

**ROCK BLASTING:****(SPECIAL)****Description**

Blast rock to excavate, break up or remove rock and construct stable rock cuts using production, controlled and trench blasting. Use production blasting to fracture rock into manageable sizes for excavation. Use controlled blasting to form cut slopes in rock by limiting the effects of blasting with cushion or trim blasting. Use trench blasting to create trenches in rock for utilities and pipes and construct open ditches. Provide blasting submittals, use blasting consultants, conduct pre-blast surveys and test blasts, design and monitor blasts, blast rock and produce post-blast reports in accordance with the contract, accepted submittals and Section 220 of the *Standard Specifications*.

**Project Requirements**

At a minimum, conduct pre-blast surveys for any structure where a PPV of more than 0.4"/sec may occur. Determine PPV based on distance to structures and maximum charge per delay for blasts using the following:

$$PPV = K \left( \frac{D}{\sqrt{W}} \right)^m \quad \text{or} \quad PPV = K (D_s)^m$$

Where,

PPV	=	peak particle velocity ("/sec),
K	=	confinement factor (K factor),
D	=	distance to structure (ft),
W	=	maximum charge per delay (lb),
m	=	decay constant and
D <sub>s</sub>	=	scaled distance (ft/lb <sup>0.5</sup> ).

Typically, K is 240 and m is -1.6. However, K and m are site specific and may be determined from regression analysis of multiple PPV and D<sub>s</sub> data pairs. Select K and m based on site conditions, rock type and structure, subsurface information and blast monitoring results.

**Construction Methods****(A) Blasting Submittals**

Submit 2 copies and a PDF copy of blasting plans and post-blast reports and if required, a personnel and experience submittal and pre-blast surveys. Submit one copy to the Resident Engineer and the other copy and PDF copy to the appropriate Geotechnical Engineering Unit regional office.

**(1) Personnel and Experience Submittal**

Submit the proposed personnel and experience submittal for acceptance at least 30 days before submitting the general blasting plan. The Engineer may waive this submittal if blasting consultants are not required and the Blaster-in-Charge was previously accepted within the last year for another NCDOT project with blasting similar to that anticipated for this project. Do not submit the general blasting plan until the personnel and experience submittal is waived or a submittal is accepted.

Submit documentation that the proposed Blaster-in-Charge is approved as a Blaster-in-Charge (key person) for the Blasting Contractor and has at least 5 years

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of experience with subsurface conditions and blasting of a scope and complexity similar to that anticipated for this project. Documentation should include resumes, references, letters, certifications, project lists, experience descriptions and details, etc. If the Blaster-in-Charge changes, discontinue explosives use until a new Blaster-in-Charge is accepted.

If a Blast Design or Monitoring Consultant is required, submit documentation that the proposed independent consultant is approved as a Geotechnical Engineer (key person) for the blasting consultant. Employees of the Contractor, any affiliated companies or product suppliers may not be independent consultants.

**(2) Blasting Plans**

If a Blast Design Consultant is required, provide blasting plans signed by the consultant. Submit the proposed general blasting plan for acceptance that meets Subarticle 220-3(B) of the *Standard Specifications* and includes the site specific blasting plan format and if required, test blast locations, pre-blast survey criteria and methods and which structures require pre-blast surveys.

After a general blasting plan is accepted, submit a site specific blasting plan for each blast at least 24 hours before beginning drilling. Site specific blasting plans may be waived for non-critical blasts as determined by the Engineer. Provide site specific blasting plans that meet Subarticle 220-3(B)(4) of the *Standard Specifications* and include blast locations by station and offset, distance to nearest utility or structure and blast monitoring locations. Do not exceed the maximum charge per delay accepted in the general blasting plan or submit a revised plan to increase the maximum charge per delay allowed.

**(3) Pre-Blast Surveys**

If a Blast Monitoring Consultant is required, provide pre-blast surveys signed by the consultant. Otherwise, provide pre-blast surveys signed by the Blaster-in-Charge.

After a general blasting plan is accepted and if pre-blast surveys are required, submit pre-blast surveys at least 24 hours before starting blasting. Provide pre-blast surveys that include at least the following:

- (a) Summary with pre-blast survey date and time, comments about existing structure condition and name of individual conducting survey;
- (b) Sketches of interior and exterior walls and foundations with existing cracks and written descriptions of cracks including length, width, type and angle;
- (c) 5-megapixel digital color pictures on CD or DVD documenting existing cracks and structure condition; and
- (d) If required, video recordings on DVD showing interior and exterior walls, existing cracks, foundations and structure condition.

**(4) Post-Blast Reports**

If a Blast Monitoring Consultant is required, provide blast monitoring results signed by the consultant. Provide post-blast reports that meet Subarticle 220-3(E) of the *Standard Specifications*.

**(B) Blast Designs**

Design blasts in accordance with the Project Requirements Section of this provision, if applicable, Subarticle 220-3(A) of the *Standard Specifications* and the following unless otherwise approved:

**(1) Production Blasting**

- (a) Provide at least 6 ft clearance between production blast holes and slope faces.
- (b) Drill production blast holes with a maximum diameter of 6".
- (c) Do not drill production blast holes below bottom of adjacent controlled blast holes.
- (d) Use delay blasting to detonate production blast holes towards a free face.

**(2) Controlled Blasting**

Use cushion or trim blasting for slopes steeper than 2:1 (H:V) with rock cuts taller than 15 ft.

- (a) Drill cushion or trim blast holes with a maximum diameter of 6".
- (b) Limit subdrilling to that necessary for excavation of slopes.
- (c) Do not subdrill below finished grade.
- (d) Provide benches or lifts with a maximum height of 25 ft.
- (e) Do not use ANFO or other bulk loaded products.
- (f) Design cushion or trim blasting with a maximum charge density and burden of one-half the charge density and burden for production blasting.
- (g) If cushion, trim and production blast holes are fired in the same blast, fire cushion or trim holes at least 25 ms after production holes.

**(3) Trench Blasting**

- (a) Drill trench blast holes with a maximum diameter of 3".
- (b) Do not use ANFO or other bulk loaded products.
- (c) Use cartridge explosives or other explosive types designed for trench blasting.
- (d) Use charges with a diameter of 1/2" to 3/4" less than the trench hole diameter.

**(C) Test Blasts**

Define a "test blast" as drilling, blasting and excavating a test section before starting or resuming blasting. If test blasts are required, conduct at least one test blast for each blast

type (production, controlled or trench blasting) and location requiring test blasts.

If blasting results in injuries or damages or PPV or air overpressure limits are exceeded at any utility or structure in any direction from blasts, the Engineer may suspend blasting and require test blasts before resuming blasting. When this occurs, inform the Engineer of test blast locations before submitting blasting plans.

Submit a site specific blasting plan for each test blast at least 72 hours before beginning drilling. Conduct test blasts in accordance with the accepted submittals and Article 220-3 of the *Standard Specifications*. Production, controlled or trench blasting may not begin or resume until the post-blast report for a test blast is reviewed, the rock cut from a test blast is fully exposed and the Engineer determines the exposed cut is acceptable. Examples of test blast results that may be unacceptable include excessive vibration, air overpressure or flyrock, overbreakage or overhangs and damaged rock cuts.

**Measurement and Payment**

No direct payment will be made for blasting including blasting submittals, blasting consultants, pre-blast surveys, test blasts, blast monitoring, post-blast reports, scaling and stabilizing rock cuts. Blasting will be considered incidental to other items in the contract in accordance with Article 220-4 of the *Standard Specifications*.

No additional payment will be made and no extension of completion date or time will be allowed when the Engineer suspends blasting and requires test blasts or additional blast monitoring or blasting submittals.

