OHIO DEPARTMENT OF TRANSPORTATION

CENTRAL OFFICE, 1980 W. BROAD ST., COLUMBUS, OHIO 43216-0899

April 17, 2009

To: Users of the Bridge Design Manual

From: Tim Keller, Administrator, Office of Structural Engineering

By: Sean Meddles, Bridge Standards Engineer

Re: 2009 Second Quarter Revisions

Revisions have been made to the ODOT Bridge Design Manual, January 2004. These revisions shall be implemented on all Department projects with a Stage 2 plan submission date after April 17, 2009.

This package contains the revised pages. The revised pages have been designed to replace the corresponding pages in the book and are numbered accordingly. Revisions, additions, and deletions are marked in the revised pages by the use of one vertical line in the right margin. The header of the revised pages is dated accordingly.

To keep your Manual correct and up-to-date, please replace the appropriate pages in the book with the pages in this package.

To ensure proper printing, make sure your printer is set to print in the 2-sided mode.

The January 2004 edition of the Bridge Design Manual may be downloaded at no cost using the following link:

http://www.dot.state.oh.us/Divisions/HighwayOps/Structures/standard/Pages/default.aspx

Attached is a brief description of each revision.

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Summary of Revisions to the January 2004 ODOT BDM

BDM Section	Affected Pages	Revision Description
204.6	2-24	The list of proprietary wall systems has been removed. Accredited MSE wall systems are listed in SS840.
204.6.2.1	2-26	The purpose for this revision is to emphasize to designers that the soil reinforcement lengths should not exceed the minimum length as defined by AASHTO unless the size of the reinforcement zone needs to be enlarged to increase sliding, overturning or bearing resistance. Increasing the length of strap translates to larger quantities of select granular fill material and increased costs. These increases should be avoided unless warranted.
208.1	2-35.1	This revision provides clarification for when to include a pay item for "Cofferdams, Cribs and Sheeting".
303.5.1	3-77 through 3-80	The revisions in this section reflect changes to the MSE wall figures provided in BDM Section 303.5.1.
Figure 329		The "Pay Limits of Wall Quantities" have been modified to reflect a more realistic soil reinforcement layout. These limits also reflect the changes made to Figures 303.5.1-2 and 303.5.1-3.
Figure 330		The volume of select granular material and Type B granular material has been reduced by eliminating the 1:1 sloping interface with the Item 203 embankment.
Figure 331		The volume of select granular material and Type B granular material has been reduced by eliminating the 1:1 sloping interface with the Item 203 embankment.
Figure 333		The volume of select granular material has been reduced by eliminating the 1:1 sloping interface with the Item 203 embankment.
Figure 333A		This new figure illustrates a wall layout for back-to-back MSE walls with 12-ft or less distance between free ends of the soil reinforcements.
Figure 333B		This new figure illustrates a wall layout for back-to-back MSE walls with greater than 12-ft between free ends of the soil reinforcements.

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to support the abutment should consider possible settlement of the MSE wall. Use piles to support the abutment if the bridge is a continuous multi-span structure, or if the bridge is constructed part width in phases. If the bridge is a single-span structure and is not constructed part width in phases, then either spread footings or piles may be used to support the abutment. Piles require a minimum 15-foot embedment below the MSE wall.

Refer to Sections 201.2.6, 202.2.3 and 204.6.2 for the staged review requirements for MSE walls. Consult the Office of Structural Engineering for additional design recommendations.

204.5 PIER TYPES

For highway grade separations, the pier type should generally be cap-and-column piers supported on a minimum of 3 columns. (This requirement may be waived for temporary conditions that require caps supported on less than 3 columns.) Typically the pier cap ends should be cantilevered and have squared ends.

For bridges over railroads generally the pier type should be T-type, wall type or cap and column piers. Preference should be given to T-type piers. Where a cap and column pier is located within 25 feet [7.6 meters] from the centerline of tracks, crash walls will be required.

For waterway bridges the following pier type should be used:

A. Capped pile type piers; generally limited to a maximum height of 20 feet [6 meters]. For heights greater than 15 feet [4.5 meters], the designer should analyze the piles as columns above ground. Scour depths shall be considered.

B. Cap-and-column type piers.

C. Solid wall or T-type piers.

Note that the use of T-type piers, or other pier types with large overhangs, makes the removal of debris at the pier face difficult to perform from the bridge deck. For low stream crossings with debris flow problems and where access to the piers from the stream is limited, T-type piers, or other similar pier types, should not be used.

For unusual conditions, other types may be acceptable. In the design of piers which are readily visible to the public, appearance should be given consideration if it does not add appreciably to the cost of the pier.

204.6 RETAINING WALLS

In conformance with Section 1400 of the ODOT Location and Design Manual, Volume Three, a Retaining Wall Justification shall be included in the Preferred Alternative Verification Review Submission for a Major Project or in the Minor Project Preliminary Engineering Study Review Submission. A description of the Retaining Wall Justification is provided in Section 1404 of the ODOT Location and Design Manual, Volume Three. Generally, the justification compares the

practicality, constructability and economics of the various types of retailing walls listed below:

A. Cast-in-place reinforced concrete
B. Prestressed concrete
C. Tied-back
D. Adjacent drilled shafts
E. Sheet piling
F. H-piling with lagging
G. Cellular (Block, Bin or Crib)
H. Soil nail
I. Mechanically Stabilized Earth (MSE)

Refer to SS840 for accredited MSE wall systems. Contact the Office of Structural Engineering for modular block wall systems. For wall systems that utilize geogrid reinforcements, the wall height shall be limited to 30 ft.

204.6.1 DESIGN CONSTRAINTS

Below are some design constraints to consider in the wall justification study to establish acceptable wall types:

A. Future use of the site (future excavations cannot be made in Mechanically Stabilized Embankments)
B. Deflection and/or differential settlements
C. Accessibility to the construction site
D. Aesthetics, including wall textures
E. Right-of-way (or other physical constraints)
F. Cost (approximate cost analysis)
G. Stage construction
H. Stability (long-term and during construction)
I. Railroad policies

204.6.2 STAGE 1 DETAIL DESIGN SUBMISSION FOR RETAINING WALLS

When a justification study has determined that a retaining wall is required, generally the wall will be a cast-in-place reinforced concrete wall or some type of proprietary wall system. The use of proprietary wall systems should be considered when the wall quantity for the project exceeds 5000 ft^2 [450 m^2].

204.6.2.1 PROPRIETARY WALLS

If a proprietary wall is justified, the Design Agency shall include the following information in the Stage 1 Detailed Design Submission: wall alignment; footing elevations; allowable bearing pressure at the leveling pad elevation; a global stability analysis; the effect of settlement and settlement calculations; and any construction constraints, such as soil improvement methods, that may be required. Refer to Section 303.5 for plan requirements for Detail Design.

The alignment of proprietary retaining walls should be straight and with as few corners or curves as is practical. When changes in wall alignment are required, use gradual curves or corners with an interior angle of at least 135 degrees whenever possible. Do not use corners with interior angles of less than 90 degrees (acute corners).

The design of the wall shall be in conformance with the 17th Edition of the "AASHTO Standard Specifications for Highway Bridges" and the following:

A. Determine the height of the wall (H) for minimum soil reinforcement lengths as follows:

   1. If the wall is not located at an abutment, measure (H) as the elevation difference between the top of the wall where the finished grade intersects the back face of the wall and the top of the leveling pad (*AASHTO Article 5.8.1*).

   2. If the wall is located at an abutment, measure (H) as the elevation difference between the profile grade at the face of the wall and the top of the leveling pad.

B. The soil reinforcement length shall not be less than 70% of the wall height (H) or 8'-0" [2.5 m], whichever is greater. Only increase this minimum soil reinforcement length as necessary to meet external stability requirements (sliding, bearing resistance, overturning, overall global stability). Generally, the soil reinforcement length should not be greater than 150% of the wall height (H). Provide calculations with the Foundation Report, BDM Section 202.2.3, that justify soil reinforcement lengths exceeding 0.70H.

C. The thickness of the unreinforced concrete leveling pad shall not be less than 6 inches [150 mm]. The minimum distance from the top of the leveling pad the ground surface at a point located 4'-0" [1.2 m] from the face of the wall shall be the larger of 3'-0" [900 mm] or the frost depth. Refer to Figure 202 for more information.

D. The minimum thickness of the precast reinforced concrete face panels may be assumed to be 5½ inches [140 mm].

E. The maximum allowable differential settlement in the longitudinal direction (regardless of the size of panels) is one (1) percent. Provide slip joints if the estimated differential settlement is greater than one (1) percent.

For the purposes of determining vertical clearances, "Reconstructed" shall refer to an improvement of an existing structure involving the replacement of the entire superstructure.

207.2 BRIDGE SUPERSTRUCTURE

Bridge superstructure widths shall be established in accordance with ODOT's Location and Design Manual, Section 302, unless specified in the scope of services or other contract criteria.

207.3 LATERAL CLEARANCE

Divided highways having four or more lanes crossing under an intersecting highway shall be provided with a minimum lateral clearance of 30 feet [9000 mm] from the edge of traveled lane to the point where the 2:1 back slope intersects the radius at the toe of the 2:1 slope. Refer to ODOT's Location and Design Manual, Figure 307-2. To satisfy cost considerations or in order to maintain the typical roadway section (including roadway ditch) of the underpass through the structure, for four or more lane highways, wall abutments or the 2:1 slope of typical two-span grade separation structures may be located farther than 30 feet [9000 mm] from the near edge of traveled lane.

Lateral clearances for other roadway classifications shall be established in accordance with ODOT's Location and Design Manual, Section 302, unless specified in the scope of services or other contract criteria.

207.4 INTERFERENCE DUE TO EXISTING SUBSTRUCTURE

Where a new pier or abutment is placed at the location of an existing pier or abutment the usual "Removal" note (and also the text of CMS 202.03) calls for sufficient removal of the old pier or abutment to permit construction of the new. However, a new pier or abutment preferably should not be located at an existing pier or abutment where the existing masonry may extend appreciably below the bottom of the proposed footing, or appreciably below the ground in case of capped-pile construction. This applies particularly where piles are to be driven. It is desirable to avoid the difficulty and expense of removing deep underground portions of the existing substructure and to avoid the resultant disturbance of the ground.

Where existing substructure units are shown on the Site Plan, the accuracy of the locations and extent should be carefully drawn. The existing substructure configuration should be shown based on existing plans or field verified dimensions, otherwise just a vertical line showing the approximate face of the abutment or pier widths should be shown. Misrepresentation of the location of the existing substructure units has resulted in expensive change orders during construction. Existing dimensions should be labeled as (+/-) plus or minus.

207.5 BRIDGE STRUCTURE, SKEW, CURVATURE AND SUPERELEVATION

During the Assessment of Feasible Alternatives, the location of the proposed structure should be studied to attempt to eliminate the presence of excessive skew, curves or extreme superelevation transitions within the actual bridge limits.

208 TEMPORARY SHORING

208.1 SUPPORT OF EXCAVATIONS

Provide a pay item for cofferdams, cribs and sheeting for the following conditions:

A. Excavation that extends below the water table or water surface.

B. Excavation of soil that supports adjacent structures, railroads or active roadways. Show the approximate locations of shoring in the plans.

For shoring that supports adjacent structures, railroads or active roadways with at least 8-ft of retained earth, the Design Agency shall provide a temporary shoring design in the plans. The designer shall consider the feasibility of this temporary shoring during the Structure Type Study.

For projects involving Railroads, the requirements will be different as each railroad company has their own specific requirements. The Design Agency is responsible for contacting the responsible railroad and obtaining the specific requirements for design and construction.

303.5.1 WORK PERFORMED BY THE DESIGN AGENCY

The Design Agency is responsible for providing sufficient information in the plans such that, prior to submitting a bid, the Contractor can select a proprietary company to design the internal stability of the wall after the project is awarded. Detail each wall on a project separately. As a minimum, the project plans for each wall location shall provide the following:

A. Plan View of the wall showing: (Refer to Figure 329)

1. Wall location with station and offset with respect to the centerline of construction for each critical point

2. All complex geometry information

3. Pay limits for wall and roadway quantities

4. North Arrow

5. Locations of typical sections for (C.) below

6. Locations of abutment footing, piles, utilities, catch basins, and other possible obstructions (Refer to Section 209.3 for drainage and Section 301.7 for utility locations)

7. Parapet/barrier locations

8. Limits of proposed wall excavation

9. Locations of sheeting and bracing

   If sheeting and bracing is required according to BDM Section 208, provide a pay item for Item 503 – Cofferdams, Cribs and Sheeting

10. Select Granular Backfill drainage locations

    Perforated plastic pipe, CMS 707.33, wrapped with filter fabric shall be located as low as possible within the select granular backfill while still providing positive gravity flow in the pipe to an outlet. The pipe shall be located near the back side of the leveling pad and near the free end of the soil reinforcement. The pipe shall be continuous and sloped to provide a positive gravity flow to an outlet. The approximate location of the outlet shall be shown on the plan view. Drainage pipe without perforations shall be used outside the limits of the select granular backfill. If the proprietary wall supports an abutment, provide backfill drainage in accordance with Section 303.2.3.1.

B. Elevation of the wall showing: (Refer to Figure 329)

1. Station and elevation for each critical point on the wall

2. Finished ground surface elevations for each critical point on the wall

3. Leveling pad showing the minimum dimension from the finished ground line to the top of the pad.

4. Locations of abutment footing, piles, utilities, catch basins, and other possible obstructions

5. Backfill drainage

6. Approximate locations of slip joints

C. Typical Sections showing: (Refer to Figures 330, 331, 332, 333, 333A & 333B)

1. Coping details

2. Parapet and sleeper slab details

3. Abutment footing details including the dimensions from the back of the proprietary wall to the centerline of bearing at the abutment, dimensions from the back of the proprietary wall to the toe of the abutment footing, and dimensions from the back of the proprietary wall to the centerline of the nearest row of piles.

4. Minimum clearance between the bottom of the footing/sleeper slab and the uppermost wall reinforcement strap. Six inches [150 mm] is preferred.

5. Locations of abutment footing, piles, utilities, catch basins, and other possible obstructions

6. Backfill drainage

7. Soil reinforcements attached to abutments

   Regardless of abutment type and foundation type, one row of soil reinforcements shall be attached to the backside of the abutment footing. These additional reinforcements are necessary to resist horizontal bridge and backwall forces, and prevent load transfer to the coping and facing panels. To estimate select granular backfill quantities, Designers may assume these additional reinforcements are the same length as those attached to the facing panels.

8. Limits of select granular backfill

   Show the limit of the select granular. The top elevation of the select granular backfill shall be at least six inches above the uppermost layer of soil reinforcement, but not lower than six inches above the bottom of the abutment footing.

9. Limits of wall excavation

   Supplemental Specification 840 requires a minimum one foot undercut beneath the leveling pad elevation for all MSE walls. If more undercut is required, show it on the plans. The backfill material is specified in SS 840.

10. Pay limits of wall and roadway quantities

11. Pile sleeves (if required)

    Pile sleeves shall be shown extending from the bottom of the abutment footing to the bottom of the wall excavation

12. Location of sheeting and bracing (if required)

13. Limits of concrete sealer

D. Requirements for wall surface textures or other aesthetic treatments (i.e. show panel size and shape restrictions specific to the project in the plans)

E. Wall design criteria including:

   1. Allowable bearing capacity at the base of the reinforced soil mass

   2. Vertical dead and live loads, horizontal loads and actual bearing pressure applied to the reinforced soil mass from the bridge

   Plan notes are provided in Section 600.

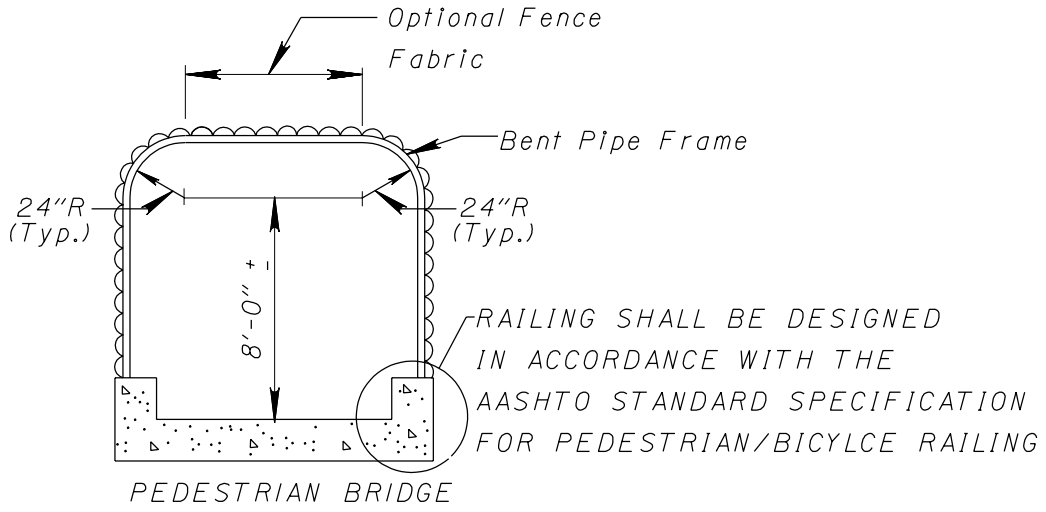
F. Final copy of the Special Provisions for proprietary wall types other than MSE walls.

G. Estimated Quantities Table (list each wall on a project separately)

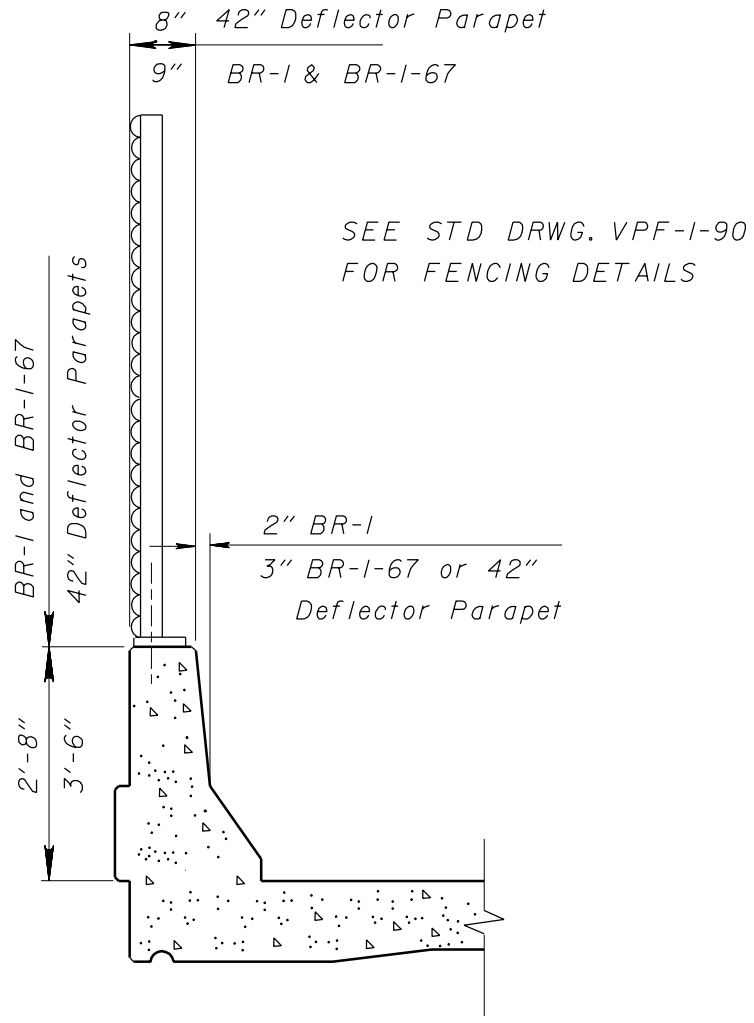
   Include all pay items listed in SS 840. Also include as necessary; Item 203 – Embankment; Item 512 – Sealing of concrete surfaces (epoxy urethane); and Item 503 - Cofferdams, Cribs and Sheeting.

303.5.2 WORK PERFORMED BY THE PROPRIETARY WALL COMPANIES

The proprietary wall companies will be responsible for designing the internal stability of the wall in accordance with the project plans and either Supplemental Specification 840 for MSE walls or the special provisions for other proprietary wall types.

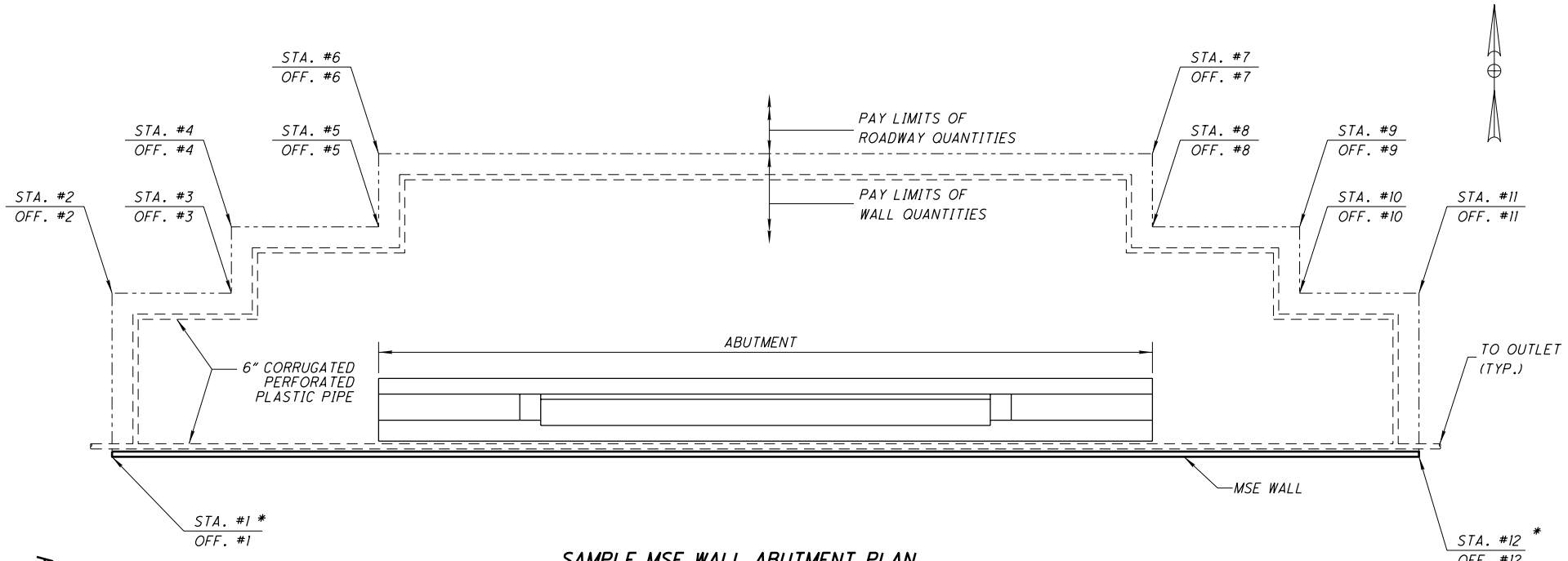


PEDESTRIAN FENCING ON STRUCTURES



DEFLECTOR PARAPET WITH FENCING

Figure 328

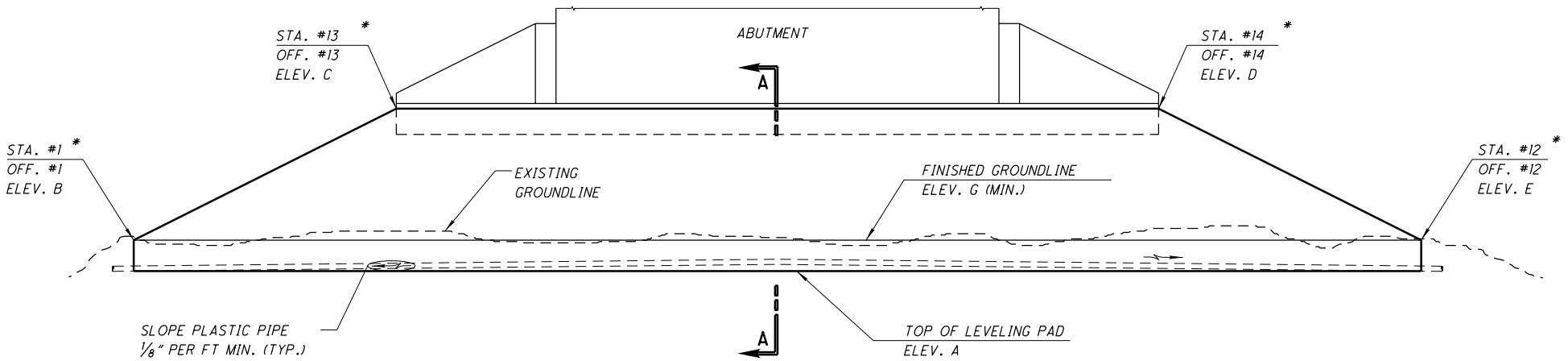


SAMPLE MSE WALL ABUTMENT PLAN

* - MEASURED TO FRONT FACE OF MSE WALL FACING PANELS

FIGURE 329

SEE FIGURE 330 FOR SECTION A-A (WITH ABUTMENT SUPPORTED ON SPREAD FOOTING AND ADDITIONAL WALL EXCAVATION)
SEE FIGURE 331 FOR SECTION A-A (WITH ABUTMENT SUPPORTED ON PILES)



SAMPLE MSE WALL ABUTMENT ELEVATION

* - MEASURED TO FRONT FACE OF MSE WALL FACING PANELS
WALL EXCAVATION LIMITS NOT SHOWN

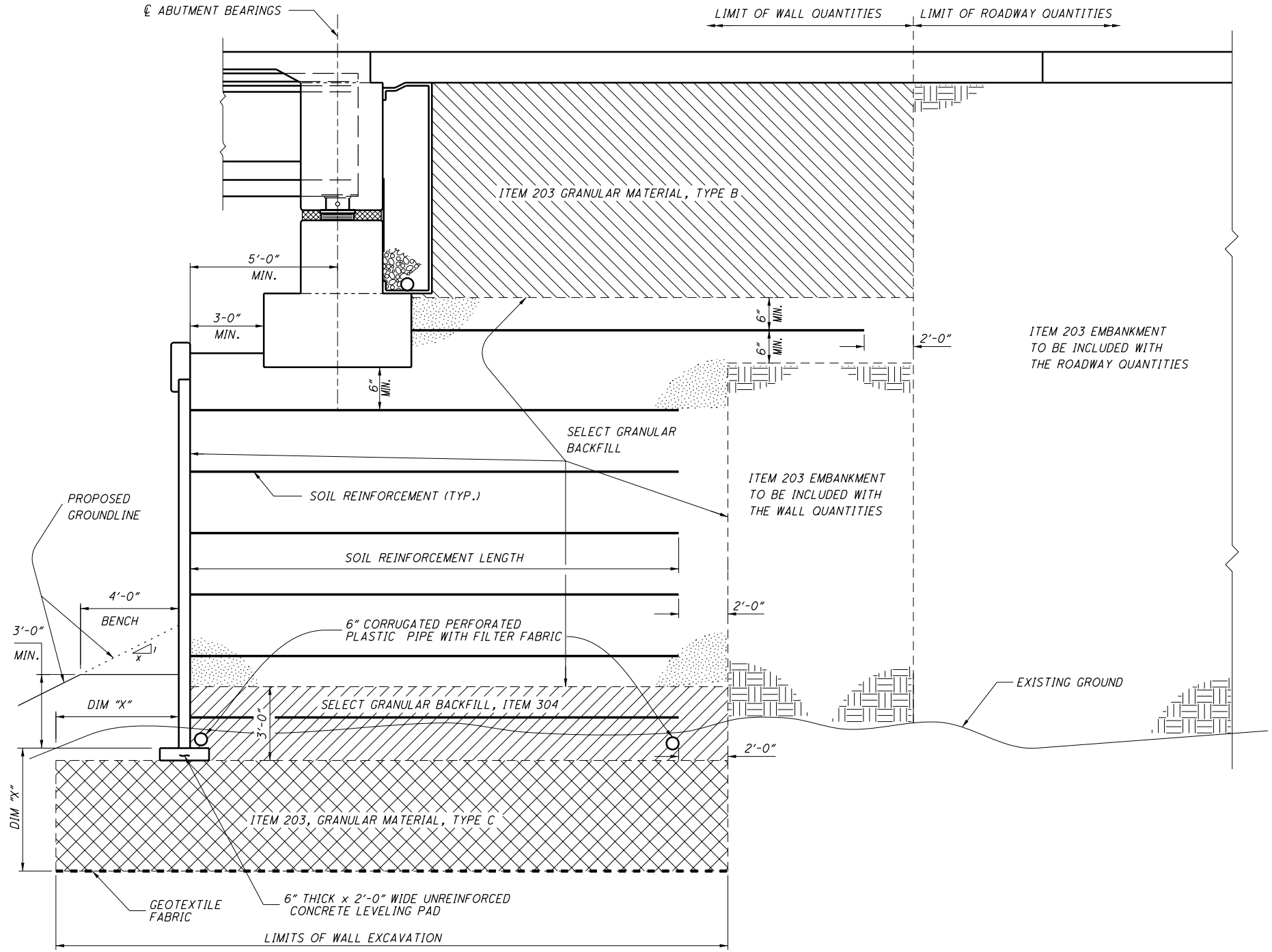
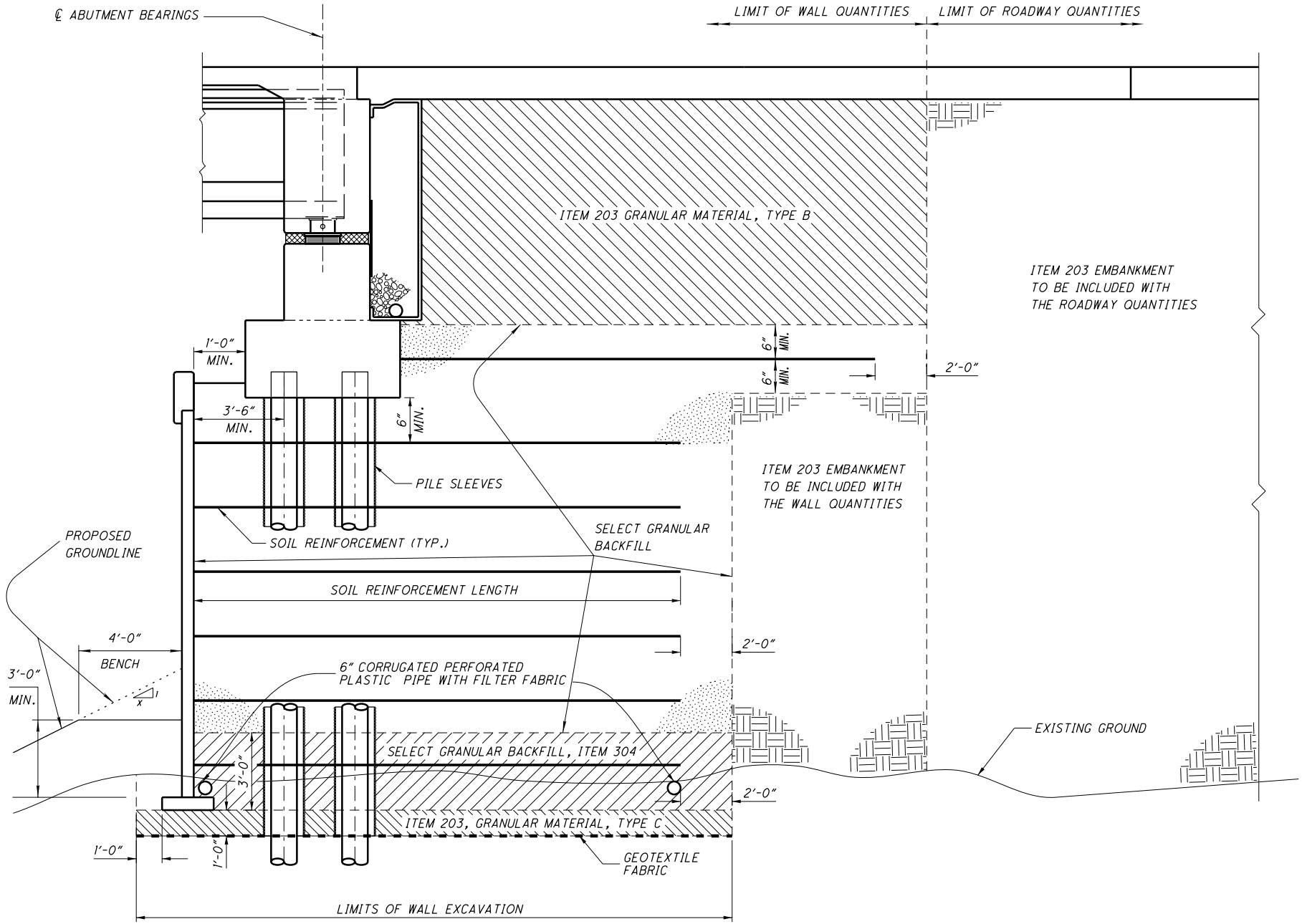


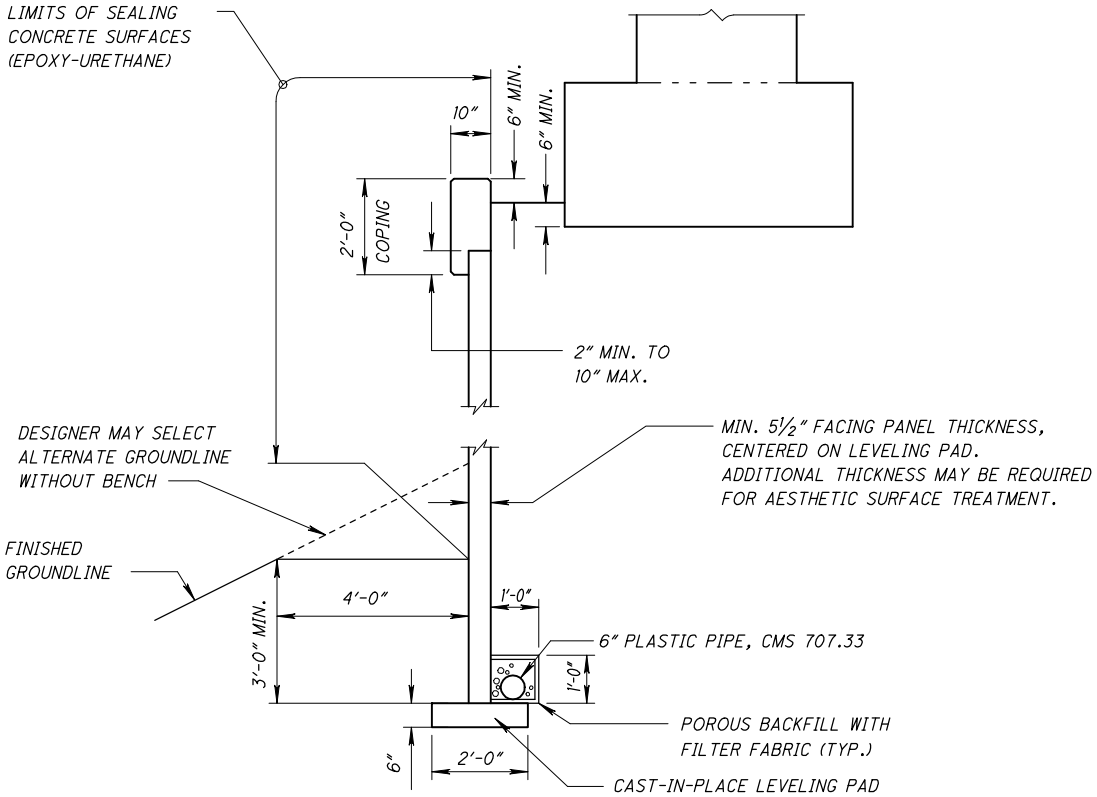
FIGURE 330

SECTION A-A

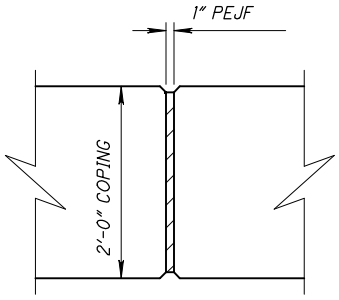
FIGURE 331



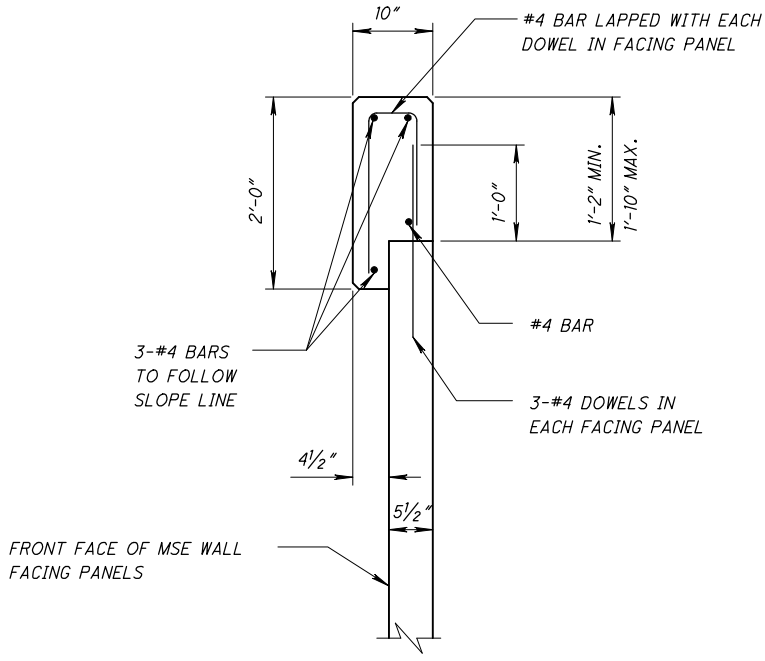
SECTION A-A



MSE WALL AND COPING DETAIL



COPING EXPANSION JOINTS



MSE WALL COPING

ALL REINFORCING STEEL TO BE EPOXY COATED

FIGURE 332

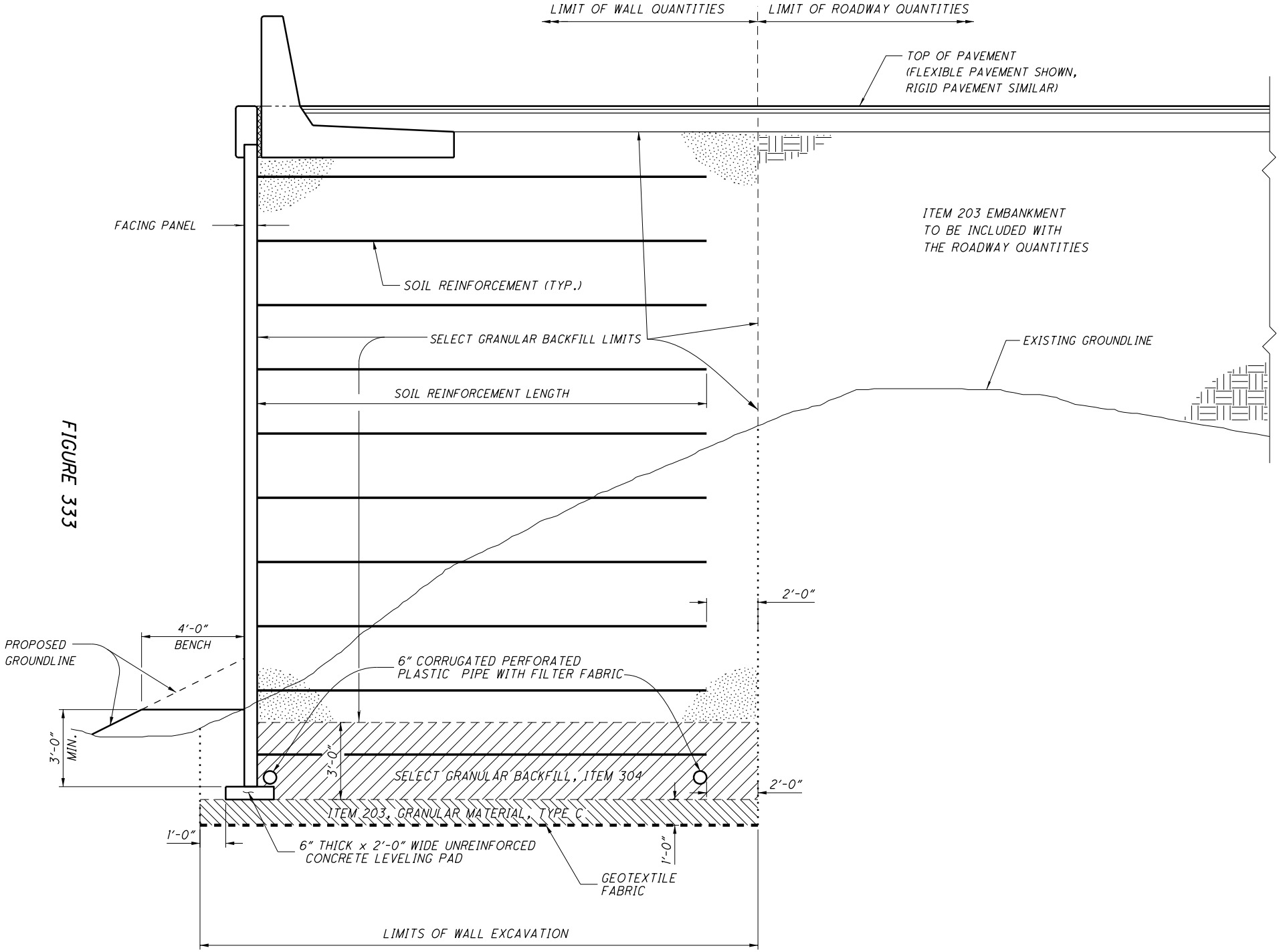

LIMIT OF WALL QUANTITIES
LIMIT OF ROADWAY QUANTITIES
TOP OF PAVEMENT
(FLEXIBLE PAVEMENT SHOWN,
RIGID PAVEMENT SIMILAR)
FACING PANEL
ITEM 203 EMBANKMENT
TO BE INCLUDED WITH
THE ROADWAY QUANTITIES
SOIL REINFORCEMENT (TYP.)
SELECT GRANULAR BACKFILL LIMITS
EXISTING GROUNDLINE
SOIL REINFORCEMENT LENGTH
2'-0"
4'-0"
BENCH
PROPOSED
GROUNDLINE
6" CORRUGATED PERFORATED
PLASTIC PIPE WITH FILTER FABRIC
3'-0"
MIN.
3'-0"
SELECT GRANULAR BACKFILL, ITEM 304
2'-0"
ITEM 203, GRANULAR MATERIAL, TYPE C
1'-0"
6" THICK x 2'-0" WIDE UNREINFORCED
CONCRETE LEVELING PAD
1'-0"
GEOTEXTILE
FABRIC
LIMITS OF WALL EXCAVATION

FIGURE 333

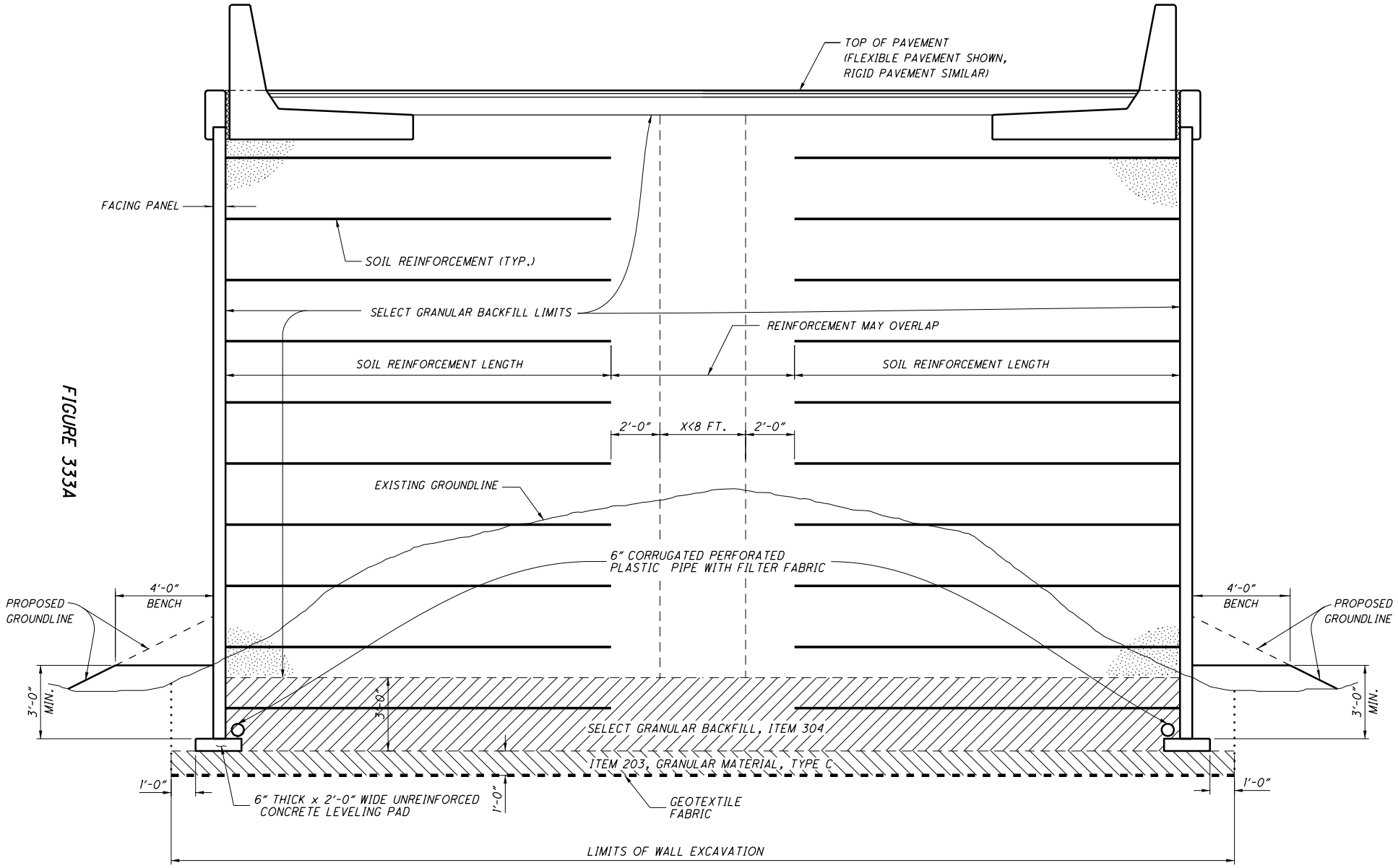


FIGURE 333A

IF X IS LESS THAN 8 FT., USE SELECT GRANULAR BACKFILL MATERIAL BETWEEN SOIL REINFORCEMENT.

SEE ROADWAY PLANS FOR PAVEMENT BUILD UP

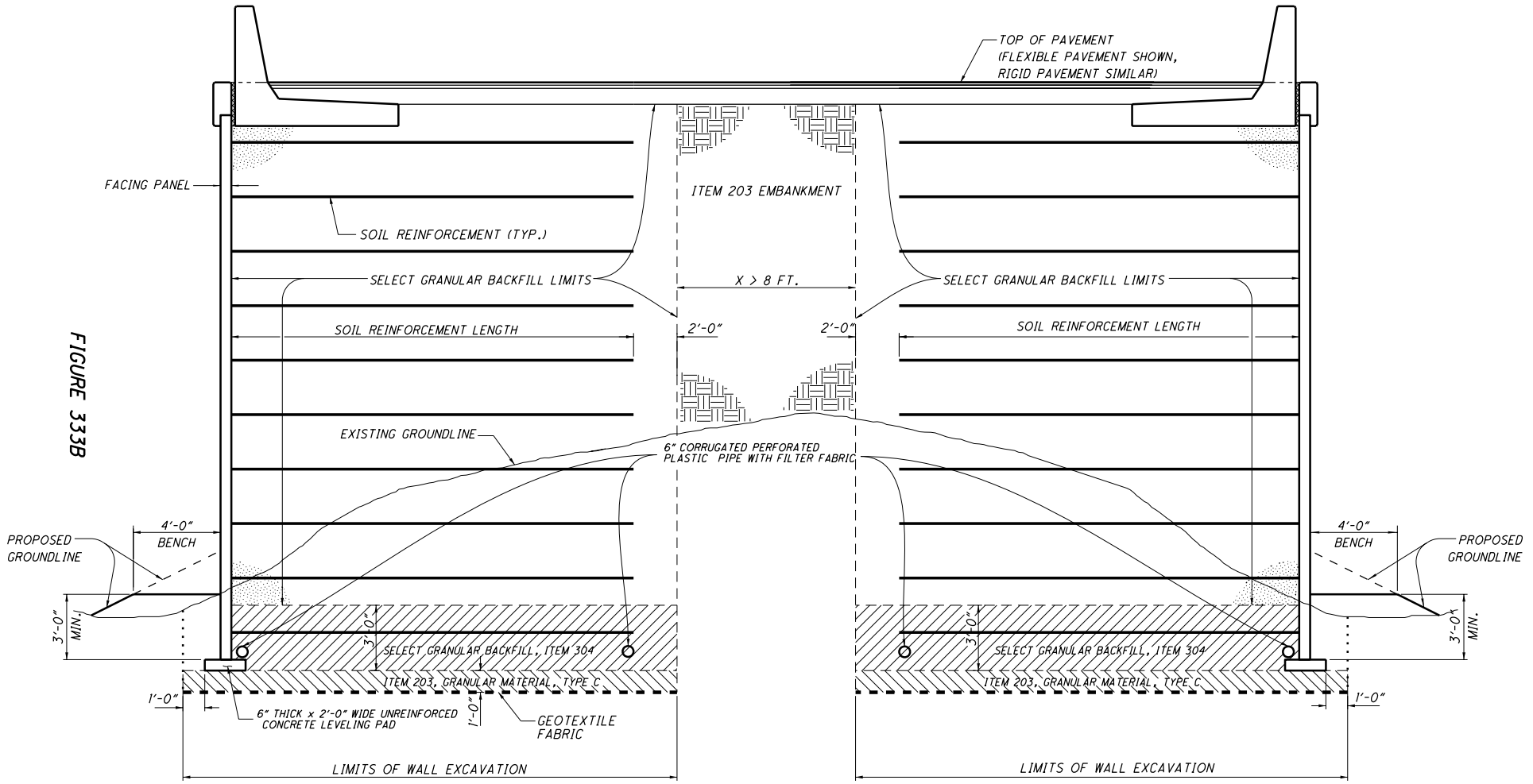


FIGURE 333B

IF X IS MORE THAN 8 FT., USE ITEM 203 EMBANKMENT BETWEEN SOIL REINFORCEMENT.

SEE ROADWAY PLANS FOR PAVEMENT BUILD UP