



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION, FERRY DIVISION

Manns Harbor, North Carolina

**Marine Maintenance Facility
Phase VII – Stage 1
Issued for Bid/Construction**

LG Project No. 019064.03

February 16, 2005



LOCKWOOD GREENE
ENGINEERING & CONSTRUCTION

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Section Number Revision Number Title

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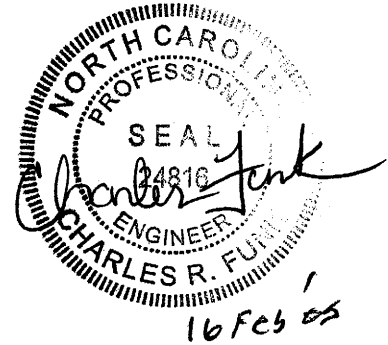
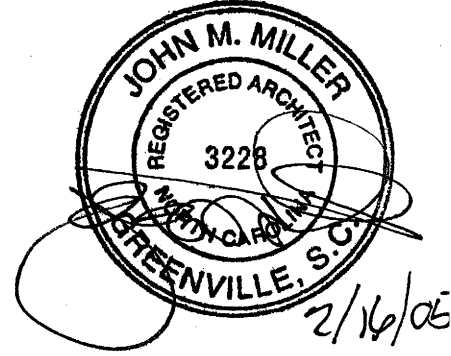
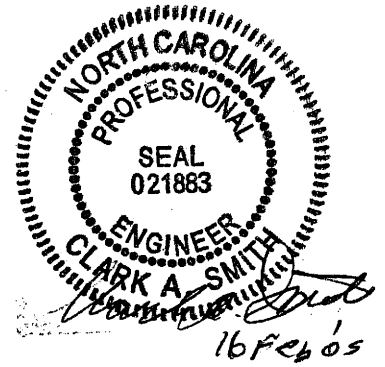
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Alfred E. Taylor
2/17/05



Caroll Walker
17 Feb 05

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REFERENCE INFORMATION

Geotechnical Investigation Excerpts

End of Section

SECTION 00021 - LIST OF DRAWINGS

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Prepared By: Clark A. Smith

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1.1 CONTRACT DRAWINGS

| <u>Drawing Number</u> | <u>Revision Number</u> | <u>Title</u> |
|-----------------------|------------------------|---|
| C-700 | 0 | COVER SHEET AND VICINITY MAP |
| C-701 | 0 | LEGEND, ABBREVIATIONS & GENERAL NOTES |
| C-702 | 0 | OVERALL SITE PLAN |
| C-706 | 0 | SECTIONS & DETAILS |
| C-711 | 0 | DEMOLITION PLAN (SHEET 2) |
| C-712 | 0 | SITE LAYOUT AND UTILITY PLAN (SHEET 2) |
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| S-701 | 0 | STRUCTURAL GENERAL NOTES AND CRITERIA |
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| S-721 | 0 | MISCELLANEOUS SECTIONS AND DETAILS |
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| A-715 | 0 | MAIN BUILDING ADDITION PLANS, ELEVATIONS, SECTIONS & DETAILS |
| A-716 | 0 | MAIN BUILDING ADDITION DOOR AND FINISH SCHEDULE AND DETAILS |
| A-717 | 0 | CONTROL BUILDING PLANS, ELEVATIONS, SECTIONS AND DETAILS |
| E-701 | 0 | ELECTRICAL LEGEND, LUMINAIRE SCHEDULE, GENERAL NOTES & ABBREVIATIONS |
| E-706 | 0 | EXISTING AREA ELECTRICAL SITE PLAN |
| E-707 | 0 | CONTROL BUILDING SINGLE LINE DIAGRAMS & RECONNECTION DIAGRAM |
| E-708 | 0 | MAIN BUILDING ADDITION LIGHTING AND POWER PLANS |
| E-709 | 0 | CONTROL BUILDING LIGHTING, POWER AND UNDERGROUND PLANS |
| H-702 | 0 | MAIN BUILDING ADDITION HVAC/MECHANICAL PLANS, SECTIONS AND DETAILS |
| H-703 | 0 | CONTROL BUILDING HVAC/MECHANICAL PLANS, SECTIONS, DETAILS AND SCHEDULES |

SECTION 00021 - LIST OF DRAWINGS

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1.2 REFERENCE DRAWINGS

A. The following drawings are provided only for general information purposes.

| <u>Drawing Number</u> | <u>Revision Number</u> | <u>Title</u> |
|---------------------------|----------------------------|-----------------------------------|
| E-3 | 4 | Phase IV, Power Plans and Details |

End of Section

SECTION 01111 - SUMMARY OF WORK

Prepared By: Clark A. Smith *CS*

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Checked By: Jim Griffith

Approved By: Clark A. Smith *CS*

1.1 SUMMARY

A. Work Includes: Work consists of Tool Room/Observation Room addition and Lift House relocation at the NC State Shipyard in Manns Harbor, NC. The Work shall be performed in accordance with the included drawings and specifications. The work includes the following items:

1. Construction of a new Lift house and demolition of the existing Lift house to include HVAC, electrical and water.
2. Installation of Lift house Syncrolift control equipment, supplied by Owner, to include:
 - a. Motor control center
 - b. Computer, monitor and communications cable between computer and MCC
3. Construction of a new Tool Room and Platen Observation Room to include HVAC, electrical and mechanical services.
4. Paving, fire protection and storm drainage.
5. Platen extensions and associated underground utility relocation.
6. Other associated Work.

B. Work Excludes:

1. Owner will remove miscellaneous stored material and equipment.
2. Construction testing: The Owner will execute separate agreements for all required testing services that are not specified as the Contractor's responsibility by the Contract Documents.
3. Provision of Lift House control equipment will be by Syncrolift through a separate contract with the Owner. Syncrolift will also provide on site observation and guidance during installation and start-up assistance.
4. Phase VII - Stage 2: Warehouse Package.
5. Phase VII - Stage 3: Maintenance Building Expansion.

1.2 FORM OF AGREEMENT

A. Agreement is per the terms and conditions provided separately by Owner.

1.3 PROJECT SCHEDULE

- A. Commence Work upon award of the Contract approximately June 2005.
- B. Owner furnished Syncrolift Control Equipment will arrive on site on or before July 1, 2005.
- C. Achieve substantial completion in October 1, 2005
- D. Within 10 days of execution of the Contract, Contractor will furnish Owner with the Project Schedule and a proposed Schedule of Values to support mutually agreeable progress payments as described in the Owner-Contractor Agreement.

1.4 WORK SEQUENCE

- A. The work must be accomplished such that the Owner has minimum disturbance to operation of the Shipyard to include the Lift Platform, Transfer Table, access to the Maintenance/Warehouse Building and access to two (2) of the three (3) Platens. In this regard, the work must be sequenced considering the following:
1. The new Lift House must be constructed, control equipment installed and underground services installed as close as possible to tie-in prior to disruption of service and demolition of the existing Lift House. Actual down time of the lifting operation should be limited to 48 hours and preferably over the weekend.
 2. The Owner must maintain access to the doors of the existing Maintenance/Warehouse Facility facing the construction area.

1.5 INFORMATION FOR CONTRACTOR

- A. The information drawings of existing construction (listed in Section 00021) are provided for information only to assist with determination of demolition/tie-in requirements. Existing drawings are provided for the bidder's convenience and general information only. Owner and Engineer do not have or assume any responsibility for accuracy or completeness of the information contained on the existing drawings.
- B. Geotechnical Data:
1. Geotechnical data provided is extracted from previous NCDOT geotechnical investigations. The extracted data is attached at the conclusion of the Bid Package.
 2. The Geotechnical information is not a contract document. Such information is made available for Bidder's convenience and general information only. Conclusions made by Bidder from data provided in report are sole responsibility of Bidder. Owner and Engineer do not have or assume any responsibility for accuracy or completeness of information contained in report.

End of Section

SECTION 01141 - ALTERATION, DEMOLITION, AND REPAIRS

Prepared By: Clark A. Smith *CS*

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Checked By: Jim Griffith

Approved By: Clark A. Smith *CS*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies requirements associated with alteration, demolition, and repairs.

1.2 LIAISON PERSONNEL

- A. Owner will assign personnel to act as liaison with Contractor in order that Work is properly coordinated with Owner's necessary functions and operations.
- B. Liaison personnel will advise Owner which utility services and facilities that must be maintained.
- C. When requested, delay specific construction operations that result in inconveniences to operations. Liaison personnel will coordinate to establish a schedule of hours in which construction operations may be carried on.

1.3 VERIFY EXISTING CONDITIONS

- A. Verify existing conditions and examine adjoining work which will affect completion of Work.
- B. Report in writing, conditions which prevent proper performance of Work.
- C. No waiver of responsibility for defective work will be considered unless notice has been filed and agreed to in writing before commencing Work.

1.4 TRAFFIC

- A. Accomplish Work with minimum interference to pedestrians, work and vehicular traffic on site and on adjacent streets and highways.
- B. Erect temporary and adequate guards, barricades, and other protective device as required by authorities having jurisdiction.
- C. Do not close, block or otherwise obstruct streets, walks, or other occupied or used facilities without written permission from authorities having jurisdiction.
- D. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

1.5 PROJECT CONDITIONS

- A. Existing buildings and grounds are occupied and in use. Except in areas required to be vacated so that Work may be performed, buildings and grounds will be occupied and used while Work is in progress.
- B. Perform Work in a manner to cause least interference with existing Shipyard operations.

SECTION 01141 - ALTERATION, DEMOLITION, AND REPAIRS

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- C. Where alterations occur, or new or old work join, cut, remove, patch, repair, and finish adjacent surfaces or so much thereof as required to match existing adjacent surfaces.

1.6 PROTECTION OF STRUCTURES AND PROPERTY

- A. Protect existing structures and property against damage.

1.7 UTILITY SERVICES

- A. Existing utilities to remain in service and protect against damage during Work.
- B. Owner will advise which utilities must be maintained.
- C. Schedule and provide 72 hours advance notice to Owner if utility shut-down is necessary.
- D. Do not interrupt existing utilities except when authorized in writing by Owner or authorities having jurisdiction.
- E. Restore accidental interruption of utility services immediately.
- F. Provide temporary services during interruptions to existing utilities, if required.
- G. Maintain fire protection services at all times.

1.8 SALVAGEABLE MATERIAL

- A. Owner reserves the right to retain existing materials, fixtures, and equipment.
- B. Remove unsalvageable materials, fixtures, and equipment from site.
- C. Unsalvageable materials shall become property of Contractor. Contractor shall have no right or title to existing materials, fixtures, and equipment removed from existing building unless and until said materials, fixtures, and equipment have been removed from premises.
- D. Where items are indicated to be delivered to Owner, remove, clean, store, and turn over to Owner.

1.9 DISPOSAL OF DEMOLISHED AND UNSALVAGEABLE MATERIAL

- A. Debris, rubbish, and demolished and unsalvageable material shall not accumulate on site or in building.
- B. Remove debris as rapidly as it accumulates.
- C. Transport and legally dispose off-site.
- D. Burning of combustible materials on Project site is not permitted.
- E. Keep debris damp to eliminate dust.
- F. Use closed type dust proof chutes to remove materials from upper levels.

End of Section

SECTION 01331 - SUBMITTAL PROCEDURES

Prepared By: Clark A. Smith *CS*

Checked By: Jim Griffith

Approved By: Clark A. Smith *CS*

1.1 SECTION INCLUDES

A. Section specifies procedural requirements associated with Contractor submittals including:

1. Contractor's Construction Schedule.
2. Submittal Schedule.
3. Shop Drawings.
4. Product Data.
5. Samples.
6. Daily Construction Reports.

B. Refer to Owner-Contractor Agreement and other Division 1 Sections for requirements associated with administrative submittals. Such submittals may include, but are not limited to:

1. Performance and Payment Bonds.
2. Insurance Certificates.
3. Schedule of Values.
4. Applications for Payment.
5. List of Subcontractors.
6. Consent of Surety.
7. Waivers of Liens.
8. Contractor's Statements, Affidavits, and Certifications.

1.2 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with purchasing, fabrication, testing, delivery, other submittals, and related activities that requires sequential activity.
2. Coordinate transmittal of different submittals involving related elements so processing will not be delayed by need to postpone review of submittals until related submittals are received.
3. A/E reserves right to withhold action on submittal requiring coordination with other submittals until related submittals are received.
4. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

B. Processing: Allow A/E sufficient review time so that installation will not be delayed as result of time required to process submittals, including time for resubmittals.

1. Allow not less than 10 working days for A/E's review; allow additional time if processing must be delayed to permit coordination with subsequent submittals.
2. If A/E requires resubmittal of an item, process subsequent submittal in same manner as initial submittal.
3. Allow 10 working days for processing each resubmittal.

SECTION 01331 - SUBMITTAL PROCEDURES

4. Extension of Contract Time not authorized because of failure to transmit submittals to A/E sufficiently in advance of Work to permit processing.
- C. Submittal Preparation: Place identification label or title block on each submittal.
1. Furnish adequate space on label, or beside title block on Shop Drawings, to record Contractor's review and approval markings.
 2. Include the following information on label or title block:
 - a. Project name: NC State Shipyard, Phase VII - Stage 1.
 - b. Name of A/E: Lockwood Greene Engineers.
 - c. LG Project No.: 019064.03
 - d. Date.
 - e. Contractor's name.
 - f. Supplier's name.
 - g. Manufacturer's name.
 - h. Related Specification Section number.
 - i. Drawing numbers and detail references, as appropriate.
 3. Include such data on cover sheets attached to Product Data, on 8-1/2"x11" format submittals, and on tags or labels attached to Samples.
- D. Transmittal: Include transmittal form or letter with each submittal.
1. On transmittal, record relevant information and, if appropriate, requests for data. On form or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations.
 2. Include Contractor's certification that information complies with Contract Document requirements.
 3. Submittals received from sources other than Contractor will be returned without action.
- E. Delivery:
1. Mail or hand deliver submittals to:

For Delivery:
Lockwood Greene Engineers, Inc.
1500 International Drive
Spartanburg, SC 29303

Regular Mail:
Lockwood Greene Engineers, Inc.
PO Box 491
Spartanburg, SC 29304

Attention: Roxanne Greenleaf

1.3 A/E'S ACTION

- A. Except for information-type submittals, A/E will review and mark submittals to indicate actions taken and instructions to Contractor, and then return appropriate number of copies to Contractor.

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SECTION 01331 - SUBMITTAL PROCEDURES

- B. A/E will affix to submittals self-explanatory stamp, marked to indicate 1 of the following:
1. If marked "Approved," that portion of Work represented by submittal may proceed provided it complies with requirements of Contract Documents; final acceptance will depend on compliance.
 2. If marked "Approved with Corrections Noted," that portion of Work represented by submittal may proceed provided it complies with noted corrections and requirements of Contract Documents; final acceptance will depend on compliance.
 3. If marked "To be Revised and Resubmitted," do not proceed with purchasing, fabrication, delivery, installation, or other similar Work activities associated with submittal. Revise submittal in accordance with notations; resubmit without delay.
 4. If marked "Rejected-See Remarks," do not proceed with purchasing, fabrication, delivery, installation, or other similar Work activities associated with submittal. Prepare new submittal in accordance with notations; resubmit without delay.
- C. A/E will review Contractor's Construction Schedule, Submittal Schedule, and other similar information-type submittals to determine if A/E has objections to information contained therein. If it has no objections, A/E will mark submittals "Action Not Required," and then return appropriate number of copies to Contractor.

1.4 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Within 10 days of date of execution of Agreement, but not later than date of submission of Schedule of Values, submit to 5 copies of horizontal barchart-type Construction Schedule.
- B. Use separate time-bar for each significant construction activity; mark each time-bar to describe its relationship to breakdown of units of Work identified in Schedule of Values.
- C. Furnish separate set of time-bars for each major portion of Work.
- D. Mark schedule to provide series of continuous vertical lines to identify first work day of each week.
- E. Within each time-bar, identify planned completion percentage in 10% increments. As Work progresses, place contrasting mark in each bar to identify actual percent completion.
- F. Furnish notations on schedule to show how Work is affected by special sequencing requirements specified in Section 01111.
- G. Prepare schedule on sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for entire construction period.
- H. Coordinate Construction Schedule with Schedule of Values, Submittal Schedule, and Applications for Payment.
- I. Indicate completion of Work in advance of date established for Substantial Completion; allow adequate time on schedule for A/E's procedures necessary for certification of Substantial Completion.
- J. Unless A/E objects to Contractor's initial construction schedule, 1 copy will be returned to Contractor marked "Action Not Required."

SECTION 01331 - SUBMITTAL PROCEDURES

- K. Update and resubmit Construction Schedule as follows:
1. Submit 3 copies with each Application for Payment.
 2. If an event occurs which adversely affects barchart data, submit 5 copies of revised schedule within 5 days of event giving rise to change.
- L. Copies accompanying Applications for Payments will not be returned to Contractor. For those situations requiring submission of 5 updated copies, A/E will, unless it objects to modifications contained in updated document, return 1 copy to Contractor marked "Action Not Required."

1.5 SUBMITTAL SCHEDULE

- A. Not later than date of submission of Contractor's Construction Schedule, submit 5 copies of Contractor's Submittal Schedule.
- B. Prepare schedule in form of list that identifies each submittal as follows:
1. Brief description of submittal.
 2. Related Specification Section number.
 3. Planned date of submission.
- C. Unless A/E objects to Contractor's initial Submittal Schedule, 1 copy returned to Contractor marked "Action Not Required."
- D. If an event occurs which adversely affects Submittal Schedule, submit 5 copies of revised schedule to within 5 days of event giving rise to change. Unless A/E objects to such revised document, 1 copy returned marked "Action Not Required."

1.6 SHOP DRAWINGS

- A. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar documents. As minimum, furnish:
1. Dimensions, including those established by field measurement.
 2. Identification of materials.
 3. Statement indicating compliance with specified requirements.
 4. Description of coordination requirements.
 5. Product and manufacturer's name, if applicable.
- B. Submit newly prepared documents drawn to accurate scale. Do not reproduce Contract Documents or copy standard information as basis of Shop Drawings; standard information prepared without specific reference to Project not considered Shop Drawings.
- C. Collect Shop Drawings into single submittal for each element of construction.
- D. Highlight, encircle, or otherwise indicate deviations from Contract Documents.
- E. Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2" x 11," but no larger than 30" x 42."
- F. Unless otherwise specified, submit 1 correctable, translucent print and 4 blue- or black-line prints; translucent print returned to Contractor.

1.7 DAILY CONSTRUCTION REPORTS

- A. Prepare daily construction report which provides:
1. Date of construction activity.
 2. Brief identification of Work activities and areas of execution.
 3. List of Subcontractors on Project site.
 4. Approximate count of construction personnel on Project site.
 5. High and low temperatures, description of general weather conditions.
 6. Description of accidents.
 7. Description of emergencies and actions taken.
 8. Minutes of meetings conducted at Project site.
 9. Information about Work stoppages, delays, shortages, and losses.
 10. Copy of orders and requests of governing authorities.
 11. Identification of services connected or disconnected.
 12. Description of tests conducted at Project site.
- B. Submit 1 copy of each report at weekly intervals; forward such copies by means ensuring A/E's receipt not later than 5 days following latest report date.

End of Section

SECTION 01451 - QUALITY CONTROL

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Prepared By: Clark A. Smith *cas*

Checked By: Jim Griffith

Approved By: Clark A. Smith *cas*

1.1 SECTION INCLUDES

- A. Section specifies coordination and support required by Contractor.

1.2 CONTRACTOR'S RESPONSIBILITIES

- A. Coordinate schedule with Owner and testing agency date for performing tests.
- B. Assist testing agency by providing labor and facilities.
- C. Assist testing agency personnel gain access to test area and obtain test samples.
- D. Correct deficiencies found by inspections or tests at no additional cost.

End of Section

SECTION 01751 - CHECK-OUT AND MECHANICAL COMPLETION

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Prepared By: Clark A. Smith

Checked By: Jim Griffith

Approved By: Clark A. Smith

1.1 SECTION INCLUDES

- A. Section specifies procedures and requirements affecting check-out and mechanical completion.

1.2 DEFINITION

- A. Mechanical completion:

1. Satisfactory completion of each operating system to point of being ready for start-up.
2. Completion of necessary Work for safe start-up excluding nonessential work i. e., painting.

1.3 IDENTIFICATION OF SYSTEMS

- A. Divide project into operating systems to provide an organized approach leading to total project check-out.
- B. Systems include equipment, piping, instruments, power interfaces, and components inside system boundary for purposes of being identified as a specific system.

1.4 CHECK-OUT AND INSPECTION (WALKDOWN)

- A. Check-out each system for completion of Work and documentation including review, check-out, and inspection of:
 1. Erection in accordance with Drawings, Specifications, and applicable codes.
 2. Non-operating adjustments and cold alignment of equipment.
 3. Mechanical, hydrostatic, and pneumatic tightness tests and cleaning.
 4. An inspection check of piping and instrumentation versus P&IDs.
 5. Lubrication of moving parts of equipment and verification of rotation.
 6. Checking and calibration of each instrument.
- B. Thoroughly inspect and document plant systems with punch list of items not in conformance with design documents.
- C. Correct punch list items essential to mechanical completion before system is accepted as mechanically complete.
- D. Prior to inspection, completely pressure test, clean, align, lubricate, and electrically connect each system.
 1. Connect controls to field devices and control room equipment.
 2. Control system with systems connected and functionally complete.
 3. Perform system loop checks and connect and test electrical wiring.
- E. Equipment manufacturer's representatives (including Syncrolift) shall assist and verify that equipment is installed per requirements to ensure compliance with guarantees.

SECTION 01751 - CHECK-OUT AND MECHANICAL COMPLETION

- F. Mechanical completion managed by Owner. Owner will witness system check-out inspection by Contractor, and Owner will follow-up on punch list items. Expedite completion of punch list items.

End of Section

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SECTION 01771 - CLOSEOUT PROCEDURES

Prepared By: Clark A. Smith *CS*

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1.1 SECTION INCLUDES

- A. Section specifies general requirements and administrative procedures associated with Substantial Completion and final acceptance of Work.

1.2 SUBSTANTIAL COMPLETION

- A. Prerequisite Actions: Prior to requesting Owner's inspection for Substantial Completion, accomplish the following:
1. Complete construction. (If an item of Work is not complete at time of request for inspection, submit with request a description of incomplete item, statement of item's monetary value, and reason for not completing item.)
 2. Complete start-up testing of equipment and systems.
 3. Submit operating and maintenance manual specified in Section 01781.
 4. Complete operating and instruction program specified in Section 01781.
 5. Complete removal of temporary facilities as specified.
 6. Repair or replace property damaged by construction activities as specified.
 7. Complete final cleaning activities specified in this Section.
 8. Submit record documents specified in Section 01781.
 9. Store spare parts/products at Project site and submit list of items stored as specified in this Section.
- B. Semifinal Inspection: Upon receipt of Contractor's request for inspection, and provided Contractor has completed prerequisite actions, Owner will inspect Work, and then either issue a Certificate of Substantial Completion which includes a list of items to be completed or corrected or notify Contractor and Owner of nonconforming items that must be completed or corrected before certificate will be issued. If notice is issued, Owner will re-inspect Work when Contractor certifies nonconforming items have been completed or corrected.

1.3 FINAL ACCEPTANCE

- A. Prerequisite Actions: Before requesting Owner's inspection for final acceptance, execute Work needed to complete or correct items which Owner identified in Certificate of Substantial Completion. In addition, submit the following:
1. Final Application for Payment which includes accounting for final Change Orders, Construction Change Directives, and liquidated damages.
 2. Written warranties. (Submit as specified in this Section.)
- B. Final Inspection: Upon receipt of Contractor's request for inspection, and provided Contractor has completed prerequisite actions, Owner will conduct final inspection, and then either issue a final Certificate for Payment or notify Contractor and Owner of nonconforming items that must be completed or corrected before certificate will be issued. If notice is issued, Owner will re-inspect Work when Contractor certifies nonconforming items have been completed or corrected.

SECTION 01771 - CLOSEOUT PROCEDURES

1.4 PROPERTY REPAIR

- A. Repair or replace new and existing construction damaged by construction activities. Execute repairs and replacements to match undamaged adjacent construction.
- B. Repair or otherwise restore marred finishes and surfaces. Replace construction that cannot be corrected without showing evidence of repair or restoration.
- C. Replace partially clogged air filters located in areas affected by construction activities.
- D. Replace damaged landscaping; plant new material matching type and size of existing growth.
- E. Restore damaged lawn areas.

1.5 FINAL CLEANING

- A. Multiple Contracts: Contractor is responsible for final cleaning of Work provided by Contractor.
- B. Environmental Requirements: Conduct cleaning and waste disposal operations in compliance with applicable laws and regulations.
 - 1. Do not dispose of solvents or other volatile materials in storm or sanitary drains.
 - 2. Do not burn or bury rubbish on Project site.

1.6 RECORD DOCUMENTS

- A. Refer to Section 01781.

1.7 SPARE PARTS/PRODUCTS

- A. Store at Project site spare parts/products specified in other Sections, and then submit to Owner 2 copies of itemized list of items stored.
- B. Store spare parts/products in places designated by Owner.
- C. Store items in containers bearing identifying labels. Mark such containers "Owner's Name - Do Not Remove."

1.8 WRITTEN WARRANTIES

- A. Submit written warranties specified in other Sections.
- B. If written warranties are required which differ from manufacturers' standard pre-published documents, submit to Owner 2 copies of proposed text not less than 30 days before submitting final warranties.

End of Section

SECTION 01781 - CLOSEOUT SUBMITTALS

Prepared By: Clark A. Smith *CS*

Checked By: Jim Griffith

Approved By: Clark A. Smith *CS*

1.1 SECTION INCLUDES

- A. Section specifies requirements for operation and maintenance (O&M) data and record documents.

1.2 SUBMITTALS

A. O&M Data:

1. **General:** Submit complete and concise O&M data on equipment or product provided. Data containing extraneous information which requires sorting through to find applicable instructions not acceptable. Present information in sufficient detail, using glossy preprinted material, not photocopies, to clearly explain user O&M requirements at system, equipment, component, and subassembly level. Include an index preceding each submittal.
2. **Quantity:** Submit 2 copies of specified manufacturers' information for components, assemblies, subassemblies, attachments, and accessories. Equipment and products which requires O&M data is listed in technical sections.
3. **Package Content:** For each product, system, or piece of equipment requiring submission of O&M data, submit data required in technical section. Content as specified herein.
4. **Delivery:** Submit O&M data by direct mail for review and acceptance. Submit data within 30 days after item is delivered to Project site.
5. **Changes to Submittals:** Submit manufacturer-originated changes or revision to previously submitted data if component of an item is so affected subsequent to acceptance of O&M data. Submit changes, additions, or revisions required for final acceptance of submitted data within 30 days of notification of change requirement.
6. **Installer Information:** Submit list that includes name, address, and telephone number of each entity installing product or equipment. Include local representatives and service organizations most convenient to Project site. Provide name, address, and telephone number of product or equipment manufacturers.

B. Record Documents:

1. Record Drawings: 1 copy.
2. Record Project Manual Including Addenda: 1 copy.
3. Shop Drawings and Product Data: 1 copy.
4. Record Log Book: 1 copy.
5. Inspection, Laboratory, and Field Test Reports: 1 copy.
6. Warranties: 1 copy.
7. Operations and Maintenance Records: 1 copy, unless specified otherwise.
8. Spare Parts Data: 1 copy, unless specified otherwise.
9. Reproducible Record Drawings: 1 copy.

1.3 O&M DATA

A. Types of Information:

1. **Operating Instructions:** Include specific instructions, procedures, and illustrations for each phase of operation:
 - a. **Safety Precautions:** List personnel hazards and equipment or product safety precautions for operating conditions.
 - b. **Operator Pre-start:** Include requirements to set-up and prepare each system for use.
 - c. **Start-up, Shutdown, and Post-Shut Down Procedures:** Include control sequence for each operation.
 - d. **Normal Operations:** Include control diagrams with data explaining operation and control of systems and specific equipment.
 - e. **Emergency Operations:** Include emergency procedures for equipment malfunctions to permit short period of continued operation or to shut down equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of utility systems including valve locations and portions of systems controlled.
 - f. **Operator Service Requirements:** Include instructions for operator performed services including lubrication, adjustments, and inspection.
 - g. **Environmental Conditions:** Include list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment. Describe conditions under which equipment should not be operated.
2. **Preventive Maintenance:** Include information for preventive and schedule maintenance to minimize corrective maintenance and repair.
 - a. **Lubrication Data:** Include lubrication data other than instructions for lubrication specified herein.
 - 1) Table indicating recommended lubricants for specific temperature ranges and applications.
 - 2) Charts with schematic diagram of equipment indicating lubrication points, recommended types and grades of lubricants, and capacities.
 - 3) Lubrication schedule indicating service interval frequency.
 - b. **Preventive Maintenance Plan and Schedule:** Include manufacturer's schedule for routine preventive maintenance, inspections, tests, and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance man-hours on daily, weekly, monthly, and annual basis including craft requirements by type of craft.
3. **Corrective Maintenance:** Include manufacturer's recommendations on procedures and instructions for correcting problems and performing repairs.
 - a. **Troubleshooting Guides and Diagnostic Techniques:** Include step-by-step procedures to promptly isolate cause of typical malfunctions. Describe why check-out is performed and what conditions are sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

- b. **Wiring Diagrams and Control Diagrams:** Provide point-to-point wiring diagrams and control diagrams of wiring and control circuits including factory-field interfaces. Provide complete and accurate depiction of actual Project specific wiring and pneumatic control tubing and terminals for each type, identically to actual installation numbering.
 - c. **Maintenance and Repair Procedures:** Include instructions and list tools required to restore product or equipment to proper condition or operating standards.
 - d. **Removal and Replacement Instructions:** Include step-by-step procedures and list required tools and supplies for removal, replacement, disassembly and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerance, dimensions, settings, and adjustments required. Instructions shall include combination of text and illustrations.
 - e. **Spare Parts and Supply Lists:** Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies having long lead time (2 weeks) to obtain.
 - f. **Corrective Maintenance Man-hours:** Include manufacturer's projection of corrective maintenance man-hours including craft requirements by type of craft. Identify and tabulate separately corrective maintenance that requires participation of equipment manufacturer.
4. **Appendices:** Provide specified information and information not specified but pertinent to maintenance or operation of product or equipment. Include:
- a. **Parts Identification:**
 - 1) Provide identification and coverage for parts of each component, assembly, subassembly, and accessory of end items subject to replacement.
 - 2) Include special hardware requirements, such as requirement to use high-strength bolts and nuts.
 - 3) Identify parts by make, model, serial number, and source of supply to allow reordering without further identification.
 - 4) Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of items.
 - 5) When illustrations omit part numbers and description, both illustrations and separate listing shall show index, reference, or key number which will cross-reference illustrated part to listed part.
 - 6) Group parts indicated in listing by components, assemblies, and subassemblies.
 - a) **Manufacturer's Standards Commercial Practice:** Parts data may cover more than 1 model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as master parts catalog.
 - b) **Other Than Manufacturer's Standard Commercial Practice:** End item manufacturer may add cross-reference to implement components' assemblies and parts requirements when implementation in manual form varies significantly from style, format, and method of manufacturer's standard commercial practice. Example format follows:

SECTION 01781 - CLOSEOUT SUBMITTALS

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| Item Manufacturer's Alphanumeric Sequence | Actual Manufacturer's Name and FSCM | Actual Manufacturer's Part No. |
|--|---|--------------------------------------|
| 1000001 | John Doe & Co. 00000 | 200002 |

- b. Warranty and Guarantee Information: List and explain various warranties and guarantees including servicing and technical precautions prescribed by manufacturers specified to keep warranties in force. Include actual warranty documents.
- c. Personnel Training Requirements: Provide information available from manufacturers to use in training designated personnel to operate and maintain equipment and systems properly.
- d. Testing Equipment and Special Tool Information: Include information on test equipment required to perform specified tests and on special tools needed for operation, maintenance, and repair of components.

B. Schedule of O&M Data:

1. Furnish O&M data specified in individual technical sections.
2. Required information for O&M data includes:
 - a. Safety precautions.
 - b. Operator pre-start.
 - c. Start-up, shutdown, and post-shut-down procedures.
 - d. Normal operations.
 - e. Emergency operations.
 - f. Operator service requirements.
 - g. Environmental conditions.
 - h. Lubrication data.
 - i. Preventive maintenance plan and schedule.
 - j. Troubleshooting guides and diagnostic techniques.
 - k. Wiring diagrams and control diagrams.
 - l. Maintenance and repair procedures.
 - m. Removal and replacement instructions.
 - n. Spare parts and supply list.
 - o. Corrective maintenance man-hours.
 - p. Parts identification.
 - q. Warranty information.
 - r. Personnel training requirements.
 - s. Testing equipment and special tool information.

C. Special Tools: Provide special tools required for maintenance and repair.

1.4 RECORD DOCUMENTS

A. General: Ensure that latest-revision documents are marked.

1. Maintain and control the following categorized documents:
 - a. Record documents.
 - b. Other Project documents requiring identification and storage control.

2. Provide the following functions:

- a. Provide adequate storage facilities at Project site and maintain file of record and Project documents separate from construction documents used in performing Work
- b. Properly identify each type of document.
- c. Verify that documents specified herein and in other Sections are received from manufacturers.
- d. Mark record documents with changes as they occur during construction. Keep a log of these changes indicating documents affected and status of marking.
- e. Make documents available for observation. Restrict documents use by other entities.
- f. Provide copies of documents at Project closeout.

B. Document Identification:

1. Record Drawings: Bind record drawings in same sequence Drawings are enumerated in Section 00021; include a durable-paper cover which bears the following notations: Owner's name, Project title, Contractor's name, date of submission, and phrase "Record Drawings."
2. Project Manual: Mark cover of Project Manual to indicate Contractor's name, date of submission, and phrase "Record Project Manual."
3. Shop Drawings, Product Data, and Test Reports: Comply with Section 01331.
4. O&M Data, Spare Parts, and Warranties: Identify as follows:
 - a. Project title, Contractor's project number, and Contractor's name.
 - b. Name of equipment or system to which it applies.
 - c. Reference Section number and equipment number.
 - d. Name of Subcontractor, manufacturer, material supplier, testing agency, or other originating party.

C. Recording Changes: Maintain 1 copy of Contract Documents to record changes between Contract Documents and construction configuration.

1. Record changes as they occur and before Work is concealed. Use non-fading, non-smearing pen. Record initials of person making entry and date change was incorporated in Work.
2. Record construction changes authorized by Change Order which have not been incorporated into Contract Documents.
3. Record Drawings:
 - a. Dimensionally locate on plans and elevations new location from established lines, floor elevations, or bench marks.
 - b. Give particular attention to concealed elements.
 - c. Add dimensions of buried or concealed Work not originally shown on Drawings. Dimension by reference to visible construction.
 - d. Add details not included on Drawings which are pertinent to facility operation and maintenance.
4. Record Project Manual, Addenda, Shop Drawings, and Product Data:
 - a. Enter change adjacent to information to which it applies. Line out, in a manner to remain legible, changed information.
 - b. Indicate changes in manufacturer, trade name, catalog number, and supplier from that specified.

- c. Bind Addenda and Amendments immediately behind Project Manual cover; include attachments to Addenda and Amendments which modify contents of Project Manual.
- d. Where Project Manual or attachments to Addenda or Amendments contain pages voided by later revision, mark voided pages to direct attention to Addendum or Amendment which provides revised pages.
- e. Record changes on 1 copy of reviewed Shop Drawings. Record Shop Drawings shall include construction changes relative to structural steel, fire protection sprinkler layouts, ductwork, and other systems where Shop Drawings are used to erect or install Work.

D. Record Log Book:

1. Record Drawings: Keep a running log in bound notebook of each record entered on Drawings. Identify Drawings by number on which record was made, date, and name of person making entry. Give brief reason for change.
2. Record Project Manual, Addenda, Shop Drawings, and Product Data: List by type of document each document which has been changed. Indicate document number, date, and name of person making entry. Give brief reason for change.

1.5 OTHER PROJECT DOCUMENTS

- A. Prepare and maintain index for other Project Documents. Each index shall identify documents by title and identifying number. Verify that warranties specified in other Sections have been received.

End of Section

Prepared By: Carroll Walker

Checked By: Mark Hester

Approved By: Carroll Walker *w*



PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies general requirements affecting sitework specified in other Division 2 Sections.

1.2 DEFINITIONS

- A. Unsuitable Material: Earth materials designated as unsatisfactory for their intended use by Geotechnical consultant.
- B. Suitable Material:
 - 1. Earth materials meeting requirements of Unified Soil Classification System (ASTM D 2487) types SW, GM, GC, SC, SM; or
 - 2. Soil having a plasticity index less than 25 , a liquid limit less than 50 and containing no more than 5% by weight of fibrous organic material is suitable; or
 - 3. Designated as being suitable for their intended use by geotechnical engineer.
- C. Waste Material: Trash, debris, trees, brush, broken concrete, and other deleterious material resting on or below grade.
- D. Unclassified Excavation: Excavation of every description regardless of type of material encountered.
- E. Off Site Borrow: Inorganic, relatively clean sands containing less than 10% passing the No. 200 sieve.

1.3 SUBMITTALS

- A. Submit request for approval prior to disturbance of monuments.
- B. Submit coherent notes and sketches of reference points.
- C. Submit copies of permits.

1.4 PROJECT CONDITIONS

- A. Soils Conditions: Verify accuracy and completeness of site topography, topographic maps, soil reports, and other topographic or soil data provided. Make additional investigations to be familiar with site topography and subsurface soil conditions.
- B. Protection:
 - 1. Monuments: Protect and prevent destruction of survey monuments, bench marks, property corners, or other survey points. Do not disturb point without written approval.

SECTION 02000 - GENERAL PROVISIONS - SITE WORK

Record relocation of reference points prior to disturbance. Only licensed surveyors registered in State where Work is performed to relocate monuments.

2. Work: Assume responsibility for Work and protection of Work. Provide additional grading to prevent damage to Work by water (surface runoff) at no additional cost.

C. Work Within Easements:

1. Verify easements have been acquired and ensure that Work, materials, and equipment do not encroach beyond limits of permanent or construction easements.
2. Remove from easements or dispose of construction debris, felled trees, brush, rock, trash, and other objectionable material.

1.5 REGULATORY AND SAFETY REQUIREMENTS

- A. Comply with and give notice required by laws, ordinances, rules, regulations, and lawful order of public authority bearing on performance of Work.
- B. Comply with safety requirements including Project specific safety regulations.
- C. Obtain and comply with permits required by Federal, State, and Local authorities that have not previously been obtained.
- D. Comply with OSHA Regulations including 29 CFR Part 1926, Subpart P; Excavations.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Choice of equipment to perform specified operations is responsibility of this Section. Replace equipment that results in waste, damage, inaccurate Work, or is otherwise objectionable.
- B. When performing Work after daylight hours:
 1. Obtain written approval.
 2. Provide and maintain sufficient artificial lighting to permit proper construction, observation, and inspection.

PART 3 - EXECUTION

3.1 FIELD ENGINEERING

- A. Establish lines, grades, and control points for construction starting from control points and elevations provided.
- B. In presence of Owner, survey by cross section areas requiring extra payment prior to and after excavation.

3.2 SPECIAL SAFETY REQUIREMENTS

- A. None

3.3 CLEAN-UP

- A. Keep premises and surrounding area free from waste materials and rubbish.

End of Section

SECTION 02200 - EARTHWORK

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Prepared By: Carroll Walker

Checked By: Mark Hester

Approved By: Carroll Walker *W*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies providing a graded site with temporary and permanent drainage.
- B. Categorize earthwork operations necessary to provide a graded site as unclassified excavation described in Section 02000.

1.2 SUBMITTALS

A. Compaction Tests:

- 1. Test Results Meeting Specified Requirements: Geotechnical consultant shall submit formal reports of compaction test and retests.
- 2. Test Results Failing to Meet Specified Requirements: Geotechnical consultant shall immediately submit, by telephone or Fax, test reports of compaction tests and retests not meeting specified requirements.
- 3. Contents of Reports: Reports include:
 - a. Date of test and date submitted.
 - b. Atmospheric conditions.
 - c. Location of test.
 - d. Wet weight, moisture content, and dry weight of field sample.
 - e. Description of soil.
 - f. Maximum dry density and moisture content of laboratory sample which best matches field sample in color, texture, grain size, and maximum dry density.
 - g. Ratio of field dry density to maximum laboratory dry density expressed as a percent.
 - h. Comments concerning field density passing or failing specified compaction.
 - i. Comments about re-compaction, if required.

1.3 QUALITY ASSURANCE

- A. Employment of geotechnical consultant not required by this Section. Geotechnical consultant shall identify soils, check densities, and classify soil materials.
- B. Geotechnical consultant will perform density tests in accordance with following minimum schedule:
 - 1. One every layer of fill,
 - 2. One density test every 2,500 square foot with at least one density test performed on each lift of material, or
 - 3. Area where compaction is in question to verify uniform quality of Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. On-Site Obtained Material: Reference Section 02000.
- B. Off-Site Obtained Material:
 - 1. Quality: Suitable Material. Reference Section 02000.
 - 2. Testing: Geotechnical consultant to define as Suitable Material prior to site delivery.
 - 3. Moisture Content: -3.0% to +3.0% of optimum moisture content when placed.
 - 4. Permit: Obtain permits for borrow source.

PART 3 - EXECUTION

3.1 EROSION AND DUST CONTROL

- A. Perform earthwork operations to minimize erosion and dust transport.
- B. Comply with erosion and sedimentation controls specified in Section 02270.
- C. Erosion and sedimentation controls on Drawings are a minimum.
- D. Provide additional protective measures to prevent sediment and dust from being removed from site.
- E. Provide equipment or stabilize areas to prevent dust. Provide water for dust control.

3.2 EXCAVATION

- A. Preparatory Work:
 - 1. Construct sedimentation control devices, as indicated on Drawings, prior to beginning excavation.
 - 2. Perform excavation in a manner and sequence to provide drainage.
 - 3. Provide, maintain and operate temporary drains, ditches, pumps, drainage lines or other equipment to intercept, divert, or remove water from excavations.
- B. Excavating:
 - 1. Excavate areas designated on Drawings to elevations or depths shown.
 - 2. Excavate to depth necessary to remove rubble.
 - 3. Segregate excavated materials into suitable and unsuitable stockpiles for future use or disposal.
- C. Stockpiling:
 - 1. Stockpile excavated materials in separate suitable and unsuitable stockpiles.
 - 2. Segregate roots, stumps, rocks larger than 6 inches, refuse, and other deleterious materials from excavated material and dispose offsite in a legal manner.
 - 3. Stockpile suitable excavated materials adjacent to excavation, but no closer to bank than depth of excavation, or 5 feet minimum.

4. Place stockpiled materials no greater than 4 feet in height and do not obstruct proper drainage of area.
- D. Use of Excavated Materials: Use suitable materials removed from excavation, including ditches, to form fill or embankment indicated on Drawings.

3.3 DEWATERING

- A. Provide and maintain an adequate dewatering system capable of removing water that accumulates in excavation to a point 2 feet below excavation or below lowest subgrade to maintain limits of Work in a dry condition.
- B. Rework unstable or damaged Work from failure to dewater properly at no additional cost.

3.4 PROOFROLLING

A. General:

1. Proofroll subgrade in areas to receive fill or embankment.
2. Extend proofrolling a minimum of 5'-0" horizontally outside area to receive pavements or structures.
3. Proofroll with a minimum of 4 coverages of a 4-wheeled rubber tired proofroller or moderately loaded dump truck, unless failure occurs during first coverage.
4. Proofroll last 2 passes perpendicular to first two.
5. An area is considered covered when out to out dimension of wheels of roller has passed over it twice.
6. An additional coverage may be required by geotechnical consultant to ensure that a suspicious area is stable.
7. Operate roller in a systematic manner so that number of coverages designated can be readily determined.
8. Operate equipment at a speed not to exceed 5 miles an hour or not less than 2-1/2 miles per hour.
9. Proofroll only in presence of geotechnical consultant.
10. Do not proofroll:
 - a. Alluvial areas having a near surface ground water level.
 - b. Where water is ponded on surface.
 - c. When rainfall has occurred within 24 hours.

B. Excavation of Unsuitable Material:

1. Excavate areas as directed by geotechnical consultant where proofrolling indicates unstable subgrade or excessive rutting.
2. Excavate to elevation or depth to correct unstable condition as directed by geotechnical consultant.
3. After areas found to be unstable have been improved by excavation and backfilling, proofroll again to ensure effectiveness of corrective measures.

C. Backfilling of Excavated Areas:

1. Backfill excavated areas with approved suitable material unless otherwise directed by geotechnical consultant.

2. Place backfill as soon as possible after excavation but in no case can excavation be left open overnight.
3. Do not place backfill on areas covered by water.
4. Remove water from excavated areas by approved methods.
5. Place and compact backfill material in accordance with requirements specified for fills or embankments.

3.5 FILLS OR EMBANKMENTS

A. Preparatory Work:

1. Perform demolition work and proofroll prior to beginning fill construction.
2. Enlarge, to permit use of proper compaction equipment, stump holes, cavities, and other irregularities resulting from demolition operation within fill construction. Backfill with suitable material and compact to specified density for fill.
3. Plow and harrow fill areas unless scarifying by disc harrow or other approved means is sufficient. Densify fill foundation to a depth of 6 inches prior to placing fill at density specified. Alter density and moisture content of soil underlying 6 inch compacted layer to obtain specified density of fill foundation.
4. Construct ditches prior to fill construction.

B. Placement of Fill Material:

1. In fill construction, deposit and spread material in successive, uniform, approximately horizontal loose layers of not more than 8 inch depth loose measurement for full width of required cross section.
 - a. Construct fill or embankment using only approved suitable material.
 - b. Place material so that during construction center of fill is kept higher than edges.
 - c. Spread sandy or rocky material in full width layers to form drainage planes from center through edge of embankments, except do not use rocky material larger than 6 inches in size in embankment or as directed by geotechnical consultant.
 - d. Avoid pockets of open graded material surrounded by tight or more impervious material.
 - e. Roll and compact each layer of embankment to specified density.
 - f. Progress from edges toward center in successive trips of compaction equipment.
 - g. Finish fills and slopes true and straight, in conformity with lines and grades with true and even surfaces.
 - h. Construct fill of approved materials.
 - i. Maintain moisture content of soils within percentage range of optimum moisture content specified.
 - j. Add water during periods of dry weather; provide sufficient moisture for compaction.
 - k. Water required to provide sufficient moisture will not be measured for direct payment.
 - l. Materials containing excessive moisture will not be measured for direct payment.
 - m. Dry materials containing excessive moisture to proper moisture content before compaction is attempted.
 - n. Provide proper drainage and properly operate borrow areas to prevent excess moisture.
2. Remove and replace fill sections failing to meet specified requirements.

3. Construct side ditches or gutters emptying from cuts to embankments to avoid damage to embankments by erosion.
4. Utilize surplus suitable material on site by uniformly widening embankments or flatten slopes after receiving written approval.

C. Completed Work:

1. Protect stability of fills.
2. Replace slope material washed away by natural rainfall or run-off.
3. Maintain final grade to $\pm 1/10$ foot of design grade until final completion.

3.6 SOIL COMPACTION CONTROL

A. Compaction Requirements: Compaction required for fill and embankment areas.

1. Compaction Standard: ASTM D 1557, Modified Proctor maximum dry density.
2. Loose Lift Thickness: 8 inch maximum layers.
3. General Fill: 95% minimum.
4. Fill Under Structures and Pavements: 98% minimum in upper 24 inches.
5. Moisture Content: Optimum $\pm 3\%$.

B. Equipment: Provide equipment for wetting or drying and manipulating fill material to secure a uniform moisture content within an allowable range as determined by geotechnical consultant.

C. Field Density Testing: Determine field density by methods outlined in ASTM D 1556, ASTM D 2937 or ASTM D 2922.

D. Compaction Test Results Failing to Meet Specified Requirements:

1. Bear costs of tests which indicates failure to meet specified requirements.
2. Do not place additional fill on a lift with any portion failing.

3.7 FINISHED GRADING

A. Preparatory Work: Complete backfilling prior to finish grading. Correct washouts or other similar irregularities.

B. Finish Grading:

1. Finish grade exposed earth surfaces and roadway subgrades to within ± 0.10 foot of design grade.
2. Use blade-grader or scraper equipment to obtain finished grade of Work as specified.
3. Obtain accuracy of finish grade using templates and stringlines; hand raking method is required in case of shoulders, gutters, and similar areas.
4. Finish ditches so they drain readily.
5. Leave finished grade 1 inch lower than top of pavement elevation where bulking of soil caused by grass growth will prevent drainage from running off pavement.

C. Protection: Maintain finish grades until final completion. Repair damage resulting from water, wind, and equipment.

3.8 DISPOSAL OF EARTHWORK DEBRIS OR WASTE

- A. Remove non-combustible materials, including, muck, broken concrete and metal, from site and dispose in a legal manner.

End of Section

SECTION 02220 - FOUNDATION AND TRENCH EXCAVATION, BEDDING, AND BACKFILL

Prepared By: Carroll Walker

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Checked By: Mark Hester

Approved By: Carroll Walker

(w)

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies procedures and requirements relating to excavation, bedding, backfill, and dewatering for:
 - 1. Foundations.
 - 2. Trench excavations.
- B. Categorize earthwork operations to provide a graded site as unclassified excavation described in Section 02000.

1.2 SUBMITTALS

- A. Compaction Tests:
 - 1. Test Results Meeting Specified Requirements: Geotechnical consultant shall submit formal reports of compaction test and retests.
 - 2. Test Results Failing to Meet Specified Requirements: Geotechnical consultant shall immediately submit, by telephone or Fax, test reports of compaction tests and retests not meeting specified requirements.
 - 3. Contents of Reports: Reports include:
 - a. Date of test and date submitted.
 - b. Atmospheric conditions.
 - c. Location of test.
 - d. Wet weight, moisture content, and dry weight of field sample.
 - e. Description of soil.
 - f. Maximum dry density and moisture content of laboratory sample which best matches field sample in color, texture, grain size, and maximum dry density.
 - g. Ratio of field dry density to maximum laboratory dry density expressed as a percent.
 - h. Comments concerning field density passing or failing specified compaction.
 - i. Comments about re-compaction, if required.

1.3 QUALITY ASSURANCE

- A. Employment of geotechnical consultant not required by this Section. Geotechnical consultant shall identify soils, check densities, and classify soil materials.
- B. Geotechnical consultant perform density tests in accordance with following minimum schedule:
 - 1. One per 100 linear feet of pipe on each lift of soil.
 - 2. One per 50 cubic yards of structural fill.
 - 3. Area where degree of compaction is in question to verify uniform quality of Work.
 - 4. Structural foundation area which has remained submerged for more than eight hours.

SECTION 02220 - FOUNDATION AND TRENCH EXCAVATION, BEDDING, AND BACKFILL

PART 2 - PRODUCTS (Not Applicable)

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PART 3 - EXECUTION

3.1 SPECIAL SAFETY REQUIREMENTS

- A. Comply with OSHA Regulations including 29 CFR Part 1926, Subpart P; Excavations.
- B. Barricade and mark with warning lights, excavations not backfilled at end of day's work.
- C. Provide and maintain temporary bridges and crossings for traffic.
- D. Do not pile excavated material closer than 5 feet to edge of excavation.
- E. Keep excavated material clear of traveled way along streets and roads.
- F. Locate underground structures and utilities, shown on Drawings or made known during construction, by hand digging and exposing structure or utility for entire width of new excavation.
- G. Prior to commencing Work, coordinate with local utility companies and site maintenance department to determine location of existing utilities.
- H. Fully protect and support each utility exposed during construction.

3.2 DEWATERING

- A. Provide and maintain an adequate dewatering system capable of removing water that accumulates in excavation to a point 2 feet below excavation or below lowest subgrade to maintain limits of Work in a dry condition.
- B. Rework unstable or damaged Work from failure to dewater properly at no additional cost.

3.3 EXCAVATION

- A. Foundation Excavation:
 - 1. Excavate areas designated on Drawings to elevations or depths shown.
 - 2. Remove loose material from excavation bottoms and level or grade excavation bottoms to receive foundation materials. Remove unsuitable or unstable material as directed by geotechnical consultant and replace with suitable compacted material, compacted stone with 100% passing a 3/4 inch sieve, or lean concrete.
 - 3. Inspect excavations to receive structures or foundations by soils technician working under direct supervision of geotechnical consultant.
 - 4. Provide sufficient excavation dimensions to accommodate forms or structures. Excavate slope walls to remain stable until backfill is placed.
 - 5. Retain suitable material from excavation and use for backfill. Geotechnical consultant will classify material as suitable or unsuitable.
 - 6. Remove and dispose unsuitable material off site.
 - 7. Perform excavation in a manner and sequence to provide drainage. Provide temporary drains, ditches, pumps, drainage lines or other equipment to intercept, divert, or remove surface and sub-surface water from excavation.

SECTION 02220 - FOUNDATION AND TRENCH EXCAVATION, BEDDING, AND BACKFILL

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B. Trench Excavation:

1. Excavate trenches to lines and grades shown on Drawings.
2. Maintain trench walls as nearly vertical as possible to an elevation 1 foot above top of utility, not to exceed a vertical height of 4 feet above bottom of trench.
3. Slope, bench, or sheet and shore trenches exceeding 4 feet in height to maintain stability of trench wall.
4. If suitable bearing, as determined by geotechnical consultant, is not encountered at depth indicated for trench bottom, excavate such material to depth required and refill and compact to proper grade with coarse sand, fine gravel, or other suitable approved material.
5. Special requirements relating to specific utilities are as follows:
 - a. Pipe Lines and Conduits:
 - 1) Open cut excavation to proper width of trench.
 - 2) Provide a clear space between barrel of pipe or conduit and vertical trench wall not to exceed 8 inches on either side of pipe or conduit.
 - 3) Above 1 foot level, provide trench width to form stable slopes or provide sheeting and bracing.
 - 4) Provide a minimum cover over top of utility of 3 feet in unpaved areas and 4 feet in paved areas, or as shown on Drawings, and to avoid interference with other utilities.
 - b. Pressure Lines:
 - 1) Unless otherwise indicated, grade trenches to avoid high points with necessity of placing vacuum and relief valves in pressure lines.
 - 2) Provide a minimum cover over top of pipe of 3 feet in unpaved areas and 4 feet in paved areas, or as shown on Drawings, and to avoid interference with other utilities.
 - c. Electrical Conduits/Ductbanks: Unless otherwise specified in Division 16, provide a minimum cover over top of conduit of 2.5 feet.

3.4 BEDDING

A. General:

1. Shape bottoms of trenches in undisturbed soil or in bedding required on Drawings.
2. Provide firm excavation bottom which is stable and at a uniform density.
3. Excavate joint holes by hand to minimum size required for proper installation so joint does not carry weight of pipe.
4. Compact bedding material around pipe barrel, with manual tamp.
5. Minimum acceptable bedding, unless otherwise shown on Drawings or specified, consists of following:
 - a. Backfill with suitable soil material or suitable granular soil material to 12 inches above top of utility.
 - b. Backfill flexible pipe or conduit in natural or manufactured sand, fine gravel, or crushed stone, not larger than 1/4 inch in size to 6 inches above top of utility.

SECTION 02220 - FOUNDATION AND TRENCH EXCAVATION, BEDDING, AND BACKFILL

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- B. Muck Areas: After muck or unsuitable material has been removed, bring bed back to grade using suitable backfill material placed in loose 8 inch layers and compacted to 95% of maximum dry density as determined by ASTM D 1557.

3.5 BACKFILL

A. General:

1. Do not proceed with backfilling operations until tests, inspections, or observations have been performed.
2. Remove debris, rock, broken concrete, formwork, and similar unsuitable material from trench prior to start of backfilling operations.
3. Provide backfill material free of muck, rock, organic material, broken concrete, or other debris.
4. Do not place backfill over areas covered by water.

B. Backfill Adjacent to Structures:

1. Compaction Standard: ASTM D 1557-Modified Proctor maximum dry density.
2. Loose Lift Thickness: 8 inch maximum layers.
3. Fill: 95% minimum.
4. Fill Under Structures and Pavements: 98% minimum in upper 24 inches.
5. Moisture Content: Optimum $\pm 3\%$.

C. Trench Backfill: Place trench backfill in uniform layers and compact full width of trench.

1. Placing:

- a. Do not disturb utility alignment when placing backfill material.
- b. Do not use bulldozer or other piece of equipment to push fill material into trench.
- c. Do not drop material on pipe.
- d. Place material to allow pipe to remain undisturbed and to allow for uniform spreading and compaction of material.
- e. Place material on both sides of utility so that backfill will have same elevation on each side during compaction operations.
- f. Avoid contact of utility with compaction equipment.

2. Backfill Around Utility: Continue specified procedure from trench bottom to 1 foot above top of utility.

- a. Compaction Standard: ASTM D 1557-Modified Proctor maximum dry density.
- b. Loose Lift Thickness: 6 inch maximum layers.
- c. Fill: 98% minimum.
- d. Fill Under Structures and Pavements: 98% minimum in upper 24 inches.
- e. Moisture Content: Optimum $\pm 3\%$.

3. Backfill 1 Foot Above Utility: After backfill has reached an elevation 1 foot above top of utility, proceed as follows:

a. Under Buildings and Pavements:

- 1) Compaction Standard: ASTM D 1557-Modified Proctor maximum dry density.
- 2) Loose Lift Thickness: 8 inch maximum layers.

SECTION 02220 - FOUNDATION AND TRENCH EXCAVATION, BEDDING, AND BACKFILL

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- 3) Fill: 98% minimum.
 - 4) Fill Under Structures and Pavements: 98% minimum in upper 24 inches.
 - 5) Moisture Content: Optimum \pm 3%.

3.6 DISPOSAL OF EARTHWORK DEBRIS OR WASTE

- A. Remove non-combustible materials, including, muck, broken concrete and metal, from site and dispose in a legal manner.

End of Section

SECTION 02270 - EROSION AND SEDIMENT CONTROL

Prepared By: Carroll Walker

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Checked By: Mark Hester

Approved By: Carroll Walker *aw*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies Best Management Practices for temporary and permanent erosion, sediment, and dust control.
- B. Prevention of migration of sediments off Project site.
- C. Prevention of damage to adjacent and downstream property.
- D. Providing additional protective measures to prevent sediment and dust from being removed from site.
- E. Prevention of sediments from being taken outside limits of Work or being tracked on facility roadways.

1.2 DEFINITIONS

- A. Best Management Practices (BMPs): Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States. BMPs also include treatment requirements, operating procedures and practices to control facility site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

1.3 SUBMITTALS

- A. Product Data: Submit Product Data for:
 - 1. Silt Fence.
 - 2. Aggregate.
- B. Test Reports: Submit for approval, notarized certification from manufacturer that materials meet specified requirements.

1.4 QUALITY ASSURANCE

- A. Qualifications: Provide at least 1 person familiar with types of materials being installed during execution of Work to:
 - 1. Direct Work performed under this Section.
 - 2. Direct best methods for installation.
 - 3. Identify defective materials.
 - 4. Attend pre-installation meeting.

SECTION 02270 - EROSION AND SEDIMENT CONTROL

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B. Regulatory Requirements:

1. Comply with all Federal, State, and Local regulations concerning the control of erosion and sediment.
2. Comply with Best Management Practices identified in the Federal, State, and Local publications.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Protect materials from crushing, tearing, or damage during transport.
- B. Storage: Store geotextiles inside water tight plastic bags affixed with an indelible label identifying manufacturer, date of manufacture, and physical characteristic of material.
- C. Handling:
1. Inspect materials for defects as they are unloaded and stockpiled.
 2. Unload in packaged units using manual labor or mechanical equipment.
 3. Do not roll or drop materials from truck.
 4. Replace damaged materials whether stockpiled or installed.

1.6 PROJECT CONDITIONS

A. Environmental Requirements:

1. Notice of Intent (NOI) Permit under National Pollutant Discharge Elimination System (NPDES) is required for construction site that disturbs 1.0 acre or more.
2. Comply with conditions stated in state and local storm water permits.

B. Field Investigations:

1. Inspect site and drainage areas prior to beginning Work.
2. Document existing areas of erosion and sediments.

1.7 SEQUENCING

A. Construction Sequencing: Proceed per the following list unless indicated otherwise on Drawings.

1. Verify storm water, erosion, and sediment control plans have been approved and all permits obtained.
2. Hold on site a pre-construction meeting with Owner's Representative at least 1 week prior to starting construction.
3. Flag limits of Work and mark buffer areas for protection.
4. Install temporary gravel construction entrance/exit.
5. Install sedimentation basins, traps and silt fences.
6. Obtain approval of control measures.
7. Perform grading operations.
8. Stabilize completed areas as soon as practical. Areas are not to remain idle for greater than 21 days without administering soil stabilization measures.
9. Install storm water drainage piping systems within the newly graded areas.
10. Install storm drain inlet and outlet protection.
11. Completely stabilize the area of disturbance.
12. Remove temporary erosion control measures.

SECTION 02270 - EROSION AND SEDIMENT CONTROL

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1.8 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Inspection: Inspect sediment control structures including but not limited to silt fences, diversion ditches, ditch checks (rock checks), ditch linings, erosion blankets, and sediment traps after every rainfall that exceeds 0.1 inches of precipitation in 24 hours or every week maximum.
- B. Repair: Repair items within 8 hours of discovery.
- C. Cleaning:
 - 1. Remove sediment in front of silt fences prior to reaching 4 inch depth.
 - 2. Remove sediment in sediment traps prior to reaching cleaning depth indicated.
 - 3. Use removed sediments to flatten slopes within areas of grading (non-structural fill areas).
 - 4. Obtain approval for sediment placement location.
- D. Removal of Temporary Sediment Controls:
 - 1. Obtain approval prior to temporary sediment controls removal.
 - 2. Remove temporary sediment controls after complete site stabilization.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Graded Stone: Gradation 67, ASTM C 33, clean.
- B. Silt Fences:
 - 1. 4x4 (10 gauge) wire fence fabric.
 - 2. Wood or steel post.
 - 3. Filter fabric conform to following requirements:

| Structure | Polymer Type | Apparent Opening Size US Sieve | Puncture ASTM D 4833 (Pounds) | Mullen Burst ASTM D 3786 (PSI) |
|-----------|---|--------------------------------|-------------------------------|--------------------------------|
| Non-Woven | polypropylene, polyester, or polyethylene | 18 to 25 | 58 to 70 | 280 to 300 |

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Inspections:
 - 1. Verify erosion and sediment controls are installed as specified and in accordance with pertinent codes and regulations.
 - 2. Obtain approval from local inspector prior to beginning earthwork operations.

- B. Discrepancies: Cease Work in areas of discrepancy until discrepancy has been resolved.

3.2 PREPARATION

- A. Pre-Installation Meeting: Schedule pre-installation meeting 5 days prior to meeting.
- B. Construction Notification:
1. 5 days prior to commencing Work.
 2. Notify local governing agency prior to start of construction.

3.3 INSTALLATION

- A. Temporary Construction Entrance: Install 8 inch thick graded stone construction entrances.
- B. Silt Fence:
1. Excavate a 12 inch wide by 10 inch deep trench along silt fence route.
 2. Install line posts at 8 foot centers (maximum).
 3. Attach wire fabric to upstream side of post. Extend wire to bottom of trench.
 4. Lay filter fabric across full width of trench.
 5. Attach filter fabric to post and wire fabric with wire ties.
 6. Backfill excavated trench with filter fabric in bottom of trench. Tamp to compact.
- C. Earthwork: Minimize transmission of sediments off Project site.
1. Maintain a 20 foot wide strip of natural vegetation full width of excavation when clearing and grubbing, unless directed otherwise.
 2. Divert concentrated water with diversion ditches, berms, or terracing into sediment control structures.
 3. Use clear water diversions ditches to divert non-sediment carrying water away from excavations.
 4. Install temporary sediment control structures per Drawings.
 5. Inspect and maintain temporary control structures during entire construction duration.
 6. Correct damage to control structure.
 7. Clean control structures as specified.
 8. Provide additional controls not indicated to prevent sediment from leaving site.
 9. Correct damage to downstream property. Remove sediment off site at no additional cost.
- D. Dewatering: Discharge dewatered trenches and excavations to rip rap or concrete receiving pad surrounded by silt fence. Do not discharge directly to Waters of the State without required sediment removal.
- E. Catch Basin Inlet Protection: Protect storm drain inlets with silt fence or block and gravel indicated on Drawings.
- F. Stabilization: Stabilize disturbed areas with building or pavement when final grade is established per other Sections.

3.4 CLEANING

A. Temporary Erosion Control Measures:

1. Remove temporary erosion control measures after site has been completely stabilized unless otherwise directed.
2. Minimize disturbance of stabilized areas during removal.
3. Place removed rip rap at inlet or outlet ends of culverts.
4. Stabilize disturbed areas after removal.

B. Clean-Up:

1. Remove promptly from site tools, equipment, erosion control devices not designed to remain, surplus materials, waste, and debris.
2. Remove materials from site and dispose in a legal manner.

End of Section

SECTION 02520 -PORTLAND CEMENT CONCRETE PAVING

Prepared By: Carroll Walker

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Checked By: Mark Hester

Approved By: Carroll Walker *W*

PART 1 - GENERAL

3.1 SECTION INCLUDES

- A. Section specifies portland cement concrete paving.

3.2 SUBMITTALS

A. Shop Drawings:

- 1. Joint layout plan for approval 21 days prior to pavement placement.
- 2. Aggregate base material.

B. Quality Control Information:

- 1. Reports: Notarized certification that materials meet referenced specifications.
- 2. Test Reports:
 - a. Mix design.
 - b. Make 3 compressive test specimens per each 30 cubic yards of concrete placed or each days work whichever is smaller.
 - c. Make 3 cores per each 30 cubic yards of concrete placed or each days work whichever is smaller at random locations to determine thickness.

- 3. Batch Ticket: ASTM C 94.

- C. Work Plan: If cores indicate failure of minimum thickness requirements, determine extent of pavement failing to meet thickness requirements.

3.3 DELIVERY, STORAGE, AND HANDLING

- A. Standards: ASTM C 94, ACI 304R, ACI 305R, and ACI 306R.

PART 2 - PRODUCTS

3.1 MATERIALS

A. Concrete:

- 1. Mix Design: Approved NCDOT mix design with minimum 4000 psi compressive strength.
- 2. Aggregate Size: ASTM C 33, 1 inch maximum.
- 3. Cement Content: ASTM C 150, 550 lbs/yd³ minimum
- 4. Water-Cement Ratio: 0.53 (by weight) maximum
- 5. Slump: ASTM C 143, 4-inch maximum.
- 6. Air Content: ASTM C 231, 6% plus or minus 1.5% by volume.
- 7. Fly Ash Content: ASTM C 618, 15% maximum.

- B. Joint Sealer: Dow-Corning 888 Silicone Highway Joint Sealer.
- C. Curing Materials:
 - 1. AASHTO M 182 membrane curing compound.
 - 2. AASHTO M 171 or ASTM C 171 white polyethylene sheeting.
- D. Grout: ASTM C 476, high strength.

PART 3 - EXECUTION

3.1 PREPARATORY WORK

- A. Base Material Inspection: Prior to construction of concrete pavement verify that base material is constructed as specified.
- B. Finished Grading: Verify final grades and elevations of base as indicated.
- C. Base Irregularities:
 - 1. Correct grade to elevation indicated.
 - 2. Compact ruts or surface irregularities caused by construction equipment prior to placing pavement.
 - 3. Remove unstable base or subgrade material discovered during paving operations. Rework and replace prior to placing pavement.

3.2 PLACEMENT

- A. General: Comply with ACI 301 and ACI 325.9 except as modified herein.
- B. Limitations to Work: Construct concrete pavement on prepared surface approved by geotechnical engineer.
- C. Joints: ACI 325.9, Portland Cement Association, and as indicated on Drawings.
- D. Joint Sealer: Install joint sealer in pavement per manufacturer's recommendations.
- E. Joint Layout: Maximum joint spacing is as follows:

| <u>Pavement Thickness</u> | <u>Longitudinal Construction</u> | <u>Transverse Contraction</u> |
|---------------------------|----------------------------------|-------------------------------|
| 8" | 15'-0" | 15'-0" |

- F. Reinforcing: As indicated on Drawings.
- G. Surface Finish: ACI 325.9, broom or belt non-skid finish.
- H. Curing:
 - 1. Curing Compound: ACI 325.9, when air temperature does not exceed 90°F during first 7 days after placement.
 - 2. Polyethylene Sheeting: When air temperature exceeds 90°F during first 7 days after placement.

3.3 TESTING AND ACCEPTANCE

A. Compressive Strength: ASTM C 39.

1. Make compressive tests as specified.
2. Minimum Criteria:
 - a. Compressive test specimens meeting or exceeding minimum requirements.
 - b. 28-day compressive strength equal to or exceeding approved laboratory mix design compressive strength.
3. No payment made for pavement failing to meet minimum strength requirements.

B. Thickness: ASTM C 42.

1. Make cores as specified. Repair core holes using grout.
2. Thickness as specified is minimum based on cores.
3. No payment made for pavement failing to meet minimum thickness requirements.

C. Smoothness Tolerance:

1. Testing: Test finished surface using a 20-foot straightedge. Test 75 percent of concrete pavement for smoothness.
 - a. Longitudinal: Apply parallel with centerline of paved area.
 - b. Cross Section: Apply at right angles to centerline of paved area.
2. Cross Section: Do not vary finished surface more than 1/8 inch from section indicated.
3. Longitudinal Profile: Do not vary finished surface more than 3/16 inch from profile indicated.
4. Correction: Correct surface irregularities exceeding specified limits. Identify limits of deficient thickness. Remove areas of deficient thickness and replaced to correct thickness, line and grade at no additional cost.

3.4 PROTECTION

A. Barricades: Provide signs, barricades, and flagmen as required to protect workers and Work.

B. Traffic: Do not allow traffic (other than joint sawing and sealing vehicles) on concrete paving for 14 days after placement.

C. CLEAN-UP

1. Remove equipment, forms, and debris from site. Clean up in accordance with Section 02000.

End of Section

SECTION 02600 - AGGREGATE BASE COURSE AND ASPHALTIC CONCRETE PAVING

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Prepared By: Carroll Walker

Checked By: Steve Bradley

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PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies dense graded aggregate base course, asphaltic prime and tack, and hot-laid asphaltic concrete superpave paving. Section also includes materials and construction testing. Where the term Geotechnical Engineer or Geotechnical Consultant is used it shall mean a Geotechnical Technician working under the direct supervision of the Geotechnical Engineer.

1.2 SUBMITTALS

- A. Tests: Geotechnical Engineer will submit formal reports of density tests, compaction tests, and retests immediately. Reports include:
 - 1. Date of test and date submitted.
 - 2. Atmospheric conditions.
 - 3. Location of test.
 - 4. Description of material.
 - 5. Percent of Gmm (Theoretical Maximum Specific Gravity).
 - 6. Laboratory Gmm - no air.
 - 7. Percent compaction
 - 8. Ratio of field density to laboratory GMM expressed as percent.
 - 9. Comments concerning field density passing or failing specified requirements.
 - 10. Comments, if required.
 - 11. Other.

- B. Frequency: Geotechnical Engineer will perform tests in accordance with following minimum schedule:
 - 1. Density:
 - a. Laboratory:
 - 1) Percent of Gmm no air.
 - 2) Asphalt: Theoretical Maximum Specific Gravity (Gmm).
 - b. In Field:
 - 1) Aggregate: ASTM D 698, Standard Proctor, 2 per every 200 square yards per layer.
 - 2) Asphalt: ASTM D 2950 nuclear density 5 per every 200 square yards of asphalt placed. Calibrate Nuclear device with laboratory 6" diameter cores.
 - 2. Asphalt Content: ASTM D 4125 nuclear asphalt content 2 per 1000 square yards of paving.
 - 3. Verification: Verify uniform quality of Work where compaction/density is in question.

SECTION 02600 - AGGREGATE BASE COURSE AND ASPHALTIC CONCRETE PAVING

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4. Thickness: A minimum of one thickness test per 200 foot of roadways or 500 square yards of pavement will be required.
 - C. Test Results Meeting Specified Requirements: Geotechnical consultant to submit formal reports of compaction test and retests.
 - D. Test Results Failing to Meet Specified Requirements: Geotechnical consultant to immediately submit, by telephone or Fax, test reports of compaction tests and retests not meeting specified requirements. Subcontractor to bear costs of tests, which indicates failure to meet specified requirements.
 - E. Shop Drawings: Asphalt mix design including optimum asphalt cement content, GMM - no air, and flow.
 - F. Product Data:
 1. Aggregate base.
 2. Asphaltic prime.
 3. Asphaltic cement.
 4. Asphaltic tack.
 5. Anti-strip agent.
 - G. Quality Control Information:
 1. Notarized Certification Reports: Material producer signatures required.
 - a. Materials: Comply with or exceed specified requirements.
 - b. Certification of Plant: Standard Specifications Section 610. Provide certification, prior to the start of construction.
 - c. Previously Used Mix Design:
 - 1) Asphalt mix design has been used and approved by North Carolina Department of Transportation on more than 1 project within last 2 years.
 - 2) Materials have previously been tested and comply with Standard Specifications.
 - d. Mix Design With No Previous Record:
 - 1) Comply with requirements of Standard Specifications.
 - 2) Make tests to establish project mix formula.
 - 3) Use certified independent laboratory that complies with ASTM D 3666.
 2. Test Reports:
 - a. Asphalt mix design.
 - b. Make 3 - 6" cores per each 500 square yards of asphaltic concrete placed or each days work whichever is smaller at random locations to determine thickness.
 - c. Hot-laid asphaltic concrete paving with dense graded aggregate base to include laboratory density, mix, date, time, and mix temperature.
 - H. Work Plan: If cores indicate failure of minimum thickness requirements, determine extent of pavement failing to meet thickness requirements.

SECTION 02600 - AGGREGATE BASE COURSE AND ASPHALTIC CONCRETE PAVING

1.3 QUALITY ASSURANCE

- A. Materials Consultant: Geotechnical consultant to verify densities, asphalt cement content, and perform thickness testing and other quality tests as needed.
- B. The contractor installing the aggregate base for roadways and parking will provide equipment and personnel to verify the stone thickness in the presence of the Geotechnical Engineer.
- C. The contractor installing the aggregate base for roadways and parking will provide an a topographical survey performed by qualified personnel verifying the final grade of the aggregate surface.
- D. Standards: Referred to herein as Standard Specifications.
 - 1. North Carolina Department of Transportation "Standard Specifications for Roads and Structures" 2002 Edition including special provisions SP6R01 except as modified.
 - 2. Standard Specifications will not govern measurements and payments.
- E. Tests: Field temperature, density tests, aggregate gradation, asphalt content, and thickness cores.

1.4 DELIVERY AND HANDLING

- A. Transportation of Mixture:
 - 1. Prevent segregation of mixture while being discharged into trucks.
 - 2. Transport mixture in clean trucks free of foreign or harmful material.
 - 3. Prevent water from contacting mixture. Provide a waterproof canvas for each vehicle.
 - 4. Maintain correct temperature of mixture.
 - 5. Do not use petroleum products as a coating release agent.
- B. Additional Requirements: Standard Specifications Section 610.
- C. Unsatisfactory Mixture: Remove and replace unsatisfactory mixture at no additional cost.

1.5 PROJECT CONDITIONS

- A. Acceptance at Site:
 - 1. Repair soft or unstable area discovered or observed.
 - 2. Undercut, backfill, and repair unstable areas under direction of Geotechnical Engineer.
 - 3. Measure volumes for payment by contract unit prices for work by others.
- B. Application:
 - 1. Climate Restrictions:
 - a. Do not apply when wet or having excessive moisture.
 - b. Do not apply when weather conditions are unsuitable.
 - c. Do not apply to frozen ground.
 - d. Do not apply when temperature has been below 35°F in the previous 12 hours.

SECTION 02600 - AGGREGATE BASE COURSE AND ASPHALTIC CONCRETE PAVING

2. Temperature: (Out of direct sunlight.)

- a. Aggregate Base: Apply when ambient temperature is above 35°F and rising.
- b. Prime and Tack Coat: Apply when ambient temperature is above 50°F.
- c. Asphaltic Cement: Apply when ambient temperature is above 50°F and rising.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Asphalt Cement: Standard Specifications Section 610, 620 and 1020.

1. Aggregate: Standard Specifications Section 640 and 645.

- a. Coarse Aggregate: Sound and angular. Free of salt, vegetable matter, and other extraneous material.
 - 1) Crushed gravel or crushed stone.
- b. Fine Aggregate: ASTM D 1073. Sand from stone crushing operations, free of injurious amounts deleterious materials.
- c. Mineral Filler: ASTM D 242, rock dust, hydraulic cement, or other inert mineral material.

2. Mixes:

- a. Job Mix Formula: Standard Specifications.
- b. General Composition of Mixtures:

1) Surface Course:

- a) NCDOT approved superpave mix S9.5C or RS9.5C.

2) Intermediate Course:

- a) NCDOT approved superpave mix I19.0C or RI19.0C.

B. Anti-Strip Additive: Standard Specifications Section 1020-8.

C. Dense Graded Aggregate Base Course: Standard Specification Section 520 Type B, free of salt, vegetable matter, sand, lumps or balls of clay, or other deleterious matter.

D. Prime: Standard Specifications Section 1020 emulsified asphalt .

E. Tack: Standard Specifications Section 1020 emulsified asphalt.

F. Mixes may contain up to a maximum of 15% recycled asphalt pavement (RAP). Mixes containing RAP must be approved by the NCDOT for current construction projects.

SECTION 02600 - AGGREGATE BASE COURSE AND ASPHALTIC CONCRETE PAVING

2.2 EQUIPMENT

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- A. Use equipment to complete Work that meets requirements of Standard Specifications. Replace equipment resulting in inaccurate Work, poor quality, or is wasteful.

PART 3 - EXECUTION

3.1 PREPARATORY WORK

- A. Inspect subgrade prior to commencing Work.
- B. Determine if subgrade has been completed as specified.
- C. Proof-roll prepared subgrade to check for unstable areas.
- D. Repair defects in subgrade before placing aggregate base material.

3.2 INSTALLATION

- A. General: Standard Specifications Section 520, 600, 605, 609 and 610 except as herein modified.
- B. Aggregate Base Course:
 1. Placement:
 - a. Place and compact base material thickness specified using mechanical spreaders.
 - b. Hand spreading or placing of stone with front end loaders and motor graders allowed only in areas that are inaccessible to stone spreaders.
 - c. Shape and compact surface to lines and grades specified.
 2. Moisture Content: Modify moisture content of base material to ensure required density. Uniformly add water to base material and mix to full depth of course. Do not place excessively wet base materials on subgrade.
 3. Compaction: 100% maximum dry density, ASTM D 698. Do not spread material until density determinations have been performed.
 4. Contamination: Provide clean aggregate base course free of dust, dirt, mud, and debris prior to placing prime coat.
- C. Prime Coat:
 1. Inspect base course and verify that surface is clean and dry. Provide a clean base course so that a bond can be developed between materials.
 2. Clean surface to be primed.
 3. Place prime coat on aggregate base before binder course is placed.
 4. Apply at following rate: 0.20 to 0.5 gallons per square yard. Variations may be allowed if requested in writing 10 days before start of application stating reason for variation.
 5. Avoid excessive coverage and over-spray. Apply material to penetrate and seal but not flood.
 6. Allow prime to cure and dry to attain penetration and evaporation of volatile compounds.
 7. Do not allow traffic to operate on primed surface.
- D. Tack Coat:

SECTION 02600 - AGGREGATE BASE COURSE AND ASPHALTIC CONCRETE PAVING

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1. Apply tack to surfaces that are clean and dry.
2. Apply at rate of 0.04 to 0.08 gallons per square yard. Variations may be allowed if requested in writing 10 days before start of application stating reason for variation.
3. Avoid excessive coverage and over-spray. Remove and clean over-spray.
4. Allow tack to cure and dry to attain proper conditions surface course to be applied.

E. Asphaltic Concrete Base, Intermediate and Surface Course:

1. General:
 - a. Cure, dry, and compact surface to receive asphaltic concrete.
 - b. Place mixture in amount that can be compacted and finished at end of day's work.
2. Placing Mixture:
 - a. Place in strips not less than 10 feet wide using mechanical spreading equipment.
 - b. Use string lines or laser controlled equipment to lay asphaltic concrete mixtures not laid between curbs or curb and gutter sections.
 - c. Place mixture to thickness specified as a minimum after compaction.
 - d. Use hand-spreading methods in areas where mechanical spreading and finishing equipment is impractical.
 - e. Make joints between old and new pavement, or between successive days' work. Ensure continuous bond between adjoining work. Joints to have same texture, density and smoothness as other sections.
 - f. Verify that pavement grades will not produce ponding of stormwater after compaction.
3. Compacting Mixture:
 - a. Compaction Requirement: Obtain 92% of GMM minimum.
4. Rolling Procedures:
 - a. Do not cause displacement of mixture by rolling at excessive speed.

3.3 TESTING AND ACCEPTANCE

A. Density:

1. Core Samples: Obtain core samples as specified. Fill core holes with hot-laid asphaltic cement. Do not use cold patch.
2. Nuclear Density: Perform nuclear density test as specified.
3. Nuclear Asphalt Content: Perform nuclear asphalt content test as specified.
4. Test Failure: Remove full depth of asphalt not meeting density requirement.

B. Smoothness:

1. Testing: Test surface of each course in presence of Contractor using a 10 foot straightedge applied parallel with and at right angles to centerline of paved area.
2. Tolerance:

SECTION 02600 - AGGREGATE BASE COURSE AND ASPHALTIC CONCRETE PAVING

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- a. Finished (Surface Course) Grades: 0 to $\frac{1}{4}$ " of elevation specified.
- b. Base and Intermediate Course Grades: 0 to $\frac{1}{2}$ " of cross section or longitudinal elevation specified.

C. Thickness Tolerance:

1. Graded Aggregate Base Course: $\frac{1}{2}$ ".
2. Asphaltic Concrete Base and Intermediate Course: $\frac{1}{4}$ ".
3. Asphaltic Concrete Surface Course: $\frac{1}{8}$ ".

D. Correcting Defects:

1. Correct surface irregularities exceeding limits specified. Correct depressions, high spots, high joints and honeycomb.
2. Remove and replace areas of deficient thickness to correct thickness, line and grade at no additional cost.
3. Bear costs of tests, which indicates failure to meet specified requirements.
4. Remove full depth of layer and replaced with fresh mixture in areas damaged by oil, gasoline, dirt or drippings, or areas showing defective construction of any nature.
 - a. Roll to conform to surrounding area.
 - b. Repair defects at no additional cost.
 - c. Bear costs of identifying deficient thickness limits.

E. Acceptance: Meeting above criteria is satisfactory for acceptance.

3.4 PROTECTION

- A. Do not allow traffic on surface until cooled and ready to accept loads. Prevent rutting. Prevent damage to pavement when constructing shoulders.

End of Section

SECTION 03000 - AGGREGATE FILL UNDER SLABS

Prepared By: J. Griffith *JG*

90

Checked By: D. Christmas *DWC*

Approved By: J. Griffith *JG*

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Applicable Standards: Conform to the following Standards:

ASTM D448: Standard Sizes of Coarse Aggregate for Highway Construction.

ASTM D698: Moisture - Density Relations of Soils Using 5.5 lb. Rammer and 12 in. Drop (Standard Proctor).

1.2 PRODUCT STORAGE

A. Product Storage: Stockpile aggregate fill material in a manner to prevent contamination with other sizes of aggregates which may be stored at the site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate Type: Clean crushed stone, crushed gravel or uncrushed gravel.

B. Aggregate Size: Size No. 57, 6, 67, or 7 as set forth in Table 1 of ASTM D448.

PART 3 - EXECUTION

3.1 PLACEMENT

A. General: Place aggregate fill on subgrade meeting density and elevation requirements.

B. Compaction:

1. Requirement: Compact fill to 100 percent of aggregate's Standard Proctor as determined by Method D of ASTM D698.
2. Procedure: Compact aggregate fill in layers not exceeding 6 inches in compacted thickness. Compact each layer with a minimum of two passes of a vibratory compactor.

End of Section

SECTION 03050 - VAPOR RETARDER UNDER SLABS

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Prepared By: J. Griffith *JG*

Checked By: D. Christmas *DC*

Approved By: J. Griffith *JG*

PART 1 - GENERAL

1.1 PRODUCT DELIVERY AND HANDLING

- A. Delivery: Deliver materials to Project site in original packages with seals unbroken. In addition, deliver materials in ample quantities sufficiently in advance of the need to avoid delays or interruptions in the Work.
- B. Handling: Exercise care to prevent damage to vapor retarder during delivery and storage.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Vapor Retarder: Select one of the following:

| <u>Manufacturer</u> | <u>Product</u> |
|------------------------|----------------|
| Fortifiber Corp. | Moistop |
| Raven Industries, Inc. | Rufco SS-300 |
| Reef Industries, Inc. | Griffolyn T-65 |

- B. Joint Material: Mastic or pressure sensitive tape recommended by vapor retarder manufacturer.

PART 3 - EXECUTION

3.1 PREPARATORY WORK

- A. Inspection and Cleaning: Prior to installation, inspect surfaces to receive vapor retarder and remove all objects that may rupture the material.

3.2 INSTALLATION

- A. General: Immediately prior to pouring concrete floor slabs, install vapor retarder over dry, properly prepared floor slab base material.
- B. Placement: Place vapor retarder parallel with the direction of concrete pour. Turn material up vertical surfaces 5 inches. After material is unrolled, stretch level and weight edges.
- C. Joints: Lap all joints 6 inches and seal watertight with full bed of mastic and/or tape provided by manufacturer.

SECTION 03050 - VAPOR RETARDER UNDER SLABS

3.3 COMPLETED WORK

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- A. Adjustments: Prior to pouring floor slabs, repair or replace ruptured vapor retarder.

End of Section

Prepared By: J. Griffith *JG*

Checked By: D. Christmas *DWC*

Approved By: J. Griffith *JG*

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Applicable Standards: Conform to the following Standards:

- ACI 301: Specifications for Structural Concrete for Buildings.
- ACI 318: Building Code Requirements for Reinforced Concrete.
- ACI 347: Recommended Practice for Concrete Formwork.
- ASTM C31: Making and Curing Concrete Test Specimens in the Field.
- ASTM C39: Compressive Strength of Cylindrical Concrete Specimens.
- USPS PS 1: Construction and Industrial Plywood.

1.2 DESIGN

- A. Design of formwork is the responsibility of the Contractor. Conform to ACI 301, 318 and 347. When designing forms for long spans where intermediate supports are not possible, figure anticipated form deflection due to weight of fresh concrete.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Plywood Forms: APA grade-trademarked, USPS PS 1, B-B Plyform, Exterior Type, Class I, sealed edges, mill oiled and not less than 5/8 inches thick.
- B. Lumber Forms: Sound lumber of uniform thickness, dressed, tongue and grooved, free from loose knots and of such moisture content as to prevent free absorption of moisture.
- C. Metal Forms: Type subject to A/E's approval.
- D. Form Oil: Non-staining type which will allow field applied paints to adhere to concrete surfaces without failing.
- E. Form Sealer: Type subject to A/E's approval.
- F. Form Accessories: Form ties, anchors and hangers of sufficient strength to completely resist displacement of forms due to construction loads and the depositing of concrete. Provide tie-and-spreader type form ties designed so that no metal will be within 1 inch of any surface when forms are removed. Where concrete surfaces are exposed to view, do not use form ties which, when removed, will leave a depression larger than 1 inch in diameter. Use water seal ties in concrete exposed to hydrostatic pressure. Conform to ACI 301 and 347.

- G. Screed Chairs: Metal; wood not permitted.

PART 3 - EXECUTION

3.1 PREPARATORY WORK

- A. Clean and oil forms in accordance with ACI 301 and 347.

3.2 ERECTION

- A. General: Except as otherwise specified or indicated on the Drawings, place all concrete in temporary forms. Where character of soil will permit, earth cuts may be used as forms for wall and column footings. Construct and erect forms in accordance with ACI 301, 318 and 347.

- B. Location:

1. Plywood Forms: Erect plywood forms at surfaces exposed to view and elsewhere at Contractor's option.
2. Lumber Forms: Use only at surfaces not exposed to view.
3. Metal Forms: Location subject to A/E's approval.

- C. Construction:

1. Forms: Make forms removable without requiring prying or hammering against concrete and constructed so sides may be removed without disturbing bottom of forms or its supports. Brace and shore forms to safely support all vertical loads, lateral concrete pressures, lateral loads and special loads and prevent displacement and distortion. Provide positive means of adjusting shores in order that settlement may be taken up during concrete depositing operations. Install truss supports where adequate foundations for shores are not possible. Construct forms for floor slab construction joints full depth of slab. Where indicated, install strips in forms to form bevelled corners.
2. Inserts, Anchors and Sleeves: Install all inserts, anchors and sleeves including those required and furnished by other trades.
3. Screeds: Set screeds to proper elevations to facilitate placement of concrete.

3.3 REMOVAL

- A. General: Removal of forms is subject to A/E's approval.
- B. Removal: Do not remove forms until concrete has hardened sufficiently to support its own weight and imposed construction loads. Remove forms in such manner as to insure the complete safety of the building and to prevent spalling or chipping of concrete. Formwork not supporting the weight of the concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal operations, but in no case sooner than 24 hours.

3.4 TOLERANCES

- A. Unless otherwise indicated on the Drawings, erect formwork to the tolerances specified in ACI 347.

End of Section

Prepared By: J. Griffith *JG*

Checked By: D. Christmas *DC*

Approved By: J. Griffith *JG*

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Applicable Standards: Conform to the following Standards:

ACI 347: Recommended Practice for Concrete Formwork.

AISC: Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings.

ASTM A653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

AWS D1.1: Structural Welding Code.

ASTM A780: Repair of Damaged Hot-Dip Galvanized Coatings.

SDI: Steel Deck Institute

B. Qualification of Welders: Qualify all welders in accordance with AWS D1.1. Conduct examinations by a recognized agency staffed and equipped for such purposes.

1.2 SUBMITTALS

A. Shop Drawings: Submit complete shop drawings and erection details in accordance with Section 01331. Include the following data:

1. Locations of floor supports.
2. Lengths and width of metal forms.
3. Details of factory cut openings.
4. Type and locations of deck attachments.
5. Type and locations of side lap attachments.
6. Type of factory finish.
7. Marking of units corresponding to sequence of installation.
8. Details of accessories.
9. Note manufacturer, product, type and gauge of metal form.
10. Diaphragm shear capacity of metal deck system submitted.

B. Welders Certificate: If requested by A/E, submit welding certificates (see Paragraph 1.1,B) to the A/E for each welder with the name of the welder, name and title of person who conducted the examination, kind of specimens, positions of welds, the results of the test and the date of examination. In addition, the welder's employer shall certify that each welder has been engaged in the type of welding for which he is qualified within the preceding three month period.

1.3 PRODUCT STORAGE

- A. Storage: Store permanent metal forms off ground and protect with a waterproof coating. Elevate one end of forms to provide proper drainage.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Permanent Metal Forms: Prefabricated, 24 gauge steel conforming to ASTM A653, SQ Grade 80, minimum yield stress of 80,000 psi, galvanized in accordance with ASTM A653, G90 Coating Designation. All metal forms shall conform with Steel Deck Institute. Furnish forms complete with all welding accessories and end closure strips as required. Select one of the following or approved equal, unless noted on Drawings. Submit manufacturer catalog of product with Shop Drawings.

| <u>Manufacturer</u> | <u>Product</u> | <u>Type</u> |
|---------------------------|----------------|-------------|
| Consolidated Systems Inc. | Consoliform | S Deck |
| United Steel Deck, Inc. | Uniform | UFS |
| Vulcraft | Conform | 0.6 C |

- B. Welding Electrodes: AISC Table J2.5 "Allowable Stress on Welds".
- C. Paint: ASTM A780.

PART 3 - EXECUTION

3.1 ERECTION

- A. General: Erect forms to shapes, lines and dimensions indicated and sufficiently tight to prevent leakage. Unless otherwise indicated, tolerances shall conform to ACI 347, Paragraph 2.4.1.
- B. Permanent Metal Forms: Install forms in accordance with reviewed shop drawings and manufacturer's directions. Place permanent forms with corrugation edges up and corrugations at right angles to supports. Place sheets end-to-end one row at a time. Place adjacent rows end-to-end, side lapping one corrugation with previously placed row. End laps shall occur at and be centered over structural supports. Make end laps a minimum of 3 inches. Do not extend bottom sheet beyond edge of structural support. Fasten sheets to each other along sidelaps at mid-span. Attach sheets to supports by 5/8 inch diameter minimum plug welding to structural supports. Use curved welding washers as recommended by manufacturer. Attach forms by welding in accordance with AWS D1.1. Minimum welding requirements as follows:
1. End Laps: Weld top sheet in valley of side lap, through four sheet thicknesses, and again at middle of sheet.
 2. Intermediate Supports: Weld in "X" pattern. Weld in valley of side lap on every other structural support and in the valley of the center corrugation on the remaining structural supports.

3.2 COMPLETE WORK

SECTION 03210 - PERMANENT CONCRETE FORMS

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- A. **Cleaning and Painting:** After welding, immediately clean each weld with a steel brush. Apply one coat of paint to welds, cut edges and damaged portions of galvanized coating. Leave no welds unpainted overnight.

End of Section

SECTION 03300 - STEEL BAR AND WIRE FABRIC REINFORCING

Prepared By: J. Griffith *JG*

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Checked By: D. Christmas *DC*

Approved By: J. Griffith *JG*

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Applicable Standards: Conform to the following Standards:

ASTM A185: Welded Steel Wire Fabric for Concrete Reinforcement.

ASTM A615: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

ACI 315: Manual of Standard Practice for Detailing Reinforced Concrete Structures.

ACI 318: Building Code Requirements for Reinforced Concrete.

CRSI: Manual of Standard Practice for Reinforced Concrete Construction.

CRSI: Recommended Practice for Placing Reinforcing Bars.

B. Observations: Materials and shop workmanship shall be subject to observations by the A/E. Notify the A/E in advance of starting shop work in order that observations may be made.

C. Mill Tests: Prepare mill tests on all specified ASTM materials.

1.2 SUBMITTALS

A. Mill Test Reports: Unless requirement is waived in writing, submit to the A/E two copies of mill test reports certifying that materials meet specified ASTM requirements.

B. Shop Drawings: Submit shop drawings in accordance with Section 01331. Shop drawings shall show complete information for placing reinforcement and accessories, including critical dimensions to ends of bars, amount of concrete cover, and minimum spacing between bars. Do not scale Design Drawings or use Design Drawings for shop drawings.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver reinforcement clean, free from loose mill and rust scale, dirt and other coatings. Deliver reinforcing bars straight, free from twists, kinks and irregularities except as necessary to conform to the reinforcing details.

B. Storage: Store materials above ground and protect from dirt and grease.

C. Handling: Exercise care to prevent damage to steel reinforcement during delivery and storage.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Reinforcing Bars: ASTM A615, Grade 60, deformed.
- B. Welded Wire Mesh: ASTM A185.
- C. Metal Accessories: All metal devices necessary for placing, spacing, supporting and fastening reinforcement shall conform to CRSI's "Manual of Standard Practice for Reinforced Concrete Construction". When concrete surfaces are exposed to weather or rust impairs the architectural finish, provide plastic or stainless steel accessories when accessories are in contact with formwork.

2.2 FABRICATION

- A. Shop fabricate all reinforcing bars. Fabricate reinforcement as detailed or in accordance with ACI 315 if detailed bending diagrams are not shown. Offset bend vertical bars at splices in columns and piers.

2.3 IDENTIFICATION

- A. Tie reinforcing bars in bundles and tag with non-rusting metal tags showing shop drawing numbers.

PART 3 - EXECUTION

3.1 CLEANING

- A. Before placing, remove all ice, dirt and other coatings from reinforcement.

3.2 PLACEMENT

- A. General: Except at slabs on grade, continue reinforcement across all joints in concrete unless otherwise indicated on the Drawings. At slabs on grade, terminate all reinforcement at construction joints and at least 50 percent of reinforcement at control joints.
- B. Reinforcing Bars:
 - 1. General: Place bars accurately, securely supported and wired together to prevent displacement from construction loads or the depositing of concrete. Do not tack weld bars or use bars with kinks or bends not shown on the Drawings.
 - 2. Bar Supports: Concrete bricks may be used to support bars for concrete on grade. Install metal or plastic chairs and spacers over formwork.
 - 3. Splices: Splices not shown on the Drawings will be subject to A/E's approval.
 - 4. Column and Pier Dowels: To insure proper alignment, furnish templates for column and pier dowels.
 - 5. Concrete Protection: If concrete covering over bars is not shown on the Drawings or specified, conform to ACI 318. Where concrete for structural members is deposited against the ground, provide not less than 3 inches of concrete between bars and ground surface. If formed concrete surfaces are exposed to the weather or in contact with the ground, protect No. 5 bars and smaller with not less than 1-1/2 inches of concrete and bars larger than No. 5 with not less than 2 inches of concrete.

SECTION 03300 - STEEL BAR AND WIRE FABRIC REINFORCING

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6. Tolerances: Place reinforcing bars to tolerances specified in CRSI's "Recommended Practice for Placing Reinforcing Bars".

- C. Welded Wire Mesh: Lap mesh two full meshes plus wire extension unless otherwise shown on the Drawings. During placing of concrete at slabs on grade, mesh may be lifted manually in lieu of adequate supports, provided mesh is completely surrounded by concrete and is not less than 2 inches above bottom of slab. Lift mesh just ahead of screed.

End of Section

Prepared By: J. Griffith *JG*

Checked By: D. Christmas *DC*

Approved By: J. Griffith *JG*

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Applicable Standards:

ASTM A36: Specifications for Structural Steel.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Polyethylene Film: Virgin, 6 mils thick.
- B. Inserts: Galvanized metal of type and size shown on the Drawings or required for other trades.
- C. Adhesive: Adhesive for grouting reinforcing bars into existing concrete shall be "Acrylic-Tie" as manufactured by Simpson-Strong-Tie.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Polyethylene Film: Except where a vapor retarder is scheduled, install polyethylene film under all slabs on grade. Stretch film level and weight edges to maintain position until concrete is poured. Lap joints 6 inches.
- B. Inserts: Build all inserts into concrete as shown, specified or required. Fill voids temporarily with readily removable material.
- C. Adhesive: Perform reinforcing bar grouting in accordance with manufacturers recommendations.

End of Section

SECTION 03415 - EXPANSION AND CONTRACTION JOINTS

Prepared By: J. Griffith *JG*

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Checked By: D. Christmas *DC*

Approved By: J. Griffith *JG*

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Installation of joint fillers in expansion (isolation) joints in concrete slabs.
- B. Cutting and filling construction and control joints in concrete slabs.

1.2 REFERENCES

- A. ASTM D1751: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

1.3 DELIVERY, STORAGE AND HANDLING

A. Epoxy Joint Filler:

- 1. Delivery: Deliver products in manufacturer's containers with seals and labels intact.
- 2. Storage:
 - a. Maintain material temperature at 60° to 70°F.
 - b. Replace lids tightly on partially used containers.
- 3. Handling: Products contain hazardous materials; follow safety precautions recommended by manufacturer.
- 4. Additional Requirements: Follow other recommendations of manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Preformed Expansion (Isolation) Joint Filler: ASTM D1751.
- B. Construction and Control Joint Materials:
 - 1. Silica Sand: Silica sand that has been washed, then thoroughly dried and bagged.
 - 2. Epoxy Joint filler: MM-80 by Metzger/McGuire Company.

PART 3 - EXECUTION

3.1 PREFORMED EXPANSION (ISOLATION) JOINT FILLER

- A. Securely anchor in place.

3.2 CONSTRUCTION AND CONTROL JOINTS

- A. Saw Cutting Joints:

1. Commencement and Completion:
 - a. Commence sawing operations as soon as concrete has hardened sufficiently to prevent dislodging of aggregate; do not delay commencement of operations for more than 24 hours after concrete is placed.
 - b. Complete sawing operations before shrinkage induces cracking.
 2. Equipment:
 - a. Use power saws fitted with 1/8 inch wide abrasive or diamond blades.
 - b. Employ sufficient number of saws to ensure completion of sawing operations before shrinkage induces cracking.
 - c. To prevent delay in operations caused by failure of equipment, have back-up saws available.
 3. Saw Joint Configuration:
 - a. Width: 1/8 inch cut; if shrinkage opens joint to a width in excess of 1/4 inch, notify A/E prior to commencing filling operations.
 - b. Depth: 1/4 slab thickness.
 - c. Line of Cut: Straight and accurately located.
 4. Joint Protection: Protect open joints from intrusion of curing compounds, dirt, and other contaminants.
- B. Mixing Epoxy Joint Filler:
1. Limitations: Mix only when temperatures of both components are 50°F or above.
 2. Procedure:
 - a. Prior to combining components, slowly stir contents of each container to uniformly blend elements.
 - b. Pour contents of hardener container into resin container.
 - c. Mix combined materials thoroughly using slow moving power mixer; do not over mix.
 - d. During warm weather (70°F and above) do not mix more material than can be placed within 15 minutes of mixing, 20 minutes in cool weather (50°F to 69°F)
 3. Other Requirements: Follow other recommendations of filler manufacturer.
- C. Installation of Epoxy Joint Filler:
1. Commencement:
 - a. Do not commence filling operations sooner than 90 days after cutting operations are complete. Recommend that installation be deferred as long as possible to permit maximum slab shrinkage to occur.
 - b. Where practicable, delay filling operations until facilities environmental systems are placed in operation.
 2. Limitations:

SECTION 03415 - EXPANSION AND CONTRACTION JOINTS

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- a. Do not fill joints when substrate or air temperature is less than 50°F.
 - b. Do not fill joints when substrate is wet.
3. Joint Preparation: Immediately prior to filling, clean joints of contaminants.
 4. Installation of Sand (Optional):
 - a. To prevent filler from seeping into cracks that may have developed in bottom of joints, Contractor may, at his option, place a uniform layer of clean, dry silica sand in bottom of joint prior to installing filler.
 - b. If Contractor places sand in bottom of joints, sand shall be placed in a carefully controlled, uniform layer not more than 1/4 inch thick (measured from bottom of saw cut to top of sand); care shall be exercised to prevent contaminating sides of joint.
 5. Installation of filler:
 - a. In two succeeding passes, fill joints flush with epoxy joint filler.
 - b. Dispense filler from bulk type caulking gun or plastic dispensers as recommended by filler manufacturer.
 - c. Exercise care to prevent underfilling or overfilling; slight convex shape acceptable.
 6. Other Requirements: Follow other recommendations of filler manufacturer.
- D. Repair of Epoxy Joint Filler:
1. If concrete shrinkage occurs after epoxy joint filler has been installed, filler may split (cohesive failure) or separate from sides of joint (adhesive failure).
 2. If such failures occur between time filler is installed and one year from Date of Substantial Completion, Contractor shall clean and repair joints using methods and materials recommended by manufacturer of epoxy joint filler.

End of Section

SECTION 03455 - STANDARD WEIGHT CONCRETE

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Prepared By: J. Griffith *JG*

Checked By: D. Christmas *DC*

Approved By: J. Griffith *JG*

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Applicable Standards: Conform to following Standards:

ASTM C31: Making and Curing Concrete Test Specimens in the Field.

ASTM C33: Concrete Aggregates.

ASTM C39: Compressive Strength of Cylindrical Concrete Specimens.

ASTM C42: Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

ASTM C94: Ready-Mixed Concrete.

ASTM C138: Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

ASTM C143: Slump of Portland Cement Concrete.

ASTM C150: Portland Cement.

ASTM C172: Sampling Fresh Concrete.

ASTM C173: Air Content of Freshly Mixed Concrete by the Volumetric Method.

ASTM C183: Sampling Hydraulic Cement.

ASTM C192: Making and Curing Concrete Test Specimens in the Laboratory.

ASTM C231: Air Content of Freshly Mixed Concrete by the Pressure Method.

ASTM C260: Air-Entraining Admixtures for Concrete.

ASTM C494: Chemical Admixtures for Concrete.

ASTM C618: Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.

ASTM D75: Sampling Aggregates.

ACI 211.1: Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete.

ACI 214: Recommended Practice for Evaluation of Compression Test Results of Field Concrete.

SECTION 03455 - STANDARD WEIGHT CONCRETE

- ACI 301: Specifications for Structural Concrete For Buildings.
- ACI 304: High Density Concrete: Measuring, Mixing, Transporting, and Placing.
- ACI 305: Hot Weather Concreting.
- ACI 306: Recommended Practice for Cold Weather Concreting.
- ACI 308: Recommended Practice for Curing Concrete.
- ACI 318: Building Code Requirements for Reinforced Concrete.
- ACI 347: Recommended Practice for Concrete Formwork.

B. Tests:

1. Definitions:

- a. Owner's Testing Laboratory: The term "Owner's Testing Laboratory" is defined as an independent testing laboratory selected and paid by Owner.
- b. Contractor's Testing Laboratory: The term "Contractor's Testing Laboratory" is defined as an independent testing laboratory selected and paid by Contractor. Selection of Contractor's Testing Laboratory is subject to approval of A/E.

2. Authority and Duties of Owner's Testing Laboratory: Owner's Testing Laboratory will check Work as it progresses. When Owner's Testing Laboratory observes that material furnished or work performed by Contractor fails to conform to Specifications, Laboratory will promptly notify Owner, A/E and Contractor. Failure to detect defective work or materials will neither prevent rejection later when such defects are discovered, nor will it obligate Owner and A/E to make final acceptance. Owner's Testing Laboratory is neither authorized to change any requirement of Specifications, nor to approve any portion of Work. Owner's Testing Laboratory will:

- a. Conduct Strength Test: Strength tests of concrete will be conducted. This service will include making specimens in field. Each strength test will consist of four cylinders; two tested at seven days and two tested at 28 days. For each class of concrete, one strength test for each pour of 100 cubic yards will be made; however, no less than one test for each day of concreting will be made. When this schedule of testing provides less than five tests for a given class of concrete, at least five randomly selected batches will be tested; if fewer than five batches are used, each batch will be tested. Additional strength tests may be required to justify removal of formwork. Specimens will be secured in accordance with ASTM C172, made and cured in accordance with ASTM C31, and tested in accordance with ASTM C39.
- b. Conduct Slump Test: For each strength test, one slump test will be made in accordance with ASTM C143.
- c. Conduct Air Content Test: For each strength test, one air content test will be made in accordance with ASTM C173 or C231.
- d. Report Test Results: All test results will be reported to A/E and Contractor.
- e. Maintain Records: Complete records of specimens will be maintained; records will include detailed location of each pour represented.

3. Responsibilities and Duties of Contractor:
 - a. Advance Notice: Advise Owner's Testing Laboratory sufficiently in advance of beginning operations to allow time for assignment of laboratory personnel.
 - b. Facilities: Provide and maintain, for sole use of Owner's Testing Laboratory, facilities for safe storage and proper curing of concrete test cylinders at Project site as required by ASTM C31.
 - c. Labor and Tools: Furnish labor and tools necessary to assist Owner's Testing Laboratory in obtaining and handling samples at Project Site or at other sources of material.
 - d. Samples: Secure and deliver to Contractor's Testing Laboratory representative samples of materials proposed for use which require testing. Secure samples in accordance with ASTM C183 and D75.
 - e. Design Mixes: Design concrete mixes to produce strengths specified; see Part 2 - Products.
 - f. Notice of Authority and Duties: Advise approved Contractor's Testing Laboratory of their authority and duties by furnishing them with a copy of this Section of Specification:

4. Authority and Duties of Contractor's Testing Laboratory:
 - a. Test Aggregates: Test fine and coarse aggregates for compliance with Specifications.
 - b. Design Mixes: Design or check Contractor's proposed mixes.
 - c. Strength Test: Before placing any concrete conduct strength tests using design mix proposed for each class (strength) of concrete. Each strength test shall consist of four cylinders; two tested at age seven days and two tested at age 28 days. If test breaks are not satisfactory, revise design mixes and conduct additional strength tests until it is established that mixes produce required strength. Make and cure specimens in accordance with ASTM C192 and test in accordance with ASTM C39.
 - d. Slump Test: Using proposed design mixes, make one slump test in accordance with ASTM C143 for each strength test made.
 - e. Air Content Test: Using proposed design mixes, make one air content test in accordance with ASTM C173 or C231 for each strength test made.
 - f. Test Reports: Promptly report all test results to A/E and Contractor.

5. Evaluation of Field Strength Tests: Strength level of concrete will be satisfactory if average of three consecutive 28 day strength tests (six cylinders) equals or exceeds required minimum compressive strength and no individual 28 day strength test (average of two companion cylinders) falls below required minimum compressive strength by more than 500 psi. However, A/E reserves right to void 500 psi allowance when, in his opinion, safety of structure is jeopardized by failure of an individual 28 day strength test to equal or exceed required minimum compressive strength. Concrete not meeting strength level stated above will be considered questionable. If concrete is questionable, at expense of Contractor, retest concrete or remove and replace with satisfactory concrete. Conduct additional tests in accordance with ASTM C42 and evaluate in accordance with ACI 318. If core tests indicate that concrete meets strength specified, results of test cylinders will be waived. If core tests fail to meet requirements of ACI 318, at expense of Contractor, A/E may order load tests or other appropriate action such as removal of defective concrete.

1.2 SUBMITTALS

- A. Test Reports: Submit to A/E proposed concrete design mixes and results of concrete tests made using proposed concrete mixes. Upon request, submit to A/E and Owner's Testing

Laboratory copies of test reports of all shipments of cement. Submittals shall be in accordance with Section 01331.

- B. Submit certificate of compliance regarding quantity of chloride ions in all admixtures.

1.3 PRODUCT STORAGE

- A. Cement: Store cement in watertight buildings, bins or silos.
- B. Aggregate: Stockpile aggregate in a manner which will prevent contamination with other materials or with other sizes of aggregate. To insure purity, conduct tests for determining conformance to requirements at point of batching. Before using, allow sand to drain until it reaches a uniform moisture content.
- C. Admixtures: Store admixtures in a manner which will prevent contamination. Protect admixtures from extreme temperatures which would adversely affect their characteristics.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cement: American Portland cement of standard manufacturer; free from earth, trash and damp set; brand subject to A/E's approval. Unless otherwise permitted by A/E, conform to ASTM C150, Type II. Do not change brand or type of cement without prior approval of A/E.
- B. Aggregates:
1. General: All aggregates are subject to A/E's approval. Do not change source of aggregates without prior approval of A/E. Do not use frozen aggregates.
 2. Fine Aggregate: Natural sand conforming to ASTM C33; free of injurious amounts of shale, alkali, organic matter, loam or other deleterious substances. Do not use manufactured sand without approval of A/E.
 3. Coarse Aggregate: Clean, crushed stone or gravel conforming to ASTM C33. Unless otherwise approved by A/E, use size number 67; however, in no case shall coarse aggregate exceed 3/4 of clear space between reinforcing bars or 1/5 of narrowest dimension between forms or 1/3 of depth of slabs. Coarse aggregate shall not exceed 3/8 inch for pan type stairs.
- C. Water: Clean and potable.
- D. Admixtures: With exception of air-entraining, water reducing and retarding admixtures do not use admixtures unless approved by A/E. Ensure no admixture contains more than 0.1% chloride ions. Use air-entraining, water reducing and retarding admixtures only as specifically permitted by this Specification. When admixtures are permitted, conform to:
1. Air-Entraining Admixtures: ASTM C260.
 2. Water Reducing Admixture: ASTM C494, Type A. Retarding Admixture: ASTM C494, Type D.
- E. Fly Ash: ASTM C618, Class C or F, except ensure that loss on ignition does not exceed three percent, unless approved by A/E.

2.2 PROPORTIONS

- A. **General:** Proportion all concrete to produce a homogeneous material which, when hardened, will have required strength, durability, appearance, watertightness, resistance to abrasion and other properties specified. Proportion concrete to produce a slump between one and four inches.
- B. **Proportioning of Ingredients:** Determine exact proportions to be used in accordance with Section 5.2 of ACI 318; however, unless permission to deviate is granted by A/E, adhere to following:

| Type of Construction | Minimum Compressive Strength psi (28 days) | Total Air | Minimum Cement Factor (Bags/cu.yd.) | Maximum W/C Ratio (By Weight) |
|-----------------------------|--|-------------------|-------------------------------------|-------------------------------|
| Footings | 3000 | Optional (8% Max) | 5.0 | - |
| Floor Slabs On Grade | 4000 | No Air Entraining | 6.0 | .56 |
| Concrete Exposed to Weather | 4000 | 4 - 8% | 6.0 | .51 |

- C. **Admixtures:** In some instances, maximum water-cement ratios and minimum cement factors may not be compatible due to aggregate characteristics, weather conditions, etc. Under these conditions, a water reducing admixture may be introduced into mix. In hot weather, a retarding admixture may be added to mix in accordance with manufacturer's recommendations.
- D. **Fly Ash:**
1. Fly ash may be used as a partial replacement for Portland cement if approved by A/E, and other requirements of this specification are met.
 2. Ensure weight of fly ash divided by the sum of the cement and fly ash weights does not exceed the following:
 - a. Class C Fly Ash: 30%.
 - b. Class F Fly Ash: 20%.
 3. Take special care concerning the following:
 - a. Maintain air entrainment at specified levels.
 - b. In cold weather ensure that concrete strength gain is above specified levels.]

2.3 MIXING

- A. **Ready-Mixed Concrete:** If ready-mixed concrete is used, mix and transport it in accordance with ASTM C94 and ACI 304. Only ready-mix plants approved by applicable State Highway Department or certified by National Ready-Mix Association may be used.

- B. Retempering: Mix concrete in quantities for immediate use only. Discard concrete which has set; do not retemper. Adding water to mix at Project Site will not be permitted unless prior approval is obtained from A/E.
- C. Weather Conditions:
1. Cold Weather: When mean daily temperature falls below 40 degrees F., do not allow as-mixed temperature to fall below 55 degrees F. If water or aggregate has been heated, combine water and aggregate in mixer before cement is added. Do not add cement to mixture of water and aggregate when temperature of mixture is greater than 80 degrees F. During cold weather, mix concrete in accordance with ACI 306.
 2. Hot Weather: In hot weather, a retarding admixture may be added to mix. If necessary, cool ingredients to prevent flash set, cold joints or loss of slump. During hot weather, mix concrete in accordance with ACI 305.

PART 3 - EXECUTION

3.1 GENERAL

- A. Quality Standard: Unless otherwise specified, place all concrete in accordance with ACI 304.
- B. Review of Test Breaks: Do not place any concrete until A/E has reviewed results of design mix seven day test breaks and has given approval to proceed; see Part 1 - General.

3.2 PREPARATORY WORK

- A. Cleaning Equipment: Remove hardened concrete and foreign materials from conveying equipment.
- B. Installation of Other Materials: Prior to placing concrete install formwork, preformed joint fillers, vapor barrier and polyethylene film. Between erection of forms and placing of concrete, allow sufficient time for other trades to install and test their work. Before placing concrete floors on grade, inspect and test piping and other utilities under slabs and compact backfilled excavations to solid bearing. Set and secure against displacement edge forms and intermediate screed strips to produce required elevations and contours.
- C. Slabs on Grade: Secure and brace bulkheads to prevent displacement. Terminate all reinforcement and other embedded items as specified in Section 03300.
- D. Building Other Materials and Fixtures Into Concrete:
1. Anchor Bolts: Install all anchor bolts for steel bearing plates. Do not deviate from dimensions shown on Drawings in excess of following tolerances:
 - a. 1/8-inch center to center of any two bolts within an anchor bolt group, where an anchor bolt group is defined as set of anchor bolts which receives a single fabricated steel shipping piece.
 - b. 1/4-inch center to center of adjacent anchor bolt groups.
 - c. Maximum accumulation of 1/4-inch per one hundred feet along established column line of multiple anchor bolt groups, but not to exceed a total of one inch, where established column line is actual field line most representative of centers of as-built anchor bolt groups along a line of columns.

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- d. 1/4-inch from center of any anchor bolt group to established column line through that group.
 - e. Within 1/4 inch of required top of bolt elevation.
 - f. The tolerances of Paragraphs b, c and d apply to offset dimensions shown on Drawings, measured parallel and perpendicular to nearest established column line for individual columns shown on Drawings to be offset from established column lines.
2. Miscellaneous Items: Accurately place and secure against displacement all steel, pipe sleeves, inserts, anchors, blocking, nailer strips and similar items. Installation of anchors, inserts and sleeves for electrical, mechanical, plumbing, heating, ventilating and air conditioning work is subject to inspection and approval by supervisors of particular trades involved. Temporarily fill voids in sleeves and inserts with readily removable material.
- E. Subgrades: Place concrete on subgrades that are well compacted to level and true grade. Before concrete is deposited between slabs on grade previously placed, recheck compaction of subgrade and, if necessary, recompact to avoid settlement of slabs at joints. Sprinkle semiporous subgrades sufficiently to eliminate suction. Seal extremely porous subgrades in a manner approved by A/E. Remove all ice, debris and excess water from subgrades.

3.3 WEATHER CONDITIONS

- A. Protection: Do not place concrete when it is raining, sleet or snowing unless adequate protection is provided and approval is obtained from A/E. Do not allow rain water to increase mixing water.
- B. Placing Temperature:
1. Cold Weather: Do not place concrete when air surrounding concrete is less than 32 degrees F. When the mean daily temperature of air surrounding concrete falls below 40 degrees F. the minimum temperature of concrete when placed shall be 50 degrees F. During cold weather, place concrete in accordance with ACI 306.
 2. Hot Weather: Do not deposit concrete in hot weather when temperature of concrete will cause loss of slump, flash set or cold joints. During hot weather, place concrete in accordance with ACI 305.

3.4 CONVEYING

- A. General: Handle concrete from mixer to place of final deposit as rapidly as practicable and in a manner which will assure that specified quality of concrete is obtained.
- B. Equipment: Provide conveying equipment of proper size and design to insure a continuous flow of concrete to delivery end. Conveying equipment will be subject to A/E's approval. Conform to following:
1. Mixers, Agitators and Non-Agitating Units: Truck mixers, agitating units, non-agitating units and their manner of operation shall conform to applicable requirements of ASTM C94.
 2. Belt Conveyers: Provide belt conveyers and discharge apparatus of a type which will not cause segregation. Discharge long runs into a hopper.
 3. Chutes: Provide metal or metal lined chutes. Install to a slope not more than one vertical to two horizontal and not less than one vertical to three horizontal. Chutes more than 20 feet long and chutes not meeting slope requirements may be used provided they discharge into a hopper.

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4. Runways: Provide runways or other means for wheeled equipment to convey concrete to placement points. Neither support runways on reinforcement, nor wheel equipment over reinforcement.
5. Pumps: Do not pump concrete without A/E's approval. Any change in concrete mix necessitated by pumping must be approved by A/E before placing concrete by this method.

3.5 DEPOSITING

- A. General: Do not deposit concrete which has partially hardened or has been contaminated by foreign matter. Remove all temporary spreaders in forms when concrete has reached an elevation rendering their service unnecessary. However, temporary spreaders may remain in place if made of metal or concrete and approval has been obtained from A/E.
- B. Segregation: To avoid segregation, deposit concrete as near to its final position as possible. Do not subject concrete to any procedure which will cause segregation. Do not drop concrete more than 60 inches; use tremies when longer drops are required.
- C. Placing:
 1. General: Deposit concrete continuously in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, locate construction joints at points approved by A/E. Except for floor slabs on grade, allow at least seven days between placing adjacent sections of concrete. Do not place floor slabs until roofing is complete.
 2. Supported Elements: Place beams, girders, brackets, column capitals, haunches and drop panels at same time as slabs. Do not deposit concrete in supported elements until concrete previously placed in columns and walls is no longer plastic.
 3. Slabs on Grade: Unless otherwise indicated on Drawings, place slabs on grade in strip sections with jointing along column lines.
- D. Consolidation:
 1. General: Thoroughly consolidate all concrete by vibrating, spading, rodding or forking until concrete is thoroughly worked around reinforcement, embedded items and into corners of forms. Consolidate each layer of concrete with previously placed layers to eliminate all air or stone pockets which may cause honeycombing, pitting or planes of weakness. When internal vibrators are used, provide mechanical vibrators with a minimum frequency of 7000 revolutions per minute. Do not use vibrators to transport concrete. Insert and withdraw vibrators at points from 18 to 30 inches apart for 5 to 15 seconds duration. Keep spare vibrator at Project Site during all concrete operations.
 2. Formed Elements: Use internal vibrators, not form vibrators. When a surface mortar is to be basis of finish, work coarse aggregate back from forms with a suitable tool to bring full surface of mortar against form.
 3. Supported Elements: Use internal vibrators in elevated beams, girders, brackets, column capitals, haunches, drop panels and along construction joints. Consolidate elevated slabs with vibrating bridge screeds, roller pipe screeds or other means approved by A/E. Tamp slabs to force aggregates away from surface and screed level to comply with ACI 347. After screeding, do not manipulate concrete prior to finishing operations.
 4. Slabs on Grade: Consolidate slabs on grade with vibrating bridge screeds, roller pipe screeds or other means approved by the A/E. Use internal vibration along construction joints. Tamp slabs to force aggregates away from surface and screed level to within 1/4

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inch to ten feet but not more than 1/2 inch in 40 feet or more. After screeding, do not manipulate concrete prior to finishing operation.

5. Footings: Work top of footings to an elevation within 1/4 inch of required elevation.

3.6 CONSTRUCTION JOINTS

- A. General: Locate construction joints perpendicular to the main reinforcement. Unless otherwise indicated on the Drawings, allow reinforcement to continue across joints. Arrange construction joints in a manner that will allow the concrete to be placed from bulkhead to bulkhead in one continuous operation. Unless otherwise indicated on the Drawings, provide continuous keys 1-1/2 inches deep in all construction joints. Immediately prior to placing adjacent concrete, thoroughly clean and wet the joint surface.
- B. Formed Elements: Locate joints in walls and columns at the undersides of slabs, beams or girders and at the tops of footings or floor slabs. Arrange joints in walls and grade beams so that no more than 80 linear feet is placed monolithically. However, arrange joints in walls of tanks and other liquid retaining structures so that no more than 30 linear feet is placed monolithically.
- C. Joints Not Shown: Do not install any joints not shown on the Drawings unless approved by the A/E. When such joints are approved, install in a manner that will least impair the structure.

3.7 PROTECTION

- A. Concrete: Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical disturbances. Make all arrangements for protecting concrete prior to placing concrete. Protect floors from damage after placing; do not permit concrete truck traffic on floors.

3.8 SETTING BEARING DEVICES

- A. Line and Grade: Establish proper line and grade for all bearing devices with surveying instrument.
- B. Attached Bearing Devices: All bearing devices attached to structural members in fabrication shop are set and adjusted under Division 5.
- C. Quality Control: After bearing devices have been set and adjusted, check for proper line and grade using surveying instrument. Set bearing devices level to within .01 inch across length and width of device and within 1/16 inch of required elevation.

End of Section

Prepared By: J. Griffith *JG*

Checked By: D. Christmas *DX*

Approved By: J. Griffith *JG*

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Applicable Standards: Conform to the following Standards:

ASTM C171: Sheet Materials for Curing Concrete.

ASTM C309: Liquid Membrane-Forming Compounds for Curing Concrete.

Section 03455: Applicable Standards as listed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Water: Clean and potable.

B. Sand: Clean and moist.

C. Fabric: Burlap or similar moisture retaining fabric.

D. Curing Paper: ASTM C171, nonstaining waterproof paper.

E. Tape: Pressure sensitive and waterproof.

F. Liquid Curing Compound: ASTM C309. Select one of the following:

| <u>Manufacturer</u> | <u>Product</u> |
|---------------------|---------------------|
| Euclid Chemicals | Super Rez-Seal |
| L&M Construction | Dress & Seal No. 30 |
| Master Builders | Cure and Seal HS |

G. Sealing-Dustproofing Compound: Select one of the materials specified for "Liquid Curing Compound".

PART 3 - EXECUTION

3.1 PROTECTION

A. Maintain concrete with minimum moisture loss and at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. Protect finished concrete from damage by mechanical disturbances, improper curing procedures and by rain or running water.

3.2 FINISHING CONCRETE

A. Formed Surfaces:

1. Ordinary Finish:

- a. General: Give all formed surfaces an ordinary finish.
- b. Finish: Immediately following removal of forms, remove fins and irregular projections from all surfaces, except those which are not to be exposed or waterproofed. On all surfaces, thoroughly clean and saturate with water all form tie cavities, honeycombs, broken edges and other defects. After saturating for not less than three hours, carefully point and trowel defects with a mortar of cement and fine aggregate mixed in proportions used in the concrete being finished. Do not use mortar more than one hour old.

2. Smooth Finish:

- a. General: Give all formed surfaces which will be exposed to view, except the underside of elevated slabs, a smooth finish in addition to the ordinary finish. Commence smooth finish operation immediately after pointing mortar has thoroughly set.
- b. Initial Operation: Commence operation by saturating surface with water for not less than three hours. After saturating, rub surface with a medium coarse carborundum stone and a small amount of mortar composed of cement and fine aggregate. Mix mortar materials in proportions used in the concrete being finished. Continue rubbing until all form marks, projections and irregularities have been removed, all voids filled, and a uniform surface obtained. Leave paste produced by this rubbing in place at this time.
- c. Final Operation: After all concrete has been placed above surface being finished, rub surface with a fine carborundum stone and water until a smooth texture and uniform color is obtained. After final stone rubbing, rub surface vigorously with clean burlap to remove loose powder leaving the surface clean and free of all objectionable marks.

3. Related Unformed Surfaces: Strike flush and float tops of walls, buttresses, horizontal offsets, and similar unformed surfaces to obtain a texture consistent with that of the adjacent formed surfaces. If adjacent formed surface is to receive a smooth finish, continue final finishing operation across the tops of related unformed surfaces.

B. Floor Finishes:

1. General: Do not begin finishing operations until concrete has been placed, consolidated, struck-off and leveled. Commence work after surface water has disappeared and concrete has set sufficiently to bear the weight of workmen and equipment. Allow surface water to dry naturally. Do not dust surface with dry cement or sand.
2. Finishes:
 - a. Floated Finish: Float surface with a power-driven float machine to produce a finish true to elevations and slopes with a uniform granular texture. Use hand floats in areas inaccessible to power-driven floats. Level surface to within 1/8 inch in ten feet in all directions.
 - b. Troweled Finish: After floating surface as specified in "Floated Finish", trowel first with power-driven trowels and finally with hand trowels. Perform power troweling

operation in a manner to produce a finish smooth and relatively free of defects. After power troweling, hand trowel surface to remove all defects leaving surface dense and uniform in texture and appearance. Continue hand troweling until a ringing sound is produced as the trowel is moved over the surface.

- c. Broomed Finish: After floating surface as specified in "Floated Finish", trowel once and draw a flexible bristle broom across the surface to produce a non-slip texture. Broom in a direction transverse to that of traffic or at right angles to the slope of the surface.

3. Selection of Finishes:

- a. Troweled Finish: Use for exposed interior walking surfaces and surfaces scheduled to receive resilient floor coverings.
- b. Broomed Finish: Use for exposed exterior walking surfaces.

3.3 CURING CONCRETE

A. Weather Conditions:

1. Cold Weather: During cold weather when the mean daily temperature is less than 50 degrees F., maintain surface temperature of all concrete between 50 degrees and 70 degrees F. for the required curing period. Do not use combustion heaters during the first 24 hours of curing without taking precautions to prevent exposure of the concrete to exhaust gases.
2. Hot Weather: When high air temperature, low relative humidity or high wind velocity is present, install wind breaks or shades; commence spraying or ponding surface with water; cover surface with wet fabric as quickly as concrete hardening and finishing operations will permit.
3. Changes in Temperature: During and immediately following curing period, keep the temperature of air immediately adjacent to the concrete as uniform as possible. Do not allow temperature to vary more than five degrees F. in any one hour or more than 50 degrees in any 24 hour period.

- B. Duration: Cure all concrete, except high early strength concrete, for at least seven consecutive days. Cure high early strength concrete for at least three consecutive days.

C. Methods of Curing:

1. General: Method of curing concrete may be altered for another method provided initial method is maintained for at least 24 hours. If curing method is altered, do not allow surface to dry during transition.
2. Curing Formed Surfaces: The period during which concrete is in contact with forms may be considered as curing time. During curing period, keep forms wet to minimize loss of moisture. If forms are removed prior to specified curing period, continue curing by one of the methods specified in "Curing Unformed Surfaces".
3. Curing Unformed Surfaces: Immediately after finishing operation is complete, commence curing unformed surfaces by one of the following methods:
 - a. Method Number One: Continuously sprinkle or pond surface with water. Use this method for footings only.
 - b. Method Number Two: Cover surface with two inches of moist sand. Keep sand moist throughout the curing period. Use this method for footings only.

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- c. Method Number Three: Cover surface with moist fabric. Keep fabric moist and in direct contact with surface so that a film of water remains on the surface throughout the curing period. This method may be used on all concrete surfaces.
- d. Method Number Four: Cover surface with curing paper. Lap sides and ends at least three inches and seal with tape. This method may be used on all concrete surfaces.
- e. Method Number Five: Apply a uniform coat of liquid curing compound at application rate not to exceed 200 square feet per gallon. This method may be used on all concrete surfaces except those scheduled to receive bonded materials. Do not use this method in hot weather.

3.4 SEALING AND DUSTPROOFING

- A. On all exposed concrete floor surfaces, apply a uniform coat of liquid sealing-dustproofing compound in accordance with manufacturer's recommendations. This application is not intended to serve the purpose of a curing compound. If walking surfaces were cured with a liquid curing compound, use the same product for sealing-dusting as was used for curing. Apply over clean dry surfaces. Commence application immediately after removing curing fabrics or papers or liquid curing compound has thoroughly dried.

End of Section

SECTION 03601 - NON-METALLIC GROUT

Prepared By: J. Griffith *JG*

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Checked By: D. Christmas *Duc*

Approved By: J. Griffith *JG*

PART 1 - GENERAL

1.1 PRODUCT STORAGE

- A. Pre-Mixed Grout: Store in watertight buildings, job storage time shall not exceed six months without written approval from manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pre-Mixed Cementitious Grout: Select one of the following: (General purpose non-shrink, non-metallic)

Manufacturer

Product

Cormix Construction Co.
Master Builders
Sonneborn Building Products
Five Star Products, Inc.

Supreme Grout
Masterflow 928 Grout
SonogROUT
Five Star Grout

- B. Water: Clean and potable.

2.2 MIXES

- A. General: Mix all parts by volume.
- B. Pre-Mixed Grout: Mix in accordance with manufacturer's specifications.

PART 3 - EXECUTION

3.1 CLEANING

- A. Prior to placing grout, remove all foreign matter from concrete and metal bearing surfaces.

3.2 INSTALLATION

- A. Grouting Pipe Sleeves and Drains: Grout pipe sleeves and drains with pre-mixed grout. Prepare, mix and place grout in accordance with manufacturer's specifications.
- B. Grouting Bearing Devices:
 - 1. General: Grout entire space between the top of concrete bearing surfaces and the bottom of bearing device with grout until all voids are completely filled. After grout has hardened, remove wedges or shims and fill resulting holes.
 - 2. Steel Bearing Plates: Grout steel bearing plates with pre-mixed grout in accordance with manufacturer's specifications.

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3. Machinery Bearing Plates: Grout machinery bearing plates with pre-mixed grout.
4. All grout shall be placed and cured in accordance with manufacturer's recommendations, subject to A/E approval.

End of Section

Prepared By: C. Hopkins

Checked By: J. Miller

Approved By: J. Miller 

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:

1. Concrete masonry units (CMUs).
2. Mortar and grout.
3. Reinforcing steel.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Embedded flashing.
7. Miscellaneous masonry accessories.
8. Masonry-cell insulation.

B. Related Sections include the following:

1. Division 7 Section 07920 "Joint Sealants" for sealing control and expansion joints in unit masonry.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ASTM A 615, "Deformed and Plain Billet-Steel Bars for Concrete reinforcement".

B. Qualification Data: For testing agency.

C. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Cementitious materials. Include brand, type, and name of manufacturer.

3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 4. Reinforcing bars.
 5. Joint reinforcement.
 6. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.
- E. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.
- 1.3 QUALITY ASSURANCE
- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- D. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.
- 1.4 DELIVERY, STORAGE, AND HANDLING
- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.5 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.2 CONCRETE MASONRY UNITS (CMU)

- A. Shapes: Provide shapes and sizes indicated.

- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units .
1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen.
 - a. Available Products:
 - 1) Addiment Incorporated; Block Plus W-10.
 - 2) Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block.
 - 3) Master Builders, Inc.; Rheopel.
- C. Concrete Masonry Units: ASTM C 90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
 2. Weight Classification: Normal weight, unless otherwise indicated.
 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 4. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

2.3 MASONRY LINTELS

- A. General: Provide masonry lintels complying with requirements below.
- B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Aggregate for Mortar: ASTM C 144.
- D. Aggregate for Grout: ASTM C 404.
- E. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.
1. Available Products:

- a. Addiment Incorporated; Mortar Tite.
 - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
 - c. Master Builders, Inc.; Rheomix Rheopel.
- F. Water: Potable.
- 2.5 REINFORCEMENT
- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
 - B. Masonry Joint Reinforcement, General: ASTM A 951.
 - 1. Interior Walls: Mill- galvanized, carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized, carbon steel.
 - 3. Wire Size for Side Rods: W1.7 or 0.148-inch diameter.
 - 4. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
 - C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.
- 2.6 TIES AND ANCHORS
- A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with subparagraphs below, unless otherwise indicated.
 - 1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 641/A 641M, Class 1 coating.
 - 2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
 - 3. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
 - 4. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 (Z180) zinc coating.
 - 5. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.
 - 6. Stainless-Steel Sheet: ASTM A 666, Type 304.
 - 7. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - 8. Stainless Steel bars: ASTM A 276 or ASTM a 666, Type 304.
 - B. Corrugated Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from steel sheet, galvanized after fabrication not less than 0.043 inch 0.053 inch 0.067 inch thick. Ties made from galvanized steel sheet may be used in interior walls, unless otherwise indicated.
 - C. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through masonry units but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of units.
 - D. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units or hollow units laid with cells horizontal.
- E. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls, unless otherwise indicated.
 2. Tie Section for Steel Frame: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.188-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls, unless otherwise indicated.
 3. Tie Section for Concrete: Corrugated metal ties with dovetail tabs for inserting into dovetail slots in concrete and sized to extend to within 1 inch of masonry face.
- F. Partition Top anchors: 0.097-inch- thick metal plate with 3/8-inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- G. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins, unless otherwise indicated or bent to configuration indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M .
 2. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors:
 - a. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches wide by 3 inches high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.
 - b. Anchor Section: Sheet metal plate, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 3-5/8 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie.
- 2.7 MISCELLANEOUS ANCHORS
- A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
- 2.8 EMBEDDED FLASHING MATERIALS
- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual " and as follows:
1. Fabricate through-wall metal flashing embedded in masonry from copper, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.

a. Available Products:

- 1) Cheney Flashing Company; Cheney 3-Way Flashing (Sawtooth).
 - 2) Keystone Flashing Company, Inc.; Keystone 3-Way Interlocking Thruwall Flashing.
2. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
 3. Fabricate through-wall flashing with drip edge, unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 4. Fabricate through-wall flashing with sealant stop, unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 3/8 inch to form a stop for retaining sealant backer rod.
 5. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.

B. Flexible Flashing: For flashing not exposed to the exterior, use the following, unless otherwise indicated:

1. Asphalt-Coated Copper Flashing: 7-oz./sq. ft. copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry.

a. Available Products:

- 1) Advanced Building Products Inc.; Cop-R-Cote.
- 2) AFCO Products Inc.; Cop-A-Cote.
- 3) Hohmann & Barnard, Inc.; H & B C-Coat Flashing.
- 4) Phoenix Building Products; Type ACC-Asphalt Bituminous Coated.
- 5) Polytite Manufacturing Corp.; Coated Copper Flashing.
- 6) Sandell Manufacturing Co., Inc.; Coated Copper Flashing.
- 7) York Manufacturing, Inc.; Copperseal.

C. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.

1. Product: Subject to compliance with requirements, provide "Blok-Flash" by Advanced Building Products Inc.

D. Solder and Sealants for Sheet Metal Flashings:

1. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
2. Elastomeric Sealant: ASTM C 920, chemically curing sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use the following, unless otherwise indicated:
 - 1. Wicking Material: Absorbent rope, made from UV-resistant synthetic fiber, 1/4 to 3/8 inch in diameter, in length required to produce 2-inch exposure on exterior and 18 inches in cavity between wythes. Use only for weeps.
- E. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.
 - 1. Available Products:
 - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
 - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10 MASONRY-CELL INSULATION

- A. Molded-Polystyrene Insulation Units (INSUL-3): Rigid, cellular thermal insulation formed by the expansion of polystyrene-resin beads or granules in a closed mold to comply with ASTM C 578, Type I. Provide specially shaped units designed for shop-installation in cores of masonry units intended for use in exterior walls. CMU with core insulation shall have insulating value of $R \geq 5$.
 - 1. Available Products:
 - a. Concrete Block Insulating Systems; Korfil.
 - b. Shelter Enterprises Inc.; Omni Core.

2.11 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
1. Available Manufacturers:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.

2.12 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
 2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
- B. Mortar for Unit Masonry: Comply with ASTM C 270 , Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type M.
 2. For reinforced masonry, use Type S.
 3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
- C. Grout for Unit Masonry: Comply with ASTM C 476.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- D. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.

3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond ; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by raking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar and remove loose masonry units and mortar if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete masonry units as follows:
1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
- D. Bond wythes of composite masonry together using one of the following methods:
1. Provide continuity with masonry joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.
- E. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:

3.5 MASONRY-CELL INSULATION

- A. Install molded-polystyrene insulation units into masonry unit cells before delivering units to job site.

3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
1. Space reinforcement not more than 16 inches o.c.
 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
 - a. Reinforcement above is in addition to continuous reinforcement.

- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at corners by using prefabricated L-shaped units.
- D. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
 - 1. Provide an open space not less than 1/2 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
- C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 7 Section "Joint Sealants," but not less than 3/8 inch.
 - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.9 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where shown and where openings of more than 24 inches are shown without structural steel or other supporting lintels.

- C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.
- 3.10 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS
- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other at obstructions to the downward flow of water in wall, and where indicated.
- B. Install flashing as follows, unless otherwise indicated:
1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 2. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for application indicated.
 4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for application indicated.
 5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
 6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
 7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
1. Use specified weep/vent products to form weep holes.
 2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
 3. Space weep holes 24 inches o.c., unless otherwise indicated.

4. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
5. Trim wicking material flush with outside face of wall after mortar has set.
6. Fill cavities full height by placing pea gravel in cavities as masonry is laid so that at any point masonry does not extend more than 24 inches above top of pea gravel.

3.11 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches.

3.12 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.13 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 2 Section "Earthwork."
 - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

Prepared By: J. Griffith *JG*

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Approved By: J. Griffith *JG*

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Applicable Standards: Conform to following Standards:

- AISC: Manual of Steel Construction - ASD.
- AISC: Code of Standard Practice for Steel Buildings and Bridges. (As modified in Paragraphs 1.2.E and 2.3.A herein).
- AISC: Quality Criteria and Inspection Standards.
- AISC: Detailing for Steel Construction
- AREA: Specifications for Spring Washers.
- ASTM A3: Steel Joint Bars, Low, Medium, and High Carbon (Non-Heat-Treated).
- ASTM A36: Structural Steel.
- ASTM A53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- ASTM A108: Steel Bars, Carbon, Cold-Finished, Standard Quality.
- ASTM A307: Carbon Steel Externally Threaded Standard Fasteners.
- ASTM A325: High-Strength Bolts for Structural Steel Joints.
- ASTM A449: Quenched and Tempered Steel Bolts and Studs.
- ASTM A500: Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- ASTM A563: Carbon and Alloy Steel Nuts.
- ASTM A 572: Standard Specifications for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality.
- ASTM A992: Steel for Structural Shapes for Use in Building Framing.
- AWS D1.1: Structural Welding Code.

Approved by Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation: Allowable Stress Design Specifications for Structural Joints Using ASTM A325 or A490 Bolts, November 13, 1985 edition (as modified in Paragraph 2.3.B herein).

SECTION 05120 - STRUCTURAL STEEL

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SSPC: Systems and Specifications.
Steel Structures Painting Council

B. Observations:

1. General: Shop materials and workmanship subject to observations by A/E.
2. Shop Painting: Prior to acceptance of steel, surface preparation and dry film thickness of shop primer subject to observations by A/E.
3. High Strength Bolting: When in judgement of A/E, inspection is required, conform to procedures outlined in "Specifications for Structural Joints Using ASTM A325 or A490 Bolts". Steel erector shall furnish wrenches and Skidmore-Wilhelm calibrator for field inspections. Costs of inspections borne by Owner.

C. Qualification of Welders: Qualify all welders in accordance with AWS D1.1. An independent testing laboratory, staffed and equipped for such purposes, shall conduct examination including preparation, welding and weld tests.

D. Inspections:

1. Shop Welding: Inspect at least 25% of following itemized joints by an approved independent testing laboratory using ultrasonic or radiographic equipment:
 - a. Splices in any structural member brought about by misordered or misfabricated material.
2. Identification: Mark names of inspector and welder on each joint inspected.
3. Defective Work: Remove welds found defective and replace with sound welds and retest at no additional cost to Owner. If specified percentage of welds inspected indicates, in the opinion of A/E, an abnormal amount of unacceptable welding, increase the percent until level of defective welds is considered normal by A/E. Costs of inspections borne by Contractor.
4. Field Welding: Inspection of field welds, (when field welding is permitted) by an independent testing laboratory selected by Owner and approved by A/E. Inspection shall conform to AWS D1.1. Inspect joints selected in field and those designated on Drawings before, during and after welding takes place. After joints have been welded, cleaned and allowed to cool completely inspect joints ultrasonically or radiographically. Remove defective welds and replace with sound welds, at no additional cost to Owner. Mark name of inspector and welder on each joint. Cost of inspection borne by Owner.
5. Extent of Inspection: Inspection shall consist of a "complete" ultrasonic or radiographic inspection (entire length of weld in each designated joint).

E. Mill Tests: Prepare mill tests on all specified ASTM materials.

1.2 SUBMITTALS

A. Test Reports: Submit to A/E two copies of mill test reports certifying that materials meet specified ASTM requirements.

B. Welders Certificate: Pursuant to Paragraph 1.1.C, submit welding certificates to A/E for each welder with name of welder, name and title of person who conducted examination, kind of specimens, positions of welds, results of test and date of examination. In addition, welder's

employer shall certify that each welder has been engaged in type of welding for which he is qualified within preceding three month period.

- C. Inspection Records: Submit records of welding inspections to Owner and A/E. Pursuant to Paragraph 1.1.D, include the names of inspector and welder, date of welds and joint locations.
- D. Welding Procedure: Where field welding is permitted, submit for approval a detail written procedure for each type of joint prior to beginning work. Include identification of joint; joint dimensions, details and tolerances; identification of welding process; type and size of electrodes; type of flux, gas, etc.; current and voltage (with changes as required for different passes); preheat and interpass temperature; pass sequence; type of inspection required; and special instructions to welder.
- E. Shop Drawings: Submit shop drawings in accordance with Section 01331. In addition, conform to following:
 - 1. General: Prior to fabricating any material, shop drawings must be reviewed by A/E. Paragraph 4.2.1 of Section 4, AISC's "Code of Standard Practice for Steel Buildings and Bridges", is hereby modified to delete the sentence, "This approval constitutes the Owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these Shop Drawings". Prepare shop drawings comparable to those in AISC's "Detailing for Steel Construction".
 - 2. Scope: Include on the shop drawings all information for erection of component parts of structure. Indicate size, weight, spacing and elevation of all members; type and location of shop and field connections; type, size and extent of all welds; and welding sequence including welding symbols adopted by American Welding Society. Pursuant to Part 2 of this Section, also indicate which shop primer fabricator proposes to use.
 - 3. Procedure: Submit shop drawings in complete sets. However, shop drawings on portions of Work may be submitted prior to other portions when so permitted by A/E. Where such portions of Work are so submitted, furnish A/E sufficient information on connecting portions which are yet submitted to facilitate review. For example, if columns are furnished prior to connecting beams, submit sketches of any special connections to columns and a tabulation or schedule of standard connections to columns along with shop drawings for columns.

1.3 PRODUCT HANDLING, DELIVERY AND STORAGE

- A. Handling: Handle steel in such a manner to prevent damage to steel member and shop primer.
- B. Delivery: Deliver structural steel to conform to erection schedule. Deliver anchor bolts and loose bearing plates in advance of other steel.
- C. Storage: Store all steel above ground on platforms, skids or other support and keep free from dirt, grease and other foreign matter.

1.4 REJECTING MATERIAL

- A. General: Damaged material and material not conforming to the Specifications and Drawings may be rejected by A/E at any time nonconformities are discovered. Remove rejected materials and replace without additional expense to Owner.

PART 2 - PRODUCTS

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2.1 MATERIALS

- A. Structural Steel Wide Flange Shapes: ASTM A992.
- B. Miscellaneous Structural Steel Shapes and Plates: ASTM A36.
- C. Structural Steel Tubing, Square or Rectangular: ASTM A500, Grade B.
- D. Welding Electrodes: AWS D1.1, Table 4.1.1.
- E. Welded Studs: ASTM A108, Grade 1015 cold drawn steel, automatic weld type.
- F. High Strength Steel Bolts, Nuts and Washers: ASTM A325.
- G. Plain Bolts, Nuts and Washers: ASTM A307.
- H. Rail:
 - 1. Transfer System Rails, A.R.E.M.A., 100 pounds per yard.
 - 2. Sliding Door Rails: New rails, A.S.C.E., 80 pounds per yard.
 - 3. Rail Accessories:
 - a. Joint Bar: ASTM A3, Grade 3, unless otherwise recommended by crane rail manufacturer.
 - b. Joint Bar Bolts and Nuts:
 - 1) Bolts: ASTM A449, Grade A, heavy hex, heat treated. Nuts: ASTM A563, Grade B, heavy hex.
 - 2) Joint Bar Spring Washer: Alloy steel, AREA's "Specifications for Spring Washers".
 - 3) Lock Nuts: Bethlehem Steel's "Anco Lock Nut".
 - 4) Clamp Plate and Reversible Filler: Bethlehem Steel or United States Steel, per manufacturer's specifications.
- I. Shop Primers:

| <u>Manufacturer</u> | <u>Product</u> |
|---------------------|-----------------------------|
| Tnemec | Series 10 10-1009 (Gray) |

b. FABRICATION

- a. General: Fabricate steel to conform to AISC's "Manual of Steel Construction ASD" and "Code of Standard Practice for Steel Buildings and Bridges", subject to modifications outlined in this Section, Design Drawings and applicable building codes and ordinances. Fabricate steel free from ragged and crooked shear cuts, straight and out of twist.

- b. **Punching:** Punch holes clean-cut without torn or ragged edges. Remove sharp fins before bolting. Bolt holes not to exceed bolt diameter by more than 1/16 inch. Punch steel for attachment of wood nailers, anchors or for other purposes as shown.
- c. **Columns:** Provide columns with necessary connections for beams, girders and miscellaneous framing members. Finish bearing ends to a smooth surface at right angles to vertical axis and have bearing plates, anchors, brackets and other details as indicated or required. Unless otherwise indicated, detail all column splices as shown in appendix of AISC's "Detailing for Steel Construction". Contact surfaces finished profile not to exceed ANSI B46.1 roughness value of 500. Oversize holes for anchor bolts in column base plates and connecting material in accordance with recommendations of AISC's "Detailing for Steel Construction", page 7-5, Table 7-1.
- d. **Beams:** Place connecting angles at ends of beams so when assembled, angles are in close contact with members connected. In general, setback between end of beam and face of connecting angles not to exceed 1/2 inch. Cope, block and cut beams to provide clearance for connection to supporting members. Shape re-entrant corners notch free to a radius of not less than 1/2 inch. Avoid long and deep copes and blocks wherever possible.
- e. **Bracing:** Where practical, design all bracing connections so that all force components can be delivered directly to the centerline of intersecting members. Where this is not possible, design connections to account for resulting eccentricities.
- f. **Welded Studs:** Accurately space and automatically end weld studs in shop in accordance with stud manufacturer's recommendations.
- g. **Masonry Anchors:** Unless otherwise indicated, provide Government anchors at all framing which bears on masonry.

c. CONNECTIONS

- a. **General:** Weld or high strength bolt all shop connections. Design connections to develop reactions and stresses shown on Design Drawings. Where reaction or stress is not noted, design connections to develop full working strength of the members in accordance with AISC standards. Notwithstanding any provision to contrary in AISC's "Code of Standard Practice for Steel Buildings and Bridges" or in this Section, all connections designed by fabricator are his responsibility and review of shop drawings by Owner or A/E shall not relieve fabricator of this responsibility. A Professional Engineer duly registered in North Carolina shall design, or directly supervise the design of, the member connections and affix his seal to the connection detail drawings. Design connections to provide suitable access for field connections. Provide not less than two bolts per connection. Remove burrs, pits and other defects from contact surfaces of steel surfaces where members are jointed.
- b. **High Strength Bolted Connections:**
 - i. **Design:** Unless otherwise indicated, design high strength bolted connections as bearing type with threads in shear planes. Include in the design of connections consideration for web tear-out (block shear).
 - ii. **Assembly:** Assemble high strength bolted connections in accordance with "Specifications for Structural Joints using ASTM A325 or A490 Bolts". Use a hardened washer under element turned in tightening for all high strength bolts, regardless of method of tightening. When an outer face of bolted parts has a slope

SECTION 05120 - STRUCTURAL STEEL

greater than 1/20 with respect to a plane normal to bolted axis, use a beveled washer to compensate for lack of parallelism.

iii. **Tightening:** Starting from most rigid part of connection, bring enough bolts to a "snug-tight" condition to ensure that all parts of joint are brought into firm contact ("snug-tight" is defined as tightness attained by a few impacts of an impact wrench or full effort of a man using an ordinary spud wrench). Following such initial operation, place bolts in remaining holes and bring them to "snug-tight". Following completion of "snug-tight" operation, tighten each bolt to minimum specified tension; tighten bolts systematically from most rigid part of connection to its free edges. Accomplish such final tightening by one of the following methods:

1. **Direct Tension Indicator:** Tightening by this means is permitted provided it can be demonstrated by an accurate direct measurement procedure that the bolt has been tightened to specified tension. If this method is used, a load indicator washer or load indicator bolt shall be used in each fastener assembly. If this method is used, do not break off tip of bolt or depress washer until "snug-tight" operation is complete. Do not use this method for tightening heavy steel plies, for connections having several plies, or for connections with poor fit.
2. **Turn-of-the-Nut Method:** Tighten bolts by rotating nuts by amount established in "Specifications for Structural Joints Using ASTM A325 or A490" as published by Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation. During tightening operation, do not permit rotation of any part of bolt assembly not turned by wrench. In order to provide A/E a visual means of determining actual nut rotation, match mark -- prior to final tightening -- bolt components with paint or crayon. Position such marks on assembly component to be turned and on adjacent rigid surface.

iv. **Tension:** Tighten each bolt to provide, when all fasteners in a joint are tight, at least minimum tension listed below:

| <u>Bolt Size</u> | <u>A325 Bolts</u> | <u>A490 Bolts</u> |
|------------------|-------------------|-------------------|
| 5/8 inch | 19 Kips | 24 Kips |
| 3/4 inch | 28 Kips | 35 Kips |
| 7/8 inch | 39 Kips | 49 Kips |
| One inch | 51 Kips | 64 Kips |

- c. **Plain Bolted Connections:** When indicated, make connections for secondary members such as girts, framed roof openings and roof struts between purlins with plain bolts. Tighten nuts to provide adequate strength for connection without overstressing bolts.
- d. **Welded Connections:** Execute welding with welders qualified in accordance with requirements outlined in Part 1 of this Section. Obtain proper current for satisfactory welding as outlined in AWS D1.1. Clean surfaces as outlined in AWS D1.1. Remove fins and burrs from joint surfaces. Finish members true to line and free from twists, bends and open joints.

d. SHOP PAINTING

- a. General: Shop prime structural steel before delivery to Project site. Do not ship steel until prime coat is thoroughly dry. Prior to use, thoroughly clean all equipment used in priming steel.
- b. Surface Preparation:
 - i. Preparation of Structural Steel in All Areas: Power tool clean in accordance with SSPC-SP 3.
- c. Shop Priming (Unless specified otherwise by manufacturer):
 - i. General: Prior to priming remove residual deposits resulting from cleaning. Apply prime coat as soon as possible after cleaning, and before deterioration of surface occurs. However, do not allow elapsed time between cleaning and priming to 24 hours for surfaces cleaned in accordance with SSPC-SP 3.
 - ii. Dry Film Thickness: Apply primer in accordance with manufacturer's recommendations to provide a minimum dry film thickness of 3.0 mils.

PART 3 - EXECUTION

3.1 ERECTION

- A. General: Erect steel to conform to AISC's "Manual of Steel Construction ASD". Furnish all erecting tools, equipment, shores and bracing needed for the erection of structural steel and related items. Bolt steel work in place as erected. Straighten and plumb by means of guys and turnbuckles, checked by surveying instruments. Do not use drift pins in a manner that will damage metal.
- B. Shop Errors: Immediately report to A/E any errors in shop fabrication or deformation resulting from handling and shipping. Obtain approval of method of correction before proceeding with Work. Make approved corrections without additional cost to Owner. Correct slight inaccuracies in matching connection holes by reaming. Do not use gas-cutting torches in field to correct fabrication errors without prior approval of A/E.
- C. Shore and Bracings: Use temporary shores and bracing during progress of work to support all loads to which structure may be subjected, including erection and operation thereof. Leave shores and bracing in place as long as required for safety. In cases where permanent stability of steel depends on other parts of building, such as masonry, timber, planking and concrete work, thoroughly brace and keep steel frame work plumb and in position against wind, weather or other damaging conditions.
- D. Setting Bearing Devices:
 1. Attached Bearing Devices: When bearing plates are attached to steel members in the shop, set plates on leveling screws or shims at grade or level lines determined and fixed under Division 3.
- E. Erecting Rails: Provide bolted tight joints for rail splices. Arrange rails so that joints on opposite sides will be staggered with respect to each other and with respect to wheelbase of crane. Use odd rail lengths, not less than ten feet long, to complete a run or obtain necessary stagger. Anchor rails with clamp plates and reversible fillers. Space clamps a maximum of three feet on centers. Do not stagger clamps, but use in pairs. Install wood bumper assembly as indicated.

3.2 CONNECTIONS

- A. General: Use high strength bolts for primary field connections. Use plain bolts for secondary field connections such as girts and framed roof openings. Field welding permitted only if specifically indicated or approved by A/E. Make all connections in accordance with requirements specified in Part 2 of this Section.

3.3 TOLERANCES

- A. General: Do not exceed tolerances permitted by AISC's "Code of Standard Practice For Steel Buildings and Bridges" and "Quality Criteria and Inspection Standards". Exercise care to ensure that individual member tolerances do not accumulate in completed structure.
- B. Rails: Center to center of rails not to exceed 1/4 inch plus or minus from theoretical dimensions indicated adjusted to 68 degrees F. Horizontal misalignment of rails not to exceed 1/4 inch per 50 feet of runway with a maximum of 1/2 inch total deviation from theoretical location. Vertical misalignment of crane rails measured at centerline of columns not to exceed 3/8 inch per 50 feet of runway length with a maximum of 1/2 inch total deviation from theoretical location.

3.4 COMPLETED WORK

A. Field Painting:

1. All Areas: Field paint all unpainted surfaces, including nuts and bolts, and touch up all damaged surfaces with same primer used for shop painting.

End of Section

Prepared By: J. Griffith *JG*

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Checked By: D. Christmas *DC*Approved By: J. Griffith *JG*

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

- A. Product Qualifications: Metal deck manufacturer shall be a member of S.D.I. Steel Deck Institute.
- B. Erector Qualifications: Minimum five years' experience in performing similar work.
- C. Welder Qualifications: Previously demonstrated competence in executing similar work.

1.2 REFERENCES

- A. ASTM A653: Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. AWS D1.3: Structural Welding Code - Sheet Steel.
- C. "Design Manual for Composite Decks, Form Decks and Roof Decks", published by SDI.
- D. "Diaphragm Design Manual", published by SDI.
- E. "Specifications for the Design of Cold-Formed Steel Structural Members", published by AISI.
- F. ASTM A780: Repair of Damaged Hot-Dip Galvanized Coatings.

1.3 SUBMITTALS

- A. Procedure: Submit complete Shop Drawings and erection details in accordance with Section 01331. Submit manufacturer's catalog of products with Shop Drawings. Include the following data:
 - 1. Locations of roof supports.
 - 2. Directions of roof slopes.
 - 3. Locations and details of slope transitions.
 - 4. Note manufacturer product, type, and gauge of metal deck.
 - 5. Lengths and width of deck units.
 - 6. Details of factory-cut openings.
 - 7. Type and locations of deck attachments.
 - 8. Type and locations of side lap attachments.
 - 9. Type of factory finish.
 - 10. Marking of units corresponding to sequence of installation.
 - 11. Details of accessories.
 - 12. Diaphragm shear capacity of roof deck system submitted.
 - 13. Submit manufacturer's catalog data on fasteners.

1.4 DESIGN

- A. Design deck and fasteners in accordance with following:
 - 1. "Design Manual for Composite Decks, Form Decks and Roof Decks", published by SDI.
 - 2. Requirements of this Section and Drawings.
 - 3. Where specified and referenced requirements differ, base design on more stringent requirement.
- B. Specified deck gauges and frequency of attachments are minimum values; increase gauges and frequency of attachments if necessary to satisfy design requirements.
- C. Maximum design stress not to exceed 20,000 psi under total dead and live load set forth on Drawings.
- D. Deflection not to exceed 1/240 of span under live load.
- E. Compute deck properties in accordance with AISI's "Specifications for the Design of Cold-Formed Steel Structural Members".
- F. Design deck and fasteners to resist uplift forces set forth on Drawings.
- G. Where Drawings indicate diaphragm shears are to be developed by deck, design deck and fasteners in accordance with SDI's "Diaphragm Design Manual".
- H. Where possible, design deck units to extend over three or more spans.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Do not deliver materials to Project site sooner than 30 days prior to date scheduled for commencement of erection operations.
- B. Storage:
 - 1. Store decking off ground with one end elevated for drainage.
 - 2. Cover decking with waterproof material; ventilate covering to prevent condensation.
- C. Handling: Do not bend or mar decking.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Metal Roof Deck:
 - 1. Configuration: Intermediate rib deck, as designated by SDI, with nesting side laps; stiffening bead in top flange not permitted.
 - 2. Steel Type: ASTM A653, SQ Grade 33 having a minimum yield strength of 33,000 psi.

3. Select one of the following or approved equal, unless noted on Drawings.

Manufacturer

Consolidated
United Steel Deck, Inc.
Vulcraft

4. Maximum Deck Spans: Provide deck units based on following:

| <u>Wide Rib</u> <u>Minimum Deck Gauge</u> | <u>Maximum Span</u> <u>(Center to Center)</u> |
|--|--|
| 18 | 5'-7" |

5. Minimum Deck Thickness: Fabricate 18-gauge decking from steel not less than .045 inch thick.
6. Factory Finish: Galvanized, ASTM A653, G90 coating designation.

B. Fasteners:

1. Welding Electrodes: AWS D1.3.
2. Mechanical Deck Fasteners:
 - a. For steel supports to 1/4 inch thick: Traxx/4 manufactured by Buildex Div., Illinois Tool Works, Inc.
 - b. For steel supports 1/4 inch to 1/2 inch thick: Traxx/5 manufactured by Buildex Div., Illinois Tool Works, Inc.

C. Side Lap Fasteners: Stitch Traxx (Traxx/1) self-drilling screws manufactured by Buildex Div., Illinois Tool Works, Inc.

D. Accessories:

1. Metal Devices: 20-gauge ridge and valley plates, 20-gauge eave plates and other metal accessories set forth on Drawings or necessary for Work; provide metal accessories with same finish specified for metal roof deck.
2. Flexible Closures: Rubber or neoprene.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that roof supports are properly aligned and attached.
- B. Verify that surfaces to receive decking are properly painted.
- C. Do not proceed with installation until defects are corrected.

3.2 PREPARATION

- A. Clean debris from surface of roof supports.

3.3 ERECTION

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- A. General Requirements: Install decking and accessories in accordance with the following:
1. Requirements of this Section.
 2. Reviewed shop drawings.
 3. Manufacturer's recommendations.
 4. Procedures set forth in SDI's "Design Manual for Composite Decks, Form Decks and Roof Decks".
- B. Cutting: Make cuts neat, square and trim.
- C. Positioning:
1. Position decking on roof supports and adjust to final position with ends joints bearing on supporting members.
 2. Lap end joints minimum of 2 inches.
- D. Deck Attachment:
1. General: Use Method One described herein where deck is to be attached to steel supports that are in excess of 1/2 inch in thickness; use Method Two at all other locations.
 2. Method One (Weld):
 - a. Weld through bottom of ribs to roof supports.
 - b. Conform to procedures set forth in AWS D1.3.
 - c. Penetrate all layers of end laps and side laps.
 - d. Exercise care to provide positive welds and prevent blow-holes.
 - e. Press bottom of deck unit tight against supporting member and make 5/8 inch diameter, minimum, puddle welds or elongated welds having an equal perimeter.
 - f. Where fillet welds are necessary, make welds at least 1 inch long.
 - g. Do not use welding washers without permission of A/E.
 3. Method Two (Screw Fastener):
 - a. Screw bottom of ribs to roof supports with mechanical deck fasteners.
 - b. Penetrate all layers of end laps and side laps.
 - c. Draw deck unit tight against supporting member; avoid over tightening.
 4. Minimum Spacing, Unless Noted Otherwise on Drawings:
 - a. Attach deck units at end joints and at all intermediate supports.
 - b. Locate attachment at 6 inch maximum centers and at each side lap.
 - c. Provide closer spacing if required to obtain diaphragm shears and/or uplift forces noted on the Drawings.
- E. Side Lap Attachment:
1. Method:
 - a. Using self-drilling screws, screw attach units with nesting side laps.
 - b. Bring surfaces to firm contact prior to attaching.
 - c. Draw overlapping material tight; avoid over tightening.

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d. Do not weld or button punch side laps.

2. Minimum Spacing:

- a. Locate attachment by 18 inch maximum centers.
- b. Equally space attachments between supports.
- c. Provide closer spacing if required to obtain diaphragm shears noted on the drawing.

F. Installation of Accessories:

1. Secure metal accessories with self-drilling screws.
2. Install flexible closures at tops of intersecting walls and elsewhere required by Drawings.

3.4 COMPLETED WORK

A. Touch-Up Painting:

1. If any portion of deck is attached by welding, clean welds with wire brush and coat with rust-inhibitive prime paint; do not leave welds unpainted overnight.
2. Touch up damage to factory finish with rust-inhibitive prime paint.
3. Use prime paint recommended by deck manufacturer.

B. Adjustments: Remove and restore damaged materials and materials not installed properly.

3.5 PROTECTION

- A. Do not use deck for storage or working platform until permanently secured in position.
- B. Do not permit construction loads to exceed capacity of deck.

End of Section

SECTION 05511 - METAL STAIRS

Prepared By: C. Hopkins

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Checked By: J. Miller

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PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Preassembled steel stairs with concrete-filled 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..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
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/240 or 1/4 inch, 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. applied in any direction.
 - b. Concentrated load of 200 lbf 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. applied in any direction.
 - b. Concentrated load of 200 lbf 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 applied horizontally on an area of 1 sq. ft..
 - b. Uniform load of 25 lbf/sq. ft. applied horizontally.
 - c. 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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, 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.
- 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, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25.
- H. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30.
- I. Expanded Metal, Carbon Steel: ASTM F 1267, Class 1 (uncoated).
- J. Woven-Wire Mesh: Intermediate-crimp, 2-inch woven-wire mesh, made from 0.135-inch nominal diameter wire complying with ASTM A 510.
- K. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

2.3 MISCELLANEOUS MATERIALS

- A. Cast-Metal Abrasive Nosings: Cast gray iron, Class 20, with an integral abrasive finish.
 - 1. Use available manufacturers.
 - 2. Apply bituminous paint to concealed bottoms, sides, and edges of units set into concrete.
- 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. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
- E. Welded Wire Fabric: ASTM A 185, 6 by 6 inches--W1.4 by W1.4, unless otherwise indicated.

2.4 FABRICATION

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, 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.
- B. Stair Framing: Fabricate stringers of steel plates. Construct platforms of steel plate headers and miscellaneous framing members.
- C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.0677 inch.
- D. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
 - 1. Configuration: 1-5/8-inch- diameter top and bottom rails, 1-1/2-inch- square posts, and 1/2-inch- square pickets spaced less than 12 inches clear.
 - 2. Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose.
 - 3. Form changes in direction of railings by bending or by inserting prefabricated fittings.
 - 4. Form curves by bending members in jigs to produce uniform curvature without buckling.
 - 5. Close exposed ends of railing members with prefabricated end fittings.
 - 6. Provide wall returns at ends of wall-mounted handrails.

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7. Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
8. Connect posts to stair framing by direct welding.

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. Place and finish concrete fill for treads and platforms to comply with Division 3 Section "Cast-in-Place Concrete."
 1. Install abrasive nosings with anchors fully embedded in concrete.
- E. Attach handrails to wall with wall brackets.
 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
- F. 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.

END OF SECTION

Prepared By: Joe Rives 

Checked By: J. Miller

Approved By: J. Miller 

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: This Section specifies preservative treated lumber and plywood and associated rough hardware.

1.2 STORAGE AND HANDLING

- A. Protect materials from the following:
1. Dirt, oil, and other contaminants.
 2. Increase in moisture content. (Provide waterproof covers for preservative treated wood during shipment.)
- B. Stack lumber to provide air circulation within and around wood; sticker between each course.
- C. Store wood off the ground and protected from the weather.
- D. Move products to roof level in quantities needed for immediate use only. Do not store products on roof.

1.3 QUALITY ASSURANCE

- A. Lumber Marking: Identify each piece of lumber with grade mark of a recognized association or independent inspection agency which is certified by American Lumber Standards Committee's Board of Review to grade species used.
- B. Plywood Marking: Identify each plywood panel with grade-trademark stamp of a qualified inspection and testing agency which maintains control over quality of plywood employed in Work. Such stamp shall provide all information required by NIST PS1.
- C. Treatment Marking: Identify each preservative-treated piece of lumber and panel of plywood in accordance with AWPA Standard U1 or C1 as required by applicable building code.

1.4 JOB CONDITIONS

- A. Install materials during dry weather only.

1.5 SEQUENCING

- A. Sequence Work so that installation of rough carpentry immediately precedes installation of roofing and sheet metals.

PART 2 - PRODUCTS

2.1 LUMBER

- A. Material: Southern Yellow Pine, S4S, No. 2KD Grade.
- B. Preservative Treatment: AWPAs Standard U1 or C2 (with ACQ, CBA-A, or CA-B preservative) as required to comply with applicable building code. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- C. Preservative Treatment Retention: AWPAs Standard U1 - Commodity Specification A, Category UC4A, or AWPAs Standard C2, Soil or Fresh Water Use.
- D. Maximum Lengths: 10 feet.

2.2 PLYWOOD

- A. Material: APA B-C, Exterior, constructed from wood species that can be preservative treated.
- B. Preservative Treatment: AWPAs Standard U1 - Commodity Specification F, or AWPAs Standard C9 as applicable building code (with CCA, ACQ, CBA-A, or CA-B preservative). Dry plywood after treatment to a maximum moisture content of 18 percent.
- C. Preservative Treatment Retention: AWPAs Standard U1 - Commodity Specification A, Category UC4A, or AWPAs Standard C2, Soil or Fresh Water Use.

2.3 ROUGH HARDWARE

- A. Wood Screws (for Wood-to-Wood Attachment): 300 series stainless steel, phillips or square socket, bugle head or equivalent type that does not require countersinking to produce flush fit. If size is not identified on Drawings, furnish minimum #8. If length is not identified on Drawings, furnish length needed to penetrate lumber substrate not less than 1 inch and completely penetrate plywood substrate.
- B. Special Screws, Type 1 (Wood-to-Metal Roof Deck Attachment): Sarnafil's "Sarnafastener MaxLoad Fastener," with minimum 5/8" OD galvanized steel washer. Furnish length needed to penetrate metal deck 3/4-inch to less than 1-1/2 inches.
- C. Special Screw, Type 2 (Wood-to-Steel Plate): ITW Buildex's "Tek's, Wood-to-Metal Fastener," 109400 12-24 x 2-3/4".
- D. Other Fasteners:
 - 1. Furnish other fasteners needed for Work which are appropriate for substrate and component being fastened; furnish 300 series stainless steel; type and length appropriate for intended use.
 - 2. Nails are not to be employed unless prior approval is obtained from A/E or specifically called for on Drawings. If nails are approved or called for on Drawings, provide stainless steel, common nails, ring-shank, length as needed to penetrate substrate not less than 1-1/2 inches or, if substrate is less than 1-1/2 inches thick, full thickness of substrate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. If Drawings do not describe size of lumber to be installed along perimeter metal edging, provide nailers matching thickness of abutting insulation and not less than 5-1/2" wide.
- B. Predrill components being fastened before installing fasteners. Countersink wood components as needed to provide flush attachment.
- C. Install materials straight, in true alignment, and free of warp and gaps between abutting members.
- D. Fasten components rigidly in place; draw fasteners tight.
- E. Do not use nails to fasten wood components unless prior approval is obtained from A/E or specifically specified on Drawings.
- F. If Drawings do not describe spacing of fasteners securing lumber, space fasteners at maximum 16 inch centers when securing wood-to-wood and at maximum 6 inch staggered centers when securing wood-to-metal deck.

3.2 PROTECTION OF WORK

- A. Protect installed rough carpentry from moisture (rain and condensation) until roofing and sheet metal systems are installed. Do not leave wood components exposed overnight or during inclement weather.

End of Section

SECTION 07210 - BUILDING INSULATION

Prepared By: C. Hopkins

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Checked By: J. Miller

Approved By: J. Miller

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Perimeter insulation under slabs-on-grade.

B. Related Sections include the following:

1. Division 4 Section 04810 "Unit Masonry Assemblies" for insulation installed in masonry cells.
2. Division 9 Section 09260 "Gypsum Board Assemblies" for installation in metal-framed assemblies of insulation specified by referencing this Section.
3. Division 15 Section "Mechanical Insulation."

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Insulation Type 1 (INSUL-1): Furnished and installed under Section 07412 and 13125.

B. Insulation Type 2 (INSUL-2): Furnished and installed under Section 07411 and 13125.

C. Insulation Type 3 (INSUL-3): Furnished and installed under Section 04810.

SECTION 07210 - BUILDING INSULATION

- D. Insulation Type 4 (INSUL-4): Furnished and installed under Section 07500.
- E. Insulation Type 5 (INSUL-5): Furnished and installed under Section 09260.
- F. Insulation Type 6 (INSUL-6): Not used.
- G. Insulation Type 7 (INSUL-7): 1 1/2" thick Dow Chemical "Styrofoam SE" extruded polystyrene foam insulation, Type IV, 1.60 lb/cu. ft., compressive strength 25 psi (ASTM D 1621-73), R=7.5, square edges, water permeability of 1.0., unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

3.4 INSTALLATION OF PERIMETER INSULATION

A. INSUL-7:

1. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions.
2. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions.
3. Protect below grade insulation on vertical surfaces from damage during backfilling by applying protective course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.
4. Protect top surface of horizontal insulation from during concrete work by applying protective course with joints butted.

3.5 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

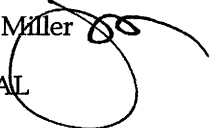
END OF SECTION

SECTION 07411 - METAL ROOF PANELS

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Prepared By: C. Hopkins

Checked By: J. Miller

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PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Factory-formed and field-assembled, standing-seam metal roof panels.
- B. Steel Sheet Thickness: Minimum thickness of base metal without metallic coatings or painted finishes.

1.2 SYSTEM PERFORMANCE REQUIREMENTS

A. Loads: All structures shall be designed for the following as a minimum plus any additional code or insurance underwriter requirements as required.

Roof:

1. Dead Load: Applicable roofing, insulation, decking, structure, etc.
2. Roof Mounted Equipment and Hanging Loads: 6 psf uniformly distributed for all members in all areas. (This load shall not to be used to resist uplift but shall be included in seismic design.)
3. Live loads: 20 psf

Wind (ASCE 7-98)

1. Basic Wind Speed: 130 MPH (3 second gust)
2. Building Category: II
3. Importance Factor: 1.00
4. Exposure Category: D
5. Building Type: Enclosed.

Seismic

1. Site Class E
2. Seismic Use Group I
3. Importance Factor: 1.00
4. Design Spectral Response: 0.2 Sec. Spectral Response Accel. $S_S=0.110$.
5. Design Spectral Response: 1.0 Sec. Spectral Response Accel. $S_1=0.480$.
6. Seismic Design Category: C

Snow

1. Ground Snow Load (Pg): 10 psf
2. Snow Exposure Factor, C_e : 1.0
3. Thermal Factor, C_t : 1.0
4. Importance Factor: 1.00
5. Roof snow calculations shall include a 5 psf rain-on-snow surcharge, as required by the code.

Rain: Design for ponding and as required for roof secondary drainage system height.

- B. Lateral Drift Limitations. $H/60$ for building frames supporting metal wall panels (based on 10-year wind). Use more stringent drift limits for walls supporting windows at office area if required to comply with window requirements.
- C. Deflection Limitations: All members and components shall be designed for the following minimum deflection limits:
 - Roof Purlins (Not Supporting Ceiling) $L/150$ (Hanging + Live/Snow)
 - Roof Main Frame (Not Supporting Ceiling) $L/180$ (Hanging + Live/Snow)
- D. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at test-pressure difference of 12 psf.
- E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with FMRC I-90.
- F. Thermal Movements: Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- G. Thermal Performance: Provide insulated metal panel assemblies with the following maximum U-factors and minimum R-values for opaque elements when tested according to ASTM C 1363 or ASTM C 518:
 - 1. Metal Roof Panel Assemblies:
 - a. U-Factor: 0.050
 - b. R-Value: R-19

1.3 SUBMITTALS

- A. Product Data: For each type of metal roof panel and accessory indicated.
- B. Shop Drawings: Show layouts of metal roof panels, including plans, elevations, sections, details, and attachments to other work.
 - 1. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories.
 - 2. Include structural analysis data signed and sealed by the qualified professional engineer in North Carolina responsible for their preparation.
- C. Coordination Drawings: Drawn to scale and coordinating metal roof panel installation with penetrations and roof-mounted items.
- D. Samples: For each exposed finish.
- E. Material certificates.
- F. Field quality-control inspection reports.
- G. Product test reports.

H. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1. Installer's responsibilities include fabricating and installing metal roof panel assemblies and providing professional engineering services needed to assume engineering responsibility.

B. Preinstallation Conference: Conduct conference at Project site.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal roof panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Structural failures, including rupturing, cracking, or puncturing.
- b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Siliconized Polyester Finish Warranty Period: 10 years from date of Substantial Completion.
2. Fluoropolymer Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CENTRIA Architectural Systems.
2. Fabral, Inc.
3. Flexospan Steel Buildings, Inc.
4. MBCI; Div. of NCI Building Systems.
5. Metal Sales Manufacturing Corporation.
6. Morin Corporation; a Metecno Group Company.

2.2 PANEL MATERIALS

A. Standing-Seam Metal Roof Panels: Factory-formed, designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and

SECTION 07411 METAL ROOF PANELS

mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Comply with ASTM E 1514.
2. Type: Vertical rib, seamed.
3. Material: Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. 24-gauge Zinc-Coated (galvanized) steel sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 37, with G90 coating designation.
 - b. Surface: Smooth, flat finish.
 - c. Exposed Finishes:
 - 1) High-Performance Organic Finish: Two-coat, thermocured system with fluoropolymer coats containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements of AAMA [2604] [2605], except as modified below:
 - a) Humidity Resistance at 100 degrees F and 100 % RH in accordance with ASTM D-2247.
 - b) Salt-Spray Resistance at 5% Salt Fog per ASTM B-117
 - c) Reverse Impact Resistance in accordance with ASTM D-2794
 - d. Concealed Finish: White or light-colored acrylic or polyester backer finish.
 - e. Color: As selected by owner's representative from manufacturer's full range.
4. Clips: Manufacturer's standard, floating type to accommodate thermal movement; fabricated from zinc-coated (galvanized) steel sheet.
5. Joint Type: Mechanically seamed, folded as standard with manufacturer.
6. Panel Coverage: 12 inches
7. Panel Height: 2 inches

2.3 THERMAL INSULATION FOR FIELD-ASSEMBLED METAL PANELS

- A. Metal Building Insulation (INSUL-2): ASTM C 991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch-wide, continuous, vapor-tight edge tabs; and with a flame-spread index of 25 or less, faced with vapor-retarder membrane.
- B. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than 0.02 perm when tested according to ASTM E 96, Desiccant Method.
 1. Composition: Vinyl-reinforced polyester facing.
- C. Retainer Strips: 0.19 inch-thick, formed, galvanized steel or PVC retainer clips colored to match insulation facing.
- D. Wire Mesh Retainer: Provide continuous galvanized metal wire mesh as a minimum to retain roof insulation in place and prevent sagging of roof insulation. Other insulation retaining systems will be considered.

- D. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.4 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating.
1. Fasteners for Roof Panels: Self-drilling or self-tapping 410 stainless or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal roof panels.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- C. Panel Sealants:
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing.
 2. Joint Sealant: ASTM C 920; as recommended in writing by metal roof panel manufacturer.
- D. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 ACCESSORIES

- A. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
 2. Clips: Manufacturer's standard, formed from steel sheet, designed to withstand negative-load requirements.
 3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel sheet.
 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Formed from 0.0179-inch- thick, metallic-coated steel sheet. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as metal wall panels.
- C. Gutters: Formed from 0.0179-inch- thick, metallic-coated steel sheet. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced 36 inches o.c., fabricated from same metal as gutters.

Provide bronze, copper, or aluminum wire ball strainers at outlets. Finish gutters with same finish system as metal wall panels.

- D. Downspouts: Formed from 0.0179-inch- thick, metallic-coated steel sheet; in 10-foot- long sections, complete with formed elbows and offsets. Finish downspouts with same finish system as metal wall panels.
- E. Roof Curbs (where applicable): Fabricated from 0.0478-inch- thick, metallic-coated steel sheet; with welded top box and bottom skirt, and integral full-length cricket. Fabricate curb subframing of minimum 0.0598-inch- thick, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads, of size and height indicated. Finish roof curbs to match metal roof panels. Insulate roof curb with 1-inch- thick, rigid insulation.

2.6 FABRICATION

- A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Where indicated, fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
- E. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."

3.2 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.
- B. Field-Assembled. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
 - 1. Install clips to supports with self-tapping fasteners.
 - 2. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

3. Field cutting of metal roof panels by torch is not permitted.
 4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels.
 5. Provide metal closures at peaks, rake edges, rake walls and each side of ridge caps.
 6. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 8. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.
- C. Fasteners: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.
- D. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal panel manufacturer.

3.3 THERMAL INSULATION INSTALLATION FOR FIELD-ASSEMBLED METAL ROOF PANELS

- A. Blanket Roof Insulation: Install insulation concurrently with metal roof panel installation, in thickness indicated to cover entire roof, according to manufacturer's written instructions and as follows:
1. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
 2. Tape joints and ruptures in vapor retarder and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
 3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths with both sets of facing tabs sealed to provide a complete vapor retarder. Comply with the following installation method:
 - a. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Hold in place by panels fastened to secondary framing.
 - b. Wire Mesh: Install continuous galvanized metal wire mesh as a minimum to hold insulation in place.

3.4 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

SECTION 07411 - METAL ROOF PANELS

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- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
 - 1. Provide elbows at base of downspouts to direct water away from building.
- E. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.
- F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.5 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
 - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning."
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION

SECTION 07412 - METAL WALL PANELS

Prepared By: C. Hopkins

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Checked By: J. Miller

Approved By: J. Miller

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Factory-formed and field-assembled, exposed-fastener, lap-seam metal wall panels, subgirts, insulation and sealed vapor barrier liner panels.

B. Steel Sheet Thickness: Minimum thickness of base metal without metallic coatings or painted finishes.

1.2 SYSTEM PERFORMANCE REQUIREMENTS

A. Structural Performance: Capable of withstanding the effects of gravity loads and the following loads and stresses, based on testing according to ASTM E 330:

Wind (ASCE 7-98)

1. Basic Wind Speed: 130 MPH (3 second gust)
2. Building Category: II
3. Importance Factor: 1.00
4. Exposure Category: D
5. Building Type: Enclosed.

Seismic

1. Site Class E
2. Seismic Use Group I
3. Importance Factor: 1.00
4. Design Spectral Response: 0.2 Sec. Spectral Response Accel. $S_s=0.110$.
5. Design Spectral Response: 1.0 Sec. Spectral Response Accel. $S_1=0.480$.
6. Seismic Design Category: C

B. Deflection Limits: Withstand test pressures with deflection no greater than 1/120 (Based on 10-year wind) of the span and no evidence of material failure, structural distress, or permanent deformation exceeding 0.2 percent of the clear span.

C. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at a minimum differential pressure of 20 and not more than 12 lb/sq. ft. (575 Pa).

D. Thermal Movements: Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

E. Thermal Performance: Provide insulated metal panel assemblies with the following maximum U-factors and minimum R-values for opaque elements when tested according to ASTM C 1363 or ASTM C 518:

1. Metal Wall Panel Assemblies:

- a. U-Factor: 0.084
- b. R-Value: R-11

1.3 SUBMITTALS

A. Product Data: For each type of metal wall panel and accessory indicated.

B. Shop Drawings: Show layouts of metal wall panels, including plans, elevations, sections, details, and attachments to other work.

1. Include details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories.
2. Include structural analysis data signed and sealed by the qualified professional engineer in North Carolina.

C. Coordination Drawings: Drawn to scale and coordinating metal wall panel installation with penetrations and wall-mounted items.

D. Samples: For each exposed finish.

E. Material certificates.

F. Product test reports.

G. Maintenance data.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: The wall panel system manufacturer shall have a minimum of ten (10) years of experience in manufacturing exposed fastener wall panels in a permanent stationary indoor facility.

B. Installer Qualifications: The wall panel system contractor shall have a minimum of two (2) years experience in the installation of exposed fastener wall panels and show evidence of successful completion of at least three (3) projects of similar size, scope, and complexity.

C. Preinstallation Conference: Conduct conference at Project site.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Structural failures, including rupturing, cracking, or puncturing.

- b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: Two (2) years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Siliconized Polyester Finish Warranty Period: 10 years from date of Substantial Completion.
 2. Fluoropolymer Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CENTRIA Architectural Systems.
 2. Fabral, Inc.
 3. Flexospan Steel Buildings, Inc.
 4. MBCI; Div. of NCI Building Systems.
 5. Metal Sales Manufacturing Corporation.
 6. Morin Corporation; a Metecno Group Company.

2.2 LAP-SEAM METAL WALL PANEL

- A. Exposed-Fastener, Lap-Seam Metal Wall Panels: Factory-formed, designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
1. Profile: Tapered rib
 2. Material: Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. 24-gauge Zinc-Coated (galvanized) steel sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 37, with G90 coating designation.
 - b. Surface: Smooth, flat finish.
 - c. Exposed Finishes:
 - 1) High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). The physical characteristics of the exterior coating shall be measured by the following laboratory, weather simulating tests to obtain test results justifying the manufacturer's 20 year warranty:

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- a) Humidity Resistance at 100 degrees F and 100 % RH in accordance with ASTM D-2247.
 - b) Salt-Spray Resistance at 5% Salt Fog per ASTM B-117
 - c) Reverse Impact Resistance in accordance with ASTM D-2794

 - d. Concealed Finish: Same as exposed finish or apply pretreatment and manufacturer's standard white or light-colored backer finish, consisting of prime coat and wash coat with a total minimum dry film thickness of 0.5 mil.
 - e. Color: As selected by owner's representative from manufacturer's full range.
3. Major-Rib Spacing: 9" o.c.
 4. Panel Coverage: 36"
 5. Panel Height: 1- 1/2"

2.3 THERMAL INSULATION FOR FIELD-ASSEMBLED METAL WALL PANELS

- A. Metal Building Insulation (INSUL-1): ASTM C 991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch- wide, continuous, vapor-tight edge tabs; and with a flame-spread index of 25 or less, faced with vapor-retarder membrane.
- B. Extruded-Polystyrene Board Insulation (INSUL-8): ASTM C 578, Type IV, 1.60-lb/cu. ft. minimum density, unless otherwise indicated; with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively.

2.4 MISCELLANEOUS METAL FRAMING

- A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80; with G90 coating designation.
- B. Subgirts: C- or Z-shaped sections fabricated from minimum 16-gauge zinc-coated galvanized steel sheet, shop-painted, cold-formed.
- C. Base or Sill Angles and Channels: 0.079-inch bare steel thickness, cold-formed, galvanized steel sheet.
- D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 1. Minimum Base Metal Thickness: as required.
 2. Depth: as required.
- E. Cold-Rolled Furring Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange.
 1. Depth: as required.
 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch.

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3. 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.
- F. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.5 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating.
1. Fasteners for Wall Panels: Self-drilling or self-tapping 410 stainless or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- C. Metal Panel Sealants:
1. Sealant Tape: Pressure-sensitive, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
 2. Joint Sealant: ASTM C 920; as recommended in writing by metal wall panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.6 ACCESSORIES

- A. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal wall panels.
 2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Formed from 0.0179-inch- thick, metallic-coated steel sheet. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.
- C. Translucent Wall Panels:

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1. Fire-Test-Response Characteristics: Provide translucent wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
2. Uninsulated Translucent Panels: Glass-fiber-reinforced polyester, translucent plastic; complying with ASTM D 3841, Type CC1 (limited flammability), Grade 1 (weather resistant); smooth finish on both sides. Match profile of adjacent metal wall panels.
 - a. Panel Weight: Not less than 8 oz./sq. ft.
 - b. Light Transmittance: Not less than 55 percent according to ASTM D 1494.
 - c. Color: White.
3. Mastic for Translucent Panels: Nonstaining, saturated, vinyl polymer as recommended by translucent panel manufacturer for sealing laps.

2.7 FABRICATION

- A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
 1. Fabricate wall panels with panel stiffeners as required to maintain fabrication tolerances and to withstand design loads.
- B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
- E. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."
- B. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorage according to ASTM C 754 and metal wall panel manufacturer's written recommendations.

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3.2 METAL WALL PANEL INSTALLATION, GENERAL

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Field cutting of metal wall panels by torch is not permitted.
 2. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Pre-drill panels.
 3. Install screw fasteners in predrilled holes.
 4. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 5. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
 6. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Fasteners:
1. Steel Wall Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies.
1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
 2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

3.3 THERMAL INSULATION INSTALLATION FOR FIELD-ASSEMBLED METAL WALL PANELS

- A. General: Install insulation concurrently with metal wall panel installation, in thickness indicated to cover entire wall, according to manufacturer's written instructions.
1. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
 2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
 3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths with both sets of facing tabs sealed to provide a complete vapor retarder.
- B. Blanket Wall Insulation (INSUL-1): Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Hold in place by metal wall panels fastened to secondary framing.
1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

- C. Board Wall Insulation (INSUL-8): Extend board insulation in field-assembled metal wall panel assembly in thickness indicated to cover entire wall. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions.
1. Retain insulation in place by adhesive within integral pockets within metal wall panels, or metal clips and straps spaced at intervals recommended by insulation manufacturer to hold insulation securely in place. Maintain cavity width between insulation and metal liner panel of dimension indicated.

3.4 FIELD-ASSEMBLED METAL WALL PANEL INSTALLATION

- A. Lap-Seam Metal Wall Panels: Fasten metal wall panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation.
 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal wall panels.
 3. Provide sealant tape at lapped joints of metal wall panels and between panels and protruding equipment, vents, and accessories.
 4. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps, and on side laps of nesting-type panels; on side laps of corrugated nesting-type, ribbed, or fluted panels; and elsewhere as needed to make panels weatherproof to driving rains.
 5. At panel splices, nest panels with minimum 6-inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.
- B. Metal Liner Panels: Install panels on exterior side of girts with girts exposed to the interior.

3.5 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 2. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Translucent Wall Panels: Provide end laps of not less than 6 inches and side laps of not less than 1-1/2-inch corrugations. Align horizontal laps with adjacent translucent wall panels. Seal intermediate end laps and side laps of translucent panels with translucent mastic.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

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- B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION

SECTION 07540 - THERMOPLASTIC MEMBRANE ROOFING

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PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Mechanically fastened (batten bar) single-ply roofing system.
 - 2. Roof insulation.
 - 3. Other roofing-system components.

1.2 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- B. Roof system consists, in general, of the following:
 - 1. One 1.5-inch-thick layer of isocyanurate insulation mechanically fastened over metal roof deck. (Two 1.5-inch-thick layers over roof of Control Room.)
 - 2. 0.060-inch-thick single-ply membrane fastened with batten bars over isocyanurate insulation.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide roofing system that remains watertight; does not permit the passage of water; provides specified fire and windstorm ratings; and resists thermally induced movement.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. FMG Listing: Provide roofing membrane and component materials that comply with requirements in FMG 4450 and FMG 4470 as part of a membrane roofing system and that are listed in FMG's "Approval Guide" for Class 1 construction. Identify materials with FMG markings.
 - 1. Fire/Windstorm Classification: Class 1A-195 or higher.

1.4 SUBMITTALS

- A. Product Data: For each type of product proposed for inclusion in roof system.

- B. Shop Drawings:
 - 1. Fastening patterns for preliminary insulation attachment.
 - 2. Arrangement of single-ply membrane and batten bars.
- C. Installer Certificates: Signed by membrane manufacturer certifying that roofing applicator is approved, authorized, or licensed by manufacturer to install roofing system.
- D. Manufacturer Certificates: Signed by membrane manufacturer certifying that roof system complies with requirements specified in "Performance Requirements" Article.
- E. Warranties: Warranties specified in this Section.
- F. Inspection Report: Copy of membrane manufacturer's inspection report of completed roofing installation.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A roofing installer that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.
- B. Source Limitations: Obtain components for roofing system from membrane manufacturer or from sources approved by membrane manufacturer.
- C. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when current and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.8 MANUFACTURER WARRANTY

- A. Provide total-system, no-dollar-limit warranty which obligates membrane manufacturer to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
 - 1. Warranty to include roofing membrane, membrane flashings, roof insulation, roofing accessories, and other components of roofing system above metal deck, excluding rough carpentry items.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

1.9 INSTALLER WARRANTY

- A. Installer warrants to Owner that roofing system will remain watertight and free of other defects for a period of two years following date of Substantial Completion.
- B. Defects include, but are not limited to, the following:
 - 1. Leaks in membrane or bituminous flashing systems.
 - 2. Moisture damaged insulation.
 - 3. Curled, warped, cupped, loose, broken, or crushed or insulation.
 - 4. Fastener back-out or adhesive failures.
 - 5. Open seams in roof membrane and flashings.
 - 6. Improperly installed materials.
 - 7. Defects in materials.
 - 8. Other similar conditions.
- C. Excluded from warranty are defects caused by lightning, hailstorm, earthquake, tornado, or similar unusual occurrences.
- D. Also excluded from guarantee are defects caused by the following:
 - 1. Foundation settlement and other similar phenomena affecting structural building elements.
 - 2. Owner's or separate contractor's installation of roof penetrations and roof-mounted equipment not flashed by roofing installer.
 - 3. Fire and vandalism.
- E. Under terms of guarantee, make temporary and permanent repairs at no expense to Owner.

- F. Upon receipt of Owner's notification of need for repairs, complete repairs within 24 hours. If conditions beyond control of Contractor prevent completion of permanent repairs within 24 hours, make temporary repairs within such time limit, and then proceed with activities needed to complete permanent repairs. If such delay is required, notify Contractor of schedule for completion of permanent repairs.

PART 2 - PRODUCTS

2.1 SINGLE PLY ROOFING MEMBRANE

A. General:

1. Type: Polyester reinforced thermoplastic single-ply membrane; either modified PVC or TPO.
2. Thickness: 0.060-inch.
3. Full-Width Sheets: Match width required to comply with specified FMG Windstorm Classification.
4. Half-Sheets: Provide half-sheets in roof corners and along perimeter edges to comply with specified FMG Windstorm Classification and membrane manufacturer's recommendations.
5. Color: Selected by A/E from membrane manufacturer's range of standard colors.

B. Acceptable Product: One of the following:

1. "S327" by Sarnafil, 60-mil modified PVC.
2. "UltraPly TPO 96" by Firestone, 60-mil TPO.

2.2 FASTENER SYSTEM FOR SINGLE PLY ROOFING MEMBRANE

- A. If Sarnafil membrane is employed, provide "Sarnarail" polymeric "Batten Strip" and "Sarnafastener XP Fasteners" applied along battens.
- B. If Firestone membrane is employed, provide "Metal Batten Strip" and "Heavy-Duty Plus Fasteners" applied along battens.

2.3 AUXILIARY MEMBRANE MATERIALS

- A. General: Auxiliary materials recommended by membrane manufacturer for intended use and compatible with membrane roofing.
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same color as roofing membrane. Match thickness of roofing membrane.
- C. Bonding Adhesive (for curbs and other similar applications): Bonding adhesive recommended by membrane manufacturer.

- D. Miscellaneous Accessories: Provide pourable sealers, preformed cone flashings, preformed inside and outside corner flashings, T-joint covers, flashing strips, and other accessories recommended by membrane manufacturer.

2.4 ROOF INSULATION

- A. General: Polyisocyanurate board insulation complying with the following:
1. FMG Standard 4450/4470 Approval for use in steel deck construction for specified Fire/Windstorm Classification when installed beneath single-ply membrane selected for Work.
 2. Approved by manufacturer of membrane selected for Work and coverage under specified total-system warranty.
- B. Size:
1. Thickness: 1.5 inch. (Two layers on roof of Control Room.)
 2. Face Size: 4' x 8'.

2.5 ROOF INSULATION FASTENERS

- A. If Siplast membrane is employed, provide Olympic Fastener's "Heavy Duty Roofing Fastener" (#14) and "3-inch Galvalume Plate."
- B. If Firestone membrane is employed, provide Firestone's "Heavy-Duty Plus "Fasteners" and "Heavy Duty Insulation Plate."
- C. Note Regarding Specified FMG Windstorm Classification: 4' x 8' insulation boards are to be fastened with not less than six fasteners, even if specified FMG Classification permits less than six.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with the following requirements and other conditions affecting performance of roofing system:
1. Verify that roof openings and penetrations are in place and braced.
 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 3. Verify that steel roof deck is properly fastened.
 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or prior to onset of rain. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.
- C. Install one 1.5-inch-thick layer of insulation over metal deck. (Two 1.5-inch-thick layers over Control Room roof).
 - 1. Install flat-stock insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards.
- D. Fasten insulation board to metal deck, all according to requirements in FMG's criteria for specified Windstorm Classification. However, secure each 4' x 8' insulation board with not less than 6 fasteners.

3.4 MECHANICALLY FASTENED (BATTEN BAR) SINGLE PLY ROOFING MEMBRANE

- A. Install roofing membrane according to roofing system manufacturer's written instructions and to provide specified FMG Windstorm Classification. Unroll roofing membrane and allow to relax before installing.
- B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
- C. Accurately align roofing membranes and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Fasten membrane along seams with specified batten strips and screws. Space screws at maximum 6-inch centers.
- E. Fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
- F. Apply roofing membrane with side laps shingled with slope of roof deck where practicable.
- G. Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation. Ensure that batten seams are encapsulated within hot-air weld.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
 - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roofing membrane that do not meet requirements. Inspect installed roofing on daily basis; make repairs same day defects are

found; do not allow defects to remain unrepaired overnight or during inclement weather.

3.5 FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- C. Terminate and seal top of sheet flashings and mechanically anchor to substrate. Extend flashing sheets over tops of curbs and other similar places.

3.6 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Owner.
- B. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

3.7 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

End of Section

SECTION 07620 - ROOFING SHEET METALS

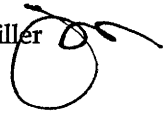
Prepared By: Joe Rives



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Checked By: J. Miller

Approved By: J. Miller



PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes roofing-related sheet metals, sealants, and fasteners.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- C. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.3 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

- C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.5 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. Membrane Manufacturer's Coated Metal:

- 1. Finish: ASTM A653, G90 coating designation, with factory applied (laminated) coating that allows single-ply membrane specified in Section 07540 to be heat-welded to coated metal.
- 2. Color: Selected by Owner from manufacturer's standard range of colors.

B. Prepainted Galvanized Steel: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755.

- 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, G90 coating designation; structural quality.
- 2. Exposed Finishes: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight.
 - b. Color: Selected by Owner from manufacturer's standard range of colors.

C. Galvanized Steel Sheet: ASTM A 653, G90 coating designation.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide accessory materials, fasteners, protective coatings, separators, sealants, and other miscellaneous items, as required for complete sheet metal flashing and trim installation.

B. Fasteners:

- 1. Nails: Common nails, ring-shank, lengths needed to penetrate solid wood substrate not less than 1-1/4 inches and full thickness of plywood. Provide 300 series stainless steel nails.

2. Rivets: Same material as sheet metal or other noncorrosive metal as recommended by sheet metal manufacturer.
 3. Stainless Steel Seal-Washer Screws: 300 series stainless steel hex-washer head screws, sharp point with bonded stainless steel seal washer (EPDM); minimum #10 by length needed to penetrate substrate not less than 1 inch.
 4. Sheet Metal Screws: 300 series stainless steel.
 5. Wood Screws: 300 series stainless steel for galvanized steel and stainless steel sheet metals. Provide length needed to penetrate solid wood substrate not less than 1 inch and full thickness of plywood.
- C. Gun-Grade Sealant: Silicone; "795" by Dow Corning.

2.3 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
- D. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 1. Thickness: As called for on Drawings or, if not on Drawings, as recommended by SMACNA's "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application, but not less than one thickness greater than thickness of metal being secured.

2.4 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Gutters, Downspouts, and Straps: 22 gauge prefinished galvanized steel. (24 gauge material will not be acceptable.)
- B. Perimeter Metal Edging: Fabricate perimeter metal edging from membrane manufacturer's coated metal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
 - 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
- B. Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation appropriate for dissimilar metals.
- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- F. Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection.
- G. Seal joints with elastomeric sealant as required for watertight construction. Prepare joints and apply sealants to comply with recommendations of sealant manufacturers.

3.3 ROOF FLASHING INSTALLATION

- A. Install sheet metal roof flashing and trim to comply with performance requirements, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

3.4 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

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- B. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- C. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07920 - JOINT SEALANTS

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Prepared By: C. Hopkins

Checked By: J. Miller

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PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in the following vertical surfaces and horizontal non-traffic surfaces:
 - a. Control and expansion joints in unit masonry.
 - b. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 - c. Control and expansion joints in ceilings and other overhead surfaces.
 - d. Other joints as indicated.

2. Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Vertical joints on exposed surfaces of interior concrete unit masonry walls and partitions.
 - d. Perimeter joints between interior wall surfaces and frames of interior doors and windows
 - e. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - f. Other joints as indicated.

3. Interior joints in the following horizontal traffic surfaces:
 - a. Control and expansion joints in tile flooring.
 - b. Other joints as indicated.

B. Related Sections include the following:

1. Division 4 Section 04810 "Unit Masonry Assemblies" for masonry control and expansion joint fillers and gaskets.
2. Division 8 Section 08800 "Glazing" for glazing sealants.
3. Division 9 Section 09260 "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.

1.2 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates, including paints and coatings.

- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates, including paints and coatings.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- E. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.
- F. Qualification Data: For Installer.
- G. Pre-construction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on pre-construction testing specified in "Quality Assurance" Article.
- H. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- I. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. 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 sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 1. Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Colors of Exposed Joint Sealants: As selected by Owner's representative from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. **Stain-Test-Response Characteristics:** Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. **Single-Component Neutral-Curing Silicone Sealant:**

1. **Products:**
 - a. GE Silicones; SilPruf LM SCS2700.
 - b. Polymeric Systems Inc.; PSI-641.
 - c. Sonneborn, Division of ChemRex Inc.; Omniseal.
 - d. Tremco; Spectrem 3.
 - e. Dow Corning Corporation; 791.
 - f. Dow Corning Corporation; 795
 - g. Pecora Corporation; 898.
2. **Type and Grade:** S (single component) and NS (nonsag).
3. **Class:** 50.
4. **Use Related to Exposure:** NT (nontraffic).
5. **Uses Related to Joint Substrates:** M, G and A.
6. **Test-Response Characteristics:** Nonstaining to porous substrates per ASTM C 1248.

D. **Single-Component Nonsag Polyurethane Sealant:**

1. **Products:**
 - a. Sika Corporation, Inc.; Sikaflex - 1a
 - b. Sonneborn, Division of ChemRex, Inc.; NP-1
 - c. Pecora Corporation; Dynatrol 1
2. **Type and Grade:** S (single component and NS (nonsag)
3. **Class:** 25
4. **Uses Related to Exposure:** NT (non traffic)
5. **Uses Related to Joint Substrate:** M, G and A.

2.4 JOINT-SEALANT BACKING

- A. **General:** Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. **Cylindrical Sealant Backings:** ASTM C 1330, Type C (closed-cell material with a surface skin), O (open-cell material), B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean 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 sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that 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.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
 - 4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants 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 sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 08111 - STANDARD STEEL DOORS AND FRAMES

Prepared By: C. Hopkins

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Checked By: J. Miller

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PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes standard hollow-metal steel doors and frames.

1.2 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, and finishes for each type of steel door and frame specified.
- B. Shop Drawings: Provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings.
- C. Product test reports.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Anweld Building Products, LLC.
 - 2. Ceco Door Products; an ASSA ABLOY Group Company.
 - 3. CURRIES Company; an ASSA ABLOY Group Company.
 - 4. Pioneer Industries, Inc.
 - 5. Republic Builders Products Company.
 - 6. Steelcraft; an Ingersoll-Rand Company.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 zinc-iron-alloy (galvannealed) coating designation.
- D. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized.
- E. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
- F. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.
- G. Grout: Comply with ASTM C 476, with a slump of 4 inches for standard steel door frames built into concrete or masonry, as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.
- I. Glazing: Comply with requirements in Division 8 Section "Glazing."
- J. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD STEEL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces. Comply with ANSI A250.8.
 - 1. Core Construction: Manufacturer's standard polystyrene core.
 - 2. Vertical Edges for Single-Acting Doors: Square edge.
 - 3. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick end closures or channels of same material as face sheets.
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide 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 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior door requirements. Provide 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 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).

2.4 STANDARD STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.

SECTION 08111 - STANDARD STEEL DOORS AND FRAMES

1. Fabricate frames with mitered or coped and welded face corners.
 2. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.
1. Fabricate frames with mitered or coped and welded face corners.
 2. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.
- D. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.
- E. Jamb Anchors: Masonry, stud-wall, compression, or postinstalled expansion type; not less than 0.042 inch thick.
- F. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick.

2.5 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch high, unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.6 FABRICATION

- A. General: Fabricate standard steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Standard Steel Doors:
 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 2. Glazed Lites: Factory cut openings in doors.
- C. Standard Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
 3. Plaster Guards: Weld guards to frame at back of hardware mortises in frames installed in concrete or masonry.
 4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

SECTION 08111 - STANDARD STEEL DOORS AND FRAMES

5. Jamb Anchors: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c.
 6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
- D. Hardware Preparation: Factory prepare standard steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
1. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.
- E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Provide fixed stops and moldings welded on secure side of door or frame.
 2. Provide loose stops and moldings on inside of doors and frames.

2.7 FINISHES

- A. Steel Finish: Factory priming for field-painted finish.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Remove welded-in shipping spreaders installed at factory.
- B. Provide doors and frames of sizes, thicknesses, and designs indicated. Install standard steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- C. Standard Steel Frames: Install standard steel frames for doors and other openings, of size and profile indicated. Comply with SDI 105.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster containing antifreezing agents.
 2. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 4 Section "Unit Masonry Assemblies."

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4. Concrete Walls: Solidly fill space between frames and concrete with grout. Install grout in lifts and take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
- D. Standard Steel Doors: Fit hollow-metal doors accurately in frames. Shim as necessary.
- E. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with standard steel door and frame manufacturer's written instructions.
- F. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.
- G. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

END OF SECTION

SECTION 08130 - STAINLESS STEEL DOORS AND FRAMES

Prepared By: C. Hopkins

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Checked By: J. Miller

Approved By: J. Miller

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes Stainless steel doors, frames and transoms.

1.2 SUBMITTALS

- A. Product Data: Provide manufacturer's standard details and catalog data demonstrating compliance with referenced standards.
- B. Shop Drawings: Submit for approval the followings:
 - 1. Shop drawings for the fabrication and installation of stainless steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location, installation requirements of finished hardware and reinforcements, and details of joints and connections, and vision lite requirements.
- C. Submit manufacturer's recommended cleaning and maintenance instructions.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store products indoors and protect from moisture, construction traffic, and damage.
- B. Store doors and frames on non-metal skids a minimum of 4 inches off the ground, with minimum 1/4-inch spacers between adjacent units, doors and/or frames. Cover to permit air circulation.
- C. All material to be fully crated such that it would survive any distance of transportation to the job site or storage location.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Provide both doors and frames from a single manufacturer who has specialized (dedicated facility, tooling, equipment, etc.) in the manufacture of commercial stainless steel entry doors and frames for not less than 3 years.

2.2 MATERIALS

- A. Stainless Steel: ASTM A 167, commercial quality type #316

2.3 FABRICATION

A. General:

1. Door shall be integrally manufactured using face sheets of prime stainless steel. No cladding or substrate will be allowed.
2. All internal components, reinforcements and anchors shall be fabricated from stainless steel.
3. Fabricate in compliance with referenced standards, except where exceeded by the requirements of this Specification.

B. Door Construction, General: Comply with SDI/ANSI-100-91, Grade 3, extra heavy duty.

1. Core: Construct doors with polyurethane insulation cores, permanently bonded to face skins. These doors will not be fire rated.
2. Thickness: 1-3/4 inches unless otherwise indicated.
3. Door Edge Construction:
 - a. Seamless; fully and continuously welded except at hardware cutouts; refinished and polished to match face surface. No exposed joints or seams.
 - b. Lock Seam; visible vertical edge seam on hinge and lock edges, except where hardware cut-out exist.
4. Door Gage: 16 gage (0.053" minimum).

C. Removable Panel Construction: Construct panels as specified for doors, above. Provide concealed means of attachment to frames.

D. Frame Construction, General: Comply with standards referenced for doors, above.

1. All corners, joints, and intersections to be fully and continuously welded Trim face welds to be ground smooth, and repolished to achieve specified finish. Miter or butt stops.
2. Frame Gage: 12 gage (0.093" minimum).
3. Jamb Anchors in Masonry Partitions: Masonry tee anchors, minimum 16 gage with 2 inch x 10-inch legs.
 - a. Over 90 up to 96 inches high: 4 jamb anchors.
 - b. Over 96 inches high: 4 jamb anchors plus 1 for each 24 inches or fraction thereof over 96 inches.
 - c. Note: Weld or burn marks on the exposed faces will not be acceptable.
4. Door and Frame Reinforcements for Builder's Hardware:
 - a. Hinge reinforcements: 1-1/4 inch x 10 inches long x 3/16-inch thick, stainless steel.
 - b. Strike reinforcements: 14 gage stainless steel.
 - c. Closer reinforcements: gage stainless steel.

SECTION 08130 - STAINLESS STEEL DOORS AND FRAMES

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- d. Surface hardware reinforcements: gage stainless steel.
 - e. Dust covers: At frame hinge preps, ¼ inch thick closed cell polyurethane foam with acrylic self-adhesive backing or minimum 22 gage stainless steel; minimum 22 gage stainless steel provided behind all other mortised hardware cutouts.
 - f. Note: Weld or burn marks on the exposed faces will not be acceptable.
- E. Fabricate all components for doors and frames from stainless steel. Other types of steel, or non-stainless steel will not be acceptable.
- F. Welding: Execute weldments such that no weld marks are visible on any exposed surface, Comply with AWS D9.1. Perform welding with gas tungsten arc (TIG) equipment, alloyed 308 stainless welding rods. Maintain proper welding temperature to avoid discoloring adjacent metal. Clamp components in appropriate jigs to avoid distortion and warpage. Discolored, distorted, or warped work will not be accepted.
- G. Carton or crate doors to prevent damage in shipping and handling. Apply PVC film or equivalent material to protect against damage after delivery and removal from shipping crates.

2.4 FINISHES

- A. Stainless Steel Finish: NAAMM #4 brushed (satin) finish.
- B. Weldments: Exposed spot welds or other weld marks on exposed surfaces are not acceptable. Grind exposed welds smooth, and repolish to match specified and surrounding finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that dimensions are correct and project conditions are suitable for installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install doors and frames in accordance with manufacturers instructions and referenced standards.
- B. Locate, secure, and brace frames prior to construction of adjacent walls and partitions.
 - 1. Remove shipping spreader before installation of frame.
 - 2. Provide temporary supports, and remove only after anchoring frames to permanent construction.
- C. Ensure that doors and frames are installed plumb and true, free of warp or twist, within tolerances specified in referenced standards.

SECTION 08130 - STAINLESS STEEL DOORS AND FRAMES

3.3 ADJUST AND CLEAN

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- A. Clean doors and frames in accordance with manufacturer' s instructions.
- B. Restore slight blemishes in finishes in accordance with manufacturer's instructions to match original finish. Remove and provide new doors and frames where repairs are not acceptable to the Architect.

END OF-SECTION

SECTION 08331 - OVERHEAD COILING DOORS

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Prepared By: C. Hopkins

Checked By: J. Miller

Approved By: J. Miller

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following types of manually and electric-motor-operated overhead coiling doors:
 - 1. Insulated service doors.
- B. See Division 5 Section 05500 "Metal Fabrications" for miscellaneous steel supports.
- C. See Division 16 Sections for electrical service and connections for powered operators and accessories.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components.
- B. Design Requirements: Design the overhead coiling doors, hardware, accessories and anchorage in accordance with the 2002 Edition of North Carolina State Building Code.
 - 1. Wind Criteria:
 - a. Wind Speed: 130 mph
 - b. Importance Factor: 1.0
 - c. Exposure: D
 - 2. Seismic Criteria:
 - a. Use Group 1
 - b. Spectral Response Coefficient
 - 1) Design Spectral Response: 0.2 Sec. Spectral Response Accel. $S_s=0.110$.
 - 2) Design Spectral Response: 1.0 Sec. Spectral Response Accel. $S_1=0.480$.
 - c. Design Category: C
- C. Operation-Cycle Requirements: Provide overhead coiling door components and operators capable of operating for not less than 20,000 cycles and for 10 cycles per day.

1.3 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachment to other work.
- C. Samples: For each exposed finish.
- D. Oversize Construction Certification: For door assemblies required to be fire-rated and those exceeding size limitations for labeled assemblies.

1.4 QUALITY ASSURANCE

- A. **Installer Qualifications:** Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. **Fire-Test-Response Characteristics:** Provide assemblies complying with NFPA 80 that are identical to door and frame assemblies tested for fire-test-response characteristics per UL 10b and NFPA 252, and that are listed and labeled for fire ratings indicated by UL, FMG, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, Article 100.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1. Atlas Door; Div. of Clopay Building Products Company, Inc.
 - 2. Cookson Company.
 - 3. Cornell Iron Works Inc.
 - 4. Raynor.
 - 5. Wayne-Dalton Corp.

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. **Door Curtains:** Interlocking slats in a continuous length for width of door of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door.
 - 1. **Steel Door Curtain Slats:** Zinc-coated (galvanized), cold-rolled structural steel (SS) sheet; complying with ASTM A 653/A 653M, G90 coating designation.
 - 2. **Slat type:** Flat profile, insulated, type F-2651.
 - 3. **Insulation:** Manufacturer's standard rigid cellular polystyrene or polyurethane-foam-type thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within metal slat faces.
- B. **Endlocks and Windlocks:** Malleable-iron casings, secured to curtain slats to comply with wind load.
- C. **Bottom Bar:** 2 angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick to suit type of curtain slats.
 - 1. **Astragal:** Replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene; as a cushion bumper for interior door.
- D. **Curtain Jamb Guides:** Steel angles or channels and angles, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Provide slotted bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

SECTION 08331 - OVERHEAD COILING DOORS

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- E. Hood: Form to act as weatherseal and entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods, and provide fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sagging.
 - 1. Steel Door Hoods: Minimum 24 gauge, hot-dip galvanized steel sheet that matches slat steel.
 - 2. Shape: Round.
- F. Integral Sills: Integral part of frame assembly; fabricate of same sheet metal.
- G. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets fitted to bottom and top of exterior doors, unless otherwise indicated. At door head, use 1/8-inch-thick, replaceable, continuous sheet secured to inside of hood.
 - 1. Motor-Operated Doors: Combination bottom weatherseal and sensor edge.
 - 2. Jamb Seals: Replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene at door jambs for a weathertight installation.
- H. Push/Pull Handles: Galvanized steel lifting handles on each side of door.
 - 1. Provide pull-down straps or pole hooks for doors more than 84 inches high.
- I. Slide Bolt: Engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- J. Locking Device Assembly: Lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.
 - 1. Locking Bars: Single-jamb side, operable from inside only.
- K. Chain Lock Keeper: Suitable for padlock.
- L. Power-Operated Doors: Safety interlock switch to disengage power supply when door is locked.
- M. Counterbalancing Mechanism: Adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to door curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
 - 1. Mounting Brackets: Cast iron or cold-rolled steel plate.
- N. Manual Door Operator: Chain hoist.
- O. Electric Door Operator: Manufacturer's standard type, size, and capacity for door and operation-cycle requirements specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories. Comply with NFPA 70.
 - 1. Disconnect Device: Hand-operated for automatically engaging chain and sprocket operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount to be accessible from floor level. Include

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interlock device to automatically prevent motor from operating when emergency operator is engaged.

2. Door-Operator Type: Hood-mounted unit with electric motor, gear-head-reduction drive, and chain and sprocket secondary drive.
- P. Electric Motors: High-starting torque, reversible, continuous-duty, , Class A insulated, electric motors complying with NEMA MG 1; with overload protection; sized to start, accelerate, and operate door in either direction from any position, at not less than 2/3 fps and not more than 1 fps, without exceeding nameplate ratings or service factor. Coordinate wiring requirements and electrical characteristics of motors with building electrical system.
1. Open drip-proof-type motor, and controller with NEMA ICS 6, Type 1 enclosure.
 2. Totally enclosed, non-ventilated or fan-cooled motor, fitted with plugged drain, and controller with NEMA ICS 6, Type 4 enclosure where indicated.
- Q. Control Equipment: NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V, ac or dc, with remote, three-button control station.
1. Exterior units, full-guarded, surface-mounted, standard-duty, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
 2. Obstruction Detection Device: External automatic safety sensor capable of protecting full width of door opening. Activation of sensor immediately stops and reverses downward door travel.
 3. Provide electric operators with ADA-compliant audible alarm and visual indicator lights.

2.3 FINISHES

- A. Factory Primer for Field Finish: Manufacturer's standard primer.
1. Painting is specified in Division 9 Section 09900 "Painting".

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install, connect and place in successful operation doors, operators, control devices, conduit, fittings, wiring, voltage matching transformers, connecting hardware and accessories in accordance with UL requirements, manufacturer's instruction details and reviewed shop drawings. Electrical service, 480 volts, 3 phase, will be provided within five feet of door opening including a Class RK5 fused disconnect switch without Class RK5 fuses. Provide all necessary power transformation, fuses, conduit, wiring and control connections required on the load side of the disconnect switch. Electrical workmanship shall be in accordance with the National Electrical Code and Division 16 specifications. After installation and connection, test, adjust and lubricate operators, hardware and controls to ensure that doors function properly. Install coiling doors and operating equipment complete with necessary hardware, jamb and head molding strips, anchors, inserts, hangers, and equipment supports
- B. Lubricate bearings and sliding parts; adjust doors to operate easily, free of warp, twist, or distortion, and with weathertight fit around entire perimeter.

END OF SECTION

SECTION 08411 - ALUMINUM-FRAMED STOREFRONTS

Prepared By: J. Miller

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Checked By: C. Hopkins

Approved By: J. Miller

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Exterior and interior aluminum-framed storefronts.
 - a. Glazing is retained mechanically with gaskets on four sides.

1.2 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Thermal movements.
2. Dimensional tolerances of building frame and other adjacent construction.
3. 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. Failure of operating units to function properly.

B. Structural Loads:

1. Wind Criteria:
 - a. Wind Speed: 130 mph
 - b. Importance Factor: 1.0
 - c. Exposure: D
2. Seismic Criteria:
 - a. Use Group 1
 - b. Spectral Response Coefficient
 - 1) Design Spectral Response: 0.2 Sec. Spectral Response Accel. $S_s=0.110$.
 - 2) Design Spectral Response: 1.0 Sec. Spectral Response Accel. $S_1=0.480$.
 - c. Design Category: C

C. Temperature Change (Range): Systems accommodate 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of systems 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 difference of 1.57 lbf/sq. ft. (75 Pa).

- E. Water Penetration Under Static Pressure: Systems do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- F. Condensation Resistance: Fixed glazing and framing areas of systems have condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each exposed finish.
- D. Product test reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Acceptable to manufacturer and capable of preparation of data for aluminum-framed 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 Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed 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, metal finishes, and other materials beyond normal weathering.
 - d. Adhesive or cohesive sealant failures.
 - e. Water leakage through fixed glazing and framing areas.
 - f. Failure of operating components to function properly.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

SECTION 08411 - ALUMINUM-FRAMED STOREFRONTS

PART 2 - PRODUCTS

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2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for aluminum-framed systems is based on Kawneer Trifab 451. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
1. Commercial Architectural Products, Inc.
 2. EFCO Corporation.
 3. YKK AP America Inc.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
- 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 1008/A 1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
- D. 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.
- E. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.
- F. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

- A. Glazing: 1" insulating glass in exterior units, 1/4" float glass in interior units, as specified in section 08800.

SECTION 08411 - ALUMINUM-FRAMED STOREFRONTS

- B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.5 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."
- B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.6 FABRICATION

- A. Form aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. 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 maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing from exterior.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).

2.7 ALUMINUM FINISHES

- A. High-Performance Organic Finish: Three-coat thermocured system with fluoropolymer topcoats containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:

SECTION 08411 - ALUMINUM-FRAMED STOREFRONTS

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.
 4. 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. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, without warp or rack.
- a. Install glazing in accordance with section 08800.
- F. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.
- G. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:
1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
 3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.

END OF SECTION

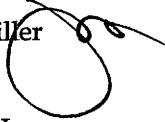
SECTION 08710 - DOOR HARDWARE

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Prepared By: J. Miller

Checked By: C. Hopkins

Approved By: J. Miller



PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Commercial door hardware.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Action Submittals:

1. Door Hardware Sets: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as procedures and diagrams.

- a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
- b. Content: Include the following information:

- 1) Identification number, location, hand, fire rating, and material of each door and frame.
- 2) Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.
- 3) Complete designations of every item required for each door or opening including name and manufacturer.
- 4) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

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- B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
 - C. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system.
 - D. Preinstallation Conference: Conduct conference at Project site.
- 1.4 DELIVERY, STORAGE, AND HANDLING
- A. Deliver keys and permanent cores to Owner by registered mail or overnight package service.
- 1.5 COORDINATION
- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- 1.6 WARRANTY
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion, except as follows:
 - a. Exit Devices: Two years from date of Substantial Completion.
 - b. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this Section.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated and/or required for the specific location/condition, and products complying with BHMA standard referenced. Provide stainless steel hardware on all exterior doors when available.
- B. Designations: Requirements for each type of door hardware are indicated in Part 3 "Door Hardware Sets" Article. Products are identified by using door hardware designations, as follows:

SECTION 08710 - DOOR HARDWARE

1. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

2.2 HINGES, GENERAL

- A. Template Requirements: Provide only template-produced units.
- B. Hinge Base Metal: Unless otherwise indicated, provide the following:
 1. Exterior Hinges: Stainless steel w/stainless steel pin.
 2. Interior Hinges: Brass, with stainless steel pin.
 3. Finish: US 32/US26.
- C. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed.
- D. Fasteners: Comply with the following:
 1. Machine Screws: Install into drilled and tapped holes.
 2. Screws: Phillips flat-head. Finish screw heads to match surface of hinges.

2.3 HINGES

- A. Butts and Hinges: BHMA A156.1.
- B. Template Hinge Dimensions: BHMA A156.7.
- C. Manufacturer:
 1. Hager Companies (HAG).
 2. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 3. Stanley Commercial Hardware; Div. of The Stanley Works (STH).

2.4 LATCHES, GENERAL

- A. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).
- B. Latches for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf (67 N) to release the latch.
- C. Trim:
 1. Levers: As selected from manufacturers available designs
 2. Dummy Trim: Match lever lock trim and escutcheons.
- D. Throw: Comply with testing requirements for length of bolts required for labeled fire doors.
- E. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

SECTION 08710 - DOOR HARDWARE

- F. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.

2.5 MECHANICAL LATCHES

- A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:
1. Mortise Latches: BHMA A156.13.
- B. Mortise Latches: Stamped steel case with steel or brass parts; BHMA A156.13, Grade 1.
1. Manufacturers:
 - a. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
 - b. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
 - c. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
 - d. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).

2.6 CLOSERS

- A. Accessibility Requirements: Comply with the following maximum opening-force requirements:
1. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 2. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
 3. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.
- C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- D. Surface Closers: BHMA A156.4, Grade 1. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.
1. Manufacturers:
 - a. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
 - b. LCN Closers; an Ingersoll-Rand Company (LCN).
 - c. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
 - d. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).

2.7 STOPS AND HOLDERS

- A. Stops and Bumpers: BHMA A156.16, Grade 1.

SECTION 08710 - DOOR HARDWARE

1. Provide floor stops for doors unless wall or other type stops are required or indicated. Do not mount floor stops where they will impede traffic.
- B. Silencers for Door Frames: BHMA A156.16, Grade 1; neoprene or rubber; fabricated for drilled-in application to frame.

2.8 DOOR GASKETING

- A. Standard: BHMA A156.22.
- B. General: Provide continuous weather-strip gasketing on exterior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications.
 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
 3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- C. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- D. Gasketing Materials: ASTM D 2000 and AAMA 701/702.
- E. Manufacturers:
 1. National Guard Products (NGP).
 2. Pemko Manufacturing Co. (PEM).
 3. Reese Enterprises (RE).
 4. Zero International (ZRO).

2.9 THRESHOLDS

- A. Standard: BHMA A156.21.
- B. Accessibility Requirements: Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch (13 mm) high.
- C. Manufacturers:
 1. National Guard Products (NGP).
 2. Pemko Manufacturing Co. (PEM).
 3. Reese Enterprises (RE).
 4. Zero International (ZRO).

2.10 FABRICATION

- A. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- B. Fasteners: Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Comply with NFPA 80 for fasteners of door hardware in fire-rated applications.
- C. Finishes: BHMA A156.18, as indicated in door hardware sets.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Steel Doors and Frames: Comply with DHI A115 Series. Drill and tap doors and frames for surface-applied door hardware according to ANSI A250.6.
- B. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. 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 referenced accessibility requirements.
 - 1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

3.2 DOOR HARDWARE SETS

HW SET 1 Doors B, TR1 and 101

- 1 1/2 Pair Butts (4-1/2 x 4-1/2)
- 1 Exit Device w/ cylinder
- 1 Closer
- 1 Set Weatherstripping
- 1 Threshold
- 1 Raindrip

HW SET 2 Door D

- 1 1/2 Pair Butts (4-1/2 x 4-1/2)
- 1 Latchset (F36)
- 1 Closer
- 3 Silencers
- 1 Door Stop (wall)

HW SET 3 Doors E and OF1

- 1 1/2 Pair Butts (4-1/2 x 4-1/2)
- 1 Lockset (F02)
- 1 Closer
- 3 Silencers
- 1 Door Stop (wall)

HW SET 4 Door F

- 1 1/2 Pair Butts (4-1/2 x 4-1/2)
- 1 Lockset (F04)
- 3 Silencers
- 1 Door Stop (wall or floor)

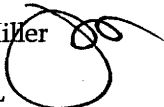
HW SET 5 Door I

- 1 1/2 Pair Butts (4-1/2 x 4-1/2)
- 1 Lockset (F07)
- 3 Silencers

END OF SECTION

Prepared By: C. Hopkins

Checked By: J. Miller

Approved By: J. Miller 

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
1. Doors.
 2. Interior borrowed lites.
 3. Storefront framing.

1.2 DEFINITIONS

- A. **Manufacturers of Glass Products:** Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. **Glass Thicknesses:** Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. **Interspace:** Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- D. **Deterioration of Coated Glass:** Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- E. **Deterioration of Insulating Glass:** Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.3 PERFORMANCE REQUIREMENTS

- A. **General:** Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) 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.
- B. **Glass Design:** Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

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1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Specified Design Wind Loads: Not less than wind loads applicable to Project as required by ASCE 7 "Minimum Design Loads for Buildings and Other Structures": Section 6.0 "Wind Loads."
 - b. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 - 1) Basic Wind Speed: 130 mph (3 second gust)
 - 2) Importance Factor: I .
 - 3) Exposure Category: D
 - c. 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.
 - 1) Load Duration: 60 seconds or less 3 seconds.
 - d. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.
 - 1) For monolithic-glass lites heat treated to resist wind loads.
 - 2) For insulating glass.
 - e. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
 - f. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.
- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
 1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 3. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
 - a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.
 - b. Solar Heat Gain Coefficient: NFRC 200.
 - c. Solar Optical Properties: NFRC 300.

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1.4 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: For the following products, in the form of 12-inch- square Samples for glass.
 - 1. Each color of tinted float glass.
 - 2. Insulating glass for each designation indicated.
- C. 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.
- D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
 - 1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.
- E. Qualification Data: For installers.
- F. Product Test Reports: For each of the following types of glazing products:
 - 1. Tinted float glass.
 - 2. Coated float glass.
 - 3. Insulating glass.
 - 4. Glazing sealants.
 - 5. Glazing gaskets.
- G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, coated float glass, and insulating glass.
- C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- D. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
 - 1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- E. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.

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1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
 2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
- F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
- G. 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 testing and inspecting agency:
1. Insulating Glass Certification Council.
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.8 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass

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units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS

- A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.
 1. Ultra-Clear (Low-Iron) Float Glass: Class I (clear); with a minimum 91 percent visible light transmission and a minimum solar heat gain coefficient of 0.87.
 - a. Available Products:
 - 1) AFG Industries Inc.; Krystal Klear.
 - 2) Pilkington Building Products North America; Optiwhite.
 - 3) PPG Industries, Inc.; Starphire.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
 1. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 2. For uncoated glass, comply with requirements for Condition A.
 3. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
 4. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.
 5. Fallout Resistance: Provide spandrel units identical to those passing the fallout-resistance test for spandrel glass specified in ASTM C 1048.
- C. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
 1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
 3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
 4. Sealing System: Dual seal, with primary and secondary sealants as follows:
 - a. Manufacturer's standard sealants.
 5. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.2 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
1. EPDM, ASTM C 864.
 2. Silicone, ASTM C 1115.
 3. Thermoplastic polyolefin rubber, ASTM C 1115.
 4. Any material indicated above.
- B. Soft 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. EPDM.
 2. Silicone.
 3. Thermoplastic polyolefin rubber.
 4. Any material indicated above.
- C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.3 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
1. Single-Component Neutral- and Basic-Curing Silicone Glazing Sealants:
 - a. Available Products:
 - 1) Dow Corning Corporation; 790.
 - 2) GE Silicones; SilPruf LM SCS2700.
 - 3) Tremco; Spectrem 1 (Basic).
 - 4) GE Silicones; SilPruf SCS2000.
 - b. Type and Grade: S (single component) and NS (nonsag).

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- c. Class: 100/50.
- d. Use Related to Exposure: NT (nontraffic).
- e. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.
 - 1) Use O Glazing Substrates: Coated glass.

2.4 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and 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.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and 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.

2.5 MISCELLANEOUS GLAZING MATERIALS

- A. General: 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.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.6 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units 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 publications, to comply with system performance requirements.

SECTION 08800 - GLAZING

2.7 MONOLITHIC FLOAT-GLASS UNITS

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Uncoated Clear Float-Glass Units (GL-2): Class 1 (clear) Kind FT (fully tempered) float glass, 1/4 inch thick.

2.8 INSULATING-GLASS UNITS

A. Tinted Solar Low-E Insulating-Glass Units (GL-3).

1. Basis-of-Design Product: Solarscreen 2000 Low-E Insulating Glass, VE3-2M, as manufactured by Viracon, or a comparable product by one of the following:
 - a. PPG Industries, Inc
 - b. Interpane Glass Company
 - c. Guardian Industries Corp.
 - d. AFGD Glass
2. Overall Unit Thickness and Thickness of Each Lite: 1/4 inch and 1 inch.
3. Interspace Content: Air.
4. Outdoor Lite: Class 2 (tinted) float glass.
 - a. Tint Color: Gray.
 - b. Kind FT (fully tempered).
5. Indoor Lite: Class 1 (clear) float glass.
 - a. Kind FT (fully tempered)..
6. Visible Light Transmittance: 35 percent minimum.
7. Winter Nighttime U-Factor: .29 maximum.
8. Summer Daytime U-Factor: .26 maximum.
9. Solar Heat Gain Coefficient: .24 maximum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep system.
 3. Minimum required face or edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

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3.3 GLAZING, GENERAL

- 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. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Install gaskets so they protrude past face of glazing stops.

3.6 LOCK-STRIP GASKET GLAZING

- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.7 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. 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 in writing by glass manufacturer.

SECTION 08800 - GLAZING

END OF SECTION

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SECTION 09260 - GYPSUM BOARD ASSEMBLIES

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PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Interior gypsum wallboard.
2. Non-load-bearing steel framing.

1.2 DEFINITIONS

A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.3 SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
- C. Samples: Submit samples of each product specified.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.
- C. Handle boards to prevent damage to edges and face surfaces. Do not bend or otherwise damage metal corner beads or trim.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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1. Steel Framing and Furring:
 - a. Clark Steel Framing Systems.
 - b. Consolidated Systems, Inc.
 - c. Dietrich Industries, Inc.
 - d. National Gypsum Company.
 - e. Scafco Corporation.
 - f. Unimast, Inc.

2. Gypsum Board and Related Products:
 - a. American Gypsum Co.
 - b. G-P Gypsum Corp.
 - c. National Gypsum Company.
 - d. United States Gypsum Co.

2.2 STEEL PARTITION FRAMING

- A. Components, General: As follows:
 1. Comply with ASTM C 754 for conditions indicated.
 2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.

- B. Steel Studs and Runners: ASTM C 645.
 1. Minimum Base Metal Thickness: 0.0179 inch unless otherwise noted
 2. Adjacent to door frames and floor runners: 0.0312 inch.
 3. Depth: As indicated.

- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 1. Minimum Base Metal Thickness: 0.0179 inch.

- D. Cold-Rolled Channel Bridging: 0.0538-inch bare steel thickness, with minimum 1/2-inch-wide flange.
 1. Depth: 1-1/2 inches.
 2. Clip Angle: 1-1/2 by 1-1/2 inch, 0.068-inch- thick, galvanized steel.

- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 1. Minimum Base Metal Thickness: 0.0179 inch.
 2. Depth: As Indicated.

- F. Cold-Rolled Furring Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch wide flange.
 1. Depth: As indicated.
 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch.

SECTION 09260 - GYPSUM BOARD ASSEMBLIES

3. 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.
- G. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.3 INTERIOR GYPSUM WALLBOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Gypsum Wallboard: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
 1. Type X: (GWB-1)
 - a. Thickness: 5/8 inch.
 - b. Long Edges: Tapered.
 - c. Location: As indicated.
 2. Fire-Rated, Moisture- and Mold-Resistant Type: (GWB-2)
 - a. Thickness: 5/8 inch.
 - b. Long Edges: Tapered.
 - c. Location: Where required for fire-resistance-rated assembly.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 2. Shapes:
 - a. Cornerbead: Use at outside corner.
 - b. Bullnose Bead: Use where indicated.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound; use [at exposed panel edges] <Insert requirements>.
 - d. L-Bead: L-shaped; exposed long leg receives joint compound and where indicated.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound; use at exposed panel edges.
 - f. Expansion (Control) Joint: Use where indicated.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
 1. Interior Gypsum Wallboard: Paper reinforcing tape with compatible joint compounds.
 2. Setting-Type Joint Compounds: Factory-prepackaged, job-mixed chemical-hardening powder products formulated for use as indicated.

SECTION 09260 - GYPSUM BOARD ASSEMBLIES

- C. Dry-Type Joint Compounds: Factory-prepackaged, vinyl based products complying with the following requirements for formulation and intended use:
1. Ready-Mix Formulation: Factory-premixed product.
 2. Taping compound formulated for embedding tape and for first coat over fasteners and flanges of corner bead and edge trim.
 3. Topping compound formulated for fill (second) and finish (third) coats.
 4. All-purpose compound formulated for use with both taping and topping compound.

2.6 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
 - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
 2. Acoustical Sealant for Concealed Joints:
 - a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
 - b. Pecora Corp.; BA-98.
 - c. Tremco, Inc.; Tremco Acoustical Sealant.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
 - 1. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
 - a. Use deep-leg deflection track where indicated.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.3 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- F. Attach gypsum panels to framing provided at openings and cutouts.
- G. Form control and expansion joints with space between edges of adjoining gypsum panels.
- H. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Fit gypsum panels around ducts, pipes, and conduits
 - 2. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch wide joints to install sealant.
- I. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- J. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

3.4 PANEL APPLICATION METHODS

- A. Single-Layer Application:

1. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
- B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.5 INSTALLING TRIM ACCESSORIES

- A. General: 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.
- B. Control Joints: Install control joints at locations indicated on Drawings.

3.6 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: 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.
- B. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- C. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
 1. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.

END OF SECTION

SECTION 09511 - ACOUSTICAL PANEL CEILINGS

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Prepared By: C. Hopkins

Checked By: J. Miller

Approved By: J. Miller 

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Drawn to scale and coordinating acoustical panel ceiling installation with hanger attachment to building structure and ceiling mounted items:
- C. Samples: For each exposed finish.
- D. Product test reports.
- E. Research/evaluation reports.
- F. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory.
- B. Source Limitations:
1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
 2. Suspension System: Obtain each type through one source from a single manufacturer.
- C. Seismic Standard: Comply with the following:
1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."
 3. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."
 4. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."
 5. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

SECTION 09511 - ACOUSTICAL PANEL CEILINGS

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANEL CEILINGS, GENERAL

- A. Acoustical Panel Standard: Comply with ASTM E 1264.
- B. Metal Suspension System Standard: Comply with ASTM C 635.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- E. Seismic perimeter stabilizer bars, seismic struts, and seismic clips.
- F. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING (ACT-1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Cortega Tile and Lay-In, No. 770 as manufactured by Armstrong World Industries, Inc.; or a comparable product by one of the following:
 - 1. Chicago Metallic Corporation
 - 2. Ecophon CertainTeed, Inc.
 - 3. USG Interiors, Inc.
- B. Classification: Provide panels complying with ASTM E 1264 for type and form as follows:
 - 1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
 - 2. Pattern: CD (perforated, small holes and fissured).
- C. Color: White.
- D. LR: Not less than 0.80
- E. NRC: Not less than 0.55
- F. CAC: Not less than 33.
- G. Edge/Joint Detail: Square.
- H. Thickness: 5/8 inch.
- I. Modular Size: 24 by 24 inches.
- J. Surface Finish: Factory-applied vinyl latex paint.

SECTION 09511 - ACOUSTICAL PANEL CEILINGS

2.3 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING (ACT-2)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Ceramaguard, No. 607 as manufactured by Armstrong World Industries, Inc.; or a comparable product by one of the following:
1. Chicago Metallic Corporation
 2. Ecophon CertainTeed, Inc.
 3. USG Interiors, Inc.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
1. Type and Form: Type XX, other types; described as high-density, ceramic- and mineral-based panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes..
 2. Pattern: CE (
- C. Color: White.
- D. LR: Not less than 0.80.
- E. NRC: Not less than 0.50.
- F. CAC: Not less than 33.
- G. Edge/Joint Detail: Square.
- H. Thickness: 5/8 inch.
- I. Modular Size: 24 by 24 inches.
- J. Surface Finish: Factory-applied vinyl plastic paint.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING (ACT-1 and ACT-2)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Prelude XL 15/16 inch Exposed Tee Suspension system as manufactured by Armstrong World Industries, Inc.; or a comparable product by one of the following:
1. Chicago Metallic Corporation
 2. Ecophon CertainTeed, Inc.
 3. USG Interiors, Inc.
- B. Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished 15/16-inch- wide metal caps on flanges.
1. Structural Classification: Intermediate -duty system.
 2. End Condition of Cross Runners: Override (stepped) type.
 3. Cap Material: Steel cold-rolled sheet.
 4. Cap Finish: Painted white.

SECTION 09511 - ACOUSTICAL PANEL CEILINGS

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders.
- C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
 - 2. Do not attach hangers to steel deck tabs or to steel deck.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

END OF SECTION

SECTION 09651 - RESILIENT FLOOR TILE

Prepared By: C. Hopkins

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Checked By: J. Miller

Approved By: J. Miller

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Vinyl composition tile.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: Full-size units of each color and pattern of resilient floor tile required.
- D. Maintenance Data: For resilient products to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store tiles on flat surfaces.

1.5 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install resilient products after other finishing operations, including painting, have been completed.

SECTION 09651 - RESILIENT FLOOR TILE

PART 2 - PRODUCTS

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2.1 VINYL COMPOSITION TILE

- A. Vinyl Composition Tile (VCT): ASTM F 1066.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries, Inc.; Stonetex Excelon
 - b. Congoleum Corporation; Alternatives
 - c. Tarkett Inc.; Cortina Stone
- B. Color and Pattern: As selected from manufacturer's full range.
- C. Class: 2 (through-pattern tile).
- D. Wearing Surface: Smooth.
- E. Thickness: 0.125 inch.
- F. Size: 12 by 12 inches.
- G. Fire-Test-Response Characteristics:
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.

SECTION 09651 - RESILIENT FLOOR TILE

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
3. Moisture Testing:
 - a. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 1. Do not install resilient products until they are same temperature as space where they are to be installed.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 TILE INSTALLATION

- A. 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 tile at perimeter.
 1. Lay tiles square with room axis.
- B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).
- C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- D. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- F. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION

SECTION 09653 - RESILIENT WALL BASE AND ACCESSORIES

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Prepared By: C. Hopkins

Checked By: J. Miller

Approved By: J. Miller

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Wall base.
2. Molding accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.4 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

SECTION 09653 - RESILIENT WALL BASE AND ACCESSORIES

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 COLORS AND PATTERNS

- A. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.3 RESILIENT WALL BASE, (RB-1).

- A. Wall Base: ASTM F 1861.
 - 1. Armstrong World Industries, Inc.
 - 2. Azrock Commercial Flooring, DOMCO.
 - 3. Burke Mercer Flooring Products.
 - 4. Marley Flexco (USA), Inc.
 - 5. Roppe Corporation.
- B. Type (Material Requirement): TV (vinyl).
- C. Group (Manufacturing Method): II (layered).
- D. Style: Cove (with top-set toe).
- E. Minimum Thickness: 0.125 inch.
- F. Height: 4 inches.
- G. Lengths: Long coils in manufacturer's standard length.
- H. Outside Corners: Premolded.
- I. Inside Corners: Job formed or premolded.
- J. Surface: Smooth.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturers for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

SECTION 09653 - RESILIENT WALL BASE AND ACCESSORIES

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1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- C. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- D. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 1. Do not install resilient products until they are the same temperature as the space where they are to be installed.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 RESILIENT WALL BASE INSTALLATION

- A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.
- E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
- F. Premolded Corners: Install premolded corners before installing straight pieces.
- G. Job-Formed Corners:
 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
 2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

SECTION 09653 - RESILIENT WALL BASE AND ACCESSORIES

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3.4 RESILIENT ACCESSORY INSTALLATION

- A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION

SECTION 09911 - EXTERIOR PAINTING

Prepared By: C. Hopkins

Checked By: J. Miller

Approved By: J. Miller

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
1. Concrete.
 2. Steel.
 3. Galvanized metal.
 4. Aluminum (not anodized or otherwise coated).
- B. Related Sections include the following:
1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
 2. Division 8 Sections for factory priming windows and doors with primers specified in this Section.
 3. Division 9 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.
1. Submit Samples on rigid backing, 8 inches square.
 2. Step coats on Samples to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

SECTION 09911 - EXTERIOR PAINTING

1.3 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

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:

B. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Tnemec Company, Inc.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

SECTION 09911 - EXTERIOR PAINTING

- B. Colors: As selected by owner's representative from manufacturer's full range

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
 2. Masonry (CMU): 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

SECTION 09911 - EXTERIOR PAINTING

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will perform tests for compliance of paint materials with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Concrete Masonry Unit Substrates:

1. High-Build System: Applied to form dry film thickness of not less than 16 mils
 - a. Prime Coat: Series 52 Tneme-Crete applied at 8.0 - 10.0 dry mils
 - b. Finish Coat: Series 52 Tneme-Crete applied at 8.0 - 10.0 dry mils

B. Steel Substrates (Metal Doors, Frames, Bollards, handrails and all Misc. Metal):

1. Epoxy Polyurethane System:
 - a. Prime Coat: Series 135 Chembuild applied at 3.0 - 4.0 dry mils.
 - b. Topcoat: Series 73 Endura-Shield applied at 3.0 - 4.0 dry mils.

C. Galvanized-Metal Substrates: (Roll-up Doors & Frames where required to paint)

1. Epoxy-Polyurethane System:
 - a. Prime Coat: Series 66 Hi-Build Epoxoline applied at 3.0 - 4.0 dry mils
 - b. Topcoat: Series 73 Endura-Shield applied at 3.0 - 4.0 dry mils

END OF SECTION

SECTION 09912 - INTERIOR PAINTING

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Prepared By: C. Hopkins

Checked By: J. Miller

Approved By: J. Miller 

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
1. Concrete.
 2. Concrete masonry units (CMU).
 3. Steel.
 4. Galvanized metal.
 5. Aluminum (not anodized or otherwise coated).
 6. Gypsum board.
- B. Related Sections include the following:
1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
 2. Division 8 Sections for factory priming windows and doors with primers specified in this Section.
 3. Division 9 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
 4. Division 9 painting Sections for special-use coatings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
1. Submit Samples on rigid backing, 8 inches square.
 2. Step coats on Samples to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

SECTION 09912 - INTERIOR PAINTING

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1.3 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.5 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 50 deg F above the dew point; or to damp or wet surfaces.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
1. Quantity: Furnish 1 gallon of each material and color applied.

SECTION 09912 - INTERIOR PAINTING

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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:
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Tnemec Company, Inc.

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: As selected by owner's representative from manufacturer's full range

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (CMU): 12 percent.
 - 3. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

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1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:

SECTION 09912 - INTERIOR PAINTING

1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Pipe hangers and supports.
 - c. Tanks that do not have factory-applied final finishes.
 - d. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - e. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
2. Electrical Work:
 - a. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
 1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. CMU Substrates:
 1. Acrylic Epoxy System (P-1):

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- a. Prime Coat: Series 54-562 Modified Filler applied at 80 - 100 sq.ft./gallon (fill all voids)
 - b. Intermediate Coat: Series 113 H.B. Tneme-Tufcoat applied at 3.0 - 4.0 dry mils
 - c. Finish Coat: Series 113 H.B. Tneme-Tufcoat applied at 3.0 - 4.0 dry mils
- B. Building Steel Frame, Joist, and all Misc. Metal Substrates:
1. Hydrophobic Acrylic Polymer System (P-2):
 - a. Prime Coat: Standard Pre-engineered Metal Building Primer
 - b. One coat: Series 30 Spra-Saf EN applied at 2.5 - 4.0 dry mils
- C. Metal Doors and Frames, all Misc. Metal:
1. Alkyd System (P-3)
 - a. Prime Coat: Series 10-1009 applied at 2.0 - 3.0 dry mils
 - b. Intermediate Coat: Series 23 Enduratone applied at 2.0 - 3.0 dry mils
 - c. Topcoat: Series 23 Enduratone applied at 2.0 - 3.0 dry mils
- D. Galvanized-Metal Substrates (Roll-up Doors & Frames where required to paint) (P-4):
1. Epoxy/Polyurethane Paint System:
 - a. Prime Coat: Series 66 Hi-Build Epoxoline applied at 3.0 - 4.0 dry mils
 - b. Topcoat: Series 73 Endura-Shield applied at 3.0 - 4.0 dry mils
- E. Gypsum Board Substrates:
1. Latex System (P-5):
 - a. Prime Coat: Series 6 Tneme-Cryl applied at 2.0 - 3.0 dry mils
 - b. Topcoat: Series 6 Tneme-Cryl applied at 2.0 - 3.0 dry mils
 2. Acrylic Epoxy System (P-6):
 - a. Prime Coat: Series 51-792 PVA Sealer applied at 1.0 - 2.0 dry mils
 - b. Intermediate Coat: Series 113 H.B. Tneme-Tufcoat applied at 3.0 - 4.0 dry mils
 - c. Topcoat: Series 113 H.B. Tneme-Tufcoat applied at 3.0 - 4.0 dry mils

END OF SECTION

SECTION 15052 - CLEANING AND TESTING PIPE

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Prepared By: G. Thomas

Checked By: B. Gray

Approved By: G. Thomas *GT*

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This Section specifies general procedures for cleaning and testing piping and fluid handling equipment furnished and installed under this contract and as specified in Division 15.
- B. Furnish all labor, tools, chemicals and equipment required for this work.
- C. Notify Owner's Representative before commencement of cleaning and testing.
- D. Use cleaning method, test medium, test procedure, and test pressure as defined for each service in the attached Cleaning and Testing Index. See Part 3 of this Section for complete descriptions of cleaning methods and test procedures.

1.2 SUBMITTALS

- A. Prior to commencement of test, submit proposed testing procedures, including test medium and pressure, line segments and equipment included in test, methods of isolating test section from rest of system, and pressure monitoring techniques.
- B. Submit detailed report of pressure tests on piping and equipment. Show date of test, lines tested, test medium, length of time test pressure was held, pressure drop or rise, and extent of venting or repressurizing.
- C. Submit cleaning procedures and disinfecting agent for potable water systems.
- D. Consideration will be given for alternative test procedure or cleaning procedure submitted in lieu of procedures specified in this Section. Any deviations from requirements in this Section must be approved in writing by Owner's Representative before any such deviation is instituted.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Use only cleaning materials compatible with materials of fabrication of systems in which they are used. No adverse impact on materials or mechanisms in systems are acceptable. Use only cleaning materials approved by equipment manufacturers.
- B. Use materials in blinds, gaskets, bolts for isolating segments of systems, that are compatible with systems being cleaned or tested.
- C. Use one of the following disinfecting agents for the potable water system :
 - 1. Sodium hypochlorite solution (commercial bleach).
 - 2. Calcium hypochlorite granules or tablets.

3. Chlorine gas.
- D. Calculate required chlorine concentration and utilize procedures to ensure adequate chlorine for disinfection reaches all points of potable water system installed under this portion of Work.

PART 3 - EXECUTION

3.1 CLEANING

A. General:

1. Clean only portions of piping systems indicated as "new" on Drawings. Where new piping connects to existing systems isolate new portions of systems from existing portions until cleaning for new connected portion is completed.
2. Attached Cleaning and Testing Index specifies application of cleaning methods.
3. Provide and install necessary temporary connections, strainers and other equipment to thoroughly clean piping systems before start up. Remove all control valves, safety valves, controllers, rupture discs, orifice plates, and other in-line meters and instruments from piping before cleaning. Dispose of cleaning agents and remove temporary connections and strainers after cleaning is complete.
4. Clean piping materials or systems just prior to installation and/or plant start up whenever possible, but in any event clean piping before testing. Protect cleaned piping material against contamination by sealing open ends with clean plastic sheet or metal foil or rubber or plastic plugs.
5. Where flushing is specified flush at a minimum velocity of 5 feet/second.
6. Perform cleaning procedures to satisfaction of Owner's Representative.

B. Cleaning Methods:

1. Cleaning Method "A1":

a. Prior to Erection:

- 1) Hammer and brush to loosen sand, dirt, scale, or other contaminants when necessary.
- 2) Blow with air, or hose with clean water, and visually inspect for contaminants.
- 3) On pipes stored before erection, dry and seal ends to prevent contamination during storage.

b. After erection thoroughly flush system with clean water to remove all foreign material. Drain thoroughly.

2. Cleaning Method "A2":

a. Prior to Erection:

- 1) Hammer and brush to loosen sand, dirt, scale, or other contaminants when necessary.
- 2) Blow with air, or hose with clean water, and visually inspect for contaminants.
- 3) On pipes stored before erection, dry and seal ends to prevent contamination during storage.

SECTION 15052 - CLEANING AND TESTING PIPE

- b. After erection thoroughly blow out system with compressed air to remove all foreign material.
3. Cleaning Method "C":
- a. Prior to Erection:
 - 1) Surface clean as required.
 - 2) Blow with air or hose with potable water and visually inspect for contaminants.
 - 3) Dry and seal ends of pipes stored before erection to prevent contamination during storage.
 - b. Provide nipples and valves for:
 - 1) Introduction of disinfectant and water.
 - 2) Venting of air.
 - 3) Drainage of disinfectant solutions.
 - c. After Erection:
 - 1) Flush system thoroughly with clean water for sufficient time to ensure thorough cleaning and removal of trash and debris from interior of piping.
 - 2) Flush system prior to making connections to existing system.
 - d. Disinfect as follows:
 - 1) Fill system uniformly with disinfection solution of 50 ppm available chlorine. Retain disinfectant for not less than 24 hours. As an alternate, a solution of 300 ppm held for three hours is also acceptable.
 - 2) After holding period, test for residual chlorine.
 - 3) If none is found, drain system and repeat disinfection procedure.
 - 4) When a positive residual chlorine test is accomplished, flush system with potable water and put into operation. Use methods of disinfection in accordance with latest published procedure of AWWA C651.
 - 5) For very minor jobs, such as replacement of a single fitting or repair of a valve, item being installed can be precleaned and then disinfected by immersing it in a solution of 300 ppm of chlorine for one hour.
- C. Resealing Systems:
1. After each section of piping and equipment has been flushed clean, remove all strainers in system.
 2. Reconnect all vessels, equipment, and piping and reinstall control valves, safety valves, controllers, rupture discs, orifice plates, and other instruments and fittings with new gaskets, or thread lubricant .
 3. If a subsequent or an additional pressure test is required, it may be necessary to leave some such items out of system until after completion of pressure test. For systems which must be hydrostatically tested and dried, hydrostatic test should be conducted prior to drying step.

3.2 TESTING

A. General:

1. Test only portions of piping systems indicate as "new" on Drawings. Where new piping connects to existing systems isolate new portions of systems from existing portions until testing and repair of leaks for new connected portion is completed.
2. Isolate equipment such as vessels, heat exchangers, pumps, compressors during testing of the piping system.
3. Inclusion of equipment in testing of piping systems requires approval of Owner's Representative.
4. Attached Cleaning and Testing Index specifies application of test procedure and test pressure for each system. Maintain final test pressure for each test for a sufficient length of time to facilitate a complete inspection of all joints and connections, but no less than that specified by the applicable testing procedure. When it is necessary, for practicality, to include a vessel or other equipment, do not exceed allowable cold limit of equipment.
5. Repair detected leaks. Retest piping systems if revisions or repairs are made in piping or pressure equipment. Retest piping systems also if design pressure is increased more than 10% above original design pressure, in which case Owner's Representative defines pressure for retest.
6. Since the risk of failure, with the attendant possibility of injury, is appreciably greater during testing, take all safety measures required by codes or ordinances applicable to the situation.
7. Do not insulate, cover, paint or conceal equipment or piping to be pressure tested prior to test.
8. Do not use these tests to establish pressure ratings.
9. Protect all piping and equipment against over-pressure, collapse from vacuum, and hydraulic shock during all filling, testing, and draining procedures.
10. Do not subject seats of iron valves to a pressure in excess of maximum cold working pressure of valve. Do not exceed manufacturer's cold pressure limit in pressure tests against other closed valves. Note that where significant differences in elevation exist, there is a risk of over-pressure in the lower portions of the system in order to attain test pressure in the upper portion of the system.
11. Apply test pressure only after system and test medium are at approximately same temperature, preferably not less than 60°F. Note that some applicable codes require testing above a specified minimum temperature. Do not allow water temperature to exceed 125°F.
12. Conduct tests, including the inspection of all joints, to satisfaction of Owner's Representative.
13. Following completion and approval of the test, restore all components of system to normal operating condition. This includes removing temporary provisions installed for test. Torque all flange bolts at equipment and control valves, after removing blinds, in presence of Owner's Representative.

B. Preparatory Work:

1. Remove from system all pumps, turbines, traps, shock arrestors, expansion joints, instruments, control valves, safety valves, rupture discs, filters, and orifice plates which might be damaged by test, or are designated by Owner's Representative for removal.
2. Remove all items which might trap air in a system to be hydrostatically tested.
3. Clean system prior to testing unless otherwise specified in Cleaning and Testing Index.
4. Systems may be separated into sub-systems for testing if such action will expedite or simplify testing.

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C. Test Procedures:

1. Test Procedure T1 (Hydrostatic Test):

- a. Use only clean water as test media.
- b. Do no hydrostatic testing when ambient temperature is 40°F or lower unless special cold weather provisions approved by Owner's Representative.
- c. Provide vents and drains as required.
- d. Thoroughly clean all lines before testing. See Article 3.1 of this Section for cleaning procedures.
- e. Either remove or blank off items which are not to be subjected to hydrostatic test.
- f. Test separately short sections of piping removed to permit installation of blinds or blanks.
- g. Provide test pump hook-up for hydrostatic test that permits applying pressure gradually under close control.
- h. Provide a valve for isolating piping from pressure source during test period.
- i. Fill system with water through a low connection point, care being taken that air is completely vented so that there are no air pockets remaining.
- j. Apply pressure gradually and hold at specified value for time required to visually check each weld, connection, joint, and flange but not less than a minimum of one hour. Take test readings at lowest point of line or system of lines with static head added to minimum hydrostatic test pressure. Ensure that at no point a dangerous over-pressure is experienced.
- k. Hydrostatic test is considered satisfactory if no visible leakage, cracks or other signs of distress are discovered on piping or at any joints. There is no requirement for minimum pressure drop during test period. However, justify the cause of any pressure loss other than that due to temperature change or similar reasons to satisfaction of Owner's Representative.
- l. Repair minor leaks in screwed or flanged joints without retesting with approval of Owner's Representative.
- m. Repair each welded joint found leaking per original welding procedure and completely retest.
- n. After completion of hydrostatic testing, completely drain system at all low points in such a way as to accomplish thorough flushing of system. Remove test blinds, temporary supports, test equipment and reinstall any valves, orifice plates, short sections of piping, miscellaneous in-line equipment or instruments that were removed prior to testing, and leave line ready for service. Use new gaskets when reinstalling flanged items.
- o. Ensure complete removal of all water from line or system after testing. If there is any danger of contamination or freezing, blow out fluid with air.

2. Test Procedure T2 (Dry Nitrogen Test):

- a. Purge all combustible liquids and gases from systems prior to pneumatic testing. This is an absolute necessity.
- b. Use only clean, dry, oil-free water-pumped nitrogen.
- c. Pressurize line with nitrogen. Conduct preliminary check at not more than 25 psig. Increase pressure gradually in steps which allow sufficient time for piping to equalize strains. When pressure given in Cleaning and Testing Index is reached, isolate line.
- d. Soap test all joints to locate leaks.
- e. Repair detected leaks.
- f. Repeat test procedure until no pressure drop is detected.

3.3 INSPECTION

- A. Owner's Representative reserves the right to conduct any inspections.
 - 1. Provide Owner's Representative with free access to work.
 - 2. When requested, furnish Owner's Representative with full information as to progress of the work and its various parts at place of fabrication or on job site.
 - 3. Such inspection does not relieve contractor from full responsibility for quality and correctness of work.

- B. If this Section, Owner's Representative's instructions, ordinances, law, or any other public authority require any special tests or approval, provide timely notice of readiness for inspection. If inspection is by an authority other than Owner's Representative, provide notification to Owner's Representative as to place and date fixed for such inspections.

- C. Perform inspections in accordance with ASME B31.3 unless another code is specifically applicable to system being tested.

3.4 ATTACHMENT

- A. Attached Cleaning and Testing Index (1 page) is part of this Section.

End of Section

SECTION 15052 - CLEANING AND TESTING PIPE

| CLEANING AND TESTING INDEX | | | | | | | | | |
|----------------------------|-----------------------|----------|----------------|-------------|---------------|----------------|-----------------|---------|--|
| Project Service Abbrev. | | Material | Section Number | Test | Test Pressure | Test Procedure | Cleaning Method | Remarks | |
| PA | PLANT AIR | CS | 15065 | Nitrogen | 225 psig | T2 | A2 | | |
| PA | PLANT AIR | HDPE | 15065 | Nitrogen | 150 psig | T2 | A2 | | |
| PW | POTABLE WATER | COPPER | 15065 | Hydrostatic | 200 psig | T1 | C | | |
| VCW | VESSEL CLEANING WATER | DI | 15065 | Hydrostatic | 175 psig | T1 | A1 | | |
| PW | POTABLE WATER | DI | 15065 | Hydrostatic | 175 psig | T1 | C | | |

Prepared By: G. Thomas

Checked By: B. Gray

Approved By: G. Thomas *MT*

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide and install all materials constituting piping systems indicated on Drawings, including miscellaneous materials not specified as part of piping systems.

1.2 QUALITY ASSURANCE

- A. Provide new, full weight, full length, and scale-free pipe and fittings of best available quality.
- B. Guarantee all materials to be as specified prior to delivery.
- C. Arrange for inspection of all piping and pipe fittings prior to installation and replace defective materials.

1.3 SUBMITTALS

- A. Submit:
 - 1. Manufacturer's written certification of compliance with requirements of regulatory agencies.
 - 2. Manufacturer's written certification of piping material design pressure rating.
 - 3. Pipe and fitting dimensional data.
 - 4. Complete listing with manufacturer's name, of all pipe, fittings, and accessories to be used.
 - 5. Sources of materials.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Receive and handle pipe and fittings so as not to damage joining surfaces, coating, lining, and as required to prevent cracking or breakage.
- B. Repair or replace all coatings, linings, or wrappings damaged during delivery, transportation, and storage.
- C. Utilize appropriate tools, equipment, and procedures to handle and transport pipe and fittings.
- D. Conform to Section 15050.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material and Dimensional Requirements:

1. Pipe Threads: ANSI B2.1.
2. Steel Pipe: ANSI B36.10.

B. Ferrous Nipples:

1. Inches and Longer: Schedule 40, material to match pipe.
2. Shorter Than 4 Inches: Schedule 80, material to match pipe.

C. Joint Compound, Ferrous Pipe: 1/2 inch x 3 mils Teflon tape, or John Crane plastic lead seal, unless specified otherwise for system.

D. Sleeves:

1. Walls:

- a. Interior: Standard weight galvanized steel.
- b. Exterior: Extra strong galvanized steel.
- c. Concrete: Same as slab on grade or, if in exterior concrete walls, cast iron with integral water stop.
- d. Interior Partitions: 22 gauge (U. S. Standard) minimum galvanized sheet steel.

2. Slab on Grade, Elevated Concrete Slab: Standard weight galvanized steel.

3. Underground (Beneath Foundations, Footings, Grade Beams): Standard weight corrugated steel, bituminous coating inside and outside, with close-fitting bituminous coated plate at each end.

E. Modular Wall and Casting Seals: Link-Seal as manufactured by Thunderline Corporation.

F. Sleeve Packing:

1. Waterproof Wall Below Grade: Oakum and lead.
2. Soundproof Wall: Glass wool or glass mat.
3. Exterior Walls, Concrete Exterior Walls, Slab on Grade: Oakum and lead or mastic.
4. Interior Non-Soundproof and Concrete Walls, Elevated Floor Slabs: Fibrous asbestos mineral wool, Fire-Stop "Elastaseal," or expandable silicone (GE 851 or approved equal) as required to contain fire and moisture.

G. Escutcheon Plates:

1. Finished Spaces and Toilet Rooms: Chrome plated, split type.
2. Projecting Floor Sleeves: Box type.
3. Unfinished Areas: Nickel-plated steel.

H. Steel Welding Fittings:

1. Flanges: Weld-neck type unless otherwise allowed or specified.
2. Elbows: Long radius except where short radius is indicated or required due to limited space. Bends may be used in place of welding elbows only if bends comply with ANSI B31.3.

I. Steel Piping Branch Connections:

1. Threaded or Screwed Pipe: Straight size or reducing tee.
2. Buttwelded Piping:
 - a. Straight size welding tee or reducing welding tee for changes not greater than one or two standard pipe sizes.
 - b. Standard weight "Weldolet" or "Elbolet" for changes more than two pipe sizes.
3. Threaded Branch: "Threadolet" or threaded coupling, pressure rating in accordance with piping specification.
4. At Contractor's option, branch lines in welded water pipe may be welded in (stubbed in) without reinforcement, regardless of size combination.

J. Flanges: Drilled, faced, and dimensioned to ANSI standards for material and various pressure classes, suitable for connection as indicated or specified.

K. Provide schedule 40 or standard weight carbon steel pipe, ASTM A53 grade B, with 150 psig malleable iron threaded fittings if 2 inches and smaller and wrought steel schedule 40 buttwelding fittings if 2-1/2 inches and larger, for piping not designated or specified in this Division or on Drawings.

L. Solder Flux: AWS approved.

M. Where ferrous metals are joined to non-ferrous metals, provide following type of insulating type fittings:

1. Threaded: Insulating unions.
2. Flanged:
 - a. Dielectric flange unions.
 - b. Insulating gaskets, bolt sleeves, and washers.
3. Design: Suitable for operating pressure, temperature, and other characteristics of piping system and specifically designed for isolation of dissimilar metals.
4. Acceptable Manufacturer: Watts, Epco, or approved equal.

N. Overflows, Drains, and Vents: Same material as adjoining pipe or equipment unless otherwise specified.

O. Unions:

1. Steel Pipe: Iron or steel, threaded or socket weld to threaded; galvanized where connected pipe is galvanized.

2. Copper Pipe: Bronze or brass, solder ends.
 3. Plastic Pipe: Material and end connections compatible with connected piping.
- P. Drip Legs and Dirt Traps: Full line size.
- Q. Provide all properly sized inserts required for proper execution of this portion of Work.
- R. Provide all adaptor fittings required to complete piping installation and connections under this portion of Work.
- S. Provide proper quantities and type of cement, adhesives, tools, and heat sources for attachment and installation of non-metallic pipe and accessories.
- T. Joint Restraint for Ductile Iron Pressure Pipe:
1. Thrust Blocks (unless otherwise specified):
 - a. Composition: Concrete having minimum compressive strength of 3000 psi at 28 days, minimum cement factor (bags per cubic yard) of 5.5, and maximum W:C ratio (gallons per bag) of 6.75. Conform to chapter 8 of NFPA 24.
 - b. Size thrust blocks for soil bearing pressure of 2000 psf and pipeline water pressure of 225 psig; conform to chapter 8 and Appendix "A" of NFPA 24.
 2. Tie Rods: Standard weight steel, coated with bitumastic; include coated nuts and nonmetallic washers.

2.2 PIPE AND FITTING MATERIALS

A. Plant Air Below Ground:

1. Pipe and Fittings:
 - a. 4" and Smaller: High density polyethylene rated at 230 psi and 88°F, socket fusion joints, injection molded fittings. ASAHI/America Air-Pro or approved equal.
 - b. 6" and Larger: Carbon steel, ASTM A53, standard weight with butt weld end carbon steel fittings. Coat with two (2) coats bitumastic.
2. Valves:
 - a. Ball Valves: 150 psi flanged, carbon steel body stainless steel ball and stem, reinforced TFE seats. Worcester controls Series 82 or approved equal. Provide cast iron roadway valve box and cover.
3. Gaskets: 1/8 inch composition or cloth reinforced rubber.

B. Potable Water, Condensate Drain and Plant Air Aboveground:

1. Pipe: 2" and Smaller: Type K solder joint copper, ASTM B88, seamless annealed.
2. Fittings: 3" and Smaller: Wrought copper.
3. Valves: 2" and Smaller: 150 lb. brass body, trim and ball, ASTM B62 solder ends. Nibco, Watts or Contromatics.

C. Vessel Cleaning Water and Potable Water (underground):

1. Pipe: Ductile AWWA C151, class 350, push-on or slip joint, cement-mortar lining, bituminous coated.
2. Fittings: Buried - push-on, slip, or m.j. type, AWWA C110, material to match pipe.
3. Gate Valves: 3" and Larger: 175 psi cast iron, ASTM A126 Class B, bronze trim, non-rising stem, AWWA stuffing box. Mueller A-2050-20 or approved equal.
4. Gaskets: Furnish with fittings.

D. Refrigerant:

1. Pipe: 1/2" OD and smaller-seam-less annealed copper tube, type DHP, ASTM B68, dehydrated and sealed, 5/8" OD and larger Seamless type K copper, hard drawn, ASTM B88
2. Fittings:
 - a. 1/2" OD and smaller: Brass flare type, ANSI B16.26.
 - b. 5/8" OD and larger: Wrought copper-brazed-joint, ANSI B16.22.

Note: Where pipe conforming to ASTM A53 is specified but is unavailable in sizes 2 inches and smaller, pipe conforming to ASTM A106 may be used.

PART 3 - INSTALLATION

3.1 INSPECTION

- A. Examine all components of piping systems for cracks and other defects before and after installation.
- B. Remove and replace promptly all materials disclosed to be cracked, damaged, or defective so that schedule of this portion of Work is not impaired.

3.2 EXECUTION

A. General Requirements for Pipe:

1. Install aboveground and underground piping and tubing systems as indicated on Drawings.
2. Clean all pipe and fittings before installation and keep clean until accepted as part of completed Work.
3. Install piping in neat manner with risers plumb and lines straight and parallel to walls and column lines.
4. Avoid running pipe through ductwork, directly under electric lights or where other lines and services are routed.
5. Use full lengths of pipe except where cut lengths are necessary.
6. Cut pipe square with ends carefully reamed and cleaned before installation.
7. Install underground piping such that any pipe is above line drawn at 45 degrees down from bottom corner, nearest pipe, of structural footings.
8. Keep exposed ends of underground pipe plugged during laying in trench.
9. Route underground utility piping perpendicular to curbs and building lines unless indicated otherwise on Drawings.

10. Where underground pipes cross, lay lower pipe first and backfill to level of higher pipe with crushed stone or gravel before higher pipe is laid.
11. Perform trenching, excavation, dewatering, and backfill operations in accordance with requirements of Division 2.
12. Place no piping in trench where water is present or imminent and where trench bottom is comprised of or covered by any material not soil.
13. Maintain minimum 6 inches clearance between outside edges of pipes installed underground.
14. Unless otherwise specified, maintain minimum clearance of 2 inches between exterior edges of aboveground parallel pipes, edges of flanges, or coverings, if any.
15. Support pipe and arrange reducers to allow piping systems to be drained at low points and vented at high points.
16. Keep exposed ends of pipe plugged during installation.
17. Install insulating or dielectric type fittings at joints between dissimilar metals and where underground steel pipe enters building.
18. Prevent direct contact of ferrous nuts, bolts, and surfaces with non-ferrous metals.
19. Bond all non-welded joints in buried steel pipe for electrical continuity.
20. Properly trap all refrigerant suction lines to ensure oil return under all operating conditions.

B. Fittings:

1. Use standard manufactured fittings for changes in direction.
2. Do not bend, spring or deform piping to prepare joints.
3. Do not use bushings except where specifically approved by Owner's Representative.
4. Use eccentric reducers to facilitate air removal and drainage from lines and as required to maintain level bottom of pipe elevation on trapeze hangers and pipe bridges.

C. Flanged Connections:

1. Align flange faces with holes straddling vertical center line of piping.
2. Where steel flanges are bolted to flat face cast-iron flanges, machine off raised face.
3. Lubricate bolts over entire thread with heavy graphite and oil mixture prior to tightening.
4. Tighten bolts with appropriate wrenches to produce uniform pressure on bolts to avoid overstressing of bolts, dishing of flanges, and compressing gasket beyond working limits.
5. Tighten commercial grade bolts to approximately 15,000 psi stress, based on root area of thread.
6. Tighten alloy steel bolts to a stress of 45,000 psi, based on root area of thread.
7. Use nonmetallic gaskets for flanged connections except where noted otherwise.

D. Screwed Connection:

1. Use full cleanly cut threads of true taper, accurate to gauge and per appropriate standard, for screwed threaded connections.
2. Use reducing fittings for reducing in line size.
3. Do not use bushings and close nipples.
4. Use square head steel plugs.
5. Use sealing tape as joint compound with threaded connections.
6. Clean threads thoroughly of cuttings, oil, and other foreign matter before applying sealant and attempting to join pipe.
7. Conform to ANSI B2.1.

E. Mechanical Grooved Joints:

1. Carefully groove ends of piping to be joined as required for attachment of couplings and gaskets; cut grooves only in pipe of wall thickness corresponding to or greater than schedule 40.
2. Lubricate joining surfaces and install gaskets to provide complete seal and tightness of joint.
3. Install couplings and necessary accessories in accordance with recommendations of coupling manufacturer and, where used for fire protection service, NFPA 13.

F. Sleeves:

1. Provide and install sleeves for pipe passing through walls, floor slabs, foundations, and grade beams.
2. Where indicated by Drawings, utilize boxed out openings in foundation walls or grade beams for underground piping passing into an unexcavated building area.
3. Install sleeves for underground piping passing through concrete floor slab on grade if the protection and insulation for the underground pipe are continued through the floor.
4. Size sleeves to allow minimum 1 inch clearance around outer circumference of uninsulated pipe or pipe insulation, if any.
5. Cut sleeves flush with inside wall and ceiling surfaces.
6. Extend sleeves 1 inch above finished floors.
7. Set floor sleeves in place before concrete is poured or securely fasten and grout sleeves with cement.
8. Set wall sleeves as wall is constructed.
9. Do not use jackhammer or pavement breaker unless specifically approved by Owner's Representative.
10. If required, wrap pipe and tubing length of sleeve plus 6 inches on both sides of sleeve.
11. Provide copper and brass pipe and tubing passing through floor with sleeve or wrap from point 12 inches beneath the slab to 6 inches above the slab.
12. Project sleeves through outside walls 1/2 inch on each side of finished walls.
13. Core drill sleeve holes in concrete or masonry walls if sleeves are omitted from Drawings.
14. Where indicated on Drawings, provide and install sleeves under foundations and elsewhere to accommodate routing of piping.
15. Before backfill, install steel plate, cut to closely fit pipe, at each end of sleeves used for underground piping.

G. Sleeve Packing:

1. Insert packing entire length of sleeve.
2. Where pipe passes through elevated floor or fire wall, pack space between bare pipe or insulation and inside surface of sleeve with fire-resistant packing material. Pack completely so that packing is flush with surfaces penetrated by sleeve.
3. Seal ends of sleeves penetrating fire walls with cap, plug, or plate.
4. Where pipe passes through slab on grade or waterproof wall below grade, pack space between pipe and sleeve with oakum and seal with lead and watertight mastic, or, install modular wall and casting seal unit.
5. Where pipe passes through soundproof wall, pack space between bare pipe insulation and sleeve (or wall if less than 1 inch thick) with glass wool.

6. Where piping 170°F or higher (at any time) penetrates combustible wall, insulate pipe with minimum 1-1/2 inches noncombustible insulation for length of penetration.
7. Conform to applicable details on Drawings.

H. Escutcheons:

1. Install escutcheons or appropriate plates on both sides of pipe penetrations through walls, floors, ceilings, and partitions for pipe exposed to view in finished areas.
2. Install chrome-plated escutcheons for pipe passing through walls or floors in toilets and finished areas.
3. Install nickel-plated steel plate for pipe passing through walls or floors in unfinished areas.
4. Install box-type sleeves only as required or as indicated.

I. Ductile Iron Pressure Piping:

1. Adequately constrain all changes in direction or capped ends of underground piping to resist developed thrusts.
2. Extend thrust blocks to undisturbed soil and construct so as to not interfere with access to joint.
3. Do not bury plugs and caps in thrust blocks; leave accessible for future extensions.
4. Design constraints to carry imposed load when piping is at maximum operating pressure and temperature plus proper allowance for water hammer.
5. Make pipe cuts that do not damage pipe or lining.
6. Level and remove sharp edges on cut ends of push-on joint pipe.
7. Install pipe and fittings for fire protection system in accordance with Owner's insurance underwriter and requirements of NFPA 13 and 14 (interior and aboveground system) and NFPA 24 (exterior system).
8. Lay pipe in trench with barrel weight uniformly distributed.

J. Joining of Ductile Iron Pipe:

1. Install mechanical joints, compression joints, push-on joints, and anchored push-on joints in accordance with manufacturer's recommendations.
2. Mechanical Joints:
 - a. Clean joining surfaces and apply soapy water before placing gasket in bell.
 - b. Tighten bolts for mechanical joints with torque limiting wrench using following ranges:

| <u>Bolt Size, in.</u> | <u>Torque Range, ft-lb.</u> |
|-----------------------|-----------------------------|
| 5/8 | 40-60 |
| 3/4 | 60-90 |
| 1 | 70-120 |
| 1-1/2 | 90-120 |

- c. All mechanical joints shall be cross-torqued.
- d. Conform to Appendix A of AWWA C111.

K. Welding Steel Pipe:

1. Use metallic-arc welding process made by qualified welders meeting minimum requirements of Section 6 of ANSI B31.1.
2. Prohibit welding when atmospheric temperature is less than 0°F and when surfaces are wet.
3. Clean welded surfaces free of loose scale, slag, rust, paint, oil, and other foreign material.
4. Insure that joint surfaces are smooth, uniform, and free from fins, tears and other defects that affect proper welding.
5. Cut bevels accurately by machining or by mechanically guided cutting torch.
6. Align pipe carefully before welding and maintain in alignment during welding.
7. Use tack welds of the same quality as final welds to maintain alignment.
8. Remove defective tack welds before final weld is made.
9. Surfaces of finished welds:
 - a. Brightly metallic after cleaning.
 - b. Fairly smooth and uniform contour with regular ripples.
 - c. Free from overlaps, undercuts, and excessive convexity.
10. Ensure that welds are sound throughout, fused thoroughly, and free of gas pockets, oxide, slag inclusions, and surface porosity.
11. Clean inside of pipe free from globules of weld metal, spacers, and other material which would restrict pipe area or become loose to enter fluid stream.
12. Remove and replace defective and unsound welds.
13. Replace with new pipe and fittings material that cannot be rewelded satisfactorily as determined by Owner or his authorized representative.
14. Field fabricated branches may be used if system operating pressure is 100 psig and less provided branch is at least one pipe size smaller than main line.

L. Joining Copper Pipe and Tubing:

1. Cut tubes and ream to prevent burrs, out of round, or improperly sized tube ends.
2. Use antler type or multiple flame torch on pipe and fittings 4 inches and larger.
3. Open all valves in system completely while joints are being made.
4. Do not peen to correct defects.
5. Redo any joints containing cracks, pinholes, or incomplete penetrations.
6. Remove all external and internal loose solder and flux after joint cools.
7. Soldering and Brazing Requirements: Section [15054] [15057].
8. Connect and tighten securely all flared and compression type fittings; conform to recommendations of fitting manufacturer.

M. General Requirements, Installation of Non-Metallic Piping:

1. Install in accordance with recommendations of pipe manufacturer, using materials supplied or recommended by pipe manufacturer.
2. Do not subject pipe to any weight or force other than weight of pipe and contents.
3. Install restraints as recommended by pipe manufacturer to allow for differential expansion induced by difference in temperature at time of installation and final operating temperature.
4. Take precautions necessary to prevent damage to outside surfaces of pipe and fittings during installation.

5. Cut, smooth, and clean ends of piping before applying any solvent cement, joint sealant, and heating appurtenance.
 6. Install adaptors as required for connection to nonplastic pipe and threaded connections.
 7. Do not cut threads on plastic pipe.
 8. Support piping such that pipe is not abraded or distorted and so as to allow free movement.
 9. Install pipe so that identifying marks are clearly visible.
 10. Install fusion welded joints in accordance with instructions of pipe manufacturer.
- N. Support: All aboveground piping shall be supported in conformance with North Carolina Mechanical Code.

3.3 FIELD QUALITY CONTROL

- A. Test piping systems in accordance with Section 15053 before permitting operation of systems or any equipment serving or connected to piping systems.
- B. Clean and flush all systems in accordance with Section 15052 before permitting operation.
- C. During installation, test pipe coating with suitable electronic tester and correct deficiencies.

End of Section

SECTION 15281 - PIPING INSULATION

Prepared By: G. Thomas

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Checked By: B. Gray

Approved By: G. Thomas 

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

- A. Provide insulation and application materials with an independent or composite flame spread rating of 25 or less and a smoke development rating no higher than 50 when tested in accordance with ASTM E84, NFPA 225 or UL 723 unless specifically indicated otherwise. (Exception allowed for polyvinyl chloride fitting covers).
- B. Certification Of Test: Permanently stamp shipping containers or materials with ASTM E84, NFPA 225 or UL 723 flame spread and smoke developed rating.
- C. Ventilation: Comply with the requirements of American Conference of Governmental Industrial Hygienists (ACGIH).
- D. All materials in direct contact with stainless steel shall be chloride-free.
- E. Asbestos shall not be used.
- F. Manufacturers and item numbers given in Part 2 of this Section are provided to define basis of selection and are not intended to prevent use of equal or superior products.

1.2 SUBMITTALS

- A. Submit product data including but not limited to:
 - 1. Manufacturer's name and product identification.
 - 2. Manufacturer's descriptive literature, including general description.
 - 3. Insulation thickness in inches.
 - 4. Thermal Conductivity in Btu per inch per square foot per degree Fahrenheit per hour at specific mean temperature.
 - 5. Perm rating in grains per hour per square foot.
 - 6. Minimum and maximum temperature limits in degrees Fahrenheit, if applicable.
 - 7. Description of:
 - a. Adhesives
 - b. Mechanical fasteners
 - c. Application, finishing and flashing materials and methods.
 - 8. Insulation and Application Materials: Independent or composite Fire Hazard Classification.
- B. If requested by Owner's Field Engineer, submit samples of insulation and finishing materials.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to project site in manufacturer's containers with labels and seal intact.
- B. Store materials in original containers at not less than 40 degrees Fahrenheit for at least 48 hours immediately before installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Type I Insulation:

1. Insulation Material:
 - a. Flexible elastomeric foam, Armstrong Armaflex II or approved equal.
 - b. Thermal Conductivity: 0.27 BTU per inch per square foot per °F per hour at 75°F mean temperature.
 - c. Water Absorption: 3 percent by weight.
 - d. Lower Temperature: -40°F.
 - e. Upper Temperature: 220°F.
2. Adhesive: Contact adhesive.
3. Tape: As recommended by insulation manufacturer.
4. Finish: Plasticized lacquer.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine piping to receive insulation and work area where insulation is to be applied for:
 1. Piping fabrication and installation defects that would affect execution of work.
 2. Proper temperature and humidity conditions.
 3. Proper ventilation in accordance with ACGIH.
- B. Do not commence work until:
 1. Unsatisfactory conditions have been corrected.
 2. Approval of Owner's Representative is obtained.

3.2 PREPARATION

- A. Clean pipe surfaces to be insulated of all foreign materials.

3.3 APPLICATION

A. Type I Insulation:

1. Apply to the following aboveground piping inside buildings:

| <u>SERVICE</u> | <u>SIZE</u> | <u>THICKNESS</u> |
|--|-------------|------------------|
| Coil condensate from air conditioning units and refrigeration equipment | All | 1 inch |
| Refrigerant suction | All | ¾ inch |
| Potable water above ground | All | ½ inch |

2. Adhere insulation to clean, oil-free metal surfaces by compression fit method and full coverage of adhesive.
3. Where possible, slip insulation onto pipe prior to connection of pipe and fittings.
4. Slice insulation and snap onto pipe where installation before joining pipe is not possible.

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5. Insulate fittings with mitered sections of pipe insulation or sections of insulation sheet; overlap to adjacent straight insulation.
6. Seal longitudinal and butt joints with adhesive in accordance with the manufacturer's recommendations.
7. Lap joints with tape minimum 2 inches wide and 1/8 inch thick.
8. Apply two coats of finish directly to the insulation surface.
9. Protect all pipe insulation from physical damage at points of support where insulation must carry load imposed by support. Coordinate with types of hangers and supports used.
10. Conform to manufacturer's installation instructions for installation of insulation, cements, and finishes.


End of Section

SECTION 15290 - DUCTWORK INSULATION

Prepared By: Barry Gray

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Checked By: Jeff Miller

Approved By: Jeff Miller 

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Flexible fiber glass duct wrap insulation.
- B. Rigid fiber glass duct board insulation.

1.2 SUBMITTALS

A. Product Data:

- 1. Thickness of insulation (inches).
- 2. Density of insulation (lbs./cu.ft.).
- 3. Maximum temperature limit (°F).
- 4. Fire and smoke hazard rating (flame spread/smoke developed).
- 5. Thermal conductivity (Btu-inch/hr/sq.ft./°F).
- 6. Permeability of insulation and finishes (perm).
- 7. Moisture absorption data.
- 8. External facing or covering.
- 9. Description of:
 - a. Adhesives.
 - b. Mechanical fasteners.
 - c. Application, finishing and flashing materials, and methods.

1.3 DEFINITIONS

- A. Concealed Areas: Areas above finished ceilings or duct chases where ductwork and equipment are not visible from floor.
- B. Exposed Areas: Areas exposed to view within building.
- C. Mineral Fiber: Includes fibers manufactured of glass, rock, or slag processed from molten state, with or without binder.

1.4 FIRE RESISTANCE

- A. Provide insulation, adhesive, sealer, vapor barrier coatings, vapor barrier, and duct lining materials that are noncombustible and meet minimum requirements of state and local building codes and ASHRAE 90.1.
- B. Provide insulation with flame spread rating of not more than 25 and smoke developed rating of not more than 50 per NFPA 255 or UL 273.
- C. Use no fugitive or corrosion treatments to impart flame resistance.

SECTION 15290 - DUCTWORK INSULATION

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store insulation materials in clean, dry place.
- B. Store insulation materials in original shipping containers with appropriate labels and seals intact.
- C. Discard insulation materials that become wet during storage.

1.6 QUALITY ASSURANCE

- A. Attach manufacturer's stamp or labels to insulation, jackets, cements, adhesives, and coatings containers indicating:
 - 1. Name of manufacturer.
 - 2. Brand and description of material.
- B. Provide asbestos-free insulation packages and containers.

1.7 MATERIAL TESTS

- A. Test factory applied materials as assembled.
- B. Use no fugitive or corrosive treatments to impart flame resistance.
- C. Provide UL label or certified test report from testing laboratory indicating fire hazard ratings for materials proposed do not exceed specified ratings.

PART 2 - PRODUCTS

2.1 MATERIAL COMPATIBILITY

- A. Provide adhesives, sealers, and vapor barrier coatings compatible with materials to which they are applied that will not corrode, soften, or otherwise attack such material in either wet or dry state.

2.2 FLEXIBLE FIBER GLASS DUCT WRAP INSULATION (CONCEALED AREAS, INDOOR USE ONLY) - TYPE A

- A. Type: Flexible inorganic blanket of glass fiber with factory applied FSK vapor barrier facing, conforming to ASTM C 1290, Type III.
- B. Acceptable Products:
 - 1. "Standard Duct Insulation" by CertainTeed.
 - 2. "Duct Wrap" with FSK facing by Knauf.
 - 3. "R-Series Microlite" by Manville.
 - 4. "Type 100" with FRK25 facing by Owens Corning.
- C. Thickness: 2 inches.
- D. Density: 1.5 pounds per cubic foot.

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- E. Thermal Conductivity at 75°F: 0.27 Btu-inch/hr/sq.ft./°F.
- F. Exterior Facing: FRK vapor barrier with one 2 inch flange.
- G. Exterior Facing Permeability: 0.02 perms maximum.
- H. Maximum Service Temperature: 250°F.
- I. Insulation Attachment Adhesive: ASTM C 916, "Stic-Safe Adhesive 85-15" by Foster.

J. Fasteners:

- 1. "Tactoo Insul-Hangers" by AGM Industries, Inc.
- 2. "Perforated Base Insulation Hangers" by Gemco:

K. Fastener Attachment Adhesive:

- 1. "Tactoo GPA-72" by AGM Industries, Inc.
- 2. "Tuff-Bond Hanger Adhesive" by Gemco.

L. Tape: Reinforced foil/scrim/Kraft to match facing, 3 inch wide with pressure sensitive adhesive. Provide with following properties as certified by Pressure Sensitive Tape Council:

- 1. Adhesion: 80 oz./inch of width.
- 2. Shear: 3000 minutes.
- 3. Tensile Strength: 25 lbs./inch of width.

M. Lap Sealing Adhesive: "Stic-Safe Adhesive 85-15" by Foster.

N. Systems Insulated: As indicated on Drawings.

2.3 RIGID FIBER GLASS DUCT BOARD INSULATION (EXPOSED AREAS, INDOOR USE ONLY) - TYPE B

A. Type: Rigid board made of inorganic glass fibers with factory applied, FSK vapor barrier facing.

B. Acceptable Products:

- 1. "Ultra Duct" by CertainTeed.
- 2. "Air Duct" by Knauf.
- 3. "Type 814 Spin-Glas" by Manville.
- 4. "Type 703" by Owens Corning.

C. Thickness: 2 inches.

D. Density: 6.0 pounds per cubic foot.

E. Thermal Conductivity at 75°F: 0.22 Btu-inch/hr/sq.ft./°F.

F. Exterior Facing: FSK vapor retarder.

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- G. Exterior Facing Permeability: 0.02 perms maximum.
- H. Beach Puncture Resistance: 50 units.
- I. Maximum Service Temperature: 250°F.
- J. Insulation Attachment Adhesive: "Stic-Safe Adhesive 85-15" by Foster.
- K. Fasteners:
 - 1. "Tactoo Insul-Hangers" by AGM Industries, Inc.
 - 2. "Perforated Base Insulation Hangers" by Gemco.
- L. Fastener Attachment Adhesive:
 - 1. "Tactoo GPA-72" by AGM Industries, Inc.
 - 2. "Tuff-Bond Hanger Adhesive" by Gemco.
- M. Tape: Reinforced Foil/Scrim/Kraft to match the facing, 3 inch wide with pressure sensitive adhesive. Provide with following properties as certified by Pressure Sensitive Tape Council:
 - 1. Adhesion: 80 oz./inch of width.
 - 2. Shear: 3000 minutes.
 - 3. Tensile Strength: 25 lbs./inch of width.
- N. Lap Sealing Adhesive: "Stic-Safe Adhesive 85-15" by Foster.
- O. Systems Insulated: As indicated on Drawings.

PART 3 - EXECUTION

3.1 GENERAL

- A. Notify the Owner's Field Engineer of insulation schedule so that duct insulation may be observed before it is concealed.
- B. Install insulation and finishes per manufacturer's recommendations.
- C. Properly seal ductwork seams and joints prior to application of insulation.
- D. Tightly butt joints and securely attach insulation materials to duct.
- E. Clean and dry duct prior to insulation application.
- F. Cut and fit insulation around irregular surfaces, and apply covering tight and smooth.
- G. Extend insulation through walls, floors, and similar penetrations without interruption.

3.2 APPLICATION

A. Type A Flexible Fiber Glass Duct Wrap Insulation:

1. Wrap insulation around entire duct with circumferential joints butted and with 2 inch flange of facing overlapped at transverse or longitudinal joints. Secure 2 inch flange of facing with 9/16 inch flare-door staples applied 6 inches on center.
2. Coat entire metal surface with adhesive at rate of 250 square feet per gallon and allow to dry.
3. For rectangular ducts wider than 24 inches, attach stick clips to bottom of duct surface within 3 inches of each joint in insulation and on 18 inch centers maximum.
4. Impale insulation on stick clips and apply pressure to ensure uniform bond.
5. Apply washers to pins without compressing insulation, and clip pin flush with washer.
6. Apply minimum 4 inch wide layer of insulation over protruding structural angles or standing seams, with insulation slit in center to fit neatly around angle or seam protrusion. Seal raw edges of 4 inch wide layer with 5 inch wide joint sealing tape.
7. For round duct over 24 inches in diameter, secure insulation with copper clad wires wrapped around duct on 18 inch centers.
8. Seal joints, raw edges, and penetrations in facing of insulation, including staples, with 3 inch wide vapor barrier tape. If necessary, utilize lap sealing adhesive and tape to complete vapor barrier seal at joints and penetrations.


B. Type B Rigid Fiber Glass Duct Board Insulation:

1. Cut insulation to fit tightly between standing seams on duct with overlaps at each corner joint. On irregular or round surfaces, pre-score insulation to allow board to conform to surface.
2. Coat entire metal surface with adhesive at rate of 250 square feet per gallon and allow to dry.
3. Attach stick clips to duct surface within 3 inches of each joint in insulation and on 18 inch centers maximum.
4. Impale insulation on stick clips and apply pressure to ensure uniform bond.
5. Apply self-locking washers to pins without compressing insulation, and clip pin flush with washer.
6. Apply minimum 4 inch wide layer of insulation over protruding structural angles or standing seams, with insulation slit in center to fit neatly around the angle or seam protrusion. Seal raw edges of 4 inch wide layer with 5 inch wide joint sealing tape.
7. For round duct over 24 inches in diameter, secure insulation with copper clad wires wrapped around duct on 18 inch centers.
8. Seal joints, raw edges, and penetrations in facing of insulation with 3 inch wide vapor barrier tape.

End of Section

Prepared By: Barry Gray

Checked By: Jeff Miller

Approved By: Jeff Miller 

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Acoustical and thermal duct lining insulation for heating, ventilating, and air conditioning systems.
- B. Ductwork size on Drawings indicate net free area. Increase size of acoustically lined ductwork to accommodate internal acoustical lining.

1.2 SUBMITTALS

A. Product Data:

1. Duct system designation.
2. Type lining.
3. Manufacturer's name and product identification number.
4. Lining thickness (in.).
5. Density (lbs./cu.ft.).
6. Thermal conductivity (Btu-in./sq.ft.-°F-hr. at 75°F mean temp.).
7. Average friction coefficient.
8. Perm rating (perms).
9. Minimum and maximum temperature limits (°F.).
10. Description of:
 - a. Airside coating.
 - b. Adhesive.
 - c. Mechanical fasteners.
 - d. Application, finishing, and flashing materials and methods.
11. Identify fire hazard classification (independent or composite).

1.3 QUALITY ASSURANCE

- A. Fire Hazard Classification: Duct lining and application materials having independent or composite Fire Hazard Classification (Flame Spread/Smoke Developed) of 25/50 or less when tested in accordance with NFPA 255.
- B. Classification Identification: Permanently stamp shipping containers and duct lining materials to identify Fire Hazard Classification.

1.4 PRODUCT DELIVERY AND STORAGE

- A. Deliver duct lining materials to fabrication shop or Project site in manufacturer's containers with labels and seals intact.

- B. Store materials in manufacturer's original containers in area maintained within temperature and humidity limits specified herein.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. **Temperature and Humidity Limitations:** In areas where lining materials are stored, installed, and cured, keep temperature between 60°F and 100°F and humidity at not more than 60% relative humidity; maintain such conditions during installation operations and for 48 hours before and after installation.
- B. **Ventilation:** When installing lining at Project site, provide forced ventilation, if necessary, to maintain following environmental conditions in areas affected by application of insulation:
 - 1. Maintain toxic concentration of gases, vapors, dusts, fumes, and mists within maximum allowable concentration levels recommended by ACGIH.
 - 2. Maintain vapor/air ratio of flammable solvents or cleaners, if used, to 25% or less than lower explosion limit.

PART 2 - PRODUCTS

2.1 ACOUSTICAL AND THERMAL DUCT LINING

- A. **General:** Flexible or rigid type as indicated, glass fiber type lining manufactured from long textile-type fibers, bonded together with thermal-setting resin and coated on 1 side with an air erosion resistant coating
- B. **Maximum Service Air Velocity:** Guaranteed by manufacturer not to erode or entrain fibers at velocities up to 6000 fpm per UL 181.
- C. **Thickness:** 1 inch.
- D. **Density:** 3.0 lbs./cu.ft.
- E. **Maximum Service Temperature:** 250°F, per ASTM C 411.
- F. **Moisture Adsorption:** 0.5% moisture by volume when exposed to moisture laden air at 120 °F and 96% relative humidity per ASTM C 553.
- G. **Acceptable Products:**
 - 1. "Ultralite Duct Liner" by CertainTeed.
 - 2. "Tenn-Mat Duct Liner" by Manville.
 - 3. "Aeroflex Type 300" by Owens Corning Fiberglas.

2.2 DUCT LINING EDGE OR LAP ADHESIVE (NONFLAMMABLE SOLVENT)

- A. "SparkFas 85-20" by Foster.
- B. "Cadoprene 400" by Epolux.
- C. "Sure-Stik I-C 225" by Insul Coustic.

2.3 MECHANICAL FASTENERS

- A. SMACNA Type 1: Clinched pin, integral head, impact applied.
- B. SMACNA Type 2: Welded pin, integral head.
- C. SMACNA Type 3: Welded pin, press-on head.

PART 3 - EXECUTION

3.1 PREPARATORY WORK

- A. Clean sheet metal surfaces scheduled to receive duct lining of foreign materials before installing liner; comply with adhesive manufacturer's recommendations.

3.2 APPLICATION

A. Installation:

1. Apply duct lining in accordance with manufacturer's recommendations, SMACNA guidelines, and details shown on Drawings.
2. Adhere duct lining to sheet metal surfaces with mechanical fasteners.
3. Position mechanical fasteners at 12 inch centers along edges of lining and along 2 rows (minimum) each side.
4. Impale liner on mechanical fasteners prior to fabrication of ductwork.
5. Install lining so that air erosion resistant coated surface faces air stream.
6. Interrupt duct lining at control devices such as fire dampers and fire doors to avoid interference with operation of devices.
7. Terminate lining at heat sources such as electric resistance and fuel burning heaters.
8. Refer to SMACNA for hat sections, fire dampers, and other lining interruption details.

B. Joints: Coat transverse joints with adhesive, neatly butt against adjacent materials.

C. Exposed Leading Edges: Coat joints, then install metal nosing on exposed leading edges for erosion protection.

D. Pin Penetrations:

1. Paint pin penetrations with edge or lap adhesive.
2. Install self-locking washers on mechanical fasteners flat on lining surface; do not dent lining surface.
3. Clip unused length of mechanical fasteners flush with self-locking washers.

E. Duct Erection: Field coat edges of joints with duct lining edge or lap adhesive immediately prior to erection.

End of Section

Prepared By: G. Thomas

Checked By: B. Gray

Approved By: G. Thomas *MT*

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section specifies piping, valves, and accessories for interior wet pipe sprinkler system and exterior underground fire protection piping (FP).

1.2 SUBMITTALS:

- A. Submit shop drawings including, but not limited to, following:

1. Manufacturer's catalog and descriptive data for all sprinkler heads, hydrants, hose racks, hose houses, fire department connections, fire extinguishers, and all other accessories and system components.
2. Temperature classification of sprinklers.
3. Flow characteristics of hydrants and automatic valves.
4. Complete plan drawings of proposed sprinkler locations and supply piping, including locations of heads, risers, control valves, hydrants, indicating valves, and routing of (all) piping; conform to NFPA 13 section 1-9 and paragraph 7-2.4.
5. Statements of NFPA and UL compliance.

1.3 QUALITY ASSURANCE

- A. Provide components and design system in accordance with UL and NFPA requirements, and requirements of the North Carolina Department of Insurance.
- B. Obtain approval of components, system configuration, design calculations, and all layout drawings from the North Carolina Department of Insurance and evidence of review by Owner's Representative before items are shipped to Project site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aboveground System:

1. Pipe:
 - a. 2 Inches and Smaller: Standard weight carbon steel. ASTM A53 Grade B Type E.
 - b. 2-1/2 Inches and Larger: Standard weight carbon steel, ASTM A53 Grade B Type E, ends to suit fittings used.
2. Pipe Fittings:
 - a. 2 Inches and Smaller: 150 psig malleable iron, ASTM A197, threaded, ANSI B16.3.

SECTION 15500 - FIRE PROTECTION

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- b. 2-1/2 Inches and Larger: Threaded 150 psig malleable iron or grooved ends for mechanical grooved couplings, ductile or malleable iron, UL listed for fire protection service, with standard EPDM gaskets.
3. Flanges: Cast iron, flat faced, minimum 125 lb., threaded or grooved as compatible with connecting pipe or fittings.
4. Bolts: ASTM A307 grade B, with nuts in accordance with ASTM A563 grade A.
5. Unions: 150 psig malleable iron, ASTM A197, threaded, ground joint, integral seat.
6. Gaskets: 1/8 inch rubber, full face.
7. Valves:
 - a. Gate Valves 2 Inches and Smaller: 200 psi, bronze, ASTM B61, threaded connections, solid wedge disc, outside screw and yoke, rising stem, UL listed. Crane 459 or approved equal.
 - b. Gate Valves 2-1/2 Inches and Larger: 175 psi cast iron, ASTM A126 class B, bronze trim, outside screw and yoke, solid wedge disc, rising stem, flanged connections, UL listed. Crane 467 or approved equal.
 - c. Swing Check Valve: Cast iron, ASTM A126 class B, swing check, bronze trim, bolted cap, bronze or iron disc, flanged ends, 175 psig rating, UL listed, Crane 375 or approved equal.
 - d. Wafer Check Valve: 250 psi CWP, wafer check, UL listed for fire protection service, with iron body, resilient Buna-N seal, aluminum bronze disc, stainless steel spring, and stainless steel hinge pin; suitable for installation between flat-faced class 125 (or equivalent) flanges. TRW Mission "Duo-Chek" fig. U12-HMP or approved equal.
 - e. Butterfly Valve: Full lug wafer type, UL listed for fire protection service, with ductile iron body, nickel-coated ductile iron disc, EPDM seat, stainless steel shaft, and UL listed gear operator with indicating means, handcrank, and locking bracket. TRW Mission 3140-AA1 or approved equal
8. Sprinkler Heads:
 - a. Rating: 165°F.
 - b. Type:
 - 1) Suspended Ceilings: Pendent type with ceiling mounted escutcheon plates.
 - 2) Open Areas Without Ceilings: Upright, uniform dispersion.
 - c. Hazard Rating: Ordinary.
 - d. Star, Gem, Reliable, Viking, or Grinnell.

B. Underground System:

1. Pipe: Ductile iron, AWWA C151, pressure class 350, standard 1/16 inch thick cement lining inside, 1 mil bituminous coating outside, ends to suit fittings.
2. Fittings: Ductile iron, AWWA C110, 350 psig, push-on or mechanical joint with all attachment appurtenances, lining and coating same as pipe.
3. Clamps and Rods: Steel, ASTM A36, coated with bitumastic; include clamps and washers suitable for underground installation.
4. Gaskets: Vulcanized crude rubber, AWWA C111.
5. Valves:
 - a. Gate Valves: Cast iron, ASTM A126 class B, bronze trim, non-rising stem, double disc, inside screw, bolted bonnet, indicator post flange, mechanical or slip joint ends, 175

psig rating, UL listed. Provide UL listed valves with AWWA style stuffing boxes where used with regular valve or curb boxes. Mueller A-2052-20 (PIV stuffing box), Mueller A-2050-20 (AWWA stuffing box) or approved equal.

- b. Gate Valves, Non-buried and Pit Service: Same as specified in subparagraph 2.1.A.7 of this section.
 - c. Check Valves, Pit Service: Same as specified in subparagraph 2.1.A.7 of this section.
6. Indicator Posts for Underground Valves:
- a. Construction: Two-piece, cast iron barrel, UL listed, with extension as required.
 - b. Operation: Counterclockwise to open valve.
 - c. Provide locking bars and supervisory switch with contacts for remote connections.
 - d. Mueller A-20800 or approved equal.
7. Hydrants:
- a. Material: Cast iron.
 - b. Type: Mechanical joint inlet, 175 psig working pressure, AWWA C502, UL listed.
 - c. Required Accessories For Each Hydrant:
 - 1) Two 2-1/2 inch hose connections each with 2-1/2 inch flanged hose gate valves with caps and chains.
 - 2) One 4 inch pumper connection with cap and chain (hydrant nearest siamese connection only).
 - 3) Operating wrench.
 - 4) Barrel extension (as required).
 - 5) Fully gasketed safety flange attaching upper and lower portions of barrel.
 - 6) Hose Threads: Same as public fire department.
 - 7) Main Valve Opening: 4-1/2 inches.
8. Thrust Blocks:
- a. Composition: Concrete having minimum compressive strength of 3000 psi at 28 days, minimum cement factor (bags per cubic yard) of 5.5, and maximum W/C ratio (gallons per bag) of 6.75. Conform to NFPA 24.
 - b. Size thrust blocks for soil bearing pressure of 2000 psf and pipeline water pressure of 225 psig; conform to and Appendix "A" of NFPA 24.

C. Fire Extinguishers:

1. Type: 4A:60BC pressurized nitrogen dry chemical.
2. Provide bracket for wall or column mounting.
3. J. L. Industries, Croker Standard, Walter Kidde, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install piping, valves, and all system components in accordance with requirements of NFPA 13, NFPA 24, AWWA C600 and as indicated on Drawings.
- B. Install extension barrels on exterior hydrants and indicator posts as required by depth of piping.

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- C. Install hydrants in accordance with AWWA M17 and NFPA 24; before backfill, flush out each hydrant and test to same pressure as specified for connected piping.
- D. Locate, assemble, install, and support exterior hose houses as required and as indicated on Drawings.
- E. Install and locate sprinkler heads and associated piping to provide coverage densities as required and as indicated on Drawings.
- F. Locate and install extinguishers and as indicated on Drawings.
- G. Install minimum two tie rods, with clamps and washers, at joints within 20 feet of changes in direction in underground pipe, for anchorage where thrust blocks are not used.
- H. Where rods are not used for anchorage, install thrust blocks at each change of direction and at tees, caps, and bends; conform to NFPA 24 and details indicated on Drawings. Prepare concrete using Type I Portland cement, natural sand, clean crushed stone or gravel (size 67), and clean potable water.
- I. Repair damaged cement-mortar lining in accordance with AWWA C602.
- J. Identify aboveground pipe in accordance with NFPA 13.
- K. Support aboveground pipe in accordance with NFPA 13.

3.2 FIELD QUALITY CONTROL

- A. Provide opportunity for Owner's representative to inspect installation of exterior and interior fire protection system at any stage of placement and installation.
- B. Repeat any work, and replace any item, disclosed as defective by test or during inspection by Owner's Representative.
- C. Coordinate all installation with work of other trades and take necessary steps to avoid interference.
- D. Clean, flush, and test all piping and system components in accordance with Section 1-11 of NFPA 13 and NFPA 24, in presence of Owner; notify Owner minimum one week in advance of scheduled commencement of tests.
- E. At completion of work under this Section, complete and submit to and Owner complete material and test certificates for aboveground and underground piping in accordance with NFPA 13.
- F. Where sprinkler heads are exposed during painting in same area and before commencement of such painting, cover heads with removable plastic bags; remove bags only after painting in immediate vicinity of head is completed. Coordinate removal of bags with general contractor.

End of Section

SECTION 15896 - FLEXIBLE DUCTWORK

Prepared By: Barry Gray

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Checked By: Jeff Miller

Approved By: Jeff Miller 

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Section specifies requirements for general purpose flexible ductwork used to convey hot and cold air in normal heating, ventilating, and air conditioning systems.

1.2 QUALITY ASSURANCE

A. Laboratory Classification:

1. Conform to requirements for Class 1 air duct connectors when tested in accordance with UL-181.
2. Outer jacket perm rating 0.1 grains per square foot, per hour, per inch of mercury when tested in accordance with ASTM E96, Procedure A.
3. Insulating materials maintain a C factor of 0.23 or less.

- B. Fire Hazard Classification: Independent or composite fire hazard classification (flame spread/smoke developed) of 25/50 or less when tested in accordance with NFPA 255 or other industry accepted standards.

1.3 SUBMITTALS

A. Submit Product Data including:

1. Duct designation number.
2. Type of flexible ductwork.
3. Manufacturer's name and product identification name or number.
4. Minimum and maximum temperature limits (°F).
5. Minimum negative and maximum positive static pressure limits (inches w.g.)
6. Complete description of adhesives and tapes:
7. Complete description of insulation:
 - a. Type.
 - b. Density.
 - c. Thickness.
 - d. Thermal conductivity.
8. Complete description of exterior facing.
9. Code compliances for each duct type.
10. Installation recommendations.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Flexmaster USA, Inc.
- B. Genflex.

2.2 FLEXIBLE DUCTWORK

- A. Construction: Factory fabricated assembly of trilaminate of aluminum foil, fiberglass, and polyester, mechanically locked, without adhesives, into an aluminum helix formed on duct's outside surface.
- B. Perm Rating: 0.02 grains per square foot, per hour, per inch of mercury.
- C. Material Properties: High tear strength, and properties to resist temperature change, mildew, and age hardening.
- D. Required Material Ratings:
 - 1. Positive Pressure: 12 inches w.g. minimum.
 - 2. Negative Pressure: 5 inches w.g. thru 16 inch diameter, 1 inch w.g. for 18 inch and 20 inch diameter.
 - 3. Operating Temperature Range: -20°F to 250°F.

2.3 INSULATION

- A. Factory wrapped blanket of fiberglass insulation.
- B. C factor of 0.23 or less.
- C. Encased in fire retardant polyethylene or reinforced metalized and protective vapor barrier with perm rating of not over 0.1 grains per square foot, per hour, per inch of mercury.
- D. UL rated as an air duct material.

2.4 MISCELLANEOUS COMPONENTS

- A. Spin Collar Fittings for Sheet Metal: Connect flexible ductwork to metallic duct system with factory fabricated fittings as described below:
 - 1. ASTM A 653 G90 Coating Designation galvanized steel construction.
 - 2. Adjustable butterfly dampers with spring loaded, refractable bearing and positive locking regulator.
 - 3. Fittings include a die formed, locking groove to ensure constant fit and ease of installation.
 - 4. Acceptable Products and Manufacturers:
 - a. "Series SM-1D" by Genflex.
 - b. "FLD" by Flexmaster for sheet metal duct system without duct lining.

SECTION 15896 - FLEXIBLE DUCTWORK

B. Tape:

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1. Width: 2 inches.
2. Flexible Ductwork With Plastic Outer Skin: Arno #520.
3. Flexible Ductwork With Aluminized Outer Skin: Arno #442.

C. Clamps: 1/2 inch wide positive locking, steel bands or self-locking nylon clamp.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install proper type of flexible ductwork in complete accordance with applicable standards, manufacturer's recommendations, and details shown on Drawings.
- B. Make connections to systems with type fittings specified for specific application.
- C. Install duct in fully extended condition free of kinks and sags.
- D. Maximum installed duct length shall not exceed 5'-0".
- E. Where duct requires supports, locate supports on 3'-0" centers.
- F. Make splices and connections with 2 inch wide tape, duct adhesives, and 1/2 inch wide positive locking bands used in conjunction with factory supplied sleeves, couplings, or spin collar fittings.

End of Section

SECTION 15898 - RIGID DUCTWORK

Prepared By: Barry Gray

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Checked By: Jeff Miller

Approved By: Jeff Miller

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section includes provision, fabrication, installation, support, and testing of rectangular and round galvanized steel sheet metal ducts for heating, ventilating, air-conditioning, and exhaust air systems in pressure classes as noted on drawings.
- B. Section additionally includes hanger systems and support systems for ductwork.
- C. Pressure classifications and duct material of sheet metal ductwork and related work shall be as indicated on the Drawings.
- D. All ductwork shall be fabricated and installed per SMACNA "HVAC Duct Construction Standards - Metal and Flexible".
- E. Related Sections:
 - 1. Section 15290 - Ductwork Insulation.
 - 2. Section 15291 - Acoustical and Thermal Duct Lining.
 - 3. Section 15896 - Flexible Ductwork.
 - 4. Section 15910 - Ductwork Accessories.
- F. The following is a list of exceptions to the SMACNA Duct Manual figures not permitted; this list is representative, but not limiting.

| <u>FIGURE NO.</u> | <u>DESCRIPTION</u> | <u>NOT PERMITTED</u> |
|-------------------|------------------------------------|----------------------|
| 1-5 | LONGITUDINAL SEAMS | L-2 |
| 3-1 | SEAMS - ROUND DUCT AND FITTINGS | RL-2,3,6A,6B,7,8 |
| 4-2 | UPPER ATTACHMENT DEVICES - TYPICAL | 1,4,5,9,10,11,14 |
| 4-4 | LOWER HANGERS ATTACHMENTS | See Note 1 below |

Note 1: Strap hangers with or without screws, wire hangers, single straps forming hangers and wrapped around duct in one continuous band are not permitted.

1.2 QUALITY ASSURANCE

- A. Comply with NFPA 90A unless otherwise indicated.
- B. Comply with NFPA 90B unless otherwise indicated.
- C. Comply with the following:
 - 1. SMACNA DCSMF: HVAC Duct Construction Standards - Metal and Flexible.

1.3 SYSTEM DESCRIPTION

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- A. Duct system design, as indicated, has been used to select and size air-moving and distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved by the Owner's Field Engineer.
- B. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.4 SUBMITTALS

- A. Product Data: Provide for sealing materials.
- B. Shop Drawings: Provide:
 - 1. Fabrication, assembly, and installation, including:
 - a. Plans.
 - b. Elevations.
 - c. Sections.
 - d. Components.
 - e. Attachments to other work.
 - 2. Duct layout indicating pressure classifications and sizes.
 - 3. Fittings.
 - 4. Reinforcement and spacing.
 - 5. Seam and joint construction.
 - 6. Hangers and supports, including:
 - a. Methods for building attachment.
 - b. Vibration isolation.
 - c. Duct attachment.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- D. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver duct system materials to site in original unopened containers or bundles with labels indicating:
 - 1. Manufacturer.
 - 2. Product name and designation.
- B. Store and handle duct materials in accordance with manufacturer's written recommendations.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Galvanized Sheet Steel: Lock-forming quality, ASTM A 653, G90 coating designation; with mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Reinforcement Shapes and Plates: Match with duct construction, galvanized steel reinforcement with galvanized ductwork and stainless steel reinforcement with stainless steel ductwork.
- C. Tie Rods: Tie rod construction to match duct construction, 1/4 - inch minimum diameter for 36-inch length or less; 3/8 - inch minimum diameter for lengths longer than 36 inches.

2.2 SEALANT MATERIALS

- A. Sealant material shall be selected to meet the SMACNA duct construction requirements as indicated on the Drawings.
- B. Gaskets: Cellular neoprene, conforming to ASTM D 1056, Grade SCE 45 or 30-40 durometer Shore-A solid neoprene. Gaskets shall be a minimum of 1/8 inch thick.
- C. Joint and Seam Sealant: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.3 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts or structural-steel fasteners appropriate for building materials.
- B. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod. Hangers installed in corrosive atmospheres shall be electrogalvanized, all-thread rod or galvanized rods with threads painted after installation.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screw compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36.

2.4 METAL DUCTWORK - MATERIALS AND FABRICATION

- A. General: This Article applies to all supply, return and exhaust ductwork.
- B. Rectangular Ductwork:
 - 1. Unless otherwise noted on the Drawings, all ductwork shall be constructed per SMACNA Duct Manual "HVAC Duct Construction Standards - Metal and Flexible".
 - 2. Unless otherwise noted on Drawings, provide ductwork constructed of galvanized steel sheets. Provide reinforcing angles and bars of galvanized coated ASTM A36 hot rolled steel for galvanized ducts. Cross break all ductwork.
 - 3. Provide duct sections jointed and fabricated in accordance with applicable Tables 1-5 through 1-18 contained in the SMACNA Duct Manual, depending on the construction required. Unless noted, provide joint connections with companion angle with intermediate bracing angles as required.

4. Assemble duct sections with Pittsburgh lock or grooved longitudinal seams carefully closed for tightness and appearance.
5. In general, minimize changes in directions and changes in shape permitted by distribution requirements and building conditions. Provide elbows in the following order of preference.
 - a. Unvaned elbow, throat radius one width of duct and full heel radius.
 - b. Six inch throat radius with full radius vanes and heel radius.
 - c. If closer elbows are required, provide them fabricated square with double-thickness air foil type turning vanes set on line bisecting intersecting duct centerlines. Provide vanes shaped for minimum turbulence, with fixed blade type for elbows of uniform section, and adjustable blade type for elbows of irregular shape.
 - d. Previously listed specifications for elbows shall apply also to a double elbow or tee.
 - e. Provide branch take-off with radius elbow or 45 degree tap-in in accordance with SMACNA.
6. Where changes in duct direction or shape require sides of duct to be other than parallel with direction of flow, the angles of such side with general direction of flow shall not be over 15 degrees.
7. Install branches, inlets, and outlets as shown on Drawings and in such a manner that air turbulence is reduced to a minimum and air volume is properly apportioned.
8. Offsets in ductwork shall be accomplished utilizing Offset Type 3 in the Duct Manual Figure 2-9. "Dog-Leg" transitions shall not be permitted.
9. Manufactured duct joining systems such as Ductmate or Transverse Duct Connectors (TDC) are acceptable and shall meet the requirements of SMACNA for the pressure class, with independent testing laboratory data provided.
10. Provide joints and connections internally sealed with clear silicone rubber sealant.

C. Round Ductwork:

1. Provide round ducts fabricated in accordance with appropriate tables, figures and requirements of the SMACNA Duct Manual.
2. Provide duct flanges and reinforcing angles of galvanized coated ASTM A36 hot rolled steel for galvanized ducts. Fabricate ductwork in 12 foot maximum sections.
3. Fabricate ductwork with standard spiral lock seams according to SMACNA Duct Manual.
4. Provide transverse joints of slip joints having beaded sleeve coupling sealed with either gray shrink bands, as manufactured by Raychem Corporation, and mechanically locked with self-sealing pop rivets. Sheet metal screws are not acceptable.
5. Install slip joints in accordance with the duct manufacturer's written instructions.
6. Provide elbows in round ductwork minimum of two gauges heavier than straight ducts of equal diameter. Provide centerline radius of elbows in round ductwork 1-1/2 times the duct diameter if no centerline radius is shown on the Drawings, provided in the following order of preference:
 - a. Smooth, two section, stamped.
 - b. Five piece, with welded seams.
 - c. Three piece, with welded seams.
7. Provide fittings with continuous welds along all seams.
8. Provide divided flow fittings manufactured as separate fittings, not as tap collars welded into duct sections.
9. Provide 90 degree tees and 45 degree laterals (wyes) up to and including 12 inch diameter tap size with radiused entrance into the tap produced by machine or press forming, with entrance free of weld build-up, burrs, or irregularities. Provide Flexmaster type STO or equal side take-off for duct sizes less than 12 inches.

10. Provide conical type branch runouts.

D. Casings and Plenums:

1. Unless otherwise indicated, fabricate of not less than 18 gauge galvanized steel as applicable and in accordance with the requirements of the Duct Manual.
2. Do not button punch standing seams. Use rivets or bolts. Use no center posts in casings unless such construction is shown on the drawings.

E. Access Doors:

1. Provide access doors installed in ducts, casings and housings as required for inspections and maintenance.
2. Unless otherwise noted, provide access doors made of the same material as ducts, casings, or housings in which they are installed, fabricated with insulation equal to insulation specified for ductwork or housings in which they are installed.
3. Access Doors for Ducts:
 - a. Installed in a position in the ductwork that ensures ease of access, cleaning, and serviceability.
 - b. Install access doors in ducts on one side of each vaned elbow, at each volume damper, smoke or fire damper, duct heating coil, and every 20 feet of horizontal duct run.
 - c. Provide access doors for rectangular ductwork fabricated in accordance with Fig. 2-10M of the Duct Manual.
 - d. Provide frames conforming to Frame 2 as shown in Figure 2-10M.
 - e. Provide latches conforming to Lock Type 2 as shown in Figure 2-10M, #100 Ventlok Latch by Vent Fabrics, Inc.
 - f. Hinges: #370 Ventlok Hinge, by Vent Fabrics, Inc.
 - g. Provide 1" x 1" x 16 gauge angle frame (same material as duct) riveted to exterior surface of duct around the door opening.
 - h. Unless noted otherwise, provide access doors for rectangular ductwork as follows:

| <u>Duct Dimension</u> | <u>Minimum Door Size</u> |
|-----------------------|--------------------------|
| Up to 18" | 8" W x 12" L |
| 19" thru 46" | 16" W x 12" L |
| 47" and Over | 24" W x 18" L |

- i. Access Doors for Round Ductwork: United McGill Corp. Type ARR combination access opening and pressure relief having non-insulated galvanized steel frame and insulated door with chain retainer.

F. Dampers: Section 15910.

G. Duct Insulation: Section 15290.

H. Interior Duct Lining: Section 15291.

I. Hangers and Support Systems:

1. Rigidly support ducts and secure with galvanized steel hanger rods, supported in an approved manner from the building structure only. Do not support from other equipment or from other equipment supports (unless indicated otherwise on Drawings).
2. Hangers and supports for ducts large enough for personnel to enter, or are so located that personnel can stand on, sit on or crawl on top of, shall have sufficient strength to support the ductwork plus 500 pounds concentrated load. Space hangers at not more than 8 foot centers along the duct.
3. Space hanger rods so as not to penetrate or go through any part of the duct or its apertures.
4. Do not screw or bolt supports to sides of ducts.
5. Use stainless steel nuts for attaching trapeze angle carrier to hanger rods.
6. Intermediate reinforcement structural members may be used for attachment if they qualify for both attachment and reinforcement duties as defined in the Duct Manual.
7. For concrete ceiling, bolt upper end of the hanger to an angle iron clip which is securely fastened to the ceiling. The clip shall consist of 1-1/2" x 1-1/2" x 1/8" steel angle, 4 inches long. It shall be fastened to a concrete ceiling by two 5/16 inch expansion bolts. For fastening to a steel beam, use one 3/8 inch "C" clamp and flattened end bolt. Fasten hanger to the clip or flattened end bolt by three 1/4" x 3/4" galvanized steel bolts.
8. For rectangular ducts, the lower end of the hanger shall extend down the side of the duct to trapeze angle carriers across the bottom of the duct.
9. Size hanger rods and trapeze angles in accordance with allowable load tables of the Duct Manual.
10. Determine hanger spacing based on the weight of the section of duct being supported, (plus a concentrated load of 500 pounds if applicable as described in this Paragraph) and the size of the hanger system components selected but in no case in excess of 8 foot on centers.

J. Wipes for Cleaning Ductwork:

1. Touch-and-Go polyurethane foam, Sills & Associates.
2. Texwipe cloths, Texwipe Company.
3. Nylon Tricot 1068 cloths, Laminaire Company.
4. Miracle Wipe, International Clean Products

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawings indicate general arrangement of ducts, fittings, and accessories. Determine duct routing and locations and indicate in shop drawings.
- B. Construct and install duct system for specific duct pressure classification indicated.
- C. Install round ducts in lengths not less than 12 feet, unless interrupted by fittings.
- D. Install ducts with fewest possible joints.
- E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- F. Install couplings tight to duct wall surface with minimum of projections into duct.

- G. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to enclosure elements of buildings.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with clearance of 2 inch plus allowance for insulation.
- J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- K. Coordinate duct system layout with suspended ceiling locations, fire damper location, piping layouts, plumbing layouts, fire protection sprinkler system layout, lighting layouts, and similar finished work.
- L. Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures unless ductwork serves that space only.
- M. Where ducts pass through non-fire rated interior partitions and exterior walls and are exposed to view, conceal space between construction and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on 4 sides by at least 1.5 inches.
- N. Where ducts pass through fire-rated interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and fire-stopping sealant (if required by UL).
- O. Flashing: Provide air and watertight flashings, where ducts pass through exterior walls, roof and walls. Refer to HVAC Drawings and Architectural Drawings for wall penetration details.

3.2 SEAM AND JOINT SEALING

- A. Seal duct seams and joints according to duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards -- Metal and Flexible."
- B. Seal externally insulated ducts before insulation installation.

3.3 HANGING AND SUPPORTING

- A. Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in SMACNA'S "HVAC Duct Construction Standards -- Metal and Flexible."
- B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Support vertical ducts at maximum interval of 16 feet and at each floor.
- D. Install upper attachments to structures with allowable load not exceeding one-fourth of failure (proof-test) load.

3.4 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect system and correct resulting defects.

SECTION 15898 RIGID DUCTWORK

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- B. Vacuum ducts before final acceptance to remove dust and debris.


End of Section

SECTION 15910 - DUCTWORK ACCESSORIES

Prepared By: Barry Gray

302

Checked By: Jeff Miller

Approved By: Jeff Miller 

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Section specifies requirements for:

1. Manual balancing dampers.
2. Flexible connectors for ductwork.

B. Related Sections:

1. Section 15898 - Rigid Ductwork.

1.2 QUALITY ASSURANCE

A. Provide ductwork accessories with independent or composite Fire Hazard Classification (Flame Spread/Smoke Developed) of 25/50 or less when tested in accordance with ASTM E 84.

1.3 SUBMITTALS

A. Product Data: Includes:

1. Manual Balancing Dampers:

- a. Manufacturer's name and product identification name or number.
- b. Materials of construction.
- c. Static pressure differential (in. w.g.) for fully open damper.

2. Flexible Connectors:

- a. Connector designation number.
- b. Type connector.
- c. Manufacturer's name and product identification name or number.
- d. Minimum and maximum temperature limits (°F).
- e. Maximum negative and positive static pressure limits (in. w.g.).
- f. Description of fabrication materials and material's flame spread and smoke developed rating.
- g. Certification of code compliances.

B. Shop Drawings:

1. Overall two-line layout, indicating available service areas and clearance requirements.
2. Elevations and sections to show clearances, methods of support, and details of installation.

SECTION 15910 - DUCTWORK ACCESSORIES

C. Operating and Maintenance Manual: **303**

1. Submittal Data:
 - a. Product Data.
 - b. Shop Drawings.
2. Spare Parts List:
 - a. Part description.
 - b. Part number.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Receive and inspect ductwork accessories for damage and shortage at Project site.
- B. Unload ductwork accessories carefully to avoid damage.
- C. Store in safe, dry location in original shipping containers with labels and seals intact.

PART 2 - PRODUCTS

2.1 MANUAL BALANCING DAMPERS - RECTANGULAR

- A. Frame: 5 inches by 5 inches by 16 gauge galvanized steel formed into structural hat channel shape with tabbed corners for reinforcement.
- B. Blades: Single skin, 8 inches maximum width, 16 gauge galvanized steel with 3 longitudinal grooves for reinforcement.
- C. Bearings: Corrosion resistant, molded synthetic sleeve type turning in extruded hole in damper frame.
- D. Axles: Square or hexagonal positively locked into damper blade.
- E. Control Shaft: 3/8 inch square plated steel.
- F. Locking Quadrant: Provided for setting and locking damper position. Provide with 2 inches standoff mounting bracket for applications on insulated ductwork.
- G. Acceptable Product and Manufacturer: "MD35" by Ruskin.

2.2 MANUAL BALANCING DAMPERS - ROUND

- A. Frame: 20 gauge galvanized steel.
- B. Blades: 20 gauge galvanized steel.
- C. Bearings: Molded synthetic.

- D. Control Shaft/Hand Quadrant: 3/8 inch square axle shaft extending beyond frame through factory mounted, locking hand quadrant.
- E. Maximum Velocity: 1500 fpm.
- F. Acceptable Product and Manufacturer: "MDRS25" by Ruskin.

2.3 DUCTWORK FLEXIBLE CONNECTORS

- A. Fire Hazard Classification: Independent or composite Fire Hazard Classification (Flame Spread/Smoke Developed) of 25/50 or less when tested in accordance with ASTM E 84 or other appropriate industry standard.
- B. Fabric:
 - 1. Material: Heavy glass-fabric, double-coated with neoprene.
 - 2. Weight: 30 ounces per square yard.
 - 3. Tensile Strength: 360 pounds per inch minimum.
 - 3. Heat Resistance: Up to 200°F for continuous operation.
- C. The clear space between connected parts shall be a minimum of 3 inches and the connection shall have 1 ½ inches minimum of slack material.
- D. Metaledge: 24 gauge galvanized steel.
- E. Acceptable Product and Manufacturer: "Standard Metaledge Ventglas" by Ventfabrics.

2.4 IDENTIFICATION

- A. Include unit's designation number on manufacturer's permanent nameplate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install manual balancing dampers, and flexible connectors in accordance with approved shop drawings, manufacturers' instructions, applicable standards and details shown on Drawings.

End of Section

SECTION 15940 - AIR DISTRIBUTION DEVICES

305

Prepared By: Barry Gray

Checked By: Jeff Miller

Approved By: Jeff Miller *JM*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Provision and installation of grilles, registers, and diffusers.

1.2 SUBMITTALS

- A. Product Data: Include the following information:

- 1. Performance characteristics.
- 2. Materials and finishes.
- 3. Dimensions.
- 4. Included accessory description.

- B. Shop Drawings: Indicate methods of installation.

PART 2 - PRODUCTS

2.1 AIR DISTRIBUTION DEVICES

- A. Provide grilles, registers and diffusers as specified and in accordance with Schedules indicated on Drawings.

- B. Acceptable Manufacturer: Titus.

- C. General Requirements for Diffusers, Registers, and Grilles:

- 1. Units shall be factory-fabricated of steel, corrosion-resistant steel, or aluminum as specified on Drawings.
- 2. Performance shall be certified in accordance with ADC 1062:GRD. Inlets and outlets shall be sound rated and certified in accordance with ADC 1062:GRD.
- 3. Diffusers and registers shall be provided with volume damper with accessible operator, unless otherwise indicated, or, if manufacturer's standard, an automatically controlled device will be acceptable.
- 4. Volume dampers shall be opposed blade type for all diffusers and registers. Where the inlet and outlet openings are located less than 7 feet above the floor, they shall be protected by a grille or screen in accordance with NFPA 90A.

- D. Diffusers:

- 1. Diffuser types shall be as indicated.
- 2. Ceiling mounted units shall be furnished with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features.
- 3. Diffusers shall be provided with air deflectors of the type indicated.
- 4. Sponge rubber gaskets shall be provided between ceiling and surface mounted diffusers.

5. Duct collar connecting the duct to diffuser shall be airtight and shall not interfere with volume controller.

E. Registers and Grilles:

1. Units shall be four-way directional-control type, except that return and exhaust registers may be fixed horizontal or vertical louver type similar in appearance to the supply register face.
2. Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling.
3. Wall supply registers shall be installed at least 6 inches below the ceiling unless otherwise indicated.
4. Return and exhaust registers shall be located 6 inches above the floor unless otherwise indicated.
5. Grilles shall be as specified for registers, without volume control damper.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air distribution devices in accordance with approved manufacturer's submittals, manufacturer's recommendations, and details shown on Drawings.

End of Section

Prepared By: J. W. Shaw

Checked By: J. W. Shaw

Approved By: E. G. Hemrick

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies general provisions affecting other Division 16 Work.

1.2 INTERFERENCES

- A. Because electrical Drawings are generally diagrammatic in nature, minor adjustments to illustrated requirements may be required to avoid interference between electrical Work and construction furnished by other trades and existing construction.
- B. Plan and coordinate Work; furnish raceway offsets, fittings, and boxes; adjust fixture and equipment locations; and provide associated supports, all as needed to avoid interferences.
- C. Take field measurements to verify dimensions provided on Drawings.
- D. If an interference cannot be avoided, obtain approval before proceeding with affected Work.

1.3 EXISTING SERVICE CONTINUITY

- A. Maintain full capacity power service continuity when connection or modification is made to existing electrical systems.
- B. When modification or connection cannot be made without interruption of power, coordinate schedule of outage and obtain approval prior to interruption of power.

PART 2 - PRODUCTS

2.1 EQUIPMENT TOUCH-UP PAINT

- A. Types and brands recommended by manufacturers of factory furnished components.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. To maximum extent practicable, install equipment to facilitate servicing, maintenance, and replacement of equipment.
- B. Connect equipment so that disconnection can be made in a convenient manner which minimizes interference with other construction.

3.2 TOUCH-UP PAINTING

- A. Repair damage to factory-applied paint finishes with touch-up paint.

SECTION 16000 - GENERAL PROVISIONS - ELECTRICAL

- B. Use touch-up paint and methods of preparation and application recommended by manufacturer of components to be repaired.

End of Section

Prepared By: J. W. Shaw

Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *E. G. Hemrick*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies receiving, unloading, storing, installing, connecting electrical circuits, and placing in operation the following:
1. Disconnect switches.
 2. Dry-type transformers.
 3. Molded case circuit breakers.
 4. Motor control centers.
 5. Panelboards.

1.2 RECEIVING, STORAGE, AND HANDLING

- A. **Receiving:** Receive, uncrate, and inspect equipment for defects or damage. If defective or damaged equipment is discovered, take necessary action to repair or replace equipment. Provide notification if Project schedule is affected.
- B. **Storage:** Store equipment in dry, clean, and secure area until time of installation.
- C. **Handling:** Handle equipment in accordance with manufacturer's instructions. Use lifting points where provided to move equipment. Protect painted and machined surfaces where exposed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. **Grounding:** Comply with Section 16450 for grounding requirements.
- B. **Identification:** Comply with Section 16195.
- C. **Cleaning:** Clean interior of enclosures prior to installation of components or pulling conductors.
- D. **Supports and Fastenings:** Comply with Section 16190.
- E. **Enclosure Application:**
1. NEMA 1 for indoor office locations unless indicated otherwise on Drawings.
 2. NEMA 12 for indoor industrial locations unless indicated otherwise on Drawings.
 3. NEMA 4X for outdoor installations.

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3.2 FLOOR OR PAD MOUNTED EQUIPMENT

- A. General: Install floor sills, anchor bolts, shims, and hardware required to level, align, secure, and connect equipment components in accordance with manufacturer's instructions. Make electrical connections in accordance with Section 16121 for supply and load circuits and leave items in operating condition.
- B. Motor and Control Centers:
1. Assembly: Make mechanical and electrical connections between shipping splits.
 2. Raceways: Locate raceway entrances in correct vertical section, both underfloor and overhead, within areas designated on Shop Drawings.
 3. Wiring:
 - a. Install incoming and outgoing power and control circuits in accordance with Section 16121.
 - b. Connect power circuits for proper phase rotation.
 - c. Connect equipment ground conductors to ground lugs.
- C. Overcurrent Protection: Set circuit breaker instantaneous trips at proper value and verify proper size fuses and thermal overload heater elements. On magnetic breakers in combination with starters, set trips at lowest value that will permit motor starting, but not higher than 13 times motor nameplate full-load current.
1. Grounding: Connect ground bus to equipment ground grounding conductors and to grounding electrode system.
 2. Controls: Check interconnection and operation of control devices, interlocks, indicating lights, and control relays. Set timers and time delay relays for correct intervals. Check controller operating coil for correct voltage rating.

3.3 WALL MOUNTED EQUIPMENT

- A. General:
1. Enclosures:
 - a. Mount enclosures plumb, level, and rigidly attach to structure.
 - b. Mount 1 inch off structure with top 6'-6" above finished floor.
 - c. Install supports in a manner to permit vertical flow of air behind enclosure.
 - d. Use steel supports fabricated from standard rolled structural steel shapes specified in Section 16190.
 2. Wiring: Make electrical connections in accordance with Section 16121 for supply and load circuits.
- B. Dry-Type Transformers:
1. Mounting: Refer to Section 16190 for proper support and anchorage.
 2. Raceway Connections: Connect raceways to transformer enclosure using flexible conduit specified in Section 16111. Use lengths of flex approximately 10 diameters in length.

C. Panelboards:

1. Enclosure: Close unused circuit positions with blanking plates.
2. Wiring: Check buses for proper insulation resistance prior to energizing.

D. Molded Case Circuit Breakers: Set adjustable instantaneous trips to minimum, unless indicated otherwise on Drawings.

E. Self-Contained Emergency Power Pack: Connect each unit to equipment ground conductor by means of a crimped ring-type terminal connector secured to housing with a self-tapping screw.

End of Section

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SECTION 16111 - METALLIC CONDUIT AND FITTINGS

Prepared By: J. W. Shaw

Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *EH*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Galvanized rigid steel conduit (GRC).
- B. PVC Coated Galvanized Rigid Steel Conduit.
- C. Flexible metal conduit.
- D. Liquidtight flexible metal conduit.
- E. Hazardous area flexible metal conduit.
- F. Associated fittings.

1.2 QUALITY ASSURANCE

- A. Furnish conduit and fittings bearing label of a Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. GRC: ANSI C80.1 and UL 6, hot dipped galvanized, zinc metalized or sheradized, heavy wall, steel.
- B. PVC Coated Galvanized Rigid Steel Conduit: NEMA RN 1-1986, hot dipped galvanized steel with galvanizing inside and outside including threads and 40 mil PVC coating bonded to outer coating.
- C. Flexible Conduit: Provide flexible conduit sized 1-1/4 inches and smaller that is UL approved for use as a grounding conductor.
 - 1. Flexible Metal (Greenfield): UL 1, hot dipped or electro-galvanized steel.
 - 2. Liquidtight Flexible Metal Conduit (Sealtite): UL 360, hot dipped or electro-galvanized steel with thermoplastic outer covering.
 - 3. Hazardous Area Flexible Conduit: Approved for area classification, with brass fittings and outer braided metal jacket.

2.1 FITTINGS

- A. Fittings: UL 514B. Provide fittings of same type by same manufacturer.
- B. Conduit Bodies:

SECTION 16111 - METALLIC CONDUIT AND FITTINGS

3. GRC: Zinc coated, cast malleable, ferrous metal, threaded fittings, Appleton "Form 35 Unilets" or Crouse-Hinds "Form 7 Condulets."
 4. Conduits 1-1/4 Inch and Larger: Cast malleable or aluminum "Mogul" size bodies.
 5. Gaskets: Where installed outdoors or in areas with gasketed enclosures, furnish neoprene cover gasket.
 6. PVC Coated Fittings: PVC coated fittings for use with PVC coated conduits.
- C. Insulated Bushings:
3. Thermoplastic: Appleton "BBU," O-Z/Gedney "IB," or Thomas & Betts "510" Series.
 4. Thermosetting Phenolic: O-Z/Gedney "A."
 5. Grounding: O-Z/Gedney "BLG."
- D. Flexible Connectors: Provide flexible conduit fittings sized 1-1/4 inches and smaller that are UL approved for use as a grounding device.
3. Metal: Thomas & Betts "3100" series "Tite Bite," insulated.
 4. Liquidtight Metal: Thomas & Betts "5200/5300" series or Appleton "ST" series, insulated.
- E. Sealing Hubs: Appleton "HUB" series or Thomas & Betts "370" series.
- F. Expansion Fittings:
3. Exposed: O-Z/Gedney type "AX" or "EX" or Appleton type "XJ" with bonding jumper.
 4. Concrete Embedded: O-Z/Gedney "DX."
- G. Unions: Appleton type "EC" or Thomas & Betts "670/680" series "Erickson" coupling.
- H. Seals: Provide seals with interior cross section to allow 40% wire fill capacity.
1. Enclosure Termination and Stub-ups Into Equipment: OZ/Gedney "CSB" series sealing bushing.
 2. "In-Line": Gasketed "C" conduit body, filled with Dow Corning "Fire Stop" sealant.
 3. Hazardous Area Seals: Appleton type "EYSEF," "EYDEF," "ESU," or "SF" or Crouse-Hinds type "EYSX," "EZS" or "EYDX," with manufacturer's recommended fiber filler and cement.
- I. Miscellaneous Fittings: Locknuts, caps, plugs, reducers, elbows, and other accessories required for a complete installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Do not make unnecessary bends or offsets.
2. Do not heat conduits for making bends or bend conduit through more than 90 degrees of arc.
3. Install conduits so that vertical runs are plumb and horizontal runs are level and parallel or perpendicular to principal structural features.
4. Maintain 6 inch clearance from steam lines, hot water lines, flues, and other heat producing lines or devices where practicable.
5. Make up joints tight and do not use running threads.

6. Clean inside of conduits and swab dry before installing conductors.
 7. Support conduits 2-1/2 inch and smaller in accordance with NEC. For conduits 3 inch and larger support at intervals of 10'-0" or less.
- B. Bending Radius: Comply with NEC 344.24 for minimum bending radius on both field bends and factory bends. Use NEC Table 344.24 Exception for field bends made with a "one-shot" bender.
- C. Concrete Embedded: Anchor conduit to reinforcing in concrete; plug or cap open ends until concrete and masonry operations are completed.
- D. Below Grade: Encase conduits installed below grade in a 3 inch red concrete envelope unless noted otherwise on Drawings.
- E. Conduit Terminations (GRC, IMC, or RAC):
1. NEMA 1 Areas, Sizes 1 Inch and Below: One interior and 1 exterior locknut with thermoplastic bushing.
 2. NEMA 1 Areas, Sizes Above 1 Inch: One interior and 1 exterior locknut with thermosetting phenolic bushing.
 3. Gasketed Enclosure Areas: One interior locknut and 1 exterior sealing locknut with appropriate type bushing.
 4. Outdoor Areas and Indoor Areas Subject to Washdown: Use sealing hubs in top and sides of enclosures. Use an exterior sealing locknut, interior locknut, and bushing in bottom of enclosures.
 5. Service Entrances: Same as specified for gasketed enclosure areas except use grounding bushing.
- F. Expansion Fittings: Furnish for building expansion joints where conduit is rigidly attached to building structure or rod supported within 18 inches of structure.
- G. Seals: Install seals where conduit passes from a conditioned space into an unconditioned space, in enclosures mounted outdoors, and in conduits entering structures from outside or underground.

3.2 APPLICATION

A. GRC

1. All areas except outdoors.
2. In concrete slabs and walls.
3. Do not use GRC conduit smaller than 3/4 inch.

B. PVC Coated Steel Conduits:

1. All outdoor locations.
2. Stub-up elbow, and last 10 feet at each end of ductbank run.
3. 3/4 inch and larger.

- C. Flexible: Use for final connection to vibrating equipment, enclosed transformers, lay-in lighting fixtures, lighting fixtures with flexible supports, and equipment or devices requiring adjustment, such as motors and limit switches.

SECTION 16111 - METALLIC CONDUIT AND FITTINGS

1. Greenfield: Indoor areas where gasketed enclosures are not required.
2. Liquidtight:
 - a. Outdoor areas.
 - b. Where gasketed enclosures are required.
 - c. For connection to production equipment.
 - d. All areas except hazardous areas.

End of Section

SECTION 16112 - PLASTIC CONDUIT AND FITTINGS

316

Prepared By: J. W. Shaw

Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *EGH*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Schedule 40 (Sch. 40) poly-vinyl chloride conduit.

1.2 QUALITY ASSURANCE

- A. Furnish conduit and fittings bearing label of a Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. Sch. 40: NEMA TC 2 and UL 651 rigid poly-vinyl chloride rigid conduit.

2.2 FITTINGS

- A. Plastic Fittings: Sch. 40: NEMA TC 3 and UL 651.
- B. Miscellaneous Fittings: Locknuts, caps, plugs, reducers, rigid galvanized steel elbows, and other accessories required for a complete installation.
- C. Conduit Cement: Conduit manufacturer's recommended solvent cement.

2.3 MARKING TAPE

- A. Permanent, bright yellow, continuous printed plastic tape, with magnetic strip, compounded for direct burial not less than 6 inches wide and 4 mils thick. Printed with works "ELECTRICAL DUCTBANK."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Do not make unnecessary bends, offsets, or bend conduit through more than 90 degrees.
 - 2. Use manufacturer's recommended heating units for making PVC field bends.
 - 3. Clean inside of conduits and swab dry before installing conductors.
- B. Bending Radius: Comply with NEC Table 344.24 for minimum bending radius on field bends and factory bends.

SECTION 16112 - PLASTIC CONDUIT AND FITTINGS

C. Conduits Below Grade:

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1. Circuits of 600 Volts or Less: 3 inch minimum red concrete encasement.
2. Conduit Bends: Make a transition to rigid steel conduit for elbows, offsets, and stub ups.

D. Concrete Embedded: Anchor conduit to reinforcing in concrete; plug or cap open ends until concrete and masonry operations are completed.

E. Making Tape: Install 6 to 8 inches below finished grade.

F. Seals: Install seals where conduit enter structures from outside or underground.

3.2 APPLICATION

A. Sch. 40:

1. Below grade.
2. Do not use Sch. 40 conduit smaller than 3/4 inch.

End of Section

SECTION 16121 - LOW VOLTAGE COPPER WIRE AND CABLE

Prepared By: J. W. Shaw

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Checked By: J.W. Shaw *JWS*

Approved By: E. G. Hemrick *EGH*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies copper wire, cable, associated connectors, and termination hardware used on systems operating at 600 volts or less.

1.2 QUALITY ASSURANCE

- A. Furnish wire, cable, associated connectors, and termination hardware bearing the label of, or listed by a Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Soft drawn, annealed copper, Class "B" stranding. Conductors #10 and smaller solid copper except for fire alarm system and control wiring.

2.2 POWER WIRE AND CABLE

- A. Acceptable Manufacturers: Single source manufacture is required for power wire and cable specified in this Section.
- B. General: Conform to UL 83 and NEMA WC 5.
 - 1. Single Conductor: Type THWN-THHN (75°C wet/90°C dry) or XHHW (75°C wet/90°C dry) cable rated 600 volts.
 - 2. Bare Cable: Single conductor, stranded.
- C. Lightning Protection System Conductors (UL 96): Braided, smooth twist, stranded, bare copper conductors with UL approved conductor labels with Issue Number attached every 10 feet.

2.3 SIGNAL CABLE

- A. Type PLCC (Power Limited Control Cable):
 - 1. General: Rated 300 volts, 90°C, single pair (pr.), triad (tri.), or quad (qd.).
 - 2. Single Pr., Tri., or Qd.: No. 16 AWG, stranded copper conductors, twisted and covered with a 100% aluminum-mylar shield, with drain wire and overall PVC jacket.
 - 3. Multiple Pr., Tri., or Qd.: Same as single construction except No. 20 AWG conductors and an overall aluminum-mylar shield in addition to individual shields.
 - 4. General: Rated 300 volts, 90°C, single pair (pr.), triad (tri.), or quad (qd.).

- B. Type RG59/U (COAX):

- 1. UL Style No. 1354.

SECTION 16121 - LOW VOLTAGE COPPER WIRE AND CABLE

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2. No. 22 AWG stranded bare copper.
3. Cellular polyethylene insulation with bare copper shield and PVC outer jacket.
4. 15 OHMS per thousand feet DC resistance.
5. 75 OHM nominal impedance.
6. 78% nominal velocity of propagation.
7. 17.3 pf per foot capacitance.

2.4 CONNECTORS AND TERMINALS

- A. Insulated Crimp Type Connectors and Terminals: Nylon insulated, Burndy "INSULINK" and "INSULUG," or Thomas & Betts "Sta-Kon."
- B. Split Bolts: High-conductivity copper alloy, Burndy "SERVIT" or Thomas & Betts "Split-Bolt."
- C. Two Bolt Connectors: High-conductivity copper alloy, Burndy "OKLIP Type KVS" or Blackburn "2BU."
- D. Compression Terminals: Copper long barrel, Burndy "HYLUG" or Thomas & Betts "Color-Keyed," or aluminum alloy Buchanan "Cytolok CL500" series.
- E. Bolted Terminals: Cast copper alloy, Burndy "QIKLUG" or Thomas & Betts "Locktite."

2.5 MISCELLANEOUS COMPONENTS

- A. Tape:
 1. Vinyl Plastic: 3M "Scotch 33+" or "Scotch 88."
 2. Varnished Cambric (VC): 3M "Irvington 2920."
 3. Friction: Black friction tape.
 4. Color Coding: 3M "Scotch 35."
 5. Fireproofing: 3M "Scotch 77."
 6. High Temperature Glass Cloth: 3M "Scotch 69" (180°C).
 7. Electrical Insulation Putty: 3M "Scotchfil."
- B. Splice Kits: 3M "Scotchcast 82 Series".
- C. Pulling Lubricants: Ideal "Yellow 77" or Polywater "Type J."
- D. Wire Markers:
 1. Individual Wires: Write-on type with self-laminating vinyl overwrap, 3M "ScotchCode," Ideal "Write-On," or Thomas & Betts "WSL."
 2. Multi-Conductor Cables or Groups of Wires as a Cable: Nylon tie on marker, Thomas & Betts "Nylon I.D. Ties Ty-Raps."
- E. Wire and Cable Ties: Thomas & Betts "Ty-Raps."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wire and Cable:

1. General:

SECTION 16121 - LOW VOLTAGE COPPER WIRE AND CABLE

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- a. Branch circuits to receptacles in offices and telecom room shall have individual neutrals (no sharing of neutrals between circuits).
 - b. Limit pulling tension to maximum values recommended by manufacturer.
 - c. Do not pull through boxes, fittings, or enclosures where change of raceway alignment or direction occurs.
 - d. Do not cut strands from conductors to fit lugs or terminals.
 - e. Do not splice new control or signal wiring.
- B. Compression Connectors and Terminals: Install on wire and cable with approved tool and die to recommended compression pressure.
- C. Bolted Connectors and Terminals:
1. Torque to manufacturer's recommended foot-pounds for size and class of connector.
 2. Where manufacturer's published torquing requirements are not indicated, tighten connectors and terminals to comply with UL 486A torque values.
 3. Use plated bolts and lock washers on terminal connections.
- D. Wiring in Enclosures:
1. Form and tie conductors in panelboards, cabinets, control panels, motor controllers, wireways, and wiring troughs in a neat and orderly manner.
 2. Use Thomas & Betts wire and cable ties of appropriate size and type.
 3. Limit spacing between ties to not more than 6 inches.
- E. Taping:
1. Above Ground and Dry Locations: Fill voids and irregularities with half-lapped layers of VC (2 minimum) or electrical insulation putty. Insulate with 3 half-lapped layers of vinyl plastic and 1 half-lapped layer of friction tape.
 2. Below Ground and Wet Locations: In lieu of taping protect connection with resin splicing kit.
- F. System Separation:
1. Control and Signal Wiring: Provide separate raceways or barriers in raceways to separate each of the following systems from other wiring:
 - a. 120 volt control wiring.
 - b. Analog.
 - c. 4-20 Milliamp.
 - d. 0-10 VDC.
 2. Coaxial Cable: Separate raceway with minimum of 3 inches separation from other control and signal system raceways and 1 foot minimum separation from power wiring raceways. Separate inside enclosures a minimum of 3 inches from other wiring by means of separate wireways, "Ty-Wrapped" cable bundles, and standoffs.

3.2 APPLICATION

A. Wire and Cable:

1. THWN-THHN or XHHW for power wiring and control wiring in conduit .

SECTION 16121 - LOW VOLTAGE COPPER WIRE AND CABLE

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2. Bare copper for ground loops.
3. No. 12 AWG minimum for power circuits and No. 14 AWG minimum for control circuits unless noted otherwise on Drawings.

B. Connectors and Terminals:

1. Branch Circuits: Ideal "Wirenuts," 3M "Scotchlock," or T&B "Piggy" connectors for splicing solid conductors in junction boxes, outlet boxes, and lighting fixtures.
2. Motor Terminations (Single Conductor Circuits): Insulated ring tongue crimp type connectors or compression terminals, connected back-to-back with plated bolt, nut and lockwasher, and then taped. Where strap screw devices are present use split tongue connectors in lieu of ring tongue connectors.
3. Motor Terminations (Parallel Conductor Circuits): Gang compression terminals on a 1/4-inch-thick copper bar.
4. Transformer Terminations: Split bolt connectors for pigtail connections. Compression terminals for all other connections.

C. Multiconductor Control Cable: 14 AWG conductors except 16 AWG may be used in control enclosures.

3.3 COLOR CODING

A. Power Wiring: Provide color coding for single and multi-conductor power circuits as follows:

| <u>Voltage</u> | <u>ØA</u> | <u>ØB</u> | <u>ØC</u> | <u>Neutral</u> |
|---------------------|-----------|-----------|-----------|----------------|
| 240 volts and below | Black | Red | Blue | White |
| 250 - 600 volts | Brown | Orange | Yellow | Natural Gray |

1. For specified insulations and jackets not manufactured with integral colors, use conductors with black insulation or jacket and color coding tape.
2. Color code conductors entering boxes, troughs, cabinets, and other enclosures.
3. Color code conductors in wireways, trenches, and other locations where conductors are continuously accessible at intervals not exceeding 5 feet.

B. Insulated Equipment Ground: Green.

C. Control Cables:

1. Single Conductors: Red (AC), Blue (DC).
2. Multi-conductor: Comply with ICEA S-66-524, "Method 1", Table K-2.

D. Signal Cables: Comply with ICEA S-82-552, "Method 9", Table E-2. In addition, number multiple pairs, traids, and quads.

3.4 IDENTIFICATION

A. Cables: Attach nylon tie on markers on both ends of cable denoting both cable type and number as noted on Drawings. Where a number of 1/C wires are identified as a single cable, group conductors using "Ty-Raps" and attach markers.

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- B. Conductor Identification: Attach conductor markers on both ends of wire and label as indicated on Drawings.

End of Section

Prepared By: J. W. Shaw

Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *E.H.*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies electrical outlet, device, pull, and junction boxes and wireways, and wiring troughs.

1.2 DEFINITIONS

- A. Outlet Box: A box used as a wiring enclosure that may be used as a device box with the addition of a plaster ring or special cover.
- B. Device Box: A box designed to house a switch, receptacle, or other wiring devices.

1.3 QUALITY ASSURANCE

- A. Furnish boxes bearing label or listing of a Nationally Recognized Testing Laboratory (NRTL), as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.1 OUTLET AND DEVICE BOXES

- A. General:
 - 1. UL 514A and 514B for all boxes.
 - 2. NEMA OS 1 for sheet steel boxes.
- B. Cast Iron Boxes: Crouse-Hinds or Appleton "FS/FD" and "ALC" series.
- C. Sheet Steel Boxes: Pressed steel, galvanized, 4 inch octagonal, or 4 inch square (or "gang") boxes, depth as needed to accommodate devices and associated wiring.
- D. Accessories: Provide fixture studs, plaster rings, extension rings, and covers as required for application. Galvanized steel indoors and galvanized cast ferrous metal or cast aluminum with neoprene gaskets outdoors.

2.2 JUNCTION AND PULL BOXES

- A. Boxes (6 Inch Minimum Dimension):
 - 1. Welded galvanized sheet steel, of sizes required by NEC, without knockouts.
 - 2. 14 gauge metal for boxes with maximum dimension of less than 24 inches, 12 gauge for boxes with maximum dimension of 24 to 35 inches, and 10 gauge for boxes with any dimension greater than 35 inches.
 - 3. Provide removable, flame retardant, insulating cable supports in boxes with any dimension greater than 42 inches.

4. Comply with UL 50 for boxes over 100 cubic inches volume.
 5. Provide screwed or bolted covers of same gauge as box.
- B. Boxes (4-11/16 Inch Maximum Dimension): Pressed steel, galvanized, 4 or 4-11/16 inches square, 1-1/2 or 2-1/8 inches deep.
 - C. Dustproof Boxes: NEMA 12, continuously welded-seam, galvanized sheet steel with gasketed cover.
 - D. Weatherproof Boxes: NEMA 4X, continuously welded-seam, stainless sheet steel enclosures with gasketed covers.
 - E. Watertight Boxes: Galvanized cast iron with gasketed, bolt-on covers, tapped holes in bosses or hubs for conduit entrances, and integrally cast mounting lugs.
 - F. Hazardous Area Boxes: Cast metal boxes conforming to UL 886 and listed or labeled for use in specific location classification.

2.3 WIREWAYS

- A. Provide hinged cover NEMA 4X lay-in stainless steel gasketed wireway assemblies of sizes indicated on Drawings.
- B. Provide special lengths, telescope fittings, box connectors, elbows, and other fittings as required for a complete system.

2.4 WIRING TROUGHS

- A. Where individual safety switches, motor starters and other distribution and control devices are group mounted, provide welded, galvanized wiring troughs with screw covers of sizes and configurations indicated on Drawings.
- B. Provide continuously welded-seam NEMA 12 troughs in areas requiring gasketed junction boxes and continuously welded-seam NEMA 3R in outdoor areas.
- C. Do not use wireway sections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Mount boxes plumb and level and rigidly attach them to structure.
2. Clean interiors before installing trims and covers.
3. Close unused openings with blanking devices or threaded plugs.
4. Install surface mounted units at least 1 inch off of walls with supports placed in such a manner to permit vertical flow of air behind enclosure.

B. Wireways:

1. Assemble and erect system so that access covers are on top of horizontal runs.
2. Do not mount wireways directly to building structure or machinery. Use a trapeze assembly to install wireways.

3.2 APPLICATION

- A. NEMA 4X for outdoor installations.
- B. NEMA 12 for all other areas unless indicated otherwise on Drawings.
- C. Hazardous area boxes in all Class 1, Division 1 or 2, Group D areas.
- D. Cast iron "FS/FD" for use with surface mounted steel conduit unless noted otherwise on Drawings or other Sections.
- E. Cast aluminum for use with surface mounted aluminum conduit.
- F. Pressed steel boxes for installation in partitions, walls, and suspended ceilings.
- G. Tile box, 3-1/2 inch deep for installation in poured concrete walls and concrete columns. 4 inch octagonal box with removable back cover for installation in overhead concrete slabs.

End of Section

SECTION 16140 - WIRING DEVICES

Prepared By: J. W. Shaw

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Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *EGH*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Snap switches and switch plates.
- B. Power outlets.
- C. General purpose receptacles.
- D. Ground fault interrupter receptacles.
- E. Receptacle cover plates.

1.2 QUALITY ASSURANCE

- A. Applicable Standards: NEMA WD 1.
- B. NRTL Labeling or Listing: Furnish wiring devices bearing the label of a Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS

- A. Snap Switches: UL 20.

| <u>Manufacturer</u> | <u>Color</u> | <u>SP-ST</u> | <u>DP-ST</u> | <u>3-Way</u> | <u>4-Way</u> |
|---------------------|--------------|--------------|--------------|--------------|--------------|
| Bryant Elect. | Gray | 4901-GRY | 4902-GRY | 4903-GRY | 4904-GRY |
| Hubbell, Inc. | Gray | 1221GRY | 1222GRY | 1223GRY | 1224GRY |
| Leviton Mfg. | Gray | 1221-GY | 1222-GY | 1223-GY | 1224-GY |

- B. Switch Plates: Indoor flush-mounted stainless steel, satin finished switch cover plates.

| <u>Manufacturer</u> | <u>1-Gang</u> | <u>2-Gang</u> | <u>3-Gang</u> | <u>4-Gang</u> |
|------------------------|---------------|---------------|---------------|---------------|
| Bryant Elect. | S-671 | S-672 | S-673 | S-674 |
| Hubbell, Inc. | S1 | S2 | S3 | S4 |
| Leviton Mfg. Co., Inc. | 84001-40 | 84009-40 | 84011-40 | 84012-40 |

- C. Weatherproof Switch Plates: Aluminum with spring loaded and gasketed lift cover.

| <u>Manufacturer</u> | <u>Std. Box</u> | <u>"FS" Box</u> |
|---------------------|-----------------|-----------------|
|---------------------|-----------------|-----------------|

SECTION 16140 - WIRING DEVICES

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| | | |
|---------------|-----------|------|
| Hubbell, Inc. | 7420/7349 | 7420 |
|---------------|-----------|------|

D. Heavy Duty Receptacles: UL 498.

| <u>Manufacturer</u> | <u>Color</u> | 20A Duplex NEMA <u>5-20R</u> | 20A Single NEMA <u>5-20R</u> |
|---------------------|--------------|---------------------------------------|---------------------------------------|
| Bryant Elect. | Gray | 5362-GRY | 5361-GRY |
| Hubbell, Inc. | Gray | 5362GRY | 5361GRY |
| Leviton Mfg. | Gray | 5362-GY | 5361-GY |

E. Class A Ground Fault Circuit Interrupters (GFI): UL 498 and UL 943.

| <u>Manufacturer</u> | <u>Color</u> | 20A Duplex <u>NEMA 5-20R</u> |
|---------------------|--------------|------------------------------------|
| Bryant Elect. | Gray | GFR53FT-GRY |
| Hubbell, Inc. | Gray | GF5362GY |

F. Receptacle Cover Plates:

| <u>Manufacturer</u> | <u>Single Indoor</u> | <u>Duplex Indoor</u> | <u>Duplex Outdoor Std. Box</u> |
|---------------------------|--------------------------|--------------------------|--|
| Bryant Elect. | S611 | S601 | - |
| Hubbell, Inc. | S7 | S8 | WP26MH |
| Leviton Mfg. Co., Inc. | 84004-40 | 84003-40 | - |

G. GFI Receptacle Cover Plates:

| <u>Manufacturer</u> | GFI | | <u>"FS" Box</u> |
|---------------------|---------------|-----------------------------------|-----------------|
| | <u>Indoor</u> | <u>Outdoor</u> <u>Std. Box</u> | |
| Bryant Elect. | S601D | GFRWPV | GFRWPVFS |
| Hubbell, Inc. | S26 | WPS6 | WPFS26 |
| Thomas & Betts | WR81-C - | WTG100-CV | WTG100-CV |

H. Power Outlets: Special purpose, locking-type, grounding outlets as indicated on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Do not install devices and cover plates until painting is completed.
2. Clean box interiors prior to installing devices.
3. Install devices and cover plates plumb.

B. Mounting Heights: Conform to the following mounting heights unless indicated otherwise on Drawings.

| <u>Device</u> | <u>Finished Areas</u> | <u>Unfinished Areas</u> |
|--|---|---------------------------|
| Snap Switches | 4'-2" A.F.F. ¹ | 4'-6" A.F.F. ¹ |
| Convenience Outlets | 1'-6" A.F.F. ¹ | 4'-6" A.F.F. ¹ |
| Power Outlets | 1'-6" A.F.F. ¹ | 4'-0" A.F.F. ¹ |
| Outlet for wall mounted electric water coolers (Finished and Unfinished Areas) | 0'-2" to left of centerline of cooler and 1'-10 1/2" A.F.F. ¹ | |

¹ A.F.F. denotes above finished floor.

End of Section

SECTION 16160 - CABINETS AND ENCLOSURES

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Prepared By: J. W. Shaw

Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *EGH*

PART 1 - GENERAL

2.1 SECTION INCLUDES

- A. Section specifies electrical cabinets and hinged door enclosures.

2.2 DEFINITIONS

- A. **Cabinets:** An enclosure designed for surface or flush mounting and equipped with a frame or trim in which a door or doors may be mounted.
- B. **Enclosure:** A box, case, cabinet, or housing for electrical wiring or components.
- C. **Hinged Door Enclosure:** An enclosure designed for surface mounting with swinging doors or covers secured directly to walls of box.

2.3 QUALITY ASSURANCE

- A. **Applicable Standards:** NEMA 250.
- B. **NRTL Labeling or Listing:** Furnish cabinets and enclosures bearing label of or listing by a Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.1 CABINETS

- A. **General:**
 - 1. UL 50.
 - 2. Minimum 16 gauge sheet steel box with front consisting of 1 piece frame and hinged door.
 - 3. Arrange door to close against a rabbet placed around inside edge of frame, with a uniformly close fit between door and frame.
 - 4. Space concealed cover fasteners not over 24 inches on centers and not over 6 inches from top and bottom of door.
 - 5. Double doors on cabinet when door opening exceeds 24 inches.
 - 6. Equip doors with latches and pin-cylinder locks; furnish locks keyed alike.
 - 7. Preformed knockouts not acceptable.
- B. **NEMA 1:** Primed, welded sheet steel with baked-on gray enamel finish.
- C. **NEMA 12:** Primed continuously welded seam sheet steel with baked-on gray enamel finish.
- D. **NEMA 4X:** Stainless steel weatherproof.

2.2 HINGED DOOR ENCLOSURES

SECTION 16160 - CABINETS AND ENCLOSURES

A. General:

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1. NEMA ICS 6 and UL 50.
2. Minimum 16 gauge sheet steel box with continuous welded seams.
3. Removable doors hinged directly to cabinet with flange around edges and shaped to cover edge of box.
4. Painted, removable internal mounting panel for component installation.
5. Comply with door, latch, and pin-cylinder requirements specified for cabinets.

- B. Terminal Cabinets: Minimum 6 inches deep with removable metal subpanel and terminal strips as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Mount cabinets and enclosures plumb and level and rigidly attached to structure.
2. Clean interiors before installing trims or covers.
3. Close unused openings with blanking devices or threaded plugs.
4. Install surface mounted units in a manner to permit vertical flow of air behind cabinets and enclosures.

B. Cabinets:

1. Mount top of cabinets 6'-6" above finished floor.
2. Install cabinet interior after conduit connections are completed.

3.2 APPLICATION

- A. NEMA 1 for indoor office locations unless indicated otherwise on Drawings.
- B. NEMA 12 for industrial indoor locations unless indicated otherwise on the Drawings.
- C. NEMA 4X for outdoor installations.

End of Section

Prepared By: J. W. Shaw

Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *E. G. Hemrick*

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Supports and hangers, anchors, and fastenings for mounting and anchoring electrical raceways, equipment, and fixtures.
- B. Related Sections: Additional support requirements for specific items are specified elsewhere in Division 16.

PART 2- PRODUCTS

2.1 FIELD FABRICATED SUPPORTS

- A. Structural steel shapes and plates as specified in Section 05500. Hot-dipped galvanized for outdoor locations.
- B. 3/8 inch minimum, continuous thread, plated or galvanized hanger rod.
- C. Prefabricated structural systems manufactured by American Electric Kindorf, Power-Strut, or Unistrut with manufacturer's standard corrosion resistant finish.

2.2 CONDUIT SUPPORTS

- A. Clamps: Steel City or American Electric Kindorf "RC" and "PC" clamps.
- B. Straps:
 - 1. Conduit Straps: Plated steel or hot-dipped galvanized, "2-hole" straps with "clamp-backs."
 - 2. Channel Straps: American Electric Kindorf "C-105," Power-Strut "PS-1300," or Unistrut "P1100" and "P1400."
- C. Hangers:
 - 1. Conduit Hangers: Steel City Series "6H" or Erico Products, Inc. Caddy "CD" series.
 - 2. Lay-In Pipe Hangers: American Electric Kindorf "C-149," Power-Strut "PS-3200," or Unistrut "J1200."

2.3 ANCHORS

- A. Toggle Bolts: US Anchor "TB" series.
- B. Metal Expansion Sleeve Anchors: ITW Ramset/Red Head "Dynabolt" series.
- C. Hollow Wall Anchors: ITW Ramset/Red Head "Dynabolt Gold" series.

- D. Wedge Anchors: ITW Ramset/Red Head "Trubolt" series.

2.4 FASTENERS

- A. Bolts and Nuts: ASTM Grade 2, low carbon, plated or galvanized, hex head.
- B. Beam Clamps: American Electric Kindorf "E-160" or "E-231," Power-Strut "PS800" and "PS2000," or Unistrut "P2600" or "P2700" clamps with retainers.
- C. Channel/Angle Clamps: American Electric Kindorf "E-177".

2.5 GALVANIZING REPAIR PAINT

- A. ASTM A 780.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Fabricate and install supports so that supported installation does not weaken or overload structure.
2. Do not impose weight of electrical equipment, raceways, or fixtures on supports provided for non-electrical systems unless indicated otherwise on Drawings.
3. Secure steel supports to structure by bolting or welding.
4. Use retaining device when making connections with setscrew-type beam clamps or C-clamps.
5. Maximum diameter of drilled holes in beam flanges shall not exceed 15% of width of flange.
6. Drill holes to leave minimum of 1/2 inch of steel from edge of member to edge of hole.
7. Support loads from bottom chord member of trusses or steel joists only where diagonal members attach to bottom chord.
8. Do not support loads from metal roof or floor decking.
9. Clean and paint all saw cuts.

- B. Outdoor Supports: Coat bolted and field welded supports with galvanizing repair paint.

3.2 APPLICATION

A. Supports for Single Conduits:

1. Conduit in Direct Contact With Steel Framing: "RC" and "PC" clamps.
2. Suspended Conduit 1-1/4 Inch and Below: Hanger rod and conduit hanger.
3. Suspended Conduit 1-1/2 Inch and Above: Hanger rod and lay-in pipe hanger.

B. Supports for Multiple Parallel Conduits:

1. In Direct Contact With Steel Framing: Attach prefabricated 1-1/2 inch wide channel, of sufficient depth to support the load, directly to framing and attach conduits to channel straps.
2. Suspended: Assemble a "trapeze" hanger using prefabricated 1-1/2 inch wide steel channel of sufficient depth to support load, and 2 or more hanger rods. Attach conduits to channel using channel straps.

SECTION 16190 - SUPPORTS AND FASTENINGS

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C. Wall Anchors:

1. Hollow Masonry Units: Support light loads such as, 1- and 2-hole straps, and outlet boxes with toggle bolts or metal expansion sleeve anchors. Provide minimum of 1/4 spacing off wall surface using "clamp-backs" or strut. Support heavy loads such as, panelboards, safety switches, and multiple conduit runs with hollow wall anchors.
2. Solid Masonry Units: Wedge anchors; use through-bolts for tension loads.
3. Gypsum Board: Toggle bolts.

D. Concrete Floor and Overhead Slabs:

1. For overhead equipment loads less than 400 lbs., use a minimum of 2 - 3/8 inch minimum diameter threaded expansion anchors.
2. For equipment loads in excess of 400 lbs., but less than 1,000 lbs., use a minimum of 2 - 3/8 inch minimum diameter wedge anchors.

End of Section

SECTION 16195 - IDENTIFICATION

Prepared By: J. W. Shaw

Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *EGH*

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Identification and information signs and warning signs for electrical equipment.
- B. Related Sections: Additional identification requirements for specific items are specified elsewhere in Division 16.

1.2 APPLICABLE STANDARDS

- A. OSHA Subpart S.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Identification and Information Signs:

- 1. Rigid laminated phenolic with following colors:
 - a. Blue surface with engraved white core for 120/208 volt equipment.
 - b. Black surface with engraved white core for 277/480 volt equipment.
 - c. Bright red surface with engraved white core for fire alarm system equipment.
 - d. Dark red (burgundy) surface with engraved white core for security equipment.
 - e. Green surface with engraved white core for emergency systems equipment.
 - f. Orange surface with engraved white core for telephone systems equipment.
 - g. Brown surface with engraved white core for data systems equipment.
 - h. White surface with engraved black core for paging systems equipment.
 - i. Purple surface with engraved white core for TV systems equipment.
- 2. 1/2 inch minimum text size.

- B. Warning Signs:

- 1. OSHA Subpart J - General Environmental Controls, Section 1910.145.
- 2. Signs provided with equipment are acceptable provided all necessary signs are issued with equipment.
- 3. Provide identical signs for each application.
- 4. High voltage warning signs to read "DANGER - HIGH VOLTAGE - KEEP OUT."

- C. Panelboard Directories: Refer to Section 16470.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identification and Information Signs:

1. Location: Place signs on the following equipment:
 - a. Dry-type transformers.
 - b. Panelboards.
 - c. Motor control centers.
 - d. Individually mounted motor controllers.
 - e. Safety/disconnect switches.
 - f. Individually mounted overcurrent devices.
 2. Minimum Information on Sign: Include the following information:
 - a. Equipment Designation.
 - b. Operating Voltage and Phases.
 - c. Served From equipment designation.
 - d. For branch circuit panelboards, include color coding for phase, neutral, and ground conductors for each voltage system used in accordance with NEC paragraph 210-4(d).
 3. Equipment Served Identification: Include Equipment Served on identification and information signs for the following equipment:
 - a. Dry-type transformers.
 - b. Individually mounted motor controllers.
 - c. Safety/disconnect switches.
 - d. Individually mounted overcurrent devices.
 4. Compartment/Device Identification: Place identification and information signs including compartment/device designation, control device and instrument device names, and equipment served on individual compartments or devices located in motor control centers.
- B. Color Coding Boxes: Paint the covers and exterior visible surfaces of junction boxes, outlet boxes, and pull boxes with colors to match the surface color scheme specified in section 2.1.A.1. above. Include covers on boxes above lift out and other type accessible ceilings.
- C. Panelboard Directories. Fill-in circuit directory cards, with a typewriter. Identify each circuit using descriptions contained in panelboard schedules on Drawings.
- D. Spare Conduit Identification: Identify spare conduits with tags which indicate the future use and indicate where they terminate. Attach tags with string or wire to conduit or outlet.
- E. Multiple Services: Where multiple services exist, equip each service disconnect with an additional identification and information sign which states Name and Location of other service disconnects.
- F. Mounting: Mount signs to clean, dry equipment surface with self-tapping stainless steel screws. For hazardous areas, mounts signs with epoxy adhesive.

End of Section

SECTION 16440 - DISCONNECT SWITCHES

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Prepared By: J. W. Shaw

Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *EGH*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies fusible and non-fusible safety and disconnect switches, individually enclosed and group mounted.

1.2 QUALITY ASSURANCE:

A. Applicable Standards:

1. NEMA 250.
2. NEMA KS 1.
3. UL 98.

- B. NRTL Labeling or Listing: Furnish switches bearing label of a Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

1.3 SUBMITTALS

- A. Submit Product Data on each switch showing ratings, overall dimensions, enclosure type, and accessories.

PART 2- PRODUCTS

2.1 EQUIPMENT

- A. General: Fusible and non-fusible "Heavy Duty" safety and disconnect switches with ratings as shown on Drawings.

B. Components:

1. Line terminal shields.
2. Visible blades.
3. Non-teasible, positive, quick-make, quick-break interrupter operating mechanism.
4. Reinforced Class R rejection-type fuse clips.
5. Handle whose position ("OFF" or "ON") is easily recognizable and can be multiple padlocked in "OFF" position.
6. Defeatable door interlocks that prevent door from opening when operating handle is in "ON" position.
7. Auxiliary control contact operated by handle mechanism to signal that switch is in the closed position, where indicated on Drawings.
8. Factory installed ground lugs.
9. Factory installed cover mounted metal nameplate containing a permanent record of:
 - a. Switch type.
 - b. Catalog number.
 - c. Horsepower ratings using both standard and time delay fuses.

SECTION 16440 - DISCONNECT SWITCHES

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- C. Horsepower Ratings:
 - 1. Horsepower rated switches for use as motor disconnecting means, with sizes in accordance with individual manufacturer's published ratings.
 - 2. For applications in excess of switch ratings, provide non-automatic molded case circuit breakers rated not less than 125% of motor full load current.
- D. Fuses: Current-limiting-type UL Class RK5 With a minimum interrupting rating of 100,000 RMS symmetrical amperes and of continuous current ratings as shown on Drawings.
- E. Enclosures:
 - 1. NEMA 1 for dry, indoor non-manufacturing areas.
 - 2. NEMA 12 for non-hazardous manufacturing areas.
 - 3. NEMA 4X for outdoor locations.
 - 4. NEMA 7 for hazardous locations.
- F. Acceptable Manufacturers:
 - 1. General Electric Company.
 - 2. Square-D Company.
 - 3. Thomas & Betts Corp.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Enclosure:
 - 1. Mount switch enclosure plumb and level and rigidly attach to structure.
 - 2. Mount 1 inch off structure with top 6'-6" above finished floor.
 - 3. Install supports in a manner to permit vertical flow of air behind enclosure.
 - 4. Use steel supports fabricated from standard rolled structural steel shapes as specified in Section 16190.
- B. Wiring: Install incoming and outgoing power circuits.
- C. Grounding: Refer to Section 16450.
- D. Fuses: Install properly rated fuses.

3.2 IDENTIFICATION

- A. Refer to Section 16195.

End of Section

Prepared By: J. W. Shaw

Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *E. G. Hemrick*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies grounding of electrical systems and equipment and grounding of conductive machine frames, enclosures, appliances, structures, and other equipment for protection of life, equipment, circuits, and systems.

1.2 QUALITY ASSURANCE

A. Applicable Standards:

1. IEEE 142.
2. NFPA 70, Article 250.
3. UL 467.

- B. NRTL Labeling or Listing: Furnish grounding fittings bearing label of or listing by a Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

1.3 SUBMITTALS

- A. Test Reports: Submit 2 copies of grounding system test report certified by testing technician and approved representative.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Conductors: Copper cable, refer to Section 16121.
- B. Exothermic Welding: Molds and charges by Erico Products, Inc. "Cadweld" or Continental Industries, Inc. "Thermoweld".
- C. Ground Rods: 3/4 inch diameter, 10 feet long, copperclad sectional ground rods.
- D. Grounding Clamps: O-Z/Gedney or Steel City "G" series.
- E. Connectors, Terminals, and Tape: Refer to Section 16121.
- F. Flexible Conduit Connectors: Refer to Section 16111.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install grounding system comprised of the following major components:

1. Steel reinforcing bars in steel column footings as grounding electrodes to provide connection to earth.
 2. Driven rod and cable ground loop connected to framing steel as a supplement to column footings, to provide connection to earth.
 3. Framing steel serving as grounding electrode conductors and as an equal-potential, highly conductive grid for connection of equipment that must be grounded.
 4. Continuous equipment grounding conductors in electrical raceways and cable runs to ensure positive path for connection of equipment that must be grounded.
- B. Connection of Steel Reinforcing Bars to Framing Steel: Connect column footing steel reinforcing bars to framing steel as detailed on structural Drawings.
- C. Ground Loop: Install No. 4/0 AWG ground loop with driven ground rods as shown on Drawings.
1. Bury conductor and drive ground rods 2'-6" below finished grade unless indicated otherwise.
 2. Connect conductor to conductor and conductor to ground rods using exothermic welds.
 3. Connect ground loop to framing steel using exothermic welds at locations shown on Drawings.
- D. Connection of Equipment to Framing Steel:
1. General: Connect No. 2 AWG and larger conductors to framing steel using exothermic welds. Connect conductors smaller than No. 2 AWG to framing steel by bolting conductor to a stud mounted in steel using a high-velocity powder actuated tool.
 2. Transformer Neutrals: Connect 9 KVA and larger transformer neutrals to framing steel using conductor sized in accordance with NEC Table 250-66 but no smaller than No. 2 AWG.
 3. Distribution Equipment: Connect ground bus in switchgear assemblies, motor control centers, motor control panelboards, and power panelboards to framing steel or building ground conductor using conductor sized in accordance with NEC Table 250-66 but no smaller than No. 2 AWG. No connection is required for power panelboards bolted directly to steel columns.
 4. Lightning Arresters and Surge Protection Capacitors: Install No. 2 AWG conductor from each set of lightning arresters or surge capacitors to nearest framing steel or building ground conductor.
- E. Equipment Grounding:
1. Install electrically continuous equipment grounding conductor sized per NEC Table 250-122, or as indicated on Drawings, in electrical raceways containing conductors rated higher than 30 volts.
 2. Bond grounding conductor to grounding bushings, grounding locknuts, grounding lugs, equipment, fixtures, enclosures, cable tray, and transformer neutrals.
- F. Flexible Metal Conduit: Install an external grounding jumper on flexible conduit runs longer than 6 feet.
1. Spiral wrap grounding conductor through a minimum of 360° around outside of flexible conduit.
 2. Terminate jumper and flex on each end with an insulated grounding fitting.

3. Size jumper same as equipment grounding conductor in flexible conduit but no smaller than No. 6 AWG.
- G. Expansion Joints: Install No. 4/0 AWG jumper with 6 inches of sag across structure expansion joints.
1. Bond jumper to framing steel on both sides of joint using exothermic welds.
 2. Install jumper every 50'-0" maximum along expansion joint with a minimum of two jumpers per expansion joint.
- H. Lightning Protection System: Provide where noted on Drawings.
1. UL 96A.
 2. Copper air terminals and components.
 3. Installers certified by Lightning Protection Institute and registered with Underwriters Laboratories.
 4. Attach air terminals and conductor to built-up roofing using adhesive approved by roofing material manufacturer and suitable for this application.
 5. Install air terminals and conductors without roof penetrations by fasteners, conductors, or other components unless detailed otherwise on Drawings.
 6. Provide spring loaded flathead air terminals for protection against accidental contact with terminal point.
 7. Obtain system certification as a "Master Label C" system.

3.2 FIELD QUALITY CONTROL

- A. Tests: After complete erection of framing steel and installation of grounding system, measure ground resistance using the three terminal "Fall-of-Potential" method.
1. Comply with IEEE 81.
 2. Space electrodes so that potential electrode is located from the reference starting point a distance equal to 62% of the sum of the distances from the reference starting point of the test object and the current electrode.
- B. Testing Firm: Employ independent testing firm using NETA certified testing technicians.
- C. Test Values: Maximum resistance value of ground electrode system is not to exceed 5 ohms. If test results exceed 5 ohms, proceed as directed.

End of Section

Prepared By: J. W. Shaw

Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *E. G. Hemrick*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies general purpose and specialty dry-type transformers with windings rated 600 Volts or less.

1.2 QUALITY ASSURANCE

A. Applicable Standards:

1. ANSI/IEEE C57.12.01.
2. NEMA ST 1.
3. NEMA ST 20.
4. UL 506.
5. UL 1561.

- B. NRTL Labeling or Listing: Furnish transformers bearing the label of a Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

1.3 SUBMITTALS

- A. Submit Product Data on each transformer showing ratings, number of phases, winding configuration, KVA capacities, overall dimensions, and weight.
- B. Submit 1 copy of manufacturer's sound rating certification.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. General: Provide transformers with the following characteristics:

1. Overload capability in accord with IEEE C57.96
2. Ratings, Configurations, and Capacities: Primary and secondary voltage ratings, number of phases, winding configuration, and KVA capacities as shown on the Drawings.
3. Windings: Two winding, totally enclosed, non-ventilated, self-cooled.
4. Primary Taps:
 - a. Below 30 KVA: 2@ 5% FCBN.
 - b. 30 KVA and Above: 2@ 2-1/2% FCAN and 4@ 2-1/2% FCBN.
5. Insulation: Class 220.
6. Average Temperature Rise (Over 40°C Ambient): 115°C.

SECTION 16461 - DRY-TYPE TRANSFORMERS

7. Sound Rating: Do not exceed ANSI and NEMA maximum levels for specified KVA capacities.
 8. Enclosure: Suitable for outdoor marine locations with a wiring compartment suitable for conduit entry.
- B. Acceptable Manufacturers:
1. Cutler Hammer.
 2. General Electric Company.
 3. Square D

PART 3 - EXECUTION

3.1 INSTALLATION.

- A. Mounting: Refer to Drawings and to Section 16190 for proper support and anchorage.
- B. Raceway Connections: Connect raceways to transformer enclosure using flexible conduit as specified in Section 16111. Use pieces of flex approximately ten diameters in length.
- C. Wiring: Terminate wiring connections in accordance with Section 16121.
- D. Grounding: Refer to Section 16450.

End of Section

Prepared By: J. W. Shaw

Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *EGH*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies circuit breaker panelboards for use in control and protection of lighting, receptacle, and general power loads rated 600 volts or less.

1.2 QUALITY ASSURANCE

- A. Applicable Standards:

- 1. NEMA PB 1.
- 2. NEMA PB 1.1.
- 3. UL 67.

- B. NRTL Labeling or Listing: Furnish panelboards bearing the label of a Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

1.3 SUBMITTALS

- A. Submit Product Data on each panelboard including:

- 1. Enclosure dimensions and type.
- 2. Voltage and number of phases.
- 3. Bus material, ampere rating, and bracing.
- 4. Overcurrent device frame designations, trip ratings, and interrupting rating.
- 5. Customer's panelboard designation.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. General: Feed-through panelboards and "Load Center" panelboards are not permitted. Conform to schedules as shown on Drawings. Each schedule shall indicate:

- 1. Panelboard designation.
- 2. Arrangement diagram.
- 3. Current and voltage ratings for each component.

- B. Acceptable Manufacturers: Single source manufacture is required. Provide factory-assembled panelboards as follows:

- 1. Power, Lighting, and Receptacle Panelboards:

SECTION 16470 - PANELBOARDS

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- a. 480/277 Volt:

| <u>Manufacturer</u> | <u>Type</u> |
|----------------------|-------------|
| Cutler Hammer | PRL2 |
| General Electric Co. | AE |
| Square D Co. | NF |

- b. 208/120 or 120/240 Volt:

| <u>Manufacturer</u> | <u>Type</u> |
|----------------------|---------------|
| Cutler Hammer | PRL1(Bolt-on) |
| General Electric Co. | AQ |
| Square D Co. | NQOD |

- C. Bus Work: Copper bus bars, isolated neutral bar as indicated on schedules, and grounding bar. Bond grounding bar to panelboard enclosure. Feed-through panelboards and "Load Center" panelboards are not permitted.
- D. Enclosure:
1. General: Refer to Section 16160.
 2. Minimum Widths:
 - a. Power Panelboards: 24 inches.
 - b. Lighting and Receptacle Panelboards: 20 inches.
- E. Enclosure Doors and Trim:
1. Door Locks: Provide each door with a pin-cylinder type lock. Key locks alike.
 2. NEMA 1 Door/Trim: Steel with primed and baked-on gray enamel and of "door-in-door" construction.
 - a. Hinge outer door to box so that access to wiring gutters is provided.
 - b. Hinge inner door to outer door so that dead-front access to the overcurrent device operators is provided.
- F. Circuit Breakers: Refer to Section 16475. Trip ratings, frame sizes, and interrupting ratings are shown on Drawings.
- G. Panelboard Directory: Provide each panelboard with a circuit directory card mounted in a holder located on inside of door.

- H. Padlocks: Provide power panelboards with provisions for padlocking individual circuit breakers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Enclosure:

1. Mount enclosures plumb and level, 6'-6" to top, and rigidly attach to structure using materials and methods specified in Section 16190.
2. Install surface mounted units in a manner to permit vertical flow of air behind cabinets and enclosures.
3. Clean interiors before installing trim.
4. Close unused circuit positions with blanking plates.

B. Wiring:

1. Install wiring in accordance with Section 16121.
2. Check buses for proper insulation resistance prior to energizing.
3. Connect grounding conductors and conduit bushing grounding terminals to panelboard grounding bar.

- C. Circuit Breakers: Set circuit breaker instantaneous trip adjustments to minimum setting unless designated otherwise on Drawings.

3.2 APPLICATION

- A. Power and Lighting and Receptacle Type Panelboards: As designated by Panelboard Schedules on Drawings.
- B. Enclosure: NEMA 1 for indoor locations unless indicated otherwise on Drawings.

3.3 IDENTIFICATION

- A. Refer to Section 16195.

End of Section

SECTION 16475 - MOLDED CASE CIRCUIT BREAKERS

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Prepared By: J. W. Shaw

Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *EGH*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies molded case circuit breakers in individual enclosures, panelboards, combination motor starters, and control panels.

1.2 QUALITY ASSURANCE

A. Applicable Standards:

1. NEMA AB 1.
2. UL 489.

- B. NRTL Labeling or Listing: Furnish circuit breakers bearing label of a Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

1.3 SUBMITTALS

- A. Submit Product Data on each circuit breaker showing ratings, overall dimensions, enclosure type, and accessories.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. General:

1. Voltage rating for the point of application, frame size, trip rating, and interrupting rating are noted on Drawings.
2. Provide individually enclosed and panelboard mounted circuit breakers of thermal-magnetic type rated for operation in a 40°C ambient.
3. Provide breakers in lighting panelboards rated "SWD" for switching lighting.
4. Provide breakers used in combination with motor starters with adjustable instantaneous trips.
5. Provide shunt trip devices, motor operators, interlocks, auxiliary contacts, bell alarm switches, and other modifications as noted on Drawings or specified in Section 16481.
6. Provide enclosures specified in Section 16160. Do not use trunk-type latches on enclosures.

B. Enclosures:

1. NEMA 1 for dry, indoor non-manufacturing areas.
2. NEMA 12 for non-hazardous manufacturing areas.
3. NEMA 4X for outdoor locations.
4. NEMA 7 for hazardous areas.

C. Acceptable Manufacturers:

SECTION 16475 - MOLDED CASE CIRCUIT BREAKERS

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1. Cutler Hammer.
2. General Electric Company.
3. Square-D Company.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Mounting: Refer to Section 16190. Mount individually enclosed circuit breakers with top of enclosure 6'-6" above finished floor unless indicated otherwise on Drawings.
- B. Trip Settings:
 1. Set adjustable instantaneous trips to minimum, unless indicated otherwise on Drawings.
 2. On magnetic breakers in combination with starters, set trips at lowest value that will permit motor starting, but not higher than 13 times motor nameplate full-load current.

3.2 IDENTIFICATION

- A. Refer to Section 16195.

End of Section

Prepared By: J. W. Shaw

Checked By: J. W. Shaw *gms*

Approved By: E. G. Hemrick *EGH*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies luminaires and associated ballasts and lamps used in interior spaces and exterior of buildings.

1.2 QUALITY ASSURANCE

- A. NRTL Labeling or Listing: Furnish luminaires bearing the label of a Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.
- B. Ballast Certification: Certified Ballast Manufacturers certification by Electrical Testing Laboratories, Inc. is required for ballasts.

1.3 SUBMITTALS

- A. Submit Product Data for each type of luminaire indicating:
 - 1. Dimensions and weight.
 - 2. Operating voltage.
 - 3. Type and number of lamps.
 - 4. Type of ballast (if any).
 - 5. Photometric data.
 - 6. Identify each Product Data sheet with fixture type designation.

1.4 WARRANTY

- A. Guarantee and replace at no additional expense, ballasts which fail in normal service or generate noise in excess of the published sound rating within a 2 year period following final acceptance or use as described below.
 - 1. Upon written notification, specific areas may be occupied for installation of production machinery or other purposes prior to final acceptance of entire Project.
 - 2. In that circumstance, install necessary lamps and place luminaires in operation.
 - 3. Replace failed or burned out lamps in these areas until Project acceptance has occurred.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Luminaires: Luminarie types with manufacturer's identification and lamp data are scheduled on "Luminaire Schedule" located on Drawings.
- B. Recessed Luminaires: Recessed luminaires are identified in "Luminaire Schedule" by manufacturer's general type or style designation only. Provide recessed luminaries that are

fully coordinated mechanically and dimensionally with ceiling system in which they are installed.

C. Ballasts:

1. General: Specific ballast type per luminaire is included on "Luminaire Schedule" located on Drawings.
2. Hazardous Materials: Do not provide ballasts containing "Askarel" or other toxic/hazardous materials.
3. Fluorescent Ballasts: High power factor, UL "Class P", electronic ballasts with manufacturer's best sound rating for lamp current and primary voltage required.
 - a. Secure ballast to fixture housing by means of screws.
 - b. Total Harmonic Distortion (THD) for electronic ballasts not to exceed 32%, 27.5% of the third triplets.
 - c. Lamp current crest factor maximum of 1.7.
 - d. Meet or exceed ANSI C82.11 requirements.
 - e. Withstand line transients per IEEE 587, Category A
 - f. Comply with FCC Rules and Regulations, part 18.
 - g. Ballast case temperature not to exceed 25 deg C rise over 40 deg C ambient.
 - h. Parallel wiring between ballast and fixture is recommended.
 - i. End-of-life shutdown circuit.
 - j. Minimum 5 year warranty required.
 - k. Minimum 5 year experience in manufacturing electronic ballast.
4. High Intensity Discharge (HID) Ballasts:
 - a. Suitable for type of HID lamp used with proper primary voltage ratings, and with secondary open circuit voltage minimum consistent with lamp start characteristics.
 - b. High power factor, constant wattage type, rated for operation in 40°C ambient.
 - c. Circuited so that currents in excess of lamp operating current will not occur during lamp rectification or warm up.
5. Special Requirements: Low temperature, dimming, flashing, or other special operating modes are stated on "Luminaire Schedule" located on Drawings.

D. Lamps: Full complement of new lamps of correct wattage, shape, color and rating, as designated on "Luminaire Schedule" located on Drawings. Provide lamps manufactured by one of the following:

1. General Electric Company.
2. North American Philips Lighting Corporation.
3. Osram Sylvania, Inc.

E. Poles and Accessories: Poles and other mounting accessories with manufacturer's identification are scheduled on the "Luminaire Schedule" located on Drawings or detailed on Drawings. Provide each pole with gasketed hand-hole for access to branch circuit wiring.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install luminaires securely in precise alignment with axes, level and plumb using supports as specified in Section 16190 and in accordance with manufacturer's recommendations. Eliminate light leaks from enclosed luminaires.
- B. Recessed Luminaires:
1. Support:
 - a. Tile Ceilings: Where installed in suspended acoustical tile ceilings using inverted T-bars with lay-in tiles, weight of luminaire may be imposed directly on T-bars. Each fixture shall be screwed to the main runner of the suspended ceiling track at all four corners using sheet metal screws. In addition, each fixture to be supported at 2 opposite corners by a wire attached to the structural steel frame of the building. Utilize the same type wire used to support the suspended tile ceiling.
 - b. Gypsum Board and Plaster Ceilings: Support luminaires with 3/8 inch diameter threaded hanger rods secured to main ceiling suspension structure or supplementary horizontal steel members as required and secured to luminaire housing, using two nuts at each end of rod.
 2. Connection: Connect each luminaire to conduit system by means of "Greenfield" type flexible conduit and fittings as specified in Section 16111. Install flexible conduit connections in lengths of no more than 6 feet and no less than 4 feet.
- C. Fluorescent Pendant Luminaires Supports:
1. Furred Ceilings: Where installed below furred ceiling and with concealed wiring, use factory-finished stems and canopies which match luminaire.
 - a. Secure stems used in wiring to fixture stud in outlet box supported from building structure.
 - b. For stems not used in wiring, use 3/8 inch diameter hanger rods secured to main ceiling suspension structure or supplementary horizontal steel members as required, and extending through ceiling into canopy.
 - c. Do not exceed 48 inch stem spacing.
 2. Exposed Construction:
 - a. Where support is used in wiring to luminaire, use a universal joint type conduit fitting at top and bottom of 1/2 inch rigid conduit stem and a ball joint box connector fitting at luminaire channel.
 - b. For supports not used in wiring, install 3/8 inch diameter hanger rods with swivel connections at top and bottom.
 - c. Do not exceed 48 inch support spacing.
- D. Grounding: Connect each luminaire housing to equipment grounding conductor by means of a crimped spade-type terminal connector secured to housing with a self-tapping screw or housing grounding lug.
- E. Lamps: Clean luminaire prior to lamp installation. Install lamps and energize lighting system to check for proper operation. Perform corrections to lighting system.
1. Do not install lamps before two weeks prior to date established for final acceptance or use.
 2. Do not utilize permanent lighting system for construction purposes.

SECTION 16510 - LUMINAIRES

End of Section

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SECTION 16535 - EMERGENCY LIGHTING

Prepared By: J. W. Shaw

352

Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *EA*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies fully automatic, storage battery operated, self-contained, emergency lighting units and exit signs.

1.2 QUALITY ASSURANCE

- A. NRTL Labeling or Listing: Furnish units bearing the label of a Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

1.3 SUBMITTALS

- A. Submit Product Data for each type of luminaire indicating:
 - 1. Dimensions and weight.
 - 2. Battery type, voltage, and quantity per unit.
 - 3. Operating voltage.
 - 4. Type and number of lamps.
 - 5. Type of ballast (if any).
 - 6. Photometric data.
 - 7. Identify each Product Data sheet with fixture type designation.
- B. Submit typewritten inventory, with full descriptive data, of lamps required for the Project and 6 copies of manufacturer's recommended maintenance instructions covering each unit.

1.4 WARRANTY

- A. Guarantee and replace at no additional expense units which fail in normal service or when tested within a 3 year period following final acceptance or use as described below. An extended pro-rated warranty for 2 additional years is required for the batteries. Include warranty in contract documentation.
 - 1. Upon written notification specific areas may be occupied for erection of production machinery or other purposes prior to final acceptance of entire Project.
 - 2. In that circumstance, install necessary lamps and place luminaires in operation.
 - 3. Additional lamping will not be required in occupied areas prior to Project acceptance unless lamp failures or burn-outs occur.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. General: UL 924. Fully automatic, self-contained, portable emergency lighting units and exit signs. Types with manufacturer's identification are scheduled on "Luminaire Schedule" located on Drawings.

- B. Housing: Minimum 20 gauge steel housing with manufactures standard finish and hardware for fastening to a mounting bracket.
- C. Batteries: 12 volt, sealed, lead acid, plastic encased storage battery with not less than 1-1/2 hours backup capacity. Life expectancy 10 years. Batteries designed to operate in a temperature range from 0 to 60 deg C. Battery case contains a resealable pressure vent and sintered positive and negative terminals.
- D. Battery Charger: Automatic, full wave rectifying with current limiting, temperature compensated, pulse type battery charger with reverse polarity and short circuit protection. Charger restores batteries to full charge within 24 hours after a discharge of 90 minutes under full rated load.
- E. Controls:
 - 1. Activated when supply voltage drops below 80 percent.
 - 2. Sealed transfer relay.
 - 3. Automatic protection against battery deep discharge.
 - 4. "ON-Off" switch mounted on housing with an indicating light to show when charger is operating at high rate, a second light to indicate when battery is fully charged, a high rate charge pilot light unless self-diagnostic type charger, and a test button to momentarily break AC supply to test lamps.
- F. Lamps: Number, type, and wattage of lamps are shown on "Luminaire Schedule" located on Drawings.
- G. Accessories: Steel mounting bracket, adjustable luminaire brackets on non-fluorescent units, and a junction box for conduit connections.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mounting: Mount units 8 feet above finished floor in unfinished areas and 1 foot below ceiling to top of housing in finished areas using fastenings specified in Section 16190 and in accordance with manufacturer's recommendations.
- B. Connection: Connect each unit to conduit system by means of "Greenfield" type flexible conduit as specified in Section 16111. Install flexible conduit in lengths a maximum of 3 feet and a minimum of 1 foot.
- C. Grounding: Connect each unit housing to equipment grounding conductor by means of a crimped spade-type terminal connector secured to housing with a self-tapping screw.
- D. Lamps: Clean luminaires prior to lamp installation. Install lamps and check unit for proper operation.
- E. Testing: Test each unit 10 days prior to final inspection by State Construction Office. After battery has been charged for 24 hours, test for 90 minutes. Repair or replace any unit with fails. Submit copy of test report to State Construction Office.

End of Section

SECTION 16950 - ACCEPTANCE TESTING AND CALIBRATION

Prepared By: J. W. Shaw

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Checked By: J. W. Shaw *JWS*

Approved By: E. G. Hemrick *EGH*

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section specifies testing low voltage power circuit breakers.

1.2 QUALITY ASSURANCE

- A. National Electrical Testing Association (NETA) membership is required for firm performing tests.

1.3 SUBMITTALS

- A. Submit two bound copies of test reports certified by testing technician and approved representative authorized to witness tests.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TESTING AND ACCEPTANCE

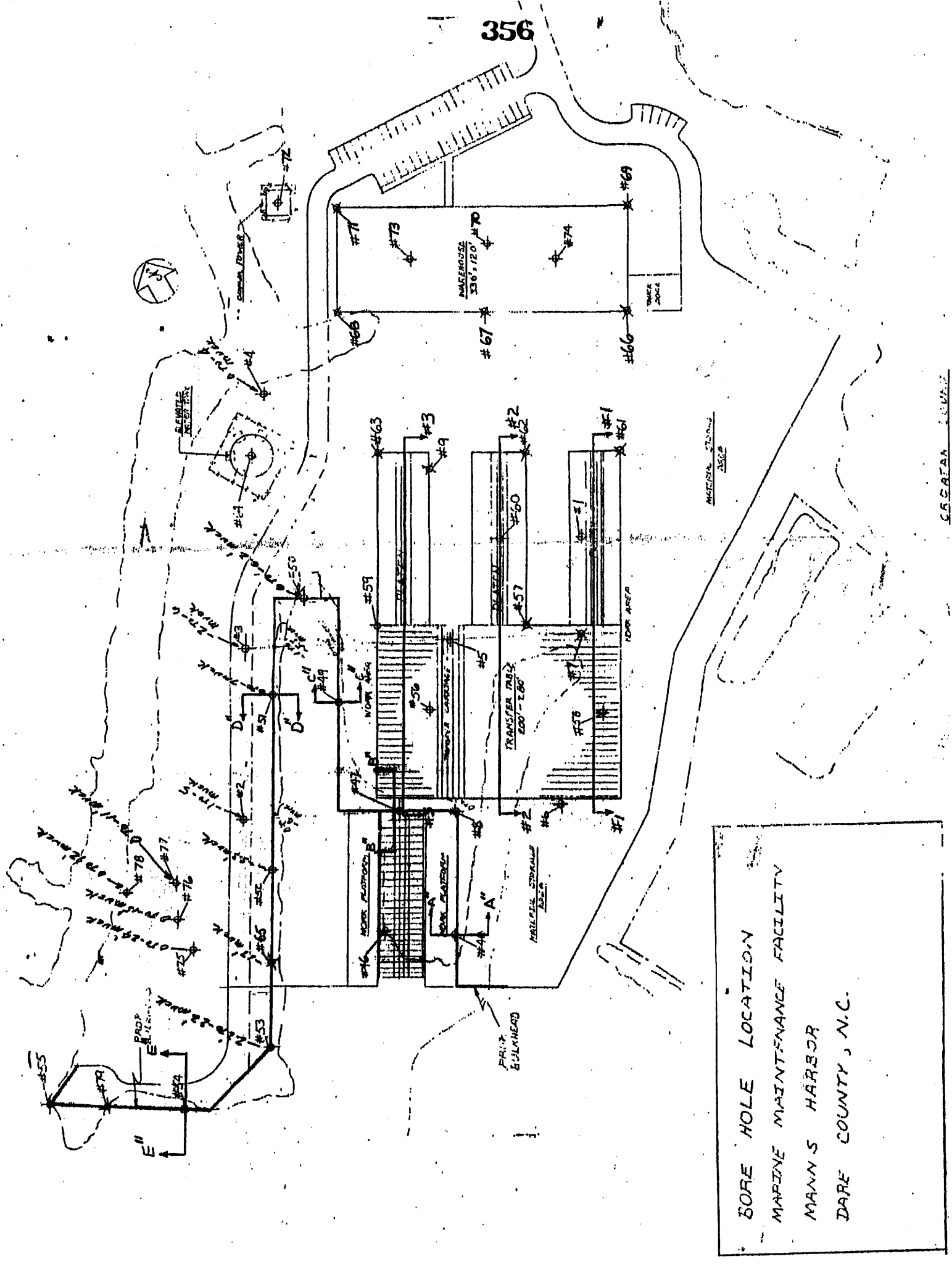
- A. General: Completely document testing indicating time of day, date, temperature, and all pertinent test information.
- B. NFPA 70B. Institute and maintain following precautions during testing requiring applications of potentials above 30 volts:
 - 1. Erect barricades around testing areas and post warning signs.
 - 2. Station watchmen to ensure unauthorized persons do not approach energized conductors and components.
 - 3. Maintain telephone or voice radio contact between potential injection point and energized remote locations.
- C. Feeder Insulation Testing. Test all phase and neutral conductors with 500 volt resistance tester. Minimum acceptable values are shown below for insulation resistance between conductors and grounding conductor.
 - 1. Minimum reading 1,000,000 ohms for #6 AWG wire and smaller.
 - 2. Minimum reading 250,000 ohms for #4 AWG and larger.
- D. Panelboard Resistance Testing: Disconnect neutral feeder conductor from the neutral bar of each panelboard after all fixtures, devices, and equipment are installed. Test between neutral bar and grounded enclosure. If reading is less than 250,000 ohms, disconnect the branch circuits from the neutral bar and test each individual neutral until cause of low reading is found. Reconnect each neutral conductor as it is tested and retest between neutral bar and enclosure

after all neutral conductors are reconnected.

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- E. Tests: Refer to manufacturer's test instructions. Determine and record the following data:
- a. Breaker identification, including Project designation, manufacturer's ratings, serial number, trip device type, ranges, and time bands.
 - b. Perform tests at operating trip device settings as specified. Include this information in report plus record of settings "as left" after calibration and adjustment of trip devices for conformance with required pickup characteristics.
 - c. Apply sufficient current to actuate each mode of trip device (long time pickup, long time delay band, short time pickup, short time delay band, instantaneous pickup, ground pickup, and ground delay band as applicable). Record test current and elapsed time at tripping for each pole. State whether or not breaker tripping is within manufacturer's tolerances.
 - d. Perform insulation resistance test on each breaker. With contacts closed apply 1000 volts DC and take resistance readings after one minute energization between each pair of poles and from each pole to breaker frame.

End of Section



SORE HOLE LOCATION
 MARINE MAINTENANCE FACILITY
 MANN S HARBOR
 DARE COUNTY, N.C.

Mr. J. F. Ledbetter



357

RECEIVED 2/21/79
GPA

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

February 2, 1979

DIVISION OF HIGHWAYS

JAMES B. HUNT, JR.
GOVERNOR

THOMAS W. BRADSHAW, JR.
SECRETARY

STATE PROJECT: O.10561
COUNTY: Dare
DESCRIPTION: Marine Maintenance Facility at Manns Harbor

MEMORANDUM TO: Mr. W. D. Bingham

FROM: G. L. Bunch

SUBJECT: Foundation Test Borings

Attached are additional completed borings for the proposed Marine Maintenance Facility at Manns Harbor, along with a sketch showing boring locations. Logs included are for borings 48, 49, 49A, 50A, 51A, 52, 52A, 53, 53A, 54A, 59, 59A. Borings 49A, 50A, etc. are auger borings made adjacent to SPT borings to confirm thickness of underlying muck layers. Additional level notes will be provided as soon as they are available.

Attention should be directed to the extreme depth of muck and very soft silt-clay soils in the vicinity of boring 53 and 54. (Auger boring only at 54).

cc: Mr. J. F. Ledbetter

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
FOUNDATION BORING LOG SHEET 1 OF 1

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PROJECT NO. 0.10561 COUNTY DARE GEOLOGIC PROVINCE COASTAL PLAIN
BRIDGE ON MANNS HARBOR FERRY BASIN OVER _____
BORING LOCATION (STA.) _____ OFFSET _____
BORING NO. 48 GEOLOGIST T.B. DANIEL GROUND WATER 0 HRS. _____ 24 HRS. 1.8'
COLLAR ELEV. 2.1 DATE STARTED 1-26-79 DRILL EQUIPMENT MUD BUG
TOTAL DEPTH 50.1 DATE COMPLETED 1-30-79 HOLLOW AUGERS ; S.P.T.

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|--|------------------|--------|-----------------|
| | | 6" | 6" | 6" | | | | |
| 2.1 | 0 | | | | | | | |
| -0.4 | 2.5 | | | | 0-12.50 FESS FILL - MUCK | | | |
| -2.9 | 5.0 | 1 | - | 1 | MUCK | W | 0 1 | |
| -5.4 | 7.5 | 2 | 2 | 1 | MOST LOST - GRAY SILT SAND A-2.4 | W.B. | 0 3 | |
| -7.9 | 10.0 | 1 | 1 | 2 | GRAY SILT SAND A-3 | " | 0 3 | |
| -11.5 | 13.6 | 1 | 3 | 3 | GRAY-GRN SILT SAND W/SOME ROOTS A-2.4 | " | 0 6 | |
| -16.5 | 18.6 | 1 | 2 | 3 | 1/2" PLUS WASHED LST GRAY-GRN SILT SAND W/ 2% GRAVEL A-1-D | " | 0 5 | |
| -21.5 | 23.6 | 2 | 2 | 3 | 2" PLUS WASHED SAMPLE AS ABOVE A-1-D | " | 0 5 | |
| -26.5 | 28.6 | 4 | 5 | 4 | 6 SD 2" PLUS WASHED SAMPLE LOST | " | 0 9 | |
| -31.5 | 33.6 | 6 | 4 | 6 | 5 SD 2" PLUS WASHED GRAY SILT SAND A-3 | W.B. | 0 10 | |
| -36.5 | 38.6 | 1 | 2 | 9 | 3 SD 2" PLUS WASHED 10% GRN SILT SAND W/ FINE SAND A-2.4 GRN SILT SAND = SAND A-3 | " | 0 11 | |
| -41.5 | 43.6 | 5 | 8 | 16 | 2 SD 2" PLUS WASHED SAMPLE LOST | " | 0 24 | |
| -46.5 | 48.6 | 5 | 12 | 19 | 2 1/2" SD 2" PLUS WASHED GRAY SILT FINE SAND W/ SOIL FRILLS A-2.4 | W.B. | 0 31 | |
| | | 4 | 3 | 3 | 1 1/2" PLUS WASHED SAMPLE AS ABOVE W/ MAKE CELLS A-1-B/A-2.4 | " | 0 8 | |

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|-----------------------|--------------------|-------------------|------------------------------|
| EST. % WT. WATER | COHESIVE | GRANULAR | |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | |
| WET 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | |
| WATER BEARING - W. B. | STIFF 9-15 BPF | DENSE 25-50 BPF | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | |
| | HARD 31-60 BPF | | |
| | V. HARD OVER 60 | | |

DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
FOUNDATION BORING LOG SHEET OF 360

PROJECT NO. 0.10561 COUNTY Dare GEOLOGIC PROVINCE Coastal
 BRIDGE ON Manns Harbor Ferry Basin OVER _____
 BORING LOCATION (STA.) _____ OFFSET _____
 BORING NO. 49 GEOLOGIST E.A.W. GROUND WATER 0 HRS. _____ 24 HRS. 2.5'
 COLLAR ELEV. 2.6' DATE STARTED 1-30-79 DRILL EQUIPMENT B-52 Mobile
 TOTAL DEPTH 53.4' DATE COMPLETED 1-31-79 w/ hollow stems S.P.T.

| ELEV. 2.6 | DEPTH 0.0 | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|--------------|--------------|------------|----|----|-----------|--|--------|-----------------|
| | | 5" | 5" | 5" | | | | |
| 0.7 | 1.9 | 2 | 4 | 2 | 1 | | | |
| | | | | | | GRY F. D. BRN DRG. F. SAND TAN F. SAND (3.5') | W | |
| -4.3 | 6.9 | 1 | 2 | 3 | 2 | TAN F. SAND | WG | |
| -9.3 | 11.9 | 2 | 5 | 7 | 3 | TAN F. SAND | WR | |
| -14.3 | 16.9 | 3 | 7 | 7 | | SAME AS ABOVE | " | |
| -20.3 | 21.9 | 5 | 4 | 5 | | LOST SAMPLE - FINE SAND | " | |
| -24.3 | 26.9 | 6 | 4 | 6 | | LOST SAMPLE / USING CATWALK TRACE OF TAN F. SAND | " | |
| -29.3 | 31.9 | 1 | - | 1 | | GRAY SILTY F. SAND LOST MOST OF SAMPLE | " | |
| -34.3 | 36.9 | 5 | 9 | 14 | 4 | DRILLS FIRM AT 35.5' GRAY F. SAND W/ SHELL FRAGMENTS | " | |
| -39.3 | 41.9 | 4 | 10 | 10 | | SAME AS ABOVE | " | |
| -44.3 | 46.9 | 4 | 4 | 6 | | SAME AS ABOVE | " | |
| -49.3 | 51.9 | 7 | 10 | 19 | | SAME AS ABOVE | " | |

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. | |
|-----------------------|--------------------|-------------------|------------------------------|------|
| EST. % WT. WATER | COHESIVE | GRANULAR | | |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | 5.5 | 51.9 |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | 2.6 | 1.5 |
| WET 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | 1.9 | 3.2 |
| WATER BEARING - W. B. | STIFF 9-15 BPF | DENSE 25-50 BPF | 1.0 | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | 3.8 | |
| | HARD 31-60 BPF | | | |
| | V. HARD OVER 60 | | | |

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
FOUNDATION BORING LOG SHEET OF

364

PROJECT NO. 0.16561 COUNTY Dare GEOLOGIC PROVINCE Coastal
 BRIDGE ON Manns Harbor Ferry Basin OVER _____
 BORING LOCATION (STA.) _____ OFFSET _____
 BORING NO. 52 GEOLOGIST FAW GROUND WATER 0 HRS. _____ 24 HRS. 3.5'
 COLLAR ELEV. 3.4' DATE STARTED 1-26-79 DRILL EQUIPMENT B-52 w/ hollow
 TOTAL DEPTH 53.2' DATE COMPLETED 1-30-79 stem Augers S.P.T.

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|-----------|---------------------------------------|--------|-----------------|
| | | 5" | 6" | 6" | | | | |
| 3.4 | 0.0 | | | | | | | |
| 1.7 | 1.7 | 2 | 2 | 1 | 1 | TAN F. SANDS FILL | M | |
| | | | | | | MUCK @ 3 1/2' - 4 1/2' | W | |
| -3.3 | 6.7 | 2 | 6 | 8 | 2 | TAN F. SAND | WD | |
| | | | | | | DRILLS FIRM | | |
| -8.3 | 11.7 | 2 | 4 | 6 | 3 | LT. GRAY F. SAND A-5 | WB | |
| | | | | | | LOST SAMPLE - M. DENSE SANDS | " | |
| -13.3 | 16.7 | 5 | 9 | 10 | | | | |
| | | | | | | LOST SAMPLE - LOOSE SAND | " | |
| -23.3 | 26.7 | 1 | 2 | 3 | 4 | TAN FINE SAND A-3 | " | |
| | | | | | | | | |
| -28.3 | 31.7 | | 1 | 1 | 5 | BRN, CLY. F. SDY. SILT A-4 | WB | |
| | | | | | | | | |
| -33.3 | 36.7 | 3 | 3 | 9 | | LOST SAMPLE - SAND A-2-4 | " | |
| | | | | | | | | |
| -38.3 | 41.7 | 4 | 4 | 9 | 6 | GRAY F. SAND w/ SHELL FRAGMENTS A-2-4 | " | |
| | | | | | | | | |
| -43.3 | 46.7 | 6 | 6 | 8 | | SAME AS ABOVE LOST MOST OF SAMPLE | " | |
| | | | | | | | | |
| -48.3 | 51.7 | 3 | 3 | 5 | | SAME AS ABOVE LOST MOST OF SAMPLE | " | |
| | | | | | | | | |

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. | |
|-----------------------|--------------------|-------------------|------------------------------|------|
| EST. % WT. WATER | COHESIVE | GRANULAR | S.S. | 26.7 |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | 3.0 | 113 |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | | |
| WET 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | 1.7 | 232 |
| WATER BEARING - W. B. | STIFF 9-15 BPF | DENSE 25-50 BPF | | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | | |
| | HARD 31-60 BPF | | | |
| | V. HARD OVER 60 | | | |

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
FOUNDATION BORING LOG SHEET OF
365

PROJECT NO. 0.10561 COUNTY Dare GEOLOGIC PROVINCE Coastal
~~BRIDGE ON~~ Manns Harbor Ferry Basin OVER
 BORING LOCATION (STA.) OFFSET
 BORING NO. 52A GEOLOGIST EAW GROUND WATER 0 HRS. 24 HRS 3.5'
 COLLAR ELEV. 3.4' DATE STARTED 1-30-79 DRILL EQUIPMENT B-52 Mobile w/
 TOTAL DEPTH 12.0' DATE COMPLETED 1-30-79 6" Augers

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|-----------------------|------------------|--------|-----------------|
| | | 6" | 6" | 6" | | | | |
| 3.5 | 0.0 | | | | | | | |
| | | | | | 0-3 1/2' TAN F. SAND | M | | |
| | | | | | -4 1/2' MUCK | W | | |
| | | | | | -10' TAN FINE SAND | WB | | |
| | | | | | -12' LT. GRAY F. SAND | " | | |
| | 10.0 | | | | | | | |

| SOIL MOISTURE | | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|----------------------|--------|--------------------|-------------------|------------------------------|
| EST. % WT. WATER | | COHESIVE | GRANULAR | |
| DRY | 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | |
| MOIST | 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | |
| WET | 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | |
| WATER BEARING - W.B. | | STIFF 9-15 BPF | DENSE 25-50 BPF | |
| | | V. STIFF 16-30 BPF | V. DENSE OVER 50 | |
| | | HARD 31-60 BPF | | |

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
 DIVISION OF HIGHWAYS
 GEOTECHNICAL UNIT
 FOUNDATION BORING LOG SHEET 1 OF 1
366

15.5
 1.1
 12.2

PROJECT NO. 010561 COUNTY DARE GEOLOGIC PROVINCE COASTAL PLAIN
 BRIDGE ON MANNA'S HARBOR FERRY BASIN OVER _____
 BORING LOCATION (STA.) _____ OFFSET _____
 BORING NO. 53 GEOLOGIST T.B. DANIEL GROUND WATER 0 HRS. 24 HRS 1.3
 COLLAR ELEV. _____ DATE STARTED 1-31-79 DRILL EQUIPMENT Mud Bug
 TOTAL DEPTH 55.9 DATE COMPLETED " HOLLOW AUGERS, S.P.T.

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|---|---|--------|-----------------|
| | | 6" | 6" | 6" | | | | |
| | 0 | | | | | | | |
| | 2.5 | | | 1 | 0-2 MIXED SILT SAND & MUCK | | | |
| | 5.0 | | | 1 | MUCK & PEAT | W | 0 1 | |
| | 7.5 | 1 | 1 | 1 | AS A-2-4 LAST 1/2 FEET - SILT - MED SAND A-2-4 | W.B. | 0 1 | |
| | 10.0 | 1 | 1 | 1 | 1/2" SAND PLUG - SAMPLE LOST | " | 0 2 | |
| | 14.4 | 1 | 1 | 1 | 2' SD P. IS WASHED PEAT & MUCK | | 0 1 | |
| | 19.4 | PUSH | | | 1 | 3' PLUG WASHED GRAY SILTY CLAY SILT w/ SOME OYS. MAR. A-2/A-7-5 | M | 0 0 |
| | 24.4 | 1 | 1 | 1 | 1/2' PLUG WASHED GRAY SILTY FINE SAND w/ SOME SILTY LAYERS A-2-4 | W.B. | 0 2 | |
| | 29.4 | 3 | 5 | 1 | 1' SD PLUG WASHED SAMPLE LOST | | 0 6 | |
| | 34.4 | 2 | 2 | 3 | 2' SD & SILT PLUG WASHED GRAY SILTY FINE SAND T. SAND AND SILT F. SAND A-2-4/A-4 | W.B. | 0 7 | |
| | 39.4 | 4 | 7 | 8 | 2' SD & SILT PLUG - MOST SAMPLE LOST GRAY SILTY FINE SAND H-3 | " | 0 15 | |
| | 44.4 | 8 | 10 | 16 | 4' SD & SILT PLUG - DROVE .5' PLUG SAMPLE LOST | | 0 26 | |
| | 49.4 | 2 | 2 | 7 | 2' SD & SILT PLUG WASHED GRAY SILTY FINE SAND w/ MANY SHELLS H-2-4 | W.B. | 0 9 | |
| | 54.4 | 5 | 6 | 8 | 1/2' SD & SILT PLUG WASHED SAMPLE AS ABOVE A-2-4 | " | 0 14 | |

| PRELIMINARY FOUNDATION INFO. | |
|------------------------------|--|
| | |
| | |
| | |
| | |

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
FOUNDATION BORING LOG SHEET 1 OF 1

15.7
1.8
13.7

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PROJECT NO. 0.10561 COUNTY DARE GEOLOGIC PROVINCE COASTAL PLAIN
 BRIDGE ON MANNA'S HARBOR FERRY BASIN OVER _____
 BORING LOCATION (STA.) _____ OFFSET _____
 BORING NO. 59 GEOLOGIST T.B. DANIEL GROUND WATER 0 HRS. _____ 24 HRS. 3.5
 COLLAR ELEV. _____ DATE STARTED 1-30-79 DRILL EQUIPMENT Mud Bug
 TOTAL DEPTH 25.2' DATE COMPLETED _____ HOLLOW AUGERS; S.P.T.

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|-----------|------------------|--------|--|
| | | 6" | 6" | 6" | | | | |
| | 0 | | | | | | | 0-2 SANDS GRAVEL FILL |
| | 2.5 | | | | | | | |
| | 5.0 | 1 | 1 | 1 | | | | TAN SIL. FINE SAND (AS S-1 A-59) A-2.4-2.4 |
| | 7.5 | - | - | 1 | | | | BROWN SIL. SL. FINE SAND A-2.4 (AS S-2 A-59) |
| | 10.0 | 2 | 4 | 5 | | | | BROWN SIL. SAND W/ SOME PEACOCK A-2.4 (AS S-3 A-59) |
| | 13.7 | 4 | 5 | 4 | | | | BROWN SIL. FINE SAND W/ SOME PEACOCK A-2.4 |
| | 18.7 | 3 | 5 | 7 | | | | 3' SPT PLUG WASHED SAMPLE LOST |
| | 23.7 | 2 | 3 | 2 | | | | 5' SPT PLUG WASHED SAMPLE LOST |
| | | 3 | 5 | 7 | | | | 7' SPT PLUG WASHED SAMPLE LOST |

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|----------------------|--------------------|-------------------|------------------------------|
| EST. % WT. WATER | COHESIVE | GRANULAR | |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | |
| WET 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | |
| WATER BEARING - W.B. | STIFF 9-15 BPF | DENSE 25-50 BPF | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | |



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STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION AND HIGHWAY SAFETY

July 26, 1976

JAMES E. HOLSHOUSER, JR.
GOVERNOR

DIVISION OF HIGHWAYS

J. F. ALEXANDER
SECRETARY

STATE PROJECT: 5:0564

COUNTY: Dare

DESCRIPTION: Ferry Repair Yard at Manns Harbor

SUBJECT: Subsurface Investigation

| CONTENTS: | PAGE |
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| Written Report | 1-2 |
| Geologic Cross Sections | 3-8 |
| Boring Logs | |
| Auger Borings (#1 thru #6) | 9-10 |
| Standard Penetration Tests (#7 thru #9) | 11-13 |
| Hand Sampled Borings (#10 thru #18) | 14 |
| Sample Reports | 15-20 |
| Photo Map | Sheet 1 |
| Soils Map | Sheet 2 |

INTRODUCTION: Borings in this area include 6 auger borings to depths ranging from 32 to 37 feet, 3 standard penetration tests to depths of approx. 47 feet, and 9 hand borings in the marshland to depths ranging from 5 to 11 feet. In the auger borings, the corkscrew method was used in order to determine the depths of the various layers. Hollow augers were used for the standard penetration tests. In boring #9, a dynamic penetration test was made in the depth interval between 47 and 55 feet. Levels were run on the borings and at intermediate points as required in order to prepare cross sections thru the site. The tide gauge in the basin was used as the datum elevation.

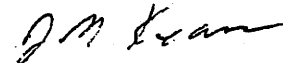
SITE DESCRIPTION. The existing ferry repair yard lies at the north end of SR 1105 in the peninsula bounded on the east by Croatan Sound and on the west by Spencer Creek. Water access to the site is via Spencer Creek. The local terrain prior to dredging and filling consisted of a sand ridge which ended near the center of the site. Terrain adjacent to the ridge consisted primarily of marshland with elevations near sea level. Spoil from the dredging operations

was utilized to fill in some of the marshland. Most of the existing ferry site consists of this filled in marshland. (See attached generalized soil map for approx. boundaries of the existing landforms.)

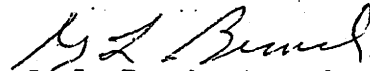
Soils in the area of the original ridge consist of fine to coarse grained sands with some pea gravel and clay in certain layers. These soils extend to depths in excess of 45 feet. The filled in areas consist of fine to coarse grained sands and organic sands varying in thickness from 1 to 7 feet. The bottom of this fill generally lies near sea level. Underlying the fill are muck and organic sand deposits which are generally 2 to 5 feet in thickness. Underlying the muck deposits are fine to coarse grained sands similar to those underlying the sand ridge. In the adjacent marshland soft muck and organic sands exist to depths varying from 2 to 11+ feet. Firm sandy soils underlie the organic soils. Water levels within the entire area generally lie between 0.5 and 1.5 feet above sea level.

EVALUATION. N values in the sand layers underlying the area generally range between 5 and 25 with an average of approx. 14. Dense sands with N values of 40 or greater were encountered in the lower portions of borings #7 and #8. Based on empirical pile data charts, 12" concrete piles should achieve 30 tons bearing between elevations -30 and -40. Based on the auger borings and penetration tests, subsurface conditions (other than the surface muck deposits) appear to be similar throughout the site. However, if high load structures are to be placed in the area, additional test borings are recommended at the specific sites before construction is begun.

Respectfully submitted,



J. M. Keane, Project Geologist



G. L. Bunch, Area Geologist

W. D. Bingham, State Hwy. Geol.

| BORING NUMBER | DEPTH | DESCRIPTION | FIELD ESTIMATE | SAMP. NO. | AASH CLAS |
|---------------|---|--|---|-----------|-----------|
| 1 | 0'-1' | Elev. 1.4' Stone fill. | | | |
| | 1'-1½' | Brown organic fine sand. | A-2-4 | | |
| | 1½'-3½' | Muck. | A-3 | | |
| | 3½'-5' | Brown-gray fine sand. | A-3 | | |
| | 5'-7' | Brown-gray cly. fine sand. | A-2-4 | | |
| | 7'-13' | Gray fine sand. | A-3 | | |
| | 13'-14' | Yel.-tan fine- coarse sand & pea gravel | A-1 | | |
| | 14'-22' | Gray tan fine sand. | A-3 | | |
| | 22'-29' | Yel.-tan fine-medium sand | A-3 | | |
| | 29'-37' | Gray cly. fine sand & med. soft micas. sandy silty clay soils. Water 0.5' | A-4 | | |
| | 2 | 0-3½' | Elev. 3.0' Gray-tan fine-medium sand (fill). | A-2-4/A3 | |
| 3½'-5½' | | Muck and peat. | | | |
| 5½'-7' | | Gray-black silty fine-medium sand with some organic. | A-2-4 | | |
| 7'-20' | | Gray silty fine-coarse sand. | A-2-4 | 2A | A-3 |
| 20'-30' | | Tan-Yel. silty fine-coarse sand. | A-3 | 2B | A-3 |
| 30'-32' | | Brown fine sandy clay. Water 1.0' | A-6 | | |
| 3 | 0'-2' | Elev. 2.5' Gray to brown gravelly medium to coarse sand fill. | A-2-4 | | |
| | 2'-4' | Dark gray to brown fill & organic medium sand mix. | A-2-4 | | |
| | 4'-8' | Dark brown muck. | A-8 | | |
| | 8'-9' | Dark brown organic medium sand | A-2-4 | 3-A | A-3 |
| | 9'-16' | Light grn. fine to medium sand | A-2-4 | | |
| | 16'-25' | Light grn. to light brown gravelly coarse sand. | A-2-4 | | |
| | 25'-29' | Brown slightly clayey & silty fine-medium sand. | A-2-4 | | |
| | 29'-30' | Brown silty medium sandy clay. | A-4 | | |
| | 30'-35' | Gray mica silty fine sandy clay. | A-4 | 3-B | A-2-4 |
| | 35'-36' | Gray mica silty fine sand. | A-2-4/A-4 | 3-C | A-2-4 |
| 36'-37' | Grn. silty clayey calc. medium sand with abundant shell fragments. Water 1.5' | A-2-4/A-4 | | | |
| 4 | 0'-3' | Elev. 6.0' Brown to gray cly silty fine to medium sand fill. | A-2-4/A-4 | 4-A | A-2-4 |
| | 3'-6' | Gray to brown silty sand & organic sand mix. | A-2-4 | 4-A | A-2-4 |
| | 6'-8' | Dark brown muck. | A-8 | | |
| | 8'-10' | Dark brown organic medium sand. | A-2-4 | | |
| | 10'-17' | Light grn. slightly silty & clayey fine to medium sand. | A-2-4 | 4-B | A-3 |
| | 17'-27' | Light grn. to brown gravelly coarse sand. | A-2-4 | 4-C | A-3 |
| | 27'-34' | Light brown fine to medium sand. | A-2-4/A-3 | 4-D | A-3 |
| | 34'-37' | Gray silty fine to medium sand to silty clayey fine to medium sand. Water 5.0' | A-4 | 4-E | |

| BORING NUMBER | DEPTH | DESCRIPTION | FIELD ESTIMATE | SAMP. NO. | CLASS. | |
|---------------|-----------|---|--|-----------|--------|--|
| 5 | 0'-0.5' | Elev. 3.3' Brown fine sandy calc gravel fill. | A-1 | | | |
| | 0.5'-1.5' | Gray organic fine to medium sand (rewrkd?) | A-2-4 | | | |
| | 1.5'-2.5' | Brown organic fine to medium sand. | A-2-4 | | | |
| | 2.5'-5' | Light brown fine to medium sand. | A-2-4/A-3 | | | |
| | 5'-6.5' | Light brown clayey fine to medium sand. | A-2-4 | 5-A | A-2- | |
| | 6.5'-12' | Light brown slightly organic gravelly medium coarse sand. | A-2-4 | 5-B | A-3 | |
| | 12'-16' | Light grn. fine sand. | A-2-4/A-3 | 5-C | A-3 | |
| | 16'-25' | Light grn. to light brown gravelly medium-coarse sand. | A-2-4 | 5-D | A-3 | |
| | 25'-32' | Light brown slightly gravelly medium sand. | A-2-4 | | | |
| | 32'-34' | Gray silty medium sand (few shells). | A-2-4 | | | |
| | 34'-35.5' | Gray fine sandy clayey silt. | A-4 | 5-E | A-4 | |
| | 35.5'-37' | Gray filty fine sand. Water 2' | A-2-4/A-4 | | | |
| | 6 | 0'-3' | Elev. 3.2' Light brown slightly organic medium sand fill. | A-2-4 | | |
| | | 3'-4.5' | Dark brown peat and muck. | A-8 | | |
| 4.5'-5' | | Brown organic medium sand. | A-2-4 | | | |
| 5'-14' | | Light green medium sand. | A-2-4 | 6-A | A-3 | |
| 14'-22' | | Light brown to light green gravelly coarse sand. | A-2-4 | 6-B | A- | |
| 22'-31' | | Light green medium sand. | A-2-4/A-3 | 6-C | A-3 | |
| 31'-31.5' | | Brown silty clayey medium sand. | A-4 | | | |
| 31.5'-33' | | Gray slightly mica. silty fine sand. | A-2-4/A-4 | 6-D | | |
| 33'-34' | | Gray clayey silty fine sand to clayey fine sand silt. | A-4 | 6-D | A-2-1 | |
| 34'-37' | | Gray silty fine sand to fine sandy silt. Water 1.5' | A-2-4/A-4 | 6-D | | |

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
FOUNDATION BORING LOG SHEET OF
375

PROJECT NO. _____ COUNTY _____ Date _____ GEOLOGIC PROVINCE Lower Coastal Pl
BRIDGE ON _____ OVER _____
BORING LOCATION (STA.) _____ OFFSET _____
BORING NO. 7 GEOLOGIST J.M. Keane GROUND WATER 0 HRS. 2' 24 HRS. 1.0'
COLLAR ELEV. 2.2 DATE STARTED 6/23/76 DRILL EQUIPMENT Truck-mounted
TOTAL DEPTH 47' DATE COMPLETED 6/23/76 B-52 Drill (Standard Penetration)

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|-----------|------------------|----------------------|-----------------|
| | | 6" | 6" | 6" | | | | |
| 2.2 | 0 | | | | | | 25 50 BLOWS PER FOOT | |
| -0.8 | 3' | | | | | MOIST | | |
| -2.3 | 4.5' | 1 | 1 | 1 | .. | | 2 | |
| -5.8 | 8' | 1 | 2 | 2 | .. | | 4 | |
| | | 1 | 0 | 1 | 7-A | WET | 1 | |
| -10.8 | 13' | | | | | | | |
| | | 7 | 10 | 10 | 7-B | WET | 20 | |
| -15.8 | 18' | | | | | | | |
| | | 8 | 8 | 7 | 7-C | WET | 15 | |
| 20.8 | 23' | | | | | | | |
| | | 9 | 8 | 11 | 7-D | WET | 19 | |
| -25.8 | 28' | | | | | | | |
| -28.3 | 30.5' | 10 | 8 | 7 | .. | | 15 | |
| -30.8 | 33' | 6 | 5 | 7 | .. | | 12 | |
| | | 8 | 8 | 10 | 7-E | WET | 18 | |
| -35.8 | 38' | | | | | | | |
| | | 8 | 6 | 8 | 7-F | WET | 14 | |
| -40.8 | 43' | | | | | | | |
| -43.3 | 45.5' | 8 | 6 | 11 | 7-G | WET | 17 | |
| | | 6 | 17 | 24 | 7-H | | 41 | |

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|-----------------------|--------------------|-------------------|------------------------------|
| EST. % WT. WATER | COHESIVE | GRANULAR | |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | |
| WET 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | |
| WATER BEARING - W. B. | STIFF 9-15 BPF | DENSE 25-50 BPF | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | |
| | HARD 31-60 BPF | | |

**NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
FOUNDATION BORING LOG SHEET OF**

376

PROJECT NO. _____ COUNTY _____ Date _____ GEOLOGIC PROVINCE Lower Coastal Pla
 BRIDGE ON _____ OVER _____
 BORING LOCATION (STA.) _____ OFFSET _____
 BORING NO. 8 GEOLOGIST J.M. Keane GROUND WATER 0 HRS. 2.5' 24 HRS. 1.5'
 COLLAR ELEV. 2.3 DATE STARTED 6/24/76 DRILL EQUIPMENT Truck-mounted
 TOTAL DEPTH 45' DATE COMPLETED 6/24/76 B-52 Drill (Standard Penetration)

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS | |
|-------|-------|------------|----|----|--|------------------|--------|-----------------|----------------|
| | | 6" | 6" | 6" | | | | 25 | 50 |
| 2.3 | 0 | | | | | | | | BLOWS PER FOOT |
| -1.2 | 3.5' | | | | 0-2' Brn silty gravelly MED sd A-2-4 | MOIST | | | |
| -2.7 | 5.0' | 1 | 0 | 2 | 2-5' DK Brn MUCK AND Org Sd A-8/A-2-4 | WET | ⊕10 | | |
| | | 4 | 6 | | | | | | |
| -6.2 | 8.5' | | | | | | | | |
| | | 2 | 5 | 6 | 8-A Brn silty org gravelly fn to MED sd A-2-4 | WET | ⊕11 | | |
| -11.2 | 13.5' | | | | | | | | |
| | | 3 | 6 | 9 | 8-B Lt brn gravelly fn to MED sd A-2-4/A-3 | WET | ⊕15 | | |
| -16.2 | 18.5' | | | | | | | | |
| | | 1 | 6 | 5 | 8-C Lt grn fn to MED sd A-2-4/A-3 grading to: DK grn silty clay + silty org fn sd grading to: A-2-4(?) Lt grn to Lt brn gravelly cfs sd A-2-4 | WET | ⊕11 | | |
| -21.2 | 23.5' | 9 | 11 | 14 | 8-D | | | | ⊕25 |
| -26.2 | 28.5' | | | | Lt grn gravelly cfs sd A-2-4 | | | | |
| | | 6 | 10 | 11 | NO SAMPLE | WET | ⊕21 | | |
| -31.2 | 33.5' | | | | | | | | |
| | | 3 | 4 | 11 | 8-E Gry silty clay fn to MED sd A-4 | | ⊕15 | | |
| -36.2 | 38.5' | | | | | | | | |
| | | 27 | 31 | 33 | 8-F Gry silty gravelly cfs sd A-2-4/A-3 | WET | | | ⊕68 |
| -41.2 | 43.5' | | | | | | | | |
| | | 22 | 33 | 36 | 8-G Gry silty calc cfs sd WISHELL frags A-2-4 | WET | | | ⊕69 |

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|-----------------------|--------------------|-------------------|------------------------------|
| EST. % WT. WATER | COHESIVE | GRANULAR | |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | |
| WET 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | |
| WATER BEARING - W. B. | STIFF 9-15 BPF | DENSE 25-50 BPF | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | |
| | HARD 31-60 BPF | | |

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
FOUNDATION BORING LOG SHEET OF _____

377

PROJECT NO. _____ COUNTY _____ Date _____ GEOLOGIC PROVINCE Lower Coastal Fla
 BRIDGE ON _____ OVER _____
 BORING LOCATION (STA.) _____ OFFSET _____
 BORING NO. 9 GEOLOGIST J.M. Keane GROUND WATER 0 HRS. 4' 24 HRS. 4.0'
 COLLAR ELEV. 4.9 DATE STARTED 6/24/76 DRILL EQUIPMENT Truck-mounted
 TOTAL DEPTH 55' DATE COMPLETED 6/25/76 B-52 Drill (Standard Penetration)

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS | | |
|-------|-------|------------|----|----|-----------|--|--------------|-----------------|----|----|
| | | 6" | 6" | 6" | | | | 0 | 25 | 50 |
| 4.9 | 0 | | | | | | | | | |
| 1.6 | 3.3' | | | | | 0-1 Brn gravelly fn sd fill | DRY TO MOIST | | | |
| | | 2 | 3 | 2 | 9-A | 1-2 Lt brn fn sd Lt brn fn sd A-3 | | | | |
| -3.4 | 8.3' | | | | | | | | | |
| | | 4 | 6 | 9 | 9-B | Lt brn fn sd A-3 grading to: Lt grn fn sd A-3 | WET | | | |
| -8.4 | 13.3' | | | | | | | | | |
| | | 7 | 8 | 9 | 9-C | Lt gry fn to MED sd A-2-4/A-3 | WET | | | |
| -13.4 | 18.3' | | | | | | | | | |
| | | 3 | 3 | 4 | 9-D | Lt gry fn to MED sd A-3 grading to: Lt brn gravelly crs sd A-2-4 | WET | | | |
| -18.4 | 23.3' | | | | | | | | | |
| | | 3 | 2 | 5 | 9-E | Lt brn gravelly crs sd A-2-4 | WET | | | |
| -23.4 | 28.3' | | | | | | | | | |
| | | 7 | 6 | 8 | 9-F | Lt brn gravelly crs sd A-2-4 | MOIST | | | |
| -28.4 | 33.3' | | | | | | | | | |
| | | 7 | 4 | 1 | -- | NO SAMPLE, TOO BAD | | | | |
| -30.9 | 35.8' | | | | | | | | | |
| | | 5 | 4 | 11 | 9-G | Gry sli cly silty fn sd A-2-4 | MOIST | | | |
| -33.4 | 38.5' | | | | | | | | | |
| | | 5 | 6 | 8 | 9-H | Gry sli silty fn sd A-2-4 | WET | | | |
| -38.4 | 43.3' | | | | | | | | | |
| | | 7 | 8 | 8 | 9-I | Gry fn to MED sd A-2-4/A-3 | WET | | | |
| -40.8 | 45.7' | | | | | | | | | |
| | | 10 | 10 | 11 | 9-J | Gry sli cly + silty calc MED sd A-2-4 w/ ABUNDANT SHELL FRAGS | | | | |
| | | 14 | | | | | | | | |
| | | 17 | | | | | | | | |
| | | 20 | | | | | | | | |
| | | 16 | | | | | | | | |
| | | 12 | | | | | | | | |
| | | 14 | | | | | | | | |
| -50.3 | 55.2' | 16 | | | | | | | | |
| | | 26 | | | | | | | | |
| | | | | | | | | | | |

Blows per foot of Penetration using a 2 inch diameter Flat Head PENETROMETER AND A 140 Lb. DRIVE HAMMER

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|----------------------|--------------------|-------------------|------------------------------|
| EST. % WT. WATER | COHESIVE | GRANULAR | |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | |
| WET 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | |
| WATER BEARING - W.B. | STIFF 9-15 BPF | DENSE 25-50 BPF | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | |

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| BORING NUMBER | DEPTH | DESCRIPTION | FIELD ESTIMATE | SAMP. NO. | AASHO CI |
|------------------|----------------------------|--|-------------------|--------------|-------------|
| 10 | 0'-6' | Elev. 0.5' Soft muck. Firm, sandy at 6'. 3" standing water. | | | |
| 11 | 0'-6' | Elev. 0.5' Soft muck. Firm, sandy at 6'. 3" standing water. | | | |
| 12 | 0'-6' | Elev. 0.5' Soft muck. Firm, sandy at 6'. 3" standing water. | | | |
| 13 | 0'-5' | Elev. 0.5' Soft muck. Firm, sandy at 5'. 4" standing water. | | | |
| 14 | 0'-5' | Elev. 0.5' Soft muck. Firm, sandy at 5'. 4" standing water. | | | |
| 15 | 0'-3' 3'-9' | Elev. 0.5' M. firm organic sand. Soft muck. Firm, sandy at 9'. Water at surface. | | | |
| 16 | 0'-10' 10'-11' | Elev. 0.5' V. soft muck. Firm sandy. Water at surface. | | | |
| 17 | 0'-1½' 1½'-6' 6'-11' | Elev. 1' Muck (spoil). Firm sand (spoil). V. soft muck. Water at surface. | | | |
| 18 | 0'-2' 2'-5' 5'-11' | Elev. 1' Muck (spoil). Sand (spoil). Soft muck. Water at surface. | | | |

7
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS & TESTS UNIT
SOILS LABORATORY

Re
Proj. -----

379

REPORT ON SAMPLES OF Subgrade

Project 5.0564 County Dare Owner _____
Date: Sampled 6/76 Received 6-25-76 Reported 7-1-76
Sampled from _____ By J. M. Keane
Submitted by W. D. Bingham 19.72 Standard Specifications

374913-374955

TEST RESULTS

du 6-14

| Proj. Sample No. | 2 A | 2 B | 3 A | 3 B | 3 C | 4 A | 4 B | 4 C | |
|----------------------|--|--------|--------|----------|----------|----------|--------|--------|----|
| Lab. Sample No. | 374913 | 374914 | 374915 | 374916 | 374917 | 374918 | 374919 | 374920 | |
| Retained #4 Sieve % | - | - | - | - | - | - | - | - | |
| Passing #10 Sieve % | 100 | 100 | 100 | 99 | 99 | 99 | 99 | 99 | |
| Passing #40 Sieve % | 94 | 92 | 95 | 95 | 94 | 89 | 94 | 72 | |
| Passing #200 Sieve % | 5 | 4 | 7 | 28 | 22 | 15 | 10 | 1 | |
| Minus #10 Soil | Coarse Sand—2.0 to 0.25 mm. Ret. #60 % | 34 | 37 | 23 | 13 | 13 | 27 | 21 | 61 |
| | Fine Sand—0.25 to .075 mm. Ret. #270 % | 62 | 59 | 70 | 65 | 71 | 63 | 69 | 38 |
| | Silt—0.05 to 0.005 mm. % | 2 | 2 | 4 | 10 | 9 | 6 | 2 | 0 |
| | Clay—Less than 0.005 mm. % | 2 | 2 | 3 | 12 | 7 | 4 | 8 | 1 |
| | Passing #40 Sieve % | - | - | - | - | - | - | - | - |
| Passing #200 Sieve % | - | - | - | - | - | - | - | - | |
| L. L. | 22 | 20 | 28 | 19 | 21 | 20 | 19 | 22 | |
| P. I. | NP | NP | NP | NP | NP | NP | NP | NP | |
| AASHO Classification | A-3(0) | A-3(0) | A-3(0) | A-2-4(0) | A-2-4(0) | A-2-4(0) | A-3(0) | A-3(0) | |
| Texture | | | | | | | | | |
| Station | | | | | | | | | |
| Hole No. | 2 | 2 | 3 | 3 | 3 | 4 | 4 | 4 | |
| Depth (ft.) | 7.0 | 20.0 | 8.0 | 30.0 | 35.0 | 0.0 | 10.0 | 17.0 | |
| to | 20.0' | 30.0' | 9.0' | 35.0' | 36.0' | 6.0' | 17.0' | 27.0' | |

cc:

- Mr. F. T. Wagner
- " F. W. Atkins (2)
- " J. M. Keane
- Soil Lab File

J. M. Keane
Soils Engineer

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS & TESTS UNIT
SOILS LABORATORY

Ref. _____
Proj. _____

380

REPORT ON SAMPLES OF _____ Subgrade _____

Project 5.0564 County _____ Owner _____

Date: Sampled _____ Received _____ Reported _____

Sampled from _____ By _____

Submitted by _____ 19____ Standard Specifications
374913-374955

TEST RESULTS

sw 6-14

| Proj. Sample No. | 4 D | 5 A | 5 B | 5 C | 5 D | 5 E | 6 A | 6 B | |
|-----------------------|--|----------|--------|--------|--------|--------|--------|--------|----|
| Lab. Sample No. | 374921 | 374922 | 374923 | 374924 | 374925 | 374926 | 374927 | 374928 | |
| Retained #4 Sieve % | - | - | - | - | - | - | - | - | |
| Passing #10 Sieve % | 100 | 100 | 99 | 100 | 97 | 99 | 100 | 97 | |
| Passing #40 Sieve % | 93 | 98 | 95 | 97 | 69 | 96 | 93 | 59 | |
| Passing #200 Sieve % | 4 | 25 | 4 | 5 | 3 | 41 | 8 | 2 | |
| Minus #10 Sieve | Coarse Sand—2.0 to 0.25 mm. Ret. #60 % | 41 | 21 | 27 | 12 | 55 | 10 | 29 | 70 |
| | Fine Sand—0.25 to .075 mm. Ret. #20 % | 56 | 55 | 69 | 84 | 43 | 52 | 58 | 28 |
| | Silt—0.075 to 0.005 mm. % | 1 | 8 | 2 | 3 | 1 | 22 | 2 | 1 |
| | Clay—Less than 0.005 mm. % | 2 | 16 | 2 | 1 | 1 | 16 | 1 | 1 |
| | Passing #40 Sieve % | - | - | - | - | - | - | - | - |
| Passing #200 Sieve % | - | - | - | - | - | - | - | - | |
| L. L. | 19 | 16 | 21 | 25 | 24 | 22 | 23 | 21 | |
| P. I. | NP | NP | NP | NP | NP | 2 | NP | NP | |
| AASHTO Classification | A-3(0) | A-2-4(0) | A-3(0) | A-3(0) | A-3(0) | A-4(1) | A-3(0) | A-3(0) | |
| Texture | | | | | | | | | |
| Station | | | | | | | | | |
| Hole No. | 4 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | |
| Depth (ft.) | 27.0 | 4.0 | 6.5 | 12.0 | 16.0 | 34.0 | 5.0 | 14.0 | |
| to | 34.0' | 6.5' | 12.0' | 16.0' | 25.0' | 35.5' | 14.0' | 22.0' | |

cc:

H. W. Anderson
Soils Engineer

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS
MATERIALS & TESTS UNIT

SOILS LABORATORY

Rel. Proj. -----

381

REPORT ON SAMPLES OF Subgrade

Project 5.0564 County ----- Owner -----

Date: Sampled ----- Received ----- Reported -----

Sampled from ----- By -----

Submitted by 374913-374955 ----- 19. aw Standard Specifications 6-14

TEST RESULTS

| Proj. Sample No. | 6 C | 6 D | 7 A | 7 B | 7 C | 7 D | 7 E | 7 F |
|--|---|----------|--------|--------|--------|--------|----------|----------|
| Lab. Sample No. | 374929 | 374930 | 374931 | 374932 | 374933 | 374934 | 374935 | 374936 |
| Retained #4 Sieve % | - | - | - | - | - | - | - | - |
| Passing #10 Sieve % | 100 | 99 | 100 | 100 | 100 | 100 | 100 | 100 |
| Passing #40 Sieve % | 92 | 95 | 99 | 89 | 89 | 90 | 95 | 93 |
| Passing #200 Sieve % | 3 | 28 | 4 | 2 | 3 | 5 | 21 | 15 |
| Minus #10 Sieve Soil M _u Minus #270 | Coarse Sand—2.0 to 0.25 mm. Ret. #60 % | 30 | 13 | 15 | 44 | 46 | 34 | 20 |
| | Fine Sand—0.25 to 0.075 mm. Ret. #270 % | 68 | 67 | 82 | 55 | 52 | 62 | 69 |
| | Silt—0.075 to 0.005 mm. % | 1 | 10 | 0 | 0 | 1 | 3 | 9 |
| | Clay—Less than 0.005 mm. % | 1 | 10 | 3 | 1 | 1 | 1 | 8 |
| | Passing #40 Sieve % | - | - | - | - | - | - | - |
| | Passing #200 Sieve % | - | - | - | - | - | - | - |
| L. L. | 21 | 19 | 23 | 21 | 20 | 22 | 19 | 20 |
| P. I. | NP | NP | NP | NP | NP | NP | NP | NP |
| AASHO Classification | A-3(0) | A-2-4(0) | A-3(0) | A-3(0) | A-3(0) | A-3(0) | A-2-4(0) | A-2-4(0) |
| Texture | | | | | | | | |
| Station | | | | | | | | |
| Hole No. | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 7 |
| Depth (ft.) | 22.0 | 31.5 | 8.0 | 13.0 | 18.0 | 23.0 | 34.0 | 38.5 |
| to | 31.0' | 37.0' | 9.5' | 14.5' | 19.5' | 24.5' | 34.5' | 39.5' |

cc:

H. W. Anderson
Soils Engineer

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS & TESTS UNIT
SOILS LABORATORY

382

Rel. Proj. -----

REPORT ON SAMPLES OF Subgrade

Project 5.0564 County ----- Owner -----

Date: Sampled ----- Received ----- Reported -----

Sampled from ----- By -----

Submitted by ----- 19 6-14 Standard Specifications
374913-374955

TEST RESULTS

| Proj. Sample No. | 7 G | 7 H | 8 A | 8 B | 8 C | 8 D | 8 E | 8 F | |
|---|---|--------|--------|--------|--------|--------|----------|--------|----|
| Lab. Sample No. | 374937 | 374938 | 374939 | 374940 | 374941 | 374942 | 374943 | 374944 | |
| Retained #4 Sieve % | -- | - | - | - | - | -- | - | - | |
| Passing #10 Sieve % | 97 | 100 | 97 | 98 | 98 | 98 | 100 | 100 | |
| Passing #40 Sieve % | 93 | 85 | 91 | 95 | 75 | 76 | 91 | 81 | |
| Passing #200 Sieve % | 6 | 10 | 3 | 2 | 3 | 1 | 23 | 5 | |
| Minus #10 Sieve Soil M _c Minus #270 | 100% Coarse Sand—2.0 to 0.25 mm. Ret. #60 % | 11 | 29 | 27 | 16 | 51 | 48 | 18 | 44 |
| | Fine Sand—0.25 to 0.05 mm. Ret. #270 % | 84 | 63 | 70 | 83 | 46 | 51 | 63 | 52 |
| | Silt—0.05 to 0.005 mm. % | 2 | 6 | 2 | 0 | 2 | 0 | 9 | 2 |
| | Clay—Less than 0.005 mm. % | 3 | 2 | 1 | 1 | 1 | 1 | 10 | 2 |
| | Passing #40 Sieve % | -- | -- | -- | -- | -- | -- | -- | -- |
| Passing #200 Sieve % | -- | -- | -- | -- | -- | -- | -- | -- | |
| L. L. | 22 | 20 | 26 | 27 | 26 | 24 | 20 | 24 | |
| P. I. | NP | NP | NP | NP | NP | NP | NP | NP | |
| AASHO Classification | A-3(0) | A-3(0) | A-3(0) | A-3(0) | A-3(0) | A-3(0) | A-2-4(0) | A-3(0) | |
| Texture | | | | | | | | | |
| Station | | | | | | | | | |
| Hole No. | 7 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | |
| Depth (ft.) | 43.5 | 46.0 | 9.0 | 14.0 | 18.5 | 23.5 | 34.5 | 39.5 | |
| to | 44.5' | 47.0' | 10.0' | 15.0' | 20.0' | 25.0' | 35.0' | 40.0' | |

cc:

[Signature]
Soils Engineer

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS & TESTS UNIT
SOILS LABORATORY

Ret. _____
Proj. _____

383

REPORT ON SAMPLES OF Subgrade

Project 5.0564 County _____ Owner _____

Date: Sampled _____ Received _____ Reported _____

Sampled from _____ By _____

Submitted by _____ 19 out Standard Specifications 6-14
374913-374955

TEST RESULTS

| Proj. Sample No. | 8 G | 9 A | 9 B | 9 C | 9 D | 9 E | 9 F | 9 G |
|--|--|--------|--------|--------|--------|--------|--------|----------|
| Lab. Sample No. | 374945 | 374946 | 374947 | 374948 | 374949 | 374950 | 374951 | 374952 |
| Retained #4 Sieve % | - | - | - | - | - | - | - | - |
| Passing #10 Sieve % | 96 | 100 | 100 | 100 | 100 | 100 | 99 | 100 |
| Passing #40 Sieve % | 76 | 98 | 98 | 93 | 52 | 71 | 60 | 99 |
| Passing #200 Sieve % | 9 | 3 | 3 | 4 | 1 | 3 | 3 | 21 |
| Minus #10 Fraction Soil M ₁₀ Minus #270 | Coarse Sand—2.0 to 0.25 mm. Ret. #60 % | 35 | 26 | 23 | 29 | 72 | 54 | 3 |
| | Fine Sand—0.25 to .075 mm. Ret. #270 % | 57 | 72 | 74 | 68 | 27 | 43 | 82 |
| | Silt—0.05 to 0.005 mm. % | 4 | 1 | 2 | 2 | 0 | 1 | 10 |
| | Clay—Less than 0.005 mm. % | 4 | 1 | 1 | 1 | 1 | 2 | 5 |
| | Passing #40 Sieve % | - | - | - | - | - | - | - |
| Passing #200 Sieve % | - | - | - | - | - | - | - | |
| L. L. | 19 | 22 | 24 | 24 | 24 | 22 | 22 | 24 |
| P. I. | NP | NP | NP | NP | NP | NP | NP | NP |
| AASHO Classification | A-3(0) | A-3(0) | A-3(0) | A-3(0) | A-3(0) | A-3(0) | A-3(0) | A-2-4(0) |
| Texture | | | | | | | | |
| Station | | | | | | | | |
| Hole No. | 8 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| Depth (ft.) | 44.0 | 3.8 | 8.8 | 13.3 | 19.3 | 23.8 | 28.3 | 36.8 |
| to | 45.0' | 4.8' | 9.8' | 14.8' | 19.8' | 24.8' | 29.8' | 37.3' |

cc:

H. W. [Signature]
Soils Engineer

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS
MATERIALS & TESTS UNIT

SOILS LABORATORY

384

AVCA:
Proj. -----

REPORT ON SAMPLES OF ----- Subgrade -----

Project 5.0564 ----- County ----- Owner -----

Date: Sampled ----- Received ----- Reported -----

Sampled from ----- By -----

Submitted by ----- 19----- Standard Specifications
374913-374955

TEST RESULTS

dw 10-14

| Proj. Sample No. | 9 H | 9 I | 9 J | | | | |
|---|---|----------|--------|----|--|--|--|
| Lab. Sample No. | 374953 | 374954 | 374955 | | | | |
| Retained #4 Sieve % | - | - | - | | | | |
| Passing #10 Sieve % | 100 | 100 | 100 | | | | |
| Passing #40 Sieve % | 100 | 99 | 84 | | | | |
| Passing #200 Sieve % | 26 | 13 | 10 | | | | |
| Soil M ₂₇₀ Minus #10 Sieve 90% | Coarse Sand—2.0 to 0.25 mm. Ret. #60 % | 1 | 2 | 24 | | | |
| | Medium Sand—0.25 to 0.075 mm. Ret. #270 % | 83 | 89 | 68 | | | |
| | Silt—0.05 to 0.005 mm. % | 11 | 4 | 4 | | | |
| | Clay—Less than 0.005 mm. % | 5 | 5 | 4 | | | |
| | Passing #40 Sieve % | - | - | - | | | |
| Passing #200 Sieve % | - | - | - | | | | |
| L. L. | 26 | 22 | 25 | | | | |
| P. I. | NP | NP | NP | | | | |
| AASHO Classification | A-2-4(0) | A-2-4(0) | A-3(0) | | | | |
| Texture | | | | | | | |
| Station | | | | | | | |
| Hole No. | 9 | 9 | 9 | | | | |
| Depth (ft.) | 38.8 | 44.3 | 46.2 | | | | |
| to | 39.8' | 44.8' | 42.2' | | | | |

cc:

H. W. Sanderson
Soils Engineer



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STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH 27611

April 13, 1979

JAMES B. HUNT, JR.
GOVERNOR

DIVISION OF HIGHWAYS

THOMAS W. BRADSHAW, JR.
SECRETARY

MEMORANDUM TO: Mr. R. Wayne Brooks, P.E.

FROM: Gary P. Alexander, P.E.

SUBJECT: Foundation Recommendations for Proposed
Marine Maintenance Facility at Manns Harbor.

We have completed our review of the proposed marine maintenance facility site. The existing ferry repair facility is located at the north end of SR-1105 in the peninsula bounded on the east by Croatan Sound and on the west by Spencer Creek. The site originally consisted of a sand ridge that ends near the center of the site with the adjacent terrain consisting of marshland at sea level. Spoil from the original dredging operation was used to fill in the marshland. Most of the existing ferry site consists of this filled in marshland.

In response to Mr. Brooks' letter of Jan. 5, 1979 the following recommendations are presented.

- 1) Foundation System For Warehouse - The soil beneath the proposed warehouse is predominately natural sand with some areas of organic sand fill. Some muck is found in the southeastern corner of the warehouse area. This muck is to be removed, brought up to grade, and compacted. A spread footing (min. width of 5') or a strip footing (min. width of 3') at a depth of 3' will have an allowable bearing capacity of $1\frac{1}{2}$ TSF. This capacity was determined for a loose sand by Terzaghi's general equation and checked by charts developed by Sowers. Maximum estimated settlement of 0.53" was calculated by a Boussinesq pressure distribution computer program and Schmertmann's method of computing settlements. Terzaghi's approximate solution was used to check these results.

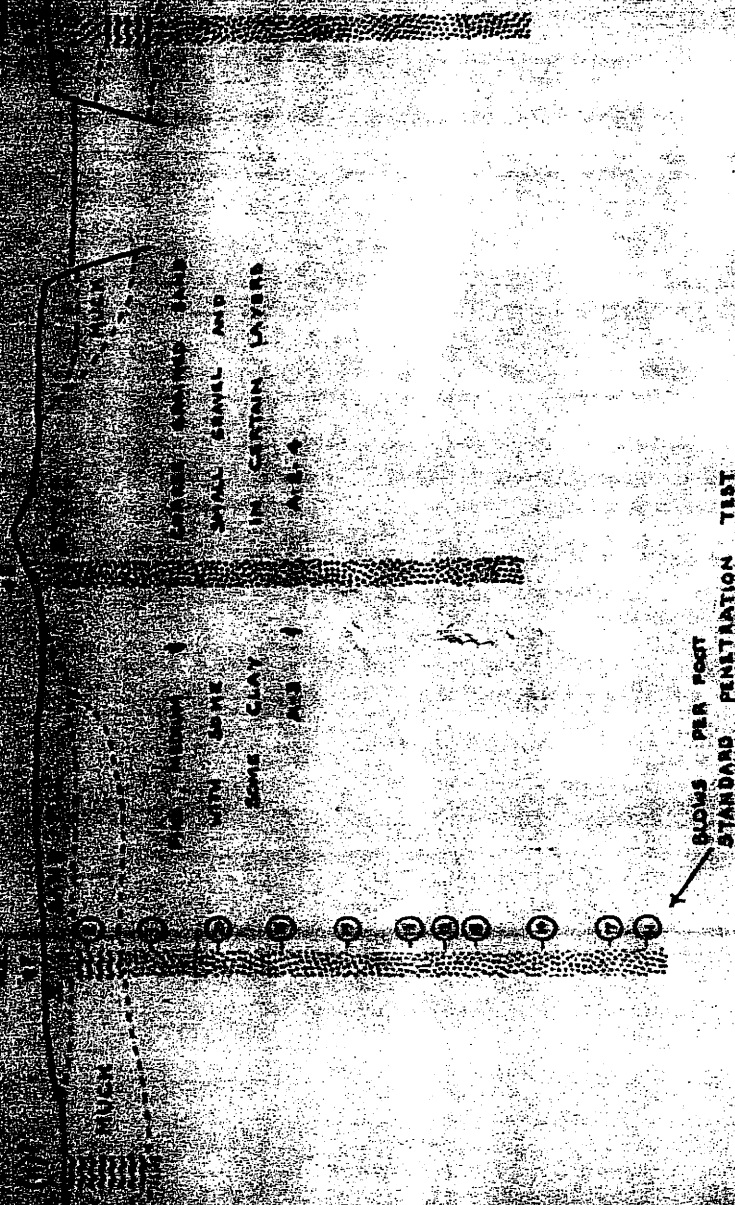
- 2) Platens And Transfere Table-Soil profiles along the centerline of the platens and through the transfer table show an organic fill over a muck layer for much of this area. The muck layer covers most of the western platen and approximately one half of the center platen. This irregular pattern of muck extends beneath the transfere table. This muck is to be removed, brought to within six inches of grade with fill sand, and compacted. We recommend a 6" layer of stone, similar to our aggregate base course, to be placed beneath the platens and the transfere table. Settlement computations were based on a 10 blow per foot fill sand with all muck removed. Platens and transfere table were loaded simultaneously with the 1.0 KSF load. Anticipated settlements under these conditions was less than $\frac{1}{2}$ " using Schmertmann's method and checked by Terzaghi's method.
- 3) Bulkhead Design - By previous mailing, assumed pressure distributions and subsurface information was sent to your office. The muck layer overlaid by organic fill sand caused an increase in pressure along the wall. Consideration should be given to changing the location of the stone storage area as muck depths in the southern end exceeds 25'. Midway along the existing slipway this muck layer is only 5'+. The proposed bulkhead and tension piles are satisfactory in these areas of this facility. Safety factor for a 20 ton tension HP 8x36 piles, 50 feet long, is 1.5.
- 4) Piles for Work Platforms - Prestressed concrete piles, 18" square, will have an allowable bearing capacity of 60 tons, with a safety factor of 2.3 for 25' (+) embedment into sand. Tensile load of 25 tons per pile is satisfactory. The methods used for computation bearing capacity that was suggested by Vesic and the method in the Navy book (DM-7) was used as a check.
- 5) Foundation System for Water and Communication Towers -

Soils below the communication tower are organic fill sands and muck for a depth of 5'+. A spread footing located below this layer would have an allowable bearing capacity of $1\frac{1}{2}$ TSF. The water tower is located on organic fill above a 6'+ of muck. A 12" square prestressed concrete pile would develop an allowable bearing capacity of 40 ton per pile with a safety factor of 2.51 for a length of 45'+. Tensile load of 20 ton per pile will have a safety factor of 1.65. The methods used for bearing capacity computation was the same as was used in the warehouse design for the spread footing and the work platform for the pile footing.

- 6) We feel surcharging and vibratory compaction, such as vibrofloatation, is not required at this site. Compaction due to the normal construction procedures will be adequate. Settlement and bearing capacity computations were based upon 10 blows per foot.
- 7) Modulus of Subgrade Reaction - Using the Navy book (DM-7) the modulus of subgrade reaction was computed to be approximately 35-50 tons per cubic foot. Our experience in residual granular soils throughout North Carolina would indicate values on the order of 120 tons per cubic foot. We recommend using a modulus of subgrade reaction of 60-70 tons per cubic foot.

Enclosed are subsurface profiles for platens and transference table, a sketch locating the borings and cross-sections, and recent soil data for boring #55. Should you require further information or assistance, please feel free to contact us.

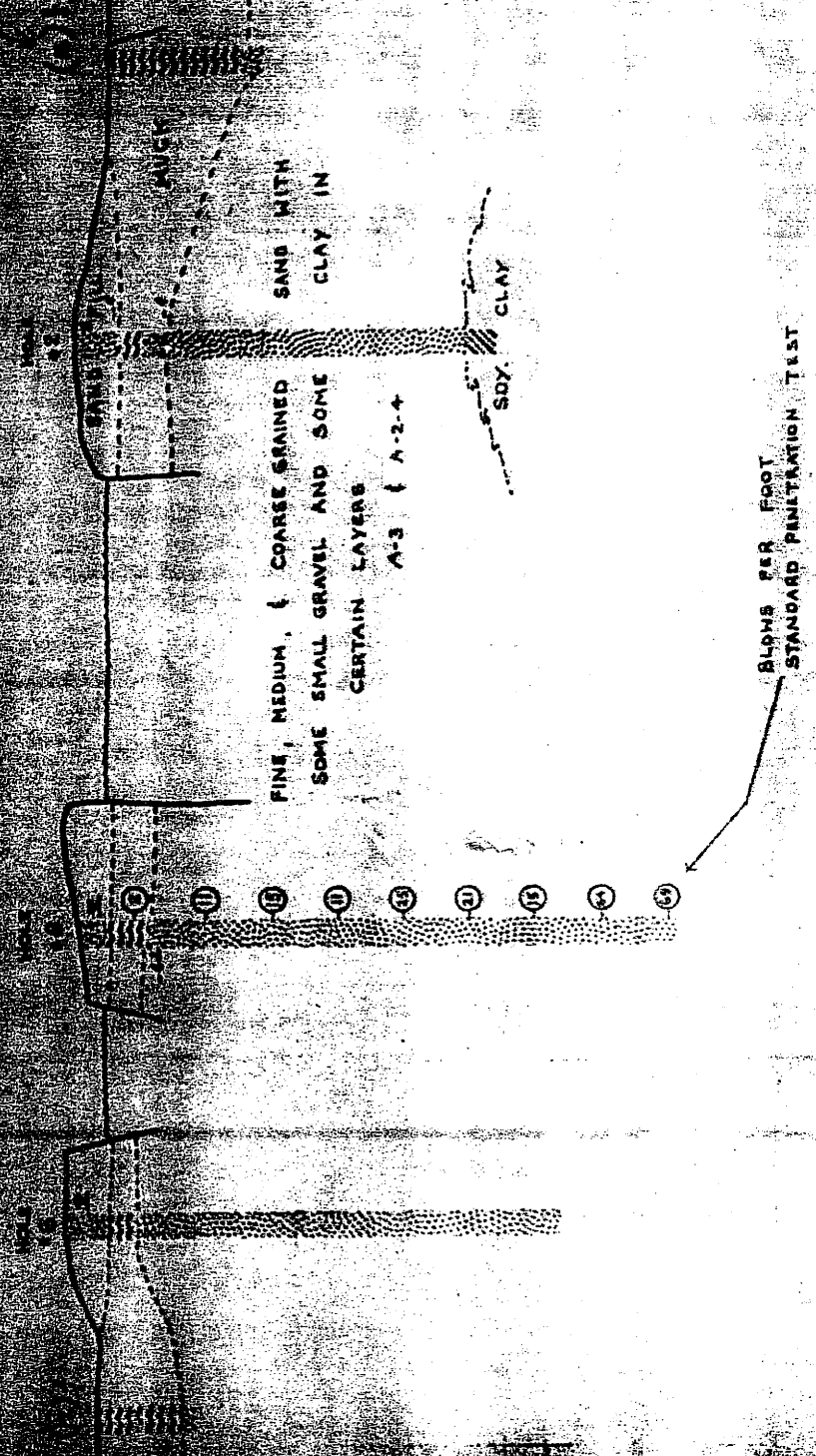
GPA:gl

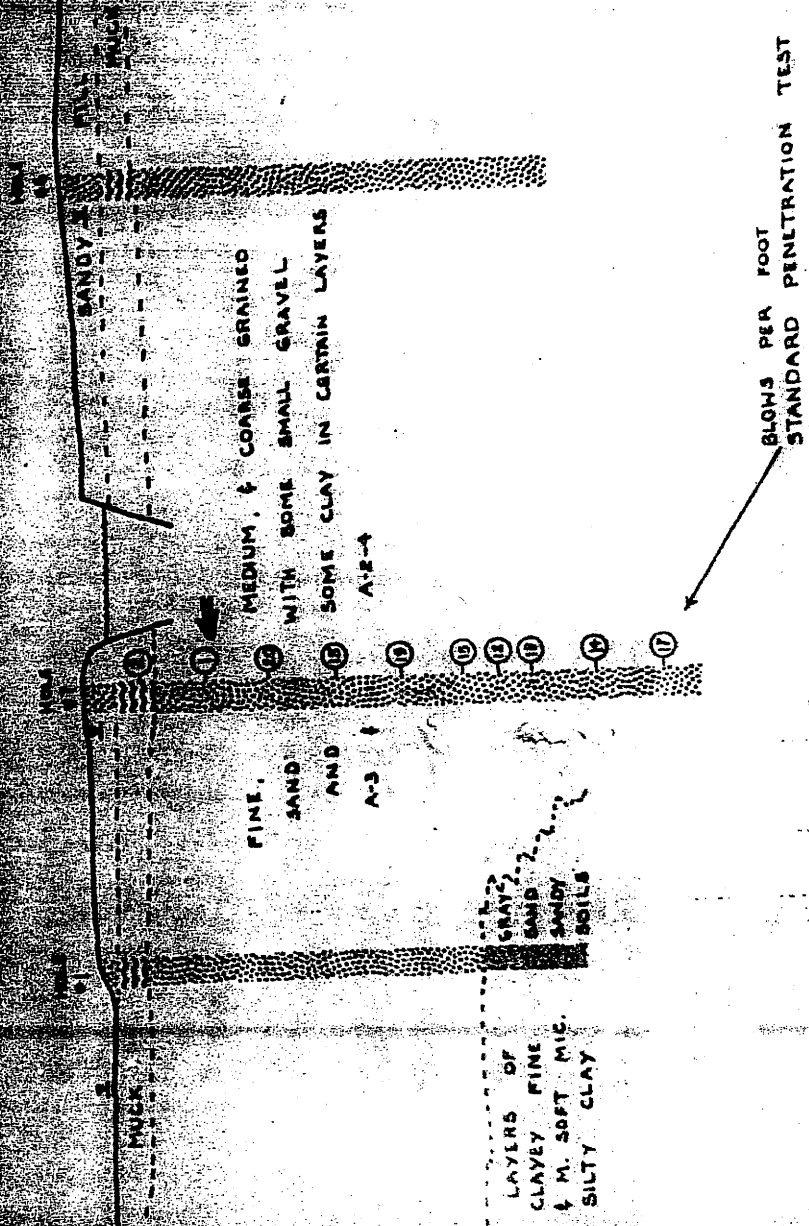


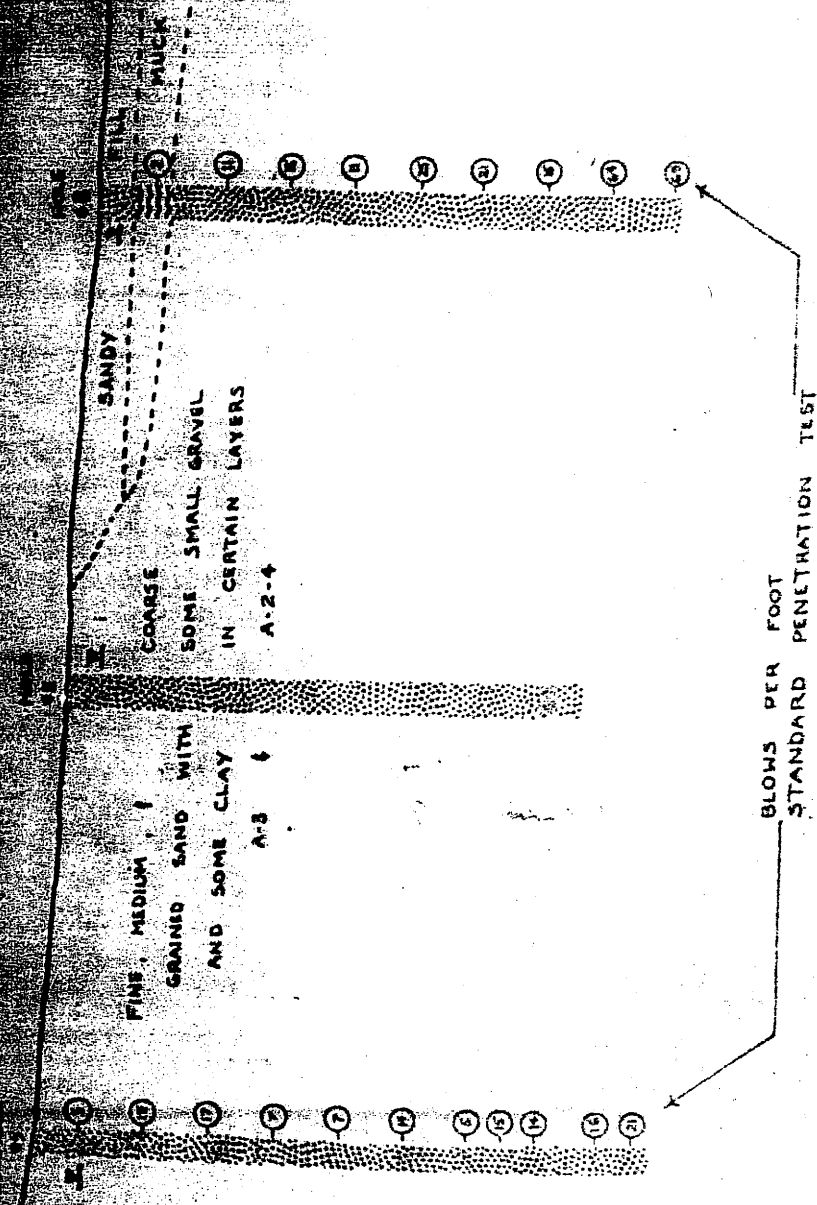
LAYER CONTAINING SMALL SAND AND SILT CERTAIN LAYERS ARE...

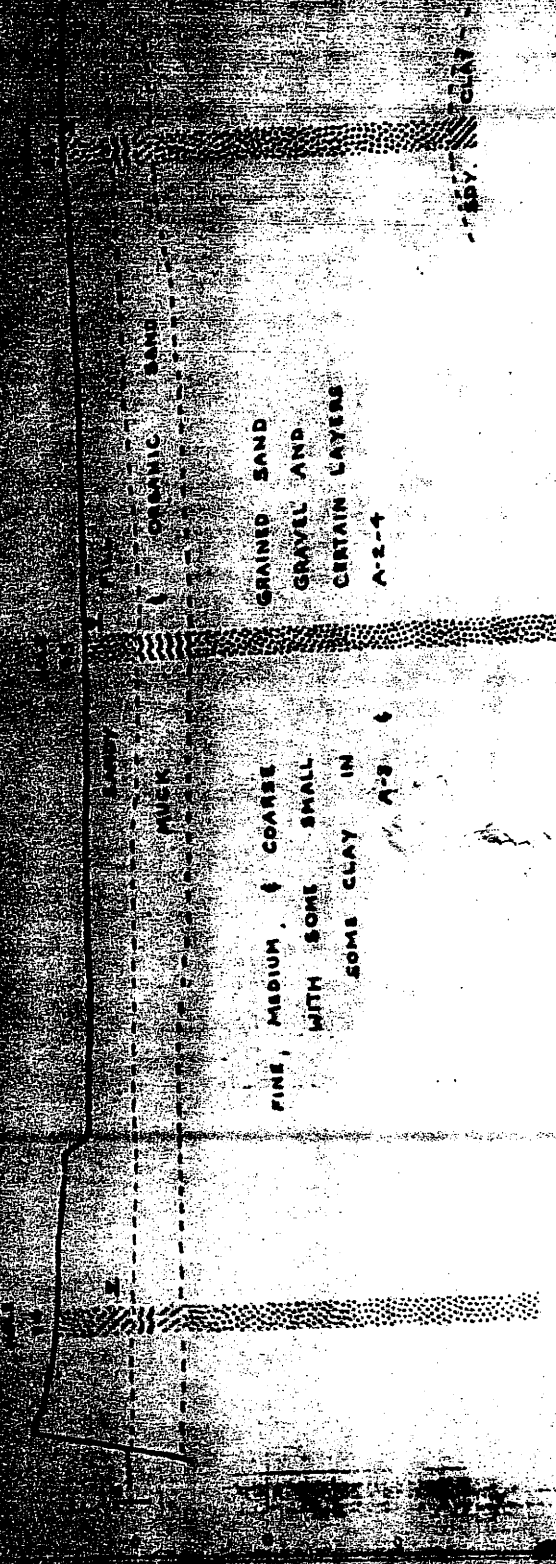
SOME CLAY ARE...

BLOWS PER FOOT STANDARD PENETRATION TEST









ORGANIC SAND

GRAINED SAND
GRAVEL AND
CERTAIN LAYERS
A-2-4

FINE, MEDIUM & COARSE
WITH SOME SMALL
SOME CLAY IN
A-2-6

MUCK

CLAY



785/3.01

| |
|---------------------------------|
| FILE NO. |
| Lockwood Greene Engineers, Inc. |
| RECEIVED |
| APR 25 1979 |
| REF. TO |
| ACK |

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH 27611

JAMES B. HUNT, JR.
GOVERNOR

April 24, 1979

DIVISION OF HIGHWAYS

THOMAS W. BRADSHAW, JR.
SECRETARY

MEMORANDUM TO: Mr. R. Wayne Brooks, P. E. *JFH*
FROM: John F. Ledbetter, Soils Engineer
SUBJECT: Subsurface Design Information for Ferry Maintenance Facility at Manns Harbor

Mr. G. P. Alexander of our office has completed his review of the subsurface conditions at this site and offers the attached recommendations for your consideration.

In addition to his recommendations, I would like to suggest the following:

1. In areas requiring muck removal and this includes the southwest corner of the warehouse, the bottom of muck removal should be sounded to insure that there are no isolated pockets left in place. The muck should be removed within a 2:1 line extending from the proposed finish grade down to firm sand.
2. The fill sand should be compacted above the water line to 95% AASHTO T99.
3. The 6 inch stone base under the concrete slabs should be compacted to 100% AASHTO T180.
4. The deep muck deposits on the southwest corner of the bulkhead may require some other configuration of muck removal other than the 2:1 slope on the land side. Pull tests should be conducted on the tension piles for bulkhead.
5. A shallow drilled shaft foundation should be considered for the communication tower.

TENSION
PILE
TEST →

continued

Mr. R. Wayne Brooks

-2-

April 24, 1979

6. For recommendations concerning the paved areas, please contact Mr. H. W. Landrum of the North Carolina Department of Transportation Geotechnical Unit.

We will be glad to discuss the subsurface recommendations and answer any questions you may have.

JFL:bl

cc: Mr. L. M. Temple
Mr. D. T. Overman
Mr. W. D. Bingham
Mr. H. W. Landrum

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
FOUNDATION BORING LOG SHEET OF
395

PROJECT NO. 0.10561 COUNTY Dare GEOLOGIC PROVINCE Coastal

~~BRIDGE ON~~ Manns Harbor Shipyard OVER _____

BORING LOCATION (STA.) _____ OFFSET _____

BORING NO. 60 GEOLOGIST EAW GROUND WATER 0 HRS. _____ 24 HRS. 4'

COLLAR ELEV. 5.0' DATE STARTED 2-5-79 DRILL EQUIPMENT B-52 Mobile w/

TOTAL DEPTH 33.5' DATE COMPLETED 2-5-79 hollow stem Augers S.P.T.

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|-----------|------------------|---------------------|-----------------|
| | | 6" | 6" | 6" | | | | |
| | 0.0 | | | | | | | |
| | 2.0 | | | | | | | |
| | 4.5 | 7 | 3 | 3 | 1 | | TAN FINE SAND | |
| | 7.0 | 1 | 1 | 1 | 2 | | BRN. CLY. F. SAND | |
| | 9.5 | 2 | 3 | 7 | 3 | | BRN. FINE SAND | |
| | 12.0 | 1 | 6 | 9 | | | SAME AS ABOVE | |
| | 17.0 | 3 | 5 | 6 | 4 | | GRAY BRN FINE SANDS | |
| | 22.0 | 2 | 2 | 2 | | | SAME AS ABOVE | |
| | 27.0 | 4 | 6 | 4 | | | SAME AS ABOVE | |
| | 32.0 | 3 | 5 | 4 | | | SAME AS ABOVE | |

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|----------------------|--------------------|-------------------|------------------------------|
| EST. % WT. WATER | COHESIVE | GRANULAR | <u>6.5</u> |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | <u>3.0</u> |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | <u>2.0</u> |
| WET 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | |
| WATER BEARING - W.B. | STIFF 9-15 BPF | DENSE 25-50 BPF | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | |
| | HARD 31-60 BPF | | |
| | V HARD OVER 60 | | |

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
FOUNDATION BORING LOG SHEET OF _____
396

PROJECT NO. 0.10561 COUNTY Dare GEOLOGIC PROVINCE Coastal
~~BRIDGE ON~~ Manns Harbor Shipyard OVER _____
BORING LOCATION (STA.) _____ OFFSET _____
BORING NO. 61 GEOLOGIST E.A.W GROUND WATER 0 HRS. 24 HRS /'
COLLAR ELEV. 1.3 DATE STARTED 2-8-79 DRILL EQUIPMENT B-52 Mobile w/
TOTAL DEPTH 33.1' DATE COMPLETED 2-8-79 Hollow Stem Augers S.P.T.

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|-----------|------------------|--------|-----------------|
| | | 6" | 6" | 6" | | | | |
| 1.3 | 0.0 | | | | | | | |
| | 1.6 | 1 | - | 1 | | | | |
| -2.0 | 4.1 | | | | | WB | | |
| | 6.6 | 2 | 3 | 4 | | WB | | |
| | 9.1 | 1 | 4 | 4 | 1 | " | | |
| | 11.6 | 1 | 3 | 4 | 2 | " | | |
| | 16.6 | 3 | 6 | 6 | | " | | |
| | 21.6 | 1 | 1 | 2 | | " | | |
| | 26.6 | 5 | 8 | 8 | 3 | " | | |
| | 31.6 | 4 | 8 | 9 | | " | | |
| | | 2 | 3 | 8 | | " | | |

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|----------------------|--------------------|-------------------|------------------------------|
| EST. % WT. WATER | COHESIVE | GRANULAR | |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | 5.5 |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | 2.9 |
| WET 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | 17.6 |
| WATER BEARING - W.B. | STIFF 9-15 BPF | DENSE 25-50 BPF | 2.1 |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | 1 |
| | HARD 31-60 BPF | | |

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
FOUNDATION BORING LOG SHEET OF
398

PROJECT NO. 0.10561 COUNTY Dare GEOLOGIC PROVINCE Coastal
 BRIDGE ON Mann's Harbor Shipyard OVER _____
 BORING LOCATION (STA.) _____ OFFSET _____
 BORING NO. 62 GEOLOGIST EAU GROUND WATER 0 HRS. _____ 24 HRS. 5.5'
 COLLAR ELEV. 6.6' DATE STARTED 2-6-79 DRILL EQUIPMENT B-52 Mobilew/
 TOTAL DEPTH 33.5' DATE COMPLETED 2-6-79 Hollow Stem Augers S.P.T

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|-----------|--------------------------------------|--------|-----------------|
| | | 6" | 6" | 6" | | | | |
| | 0.0 | | | | | | | |
| | 2.0 | | | | | | | |
| | 4.5 | 2 | 3 | 4 | 1 | TAN FINE SAND | D | |
| | 7.0 | 1 | 2 | 3 | | SAME AS ABOVE | WB | |
| | 9.5 | 3 | 1 | 2 | 2 | SAME AS ABOVE | " | |
| | 12.0 | 3 | 4 | 5 | | SAME AS ABOVE | " | |
| | 17.0 | 3 | 5 | 7 | 3 | SAME AS ABOVE | " | |
| | 22.0 | 3 | 8 | 9 | | SAME AS ABOVE | " | |
| | 27.0 | 3 | 3 | 6 | 4 | YEL BRN. CSE. SANDS | " | |
| | 32.0 | 2 | 5 | 6 | | SAME AS ABOVE LOST MOST OF SAMPLE | " | |
| | | 5 | 5 | 4 | | GRAY BRN. F. SAND | " | |

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|----------------------|--------------------|-------------------|------------------------------|
| EST. % WT. WATER | COHESIVE | GRANULAR | |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | |
| WET 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | |
| WATER BEARING - W.B. | STIFF 9-15 BPF | DENSE 25-50 BPF | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | |
| | HARD 31-60 BPF | | |
| | HARD OVER 60 | | |

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
FOUNDATION BORING LOG SHEET 399 OF

PROJECT NO. 0.10561 COUNTY Dare GEOLOGIC PROVINCE Coastal
~~BRIDGE ON~~ Manns Harbor Shipyard OVER
 BORING LOCATION (STA.) OFFSET
 BORING NO. 63 GEOLOGIST EAW GROUND WATER 0 HRS. 24 HRS. 5.5
 COLLAR ELEV. 5.1' DATE STARTED 2-6-79 DRILL EQUIPMENT B-52 Mobile w/
 TOTAL DEPTH 23.7' DATE COMPLETED 2-6-79 Hollow Stem Augers S.P.T.

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|-----------|------------------|--------|-----------------|
| | | 6" | 6" | 6" | | | | |
| | 0.0 | | | | | | | |
| | 2.2 | | | | | | | |
| | 4.7 | 2 | 9 | 8 | 1 | | D | |
| | 7.2 | 1 | 2 | 5 | 2 | | wB | |
| | 9.1 | 1 | 1 | 4 | | | " | |
| | 12.2 | 1 | 2 | 3 | 3 | | " | |
| | 17.2 | 2 | 2 | 3 | 4 | | " | |
| | 22.2 | 3 | 5 | 4 | | | " | |

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. | |
|----------------------|--------------------|-------------------|------------------------------|------------|
| EST. % WT. WATER | COHESIVE | GRANULAR | | |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | <u>2.2</u> | <u>4.7</u> |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | <u>1.5</u> | <u>1.5</u> |
| WET 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | <u>7.7</u> | <u>2</u> |
| WATER BEARING - W.B. | STIFF 9-15 BPF | DENSE 25-50 BPF | | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | | |
| | HARD 31-60 BPF | | | |

NORTH CAROLINA
 DEPARTMENT OF TRANSPORTATION
 LOCATION AND SURVEYS UNIT
 FOUNDATION BORING LOG SHEET 1 OF 1
 400

PROJECT NO. 0.10561 COUNTY DARE GEOLOGIC PROVINCE COASTAL
 BRIDGE ON MAYNARD LAYTON FERRY BASIN OVER _____
 BORING LOCATION (STA.) DRILLED 12' FROM STAKE OFFSET TOWARDS THE ROAD
 BORING NO. 66 GEOLOGIST T.B. DANIEL GROUND WATER 0 HRS. 9.0 24 HRS. _____
 COLLAR ELEV. 10.4' DATE STARTED 2-14-79 DRILL EQUIPMENT MUD BUG w/
 TOTAL DEPTH 55.5 DATE COMPLETED " HOLLOW AUGERS; S.P.T.

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|-----------|---|--------|-----------------|
| | | 6" | 6" | 6" | | | | |
| | 2.5 | 1 | 2 | 2 | 1 | 0-1/2" D. SEA-GRAY SIL. OVER SIL. F. SAND P.S. A-2-A | | |
| | 5.0 | 1 | 2 | 3 | 2 | TAN SIL. F. SAND A-3 W. DIAL ROOTS AS ABOVE A-3 | M | 0 4 |
| | 7.5 | 1 | 3 | 3 | 3 | AS ABOVE A-3 | " | 0 5 |
| | 10.0 | 1 | 2 | 2 | 4 | BKN SIL. FINE SAND 1-2-A | W.B. | 0 4 |
| | 14.0 | 2 | 3 | 6 | 5 | SEA-GRAY NAT. SILT FINE SAND A-2-A - V. TP. LG. CN SIL. F. SAND A-3 | " | 0 9 |
| | 19.0 | 7 | 9 | 13 | 6 | LG. TP. SAND LG. CN SIL. F. SAND A-3 | " | 0 22 |
| | 24.0 | 3 | 3 | 6 | | 2" DIA. WASHED MOS. LOST - DRAIN SIL. F. SAND A-3 | " | 0 9 |
| | 29.0 | 3 | 3 | 3 | | 2" DIA. WASHED - .5" W. W. SAMPLE LOST | " | 0 6 |
| | 34.0 | 5 | 4 | 5 | | 2" DIA. WASHED - 1" DIA. (B. SAND) SAMPLE LOST | " | 0 9 |
| | 39.0 | 4 | 3 | 2 | 7 | 2" DIA. WASHED - MOS. LOST - F. SAND A-3 FINE SAND 1-2-A | V.B. | 0 5 |
| | 44.0 | 1 | 1 | 2 | 8 | SEA-GRAY LAYERED SILTY M.C. LINT SAND (M) "CLAY" M.C. (CL. SIL) A-2-A/1-A | W | 0 3 |
| | 49.0 | 6 | 3 | 3 | 9 | 3" DIA. WASHED - CLAY AS ABOVE w/ LAYERS OF SILT SAND A-3 | W.B. | 0 6 |
| | 54.0 | 13 | 20 | 23 | 10 | 2" DIA. WASHED - DRAIN .6" * MOS. LOST - GRAY SIL. FINE SAND A-3 | " | 0 43 * |

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|-----------------------|--------------------|--------------------|------------------------------|
| EST. % WT. WATER | COHESIVE | GRANULAR | |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | * POSSIBLE OVERDRIVE |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | |
| WET 30-70% | M. STIFF 5-8 BPF | M. DENSE 11-24 BPF | |
| WATER BEARING - W. B. | STIFF 9-15 BPF | DENSE 25-50 BPF | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | |
| | HARD 31-60 BPF | | |
| | V. HARD OVER 60 | | |

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
FOUNDATION BORING LOG SHEET ___ OF ___
401

PROJECT NO. 0.10561 COUNTY Dare GEOLOGIC PROVINCE Coastal

~~BRIDGE ON~~ Manns Harbor Shipyard OVER _____

BORING LOCATION (STA.) _____ OFFSET _____

BORING NO. 67 GEOLOGIST EAW GROUND WATER 0 HRS. _____ 24 HRS. 5.5

COLLAR ELEV. 3.6' DATE STARTED 2-13-79 DRILL EQUIPMENT B-52 Mobile w/

TOTAL DEPTH 53.5 DATE COMPLETED 2-13-79 Hollow Stem Augers s.p.t.

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|-----------|------------------|--------|-----------------|
| | | 6" | 6" | 6" | | | | |
| 3.6 | 0.0 | | | | | | | |
| | 2.0 | | | | | | | |
| | 4.5 | 1 | 2 | 3 | 1 | | | |
| | 7.0 | 2 | 3 | 4 | 2 | | | |
| | 9.5 | 2 | 3 | 4 | | | | |
| | 12.0 | 2 | 6 | 7 | | | | |
| | 17.0 | 2 | 5 | 8 | 3 | | | |
| | 22.0 | 2 | 4 | 4 | | | | |
| | 27.0 | 2 | 2 | 2 | | | | |
| | 32.0 | 4 | 7 | 6 | | | | |
| | 37.0 | 4 | 3 | 3 | | | | |
| | 42.0 | 5 | 6 | 6 | | | | |
| | 47.0 | 4 | 8 | 12 | 4 | | | |
| | 52.0 | 6 | 10 | 11 | 5 | | | |
| | | 3 | 6 | 10 | | | | |

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|-----------------------|--------------------|--------------------|------------------------------|
| EST. % WT. WATER | COHESIVE | GRANULAR | |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | |
| WET 30-70% | M. STIFF 5-8 BPF | M. DENSE 11-24 BPF | |
| WATER BEARING - W. B. | STIFF 9-15 BPF | DENSE 25-50 BPF | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | |
| | HARD 31-60 BPF | | |
| | V. HARD OVER 60 | | |

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
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402

PROJECT NO. 0.10561 COUNTY DARE GEOLOGIC PROVINCE COASTAL
BRIDGE ON MANHATTAN LAKES BASIN OVER _____
BORING LOCATION (STA.) _____ OFFSET _____
BORING NO. 68 GEOLOGIST T.B. DANIEL GROUND WATER 0 HRS. 24 HRS 2.5
COLLAR ELEV. 2.6' DATE STARTED 2-6-79 DRILL EQUIPMENT MUD BUG
TOTAL DEPTH 55.3' DATE COMPLETED 2-7-79 HOLLOW AUGERS: S.P.T.

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|-----------|--|--------|-----------------|
| | | 6" | 6" | 6" | | | | |
| | 2.5 | 3 | 3 | 6 | | | | |
| | 5.0 | 4 | 8 | 9 | 1 | GRAY SIL. FINE SANDS A-2.4/A-3 | W.B. | 9 17 |
| | 7.5 | 2 | 3 | 5 | 2 | GRAY SIL. FINE SAND/W/ SOME WOOD A-2.4/A-3 | " | 8 |
| | 10.0 | 3 | 4 | 6 | 3 | 1/2" SDR WOOD PLUS WASHED GRAY MIC. SILTY F. SANDS A-2.4 | " | 13 |
| | 13.8 | 3 | 6 | 8 | 4 | 2 1/2" SDR WOOD PLUS WASHED GRAY MIC. FINE SAND/W/ WOOD A-3 | " | 14 |
| | 18.8 | 2 | 4 | 3 | | 4" MIC. SDR WOOD PLUS WASHED SAMPLE LOST | | 7 |
| | 23.8 | 4 | 7 | 10 | | 4" SDR WOOD PLUS WASHED SAMPLE LOST | | 11 |
| | 28.8 | 7 | 13 | 14 | | 4" SDR WOOD PLUS WASHED SAMPLE LOST | | 27 |
| | 33.8 | 3 | 4 | 4 | 5 | 2" SDR WOOD PLUS WASHED DEEP MIC. SILTY FINE SANDS A-2.4 | W.B. | 8 |
| | 38.8 | 1 | 4 | 6 | 6 | 2" SDR WOOD PLUS WASHED DEEP MIC. SILTY FINE SANDS LOCAL LAMINATIONS OF MIC. SILTY SILT A-2.4 | " | 10 |
| | 43.8 | 4 | 8 | 15 | 7 | 3" SDR WOOD PLUS WASHED GRAY-BRN SILTY FINE SAND W/ TRACE OF SHELL AT 43.1' A-2.4 | " | 23 |
| | 48.8 | 3 | 4 | 3 | 8 | GRAY SIL. FINE SAND/W/ SHELL FRAGS A-2.4 | " | 7 |
| | 53.8 | 7 | 13 | 21 | | 3" SDR WASHED - WOOD SAMPLE AS ABOVE A-2.4 | " | 34 |

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|-----------------------|--------------------|-------------------|------------------------------|
| EST. % WT. WATER | COHESIVE | GRANULAR | |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | |
| WET 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | |
| WATER BEARING - W. B. | STIFF 9-15 BPF | DENSE 25-50 BPF | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | |
| | HARD 31-60 BPF | | |

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
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PROJECT NO. 0.10561 COUNTY DARE GEOLOGIC PROVINCE COASTAL
 BRIDGE ON MARSH HOLLOW FERRY BASIN OVER _____
 BORING LOCATION (STA.) _____ OFFSET _____
 BORING NO. 71 GEOLOGIST T.B. DANIEL GROUND WATER 0 HRS. 24 HRS.
 COLLAR ELEV. 6.1' DATE STARTED 2-7-79 DRILL EQUIPMENT MUD BUG
 TOTAL DEPTH 50.4' DATE COMPLETED 2-8-79 HOLLOW AUGER, S.P.T.

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|-----------|--|--------|-----------------|
| | | 6" | 6" | 6" | | | | |
| | 2.5 | 2 | 3 | 4 | 1 | MUDY BR.-GRAY SIL. FINE SANDY SILL A-2-A | M | 7 |
| | 5.0 | 3 | 3 | 2 | 2 | BRN.-GRAY SIL. F. SAND SILTY CLAY A-2-A | " | 5 |
| | 7.5 | 2 | 3 | 3 | | SAMPLE LOST | | 6 |
| | 10.0 | 2 | 5 | 3 | 3 | MED. SILTY FINE SAND A-3 | V.B. | 5 |
| | 13.9 | 4 | 7 | 9 | | 2 1/2 GAL WASHED SAMPLE AS ABOVE A-3 | " | 16 |
| | 18.9 | 5 | 5 | 6 | 4 | 2 1/2 GAL WASHED SAMPLE AS ABOVE A-3 | " | 11 |
| | 23.9 | 3 | 4 | 6 | 5 | 2 1/2 GAL WASHED SAMPLE (BRN. SAND) A-2-A/A-3 (TRAVEL) | " | 10 |
| | 28.9 | 7 | 9 | 10 | | 2 1/2 GAL WASHED SAMPLE LOST | | 19 |
| | 33.9 | 2 | 2 | 6 | 6 | DEEP BRN. F.-CSF SAND W/DEA CORREL A-2-A/A-3 | V.B. | 8 |
| | 38.9 | 2 | 1 | 3 | 7 | 2 1/2 GAL WASHED SAMPLE SECTION SANDS / LAYERS (MUDY SILTY SILT) A-3/A-4 | " | 4 |
| | 43.9 | 4 | 7 | 10 | 8 | 2 1/2 GAL WASHED SAMPLE SECTION SANDS A-3 | " | 17 |
| | 48.9 | 9 | 16 | 23 | 9 | GRAY SILTY FINE SAND W/SHELL (MUD) A-2-A | " | 39 |

| SOIL MOISTURE | | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|-----------------------|--------|--------------------|-------------------|------------------------------|
| EST. % WT. WATER | | COHESIVE | GRANULAR | |
| DRY | 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | |
| MOIST | 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | |
| WET | 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | |
| WATER BEARING - W. B. | | STIFF 9-15 BPF | DENSE 25-50 BPF | |
| | | V. STIFF 16-30 BPF | V. DENSE OVER 50 | |
| | | HARD 31-60 BPF | | |

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
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FOUNDATION BORING LOG SHEET 1 OF 1

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PROJECT NO. 0.10561 COUNTY DARE GEOLOGIC PROVINCE COASTAL
 BRIDGE ON MAZING HARBOUR CARRY BASIN OVER _____
 BORING LOCATION (STA.) _____ OFFSET _____
 BORING NO. 72 GEOLOGIST T.B. DANIEL GROUND WATER 0 HRS. 24 HRS.
 COLLAR ELEV. 2.7 DATE STARTED 2-8-79 DRILL EQUIPMENT Hand Bore
 TOTAL DEPTH 50.1 DATE COMPLETED 2-9-79 HOLLOW AUGERS SPT

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|---|------------------|--------|-----------------|
| | | 6" | 6" | 6" | | | | |
| | 2.5 | 1 | 1 | | 0 - SAND-CLAY MIXED ORG SAND SOIL | | | |
| | 5.0 | 1 | 2 | 1 | MUCK & PEAT | | | |
| | 7.5 | 1 | 1 | 2 | DEGRADED ORG. SILTY SAND W/ WOOD A-2-A | W.B. | 0 3 | |
| | 10.0 | 1 | 2 | 2 | DEGRADED ORG. SILTY SAND W/ WOOD A-2-A | " | 0 3 | |
| | 13.6 | 3 | 4 | 5 | GRAY SILTY FINE SAND A-3 | " | 0 4 | |
| | 18.6 | 3 | 4 | 5 | GREEN SILTY FINE SAND A-3 | " | 0 9 | |
| | 23.6 | 4 | 5 | 5 | 3' PUG WASHED SAMPLE LOST | | 0 9 | |
| | 28.6 | 3 | 3 | 6 | 2' PUG WASHED SAMPLE LOST | | 0 10 | |
| | 33.6 | 2 | 5 | 5 | 5' PUG WASHED DEGRADED ORG. LAYERED SILTY FINE SAND A-2-A/A-4 | W.B. | 0 9 | |
| | 38.6 | 1 | 2 | 3 | 7' PUG WASHED DEGRADED ORG. SILTY FINE SAND A-2-A/A-4 | " | 0 10 | |
| | 43.6 | 4 | 3 | 6 | 2' PUG WASHED DEGRADED ORG. SILTY FINE SAND W/ SMALL FRAGS. A-2-A | " | 0 5 | |
| | 48.6 | 3 | 5 | 5 | 2' PUG WASHED DEGRADED ORG. SILTY FINE SAND W/ SMALL FRAGS. A-2-A | " | 0 9 | |
| | | | | | | | 0 10 | |

| SOIL MOISTURE | | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|-----------------------|--------|--------------------|-------------------|------------------------------|
| EST. % WT. WATER | | COHESIVE | GRANULAR | |
| DRY | 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | |
| MOIST | 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | |
| WET | 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | |
| WATER BEARING - W. B. | | STIFF 9-15 BPF | DENSE 25-50 BPF | |
| | | V. STIFF 16-30 BPF | V. DENSE OVER 50 | |
| | | HARD 31-60 BPF | | |

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
LOCATION AND SURVEYS UNIT
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PROJECT NO. 0.10561 COUNTY Dare GEOLOGIC PROVINCE Coastal
 BRIDGE ON Manns Harbor Shipyard OVER _____
 BORING LOCATION (STA.) _____ OFFSET _____
 BORING NO. 73 GEOLOGIST EAW GROUND WATER 0 HRS. _____ 24 HRS. 3.5
 COLLAR ELEV. 2.9 DATE STARTED 2-9-79 DRILL EQUIPMENT B-52 Mobile w/
 TOTAL DEPTH 43.8' DATE COMPLETED 2-12-79 Hollow Stem Augers S.P.T.

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|-----------|------------------|--------|-----------------|
| | | 6" | 6" | 6" | | | | |
| 2.9 | 0.0 | | | | | | | |
| | 2.3 | | | | | | | |
| | 4.8 | 1 | 3 | 5 | 1 | | | |
| | 7.3 | 1 | 1 | 1 | | | | |
| | 9.8 | 1 | 2 | 4 | 2 | | | |
| | 12.3 | 2 | 5 | 6 | | | | |
| | 17.3 | 4 | 6 | 7 | | | | |
| | 22.3 | 3 | 4 | 5 | 3 | | | |
| | 27.3 | 5 | 4 | 3 | | | | |
| | 32.3 | 3 | 4 | 5 | | | | |
| | 37.3 | 2 | 8 | 5 | | | | |
| | 42.3 | 1 | 2 | 4 | 4 | | | |
| | | 5 | 10 | 8 | | | | |

| SOIL MOISTURE | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. | |
|-----------------------|--------------------|-------------------|------------------------------|-----|
| EST. % WT. WATER | COHESIVE | GRANULAR | | |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | 5.5 | 2.3 |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | 3.2 | 2.0 |
| WET 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | 2.3 | 2.3 |
| WATER BEARING - W. B. | STIFF 9-15 BPF | DENSE 25-50 BPF | | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | | |
| | HARD 31-60 BPF | | | |

NORTH CAROLINA
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LOCATION AND SURVEYS UNIT
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15.3
23
13.2

PROJECT NO. 0.10561 COUNTY DAVE GEOLOGIC PROVINCE COASTAL
~~BRIDGE ON~~ MANNING HARBOR FERRY BASIN OVER _____
 BORING LOCATION (STA.) _____ OFFSET _____
 BORING NO. 74 GEOLOGIST T.B. DANIEL GROUND WATER 0 HRS. _____ 24 HRS. 4.5'
 COLLAR ELEV. 5.1' DATE STARTED 2-13-79 DRILL EQUIPMENT MUD BUG W/
 TOTAL DEPTH 44.7' DATE COMPLETED _____ " _____ HOLLOW AUGERS ; S.P.T.

| ELEV. | DEPTH | BLOW COUNT | | | SAMP. NO. | SOIL DESCRIPTION | MOIST. | NOTES & REMARKS |
|-------|-------|------------|----|----|--|------------------|--------|-----------------|
| | | 6" | 6" | 6" | | | | |
| | 2.5 | 1 | 1 | 1 | 0-1 BRN SILT CLAY SAND A-2.4 | | | |
| | 5.0 | 1 | 1 | 2 | TAN SIL FINE SAND A-3 | M. | 2 | |
| | 7.5 | 2 | 2 | 3 | DRY-GY. NOT SILTY SILTY FINE SAND A-2.4/A-4 | W. | 2 | |
| | 10.0 | 4 | 6 | 4 | CRAY-GY. SIL FINE SAND A-3 | W.B. | 5 | |
| | 13.2 | 2 | 8 | 5 | AS ABOVE | " | 12 | |
| | 18.2 | 2 | 3 | 4 | 2' PLUG WASHED TICKY SIL FINE SAND A-3 | " | 20 | |
| | 23.2 | 4 | 3 | 6 | 1' PLUG WASHED SAMPLE LOST | | 7 | |
| | 28.2 | 2 | 4 | 5 | 3' PLUG WASHED SAMPLE LOST | | 9 | |
| | 33.2 | 2 | 6 | 3 | CRAY WASHED - MISS. B SAMPLE LOST | | 9 | |
| | 38.2 | 2 | 2 | 4 | 4' PLUG WASHED BRN SILT SAND w/ SHELL FRAGS A-2.4 | W.B. | 9 | |
| | 43.2 | 4 | 6 | 8 | 2' PLUG - SOME CLAY CRAY INTERB. D. MIC SILTY F. SAND & MIC. CLY SILT A-4 | W. | 6 | |
| | | | | | 3' PLUG WASHED CRAY SILTY FINE SAND A-3 | W.B. | 14 | |

| SOIL MOISTURE EST. % WT. WATER | SOIL CONSISTENCY | | PRELIMINARY FOUNDATION INFO. |
|-----------------------------------|--------------------|-------------------|------------------------------|
| | COHESIVE | GRANULAR | |
| DRY 0-10% | V. SOFT 0-1 BPF | V. LOOSE 0-4 BPF | |
| MOIST 10-30% | SOFT 2-4 BPF | LOOSE 5-10 BPF | |
| WET 30-70% | M. STIFF 5-8 BPF | M DENSE 11-24 BPF | |
| WATER BEARING - W. B. | STIFF 9-15 BPF | DENSE 25-50 BPF | |
| | V. STIFF 16-30 BPF | V. DENSE OVER 50 | |
| | HARD 31-60 BPF | | |