ECC Patching of Bridge Decks

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Presentation Outline

• Project Goals
• Observation of Concrete Patch Work
  – Preparation of Patch Area
• Preliminary Site Visit
• ECC Preparation and Field Work
• Conclusions
• Future Work
Project Goals

- Verify ECC Performance in Field Environment
  - Field Processing Capability
  - Vehicle Loading
  - Interfacial Behavior
  - Environmental Durability
  - Surface Finishing

- Acquire experience for future field applications
Preliminary Patch Observation

- Observation of Michigan Department of Transportation (MDOT) Maintenance Crew to view patch preparation
  - August 2002
  - Miscellaneous deck repair of a three span two-lane steel girder bridge
  - Repair of deteriorated fixed joint
  - Originally constructed in 1964
  - Complete resurfacing in 1995
  - Located in central Michigan
Joint and Deck Deterioration

Underside of deteriorated fixed joint

Deteriorated deck
Patch Preparation

Partial depth removal by pneumatic hammering

Vacuuming debris
Patch Preparation

Sandblasting of patch area

Prior to sandblasting

After sandblasting
Patch Preparation

Replacement of damaged reinforcement

Completed patch preparation
Preliminary Site Visit

- September 2002
- Miscellaneous deck repair of a two span two-lane steel girder bridge
- Originally constructed in 1976
- Located in southeast Michigan
ECC Patching Preparation

**Mix Proportions**

- Cement: 1.0
- Water: 0.53
- Sand: 0.8
- Fly Ash: 1.2
- SP: 0.03
- \( V_f \): 2.0

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**M45 Representative Strain vs. Stain - 28 Days**

<table>
<thead>
<tr>
<th>Mix No.</th>
<th>First Cracking Strength (MPa)</th>
<th>Ultimate Strength (MPa)</th>
<th>Ultimate Strain (%)</th>
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<tbody>
<tr>
<td>45</td>
<td>4.0 ± 0.22</td>
<td>5.8 ± 0.37</td>
<td>3.7 ± 0.35</td>
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ECC Patching Preparation

- Mixing materials were pre-batched for easy field processing

Cement and fly ash

PVA fiber
ECC Processing

- Materials were transported to the site
- Mixing performed using 340 liter drum mixer
ECC Processing

- Mixing time lasted roughly 25 minutes
- ECC exhibited desirable creamy viscosity and good flowability
ECC Patching

Prior to placing patch material

- Sawn edges were mechanically roughened
- Surface was wetted to strengthen interface

Roughened edges
ECC Patching

- ECC was poured into patch

Pouring ECC into wheelbarrow for transportation

Placing ECC in patch
ECC Surface Finishing

- Finishing proceeded immediately after placement

Hand finishing of ECC patch with steel trowel
ECC Surface Finishing

Riding Surface Preparation

• Transverse grooves drawn into the surface to improve vehicle traction

• Tining rake used to create grooved texture
Completed Patchwork

After tining

- ECC patch sprayed with latex based curing compound to reduce evaporation and shrinkage
- ECC patch covered with plastic sheet
ECC Patch Strength Development

- Recommended compressive strength 25MPa – 30MPa
- Curing time between 24 – 29 hours
- Traffic was reopened 48 hours after ECC patch work was completed
ECC Patch Performance – Concrete vs. ECC

- ECC and concrete 2 days after patching

Concrete Cracking

ECC patch under heavy 11 axle truck loading
Conclusions

• ECC patching on bridges and roadways is viable

• ECC mixing time is currently too long for most patch operations but can be shortened

• Relatively short 24 hour curing time of ECC needed for reopening traffic is desirable

• Field processing of ECC results in flowable material not requiring vibration into existing patch reinforcement

• ECC performs well in comparison to concrete under very heavy truck loading
Future Work

- Long term monitoring
  - interfacial crack
  - surface deterioration
  - salt resistance
  - performance under snow removal equipment
  - overall performance

- Reduction of mixing time

- Reduction of curing time

- Application into larger projects requiring larger volumes
  - concrete trucks
  - concrete pumping equipment