



# INFRASTRUCTURE REPAIRS AND STRENGTHENING WITH FRP COMPOSITE MATERIALS

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# U.S. INFRASTRUCTURE - BRIDGES

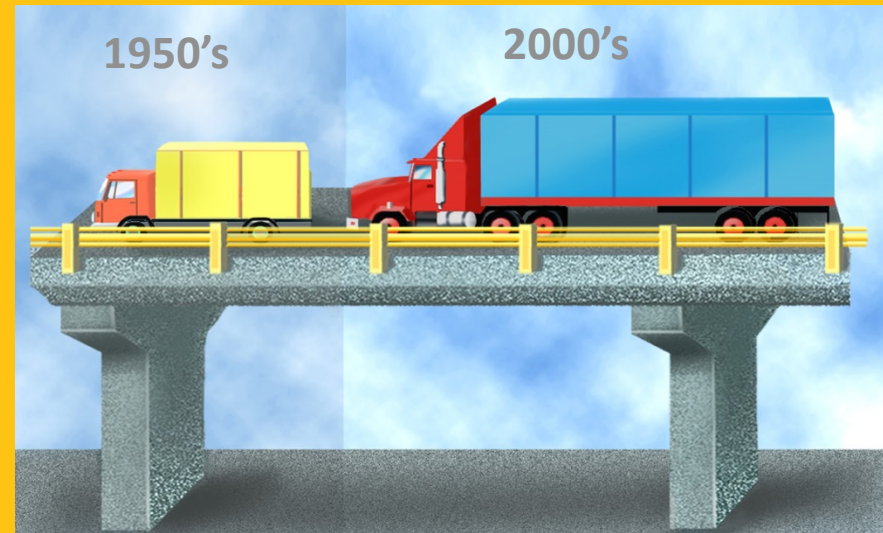
- Over 600,000 bridges in U.S.
- 1 in 9 rated structurally deficient
- Average age currently 42 years old
- \$20.5 billion needed annually to repair bridges
- \$12.8 billion currently being spent (ASCE 2013 Report Card)





# WHY DO STRUCTURES NEED STRENGTHENING?

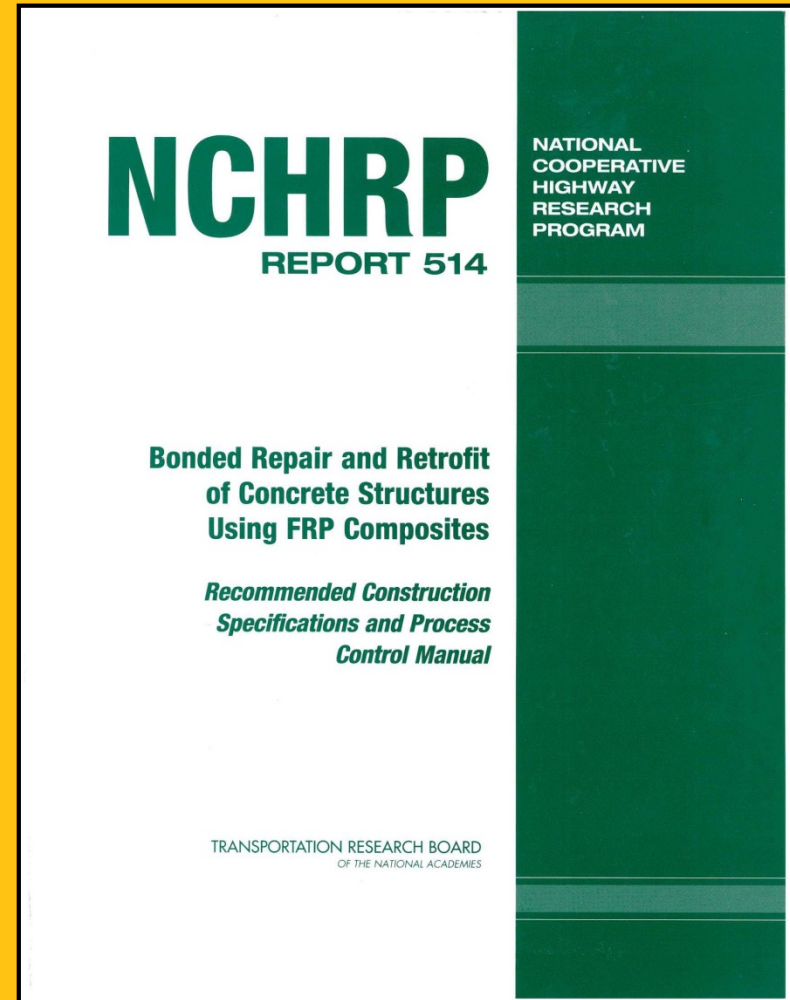
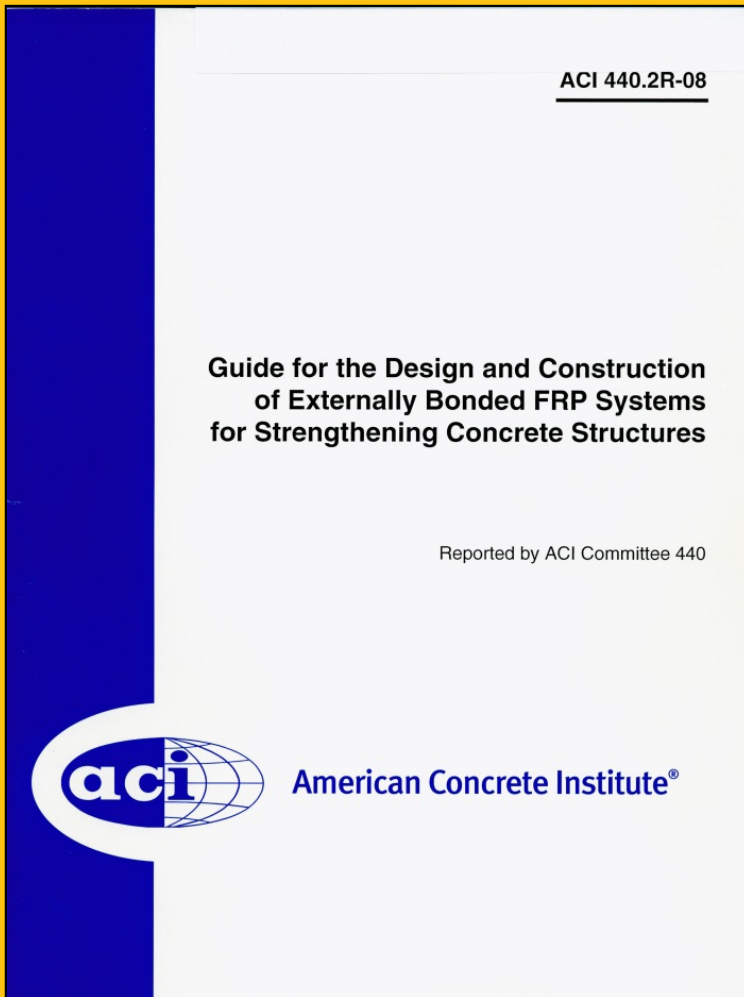
- Insufficient reinforcement
- Corrosion damage
- Change in use
- Structural damage
- Seismic upgrade
- Blast hardening



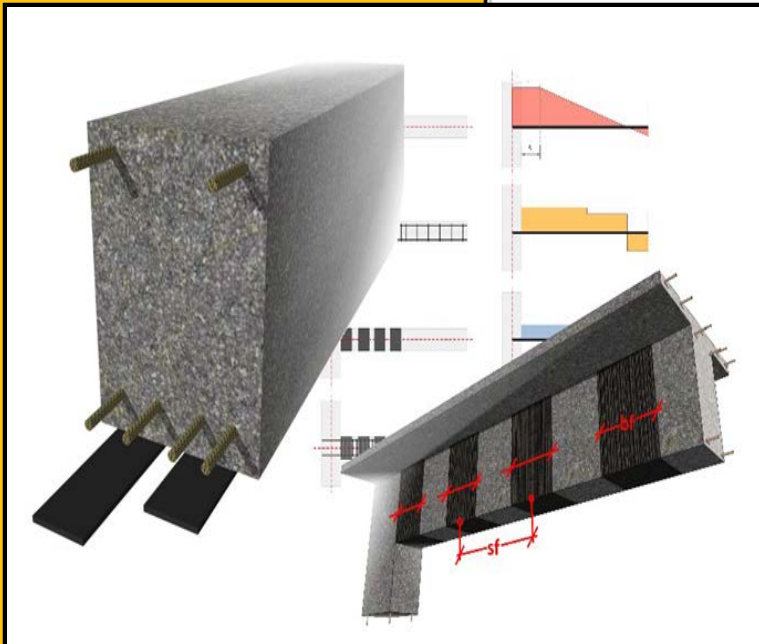
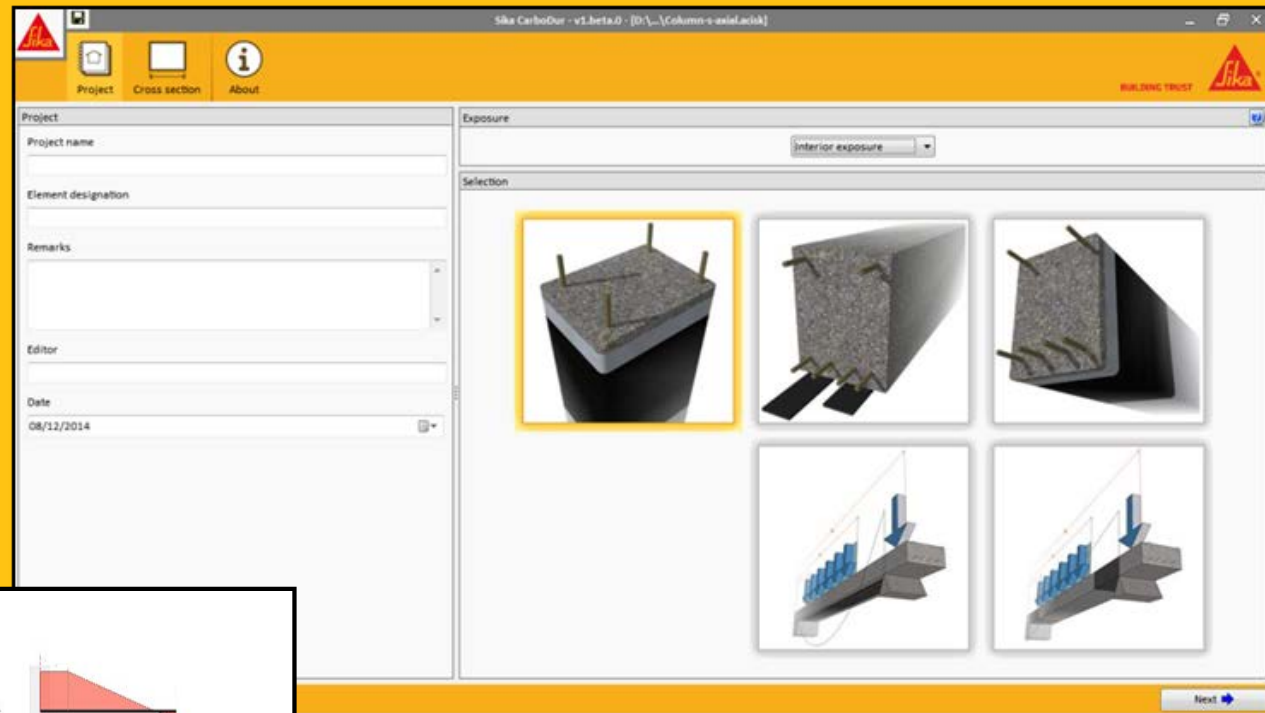
# ADVANTAGES OF FRP REPAIRS

- Cost/scheduling benefits
- **“Get in, Get out, Stay out!”**
  - FHWA Mantra for accelerated construction
- Reduced maintenance costs
- Light weight materials puts less strain on infrastructure
- Non-corrosive materials are designed for long-term performance
- Less expensive repairs allow for more structures to be repaired with fixed budget

# DESIGN DOCUMENTS



# FRP DESIGN SOFTWARE





# CORROSION DAMAGE



# CORROSION DAMAGE REPAIRS – SEISMIC UPGRADES



6 June 2013

BUILDING TRUST

**Jika**



# SUNSHINE SKYWAY BRIDGE



# AASHTO GIRDER REPAIRS





# IMPACT DAMAGE



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# LOSS OF STRANDS



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# DAMAGED CONCRETE REPAIRED



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# APPLICATION OF FRP



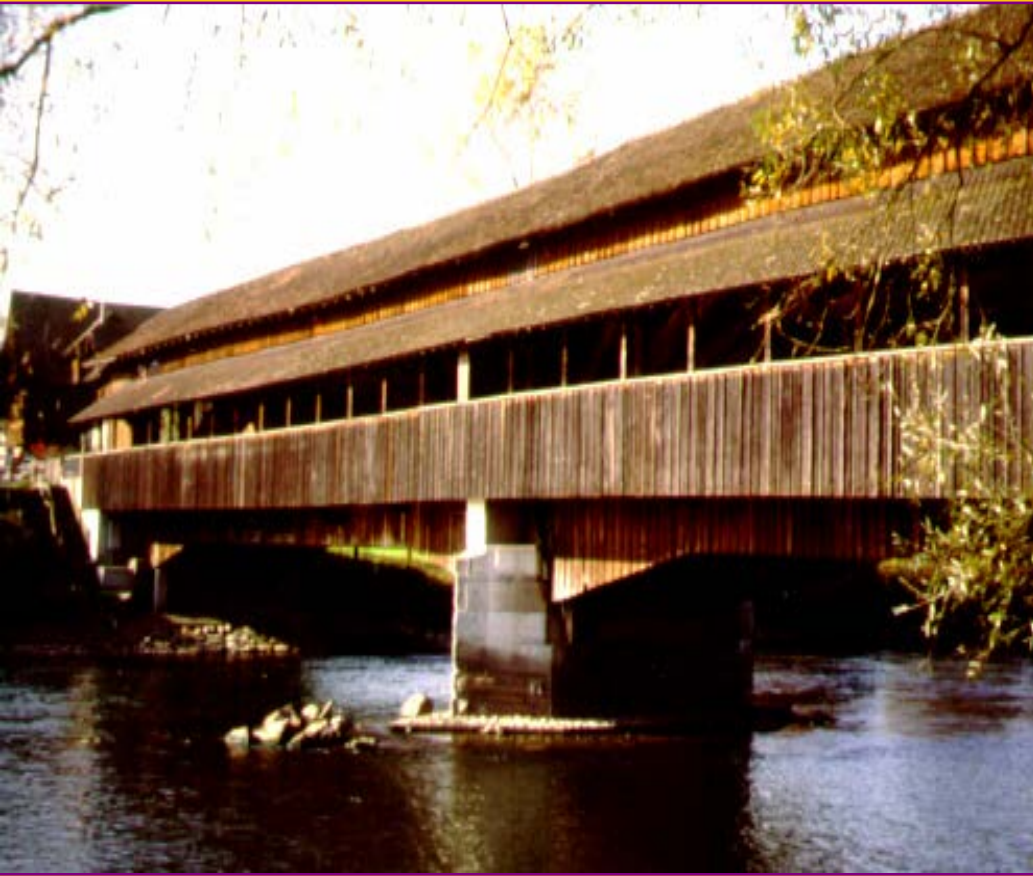
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# FINISHED SURFACE



# HISTORIC STRUCTURES – WOODEN BRIDGE



- Original: 12 tons
- Required: 20 tons
- Residents opposed construction of new bridge

# SINS BRIDGE, SWITZERLAND

- First bridge strengthened with CFRP plates
- Timber bridge originally constructed 1807
- Strengthened 1992
- Still in service today



**1992**



**24 yrs. later**



**2016**



# CONCRETE ARCH BRIDGE CORROSION DAMAGE



# STATION STREET BRIDGE KANKAKEE, IL



# CONCRETE BOX GIRDER BRIDGES





# DAMAGED STRANDS/REBAR FROM CORROSION



# POST-TENSIONED CFRP PLATE



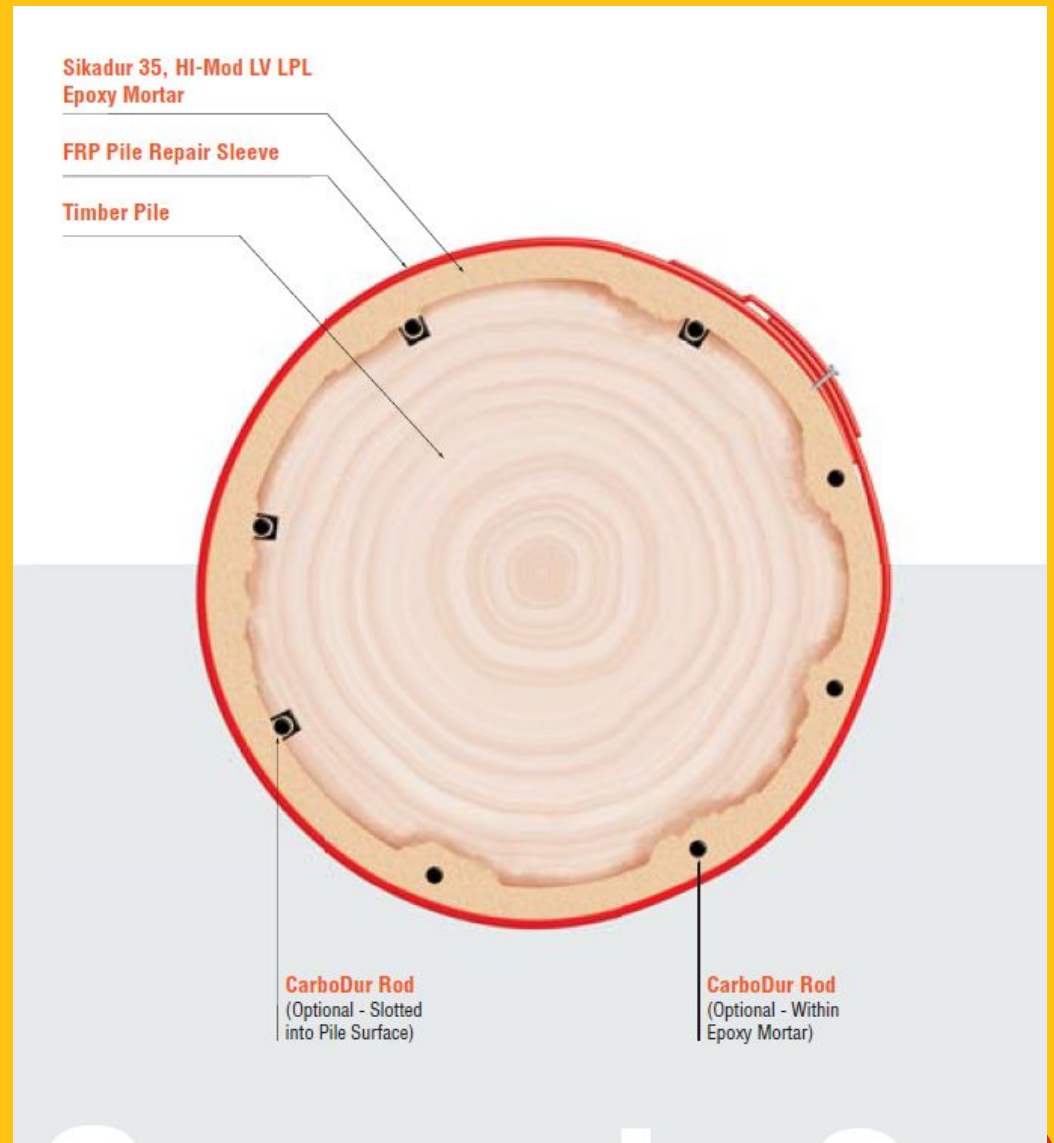


# PILE RESTORATION

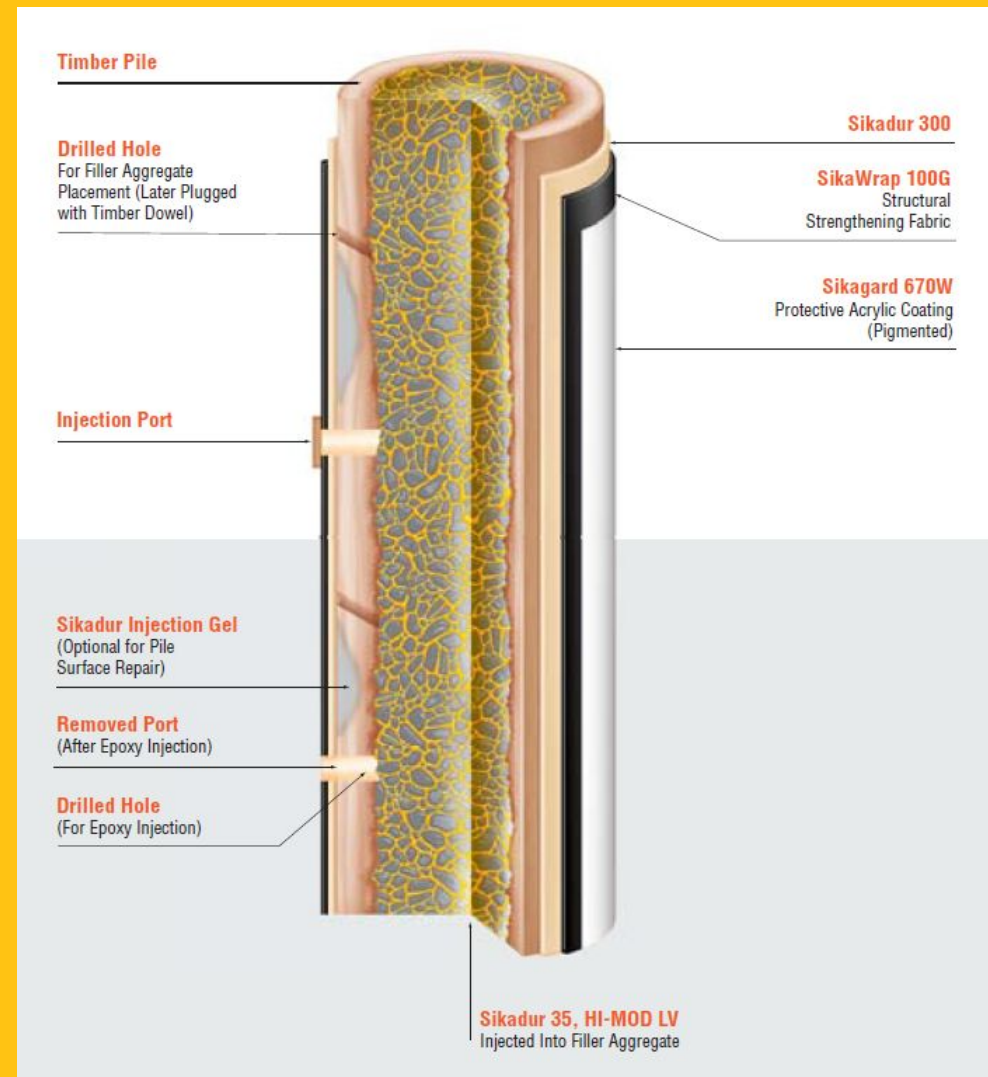




# TIMBER PILE DAMAGED FROM BORER INFESTATION

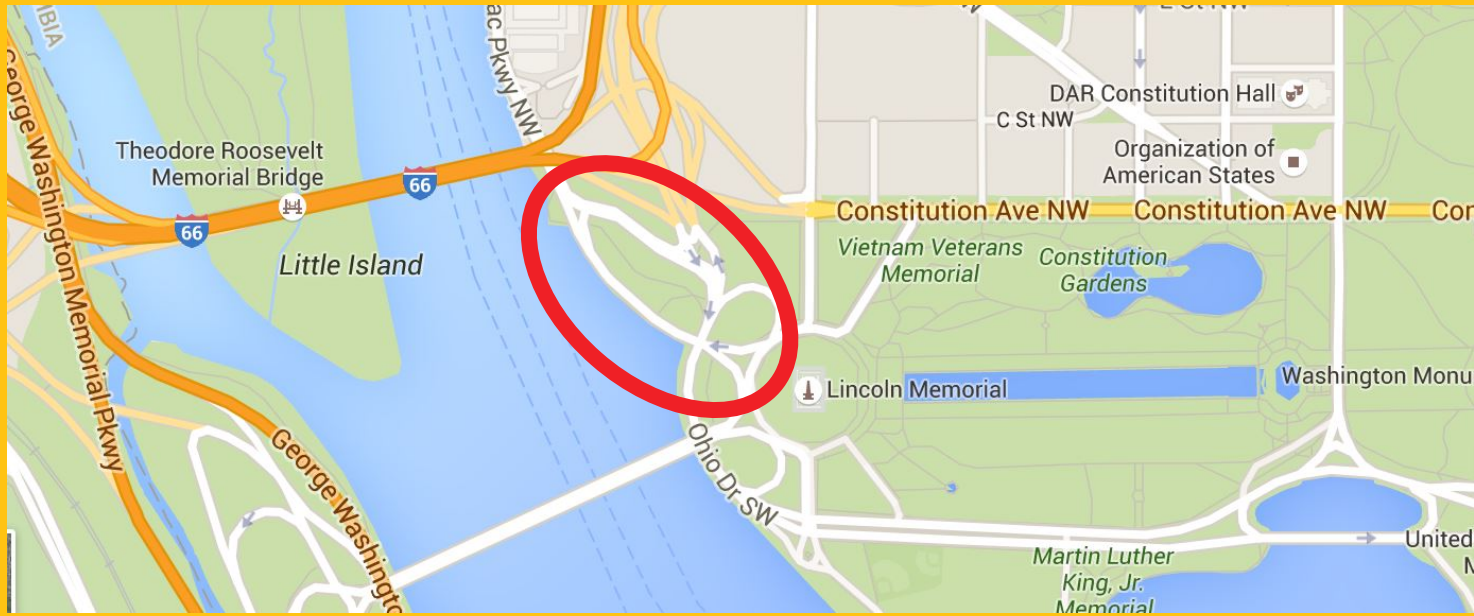


# FRP PILE JACKETS





# PRE-SATURATED (PREPREG) FRP REPAIRS





# PRE-SATURATED FRP FABRICS





# NATIONAL PARK SERVICE BRIDGE





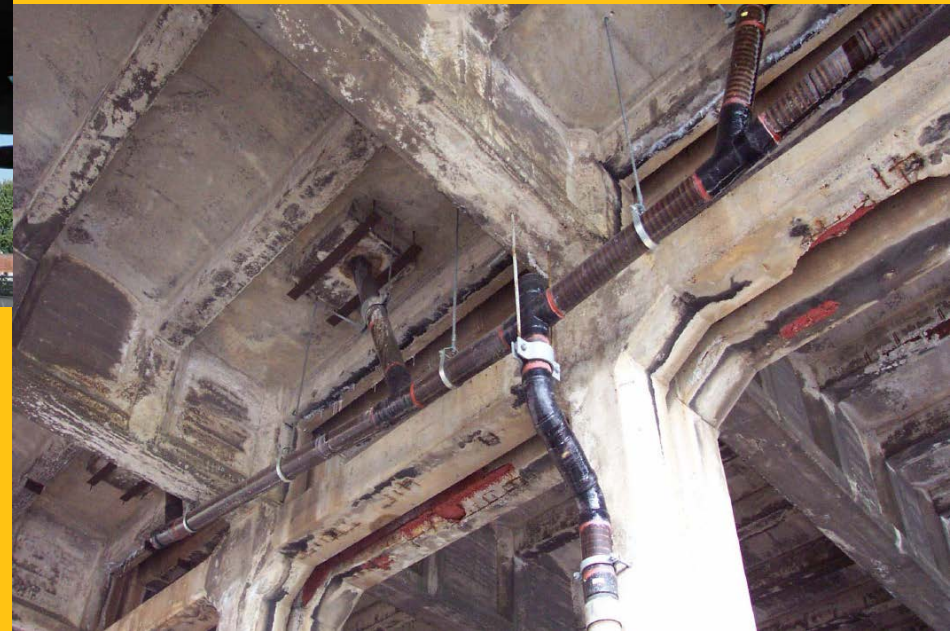
# TRANSIT BRIDGES



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# CONCRETE DETERIORATION



# CULVER LINE VIADUCT, BROOKLYN, NY





# CONTRACTOR TRAINING





# CONCLUSIONS

- U.S. infrastructure is literally crumbling before our eyes and is in critical need of repair
- Extending the service life of existing bridges is one key element of sustainable repairs
- FRP Composites have been used successfully to retrofit thousands of bridge projects around the world for over 25 years
- FRP Composites are available in many shapes and functions to repair all types of bridge elements
- FRP Composite materials offer many advantages to DOT's including corrosion resistance, high strength, low weight and are extremely durable even in marine environments



THANK YOU FOR YOUR ATTENTION

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