



20 reasons why concrete pipeline systems are the best option now and for the future

Introduction

Concrete pipeline systems have been the backbone of our drainage and sewerage network since the early 1860s. For well over 140 years they have offered a number of advantages, including speed of installation, inherent strength and durability.

Today, modern systems need to provide installed cost benefits and low maintenance costs over a long service life. They must be made to exacting quality standards with stringent specifications developed within the public domain – and have low environmental impact.

Concrete pipeline products address these needs and have evolved to meet new challenges. This booklet explains the 20 main reasons why the legacy we leave for our children and grandchildren, as well as for our own sake today, is best met with concrete.

1. Cost & affordability
2. Rapid production & installation
3. Resistance to damage, abrasion & corrosion
4. Inherent strength
5. High, consistent standards & specifications
6. Resistance to jetting
7. Resistance to sulphate attack
8. Stability
9. Sustainability
10. Design flexibility
11. Customisation & adaptability in use
12. A track record of long service life
13. Water tightness & joint integrity
14. Inertness
15. Hydraulic efficiency
16. High health & safety standards
17. Resistance to high temperatures/fire
18. Innovative solutions
19. Off-site manufacture
20. Responsiveness to flooding requirements

1. Cost & affordability

- Concrete pipes provide **installed cost savings** as they can be laid without using a full granular bedding and surround. Excavated material can be reused and imported granular material can be reduced to a minimum. The reuse of excavated material during installation also reduces disposal costs – a key benefit when faced with continued increases in landfill tax.
- Concrete pipes also require **less bedding compaction effort**, reducing site work costs by cutting down on machine use.
- With concrete products, **material prices tend to be stable**, unlike drainage products made of thermoplastics, which can be affected by surges in oil prices.
- Concrete pipes have a specified and proven **service life of over 100 years**, so keeping maintenance and asset replacement costs to a minimum.
- Costing and design help is available online from the CPSCA** at www.concretepipes.co.uk. The *Bedding material cost* calculator helps you estimate the cost of bedding and pipes and compares different types of pipeline materials. The *Design load* calculator simplifies concrete pipeline calculations by providing all the basic values and then recommending a bedding class.

Concrete Pipe		Plastic Pipe
Class B	Class S	Class S
525	525	525
0.671	0.671	0.671
0.150		
1.100		
0.71		
14		
2		
19.88		
6		
5		
0.36		
2.2		
4.99		
40		
£64.87		

NEW!

Class B
180° Granular bedding
Bedding factor = 1.9

Class S
360° Granular bedding & surround
Bedding factor = 2.2

Lay joint and bed pipes as for Class B then place and well compact layers of the same bedding material taking care not to displace the pipes. This is followed by 300mm of the same granular bedding material but lightly compacted directly over the pipe, after which ordinary backfilling is commenced.

The online *Bedding material cost* calculator provides a method of comparing material costs of different pipeline installations.

2. Rapid production & installation

- › Up to 35% of pipeline construction time is consumed during compaction and backfilling, according to a study carried out by University of Munich Federal Army (UniBwM).
- › Concrete pipes do not always require a full granular surround, saving time in bedding and compaction.
- › Installation is easy and well understood by contractors and the process often **uses machinery already available on site**.
- › **Advances in technology** ensure fast and efficient system design, ordering, manufacture, transport and installation. Some components can take as little as 2 to 3 minutes to be made using high-frequency vibration.
- › Manufacturers are renowned for their **excellent design support and customer focus**.
- › Suppliers maintain **good stocks** of standard products to ensure prompt delivery to site.



Fast and well-organised delivery is backed by efficient production and good stock levels.

3. Resistance to damage, abrasion & corrosion

- › Concrete pipeline products are **strong and robust**. They are not prone to damage during storage, handling, installation or use.
- › **No special protection measures are required** against damage on site, whereas other materials may require special storage and protection against sunlight, heat and general site activities.
- › Concrete products **do not deform or lose shape** over their service life, thus preserving their structural integrity and hydraulic efficiency.
- › Even when it is over-stressed, **cracks in concrete can mend over time** due to a process known as autogenous healing. The calcium hydroxide in the concrete reacts with carbon dioxide and water to produce calcium carbonate to seal the crack. Other pipeline products do not offer such protection when subject to additional or unforeseen loads.
- › Due to their inherent strength and durability, concrete pipeline products are **abrasion and corrosion resistant**.
- › Concrete pipeline systems **do not lose strength or resistance over time**. Concrete hardens with age and thus maintains resistance. Other materials are known to deteriorate with age and are more likely to suffer age-related defects.
- › As noted in a report by the House of Commons Select Committee on Environment, Transport and Regional Affairs in 1998, concrete pipes are **not affected by rodent attacks**.



Concrete pipes do not require special protection on site.

4. Inherent strength

- › Concrete pipeline systems are **less susceptible than flexible systems to inadequate bedding and poor installation**. The strength and structure of a concrete pipeline system comes from the pipe itself – unlike flexible systems it is not heavily reliant on the design and quality of the installation.
- › Concrete pipes and manholes are **designed to high strength Classes** and offer the most inherently strong option in the market.
- › Concrete pipes are the overwhelmingly **preferred option where traffic is expected** to run over the pipeline.
- › For installations with **deeper cover depths** where greater stresses are imposed on the pipes, concrete systems are the most suitable choice.



Concrete pipes can withstand even the most extreme loading situations.

5. High, consistent standards & specifications

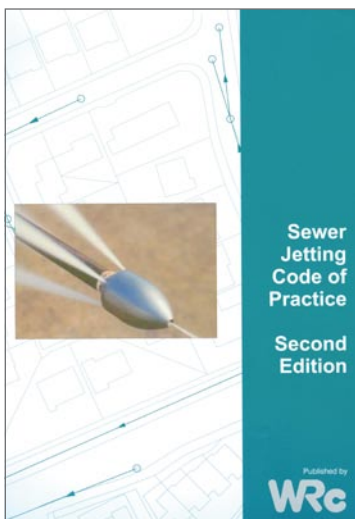
- In 2002, concrete drainage components became one of the first construction products to be manufactured to a **complete and consistent** family of European and British standards.
- These standards ensure that products are made to meet the highest requirements. They include **rigorous product testing** on each requirement at every stage of manufacture. The relevant standards are:
 - BS EN 1916 and 1917 provide information relating to essential performance requirements on material and product characteristics, product strength and testing, water tightness testing, and product sampling and inspection.
 - Complementary standards BS 5911 Parts 1 and 3 (for pipes, manholes and cover slabs) cover other aspects, including detailed cement/concrete content information, geometrical characteristics and finishing, sizes and strength Class.
 - BS 5911 Part 4 covers reinforced and unreinforced inspection chambers and Part 6 with road gullies and gully cover slabs.



Testing a 1200 mm pipe for strength.

6. Resistance to jetting

- › Concrete pipes and manholes are **resistant to damage** by high-pressure water jetting, an established method of maintenance in the UK. Jetting ensures that pipelines run free of blockages and accumulated material that would otherwise compromise the hydraulic performance of the system.
- › According to WRc's *Sewer Jetting Code of Practice*, concrete pipeline systems currently withstand a **maximum water jetting pressure of 5,000 psi (345 bar)**.
- › Concrete pipe manufacturers are confident that their products can actually take higher pressure levels and can therefore **last longer than alternative materials**.
- › Compare this with **2,600 psi (180 bar) maximum for plastic pipeline systems** according to the same code and **no more than 1745 psi (120 bar)** for plastic pipes according to European standards.
- › Up to about 20 years ago, there was a trend to reduce wall thicknesses in plastic pipes, after which they have remained relatively unchanged. This suggests that there may be even greater potential for damage arising from high pressure jetting of these more recent systems.



The *Sewer Jetting Code of Practice* shows that higher pressures can be safely used with concrete pipes to clear blockages without causing damage to the pipe.

7. Resistance to sulphate attack

- Concrete pipes and manholes are **resistant to sulphate and chemical attack**.
- The second edition of Building Research Establishment Special Digest–1: 2005 *Concrete in aggressive ground* (BRE SD–1) was based on a three-year research project conducted by BRE on the impacts of Thaumasia sulphate attack on concrete pipeline systems. It concluded that these systems can cope successfully with aggressive ground conditions reaching up to AC–3 without any protection, making them **ideal for most soil conditions in the UK**. *"Despite their relatively thin walls and frequent subjection to a significant hydraulic gradient from groundwater, precast concrete pipes manufactured to British Standards in the UK have a long in-service record of good resistance to sulphate attack."*
- Concrete pipeline products with higher design chemical classes of DC3 and DC4 are **capable of withstanding attack from the vast majority of aggressive ground environments in the UK**.



BRE Special Digest – 1 describes tests proving that concrete can withstand aggressive ground conditions.

8. Stability

- › Concrete drainage products offer **better resistance to uplift or flotation** than other materials, particularly during floods or in cases of rising groundwater.
- › Concrete pipes are designed with flexible joints so they can take up movements in the ground. The self-weight and superior stability of concrete pipeline products offer **advantages during installation and in service**. They are able to **maintain alignment and resist being displaced** out of position.
- › **Maintenance and refurbishment** activities can be carried out after years of installation **without concern over the system's stability**.



These pipes will stay put during installation and for years to come.

9. Sustainability

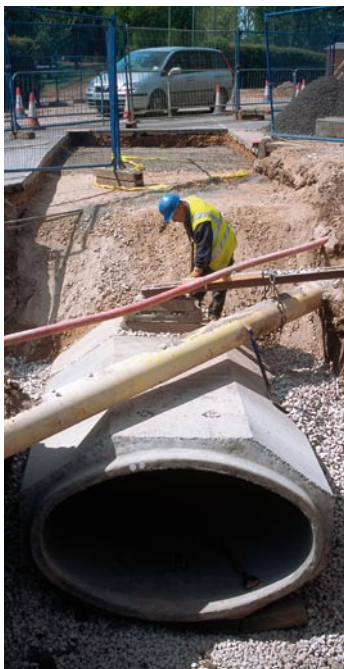
- › Concrete pipeline systems are **by far the most sustainable option** available.
- › They are made from **responsibly sourced materials, available locally**; cement and aggregates have much shorter supply routes compared with many alternative products. They can also be **made using recycled aggregates and cement replacements** such as fly ash or ground granulated blastfurnace slag. The **products themselves can also be recycled** at the end of their 100+ year lifetime and used in new applications.
- › Concrete pipes can be laid using trenchless technology known as pipe jacking or microtunnelling. This method **avoids disruption** caused by the excavation and reinstatement of trenches. Additionally, the excavated material going to **landfill is minimised**, there is **no imported backfill** required and **movement of heavy vehicles is significantly reduced**.
- › A Life Cycle Assessment (LCA) study conducted by Dutch consultants INTRON concluded that concrete pipeline manufacture has **much lower embodied impacts** than other pipe materials and the extensive use of fly ash in production contributes further to **reduce the carbon footprint**.
- › Concrete pipeline products can use excavated earth as a bedding material. This can **reduce off-site disposal and the need for imported bedding materials**.
- › There are **no scarcity concerns** for the materials used in producing concrete pipeline products as they are abundantly available.



Pipe jacking is an excellent technology for reducing impact on the local environment as it leaves the ground undisturbed.

10. Design flexibility

- › Enormous design flexibility is possible due to a **wide choice of standard sizes and cross-sectional shapes** and the ability to manufacture **bespoke solutions**. The industry offers pipe and manhole sizes ranging from 225 mm diameter pipes to 2400+ mm reinforced pipes and one-off manhole solutions exceeding 12 metres in diameter.
- › Concrete pipeline products are used for a number of purposes, including **sewerage, drainage, attenuation and storage**.
- › Products can be chosen to suit **conventional cut-and-cover techniques or trenchless jacking pipe solutions** can be used to minimise disruption and to avoid the movement of excavated material to landfill and importing of backfill.
- › Elliptical (ovoid) and egg-shaped pipe sections may be used where there are limitations to pipe gradient, or cover depth and to avoid existing services buried underground.
- › Normal and uni-junction solutions are also available to provide **watertight branch connections** to concrete pipes.



An elliptical pipe in a constrained area under a gas main and with minimal cover depth under a road.

11. Customisation & adaptability in use

- › Concrete drainage products can be **easily customised**, for example by cut-outs or the incorporation of other drainage product components.
- › Products can be readily **adapted in situ** to accommodate a wide range of situations whilst **maintaining structural integrity**.
- › A variety of **pipe bends and junctions** can be produced **across the full range of sizes**.



This large diameter concrete pipe is being used as a stormwater attenuation tank. It has a specially made 90 degree bend to provide easy access for inspection and maintenance.

12. A track record of long service life

- › Concrete pipeline systems offer an asset **service life exceeding 100 years** - an advantage no designer, developer or sewerage undertaker can ignore. The Highway Agency Design Manual allows for a service life of 120 years for concrete pipes and manholes.
- › Building Research Establishment Special Digest-1: 2005 *Concrete in aggressive ground (BRE SD-1)* provides guidance on the installation of concrete products with a **predicted durability** exceeding 100 years of service life.
- › There are a number of case studies where concrete pipes laid over 100 years ago were salvaged and tested successfully to current standards. Drainage products made of thermoplastic materials have been in use for only 50 – 60 years and do not have the benefit of such a long history to predict future performance.
- › The long service life of concrete is also supported by the fact that products **do not deteriorate with age**, as concrete gets stronger as it gets older. This is not the case for alternatives where the product deteriorates with age and its physical characteristics can be adversely affected over time.
- › Studies at Manchester and Surrey Universities in the 1990s **predicted a 400 – 500 year service life** for concrete pipes.
- › It may be misleading to make service life projections for thermoplastics products based on the performance of drainage systems more than 20 years old. This is due to changes in product design and manufacture, and the potential for wide quality variations.



The US *Concrete pipe news* shows how 27-year old pipes were successfully reused in a new project.

13. Water tightness & joint integrity

- › A rigid concrete pipe **will not deform at the joint so the integrity of the seal will not be compromised** through loss of shape.
- › Concrete pipes and manholes are designed to be water tight and are **tested to pressure levels equivalent to a 5 metre head of water**.
- › The robustness of the system is not just restricted to pipes and manholes but also applies to the joints. New generations of durable seals are used to provide integrity and strength to the joints. These seals are **subjected to demanding tests** under angular deflection and shear load.
- › Modern concrete pipeline systems are available with **integrated seals**. The sealing ring is cast into the socket and is also used for connections to manholes.



Integrally-cast sealing rings are part of the pipe socket.

14. Inertness

- › Concrete drainage products are inert, so **do not leach harmful chemicals into the environment** throughout their long service life. This is an essential property for any material used in a substructure that has direct contact with groundwater.
- › It also means that it is a **safe option for handling drainage** and storm wastewater without causing contamination.



Concrete drainage products do not leach harmful chemicals into the environment.

15. Hydraulic efficiency

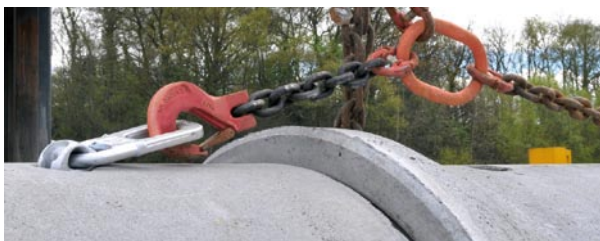
- › The hydraulic efficiency of concrete pipeline products is **not affected by age**. Unlike flexible pipes, concrete pipes do not deform. A concrete pipe maintains its shape throughout its service life without any bulges or constrictions, nor does it suffer adverse effects from knocks.
- › The **hydraulic efficiency of concrete pipes has improved** considerably over the last 30 to 40 years due to improvements in production technology and material formulation. This has led to improved surface finishes and lower K values.
- › This hydraulic efficiency can be maintained with high pressure water **jetting without risk of damage**.
- › Concrete pipes can also perform well over **lower gradients and with reduced cover depths**. Ovoid pipes, first invented by Joseph Bazalgette in the 19th Century, are still manufactured today.



Special shaped pipes can provide advantages in hydraulic performance.

16. High Health & Safety standards

- Due to improved Health & Safety standards and advances in material handling technologies, the process of transporting, handling and installing **a concrete pipeline system is very safe.**
- Concrete pipes are available with integrally cast lifting anchors and specially designed chains for safe and easy transporting, laying and jointing. CPSA and its member companies have extensive experience and can provide advice and guidance on issues associated with handling and offloading.
- In contrast, lighter-weight products made from other materials may initially appear easier to use and some suppliers have suggested that manual handling can be used in place of mechanical lifting equipment. In fact, according to Health & Safety Executive guidance on weight limitations for manual handling, **many lighter-weight products are in excess of the upper limit for safe lifting off the ground by two people.** This means that HSE Guidelines and Safety Best Practice are not being advocated **and false perceptions that lighter is automatically safer can pose a great threat** to the workforce.
- There have been serious H&S incidents relating to offloading supposedly light pipeline products made from alternative materials. The use of "light weight" as a marketing tool could lead to a lack of appropriate risk assessment and safety management on site.
- All CPSA members regularly submit safety statistics to British Precast. The precast concrete sector collectively reduced accidents by 65% in the 7 years to 2008. The sector is used as an exemplar by the HSE with which British Precast collaborates closely in its Concrete 2010 safety reduction scheme.



Cast-in lifting anchors and specially designed chains are a major safety feature.

17. Resistance to high temperatures & fire

- › Concrete pipeline systems have **excellent fire and high temperature resistance**.
- › Concrete products **do not lose their structure or deform when exposed to heat**, unlike many thermoplastic pipeline products.
- › Wastewater can be transported through concrete pipes and manholes at temperatures reaching **well over 80°C** when fitted with appropriate seal systems specifically designed for such high temperatures.
- › Concrete products will not burn and **will not release harmful emissions and fumes** during fires, unlike many plastic products. This makes it the only realistic option for drainage installations at areas such as airports, fuel storage depots and filling stations.



It is essential that drainage products used at airports will not catch fire.

18. Innovative solutions

- › The concrete pipeline industry has evolved and **constantly innovated** to address the changing needs of the drainage and sewerage market, and aims to continue to offer the best solution.
- › Standards and Specifications have changed to provide even **higher, consistent standards of performance**.
- › Production techniques have advanced and modern ordering and logistics systems ensure **excellent product quality and a reliable service** for product availability and on time deliveries.
- › Responsible sourcing and a high use of recycled raw materials means concrete pipeline systems remain the **most sustainable option**.
- › The use of modern durable seals ensures **water tightness and the integrity and strength of joints**.
- › A recent innovation is a manhole system that can be installed **without the need for a separate concrete surround or the construction of an in-situ base**. A number of design elements were combined successfully into one manhole product with strengthened walls, a precast concrete base and high-performance joint seals.
- › Other innovations include **silt prevention and vortex control systems** that can be built into concrete chambers.



Precast manhole bases are watertight and save time on site.

19. Off-site manufacture

- › The strength and structure of a concrete pipeline comes mainly from the pipe itself and is achieved in a **controlled factory environment**.
- › **Quality** management systems at all factories are covered and **regularly assessed** by the British Standards Institute.
- › Manufacturing **tolerances are set to very tight levels**.
- › A flexible pipe is manufactured to act only as a conduit and the construction of the supporting structure has to take place on site. The pipeline bedding structure is the responsibility of the contractor and has to be built around the product to give a flexible pipe the necessary strength. This means that the performance of the system is significantly dependent on the quality of the installation and the onus is on the design of the system and the contractor's ability to provide satisfactory quality control and supervision on site.



Quality of concrete pipeline installation is derived from the factory processes, which are more controllable than on-site works.

20.Responsiveness to flooding requirements

- As climate patterns change, concrete pipeline systems offer a **viable solution to** the increased **challenge of flooding**.
- A wide range of attenuation and water storage solutions is available. These can be configured to provide **solutions to fit specific situations**.
- Concrete drainage products are **resistant to uplift or flotation**, even in flooding and cases of rising groundwater.
- They are also **resistant to damage** from the impact of hard objects carried with flood water.
- In areas with **high traffic loading and deep cover depths**, the inherent strength of concrete drainage products can offer important advantages over other SUDS solutions.
- Special shaped units are available for **shallow gradients and reduced cover depths**.
- **Hydraulic features can easily be incorporated**, such as silt traps and flow control devices.
- Access can be incorporated into design solutions for **easy inspection and maintenance**.



Elliptical tanks used for flood attenuation at Twickenham Rugby Stadium.

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CPSA e-Newsletter. Register on line to receive regular news and to keep up to date on the latest developments within the drainage and sewerage sector.

CPD presentation – *Choosing the right pipeline system – now and for the future.*

Download a booking form on line or contact CPSA (see back cover) to book a free event at your office or convenient location.



Selected CPSA publications

CPSA six point action plan (PDF)

CPSA Technical guide (set of 7 topics) (PDF)

European Standards information 1 – *A guide for specifiers and users of concrete pipeline systems* (PDF)

European standards information 2 – *A guide for builders' merchants and purchasers of concrete pipeline systems* (PDF)

Bedding material cost calculator (on-line tool)

Design load calculator (on-line tool)

Technical Bulletin 1 – *Manhole access* (PDF)

Technical Bulletin 2 – *Quality pipeline systems* (PDF)

Technical Bulletin 3 – *Routine testing of pipes and their resultant allowable cracks in tensile concrete* (PDF)

Concrete drainage and sewerage products – your sustainable option (PDF and printed copy)

Environmental assessment of UK sewer systems (PDF and printed copy)

Service life of concrete pipelines systems (PDF)

Factsheet – *Inherent strength: concrete vs plastic* (PDF)

Factsheet – *What do you know about deformation?* (PDF)

Factsheet – *Concrete and plastic pipes, the durability question* (PDF)

Factsheet – *Sewer pipes and resistance to jetting* (PDF)

Factsheet – *Guide for offloading deliveries from CPSA members* – (PDF and printed copy)

Information Sheet – *"Light" pipes can be a disadvantage* (PDF)

All PDF files can be downloaded from the CPSA website

www.concretepipes.co.uk

For a printed copy contact the CPSA on 0116 253 6161

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Please refer to the CPSA website for the latest information.



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The Concrete Pipeline Systems Association (CPSA) is the main trade association representing the interests of the manufacturers of concrete pipeline and manhole systems in the UK. The association is active in research and promotion of the many technical, commercial and environmental benefits of precast concrete pipeline systems. CPSA is a product association of British Precast Concrete Federation.

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