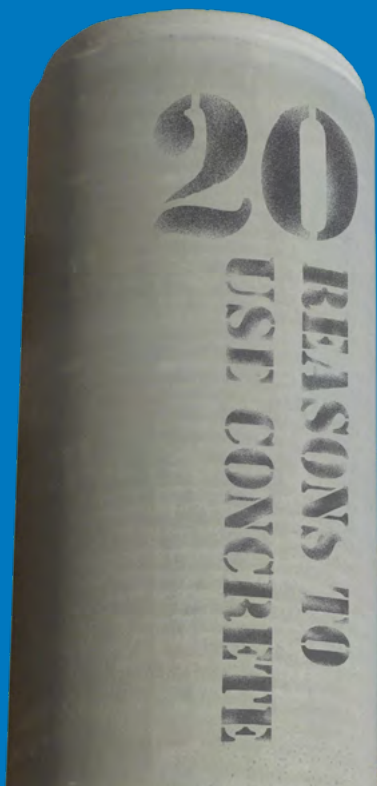




**British Precast
Drainage Association**



CIWEM Chartered Institution of
Water and Environmental
Management

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Introduction

Concrete drainage systems have been the backbone of our sewerage network since the early 1860s. For over 150 years they have offered a number of advantages, including speed of installation, inherent strength and durability.

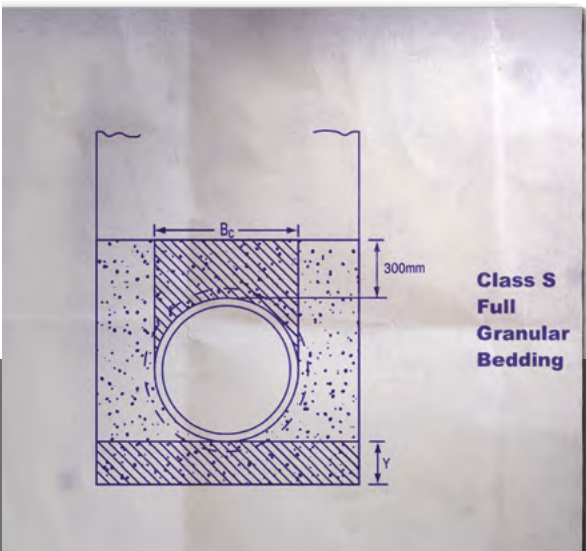
Precast drainage systems provide installed cost benefits and low maintenance costs compared with other drainage materials and operate over a long service life. They must be made to exacting quality standards with stringent specifications developed within the public domain – and have low environmental impact.

Concrete products address these needs and have evolved to meet new challenges. This booklet gives 20 reasons why concrete is the right choice to meet today's needs and to provide a sustainable future for our children and grandchildren.

- 1 Installed & whole life cost savings**
- 2 Safe, efficient delivery and installation**
- 3 Resistance to damage, abrasion & corrosion**
- 4 Inherent strength**
- 5 Consistent high performance standards**
- 6 Resistance to jetting**
- 7 Resistance to sulphate attack**
- 8 Inertia**
- 9 Sustainability**
- 10 Design flexibility**
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- 12 Durability**
- 13 Water tightness & joint integrity**
- 14 Inertness**
- 15 Hydraulic efficiency**
- 16 High standards of health and safety**
- 17 Resistance to high temperatures and fire**
- 18 Innovative solutions**
- 19 Off-site manufacture**
- 20 Flood resilience**

1 Installed & whole life cost savings

- Concrete pipes provide **installed cost** savings as they can often 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.
- 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 proven service life of over 100 years, demonstrating lower whole life costs. In some cases, exhumed concrete pipes have even been re-used in new projects.
- **Costing and design help is available online** from the BDPA at www.precastdrainage.co.uk. The Structural Design Calculator simplifies concrete pipeline calculations by providing all the basic values and then recommending a bedding class. The Material Cost Calculator helps you estimate the cost of bedding and pipes and compares different types of pipeline materials.



With concrete pipes full granular “Class S” bedding is often an unnecessary and costly over-specification.

2 Safe, efficient delivery & installation

- Up to 35% of pipeline construction time can be consumed during compaction and backfilling, according to a study carried out by University of Munich Federal Army (UniBwM).
- Concrete pipes are rigid structural elements that do not always require a full granular surround, saving time in bedding and compaction.
- Next day delivery available for most products.
- Manufacturers are renowned for their **excellent design support and customer focus**.
- Suppliers maintain good stocks of standard products to ensure **prompt delivery to site**.

Finalist

Ground
Engineering Awards

Health & Safety

Winner

Water Industry
Awards

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**Featured
in the**
Construction
Products Association
of CPIA



The Award-winning Pipelifter makes offloading fast, efficient and safe. Check the BPDA website for a list of suppliers.

3

Resistance to damage, abrasion & corrosion

- Concrete drainage products are **strong and robust**.
- **No special protection measures are required** against damage from 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 over-stressed, **minor 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 drainage products do not offer such protection when subject to additional or unforeseen loads.
- Due to their inherent strength and durability, concrete drainage products are **abrasion and corrosion resistant**. Concrete drainage 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 attack**.



Concrete drainage does not require special protection from sunlight and heat.

4 Inherent strength

- Concrete drainage 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 concrete is not as reliant on the design and quality of the installation.
- Concrete pipes and manholes are designed to **high strength Classes** and offer an inherently strong option.
- Concrete pipes are, overwhelmingly, **the 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 Consistent, high-performance Standards

- Concrete drainage components were 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 key Standards for precast pipes and manholes:

- European Standards BS EN 1916 (pipes) & 1917 (manholes) provide performance requirements on material and product characteristics including product strength and testing, watertightness testing, product sampling and inspection.
- Complimentary British Standards BS 5911 -1 (pipes) and -3 (manholes) cover detailed cement content and concrete mix design information, geometrical characteristics, sizes and strength Class.
- BS 5911 – 4 covers inspection chambers and -6 relates to road gullies.

The key Standards for precast box culverts:

- BS EN 14844:2006 +A2:2011 - Precast concrete products - Box culverts.
- BS EN 13369:2001 2013 - Common rules for precast concrete products.



Testing a 1200mm pipe for strength.

6 Resistance to jetting

- British Standards for precast concrete pipes and manholes BS 5911 Parts 1 & 3 include a jetting resilience test. Compliance with the test provides users with confidence that precast drainage systems are manufactured to a high quality and their performance will not be compromised when subject to high pressure water jetting operations.
- According to WRC's Sewer Jetting Code of Practice, concrete pipeline systems can withstand a **water jetting pressure of 5,000 psi (345 bar)**.
- In contrast, according to the same code, **the maximum water jetting pressure for plastic pipeline systems is 2,600 psi (180 bar)** and no more than 1745 psi (120 bar) according to European Standards.
- 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.
- Concrete pipe manufacturers are confident that their products can actually take higher pressure levels and can therefore **last longer than alternative materials**.
- Until the late 1990's, 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

- BPDA members' concrete drainage systems are **resistant to sulphates and chemical attack** from normal ground conditions.
- 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 Thaumassite 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 Inertia

- 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 displacement**.
- Concrete drainage products offer **better resistance to flotation** than lighter weight products made from other materials. This is particularly important during floods or in cases of high groundwater.
- **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

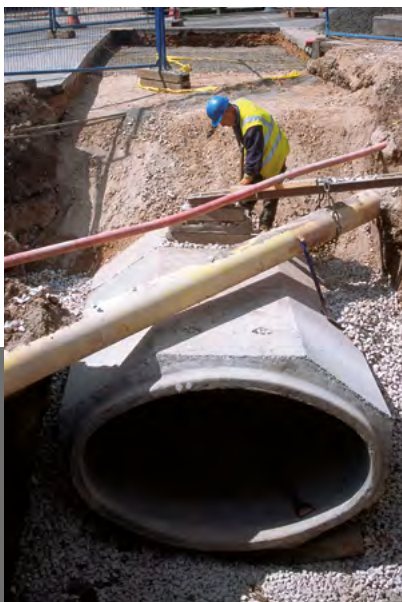
- Concrete drainage systems are **the most sustainable option** available.
- They are made from **responsibly sourced materials, available locally**; cement and aggregates have much shorter supply routes than many alternative products. They can also be **made using recycled aggregates and cement replacements** such as fly ash or ground granulated blast furnace slag. **The products themselves can also be recycled** at the end of their 100+ year lifetime and used in new applications.
- The carbon footprint of precast drainage systems has been regularly evaluated and independently validated to a recognised methodology. The latest study based on EN 15804 indicates that precast concrete pipes now have a 10% lower carbon footprint than previous detailed estimates carried out in 2011.
- The latest comparisons with plastic pipes continues to prove that precast concrete drainage systems can provide a significant reduction in carbon emissions and offer the most sustainable long term solution.
- In appropriate situations, concrete pipeline products can use excavated earth as a bedding material. This can **reduce off-site disposal of soil** 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.
- 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**.



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 the **wide choice of standard sizes and cross-sectional shapes** available 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 drainage products are used for a number of purposes, including **sewerage and sustainable drainage systems (SuDS)** applications such as storm water 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.
- Traditional 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, low-flow channels or the incorporation of other drainage product components.
- Products can be readily adapted in-situ for **new build and retro-fit applications 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**.



These concrete pipes are being used as a storm water attenuation tank. It has a specially made manifold section that provides easy access for inspection and maintenance.

12 Durability

- Actual service life performance is critical in determining an authentic whole life cost. Many studies including DEFRA's White Paper 'Water for Life' (Dec 2011), estimate an average **800 years' service life** requirement for sewers in England.
- Concrete drainage systems can demonstrate a **service life exceeding 100 years** as defined within BS 5911 – an advantage no designer, developer or asset owner can ignore.
- 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.
- Concrete drainage systems 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.
- There is evidence that 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.
- It may be misleading to make service life projections for thermoplastics products based on the performance of drainage systems more than 25 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 watertight and are **tested to pressure levels equivalent to a 5 metre head of water**.
- New generations of durable seals are used to provide long term integrity and strength to the joints. These seals are **subjected to demanding tests** under angular deflection and shear load plus a durability requirement to ensure the joint remains watertight over the life of the system.
- Concrete pipeline systems are available with **integrated seals**. For these products, the sealing ring is cast into the socket and is also used for connections to modular precast manholes systems.



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 and designed to carry flows that discharge into the environment.
- It also means that concrete 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

- Unlike flexible pipes, concrete pipes **do not deform**. A concrete pipe maintains its shape throughout its service life without bulges or constrictions. So the hydraulic efficiency of a concrete pipe cannot be affected by changes in its shape.
- This hydraulic efficiency can be maintained with high pressure water **jetting without risk of damage**.
- Special shapes of concrete pipe 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. Elliptical pipes, circular pipes and box culverts with dry weather flow channels are further examples to solve hydraulic design challenges



Special shaped pipes can provide advantages in hydraulic performance.

16 High standards of health and safety

- All BDPA members regularly submit safety statistics to British Precast. The precast concrete sector collectively reduced accidents by 80% since 2000. The sector is used as an **exemplar by the HSE** with which British Precast collaborates closely in its Concrete Targets safety reduction scheme.
- Large concrete pipes are available with integrally-cast lifting anchors and specially-designed chains for safe and easy transporting, laying and jointing. BDPA 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.** The **false perception that lighter is automatically safer** can mean HSE Guidelines and Safety Best Practice are not followed, which can pose a 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.
- The Award-winning concrete Pipe Lifter reduces risk to operatives during offloading, handling and installation.

Finalist

Ground
Engineering Awards

Health & Safety

Winner

Water Industry
Awards

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Featured in the

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of CPIA



The Award-winning Pipe Lifter. No-one needs to work at height during off-loading or in the trench during pipe jointing.

17 Resistance to high temperatures & fire

- Concrete drainage 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 is **constantly innovating** to address the changing needs of the market. 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, low embodied carbon 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 long term integrity and strength of joints.
- One example of 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 are combined successfully in a single manhole product with strengthened walls, a precast concrete base and high-performance joint seals.
- Other innovations include the **Award winning concrete Pipe Lifter and a range of precast concrete SuDS components** including silt prevention and vortex control systems that can be built into concrete chambers.



Precast manhole systems are watertight, safer to construct and save time and money to install.

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**.
- In comparison, a flexible pipe is manufactured to act generally as a conduit and the construction of the supporting structure must 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 Flood Resilience

- As climate patterns change, concrete pipeline systems offer a **viable solution** to the **increased challenge of flooding**.
- Concrete drainage products are inherently **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.
- A wide range of **engineered concrete SuDS components** are available. These can be configured to **provide solutions to fit specific situations and with a long service life**.
- 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**.
- **Hydraulic features can easily be incorporated** into concrete chambers, such as silt traps and flow control devices.
- Access for **easy inspection and maintenance** can be incorporated into design solutions.



Elliptical tanks used for flood attenuation at Twickenham Rugby Stadium.

Keep up to date with BPDA

e-Newsletter

Register on line to receive regular news and to keep up to date with the latest developments in the sewerage sector.

<https://www.precastdrainage.co.uk/enewsletters>

CPD presentations

1. **Choosing the right pipeline system – now and for the future.**
2. **Embodied Carbon Emissions in Concrete and Other Pipeline Materials**
3. **Surface Water Management using proprietary precast concrete SuDS systems**
4. **Optimising Pipeline Bedding Design to Achieve Installed Cost & Carbon Efficiencies**

Download a synopsis and booking form on line or contact BPDA (T: 01162 325 170 email@precastdrainage.co.uk) to book a free event at your office or convenient location

Technical Design Guide

Download [here](#)

Technical advice and FAQ

<https://www.precastdrainage.co.uk/FAQ>

On-line design and estimating assistance with our Structural Design calculator, Material Cost calculator and web App

<https://www.precastdrainage.co.uk/calculator-app>



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The British Precast Drainage Association (BPDA) is the main trade association representing the interests of the manufacturers of concrete pipes, manholes, box culverts and sustainable drainage systems in the UK. The association is active in the research and promotion of the many technical, commercial and environmental benefits of precast concrete drainage systems. BPDA is a product association of the British Precast Concrete Federation Ltd.



As part of our commitment to sustainable development, this brochure has been printed using vegetable-based inks on paper sourced from managed forests as certified by the Forest Stewardship Council.

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