: Comply with resilient product manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.

- C. Tile Installation: Comply with tile manufacturer's written installation instructions.
1. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter.
 - a. Lay tiles square with room axis.
 - b. Lay tiles in basket-weave pattern with grain direction alternating in adjacent tiles.
- D. Clean and protect resilient products according to manufacturer's written recommendations. Clean resilient products after installation and not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project.

499.19 - PAINTING

PART 1 - GENERAL

- A. This Subsection includes surface preparation and field painting of exposed exterior and interior items and surfaces.
1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
1. Prefinished Items include the following factory prefinished items:
 - a. Finished mechanical and electrical equipment
 - b. Light fixtures
 - c. Signage
 - d. Louvers
 2. Finished metal surfaces include:
 - a. Anodized Aluminum
 - b. Stainless Steel
 - c. Chromium Plate
 3. Concealed Surfaces include walls or ceilings in the following in accessible spaces:
 - a. Foundation spaces
 - b. Furred Areas

- c. Utilites
 4. Operating Parts include:
 - a. Valve and Damper operators
 - b. Linkages
 - c. Sensing Devices
 - d. Motor and Fan Shafts
 5. Labels:
 - a. Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- D. Submittals: For each paint system specified, provide the following:
1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
- E. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.
1. After color selection, the Engineer will furnish color chips for surfaces to be coated.
- F. Quality Assurance:
1. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.
 2. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label.
 3. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers in clean condition, free of foreign materials and residue. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.
 4. Project Conditions: Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

- A. Subject to the compliance with requirements, products may be incorporated into the Work include, but are not limited to:

1. Benjamin Moore & Co.
2. PPG industries, Inc
3. Sherwin Williams Co.

B. Paint Materials

1. **Material Compatibility:** Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
2. **Material Quality:** Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

C. Color: Drawings indicate paint colors for the various surfaces. Final selection of colors shall be by the Engineer. Contractor to submit a full range of manufacturer's standards to be selected by Engineer.

PART 3 - EXECUTION

- A. Examine substrates, areas, and conditions under which painting will be performed for compliance with paint application requirements.** Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
- B. Coordination of Work:** Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates.
- C. Preparation:** Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- D. Cleaning:** Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- E. Surface Preparation:** Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
 1. **Cementitious Materials:** Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - a. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint

to blister and burn, correct this condition. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.

2. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
- F. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
- G. Application: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in items are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 7. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 8. Sand lightly as required between each succeeding coat.
- H. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 3. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- I. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

- J. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- K. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- L. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.
- M. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Engineer.
- N. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
 - 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.
- O. Paint Schedule: As indicated in Contract Drawings

499.20 - HI PERFORMANCE COATING SYSTEM

PART 1 - GENERAL

- A. This Subsection includes cementitious coating for Roof surface of South Pier Machinery Room.
- B. Submittals: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
- C. Provide Color sample for approval of Engineer. Color shall match Gray Concrete color of Bascule Pier.

PART 2 - PRODUCTS

- A. Polymer Modified Portland-Cement Coating: Sikatop 144 by Sika Corporation or approved equal.

- B. Performance: Coating shall be slip resistant and provide protection against water infiltration of the Roof Slab.

PART 3 - EXECUTION

- A. Follow Manufacturers standards and recommendations.

499.21 - CERAMIC TILE

PART 1 - GENERAL

- A. This Subsection includes

1. Glazed Wall Tile
2. Floor Tile
3. Stone Threshold

- B. Submittals: In addition to Product Data for each type of tile and setting material indicated, submit the following:

1. Samples of each type and composition of tile.
2. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

PART 2 - PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Tile Products:
 - a. Crossville Ceramics.
 - b. Dal-Tile Corporation.
 - c. Or approved Equal
2. Tile-Setting and -Grouting Materials:
 - a. Custom Building Products.
 - b. Dal-Tile Corporation.
 - c. Or approved equal

- B. ANSI Ceramic Tile Standard: Provide tile that complies with Standard Grade requirements of ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

- C. ANSI Standards for Tile Installation Materials: Provide materials complying with referenced ANSI standards.

- D. Colors, Textures, and Patterns: For tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, comply with the following requirements:
1. Match colors, textures, and patterns indicated by referencing manufacturer's standard designations for these characteristics.
- E. Ceramic Mosaic Tile for Wall and Floor of Toilet Room and Alcove: Provide factory-mounted flat tile complying with the following requirements:
1. Composition: Impervious Natural Clay or Porcelain.
 2. Module Size: 2 by 2 inch.
 3. Thickness: 1/4 inch (6.35 mm).
 4. Face: Plain with cushion edges.
 5. Color: Dal-Tile Light Gray, D014
- F. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile. Provide Stretchers, Outside and Inside Angles, etc.
- G. Stone Thresholds: Provide stone thresholds that are uniform in color and finish, fabricated to sizes and profiles indicated to provide transition between tile surfaces and adjoining finished floor surfaces.
1. Fabricate thresholds to heights indicated, but not more than 1/4 inch above adjoining finished floor surfaces, with transition edges beveled on a slope of no greater than 1:2.
 2. Provide white, honed marble thresholds complying with the Marble Institute of America's Group A requirements for soundness, with ASTM C 503 requirements for exterior use, and with a minimum abrasive-hardness value of 10 per ASTM C 241.
- H. Waterproofing for Thin-Set Tile Installations: Provide products that comply with ANSI A118.10.
- I. Setting Materials: As follows:
1. Portland Cement Mortar Installation Materials: Provide materials complying with ANSI A108.1A.
 2. Organic Adhesive: ANSI A136.1, Type I.
- J. Grouting Materials: As follows:
1. Sanded-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.
 - a. Factory-Prepared, Dry-Grout Mixture: Factory-prepared mixture of portland cement; dry, redispersible, ethylene vinyl acetate additive; and other ingredients to produce the following:
 - 25) Sanded grout mixture for joints 1/8 inch (3.2 mm) and wider.

2. Polymer-Modified Tile Grout: ANSI A118.7, color to match tile selected.:
 - a. Polymer Type – Manufactureres standard.
 - 26) Unsanded Dry-Grout Mix: Dry-set grout complying with ANSI A118.6 for materials described in Section H-2.3, for joints 1/8 inch (3.2 mm) and narrower.

K. Elastomeric Sealants: Comply with applicable requirements 523.09 – Joint Sealers.

L. Miscellaneous Materials: As follows:

1. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

PART 3 - EXECUTION

- A. Provide concrete substrates for tile floors installed with dry-set or latex-portland cement mortars that comply with flatness tolerances specified in referenced ANSI A108 series of tile installation standards for installations indicated.
- B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- E. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
- F. Grout tile to comply with ANSI A108.10.
- G. Floor Tile Installation: Install tile to comply with requirements of ANSI A108.
- H. Wall Tile Installation: Install types of tile designated for wall installations to comply with requirements indicated, including those referencing TCA installation methods and ANSI setting-bed standards.
- I. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter. Use cleaning materials and methods that comply with tile and grout manufacturers' written instructions.

PART 1 - GENERAL

- A. This Subsection includes the Fabrication and Erection of Steel Panel Signs in the various rooms and buildings as described on the plans and herein specified.
- B. Signs shall be permanent baked enamel on steel sheet of size, Type and color to meet the requirements of The North Carolina State Accessibility Code.
- C. Submittals: Submit the following:
 - 1. Shop Drawings: Provide plans, elevations, and sections showing typical members, anchors, layout, reinforcement, accessories, and installation details. Include the following:
 - a. Message list for each sign with wording and letter layout.
 - b. Setting drawings, templates, and directions for installing anchors.
 - 2. Samples: For initial selection of color, pattern, and surface texture, and for verification of compliance with requirements indicated.
 - a. Dimensional Letters: Full-size sample of each letter type.

PART 2 - PRODUCTS

- A. Steel Sheet: 20 gauge sheet with baked on enamel finish.
- B. Anchors and Inserts: Nonferrous metal or hot-dipped galvanized. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts for concrete or masonry work.
- C. Metal Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations and applications recommendations.
- D. Lettering shall be all capitals in Black on a White Background with 1" High Letters in Helvetica Medium Type Face, unless otherwise approved by Engineer.
- E. Contractor shall meet with Engineer to verify locations of signage.

PART 3 - EXECUTION

- A. Installation: Locate signs where indicated, using mounting methods specified. Install level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
- B. Wall-Mounted Panel Signs: Attach using methods indicated below:
 - 1. Face Mounting: Use exposed Stainless Steel fasteners attached through plaque face into the wall surface.

C. Cleaning: After installation, clean soiled surfaces. Protect units from damage until acceptance by the Owner.

D. Sign Schedule

<u>Sign No.</u>	<u>Location</u>	<u>Sign Text</u>
1	Control Room	Live Load - 100 P.S.F. Occupancy Load – 4 People
2	Electrical Room (North)	Live Load - 250 P.S.F. Occupancy Load – 2 People
3	Generator Room	Live Load - 250 P.S.F. Occupancy Load – 2 People
4	Electrical Room (South)	Live Load - 250 P.S.F. Occupancy Load – 2 People

499.23 - METAL LOCKERS

PART 1 - GENERAL

A. This Subsection includes the furnishing and installation of factory-assembled Heavy-Duty All-Welded Metal Lockers, single tier.

B. Submittals: Submit the following:

1. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker.
2. Samples: Manufacturer's color charts showing the full range of Neutral and Classic colors and glosses available for units with factory-applied color finishes.

C. Deliver master keys, control keys, and combination control charts to Owner.

PART 2 - PRODUCTS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. List Industries, Inc. (Basis of Design)
2. Lyon Metal Products, Inc.
3. or Approved Equal by Engineer.

B. Fabricate lockers as follows

1. Lockers shall be "SUPERIOR FULLY-FRAMED ALL-WELDED ATHLETIC LOCKERS" as manufactured by List Industries Inc. or approved equal.

- 2. Locker Schedule:
 - a. Type: Varsity, Single Tier
 - b. Size: 24" wide x 22" deep x 36" high
 - c. Doors: Diamond perforated
 - d. Sides: Solid
- 3. Body: Form tops and bottoms from minimum 0.0598-inch-thick steel sheet.
- 4. Continuous Hinges: Manufacturer's standard, steel continuous hinge.
- 5. Recessed Handle and Latch: Manufacturer's standard nickel-plated steel or stainless-steel housing, with integral door pull, recessed for latch lifter and locking devices; nonprotruding latch lifter; and automatic, prelocking, pry-resistant latch, as follows
- C. Locks: Fabricate lockers to receive manufacturer's standard locking devices, installed on lockers using security-type fasteners.
 - 1. Key Locks: Built-in flush locks with five-pin tumbler keyway, keyed separately and master keyed for grooved key. Furnish two cut keys for each lock and five cut master keys.
- D. Locker Accessories: Provide the following accessories, finished to match lockers, unless otherwise indicated:
 - 1. Interior Equipment: Furnish each locker with manufacturer's standard zinc-plated, ball-pointed, double-prong steel hooks.
 - 2. Number Plates: Manufacturer's standard aluminum number plates. Number lockers in sequence indicated. Attach plates to each locker door with rivets.

PART 3 - EXECUTION

- A. Install metal lockers and accessories level, plumb, rigid, and flush according to manufacturer's written instructions. Connect groups of all-welded lockers together with standard fasteners, with no exposed fasteners on face frames. Anchor lockers to walls at intervals recommended by manufacturer, but not more than 36 inches o.c. Provide additional reinforcement in walls as required to support lockers.
- B. Locker Schedule:

<u>Quantity</u>	<u>Location</u>
4 lockers	Control Room

499.24 - TOILET ACCESSORIES

PART 1 - GENERAL

- A. Submittals: Manufacturer's Product Data. Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet Accessory Schedule in this section.

1. Other manufacturers' products with equal characteristics may be considered.

PART 2 - PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:

1. Toilet Accessories:
 - a. Bobrick Washroom Equipment, Inc. (Basis of Design)
 - b. American Specialties, Inc.
 - c. McKinney/Parker Washroom Accessories Corp

B. Materials: As follows:

1. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch minimum nominal thickness, unless otherwise indicated.
2. Sheet Steel: ASTM A 366, cold rolled, commercial quality, 0.0359-inch minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.
3. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
4. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.
5. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.
6. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

B. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

C. Clean and polish exposed surfaces according to manufacturers written recommendations.

D. Toilet Accessory Schedule:

<u>Description (1 of each)</u>	<u>Manufacturer and Model number</u>
Toilet Paper Dispenser	Bobrick – Two Roll Model B-27460
Hook Strip	Bobrick – Surface mounted Model B-232
Soap Dispenser	Bobrick – Recessed Model B-4112 Contura
Mirror	Bobrick – B-165 36 36
Paper Towel Dispenser/Trash	Bobrick – Recessed Model B-369
Mop Rack	American Specialties, Inc – Model 1308-3
Grab Bars	Bobrick – B-5806.99 x 36 & B-5806.99 x 42

499.25 - ROLLER SHADES

PART 1 - GENERAL

A. This Subsection includes

1. Transparent Sun Control Shades for all exterior windows in Control Room. Shades not required for windows in Stair Tower.
2. Cloth Sun Control Shade for all other windows on other levels of Control House and Machinery Room.

B. Submittals: In addition to Product Data, submit the following:

1. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, and attachments to other Work, operational clearances, and relationship to adjoining work.
2. Provide color and Transparency standards for selection by Engineer.

C. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Engineer of discrepancies.

PART 2 - PRODUCTS

- A. Manufacturers: Shade subject to compliance with requirements, provide shade product by Sol-R-Veil Co., Inc., Regional representative- Kenney Drapery, 135 east 144 street, Bronx, New York 10451, or an Approved equal.
- B. Transparent sun control rolling shades shall be model "met-l- Sphere control".
 1. Transparent sun control shade system must meet FAA specification FAA-e-247.b for Fabrication and installation of transparent plastic window shades.
 2. Plastic sheet and strip polyester material must meet federal specification 1-p-377b standards.

C. Cloth sun control shades shall be model "Sol-R-Control Shadecloth 1000 Series.

1. Performance: The shadecloth shall hang flat without deflection or distortion. The edges of the shadeband shall be cut square to insure true tracking of the shadeband and cut clean so that the core yarn is not exposed.
2. Flame Retardance: The shadecloth shall pass the California Flame Text Title 19, Section 1273.3, medium-scale test for interior fabric and shall pass the NFPA Flame Test.

D. Mounting: Recessed in Manufacturer's custom or standard ceiling pocket and as indicated on Drawings, mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

E. Operation: Chain-driven manually operated.

PART 3 - EXECUTION

- A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, Allow clearances for window operation hardware. Adjust roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- B. Fastening: The shade shall be installed according to manufacturer's instructions. Each bracket shall receive two (2) screws. The shade shall be set into place and leveled via a leveling screw. The shade shall pass final inspection tests.
- C. Cleanup: All debris related to the trade shall be removed from the building and disposed of legally. The job site shall be left clean and orderly. Damaged surfaces and finishes resulting from a careless installation shall be repaired at no cost to the owner.

499.26 - FURNISHINGS

GENERAL

- A. This subsection includes furnishing and installing Furniture including Chairs, Desks, File Cabinets and Desk Lamps.
- B. Submittals: Product data for each type of furniture item and assembly accessory required. Submit written data on physical characteristics, durability and flame resistance characteristics.
 1. Samples for initial selection purposes in standard size.
- C. Samples showing full range of colors, textures and patterns available for each type of furniture item required.
- D. Special product warranty: Submit a written warranty, executed by manufacturer, agreeing to repair or replace furniture which fails in materials or workmanship within the specified warranty period. This warranty shall be in addition to, and not a limitation of, other rights the state may have against the contractor under the contract documents.

PART 2 - PRODUCTS

- A. Manufacturers: Available manufacturers: Subject to compliance with requirements, manufacturers offering products which may be Incorporated in the work include, but are not limited to, the following:
1. Allsteel
 2. HON
 3. J.L. Industries
 4. Kreuger International
 5. Steelcase, Inc.
 6. Waldman Lighting
- B. Casegoods: The following casegoods models are those of manufacturers Noted to indicate relative style and quality:
1. Desk: Furnish the Kreuger International Model or an equal to be approved by the engineer as follows:
 - a. WorkZone 30"x60" Level 2 Desk , Model #: WBW3060-BN/9/CW/S/L2
27) With center drawer model WCD/BL, hanging box, box, file pedestal model S7p-1524h-bbf/bl and glide kit model s7p-gk.
 - b. Note: provide 2 keys per lock.
 2. File Cabinet (2 drawer): These are noted on the furnishings schedule as file cabinet on the drawings. Furnish HON model 312-C legal size black units with lock and one hang rail set per drawer
 - a. Note: provide 2 keys per lock.
- C. Fire Extinguishers: The following Fire Extinguishers and Cabinet models are those of JL Industries to indicate relative quality. Provide as specified or equal to be approved by Engineer.
1. Extinguisher: Cosmic 10E with UL rating 4A-60BC capable of being used on Class A, B and C fires.
 2. Cabinet: Cosmopolitan stainless steel surface-mounted cabinet with FE letters on full glass door.
- D. Desk Lamp: Montreaux-Single Vertical by Waldman Lighting or approved equal
1. Finish: Black
- E. Chair: Provide Allsteel Trooper Model (Fabric) or approved equal.
1. Task Chair with adjustable arms
 2. Color to be selected by Engineer from manufacturer's standard colors.

PART 3 - EXECUTION

- A. Installation: Install furniture, furnishings and equipment after other finishing operations, including painting, have been completed.
- B. Adjustment and cleaning: Repair damaged and defective work where possible to eliminate defects functionally and visually. Where it is not possible to repair, replace furnishings. Clean, lubricate and adjust furnishings, including hardware. Clean exposed and semi exposed surfaces. Touch up factory applied finishes to restore damaged or soiled areas in concealed and semi-exposed surfaces.
- C. Furnishing Schedule

<u>Quantity</u>	<u>Location</u>	<u>Description</u>
1	Control Room	Desk
2	Control Room	Arm Chair
1	Control Room	File Cabinet
1	Control Room	Desk Lamp
6	All levels of West Pier and East Pier	Fire Extinguisher & Cabinet

499.27 - PLUMBING FIXTURES

PART 1 - GENERAL

- A. This Subsection includes plumbing fixtures and trim, fittings, "exposed" piping and accessories, and supports associated with plumbing fixtures.
- B. Submittals - Product data for each type of plumbing fixture specified, including fixture and trim, fittings, accessories, supports, "exposed" piping construction details, dimensions of components, and finishes.
- C. Wiring diagrams for field-installed wiring of electrically operated units.
- D. Energy Ratings: Provide appliances that carry labels indicating energy-cost analysis (estimated annual operating costs) and efficiency information as required by the Federal Trade Commission.
- E. UL and NEMA Compliance: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.

PART 2 - PRODUCTS

- A. Available manufacturers: subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
 - 1. Water Closet: Kohler Co., American Standard, Eljer Plumbingware, or approved equal.

2. Lavatory: Elkay Manufacturing Co., Eljer Plumbingware, Kohler Co., or approved equal.
 3. Electric Water Cooler: Oasis by Ebco Manufacturing Co., Elkay Manufacturing Co., or approved equal.
 4. Refrigerator: GE, Amana or approved equal
- B. Provide plumbing fixtures and trim, fittings, other components, and supports as specified below.
- C. Water closet (assembly): This unit is indicated on the drawings. Water closet shall be Kohler Company Model K-3386 Rialto toilet with round-front bowl in white glazed vitreous china with included Lustra seat. Toilet shall be a 1.6 gallon gravity per flush one piece bowl/tank combination with model K-7637 3/8" angle supply with stop. Color: White
- D. Lavatory: This unit is indicated on the drawings for installation in a plastic laminated vanity. Lavatory shall be Elkay Manufacturing Co. "Pacemaker starlite" 20 gauge stainless steel type 304 self rimming model PSLVR-1917-CS complete with all supply and drainage fittings and trim including stops, trap, etc., in chrome plated copper or chrome plated brass where exposed or semi-exposed in the vanity. Faucet shall be chrome plated, swivel goose neck style LK24898BH as manufactured by Elkay Manufacturing Co. with a maximum rate of 2.2 gallons per minute at 80 pounds per square inch pressure per North Carolina Plumbing Code, 2002 edition, table 604.4 for a private lavatory.
- E. Service Sink/Floor Model: This unit is indicated on the drawings. Sink shall be Elkay Manufacturing Co. Service Sink, 16 gauge stainless steel type 304 model EFS2523C complete with drainage fitting LK43 and trim including stops, trap, etc. Sink shall come with wall mounted, high swing goose neck spout faucet, Model LK393A as manufactured by Elkay Manufacturing Co.
- F. Electric Water Cooler: This unit is indicated on the drawings. Water cooler shall be OASIS Reverse Osmosis Cooler, Model Hot, Cook 'N Cold or approved equal. Unit shall be installed below countertop in Control Room. Color: Black.
- G. Refrigerator: This unit is indicated on the drawings. Refrigerator shall be GE Spacemaker Compact Refrigerator, Model# GMR04BANWW or approved equal. Unit shall be installed below countertop in Control Room. Color: Black

PART 3 - EXECUTION

- A. Examine roughing -in for potable cold water and hot water supplies and soil, waste, and vent piping systems to verify actual locations of piping connections prior to installing fixtures.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Do not proceed until unsatisfactory conditions have been corrected.

- D. Install plumbing fixtures and specified components, in accordance with designations and locations indicated on the drawings. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written installation instructions, roughing-in drawings, and referenced standards. Install floor-mounted, floor -outlet water closets with closet flanges and gasket seals. Fasten counter-mounting-type plumbing fixtures to casework.
- E. Secure supplies behind wall or within wall pipe space, providing rigid installation.
- F. Install stop valve in an accessible location in each water supply to each fixture. Install trap on fixture outlet except for fixtures having integral trap. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.
- G. Seal fixtures to counters using a sanitary-type, one part, mildew resistant, silicone sealant in accordance with sealing requirements specified in "joint sealers" section. Sealant color to be clear.
- H. Connections
 - 1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other sections of this specification.
 - 2. Install piping connections indicated between appliances and equipment specified in other sections, direct connected to plumbing piping systems.
 - 3. Field quality control inspect each installed fixture for damage. Replace damaged fixtures and components.
- I. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly to the satisfaction of the Engineer.

499.28 - PLUMBING

PART 1 - GENERAL

- A. Plumbing work shall include furnishing and installing, backflow preventer, valves and water hammer arresters as well as furnishing and installing all water, waste and vent lines and all other related piping and connections to service the above facilities in the control house, all in accordance with the plans, specifications and as ordered by the Engineer.
- B. Materials, methods and details of plumbing work not specifically shown, required or specified shall conform to the National Standard Plumbing Code which shall constitute minimum requirements.
- C. Furnishing and installing the water line shall include copper water pipe to each of the facilities to be serviced in the control house to the piping outside of control house including, shut-off valves, check valves, water hammer eliminators, backflow preventer and supports.

- D. Waste and vent lines shall be furnished and installed connecting water cooler, lavatory, water closet and floor sink to the waste line passing through the wall of the control house, including vent shield, cleanouts, plugs and supports.
- E. Payment for water line will be for piping from the inside of the control house to each plumbing fixture.
- F. Payment for waste (sewer) line will be for piping from the inside of the control house to each plumbing fixture including vent line.

PART 2 - PRODUCTS

- A. Water pipe shall be seamless copper pipe conforming to the requirements of ASTM Specification B88, type K. Size as indicated on the plans.
- B. Piping and fittings for drainage and vent piping within the control house shall be polyvinyl chloride (PVC) socket type Schedule 40 plastic pipe conforming to ASTM F1866.
- C. Fittings for water pipe shall conform to ANSI B16.22. Solder filler metal shall conform to ASTM B32. Lead-free solder and fluxes shall be used for joining water supply piping.
- D. Piping supports shall conform to AASHTO Specification M270 grade 36 and galvanized in accordance with AASHTO M111.
- E. Valves shall be two piece construction with bronze body conforming to ASTM B62 having standard porting and solder ends. Valves shall include chrome plated ball, replaceable Teflon seats and seals, blowout proof stem and vinyl covered handle. Valves shall be rated for 600 psi wog pressure as manufactured by Nibco Inc. or approved equal by Stockham and Grinnell Corp. Size of valve shall be equal to size of pipe on which it is installed.
- F. For water closet, lavatory, and mop basin/service sink, see subsection 499.27 on plumbing fixtures.
- G. Water hammer arresters shall be Zurn model Z1700-500 as manufactured by Zurn Industries, Inc., Erie, Pennsylvania, or approved equal by Watts Regulator Co. And Jay R. Smith Manufacturing Co.
- H. Hot Water Heaters in the control house shall be an instantaneous electric water heater type. The heaters shall be a point of use Model SP3012 and Model EX120P2 for the lavatory and mop basin respectively as manufactured by Eemax Inc. or approved equal. Heaters shall be rated for 3.0 kW and 11.5 kW respectively. Heater shall utilize a flow switch to activate the heater only on demand
- I. Wall hydrant shall be model 65 freezeless, automatic draining with hose connection anti-siphon vacuum breaker as manufactured by Woodford Mfg. ASSE Standard 1019-B approved. Hardened stainless steel operating stem and one-piece valve plunger to control both flow and drain functions. Exterior finish shall be chrome plated. Three loose tee

key to be furnished with hydrant. The wall hydrant shall be furnished for the proper wall thickness at the location as shown on the Plans.

- J. Reduced pressure zone backflow preventer shall be manufactured by Watts Regulator or approved equal by Zurn Industries and ITT Hoffman Specialty. Backflow preventer to be at least same size as pipes. Preventer shall have a maximum working pressure of 175 psi and have an intermediate atmospheric vent.
- K. Unions shall be two piece construction with bronze body conforming to ASTM B62, having standard porting and solder ends. Unions shall be rated for 600 psi working pressure. Size shall be equal to the size of the pipe on which it is installed.

PART 3 - EXECUTION

- A. The Contractor shall prepare and submit for review, shop drawings and catalogs for new water and sewer piping within the control house. Shop drawings shall include the following:
 - 1. Piping configurations in plan and elevation showing their relation to the structure, control house and other work including electrical, structural and mechanical being installed.
 - 2. Details showing all steel and concrete penetrations including sealing and fire stopping as well as support details and spacing.
 - 3. Manufacturer's catalog information and data for piping, fittings, and piping supports, including installation and maintenance instructions.
- B. All plumbing work shall be coordinated with other trades, so that all sleeves, inserts, conduits, etc., are placed in concrete and all other locations, and that conflicts between the elements of different trades do not occur. The Contractor shall be solely responsible for any repairs, modifications, removals, patching and extra work required as a result of lack of trade coordination.
- C. Piping systems: The Contractor shall install all exposed piping in rooms as nearly as possible parallel to or at right angles to the building. All piping shall be run straight and true. Springing or forcing piping into place will not be permitted. Piping shall be installed in such a manner as to prevent strain on the equipment or fixtures.
- D. Valves shall be provided as required at the service entrance in the control house and at each fixture, and at inlets and outlets of each item of equipment.
- E. All piping shall be of the size and routing indicated on the plans or as required to service all equipment and systems. Use fittings for all changes in direction and branch connections.
- F. All piping shall be carefully graded so as to eliminate traps and pockets where possible. Where air pockets or water traps cannot be avoided, means shall be provided for draining traps with a valved hose connection.
- G. Where pipes change size, reducing fittings shall be used.

- H. Soldered joints shall be installed in accordance to the procedures contained in the American Welding Society soldering manual. All joint surfaces shall be cleaned by an approved procedure. An approved flux shall be applied and the joint shall be made by heating to the proper temperature.
- I. All soldered joints shall be made smooth and unobstructed inside. All cut pipe ends shall be reamed to remove burrs. Obstruction shall be removed prior to fabrication and installation.
- J. PVC piping shall be installed and joined as per manufacturer's specifications and as specified herein for PVC joints using solvent cement.
- K. Where flanges on PVC pipe are required, the Contractor shall install flanges using solvent cement and shall use full face flat-type gaskets between flanges.
- L. Cutting of PVC pipe shall be square cuts at pipe ends, inside diameter shall be deburred and outside diameter of the PVC pipe shall be beveled to the manufacturer's requirements.
- M. A union or flanges shall be installed on the downstream side of shutoff valves, at both sides of automatic valves, at equipment connections, and elsewhere as indicated or required.
- N. Shut-off valves and check valves shall be installed where shown on the plans.
- O. All supports for vertical piping and all piping within the control house shall be directly fastened to the piping. The Contractor shall include additional supports as required or ordered by the Engineer, to accommodate loads at elbows and turns and additional loads on piping created by cleanouts and expansion Joints.
- P. Test drainage and vent system in accordance with the procedures of the authority having jurisdiction or, in the absence of a published procedure in accordance to Section 312 of the North Carolina Plumbing Code.
- Q. Repair all leaks and defects using new materials and retest system as many times as required until satisfactory results are obtained.
- R. Water piping shall be subjected to a static water pressure as per Section 312 of the North Carolina Plumbing Code or 50 psi above the operating pressure or 80 psi, whichever is greater. Test shall not exceed pressure rating of the piping materials. Pressure test shall be repeated as many times as required until satisfactory results are obtained.
- S. Prior to the water being placed in-service it shall be cleaned and disinfected in accordance with Section 610 of the north Carolina Plumbing Code or the authority having jurisdiction or, in case a method is not prescribed by the authority, the procedure described in AWWA C651. Upon completion of the disinfection samples shall be taken, delivered to and analyzed by an approved laboratory. Test reports shall be submitted to the Engineer.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Roof deck.
- 2. Composite floor deck.

- B. Related Sections include the following:

- 1. Division 03 Section "Cast-in-Place Concrete" for concrete fill.
- 2. Division 05 Section "Structural Steel Framing" for shop- and field-welded shear connectors.
- 3. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
- 4. Division 09 painting Sections for repair painting of primed deck.

1.3 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, boundary details, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
- C. Product Certificates: For each type of steel deck, signed by product manufacturer.
- D. Welding certificates.
- E. Field quality-control test and inspection reports.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Powder-actuated mechanical fasteners.
 - 2. Self-drilling screws.
- G. Research/Evaluation Reports: For steel deck.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- D. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-120 windstorm ratings.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Steel Deck:
 - a. Epic Metals Corporation.
 - b. Marlyn Steel Decks, Inc.
 - c. Nucor Corp.; Vulcraft Division.
 - d. Roof Deck, Inc.
 - e. United Steel Deck, Inc.
 - f. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

2.2 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
 - 1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G90 zinc coating.
 - 2. Deck Profile: Type WR, wide rib.

3. Profile Depth: 1-1/2 inches.
4. Design Uncoated-Steel Thickness: 0.0358 inch.
5. Span Condition: Triple span or more.
6. Side Laps: Overlapped.

2.3 COMPOSITE FLOOR DECK

A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:

1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G90 zinc coating.
2. Profile Depth: 2 inches.
3. Design Uncoated-Steel Thickness: 0.0358 inch.
4. Span Condition: Triple span or more.

2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter, or 3/4" diameter puddle welds.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0358-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated or as recommended by SDI Publication No. 30 for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- I. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- J. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

- K. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.
- B. Locate deck bundles to prevent overloading of supporting members.
- C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- H. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions. Submit data showing that mechanical fasteners meet or exceed shear and tension capacities of welded connections.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 - 1. Weld Diameter: 3/4 inch, nominal.
 - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of five welds (36/5 pattern, at each side laps and at three flutes between) per deck unit at each support (end and intermediate supports). Space welds 12 inches maximum

apart in the field of roof and 6 inches apart in roof corners and perimeter, based on roof-area definitions in FMG Loss Prevention Data Sheet 1-28.

- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding 12", and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 - 2. 3/4" diameter puddle welds
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and weld.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 3/4 inch, nominal.
 - 2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart to form 3/4" weld pattern..
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding 12 inches, and as follows:
 - 1. Side-Lap: Fasten with 3/4" diameter puddle welds.
 - 2. Perimeter Edge Support: Fasten with 3/4 inch puddle weld.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Butted.

- D. Shear Connectors: Weld shear connectors through deck to supporting frame according to AWS D1.1 and manufacturer’s written instructions. Butt end joints of end panels; do not overlap. Remove and discard arc shields after welding shear connectors.
- E. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.
- F. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Designer.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

499.30 - MEASUREMENT AND PAYMENT

Control House / Electrical Room – Architectural / General Construction will not be measured and payment will be made on a lump sum basis.

Control House / Electrical Room – Structure construction will not be measured and payment will be made on a lump sum basis.

Control House Plumbing will not be measured and payment will be made on a lump sum basis.

Payment will be made under:

<u>Pay item</u>	<u>pay unit</u>
Control House/Electrical Room – Architectural/General Construction	lump sum
Control House/Electrical Room – Structure	lump sum
Control House Plumbing	lump sum

Payment for all electrical work necessary to place the equipment in operating order will be made as specified in Section ~~400~~ (Electrical).

Payment for Cast-in-Place Concrete shall be made under Section 420.