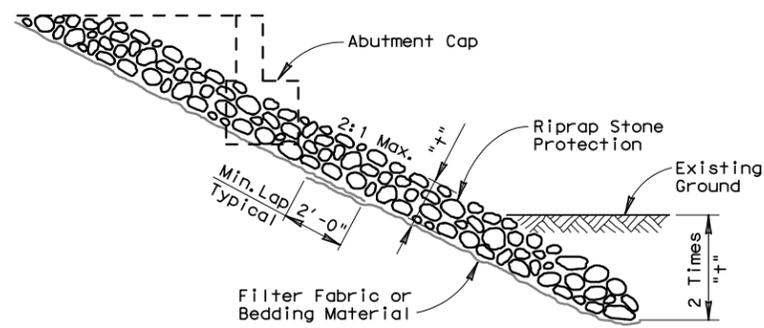
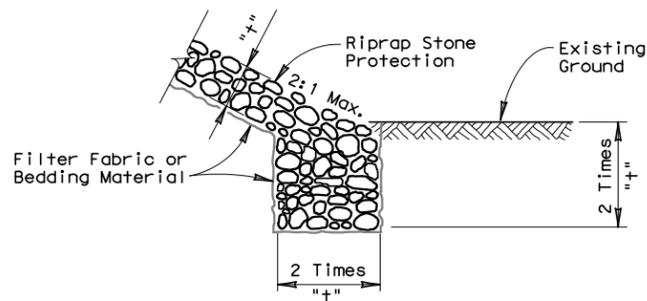


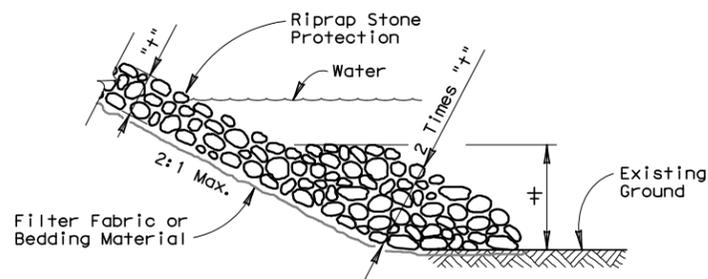
EMBANKMENT



TOE DETAIL ①

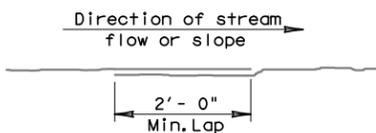


TOE DETAIL ① (ALTERNATE)



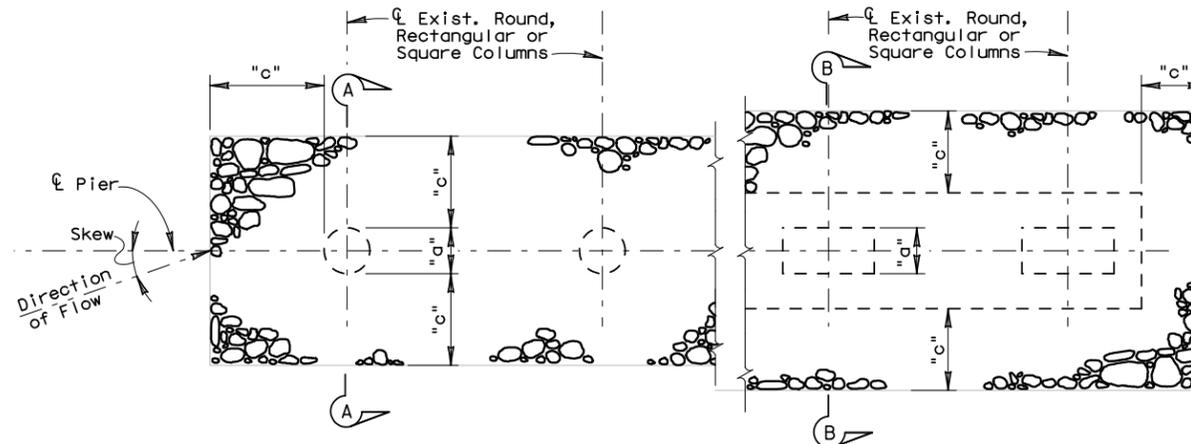
TOE DETAIL ① UNDER WATER

‡ 2 times the thickness ("t") or maximum expected scour considering site history if available.



FILTER FABRIC LAP

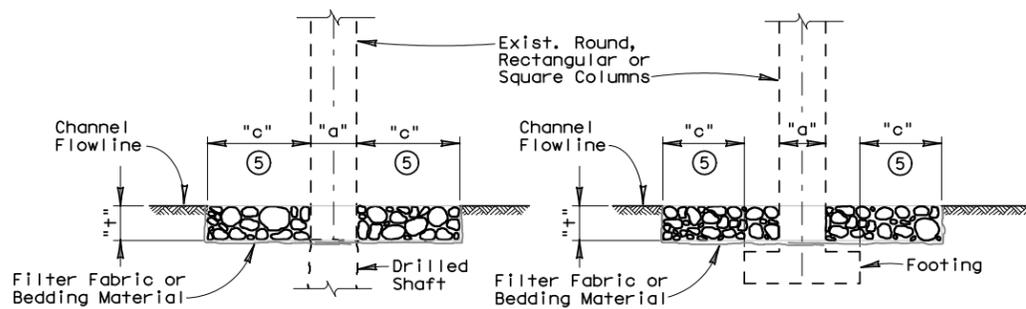
PIER



COLUMN ON DRILLED SHAFT OR PILING

COLUMN ON SPREAD FOOTING

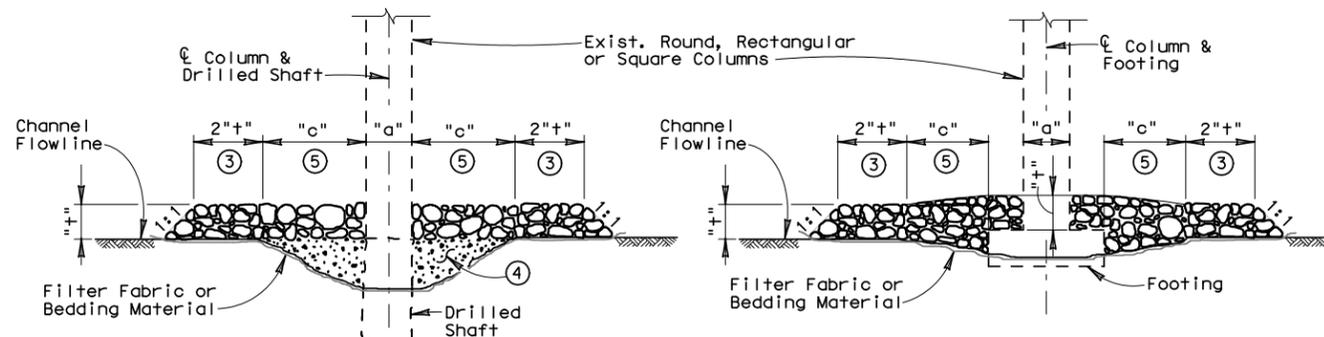
PLAN VIEW



SECTION A-A

SECTION B-B

ELEVATION



SECTION A-A

SECTION B-B

ELEVATION UNDER WATER OR SCOUR CRITICAL

NOTES:

- ① Toe required at all boundaries of stone protection except where placed next to a structure such as an abutment or pier.
- ② Bedding material is not required if filter fabric is used. Filter Fabric will be Type 2 (6 oz/sy) as per DMS 6200.
- ③ In areas where excavation in the channel will exacerbate scour, an additional width of stone protection is required as shown.
- ④ Scour damage may be filled with a material having a gradation equal to the bedding material but will not be more coarse than stone protection being placed, as specified in item 432 "RIPRAP", approval of the engineer is required.
- ⑤ Surface of stone protection will slope away from the pier, but not exceed 2:1.

GENERAL NOTES:

Refer to item 432 for the gradation of stone protection and bedding material, alternate gradations are not permitted. Placement of stone protection will not be performed in a manner that will cause segregation such as dumping or pushing material in place.

See Layout for limits and thickness of riprap specified, design table provided below is a guide for the designer. All work will be performed in accordance with item 432.

DESIGN TABLE:

Minimum specific gravity for stone protection is 2.40
Minimum thickness permissible is 12 inches, channel velocities (V) for a given thickness and gradation will not exceed the limits indicated in the table below.

- "t" = Thickness of revetment
- "a" = Column width
- Skew = Angle between direction of flow and center of pier
- "c" = $2"a"/\cos(\text{skew})$
- "v" = Stream velocity

		REVETMENT TYPE	
ABUTMENT OR CHANNEL BANK		PIER	
		RECT. NOSE	ROUND NOSE
"t" in.	"v" (max.) ft/s	"v" (max.) ft/s	"v" (max.) ft/s
12	5.8	6.0	6.8
15	6.5	6.8	7.7
18	7.1	7.2	8.2
21	7.7	7.7	8.7
24	8.2	7.8	8.8
30	9.2	9.1	10.3

SAN ANTONIO DISTRICT STANDARD



**FLEXIBLE RIPRAP
STONE PROTECTION
EMBANKMENTS
AND PIERS**

FRR (SP)

T:\Engdata\Standards\StoneProtect.dgn		PREPARED BY AND FOR USE OF TxDOT.			
ORIGINAL DRAWING DATE:	SEPT. 2007	STATE DISTRICT:	FEDERAL REGION:	FEDERAL AID PROJECT:	SHEET:
DN. JHK		SAT	6		
CK. JGD	09-01-08	REVISIONS:			
DW. MRM				COUNTY:	CONTROL SECTION JOB HIGHWAY
CK. JHK					