Maine Department of Transportation

Highway Program

Design Guidance

Title: Box Culvert End Slope Treatment	Issue Date: November 15, 2024
Discipline: Highway Engineering	Revised Date:
Originator: Highway Program	
Approved By: Bradford Foley, P.E.	

Background:

The design of slopes around box culvert ends is an important aspect of box culvert design that affects project cost, safety, and long-term maintenance of the culvert. This guidance provides some basic criteria to be used in the design of box culvert end slope treatments.

Guidance:

Guardrail Requirements:

Since guardrail systems can be a hazard, use should always be limited to those situations where the guardrail system is less of a hazard than what is behind it. Considering ways to eliminate or minimize guardrail usage is encouraged. As indicated in Design Guidance – Sideslopes and Backslopes, when the height of fill from the roadway surface to the toe of slope is greater than or equal to twenty feet, guardrail is generally required. Other situations where guardrail should be considered include roadway curvature, crash history, and the presence of existing guardrail.

Mitered Ends:

If guardrail is determined to be necessary, mitering the box culvert ends should be considered. Mitering the box culvert ends reduces the amount of exposed concrete and minimizes the perception of excessive culvert length.

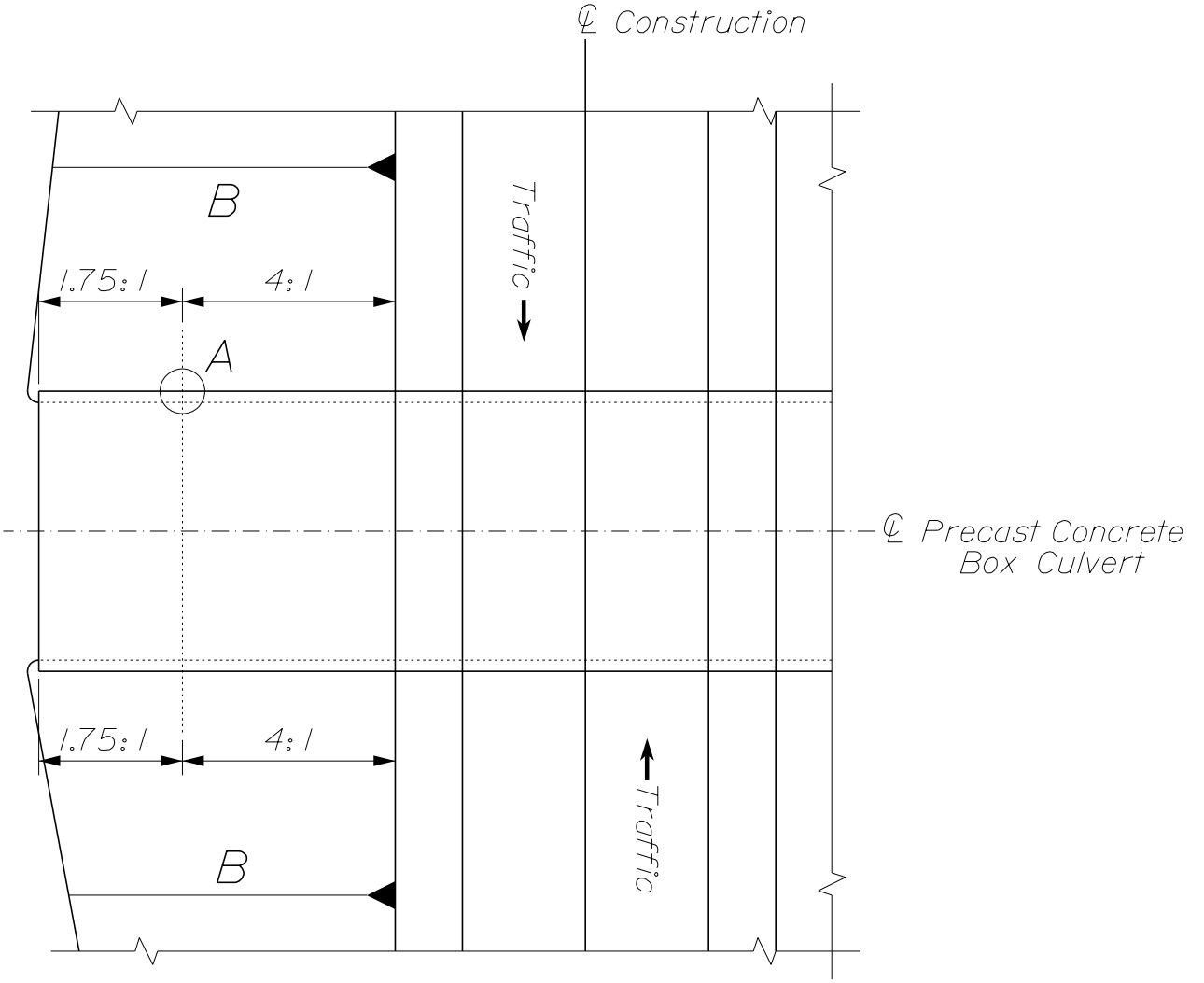
Non-Mitered Ends:

If guardrail is determined to be unnecessary, box culvert ends shall not be mitered. A recoverable slope of 4:1 or flatter will be required at least to the project clear zone. To reduce the amount of exposed concrete and minimize the perception of excessive culvert length, steepen the end treatment slopes to 1.75:1, vary the slopes on top of the box culvert, and consider reducing the box culvert skew.

The following details illustrate the application of these strategies.

(A) Maintain a 4:1 slope to a point 18" above the top of the Precast Concrete Box, and then hinge to 1.75:1.

(B) Transition to the design side slope. Slopes steeper than 2:1 shall be riprapped and discussed with the Geotechnical Engineer.

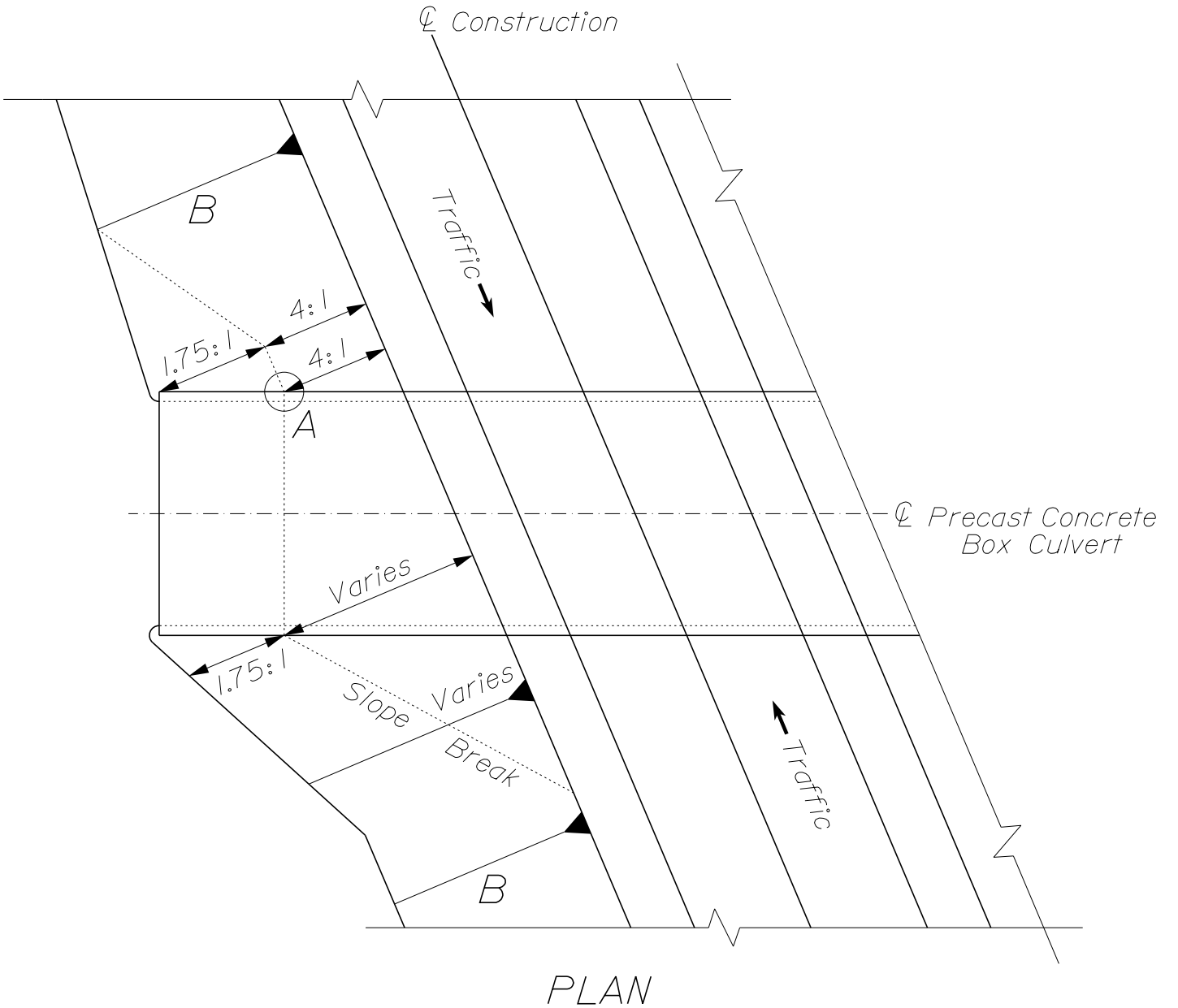


PLAN

PRECAST CONCRETE BOX WITH NO SKEW NON-MITERED END, NO GUARDRAIL

(A) At the closest corner, maintain a 4:1 slope to a point 18" above the top of the Precast Concrete Box, and then hinge to 1.75:1.

(B) Transition to the design side slope. Transition to 3:1 at least 50 feet beyond the last 4:1 slope. Slopes steeper than 2:1 shall be riprapped and discussed with the Geotechnical Engineer.



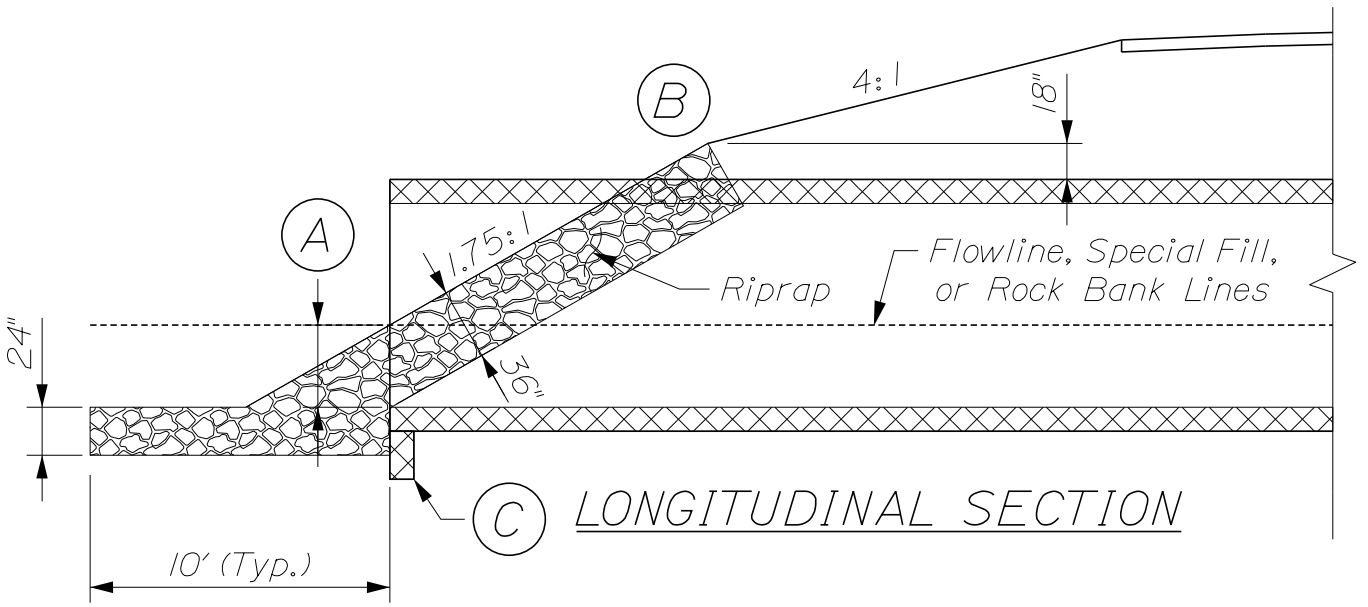
PLAN

PRECAST CONCRETE BOX WITH SKEW NON-MITERED END, NO GUARDRAIL

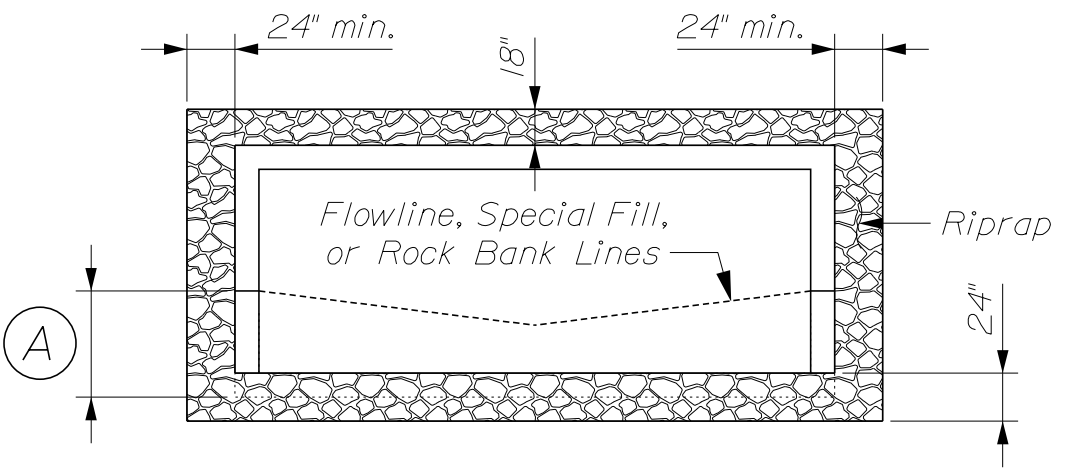
(A) This height will vary depending on where the sideslopes match the invert of the box or special fill or rock bank line elevation.

(B) Maintain a 4:1 slope to a point 18" above the top of the Precast Concrete Box, and then hinge to 1.75:1. Slopes steeper than 2:1 shall be riprapped and discussed with the Geotechnical Engineer.

(C) Concrete toewall, 1 Ft. x 2 Ft.



LONGITUDINAL SECTION



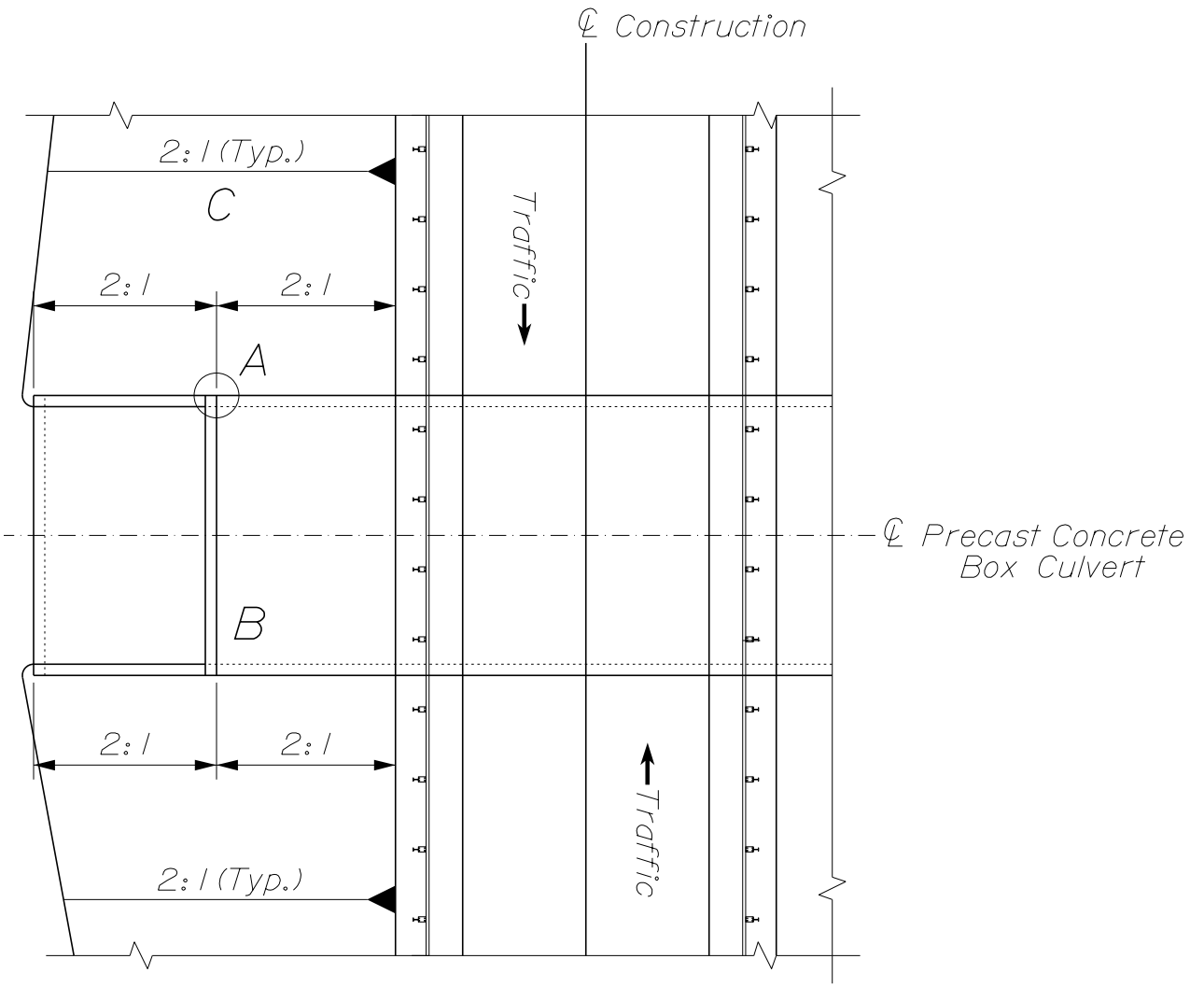
ELEVATION

PRECAST CONCRETE BOX
NON-MITERED END, NO GUARDRAIL

(A) Maintain a 2:1 slope to the top of the Precast Concrete Box, and then maintain a 2:1 slope to the flow line, special fill line, or rock bank line.

(B) Maintain a 6" minimum of fill over the top of the Precast Concrete Box.

(C) Typical sideslope behind guardrail is 2:1. Slopes steeper than 2:1 shall be riprapped and discussed with the Geotechnical Engineer.



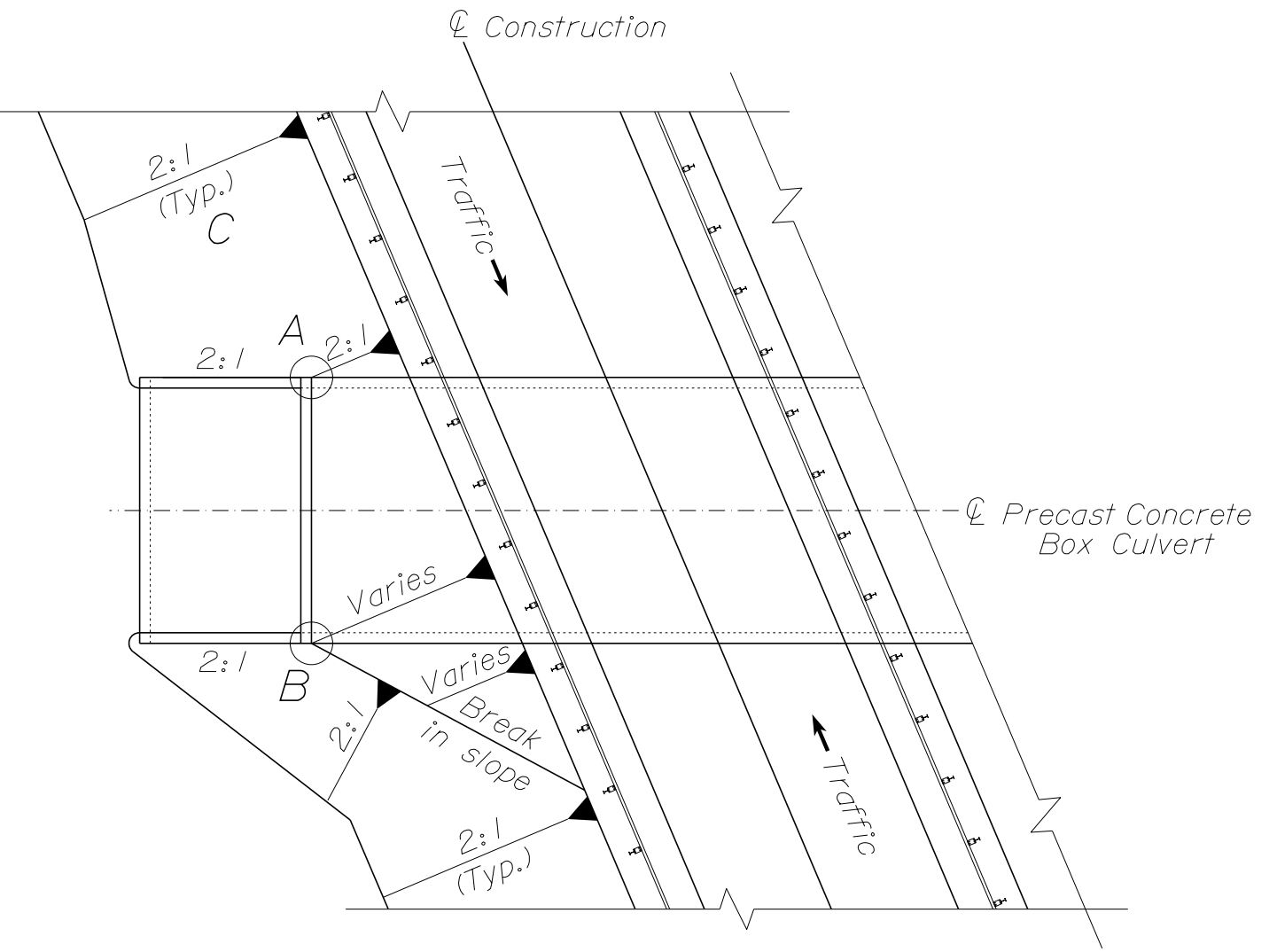
PLAN

PRECAST CONCRETE BOX WITH NO SKEW MITERED END, WITH GUARDRAIL

(A) Maintain a 2:1 slope to the top of the Precast Concrete Box, and then maintain a 2:1 slope to the flow line, special fill line, or rock bank line.

(B) Maintain a 6" minimum of fill over the top of the Precast Concrete Box.

(C) Typical sideslope behind guardrail is 2:1. Slopes steeper than 2:1 shall be riprapped and discussed with the Geotechnical Engineer.



PLAN

PRECAST CONCRETE BOX WITH SKEW MITERED END, WITH GUARDRAIL

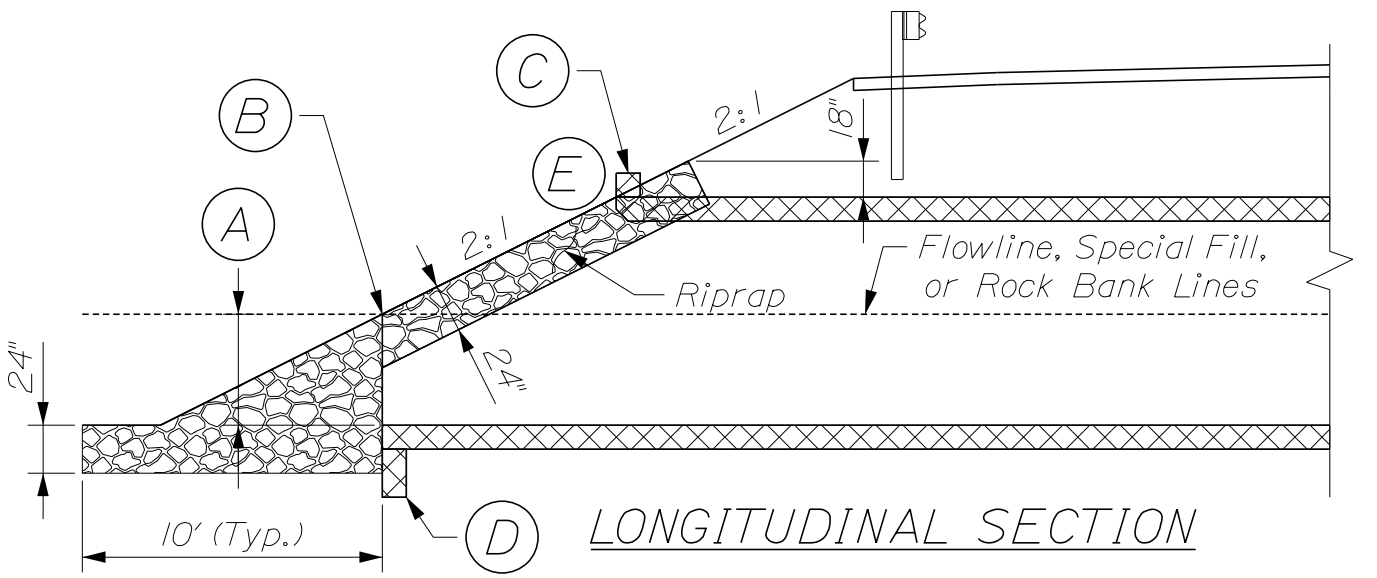
(A) This height will vary depending on where the sideslopes match the invert of the box or special fill or rock bank line elevation.

(B) Sideslope should follow edge of mitered edge if it is riprapped. If granular material is used then the concrete mitered edge should be raised 6" above sideslope.

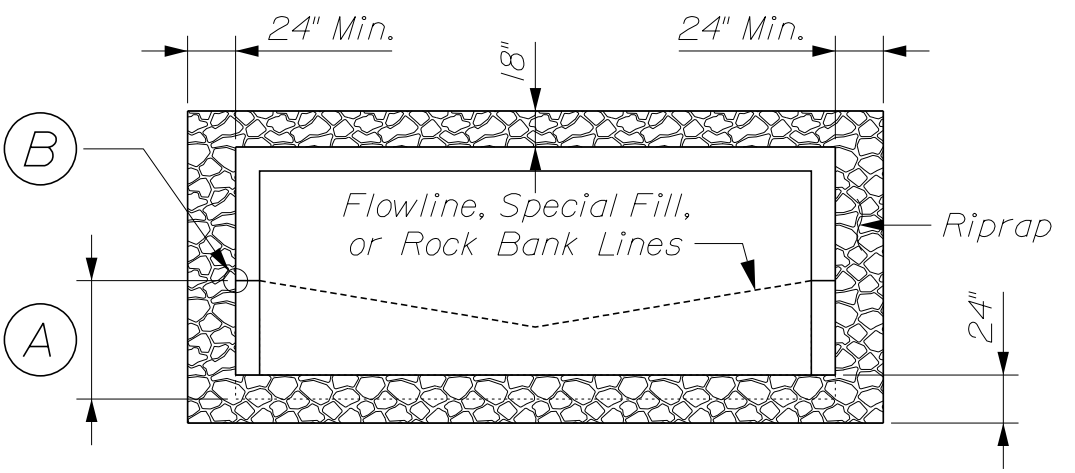
(C) Concrete headwall, 1 Ft. x 1 Ft. Min. Adjust as required to provide a 6" reveal.

(D) Concrete toewall, 1 Ft. x 2 Ft.

(E) Maintain 2:1 slope to the elevation of the top of the Precast Concrete Box, and then maintain a 2:1 slope to the flow line, special fill line, or rock bank line. Slopes steeper than 2:1 shall be riprapped and discussed with the Geotechnical Engineer.



LONGITUDINAL SECTION



ELEVATION

PRECAST CONCRETE BOX MITERED END, WITH GUARDRAIL