Precast Concrete Pavement

Background Concepts

Project 1517
FHWA, CTR & TxDOT
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CTR contracted by FHWA/TxDOT to investigate the feasibility of using precast panels for highway construction

Two aspects are emphasized:
• expedited construction
• high performance i.e. 30-40 year life
Primary Objectives

- Identify existing and/or develop new methods to expedite highway construction through the use of precast construction techniques.

- The proposed method should be able to have a design life of 30 or more years.
Secondary Objectives

- Determine the current state-of-the-art
- Identify possible concepts for a precast pavement
- Feasibility analysis for the identified concepts
- Recommendations for future implementation
- Guidelines for performance monitoring
Benefits

- Expedited construction
- Reduced user cost
<table>
<thead>
<tr>
<th>Pavement Type</th>
<th>Daily User Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRCP/JCP</td>
<td>$380,000</td>
</tr>
<tr>
<td>Precast</td>
<td>$1,800</td>
</tr>
</tbody>
</table>
Benefits

Over-capacity

Roadway Capacity
Benefits

Roadway Capacity

Reduced Capacity
Benefits

- Expedited construction
- Reduced user cost
- Reduced thickness of sections (prestressed pavement)
- Controlled concrete fabrication conditions
- Improved performance
Expert Panel: Primary Recommendations

- **Expediting construction**
  - Lane closure at 8:00 pm
  - Reopening for traffic 5:00 am next day

- **Focus on full-depth panels without BCO**
  - Using precast panels with a BCO will extend construction time due to the additional paving operation required
  - Possible to get a smooth ride without a BCO
Expert Panel: Primary Recommendations

- Panels
  - Size: About 24ft x 12ft x 8 inch
  - Weight: Less than 12-15 tons
  - Flexibility with concrete mix and panel treatment in a precast plant
    - Use of lightweight aggregate
    - Use different aggregates in panels
    - Match-casting of panels
    - Surface treatment of panels (tining, etc.)
Expert Panel: Primary Recommendations

❖ Panel Joints
  • Use of tongue-and-groove joints is possible
  • Epoxy is required on panel joints

❖ Leveling
  • Place AC leveling coarse - plane if necessary
  • Leveling devices are unnecessary
    – Use shims if anything
  • Improve ride quality by grinding the joints after assembly
Expert Panel: Primary Recommendations

- Use prefabricated ramps to aid with turning traffic on the sections
- Ramps are reusable
Expert Panel: Further Investigation

- Use of an asphalt leveling course
- Methods for joining panels
- Materials for filling voids beneath the panels
- Use of different aggregates in the panels
- Accommodation of horizontal and vertical curves
- Use of bonded (grouted) vs. unbonded post-tensioning tendons
Concept for Precast Pavement

- 8” Full Depth precast panels

- Base Panels
- Joint Panels
- Central Stressing Panels

8” VS. 14”

Precast Pavement  VS.  CRCP
Concept for Precast Pavement

- Ducts for post-tensioning are cast into the panels
- Panels are pretensioned (40 - 45 psi) in the transverse direction during fabrication
Joint Panel

- 38’
- 10’?
- 8”

Ducts for Post-tensioning

Match-cast keys

Expansion Joint Detail
Central Stressing Panel

- 38'
- 10'?
- 8"

- Ducts for Post-tensioning
- Central Stressing Pockets
- Pretensioning Strands
Concept for Precast Pavement

- Joints between precast panels
  - Match-cast, keyed edges to aid with:
    - alignment of panels
    - load transfer
  - Epoxy along joint to aid with:
    - pavement continuity (tensile strength)
    - lubrication of keys for assembly
    - sealing of joint
Joint Between Adjacent Panels

Keyed Joint

Precast panels

Epoxy
Concept for Precast Pavement

- **Surface preparation**
  - 2” ACP layer as leveling course, plane/grind if necessary
  - Place single layer of polyethylene as friction reducing membrane

- **Slab length (between expansion joints)**
  - Max: 340 ft for summer placement
  - Max: 440 ft for winter placement
Panel Assembly

- Base or existing pavement
- 2" AC Leveling Course
- Joint Panel
- Duct Holes
- Polyethylene Sheet
Panel Assembly
Concept for Precast Pavement

- Strands are anchored at the joint panels and threaded through ducts in panels

- Panels are “strung together” and post-tensioned longitudinally
  - 195 - 255 psi prestress, depending on slab length and support conditions
Panel Assembly
Feasibility Conclusions

- It appears that the use of precast panels is a feasible method to expedite highway construction.
- The proposed method should meet the requirements for durability and expedited construction.
- CTR will continue to evaluate the feasibility of this and other concepts.
Feasibility Conclusions

- **RECOMMENDED IMPLEMENTATION ON:**
  - Highway sections in Texas and California
  - Intersection in Texas
IMPLEMENTATION
IPR 1517

- First tests section on inactive roadway
- Austin District, IH 35 project, change order frontage road, north of Georgetown
- IPR Funding approximately $1.6 Million
- Granite Construction, Texas Concrete
Implementation Section

- Full Roadway width panels 10’ x 36’
- Partial Roadway width panels
  - Post tension in longitudinally and transversely?
  - 10’ x 16’ + 10’ x 20’ = 10’ x 36’
  - Five 250’ (approx.) segments of full & partial
Casting Panels

- Texas Concrete Products - Victoria, Texas
- Base, End and Stressing Panels