Industrial Fiberglass Specialties, Inc.

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INTRODUCTION

These specifications pertain to buried flexible piping where the pipe, trench walls, and bedding material work together to form a complete pipe support system.

The elements of this system can best be defined by considering a section of buried flexible pipe and the loads acting on it. These loads, the dead load (backfill) and the live loads (vehicle traffic), act downward on the pipe tending to deflect it into an oval shape. If the bedding material at the sides of the pipe is compacted sufficiently, it will resist the pipe movement and minimize the deflection and ovalization to an acceptable amount. For this reason, the construction of the trench and selection of bedding materials must be closely controlled.

These specifications cover the burial techniques required for the installation of fiberglass pipe under most conditions.

SECTION I

Storage and Handling

When storing fiberglass pipe directly on the ground, select a flat area free of rocks and other debris that could damage the pipe. Also, when preparing the ends for joining (butt wrap or tapered bell and spigot joints), do not roll the pipe over rocks, debris, or uneven ground that does not fully support the pipe.

Before installation, inspect the pipe inner surface (if possible) and outer surface for any damage. Do not use damaged pipe unless inspected and approved by a Company Representative.

Lift pipe sections only with wide fabric straps or belts. Do not use chains or cable to lift the pipe.

SECTION II

Trench Excavation and Preparation

A. The nominal trench widths are listed by pipe size in Table I. The actual depth of the trench is determined by the final grade, plus the depth required for the initial (bottom) layer of bedding material. This additional depth will be determined by the soil conditions and bedding materials being used.

B Trench Construction in Solid Rock Conditions: If solid rock conditions are encountered during trench constructions, the depth and width of the trench must be sufficient to allow the minimum required bedding between the rock and pipe surface when the pipe is at the design grade. When additional bedding and backfill materials are brought in, they must meet the specified criteria listed in Table II.

C. Granular or Loose Soils: These types of soils are characterized by relatively high displacement under load, and soft to very soft consistencies. The walls of trenches in this type of soil usually have to be sheeted or shored, or the trench made wide enough to place a substantial amount of bedding material in order to prevent excessive deformation in the pipe sides (see Figs. 1, 2, and 3). In some cases, additional depth of supplementary trench foundation material may be required.

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D. For bell and spigot pipe, slight over-excavation is allowed at each joint. For butt and wrap joints, considerable over-excavation is required at each joint to allow for the wrapping operation. After the joint has cured, fill this over-excavation with bedding material.

TABLE I - NOMINAL TRENCH WIDTHS*

NOMINAL PIPE DIAMETER IN INCHES	MINIMUM WIDTH EARTH EXCAVATION IN INCHES	MAXIMUM WIDTH IN INCHES
2	18	26
3	18	27
4	18	28
6	20	30
8	23	32
10	25	34
12	28	36
14	31	38
16	33	40
18	36	42
20	39	44
24	44	48
30	52	56
36	60	64
42	66	70
48	72	80
54	78	86
60	84	96
72	96	108

*Trench widths may be wider depending on soil conditions

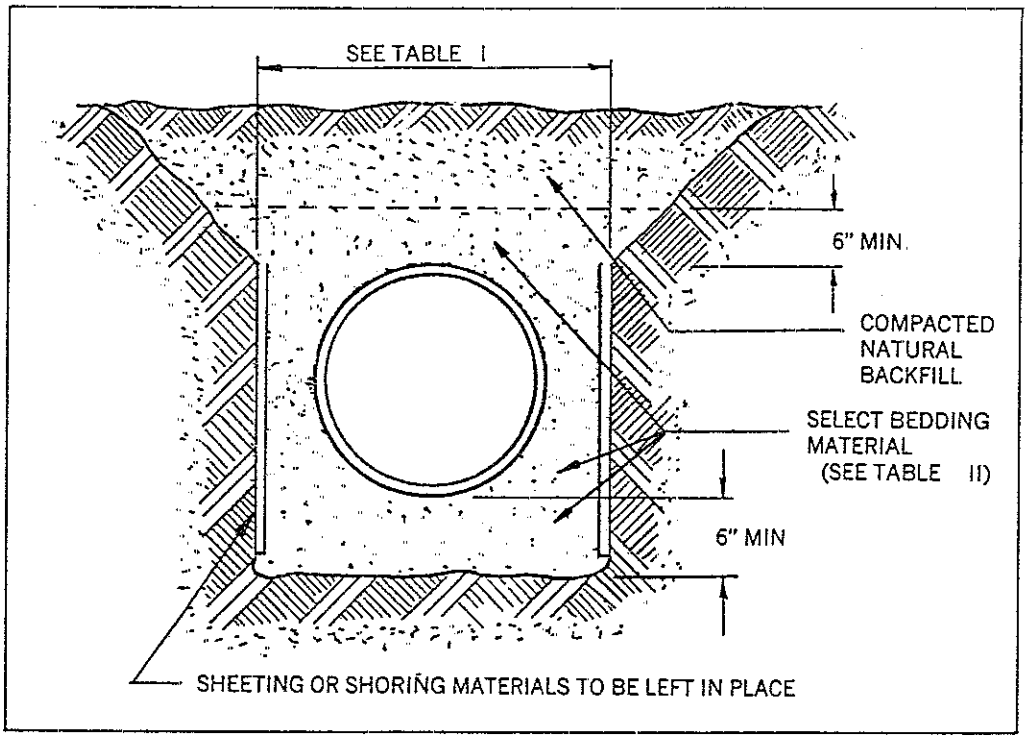

Fig. 1 - Trench shape and bedding for soft and medium consistency soil with sheeting or shoring.

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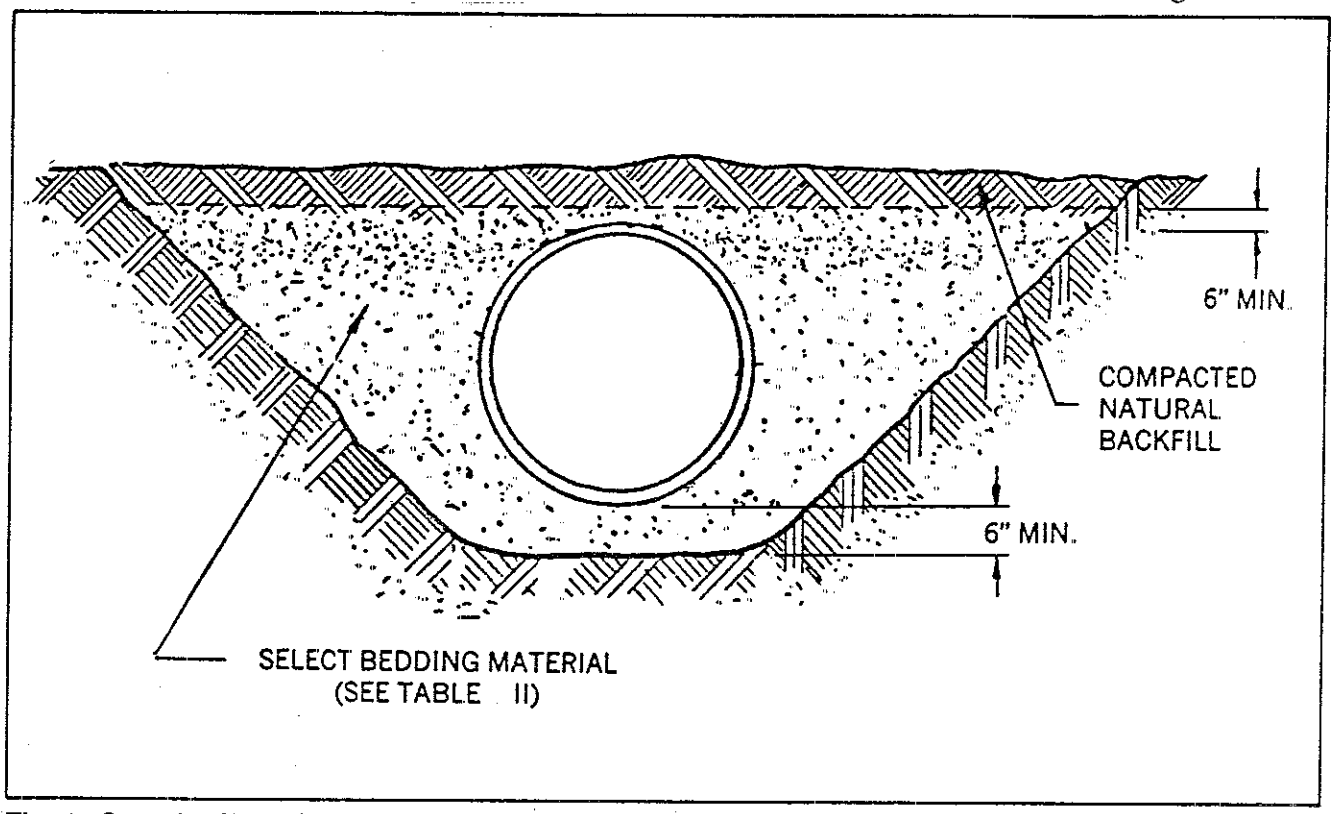

Fig. 2- Granular Type Soils (sand, etc.)
Trench shape where angle of repose of soil will not allow vertical walls

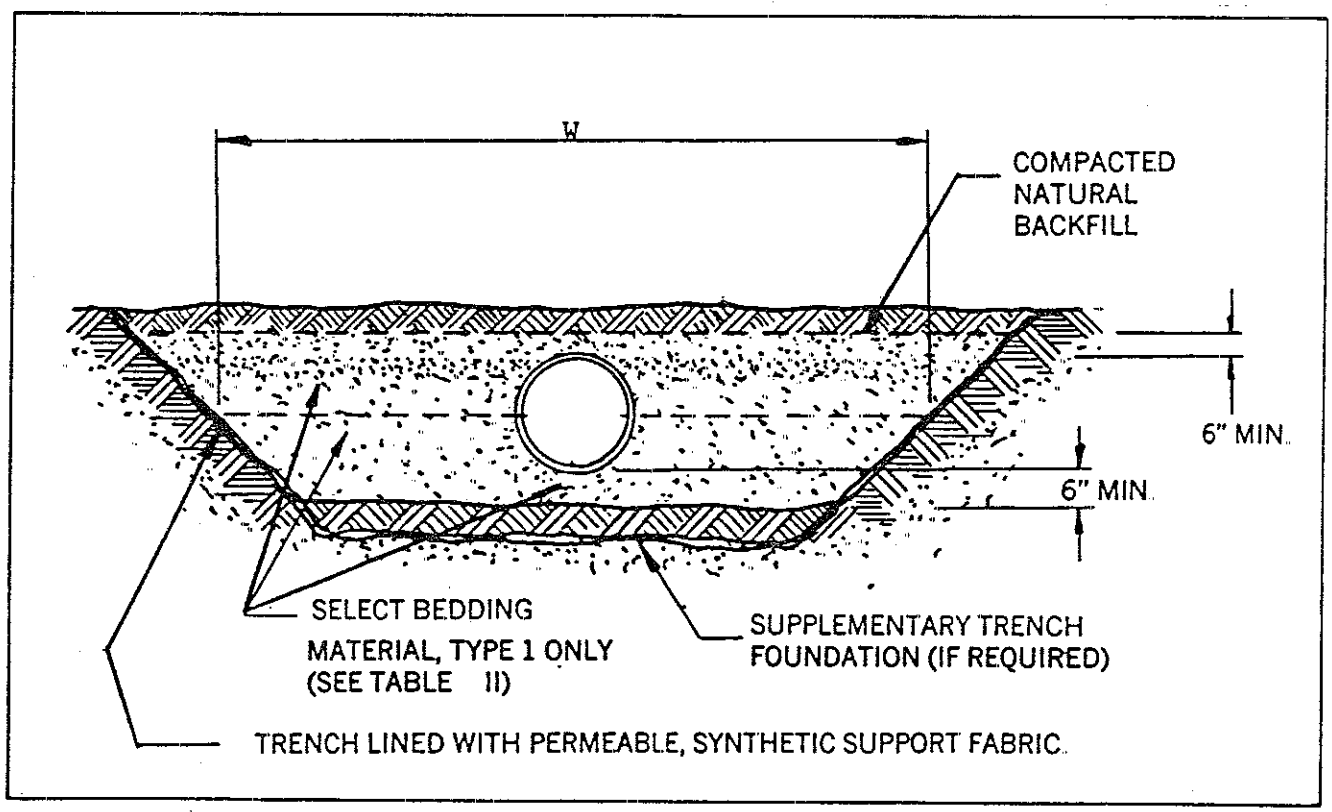

Fig. 3 - Wide Trench for Very Soft Consistency Soils
NOTE: "W" is 4 to 5 times pipe diameter, depending on bedding material

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SECTION III

Bedding and Backfilling

A. The trench bottom is the first element of the pipe support system. This surface shall either be shaped by hand to conform to the bottom 1/4 pipe diameter, or, if flat, the bedding material carefully placed and tamped by hand to ensure complete pipe support (see Fig. 4 and 4A).

B. The bedding material at the sides of the pipe is to be added in lifts, not to exceed 6" at a time, mechanically compacted to the required density, and continued to 6" above the top of the pipe. This degree of compaction is dependent upon the type of bedding material being used. Water flooding compaction is not recommended, nor is compacting the bedding material while it is highly saturated.

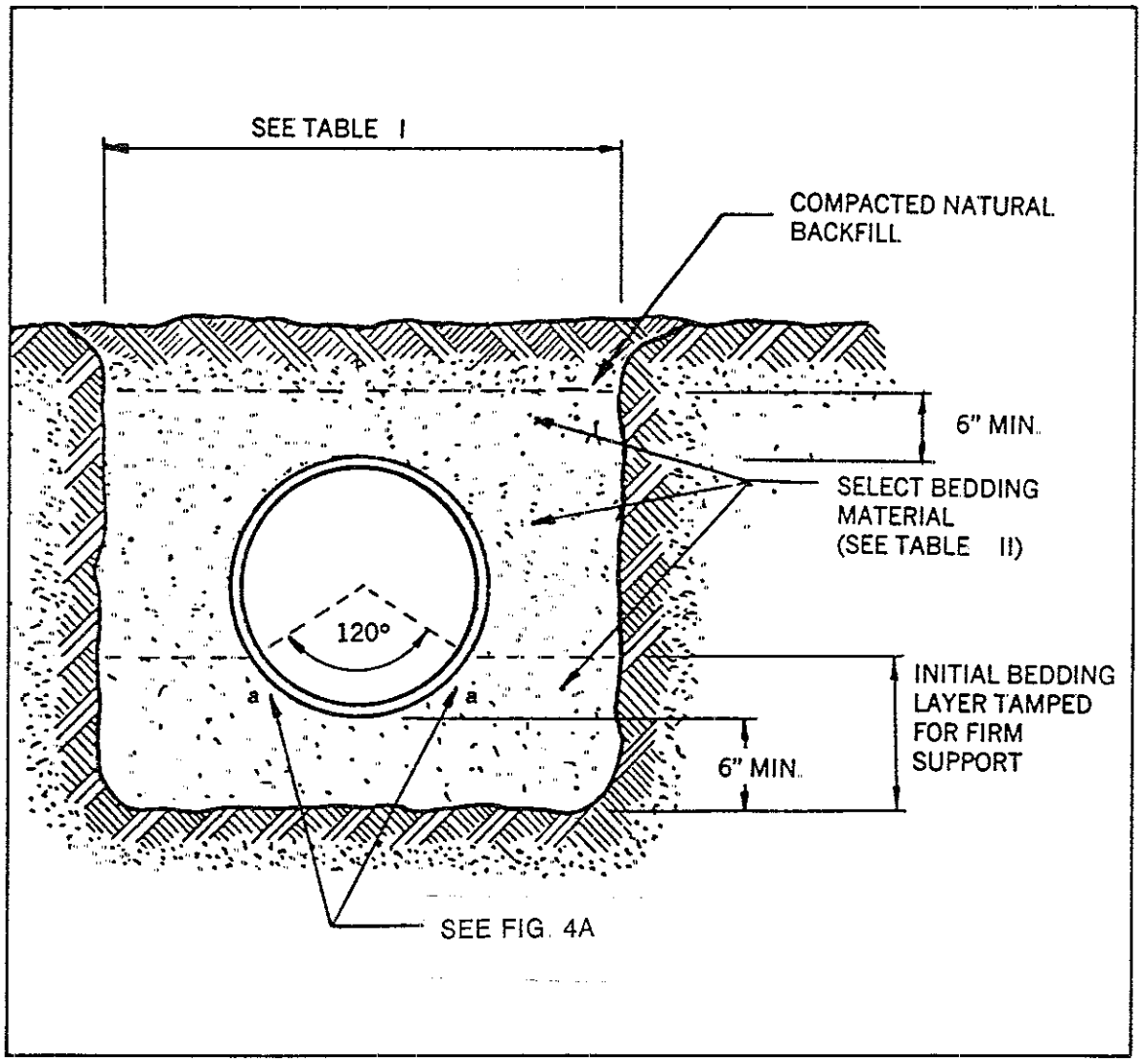

Fig. 4 - Standard Conditions - Firm or Hard Soils Typical Class "B" Bedding
NOTE: Areas "a" must conform to and firmly support pipe. Hand shaping or careful packing may be used

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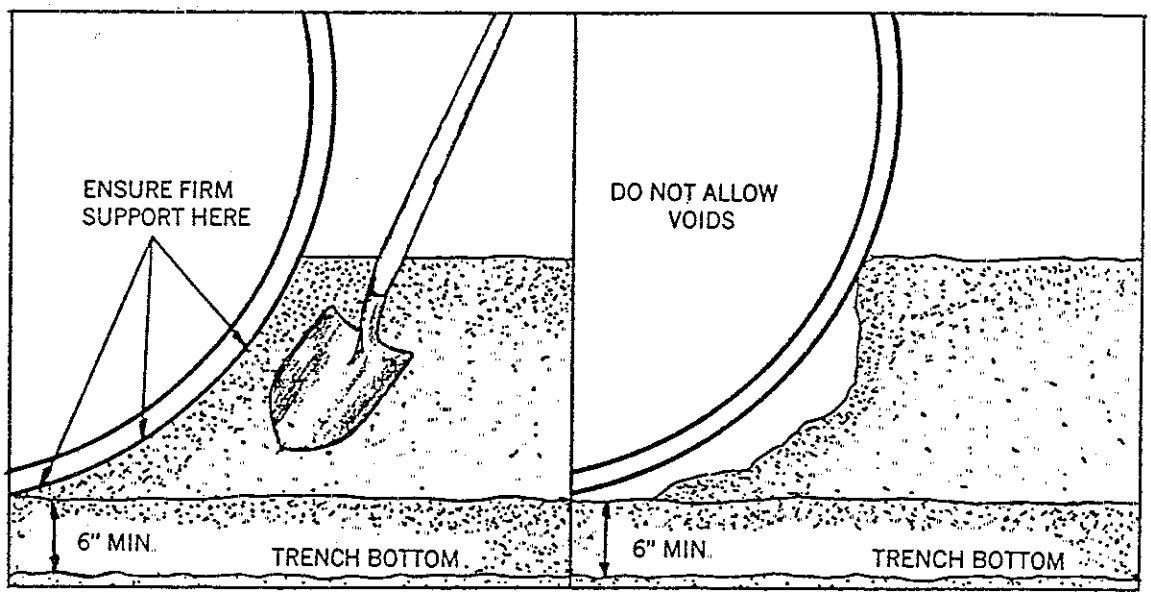

Fig 4A - Flat Trench Bottom

The primary factor for bedding and backfilling is the correct compaction of the proper selected bedding materials. For fiberglass pipe, sand, pea gravel, or crushed rock are the recommended bedding materials, compacted per Table II below.

If excavated material meets the requirements listed in Table II below, it may be used for bedding, provided there is no organic matter, frozen lumps, or particles larger than 1/2 inch. If there is any question as to the classification of the native soil, a soil testing laboratory should be consulted.

However, in poor soil conditions (i.e., very soft soils) only pea gravel or crushed rock compacted to the proper density is acceptable. In addition, a permeable, synthetic support fabric should be used as a trench liner to prevent migration of the gravel into native soil

C. The next two layers (12" cover over pipe), in lifts of 6", may be excavated material, provided there is no organic matter, frozen lumps, or particles larger than 1/2 inch. Each layer is to be compacted to the required density.

TABLE II - BEDDING MATERIAL FOR BURIAL

Type	Typical Names	Description[1]	Unified Soils Classification system	Degree of Compaction Required[2]
1	Crushed Rock or Pea Gravel	¾" Max. size with less than 50% passing No. 4 Sieve.	GW,GP	80-85%
2	Sand	Coarse or medium sand, moist	SW, SP	90-95%
3	Gravel, Sand, Clay and Gravel, Sand, Silt Mixtures	Coarse grained soils 5% and 12% fines	GW-GM, GW-GC, SW-SM, GP-GM, SP-SM, GP-GC, SW-SC, SP-SC	85-90%
4	Silty gravels, Clayey gravels, Silty sands, Clayey Sands	Coarse grained soils more than 12% fines–low compressibility	GM, GC, SM, SC	90-95%

[1]All types have a maximum particle size of ¾ inch.
[2]Compaction Required: Standard Proctor Density per ASTM D-698

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The remainder of the backfill may be completed with machines, such as front end loaders, provided there are no pieces larger than 12" and the lifts do not exceed 12". Again, each layer is to be compacted to the required density.

Do not allow heavy machinery to cross before final shaping unless there is adequate planking to distribute the load.

NOTE:

Under most soil conditions, fiberglass pipe requires a minimum of a First Class or "Class B" bedding. This is defined as a shaped trench bottom of select material and carefully compacted select sidefill material as previously defined (see Fig. 5).

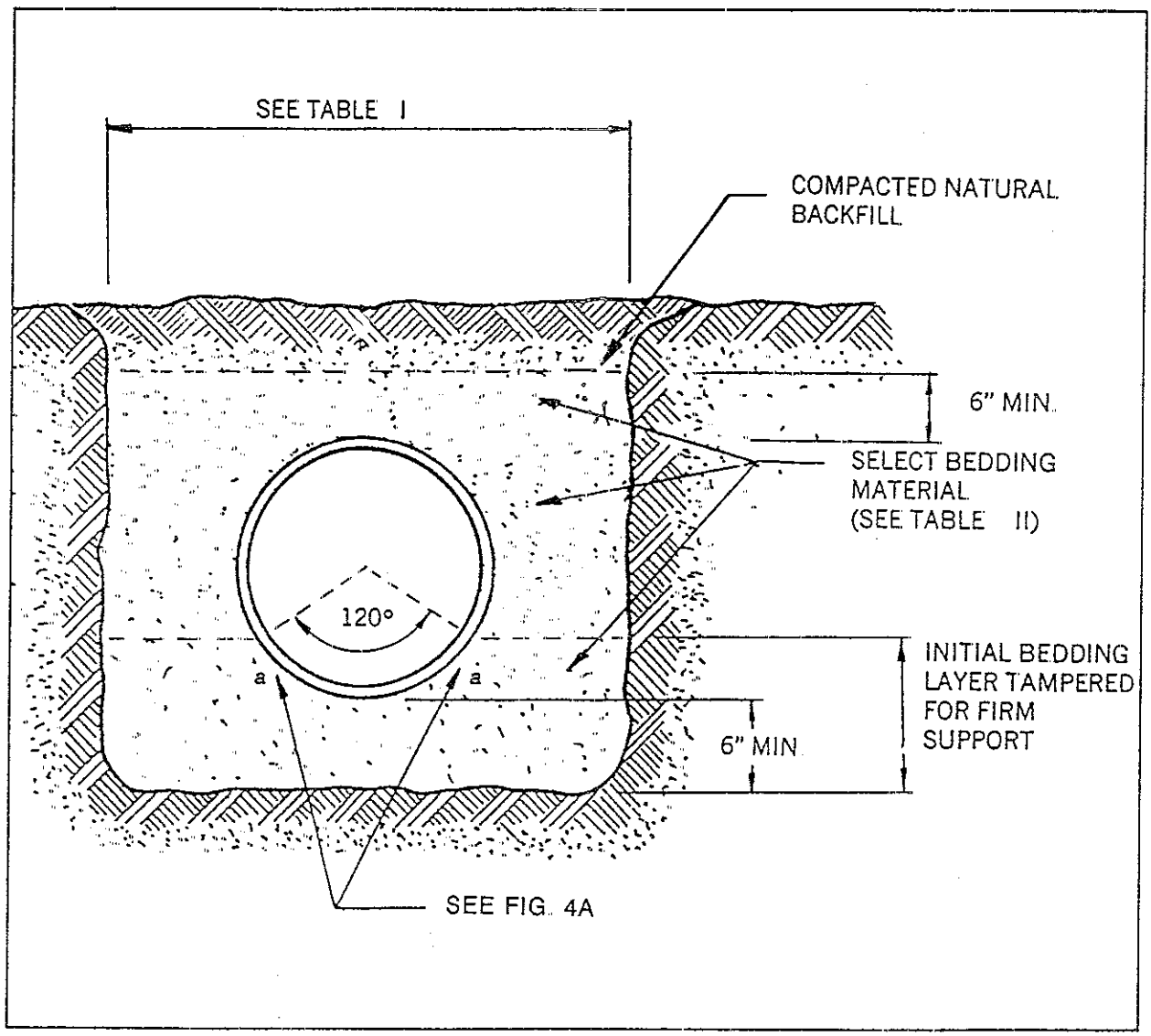

Fig. 5 - Standard Conditions - Firm or Hard Soils Typical Class "B" Bedding
NOTE: Areas "a" must conform to and firmly support pipe Hand shaping or careful packing may be used.

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D. High Water Table: Areas with permanent high water tables are usually coincident with very poor soil conditions. In most of these areas, it will be necessary to use crushed rock or pea gravel as the bedding and backfilling material. In addition, a permeable, synthetic support fabric should be used as a trench liner to prevent migration of the gravel into the native soil. In extreme cases, such as soft clay and other plastic soils, it will be necessary to use "Class A" bedding (see Fig. 6). Also, if the depth of the pipe and the depth of cover is less than one pipe diameter, tie-downs or concrete encasement will be recommended in sufficient quantity to prevent flotation.

E. Artificial Water Table: In some areas with a normally low water table (i.e., below the installed depth of the pipe and bedding material), it is possible to have a false or artificial water table created, due to flooding, poorly draining soil, and/or inadequate drains in the surrounding area. These areas can usually be determined by the local test laboratories. If this situation exists, install the pipes as in Paragraph D

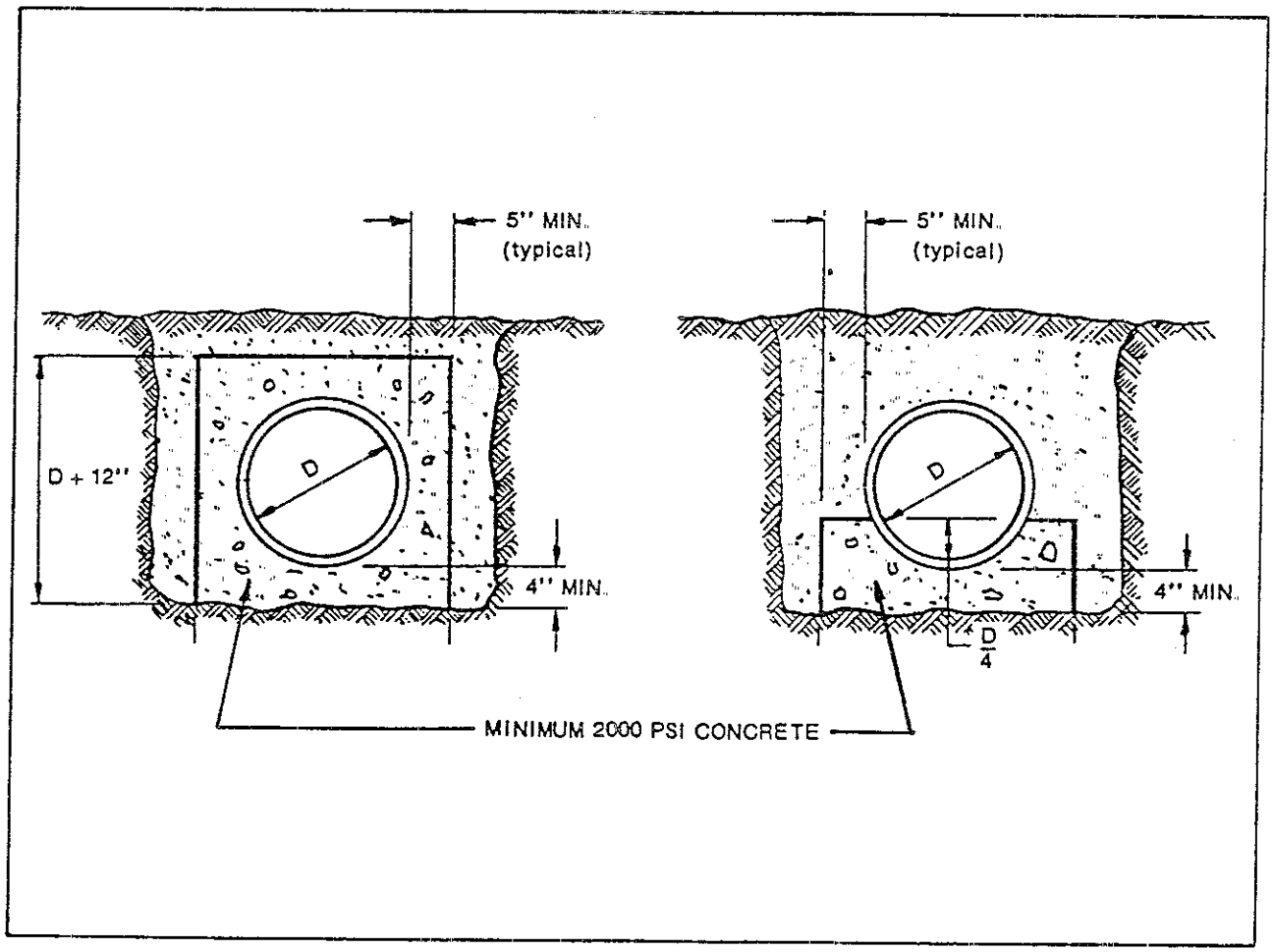

Fig. 6 - Typical Class "A" Bedding

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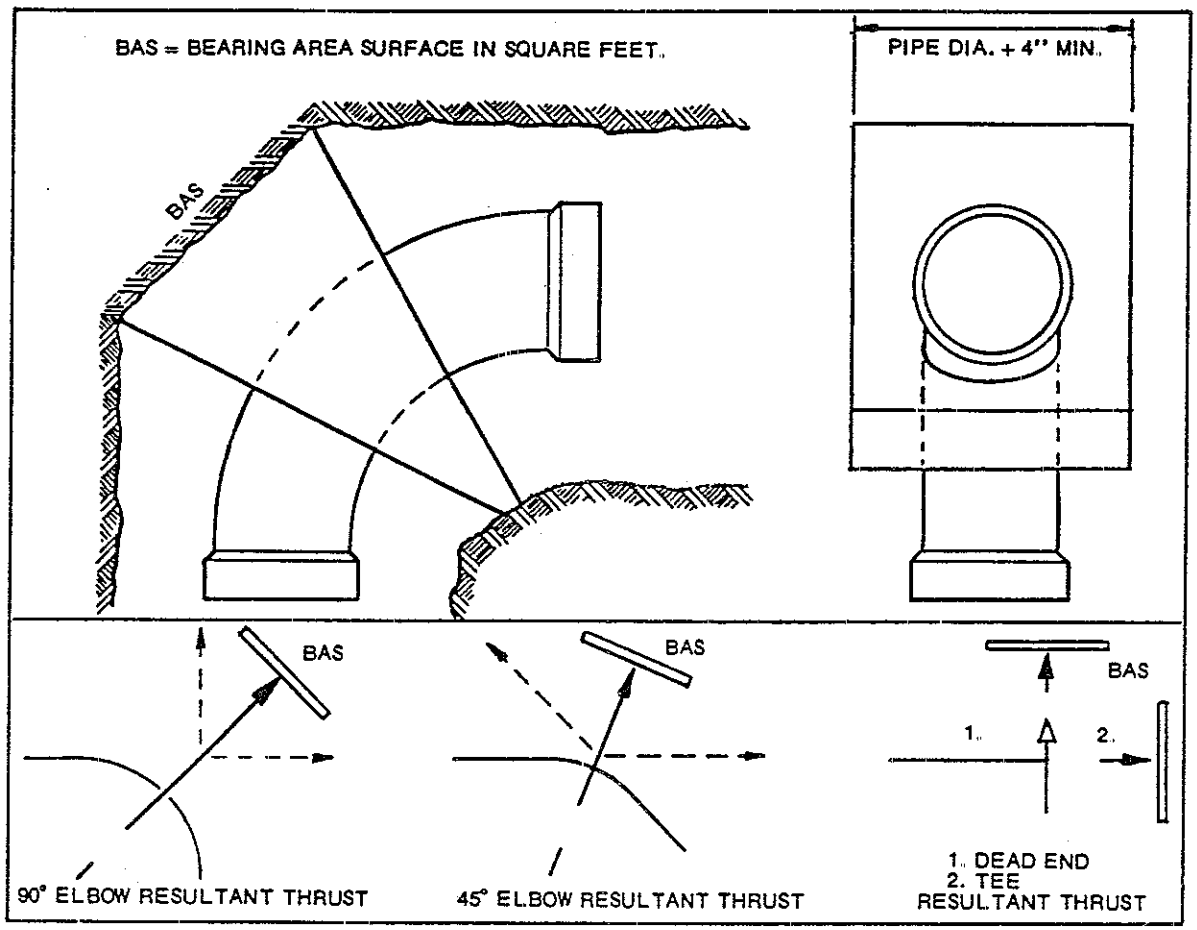

Fig. 7 - Suggested Thrust Block Design for Elbows, Tees, and Dead Ends

F Thrust Blocks: All buried "O" ring bell and spigot type pipe must have concrete thrust blocks at elbows, tees, etc. The size of the thrust block is determined by the pipe size, pressure, and the load-bearing capabilities of the native soil.

When butt and wrap, adhesive socket, or tapered bell and spigot joints are used, thrust blocks are generally recommended when soft soils, high temperatures, or high pressures are encountered in the system. Consult factory for specific applications.

The concrete used in thrust blocks shall have a minimum compressive strength of 2000 psi with the load-bearing sides poured directly against undisturbed soil. Non-load-bearing sides may be poured against forms (see Fig. 7 and Table III). In very soft soils, supplementary foundations beneath and behind the thrust block may be required.

G Dewatering Systems: In all cases of pipeline burial, it is an absolute necessity that the trench be kept free of water to allow dry compaction of the bedding material. If in a high water table area, a dewatering system must be used continuously. In other areas where rain or leakage creates water in the trench, it may be pumped as required.

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TABLE III - THRUST BLOCK MINIMUM BEARING AREA IN SQUARE FEET

PIPE SIZE	TEES & DEAD ENDS	90° ELBOWS	45° ELBOWS	22½° ELBOWS	11¼° ELBOWS
14"	4	5.5	3	1.5	1
16"	5	7.5	4	2	1
18"	6.5	9	5	2.5	1.5
20"	8	11.5	6	3.5	1.5
24"	11.5	16	9	4.5	2.5
30"	18	25	13.5	7	3.5
36"	26	36	19.5	10	5
42"	35	49	27	14	7
48"	46	64	35	18	9
54"	58	81	44	22	11.5
60"	71	100	54.5	28	14
72"	102	144	78	40	20

Bearing Area designed for 50 psi working pressure; if design working pressure is....	75	100	125	150	200
multiply bearing area by...	1.5	2	2.5	3	4

NOTES: 1. Values based on a test pressure of 1.5 x design working pressure and soil bearing load of 3,000 lb/ft². For other allowable soil bearing loads, multiply final minimum required bearing area by 3,000 and divide by actual allowable soil bearing load.

2. VALUES DO NOT INCLUDE PROVISIONS FOR LOADS DUE TO THERMAL EXPANSION.

Load Bearing Capabilities of Various Soils

SOIL TYPE	LOAD BEARING RANGE	
	MINIMUM LOAD	MAXIMUM LOAD
Rock	20,000 lb/ft²	30,000 lb/ft²
Shale	12,000 lb/ft²	20,000 lb/ft²
Sand and Gravel with Clay	8,000 lb/ft²	12,000 lb/ft²
Sand and Gravel	6,000 lb/ft²	8,000 lb/ft²
Sand	4,000 lb/ft²	6,000 lb/ft²
Soft Clay	2,000 lb/ft²	4,000 lb/ft²
Alluvial Soil	1,000 lb/ft²	2,000 lb/ft²

NOTE: No responsibility can be assumed for the accuracy of the data in this table due to the wide variation of bearing load capabilities of each soil type. Actual safe allowable soil bearing values can be obtained through the services of a soils laboratory.

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Section IV

Concrete Structure

A. Where the pipe goes through or passes under a concrete structure, precautions must be taken to prevent excessive strain on the pipe due to the differential settling between the structure and the pipe.

Several methods are available to compensate for this settling without straining the pipe. A flexible joint, such as an "O" ring bell and spigot, may be used at the interface of the structure. Also, a sufficient thickness of a resilient material, such as rubber, wrapped around the pipe before pouring the concrete, will prevent localized or point loading for small amount of differential settling

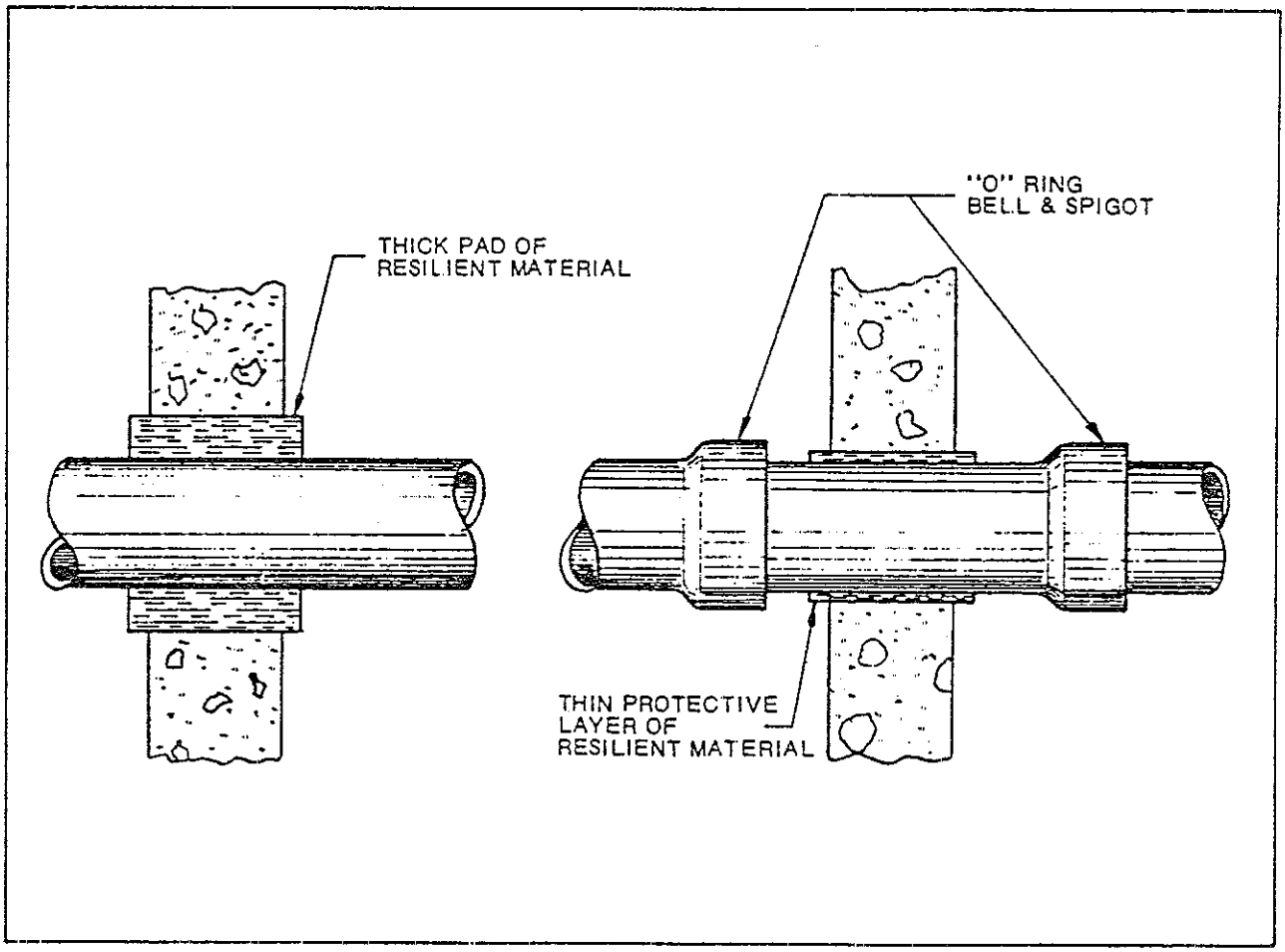

Fig. #8 - Pipe Penetrating Concrete

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B. The correct trench configuration adjacent to the structure is shown in Fig. 9. To allow for the possibility of unequal settling of the concrete and pipe, it is necessary to have extra bedding to prevent overstressing the pipe.

C. Where the pipe is buried under a non-paved roadway, it is recommended that a concrete or steel conduit be used as a sleeve, especially for shallow burial depths. A sleeve must be used if the depth below a paved roadway (i.e., H-20 Loading), is less than the minimum.

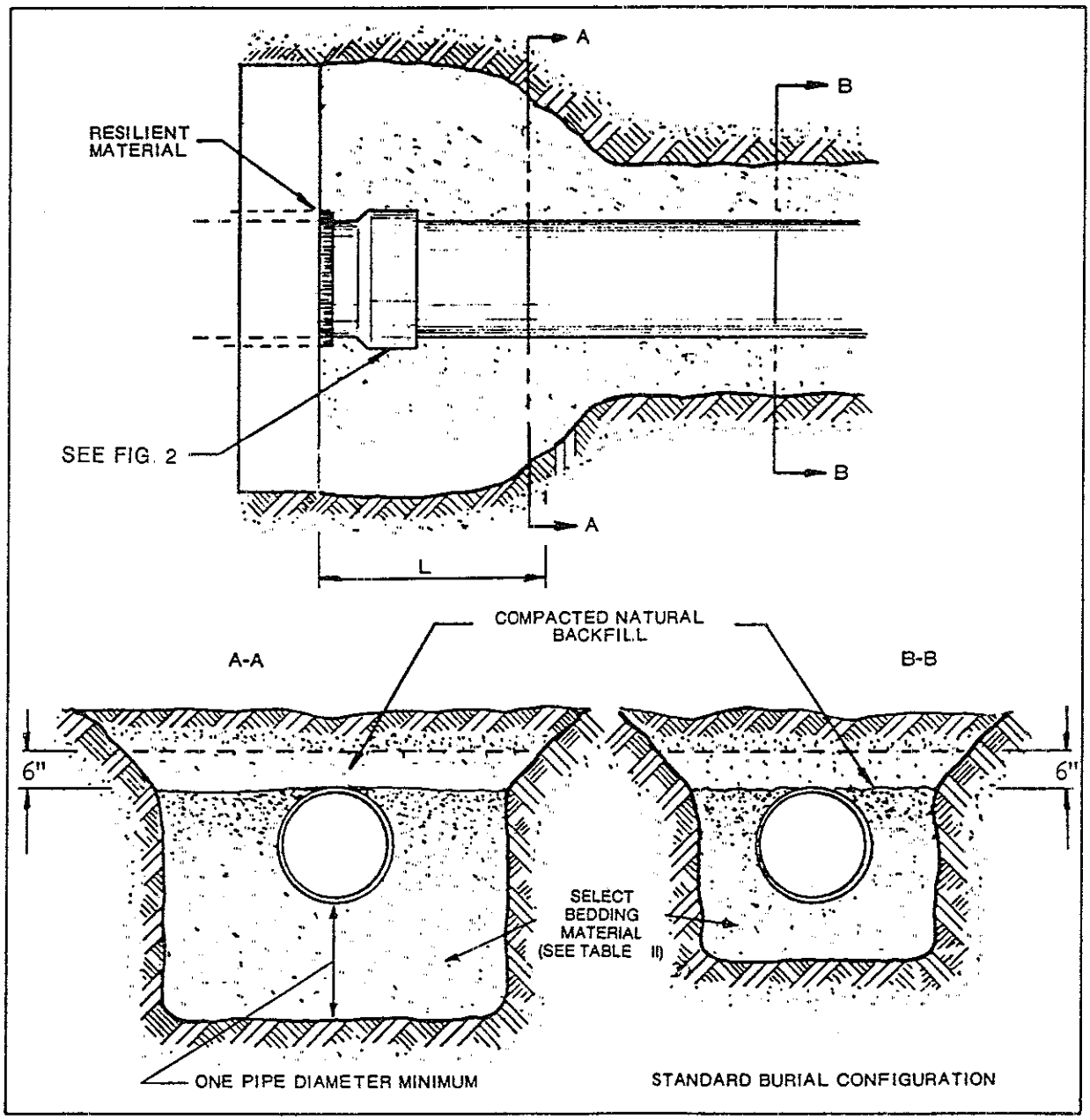

Fig. 9 - Pipe Going Through (or Under) Concrete Structure
NOTE: "L" is 3 feet for each 1 inch of probable differential settling between pipeline and structure.

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DEFINITION OF TERMS

1. E' or Modulus of Soil Reaction - This term reflects the stiffness of the soil surrounding the pipe; i.e., the bedding material. Its value is dependent on the soil type and density. Granular-type soils have a higher modulus than cohesive soils, and this modulus is further increased by compaction.

2. Dead Loads - This is the weight of the overburden acting on the pipe. The value is determined by multiplying the density of the soil ($lb./in.^3$) by the depth of cover (inches).

3. H-20 Loading - This is a standardized live load of 32,000 lbs./axle per the American Association of State Highway Transportation Officials (AASHTO) considered to be applied through a pavement one foot thick.

4. Off Road Vehicle Traffic Load - As used in burial calculations is defined as 32,000 lbs /axle with 50% impact allowance. This load is considered to act at the surface without the benefit of pavement.

5. Supplementary Foundations - Usually crushed rock or pea gravel dumped and properly compacted in over-excavated trenches because of very poor soil conditions. In some cases, concrete supplementary foundations are required.

6. Angle of Repose - The maximum angle soil can be piled without additional support.

APPENDIX A

Unified Soil Classification System Soil Designations:

G -- Gravel [No. 4 Sieve (3/16") to 3" Size]

S -- Sand [No. 200 Sieve (1/64") to No. 4 Sieve]

P -- Poorly Graded (predominately one size)

W -- Well Graded (even size distribution)

M -- Low Plasticity (i.e., GM or SM)

C -- Plastic or Clay-like Soils (i.e., GC or SC)

L -- Low Compressibility (i.e., ML or CL)

H -- High Compressibility (i.e., CH or MH)

O -- Include Organic Matter (i.e, OL or OH)

Combinations of these designations are used to define particular types of soil. A GW-GM soil would be well-graded with a small amount of low plasticity fines.