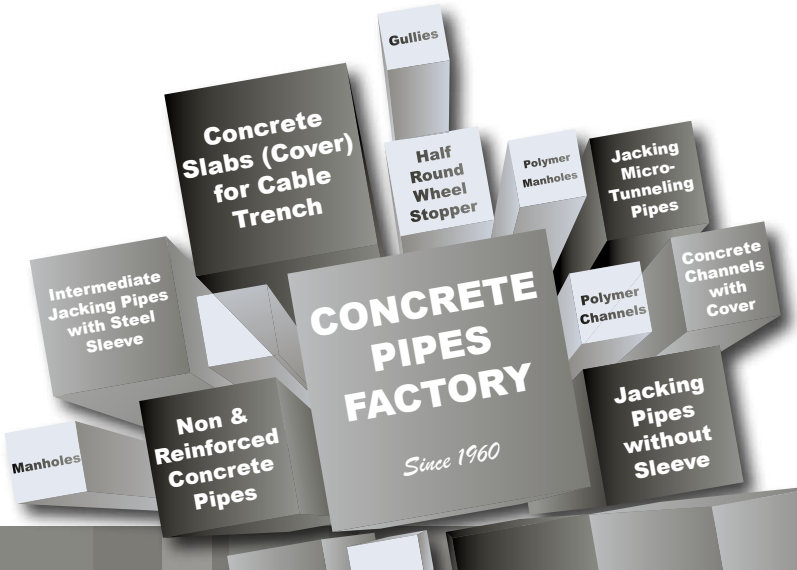
شركة الصناعات الوطنية ش.م.ك
NATIONAL INDUSTRIES COMPANY K.S.C.C.
www.nicbm.com | ☎ 1 844 555
national_Industries | 99 00 11 46

CONCRETE PIPES

NIC Catalogues



NIC Products


Interlock & Yard Tiles


Limestone


Plastics


LED Lights


Dry Mortar


Cement Cladding Bricks


Ready Mix


Ceramics


White Blocks


Benches & Flower Pots

Paints


Cladding


Concrete Pipes

HDPE


NI Panels

introduction

The National Industries Companys Concrete Pipe Factory is one of the largest modern pipe factories in the Middle East. The Production capacity of the plant is approx. 250 metric Km per year.

Its technology and comprehensive qulity control programme makes it a pioneer in the field. Pipes are produced using semi-dry concrete mixes in a vertical cast method with the latest vibration technique. Fresh concrete pipes are cured in heated kilns using thermal oil in a moist atmosphere. Raw materials for the production are procured and tested according to British standard specifications. Only tested raw materials shall be used for production. Aggregates and sand are washed in the factory before usage.

THE CONCRETE PIPE FACTORY PRODUCES THE FOLLOWING PIPES / FITTINGS

1. Precast Non reinforced & Reinforced concrete pipes for open trench.
2. Ancillary Products such as:
   - Manhole rings.
   - Road side Gulley & Shaft.
3. HDPE / GRP lined concrete pipes for open trench.
4. Precast Jacking / Micro tunneling concrete pipes.
5. HDPE / GRP lined Jacking / Micro tunneling concrete pipes.
6. Precast concrete box culvert / Barriers / Dolos / U-Shape Channel / Covers. etc.
7. Intermediate Concrete Jacking pipes.

USAGE

Concrete pipes are used for:

- Storm drains.
- Sanitary sewers
- Irrigation distribution systems.
- low pressure sewer force mains.
- Treatment plant piping
- Jacked or tunneled systems.
- Ground water recharge systems.

DIAMETER

Pipes are available in the following diameters:
DN. 250, 300, 350, 400, 450, 500, 600, 700, 800, MM.
DN. 900, 1000, 1200, 1400, 1600, 1800, 2000, 2100 & 2400 MM.
Larger and other special diameters can be produced.

LENGTH

Pipe DN 250 & 300 mm shall have a length of 1.250 meters.
All other diameters from DN 350 to 2400 mm shall be in 2 meters.
Pipes can be cut to any shorter length.

APPLICABLE STANDARDS

1. BS EN 1916:2002 & BS 5911-1:2002
2. ASTM C 76 specification for reinforced sewer and storm drain pipes. (Only on special requests)

INTERNATIONAL & LOCAL APPROVALS

- ISO 9001 registered firm.
- M.P.W Approval

QUALITY ASSURANCE

- Concrete pipe factory has an independent quality control department with a well equipped laboratory, aided by experienced staff to give the necessary backup for the quality assurance program.
- Ministry of Public Work's staff monitor all matters pertaining to the quality of the products.
- A certificate of compliance is issued for each production.

REINFORCEMENT

- Storm drainage pipes DN 250 to 600 mm are available in non-reinforced as per B.S. standard.
- DN 350 mm and above are reinforced.

JOINTS

- Joints of normal concrete pipes are of spigot and socket type with an elastomers ring.
- GRP / HDPE lined sewer drainage pipes have in wall flexible joints with an elastomeric ring.

LAYING

Refer to concrete pipes laying instruction manual.

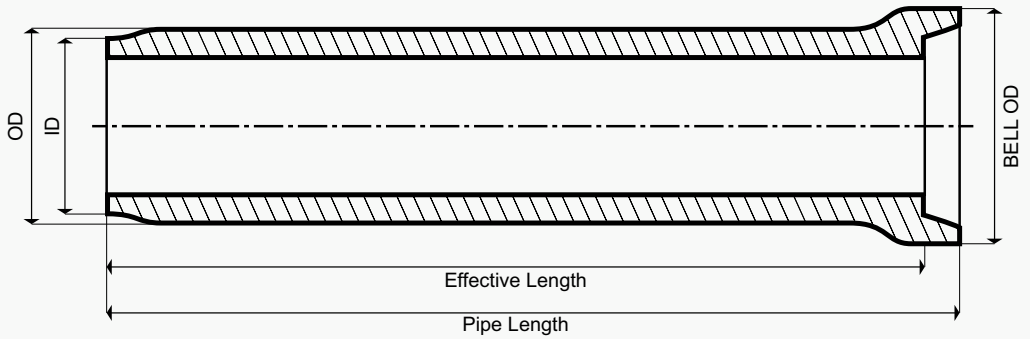
GRP/HDPE LINED CONCRETE, SEWER PIPE AND MANHOLES

Glass fibre reinforced plastic pipe (GRP) / high density polyethylene (HDPE) are durable and resistance to acid, alkaline and salts.

GRP / HDPE proved to be the most successful method to protect concrete from the corrosive effects of sanitary and industrial wastes. Continuity of the lining is assured by having in-wall flexible joints.

When GRP / HDPE lines are installed in aggressive soils, external corrosion is avoided by coating the outer side of the pipe with two coats of coal tar epoxy. Two types of sewer pipes are produced. One for open trench laying and the other for microtunelling / jacking process

CONCRETE PIPES FOR OPEN TRENCH LAYING WITH SPIGOT & BELL



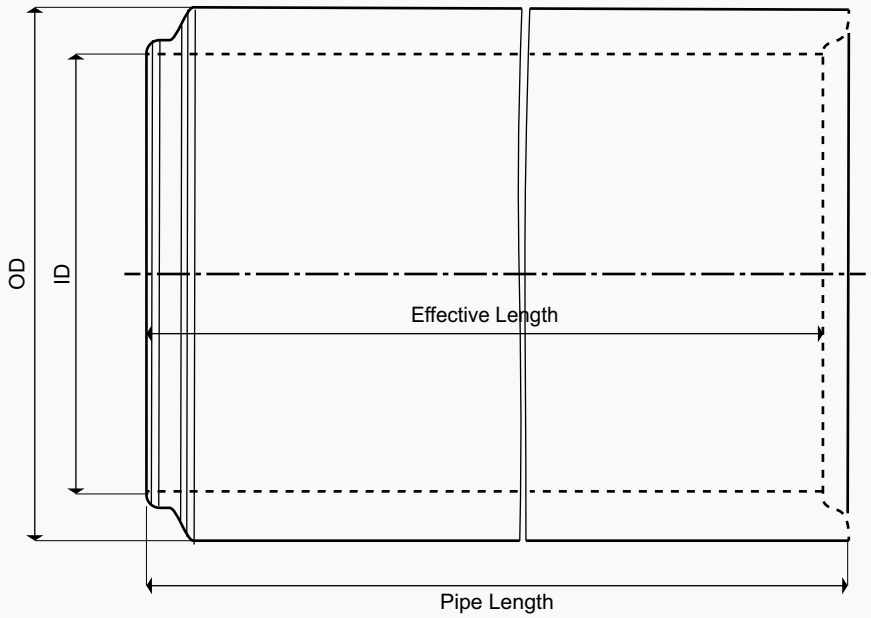
Non-Reniforced Concrete Pipes

Pipe Dia *mm*	Wall Thick. *mm*	Outer Dia *mm*	Bell Dia *mm*	Effective Length *mm*	Pipe Length *mm*	Joint *Type*	Pipe Weight *kg*
250	45	340	426	1250	1340	spigot & bell	140
300	50	400	496	1250	1340	spigot & bell	195
350	65	480	585	2000	2090	spigot & bell	450
400	70	540	665	2000	2090	spigot & bell	555
450	75	600	745	2000	2090	spigot & bell	685
500	85	670	825	2000	2090	spigot & bell	850
600	105	810	933	2000	2110	spigot & bell	1210

Reniforced Concrete Pipes

Pipe Dia *mm*	Wall Thick. *mm*	Outer Dia *mm*	Bell Dia *mm*	Effective Length *mm*	Pipe Length *mm*	Joint *Type*	Steel Cages *No.*	Pipe Weight *kg*
350	95	540	665	2000	2090	spigot & bell	single	700
400	100	600	745	2000	2090	spigot & bell	single	808
450	110	670	825	2000	2090	spigot & bell	single	1121
500	125	750	858	2000	2090	spigot & bell	single	1235
600	105	810	933	2000	2110	spigot & bell	single	1210
700	85	870	988	2000	2110	spigot & bell	single	1120
800	100	1000	1128	2000	2110	spigot & bell	single	1500
900	110	1120	1282	2000	2126	spigot & bell	single	1900
1000	115	1230	1410	2000	2126	spigot & bell	single	2300
1200	130	1360	1702	2000	2126	spigot & bell	double	3200
1400	150	1700	1962	2000	2126	spigot & bell	double	4250

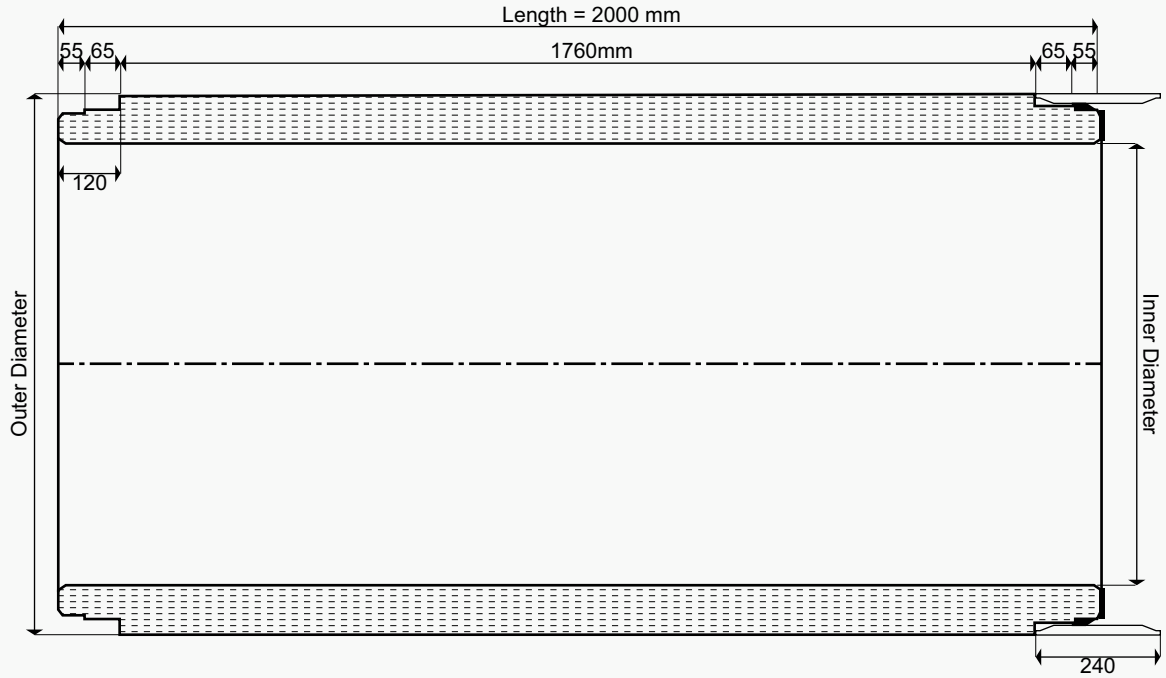
CONCRETE PIPES FOR OPEN TRENCH LAYING WITHOUT BELL



Reniforced Concrete Pipes

Pipe Dia *mm*	**Wall Thick.** *mm*	**Outer Dia** *mm*	**Effective Length** *mm*	**Pipe Length** *mm*	**Joint** *Type*	**Steel Cages** *No.*	**Pipe Weight** *kg*
1600	170	1940	2000	2126	spigot & socket in wall	double	4650
1800	190	2180	2000	2126	spigot & socket in wall	double	5800
2000	220	2440	2000	2126	spigot & socket in wall	double	7700
2100	235	2570	2000	2126	spigot & socket in wall	double	7980

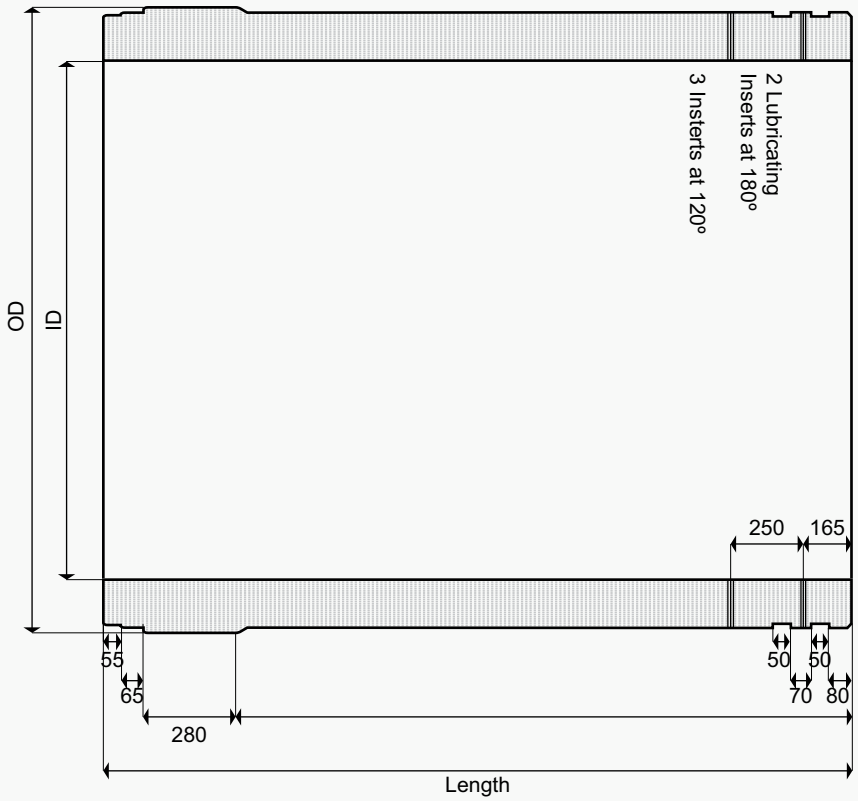
CONCRETE JACKING /MICRO TUNNELING PIPES



Reniforced Concrete Pipes

Pipe Dia *mm*	**Wall Thick.** *mm*	**Outer Dia** *mm*	**Pipe Length** *mm*	**Joint** *Type*	**Steel Cages** *No.*	**Pipe Weight** *kg*	**Allowable Jacking Force** *tonne*
400	130	660	2000	collar	single	993	200
500	130	760	2000	collar	single	1160	200
600	125	850	2000	collar	single	1300	230
800	120	1040	2000	collar	double	1550	240
900	152.5	1205	2000	collar	double	2260	400
1000	115	1230	2000	collar	double	1800	280
1200	150	1500	2000	collar	double	2860	500
1400	185	1770	2000	collar	double	4200	800
1600	170	1940	2000	collar	double	4250	800
1800	180	2160	2000	collar	triple	5050	950
2000	190	2380	2000	collar	triple	5880	1100
2400	300	3000	2000	collar	double	11470	2400

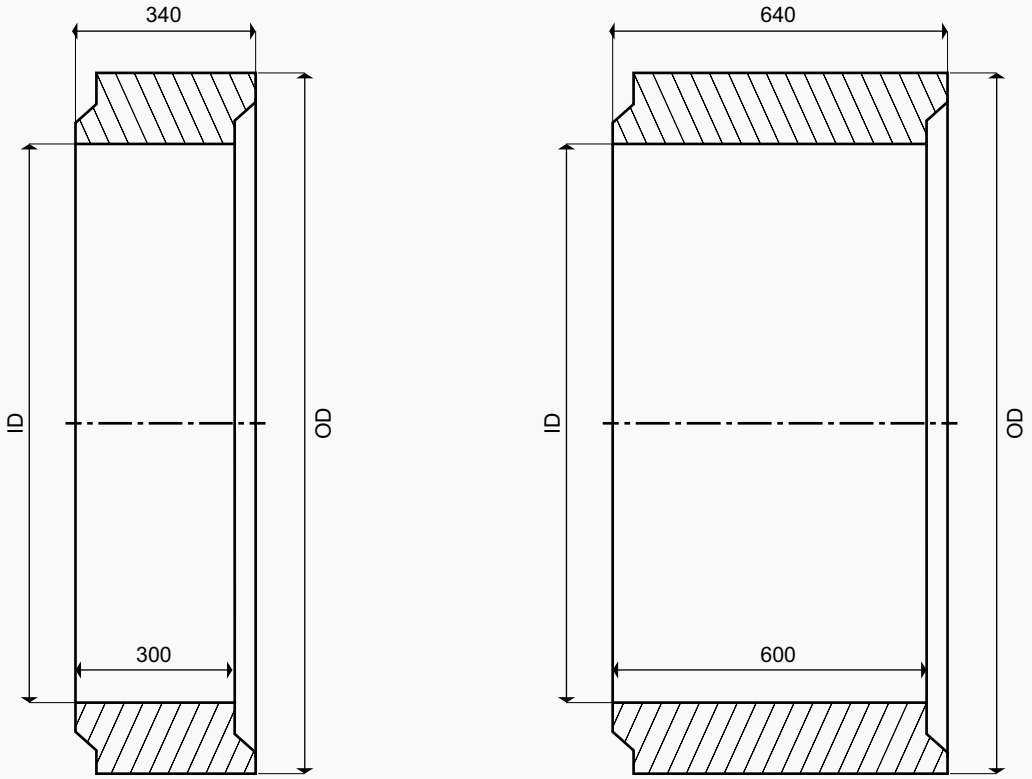
INTERMEDIATE CONCRETE JACKING PIPE



Reniforced Concrete Pipes

Pipe Dia *mm*	**Wall Thick.** *mm*	**Outer Dia** *mm*	**Pipe Length** *mm*	**Joint** *Type*	**Steel Cages** *No.*	**Pipe Weight** *kg*	**Allowable Jacking Force** *tonne*
1600	170	1940	2250	collar	double	4740	800
2400	300	3000	2250	collar	double	12900	2400

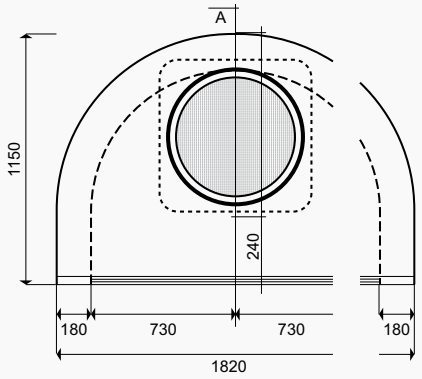
CONCRETE MANHOLE RINGS



Reniforced Concrete Pipes

Pipe Dia *mm*	**Wall Thick.** *mm*	**Outer Dia** *mm*	**Effective Hight** *mm*	**Total Hight** *mm*	**Joint** *Type*	**Steel Rings** *No.*	**Weight** *kg*
1000	120	1240	300	340	spigot & socket in wall	2	300
1000	120	1240	600	640	spigot & socket in wall	3	600

ROAD SIDE D SHAPE WERTICAL GULLEY



Reniforced Concrete Gulley

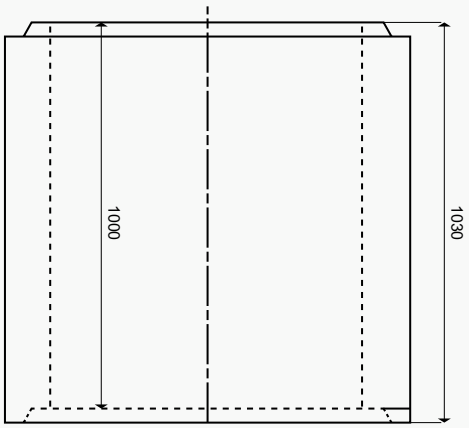
Length: 1840 mm

Width: 1150 mm

Height: 450 mm

Weight: 1070 kg

REINFORCED CONCRETE SHAFT

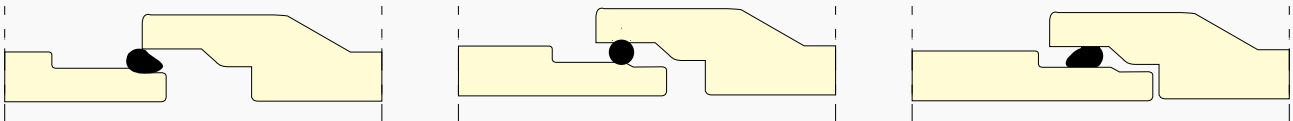


Pipe Diameter	800 mm
Wall Thickness	110 mm
Outer Diameter	1020 mm
Effective Hight	1000 mm
Total Hight	1030 mm
Joint	spigot & socket in wall
Steel Rings	8 rings
Weight	700 kg

Joint:

The Seal is a compression seal which is rolled into place.

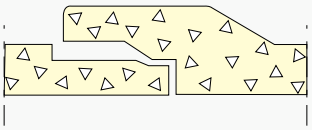
The G-ring as a roll joint



Starting position

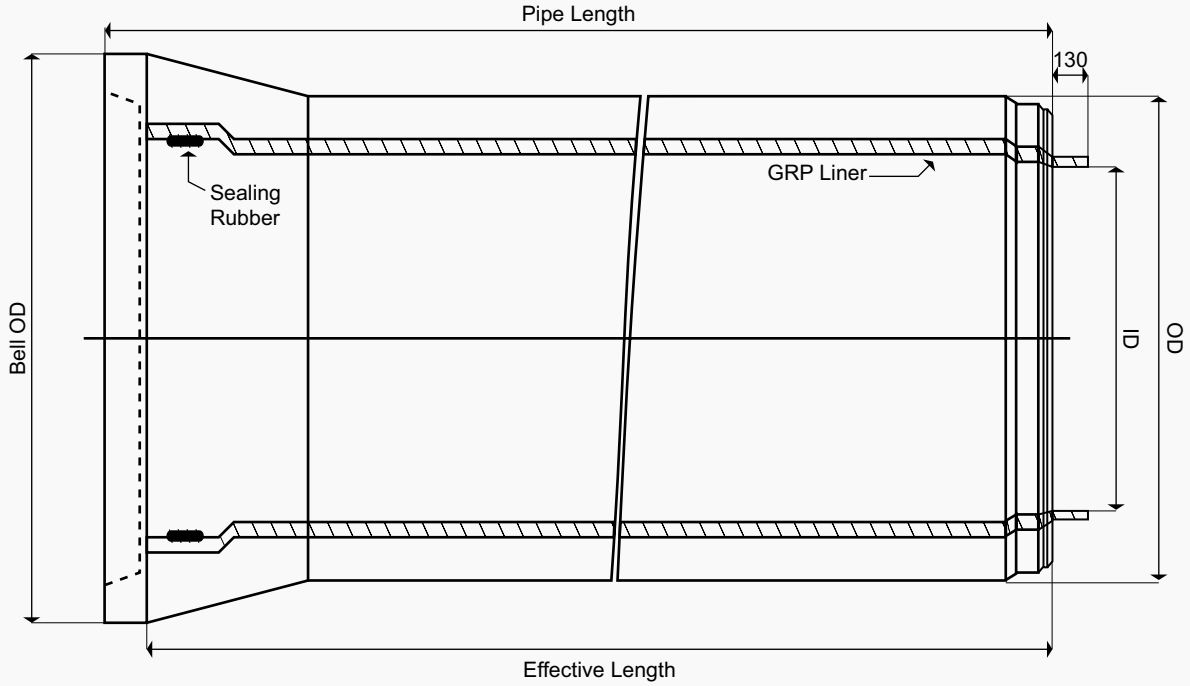
The pipes are pushed together.
The G-ring rolls over half a turn

Finished joint



Pipe material and design:
Spigot-and-socket concrete pipe.
A typical joint design is shown below.

GRP INTEGRAL CONCRETE PIPES FOR OPEN TRENCH LAYING WITH SPIGOT & BELL



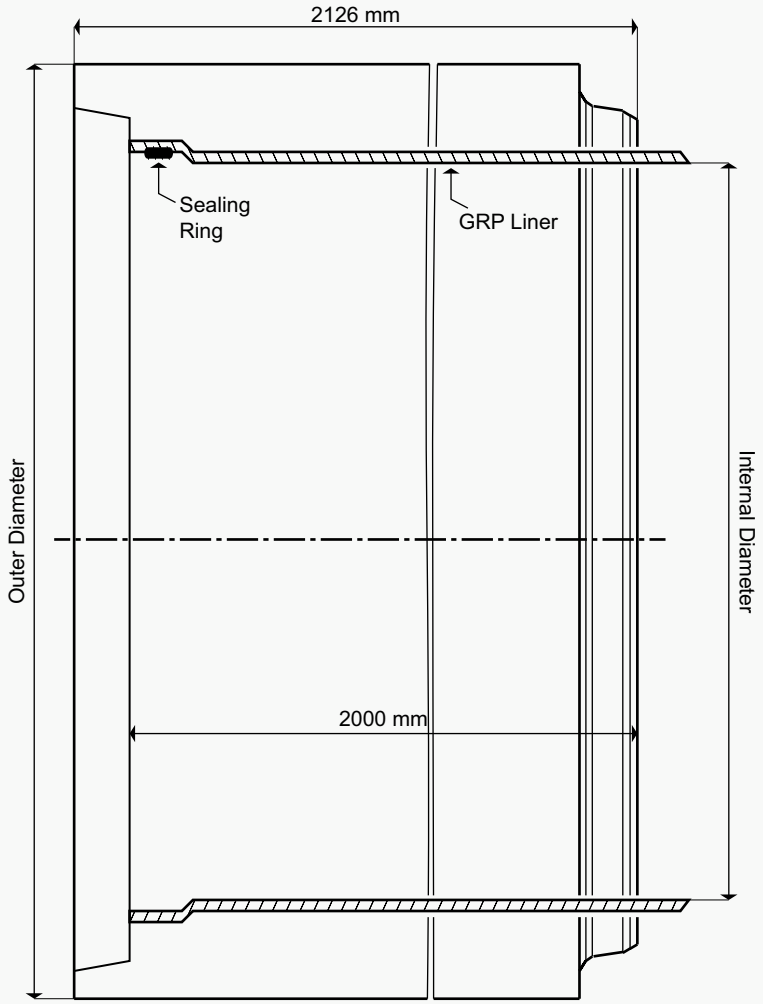
Non-Reniforced Concrete Pipes

Pipe Dia *mm*	Wall Thick. *mm*	Outer Dia *mm*	Bell Dia *mm*	Effective Length *mm*	Pipe Length *mm*	Joint *Type*	Pipe Weight *kg*
500	85	670	825	2000	2090	spigot & bell	850
600	105	810	933	2000	2110	spigot & bell	1210

Reniforced Concrete Pipes

Pipe Dia *mm*	Wall Thick. *mm*	Outer Dia *mm*	Bell Dia *mm*	Effective Length *mm*	Pipe Length *mm*	Joint *Type*	Steel Cages *No.*	Pipe Weight *kg*
600	105	810	933	2000	2110	spigot & bell	single	1210
700	85	870	988	2000	2110	spigot & bell	single	1120
800	100	1000	1128	2000	2110	spigot & bell	single	1500
900	110	1120	1282	2000	2126	spigot & bell	single	1900
1000	115	1230	1410	2000	2126	spigot & bell	single	2300
1200	130	1360	1702	2000	2126	spigot & bell	double	3200
1400	150	1700	1962	2000	2126	spigot & bell	double	4250

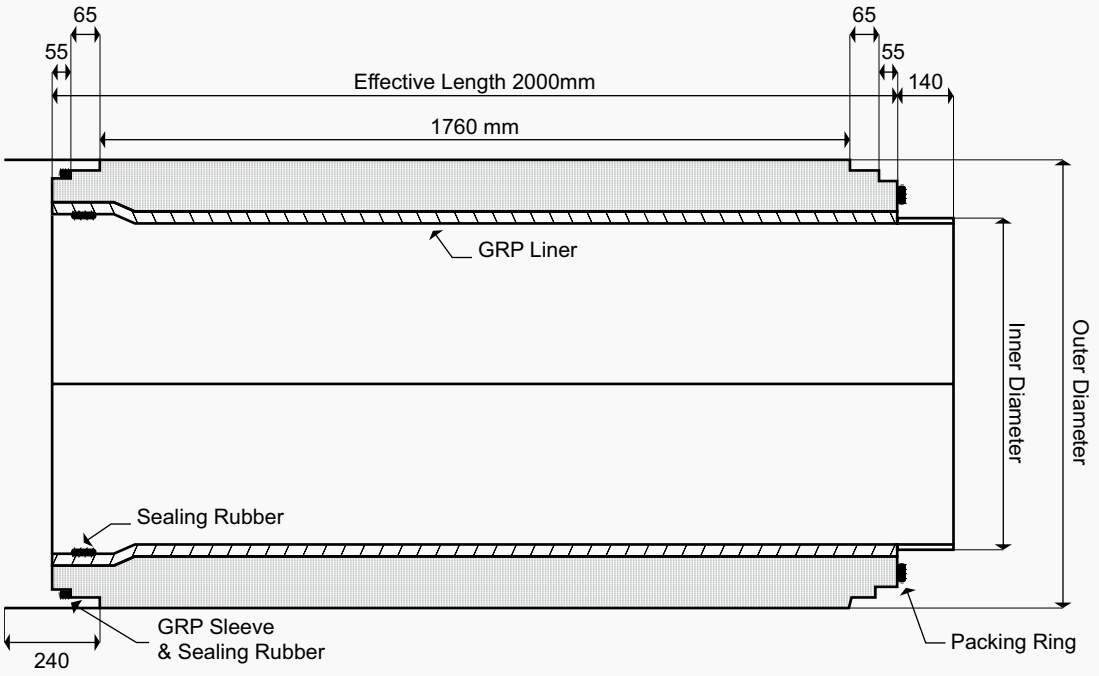
GRP INTEGRAL CONCRETE PIPES FOR OPEN TRENCH LAYING WITHOUT BELL



Reniforced Concrete Pipes

Pipe Dia *mm*	**Wall Thick.** *mm*	**Outer Dia** *mm*	**Effective Length** *mm*	**Pipe Length** *mm*	**Joint** *Type*	**Steel Cages** *No.*	**Pipe Weight** *kg*
1600	170	1940	2000	2126	spigot & socket in wall	double	4650
1800	190	2180	2000	2126	spigot & socket in wall	double	5800
2000	220	2440	2000	2126	spigot & socket in wall	double	7700
2100	235	2570	2000	2126	spigot & socket in wall	double	7980

GRP INTEGRAL CONCRETE JACKING /MICRO TUNNELING PIPES

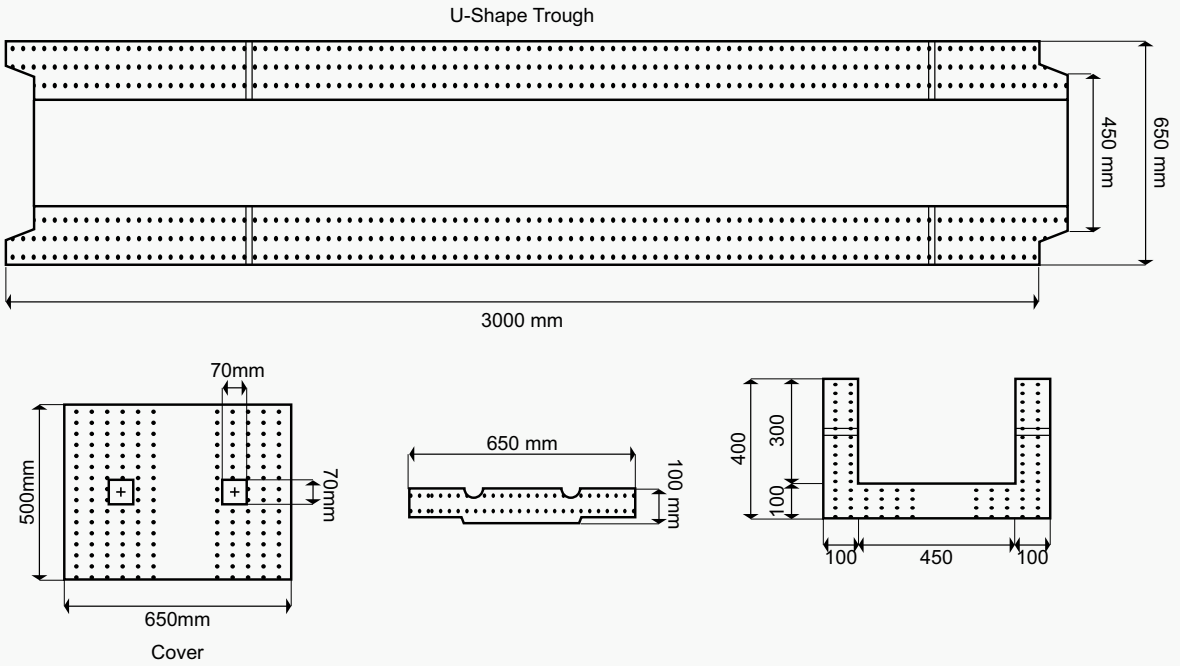


Reniforced Concrete Pipes

Pipe Dia *mm*	**Wall Thick.** *mm*	**Outer Dia** *mm*	**Pipe Length** *mm*	**Joint** *Type*	**Steel Cages** *No.*	**Pipe Weight** *kg*	**Allowable Jacking Force** *tonne*
400	130	660	2000	**	single	993	200
500	130	760	2000	**	single	1160	200
600	125	850	2000	**	single	1300	230
800	120	1040	2000	**	double	1550	240
900	152.5	1205	2000	**	double	2260	400
1000	115	1230	2000	**	double	1800	280
1200	150	1500	2000	**	double	2860	500
1400	185	1770	2000	**	double	4200	800
1600	170	1940	2000	**	double	4250	800
1800	180	2160	2000	**	triple	5050	950
2000	190	2380	2000	**	triple	5880	1100
2400	300	3000	2000	**	double	11470	2400

** Outer joint with collar, Inner joint & bell type

REINFORCED CONCRETE TROUGH UNIT

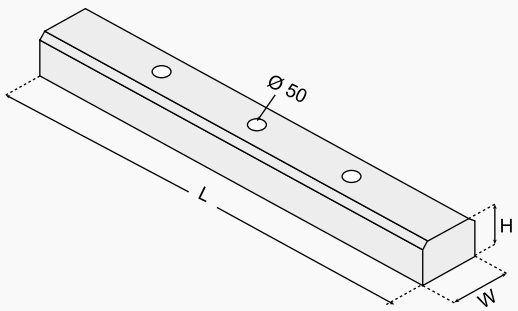


Product	*Length*	*Width*	*Height*
U-Shape Through	3000 mm	650 mm	400 mm
Concrete Cover	500 mm	650 mm	100 mm

Other products of the Concrete Pipes Factory

- U-Shape Concrete Channel & its Cover
- Manhole
- Box Culvert & etc,

Reinforced Concrete Wheel - Stopper



L *mm*	**W** *mm*	**H** *mm*	**No. of Holes**	**Weight** *kg*
650	150	150	2	35
1000	200	170	2	82
1500	150	150	3	81
1600	200	120	3	92
1800	200	150	3	130
1800	150	150	3	97
2000	150	150	3	108
2000	200	150	3	144

LAYING INSTRUCTION MANUAL

LAVING INSTRUCTIONS

for precast concrete pipes and fittings ace. to BS 5911.

1. Delivery

Reinforced concrete pipes are carefully inspected before leaving the factory. Confirm that th~ consignment has been duly received on the delivery note, stating any damage which might have occured during transport.

1.1 Transport & Stacking

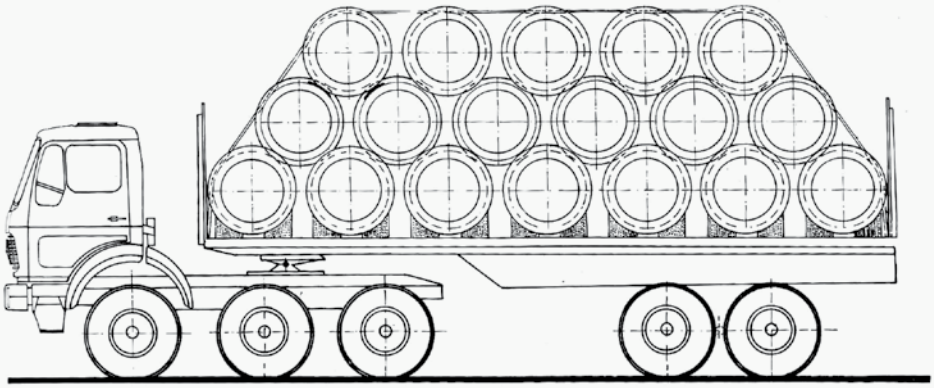


Fig. 1. Shows the correct method for transporting the pipes.

Fig. 2. Shows the correct method for Stacking the pipes.

1.2 Rubber gaskets supplied with the pipes should be stored in a cool, dry place under no tension.
Do not bring into contact with fuels or lubricants, chemicals, solvents etc. and keep away from strong sunlight.

2. Unloading and intermediate storage

Unload the pipes with suitable hoisting units (with prec1s1on hoisting mechanism) using cables or straps (especially for outside coated pipes) (Fig. 3)
Avoid setting the pipes down abruptly or knocking or rolling from a truck.

Deposit the pipes on a firm base of squared timber and secure with wedges to prevent from rolling. (Fig. 2).

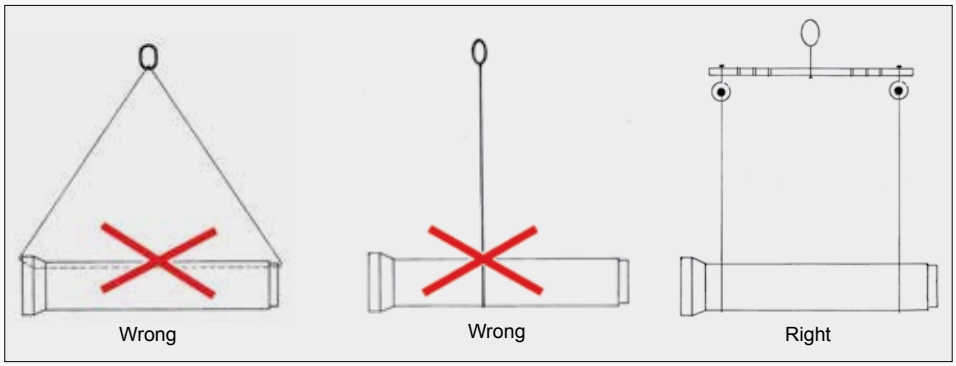


Fig. 3 Hoisting the pipe

3. Trenches

The width for sloped or sheeted trenches should comply with the regulations of the Ministry of Public Works (Fig. 4).

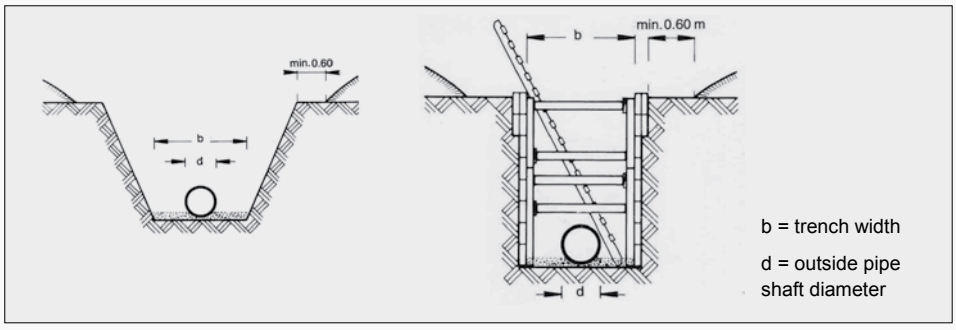


Fig. 4. Sloped & sheeted trenches

4. Laying

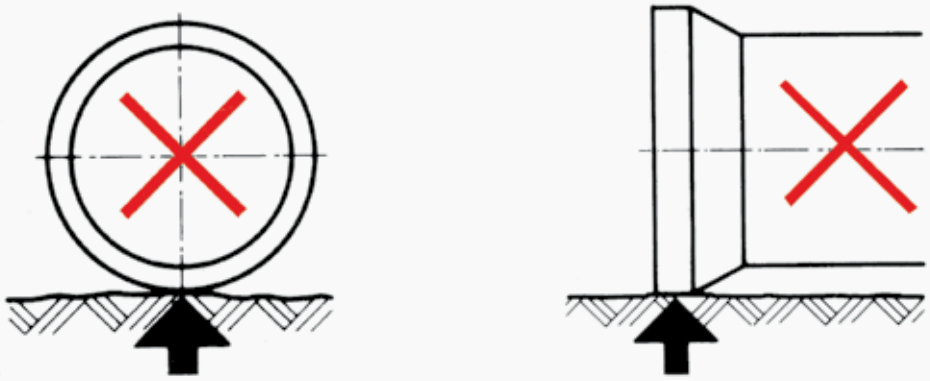
4.1 Bedding

The bedding should be designed such that an equal distribution of pressure is guaranteed. Therefore, the whole length of the pipes should rest equally on the bedding. The soil at the angle of support (see item 4.1.1 & 4.1.2) shall have at least the same density as at the bottom range of the pipes.

However, it is advisable not to increase the natural density of the bedding at the trench bottom. This means that the trench bottom is to be compacted only slightly before installation, but a better compaction is to be cared for the supporting parts.

Pipes with bell sockets need to have sufficiently large socket holes.

Linear and point beddings are not permissible (Fig. 5)



linear bedding (wrong) point bedding (wrong)

Fig. 5. Linear and point bedding

A concrete support is recommended, in case the natural soil is not suitable for a sand or sand gravel bedding or if statical or other reasons demand it.

For pipes with an outside coating , sand shall be used. In case of concrete cradle or encasing, measures against buoyancy are to be taken.

4.1.1. Bedding on natural soil

a) Pipes with circular cross section. Shape a bearing surface in the natural soil for the shaft of the pipes in accordance with the required angle of support 2 cc M.P.W. regulations. The pipe shall lie equally on the natural soil. The socket should not rest on the soil (Fig. 6).

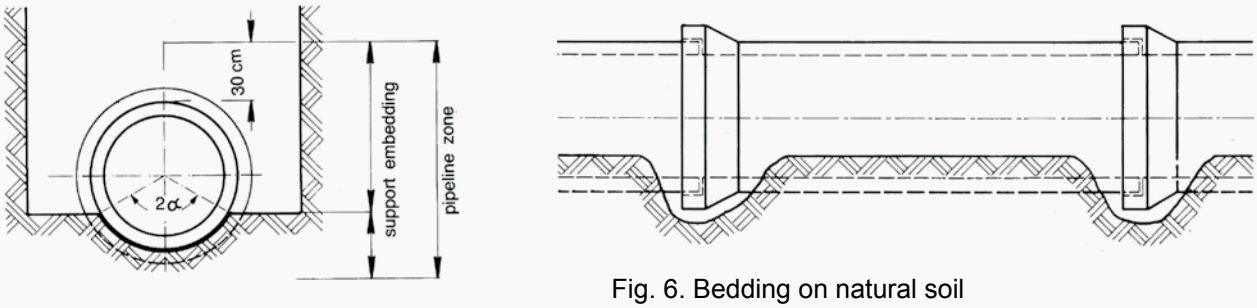


Fig. 6. Bedding on natural soil

b) Pipes with base.

If the ground is suitable, laying on natural soil or on a support out of compactable material is possible. Normally the pipes are laid on a concrete slab, but at least on blinding concrete.

4.1.2 Bedding on placed sand or gravel sand

-Trench.

Here the pipe trench should be excavated at least 100 mm. + 1/1 0 DN deeper than the bottom level of the pipe. (Fig. 7). Introduce sand and fine gravel and compact in su9h a way that the pipe when laid lies squarely and uniformly on the bedding at the given support angle 2oc M.P.W. regulations.

After laying the pipe, always remember to remove all wedges, planks or boards used for aligning in order to avoid linear and point bedding.

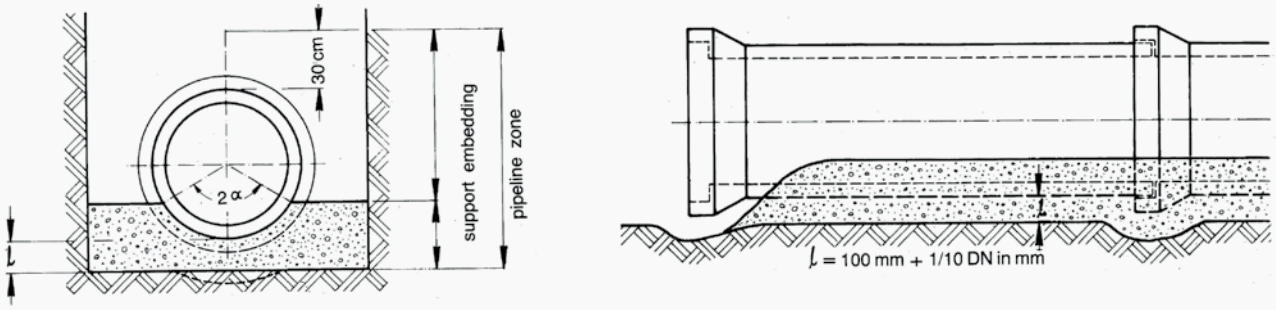


Fig. 7. Bedding on placed sand or gravel sand

- Embankment:

Only possible when compaction of embedding is done on natural soil.

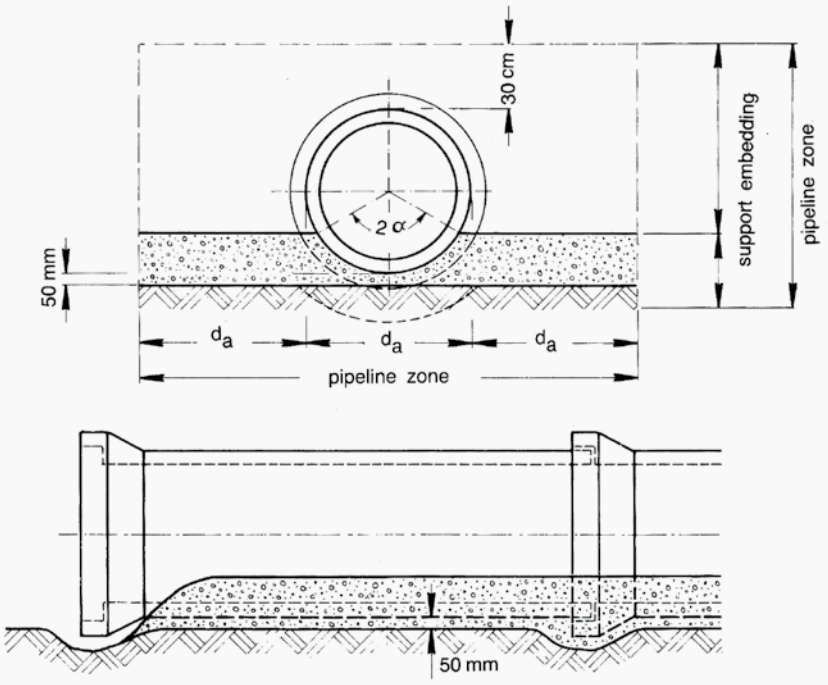


Fig. 8. Embankment

In case of bedding on hard subground, e.g. rock or strongly compacted gravel, the thickness of support is to be increased to 100 mm + 1/4 DN. See (Fig. 9).

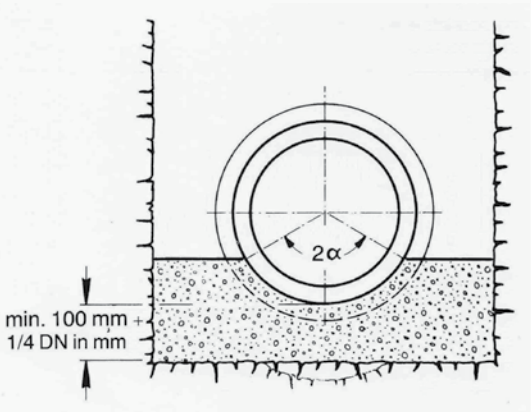


Fig. 9. Avoid linear and point bedding

4.1.3 Bedding on concrete cradle support

If M.P.W. regulations required, for example for very compact subground or rock, the concrete support at the bottom level shall be 50 mm + 1/4 DN, but at least 100 mm thick (Fig. 10).

The concrete support is made out of concrete K 100, or, K150 if reinforcement is required.

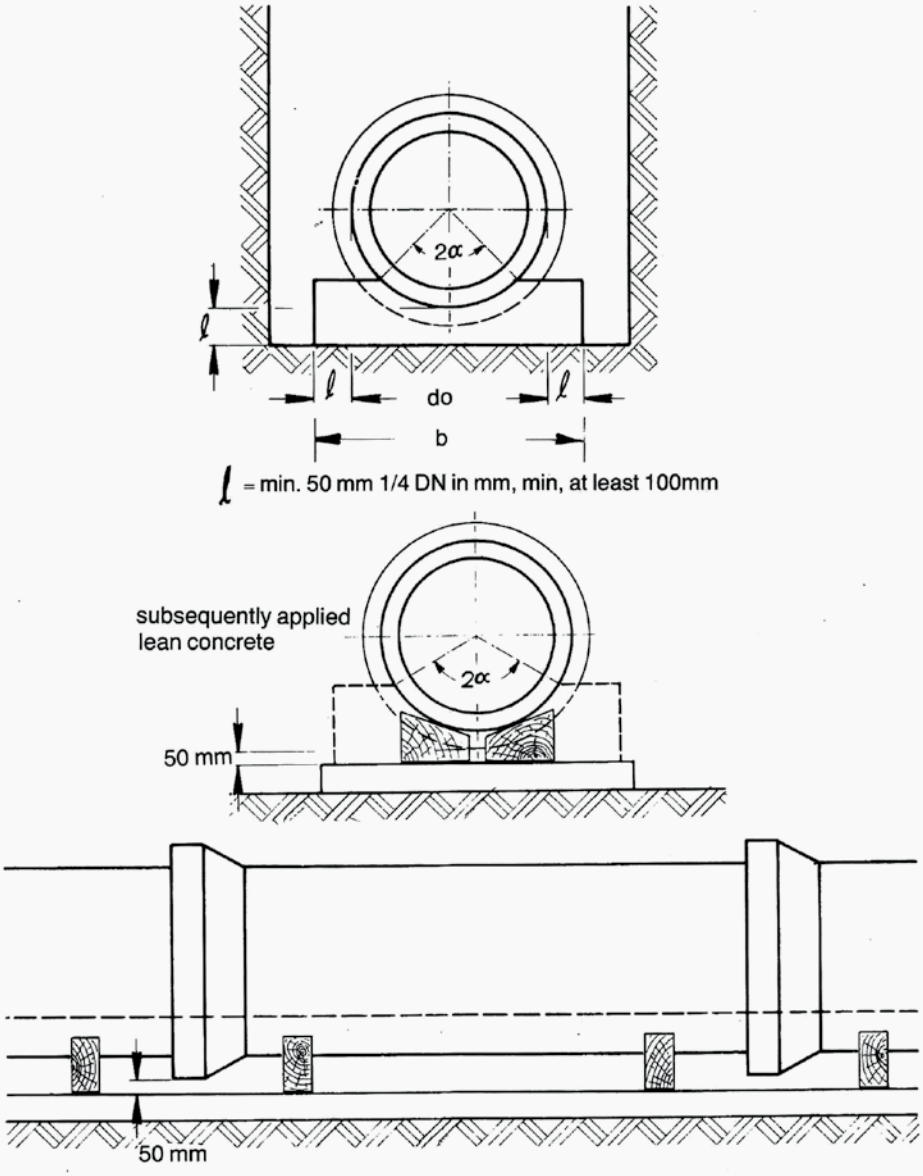


Fig. 10. Concrete cradle support with monolithic bottom slab

4.1.4 Concrete encasing

Concrete encasing is made to increase bearing capacity of the pipe. It might become reasonable to subdivide the encasing at proper distances at the pipe joints by gaps.

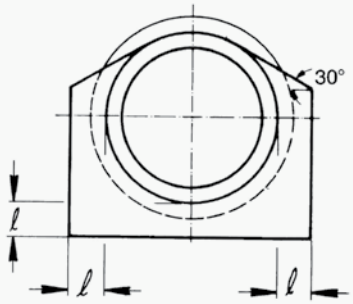


Fig. 11. Partial encasing

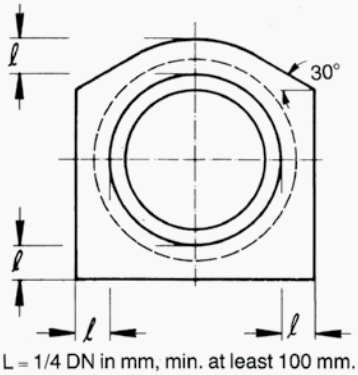


Fig. 12. Complete encasing

The gasket is mounted on the spigot, ensuring that it is not twisted and is under uniform tension.

4.2 Pipe joint

4.2.1 Rubber gasket rings

Only the rubber rings delivered together with pipes may be used. Before installation they are to be thoroughly cleaned and wipped off. The pipe sealing surface at the bell and spigot is also cleaned and wipped off (--). (Fig. 13)

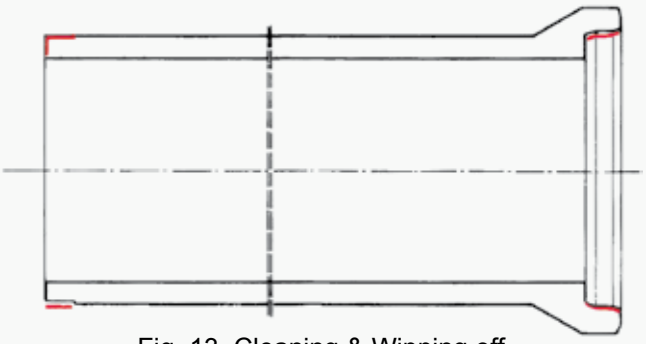


Fig. 13. Cleaning & Wipping off

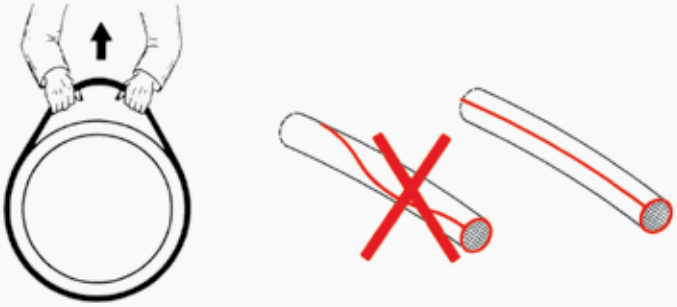


Fig. 14. Installing Rubber Gasket Rings

4.2.2 Jointing of pipes

The pipe, hanging horizontally on the hoisting unit (with precision hoisting mechanism), is pulled towards the already laid pipe until the rubber ring is equally situated at the bevelled side of the socket.

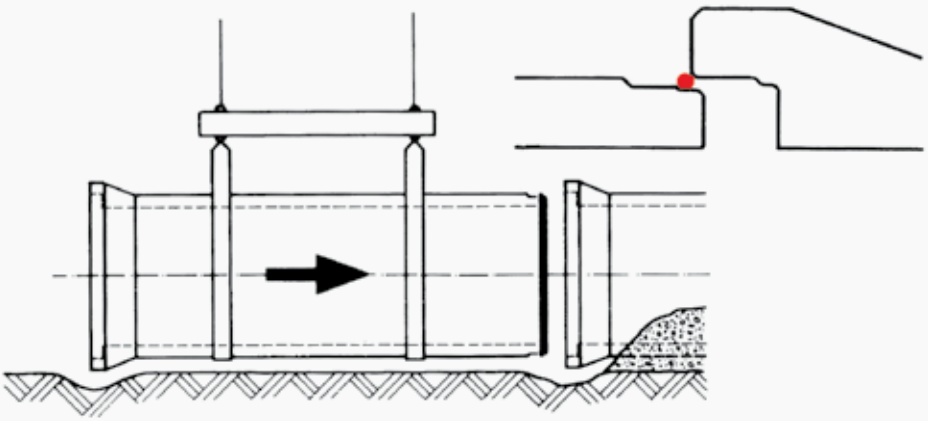


Fig. 15. Jointing of Pipes

- Centric introduction into the socket in the straight elongation of the previously laid pipe.
- Equal and slow contraction with pulling unit or other equipment. The pipe should hang freely.
- As a standard value for the force is equal to the pipe weight.
- During the contraction the straight position of the pipe towards the laid pipe is to be guaranteed.

After the contraction, the position of the pipe concerning the inclination and the direction should be checked and corrected (the pipe is still hanging on the hoisting unit). Minor deflections of the socket are now possible. The positioned pipe is fastened with wedges and finally underfilled.

4.2.3. Pipe Joints

-Roll-on gasket (Fig. 16)

The rubber ring is mounted on the notch at the spigot end. Do not use LUBRICANTS for roll-on gaskets. During contraction, the rubber ring should roll in equally.

If the rubber ring rolls in unevenly or it slides (when contacted with moisture) the socket might burst. The pipe has to be drawn out and inserted a new rubber ring.

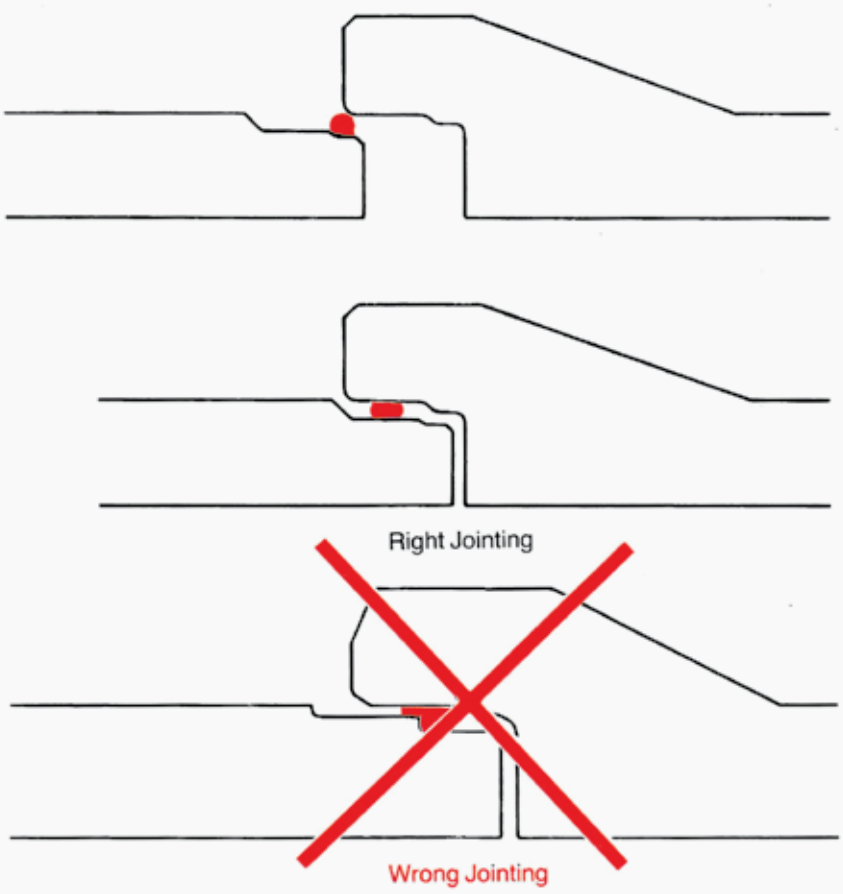


Fig. 16. Roll-on gasket

4.2.4 Gap width and pipe deflection

The gap width between the ends of the pipes shall be at least 5 mm, but on average, depending on the pipe diameter, 1 0 to 20 mm, as spacers wedges may be used and removed later. After the centering of the pipes and before the construction of the pipe support a deflection can be made in the permissible size, if necessary.

The maximum permissible deflections are:

DN	250- 600	2º	35mm/m
DN	700-1200	1º	18mm/m
DN	1400/2100	½º	8mm/m

The maximum permissible gap width depends on the pipe diameter and the shape of the socket (consult pipe factory).

5. Testing of Watertightness of Pipelines

Before embedding, it is to be assured that the pipeline is in the correct position.

5.1 Testing of pipelines

The test for watertightness of the pipeline out of concrete and reinforced concrete pipes may be made with the complete pipeline, sections of the pipeline (Fig. 17)

The pipeline shall be tested before backfilling. In order to prevent buoyancy or the sliding of the pipeline, it may be covered partially. The pipe joints need to remain free. Close the pipeline at the ends of the section to be tested as well as all inlets and branches with adequate cover slabs. At the cover slabs, bends, branches and other fittings where forces might occur during tests, have to be secured thoroughly, i.e. supported against firm abutments.

In order to avoid damages of the pipes, the line shall be filled without pressure from a water tank or a water truck. The pipeline to be tested must not have any connection with a pressure pipeline. The pipeline must be filled by enough time before testing. The pipelines are tested with an internal pressure of max 0.15 bar for 15 minutes or If necessary, water can be added continuously. The pipeline is watertight, whenever the added amount of water during the testing period of 15 minutes does not exceed the values listed in (table 1) and when the pipe joints remain tight.

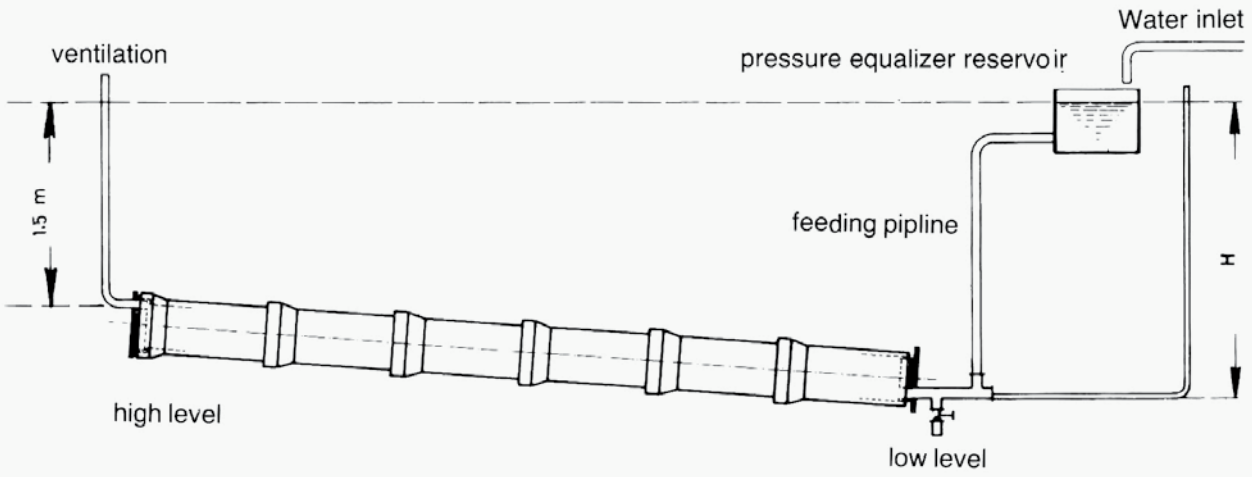


Fig. 17 Pipeline Test Procedure

Inside diameter	Inside surface	Water addition	
mm	m^2/m	L/m^2	L/m
250	0.79	0.15	0.12
300	0.94	0.15	0.14
350	1.01	0.15	0.17
400	1.26	0.15	0.19
450	1.40	0.15	0.21
500	1.57	0.15	0.24
600	1.88	0.15	0.28
700	2.20	0.13	0.29
800	2.51	0.13	0.33
900	2.83	0.13	0.37
1000	3.14	0.13	0.41
1200	3.77	0.10	0.38
1400	4.40	0.10	0.44
1600	5.03	0.10	0.50
1800	5.65	0.10	0.56
2000	6.28	0.10	0.63
2100	6.59	0.10	0.66

Table 1. Permissible addition of water for concrete and reinforced concrete pipes.

5.2 Testing of single pipe joints

For pipes with diameters exceeding 1000 mm the single pipe joints can be tested with certain socket testing insturments. (Fig. 18). Tne pipes of the section to be tested should be secured against lateral shifting.

A classification with water addition values is not possible for single pipe joints. The tightness is proven when no water is leaking out of the pipe joints. A slow decrease of pressure is permissible.

Fig 18 Testing device for the single joints

6. Embedding and Backfilling

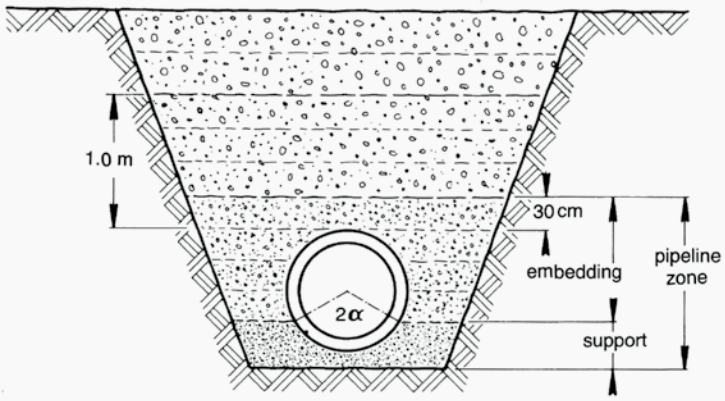
6.1 Pipe support and embedding together are called the pipeline zone. (Fig 19).

The embedding of the pipeline is the initial work for the manufacture of the pipe support and determines the distribution of loads and pressures at the pipe›s circumference as well as the possibility of lateral earth pressures acting reliefing on the pipeline. Make sure that the actual angle of support corresponds with the one of the M.P.W. requirements.

The embedding material in the pipeline zone is compactable stonefree soil.

It is compacted equally from both sides manually with a flat tamper or by means of a compacting machine. The height of the embedding material is max. 30 em, depending on the type of soil and the comapcting equipment.

6.2 The backfilling (range above pipeline zone) shall be placed in layers with the adequate compacting equipment on the present soil and sheeting. The thickness of the layers depends on the present type of soil and the compacting equipment. Medium size and heavy tampers and vibrators are only permissible for a height of backfill- over pipe ‹s top- of at least (1 m) compacted height. (Fig. 19). It is not permissible to drive over the pipeline with heavy construction machinery or trucks. Heights of backfill that were not planed are not permissible.



When Pipeline Zone Compacted, the use of medium Size or heavy tamper and vibrating equipment is not permissible.

Fig. 19 Embedding and backfilling

6.3 Soil compaction, height of backfill and number of transitions.

From the following table please obtain the standard values for the height of backfill, depending on the class of compactability of the material and the compacting equipment. (Table 2).

Table 2. Guidelines for Dumping Heights and Number of Compacting Operations (Runs) Compacting Equipment

Type of equipment		Operation Weight Kg	Type of Soil I Coarse-grain (non-cohesive) suitability	Dumping height cm	No. of runs	II fine-grain (cohesive) suitability	Dumping height cm	No. of runs	III mixed grain (cohesive) suitability	Dumping height cm	No. of runs
1. Light compacting equipment (mainly for pipe zone)											
Vibrating tamper	light	up to 25	+	up to15	2-4	+	up to10	2-4	+	up to 15	2-4
	medium	25-60	+	20-40	2-4	+	10-30	2-4	+	15-30	3-4
Detonating tamper	light	up to100	o	20-30	3-4	+	20-30	3-5	+	15-25	3-5
Vibrating plates	light	up to100	o	up to 20	3-5	-	-	-	o	up to15	4-6
	medium	100-300	+	20-30	3-5	-	-	-	o	15-25	4-6
Vibrating rollers	light	up to 600	+	20-30	4-6	-	-	-	o	15-25	5-6
2. Medium and heavy compacting equipment(above the pipe zone)											
Vibrating tamper	medium	25-6.0	+	20-40	2-4	+	10-30	2-4	+	15-30	2-4
	heavy	60-200	+	10-50	2-4	+	20-30	2-4	+	20-40	2-4
Detonating tamper	medium	100-500	o	20-40	3-4	+	20-30	3-5	+	25-35	3-4
	heavy	up to 500	o	30-50	3-4	+	30-40	3-5	+	30-50	3-4
Vibrating plates	medium	300-750	+	30-50	3-5	-	-	-	o	20-40	3-5
	heavy	up to 750	+	40-70	3-5	-	-	-	o	30-50	3-5
Vibrating rollers		600-8000	+	20-50	4-6	-	-	-	+	20-40	5-6

+ = recommended O = mostly suitable (- = not suitable)

The height of backfill in (Table 2) is average value which may be decreased in case of unfavourable conditions (e.g. high water content, trench sheeting) or increased in case of most favourable conditions.

Exact figures can only be evaluated through test compaction. For the first layer above the pipeline zone only the maximum values of the table for the heights of backfill should be used.

6.4 Compaction requirements

6.4.1 Required degree of compaction for pipeline trenches is as follows:

1 . Subground approx. 95% Proctor
2. Pipe Support approx. 97% Proctor
3. Embedding above the pipe support approx. 95% Proctor

7. Dimensions and weights.

7.1 Non reinforced concrete pipes. (9 250- 600 mm) Fig. 20

Table 3

DN	250	300	350	400	450	500	600
d	323.9	383.9	455.9	515.9	575.9	645.9	753.4
D1	329.9	389.9	461.9	521.9	581.9	651.9	758.6
D2	343.2	403.2	475.2	535.2	595.2	665.2	775.3
D3	345.8	405.8	477.8	537.8	597.8	667.8	778
D4	426	496	585	665	745	825	933
T	45	50	65	70	75	85	105
ds	325.1	385.1	457.1	517.1	577.1	647.1	755.5
Dm	343.8	403.8	475.8	535.8	595.8	665.8	776.5
L1	1340	1340	2090	2090	2090	2090	2110
L2	1250	1250	2000	2000	2000	2000	2000
L3	1080	1061	1794	1757	1719	1701	1760
L4	160	179	196	233	271	289	230
L5	100	100	100	100	100	100	1›20
L6	6	6	10	10	fo	10	15
L7	87	87	91	91	91	91	116
♦	15	15	15	15	15	15	18
Kg	140	195	450	555	685	850	1210

♦ Rubber ring Thickness

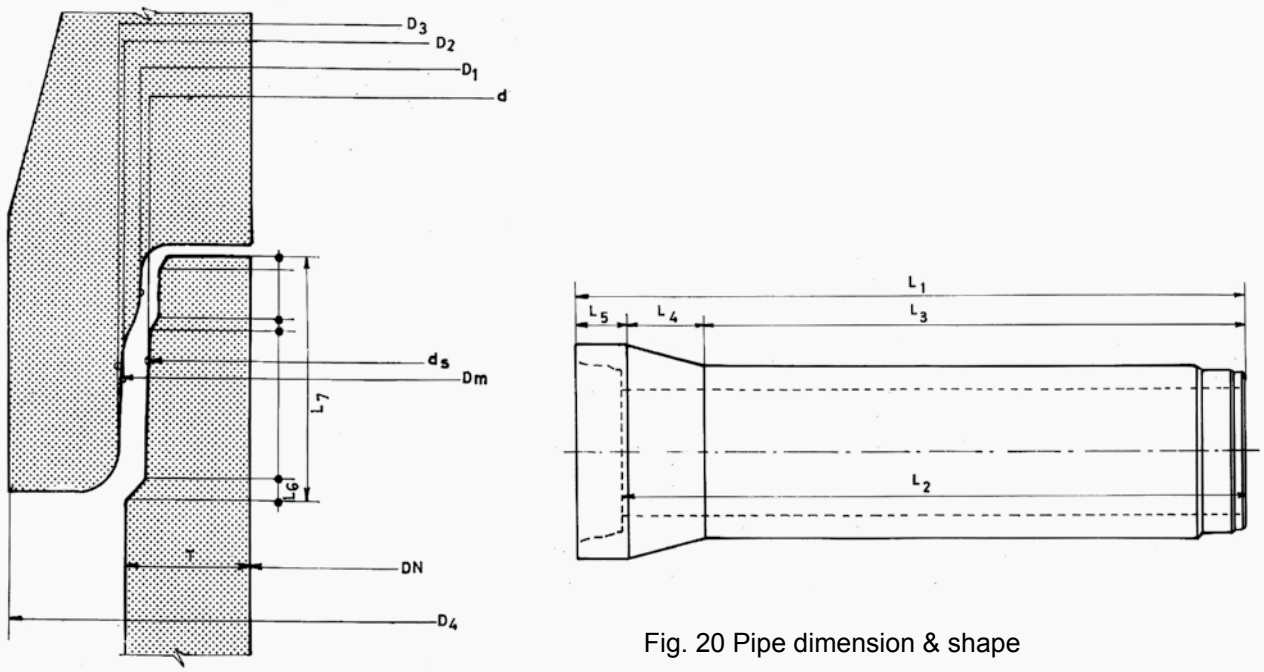


Fig. 20 Pipe dimension & shape

7.2 Reinforced concrete pipes~ 350-1400 mm). Fig. 20

Table 4

DN	350	400	450	500	600	700	800	900	1000	1200	1400
d	515.9	575.9	645.9	645.9	753.4	819	935.1	1043.5	1159.5	1407.5	1627.5
D1	521.9	581.9	651.9	651.9	758.6	824.6	940.6	1053.14	1169.14	1417.14	1637.14
D2	535.2	595.2	665.2	665.2	775.3	841.3	957.3	1074.1	1190.1	1438.1	1658.1
D3	537.8	597.8	667.8	667.8	778	844	960	1078	1194	1442	1662
D4	665	745	825	825	933	988	1128	1282	1410	1702	1962
T	95	100	110	110	105	85	100	110	115	130	150
ds	517.1	577.1	647.1	647.1	755.5	821.5	937.5	1046.4	1162.4	1410.4	1630.4
Dm	535.8	595.8	665.8	665.8	776.5	842.5	958.5	1075	1191	1439	1659
L1	2090	2090	2090	2110	2110	2126	2110	2126	2116	2126	2126
L2	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
L3	1757	1719	1701	1701	1760	1770	1751	1688	1654	1538	1501
L4	233	271	289	289	230	220	239	302	336	452	489
L5	100	100	100	100	120	120	120	136	136	136	136
L6	10	10	10	10	15	15	15	20	20	20	20
L7	91	91	91	91	116	116	116	132	132	132	132
♦	15	15	15	15	18	18	18	24	24	24	24
Kg	700	808	1121	1235	1210	1120	1500	1900	2300	3200	4250

♦ Rubber ring Thickness

-Reinforced concrete pipes(~ 1600- 2100 mm) Fig. 21

Table 5

DN	1600	1800	2000	2100
d	1743.7	1967.4	2187.1	2297.1
D1	1750.86	1969.4	2188.6	2300.6
D2	1753.14	1971.4	2190.6	2298.6
D3	1774.1	1997.5	2216.7	2326.7
D4	1778	2001.2	2220.4	2332.2
T	170	190	220	235
ds	1746.4	1970.8	2190	2300
Dm	1775	1999.4	2218.6	2328.6
L1	2126	2126	2126	2126
L2	2000	2000	2000	2000
♦	24	24	24	24
KG	4650	5800	7700	7980

♦ Rubber ring Thickness

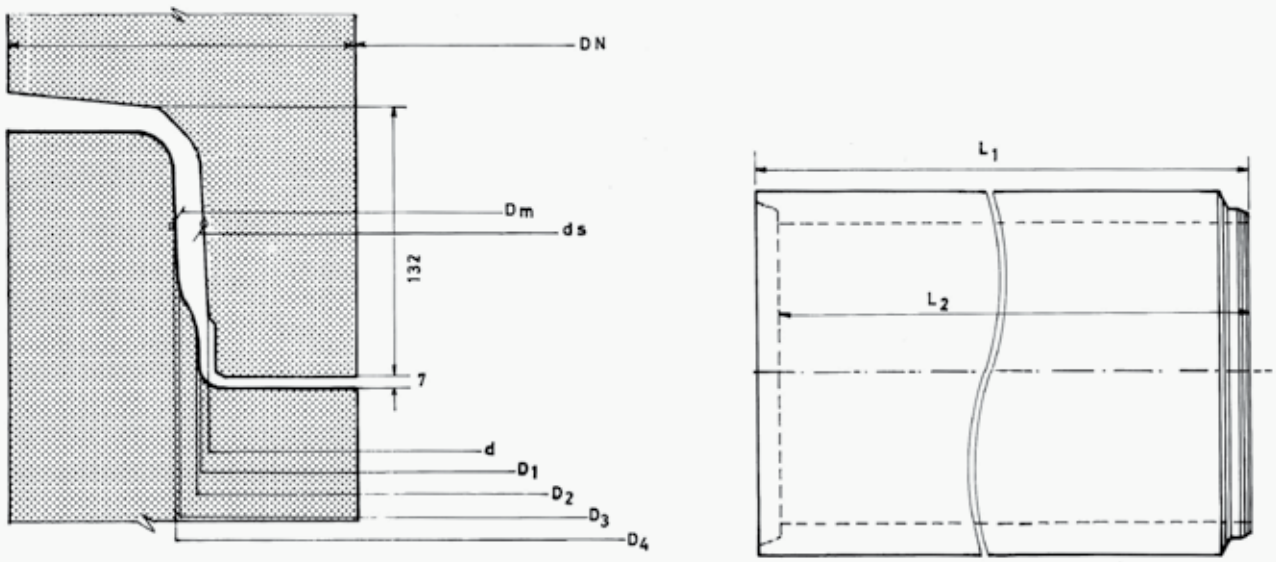


Fig. 21 Pipe dimension & shape

7.3 Short pipes

Shorter pipes can be supplied with different lenghts to complete the pipeline, as per client request.

Fig. 22.
Short pipes

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