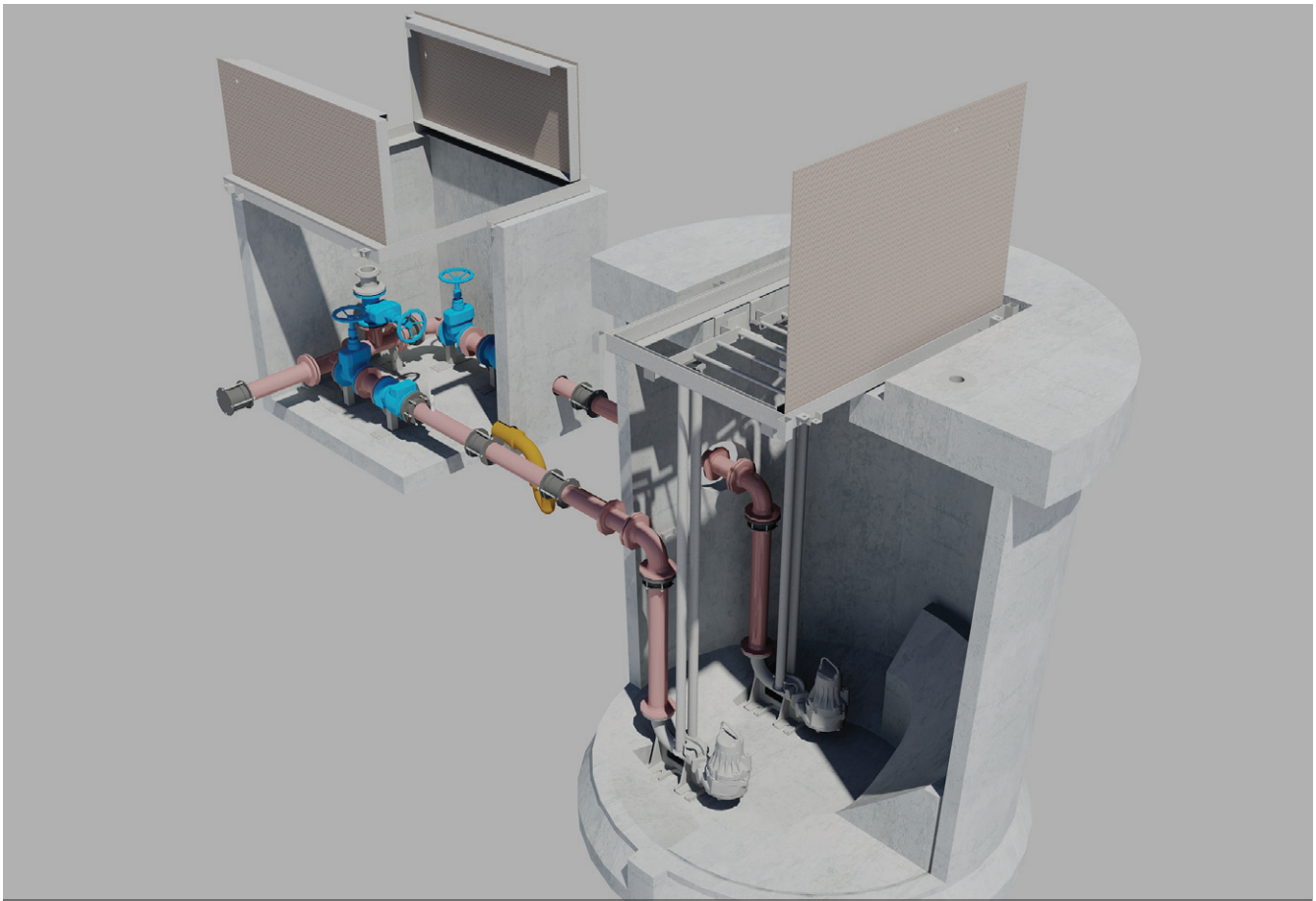
North Area Pumping Stations, North Yorkshire

Precast products drive efficiency across the Yorkshire Water region

by Stuart McBryer BEng Hons

The North Area Pumping Stations group consists of 12 (No.) Sewage Pumping Stations (SPSs) in rural or semi-rural locations across North Yorkshire. The SPSs vary in age and size, serving from 33 (No.) up to 261 (No.) properties. In AMP5 there is a requirement to bring these SPSs, and others across the region, in line with Yorkshire Water Asset Standards. The 12 (No.) SPSs making up the 'North Pumping Stations Batch 1' contract (based on NEC ECC Option C, Target Cost), which is valued in total at £2.15 million, are spread across North Yorkshire at locations such as York, Whitby, Malton and Richmond.



Pump wet well product image in CAD *Courtesy of Mott MacDonald Bentley Ltd*

Project scope

The work is being delivered as part of Yorkshire Water's (YW) AMP5 *'Other Installations'* framework agreement. As part of this five-year agreement, Mott MacDonald Bentley (MMB) has been commissioned to deliver four separate 'batches' of pumping station works across the north of the region. Each batch comprises a number of different small sites, together with an overall target cost built-up and agreed between MMB, as Principal Contractor, and Yorkshire Water as the Client. The idea behind 'batching' the SPS upgrades in this way is to achieve capital efficiencies, primarily through savings in design time, refining construction methods through experience, and programme management.

Feasibility and design

As part of the contract, MMB carried out initial site visits to all pump stations in order to recommended appropriate solutions to bring each site up to the required Asset Standards. Yorkshire Water then reviewed this information in order to set the scope for the improvements to each pumping station.

In AMP5, MMB has been working to deliver capital efficiencies through the application of standardised products, not just for pumping station components, but also in spillways, service reservoirs and other storage facilities. Such products not only provide assets with a high quality finish, they deliver value in themselves, as well as savings in design and installation time. Once designed and refined, such products come with a tested and defined installation process and associated safety and quality benefits, as well as a full suite of supporting documentation.

In order to use the best available technology to develop the most efficient components, MMB worked closely with the supply chain, in particular supplier Carlow Precast. Essentially the components used to construct the North Area SPSs are off the shelf precast units.

The development of the pump station product has enabled MMB to design and build pump stations, with not only a 4-week reduction in the construction program, but a reduction in the time taken to design a pump station scheme. Further design and procurement time is saved when working on an SPS batch using 3D-modelled components and calculation sheets, which automatically work out the number of each component unit required, and can be directly sent to our supplier Carlow.

Carlow provided a number of commodity pump chamber assemblies. These units are supplied complete with nominal benching, cores and fittings for installation. The installation is usually within one day and does not require concrete backfill for strength.

The features of each installation, including depth and opening locations, are unique to the project. Practically any type of fitting can be installed at the factory for a speedy assembly on site. By taking this standard product from Carlow, MMB has developed its own pump station product complete with design sheets and associated documentation. Significant work was done by Carlow to successfully prove the suitability of this method of construction.

Construction

During the 'North Area Pumping Stations Batch 1' series of projects, MMB has been required to schedule the works to be delivered alongside three further batches of pumping station works in the north of Yorkshire Water's jurisdiction.

The delivery of numerous schemes similar in nature also means that the batch teams can learn from site to site, and look for continuous improvements, all of which drives management and programme efficiencies for Yorkshire Water and MMB alike. Product-based delivery is one area that MMB has focused on because if one-complete design is produced (including drawings, 3D models, design data, Operation and Maintenance (O&M) manuals, Contractor's Works Information (CWI), procurement data, etc) with construction risks 'designed out', this can be reused from one site to the next, reducing costs and increasing productivity.

At Bolton on Swale SPS, for example, MMB was able to use a number of standard product designs, including wet well and valve chamber sections and cover slabs, which contributed to the success of the scheme. The task was to provide Yorkshire Water with 6 hours of storage (approx 5m^3). Initial options included offline storage in the upstream sewer, reduction of storage (with increased risk) by reusing the existing wet well, or the installation of a new wet well sized for the full storage requirement.

The limited area of the existing compound meant that any scheme retaining the existing pump station building would need additional land purchase. The use of the precast wet well option allowed MMB to provide the required storage volume in a small footprint, thus retaining the existing SPS boundary. The precast modular nature of the system meant that the excavation footprint was significantly reduced and facilitated a shorter construction period on site, saving both time and money. The batch team was in fact able to install the wet well, wet well cover slab, valve chamber and backfill to ground level all in one day.

At Crayke SPS a different precast solution was employed. Due to other site constraints the existing SPS building needed to be retained, but installation of a storage volume of 9m^3 was required. The options were either to install a storage tank within the Yorkshire Water site compound or incorporate the storage into the upstream sewer.

The existing site was of insufficient size to install a storage tank, without additional land purchase, so the sewer option beneath the highway was chosen. MMB worked closely with Yorkshire Water

and elected to use a precast concrete pipe of 600mm diameter into which was formed a 600mm x 400mm ovoid sewer. This allowed the pipes to be installed in a traditional manner but incorporated the dry weather flow channel, a Yorkshire Water requirement.

Stakeholder engagement

Yorkshire Water specifies that any asset delivery works are designed with the aim of minimising any impact on customers, users of surrounding highways, local residents and businesses. The use of prefabricated products for pumping station upgrades, which are quicker and simpler to install than traditional construction methods, reduces both the duration and the extent of such works. This is of particular advantage considering the rural or semi-rural location of many of the SPSs.

Health and safety

Construction using precast units vastly reduces the number of trades (and subcontractors) on site, so reducing the exposure to construction risk, and simplifying the work. The construction of a section of wall or a wet well is a single lift operation, compared to several lift operations to move large in-situ steel. The resulting reduction in complexity and lift operations not only improves site safety by reducing exposure to risk from those operations, but also yields a significant saving in terms of programme too.

Efficiency

In addition to lower unit cost, design, procurement and programme efficiencies, repeated installation of standardised precast products means that assets become familiar, making them easier for site teams to install and for Yorkshire Water teams to operate and maintain. In addition, all of the asset information is delivered with the product so there is no waiting time required for training or maintenance information.

Quality

The obvious benefit of precast is the greater consistency of output which is easily repeatable. As the concrete is poured in a controlled factory environment, this negates some of the issues experienced with traditional construction as a result of the Yorkshire climate! The precast element of construction is neither affected by weather nor subject to variable quality.

Progress to date

At the time of writing (August 2011), 10 (No.) of the 12 (No.) sites in 'North Area Pumping Stations Batch 1' have already been handed back to Yorkshire Water, with 2 (No.) still in construction, due for completion in November 2011.

Outcomes and learning

Of course, precast concrete in itself is not a new technology. The real value gained from the use of this component style of batch construction is in the continual process improvements which can be realised throughout the asset delivery process. MMB is now working with Yorkshire Water on batches 2 and 3 of SPS delivery and continue to further refine the project methodology. For example, material supply was delivered to individual sites in Batch 1 but for Batch 3, MMB has now set up a regional depot at Knaresborough. Using this depot, a single delivery point has been created, freeing up space on individual sites, whilst also saving time on ordering as this can be done centrally. The more times a product, and associated processes and documentation can be used and refined, the greater the cost saving.

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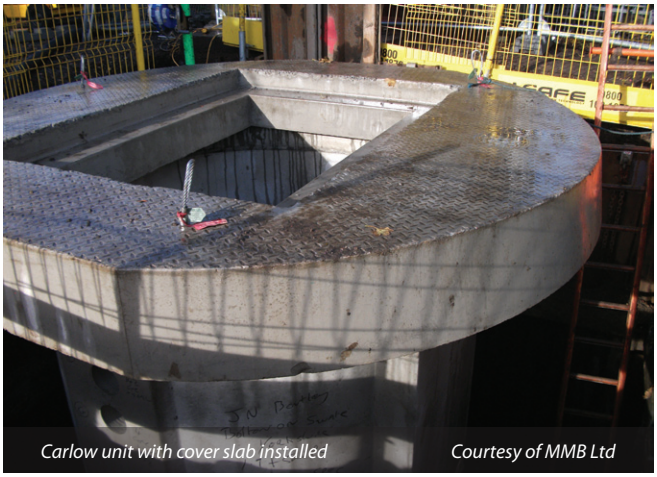
Carlow base unit being lowered into excavation at Bolton on Swale
Courtesy of Mott MacDonald Bentley Ltd

Checking alignment of Carlow base unit *Courtesy of MMB Ltd*



Carlow unit with cover slab installed *Courtesy of MMB Ltd*

Typical valve chamber arrangement prior to installation of cover
Courtesy of Mott MacDonald Bentley Ltd

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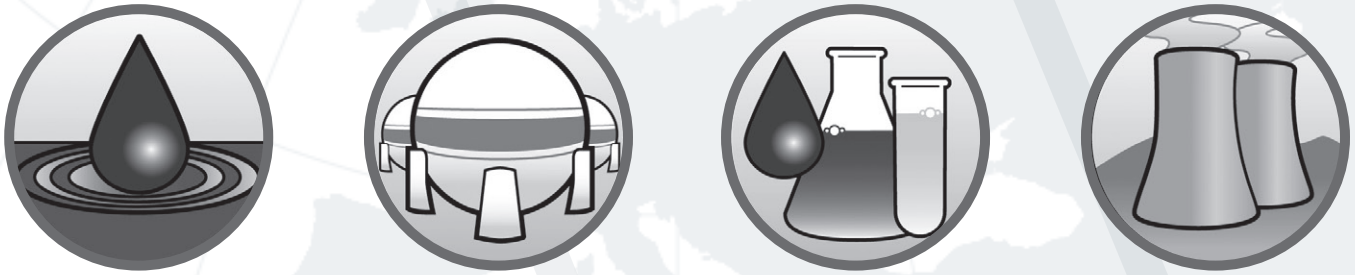

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