EDITION 3 | WINTER 2020

mpa British Precast Drainage Association

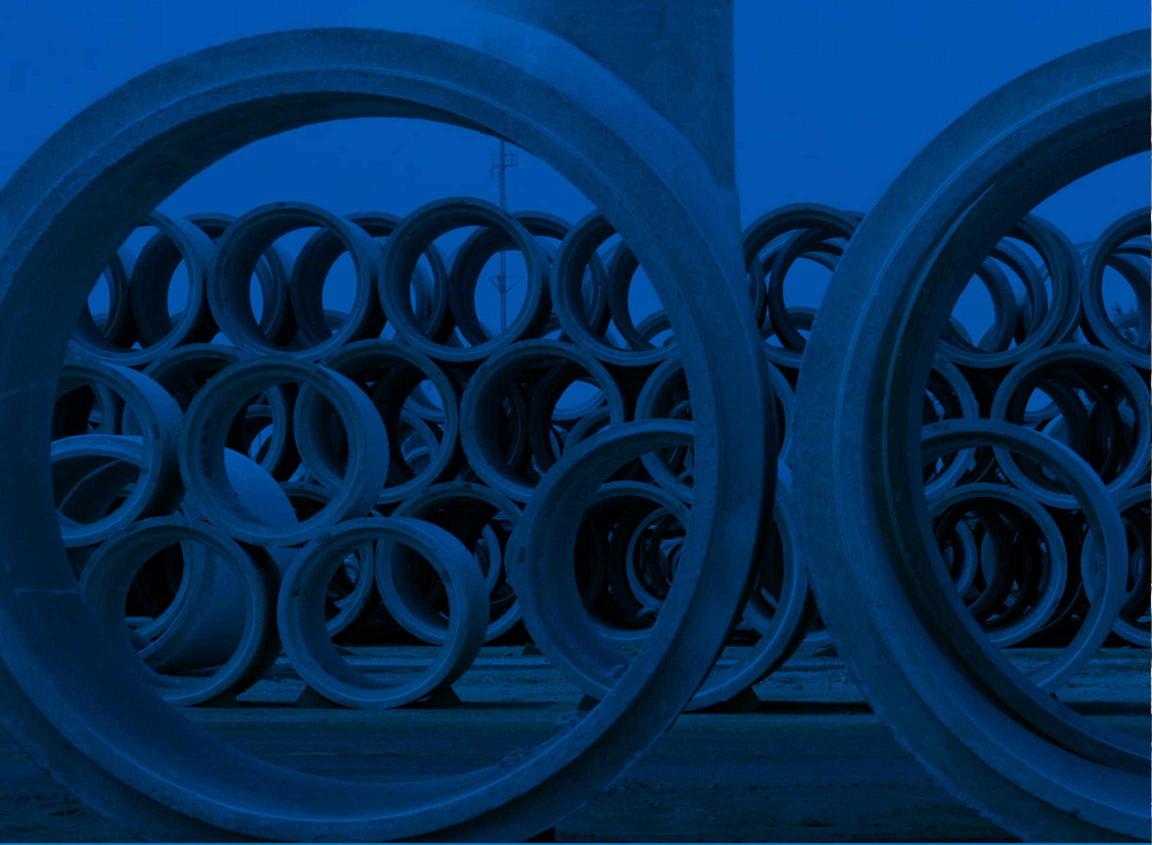
BRITISH PRECAST NEWS
DRAINAGE ASSOCIATION

☐ Case Studies ☐ Best Practice ☐ Technical Updates

Sewer guidance signals shift on SuDS

Sustainable drainage assets included in new sewers adoption code

Full feature on page 2



Sewer guidance signals shift on SuDS

The new code for sewers adoption, which comes into effect in April 2020, includes certain SuDS assets for the first time. British Precast sustainability & product manager **Hafiz Elhag** explores the implications along with the issues affecting selection of attenuation solutions.

A historic change to the Design & Construction Guidance (DCG) for the adoption of foul and surface water sewers in England comes into force in April 2020. It introduces for the first time a mechanism for water companies to take ownership and responsibility for sustainable drainage systems (SuDS).

Many conventional sewer systems in the UK and other parts of the world are no longer able to cope with increasing volumes of rainfall and increasingly frequent flooding incidents due to climate change. In 2014 SuDS was introduced as one of the main measures to control and mitigate flooding through the government's National Planning Policy Framework (NPPF).

SuDS offer a range of alternative techniques to conventional piped sewerage in managing stormwater. These methods are designed to be more sympathetic to the natural landscape and conventionally include using ponds, swales, wetlands and natural waterways to control, manage and store surface water runoff.

The new DCG replaces *Sewers for Adoption 7* and will offer clearer rules and requirements on where responsibility lies for the long-term maintenance of new SuDS. It is produced by industry trade association Water UK and was approved by Ofwat on 25 October 2019.

Water UK says water companies have taken the initiative on SuDS responsibility in the absence of a governmental plan. This has involved reinterpreting laws on sewers going back to the Victorian era.

The basic criteria that need to be met for a sewer to be "adoptable" can be found in Water UK's *Sewers for Adoption in England* report. They include those assets that convey and returns flows to a sewer, surface water body or groundwater and those that have an effective point of discharge into a water body or onto land.

It is also worth noting that attenuation tanks are included in the new guidance for the first time, but underground tanks holding water without discharge will not qualify. Ultimately, it is for the water and sewerage company to apply these criteria to assets that are being offered for adoption.

Not only do SuDS ease pressure on drainage networks, they also improve the urban water cycle by enhancing the quality of surface water. Additional benefits include enhancement of the landscape, the environment, biodiversity and quality of life in urban communities.

Alongside natural sustainable drainage systems, manufactured proprietary technologies can be employed within a sustainable water management train to manage surface water runoff. Like the more natural techniques, manufactured SuDS can be used to intercept, collect, treat or store stormwater and direct them to nearby waterways, depending on specific site requirements.

In heavily built up urban developments, it may not be possible afford land area for natural SuDS solutions such as ponds. For many projects, stormwater attenuation is carried out using proprietary SuDS, most likely an underground tank system comprising a lightweight or precast concrete tank, box culvert, or piping system.

A SuDS survey of engineers, developers and others by the Institution of Civil Engineers and Wavin last year indicated that attenuation was the preferred SuDS solution of 70% of those responding in England and 63% in Wales. Given that this is the first code that enables the adoption of SuDS, it is worth considering five issues affecting developers' choice of attenuation solutions.

Top five issues affecting attenuation choice

1 Whole-life cost

As with any other project, the cost of building, running and maintaining a SuDS attenuation solution can be the main factor in determining which system to go for. Residential developments and housing estates in England have a significantly long lifespan.

According to the *English Housing Survey (2014-2015)*, well over 75% of the 23.4 million homes in England are over 40 years old, over 56% are over 55 years old and more than a fifth of occupied houses are over 100 years old. It is therefore reasonable to assume that entire neighbourhoods and housing estates will have a >100 years lifespan.

SuDS will need to meet this life expectancy as they will need to perform effectively over the lifetime of a development. For SuDS not expected to last 100 years or more, the cost of replacement, renovation or major refurbishment will need to be incorporated into the whole-life cost assessment.

Members of BPDA are aware of these expectations and of the need for any underground attenuation solution, such as pipe-based, box culvert based or modular tank systems, to have an expected working life that matches the lifetime of the development - 100 years or more.

2 Space restrictions

Landscape design and site requirements are the main factors determining particular attenuation systems. Ponds are usually preferred by planners, but they take up significant land area which may not be available in heavily built-up areas.

In such cases, underground tank systems may be the only choice and in places where even underground storage space is tight, developers may prefer systems that make the most out of available space underground with the lowest cover depth possible.

3 Construction constraints

Constraints associated with construction can always pose engineering and execution challenges. Unsuitable ground conditions, such as elevated water tables, may make it impossible for some types of lightweight attenuation systems to be used.

The nature of soil can also pose risk for some types of underground attenuation systems, unless they are treated effectively to resist corrosion. The availability of space for lifting and installation machinery can be a challenge, but as all installations require excavators, these same excavators can usually be used in the installation of any engineered storage products requiring mechanical lifting.

Weather can also pose a challenge as some systems cannot be installed with stormwater inside the excavated area due to risk of floatation. Climate change could mean such events occur more frequently. Some engineered systems may also be adversely affected by bursts of bright sunlight and hot weather during installation, due to the high degradation rate of polypropylene components when exposed to UV light.

Manufacturers of precast engineered SuDS have solutions for these challenges that would not affect the effectiveness of the system or lead times.

4 Structural integrity

Developers and adoption authorities need to have confidence in the structural integrity of an engineered attenuation SuDS system. The new DCG code offers detailed guidance on the standards to be used in constructing underground tank systems.

For example, concrete pipelines design will need to comply to BS 9295, British Standards' guide to the structural design of buried pipelines. Other concrete structures will need to comply to relevant Eurocodes standards.

The adoption of SuDS will face further challenges as new product types, such as geocellular boxes and precast concrete tank systems, are brought under its remit. The absence of an established track record of deployment, along with limited experience of working with certain types of systems, poses a risk that designers may deviate from the established, universally agreed standards.

Where standards like BS 9295 or BS 5911 for concrete pipes and ancillary concrete products or CIRIA's C737 report - *Structural and Geotechnical Design of Modular Geocellular Drainage* Systems - are not used, designers need to employ established engineering principles and justify why European and national standards should not apply.

5 Sustainability

SuDS provide a valuable contribution to sustainable development planning and execution, offering an environmentally sensitive approach to stormwater and surface water management. In this capacity, they should also have a lower impact and environmental footprint over their lifetime. This would include lower operational and capital carbon emissions, lower embodied water, transparency and responsible sourcing throughout the supply chain.

There is still a strong need for the sustainable drainage systems industry to improve transparency and provide better quality data so that the benefits of both natural and engineered SuDS become more visible. The differences between engineered SuDS and natural techniques can also be judged sustainably through a complete whole lifecycle assessment approach.

Large box-culverts enable watercourse diversion

Some of the largest precast concrete box-culvert sections ever manufactured by FP McCann have been installed on a watercourse diversion project for one of the UK's newest towns. Wixams in Bedfordshire is a 4,500-home development, which also includes schools and commercial and retail properties.

The town is situated on 750 acres of brownfield land and it was necessary for the developer, L&Q Estates, to temporarily divert a section of Harrowden Brook to prepare the existing trench for installation of the box culvert. The brook runs beneath the site's Northern Distributor Road, an access road to two new warehouses which will help deliver jobs to complement the housing at Wixams.

Significant vehicle loadings on the access road during onsite construction meant that precast concrete box-culvert sections were considered the only option to channel the watercourse. Smith Construction Group, which is based in Milton Keynes, is undertaking the civil engineering and groundworks at Wixams and worked closely with FP McCann's Derbyshire-based box-culvert design team.

L&Q Estates' project engineers specified a 65m-long precast concrete box-culvert with 4.8m internal width and 2.7m internal height. The 35 individual sections each weighing around 22 tonnes were manufactured at FP McCann's production facility in Byley, Cheshire.

A diversion was created 25m from the original course of the brook and a new 100m long, 4.5m deep open-cut trench created to carry the flow to allow the construction of the culvert. The existing watercourse had to be correctly sized and lined with sand screed in preparation for installation of the box culvert units.

Each unit was delivered to site on a single articulated lorry and offloaded and installed using the largest crane available from the hire company. A schedule was put in place to manage delivery of the culvert units, with 60 to 90 minute intervals between shipments, starting at 8am. Three units were delivered on the first day and seven-a-day thereafter.

The first precast box-culvert unit was carefully lifted into the trench, which was repeated for each subsequent section. A culvert puller was used to winch each section tight to the next throughout the run.

The precast units were externally waterproofed with bitumen across the base and sides during the manufacturing process. An onsite contractor sealed all joints with bitumen and waterproofed over the top of the culvert. A 3mm rubberised board was laid over the culvert to protect the waterproofing.

With the culvert in place, headwalls were built using reinforced concrete and gabion baskets to improve the flow of water into and out of the conduit and to control erosion and scour. The brook was then reverted back to the original channel and the trench around the box culvert filled in. A landscaper was brought in to finish the job.

> ...as master planners of this site, it was vital we employed contractors we knew we could trust and would carry out this detailed work on time and to a high standard. This has been achieved through a united approach to the work and we are delighted with the final outcome.

John Banks, commercial director, Smith Construction, said: "The box-culvert team at FP McCann has successfully helped design an offsite precast concrete solution to successfully manage the natural watercourse diversion at this location.

"The scale of this project and the size of the precast box-culvert sections meant we had to take extra care at the planning stage. From start to finish, the culvert run was completed in just eight days, which was as good as we were hoping.

"Given how smoothly delivery and installation went, we might aim for eight or nine units a day in a future project. The work at Wixams demonstrates the flexibility that concrete box-culvert sections can offer."

FP McCann's box-culverts manager Alex Kirkham added: "The precast culvert sections for the infrastructure works at Wixams are amongst the largest we have ever manufactured at Byley and demonstrate our ability to offer a design solution to fit the most exacting of briefs."

Gregg Wilkinson, group managing director at Warwick-based L&Q Estates, said: "As master planners of this site, it was vital we employed contractors we knew we could trust and would carry out this detailed work on time and to a high standard. This has been achieved through a united approach to the work and we are delighted with the final outcome."

Nottingham site requires high-capacity bespoke chamber

A high-capacity surface water management system, requiring a deep-chamber shaft, has been installed as part of advanced drainage works required to divert a number of open watercourses that lay in the path of the Gedling Access Road. This is a new 3.8km road in Gedling near Nottingham and is adjacent to a 1,000-home development.

The Gedling Access Road, which is being managed and delivered by Via East Midlands, a Nottinghamshire County Council owned company, delivering highways and engineering solutions in the County.

Given the anticipated volume of water involved, a 100m run of large-diameter pipes and a large central chamber were proposed to manage the flow. Designers proposed that pipe diameters of 900mm and 1,400mm were required, flowing into a central chamber of 2,700m diameter.

Adrian Peck, account manager at Keyline Civils Specialist, a framework supplier to Via, recommended Stanton Bonna Concrete to provide a bespoke solution, working with the drawings provided. To facilitate the entry of such large pipes, an adapted three-part precast concrete chamber ring and base was required.

Production was carried out at Stanton Bonna's works in Ilkeston, Derbyshire. Partial apertures were cut into two of the sections, which meant the chamber could be put in place before safely removing the centre section on site. This helped retain the structural integrity of this extra-large ring, whilst at the same time allowing for multiple pipe entries.

Via East Midlands originally considered a prefabricated plastic solution, but due to the depth and diameter of the chamber and weight of loadings, a complete plastic system was not possible. Precast concrete was selected as the more cost-effective option.

The new Gedling Access Road will support the 33-acre brownfield development of the former Gedling Colliery site and provide a bypass around the village of Gedling. It will also link to the region's road network and Nottingham city centre.

The advanced drainage works started in September 2019 and was time-critical due to the risk of wet winter weather in this flood-prone valley. From design to onsite delivery the works on the deep-chamber shaft and 100m run of large-diameter pipes took six weeks to complete.

Adrian Peck, midlands & northern region key account manager, Keyline Civils & Drainage said, "The team at Stanton Bonna were happy to rise to the challenge on this unusually high capacity water management system and delivered on time and in spec."

Rob Cannon, area sales manager - central region, Stanton Bonna said, "This was a challenging project given the high volume of water and complexity of the existing watercourses. We are pleased that our bespoke option, using large-diameter manhole chambers together with precast concrete pipes, provided a long-term flood management solution to help deliver this important development."

Combined attenuation system meets flood prevention requirement

Flood prevention was a key requirement of planning permission for a 475-home development on agricultural land in the Vale of Glamorgan. The project also includes a new primary school and a roundabout being constructed as part of a link road.

The main contractor, Lewis Civil Engineering, specialises in deep sewer and water main pipelines and worked closely with Marshalls CPM. Precast concrete dry-weather-flow pipes are suited to areas prone to flooding as they can reduce over-pumping costs by up to 15 per cent.

A three-line attenuation tank using 1500mm dry weather flow pipes was specified. This was combined with Hydro-Brake Optimum flow-control chambers, as part of the sustainable drainage system (SuDS), which Marshalls CPM also supplied.

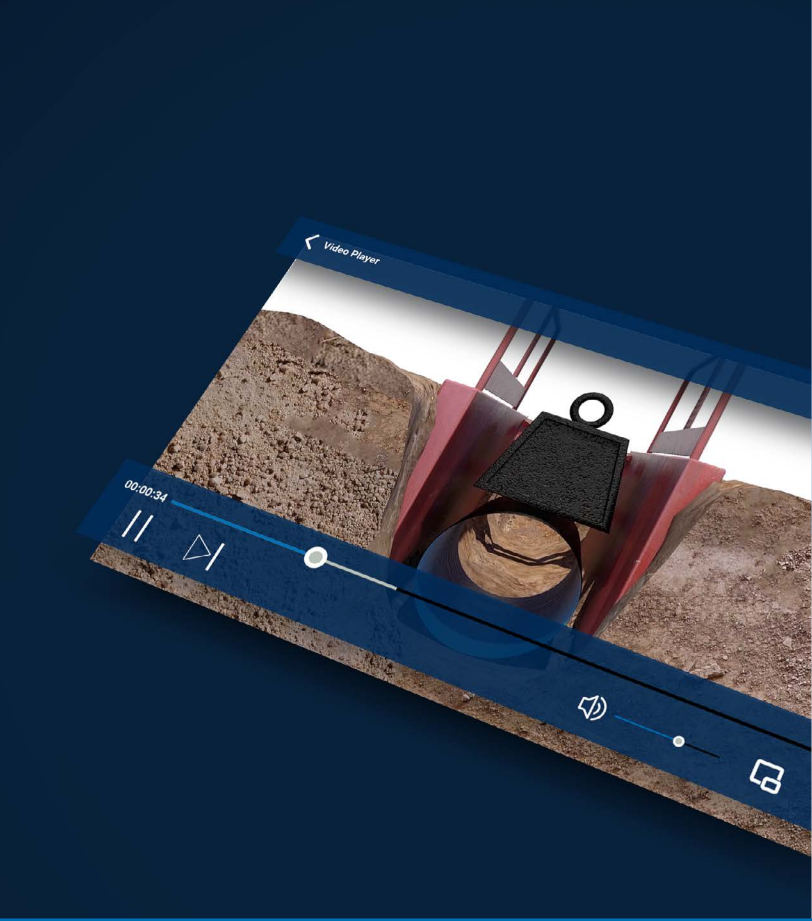
Les Vile, specifications manager for Marshalls CPM said: "Using the precast dry-weather-flow pipes concentrates the flow of stormwater into a channel at the bottom of the attenuation system. This increases velocity and prevents the settlement of solids or water in the tank.

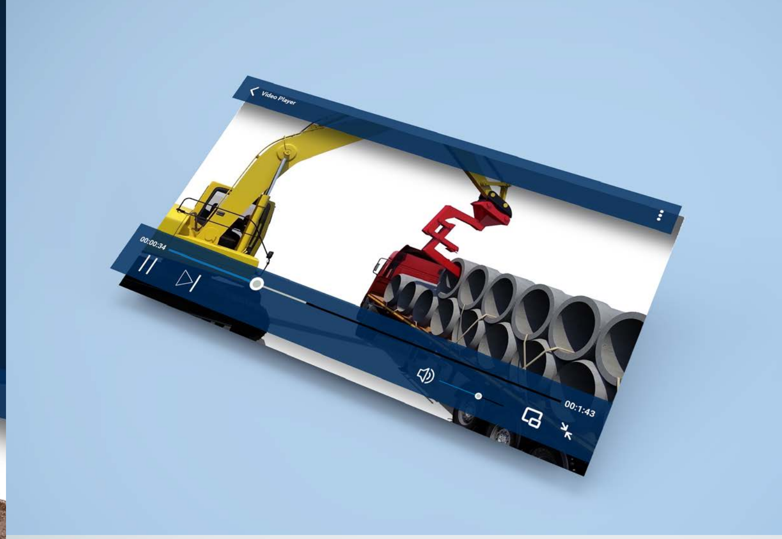
"When flooding or high-flow levels are in action, the open channel overflows, utilising the full volume of pipe. This means stormwater can move freely during both high-flow and low-flow events, eliminating blockages throughout the system."

Jo Wallace-Blaker, Marshalls CPM's trading manager said, "There are multiple benefits to using a precast concrete solution like the one deployed here. It reduces onsite construction time, in turn reducing health and safety risk.

"In addition, heavyweight concrete has the ability to withstand ground movement and water jetting, making the system more resilient. By aligning modern precast drainage with Hydro-Brake flow control as part of the SuDS, it has been possible to mirror the natural watercycle at this site."

"There are multiple benefits to using a precast concrete solution like the one deployed here. It reduces onsite construction time, in turn reducing health and safety risk."





Video makes the case for concrete

The price of the pipes is not the only consideration when costing a drainage installation project, as a video launched by the BPDA explains. *Drainage: the compelling case for concrete* is a straightforward guide to assessing the whole cost of drainage projects.

Bedding design and infill material are the main variables affecting cost and they differ depending on the types of pipes used in a given project. As the video reveals, the savings go beyond the price of the aggregate itself - less granular bedding means less imported aggregate and less soil taken to landfill, resulting in far fewer lorry movements.

Flexible plastic pipes have very little inherent strength and are usually installed with a full surround of granular material known as Bedding Class S. This transfers the majority of imposed loads, such as those coming from ground-level traffic, into the surrounding bedding.

Pipes made from rigid materials such as precast concrete do not deform, using their inherent strength to withstand loads and stresses. Typically 60-90% of the design strength is built into concrete pipes during manufacture, so bedding classes requiring at least half the quantity of granular material – such as B and N - can be used.

The BPDA drainage video points specifiers to BPDA's free Concrete Pipe Calculator app, which combines a structural design calculator and material cost calculator and can run whole-cost scenarios for pipes of various materials and dimensions.

This calculator, which is available for download from app stores, is designed to help estimate the combined cost of bedding, infill material and pipes for underground sewerage installations using different bedding designs. It compares four classes of bedding for rigid concrete pipes along with the bedding class usually used for flexible (plastic) pipes.

Visit: www.precastdrainage.co.uk/calculator-app for more information about the app.

The video can be viewed here:
www.precastdrainage.co.uk/news/Video-makes-the-case-for-concrete

Published 2020 © British Precast. 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. **www.precastdrainage.org**

British Precast Drainage Association Members: StantonBonna | McC fpmccann | cpm Part of Marshalls