

## **Circular Clarifier Mechanisms Pier Anchorage**

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*This is an excerpt from a paper written by WPE engineering staff in February 2016 titled **Interface Issues with New Equipment and Existing Concrete Tankage**.*

### **SUMMARY**

Almost any existing concrete circular clarifier tank that is being refitted with a new pier supported clarifier mechanism, including pier anchorage, may not have a sufficient concrete base and configuration to hold loads introduced by pier anchorage. Specifications that require the equipment supplier to provide new anchorage that complies with current design codes sets up a costly and time-consuming issue of responsibility if there is insufficient concrete to hold the anchorage.

### **Anchorage for New Equipment to be Installed in Existing Tanks**

The use of existing anchors for replacement equipment going into existing concrete tanks involves consideration of who is responsible for the design of the anchorage. Existing concrete tanks are generally quite old, perhaps several decades old, and were designed in an era when seismic design was in its infancy and anchorage calculations were performed with engineering judgment and no codified guidance. In 2002 the American Concrete Institute (ACI) produced in its ACI 318, Building Code Requirements for Structural Concrete, an appendix, Appendix D, which prescribed proper procedures for designing concrete anchors. The concrete anchor industry was initially slow to take this new appendix seriously, but after concrete panels fastened to the Boston tunnel by epoxy anchors failed, resulting in a death, all of the concrete fastener providers took a much more proactive approach. The vendors now spend extensive time and money performing research and development and keeping their anchor specifications and software up to date with the current design Codes.

Anchors for new equipment attached to existing concrete will involve the design of threaded rods to be installed in predrilled holes filled with a proprietary epoxy. Responsibility for the design of the new anchorage becomes troublesome for the equipment supplier for the following reasons:

- Concrete anchor vendors assume their product will be installed in compliance with their Evaluation Service Report (ESR), with which their software complies. While they don't guarantee the installation of their product, their disclaimer does reserve the right to pursue litigation against anybody who installs their product not in compliance with their guidance.
- The ESR is issued by a subsidiary of the International Code Council (ICC).
- The ICC publishes the International Building Codes (IBC).
- Outside of Chicago, some version of the IBC (2003, 2006, 2009, 2012 or 2015) is endorsed by all municipalities as law.
- The IBC references and modifies, normally conservatively, some version of the above named ACI 318 (02, 05, 08, 11 or 14) as part of its Code.
- Almost without exception, anchorage installed previously will no longer comply with modern Codes.

The more recent changes in the design codes and standards require larger edge distance spacing and thicker concrete due to more stringent tension, shear and combined loading requirements. This is especially true in moderate and high seismic regions where forces can be large and the codes require ductile failure of the steel before concrete failure, even if both

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materials demonstrate adequate strength to resist the seismic loading. In other words, upgrading an anchor rod from 1 inch to 1 ¼ inch or increasing the number of anchors reduces the design capacity and can cause the anchors to fail to meet design code requirements. Another counterintuitive example of the difficulty is a deeper anchor embedment decreases an anchor's capacity once it exceeds a certain depth because of some of the equations the Code prescribes.

This leads us to a question of who is responsible for compliance with current design codes if existing anchors are to be re-used. Equipment suppliers cannot be responsible for determining the condition, adequacy, capacity or suitability of existing concrete for use with either new anchors or the existing anchors. We expect that bringing an existing concrete tank into compliance with the governing code would involve added reinforcement, and necessary concrete modifications that is beyond the scope of an equipment supplier.

### **Recommendation -**

We recommend that, prior to bid; appropriate concrete experts evaluate existing concrete tankage for placement of anchors for support or attachment of retrofit equipment so that the anchors will be in compliance with current design codes. If modifications to the existing concrete are necessary, then the design of the anchorage should be incorporated in the modifications and be based on loads determined by the suppliers of the proposed new equipment to be installed. An added step may be to have the concrete experts devise field test methods to test the original existing anchor bolts to see if they can resist the determined loads. If the anchor bolts successfully pass the tests, then the Consulting Engineer or Engineer of Record for the project can instruct the equipment suppliers to design their equipment to utilize the original anchor bolts.

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