
TECHNO
LENE OUT®
أنظمة متطورة ....
لشبكات الصرف الصحي والأمطار
ديمومة عالية للبنى التحتية
حلول إقتصادية ...
Plastics piping systems for non-pressure underground drainage and sewerage.
Made of polyethylene (PE)
According to EN 13476

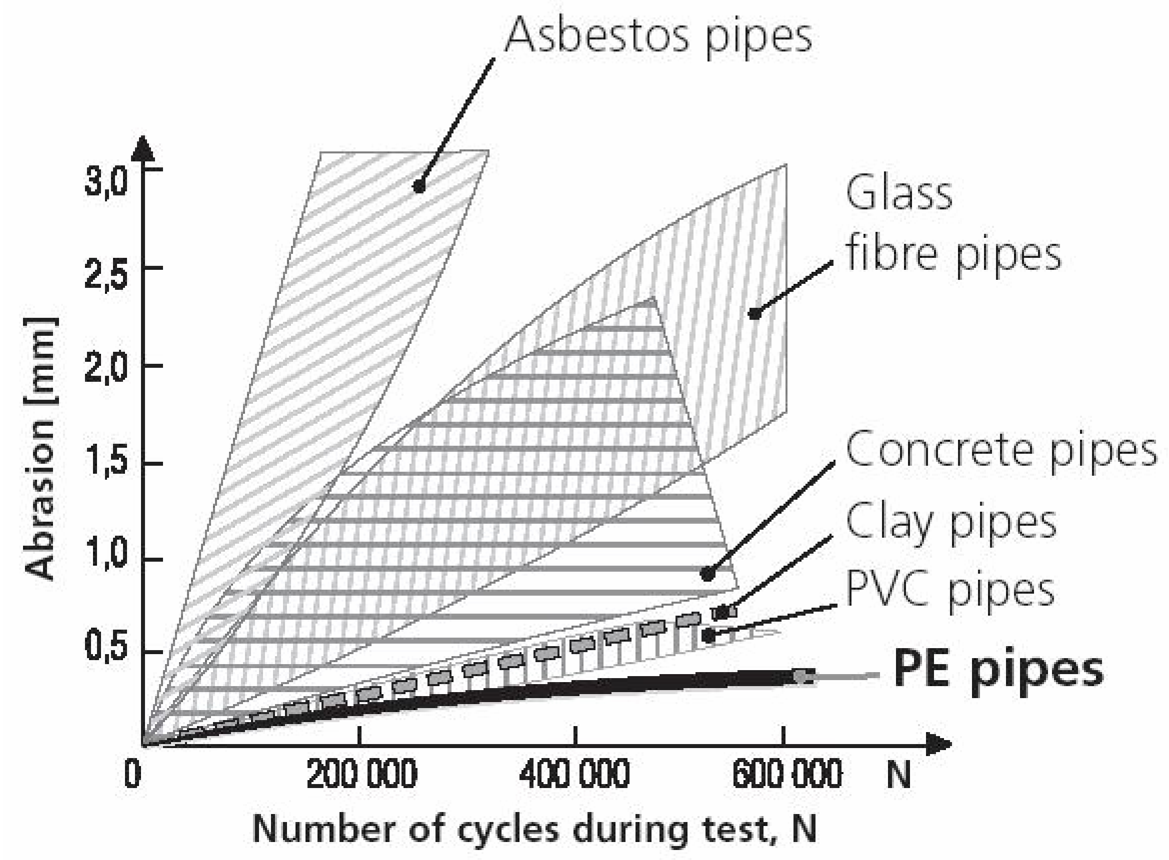
ID < 500mm (200, 250, 300, 400mm)

ID > 400mm (500 up to 3000 mm)

Properties of PE pipelines

- High abrasion resistance
- Corrosion resistance (chemical compounds)
- Very good fluid-flow properties
- Non toxic material
- 100% tight joints
- Flexibility
- Light weight
- Reliability

High Abrasion Resistance

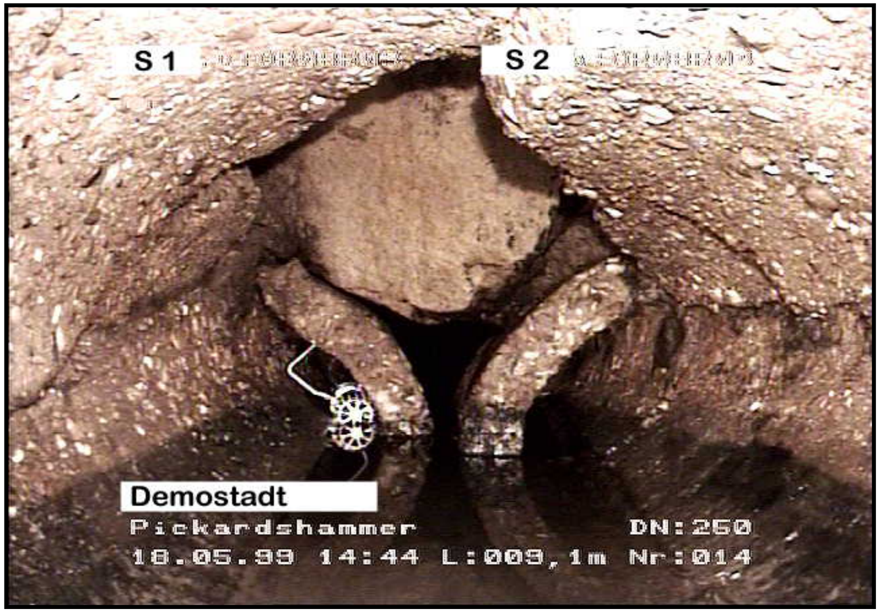


SOURCE: University of Darmstadt (DIN 19534)

Corrosion Resistance (chemical compounds)

Polyethylene pipes are low-resistant to oxidants and aromatic solvents.

Concrete & Clay Failures



Very Good fluid-flow Properties

PE pipes retain low and constant roughness grade k = 0.01 mm.

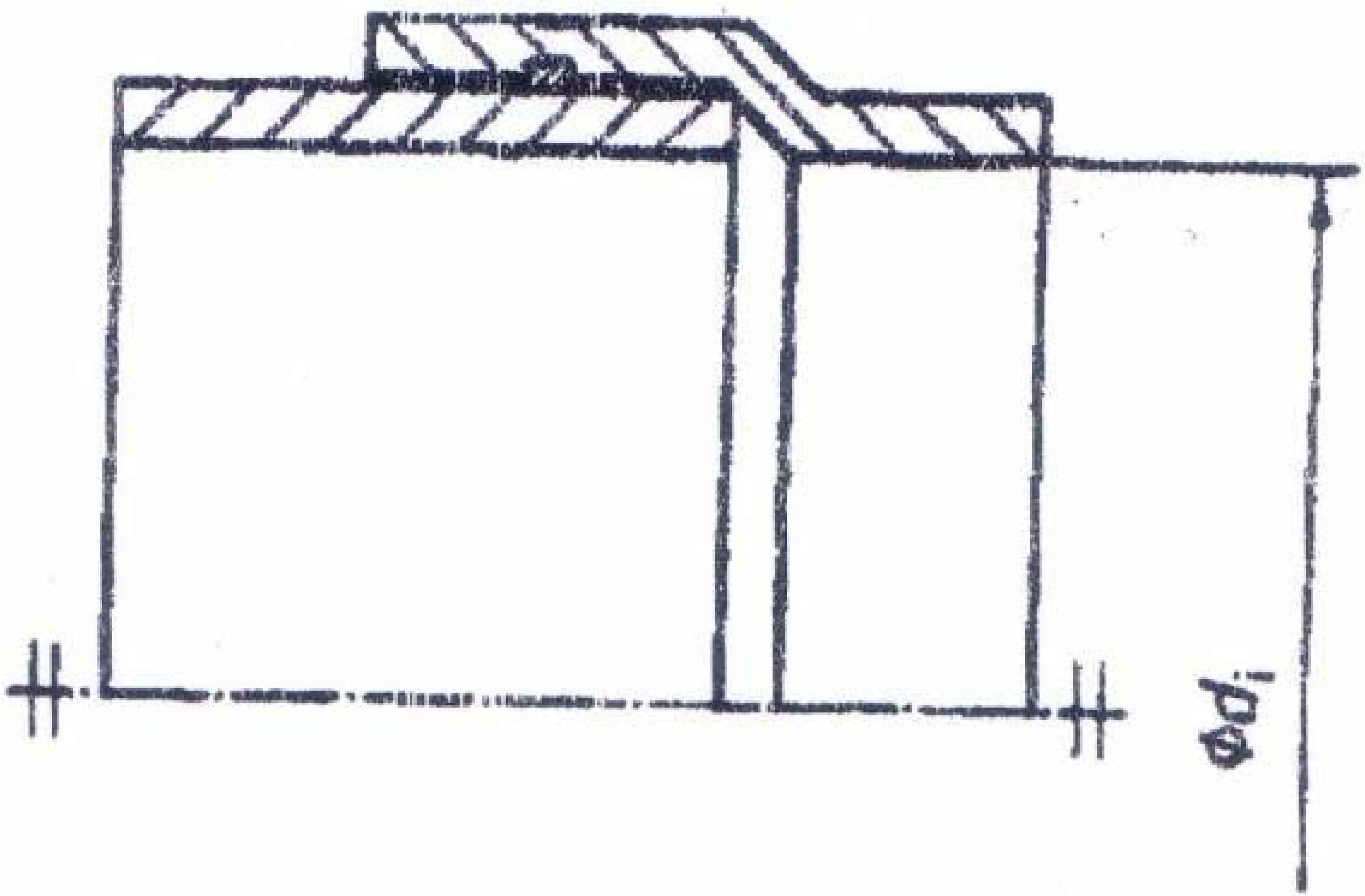
Non Toxic Material

Construction of drinking water tanks. Such tanks are made
of PE material approved by the PZH (National Institute of Hygiene) in Warsaw.

100% Tight Joints

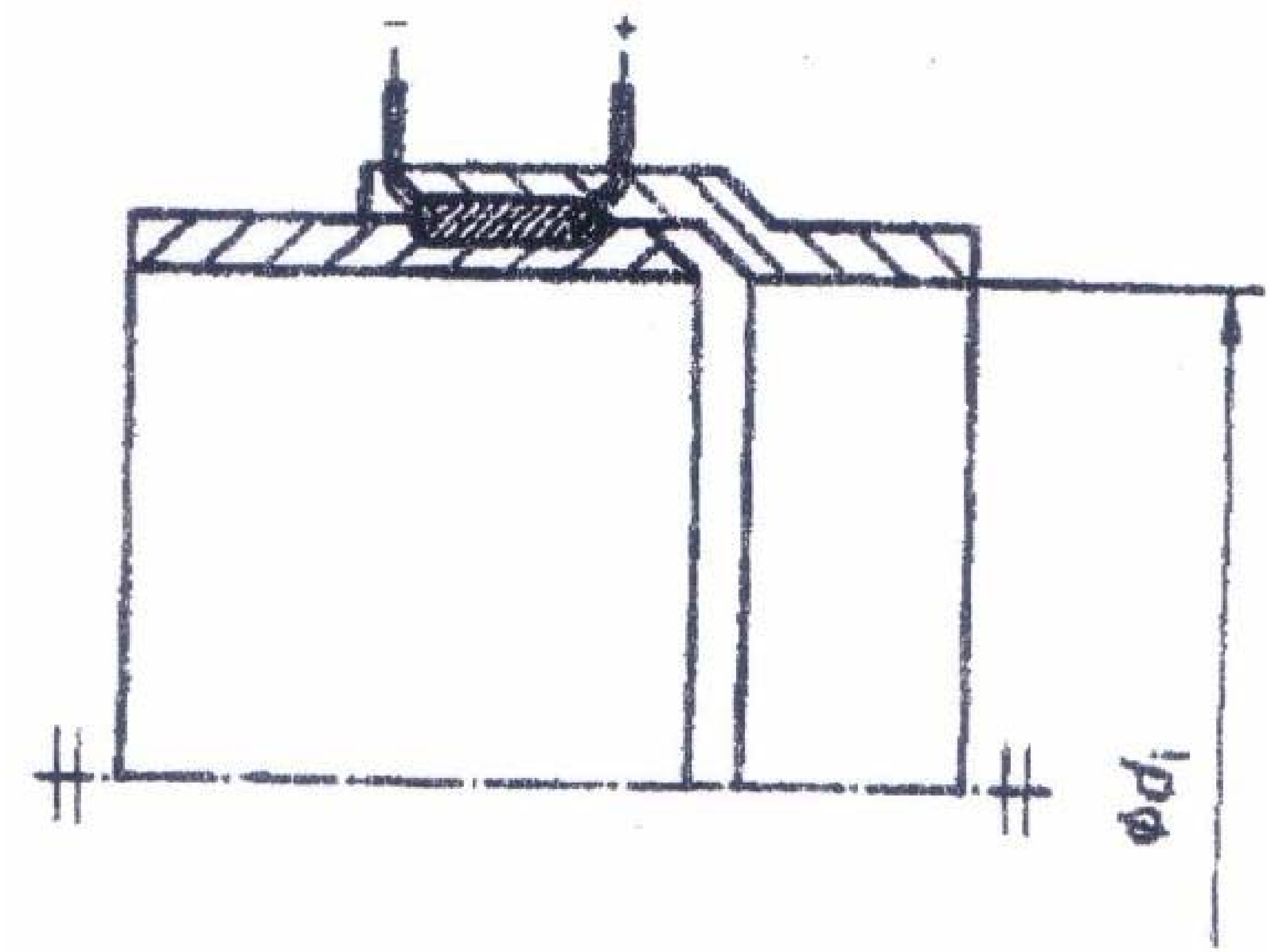
Joints DIN 16961-1

Push-in Joint With Seal



Joints DIN 16961-1

Socket For Resistance Welding

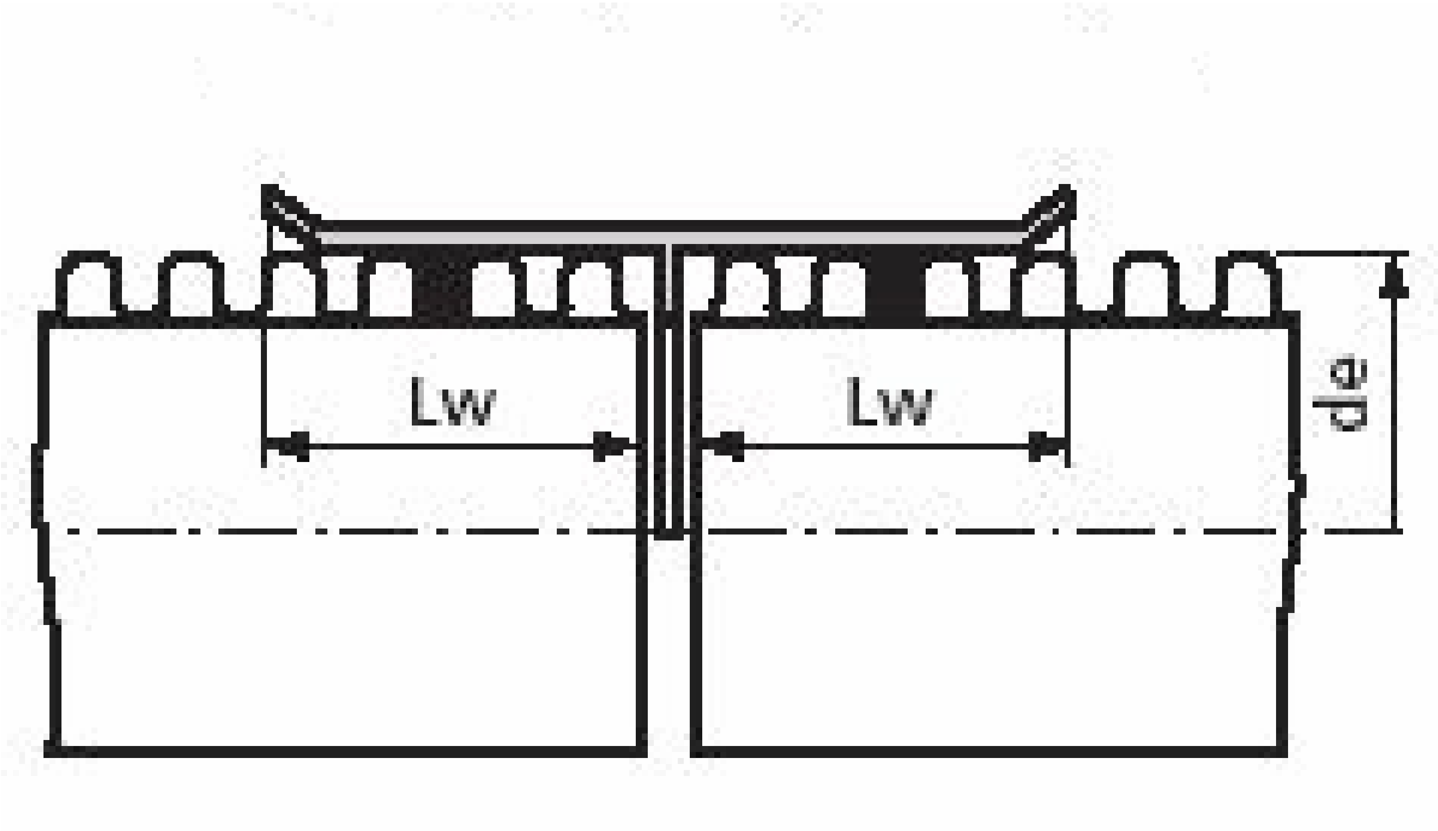


SASMO 3062 / 2009

الجدول (6) ــ الثخانة الجدارية الأصغرية المطلوبة للجرس الاملس المصمت

المادة	القطر الخارجي	e_{min}
PE	$d_e \le 500$	$d_e/33$ على ألا تقل عن (4,2) أيهما أكبر
	$d_e > 500$	15.2

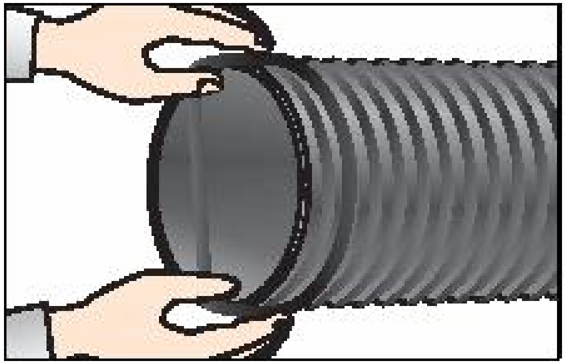
Schematic view of connection



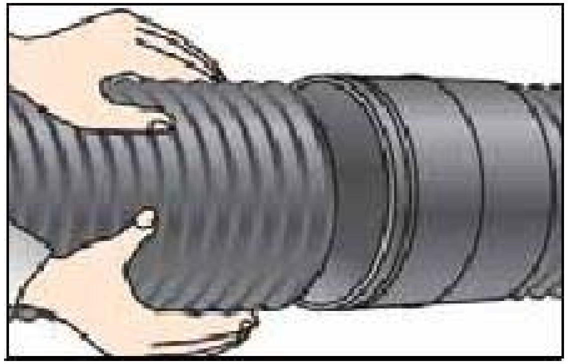
Socket Connections

1) Thoroughly clean all dirt off pipe socket

2) Place seal between two first ridges of the pipe



3) Push the pipe end into socket



Flexibility

With natural bend radius of R = 50 outside diameters, PE pipes may be laid according to variations of the pipeline route and in many cases use of expensive fittings can be avoided.

Light Weight

Reliability

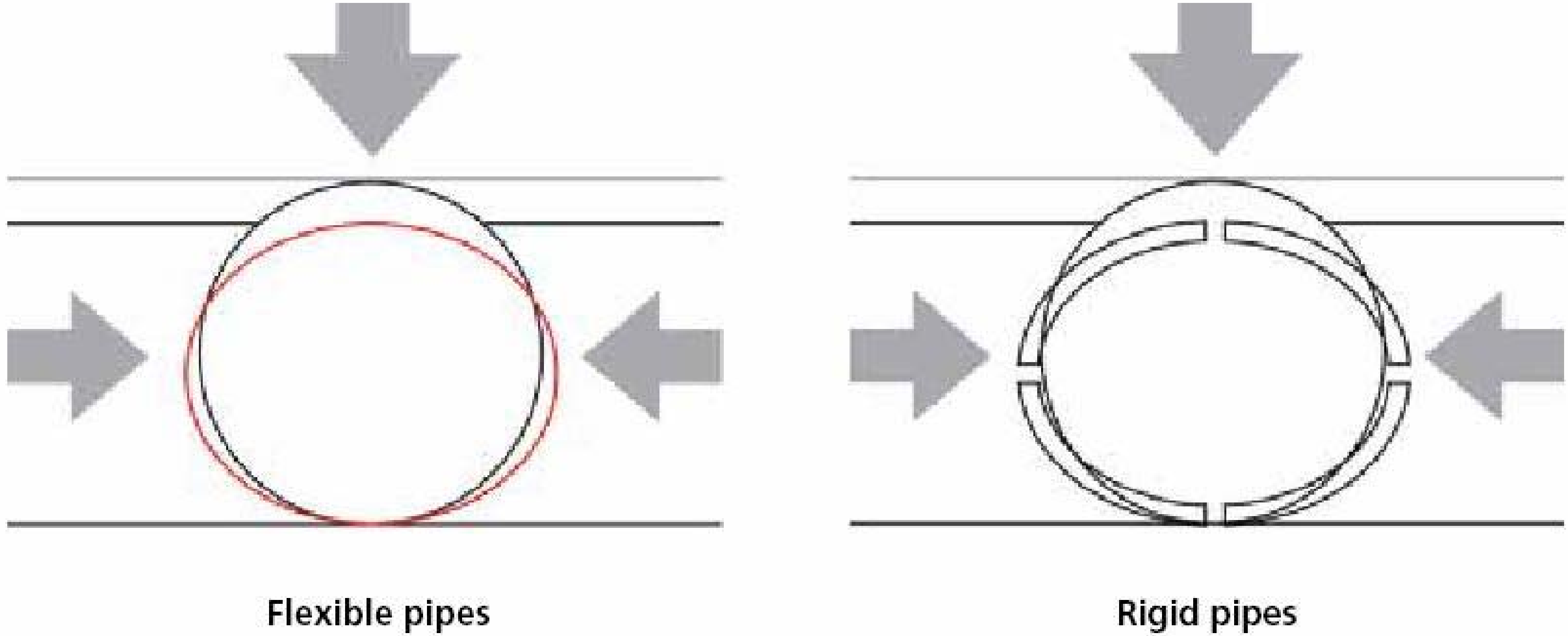
Failure frequency of PE pipes is much lower than that of rigid pipes (Concrete, Clay, GRP).

PE pipes are resistant to changing atmospheric conditions.

Interaction Between pipe & ground

flexible and rigid pipes

- Behavior of the pipe under load depends on its stiffness.
- Flexible PE pipes interact with the ground and form stable ground-pipe system.
- Rigid pipes load is mainly taken by the pipe material. When the load exceeds permissible value damage of the pipe occurs.



Ring Stiffness

$$SN = E\, I/D_m^{\,3}$$

Where :

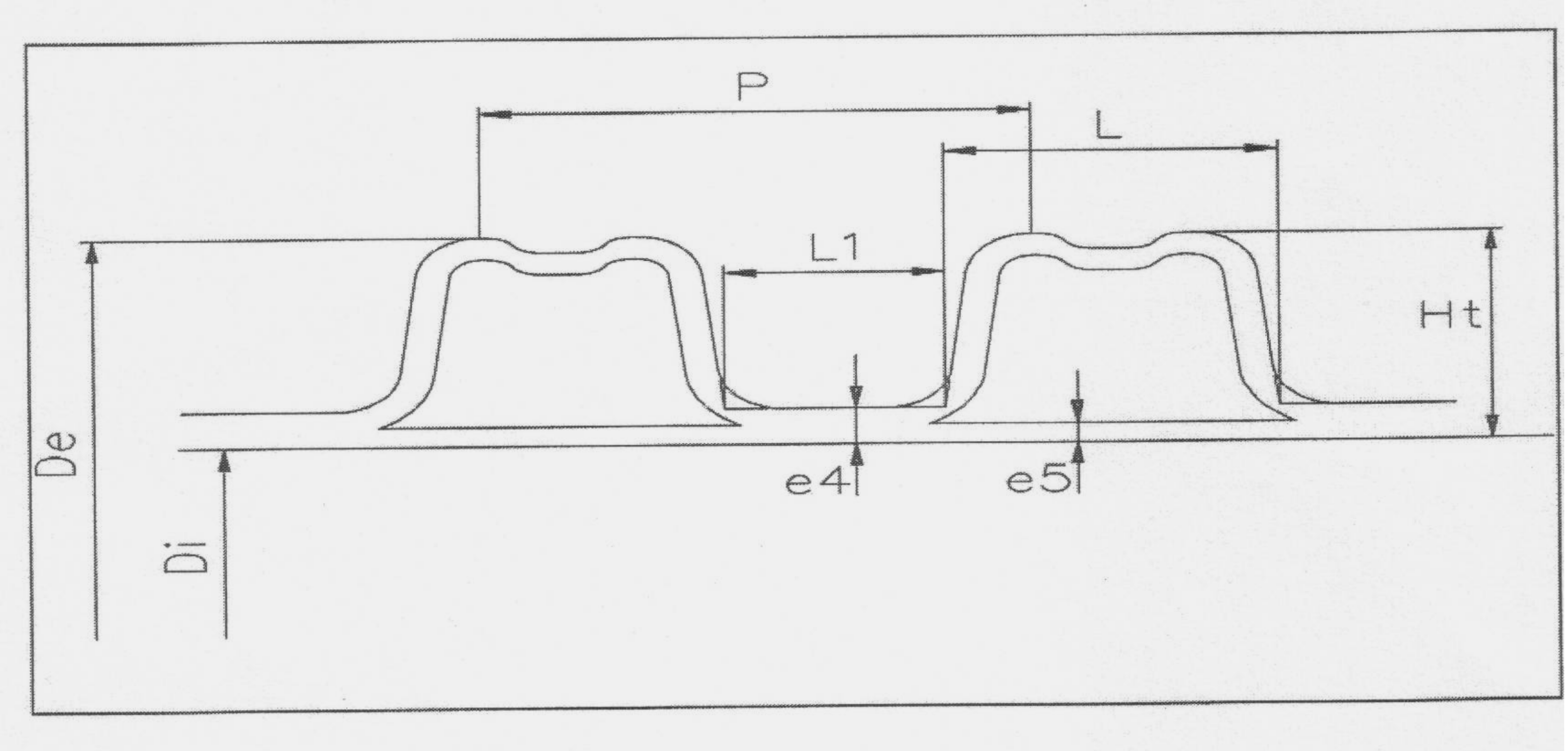
- **E** = Modulus of material elasticity, in Pa
- **D_m** = means pipe diameter, in m
- **I** = moment of inertia, in m^4/m

Moment of Inertia, I

$$I = S^3/12$$

S: Effective Thickness

Pipe Profile

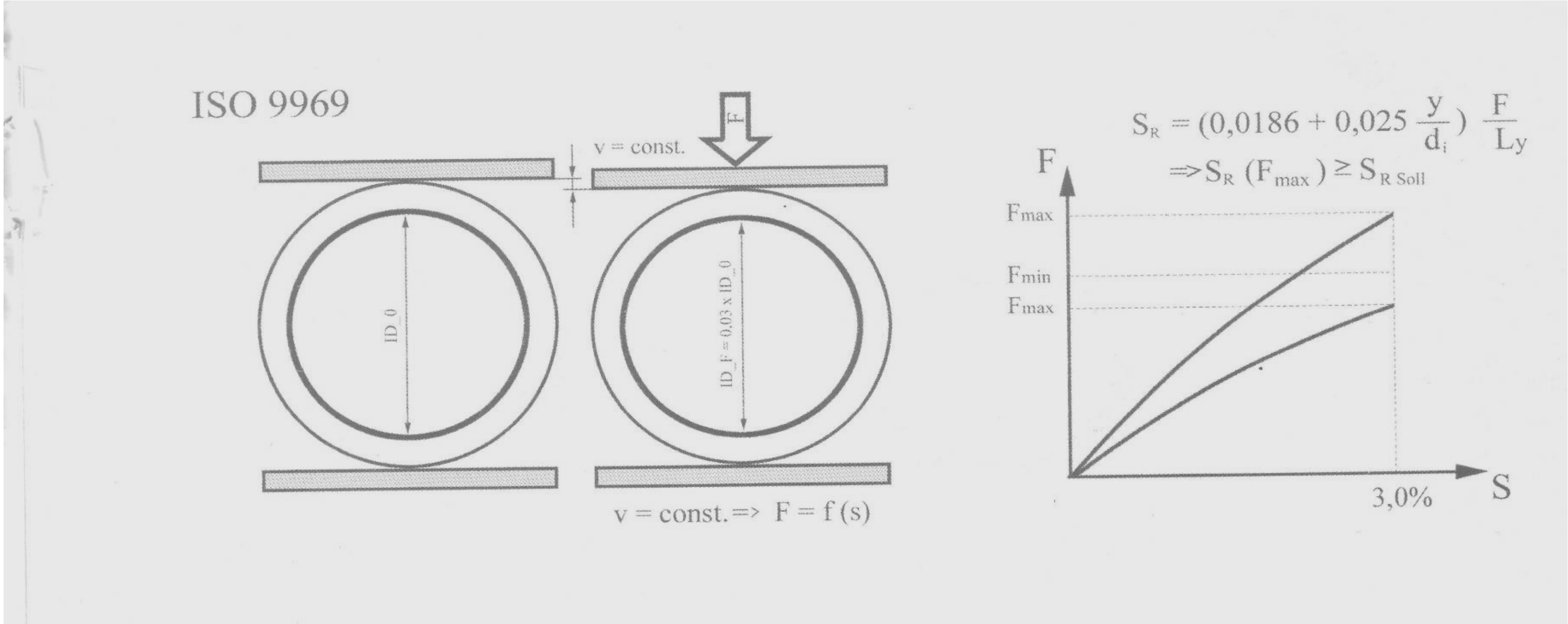


D_e : External Diameter

D_i : Internal Diameter

Ring Stiffness Against Deformation

$$S_R = (0.0186 + 0.025\ y/d)\ F/L_y$$



Classification Of Mineral Soil

Name of soil	Symbol	Sub-type	Fraction [mm]
Loam	I		<0,002
Clay	G	Dusty clay	0,002 - 0,006
		Clay	0,006 - 0,02
		Sandy clay	0,02 - 0,06
Sand	P	Fine sand	0,06 - 0,2
		Medium sand	0,2 - 0,6
		Coarse sand	0,5 - 2,0
Gravel	ż	Fine gravel	2,0 - 6,0
		Medium gravel	6,0 - 20,0
		Coarse gravel	20,0 - 60,0

Modulus of The Resistance of The Ground

VALUES FOR *E'*

	LOOSE MATERIAL	COMPACTED MATERIAL		
PROCTOR INDEX		< 85 %	85÷90 %	> 95 %
RELATIVE DENSITY		< 40 %	40÷70 %	> 70%
TYPE OF GROUND	E' N/mm²			
Ground with low granulometry LL > 50	0	0	0	0.35
Soils with average and high plasticity	(recommended a detailed analysis)			
Cohesive ground with low granulometry LL>50 Soils with average and low plasticity with less than 25% of coarse particles	0.35	1.38	2.76	6.9
Ground with low granulometry LL>50 Soils with low or average plasticity with more than 25% of coarse particles Soils with coarse granulometry with more than 12% of fine particles	0.69	2.76	6.9	13.8
Ground with coarse granulometry with less than 12% of fine particles	0.69	6.9	13.8	20.7
Crushed rock	6.9	20.7	20.7	20.7
Accuracy in terms of difference between calculated and real deformation (in %)	± 2 %	± 2 %	± 2 %	± 0.5 %

Soil Classification

	Group of soils					
Type of soil	#	Typical description	Symbol	Characteristics	Example	Use
loose	1	Gravel, gap graining	(GE) [GU]	Steep grain-size distribution curve, domination of one fraction	Crushed stone, valley and beach gravel, glacial gravel	YES
		Gravel, continuous grading	[GW]	Smooth grain-size distribution curve, several fractions	scoria, volcanic dust	
		Well graded aggregate	(GI) [GP]	Stepped grain-size curve, certain fractions missing		
	2	Sand, gap grading	(SE) [SU]	Steep grain-size distribution curve, domination of one fraction	Dune sands, deposited sands, sands from valleys and troughs	YES
		Sand, continuous grading, well graded aggregate	[SW]	Smooth grain-size distribution curve, several fractions	Glacial, terrace and shoreface sands	
		Well graded aggregate	(SI) [SP]	Stepped grain-size curve, certain fractions missing		
loose	3	Loam gravel, gap grained loam aggregate	[GM] (GU)	Gap grained, contains loam fraction	Weathered gravel, rock waste, clay gravel	YES
		Clay gravel, well graded gap grained loam aggregate	[GC] (GT)	Gap grained, contains fi ne clay fraction		
		Loam sand, gap grained sandclay mix	[SM] (SU)	Gap grained, contains fi ne loam	Watered sand, clay sand, sand loess	
		Clay sand, gap grained sand-clay mix	[SC] (ST)	Gap grained, contains fi ne clay	Clay sand, alluvial clay, marl	

Soil Classification

	Group of soils					
Type of soil	#	Typical description	Symbol	Characteristics	Example	Use
coherent	4	Inorganic loam, fi ne sand, stone dust, clay and loam	[ML] (UL)	Poor stability, quick mechanical reaction, plasticity zero to small	Loess, sand clay	YES
		Inorganic clay, clay of high plasticity	[CL] (TA) (TL) TM	Stability medium to very good, mechanical reaction not very fast, plasticity poor to medium	Alluvial marl, clay	
organic	5	Multi-fractional loose soil with humus	[OK]	Vegetable and non-vegetable matter, putrefactive stench, low volumetric weight, high porosity	Humus, chalk sand, tuff	NO
		Organic loam and organic clay-loam mix	[OL] (OU)	Medium stability, mechanical reaction slow to very fast, plasticity low to medium	Sea chalk, humus	
		Organic clay, clay with organic matter	[OH] (OT)	High stability, no mechanical reaction, plasticity medium to high	Silt, moulder's loam	
organic	6	Peat, and other highly organic soils	[Pt] (HN) (HZ)	Decomposing peat, fi brous, colours from brown to black	Peat	NO
		Silt	[H]	Sludge deposited at the bottom of water-course, often mixed with sand/clay/chalk, very soft	Silt	

Deformation Under Load

SPANGLER Equation

$$Y = 0.083\,(p)/(16Sr + 0.12Es)$$

Where :

- **Y** : Deformation in meters(m)
- **P** : Total Load(Ground + Traffic) kN/m^2
- **Sr** : Ring Stiffness in KN/m
- **Es** : Secant Modulus of Ground in kN/m^2

Loads Due to Traffic And Static Loads

$$p_t = 3Q\, D_e / 2\pi H^2, \text{ in N/m}$$

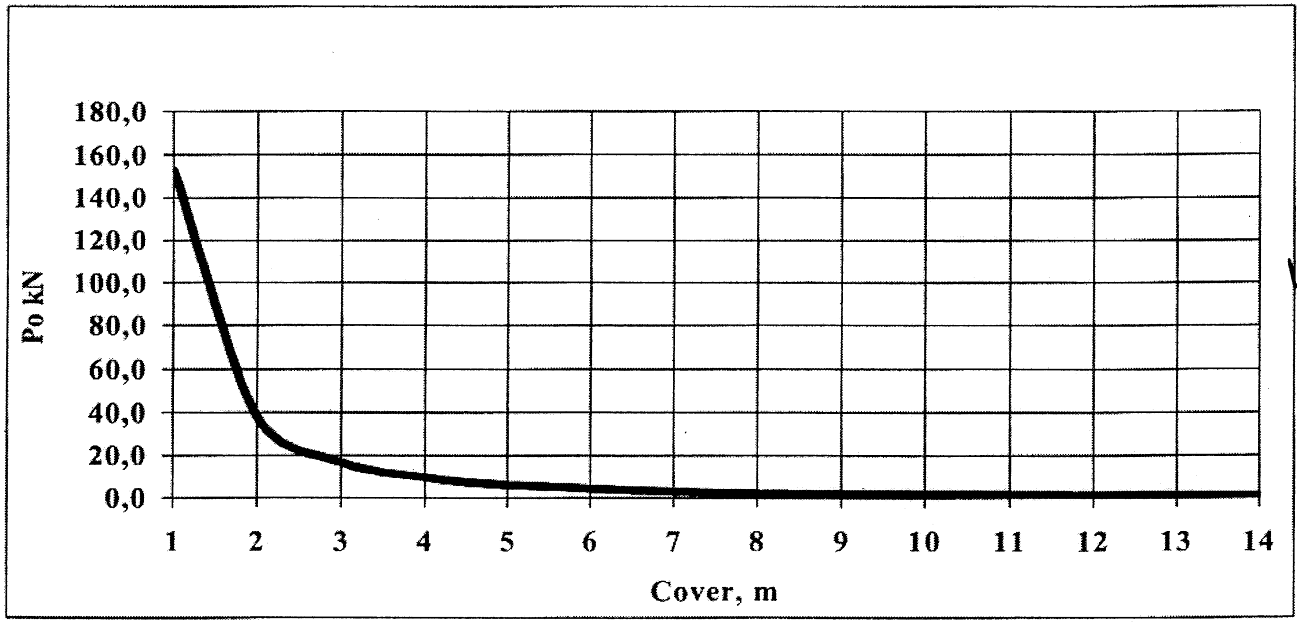
Where :

- **Q** : Wheel Load in KN, **D** : External Diameter in M
- **H** : Cover height, in M

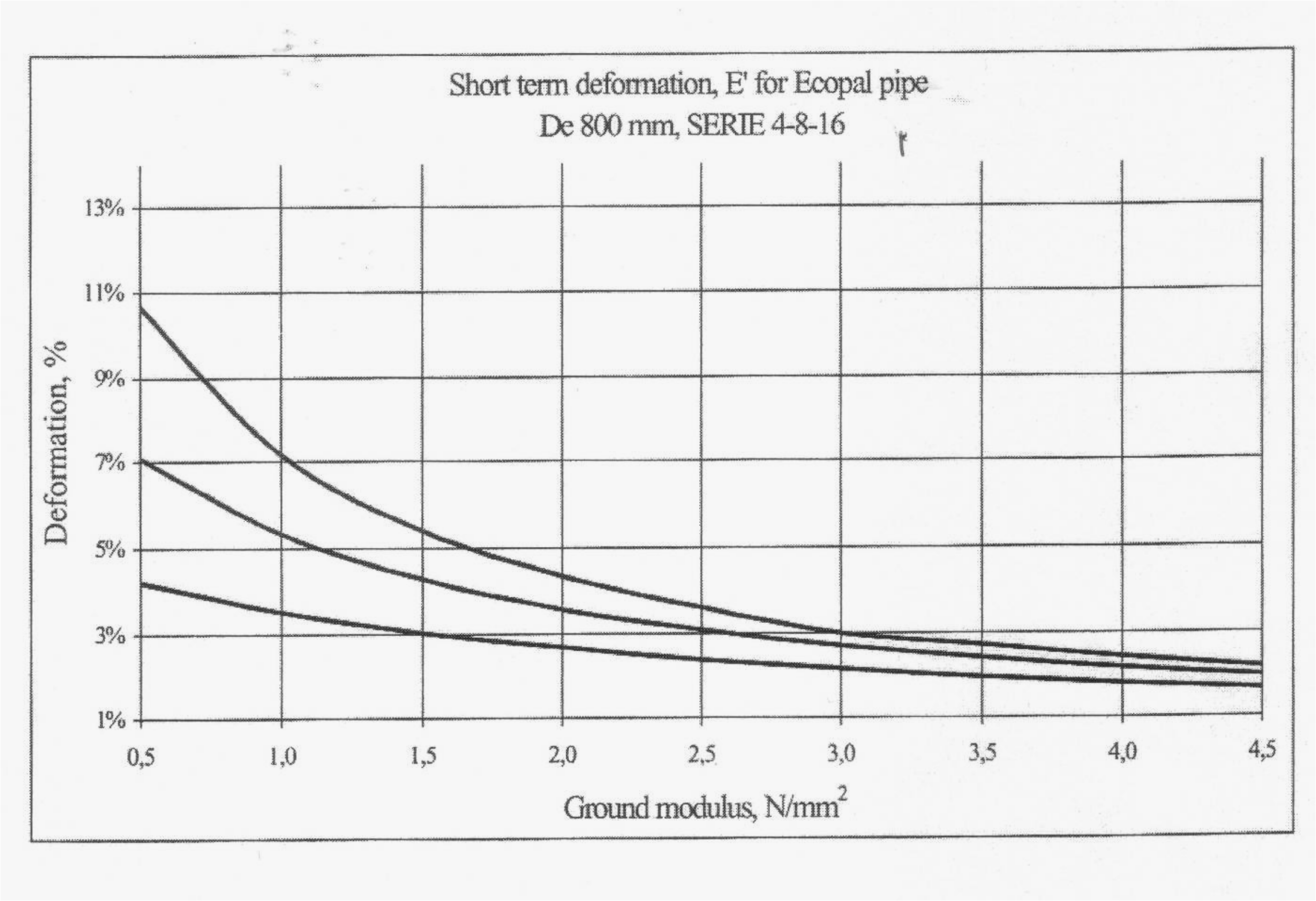
Class of load	Total load Q, kN	Wheel load Q, kN
Heavy traffic	600	100
Average traffic	450 300	75 50
Light traffic	120 60	20 20
Cars	30	10

Loads In Function of Laying Depths

H, m	0.5	1	2	3	4	5	6	7
P_0, kN	6.5	12	23	31	37	43	47	51
P_t, kN	153	38	10	2.2	2.4	1.5	1.1	0.8
P_{tot}, kN	159	51	32	35	40	44	48	52



Ground Modulus against Deformation Using pipes with different Ring Stiffness



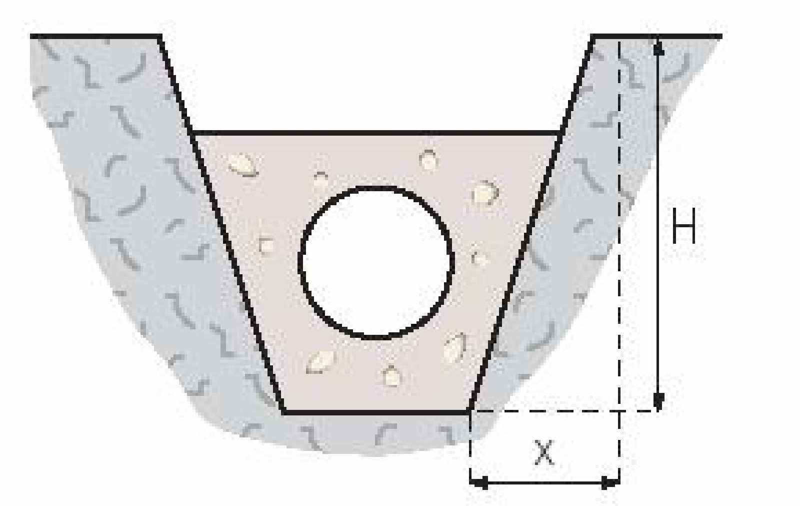
as the shortening of the vertical diameter can be simply kept within reasonable limits by fairly slight compaction, provided that the filling around the pipe consists of unfrozen friction material. Under such conditions as a rule, only 75 - 80% Modified Proctor packing is required which is generally attainable by mere foot tramping of the fill. An excellent example of a feasible embedment material, which does not need very much of compaction is a single size gravel, type pea gravel, commonly used in UK according to British Code of Practice. Thus, the mechanical compaction energy needed for achieving a dense soil around the pipe is rare. Pea gravel is therefore particularly suitable for supporting pipes with low ring stiffness values significantly below 4 kN/m^2, as then the compaction work itself will not contribute so very much to the otherwise easily occurring local "wild" deflections.

Pict 6.1.a. 17 caterpilar, 0,5m of cover. No deflection is visible. Pipe stiffness is $2kN/m^2$.

Trench construction

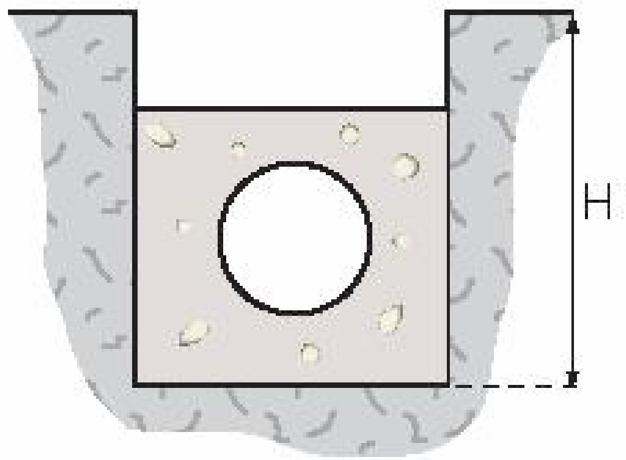
A. Open trench, sloping walls without boarding

Permissible slope in open trench without boarding	
Type of soil	**Max. slope H:x**
Highly cohesive	2:1
Rocky	1:1
Other cohesive soils	1:1.25
Non-cohesive	1:1.5



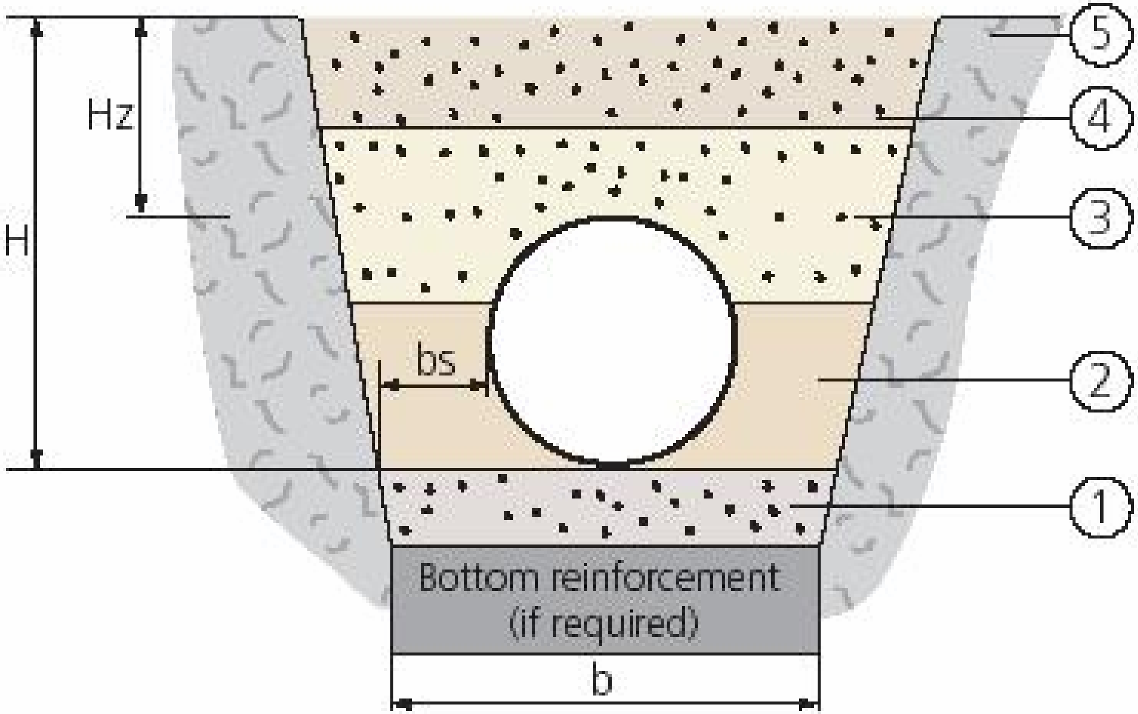
B. Open trench with vertical walls without boarding

Permissible depth of vertical wall trench without boarding	
Type of soil	**Max. trench depth**
Solid rocky ground without cracks	4.0 m,
Cohesive soils	1.5 m,
Other soils	1.0 m.



Laying Gravity Pipelines in the Ground

Sectional view of a trench for laying a pipeline



1. Sub-grade (bottom backfill)
2. Main backfill
3. Upper backfill
4. Top charge
5. Virgin soil

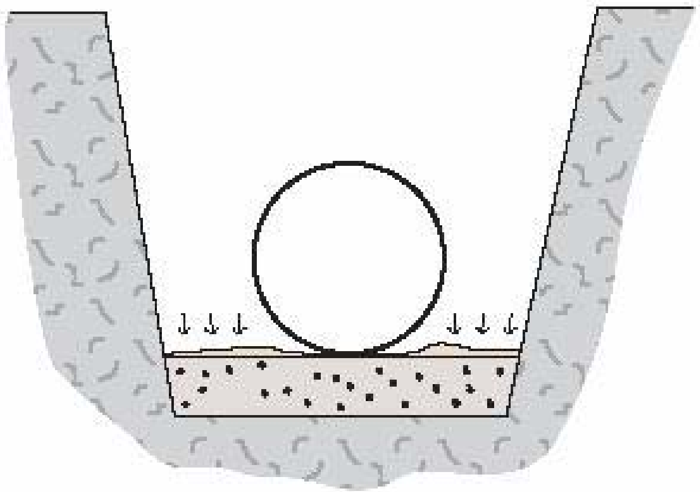
H – Trench depth
b – Trench width
Hz – Cover thickness

Minimum bs values	
de [mm]	bs [mm]
de < 300	200
300 < de < 900	300
900 < de < 1600	400
1600 < de < 2400	600
2400 < de < 3000	900

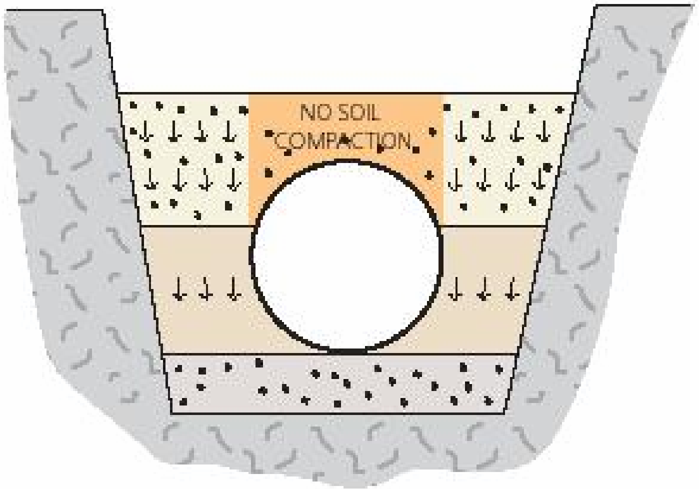
Minimum distance between pipe and trench slope depending on pipe diameter

Method for installation of pipelines in the ground

Preparation of sub-grade



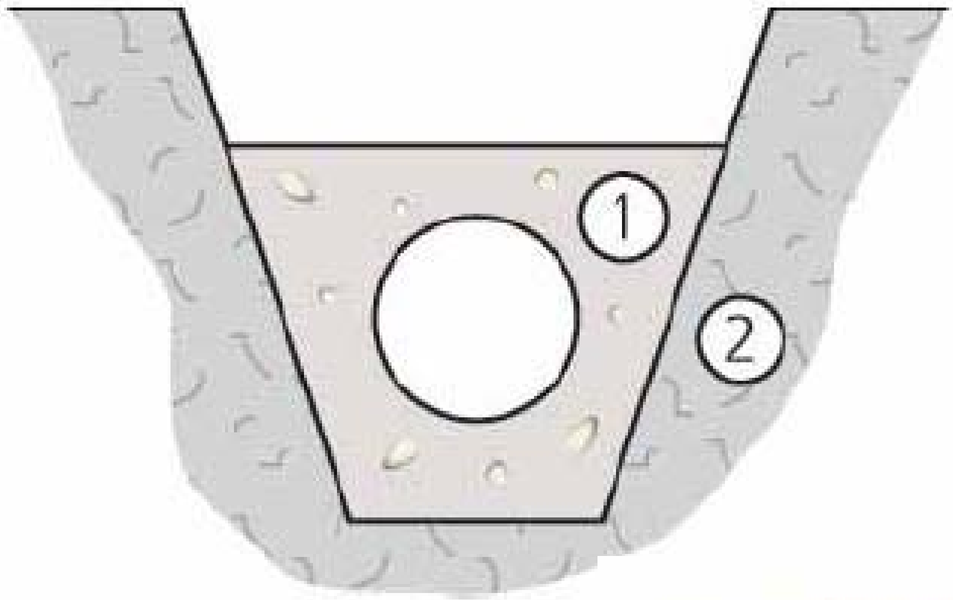
Main and upper backfill



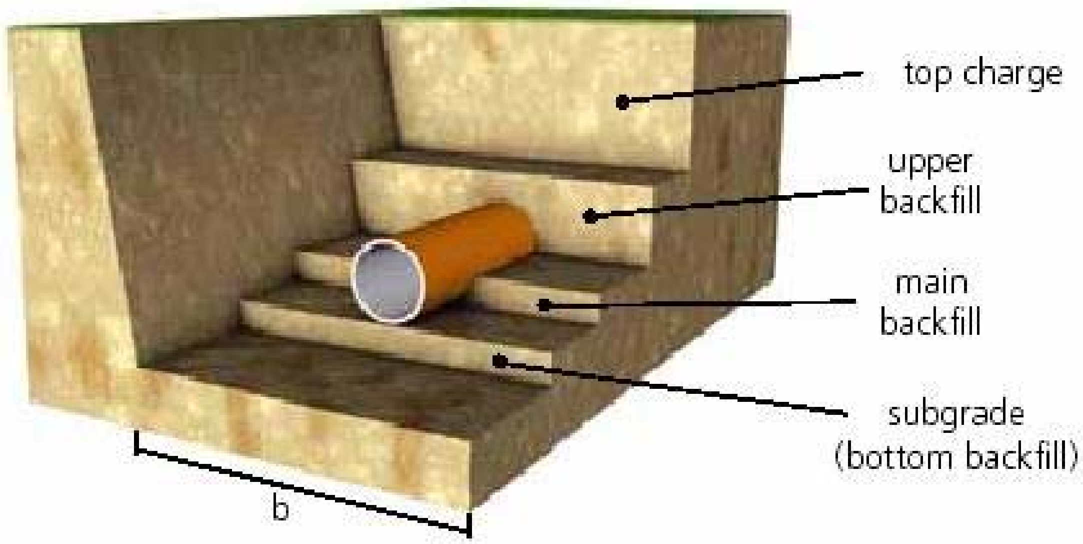
Required Granulation of Soil

Nominal diameter of pipe	Maximum particle size
DN ≤ 100	15
100 < DN ≤ 300	20
300 <DN ≤ 400	30
300 < DN ≤ 600	30
600 < DN ≤ 1600	40
1600 < DN ≤ 3000	50

Division of trench into zones of virgin soil (2) and the ground around pipeline (1)



Layers of soil with different density



Recommended minimum stiffness for pipes laid in ground not exposed to traffic generated loads

Backfill material [Group] ①	Class of density	Pipe stiffness [kN/m²]					
		1 m < Thickness of cover < 3 m					
		② Virgin soil group					
		1	2	3	4	5*	6*
1	W M	4 4	4 4	4 4	4 4	4 8	8 8
2	W M		4 4	4 4	4 8	8 8	8 8
3	W M			4 8	8 8	8 8	8 **
4	W M				8 **	8 **	8 **
		3 m < Thickness of cover < 6 m					
1	W M	4 4	4 4	4 4	4 8	8 8	8 8
2	W M		4 8	4 8	8 8	8 8	8 **
3	W M			8 **	8 **	8 **	** **
4	W M				** **	** **	** **

*) In grounds with low carrying capacity, pipe foundation should be reinforced e.g. with geotextiles (see paragraph 8.12.)
**) Static calculations are necessary for determination of geometry of trench and pipe stiffness.

Recommended minimum stiffness for pipes laid in ground subjected to traffic generated loads

Backfill material [Group] ①	Class of density	Pipe stiffness [kN/m²]					
		1 m < Thickness of cover < 3 m					
		② Virgin soil group					
		1	2	3	4	5*	6*
1	W	4	4	8	8	8	**
2	W		8	8	8	**	**
3	W			8	**	**	**
4	W				**	**	**
		3 m < Thickness of cover < 6 m					
1	W	4	4	4	8	8	8
2	W		4	4	8	8	8
3	W			8	8	8	**
4	W				**	**	**

*) In grounds with low carrying capacity pipe foundation should be reinforced e.g. with geotextiles (see paragraph 8.12.)

**) Static calculations are necessary for determination of geometry of trench and pipe stiffness.

In addition, when pipeline is laid under unsurfaced road (particularly if depth is small) pipeline may be covered with reinforced slabs for greater safety.

Manhole according to DIN 19537

UDC 621.643.2.06-036.742.2 : 628.253 : 620.1 DEUTSCHE NORM November 1990

Prefabricated high density polyethylene (PE-HD) manholes for use in sewerage systems
Dimensions and technical delivery conditions

DIN 19 537 Part 3

Rohre, Formstücke und Schächte aus Polyethylen hoher Dichte (PE-HD) für Abwasserkanäle und -leitungen; Fertigschächte; Maße, technische Lieferbedingungen

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

Dimensions in mm

Contents

1 Scope and field of application

This standard specifies requirements and methods of test for prefabricated circular manholes made from high density polyethylene (PE-HD) components as specified in subclause 2.2 of this standard and DIN 19 537 Part 2.

This standard shall apply by analogy for prefabricated manhole components of other cross-sectional shape.

2 Concepts

The general terminology used here has been taken from DIN 19 549, except for concepts and nomenclature characteristic of manholes made from PE-HD components.

2.1 Manhole

For the purposes of this standard, a manhole is a structure built on a buried drain or sewer, which is mainly intended for ventilation purposes and permits entry of a person for inspection, maintenance and cleaning. It may be designed to accommodate sewage lifting equipment and be provided at junctions of drains or sewers and at points where these change direction, gradient or cross section (quoted from DIN 19 549, February 1989 edition).

PE-HD manholes are assembled from prefabricated components, as illustrated in figure 1.

2.2 Manhole components

2.2.1 Bottom section

A bottom section is a manhole component that consists of:

a) base;
b) channel;
c) benching;
d) connector;
e) single-unit shaft.

Table 1. Diameter and wall thickness of single-unit shaft

Manhole size DN	External diameter, d	Minimum wall thickness, s*)
1000	1100 [illegible]	34,2
1100	1200 [illegible]	37,3
1600	1800 [illegible]	49,7

*) s as determined by design analysis.

Continued on pages 2 to 6

Table 1. Diameter and wall thickness of single-unit shaft

Manhole size DN	External diameter, d	Minimum wall thickness, s*)
1000	1100 [illegible]	34,2
1100	1200 [illegible]	37,3
1600	1800 [illegible]	49,7

*) s as determined by design analysis.

Manhole according to DIN 19537

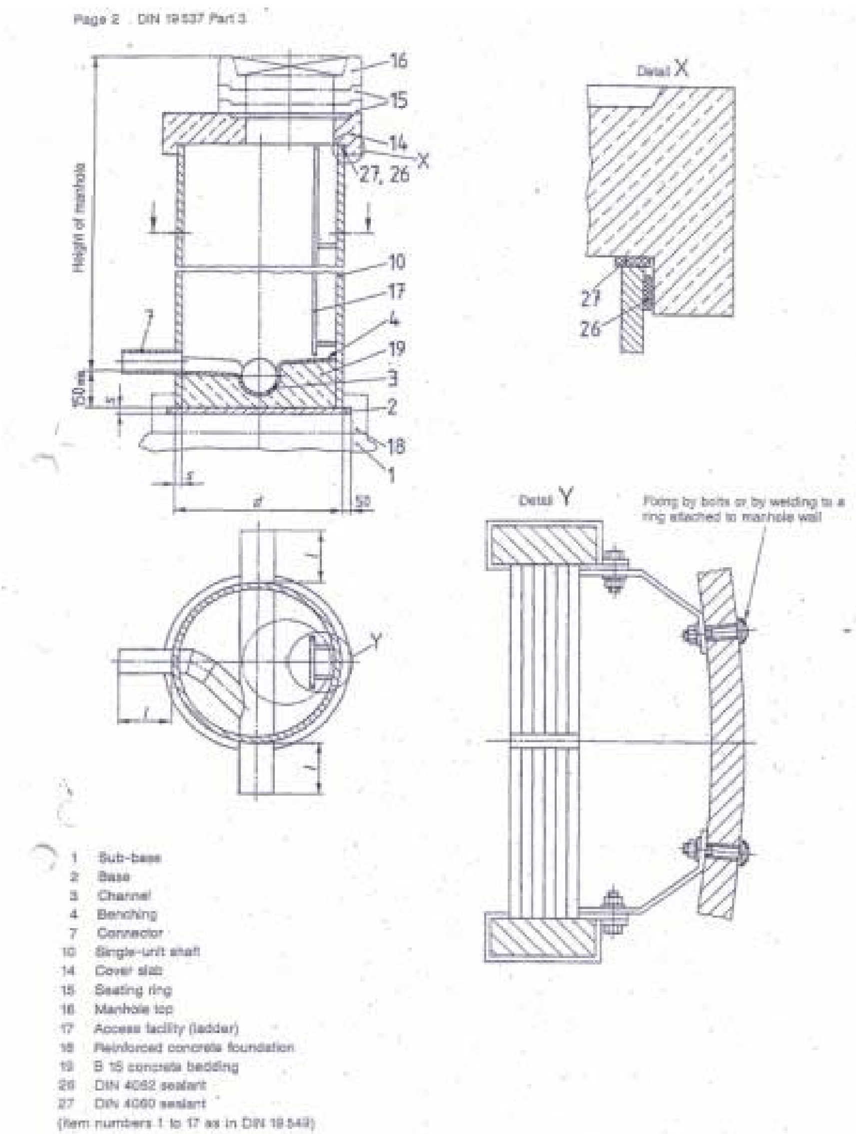
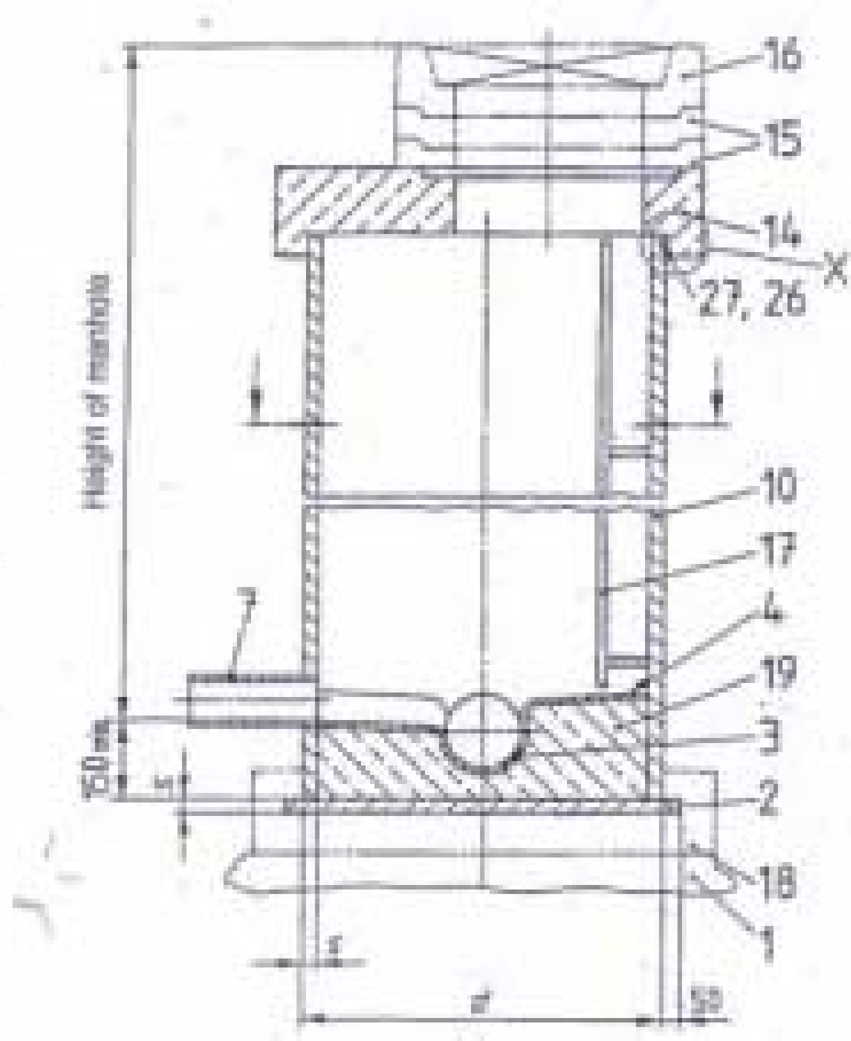


Figure 1. Prefabricated PE-HD manhole (assembly)

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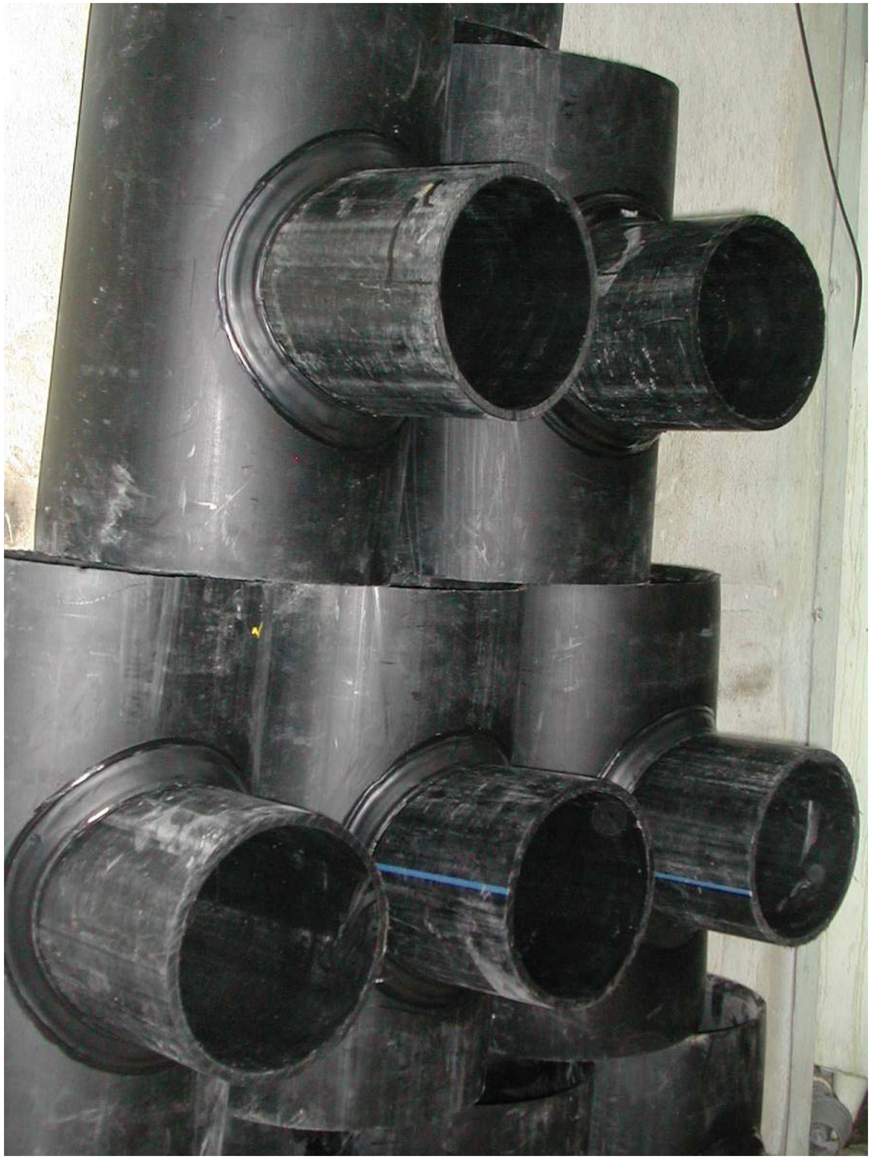
House Connection

House Connection

House Connection



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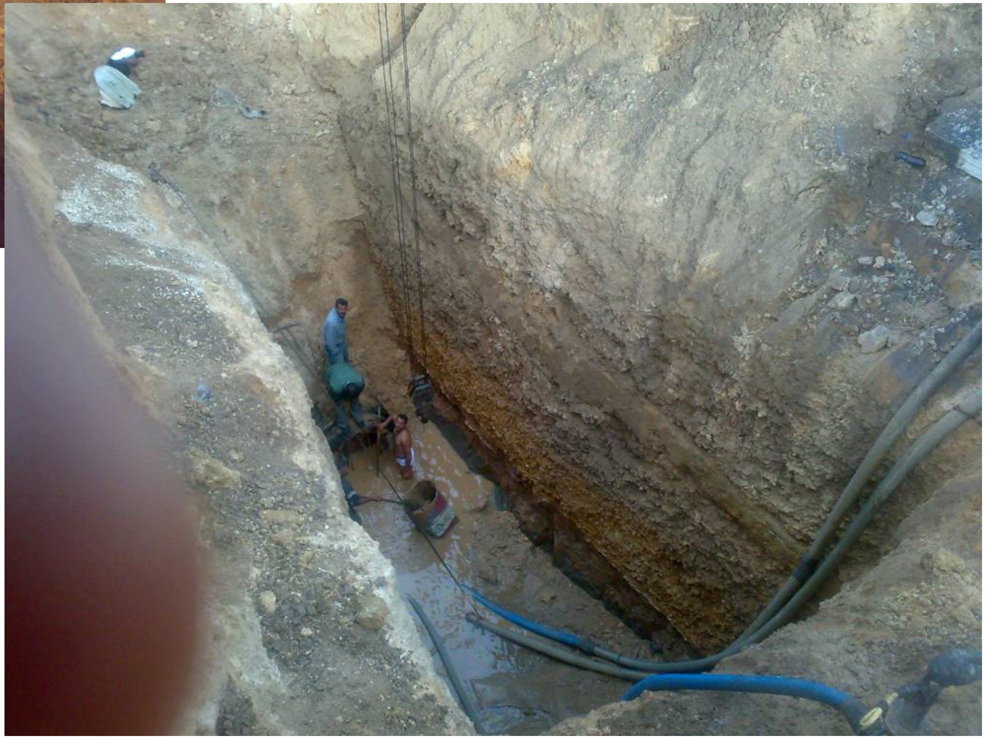

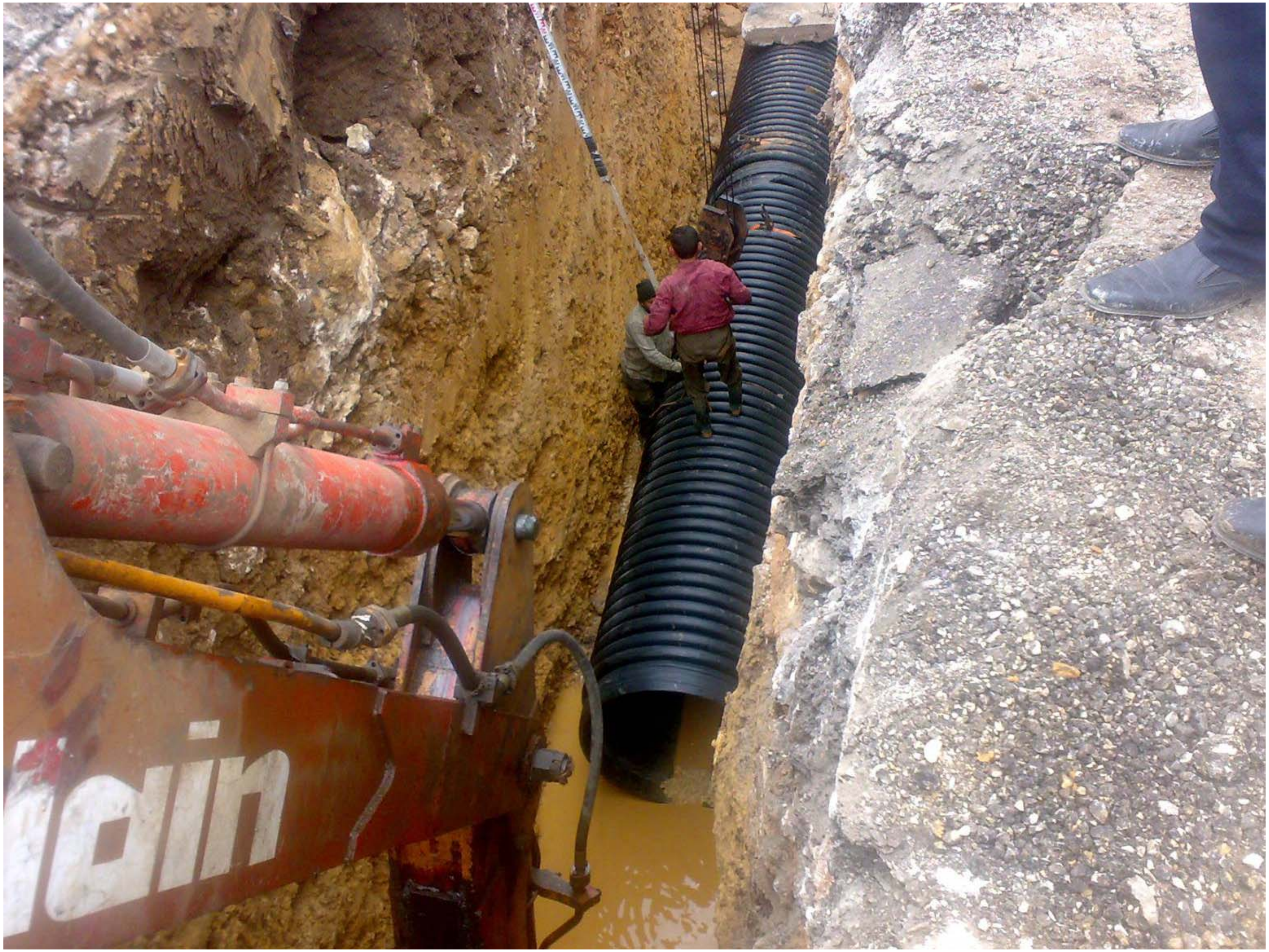

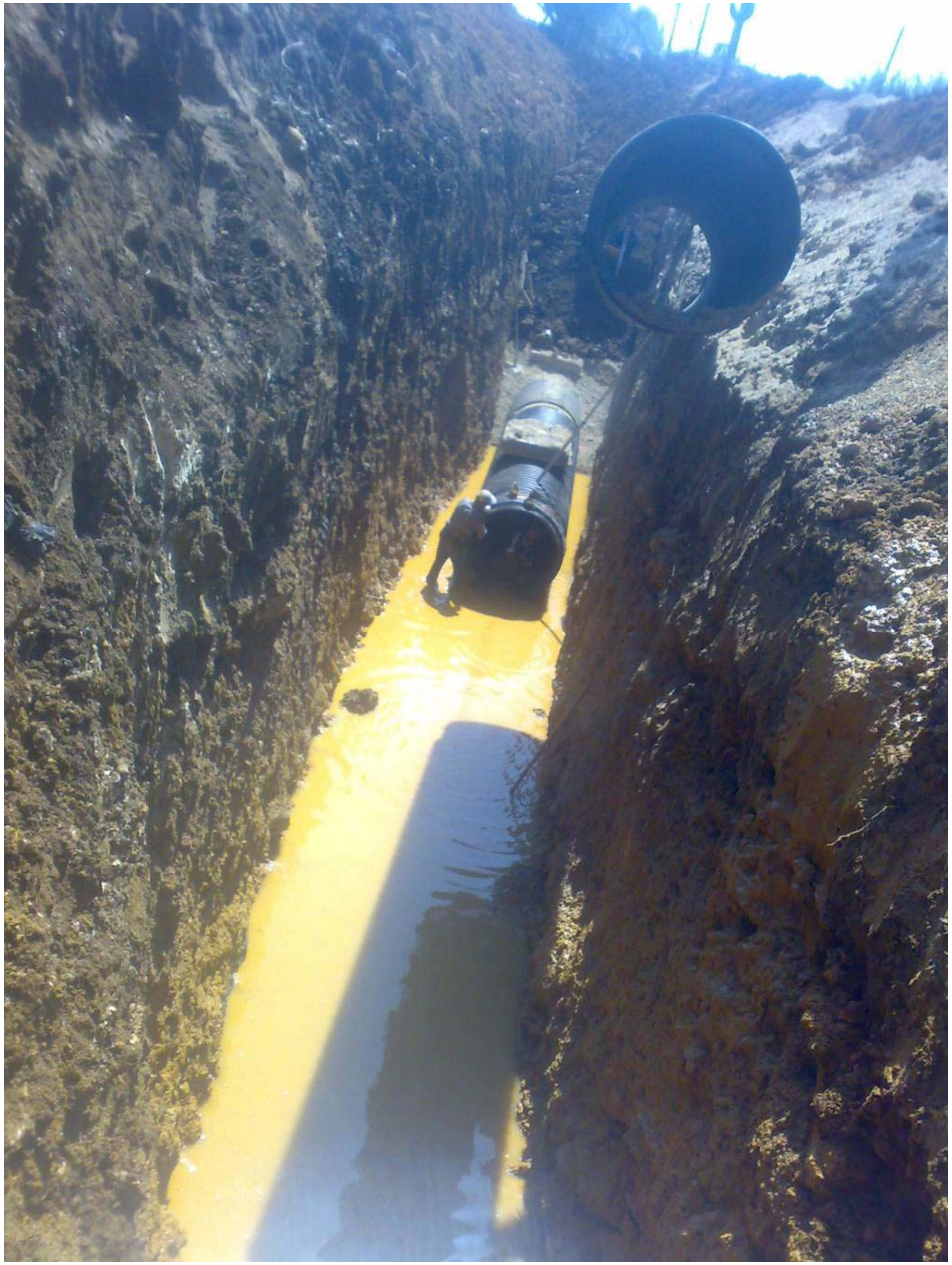




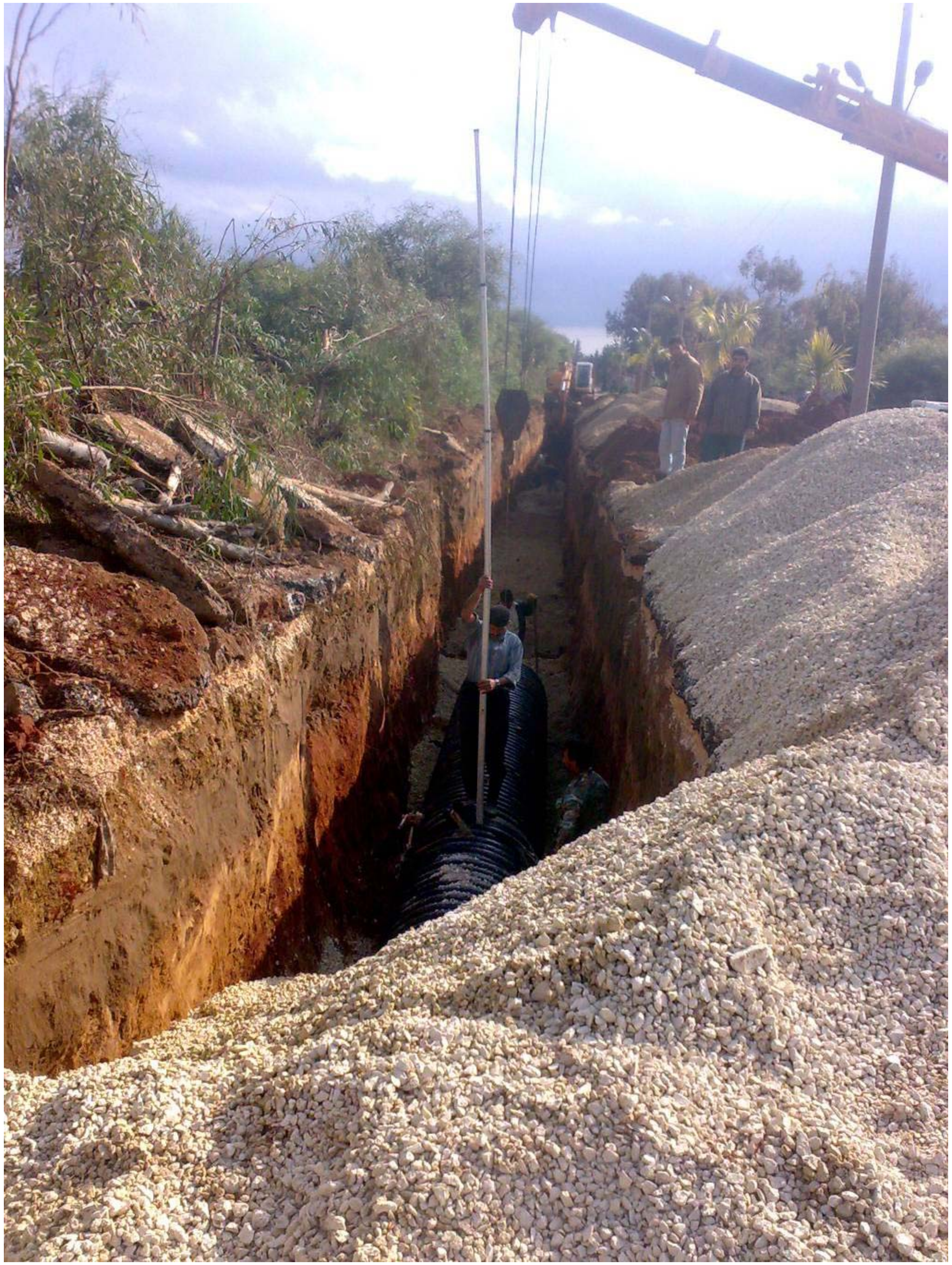

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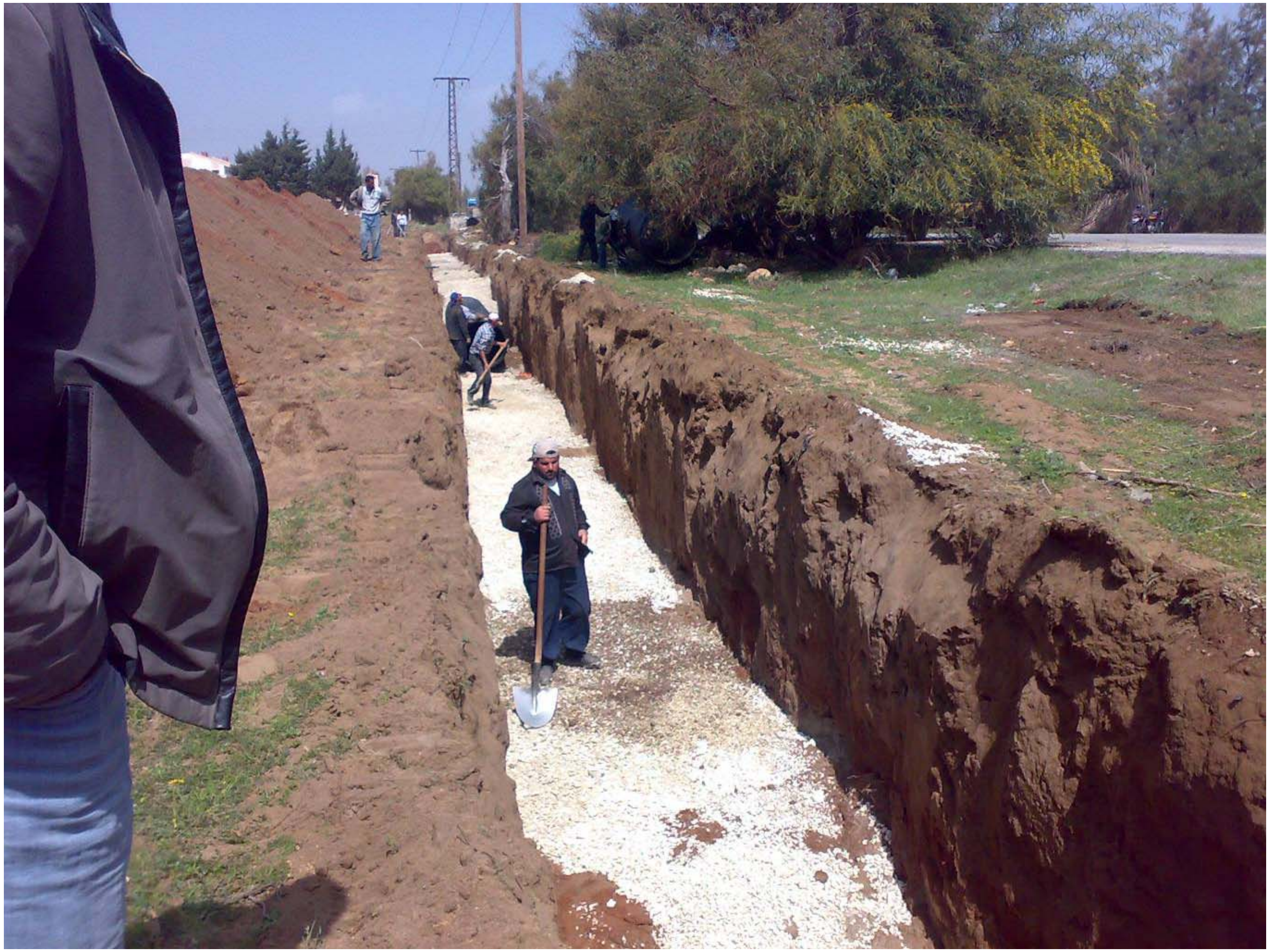

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Cost Comparisons Of Sewer Pipes

Description	Percent	Corrugated HDPE Pipes	PVC Spiral Wound Pipes	Reinforced Concrete Pipes	GRP Polyster Pipes	Asbestos Cement Pipes	Ductile Iron Pipes	Steel Pipes
Material cost	25%	20	16	12	18	14	25	22
Installation cost	45%	25	32	45	38	40	35	35
Maintenance cost	17%	6	8	17	12	15	10	10
Transportation	10%	8	8	10	8	10	10	10
Site Waste	3%	1	2	3	3	3	1	1
Total Cost	100%	60	66	87	79	82	81	78
Service Life		50	25	15	25	15	25	20
Annual cost		1.2	2.64	5.8	3.16	5.46	3.24	3.90

Specification Comparison Of Sewer Piping

Description	Corrugated HDPE Pipes	PVC Spiral Wound Pipes	Reinforced Concrete Pipes	GRP Polyester Pipes	Asbestos Cement Pipes	Ductile Iron Pipes	Steel Pipes
Chemical resistance	Excellent	Average	Poor	Average	Poor	Poor	Poor
Tightness/Joint quality	Excellent	Average	Poor	Average	Poor	Average	Average
Soil movement strength	Excellent	Poor	Poor	Poor	Poor	Poor	Poor
Service maintenance	Too Low	Low	High	Average	High	Average	Average
Service life	Excellent	Average	Low	Average	Low	Average	Average
Abrasion	Excellent	Average	Poor	Poor	Poor	Good	Good
Installation	Fast	Fast	Slow	Slow	Slow	Average	Slow
Site Waste	Low	Average	High	Average	High	Average	Average
Smoothness	Excellent	Excellent	Poor	Average	Average	Average	Average
Impact Strength	Excellent	Poor	Poor	Poor	Poor	Poor	Poor
Flexibility	Excellent	Poor	Poor	Poor	Poor	Poor	Poor
Tensile strength	Average	Good	Poor	Poor	Poor	Excellent	Excellent