

Section 2513. Concrete Barrier

2513.01 DESCRIPTION.

- A. This section describes the production and construction of concrete barrier, both permanent and temporary, as shown in the contract documents.
- B. Used temporary barrier rail furnished and placed as temporary barrier rail shall have been manufactured according to the contract documents after December 20, 1988.
- C. Used barrier rail shall be included in installations containing units with similar shape and dimensions with compatible connecting loops.
- D. Use F-shape temporary concrete barrier rail on roadways with a posted speed limit greater than 45 mph. Use F-shape temporary barrier rail, Type A, as defined in the Standard Road Plans, in all situations requiring the railing to be in place during the winter work period as defined in Article 1108.02, F.

2513.02 MATERIALS.

Use materials for concrete barrier and temporary concrete barrier rail meeting the requirements of Division 41 for the respective materials, and the following paragraphs. Use only approved supports and bedding grout when placing permanent precast concrete barrier.

- A. **Cement.**
Apply Section 4101. Type I or Type III Portland Cement may be used.
- B. **Aggregates.**
Use Class 2 or better durability coarse aggregate, unless otherwise specified.
- C. **Admixtures.**
Apply Section 4103. Use air entrainment. To improve workability or retard hardening, other approved admixtures may be used with Engineer's approval. Those containing more than 1.0% chlorides will not be allowed.
- D. **Bolts, Anchors, and Other Metal Fastenings.**
Apply Article 2407.02, G.
- E. **Steel Reinforcing.**
Apply Section 2404. Unless otherwise specified, use epoxy coated reinforcement for all reinforcement other than temporary concrete barrier.
- F. **Guardrail and Barrier Markers.**
Use guardrail and barrier markers, if required, that meet the requirements of Article 4186.12.

2513.03 CONSTRUCTION.

Unless otherwise designated, concrete barrier may be cast-in-place, precast in an approved casting yard or plant and hauled to the placing site, or slip formed at the project site. Approved manufacturers of precast barrier are listed in Materials I.M. 571, Appendix A. Use Precast barrier produced in a plant for which the District Materials Engineer has approved equipment, procedures, and quality of concrete. Provide, or have the Fabricator provide, technical personnel who are experienced and skilled in the procedures being used. Have these personnel collaborate fully with the Engineer in all technical aspects of the work.

A. Concrete.

1. Precast.

- a. Use concrete specified in Article 2513.03, A, 2, or as approved by the Engineer, and complying with Section 2403 2407. Proportion, mix, place, and cure the concrete in a manner that will produce the minimum compressive strength at the time designated, as specified in Table 2513.03-1:

Table 2513.03-1: Compressive Strength

	Strength Before Moving From Casting Bed (psi (MPa))	Strength At Age 28 Days (psi (MPa))
Precast	1750 (12)	5000 (34.5)

- b. Allow concrete to reach strength at age 28 days before storing in multilayers or shipping.
- c. Use 7% as a target value for the air content of fresh, unvibrated concrete, with a maximum variation of plus 1.5% or minus 1.0%.

2. Cast-in-Place and Slip Form.

- a. For cast-in-place, use Class C concrete complying with Materials I.M. 529. For slip form, use Class BR complying with Materials I.M. 529.
- b. Submit Class BR mix design to the District Materials Engineer for approval at least 7 calendar days prior to placement. Apply Section 2403, except meet the following mix design requirements:
 - 1) **Cement for Class BR.** Use a minimum cement content of 603 pounds per cubic yard (358 kg/m³).
 - 2) **Water.** Do not exceed Table 2513.03-2 for total mixing water and free moisture in the aggregate. Minimum slump is 1/2 inch (12.5 mm).

Table 2513.03-2: Mixing Water and Free Moisture

Class of Concrete	Pounds (kg) of Water Per Pound (kg) of Cementitious Material
BR (Slip Form)	0.450
C (Cast-in-Place)	0.488

- 3) **Aggregates for Class BR.** Use a well graded combination of aggregates complying with Materials I.M. 532. Provide a target gradation and apply the limits of Table 2513.03-3. A new target gradation will require the Engineer's approval.

Table 2513.03-3: Gradation Limits

Sieves	Limits
No. 4 (4.75 mm) and larger	± 5%
No. 8 (2.36 mm) to No. 30 (600 µm)	± 4%
No. 50 (300 µm)	± 3%
No. 100 (150 µm)	± 2%
No. 200 (75 µm)	Maximum 1.5% Passing

- 4) **Admixtures.** Use air entrainment. Use 7% as a target value for the air content of fresh, unvibrated concrete, with a maximum variation of plus 1.5% or minus 1.0%. To improve workability and aid in air entrainment, water reducing or retarding admixtures may be used according to Article 2513.02, C.
- 5) **Fly Ash and GGBFS.** Use the conditions and allowable rates of fly ash and GGBFS substitution in Table 2513.03-4:

Table 2513.03-4: Fly Ash and GGBFS Substitution

Cement Type	Maximum Allowable Substitution^(a)	Time Period
Type I, II	35% GGBFS 20% Fly Ash	March 16 to October 15
Type IS, IP	20% Fly Ash	March 16 to October 15
Type I, II	20% Fly Ash	October 16 to March 15
Type IS, IP	0%	October 16 to March 15
^(a) Maximum total mineral admixture substitution is 50%.		

B. Equipment.

Use equipment that meets the requirements of Section 2001 and the following:

1. Forms.

Ensure forms for all concrete barrier are true to dimensions as shown in the contract documents, true to line, mortar tight, and sufficiently rigid to maintain the required shape during placement, vibration, and curing. Ensure inside surfaces are smooth and free of any projections, indentations, or offsets.

2. Bins.

Apply Article 2001.06.

3. Weighing and Proportioning Equipment.

Apply Article 2001.20. A vibrator will not be required on the cement batch hopper.

4. Mixing Equipment.

Apply Article 2001.21. A continuous mixer with volumetric proportioning may be used with the Engineer's approval.

C. Proportioning, Mixing, and Placing Concrete.

1. Apply Article 2407.03, D, except apply the finishing requirements in Article 2403.03, P, 2, b, only to temporary barrier rail.

2. For precast temporary and permanent barrier cast upside down, finish the bottom of the concrete, exposed at the top of the form, as provided in Article 2403.03, P.

D. Curing.

1. Cast-in-Place and Precast.

a. Cure using a method preventing loss of moisture and maintaining an internal concrete temperature of no less than 40°F (4°C) during the curing period. Apply Article 2407.03, D when elevated temperature curing is used.

b. When nonelevated temperature curing is used, keep the concrete barrier damp with wet burlap for a minimum of 12 hours after casting. If forms remain in place during the 12 hours, only the exposed concrete surface will require the wet burlap application. Complete finishing operations after this period in an expedient manner. Once finishing and all necessary repairs have been accomplished, apply clear curing compound to all exposed surfaces as specified.

2. Slip Form.

Cure slip formed concrete barrier by application of a clear curing compound. No moist cure period will be required. Apply clear curing compound to the concrete barrier rail within 15 minutes after final finishing, provided that the free water (sheen) has appreciably disappeared from the concrete surface.

3. Clear Curing Compound.

a. Apply a clear curing compound, when specified, to all exposed surfaces. Use a compound that complies with Article 4105.07. Use a fine spray to form a continuous, uniform film on the surface and vertical edges of the pavement slab. Apply clear curing compound as soon as the free water has appreciably disappeared, but no later than 30 minutes after finishing. Use an application rate of no less than 200 square feet per gallon (5 m²/L). Use a fugitive dye to ensure uniform application and coverage.

b. Prior to application, thoroughly agitate the curing compound in the supply drum immediately before transfer to the sprayer. After removal of forms following finishing, apply this compound promptly and at the same rate to exposed surfaces. If the coating is damaged within 72 hours after being applied, recoat the affected area without delay. Further sealing is not necessary.

E. Removal of Forms.

For precast and cast-in-place concrete barrier, forms may be removed before the concrete has attained 250 psi (1.7 MPa) in flexure. If form removal interrupts the moist cure process, accomplish

form removal without delay and immediately reapply the moist cure process. Ensure form removal does not cause damage to, or deformation of, the barrier.

F. Finish.

1. For permanent precast and cast-in-place concrete barrier, apply Article 2407.03, L, except do not commence the finishing operation until completion of the initial wet cure period.
2. Ensure permanent precast barrier is free from honeycomb or surface defects. When defects develop, evaluate production procedures and make corrections. Patching of such defects is to be very limited.
3. Finish temporary barrier rail according to Article 2403.03, P, 2, b.
4. For slip form concrete barrier, the finish remaining after the steel form passes will not require further surface manipulation. Apply Article 2403.03, P, 2, b. Ensure the finished slip form barrier is free from honeycomb or surface defects. Complete patching operations only as directed by the Engineer and according to Article 2407.03, L.

G. Tolerances.

1. Ensure all newly fabricated units of temporary barrier rail are free from honeycomb, surface spalling, and surface defects. Ensure corner breaks and bottom spalls after shipping and placement do not exceed 1 square foot (0.1 m²) of total surface area, which includes the base.
2. Other than honeycomb, shallow voids, not exceeding 3/4 inch (19 mm) diameter, which appear on the formed surface after proper consolidation will not be considered as surface defects. They need not be filled unless they appear in an abnormal concentration.
3. For concrete barrier, apply the tolerances of Table 2513.03-5:

Table 2513.03-5: Tolerances for Concrete Barrier

Item	Precast Fabrication ^(a) (Permanent or Temporary)	Cast-In-Place or Slip Form Installation
Length	± 3/4 inch (± 19 mm)	
Width	± 1/4 inch (± 6 mm)	^(b)
Height	± 1/4 inch (± 6 mm)	^(b)
Horizontal Straightness (Sweep)	1/2 inch maximum in 10 feet (12 mm maximum in 3 m)	3/4 inch maximum in 10 feet (19 mm maximum in 3 m)
Top Straightness (Vertical)	1/4 inch maximum in 10 feet (6 mm maximum in 3 m)	3/4 inch maximum in 10 feet (19 mm maximum in 3 m)
Exposed Ends (Deviation from square)	± 1/4 inch (± 6 mm)	
^(a) Installation of permanent precast barrier includes shimming and grouting such that adjoining sections match within 1/4 inch (6 mm) on the sides and top, and the finished height is not less than required by the contract documents.		
^(b) The width and depth are not to be less than required by the contract documents.		

4. Ensure each unit of temporary barrier rail does not have spalls, corner breaks, and bottom spalls totaling more than 5 square feet (0.5 m²) of surface area, including the base.
5. Ensure connecting loops on all barriers are not deformed. Ensure they are true to dimensions.
6. Ensure gaps between units do not exceed the dimensions shown in the contract documents.

H. Handling, Storage, and Hauling New and Used Precast Units.

1. Do not lift or stress precast barrier units in any way before they have developed the strength specified. Support units at designated pickup points. Do not use connecting loops as pickup points.
2. Ensure fabrication, storage, handling and transporting will not result in cracking, twisting, or other damage. Minor chips on edges may be patched with the Engineer's approval. Breakage and chipping may be cause for rejection.
3. Ensure tiedowns are not in direct contact with concrete surfaces, which may cause chipping or breakage
4. Do not subject units to excessive impact.
5. Replace at no additional cost to the Contracting Authority units that, in the Engineer's opinion, are damaged in such a way as to impair their appearance or suitability. Mark new barrier units for the proper identification according to Materials I.M. 571.
6. The Engineer will mark temporary barrier rail units that are rejected with an orange painted "R" approximately 12 inches (300 mm) high and 6 inches (150 mm) wide on both ends to show that piece has been rejected for use as a traffic control device.

2513.04 METHOD OF MEASUREMENT.

Measurement will be as follows:

- A. Concrete Barrier: linear feet (meters) shown in the contract documents, based on the contract quantity from end to end of the barrier ~~including~~ **excluding** end sections, **width transition sections, and height transition sections.**
- B. End sections, width transition sections, and height transition sections: By count for each type of end section, width transition section, or height transition section.**
- BC. Reinforcement in For concrete barrier railing for bridge structures: ~~as provided in~~ **apply** Article 2404.04 **2414.04.****
- CD. Reinforcement in concrete barrier for other than bridge structures will not be measured separately.**

2513.05 BASIS OF PAYMENT.

Payment will be the contract unit price as follows:

- A. Concrete Barrier, of the type specified: linear feet (meters).
- B. End sections, width transition sections, and height transition sections: Each for the type of end section, width transition section, or height transition section specified.**
- BC. Reinforcement in For concrete barrier railing for new bridge structures: ~~as provided in~~ **apply** Article 2404.05 **2414.04. The quantities will be included in the quantities for the superstructure or abutments.****
- CD. Reinforcement in ~~retrofit~~ concrete barrier **for other than bridge structures**: not paid for separately.**
- DE. Payment as described above is considered full compensation for all work involved.**