Precast Concrete Pavement
Background Concepts

Project 1517

FHWA, CTR & TxDOT

Gary Graham

November 15, 2001

Project Background

- 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

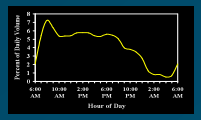
Benefits

- Expedited construction
- Reduced user cost

User Costs

Pavement Type	Daily User Costs
CRCP/JCP	$380,000
Precast	$1,800

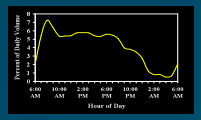
Benefits



Over-capacity

Roadway Capacity

Benefits


Percent of Daily Volume
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7
6
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10:00 PM
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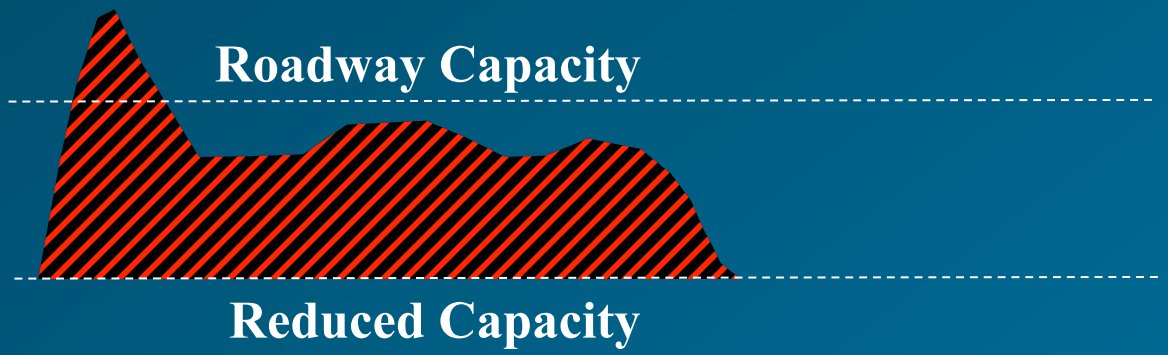
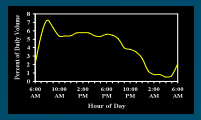
6:00 AM
Hour of Day


Roadway Capacity
Reduced Capacity

Benefits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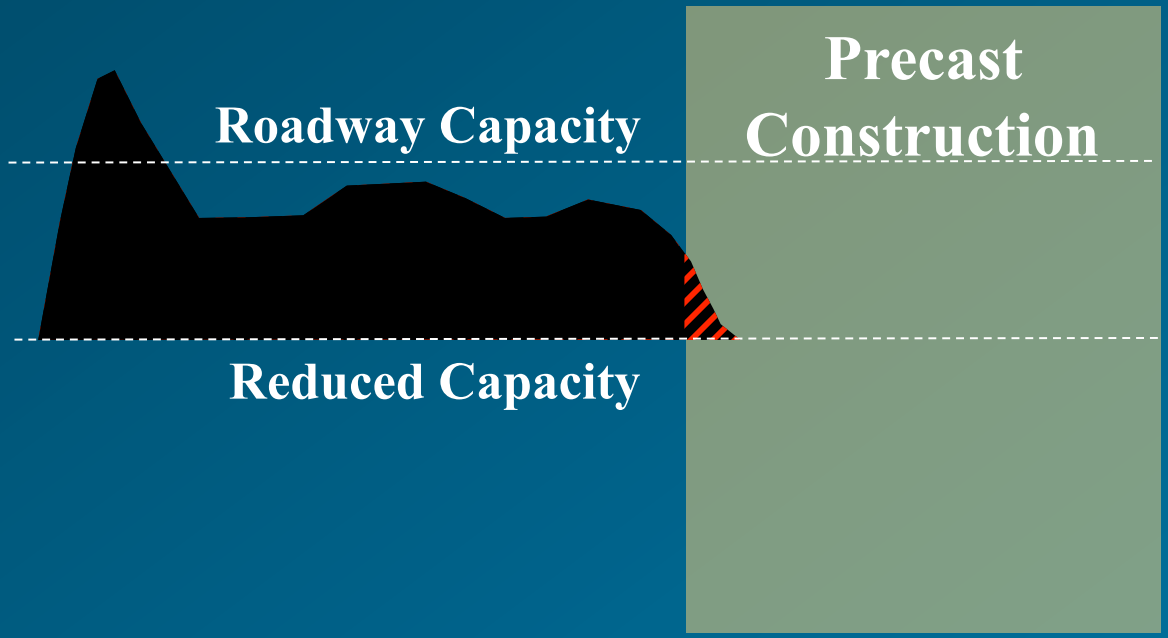

Roadway Capacity
Precast Construction
Reduced Capacity

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

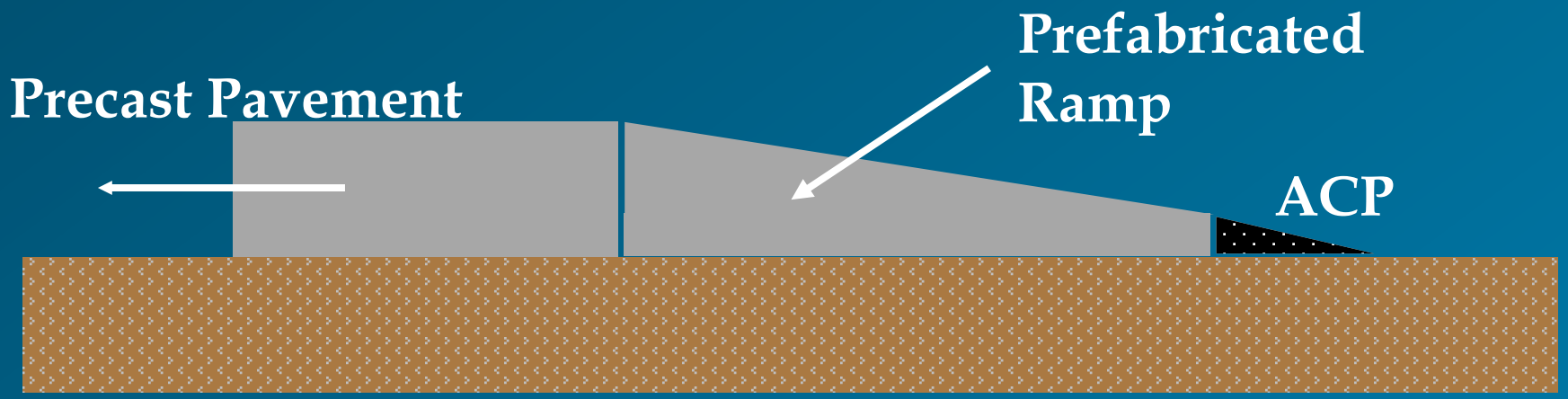
- Panels
  - Size: About 24ft x 12ft x 8 inch
  - Weight: Less than 12-15 tons
  - Flexibility with concrete mix and panel treatment in a precast plant
    - Use of lightweight aggregate
    - Use different aggregates in panels
    - Match-casting of panels
    - Surface treatment of panels (tining,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

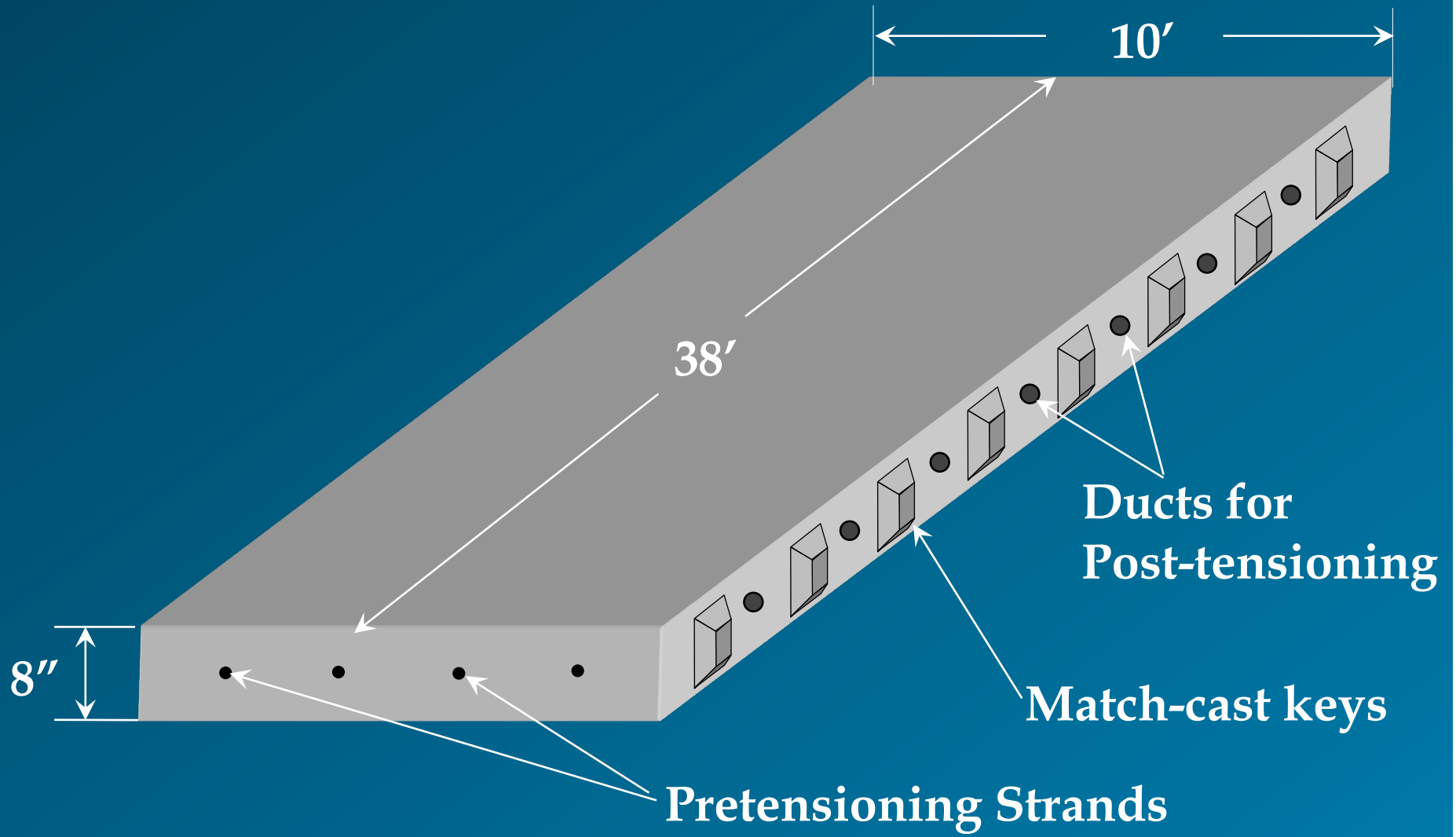
- 8” Full Depth precast panels

  - Base Panels
  - Joint Panels
  - Central Stressing Panels

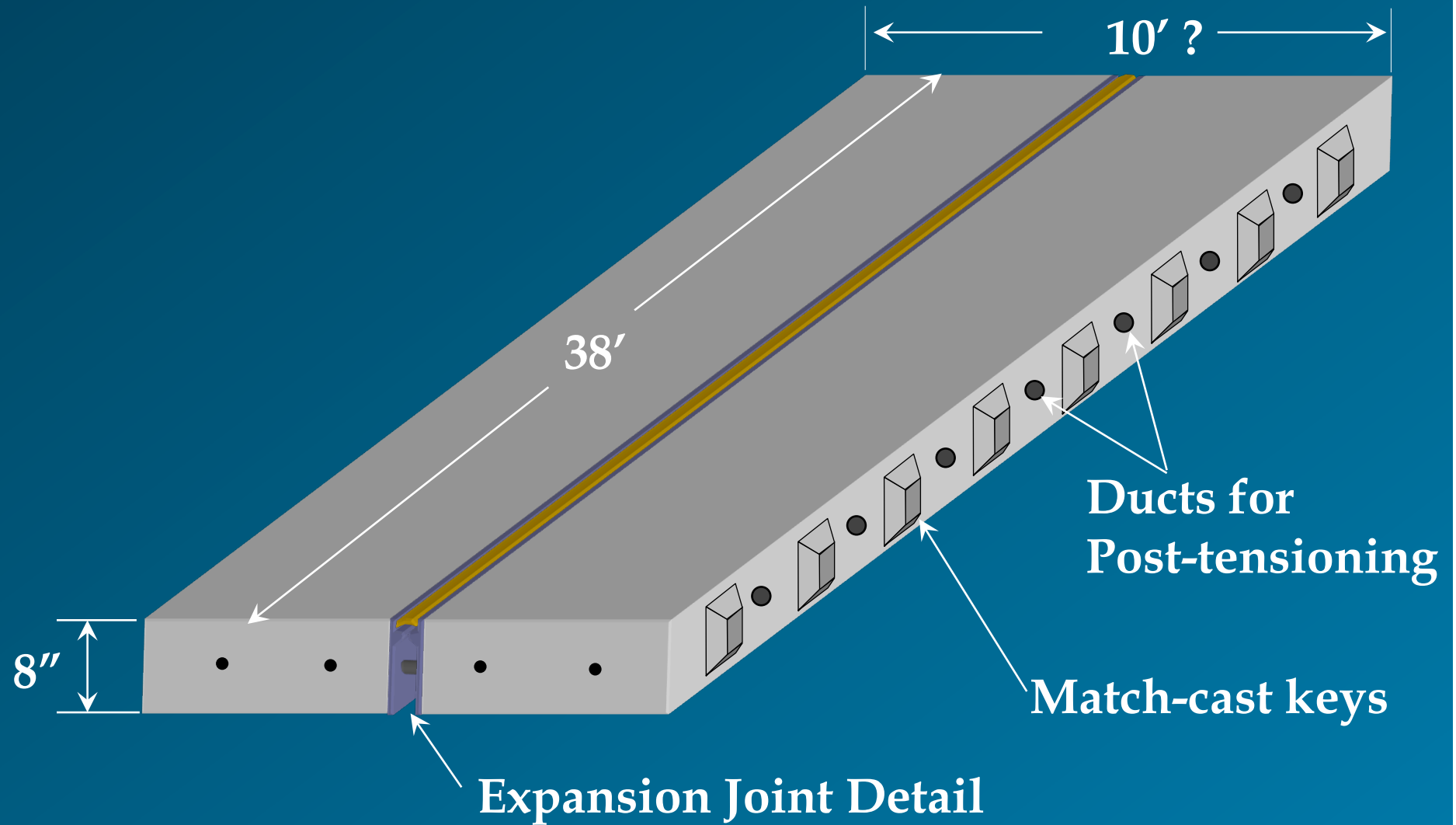
Concept for Precast Pavement

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

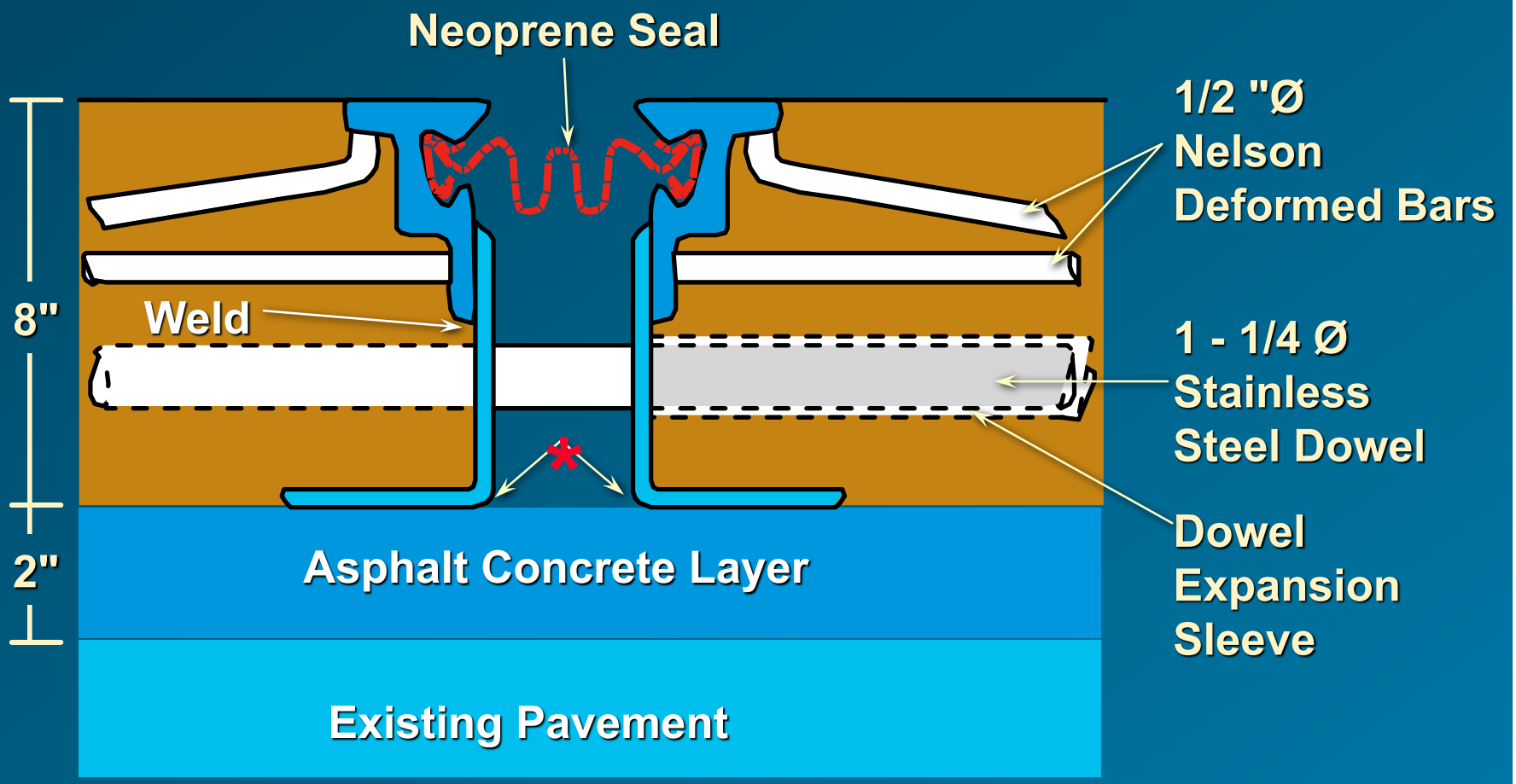
Base Panel


10′
38′
8″
Ducts for
Post-tensioning
Match-cast keys
Pretensioning Strands

Joint Panel

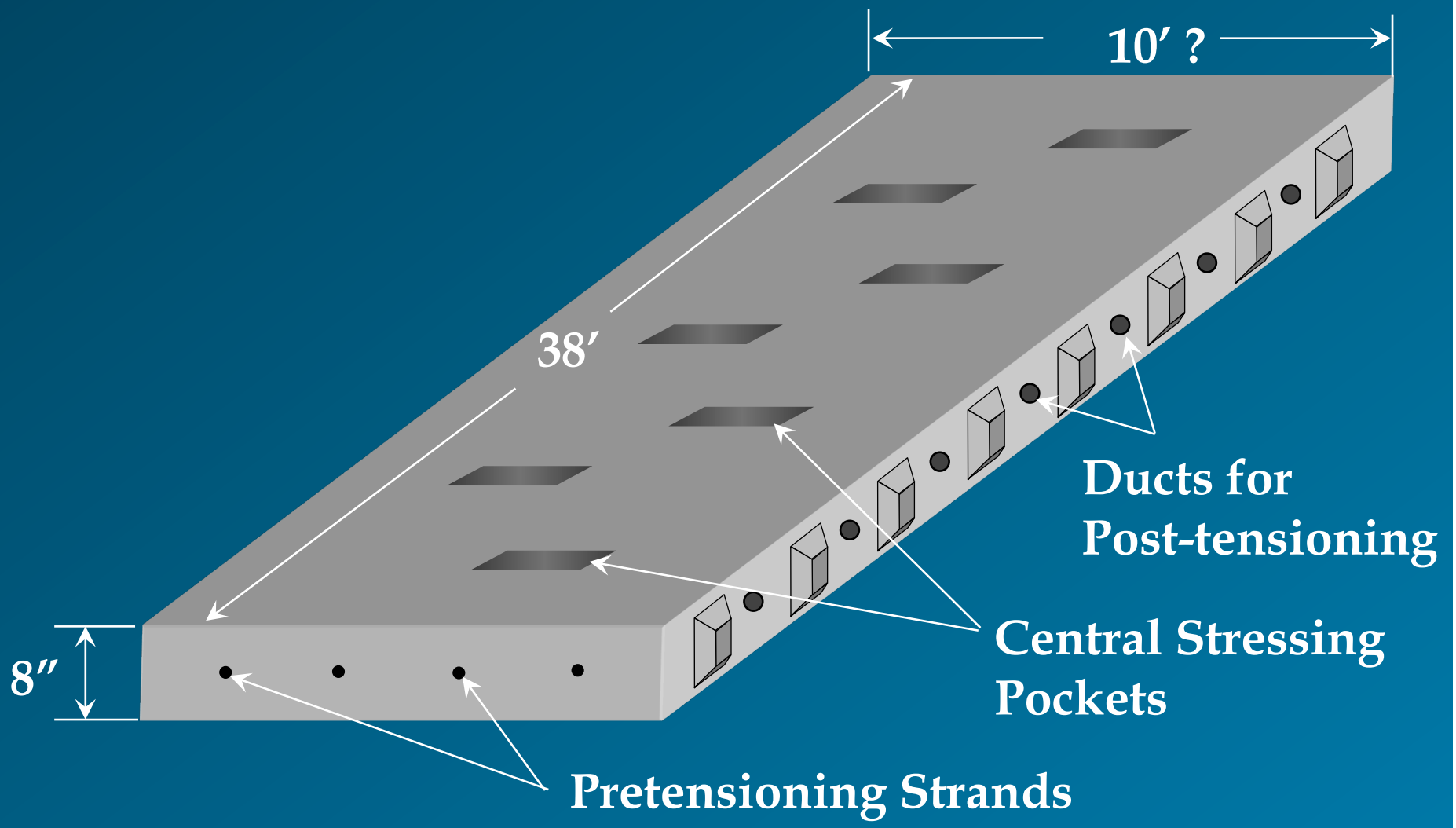

10′ ?
38′
8″
Ducts for
Post-tensioning
Match-cast keys
Expansion Joint Detail

Expansion Joint Detail (Joint Panel)



* L4 x 3 x 1/4

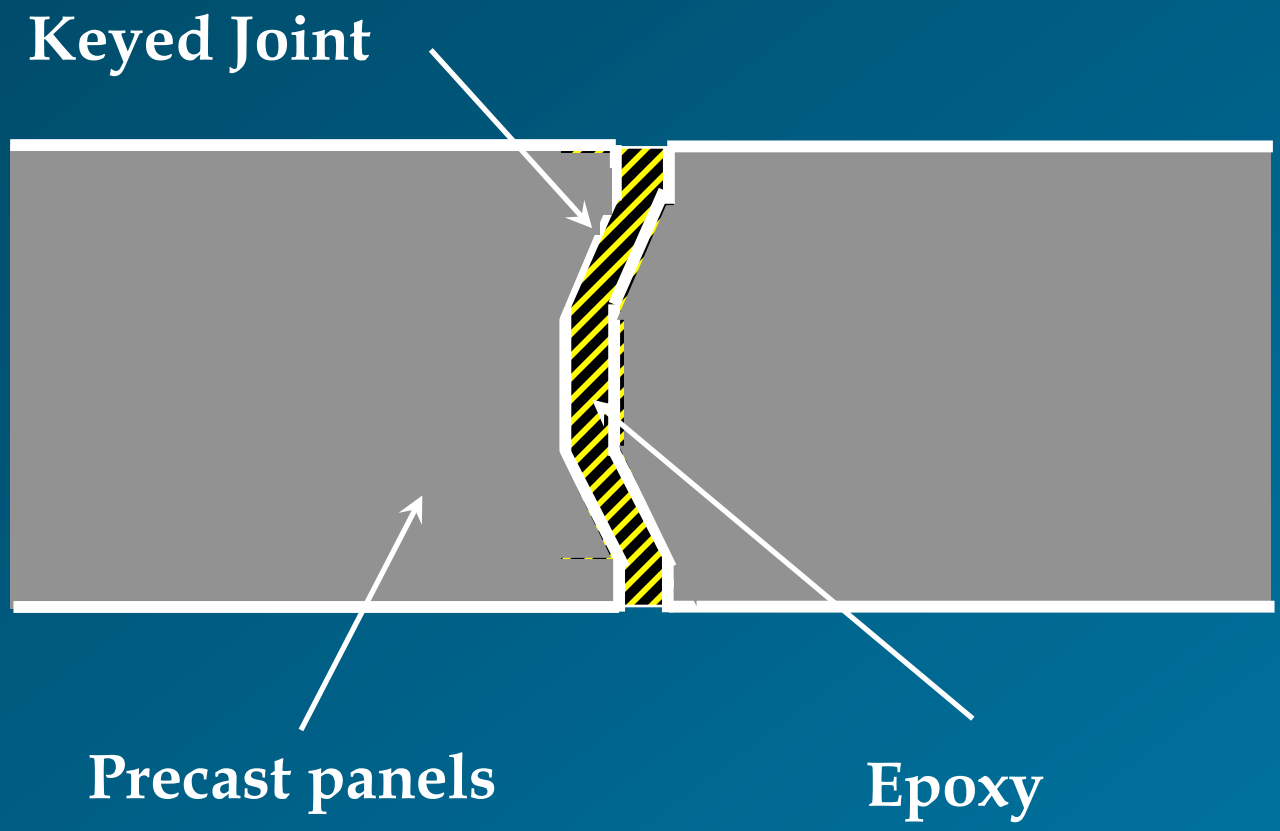
Central Stressing Panel



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

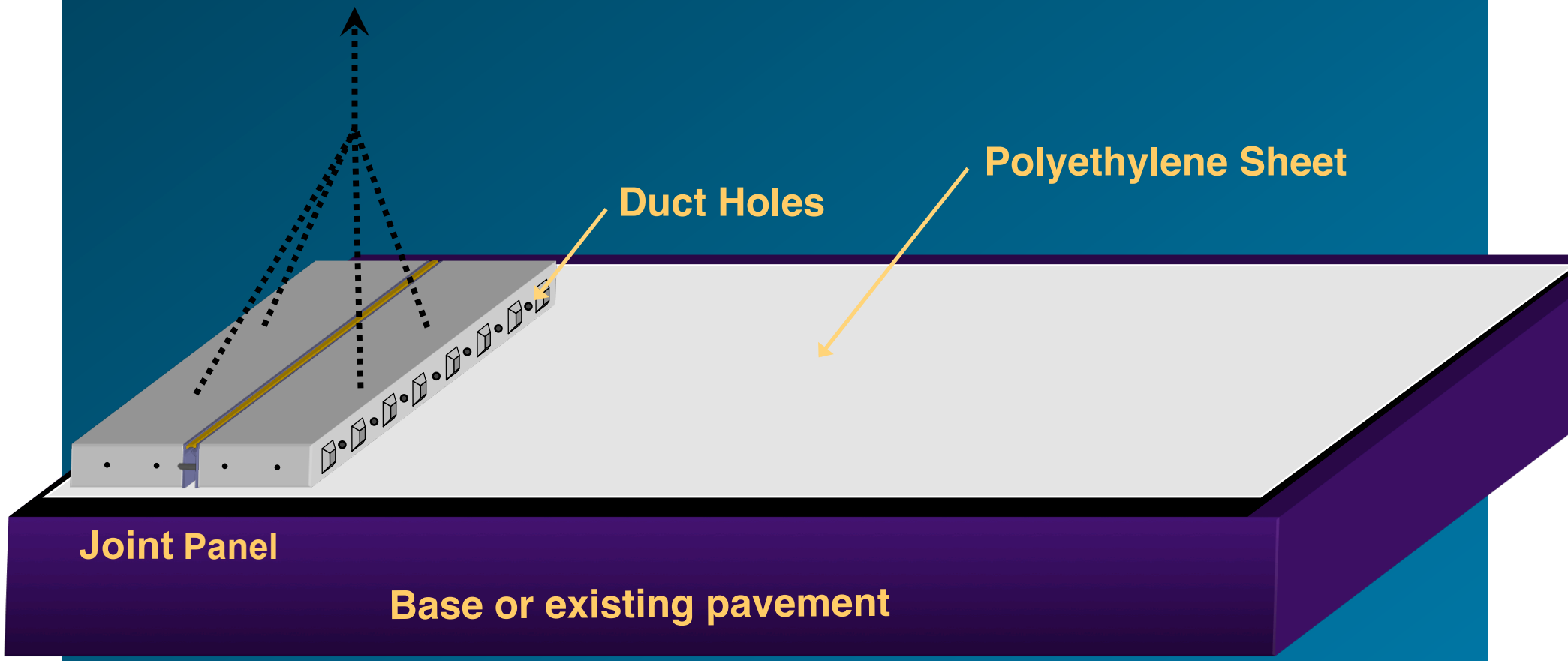
Joint Between Adjacent Panels



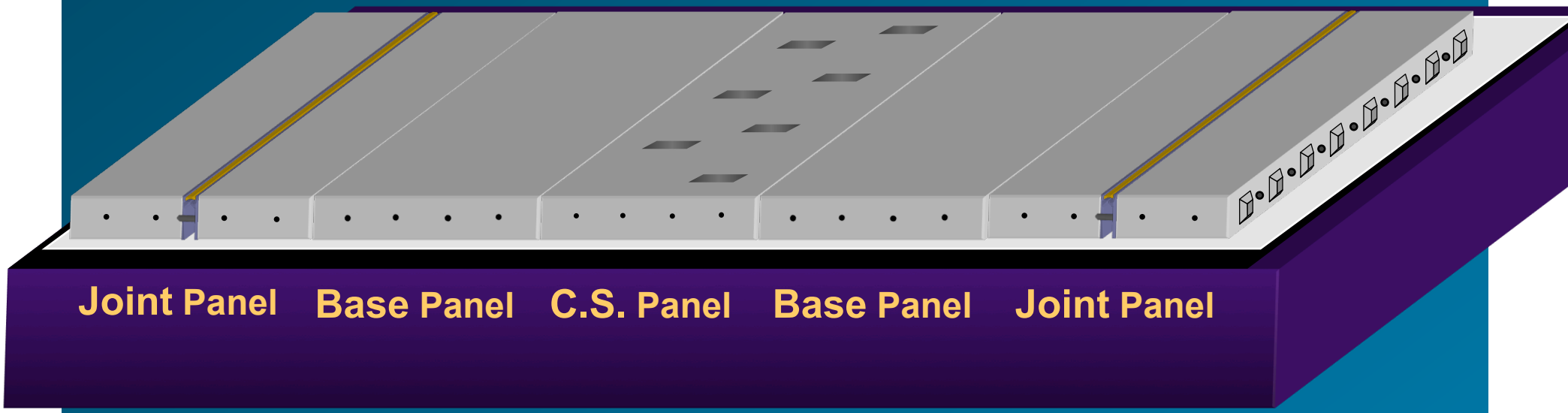
Concept for Precast Pavement

- 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



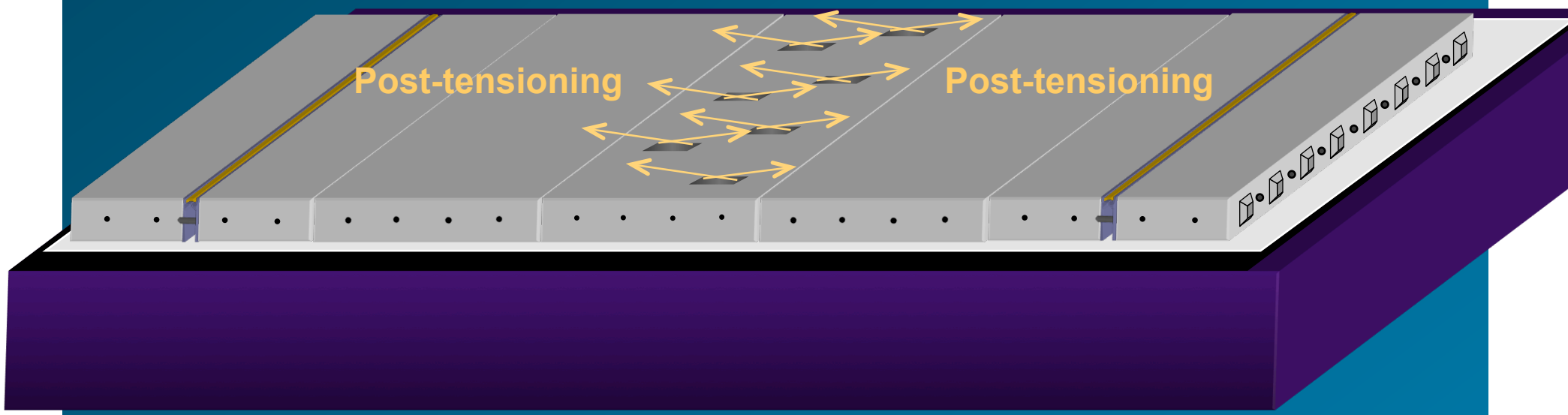
Panel Assembly



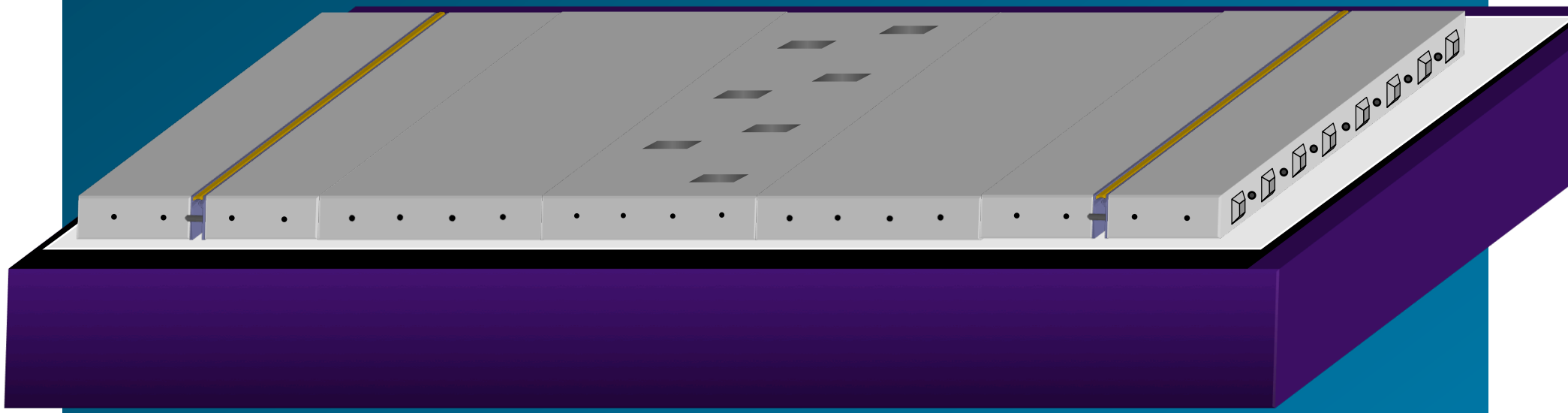
Concept for Precast Pavement

- 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



Panel Assembly

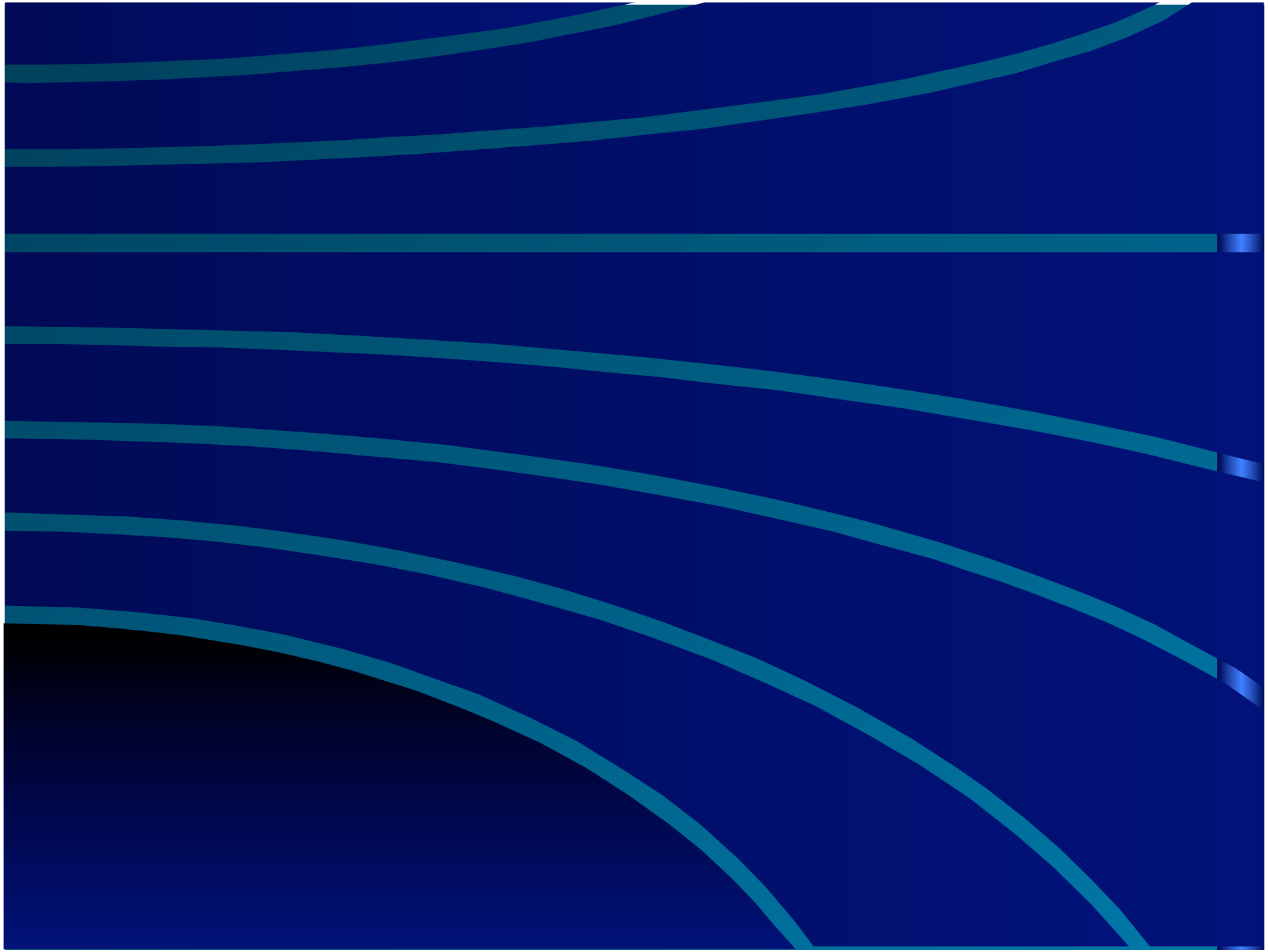


Feasibility Conclusions

- 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