E-Stone vs. Stone Fill White Paper

Environmental Stone (E-Stone)

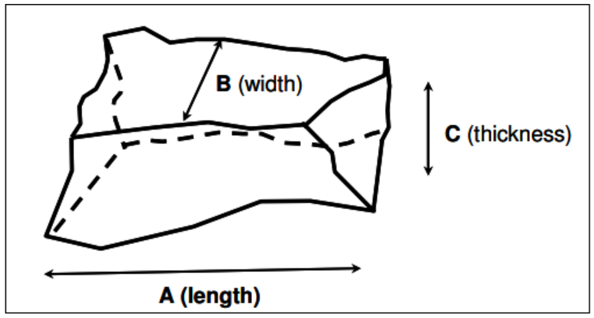


***Figure 1**: General Stone shape described by three axes*

The purpose of E-Stone is to provide a stable channel bottom through the culvert while providing stream simulation for fish and other aquatic organism passage. E-Stone can be used to regrade the channel and/or banks upstream and downstream of the crossing typically below Ordinary High Water (OHW). E-Stone consists of course material and fine material (a gap graded material). The coarse material provides a stable bottom, while the fine material's primary function is to fill the voids to maintain surface water flow, as well as to allow for some sediment transport through the crossing. E-Stone Course material gradation is shown below for reference. Figure 1 can be used to determine the general shape of the E-Stone.

***Table 1:** E-Stone Fill Course Material Gradation (50% of Volume) **

E-Stone Type	Least Dimension (in) (C axis)	D50 (in) (B axis)	Longest Dimension (in) (A axis)	Length to Thickness Ratio, A/C	Embedment/ Thickness (in)
I	12	**12**	18	1.5	18
II	18	**18**	24	1.3	24
III	24	**24**	36	1.5	36
IV	36	**36**	48	1.3	48

*at least 25 percent of the particles shall have a maximum dimension of 2 inches and be well graded material (or streambed material)

Sand Borrow and/or fines may be added to seal the bed and maintain surface water flow

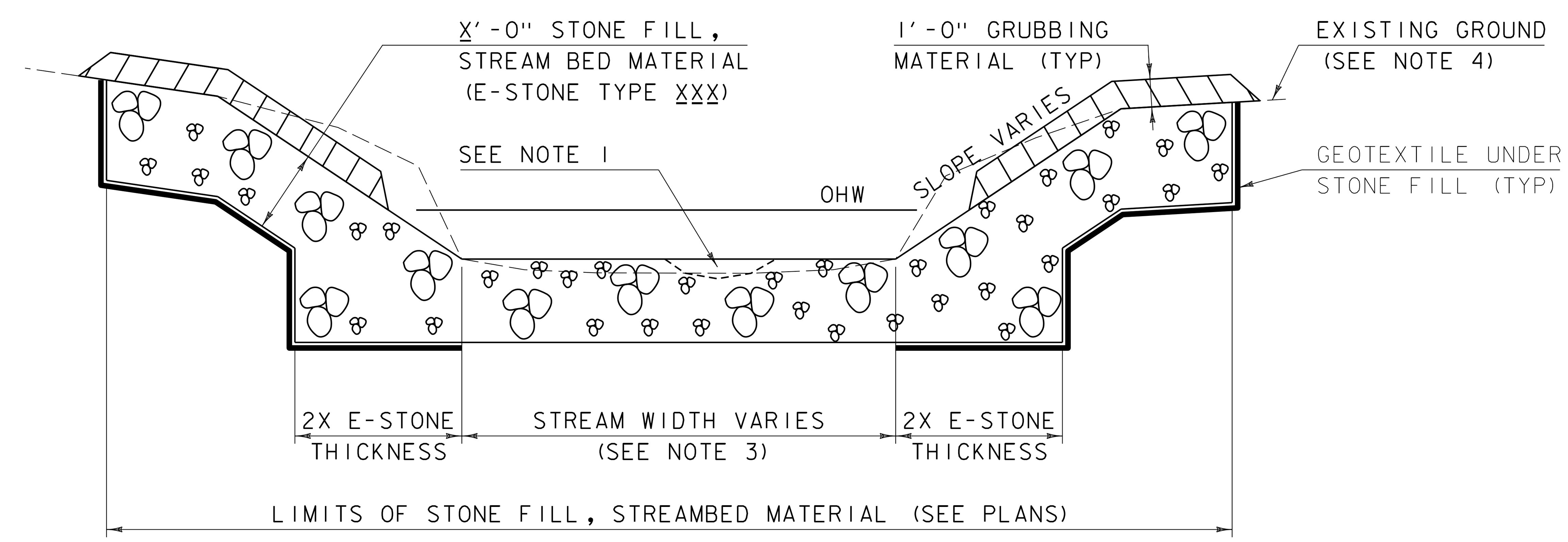
Stone Fill

The main purpose of stone fill is primarily for bank armoring above OHW. For a slope stability project along a river or stream, stone fill type III and IV can also be used as a counterweight/berm to provide resistance to a rotating/sliding mass of material. Stone Fill mostly consists of course material that is not well graded and should not be used for any in channel work as there are not any fines to prevent seepage/subterranean flow. Stone Fill Course material gradation is shown below for reference. Figure 1 can be used to determine the general shape of the Stone Fill Course material.

***Table 2:** Stone Fill Course Material Gradation (50% of Volume) ***

Stone Fill Type	Least Dimension (in) (C axis)	D50 (in) (B axis)	Longest Dimension (in) (A axis)	Remaining 50% shall have longest dimension (in) vary from**:	Embedment/ Thickness (in)
I	4	**6**	12	1 to 12	12
II	12	**12**	36	2 to 36	24
III	16	**18**	48	3 to 48	36
IV	20	**24**	60	3 to 60	48

**Maximum length to thickness ratio, A/C, equal to 3



CHANNEL SECTION: CULVERT TYPE PROJECTS

NOT TO SCALE

NOTES

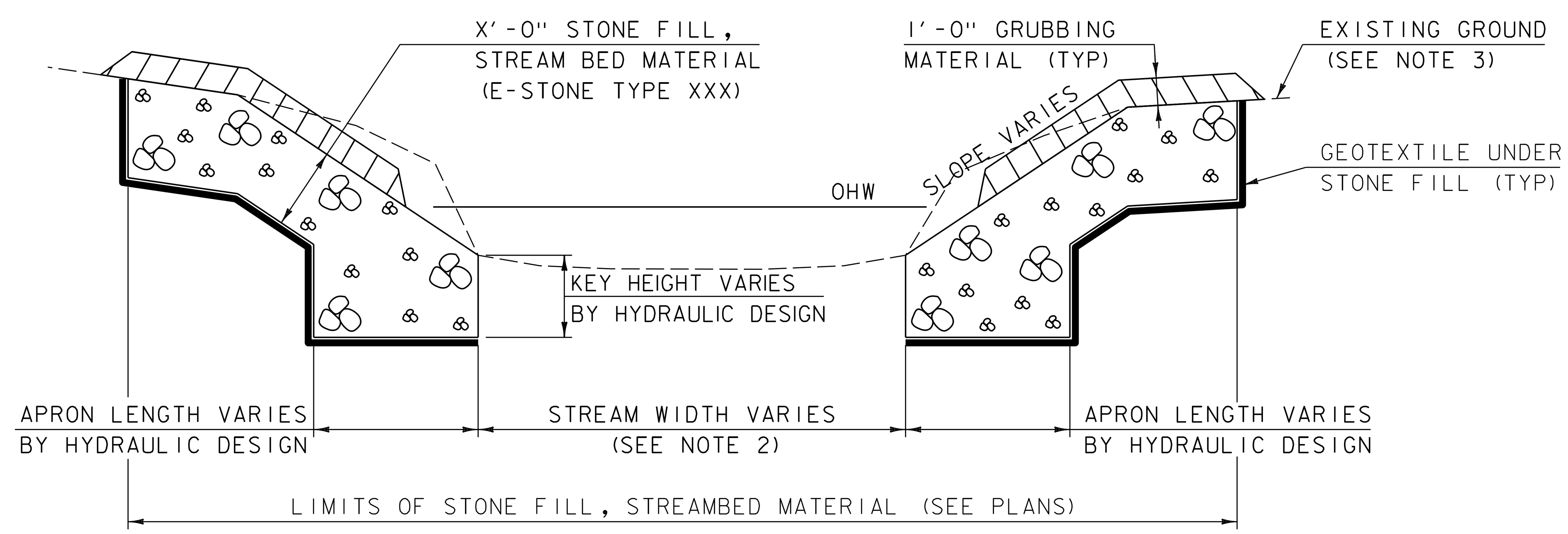
1: AT THE DISCRETION OF THE RESIDENT, A CHANNEL SHOULD BE CONSTRUCTED TO GRADE SIMILARLY TO A NATURAL LOW FLOW CHANNEL.

2: STONE FILL SHOULD BE PLACED OVER THE GEOTEXTILE BY METHODS THAT DO NOT STRETCH, TEAR, PUNCTURE, OR REPOSITION THE FABRIC.

NOTES TO DESIGNER

3: FULL-WIDTH OR PARTIAL-WIDTH ARMORING, VARIES BY HYDRAULIC DESIGN.

4: STONE FILL LIMITS ARE NOT SHOWN FOR CLARITY. STONE FILL LIMITS ARE TO BE DETERMINED BY DESIGNER ABOVE OHW. E-STONE MAY BE USED IN PLACE OF STONE FILL.



CHANNEL SECTION: BRIDGE TYPE PROJECTS

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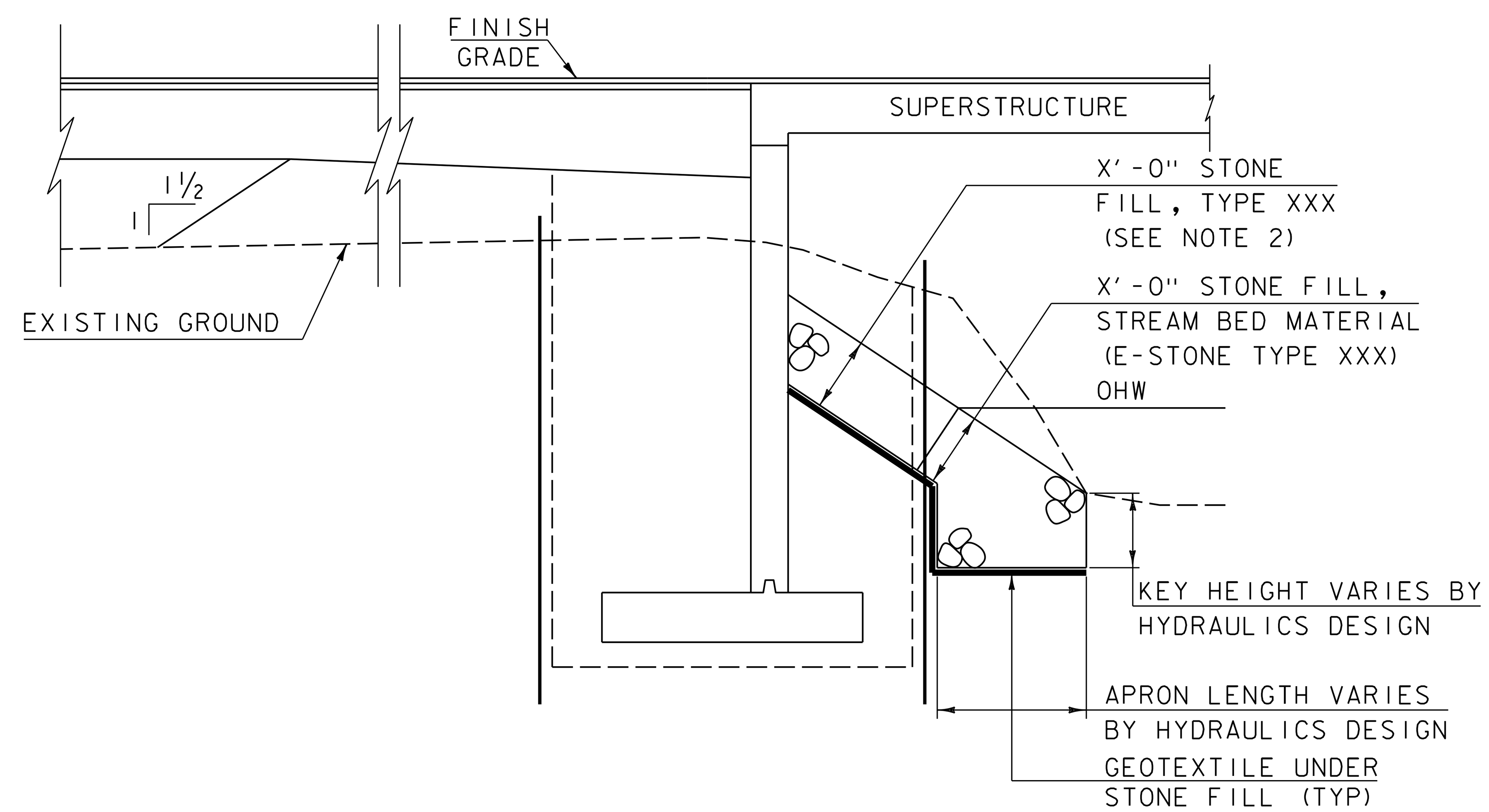

COFFERDAM AND EARTHWORK SECTION

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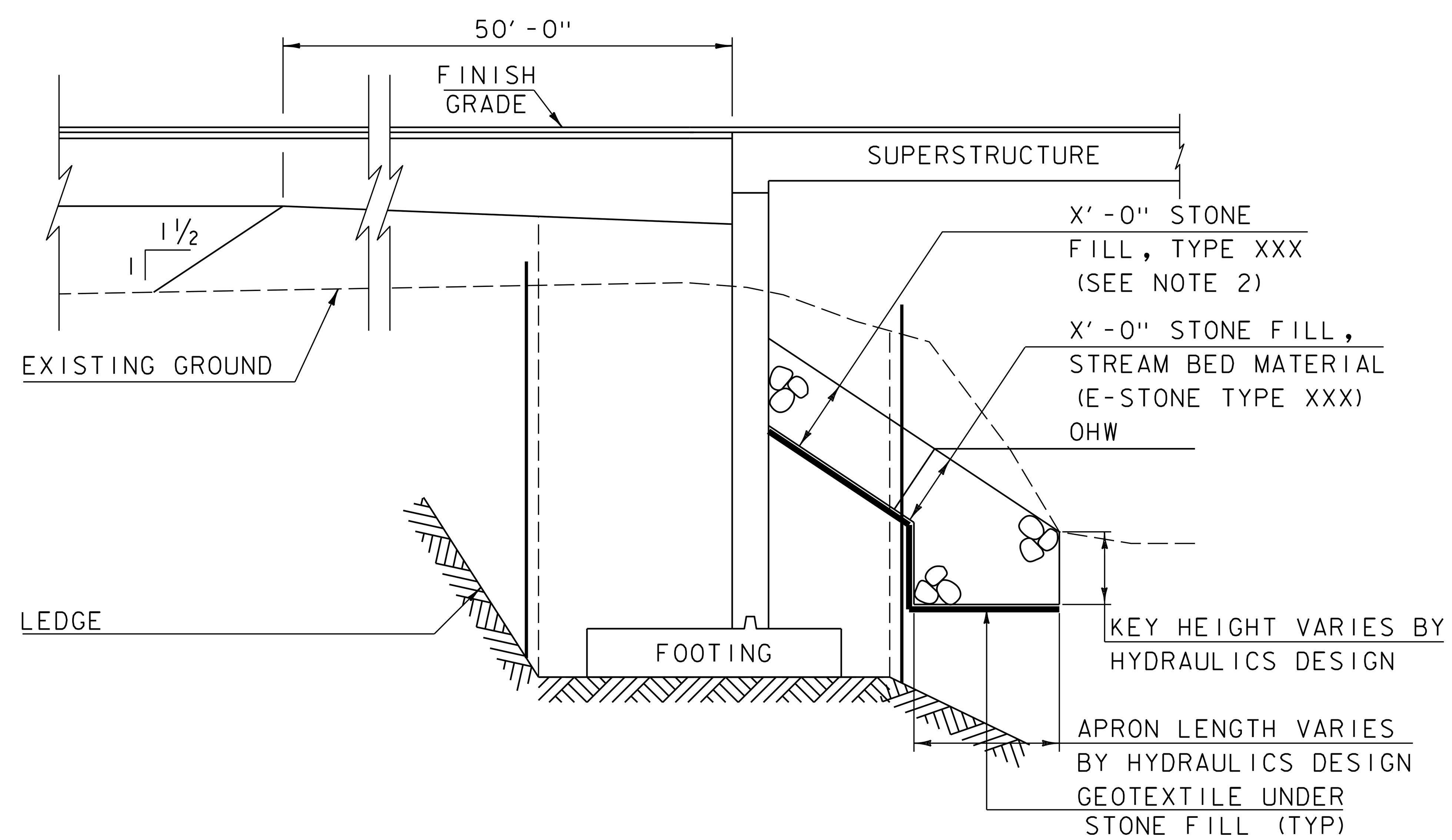

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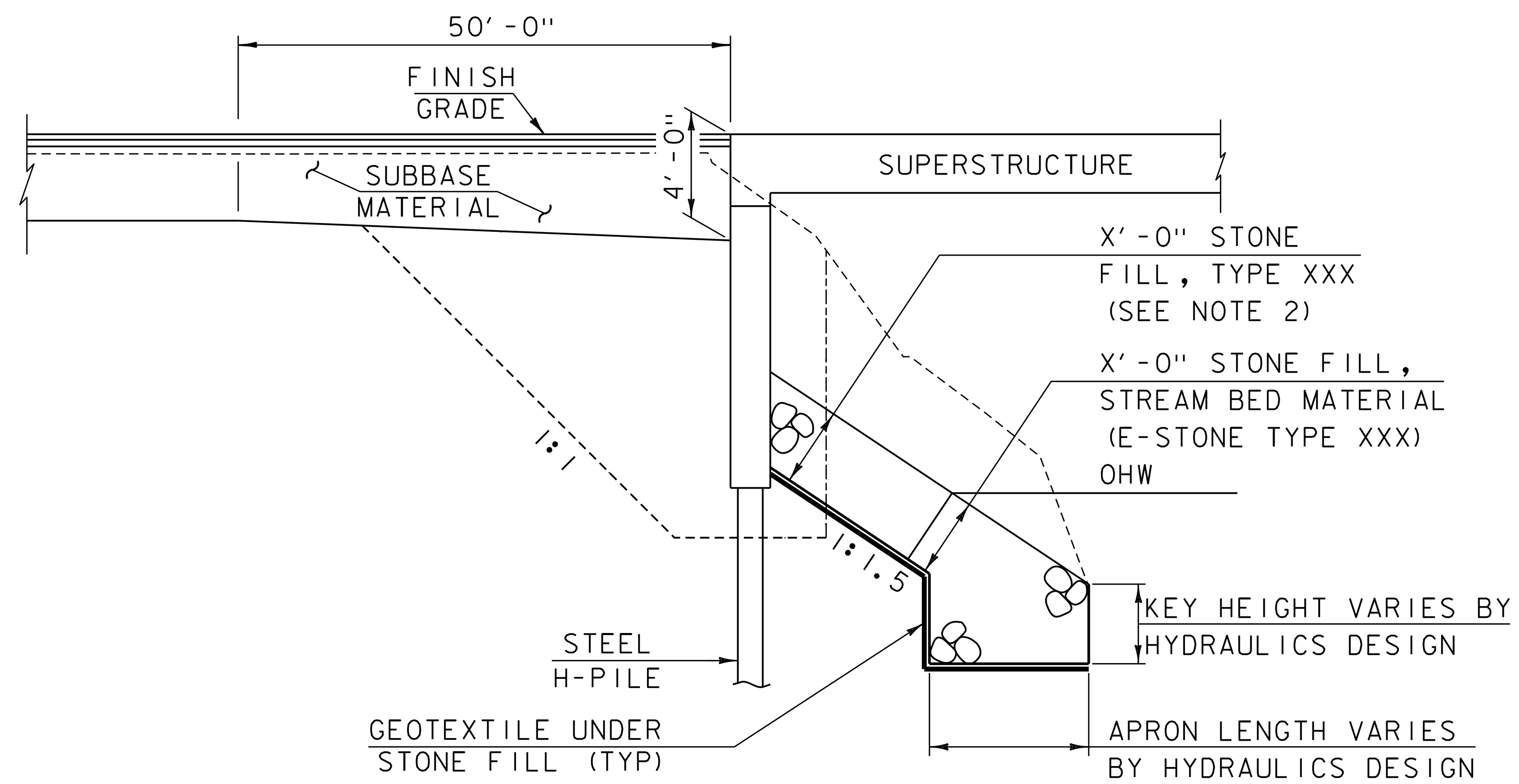

EARTHWORK TYPICAL SECTION

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