Sample project special: 203re

02-03-11

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# Revision Of Section 203 Rock Excavation

Section 203 of the Standard Specifications is hereby revised for this project to include the following:

**DESCRIPTION**

**General.** This work consists of blasting, scaling, excavation, and disposal of all materials in the excavation areas in accordance with these specifications and in conformity with the limits, lines and grades shown on the plans or as established in the field by the Engineer.

**Special Considerations.** The Contractor shall utilize controlled blasting techniques for all excavations to reduce overbreak and to control slope contour. The Contractor shall conduct the work in a manner that ensures the safety of employees, CDOT personnel, adjacent properties, and the public.

The Contractor shall prevent damage outside the excavation limits, and shall prevent rocks and blast debris from entering adjacent streams, or properties. All damages resulting from rock excavation operations shall be repaired, and items replaced to the satisfaction of the Engineer, at the Contractor’s expense.

**Definitions.**

Production Blasting. The controlled use of explosives and blasting accessories in carefully spaced and aligned drill holes to provide a distribution of charge that will excavate the rock to the required limits and minimize overbreak, stressing and fracturing of the rock beyond the design lines.

Controlled Blasting. The use of explosives and blasting accessories in carefully spaced and aligned drill holes to produce a free surface or shear plane along the controlled blast line.

Trim (Cushion) Blasting. A controlled blasting method involving the drilling of a single row of holes which are loaded with light, decoupled, well distributed charges and are fired either after the main excavation is removed or in the last delay of a single blast.

Pre-splitting. A controlled blasting method involving a single row of drilled holes which are loaded and fired before any holes in the main excavation are fired.

Line Drilling. A controlled blasting method, which includes a single row of closely spaced, unloaded, small diameter drilled holes providing a plane of weakness in the rock mass to which the primary blast can break.

Controlled Blast Line. The single row of holes used to achieve the results of all controlled blasting methods including trim blasting, line drilling, and pre-splitting.

Trial Blast. A blast or series of blasts to assist in determining the combination of blast parameters that are most appropriate to achieve the desired result as described in this special provision.

Final Wall Face. The remaining slope surface after all excavation is complete.

**CONSTRUCTION REQUIREMENTS**

**Pre-Construction Submittals.** At least two weeks prior to start of excavation, the Contractor shall submit for approval by the Engineer:

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1. Copies of all Contractor’s forms that shall be used to meet the requirements of this specification. At a minimum, these shall include blast design and blast report forms.
2. Manufacturers’ data sheets for all explosives, primers and initiators to be used.
3. The proposed excavation plans and procedures, including:
4. Equipment and methods for accessing the work area.
5. Equipment and methods to be used for drilling, loading and firing blastholes.
6. Equipment and methods to be used for blast monitoring
7. Locations, dimensions and sequence of blasts.
8. Intended direction of rock movement and delay plan.
9. Methods of removing shot rock from the cut bench.
10. Expected excavation rates.
11. Methods of stabilizing or protecting adjacent structures and vegetation.
12. Proposed method of controlling flyrock.
13. Methods for protecting the traffic and roadway from debris produced by the Contractor’s excavation operations.
14. A description of the pre-blast warning system to be used.
15. Traffic control procedures and procedures for cleaning of blast debris in accordance with subsection 104.04 and the traffic control specification.
16. Excavation plans, schedules and procedures.
17. Rock Scaling procedures.
18. Proof of current blasting related insurance.
19. Seismographic equipment specifications.
20. Documentation confirming that blasting supervisors have a minimum of five years of experience in designing, supervising, loading and firing of blasts for rock slopes or tunnel excavations, as applicable, and have all licenses and permits required by local agencies and others having jurisdiction..

**Construction Submittals.** Unless otherwise directed, the following shall be submitted at least one week prior to the initial blast as noted below:

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1. A blast design for the initial blast at each rock cut shall be submitted not later than seven days prior to beginning drilling at that cut location. A blast design shall be submitted for each subsequent blast at that rock cut or foundation excavation not later than 24 hours prior to drilling for that blast, if there are substantial differences from the original. Blast plans shall include the following:
2. Location of blast.
3. Drilling pattern, including diameters, spacing, depth, and orientation of drill holes.
4. Types, strengths and quantities of explosives proposed for use in each hole, on each delay and for each blast.
5. Distribution of the charge in the holes, priming of each hole and stemming of holes.
6. Type, sequence and number of delays, delay pattern, diagram for blast, size and type of hookup lines and lead lines and type and capacity of blast initiation device.
7. Name and signature of blasting supervisor.
8. Procedures for the control and disposal of water during excavation.
9. Daily records of scaling and excavation work shall be maintained, and one copy of the record of each day's work shall be submitted to the Engineer on the following day. Daily records shall include:

(1) Locations of scaling work.

(2) A blast report for each round of blasting that includes a complete description of each blast conducted. The report shall be furnished to the Engineer no later than 24 hours after the round is fired, and shall include:

1. Date, time and limits of blast by station and offset from centerline of roadway.
2. Diagram of the blast pattern and delay sequence drawn to scale with diameter, spacing, depth and orientation of drill holes. Indicate holes that were not drilled, drilled but not loaded and changes in spacing, pattern, delays or loading of holes.
3. General response to drilling action (noting especially any soft zones or voids encountered) and what if any, adjustments were made in the blast parameters as a result.
4. Quantity of explosives used by weight and number of cartridges per hole and per round and distribution of explosives in holes.
5. Total number of delays used, number of holes for each delay period, maximum charge per delay and type of detonators.

1. Power factor (the weight of explosives per cubic yard of rock in place as determined from the blast pattern).
2. Name and signature of blasting supervisor.

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1. An evaluation of the blast indicating areas of significant overbreak and planned adjustments to the blast design for the next blast.
2. Unusual occurrences (including rock falls, unstable ground, groundwater problems, equipment malfunction and the location elevation and time of each occurrence).
3. Seismographic data.

**Excavation General.** Excavation shall not extend beyond the dimensions and elevations established except as specified on the plans or as directed by the Engineer.

The Contractor shall not begin excavation prior to the slope staking of the site.

For sliver cuts, pioneering the top of cuts and preparing a working platform to begin operations may require unusual working methods and equipment. The Contractor may use angle drilled holes or fan drilled holes during the initial pioneering operation to obtain the required rock face.

Excavation, rock reinforcement. stabilization, or both, carried out below or beyond the lines and grades shown on the plans, below or beyond that established by the Engineer, or for the convenience of the Contractor, shall be at the Contractor’s expense.

The Contractor shall provide surveyed points on ♦ [100,50] foot stations, indicating grade and centerline offset on the backslope after each lift has been excavated and before drilling begins for the next lift. This work shall be performed under the supervision of a Licensed Professional Surveyor in the State of Colorado.

Excavation shall be staged to allow the installation of rock reinforcement as the cut is brought down. Drilling of the next lift shall not begin until rock reinforcement for the preceding lift is completed.

The rock on this project is not homogeneous. The Contractor shall perform trial blasts and or adjust the blast parameters as required by the existing rock conditions, in order to comply with all other specifications.

Blasts shall be conducted in conformance with the following limitations as required by the Engineer. These limitations shall remain in effect unless it is demonstrated through trial blasts that the desired results can be achieved when said limitations are exceeded.

**Drilling General.** The inclination of vertical holes shall not exceed 1(Vertical): 4(Horizontal).

Bench height shall be a maximum of 20 feet.

Blasts shall be sized such that the requirements of the traffic control specifications are fulfilled.

Maximum depth of sub-drilling for all blastholes at final grade shall be 6 inches.

Drillhole conditions may vary from dry to filled with water. The Contractor shall use explosives or blasting accessories that are appropriate for the hole conditions at no additional cost to the project.

The blast design shall take into consideration the natural joints, seams, fractures and bedding of the slope.

♠Where possible, hole alignment and stemming techniques shall be used to maximize the contribution of the natural slope characteristics to the final face. The Engineer shall approve locations where the use of natural slope characteristics will be used to shape the final wall face.

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**Production Blasting.** Blast parameters such as hole size, hole depth, hole spacing, burden, charge size, charge distribution and delay sequence shall be carefully designed and controlled to provide a distribution of charge that will excavate the rock to the required limits.

Production blastholes shall not exceed 3 inches in diameter when pourable explosives or emulsions are used. Packaged charges shall not exceed 3 inches in diameter when used in production blastholes that exceed three inches in diameter. The production blastholes shall be sequenced to provide the highest degree of relief to the final excavation surfaces.

The burden for production blastholes shall not exceed ½ the bench height.

Production blastholes shall not be drilled closer than 6 feet to the controlled blast line. The bottom of the production holes shall not be drilled deeper than the bottom of the Controlled Blast Line blastholes.

The Contractor shall use blasting mats suitable to prevent flyrock during each round fired. At the request of the Contractor and upon demonstration that flyrock can be prevented by other means, elimination of the blasting mat may be approved by the Engineer. Elimination of the blasting mat requirement shall not relieve the Contractor of responsibility for damages caused by blasting.

Blasts shall be designed so as not to exceed a maximum peak particle velocity (largest single component) of one inch per second measured 100 feet from the blast. If peak particle velocity exceeds this value, the Contractor shall modify charge weight per delay, sequence, and other applicable blast parameters to achieve acceptable vibration levels.

Blasting at distances less than 200 feet from concrete that has not developed 0.8 f’c strength will not be permitted.

All blasts shall be drilled, loaded, tied-off, and detonated under the direct charge of the approved blasting supervisor.

**Controlled Blasting.** Controlled blasting shall be used for all drill and blast operations required to carry out the work. Non-electric detonation systems shall be used.

**◊**Trim blasting (shall, shall not) be permitted on this project.

**\***Trim blasting shall be used to create the final wall face on all blasts, unless otherwise approved by the Engineer.

**◊**Presplitting (shall, shall not) be permitted on this project.

**\***Preslitting shall be used to create the final wall face on all blasts, unless otherwise approved by the Engineer.

**◊**Line drilling (shall, shall not) be permitted on this project.

**\***Line drilling shall be required to create the final wall face at the locations shown on the plans.

Pourable explosives and emulsions shall not be used in controlled blast line holes. The maximum charge diameter in controlled blast line holes shall not exceed ½ of the diameter of the hole, unless the Contractor can demonstrate through trial blasting that a greater amount of explosive is acceptable.

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Controlled blast line holes shall not deviate from the neat excavation line by more than 12 inches unless directed by the Engineer.

Controlled blast line holes blastholes shall be 2 ½ to 3 inches in diameter.

The Contractor shall control drilling operations such that no controlled blast line holes shall deviate from the plane of the planned slope by more than 12 inches.

The length of controlled blast line holes shall not exceed 30 feet, unless otherwise approved.

The burden shall not exceed 1.3 times the spacing of the trim blastholes.

Pre-split holes shall extend a minimum of 30 feet beyond the limits of the production holes or to the end of the cut, whichever is less.

Pre-split holes shall be spaced such that presplitting is ensured. The spacing of presplit holes shall not exceed 14 times the diameter of the holes.

**Blast Monitoring.** Blast induced vibrations shall be monitored by the Contractor for every blast. Data will be made available to the Engineer no later than the next working day following each blast. The Contractor's seismograph equipment shall, as a minimum:

1. Be equipped with a self-triggering device.
2. Be capable of measuring vibrations in three planes.
3. Automatically calculate peak resultant particle velocity.
4. Be capable of providing a hard copy of the wave form and a summary of the results.

**Rock Scaling.** Immediately after each blast, the Contractor shall scale loose rock and blast debris and shall inspect rock surfaces.

All rock on the cut face that is loose, hanging, or that creates a potentially dangerous situation shall be removed or stabilized, to the Engineer's satisfaction, during or upon completion of the excavation in each lift. Drilling of the next lift shall not proceed until this work has been completed.

The slopes shall be scaled throughout the duration of the Contract and at such frequency as required to remove all hazardous loose rock or overhangs.

The slopes shall be scaled using a suitable standard steel mine-scaling rod. Subject to the Engineer's approval, other methods such as machine scaling, hydraulic splitting, or incidental, low-quantity blasting may be used in lieu of or to supplement hand scaling.

**Traffic Control.** Traffic control for blasting work shall be in accordance with the Traffic Control Plan.

The time of blast initiation for each blast shall be furnished to the Engineer by the Contractor‘s Traffic Control Supervisor. This notification shall occur at least 12 hours prior to the blast and shall be confirmed 30 minutes prior to the blast by phone or traffic control radio network.

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**METHOD OF MEASUREMENT**

\*Rock excavation will not be remeasured but will be the quantities designated in the Contract. Exceptions will be made when field changes are ordered or when it is determined that there are discrepancies on the plans in an amount of at least plus or minus two percent of the plan quantity. All accepted excavation shall be measured in its original position by cross-sectioning the area excavated. The Contractor shall bear the expense of excavation outside the lines and grades shown on the plans or outside the limits established by the Engineer.

**\***Rock excavation will be measured and paid for as Unclassified Excavation (CIP) in accordance with Section 203

\*Rock excavation will be measured and paid for as Structure Excavation in accordance with Section 206.

**BASIS OF PAYMENT**

The accepted quantities will be paid for at the unit price bid for the pay items listed below:

**Pay Item Pay Unit**

\*Rock Excavation Cubic Yard

\*Payment for Rock Excavation will be full compensation for furnishing all materials, labor, tools, equipment, and incidentals necessary to complete the work.

\*Payment for Rock Excavation as Unclassified Excavation will be full compensation for furnishing all materials, labor, tools, equipment, and incidentals necessary to complete the work.

\*Payment for Rock Excavation as Structure Backfill will be full compensation for furnishing all materials, labor, tools, equipment, and incidentals necessary to complete the work.

Rock scaling will not be measured and paid for separately but shall be included in the work.

Blasting will not be measured and paid for separately but shall be included in the work.

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**INSTRUCTIONS TO DESIGNERS** (delete instructions and symbols from final draft):

The Geotechnical Unit in Staff Materials will be consulted prior to using this specification. The Geotechnical Unit will assist the Project Manager in selecting the appropriate requirements depending on project goals and geologic conditions.

♦ Select either “50 foot” or “100 foot” as appropriate for the project.

**♠** Include or delete as appropriate for the project. Existing field conditions and project goals may dictate the use of presplitting, trim blasting, or line drilling. For those conditions, this language is not desirable.

**◊** Select either “shall, or “shall not” as appropriate for the project.

\* Select as appropriate for the project.