

TO: All Design Section Staff  
FROM: Bijan Khaleghi  
DATE: January 28, 2021  
SUBJECT: Abutments Supported By Mechanically-Stabilized Earth Walls

This design memorandum provides revisions to the requirements for abutments supported by mechanically-stabilized earth walls. Bridge Design Manual Sections 7.5.2 and 15.7.5 shall have the following updates.

## **BDM 7.5.2**

The last paragraph before section A shall have the following sentence added.

Structural earth walls shall also follow the requirements given in Section 8.1.6.

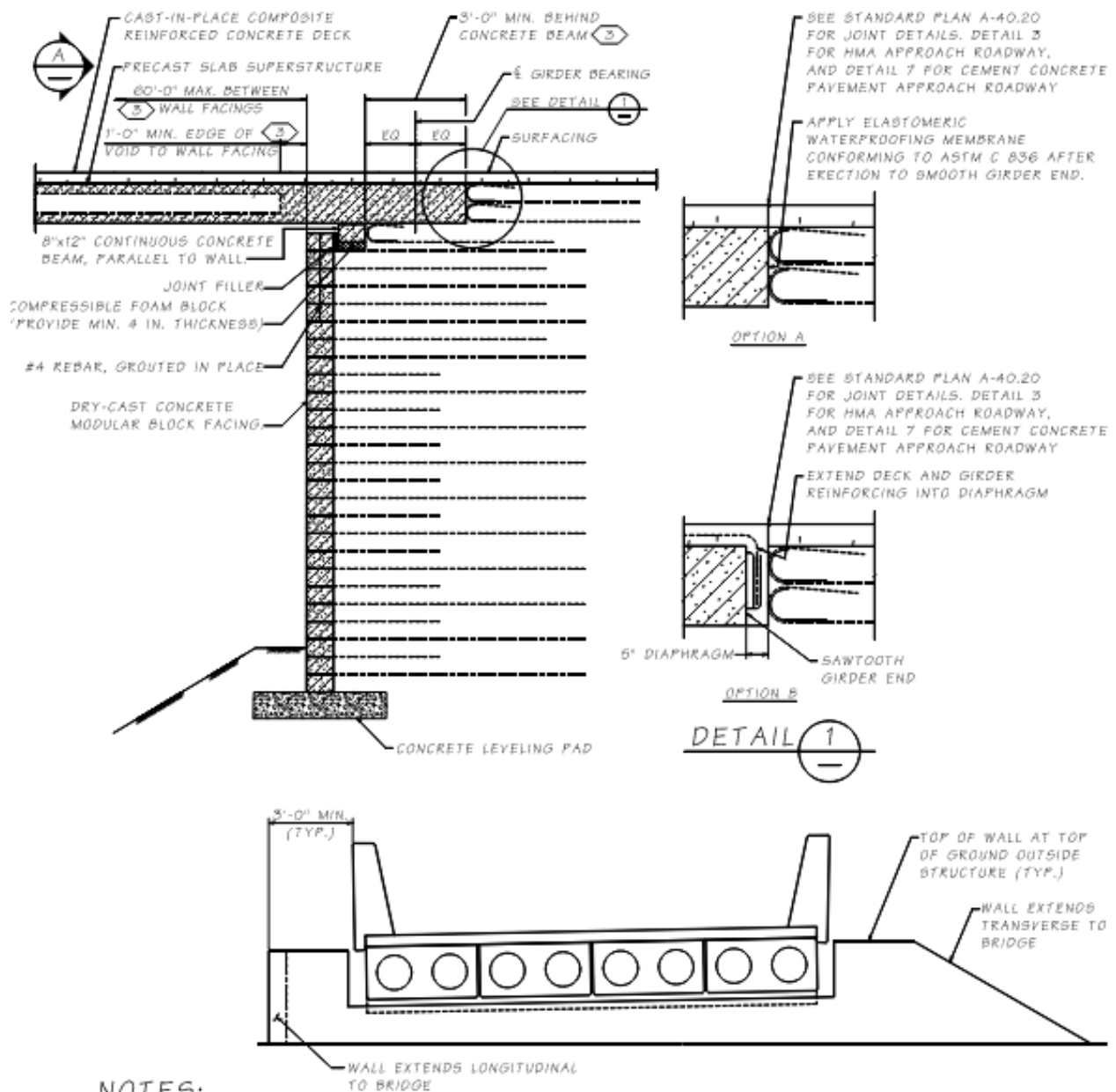
The following items shall be updated in Section A.

2. The superstructure length shall not exceed 60 feet between wall facings, and the bearing location shall be taken as the midpoint between the concrete beam and the girder end.

The following items shall be added to Section A.

11. Erosion shall be prevented off the ends of the bridge. Coordinate with hydraulics as required.
12. The minimum horizontal clearance for embankment at the end of the bridge shall be 3 feet from back face of traffic barrier.
13. Lateral restraint shall be provided to resist transverse loads. Passive resistance of the soil above the soffit of the girder shall be neglected. The transverse load shall not be less than the horizontal seismic force; which is the acceleration coefficient,  $A_s$ , times the tributary permanent load.

Figures 7.5.2-1 and 7.5.2-2 shall be replaced with the following Figures 7.5.2-1 and 7.5.2-2.



**NOTES:**

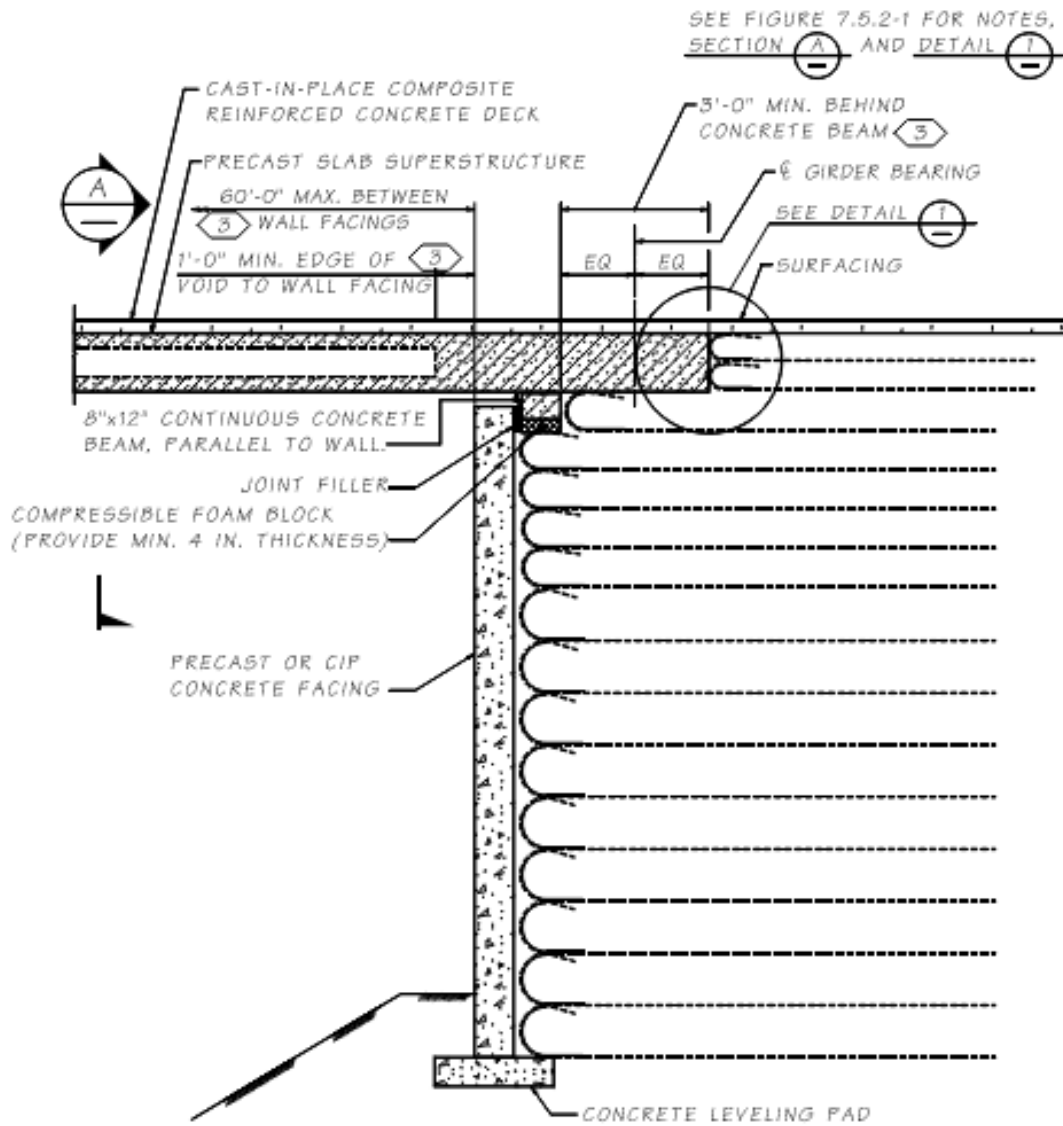
1. LATERAL RESTRAINT NOT SHOWN, BUT REQUIRED FOR DESIGN.
2. FALL PROTECTION NOT SHOWN FOR CLARITY.

(3) LONGITUDINAL DIMENSIONS ARE MEASURED NORMAL TO THE WALL

SECTION (A)

**Reinforced Soil Abutment with Dry-Cast Modular Block Facing**

Figure 7.5.2-1



**Reinforced Soil Abutment with Full-Height Concrete Facing**

Figure 7.5.2-2

**BDM 15.7.5**

The following shall be added to Section A.2.

In the list of documents, the following shall be added as the first document.

- Section 7.5.2

At the end of Section A.2, the following sentence shall be added.

Structural earth walls shall also follow the requirements given in Section 15.8.1E.

**Background:**

This policy memorandum provides additional guidance for BDM Section 7.5.2 Abutments Supported By Mechanically-Stabilized Earth Walls and Section 15.7.5 Abutment Design and Details.

If you have any questions regarding this policy memorandum, please contact

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## BDM Revisions:

### 7.5.2 **Abutments Supported By Mechanically-Stabilized Earth Walls**

Bridge abutments may be supported on mechanically-stabilized earth (MSE) walls, including geosynthetic retaining walls (with and without structural facing), structural earth walls and reinforced soil. Abutments supported on these walls shall be designed in accordance with the requirements of this manual and the following documents (listed in order of importance):

1. *Geotechnical Design Manual* (GDM) Section 15.5.3.6.
2. AASHTO LRFD.
3. Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, Volume I and II, FHWA-NHI-10-024, FHWA-NHI-10-025.

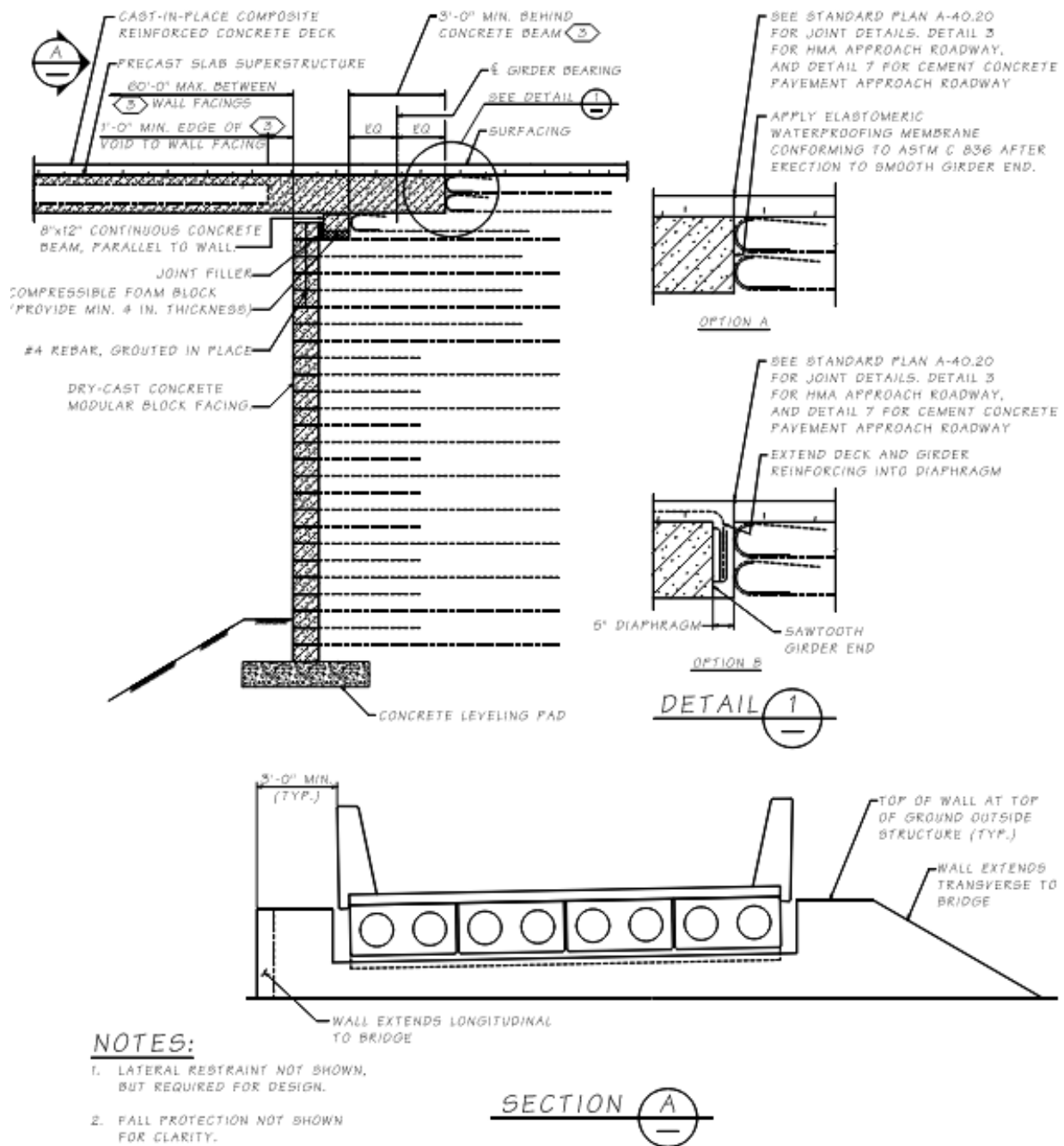
Bridges with MSE supported abutments shall be designed as one of two types described below, and shall satisfy the associated design requirements. Structural earth walls shall also follow the requirements given in Section 8.1.6.

#### **A. Single-span bridges with precast slab superstructures supported directly on reinforced soil**

These bridges shall conform to the following requirements, see Figures 7.5.2-1 and 7.5.2-2:

1. Walls supporting abutments shall be special designed wall systems, and shall conform to GDM Section 15.5.3.6 MSE Wall Supported Abutments. Additionally, the top 3 rows of dry-cast modular concrete blocks shall be grouted with #4 rebar.
2. The ~~span~~ superstructure length shall not exceed 60 feet between wall facings, and the bearing location shall be taken as the midpoint between the concrete beam and the girder end.
3. The superstructure shall include a 5" **minimum** thick C.I.P. composite topping.
4. The end of the precast superstructure shall be at least 4 feet from the back face of the MSE wall. Minimum seat width requirements shall be provided on the reinforced soil bearing area.
5. A foam board detail shall be used to create a 1 foot horizontal buffer between the bearing area and the wall facing.
6. The vertical gap between the top of wall facing and the bottom of superstructure shall be 4" or 2 percent of the abutment height, whichever is greater.

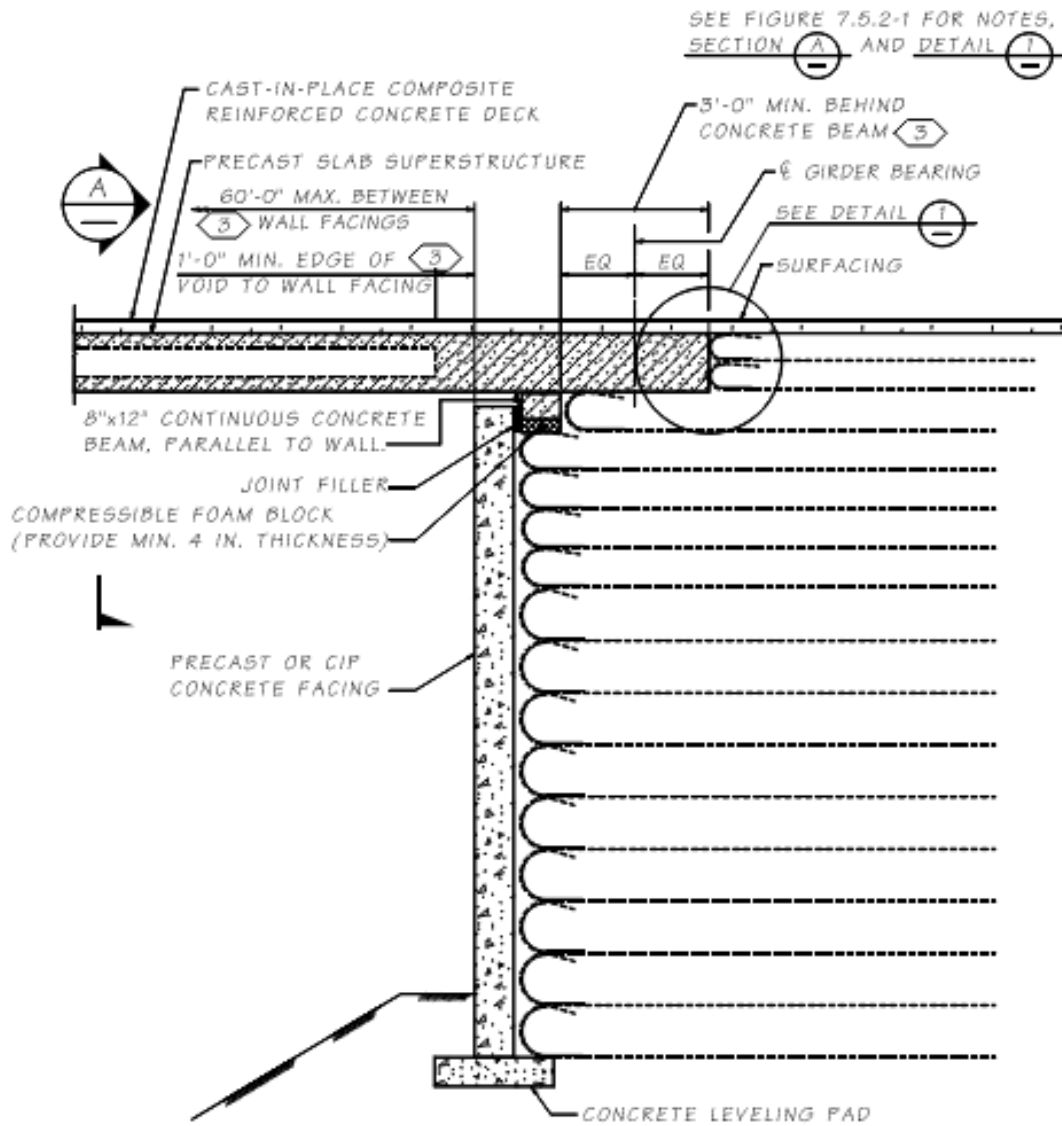
7. Prestressing strands in the zone bearing on reinforced soil shall have a minimum concrete cover of 2". Transverse reinforcing steel within this zone shall have a minimum concrete cover of 1½". All prestressing strand shall be removed to a 2" depth from the end of the slab. The voids shall be patched with epoxy grout.
8. Where voided slab superstructures are used, the slab section shall be solid from the end of the slab to at least 1 foot in front of the fascia.
9. The abutment shall be designed for a bearing pressure at service loads not to exceed 2.0 tons per square foot (TSF) and a factored load at strength and extreme limit states not to exceed 3.5 TSF. The bearing pressure may be increased to 3.0 TSF at service loads and 4.5 TSF at strength and extreme limit states if a vertical settlement monitoring program is conducted in accordance with WSDOT GDM Section 15.5.3.6.
10. Bridge approach slabs may be omitted.
11. Erosion shall be prevented off the ends of the bridge. Coordinate with hydraulics as required.
12. The minimum horizontal clearance for embankment at the end of the bridge shall be 3 feet from back face of traffic barrier.
13. Lateral restraint shall be provided to resist transverse loads. Passive resistance of the soil above the soffit of the girder shall be neglected. The transverse load shall not be less than the horizontal seismic force; which is the acceleration coefficient,  $A_s$ , times the tributary permanent load.



**Reinforced Soil Abutment with Dry-Cast Modular Block Facing**

Figure 7.5.2-1

Figure 7.5.2-1 Reinforced Soil Abutment with Dry-Cast Modular Block Facing



**Reinforced Soil Abutment with Full-Height Concrete Facing**

Figure 7.5.2-2

**Figure 7.5.2-2** Reinforced Soil Abutment with Full-Height Concrete Facing

**B. Bridges with spread footing abutments supported by a geosynthetic wall or SE wall**

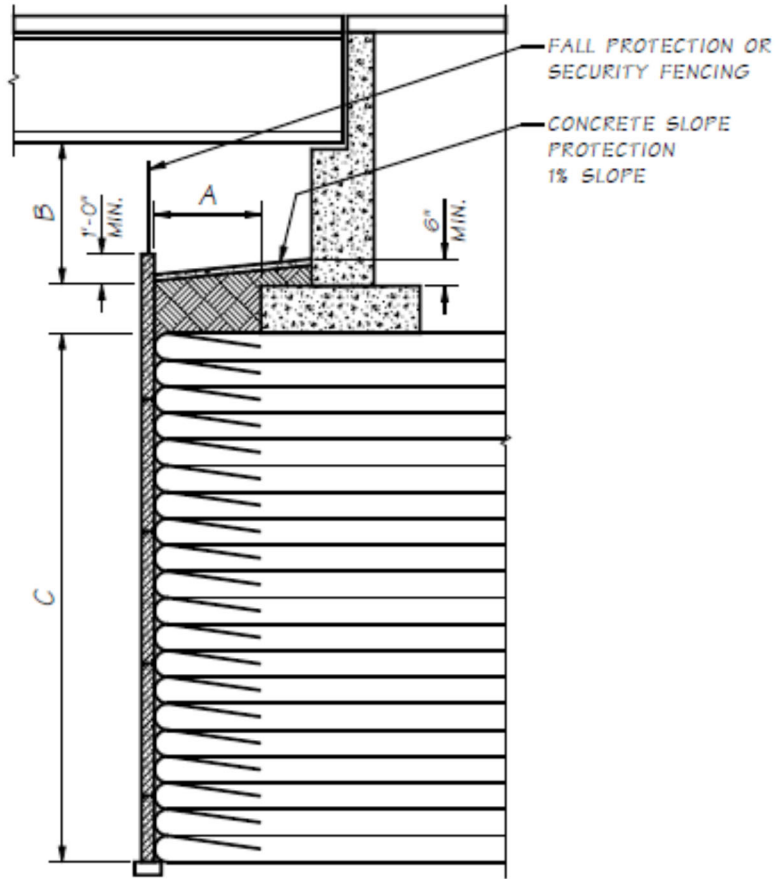
These bridges shall conform to the following requirements, see Figure 7.5.2-3:

1. Walls shall be 30 feet or less in total height, which includes the retained soil height up to the bottom of the embedded spread footing.



2. For SE walls, the front edge of the bridge footing shall be placed 4 feet minimum from the back face of the fascia panel. For geosynthetic retaining walls with a wrapped face, the front edge of the bridge footing shall be placed 2 feet minimum from the back face of the fascia panel.
3. The abutment footing shall be covered by at least 6 inch of soil for frost protection.
4. The superstructure of continuous span bridges shall be designed for differential settlement between piers.
5. Abutment spread footings shall be designed for bearing pressure at service loads not to exceed 2.0 TSF and factored load at strength and extreme limit states not to exceed 3.5 TSF. The bearing pressure may be increased to 3.0 TSF at service loads and 4.5 TSF at strength and extreme limit states if a vertical settlement monitoring program is conducted in accordance with the *Geotechnical Design Manual* Section 15.5.3.5.
6. Walls supporting abutments shall be special designed wall systems, and shall conform to GDM Section 15.5.3.5 MSE Wall Supported Abutments. Additionally, the top 3 rows of dry-cast modular concrete blocks shall be grouted with #4 rebar.
7. Concrete slope protection shall be provided. Fall protection shall be provided in accordance with *Design Manual* Chapter 730.
8. The presence of a landform shelf beneath the superstructure between the abutment face and top of wall may constitute an attractive nuisance. Limiting access to this area per BDM Chapter 2.8, may also be required. Where required, coordinate with the State Bridge and Structures Architect for bridge security issues.

Deviations from the design requirements require approval from the State Bridge Design Engineer and the State Geotechnical Engineer.



- A. 4'-0" MIN. FOR SE WALLS (PRECAST CONCRETE PANEL FACE OR CAST-IN-PLACE CONCRETE FACE) AND 2'-0" MIN. FOR SPECIAL DESIGNED GEOSYNTHETIC RETAINING WALLS WITH WRAPPED FACE.
- B. 3'-0" MIN. FOR GIRDER BRIDGES AND 5'-0" MIN. FOR NON-GIRDER, SLAB, AND BOX GIRDER BRIDGES. (SEE SECTION 7.5.3)
- C. 30'-0" MAXIMUM (SEE SECTION 7.5.2B.1)

**Figure 7.5.2-3** Spread Footing on SE Wall or Geosynthetic Wall