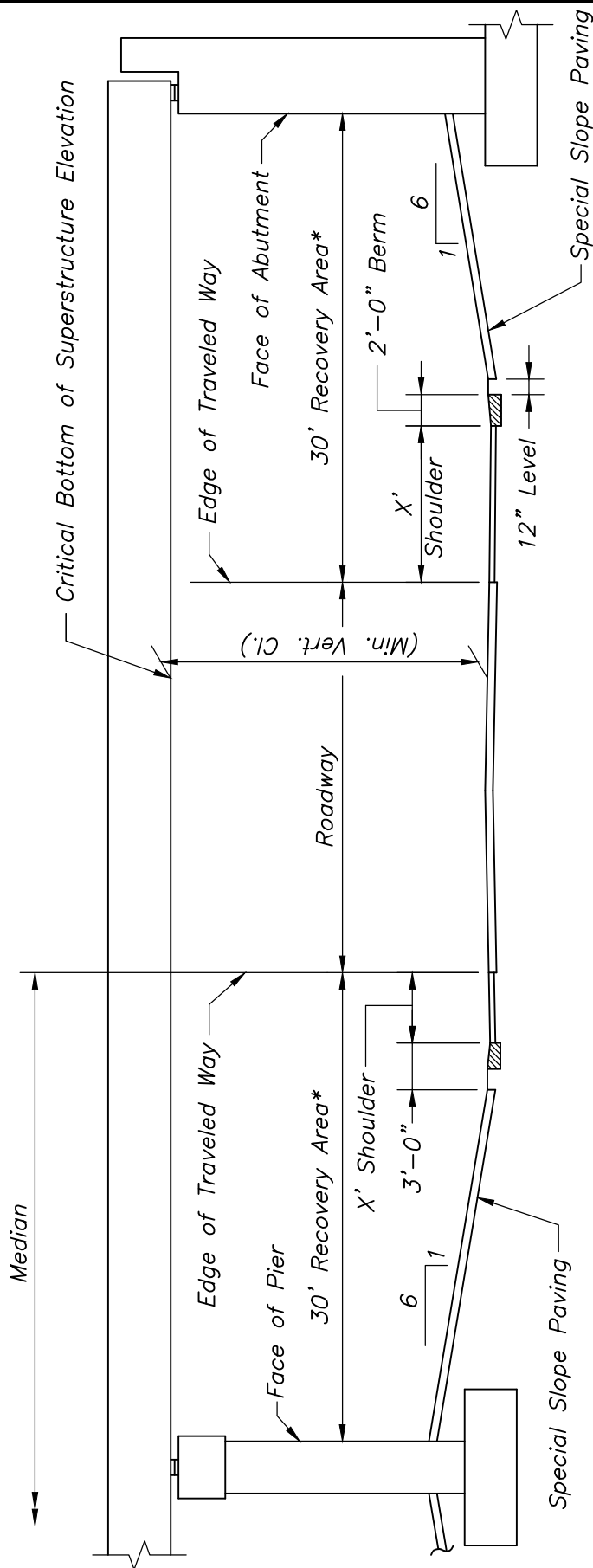




LONGITUDINAL SECTION

SCALE: $\frac{3}{32}'' = 1' - 0''$

NOTES:

1. * If an additional lane is anticipated in Recovery Area, set bottom of footing to provide sufficient cover for future use.
2. Show all dimensions on Sketch Plans and Construction Drawings.
3. Minimum vertical clearance shall be measured wherever critical within the roadway or shoulder.

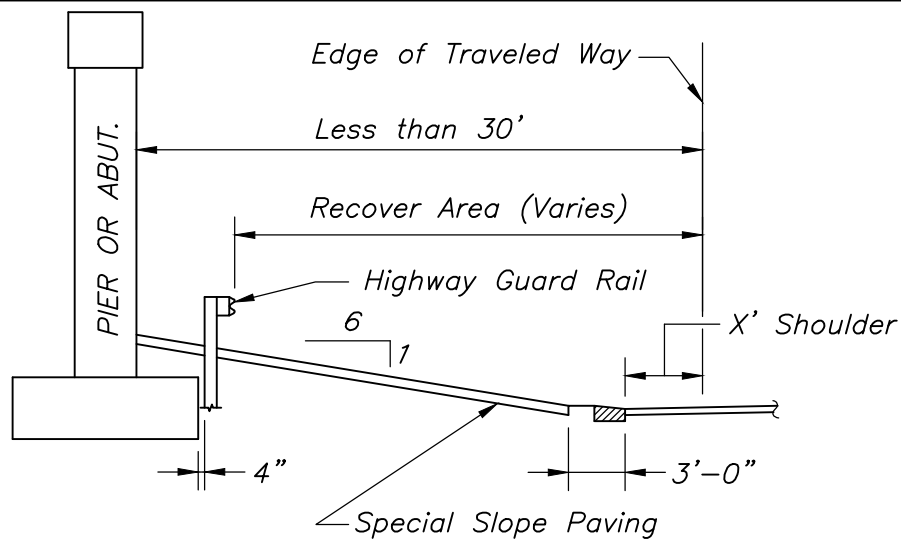


LRFD BRIDGE
MANUAL, PART II

LIMITED ACCESS HIGHWAY
(30' RECOVERY AREA)
CLEARANCES UNDER BRIDGE

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER
2.1.1

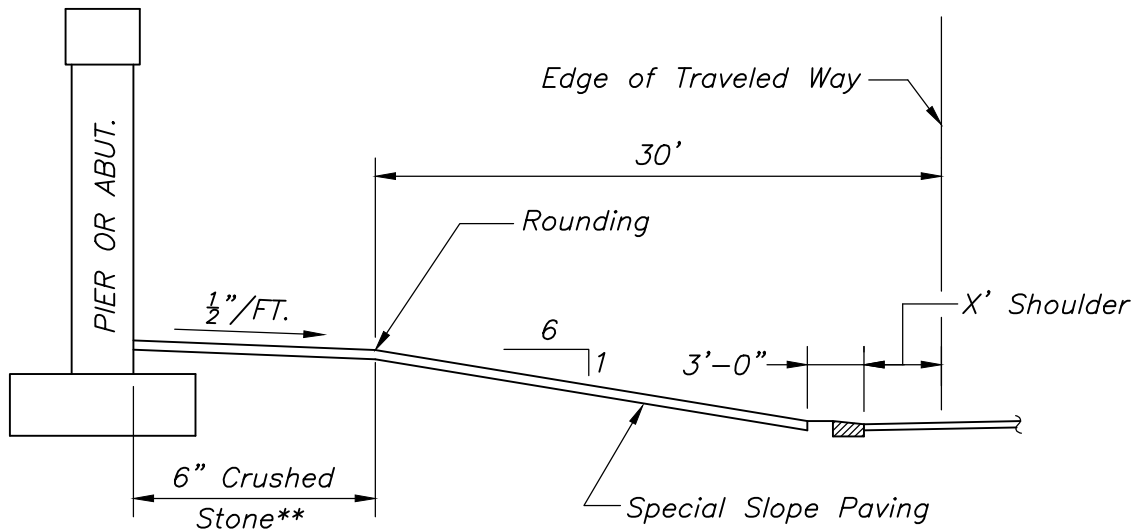


NOTE:

The Designer shall follow provisions of Paragraph 3.3.1.7 of Chapter 3 of Part I of this Bridge Manual for evaluating pier protection requirements from vehicular impact.

SUBSTRUCTURE WITHIN STANDARD RECOVERY AREA

SCALE: $\frac{3}{32}'' = 1'-0''$



SUBSTRUCTURE OUTSIDE OF STANDARD RECOVERY AREA

SCALE: $\frac{3}{32}'' = 1'-0''$

NOTES:

1. ** 4" Cement Concrete over 6" Gravel is to be substituted for the above in urban areas and locations that may be accessible to pedestrians.
2. Show all dimensions on Sketch Plans and Construction Drawings.



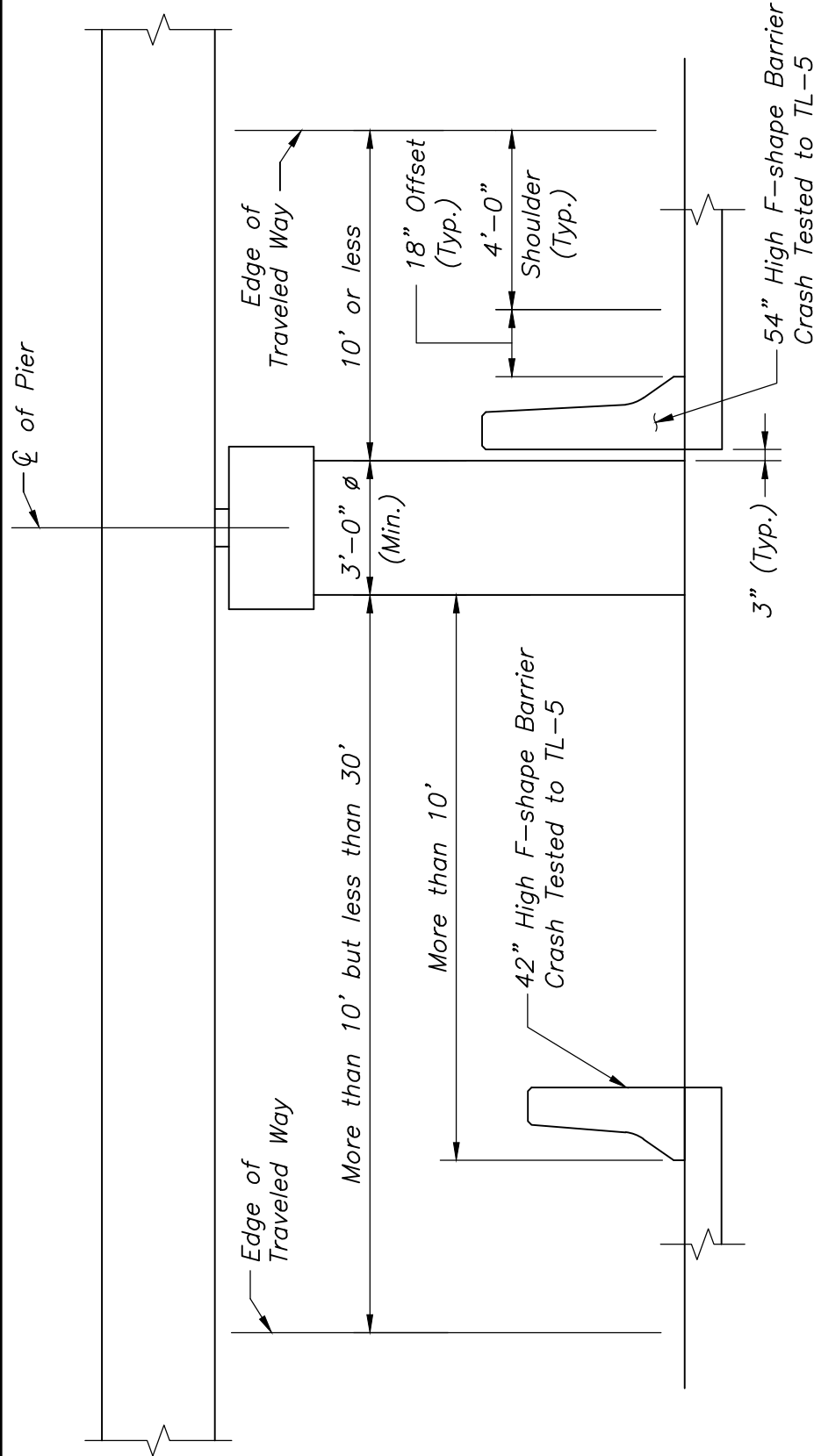
LRFD BRIDGE
MANUAL, PART II

LIMITED ACCESS HIGHWAY
(VARIOUS RECOVERY AREAS)
CLEARANCES UNDER BRIDGE

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER

2.1.2



LONGITUDINAL SECTION

SCALE: $\frac{1}{4}" = 1' - 0"$

NOTES:

1. Pier protection shown complies with Article 3.6.5 of the AASHTO LRFD Bridge Design Specifications and allows pier not to be designed for vehicular impact.
2. All dimensions are for square section.
3. Show all dimensions on Sketch Plans and Construction Drawings.
4. Refer to the Highway Design Manual for complete instructions regarding shoulder widths.



LRFD BRIDGE
MANUAL, PART II

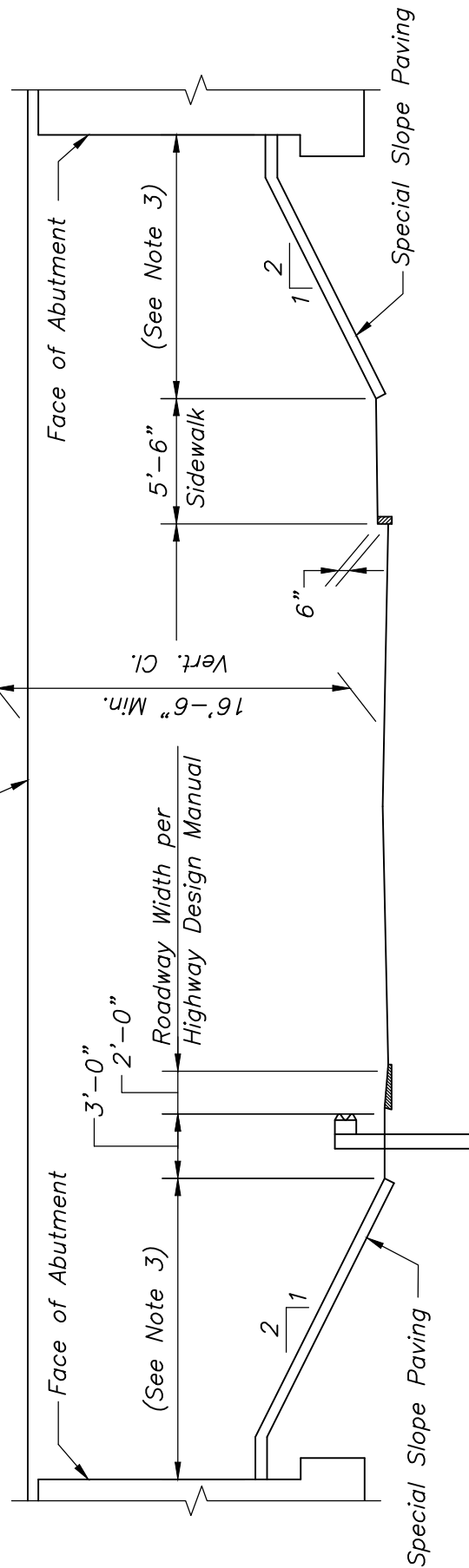
PIER PROTECTION WITHOUT DESIGN FOR IMPACT CLEARANCES UNDER BRIDGE

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER

2.1.3

Critical Bottom of
Superstructure Elevation



NON-SIDEWALK SIDE

SIDEWALK SIDE

LONGITUDINAL SECTION

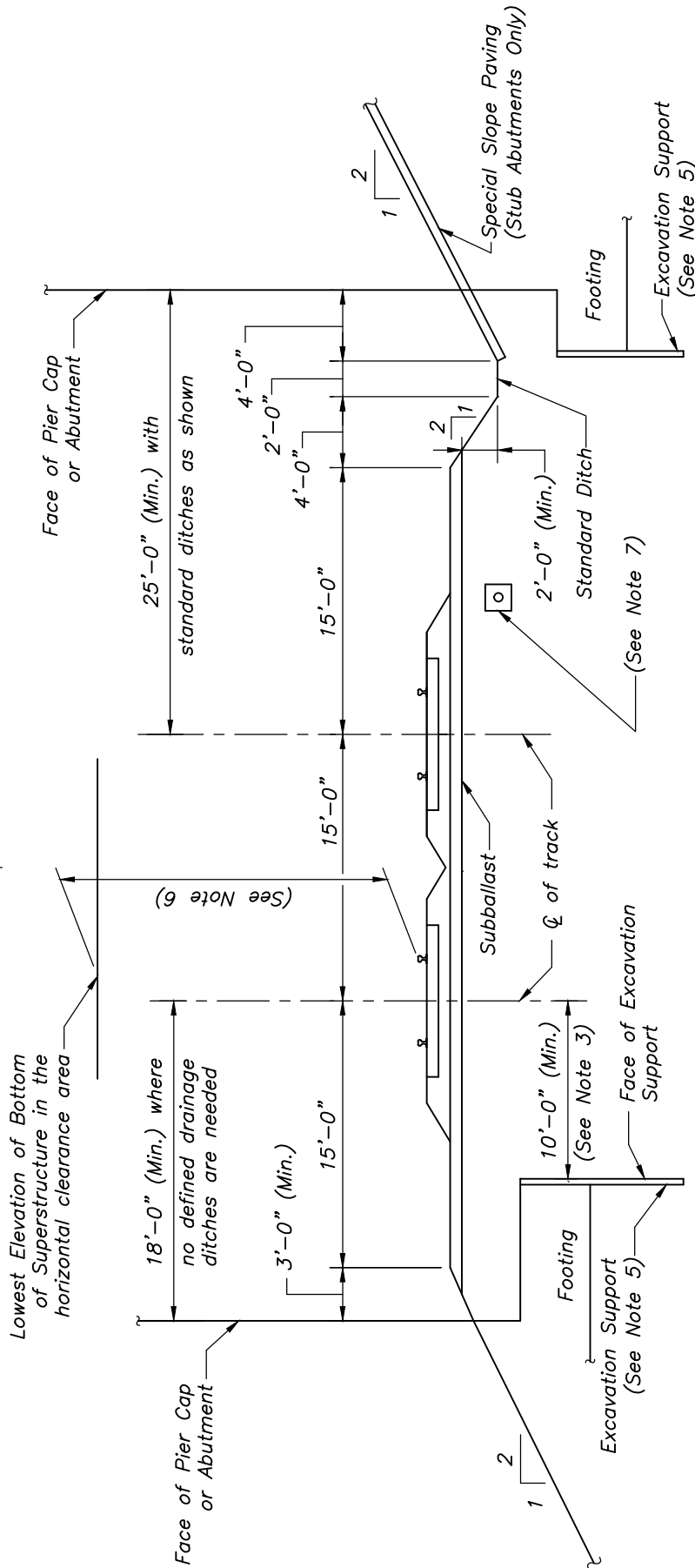
SCALE: $\frac{1}{8}'' = 1'-0''$

NOTES:

1. Show all dimensions on Sketch Plans and Construction Drawings.
2. Vertical underclearances less than 16'-6" require an approved design exception.
3. Distance approximately equal to Vertical Clearance for Cantilever Abutments only.

Typical Railroad Bed Section with Standard Ditches

Railroad Bed Fill Section



LONGITUDINAL SECTION

SCALE: $\frac{1}{8}" = 1'-0"$

NOTES:

1. The clearances shown are for guide purposes and are subject to CSX approval. Provide actual distance between track centerlines.
2. Single track R.R. lines are to be treated similarly.
3. Minimum distance from footing to $\bar{Q}$ of main line track is 11'-0".
4. Provide standard ditches when they currently exist or are required by CSX.
5. See Dwg. No. 2.1.9 for excavation support details and requirements.
6. For vertical clearance, consult State Bridge Engineer.
7. Existing buried utilities must be accommodated.
8. All horizontal clearances to be increased $1\frac{1}{2}"$ per degree of curvature. When track is superelevated clearances on inside of the curve shall be increased $3\frac{1}{2}"$ per each 1" of superelevation.



LRFD BRIDGE
MANUAL, PART II

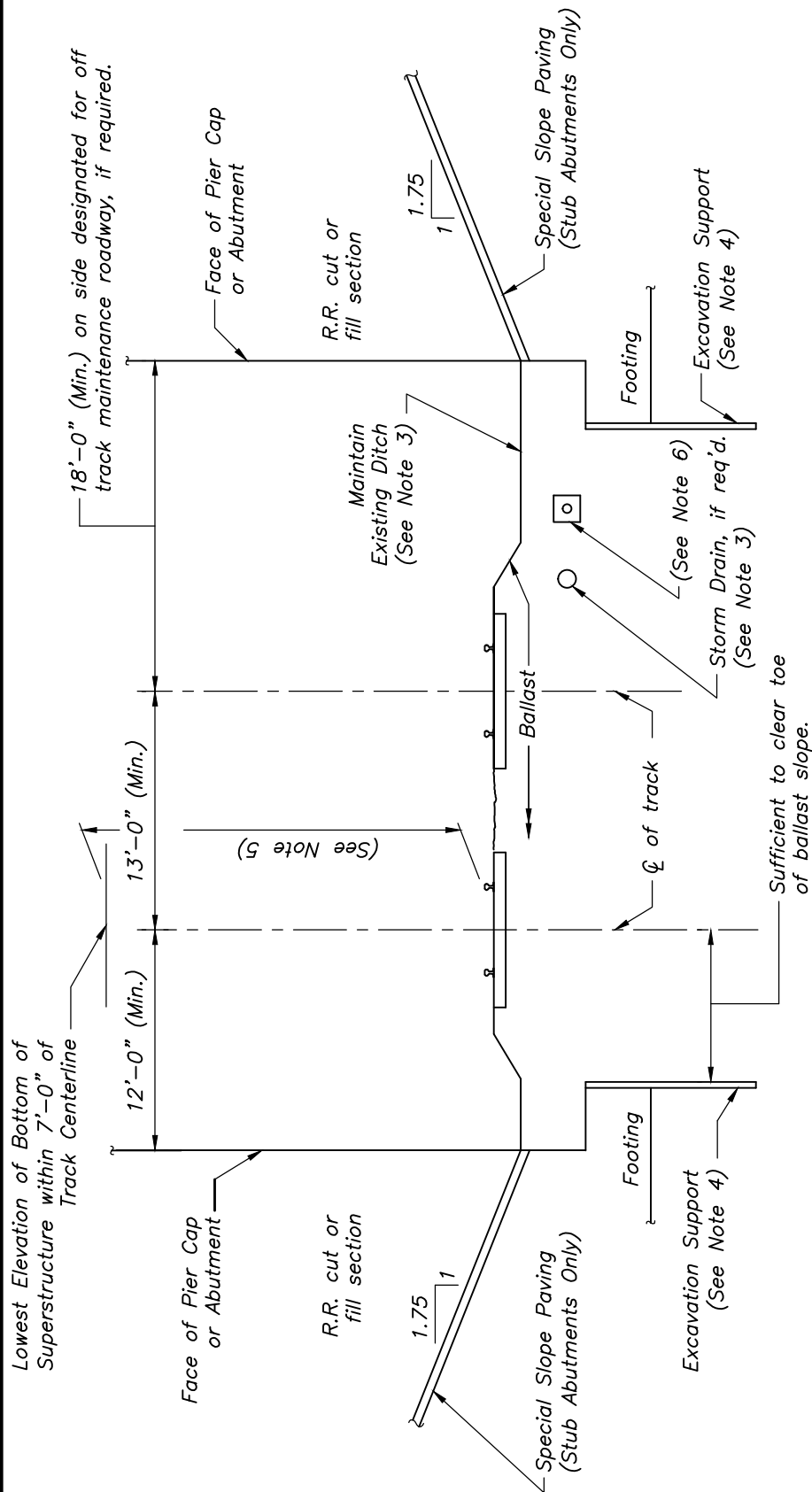
CSX TRANSPORTATION, INC.

CLEARANCES UNDER BRIDGE

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER

2.1.5



LONGITUDINAL SECTION

SCALE: $\frac{1}{8}" = 1'-0"$

NOTES:

1. The clearances shown are for guide purposes and are subject to MBTA approval. Provide actual distance between track centerlines.
2. Single track R.R. lines are to be treated similarly.
3. Survey the existing ditch so that the grade of the proposed ditch under bridge matches. If ditch can not be provided, provide storm drains sized to have flow capacity equal to adjacent R.O.W. ditches, 12" diameter minimum.
4. See Dwg. No. 2.1.10 for excavation support details and requirements.
5. For vertical clearance, consult Bridge Engineer.
6. Existing buried utilities must be accommodated.
7. Horizontal side clearances shall be increased 1" per degree of curvature.



LRFD BRIDGE

MANUAL, PART II

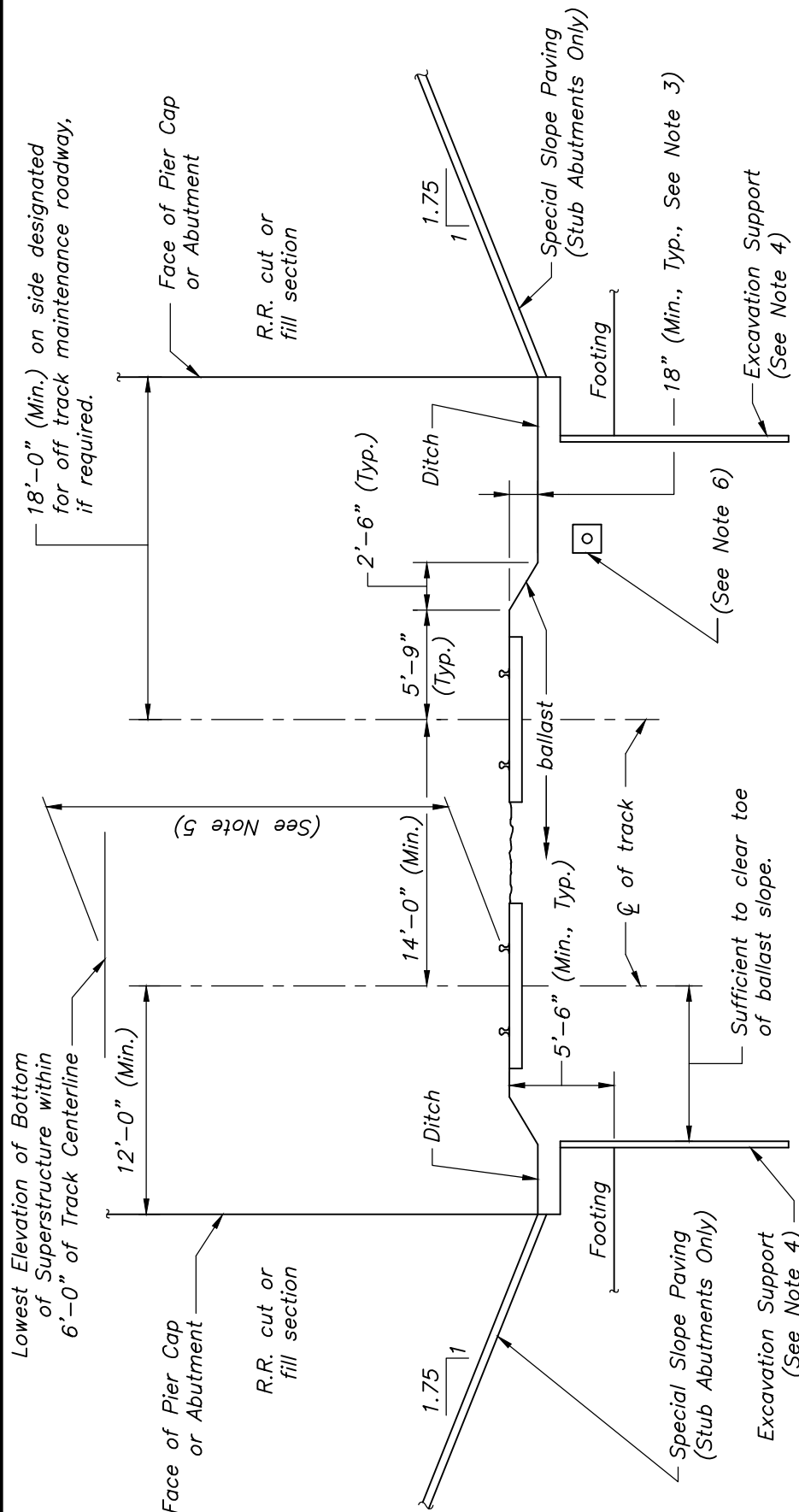
MBTA COMMUTER RAIL

CLEARANCES UNDER BRIDGE

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER

2.1.6

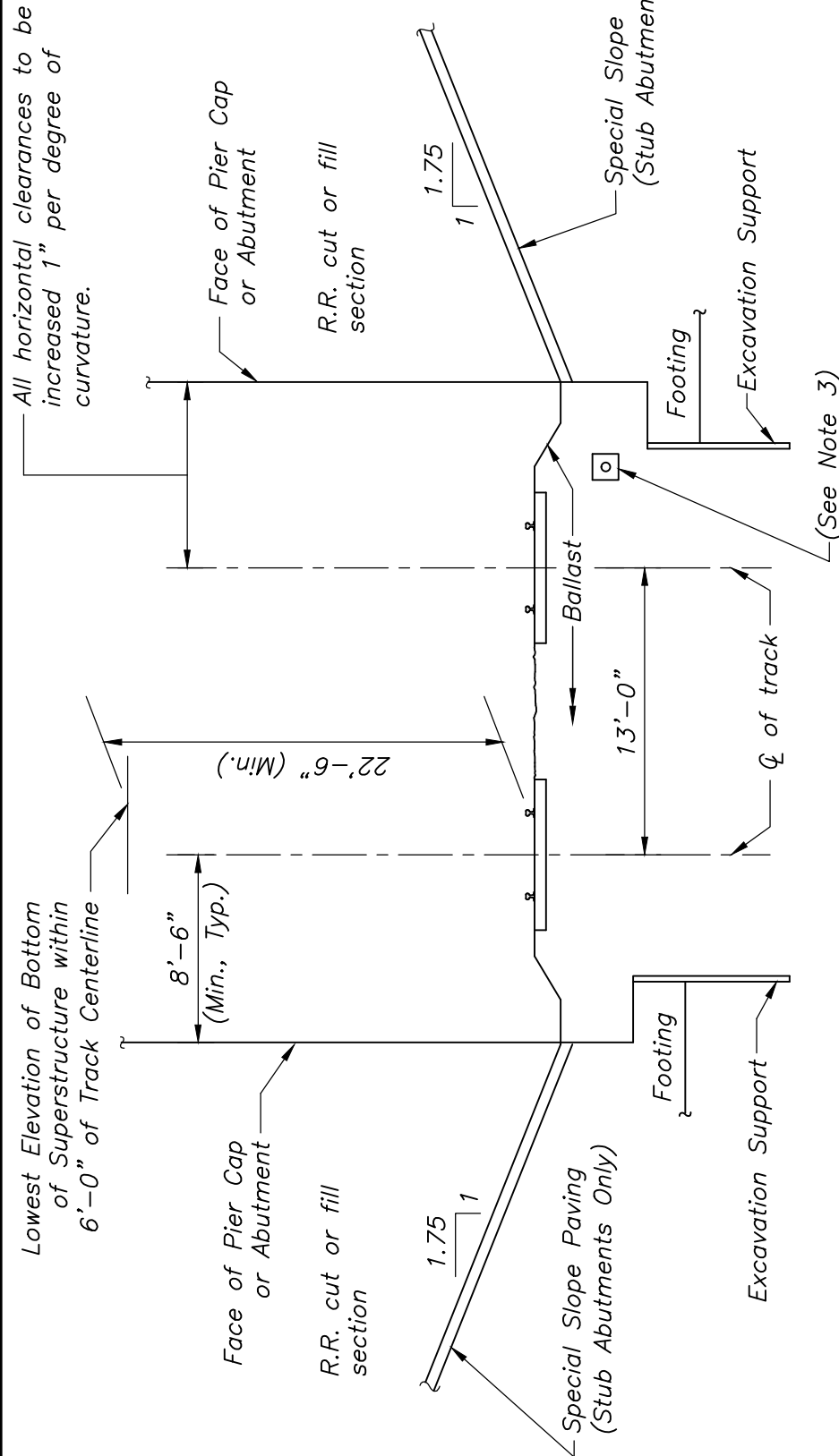


LONGITUDINAL SECTION

SCALE: $\frac{1}{8}" = 1'-0"$

NOTES:

1. The clearances shown are for guide purposes and are subject to R.R. approval. Provide actual distance between track centerlines.
2. Single track R.R. lines are to be treated similarly.
3. Survey the existing ditch so that the grade of the proposed ditch under bridge matches.
4. See Dwg. 2.1.11 for excavation support details and requirements.
5. For vertical clearance, consult State Bridge Engineer.
6. Existing buried utilities must be accommodated.
7. Horizontal side clearances shall be increased 1" per degree of curvature.



LONGITUDINAL SECTION

SCALE: $\frac{1}{8}" = 1'-0"$

NOTES:

1. The clearances shown are for new bridges on new roads in accordance with MGL Chapter 160, Section 134A and may be modified by other legal requirements, such as MGL Chapter 634.
2. Single track R.R. lines are to be treated similarly.
3. Existing buried utilities must be accommodated.



LRFD BRIDGE
MANUAL, PART II

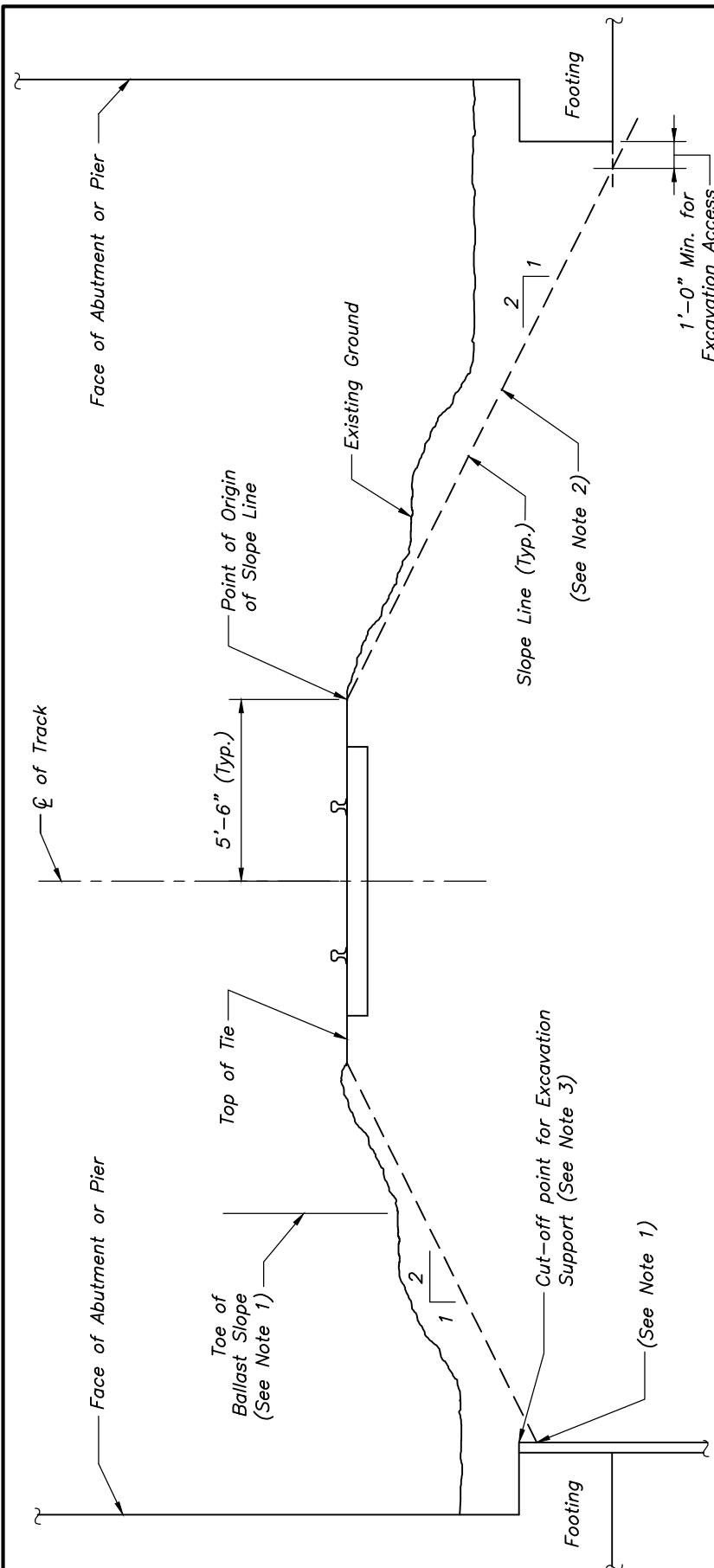
LEGAL MINIMUM RAILROAD CLEARANCES

CLEARANCES UNDER BRIDGE

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER

2.1.8



LONGITUDINAL SECTION

SCALE: $\frac{1}{4}" = 1'-0"$

NOTES:

1. Provide excavation support whenever the 2:1 slope line would be disturbed in the placement of the structure. Excavation support must not be closer to track than toe of ballast slope.
2. If elevation of Bottom of Footing falls at or above the 2:1 slope line, excavation support is not required.
3. Excavation support shall be cut off at top of tie during construction. After construction and backfilling is completed, the excavation support within 12'-0" of the track centerline shall be cut off 2'-0" below the bottom of the tie or 2'-0" below finished grade, whichever is greater. In no case shall the cut-off point be below the top of footing.
4. Excavation support for the protection of railroad shall be designed in accordance with provisions of AREMA specifications. Extent of excavation support shall be dimension on plan view of bridge.
5. Excavation support is to be designed for a lateral earth pressure from E-80 vertical loading surcharge plus 50% impact (8'-6") and axle spacing (5'-0"). Horizontal pressure on the excavation support due to the E-80 tie length (8'-6") and axle spacing (5'-0"). Horizontal pressure on the excavation support due to the E-80 surcharge shall be determined using the strip load formula shown in the AREMA specifications. Allowable stresses for materials shall be in accordance with AREMA.



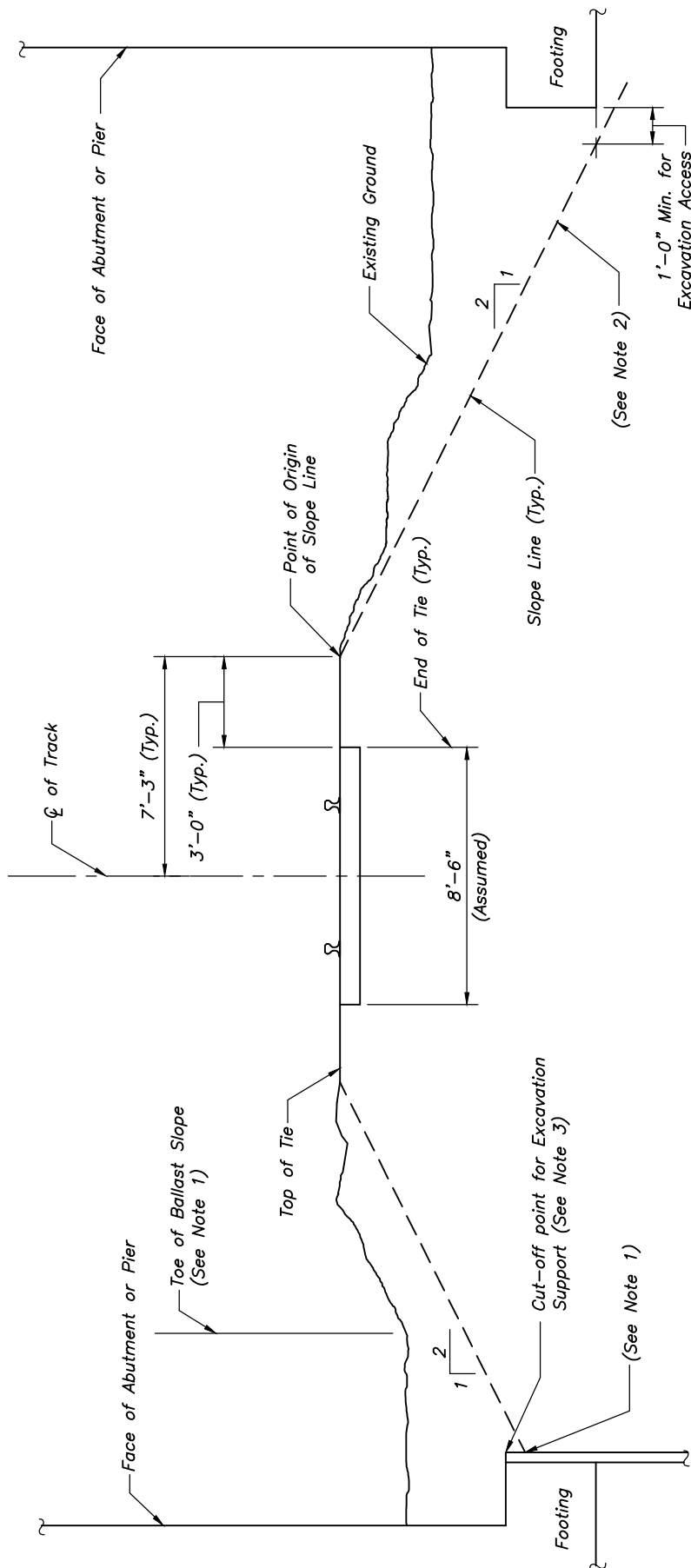
LRFD BRIDGE
MANUAL, PART II

EXCAVATION SUPPORT REQ'S MBTA COMMUTER RAIL CLEARANCES UNDER BRIDGE

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER

2.1.10



LONGITUDINAL SECTION

SCALE: $\frac{1}{4}" = 1'-0"$

NOTES:

1. Provide excavation support whenever the 2:1 slope line would be disturbed in the placement of the structure.
 2. Excavation support must not be closer to track than toe of ballast slope.
 3. If elevation of Bottom of Footing falls at or above the 2:1 slope line, excavation support is not required.
 4. Excavation support shall be cut off at top of footing or intersection with the influence line, whichever is higher.
 5. Excavation support for the protection of railroad shall be designed in accordance with provisions of AREMA specifications. Extent of excavation support shall be dimensioned on plan view of bridge.
- Excavation support is to be designed for a lateral earth pressure from E-80 vertical loading surcharge plus 50% impact in addition to active earth pressure. The 80 kips surcharge shall be uniformly distributed over the tie length (8'-6") and axle spacing (5'-0"). Horizontal pressure on the excavation support due to the E-80 surcharge shall be determined using the strip load formula shown in the AREMA specifications. Allowable stresses for materials shall be in accordance with AREMA.

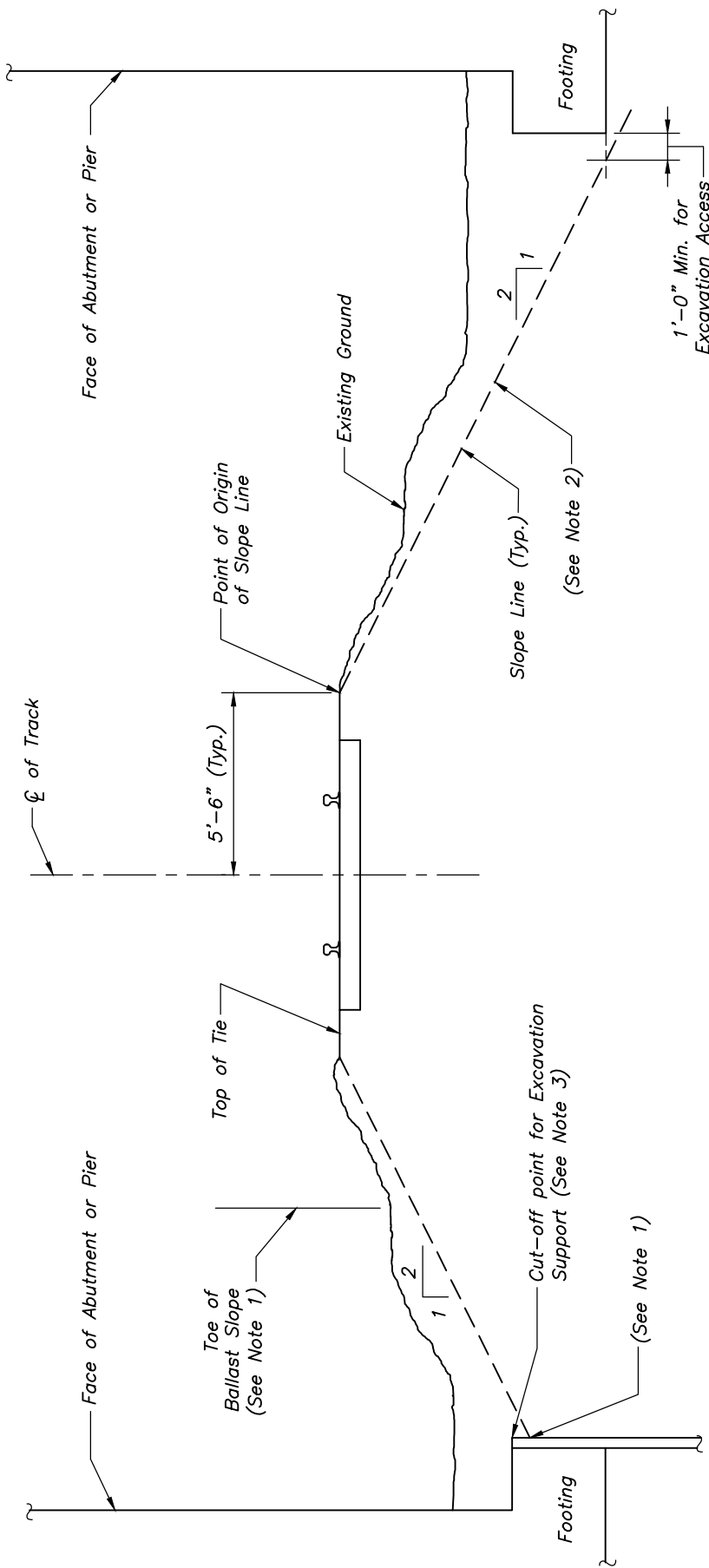


LRFD BRIDGE
MANUAL, PART II

EXCAVATION SUPPORT REQ'S
B&M CORPORATION
CLEARANCES UNDER BRIDGE

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER
2.1.11

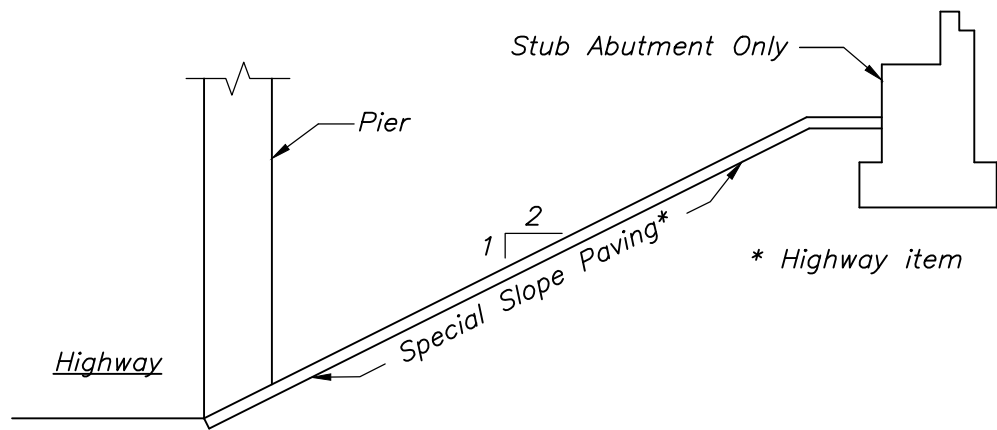


LONGITUDINAL SECTION

SCALE: $\frac{1}{4}" = 1'-0"$

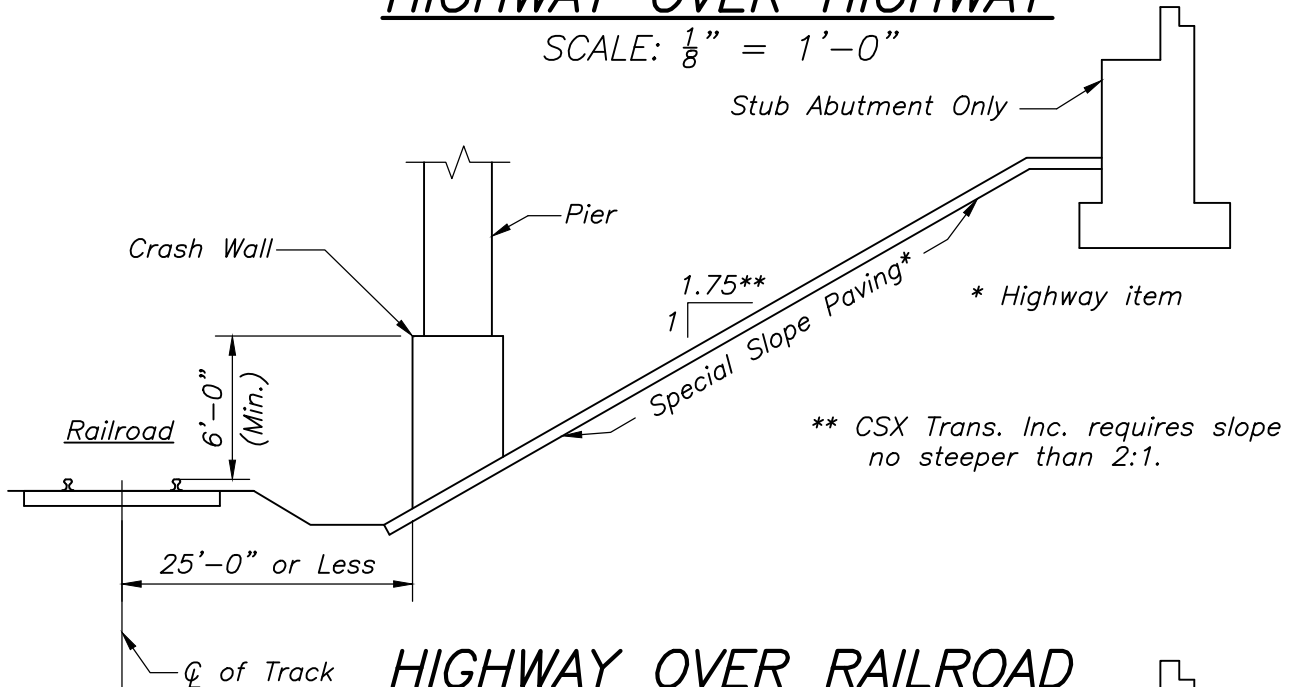
NOTES:

1. Provide excavation support whenever the 2:1 slope line would be disturbed in the placement of the structure. Excavation support must not be closer to track than toe of ballast slope.
2. If elevation of Bottom of Footing falls at or above the 2:1 slope line, excavation support is not required.
3. Excavation support shall be cut off at top of tie during construction. After construction and backfilling is completed, the excavation support within 12'-0" of the track centerline shall be cut off at the top of footing.
4. Excavation support for the protection of railroad shall be designed in accordance with provisions of AREMA specifications. Extent of excavation support shall be dimensioned on plan view of bridge.
5. Excavation support is to be designed for a lateral earth pressure from E-80 vertical loading surcharge plus 50% impact in addition to active earth pressure. The 80 kips surcharge shall be uniformly distributed over the tie length (8'-6") and axle spacing (5'-0"). Horizontal pressure on the excavation support due to the E-80 surcharge shall be determined using the strip load formula shown in the AREMA specifications. Allowable stresses for materials shall be in accordance with AREMA.



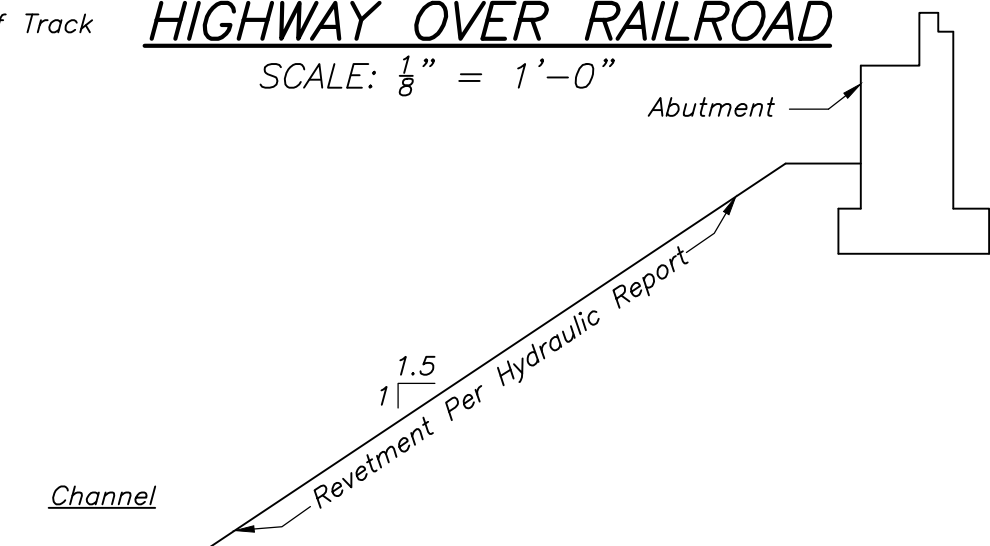
HIGHWAY OVER HIGHWAY

SCALE: $\frac{1}{8}" = 1'-0"$



HIGHWAY OVER RAILROAD

SCALE: $\frac{1}{8}" = 1'-0"$



HIGHWAY OVER RIVER

SCALE: $\frac{1}{8}" = 1'-0"$



LRFD BRIDGE
MANUAL, PART II

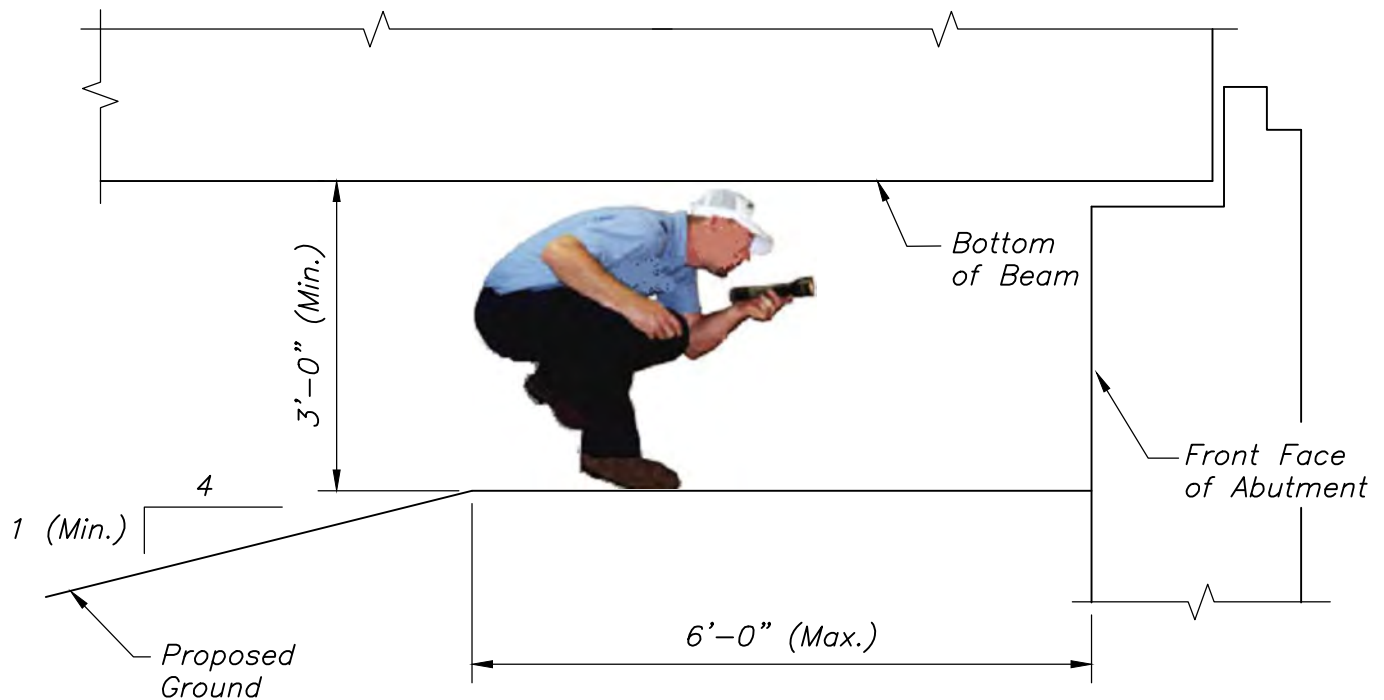
END SPAN SLOPES

CLEARANCES UNDER BRIDGE

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER

2.1.13



ABSOLUTE CLEARANCE REQUIREMENTS
FOR INSPECTION ACCESS OF
NON-STANDARD BRIDGES
 NOT TO SCALE

NOTE:

The above absolute clearances shall be provided in the situations where standard bridge geometry for bridge inspection, as specified in Chapters 3 and 12, can not be satisfied. An example is a bridge spanning over existing abutments.

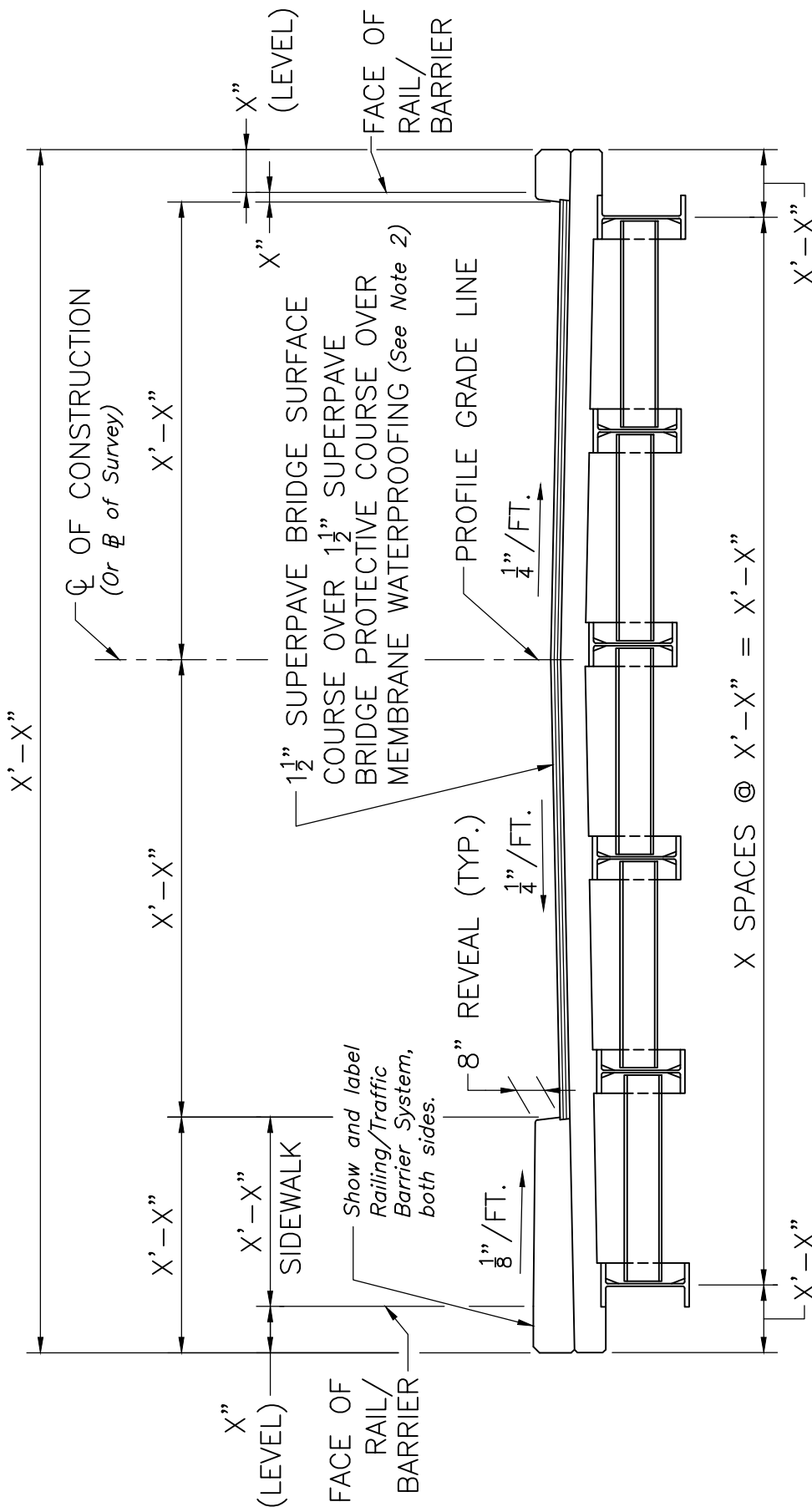


LRFD BRIDGE
MANUAL, PART II

ABSOLUTE CLEARANCES FOR
BRIDGE INSPECTION ACCESS
CLEARANCES UNDER BRIDGE

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER
2.1.14



TRANSVERSE SECTION

SCALE: $\frac{1}{4}$ " = 1'-0"

NOTES:

1. Transverse section shall be drawn to scale on the Construction Drawings. All dimensions and items above shall be included and altered to suit the bridge project. Show and label all utilities. Steel stringer bridge shown as an example.
2. HMA wearing surface shall be placed on all bridges when the profile slope is less than 4%. When the profile slope is greater than 4% or when special conditions may warrant, the Designer shall select exposed deck option.



LRFD BRIDGE

MANUAL, PART II

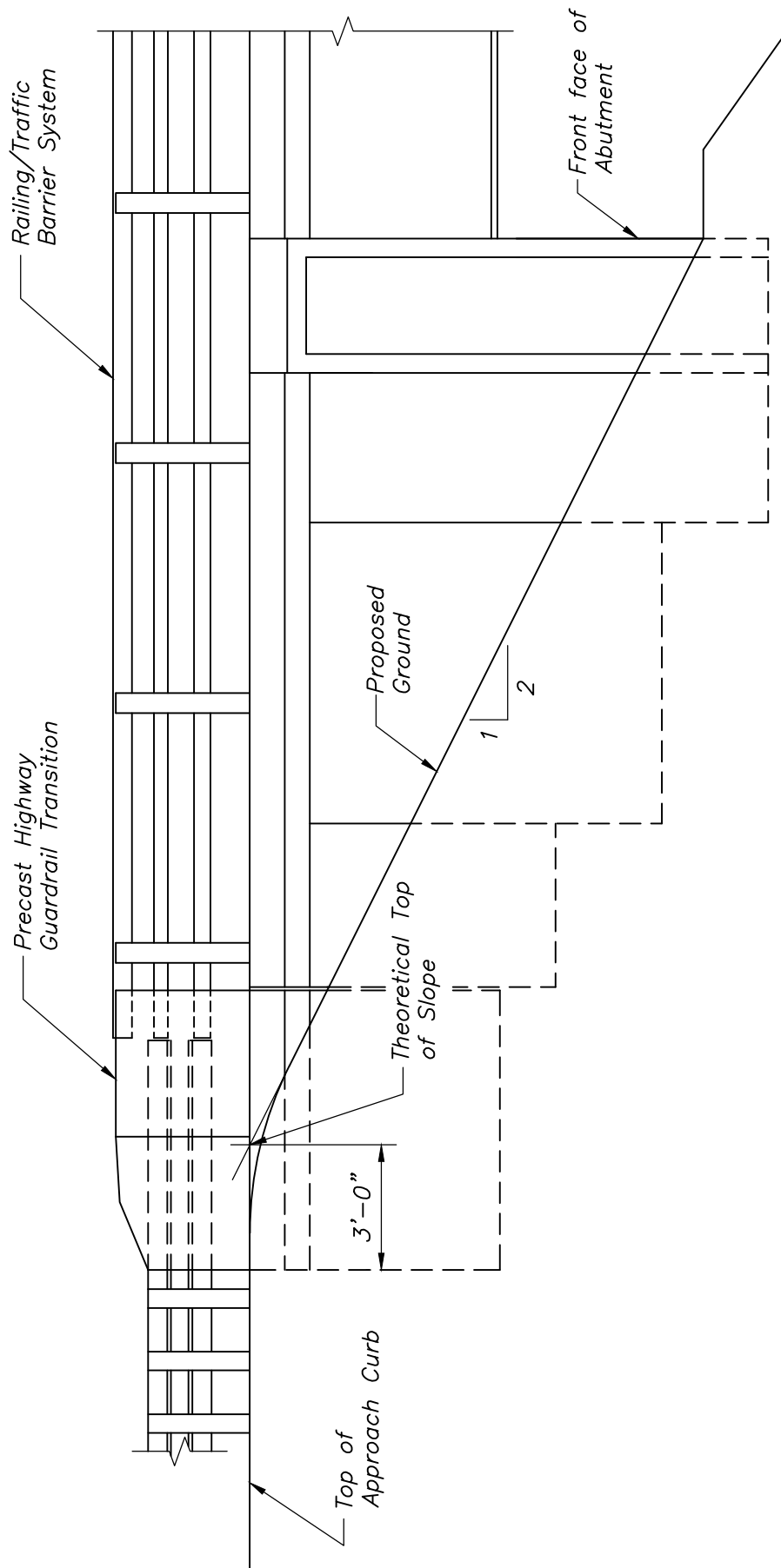
TYPICAL TRANSVERSE SECTION

ROADWAY CROSS SECTION OVER BRIDGE

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER

2.2.1



U-WINGWALL ELEVATION

NOT TO SCALE

NOTES:

1. The above is to be used to calculate the theoretical length of the wingwall.
2. U-Wingwall for non-semi integral abutments is similar, except for curtain wall.



LRFD BRIDGE
MANUAL, PART II

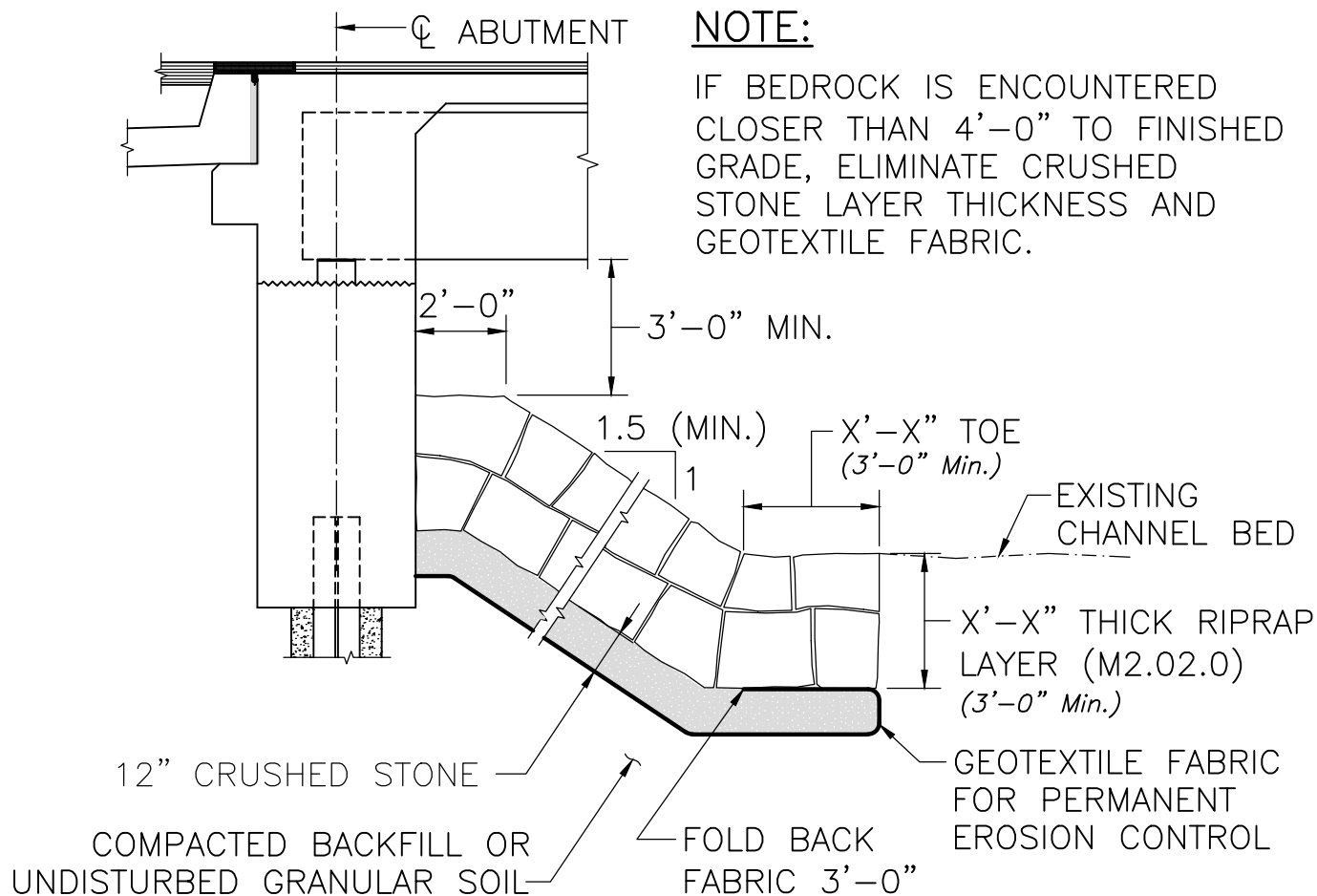
U-WINGWALL LENGTH

WINGWALL GEOMETRY

DATE OF ISSUE
JUNE 2013

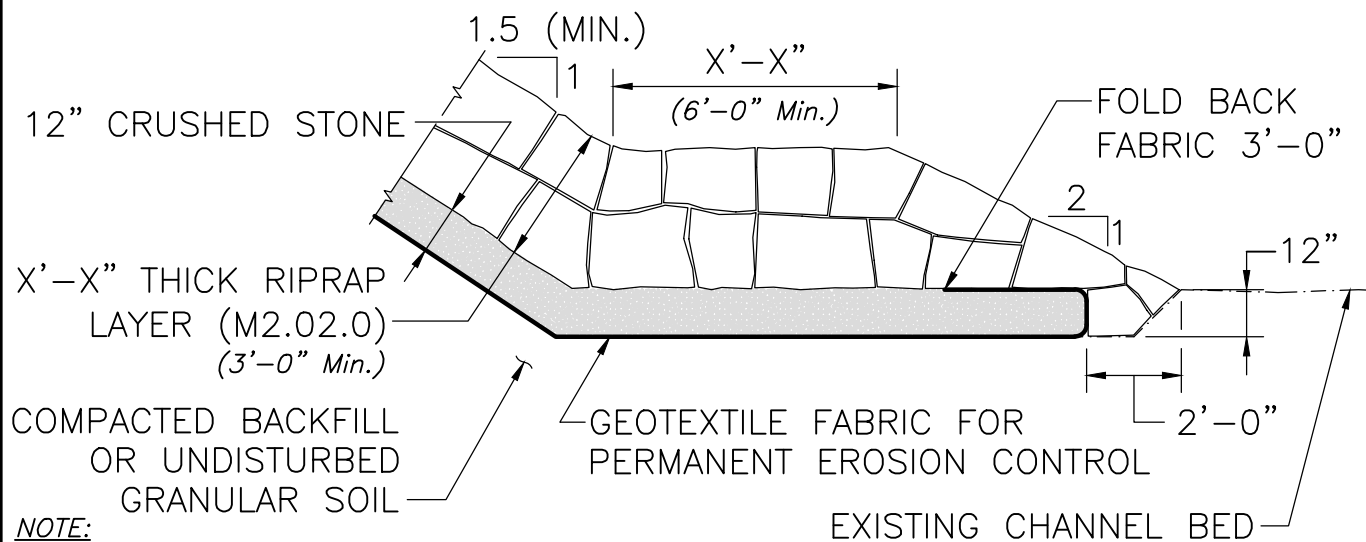
DRAWING NUMBER

2.3.1



RIPRAP DETAIL

SCALE: $\frac{1}{4}" = 1'-0"$



NOTE:

See Note 2 on Dwg. No. 2.4.2

RIPRAP DETAIL WITH TOE ABOVE CHANNEL BED

SCALE: $\frac{1}{4}" = 1'-0"$



LRFD BRIDGE
MANUAL, PART II

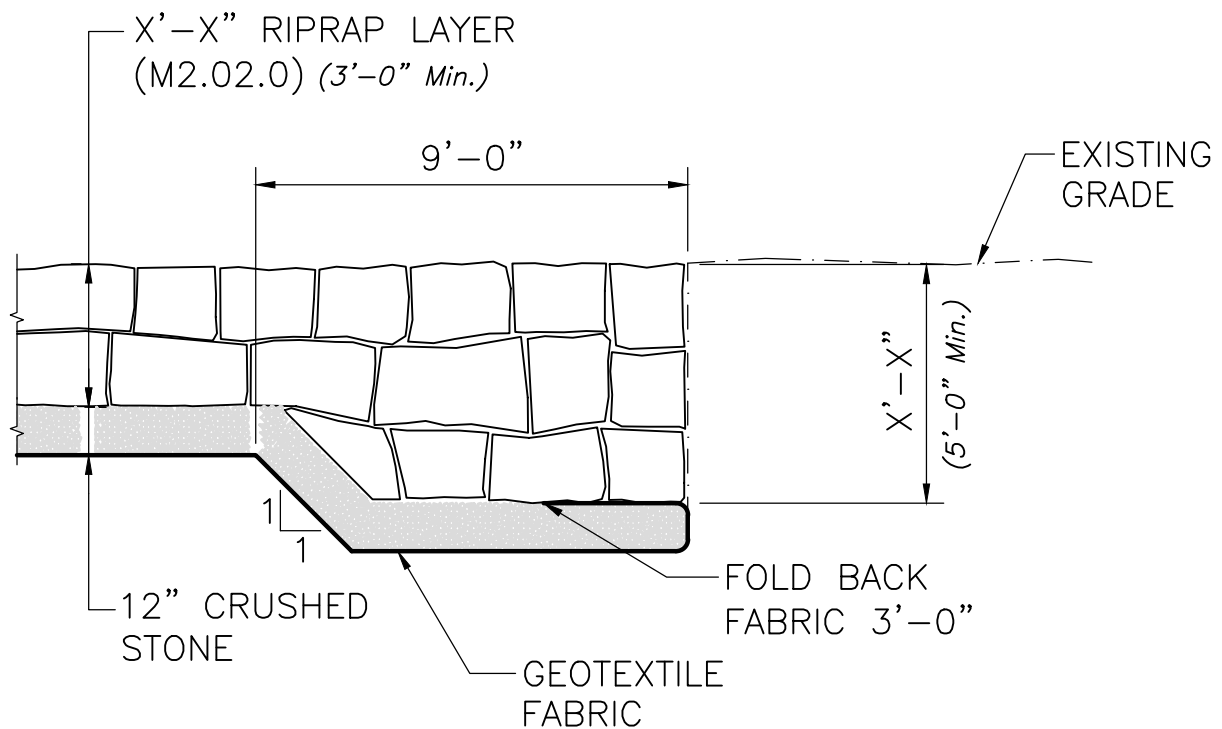
RIPRAP TOE DETAILS

EMBANKMENT PROTECTION

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER

2.4.1



DETAIL AT UPSTREAM/DOWNSTREAM EDGE OF EMBANKMENT

SCALE: $\frac{1}{4}" = 1'-0"$

NOTES:

1. The details presented here should be reviewed and modified to suit site specific details.
2. Two different toe treatments are shown on Dwg. No. 2.4.1. The Designer shall select the most appropriate for the site and show this one on the plans.
3. The riprap detail with toe above the channel bed reduces the quantity of required channel excavation. However, the Engineer needs to evaluate the following drawbacks of this detail:
 - a. The embankment needs to be founded on firm granular material.
 - b. The reduction of the channel cross section needs to be evaluated.
 - c. Since the riprap stone is raised above the channel bed, the stone is subject to a higher water velocity than when level with the top of the channel bed.



LRFD BRIDGE
MANUAL, PART II

RIPRAP EMBANKMENT EDGE

EMBANKMENT PROTECTION

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER

2.4.2