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Best practice

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Guide makes easy work of precast manholes

BPDA has now produced a handy guide to installation.

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Guide makes easy work of precast manholes

Advances in production techniques for precast manholes offer multiple advantages for the construction sector. Innovations championed by BPDA members mean manhole installation can be completed in about an hour, with a much higher success rate when compared with traditional techniques.

Precast manhole systems are easier to install, but they also improve onsite safety and raise the bar on quality and performance as well as lowering costs and reducing waste to landfill. To help contractors deliver best practice on-site, BPDA has now produced a handy guide to installation.

The Pocket Guide to Installing Concrete Manholes can be downloaded from the BPDA website as a PDF or is available as a printed document. It lists seven simple steps to successful precast manhole installation (with minimum 125mm wall thickness) and the full version can be found at **https://www.precastdrainage.co.uk/uploads/downloads/manhole_guide_interactive.pdf**

Design flexibility

Precast concrete manhole systems are suitable for a wide-range of pipe connections and can be retrofitted without complete replacement of the chamber. The systems comprise a precast concrete base unit with channel and benching and predetermined combinations of flexible and watertight inlet(s) and outlet.

Base units and chamber rings are made with thick strong walls and lifting points, eliminating the need for a concrete or granular surround unless specifically required by the client. High-performance seals and extra-thick chamber walls ensure long-term water-tightness and durability.

The excavation is backfilled sooner than with traditional techniques, minimising the health and safety risks associated with open excavations, and there is less need for work in confined spaces, which also lessens risk to workers. By reducing project time, overall costs are also brought down.

Sourcing constituent parts from local suppliers and a rise in the use of recycled materials keeps embodied carbon impact to a minimum. Production techniques for precast manhole systems continue to advance and the use of modern logistics ensures excellent and consistent product quality and reliable service.

Fact Zone: Concrete Manholes

Up until the 2000s concrete manhole construction has required manhole bases to be constructed onsite from ready-mixed concrete. This required the channels, connections and benching to be constructed in confined spaces with works often carried out in wet and hostile conditions.

Additional external contractors were required to supply and pour the concrete and the process for each installation would take several hours due to routine logistical and operational challenges. Furthermore, construction was not always successful.

In 2011, a revision of Part 3 of BS 5911, the main standard for precast concrete manholes, introduced a new type of precast manhole system. This comprised a factory-made precast base with elastomeric or plastomeric seals on all joints and connections to ensure permanent watertightness.

The new types of manholes are manufactured entirely offsite and do not involve any wet trades on site. The main advantage of precast base manholes is that all the time-consuming site-based operations are eliminated.

A precast base manhole can take under an hour to install. BPDA estimates that compared with traditional in situ construction a precast manhole will save up to 50% on installation time and reduce construction costs by 15-30%, particularly when manholes are installed without a concrete or granular surround.

Another advantage of precast base manholes is that they offer significant reductions in embodied (capital) carbon, reaching as much as 43%.

Precast manholes can also be installed to far greater depths than other systems. They are resistant to flotation and can directly take traffic-loading without the need to isolate the chamber from its cover slab, a design detail that could be time-consuming and expensive to build.

In summary the seven steps are:

1. **Safety**
   Safety must always be the first priority for any construction project and all site activities must be preceded by an appropriate risk assessment. Typical activities include vehicle offloading, movement of components, excavation, backfilling and the lifting and positioning of components.

2. **Preparation**
   Excavate a trench of appropriate dimensions to accommodate the manhole structure. The trench must allow sufficient working space outside the chamber for access and backfilling to the required specification, taking into account the ground conditions, depth of excavation and any other relevant factors. The heights of the manhole components supplied by the manufacturers are nominal, so it is beneficial to measure the units prior to installation in order to assist with obtaining the required height of the completed chamber.

3. **Installing the precast manhole base**
   Prior to lowering into the trench, the precast base unit may be pre-fitted with a lubricated outlet if required. A plastomeric sealing strip/elastomeric seal is used to form a waterproof joint between units. It may be fitted before lifting into position or after each unit has been individually placed. Concrete to concrete contact between units must be avoided.

   Place the base unit onto the prepared granular bed and mate the stub pipe with the installed outlet pipe. Check the base position for alignment, level and inverts. Note that precast bases have an inbuilt fall across the main channel and can be installed level.

4. **Fitting the chamber rings**
   Make sure that the joints are clean and free from foreign objects before fitting the next chamber ring unit. The plastomeric sealing strip/elastomeric seal should already be in place on the installed unit and ready to receive the next chamber ring unit.

   Repeat with further ring units until the chamber has been constructed to the required height. Ensure that the steps are correctly aligned.

5. **Fitting the cover slab**
   Place the cover slab directly on the last chamber ring with the access opening lined-up with the steps. Apply slight pressure onto the cover slab using suitable protection, such as timber, to seal the chamber.

6. **Backfilling**
   When using wide-wall precast concrete manhole chamber rings, the excavated soil can be returned as backfill unless an alternative arrangement is specified by the client. Compact the backfill soil as specified in the design.

7. **Operation and maintenance**
   Precast concrete manhole base systems are strong and durable and eliminate the risk of inconsistent quality from site-based operations. They are designed to remain watertight and maintain their structural integrity for over 120 years.

Constant flow of manholes supports St Neots expansion – Case study

Precast concrete manholes have been used in the drainage network installed on the first phase of a new housing and community development in Cambridgeshire. FP McCann's Easi-base system and chamber rings were chosen for the Wintringham project, which forms part of the Eastern expansion of the town of St Neots.

The first phase of the project is being managed by one of the landowners along with development partners Urban & Civic. It will eventually see the building of some 2,800 new homes, community facilities, schools and commercial properties.

The main contractor, Breheny Civil Engineering is responsible for the enabling works and utilities' connections on the first phase, which relates to approximately 800 building units. Breheny was asked by sewerage undertaker Anglian Water to specify exactly which manhole bases were precast concrete and which were being installed in the traditional way on the planning documents.

FP McCann's in-house team created orientations of each manhole, showing the precise specification of pipe entries and any changes in level. Altogether 125 manholes were required as part of the drainage installation for the first phase of works and 70% were suited to precast concrete systems.

The chamber rings and proprietary pre-formed manhole bases were delivered to site from FP McCann's factory in Leicestershire. A constant flow of pipe and manhole deliveries was maintained, and turnaround from placement of an order to delivery on site was two to three weeks.

Four or five large loads were delivered to site each day during the works, with logistical efficiency optimised by shipping precast manholes, pipes and other components aboard the same vehicles. Once delivered, the Breheny team ensured productivity levels were maintained over the expansive area throughout the works.

FP McCann delivered 16no. 1800mm Easi-Base wide-wall manhole chamber systems and 3no. 1500mm Easi-Bases, along with standard chamber rings sized at 2100mm and 2400mm diameter and cover slabs from 1200 to 2400mm. Some 283 pipes, ranging in diameter from 375 to 1050mm have been supplied along with the sealed sump 1200mm catchpit unit, which is also being used.

Most of the drainage and the manhole chambers are now in place. A mechanical pipe-lifting system was employed for unloading and maneuvering the precast concrete components around the site, as well as placing them in trenches. The system can be quickly hitched to any 360 excavator and is a safe and efficient means of off-loading pipes and manholes.

Each manhole installation can vary depending on ground conditions, accessibility and presence of groundwater. However, at Wintringham conditions were quite straightforward and the works were carried out by five drainage gangs all working on separate parts of the system. Installation followed standard procedure, with excavation of the position for the manhole and the base works put in place to support the system. Shingle was placed at the foot of the chamber hole to level up the base.

The base was then dropped in and the rest of the manhole built up out of separate components. Manhole depth depends on the orientation of each installation and the deepest at Wintringham was 8.5m. Manhole installations were carried out through the winter months from mid-November 2018 to the end of April 2019.

Commenting on the site preparation to date, Matt Bruce, site agent for Breheny says, "The early enabling and drainage works at Wintringham are nearing completion. The steady flow of precast concrete drainage products from FP McCann meant work on site proceeded uninterrupted throughout this first phase."

Kieran Fields, marketing manager, FP McCann said, "Using a high proportion of precast manhole systems at Wintringham meant the drainage infrastructure could be built at speed, even during inclement winter conditions. In addition, the overall quality of the installation is more consistent as the products are made under factory conditions and delivered to site as they're required."

Precast manhole base systems are preferred by specifiers on most applications because they can reduce construction time and cost significantly. The need for an in situ concrete base, benching and surround is eliminated and the entire manhole structure, from base to cover slab can take under an hour to install. Precast manholes offer a watertight system which can last for well over a hundred years.

> "...using a high proportion of precast manhole systems at Wintringham meant the drainage infrastructure could be built at speed, even during inclement winter conditions."

Manholes supplied for major housing project

A total of 150 manholes have been installed in the first phase of a 900-house development in the Midlands. As 97% of the manholes were within the 1500mm-diameter range, contractor Newline Civils decided that Watertight precast concrete systems would be ideal for the majority of installations and an order was agreed with Stanton Bonna.

Once Newline's project drawings had been prepared, the precast systems went into manufacture and the time from sign-off of the designs to the systems appearing was two-to-three weeks. Manufacture and delivery were scheduled to ensure continual production and efficient installation.

Newline carried out the foul and stormwater drainage works between April and October 2018, installing some 4,000m of pipework for the 200 houses being built in phase one.

The logistics for Stanton Bonna's Watertight precast manholes is much simpler than onsite casting, where delivery of clay channels coming from one manufacturer and concrete from another have to be managed. For this housing development, four or five Watertight manhole systems were delivered per load, in advance, including the chamber rings and cover slabs.

"The main benefit of precast concrete manhole systems is the speed of installation," said John Fowler contracts manager of Newline Civils. "Delivery of ready-mixed concrete for casting manholes onsite can be unreliable, with workers sometimes left waiting around for a couple of hours.

"Once the manhole is cast, you then have to wait until the next day for it to cure before pushing the next pipe into it. With precast manholes, all the materials are delivered to site in advance, you can lay a pipe-run and fit a manhole and go again."

The installation process involves laying a sewer run and excavating the manhole to the required depth. A gravel bed is laid and the Watertight precast base is placed on top and fitted to the end of the pipe.

The Watertight precast manhole rings are lifted into place, raising the chamber to surface level. The Watertight concrete cover slab is fitted, which reduces the aperture to the diameter of the manhole lid, which is all that will be visible once the landscape is surfaced. The void around the manhole is then backfilled with stone and the process is repeated for the next pipe length.

Depending on the depths and distance between manholes, a three-to-four person team can install approximately two precast manhole systems, with connecting pipework, in a day. This is significantly faster than casting onsite, where the concrete surround has to be built separately, making it necessary to wait while the concrete cures.

An additional advantage is that the factory produced units are already smooth and do not require a further skim where the pipes connect. This carries a health and safety advantage too.

Newline says, "Where manholes are cast onsite, workers have to re-enter the manhole to apply a skim of granolithic concrete to smooth out the rough benched concrete. Any confined space working carries a health and safety risk, so where this can be minimised, that is very welcome."

He adds that the overall quality of precast units should be better as they are produced in factory-controlled conditions and installed more efficiently, with less risk of impact from adverse weather conditions. Variable ground conditions and the presence of groundwater also have less impact on the installation, with no need for extra groundwater pumping.

Daniel Cross, national sales manager, Stanton Bonna said, "Our Watertight precast concrete manholes systems are ideal for the vast majority of installations on housing projects. They offer clear logistical advantages over casting onsite and enable foul and storm water infrastructure to be installed more safely, significantly quicker and with a higher quality product."

Precast concrete sector hits 2020 carbon targets early

Members of the Precast Concrete have hit most of their 2020 factory carbon emissions targets two years early according to the latest edition of the trade association's sustainability report.

Emissions per tonne of production have halved in eight years and the precast concrete sector continues to make significant progress across most key performance indicator targets. Work has now started on post-2020 targets, with the clear objective of reaching net zero carbon by 2050.

The 2019 edition of *Sustainability Matters*, British Precast's performance report, shows significant progress is being made towards the sector's 2020 targets. In key areas such as factory CO_2 emissions, members have already met both the Precast Concrete Sustainability Charter 2020 target and the Green Construction Board's Carbon Route Map target.

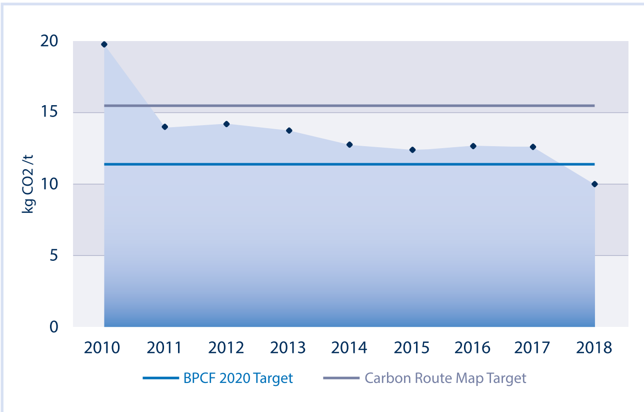
This means that the membership has also fulfilled the Infrastructure Carbon Review pledge of a 20% reduction in carbon emissions. The reductions are part of a long-term trend; factory emissions per tonne of precast concrete continued to fall in 2018, reaching 10kg CO_2/tonne compared to 19.9 kg CO_2/tonne in 2010.

Precast drainage manufacturers, who make a significant proportion of companies reporting to British Precast, have also reported significant reductions in greenhouse gas emissions over the last few years. An Environmental Product Declaration (EPD) for concrete pipes published in 2017 showed that the carbon footprint of concrete pipeline systems has dropped by almost 9% since 2010. Further reductions have been achieved since.

One of the many benefits of precast concrete is its production in a factory setting. This allows for more precision in production and means less waste is generated and significant savings in energy and materials are made.

Ninety percent of precast concrete produced by the 60+ members of British Precast, which includes all members of the British Precast Drainage Association, is covered by international standards ISO 9001 quality management and ISO 14001 environmental management systems. These standards indicate both a commitment to address environmental impact along with a willingness to embrace new technologies and innovation on the journey of continuous improvement.

For more information on the sustainability performance of precast concrete manufacturers, download Sustainability Matters 2019 **https://www.britishprecast.org/Publications/Sustainability-Matters-2019.aspx**



Swedish pipes last more than a lifetime

A report into Sweden's water and wastewater networks anticipates a long-life for the next generation of pipes. The authors of *Sustainable water and wastewater pipe systems of the future*, which has been published by the Swedish Water & Wastewater Association (SWWA), argue that the networks currently being installed should have an operational life of at least 100 years and that pipes laid from 2020 should have an operational lifetime of 100-150 years.

The report also argues that the current renewal rate needs to increase by 40% to maintain the current condition of the network. However, when renewal is carried out, it should be done to such a standard that the new pipes have an average operational lifetime of 100-150 years.

Concrete pipes account for 69% of the waste- and storm water pipelines in four of the main water utilities – NSVA (six southern municipalities), Kretslopp och vatten (Gothenburg), VA Syd (Malmö) and Höganäs. This is representative of the country as a whole, though some have been rehabilitated or replaced in the 10 years since this figure was calculated.

A survey in Malmö found that many concrete pipes are still operating successfully 100 years after installation. Unreinforced concrete pipes manufactured in Sweden today are generally 150-1000mm diameter, with the larger reinforced concrete pipes coming in at 400-3000mm.

The main method for condition assessment of gravity sewer lines is CCTV, particularly for assessment of pre-stressed steel reinforcement pipes.

Concrete pipes laid in the 1940s generally have a shorter life of 50-100 years due to the shortage of cement during the Second World War and its substitution with finely ground limestone filler. They currently require replacement. It was during the 1960s and 1970s that most concrete pipes were installed and, given a pipe-life of 100 years, a major replacement programme will be required around 2050.

The various causes of deterioration of underground concrete pipes are already fairly well known. Sulphuric acid attacks from the hydrogen sulphide (H_2S) in sewage can reduce the thickness of concrete, especially where the sewage flow slows down or becomes stationary.

Increasing durability

The durability of concrete pipes can be improved in a number of ways and cured-in-place pipe (CIPP) lining is common in Sweden. Resistance to acid and sulphate degradation can be improved by mixing a number of alternative binding agents into the concrete, particularly a ground granulated blast-furnace slag (GGBS) such as Alfarör, which uses a 15% slag mix and fly ash.

Some of the older pipes in Sweden are believed to have been made using 100% Portland cement. In the UK almost all concrete pipes are manufactured to exposure class DC-4, which includes 30% fly ash or GGBS to 70% Portland cement.

Other additives, such as limestone filler or polymers, can be effective, as can a number of surface treatment methods including internal centrifugal spraying.

Recent innovations include mixing bactericidal additives, such as a cationic polymer, into fresh concrete. The polymer is particularly effective in binding and rendering H_2S bacteria, while avoiding harm to other bacteria. It has been used successfully in North America since 1996 and became available to the Swedish market in 2010.

In parts of the world where bacterially-induced H_2S formation appears as a result of exposure to an optimum temperature of around 30°C, calcium aluminate cements such as Ciment Fondu Lafarge are used. They have greater chemical resistance than most Portland cement and are used for both the manufacture of concrete pipes and also as cement mortar insulation.

Further research

The report's authors recommend that more research is undertaken on how to prevent, control and forecast the degradation of concrete in ageing sewer pipe systems. Particular regard needs to be paid to developing innovative non-destructive methods for condition assessment and online surveying, which can provide valuable data to support maintenance planning and prevent unexpected disruption to operations.

New non-destructive techniques and sensors need to be developed, along with forecasting tools that can enable proactive maintenance and minimise leaks, bursts and network failure. For concrete sewerage this involves the generation of a model for pipe degradation based on the key factors of H_2S, temperature, soil movement, reinforcement and corrosion.

Selected information translated from the SWWA's report The Sustainable Water Management System of the Future (Framtidens hållbara VA-ledningssystem, 2018). Authors: Helena Mårtensson, Annika Malm, Bror Sederholm Jan-Henrik Sällström, Jan Trägårdh.