

Field retrofit and testing of a corroded metal culvert using GFRP

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\$160,000

Field-testing an efficient, low-cost glass fiber reinforced polymer coating to protect culverts from corrosion.

Metal culverts have widely served as structural elements in highway design for over 60 years because of their low cost, ease of fabrication, and simple construction method. However, there has been much corrosion of metal culverts for the last decade. Such corrosion results in loss of cross-section and occasionally structural failures. Numerous failures lead to costly rebuilds as well as significant indirect costs associated with highway closure. Glass fiber reinforced polymers (GFRP) have become a desirable material for structural strengthening and rehabilitation over the past two decades. Prior research supported has shown that GFRP profile liner can retrofit an existing metal culvert and provide structural capacity for the corroded metal culvert to extend its service for 50-100 years. This proposal requests support for field experimentation of said technology. New Mexico Department of Transportation (NMDOT) has recently chosen a field trial site. A mock road resembling a two-lane rural road with a 6-inch backfill above a 22-foot long and 24-inch diameter corroded metal culvert is being prepared by NMDOT. This project will perform field retrofit of the corroded metal pipe using the fit-in GFRP profile liner technology and will provide field monitoring of the retrofitted pipe under truck loads. The retrofitted culvert will be monitored for up to 60 days after the retrofit is done. The implementation phase of this project includes creating a guidebook for Departments of Transportation (DOTs) with information on design method for the GFRP retrofit technology and recommendations for work force training on field implementation of this new technology in the future.

over the past two decades. Corrosion free and low weight, GFRP cost has also dropped considerably with production advances. In addition, GFRP material does not require additional protective coatings or maintenance. Recently, the team at the University of New Mexico finished an extensive experimental investigation conducted in the time of 2016-2019 examining the potential use of GFRP to retrofit corroded metal pipes. The experimental investigation at UNM, summarized above, showed that slip on GFRP profile liner can completely retrofit an existing metal culvert and provide a new culvert with significant structural capacity and excellent ductility.

Objectives

The objective of this research project is to perform full-scale field implementation and testing of the field retrofit of CMP using GFRP slip liner and provide an implementation guidebook for future application. The technical phase objectives are

1. Structural design of GFRP liner retrofit for a field corroded metal culvert.
2. Field application of GFRP profile liner to retrofit corroded metal culvert.
3. Survey the behavior of the retrofitted CMP-GFRP culvert subjected to traffic loads.

Intended Implementation of Research

Education and Workforce Development: This study will fund one graduate student at the University of New Mexico (UNM). The project will help prepare future leaders in the Transportation Sector specializing in development of new materials for transportation infrastructure. The research team will also prepare educational modules on using GFRP to retrofit corroded metal culverts and will be shared with other universities of Tran-SET. Moreover, results of this work will also be shared at national conferences such as TRB and ASCE and will be published in journals.

Problem Statement

In some parts of New Mexico, culverts go obsolete within three years of installation due to the high corrosion. There is an urgent need to address the issue of metal culverts corrosion in the United States. GFRPs have become a desirable material for structural strengthening and rehabilitation



Outreach: This project will extend training opportunities for undergraduate students. The PI will also arrange a tour for high school students participating in UNM Transportation Institute in summer 2020. In addition, the PI will present findings of this work in the annual meetings of ASCE and New Mexico Society of Professional Engineers (NMSPE).



Figure 1: A corroded metal culvert

Anticipated Impacts/Benefits of Implementation

The outcome of this research project will include the demonstrating field project showing the possible retrofit of existing corroded metal culvert using GFRP technology to NMDOT engineers and personnel. Deliverables also include the guidebook include recommendations for methods for design and implementation of the GFRP retrofit technology for NMDOTs. The main deliverables from this study are:

- (1) A guidebook including recommendations for methods for design and implementation of the GFRP retrofit technology for NMDOTs.

Web links

- Tran-SET's website
<https://transet.lsu.edu/research-in-progress/>

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit [our website](#), LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at transet@lsu.edu.

