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

Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures

Reported by ACI Committee 440

American Concrete Institute®

NCHRP REPORT 514

Bonded Repair and Retrofit of Concrete Structures Using FRP Composites

Recommended Construction Specifications and Process Control Manual

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES
FRP DESIGN SOFTWARE
CORROSION DAMAGE
CORROSION DAMAGE REPAIRS – SEISMIC UPGRADES
SUNSHINE SKYWAY BRIDGE
AASHTO GIRDER REPAIRS
IMPACT DAMAGE

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LOSS OF STRANDS

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DAMAGED CONCRETE REPAIRED
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

Timber Pile

Drilled Hole
For Filler Aggregate
Placement (Later Plugged with Timber Dowel)

Injection Port

Sikadur 300
SikaWrap 100G
Structural Strengthening Fabric

Sikagard 670W
Protective Acrylic Coating (Pigmented)

Sikadur Injection Gel
(Optional for Pile Surface Repair)

Removed Port
(After Epoxy Injection)

Drilled Hole
(For Epoxy injection)

Sikadur 35 HI-MOD LV
Injected Into Filler Aggregate
PRE-SATURATED (PREPREG) FRP REPAIRS
PRE-SATURATED FRP FABRICS
TRANSIT BRIDGES

Structural rehabilitation of mile-long Culver Viaduct

copyright NYCT
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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