

**REVISION OF SECTION 506**  
**GROUTED BOULDERS**

For all work pertaining to the placement of grouted boulders, Section 506 of the Standard Specifications is revised as follows:

Subsection 506.01, include the following:

This work consists of the construction of grouted boulders in accordance with these specifications and in conformity with the lines and grades shown on the plans or established.

In Subsection 506.02, first paragraph, the third sentence shall be modified as follows:

Boulders shall have a specific gravity of at least 2.6, measured according to the bulk-saturated surface-dry basis, AASHTO T85.

Subsection 506.02 shall include the following:

Grouted boulder materials used shall conform to the following:

1. A small representative sample of the boulders shall be submitted to the Engineer for approval of the color prior to any deliveries to the project site.
2. Boulders shall be generally block shaped, with relatively flat surfaces on the top, bottom, and sides adjoining adjacent boulders to provide for stable placement, level top surfaces, and tight interlocking with minimal space between boulders.
3. Maximum Ratio of Largest to Smallest Rock Dimension shall be 1.75.
4. The boulders shall have a percentage loss of not more than 10 percent after 5 cycles when tested in accordance with AASHTO Test T104 for ledge rock using sodium sulfate.
5. The boulders shall have a percentage loss of not more than 10 percent after 12 cycles of freezing and thawing when tested in accordance with AASHTO Test T103 for ledge rock, procedure A.
6. Control of gradation will be by visual inspection. However, in the event the Engineer determines the boulders to be unacceptable, the Engineer will pick 2 random truckloads to be dumped and checked for gradation. Mechanical equipment and labor needed to assist in checking gradation shall be provided by the Contractor at no additional cost to the Owner.
7. Rock shall be free of calcite intrusions.

-2-

**REVISION OF SECTION 506**  
**GROUTED BOULDERS**

8. Grout: Concrete for the grout shall be an approved batch meeting the following requirements: All concrete shall develop 3200 psi compressive strength within 28 days. One cubic yard of grout shall have a minimum of 6 sacks of Type II Portland cement. A maximum of 25% Type F fly ash may be substituted for the Portland Cement. The stone aggregate shall be comprised of 70% natural sand (fines) and 30% 3/4-inch rock (coarse), the slump shall be within a range of 4 to 6 inches and air entrainment shall be 6.5 percent +/- 1.0 percent. Stiffer grout mix or other measures shall be used for steeper slope applications as approved by the Engineer. The water/cement ratio shall not exceed 0.48. The grout shall contain 1.5 pounds per cubic yard of Fibermesh synthetic fiber reinforcement per manufacturer's instructions. The contractor shall submit grout mix design information as specified in Section 601.

Contractor shall furnish laboratory test results that the boulders meet the gradation and specific gravity requirements and the abrasion resistance/compressive strength requirements.

Subsection 506.03 shall include the following:

Prior to placement of boulders, the Engineer shall be notified in order to approve the depth and limits of boulders.

The subgrade to receive each boulder shall be excavated and any unstable material shall be removed. Approved material shall be placed and compacted in a maximum of 8-inch lifts to 95% of Maximum Standard Proctor Density (ASTM D698) and within 2 percent of optimum moisture to re-establish the subgrade of each boulder. Removal and replacement of unstable material shall only be completed at the direction of the Engineer.

The top of all boulders shall be as indicated on the Drawings. Finished grades and subgrades for boulders will be determined from the height of each boulder used.

Boulders shall be carefully picked and arranged so that adjacent rock surfaces match within 2 inches in top elevation and 2 inches along the vertical exposed face or channel side of rock (unless otherwise indicated in the drawings). Boulders shall be placed such that adjacent boulders "touch" each other and voids do not exceed 4 inches. It is the intent of construction to minimize voids and grout placed between boulders. Boulders shall be arranged in a step-like fashion and/or in rows to form "steps" as indicated on the Contract Drawings.

The grout depth shown on the Drawings applies to overall mass of grouted boulders and is intended to generally keep the top of grout well below the top of boulders; however, the depth of grout and/or size or placement of boulders shall be adjusted at the perimeters of the grouted boulders, and at the upstream and downstream ends of drop structures.

-3-

**REVISION OF SECTION 506  
GROUTED BOULDERS**

Prior to placing the grout, all debris, fines, smaller rock, and silt shall be removed from around or under the boulders. Boulder placement shall be approved by the Engineer prior to placing the grout.

Dewatering shall be implemented to ensure that the grout will not be placed in water and for a period of 24 hours after the grout has been placed.

Clean boulders by brushing and washing before grouting. Boulders receiving grout shall be kept wet when receiving grout. The concrete grout shall be placed by means of a low pressure (less than 10 psi) grout pump using a 3-inch diameter nozzle to ensure complete penetration of the grout into the boulder layer as shown on the drawings. A "pencil" vibrator shall be used to make sure all voids are filled between and under the boulders. The intent is to fill all voids from the subgrade level around the boulders to the depth indicated. In all cases, grout must penetrate to the subgrade of boulders.

The operator shall be able to stop the flow and will place grout in the voids and not on the surface of the rocks. Any spillage of grout on exposed boulder faces shall be cleaned and washed before the grout sets. The visual surfaces of the rocks shall be free of grout to provide a clean natural appearance. If washing does not clean off grout residue, then the Contractor shall wash off any grout residue with muratic acid and water, using a brush to scrub off the residue.

All grout between boulders shall be finished with a broom finish.

Batching and mixing requirements, time constraints, and hot and cold weather limitations for grout placement shall conform to specifications in Section 601. Grout shall not be placed when the air temperature is below 40 degrees F. Grout shall not be placed if the weather conditions are such that the grout being placed cannot be completely protected before the advent of damaging weather (such as overnight below 35 degrees F, cold fronts, rainstorms, etc.).

All finished grout surfaces shall be cured immediately after placement by applying a clear membrane forming curing compound as specified in Section 601.13(b). In addition, the blanket method for curing as described in Subsection 601.13(d) shall be used in cold weather to maintain the grout surface at a temperature above 40 degrees F and in a moist condition during the first 7 days after placement. The minimum curing period shall be 7 days. Curing conditions and temperature will be monitored by the Engineer during the curing period.

Subsection 506.05 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Grouted Boulders (___ Inch)	Cubic Yard

Grout, weep drains, and smaller boulders in locations shown on the plans will not be measured or paid for separately, but shall be included in the price of the Grouted Boulders.