

A Summary of the ASTM Standard for Wire and Welded Wire Reinforcement and Uses in Building and Highway Structures

A Presentation for Mexican Wire Manufacturer's



wri

WIRE REINFORCEMENT INSTITUTE®

Presentation Summary

I. Brief history of Structural Welded Wire Reinforcement (WWR) and recent applications

- **A Bit of History, Early History** (driven by welding technology and construction needs)
- **Historical Summary**
 - **The Empire State Building - Early 1920's**
 - **The ASB Bridge in Kansas City, MO, 1949 photo**
- **Recent Applications**
- **WRI Information**

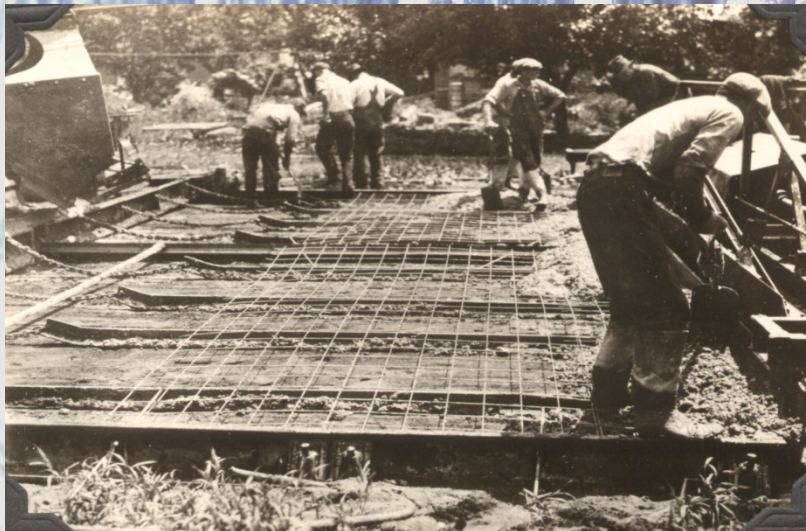
II. Definitions

III. ASTM A1064

- A. Scope**
- B. Wire and WWR Reinforcement Sizes**
- C. The Manufacture of US Wire and Welded Wire Reinforcement**
- D. The Production/Testing of US Wire and Welded Wire: Plain Wire, Deformed Wire, & WWR**
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- F. Current Codes and Standards**

IV. DOT Example Applications Using WWR

I. A Bit of History – Early 1900's!



Historical Summary!

The Empire State Building - Early 1920's

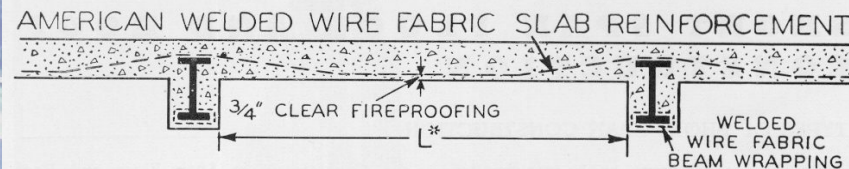


Figure 1—Structural Steel Frame



Figure 2—Reinforced Concrete Frame

Section through beams and slabs showing typical Welded Wire Fabric reinforced slabs.

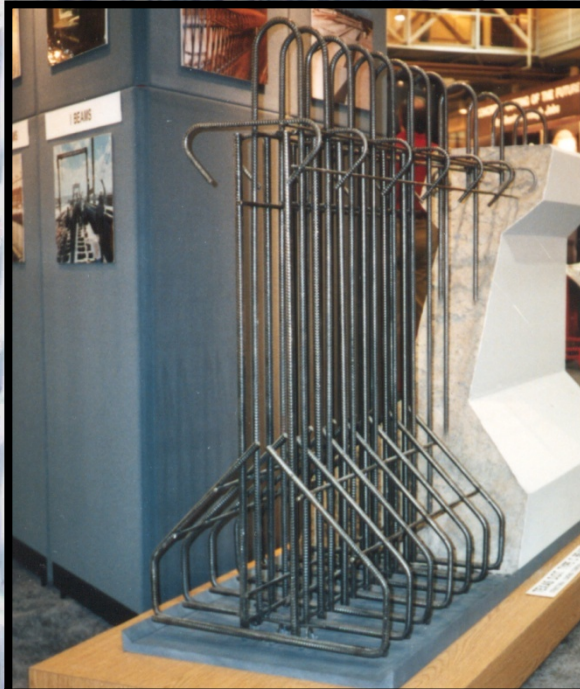
*Note: If L exceeds 10'0" use center to center of beams; for less than 10'0" use face to face of beams if concrete is poured integrally with the slab.

The ASB Bridge in Kansas City, MO

A 1949 photo



Recent Applications



WRI Information

- A. WRI web site has all Technical Facts, Manuals and Detailing Manuals available:**
- **www.wirereinforcementinstitute.org**

II. Definitions

Deformed Wire - Is a wire material composed of cold-worked deformed steel wire as cold-drawn or cold-rolled from hot-rolled rod. Deformations are indented or raised rib (protrusion) types. The deformations provide bond strength in concrete for development of reinforcement and shear resistance.

Deformed Welded Wire Reinforcement (WWR)- Deformations and the welded intersections provide bond strength for concrete reinforcement (shear resistance) and development of reinforcement

Plain or Smooth Wire - Is a wire material composed of cold-worked steel wire as cold-drawn or cold-rolled from hot-rolled rod.

Plain(Smooth) Welded Wire Reinforcement (WWR)- The welded intersections provide bond strength for concrete reinforcement (shear resistance) and development of reinforcement

Welded Wire Reinforcement - Also known as wire mesh, welded wire fabric (WWF).

III. ASTM A1064



Designation: A 1064/A 1064M – 09

Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete¹

This standard is issued under the fixed designation A 1064/A 1064M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

- **ASTM A1064 replaces the following standards:**
 - **A82 -** Standard Specification for Steel Wire, Plain, for Concrete Reinforcement¹
 - **A185 -** Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
 - **A496 -** Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
 - **A497 -** Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete

These previous standards will eventually be archived by ASTM but presently are still available.

ASTM A1064 Scope

1. Scope

1.1 This specification covers steel wire and welded wire reinforcement produced from hot-rolled rod to be used for the reinforcement of concrete. The steel wire is cold-worked, drawn or rolled, plain (non-deformed, as-drawn or galvanized), or deformed. Welded wire reinforcement is made from plain or deformed wire, or a combination of plain and deformed wire. Common wire sizes and dimensions are given in [Table 1](#), [Table 2](#), [Table 3](#), and [Table 4](#). Actual wire sizes are not restricted to those shown in the tables.

NOTE 1—Welded wire for concrete reinforcement has historically been described by various terms: welded wire fabric, WWF, fabric, and mesh. The wire reinforcement industry has adopted the term *welded wire reinforcement* (WWR) as being more representative of the applications of the products being manufactured. Therefore, the term *welded wire fabric* has been replaced with the term *welded wire reinforcement* in this specification and in related specifications.

1.2 Supplement S1 describes high-strength wire, which manufacturers furnish when specifically ordered. Manufacturers furnish high-strength wire in place of regular wire if mutually agreed to by the purchaser and the manufacturer.

The Manufacture of US Wire and Welded Wire: Plain and Deformed Wire

- **Manufacturing of Wire shall be cold-worked, drawn or rolled from rods – rods that have been hot-rolled from billets**
- **The wire for WWR shall be of proper yield and tensile strength**
-
- **For WWR, the wires are required to be assembled by an automatic process which ensures accurate placement, spacing and alignment**
- **The wires at all intersections shall be electrically resistant welded**

The Production/Testing - US Wire and Welded Wire: Plain Wire

- **Mechanical Property Requirements:**

- Plain wire shall have a minimum tensile strength of 80 ksi (70 ksi minimum yield strength) and the reduction of area in the tensile test shall be a minimum of 30%.
- A purchaser may specify a minimum yield strength as well and shall be determined by extensometer. The yield strength is determined by an extension under load of 0.5% of gage length.

- For plain wire to be utilized in the manufacture of Plain WWR, the minimum tensile and yield strengths shall be determined based on the nominal area of the wire and as follows:

	Size W1.2 and Larger	Smaller than W.12
– Minimum Tensile Strength	75 ksi	70 ksi
– Minimum Yield Strength	65 ksi	56 ksi
– Reduction of Area	30%	30%

- Wire Diameter Tolerances are noted in Table 7 of ASTM A1064.
- Bend Test requirements are noted in Table 8 of ASTM A1064.

The Production/Testing - US Wire and Welded Wire: Deformed Wire

- **Mechanical Property Requirements:**
 - Deformed wire shall have a minimum tensile strength of 85 ksi (75 ksi minimum yield strength).
 - A purchaser may specify a minimum yield strength as well and shall be determined by extensometer. The yield strength is determined by an extension under load of 0.5% of gage length.
 - Deformation criteria: Refer to ASTM A1064, Section 7.2.4 for specific criteria.
 - For deformed wire to be utilized in the manufacture of Deformed WWR, the minimum tensile and yield strengths shall be determined based on the nominal area of the wire and as follows:

– Minimum Tensile Strength	80 ksi
– Minimum Yield Strength	70 ksi
 - Bend Test requirements are noted in Table 11 of ASTM A1064.

The Production/Testing - US Wire and Welded Wire: WWR

- **Mechanical Property Requirements:**
 - **Plain and Deformed wire can be utilized in the manufacture of Welded Wire Reinforcement and as mentioned previously tensile and yield strengths shall meet the requirements of ASTM A1064, Section 7.**
 - **Weld Shear Strengths between longitudinal and transverse wires shall be tested in accordance with ASTM A1064 Section 9.**
 - **The minimum average shear (in units of pounds-force, lbf) determined by testing shall not be less than 35,000 times the nominal area of the larger wire in square inches and where the area of the smaller wire is not less than 40% or more of the area of the larger wire.**

The Production/Testing - US Wire and Welded Wire: HSWWR

- **High Strength Wire and Welded Wire Reinforcement (HSWWR)**
 - Building Codes such as the American Concrete Institute, ACI 318 code, allow the use of higher strength wire and welded wire reinforcement as shear reinforcement for beams/columns – in the form of spiral and longitudinal tie reinforcement or stirrups in the case of beams.
 - Refer to ASTM A1064, Supplementary Requirements:
 - Minimum yield strength shall be specified by the purchaser in increments of 2500 psi.
 - When testing the yield strength for high strength wire and welded wire, the yield strength shall be determined by an extension under load of 0.35%.
 - The minimum tensile strength determined at the time the above yield strength is tested, shall be at least 10,000 psi higher than the measured yield strength.

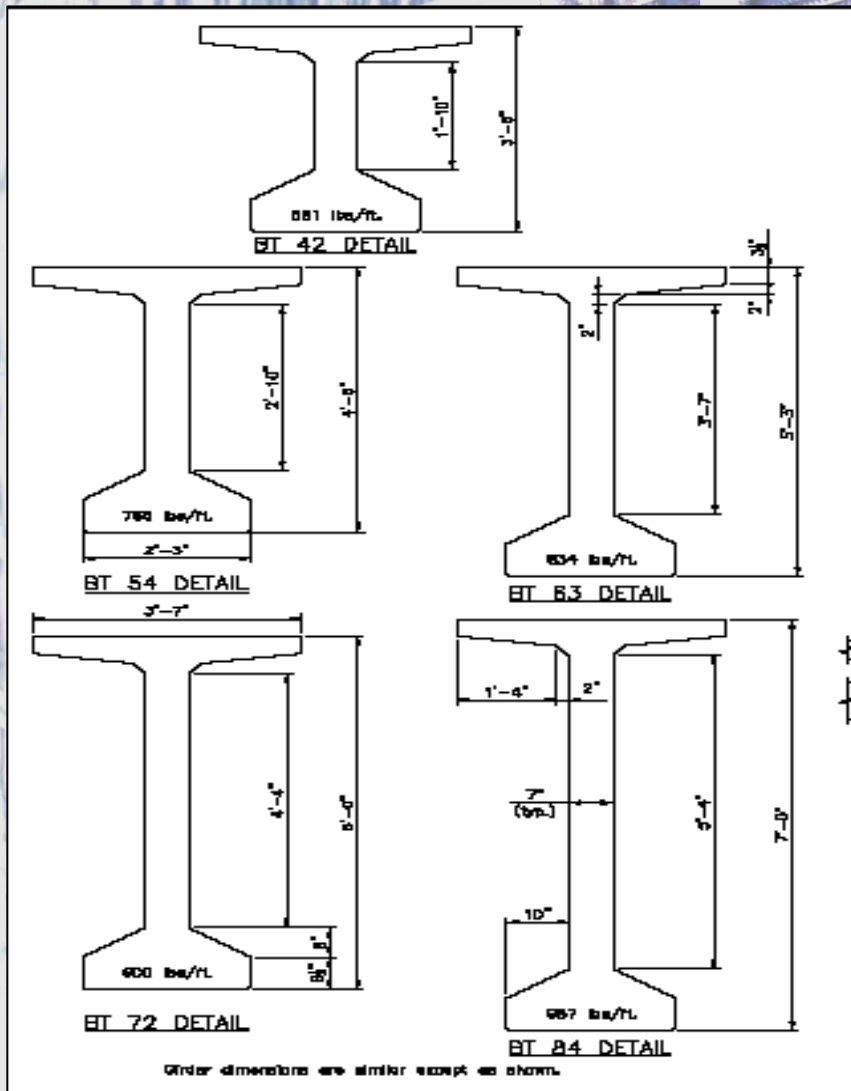
CURRENT CODES AND STANDARDS

- **AASHTO**
 - LRFD Bridge Design Specifications, 4th Edition 2007
 - Increases strength of WWR to 75 ksi.
- **ASTM**
 - ASTM A1064 Combined Standard, formerly ASTM A82/A185 (smooth wire) and A496/A497 (deformed wire)
- **ACI**
 - ACI 318 Building Code & ACI 439 Guides
- **WRI-Wire Reinforcement Institute**
 - Manual of Standard Practice for WWR (WWR-500).

IV. DOT Use Of Welded Wire Reinforcement In Highway structures

- **Examples of Uses in Highway structures.**
- **Examples of Standard Details specifying WWR.**

DOT Use of WWR in Highway Structures Precast Bulb T & I Girders

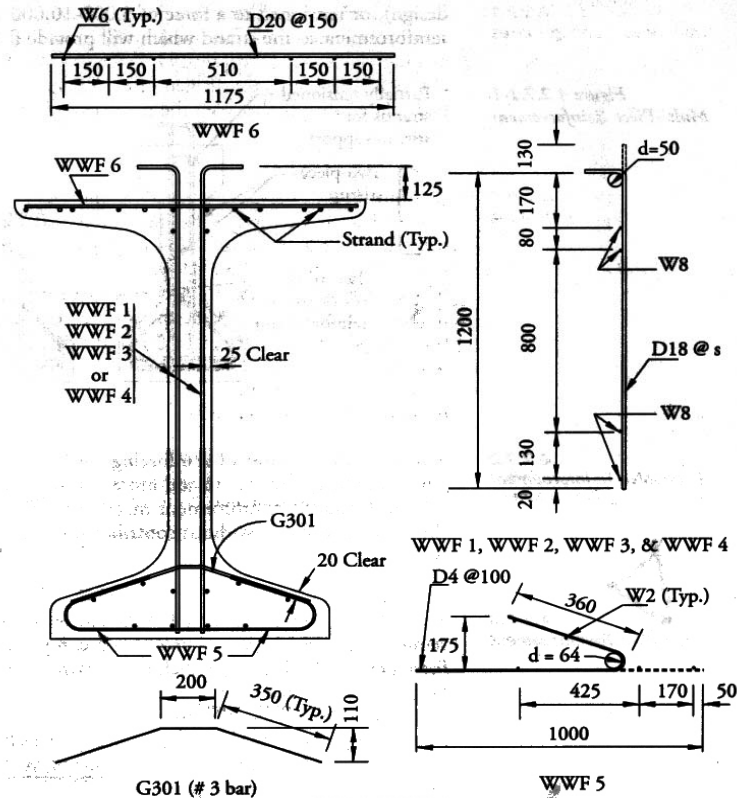


- Sections has variable depths from 48" to 84"
- Capability of both pre-Tension and Post-tension
- Spliced Girders to accommodate longer spans

NU 2000 I Girders - University of Nebraska

NE DOR - WWR Shear & Confinement Steel

Figure 4.2.7.3-1
Welded Wire Reinforcement
Details used by Nebraska
Department of Roads



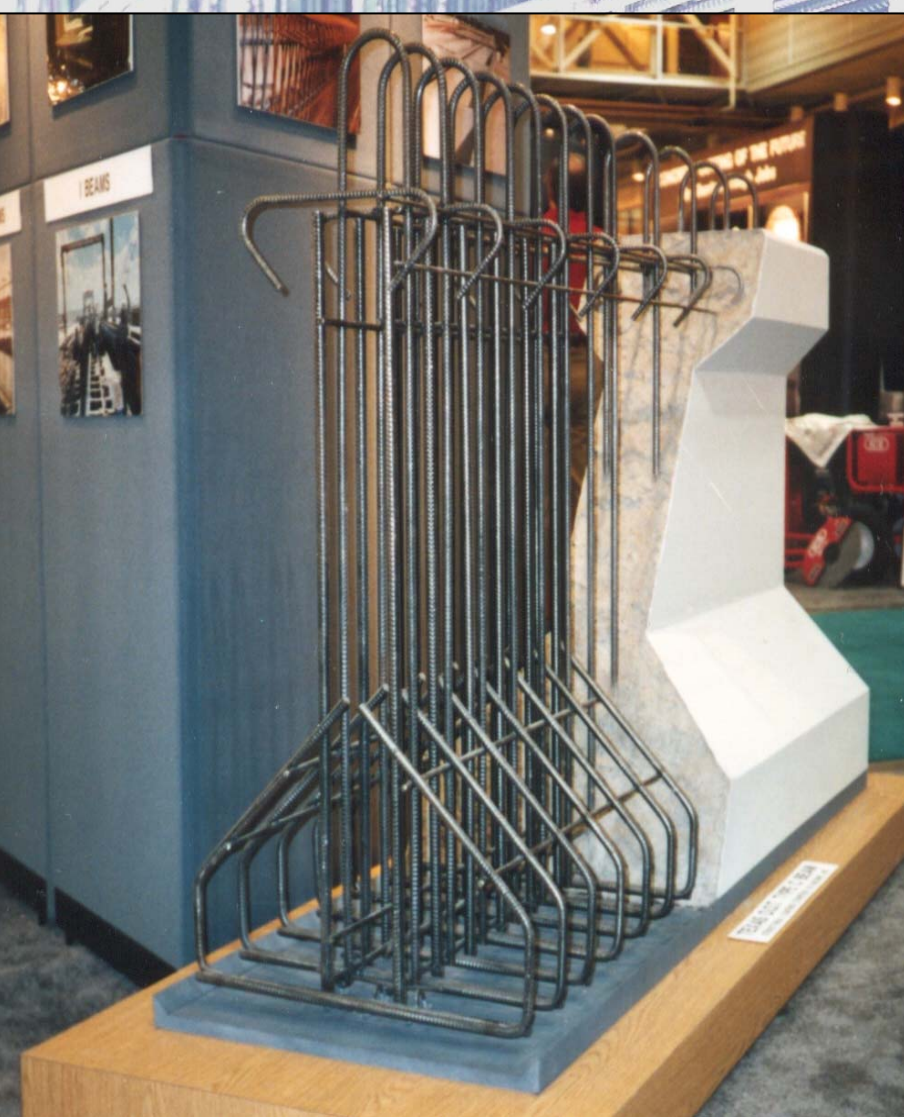
Notes:

Dimensions in mm
1 inch = 25.4 mm
D18 designates a deformed wire whose area is 0.18 in.²
W designates a smooth wire

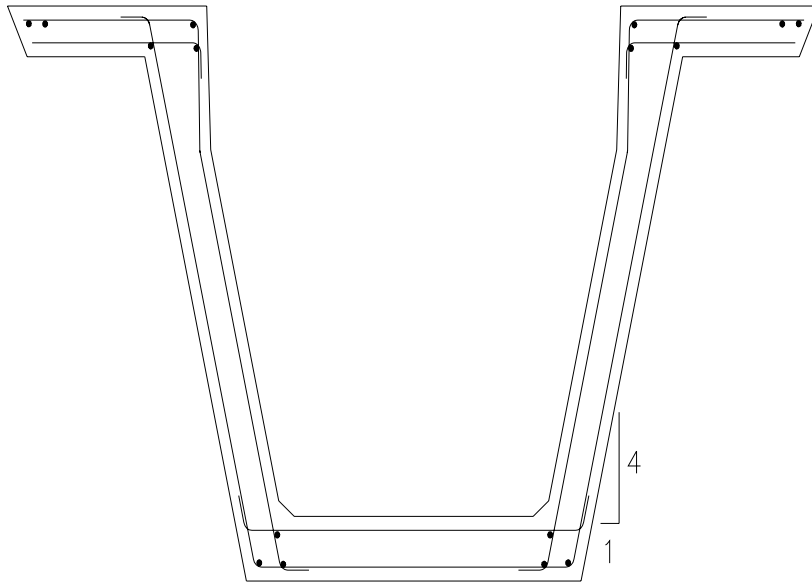
Fabric Designation	WWF1	WWF2	WWF3	WWF4
Spacing, s (mm)	50	100	200	300



Texas Type "C" Bridge Beam



"U" Girders



TYPICAL GIRDER SECTION

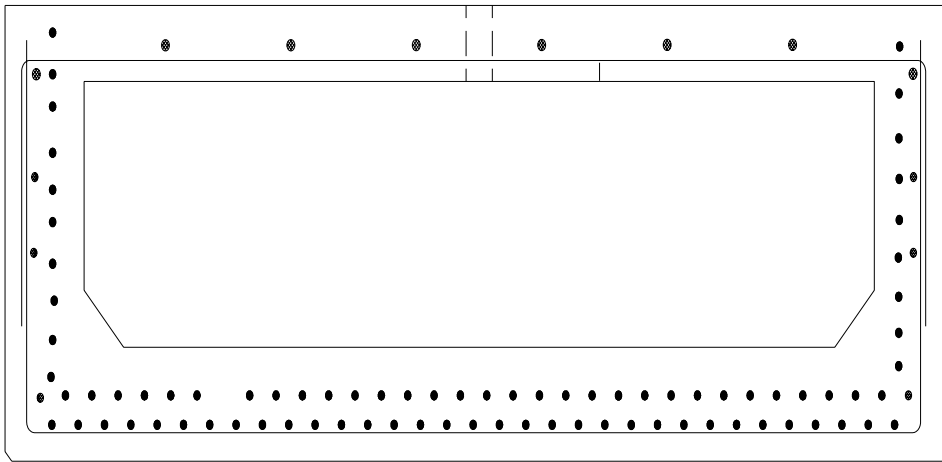
- Depth varies from 48" to 96 "
- Accommodates both Pre-Tension and Post-Tension
- Straight and Curved sections have been used.

Highway Structures



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Precast Girders



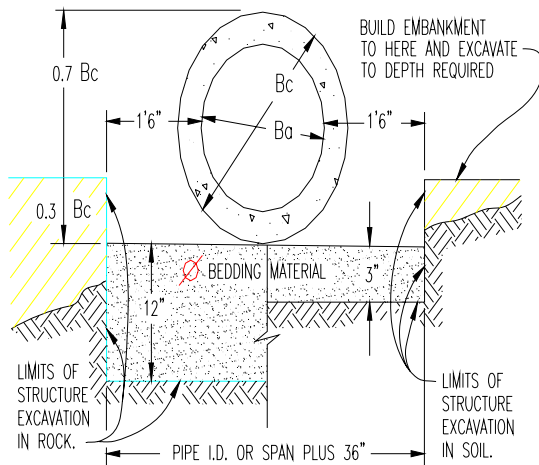
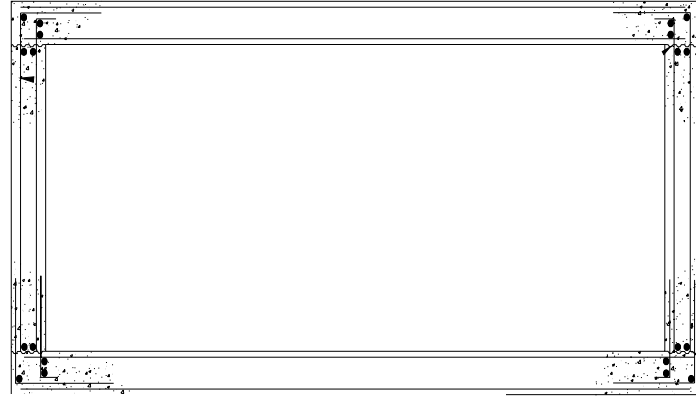
- Depth varies 18" to 72"
- Width varies up to 72"
- Advantages are:
shallow structures
and speed of
construction

Box/Slab Girder Photos



Underground Structures

Concrete Box Culvert



Ø BEDDING MATERIAL FOR SOIL SHALL BE 3 IN. LOOSE THICKNESS
STRUCTURE BACKFILL CLASS 2.
BEDDING MATERIAL FOR ROCK SHALL BE 12 IN. LOOSE THICKNESS

Concrete Pipe Culvert

Box & Pipe Culverts



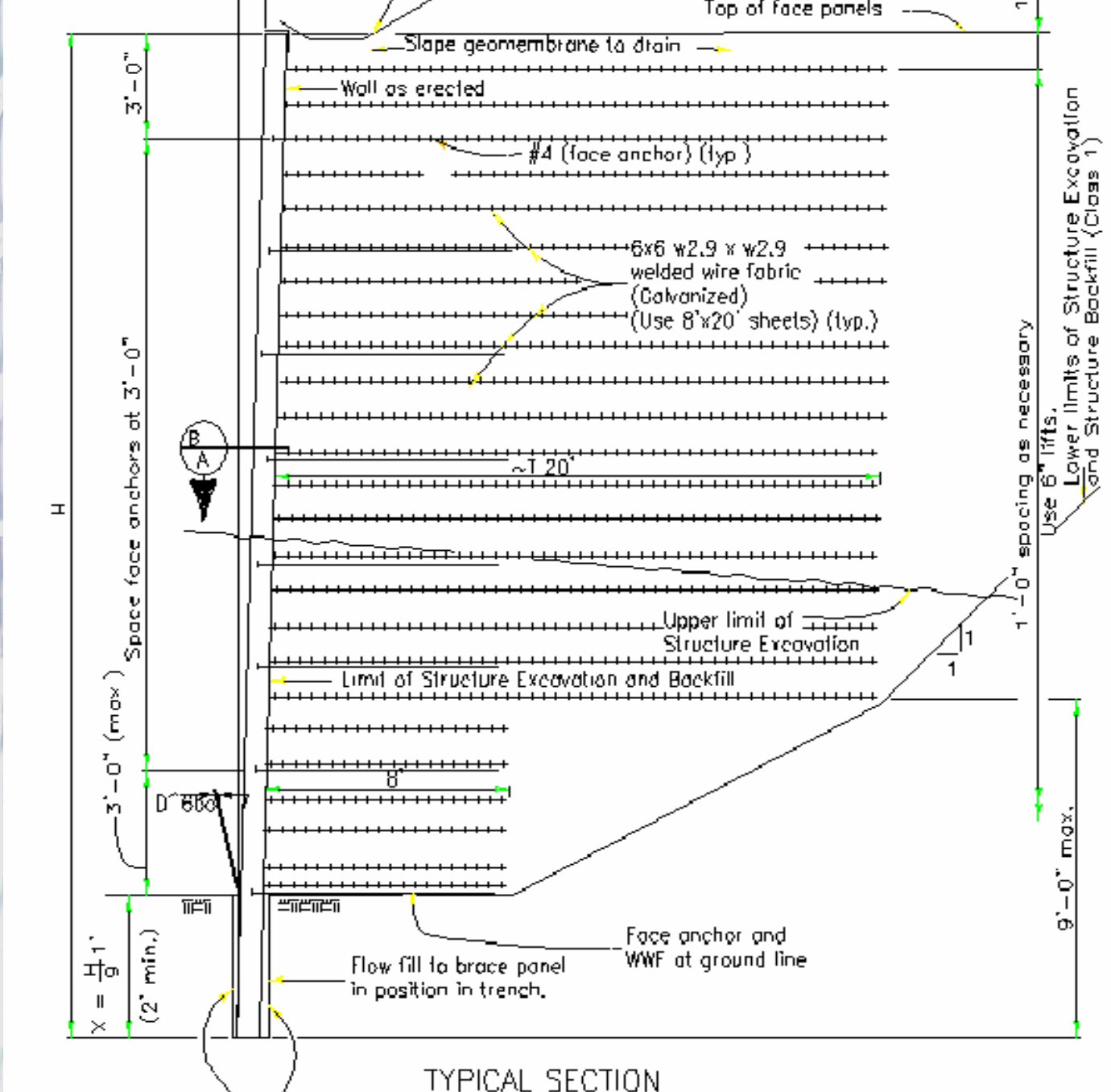
Bridge & Traffic Rails



Precast & CIP Median Barriers



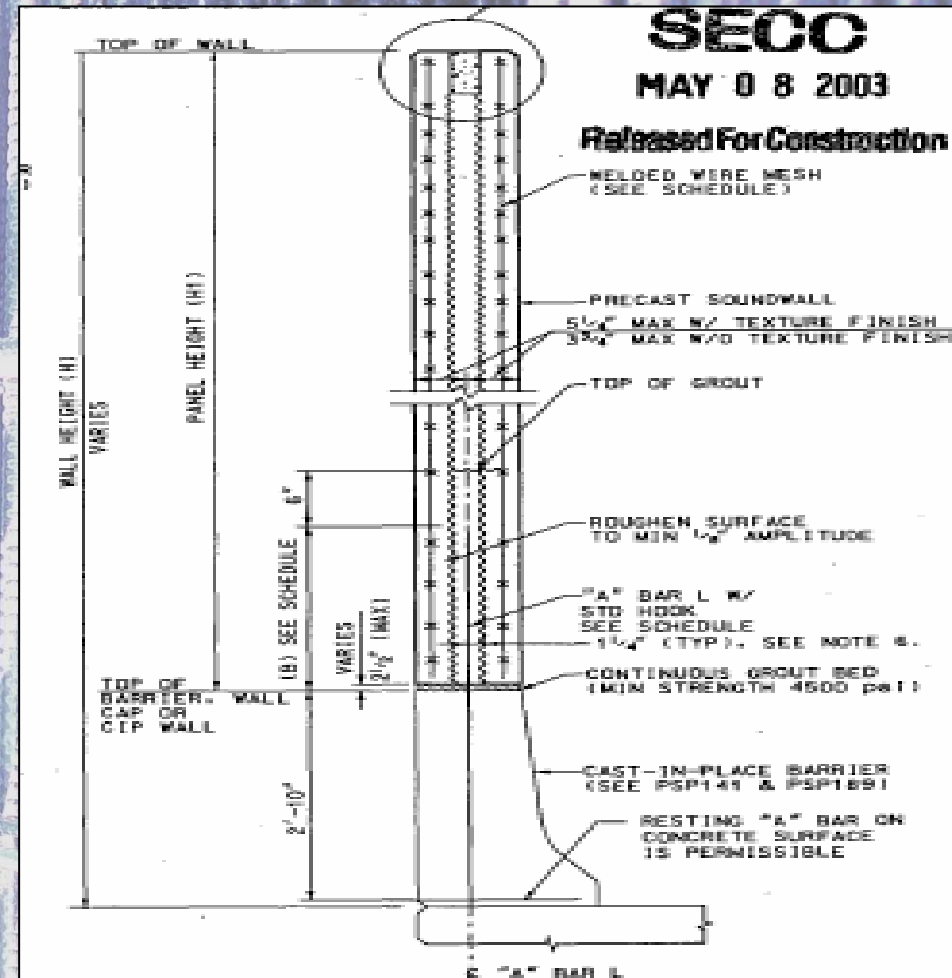
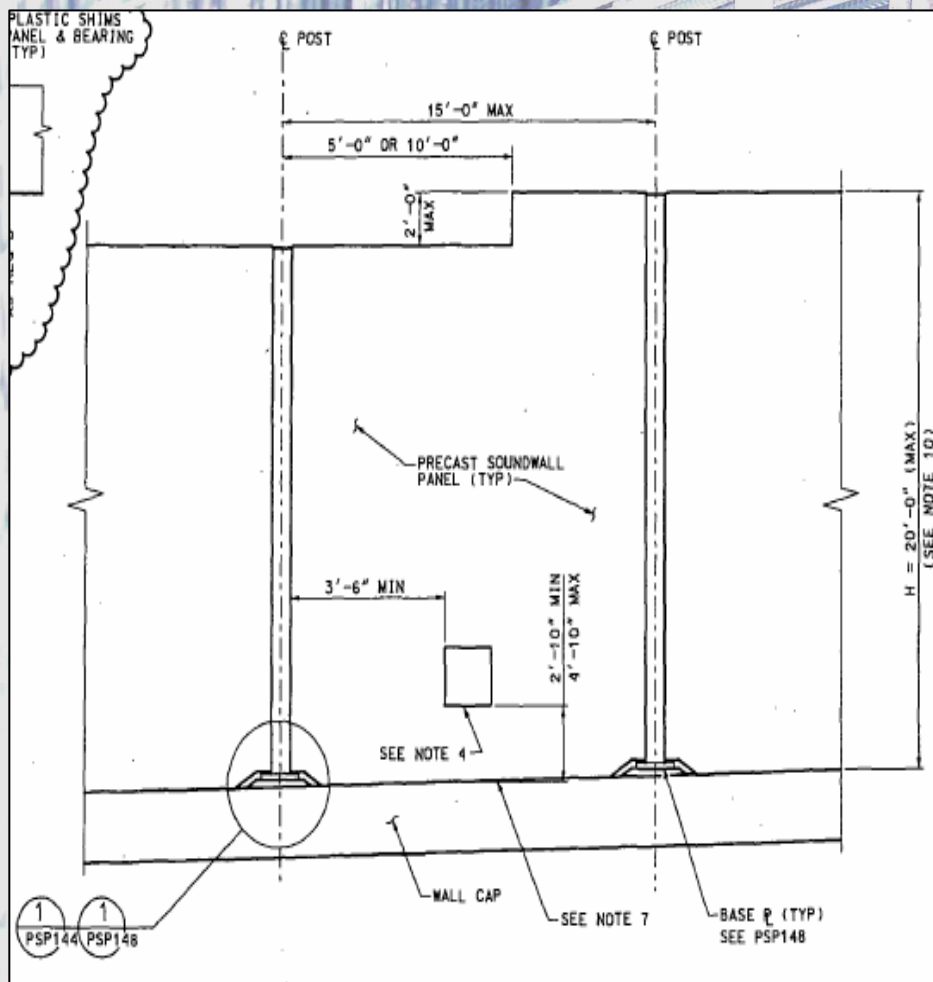
MSE FULL PANEL WALL



MSE FULL PANEL WALL



Other Structural Components



Precast Sound Barrier

Noise Walls



Epoxy - Coated High Strength Reinforcing for Bridge Decks



Cast In Place Concrete

B-507-1

These drawings show general details only.
For limits of slope paving see General
Layout.

NOTES:

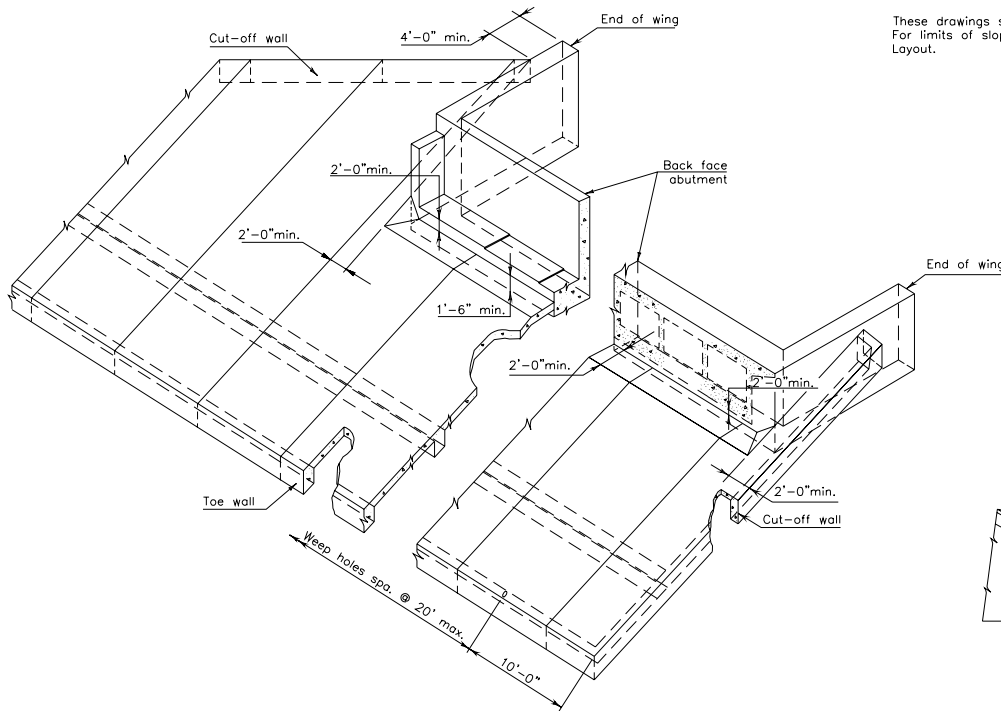
Slope paving shall be poured in 10 ft. transverse sections with a tooled construction joint at each section.

Wire fabric shall be 2" from the end of joints and shall lap 8" at splices.

Where slope or berm paving butts against structural concrete, separate with 1" expansion joint material.

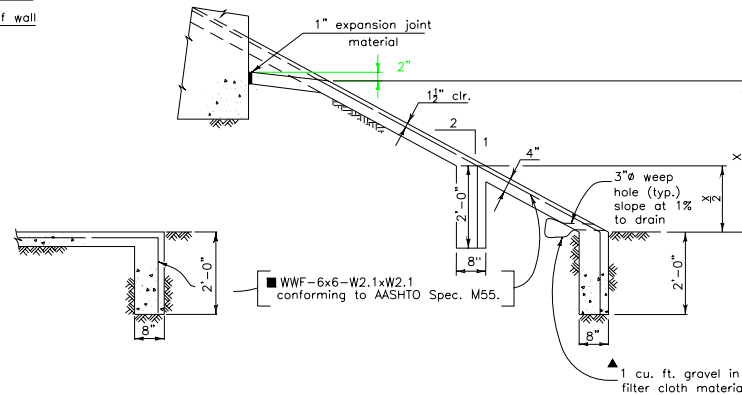
Expansion joint material and welded wire fabric shall not be paid for separately, but shall be included in the work.

Structure excavation for concrete slope and ditch paving shall be limited to the actual volume occupied by the slope paving concrete.



Slope
paving

- 2.5 lbs. of an approved polypropylene fiber, per cubic yard of concrete, may be substituted for the WWF in this slope paving. If this substitution is made, a continuous #5 reinforcing bar shall be added near the top and bottom of the cutoff wall. The fiber shall be added to the concrete mix in such a fashion that the fibers are uniformly dispersed in the concrete without visible balls or clumps in either the finished slope paving or in the plastic concrete delivered from the concrete truck.



TYPICAL SECTION
THRU CUT-OFF WALL

TYPICAL SECTION
THRU SLOPE PAVING

▲ To be included in Item 507.

Slope Paving & Channels

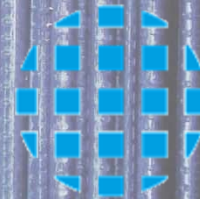
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Thank you – Its been a Pleasure!
Do you have questions ????
www.wirereinforcementinstitute.org



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