

PCCP: Condition Assessment, Repair, and Replacement Strategies

Prestressed concrete cylinder pipe (PCCP) condition assessment and emergency response plan development

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Prestressed concrete cylinder pipe (PCCP) is used by Reclamation and other agencies for water conveyance, primarily as siphons on non-redundant transmission systems. The goal of this study was to survey the state of the art in PCCP condition assessment, repair and service extension methods, and replacement strategies to provide operators with successful strategies for maintaining their PCCP assets.

Mission Issue

Improving the condition assessment, repair, and replacement plans for PCCP will allow Reclamation to more efficiently manage its PCCP assets.

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Problem

Prestressed concrete cylinder pipe (PCCP) is used by Reclamation and other agencies for water conveyance, primarily as siphons on non-redundant transmission systems. Reclamation specified PCCP from approximately 1960 to 1990. Beginning in 1984 and continuing through 2016, Reclamation has seen instances of both catastrophic failure and extreme deterioration of PCCP installations. Investigations have revealed problems with the PCCP including split, corroded, and broken wires and damaged mortar coating. The primary failure seen in PCCP is compromised mortar coating and subsequent severe corrosion of the prestressing wire. Unlike many other pipe types, failure of PCCP is typically by sudden rupture of the pipe wall. For this reason, it is important to have well-developed and actionable condition assessment and emergency response plans for PCCP assets, and to know the risk of failure for each installation.

Solution

The goal of this study was to survey the state of the art in PCCP condition assessment, repair and service extension methods, and replacement strategies to provide operators with successful strategies for maintaining their PCCP assets. The study found techniques broken down into method overview, logistics of implementation, and order-of-magnitude cost projections. This project also compiled Reclamation's inventory of PCCP into a web-based geospatial database. The condition assessment is the first line of defense towards preventing a catastrophic failure of PCCP. Depending on site-specific needs and restrictions, some inspection techniques may be better suited than others. Even with a thorough condition assessment plan, necessary repairs to sections of PCCP are inevitable. This report outlines commonly used techniques to extend the service life of distressed PCCP including. Finally, when pipeline segments have deteriorated beyond repair, pipeline replacement projects must be considered. Proactive planning for replacement allows work to be budgeted and scheduled and is much preferred to costly emergency replacements. This report outlines replacement methods.



Tendon wrapping operations at Centennial Wash Siphon.

“The report is well done and will be very informative to our Operating Entities on Transferred Works and for our Reclamation O&M Crews and Engineering support staff on Reserved Works.”

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More Information

<https://www.usbr.gov/research/projects/detail.cfm?id=7108>

Application and Results

Condition assessment is the first line of defense towards preventing a catastrophic failure of PCCP. Combining inspection results with structural analysis, a performance curve can be produced showing the number of wire breaks versus operating pressure and the conditions that will produce cracking, yield, etc. After a baseline condition assessment has been established, further inspections can be performed on a scheduled basis as needed, for example every five to ten years. As the number of observed defects or detected wire breaks in a given section increases, the frequency of inspections can be increased; or alternately, monitoring technology, such as acoustic fiber optic monitoring can be used.

Condition assessment results are only useful to PCCP asset managers when followed up with either a plan for subsequent inspections, or an actionable maintenance and repair plan. Proactively planning for necessary inspections, maintenance, and repairs, both from a budgetary perspective and from scheduling perspective, can avoid the consequences demonstrated in the case histories presented.

Future Plans

Reclamation has several ongoing efforts in the field of PCCP management. The Policy Office- Asset Management Division has a program to maintain the PCCP inventory and web-based viewer that was begun as part of this research project. It will also fund, on a priority basis, baseline electromagnetic inspections for many Reclamation-owned PCCP and continue to feed that data, as well as risk assessments for each pipeline, into the GIS database.

The Science & Technology Program has a three-year project to install an aboveground section of PCCP on the Denver Federal Center as an educational demonstration and inspection method truthing specimen. The pipe should arrive in Denver in first quarter of FY 2020.



Pre-impregnated CFRP sheets applied to interior walls of PCCP.