Inspection of Flexible Fillers

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Introduction:

The purpose of this research is to explore the use of flexible fillers in post tensioned bridge members and the different nondestructive evaluation (NDE) techniques used to assess these bridges.

This is an important contribution to the field of civil engineering because it will…

- Add to current knowledge of these fillers
- Push towards fillers being used more frequently in future bridges
- Create bridges with longer design lives

These fillers have the potential to create longer lasting bridges, but at this point there is no proven inspection methods available to bridge inspectors. This research will provide inspectors with various techniques to accurately detect corrosion in the steel strands found within the internal and external ducts of post tensioned bridges.

The more common material used in bridge construction today is cementitious grouts, but there are many disadvantages to using them such as…

- Presence of voids which allows moisture to access the steel strands thus leading to corrosion
- Does not allow for accessibility of the strands making it difficult to inspect and replace

Therefore the use of flexible fillers is being explored for use in future bridge design and construction.

Bridges of Concern:

Each of the bridges in the table below experienced corrosion in these tendons and anchorages before reaching their design life which could have been prevented

Bridge	Bridge Type	Year Built	Location	Age of Corrosion	Description	Cause
Ynys-y-Gwas Bridge	Segmental post-tensioned bridge	1953	South Wales	32 years	Completely collapsed with no evidence of distress before failure	Pre-stressing tendons were severely corroded due to inconsistent grout
Ringling Bridge	Segmental box girder bridge	2003	Sarasota, Fl	8 years	Two external post-tensioned (PT) tendons failed	Severe corrosion of steel strands due to deficient grout
Niles Channel Bridge	Segmental box girder bridge	1983	Florida Keys	16 years	Corrosion on/near anchorages	Voids and chlorides found within the grout
Mid Bay Bridge	Segmental pre-cast girder bridge	1993	Destin, Fl	7 years	Corrosion on/near anchorages	Voids and chlorides found within the grout

Shows the top of a tendon found in the Ringling bridge with deficient grout and strand corrosion

Collapse of the Ynys-y-Gwas bridge in South Wales

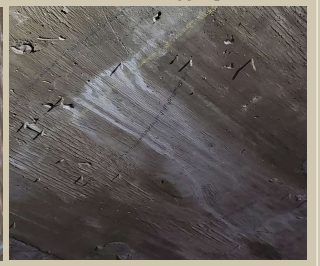
With the use of flexible fillers, this corrosion is less likely to occur due to the added protection these fillers provide to the strands against moisture.

Methods of Focus

Visual Indicators

- Most common and oldest form of NDE
- Inexpensive and easy to perform
- Approximately 80% of all bridge inspections are done visually
- Appearance is a good indication that something is wrong
  - Cracking, pitting and surface corrosion can all be indicators of a much bigger problem

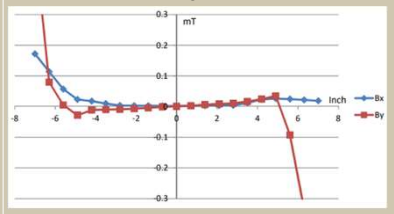
Example of cracking from the eastbound Seabreeze Blvd Bridge inspection



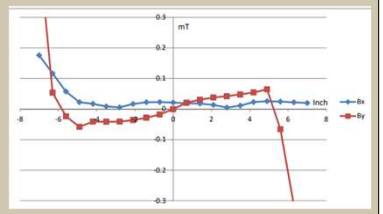
Example of efflorescence from the eastbound Seabreeze Blvd Bridge Inspection

Magnetic Flux Leakage (MFL)

- Makes use of the interaction between magnetic fields and their interaction with matter
- Effective in detecting distress in ferrous materials such as steel
- Effective in detecting corrosion in internal and external ducts



Flux Densities of Intact Strand



Flux Densities of Broken Strand

Active MFL Sensor

- There is a visual difference between the two charts comparing the MFL results from an intact strand vs. a broken strand. This is clearly effective in detecting defects in these strands.

NDE Methods

- Visual Methods
- Electromagnetic wave methods
- Magnetic Methods
- Electrochemical Methods
- Mechanical wave/Vibration methods
- Penetrating radiation methods

Results

Flexible fillers hold many advantages over cementitious grouts such as…

- Easy accessibility to the strands
- Effective strand protection from moisture
- Longer design lives of bridge

Due to these advantages, it is important to research more about these fillers and work towards incorporating them into future bridge designs. By using these fillers, engineers can create bridges with longer design lives that require less repairs. Determining an effective NDE method for bridges using these fillers ensures that bridge inspectors can guarantee the safety of the structure and detect corrosion before serious damage occurs.

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Acknowledgements:
ERAU Office of Undergraduate Research
Florida Department of Transportation (FDOT)

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