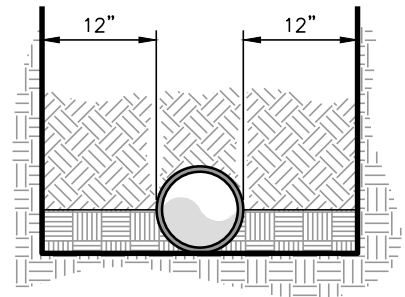


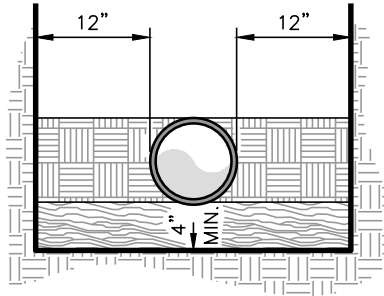
TYPE 1

FLAT BOTTOM TRENCH WITH LOOSE DIRT (FLAT BOTTOM IS DEFINED AS UNDISTURBED EARTH)



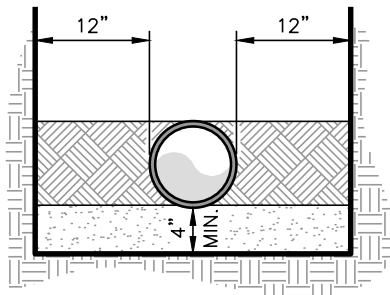
TYPE 2

FLAT BOTTOM TRENCH WITH BACKFILL LIGHTLY CONSOLIDATED TO CENTERLINE OF PIPE (FLAT BOTTOM IS DEFINED AS UNDISTURBED EARTH)



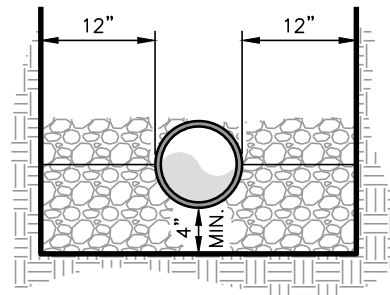
TYPE 3

PIPE BEDDED IN 4" MINIMUM LOOSE SOIL WITH BACKFILL LIGHTLY CONSOLIDATED TO TOP OF PIPE (LOOSE SOIL IS DEFINED AS NATIVE SOIL EXCAVATED FROM THE TRENCH, FREE OF ROCKS, ORGANIC MATERIAL, FOREIGN MATERIALS AND FROZEN EARTH)



TYPE 4

PIPE BEDDED IN SAND, GRAVEL, OR CRUSHED STONE TO A DEPTH OF $\frac{1}{8}$ PIPE DIAMETER, 4" MINIMUM WITH BACKFILL COMPACTED TO TOP OF PIPE (APPROXIMATELY 80% STANDARD PROCTOR, AASHTO T-99)



TYPE 5

PIPE BEDDED TO IT'S CENTERLINE IN COMPACTED GRANULAR MATERIAL, 4" MINIMUM UNDER PIPE. COMPACTED GRANULAR OR SELECT MATERIAL TO TOP OF PIPE. (APPROXIMATELY 90% STANDARD PROCTOR, AASHTO T-99) (SELECT MATERIAL IS DEFINED AS NATIVE SOIL EXCAVATED FROM THE TRENCH, FREE OF ROCKS, ORGANIC MATERIAL, FOREIGN MATERIALS AND FROZEN EARTH)

NOTES:

1. FOR NORMAL WATER PIPE SIZES 14" AND LARGER, CONSIDERATION SHOULD BE GIVEN TO THE USE OF LAYING CONDITIONS OTHER THAN TYPE 1.
2. CONSIDERATION OF THE PIPE-ZONE EMBEDMENT CONDITIONS INCLUDED IN THIS FIGURE MAY BE INFLUENCED BY FACTORS OTHER THAN PIPE STRENGTH. FOR ADDITIONAL INFORMATION ON PIPE BEDDING AND BACKFILL, SEE ANSI/AWWA C600.



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TABLE 10.7 - DESCRIPTION OF MATERIAL CLASSIFICATION (AS DEFINED IN ASTM D2321)

CLASS	TYPE	SOIL SYMBOL GROUP	DESCRIPTION ASTM D 2487	PERCENTAGE PASSING SIEVE SIZES			ATTERBREG LIMITS		COEFFICIENTS	
				1.5 in (40 mm)	NO. 4 (4.75 mm)	NO. 200 (0.075 mm)	LL	PL	UNIFORMITY Cu	CURVATURE Cc
IA	MANUFACTURED AGGREGATES: OPEN GRADED, CLEAN	NONE	ANGULAR, CRUSHED STONE OR ROCK, CRUSHED GRAVEL, BLENDED CORALS, SLAG, CHINDERS OR SHELLS; LARGE, VOID CONTENT; CONTAIN LITTLE OR NO FINES	100	≤10%	<5	NON PLASTIC			
IB	MANUFACTURED PROCESSED AGGREGATES: DENSE GRADED, CLEAN	NONE	ANGULAR, CRUSHED STONE (OR OTHER CLASS IA MATERIALS) AND STONE/SAND MIXTURES WITH GRADATIONS SELECTED TO MINIMIZE MIGRATION OF ADJACENT SOILS; CONTAIN LITTLE OR NO FINES	100	≤50%	<5	NON PLASTIC			
II	COARSE-GRAINED SOILS, CLEAN	GW	WELL-GRADED GRAVELS AND GRAVEL-SAND MIXTURES; LITTLE OR NO FINES	100	<50% OF COARSE FRACTION	<5	NON PLASTIC		>4	1 TO 3
		GP	POORLY-GRADED GRAVELS AND GRAVEL-SAND MIXTURES; LITTLE OR NO FINES						<4	<1 OR >3
		SW	WELL-GRADED SANDS AND GRAVELLY SANDS; LITTLE OR NO FINES		>50% OF COARSE FRACTION				>6	1 TO 3
		SP	POORLY-GRADED SANDS AND GRAVELLY SANDS; LITTLE OR NO FINES						<6	<1 TO >3
	COARSE-GRAINED SOILS, BORDERLINE CLEAN TO W/FINES	e.g. GW-GC, SP-SM	SANDS AND GRAVELS WHICH ARE BORDERLINE BETWEEN CLEAN AND WITH FINES	100	VARIES	5% TO 12%	NON PLASTIC		SAME AS FOR GW, GP, SW AND SP	
III	COARSE-GRAINED SOILS WITH FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	100	>50% OF COARSE FRACTION	>12% TO <50%		<4 OR <"A" LINE		
		GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES					<7 OR >"A" LINE		
		SM	SILTY SANDS, SAND-SILT MIXTURES		>50% OF COARSE FRACTION			>4 OR <"A" LINE		
		SC	CLAYEY SANDS, SAND-SILT MIXTURES					>7 OR >"A" LINE		
IV	FINE-GRAINED SOILS (INORGANIC)	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY	100	100	>50	<50	<4 OR <"A" LINE		
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVEL CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS					>7 OR >"A" LINE		
IVB	FINE-GRAINED SOILS (INORGANIC)	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, SILTY SOILS, ELASTIC SILTS	100	100	>50	>50	<"A" LINE		
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS					>"A" LINE		
V	ORGANIC SOILS	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	100	100	>50	<50	<4 OR <"A" LINE		
		OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS				>50	<"A" LINE		
	HIGHLY ORGANIC	PT	PEAT AND OTHER HIGH ORGANIC SOILS							



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TABLE 10.8
RECOMMENDATIONS FOR INSTALLATION AND USE OF SOILS AND AGGREGATES FOR FOUNDATION, EMBEDMENT AND BACKFILL

SOIL CLASS (SEE TABLE 10.7)					
	CLASS IA	CLASS IB	CLASS II	CLASS III	CLASS IV-A
GENERAL RECOMMENDATIONS AND RESTRICTIONS	DO NOT USE WHERE CONDITIONS MAY CAUSE MIGRATION OF FINES FROM ADJACENT SOIL AND LOSS OF PIPE SUPPORT. SUITABLE FOR USE AS A DRAINAGE BLANKET AND UNDERDRAIN IN ROCK CUTS WHERE ADJACENT MATERIAL IS SUITABLY GRADED.	PROCESS MATERIALS AS REQUIRED TO OBTAIN GRADATION WHICH WILL MINIMIZE MIGRATION OF ADJACENT MATERIALS. SUITABLE FOR USE AS DRAINAGE BLANKET AND UNDERDRAIN.	WHERE HYDRAULIC GRADIENT EXISTS CHECK GRADATION TO MINIMIZE MIGRATION. "CLEAN" GROUPS SUITABLE FOR USE AS DRAINAGE BLANKET AND UNDERDRAIN.	DO NOT USE WHERE WATER CONDITIONS IN TRENCH MAY CAUSE INSTABILITY.	OBTAIN GEOTECHNICAL EVALUATION OF PROPOSED MATERIAL. MAY NOT BE SUITABLE UNDER HIGH EARTH FILLS. SURFACE APPLIED WHEEL LOADS AND UNDER HEAVY VIBRATORY COMPACTORS AND TAMPERS. DO NOT USE WHERE WATER CONDITIONS IN TRENCH MAY CAUSE INSTABILITY.
FOUNDATION	SUITABLE AS FOUNDATION AND FOR REPLACING OVER-EXCAVATED AND UNSTABLE TRENCH BOTTOM AS RESTRICTED ABOVE. INSTALL AND COMPACT IN 6" MAXIMUM LAYERS.	SUITABLE AS FOUNDATION AND FOR REPLACING OVER-EXCAVATED AND UNSTABLE TRENCH BOTTOM AND COMPACT IN 6" MAXIMUM LAYERS.	SUITABLE AS FOUNDATION AND FOR REPLACING OVER-EXCAVATED AND UNSTABLE TRENCH BOTTOM AS RESTRICTED ABOVE. INSTALL AND COMPACT IN 6" MAXIMUM LAYERS.	SUITABLE AS FOUNDATION AND FOR REPLACING OVER-EXCAVATED AND UNSTABLE TRENCH BOTTOM AS RESTRICTED ABOVE. DO NOT USE IN THICKNESS GREATER THAN 12" TOTAL INSTALL AND COMPACT IN 6" MAXIMUM LAYERS.	SUITABLE ONLY IN UNDISTURBED CONDITION AND WHERE TRENCH IS DRY. REMOVE ALL LOOSE MATERIAL AND PROVIDE FIRM, UNIFORM TRENCH BOTTOM BEFORE BEDDING IS PLACED.
BEDDING	SUITABLE AS RESTRICTED ABOVE. INSTALL IN 6" MAXIMUM LAYERS. LEVEL FINAL GRADE BY HAND. MINIMUM DEPTH 4". (6" IN ROCK CUTS).	INSTALL AND COMPACT IN 6" MAXIMUM LAYERS. LEVEL FINAL GRADE BY HAND. MINIMUM DEPTH 4". (6" IN ROCK CUTS).	SUITABLE AS RESTRICTED ABOVE. INSTALL AND COMPACT IN 6" MAXIMUM LAYERS. LEVEL FINAL GRADE BY HAND. MINIMUM DEPTH 4". (6" IN ROCK CUTS).	SUITABLE ONLY IN DRY TRENCH CONDITIONS. INSTALL AND COMPACT IN 6" MAXIMUM LAYERS. LEVEL FINAL GRADE BY HAND. MINIMUM DEPTH 4". (6" IN ROCK CUTS).	SUITABLE ONLY IN DRY TRENCH CONDITIONS AND WHEN OPTIMUM PLACEMENT AND COMPACTION CONTROL IS MAINTAINED. INSTALL AND COMPACT IN 6" MAXIMUM LAYERS. LEVEL FINAL GRADE BY HAND. MINIMUM DEPTH 4". (6" IN ROCK CUTS).
HAUNCHING	SUITABLE AS RESTRICTED ABOVE. INSTALL IN 6" MAXIMUM LAYERS. WORK IN AROUND PIPE BY HAND TO PROVIDE UNIFORM SUPPORT.	INSTALL AND COMPACT IN 6" MAXIMUM LAYERS. WORK IN AROUND PIPE BY HAND TO PROVIDE UNIFORM SUPPORT.	SUITABLE AS RESTRICTED ABOVE. INSTALL AND COMPACT IN 6" MAXIMUM LAYERS. WORK IN AROUND PIPE BY HAND TO PROVIDE UNIFORM SUPPORT.	SUITABLE AS RESTRICTED ABOVE. INSTALL AND COMPACT IN 6" MAXIMUM LAYERS. WORK IN AROUND PIPE BY HAND TO PROVIDE UNIFORM SUPPORT.	SUITABLE ONLY IN DRY TRENCH CONDITIONS AND WHEN OPTIMUM PLACEMENT AND COMPACTION CONTROL IS MAINTAINED. INSTALL AND COMPACT IN 6" MAXIMUM LAYERS. WORK IN AROUND PIPE BY HAND TO PROVIDE UNIFORM SUPPORT.
INITIAL BACKFILL	SUITABLE AS RESTRICTED ABOVE. INSTALL TO A MINIMUM OF 6" ABOVE PIPE CROWN.	INSTALL AND COMPACT TO A MINIMUM OF 6" ABOVE PIPE CROWN.	SUITABLE AS RESTRICTED ABOVE. INSTALL AND COMPACT TO A MINIMUM OF 6" ABOVE PIPE CROWN.	SUITABLE AS RESTRICTED ABOVE. INSTALL AND COMPACT TO A MINIMUM OF 6" ABOVE PIPE CROWN.	SUITABLE AS RESTRICTED ABOVE. INSTALL AND COMPACT TO A MINIMUM OF 6" ABOVE PIPE CROWN.
FINAL BACKFILL	COMPACT AS REQUIRED BY ENGINEER.	COMPACT AS REQUIRED BY ENGINEER.	COMPACT AS REQUIRED BY ENGINEER.	COMPACT AS REQUIRED BY ENGINEER.	SUITABLE AS RESTRICTED ABOVE. COMPACT AS REQUIRED BY ENGINEER.



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