Bristol Wastewater Treatment Works

pre-cast concrete panels for storm tanks saved time & cost

by

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Bristol Waste Water Treatment Works, situated on 46.5 hectares of marshland reclaimed from the Severn Estuary at Avonmouth, is Wessex Water's largest plant. It serves the Bristol area which has a population equivalent of approximately one million. Part of the Company's current AMP3 quality output is the provision of storm tank storage at the site. An alternative to conventional reinforced concrete construction has been employed on the storm tanks to not only provide a cost-effective solution but to maintain the tight construction programme.

Completed tank 45m in diameter and 8m high *(courtesy Wessex Water).*

Project objectives

Improvements at the site are required as part of Wessex Water's AMP3 quality outputs and to improve compliance with the Bathing Water Directive. These include the provision of 25,000m³ of storm tanks storage and a further increase in secondary treatment capacity to 300Ml/d by extending the SBR plant, thus eliminating any primary settled effluent discharge. No qualitative changes to the discharge consent are proposed.

The fixed volume of storm tank storage has been negotiated and agreed with the Environment Agency.

Maximum pass-forward flow to the works, established by modelling the extended plant in conjunction with the trunk sewer model for the Bristol Catchment, has also been agreed with the Environment Agency at 657 Ml/d.

Provision had been made for future storm tanks in the original design of the Inlet Works. This comprised a partially completed overflow structure at the downstream end of the grit channels together with two additional grit channels. The overflow has been modified to incorporate the Storm Tanks Feed PS. The additional grit channels are being commissioned and fitted with grit removal trains and fine screens at their downstream end to match the six existing operational channels.

Procurement of both the storm tanks and SBR extension is being undertaken through an Alliance Agreement established at the beginning of 2002 between Wessex Water, Wessex Engineering Services (a wholly owned subsidiary of Wessex Water) and MJ Gleeson Group plc with consultant Black & Veatch as designers. The Alliance uses a modified form of the Engineering and Construction Contract (2nd Edition)—Option C.

Storm tanks

Two storm tanks, each 45m in diameter and 8m high have been constructed to provide the required storage. These are equipped with full bridge scrapers.

From an early stage it was clear that the construction programme was tight to achieve the target completion of end of April 2003. An examination of the critical elements of the construction programme identified the storm tank walls to be the activity putting completion at risk. Conventional reinforced concrete construction was expected to take 15 weeks.

One of the objectives of Alliancing is to challenge the proposals at every stage through outline and detailed design, even into construction, in order to provide the most cost effective solution. At an early review, contractor MJ Gleeson suggested that savings in both capital cost and construction programme may be possible by using post

tensioned, pre-cast concrete walls. The *Aqua-Tank* system from *A-Consult* was proposed by Gleeson. Wessex Water had not previously used pre-cast concrete tanks and needed to be persuaded that the system offered the benefits claimed. Technical reviews of the design of the concrete panels and the joint sealing strips, which are a key element of the design, were followed by a visit to a site in Scotland to see similar tanks in service.

Asset life expectancy is 60 years. A capital cost analysis showed the potential saving at Bristol to be approximately £85,000.

Construction *& benefits*

The *Aqua-Tank* system from *A-Consult* uses high specification concrete, full height panels held together by a series of circumferential high yield steel tendons which pass through ducts embedded within the panels. The number and spacing of the tendons varies over the height of the walls and the design accommodates manway access hatches and discharge pipe penetrations. The tendons are terminated, grease packed and capped at 'buttress' panels, of which there are four in each tank at Bristol. The panels being 8m high also incorporate pre-stressed reinforcement.

Between the panels is a substantial EPDM sealing strip to absorb any movement and removes the need for any grouting of joints. This was particularly important at Bristol considering the cyclic loading which occurs in storm tank operation.

GRP launder channels over one-quarter of the circumference have been installed. Stainless steel fixings for the support brackets were cast into the wall panels during manufacture and have been provided in all panels, should it be necessary to extend the launder channel to the full circumference in the future.

Following completion of the in-situ reinforced concrete tank bases, erection of wall panels commenced on 9 December, 2002 with completion and the walls partially tensioned by 20 December 2002. The first three weeks of January 2003 saw final tensioning and installation of the pre-cast concrete capping beam which provides a runway for the bridge scraper.

Benefits at this location, of this method of construction, can be summarised as follows:

* estimated cost saving of £85,000
* quality of finished panels is highly controlled due to manufacture in a factory environment;
* work at height is significantly reduced and the need for scaffolding is eliminated;
* craneage is limited to erection of the wall panels and capping beams;
* temporary works are significantly reduced as there is no requirement for large, special formwork;
* wall panels are full height and generally 175mm thick, pre-stressed, thus reducing the volume of concrete;
* tank walls construction reduced from an estimated 15 weeks to 5 weeks.

At the time of preparing this article (early May 2003), both tanks have been successfully hydraulically tested and wet commissioning is well advanced. First flows through the Storm Tanks and the Feed Pumping Station were achieved within one week of the target date.■

Note: *The author of this article, Richard Thackeray, is Project Manager, Wessex Engineering Services.*

Photo shows start of construction **9/12/02**
(Time lapse photography by John Adderley, courtesy MJ Gleeson).

Midway through construction **10/12/02**
(Time lapse photography by John Adderley, courtesy MJ Gleeson).

Final wall installation **12/12/02**
(Time lapse photography by John Adderley, courtesy MJ Gleeson).