

## Introduction

In September 2006, Anglian Water suffered a sudden and catastrophic failure of a concrete tank at a sewage treatment works in Lincolnshire, a Safety Bulletin was produced [031 – Catastrophic Failure of Concrete Tank.doc](#)

The results of this investigation, carried out by Anglian Water have not been issued however a number of other issues have come to light which require consideration.



## Action to be taken

- If a project team is currently thinking about using a similar post-tensioned tank, then don't – they should be boycotted until the full report from Anglian Water is available and we have considered its recommendations.
- If a project team is already committed to using a similar tank and it is too late to change, then they should follow the advice within this sheet.
- If a project team has to work with an existing tank, then they should follow this advice sheets recommendation regarding making amendments to that tank, particularly in respect of coring or forming holes in it.

The following guidelines were kindly provided by Black and Veatch

## Post Tensioned Concrete Tank Issues Include

- Cracking of walls
- Damage to tendons
- Ingress of water into tendon ducts
- Concrete corrosion cracking
- Drilling and cutting of existing tanks

**As a result some Clients have stated that they do not want tanks of this type of construction built in the short term until the issues are resolved.**

In order to help design and construction teams to make informed decisions **we strongly recommend that where tanks of pre-cast panels with post tensioned unbonded internal cables are currently proposed the issues are discussed with the Client so that direction can be received specific to each case.** Risk assessments comparing alternative designs (conventional RC etc) may help in assessing the particular issues in any given case and in reaching a decision

The following bullets outline a number of considerations which should be made if the decision to proceed with tanks of pre-cast panels with post tensioned unbonded internal cables is made in consultation with the client. The considerations for new tanks and already constructed tanks which may require modification are different and the requirements are listed below:

## New Installations - Do's

- Consult with the Client to establish his requirements and/or preferences.
- Carry out high level risk assessments to enable informed decisions to be made.
- Consider the effects of cyclic loading and thermal stresses. Failure and cracking appears to be associated with Sequencing Batch Reactors and to a lesser extent with Sludge Holding Tanks, Balancing Tanks, Storm tanks, filters and settlement tanks.
- Consider tank elevations. Tanks partially below ground level appear to be less vulnerable to cracking.
- Ensure that backfill compaction loads are considered in the initial design.
- Consider foundation conditions and in particular the potential for differential settlement which may exert additional stresses not included in the initial design. Check if the designer has set any limits on differential settlement or foundation movement.
- Consider the effects of internal corrosion on covered tanks due to H<sub>2</sub>S attack particularly with sludge holding tanks. Air mixing is a good means of control as is the use of protective elastomeric coatings etc if the panel joints are properly covered.
- Consider the use of elastomeric linings for tanks which are subject to cyclic loading. This can limit the ingress of water to tendon ducts even if cracks are self healing.
- Establish a mechanism for properly controlling mechanical sub-contractors on site who are required to fix equipment to the tank walls (e.g. launders). Preference is for the tank supplier/erector to mark drilling positions.
- Ensure that design details, calculations and drawings including tensioning records are held in the O&M manuals and Health and Safety File.
- Decide how much checking we want to do of the supplier's design. The calculations are not 'run-of-the-mill' and cannot be easily checked so this may involve a specialist check by a third party.
- Ensure signs are attached to the tanks stating 'Do not modify this structure without reference to the Designer and the Health and Safety File' the method of construction and the tank designer's name should also be included.
- Establish at an early stage what fixings/penetrations are required to be inserted in the tank walls. Agree these positions with the designer, together with any associated loads.
- Ensure any changes to fixings and penetrations are brought to the designer's attention.
- Ensure the designer has a proper contract and adequate PI cover.
- Ask the designer for details of the level of redundancy in the post-tensioning cables and if necessary specify a reasonable level of redundancy based on risk and tank duty - consider increasing cable areas to reduce stresses.
- Carry out a thorough walk-over inspection of the tanks upon completion (preferably with the supplier and before water-testing) to check for any signs of distress.
- If possible carry out a further inspection of the tanks after they have been in service for several months.

### Don'ts

- Deviate from the designer's construction method statements. This can lead, amongst other things, to damaged tendons being installed.
- Repair defects to tanks without the full approval of the designer.
- Modify tanks in any way without the full approval of the designer. In particular changes in the location of penetrations and fixings should be formally notified.

## Existing Installations - Do's

- Locate all design materials for the tanks using O&M manuals, drawings, calculations and the Health and Safety File as appropriate.
- Consult the original designer and gain his approval before any modifications are made. If necessary pay him for the advice to activate his PI insurance.
- Ensure that contractors understand the construction method adopted for this type of tank construction and the consequences of inappropriate actions.
- Make an issue of missing design documentation and ensure the Client is made fully aware of the implications of proceeding with modifications without adequate design data. In these circumstances there is a strong case for not touching such tanks unless the Client accepts responsibility in writing, acknowledging the risks and issues.
- Check the tank for details of manufacture/designer etc.

### Don'ts

- Cut drill or modify the tank without the approval of the original designer. Consider up and over type pipework wherever possible.
- Post install roofs without the approval of the original designer.