FRCPIPE
INSTALLATION GUIDE

RCPA
THE AUSTRALIAN PIPE COMPANY

CONTENTS

1. Introduction

1.1 Overview

Thank you for choosing FRCPipes concrete pipes. Today the smart thinking is towards modern concrete pipe design and construction. At the forefront of this new technology is the unique range of FRCPipes concrete pipes and fittings. As a result of our ongoing research and development the FRCPipes product range has revolutionised modern construction practices. Proven, smart, fast and strong features enable speed of construction efficiencies that deliver real cost benefits.
We hope that you enjoy the advantage of using FRCPipes concrete pipes, the SMART option.

1.2 Scope

The purpose of this document is to give you, the skilled pipe layer, a guide to installing FRCPipes. Our aim is to present this information to you in the clearest and easiest way possible, while presenting all the facts you need to know to get the job done. This manual does not cover material performance, durability, design and other technical aspects. Refer to Section 1.3 for more information on these topics.

This document is intended for an audience who are already familiar or experienced in pipe laying and hence topics on general safety, setting out, levelling, earthworks, working with trenches, lifting and handling of construction materials are not covered in this manual although they are relevant to pipe-laying. This knowledge is assumed, or would be acquired through other training and development courses, programs, or literature.

Pipe installers should also familiarise themselves with any applicable local government specifications that may affect the particular project. This installation guide refers primarily to the Australian Standard AS/NZS3725:2007

1.3 More Information

Refer to our FRCPipes Material Properties manual for information about FRCPipes, our pipes history, the manufacturing process, physical properties, standards, design life, quality and durability.

For detailed product information on all FRCPipes products refer to our Product Information Books.

The above publications are available at www.rcpa.com.au

For further information you can also contact RCPA on 1800 88 7272
or email frcsales@rcpa.com.au.

2. Why choose FRCPipes?

2.1 FRCPipes core DNA

The core DNA of FRC concrete pipes is based upon FRCPipes' smart technologies and thinking. This thinking has delivered one of the world's smartest concrete pipe products.

Over almost three decades, FRCPipes have proven themselves in a wide variety of projects and installation environments. FRCPipes come with marine grade durability as standard, thanks to the absence of traditional steel reinforcement. FRCPipes lead the market in smart pipe technology.

FRCPipes' strength and economic benefits are well documented and recognised. Designed to achieve a 100 year service life, the FRCPipes range of concrete pipes are recognised for their impressive strength capacity.

This core DNA is expressed as:

2.1.1 Proven.

For decades FRCPipes have proven themselves in a diverse variety of projects and installation environments. With over 12,000 kilometres of pipe in service, our pipes strength, durability and economic benefits are well documented and recognised by industry professionals.

2.1.2 Smart.

The core DNA of the FRCPipes product range is based upon FRCPipes' smart technologies and thinking. This thinking has delivered one of the worlds smartest concrete products.

2.1.3 Fast.

At 4 metres long FRCPipes offer significant installation speed advantages over shorter conventional SRC pipes. And FRCPipes' reduced weight per metre delivers easier handling and greatly improved efficiency during installation when compared to SRC pipe.

2.1.4 Strong.

Designed to meet a 100 year service life, the range of FRCPipes are recognised for their impressive strength capacity. The minimum test load of fully saturated FRCPipes concrete pipes is, conservatively, at least the same as that for dry SRC pipe manufactured in accordance with AS4058.

Pipe reinforced concrete pipes

FRCPipe+ reinforced concrete pipes

3. Product Information

3.1 FRCPipe concrete pipes are manufactured using a high strength, light weight reinforced concrete composite. FRCPipe is a high performance stormwater drainage pipe ideal for road infrastructure in residential and industrial subdivisions. Also ideal for commercial property developments where a high performance below ground drainage system is required.

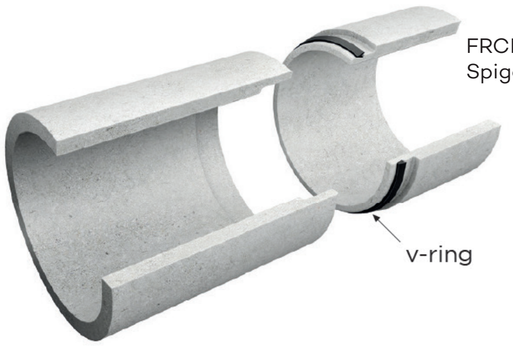
Precision Joint Technology provides a highly accurate machined joint, with allowable variation of less than 1mm on all pipe sizes. This smart technology allows for easy pipe installation and can be combined with other jointing options for a smart solution to challenging situations.

STANDARDS	
Quality	ISO9001:2008
Design	AS/NZS3725:2007
Manufacture	AS4139:2003

Note: Nominal length 4m

The standard precision rubber ring joint enables:

- Easy pipe assembly – low insertion forces mean less effort to equipment and strain to join pipelines
- Flush pipe exterior increases ease of laying
- Rubber v-ring seal – resistant to tree root and ground water ingress.



TECHNICAL SPECIFICATIONS (FRCPipe REINFORCED CONCRETE PIPES)

Nominal Pipe Size DN (mm)	Strength Class	Product Code	Pipe I.D. (mm)	Pipe O.D. (mm)	Pipe Wall Thickness (mm)	Finished Weight (kg)
225	4	403133	233	274	22	110
300	4	403151	302	354	26	180
375	3	403166	378	432	27	231
	4	403170		439	31	263
450	2	402432	455	512	29	292
	3	402450		520	32	335
	4	401263		530	37	389
525	2	402364	531	594	31	367
	3	402382		607	37	448
	4	401380		619	43	525
600	2	402386	608	679	35	480
	3	402404		694	42	587
	4	401483		707	49	682
675	2	402408	673	752	40	593
	3	402443		770	49	736
	4	401574		787	57	874
750	2	402426	719	806	42	693
	3	402441		825	52	855
	4	401609		842	60	1002

3.2 FRCPipe concrete pipes are manufactured using a high strength, light weight reinforced concrete composite. This high performance stormwater drainage pipe is ideal for road infrastructure in residential and industrial subdivisions. Also ideal for commercial property developments where a high performance, below ground drainage system is required. FRCPipe+ has the same core DNA as FRCPipe with the addition of RCPA's Advanced Joint Technology

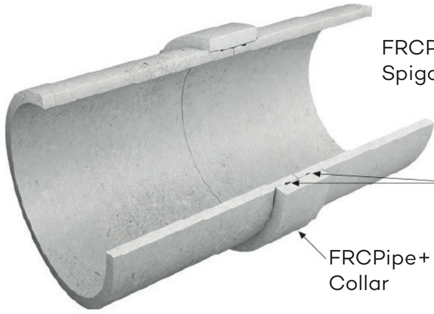
Advanced Joint Technology is a robust dual v-ring joint utilising a separate collar to provide a high strength connection in addition to the accurately machined joint. This provides another construction option where additional joint strength is required.

STANDARDS	
Quality	ISO9001:2015
Design	AS/NZS3725:2007
Manufacture	AS4139:2003
Compliance	NSW RMS - R11 Stormwater Drainage

Note: Nominal length 4m

The advanced rubber ring joint enables:

- Easy pipe assembly – low insertion forces mean less effort to equipment and strain to join pipelines;
- Dual v-ring collared joint;
- High strength joint.



TECHNICAL SPECIFICATIONS (FRCPipe+ REINFORCED CONCRETE PIPES)

Nominal Pipe Size DN (mm)	Strength Class	Product Code	Pipe I.D. (mm)	Pipe O.D. (mm)	Collar O.D. (mm)	Pipe Wall Thickness (mm)	Finished Weight (inc. collar)
225	4	401691	233	274	305	22	114
300	4	401700	302	354	392	26	186
375	3	401708	378	431	476	27	238
	4	401709		439		31	270
450	2	401240	455	512	581	29	305
	3	401257		520		32	348
	4	404230		530		37	402
525	2	401358	531	594	670	31	384
	3	401375		607		37	465
	4	404231		619		43	542
600	2	401462	608	679	754	35	500
	3	401479		694		42	607
	4	404232		707		49	702
675	2	404232	673	752	835	40	619
	3	401569		770		49	762
	4	404233		787		57	900
750	2	401596	719	806	885	42	720
	3	401605		825		52	882
	4	404234		842		60	1029

4. Safe Working Practices

4.1 Health & Safety Information

WARNING DO NOT BREATHE DUST AND CUT ONLY IN WELL VENTILATED AREA.

FRCPipes products contain sand, a source of respirable crystalline silica which is considered by some international authorities to be a cause of cancer from some occupational sources.

Breathing excessive amounts of respirable silica dust can also cause a disabling and potentially fatal lung disease called silicosis, and has been linked with other diseases. Some studies suggest smoking may increase these risks.

For further information such as Installation Instructions or Material Safety Data Sheets, please ask FRCPipes on 1800 88 7272

FAILURE TO ADHERE TO OUR WARNINGS, MATERIAL SAFETY DATA SHEETS, AND INSTALLATION INSTRUCTIONS MAY LEAD TO SERIOUS PERSONAL INJURY OR DEATH.

4.2 Cutting FRCPipes Concrete Pipes

From time to time it will be necessary to cut pipes and install fittings. Only use suitable cutting equipment capable of adequately suppressing dust. All power cutting operations should be carried out in an open-air situation or in well ventilated spaces.

As there is no steel reinforcement to corrode, no corrosion protection is required to be applied to the cut end.

Use appropriate safety precautions when operating saw/ blade in accordance with manufacturers recommended practices.
Cutting guide:

1. Mark a cut line on the outside of the pipe.
2. Make sure pipe is stable before cutting.
3. Cut to the line marked.
4. When cutting a length of pipe, it will be necessary to roll the pipe to get access to the entire circumference. After rolling make sure pipe is stable before resuming cutting. It is recommended pipe be chocked to prevent the pipe rolling during cutting.
5. Proper safety gear must be worn to protect operator in accordance with applicable safety standards and manufacturers recommendations.

Note: Refer to section 11 for further cutting recommendations.

5. Handling and Storage

5.1 Avoiding Product Damage

FRCPipes concrete pipes are supplied in timber crates to facilitate safe and economical transport and to reduce the likelihood of damage during transit. Before attempting to unload FRCPipes personnel should be aware of the weight to be lifted. The mass of pipes is given in Tables 4, 5 & 6.

Careless handling can damage pipes and couplings. They should not be dropped or thrown to the ground and severe impact with other pipes or objects should be avoided.

Pipes should be unloaded using a crane or a forklift with slippers supporting the full width of the crate.

Wire slings must be kept clear of pipes. The timber crating is solely for packing purposes and should never be used for lifting.

5.2 Pipe Stack Configuration & Mass

FRCPipes are delivered in "safety crates" for secure transportation and site storage.

Pipes are packed in "rows" onto timber gluts. "Crates" are made up of either one or two rows tied together with metal strapping.

A "stack" is made up of a certain number of "crates" depending on the pipe size. The diagram in Figure 2 helps understand the packaging configuration

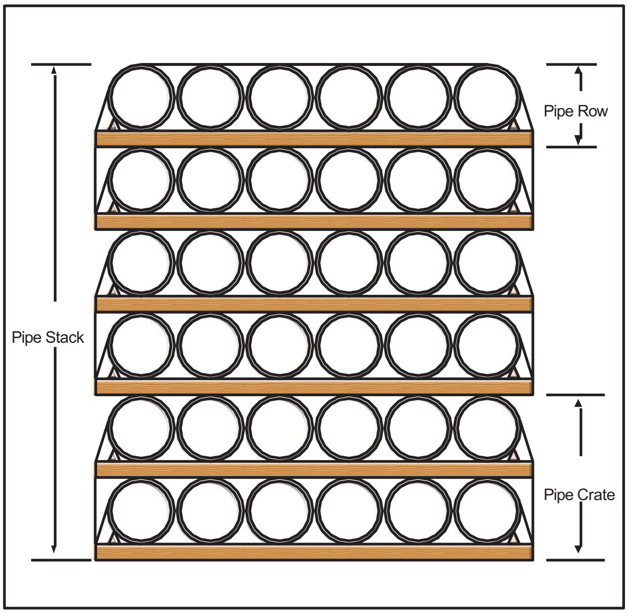


Figure 2 – Pipe stack configuration example – 300 diameter class 2

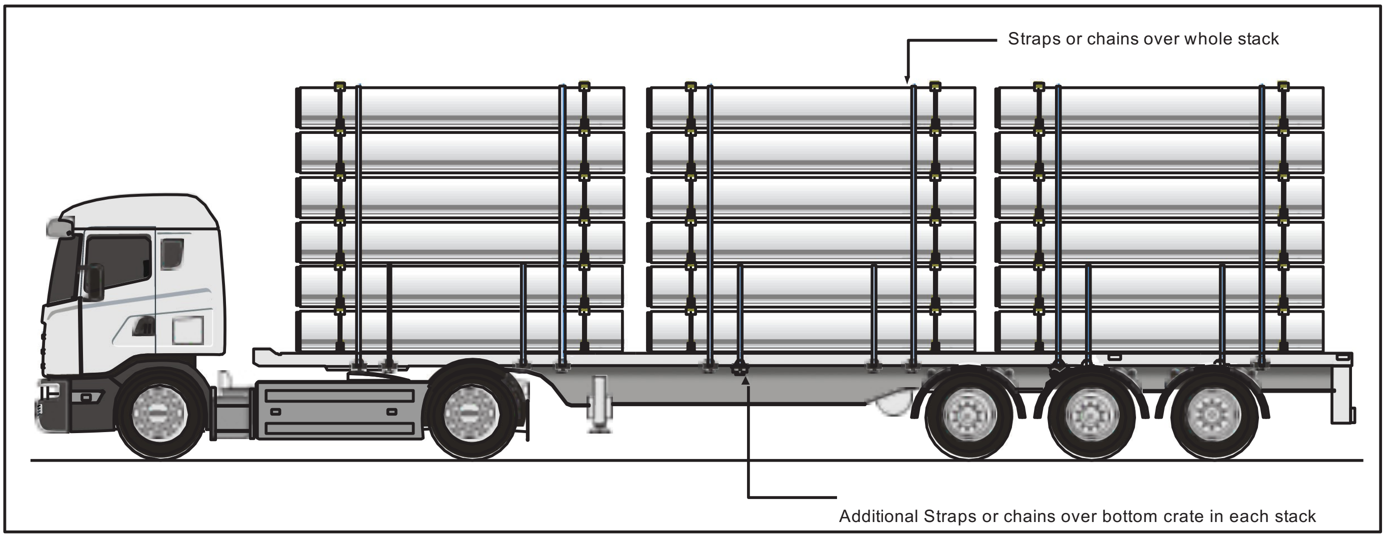


Figure 3 – A Semi-trailer can hold three full stacks

TABLE 4 - FRCPIPE MASS & PACKING CONFIGURATION							
Product Type		Packing Configuration			Dimensions		
Size	Class	Pipes per row	Rows per Crate	Pipes per Crate	Crates per Stack	AVG. Crate height (m)	AVG. Stack height (m)
225	4	8	2	16	4	0.72	2.88
300	4	6	2	12	3	0.88	2.64
375	3	5	1	5	5	0.54	2.68
	4	5	1	5	5	0.55	2.75
450	2	4	1	4	4	0.61	2.44
	3	4	1	4	4	0.63	2.52
	4	4	1	4	4	0.64	2.56
525	2	4	1	4	4	0.69	2.76
	3	4	1	4	4	0.71	2.82
	4	4	1	4	4	0.71	2.84
600	2	3	1	3	3	0.77	2.31
	3	3	1	3	3	0.79	2.37
	4	3	1	3	3	0.82	2.46
675	2	3	1	3	3	0.85	2.55
	3	3	1	3	3	0.86	2.58
	4	3	1	3	3	0.9	2.7
750	2	3	1	3	3	0.9	2.7
	3	3	1	3	3	0.92	2.75
	4	3	1	3	3	0.95	2.85

Table 4 – shows the standard packing configuration and masses for all sizes and classes of FRCPipe concrete pipes.

TABLE 5 – FRCPIPE MASS & PACKING CONFIGURATION							
Product Type		**Packing Configuration**				**Dimensions**	
Size	**Class**	**Pipes per row**	**Rows per Crate**	**Pipes per Crate**	**Crates per Stack**	**AVG. Crate height (m)**	**AVG. Stack height (m)**
225	4	8	2	16	4	0.72	2.88
300	4	6	2	12	3	0.88	2.64
375	3	5	1	5	5	0.54	2.68
	4	5	1	5	5	0.55	2.75
450	2	4	1	4	4	0.61	2.44
	3	4	1	4	4	0.63	2.52
	4	4	1	4	4	0.64	2.56
525	2	4	1	4	4	0.69	2.76
	3	4	1	4	4	0.71	2.82
	4	4	1	4	4	0.71	2.84
600	2	3	1	3	3	0.77	2.31
	3	3	1	3	3	0.79	2.37
	4	3	1	3	3	0.82	2.46
675	2	3	1	3	3	0.85	2.55
	3	3	1	3	3	0.86	2.58
	4	3	1	3	3	0.9	2.7
750	2	3	1	3	3	0.9	2.7
	3	3	1	3	3	0.92	2.75
	4	3	1	3	3	0.95	2.85

Table 5 – shows the standard packing configuration and masses for all sizes and classes of FRCPipe+ concrete pipes.

5.3 Unloading Requirements

Coordinate delivery and unloading with the construction schedule to avoid re-handling and unnecessary equipment movement. It is the responsibility of the contractor to ensure that FRCPipes delivery trucks have full access to the unloading area.

For ease in shipping and offloading, FRCPipes concrete pipes are bundled and banded together in standard quantities and loaded on flatbed trucks. FRCPipes are longer than traditional steel reinforced concrete pipe. It is therefore important to centre the load on your equipment before the pipe is lifted off the truck. Follow the manufacturer's guidelines and safety procedures for the specific piece of equipment used to unload the pipe.

Unloading can be undertaken using a suitably load rated 'Franna' crane or similar, which has a load capacity able to carry a stack off the truck. The stack should be kept strapped together if opting to unload by stack. The crane operator should determine the correct sling method to secure the load, however we recommend that the method of lifting chosen should not place excessive forces onto the pipes to avoid damage to the pipe.

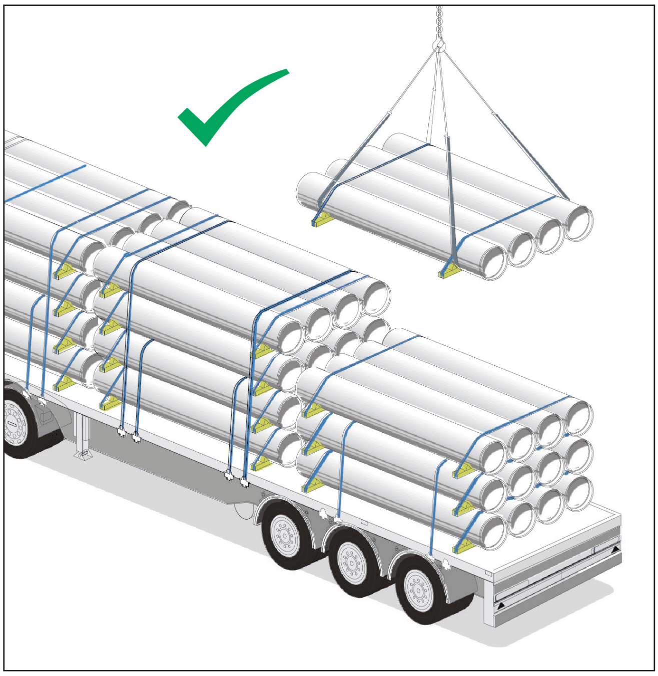


Figure 4 – Unloading of Pipes

If the crane does not have sufficient load carrying capacity to lift a full stack, then the stack should be untied by cutting off the metal straps that hold together the individual crates together in the stack. Slings can be used and looped around each end of the crate as shown in Figure 5 and unloaded crate by crate or row by row. Ensure that the straps holding the pipes in the crate together remain intact.

Forklifts can also be used as long as the load is spread evenly onto the underside of all pipes. Depending upon equipment, fork extensions may be used if designed

to properly support the load of the pipe bundle. Align forks on pipe as recommended and place FRCPipes concrete pipes on level ground as appropriate.

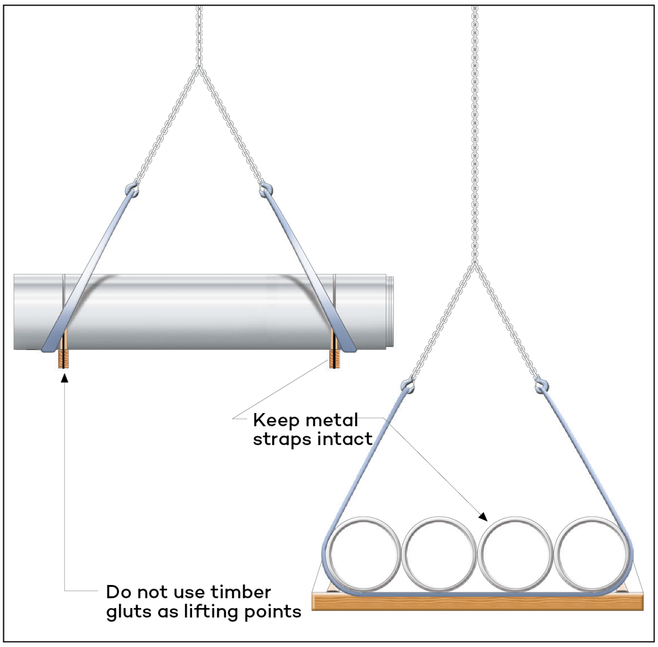


Figure 5 – Supporting Pipes while unloading

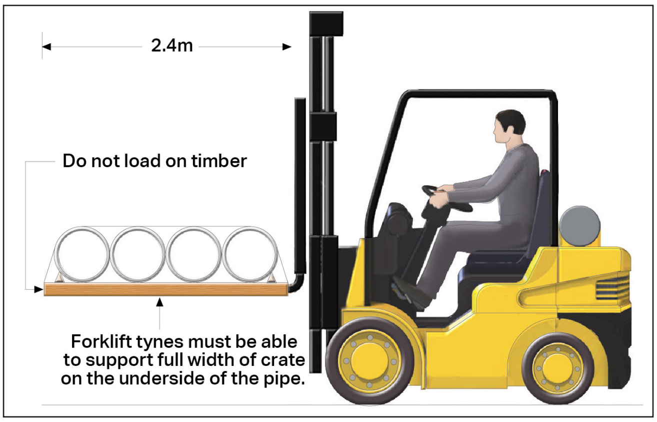


Figure 6 – Unloading by forklift

Notes:

1. FRCPipes concrete pipes are heavy and need to be handled with extreme caution to prevent injury or property damage.
2. When the contractor is unloading it is their responsibility to do so in a safe manner. All necessary risk assessments, hazard identifications, and safe work methods must be implemented.
3. It is not recommended to cut the steel bands bundling the pipe together until safely stored on site. However, if it is necessary to cut the bands while on the truck, please take safety precautions to stabilise the pipe on the pallet and the remaining pipe on the truck.
4. Do not use the timber gluts or beams as lifting points at any time.
5. Contact your local sales representative or Ask FRCPipes on 1800 88 7272 if you are not sure about offloading procedures.

5.4 Storing On-site

FRCPipes should be stored properly on site to prevent unnecessary damage to the pipe and gaskets. Be sure to keep stored gaskets out of direct contact with sunlight to prevent the rubber from experiencing UV damage. Storage area must be a level area with a stable base. FRCPipes should not be stored on sloping ground as shown in Figure 6.

Pallets of pipe can usually be stacked up to 2.4 metres high provided:

- Pipe must be aligned in the same direction
- Pallets must be aligned in the same direction
- Pallets must be centred on the lower bundle
- No cantilever pipe or pallets are allowed

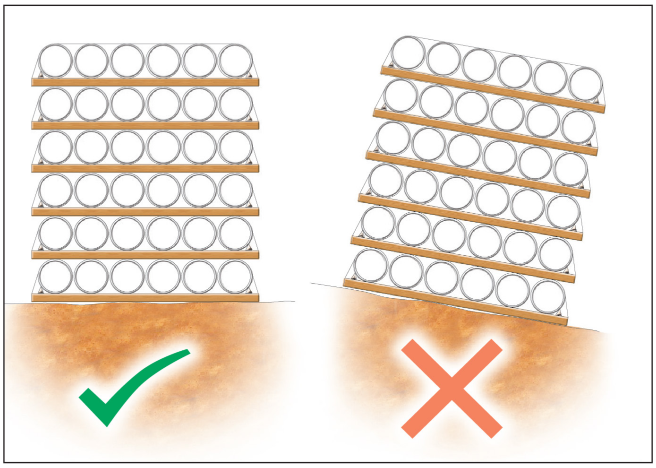


Figure 7 – Storage on level ground

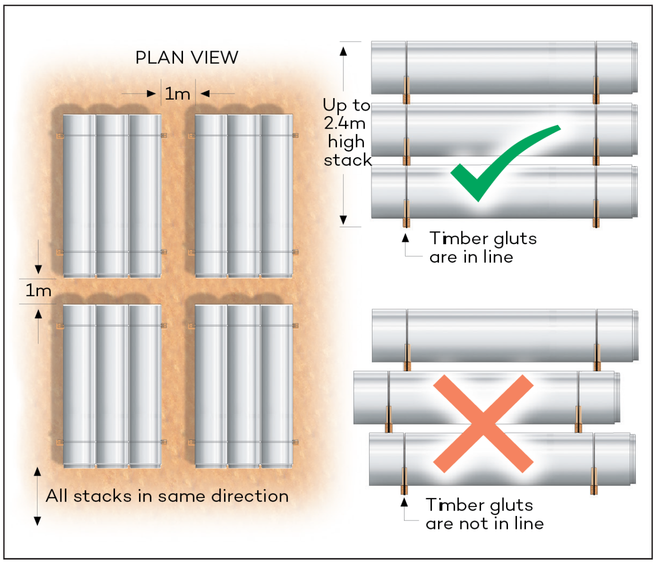


Figure 8 – Storage on level ground

Note: The above recommendations must be considered in addition to any on-site OH&S requirements applicable to the safe handling and storage of FRCPipes concrete pipes

5.5 General Handling

FRCPipes should be picked up and handled using properly rated rigging equipment capable of lifting appropriate load (refer to Table 4 and 5 for pipe masses). Care should be taken to ensure that the pipe ends are not damaged and worker safety is maintained while manoeuvring FRCPipes around the jobsite and setting pipes into the trench. Pipe should be carried level to avoid damaging joints.

Good handling practice is based on sound judgment and common sense, keeping in mind regard for safety, health, and the environment. We believe that a skilled pipelayer is the best person to manage the handling of our products around the worksite, but we offer some tips here to encourage best practices:

- Lifting operations should be undertaken by skilled operators using suitable equipment
- Do not impact the pipe, this may cause damage eg dropping the pipe, bumping into the pipe
- Protect the pipe from damage – in storage, handling or installation
- Do not create hazards from handling operations – for example, having a suspended pipe directly above workers in a trench.

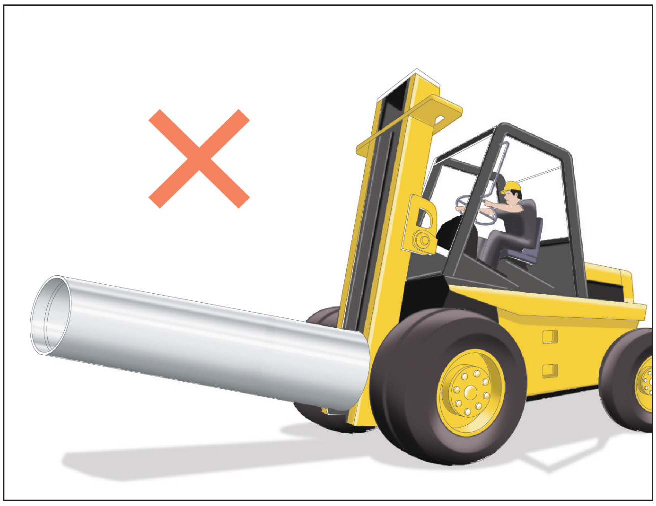


Figure 9 – Incorrect handling – do not lift through centre of pipe

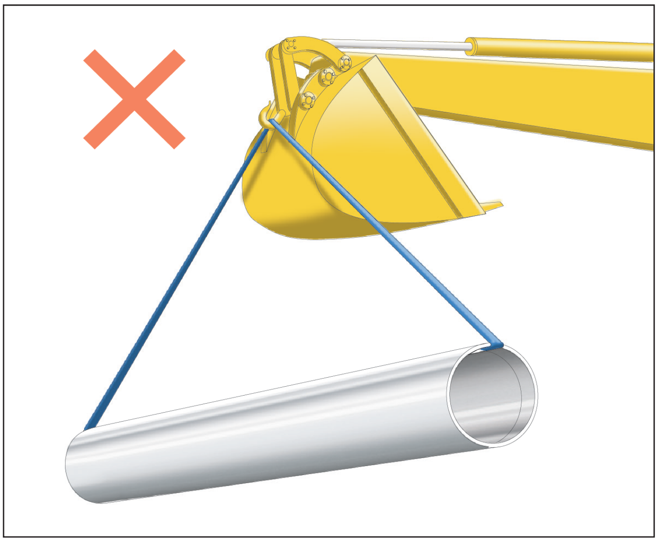


Figure 10 – Incorrect handling – do not sling through pipe barrel

Figure 11 – Unsafe handling

5.6 Lifting

When lifting pipes using a sling, it is important to have the load well balanced to prevent unexpected movement and allow lifted loads to be handled safely.

Locate the pipe's centre of mass for lifting (usually the mid point along the pipe length). FRCPipes recommends using a soft sling, that is in good condition and rated for the weight being lifted. Chains are not recommended for lifting FRCPipes.

Refer to site specific requirements for crane usage or load lifting.

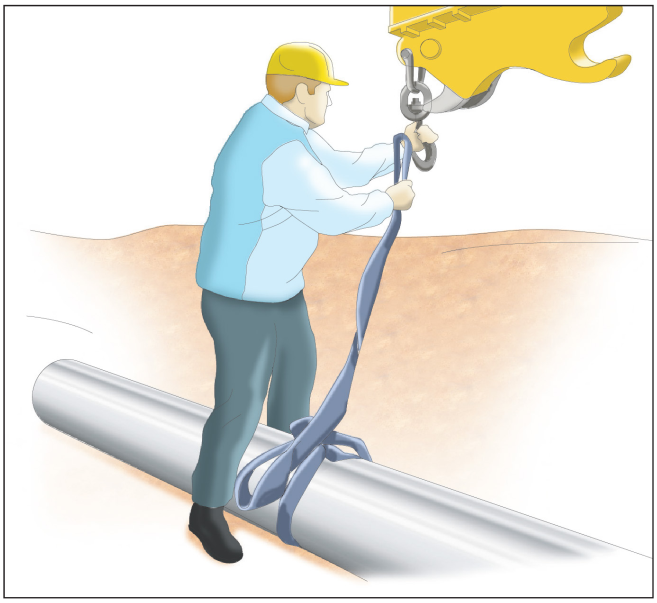


Figure 12 – Rigging of nylon straps

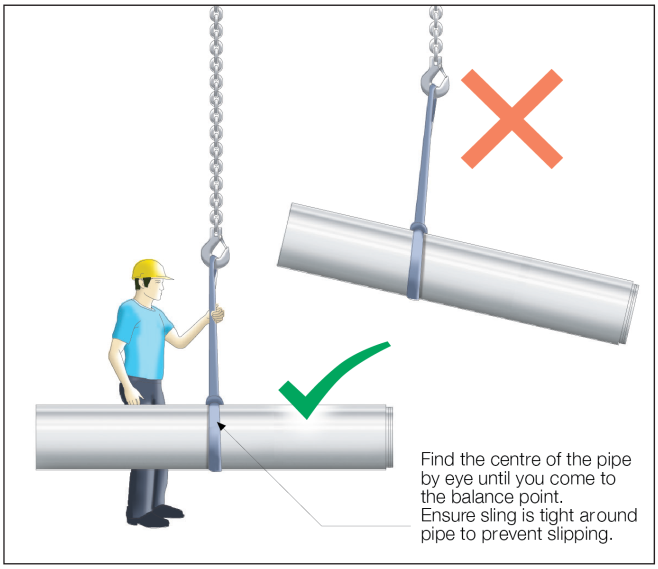


Figure 13 – Proper lifting

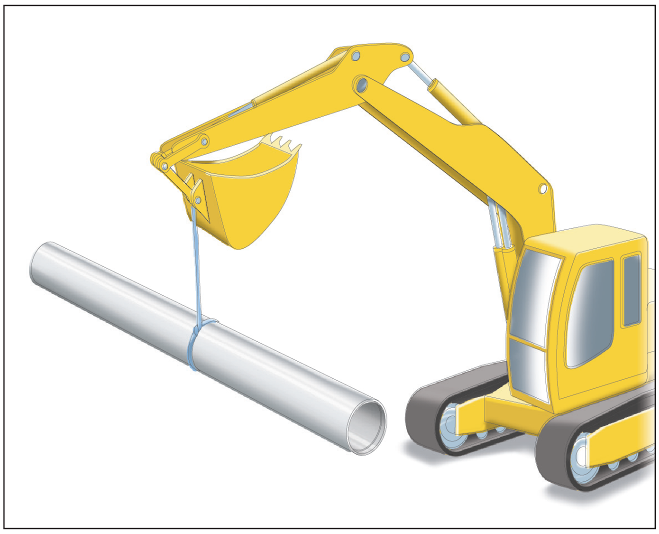


Figure 14 – Pipe Lifting

6. Loads on Buried Pipes

6.1 Types of Loads

A buried pipeline must be tough enough to withstand all forces that are imposed on it. FRCPipes are strong and made to last. It is however important to appreciate the kind of punishment that buried pipe must withstand. Typically buried pipes are subjected to loads from the self weight of backfill and pavements, construction loads and long-term traffic loads. See Figures 15-17.

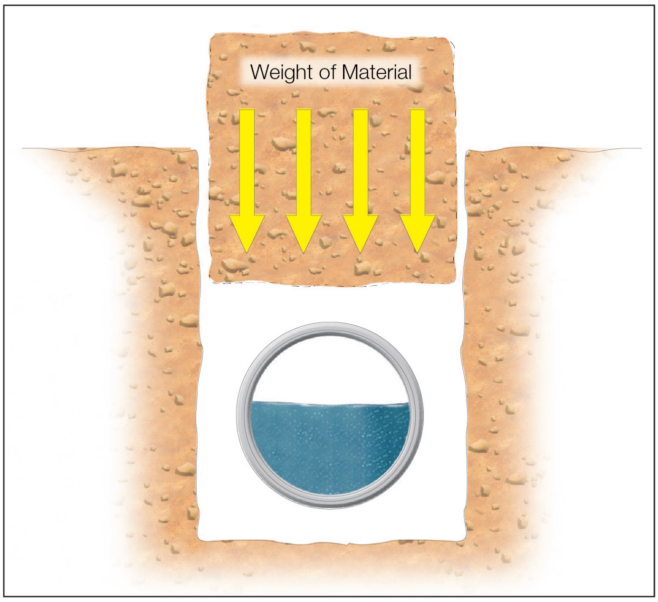


Figure 15 – Self-weight of backfill and pave

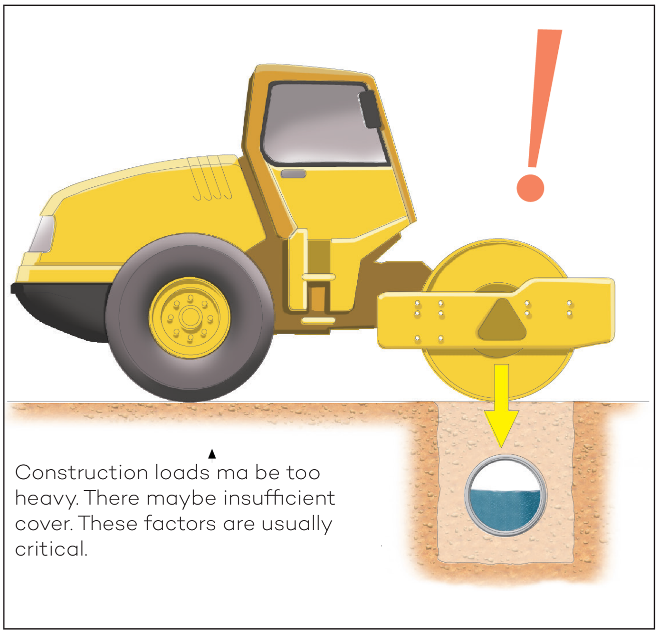


Figure 16 – Construction loads

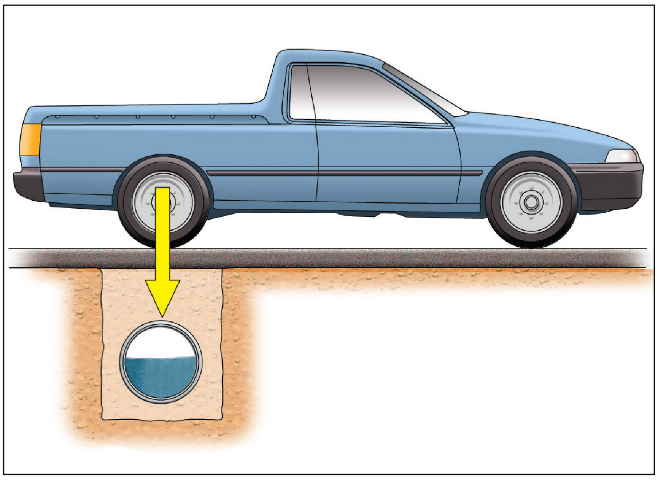


Figure 17 – Wheel loads from traffic

6.2 Force from Backfill Weight

This is the force caused by the weight of the material on top of the pipe. The width of the trench is related to the size of the force, with a wider trench causing greater force. It is important not to exceed the width of the pipe trench, otherwise the forces will be more severe than what has been allowed for.

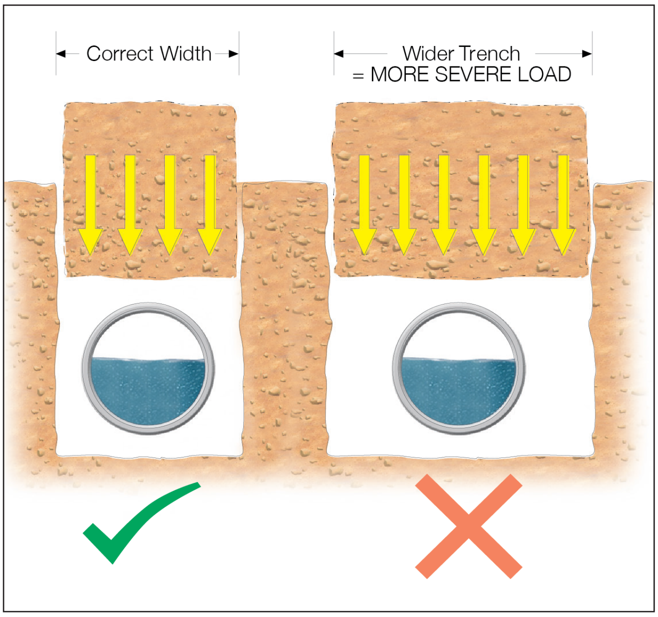


Figure 18 – Correct trench width

6.3 Construction Loads

In many cases loads imposed on pipes during construction can exceed those the pipe will experience once in service. This will depend on the type of compaction/construction equipment used on-site, the ground/trench condition, the given depth and cover, etc.

When a designer specifies the pipe strength class he/she may not be aware of the type of construction equipment and temporary cover being used by the contractor. It is not uncommon that the actual cover over the pipe during construction will be less than the final cover once the finished surface levels have been established, see Figure 19. This combined with heavy construction equipment can cause pipe cracking if the construction cover and loads have not been allowed for.

The effect of heavy machine wheel loads and shallow cover may induce an extremely severe load onto the pipe and lead to failure. The contractor must take care that they do not run heavy machines over buried pipelines unless they have provided adequate cover over the pipe.
The pipeline should be protected by either mounding up soil temporarily over haul roads, or to redirect heavy construction plant to alternative locations, see Figure 20.

TIP. In some cases it may be necessary to use a stronger pipe (eg Class 3 instead of Class 2) to meet construction load requirements

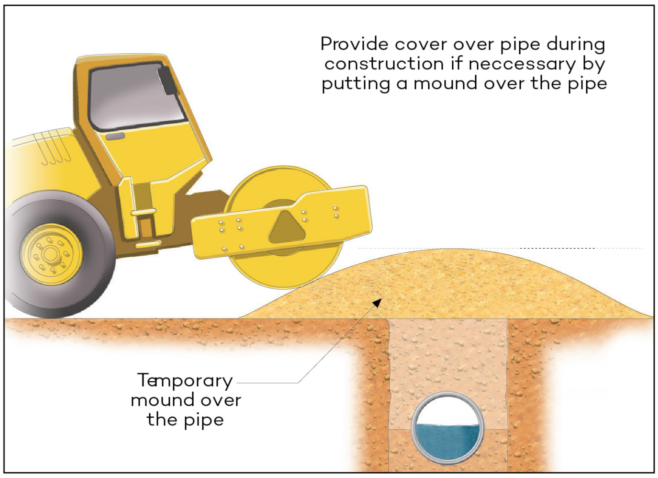


Figure 20 – Temporary construction cover

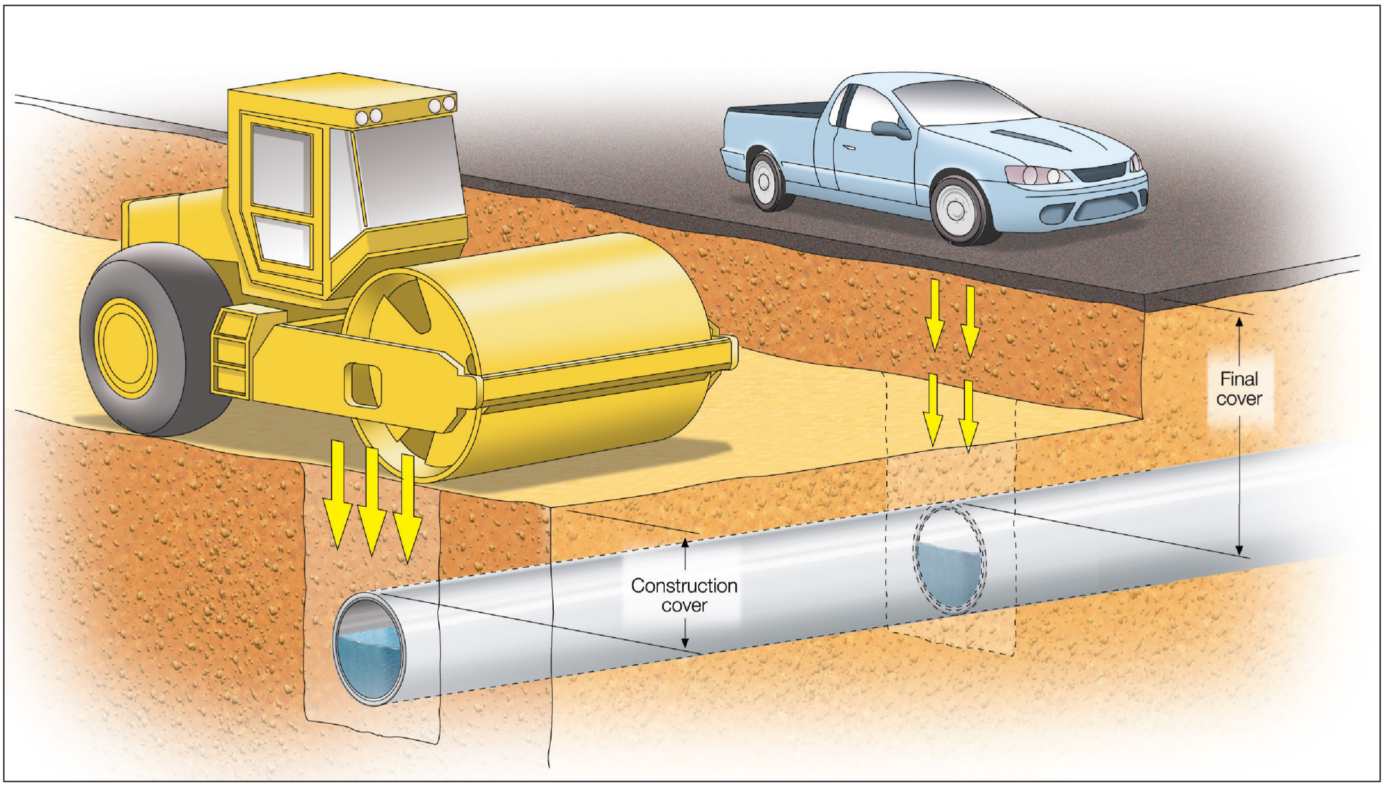


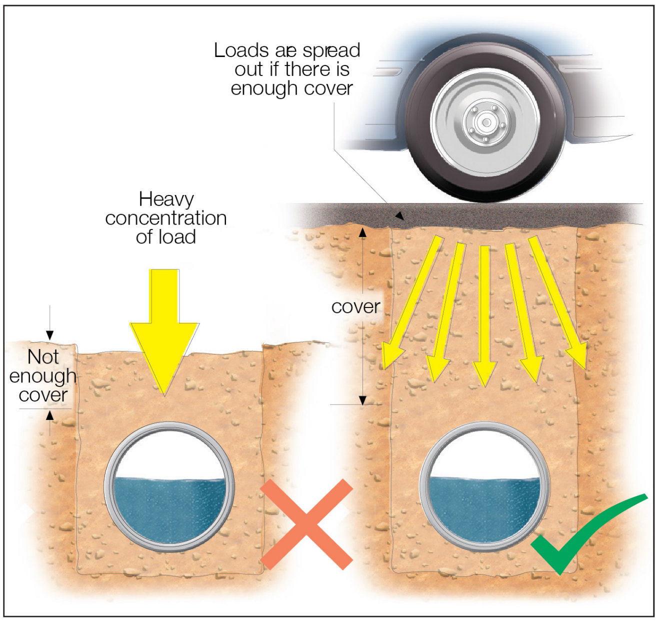
Figure 19 – Design vs construction cover

6.4 Traffic Loads

Wheel loads from traffic are transferred to the pipe and could pose a potential danger of failure unless the correct amount of 'cover' is provided. The cover provides cushioning for the pipe, and spreads out the force from wheels over a larger area, rather than having it concentrated in one spot, where the effect will be more severe.

Shallow cover is considered cover less than 400mm over the crown of the pipe, however adequate cover is dependent on the magnitude of wheel force. Typically heavier wheel loads would require a thicker cover over the pipe.

Wheel loads act as concentrated forces onto the pipe when pipe has shallow cover. Cover more than 400mm is required before allowing any traffic load, but the cover thickness may need to be thicker to carry heavier wheel loads. The engineer must be consulted to determine the correct amount of cover.



7. Trench

7.1 Trench Size

Care should be taken to ensure that excavation of the trench conforms to any specifications, AS/NZS3725, local regulations or other statutory requirements, particularly in regard to benching or shoring.

The width and depth of trenches to be excavated will depend on many factors including:

- Pipe size
- Type of soil and substrate
- Application and load (local road, highway, inter-allotment, etc)
- Pipe invert depth
- Pipeline direction (whether straight or deflecting around a curve)

Trenches should be excavated in accordance with drainage plans and specifications. The pipe designer has specified the pipe strength class based on a maximum trench width at the level of the top of the pipe and the trench depth and/ or pipe invert level. The width and depth of the trench nominated must not be exceeded without consulting the designer.

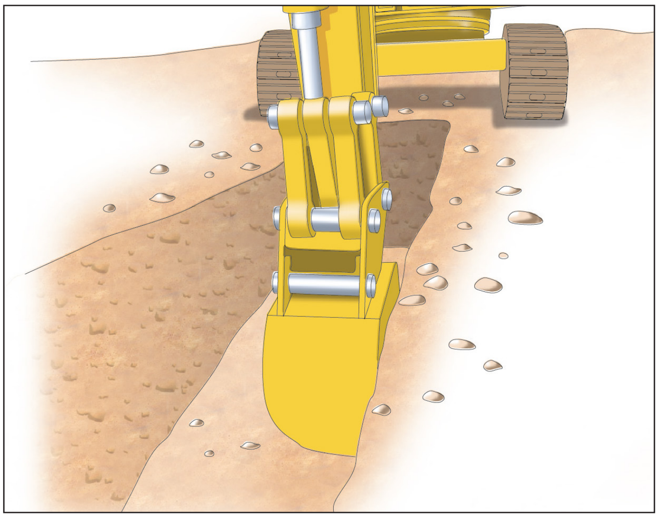


Figure 23 – Trench excavation

7.2 Preparing the Trench

The trench bottom provides the foundation for the pipeline and therefore should be stable and uniform along the pipeline.

Prior to placement of bedding material, in good working conditions, the trench bottom should be made sufficiently even with stones and rocks removed to provide even distribution of the bedding material layer and provide continuous support for the pipes.

Depressions left in the trench bottom below the pipe can result in damage to the pipe. When the trench bottom is flat, localised holes or pockets should be backfilled to ensure that the pipe is supported over the whole length of the barrel. See Figure 24.

As a guide, the bedding material should be spread across the full trench width to a depth of 100mm - 150mm above the highest projection in the trench bottom and compacted to prevent settlement of the pipeline.

The trench walls should be firm, to provide effective side support. The trench wall firmness is an important consideration for HS type installations.

When installing FRCPipe+ a small recess must be dug in the trench foundation to allow the pipe to rest evenly on the pipe barrel. Any excess material removed should be replaced around the collar when the pipe is laid in position.

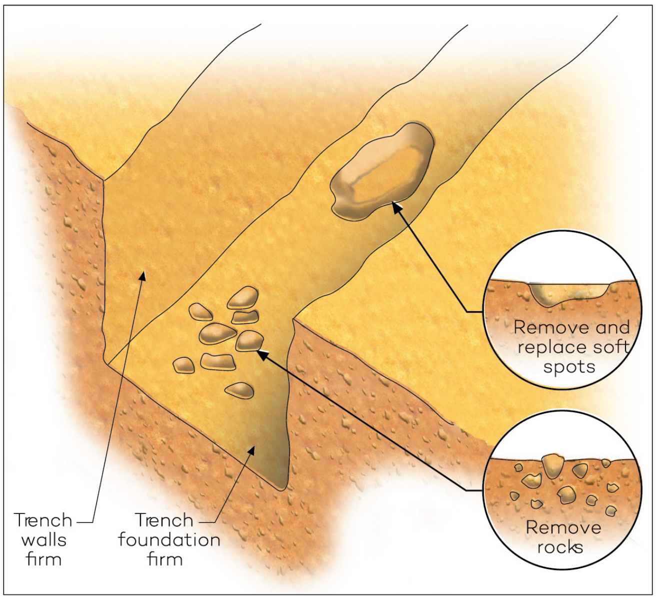


Figure 24 – Trench walls and foundations

7.3 Width of the Trench

The width of the trench has a bearing on the amount of load a pipeline will receive from the weight of materials above it. The design engineer specifies a particular trench width for the pipeline. The installer is to take heed of the design trench width and excavate as close as possible to the design.

Typically the available bucket widths will dictate the trench widths, the pipelayer should ensure the bucket used is as close as possible to the required trench width.

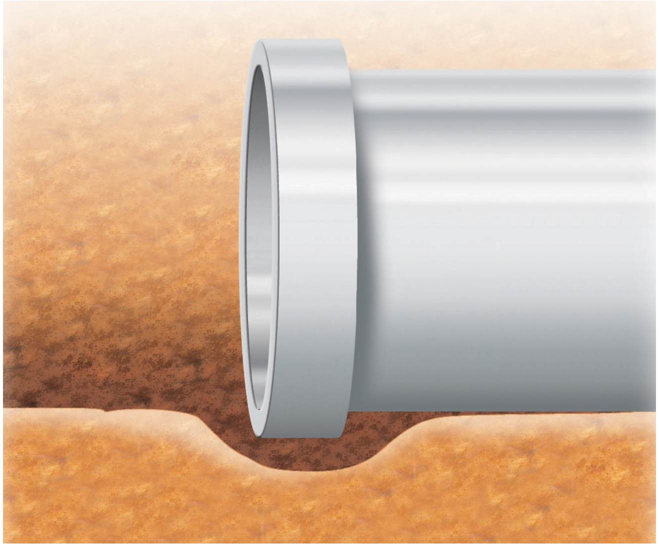


Figure 25 – Local excavation for collar

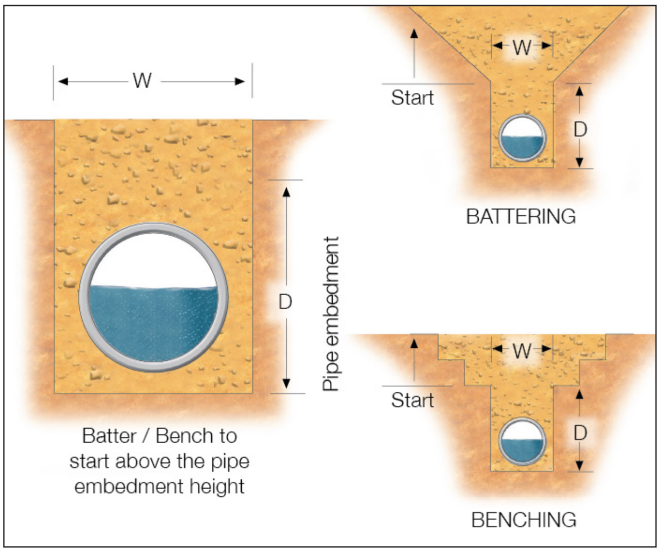


Figure 27 – Battering and benching

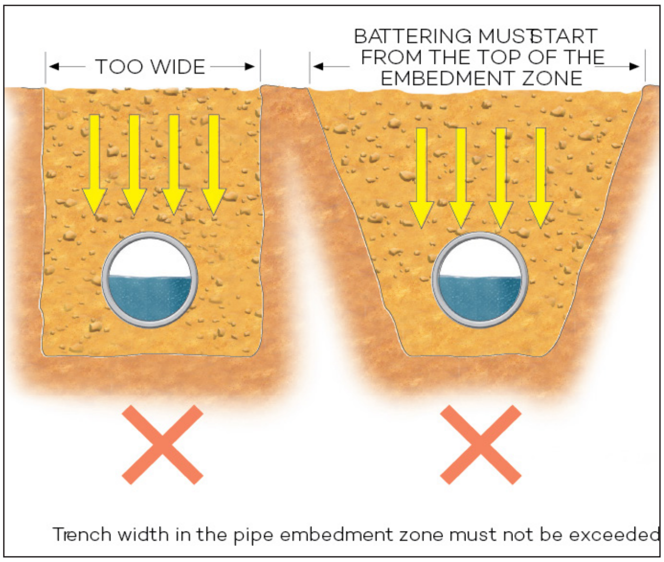


Figure 26 – Trench width

7.4 Trench Stability

Stable conditions are those where, after excavation, the trench walls remain solid and do not show any signs of collapse or cave-in. Unstable conditions are those where, during or after excavation, the trench walls tend to collapse and cave-in. Under these conditions, in open or unrestricted areas, the top of the trench can be widened until stability is achieved. A smaller trench should then be dug in the bottom of the excavation to contain the pipe as shown. If for any reason trench widths exceed the maximum allowed, provision should be made for additional loading on the pipes. Trench shoring or bracing may be required, but this is to be determined by a suitably qualified engineer or supervisor

8.5 Trench Depth

The trench depth and/or invert level should be specified by the pipeline designer. As a guide, typical figures for the minimum clear cover above pipes would be:

- Highways – 750mm
- Other roads – 600mm
- Areas not subjected to wheel loads – 450mm

Typically trenches deeper than 1.5m require shoring or battering of trench walls. Battering of walls can only be applied from the top of the overlay layer of the pipeline – the trench walls must be vertical and firm to provide pipe support.

7.6 Groundwater

The presence of ground water may affect the trench foundation and side walls by making the material soft. The trench foundation and walls ability to provide a stable base for the pipeline may be adversely affected. The engineer must determine the best way to stabilise the trench in light of groundwater, and ensure that the trench provides adequate support for the bedding and side support layers that the pipeline depends on for its structural integrity.

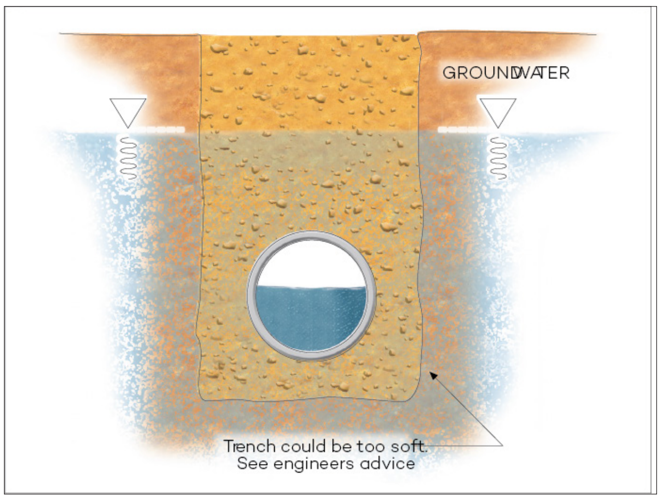


Figure 28 – Groundwater

8. Suitable Pipe Support Material

8.1 Overview

There are many types of materials available on the market place that could be used for pipe support. The most common materials are sand, crusher dust and gravel amongst others. Australian Standard AS/NZS3725 provides guidance on assessing whether the material you intend to use is suitable for supporting the pipe
.
Check with the relevant local government authority for applicable specifications in a specific area.

Pipe support components consist of:

- Bedding
- Haunch
- Side support
- Overlay
- Backfill

9.2 Bedding and Haunch

Bedding and haunch layers of the pipe support have identical requirements on material properties. The material must be a non-cohesive soil. The particles of the material must not be made of a material that would break down, such as shale. The grading of the material is such that it is a free draining material.

The material must pass the particle size distribution shown in Table 12 (from AS/NZS3725).

TABLE 12 – BEDDING & HAUNCH MATERIAL

Sieve Size mm	% Weight Passing through Sieve
19.0	100
2.36	100-50
0.6	90-20
0.3	60-10
0.15	25-0
0.075	10-0

8.3 Side Zone

Side zone material must be a non-cohesive soil. The particles of the material must not be made of a material that would break down, such as shale. The material must pass the particle size distribution shown in Table 13 (from AS/NZS3725).

TABLE 13 – SIDE ZONE MATERIAL

Sieve Size mm	% Weight Passing through Sieve
75.0	100
9.5	100-50
2.36	90-20
0.6	60-10
0.075	25-0

8.4 Overlay

The overlay layer is to be at least 150mm thick. It can be made up of 'ordinary fill', which can be material obtained from excavation of the pipe trench. It is often the case that the size zone material is used for overlay. The overlay is the last layer of the pipe support layers.

Note: Whilst the Standard allows for 20% of material to be 75-150mm particle size, we recommend that all large rocks be removed from the overlay to prevent damage to the pipe during compaction.

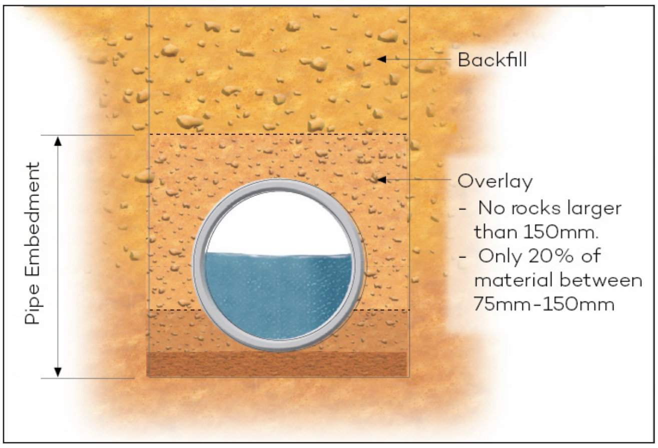


Figure 29 – Overlay material

8.5 Backfill

The backfill layer is material that fills up the rest of the trench. There are no specific requirements for backfill for the pipe support itself, but note there may be other requirements such as pavement layers that may apply.

The pipelayer is recommended to check with their materials supplier to ensure that material requirements are met.

9. Installation

9.1 Overview

Although laying conditions vary from site to site, the following information is intended as a guide and covers some issues encountered during normal installation of FRCPipes. All construction must comply with the project specific engineering specifications and any relevant regulations and standards.

9.2 Preparation

Pipes are laid after the preparation of the trench and the bedding. The pipelayer should make sure that the pipe is going to be sitting on firm support, meaning there are no soft areas in the trench foundation, and no sharp protruding material anywhere in the bedding, see Section 7 for more information relating to the trench.

Bedding must be flat, with appropriate level and grade to achieve fall for the pipeline. Bedding is compacted around the outer thirds of the bedding width, leaving the middle third lightly compacted or not compacted at all. The pipe sits on top of the middle third, and will induce compaction through its own self weight and the weight of other loads.

9.3 Grade

Check for proper line and grade. Ensure minimum specified bedding thickness is maintained. If pipe grade needs to be raised, remove the pipe from the trench and regrade full length of bedding.

Lifting up pipe and shovelling dirt/bedding material under the pipe will leave voids and is NOT acceptable. Do not use excavation equipment to bring pipe into line with grade, see Figure 30.

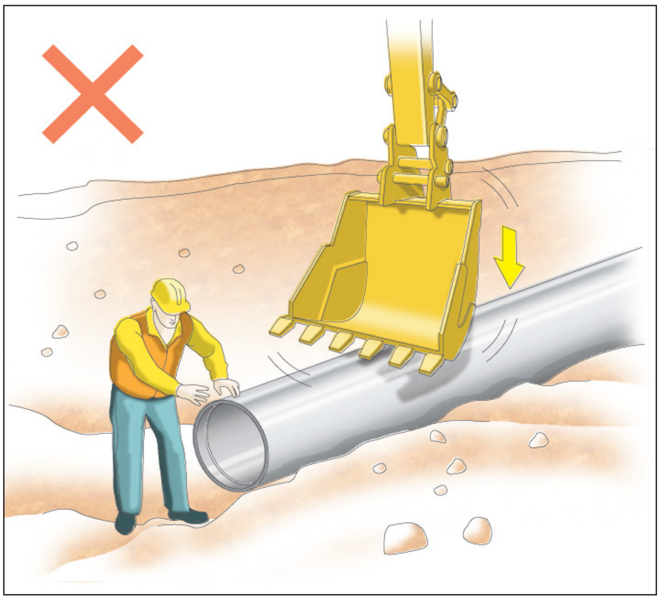


Figure 30 – Improper grade alignment

If pipe grade needs to be lowered, remove pipe from the trench and correct the grade. Do not make adjustment in grade by lifting and dropping the pipe, by pushing down on pipe with excavating equipment or by lifting the pipe and packing bedding material beneath the pipe. Any pipe not installed at correct grade should be completely removed, the grade corrected and the pipe re-laid.

9.4 Pipe Laying Sequence

The pipe laying sequence is normally conducted facing upstream, with the spigot (male) end facing down-stream. The spigot (male) ends are pushed into the socket (female) end.

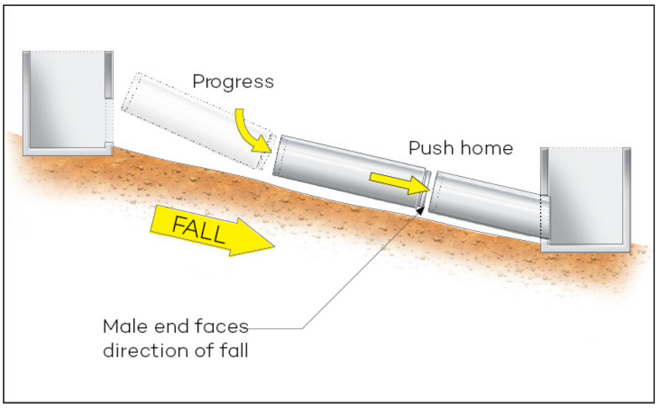


Figure 31 – Pipe laying sequence

9.5 Joints

Precision Joint Technology
The patented FRCPipe precision joint provides a highly accurate machined joint with allowable variation of less than 1mm on all pipe sizes. This joint has an in-wall rebated spigot and socket which is designed to resist water ingress/egress using rubber 'v-rings', see Figure 32. The joint, which allows a smooth flush surface on the outside of the joint, enables you to lay the pipe on a continuous bed, without having to dig recesses in your bedding. The joint also allows for some degree of movement to allow the pipeline some

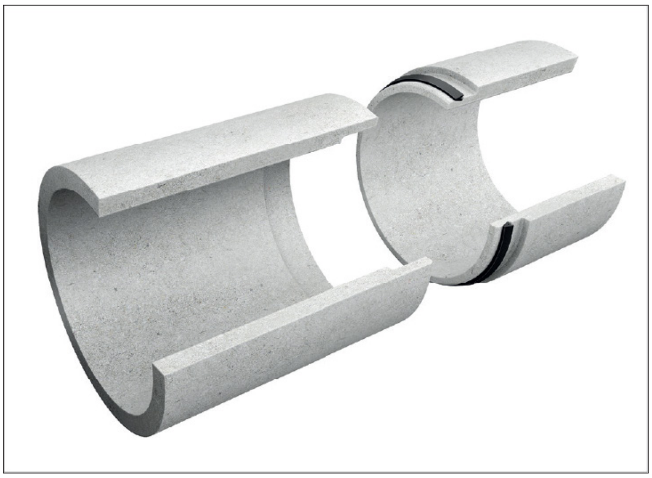


Figure 32 – Precision joint technology

Advanced Joint Technology
The patented FRCPipe+ is a robust dual v-ring joint untilising a separate collar to provide a high strength connection in addition to the accurately machined joint. This provides another construction option where additional joint strength is required. Refer to Figure 33.

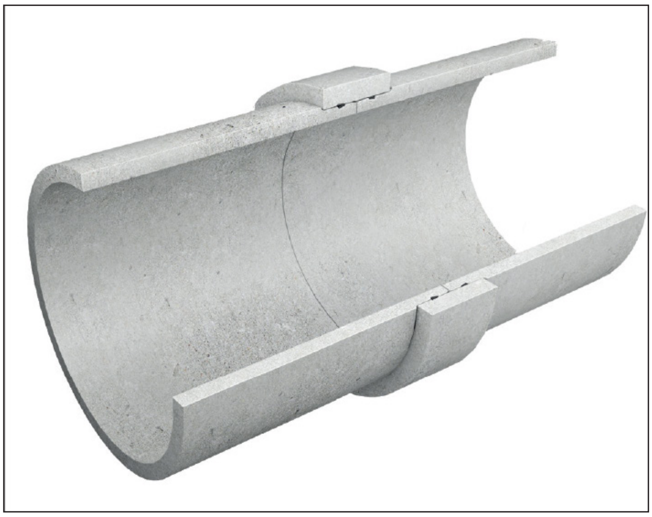


Figure 33 – Advanced joint technology

9.6 Installing Rubber v-ring

Carefully clean all dirt and foreign substances from the jointing surfaces of the spigot end of FRCPipes, including the rubber ring groove. Rubber ring should not be placed on FRCPipes joints until the pipe is ready to be installed. Confirm that rubber ring diameter matches the pipe diameter. Install the rubber ring on spigot end of pipe in the machined groove and orientate in the proper direction as illustrated in Figure 31.

Warning: Be sure that gasket is seated properly in machined gasket groove and free of any soil, twists, or abrasions to ensure proper joint seal is made.

9.7 Applying Lubricant

PipeJoin lubricant is used to aid in the jointing of FRCPipes. Without lubricant, jointing is difficult if not impossible and may compromise the sealing performance of the joint.

After placing the rubber v-ring in the spigot groove, apply a generous layer of lubricant to the socket end only. It is not generally necessary to apply lubricant to the spigot and v-ring, however this can be done if desired.

PipeJoin lubricant can be applied by hand (with appropriate PPE in use) or with a brush.
Note: Use only PipeJoin lubricant. Grease or other petroleum based products must not be used as these will cause the rubber v-ring to perish rapidly.

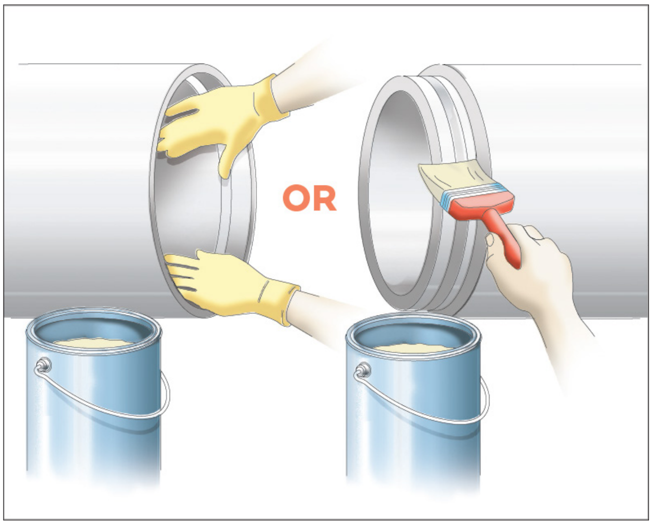


Figure 34 – Applying lubricant

9.8 PipeJoin Lubricant

PipeJoin lubricant is a special compound that consists of a soft soap solution, which facilitates jointing of the FRCPipe rubber ring joint. In an emergency, a solution of soap or soap powder and water can be used as a jointing compound. Table 14 identifies the approximate number of pipes which can be jointed per litre of PipeJoin lubricantflexibility to withstand some ground movement.

TABLE 14 – PIPEJOINT LUBRICANT USAGE CHART

Pipes joined per litre of PipeJoin Lubricant (approx)		
Pipe Size mm	Joints pet Litre	Meters per Litre
225	19	80
300	14	60
375	11	48
450	9	40
525	8	36
600	7	32
675	5	24
750	4	20

9.9 Joining Lubricated Pipes

Join pipe by inserting the spigot into the socket end at as small of an angle as possible. By doing this you prevent rolling of gasket. Push pipe home using standard wooden block and lever techniques as shown in Figure 33. For larger diameter pipes it may be necessary to use machine assistance. In all cases take care not to damage the pipe end, see Figure 36.

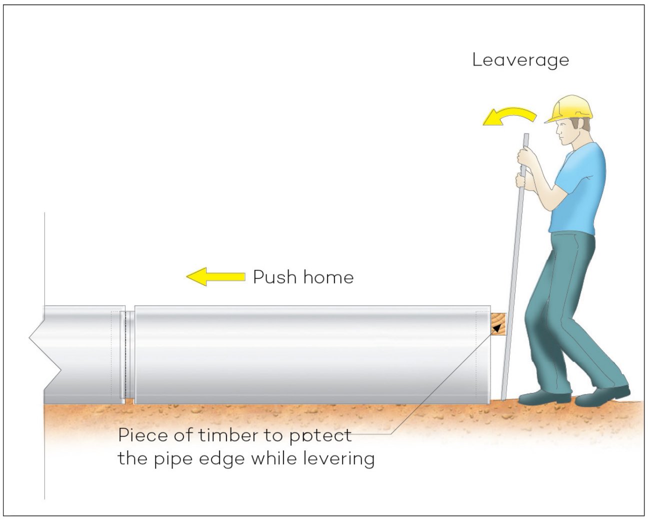


Figure 35 – Pushing home using block and lever

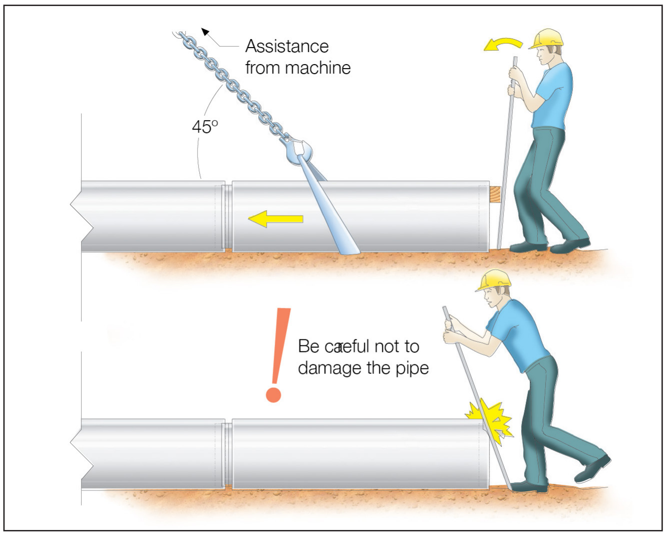


Figure 36 – Pushing home using machine assistance

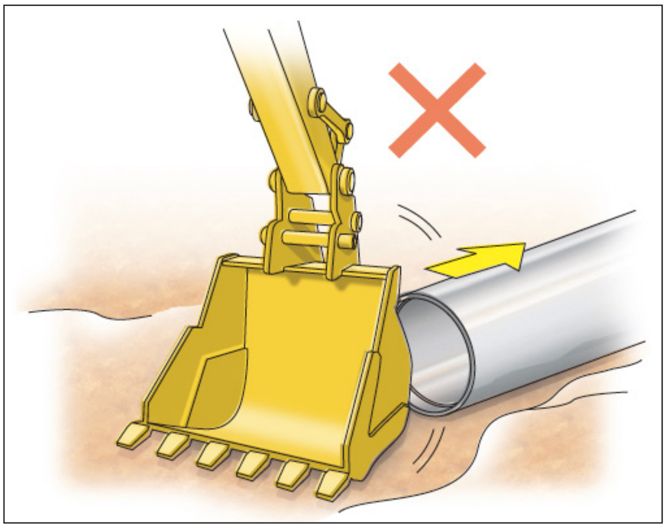


Figure 37 – DO NOT use excavator to push pipe

9.10 Joint Gap Tolerances

It is recommended that when joining FRCPipe concrete pipes the pipes are pushed fully home so that no gaps are visible on the outside of the pipe. The design of the FRCPipe joint leaves a nominal 3mm finished gap on the inside of the pipe even when the pipe is pushed fully home, see Figure 38. flexibility to withstand some ground movement.

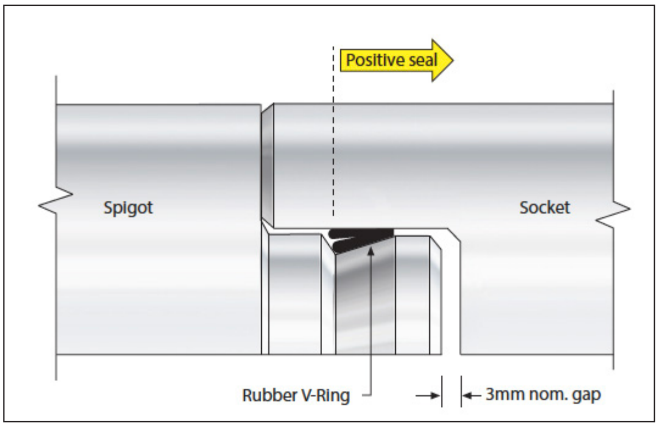


Figure 38 – FRCPipe

The Advanced Joint Technology of FRCPipe+ utilises a separate collar to form the external sealing surface for the dual rubber ring joint.

If using FRCPipe+, the joint is designed so that when assembled there is no internal gap between the pipe ends, see Figure 39.

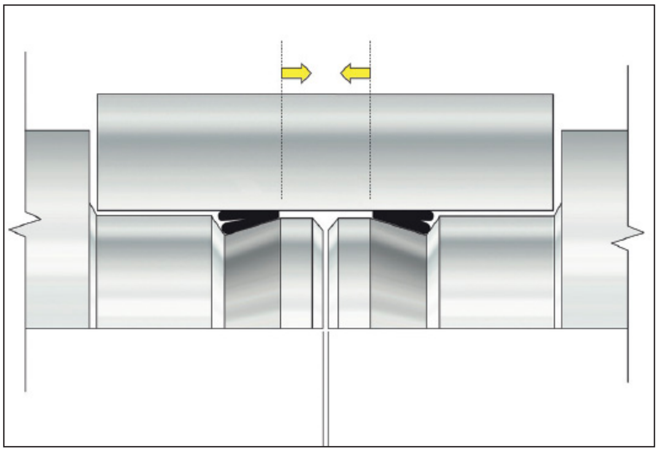


Figure 39 – FRCPipe+ and FRCPipeR+

9.11 Splayed Joint Deflection

In some circumstances, a slight deflection may be required to achieve a curved pipe alignment. This is possible using the standard FRCPipe or FRCPipe+. Table 15 lists the achievable joint deflection that is possible wit either the FRCPipe or FRCPipe+.

TABLE 15 – JOINT DEFLECTION FRCPipe, FRCPipe+ (4M LENGTH)

Pipe Diameter	Max. Deflection Angle (degrees)	Max. Joint Gap (mm)	Max. Deflection at Pipe End (mm)	Max. Radius of Curvature (m)
225	3.0	15	206	76
300	2.0	12	138	112
375	1.5	11	104	151
450	1.5	13	104	151
525	1.0	10	70	228
600	1.0	12	70	228
675	1.0	13	70	228
750	1.0	14	70	228

When installing pipes with splayed joints, a gap will be created within the joint. For FRCPipe, this gap can be directly measured on the outside surface of the pipe. If using FRCPipe+, the joint gap is only visible and measurable on the inside surface of the pipe. Table 15 details the “Max. Joint Gap (mm)” that should result when a pipe joint is splayed to the maximum recommended value.

When creating splayed joints, it is recommended that the pipes are initially jointed in a straight line. This ensure the v-ring will seat correctly in the socket. Once this is done, the pipe location at the end to be deflected can be marked. Using a bar, the pipe can be carefully deflected in the required direction, up to the “Max. Deflection at Pipe End (mm)” value listed in Table 15. Pipe support material should be placed at both ends of the pipe to secure it against any subsequent movement.

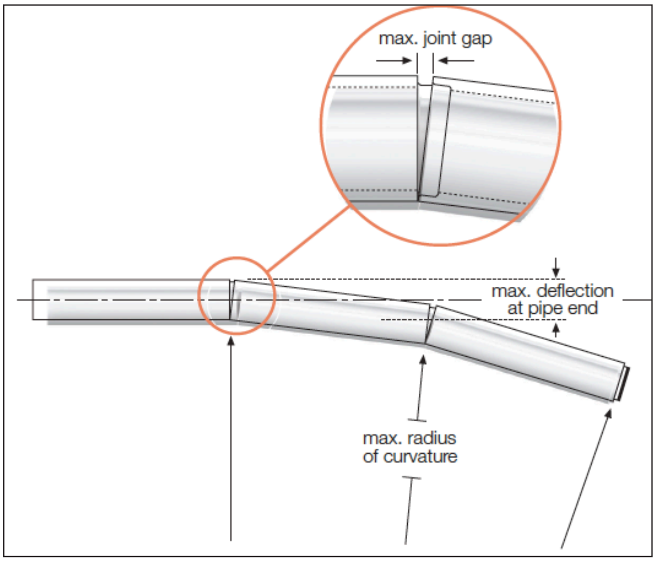


Figure 40 – FRCPipe

9.12 Haunch, Side and Overlay Installation

Compaction requirements and suitable materials for haunch, side and overlay is covered in Sections 7 & 9 respectively.

Material is placed on both sides making sure that the height of the material is kept equal on both sides of the pipe to avoid the pipe moving about during installation. These materials must be placed in thin layers (typically 150mm each layer as per the engineering specifications) and compacted using suitable compaction equipment. Typical compaction equipment include tampers, vibrating plates, wacker packers and trench rollers as shown in Figures 41-44.

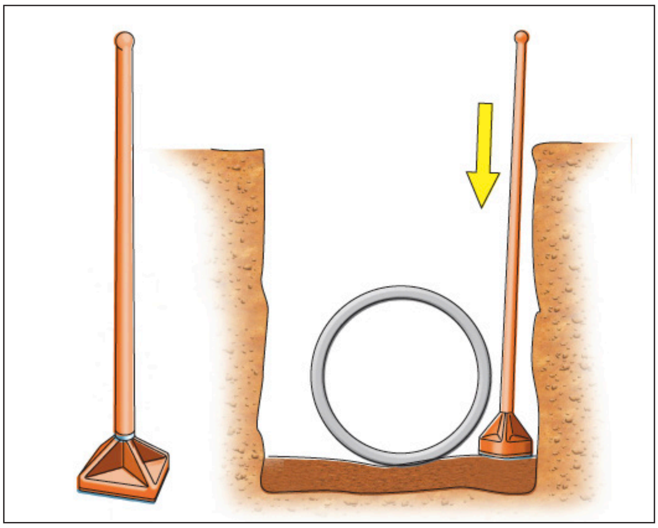


Figure 41 – Temping Bar

Figure 42 – Vibrating Plate

Figure 43 – Wacker Packer

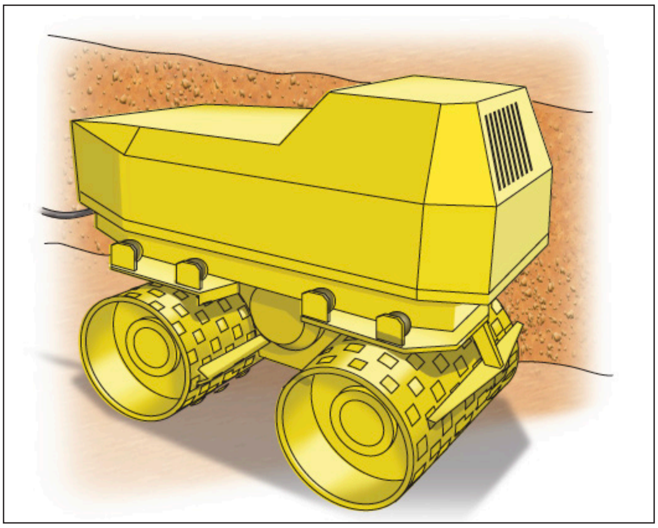


Figure 44 – Trench Roller Compactor

Ensure there are no gaps or voids in the support. Gaps typically appear near the pipe and pit connection, in the haunch, or sometimes occur where the bedding has not been graded properly, see Figure 45.

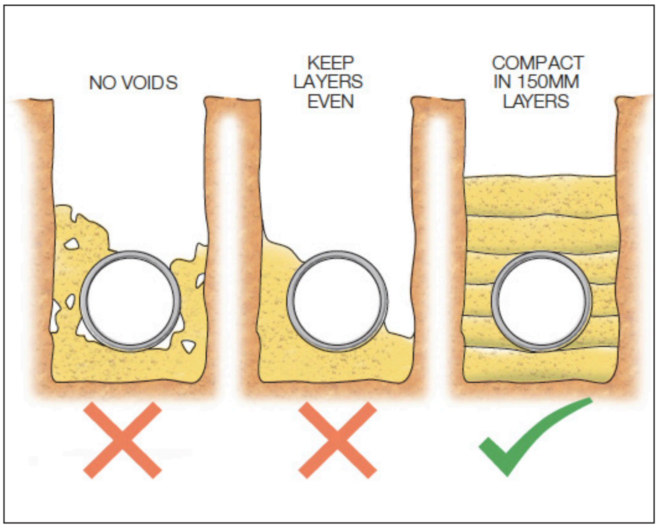


Figure 42 – Vibrating Plate

You should also ensure that you achieve the required compaction levels in the supports, and use suitable material for each component. Compaction is discussed in Section 7. Also, refer to Section 9 for pipe support material requirements.

Note: Whilst the Standard allows for 20% of material to be 75- 150mm particle size, we recommend that all large rocks be removed from the overlay to prevent damage to the pipe during compaction.

9.13 Compaction Using Flooding Method

Flooding with water is a method that is sometimes used to compact materials such as sand. However this only achieves approximately 30% density index, and does not achieve bedding, haunch and side zone compaction levels that are required. Flooding with water could be used for the overlay and backfill layers, provided that the trench and supporting material can drain away the water quickly.

9.14 Optimum Moisture Content for Compaction

The best compaction occurs at the optimum moisture content for the particular material. A suitably qualified engineer can advise on this. A balance must be found between either being too dry or over saturated to find this optimum moisture content.

9.15 Backfill

The remaining backfill material should be placed and compacted over the pipe in accordance with project plans and specifications. To ensure that the pipe does not move when installing the next section of pipe, uniformly place and compact backfill on each side of the pipe to the specified density to prevent lateral displacement of pipe.

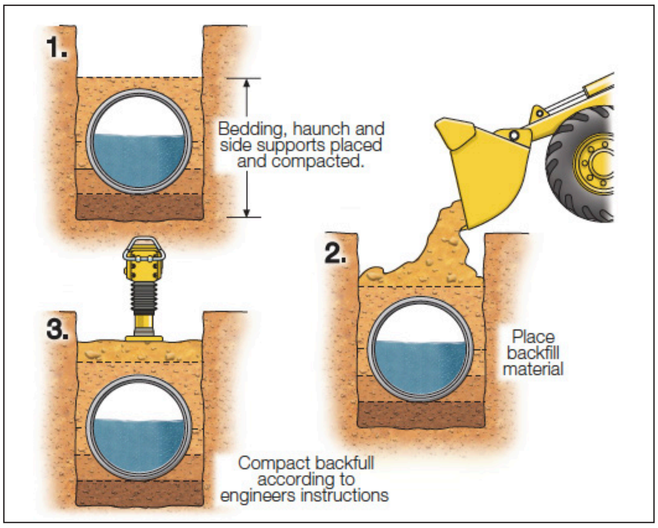


Figure 42 – Vibrating Plate

Avoid running heavy construction equipment over the pipes until a sufficient cushion of material has been placed. Since FRCPipes are manufactured to achieve high initial ultimate crush strength compared with the long term design load, FRCPipes perform well under construction loads of this type.

10. Installation

10.1 Cutting

From time to time it will be necessary to cut pipes and install fittings. Refer to Section 4 for safe working methods. Use appropriate safety precautions when operating saw/blade in accordance with manufacturers recommended practices.

Cutting guide:

1. Mark a cut line on the outside of the pipe.
2. Make sure pipe is stable before cutting.
3. Cut length of pipe to the cut line marked.
4. When cutting a length of pipe, it will be necessary to roll the pipe to get access to the entire circumference. After rolling make sure pipe is stable before resuming cutting. It is recommended pipe be chocked to prevent the pipe rolling during cutting.
5. Proper safety gear must be worn to protect operator in accordance with applicable safety standards and manufacturers recommendations.

As there is no steel reinforcement to corrode, no corrosion protection is required to be applied to the cut end.

10.2 Making Holes

Holes can be made within the 'Overlay' zone of the pipe. Holes are to be formed using clean cuts by using a circular drill, or a suitable wet saw with straight cuts as shown in Figure 47.

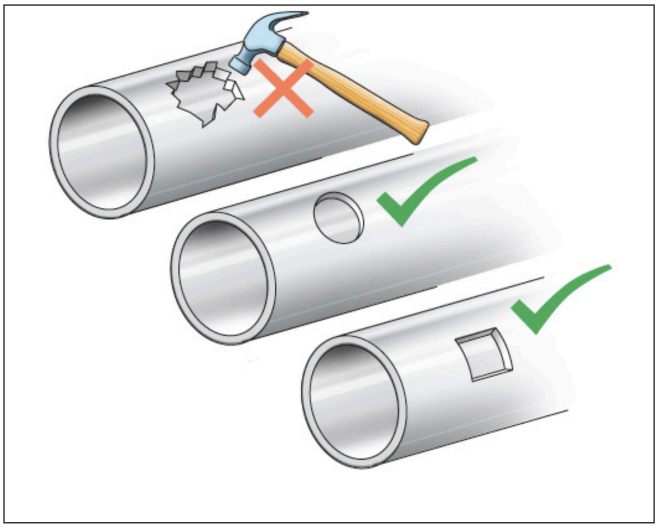


Figure 47 – Hole forming

10.3 Saddles

FRCPipes saddles are used to provide connections without the need to install a pit structure. Saddles are epoxy glued over an already formed hole as shown in Figures 48 and 49. Once installed a branch drainage line can then be connected to the saddle connection.

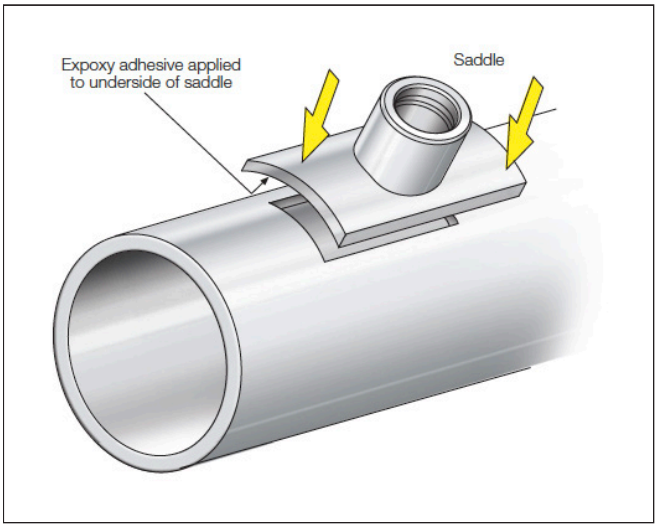


Figure 48 – Saddle installation

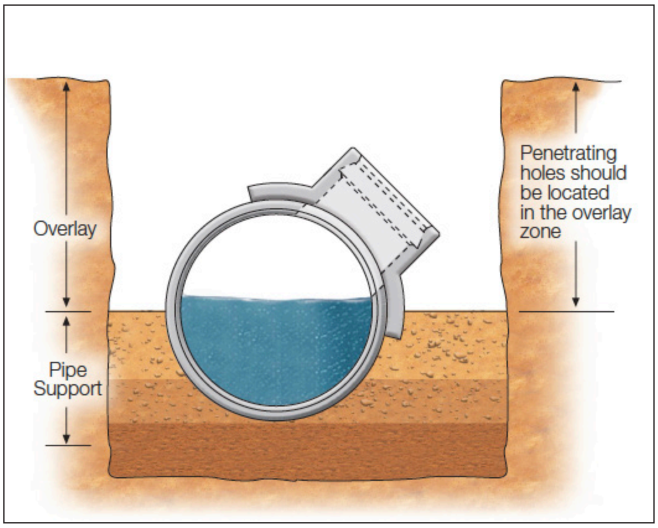


Figure 49 – Saddle connection cross section

10.4 Joining a Cut Pipe

Unturned Couplings are used with FRCPipes in underground applications to enable two cut pipe ends to be joined.

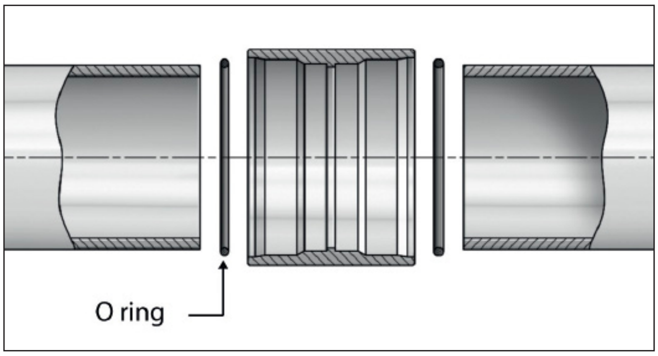


Figure 50 – Unturned couplings

When joining using unturned coupling follow these steps:

1. Locate the required position of the fitting
2. Cut the pipe end square
3. Roll the Unturned O-ring onto the outside of the pipe rolling up and down to remove any twist from the O-ring
4. Align the O-ring close to the of the pipe
5. Push the coupling onto the pipe, ensuring the ring rolls on square

Note: DO NOT APPLY PIPEJOIN LUBRICANT when joining with the Unturned coupling O-ring.

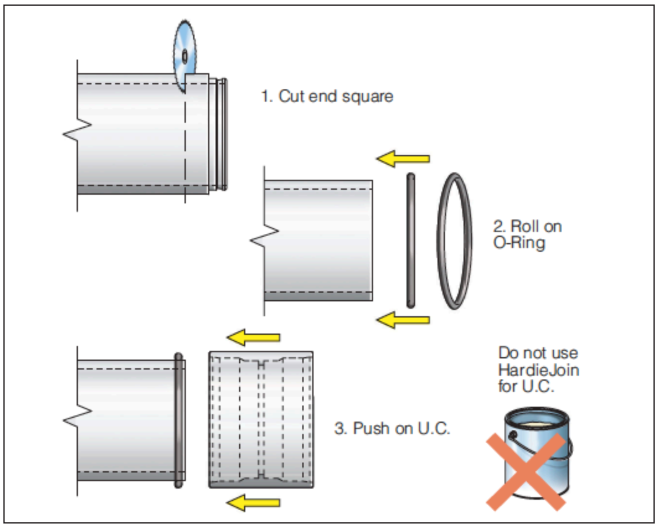


Figure 51 – Joining with unturned couplings

10.5 Connecting to Pits

Pipes connected to pits should be designed to accommodate differential movement between pipes and pits. It is recommended that a short pipe or 'rocker pipe' is used in this situation. The end of the pipe joining to the pit should be cut square and aligned with the inside wall of the pit. Figure 52 shows the typical configuration.

Generally the short pipe length nominated is the maximum length, there is a degree of customisation allowable to ensure that your pipeline fits between the pit distances.
It is common to find cracks in pipe near the pit and pipe joint due to differential settlement and voids in bedding between the pit and pipe. The installer can custom cut short lengths of FRCPipes and connect to adjacent pipe lengths using the Unturned Coupling. See Clause 11.4 for information about joining a cut pipe.

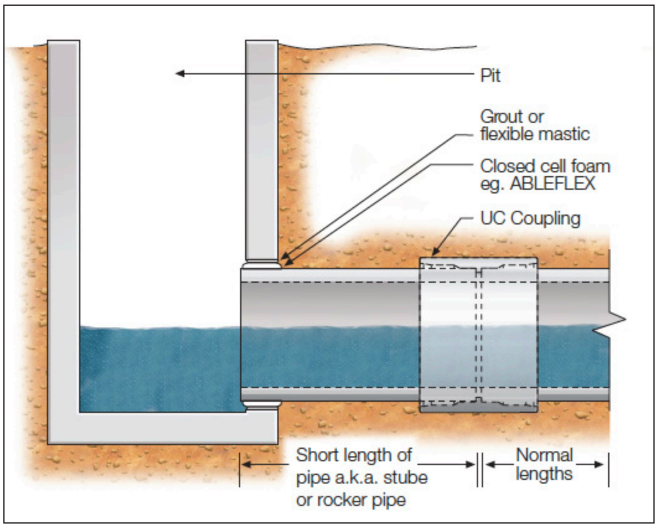


Figure 52 – Flexible pit junction

10.6 Fittings

As an integral part of the FRCPipes stormwater drainage system, the unique range of SuperTite Fittings allow design flexibility and quick installation. Fittings allow pipeline to change direction, join multiple lines, introduce smaller diameter branch lines or connect to other pipe materials.

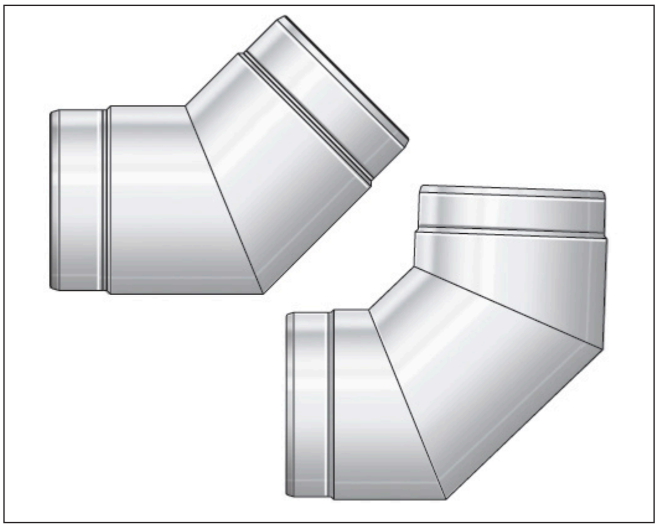


Figure 53 – Bends

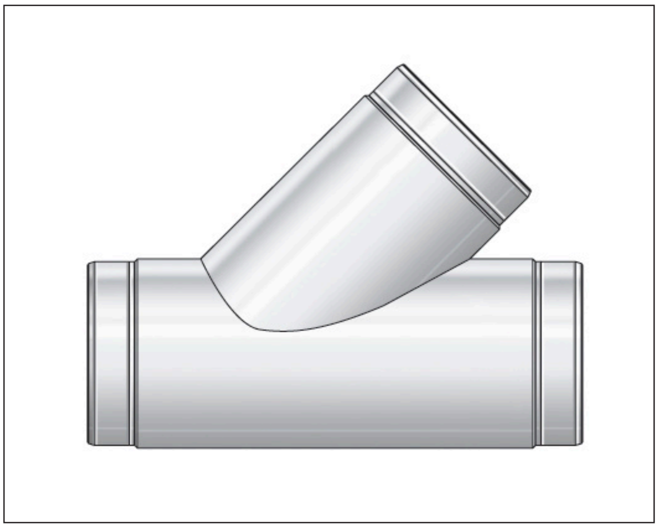


Figure 54 – Slope Junction

10.7 Connecting a Fitting to FRCPipe

As an integral part of the FRCPipes stormwater drainage system, the unique range of SuperTite Fittings allow design flexibility and quick installation. Fittings allow pipeline to change direction, join multiple lines, introduce smaller diameter branch lines or connect to other pipe materials.

For bends and junctions, installation is simple using the range of adaptor couplings to connect the fitting to a FRCPipes cut end. When joining a fitting using a SuperTite to Unturned Adaptor (S.A.U. coupling), follow these steps:

FRCPipes (Unturned Connection) Connection

1. Locate the required position of the fitting
2. Cut the pipe end square
3. Roll the Unturned O-ring onto the outside of the pipe rolling up and down to remove any twist from theO-ring
4. Align the O-ring close to end of the pipe
5. Push the S.A.U coupling onto the pipe, ensuring the ring rolls on square.

Note: DO NOT APPLY PIPEJOIN LUBRICANT when joining with an Unturned coupling O-ring

Fitting (SuperTite Connection)

1. Position the SuperTite v-ring into the coupling groove
2. Apply PipeJoin lubricant to the fitting spigot
3. Push the fitting into the coupling

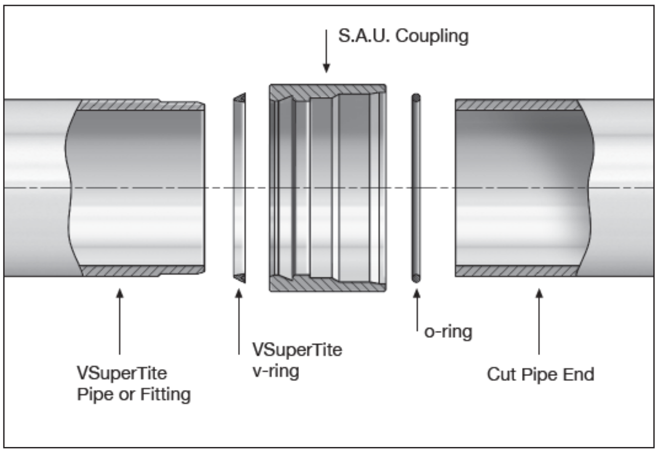


Figure 55 – Connecting fitting to FRCPipe

11. Damage and Repairs

11.1 Pipe Cracking

Cracking of concrete pipe is an industry issue which everyone wants to avoid. There are many factors which affect the performance of a pipe when installed including, but not limited to; quality of pipe material, ground conditions, pipe support material, compaction, proper installation, construction loading, etc. Common causes of pipe cracking are overloading (during construction or in service) and lack of adequate pipe support.
The most common types of cracks observed are as follows:

Circumferential cracking – typically due to inadequate bedding and haunch support, which leads to bending of the pipe. This type of damage can also be caused by unstable trench foundation and walls.

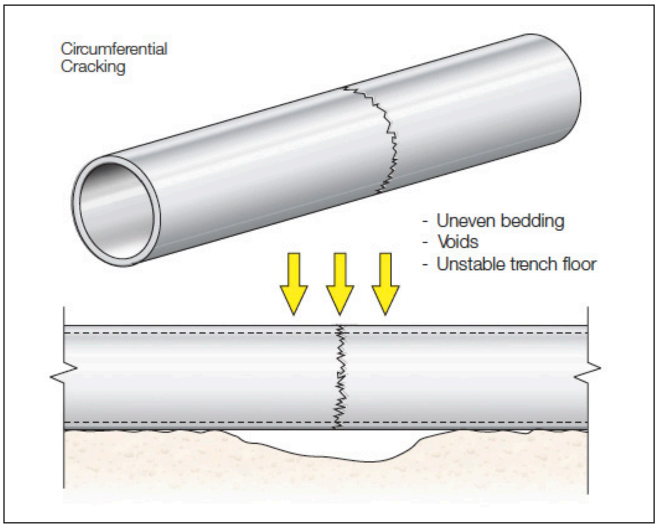


Figure 56 – Joining with unturned couplings

Longitudinal cracking – typically due to over-loading of the pipe. Overload occurs when an extremely heavy wheel load is imposed or where there is not enough cover over the pipe.

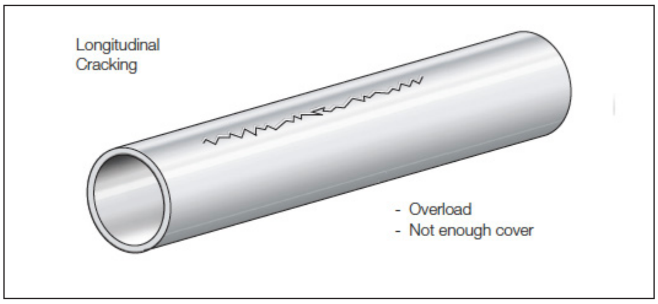


Figure 57 – Joining with unturned couplings

11.2 Repairing Pipe Sections

Repairing damaged FRCPipes is relatively straight forward as the material does not contain steel reinforcing and is easy to cut when using the right tools. Damaged sections can be cut-out and repaired using rubber repair collars as outlined below:

1. Cut away pipe to sound material using suitable wet saw
2. Insert a length of pipe equivalent to that cut away with the rubber repair collar positioned on the pipe
3. Slide and position the rubber repair collar across the joints and secure with the stainless steel straps, see Figure 58.

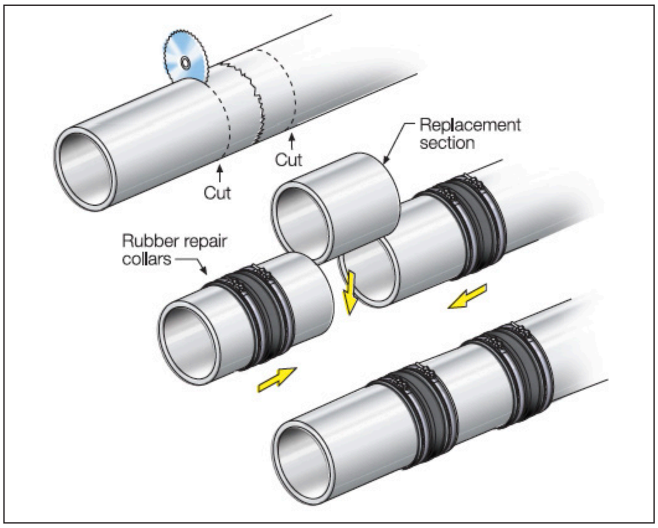


Figure 58 – Joining with unturned couplings

11.3 Repairing Punctures

Pipe damage can occur due to a number of factors, including machine damage during excavation after pipes are installed or large rocks in backfill being compacted into the pipe. There are a number of options available for repairing small areas, including patching over the damaged section with a CIPP (cured in place pipe) liner or exposing the outside diameter of the pipe and using a FRCPipes saddle repair.

There are restrictions when considering repair suitability. If an internal CIPP liner is being proposed then advice should be sought from the liner provider.

For a saddle repair, the size and location of the damaged section must be considered. The damage should be in the overlay zone, or the top half of the pipe. This prevents significant obstruction to the water flow within the pipe after the repair is completed. The size of the damage must small enough to not cause risk of further pipe cracking.

For example, typically holes larger than 150mm in any direction are not suitable for the saddle repair method.

The saddle repair is conducted as follows:

1. Cut away damaged material back to firm substrate as shown in Figure 59.
2. Measure the size of the hole and confirm suitability for repair.
3. Cut a saddle section from the next pipe size up (i.e. for a DN375 repair, cut the saddle piece from a DN450 pipe).
4. Ensure the saddle piece is large enough to cover the damage with a minimum of 100mm overlap all around.
5. Ensure all surfaces to be bonded are free from dust and dirt and are dry.
6. Mix and apply a liberal amount of cementitious construction epoxy around the edge of the damage.
7. Position the saddle piece over the damage and ensure there is a seal formed by the epoxy, see Figure 60.

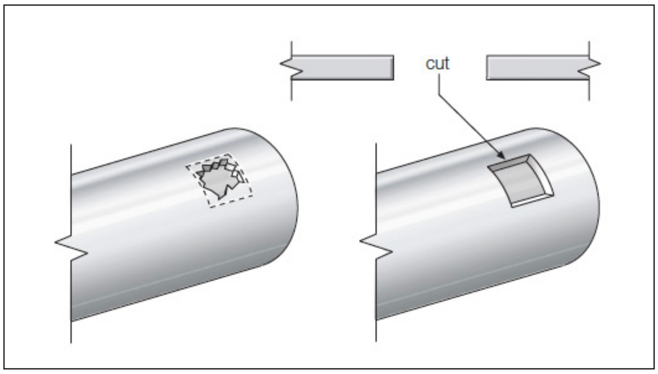


Figure 59 – Repair section step 1

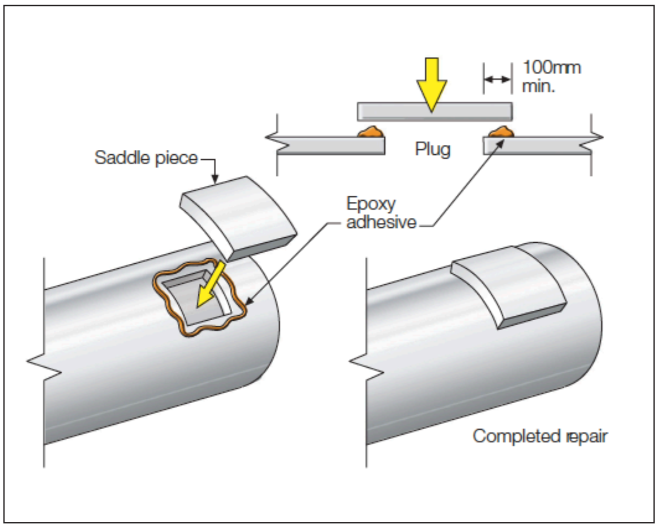


Figure 60 – Joining with unturned couplings

11.4 Damaged Ends

Damaged joints and ends should be cut off to leave a square end, see Figure 61. Cut pipe sections can be joined using 'Unturned Coupling' as shown in Section 11.3. Cut ends can also be used as a piece connecting into or out-of pit structures.

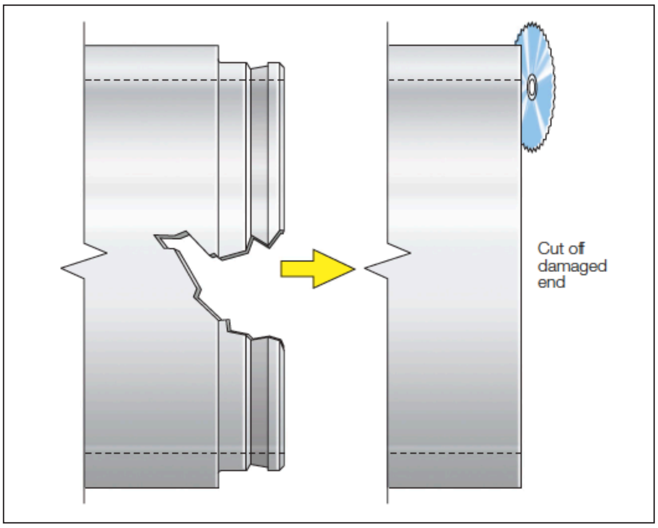


Figure 61 – Damaged end

Notes:

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