SHRP2 Project R05
Precast Concrete Pavement Technology

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The Problem – Pavement Rehab

A very serious issue – coast to coast

- Need to rehab AC & PCC pavements AQAP
- Versus
- Traffic delays
- Durability concerns

- **Shorter delays & shorter service life or Longer delays & longer service life vs.**
- **Shorter delays & longer service life**

SHRP 2 – RAPID RENEWAL

The objective of SHRP 2 highway renewal program is to achieve renewal that is **performed rapidly, causes minimum disruption, and produces long-life facilities**.

Shorter life rehabs cannot be accepted as the price of rapid renewal.

A tactic is to ***minimize field fabrication effort*** *and* **speed up** the on-site construction phase of the work that actually impacts traffic.

This can be achieved using modular pavements.

SHRP2 Project R05: Modular Pavement Technology

Prime Contractor: FUGRO CONSULTANTS
Budget: $1,000,000
Duration: 36 months
Start Date: February 2008

Project objective is to develop tools for public agencies to use for the design, construction, installation, maintenance, and evaluation of modular pavement systems.

By necessity, the primary focus of this study will be precast concrete pavements.

R05. Modular Pavement Technology

Anticipated Products

- Synthesis of performance of constructed modular pavement projects
- A feasibility study on the potential uses of modular pavement systems for specific rapid renewal applications.
- Generic Modular Pavement Design Procedures.
- Guidelines and model specifications for construction, installation, and acceptance criteria

Modular Pavement Systems
A Definition

- Modular pavement systems are fabricated or assembled off-site, transported to the project site and installed on a prepared foundation (existing pavement or re-graded foundation).

- The system components require **minimal field curing or time** to achieve strength before opening to traffic.

- These systems are primarily used for **rapid repair, rehabilitation and reconstruction** of asphalt and concrete pavements.

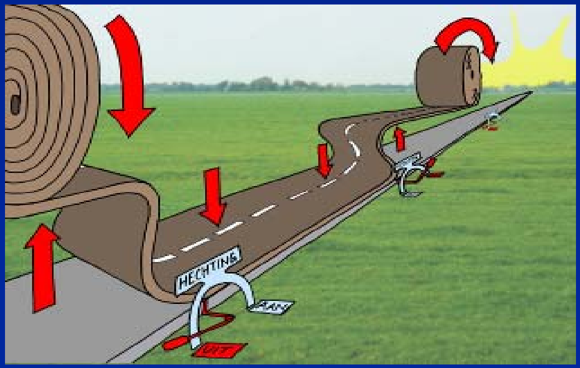
Modular Pavements – Precast Concrete

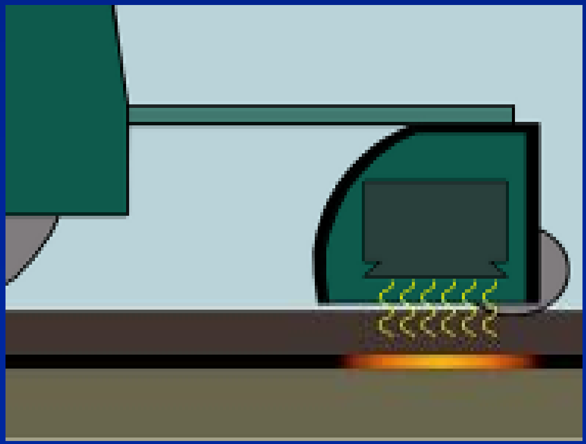
- Intermittent repairs – plain concrete panels
  - Full-depth or full panel replacement

- Continuous Applications (longer length/larger area) – Rehab of ACP or PCCP; bridge approach slabs
  - Conventional jointed systems
  - Prestressed panels – fewer active joints

Modular Pavements – Rolled Flexible

- Only one known system - RollPave, developed in the Netherlands
  - Thin, rollable surface of porous asphalt with a thickness of approx. 3 cm
  - Accelerated load testing conducted in the laboratory
  - One test section installed

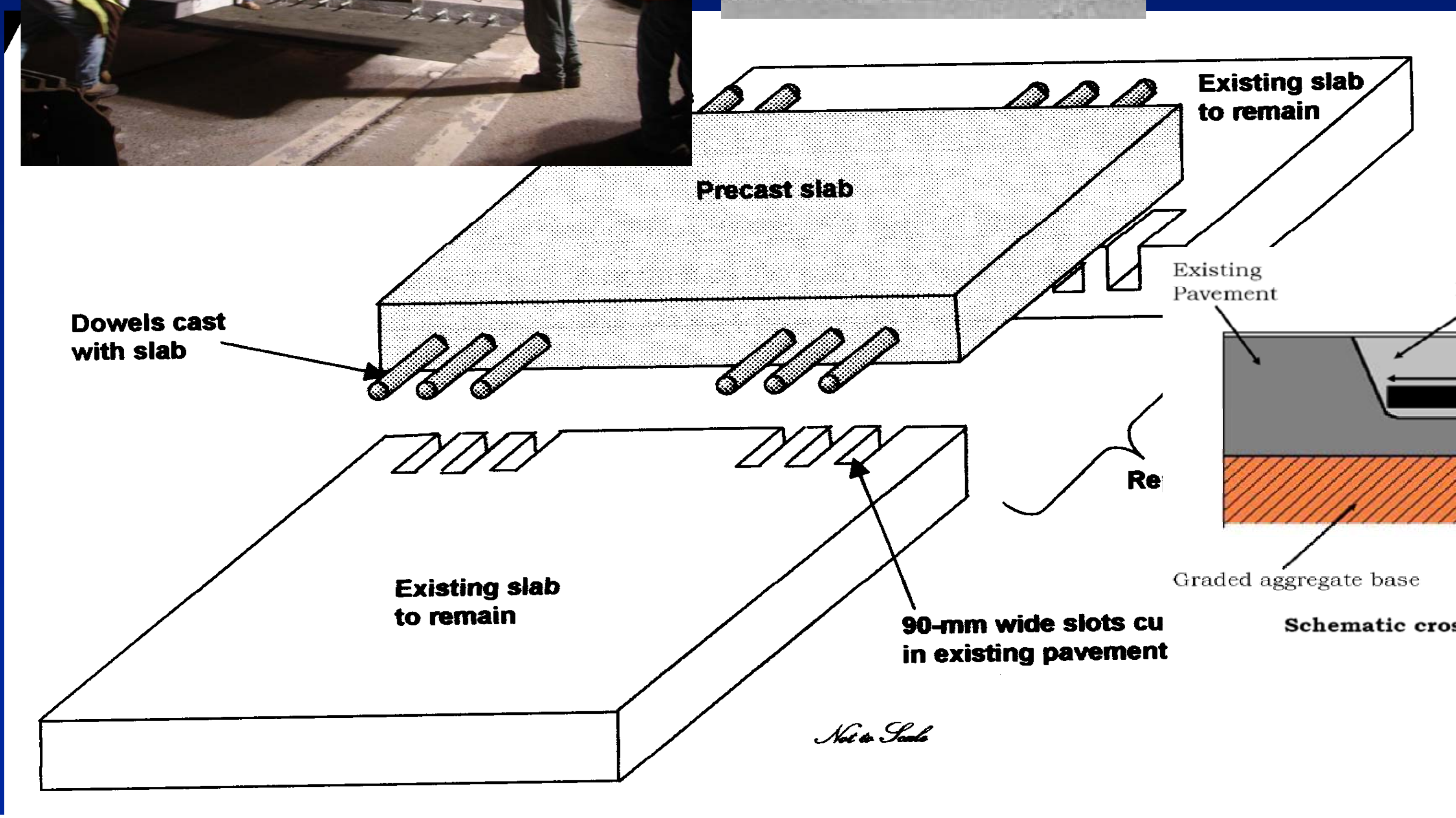


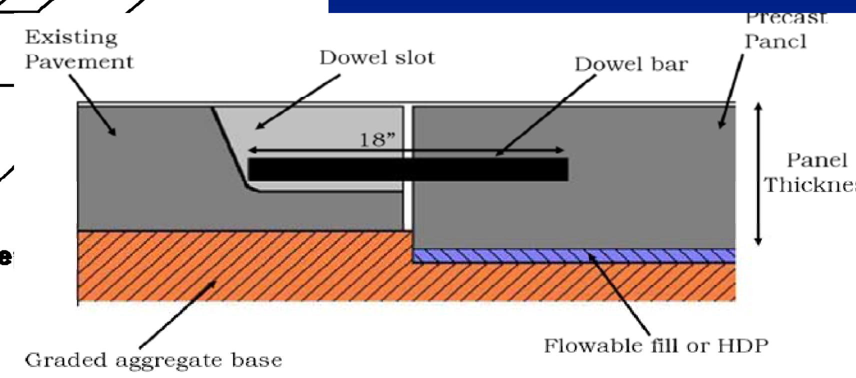



FHWA/Industry Initiatives – 2000 0n

- FHWA sponsored
  - o Post-tensioned precast concrete pavement (U of Texas)
  - o Full-depth precast repair system (MSU)
- Industry developed
  - o Fort Miller Super Slab system
  - o Uretek Stitch-in-Time system
  - o The Kwik Slab system
- Other systems
  - o PANY/NJ – test sections at La Guardia Intern. Airport
  - o Non-US: Japanese, European, Russian

Intermittent (Repair) Applications

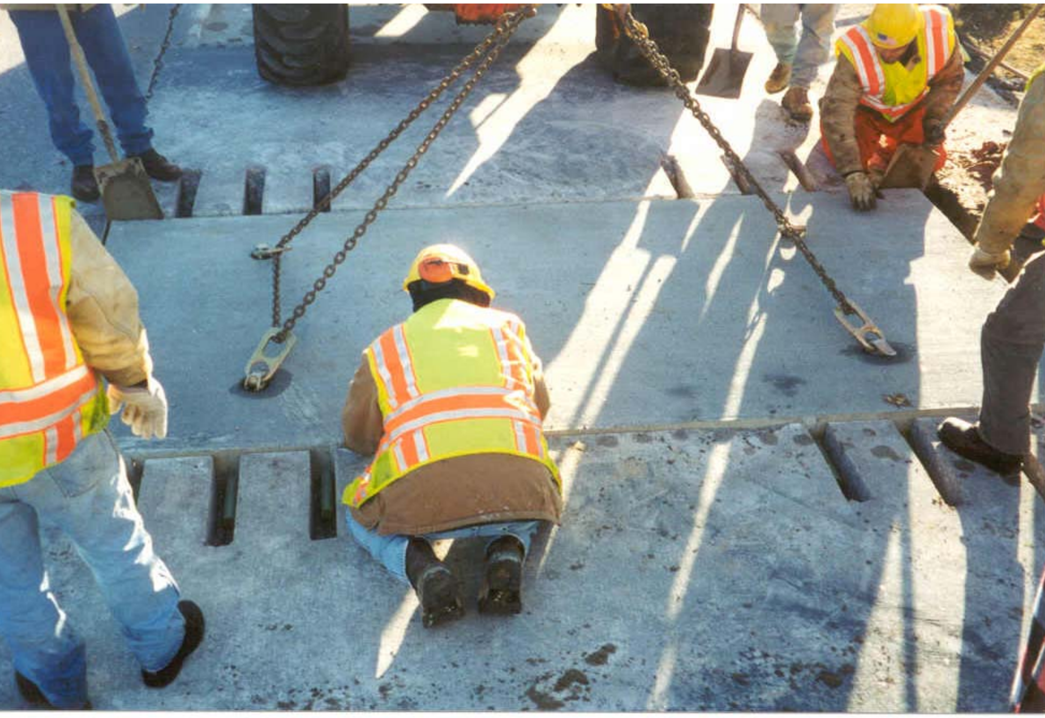




Schematic cross-section of the dowel assembly

The Full-Depth Repair System (MSU)

(Development funded by FHWA CPTP)



Completed Repair
Ready for traffic in 3 hours

NJ I-295 (June 2008)

Intermittent Repairs using the Super Slab System

Project Details

- 50+ years long jointed reinforced concrete pavement
- 78 ft panels - expansion joints and cracks deteriorated
- Large no. of panels replaced
- Length: 8, 10, 12, 14 ft long, full lane width, thickness: 9 in.
- Night-time placement – 8 PM to 6 AM
- 8 to 16 panels replaced per night
- Process:
    - Sawcut repair boundaries in advance
    - Night of repair – remove damaged panel; prepare base; drill dowel bar holes in existing adjacent panels; insert dowel bars; install precast panel
    - Next night – patch dowel slots; underseal panel

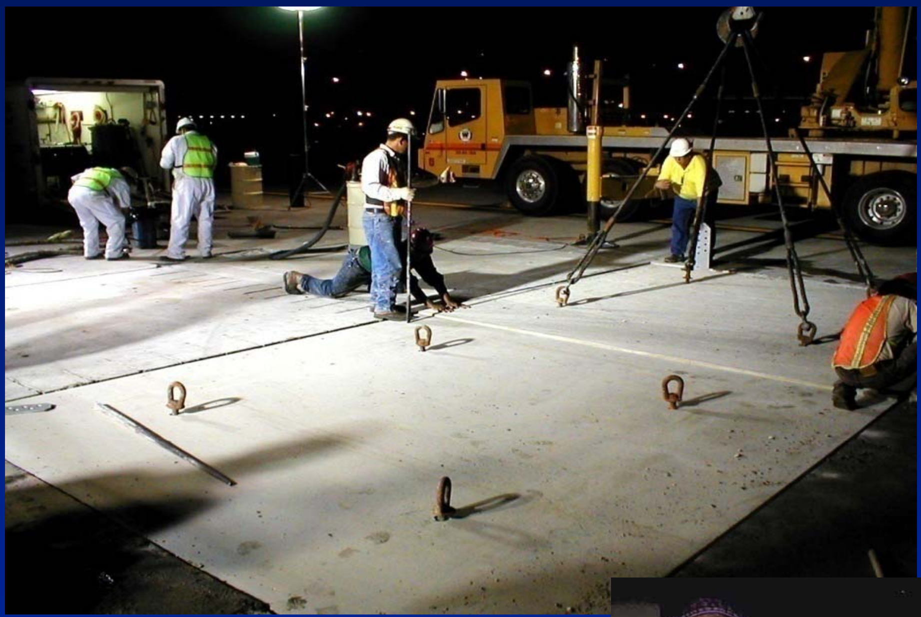
NJ I-295 (June 2008)

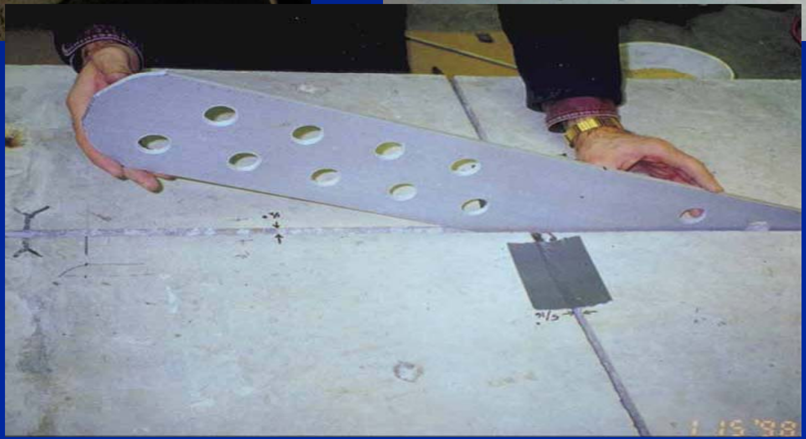
Intermittent Repairs

NJ I-295 (June 2008)

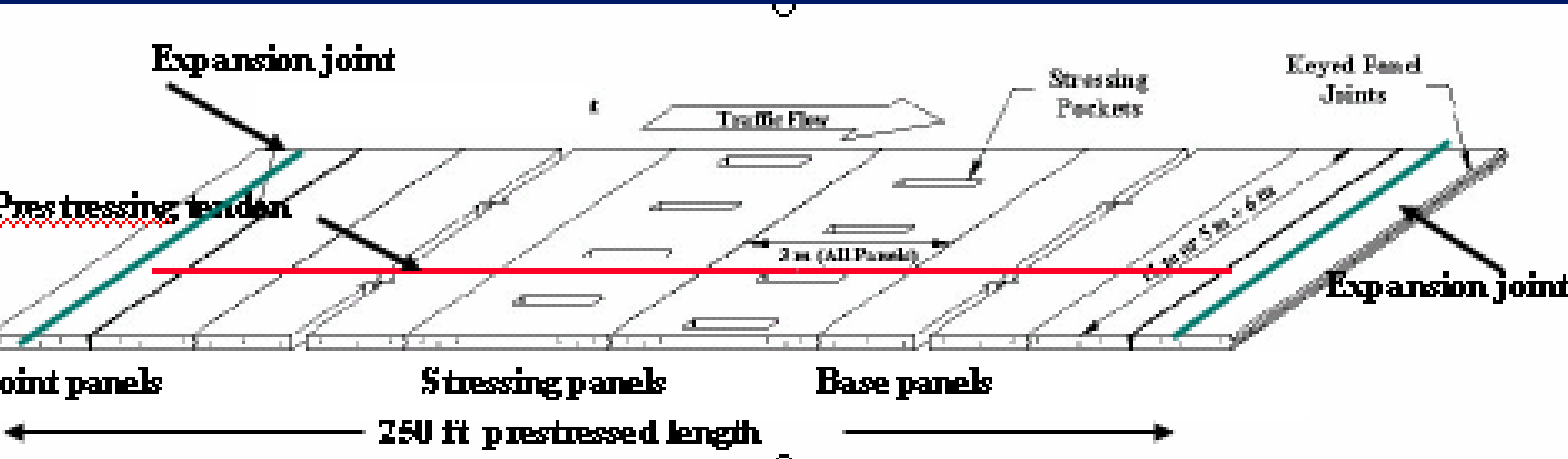
Intermittent Repairs

The Stitch-in-Time System





Prestressed Precast Concrete Pavement (PPCP) System



2002: FHWA Pilot Project in Georgetown, TX

2004 - 2006 – Demo projects in CA, MO, IA

Typical Design Details

- 2-lane wide plus shoulders
- Panel size: upto 34ft wide, 10 ft long, t ~ 8 in.
- Panel types:
  - Base, joint & central stressing panels (original)
  - Base & joint stressing panels (Missouri)
- Tongue & groove transverse epoxied joint
- Expansion joints @ ~ 250 ft
- Base
  - AC base – Texas; CTB - California
  - PATB – Missouri; Crushed limestone base - IA
- Poly sheet over base
- Prestress force – residual prestress at mid-point

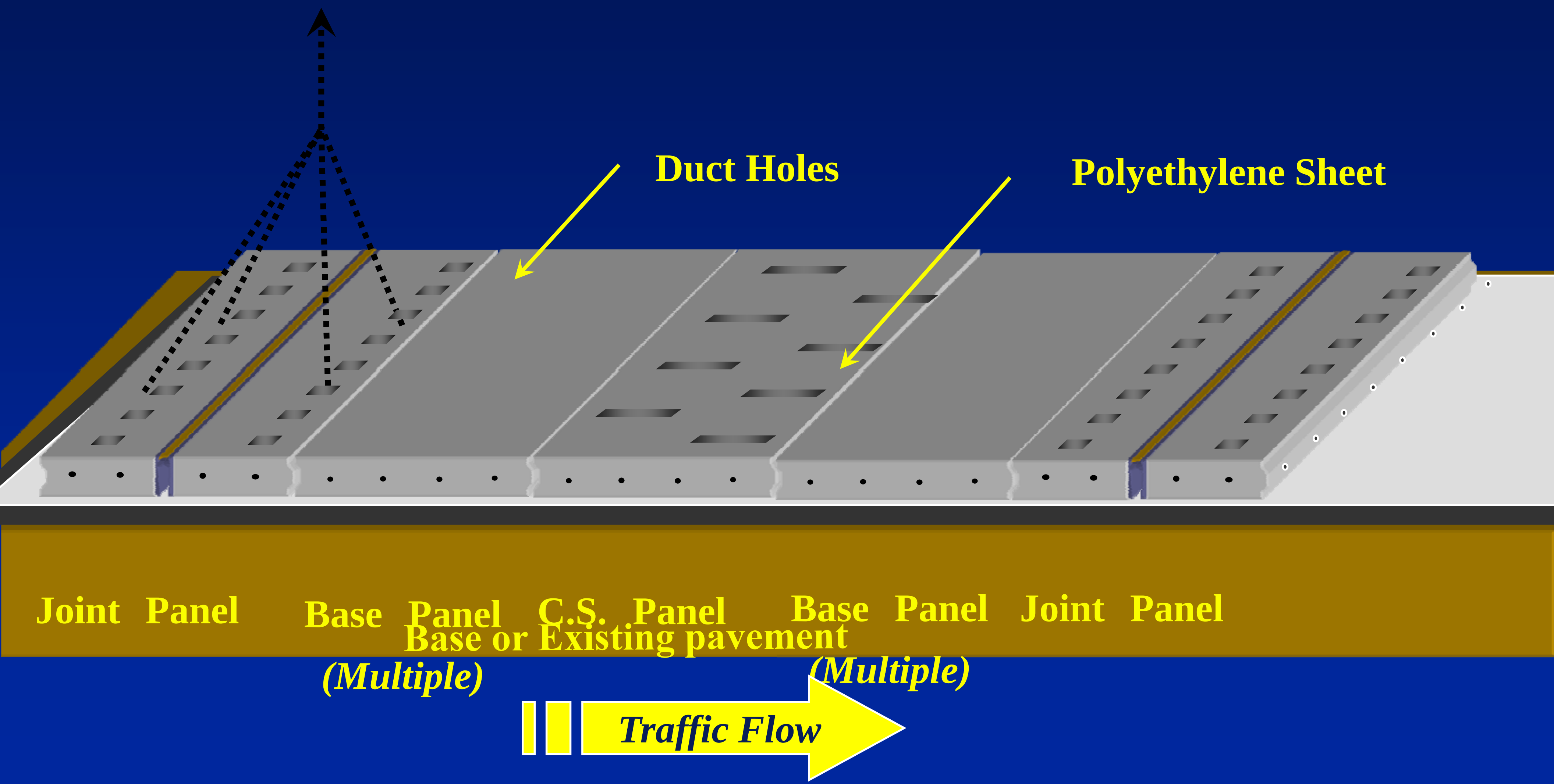
Overall Process

- Fabricating precast panels at plant
  - Controlled process
  - Better quality control, better durability
- Transporting panels to the site
  - Need sufficient no. of trucks
- Removal of old pavement/preparing base
  - Or, place as an overlay
- Installing panels on finished base
  - Over a pre-placed poly sheet

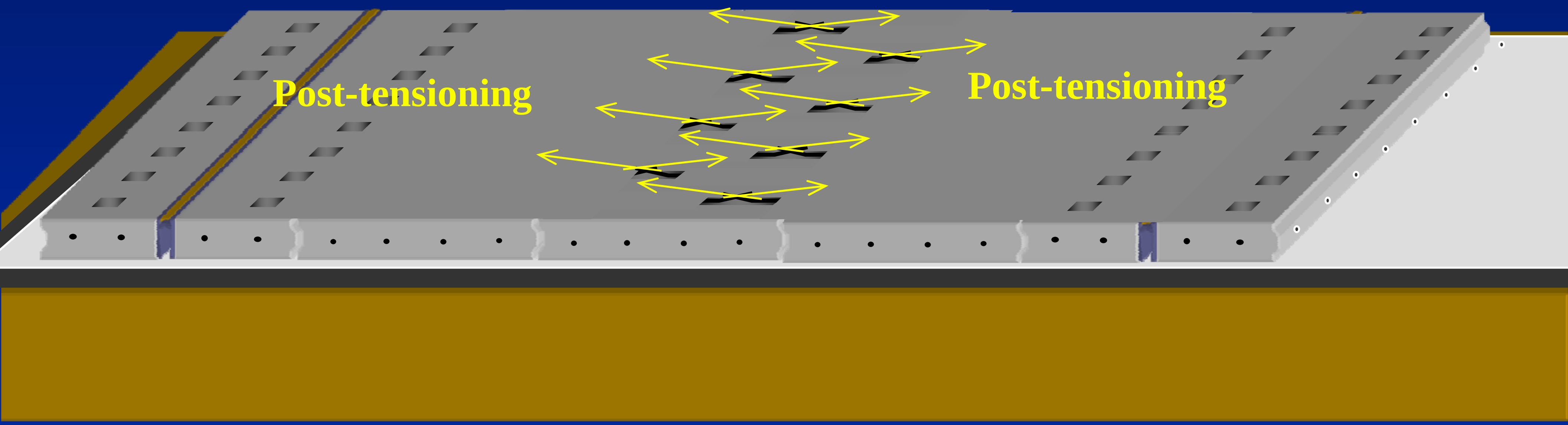
Overall Process

- Interconnecting panels
  - Good fit (keyway use)
- Post-tensioning panels
  - 15 mm diameter 7-wire monostrand tendons
  - 75% of ultimate load applied
  - Residual prestress at mid-point
- Grouting post-tensioning ducts
- Injecting bedding grout to firmly seat panels, if necessary

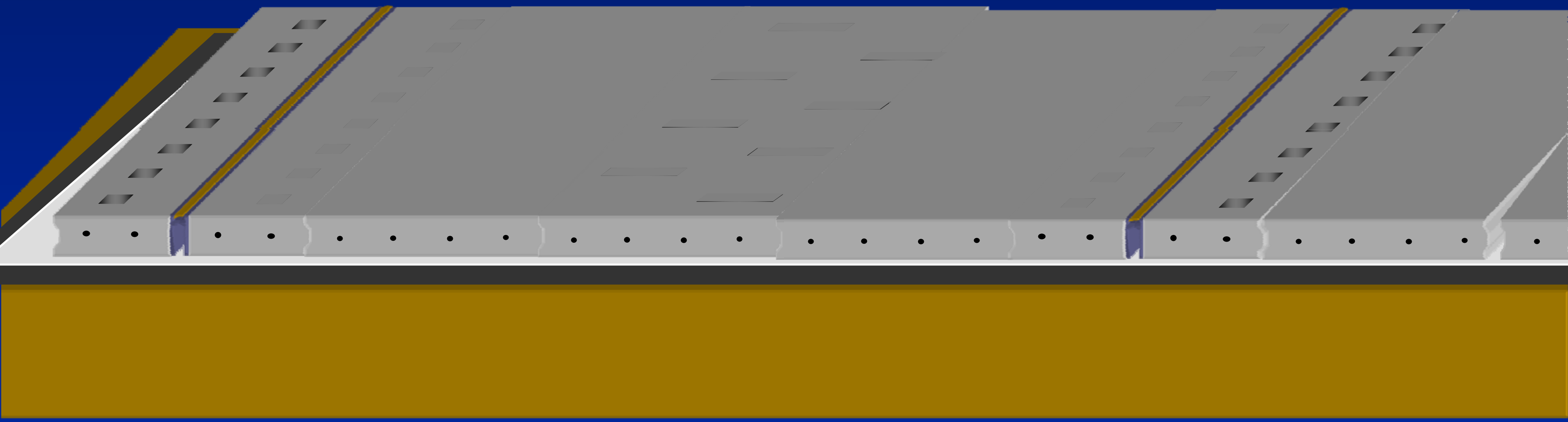
Panel Assembly



Panel Assembly



Panel Assembly



Completed PPCP Projects

Georgetown, Texas



Two pavement lanes plus inside and outside shoulders

Completed PPCP Projects

Los Angeles (El Monte), California

Added two new traffic lanes and shoulder
- nighttime

Completed PPCP Projects

Sikeston, Missouri

Replaced two pavement lanes and added integral shoulders on both sides

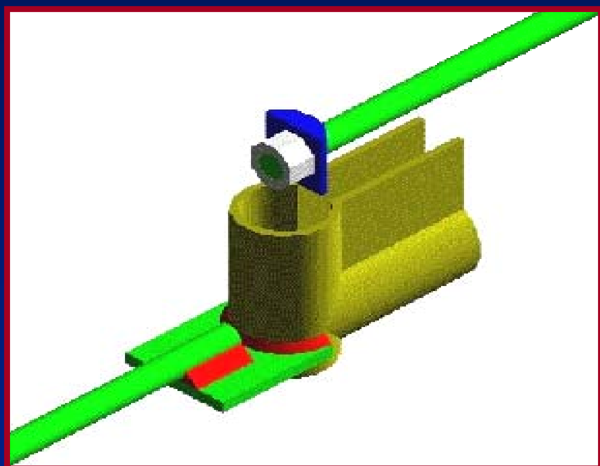
Completed PPCP Projects

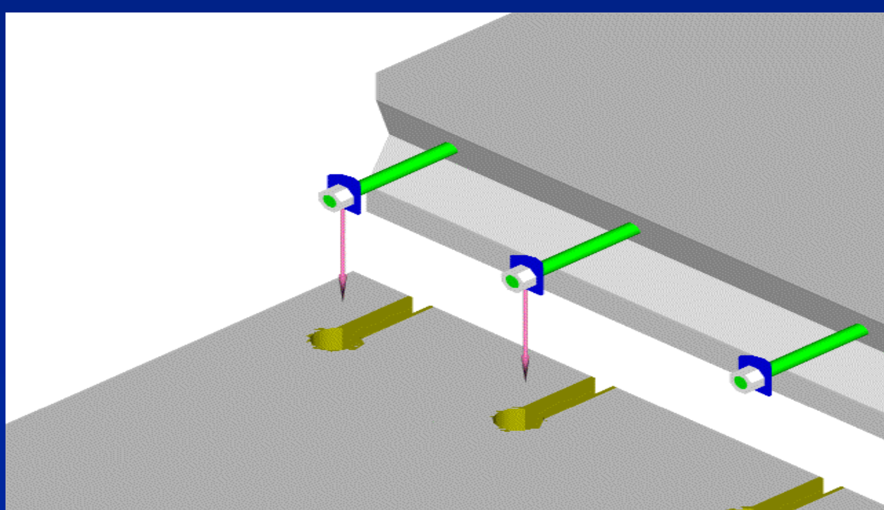
Sheldon, Iowa

Two-lane approach slabs anchored to integral abutment of new bridge

The Super Slab System

The Kwik Slab System





The PANY/NJ System (Airport)

2 test sections – 16 in. & 12 in. prestressed panels – 25 long by 12.5 ft wide

Other Experience

- The Netherlands – The Modie slab system
- Japanese - for highway, urban intersections, airport and tunnels
- Russian (Soviet Union) - precast pavements in Russia & at air bases in Afghanistan
- French - Removable hexagonal panels in urban areas

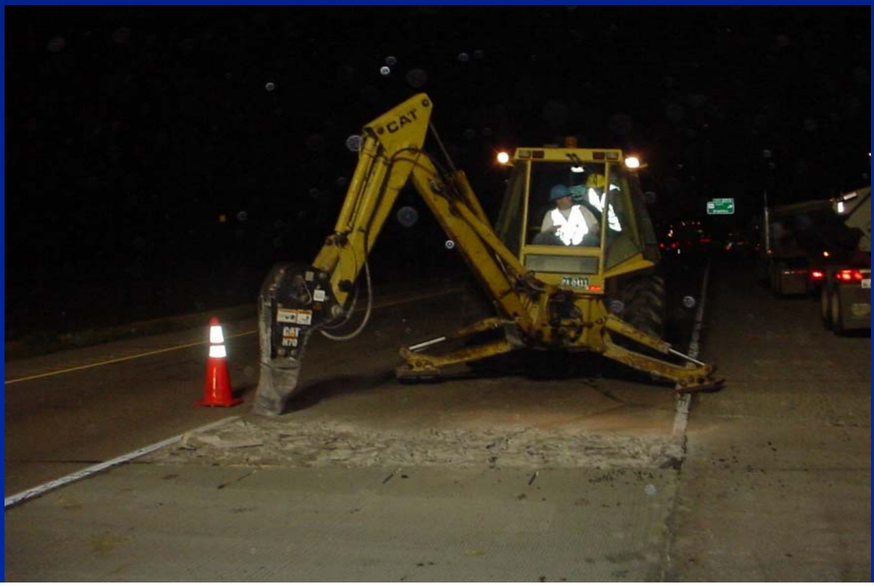
Precast Pavement Performance

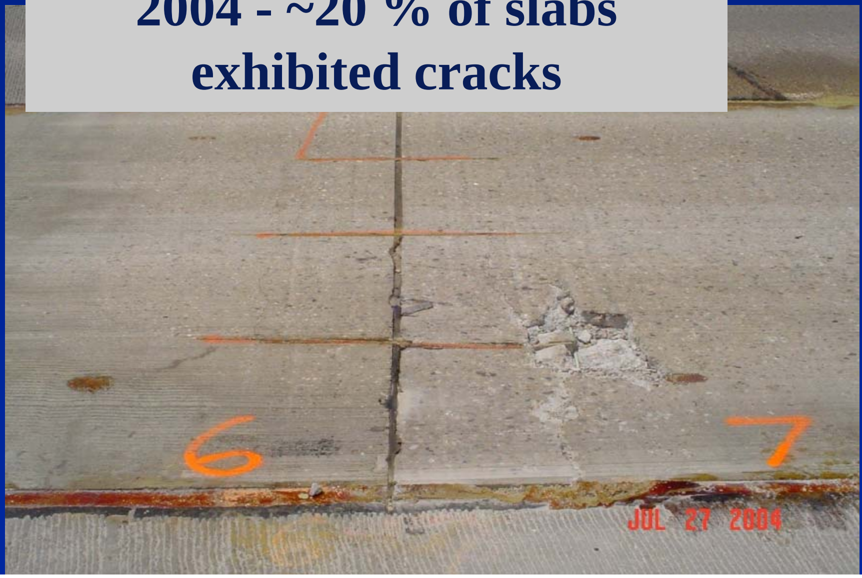
- In-service systems
  - o Highways
    - PPCP – no issues
    - Super Slab – no issues
    - Stitch-in-Time – poor performance in longer lengths
    - Kwik Slab – only limited applications in Hawaii
  - o Airports
    - PANY/NJ – the two test sections performing well
  - o Accelerated load testing – Super Slab – very good performance

Colorado's I-25 (2003)
(FHWA CPTP Task 7 Evaluation)

Project Details:

- Uretek process
- Total Slabs Replaced = 450; 18 Locations
- Length: 12'-20'
- Panel Thickness: 5.5'-7.25'





2004 - ~20 % of slabs exhibited cracks

Gaps in Technology

- Optimize system design – thickness, connectivity at joints, load transfer, prestressing, bedding
- Simplify fabrication/installation process
- Improve fabrication/installation process – to ensure that systems can be fabricated/installed to high quality standards
- Improve materials/components – to ensure long-term durability of materials –load transfer systems, grout systems
- **MOST CRITICAL – BRING COST DOWN**

Current Activities

- AASHTO Technology Implementation Group (TIG) – generic guidelines developed
- FHWA Highways for Life program
  - Adopted precast pavement technology as a ready to implement technology
- Strategic Highway Research Program (SHRP) 2 Project R05
- ACI, PCI, NPCA, TRB – Developing guidelines & technology update reports
- Several production projects in the US and Canada
- Several showcase/demo activities during 2008/2009
  - NJDOT – October 14/15

AASHTO TIG

Promoting Use of Precast Pavements for Rapid R&R

Developed following documents (June 2008)

Generic Specification for
Precast Concrete Pavement System Approval

Guidance and Considerations for the Design of
Precast Concrete Pavement Systems

Generic Specification for Fabricating and Constructing
Precast Concrete Pavement Systems

Summary

- **Precast pavement technology – ready to implement**
  - Still lots of room for innovations
- Aggressive T2 effort underway by FHWA /AASHTO-TIG, creating market demand.
- Initial costs are higher compared to conventional procedures
  - However, rapid process and better durability may offset higher initial costs
- Some technology gaps remain - being addressed over the next few years
- **A SUCCESSFUL PRECAST PAVEMENT SYSTEM REQUIRES SOUND PAVEMENT ENGINEERING**


Thank You!