Innovative Concrete Preservation Practices Used in California

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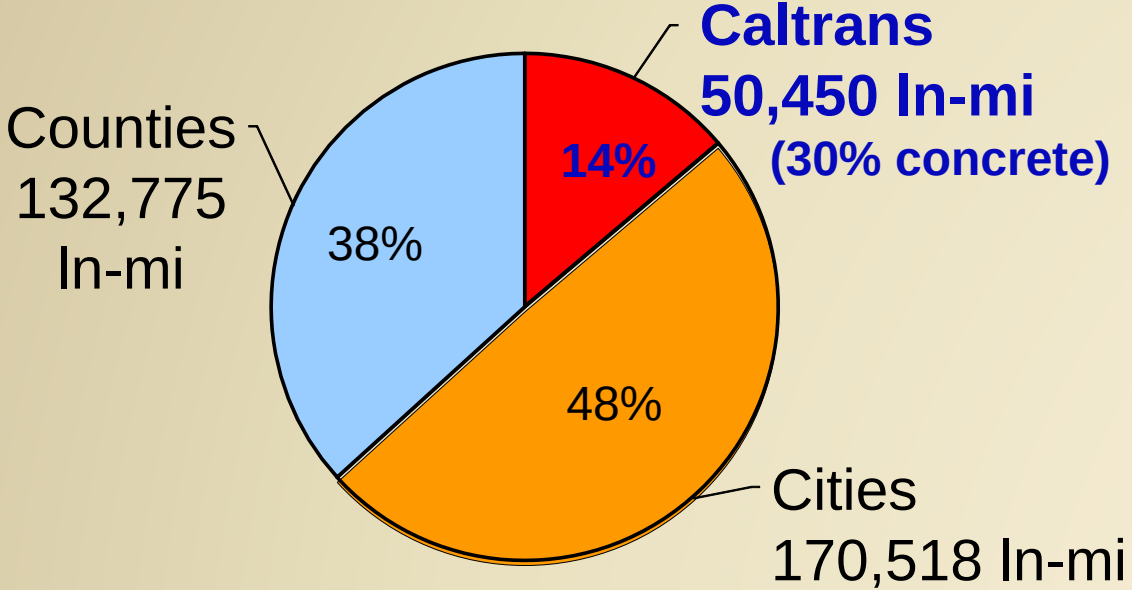
California Pavement Inventory



Total state network: 353,743 ln-mi

Financial Breakdown

Caltrans Pavement Projects:

Last 4 yrs: $4.0 billion /16,500 ln-mi

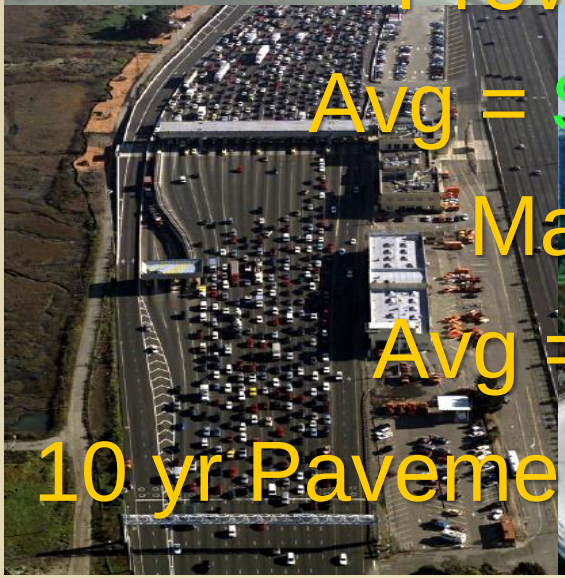
Preventive Maint:

Avg = $104,000/ ln-mi

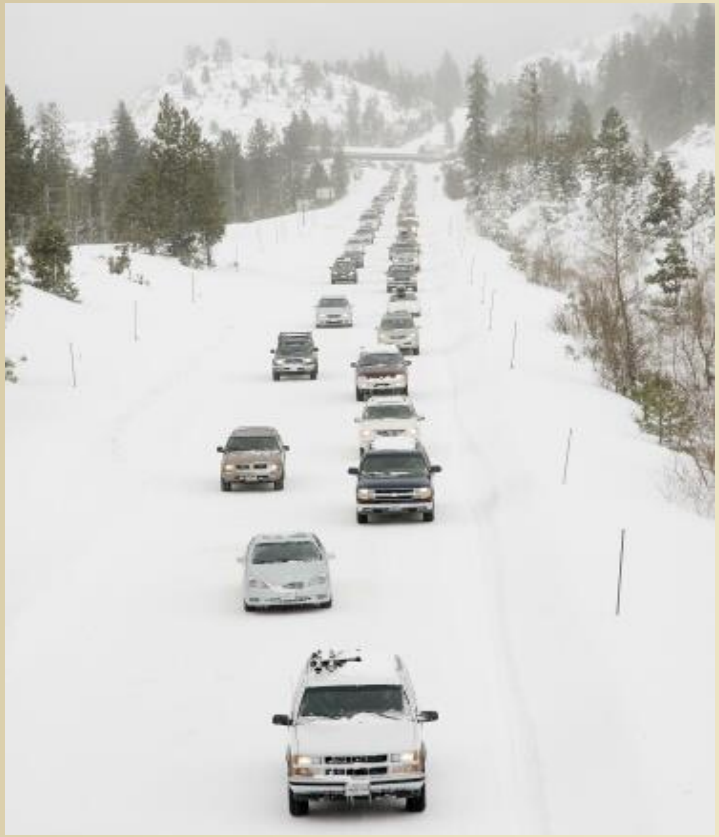
Major Rehab:

Avg = $1 mil/ ln-mi

10 yr Pavement Needs = $2.0 bil / yr



Traffic & Climate



Cracking

- 1st Stage:

Single longitudinal or transverse

- 3rd Stage:

Intersecting, 3 or more pieces

Typical Concrete Repair Strategies

Distress Level	Strategies
❑ Preventive Failed joint seal 3rd stage < 3%; spalling	➢ Seal joints ➢ Slab replacement ➢ **Spall repair**
❑ Corrective IRI >170 Faulting > ¼” 3rd stage: 3% - 10%	➢ Grind ➢ **DBR** ➢ **Slab replacement**
❑ Rehabilitation 3rd stage > 10 or 20%	➢ Lane replacement ➢ CSOL

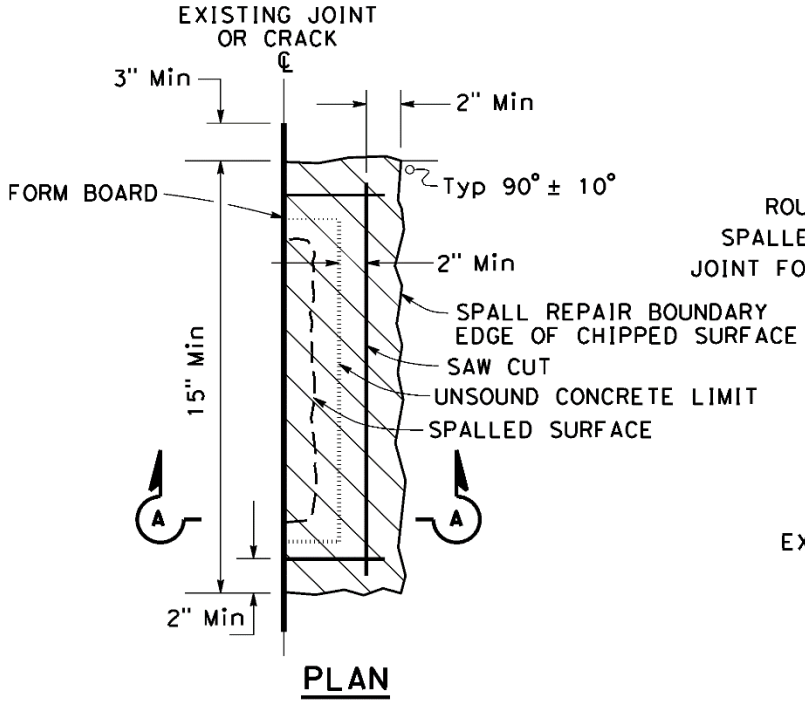
Preventive Strategies: Spall Repair

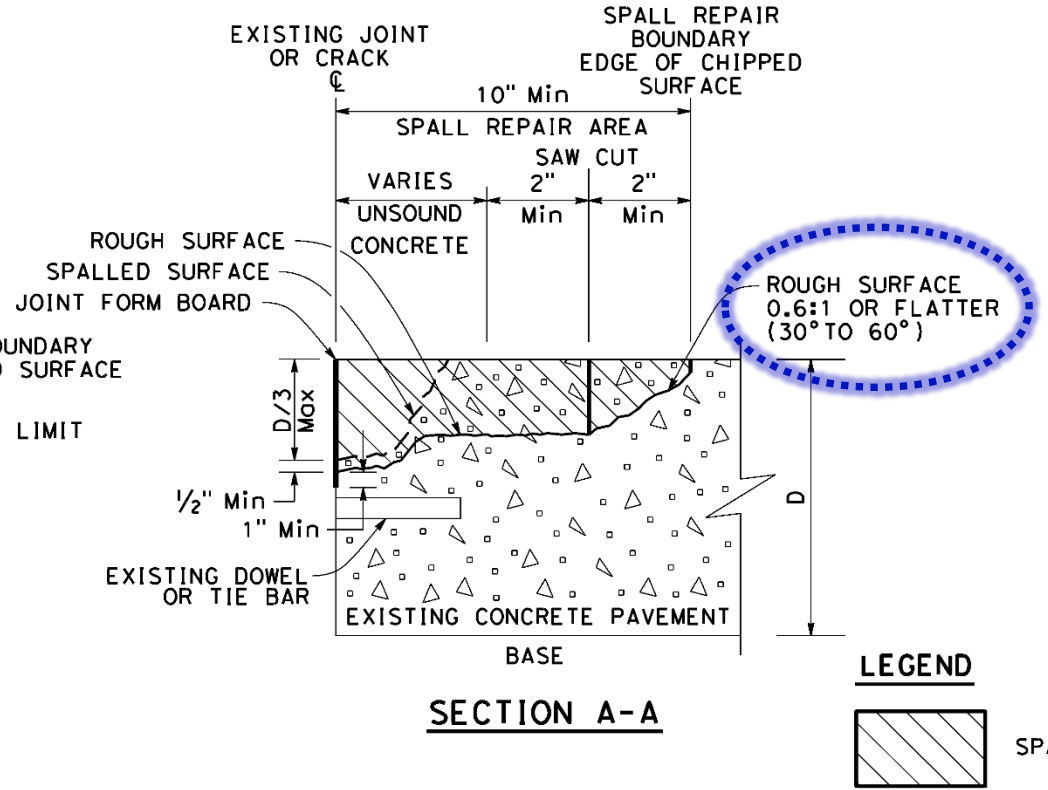
GUIDANCE

http://www.cptechcenter.org/technical-library/documents/PDR_guide_Apr2012.pdf

Preventive Strategies

SPALL REPAIR





Spall Repair

Spall Repair

Spall Repair

Spall Repair

Future Innovation

- Developing an Authorized Materials List to allow alternative spall repair materials on contract projects

Spall Repair

Potential Authorized Materials Lists

Polymeric	Cementitious	Hot-Applied
• Polyester • Polyurethane • Epoxy	• Portland cement • Modified high-alumina • Magnesium phosphate? • Pozzolanic	• Polymer-modified resins • Use aggregate extenders • Require specialized placement equipment

Corrective Strategies

Dowel Bar Retrofit

- Limited given age of freeway sys

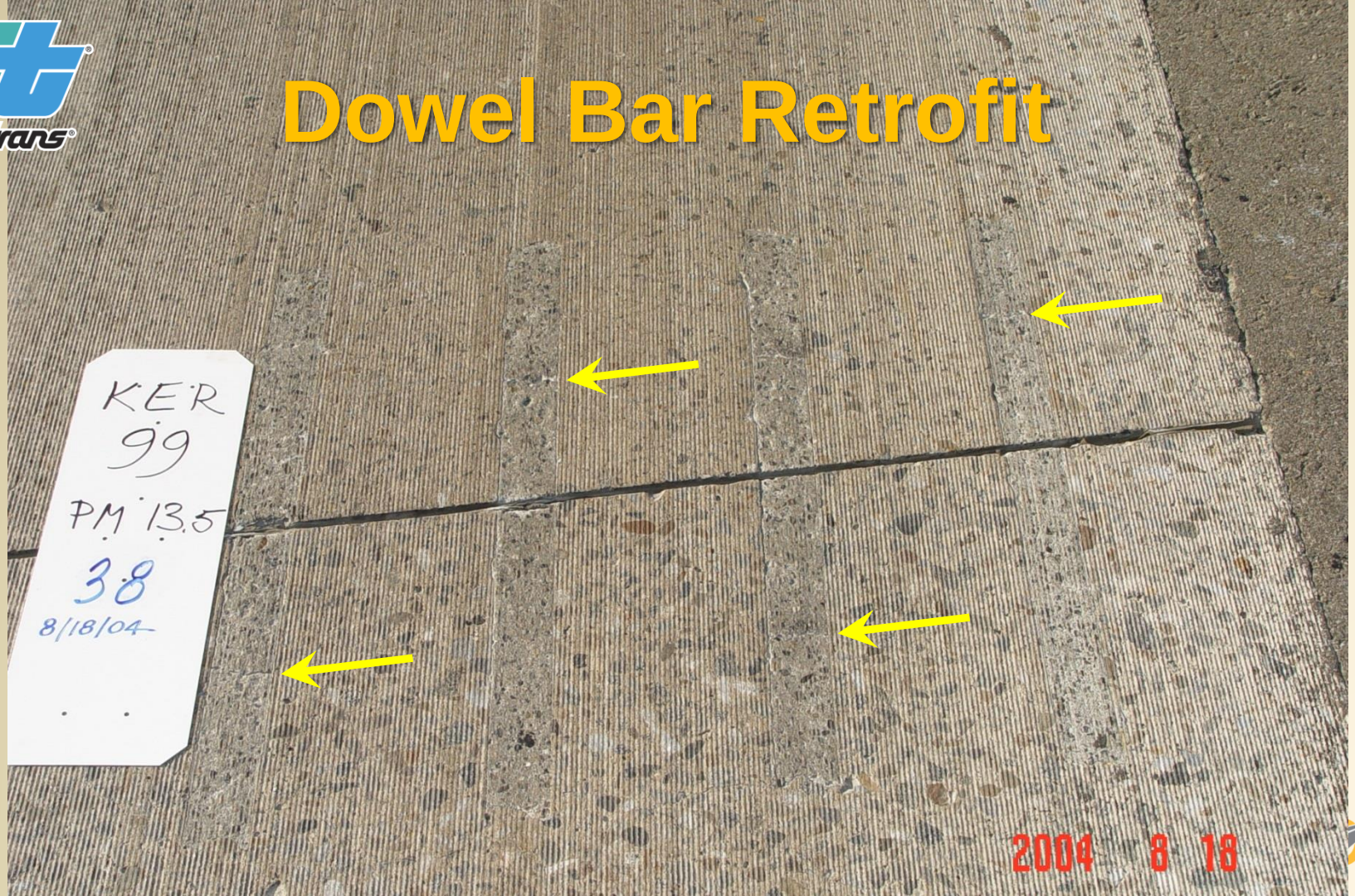
Individual Slab Replacement

- Rapid Strength Concrete or Precast

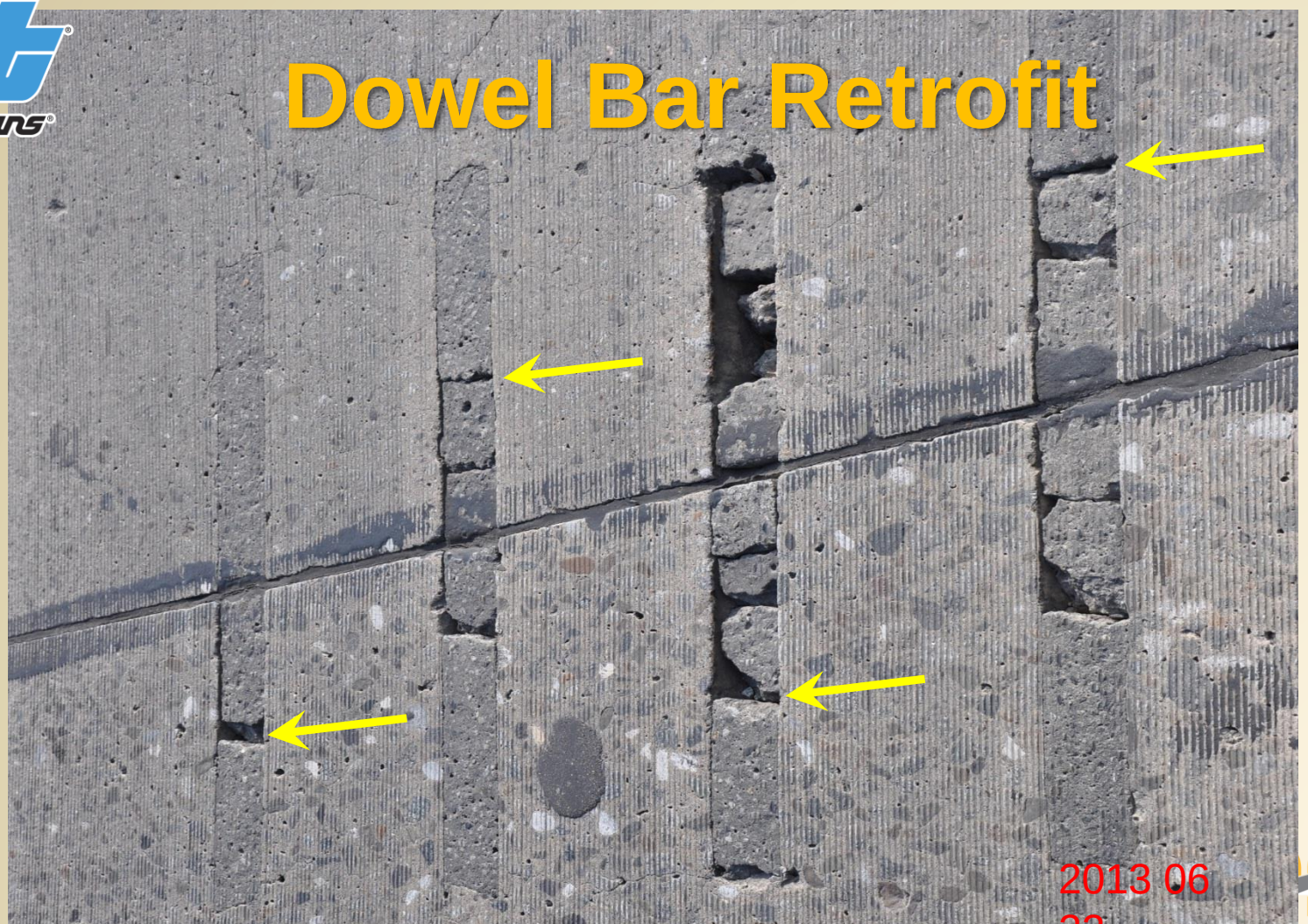
Diamond Grinding

- Long CA history to 1965
- Up to 17-yr service life (78% IRI ↑)

Dowel Bar Retrofit



Dowel Bar Retrofit



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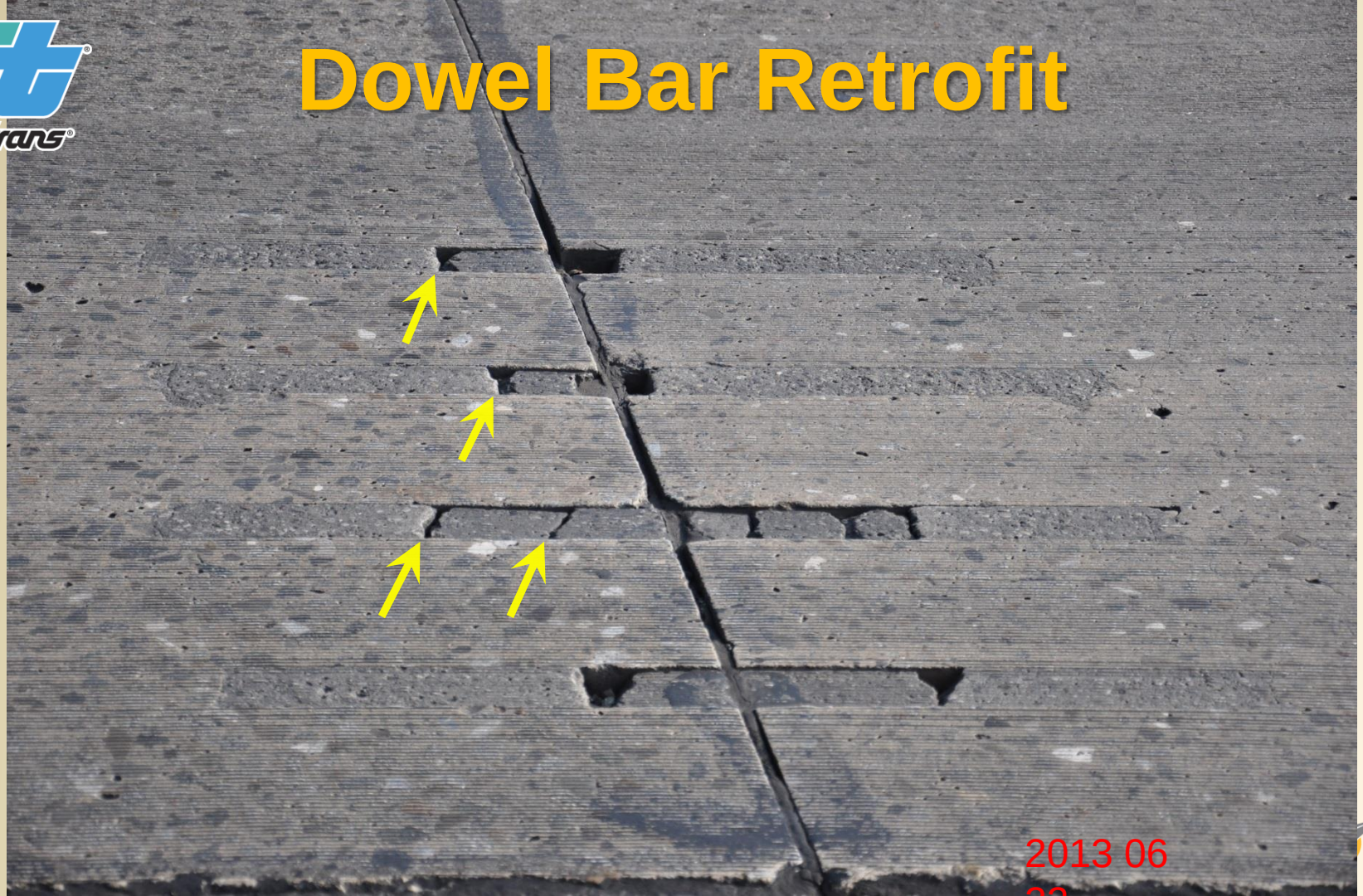

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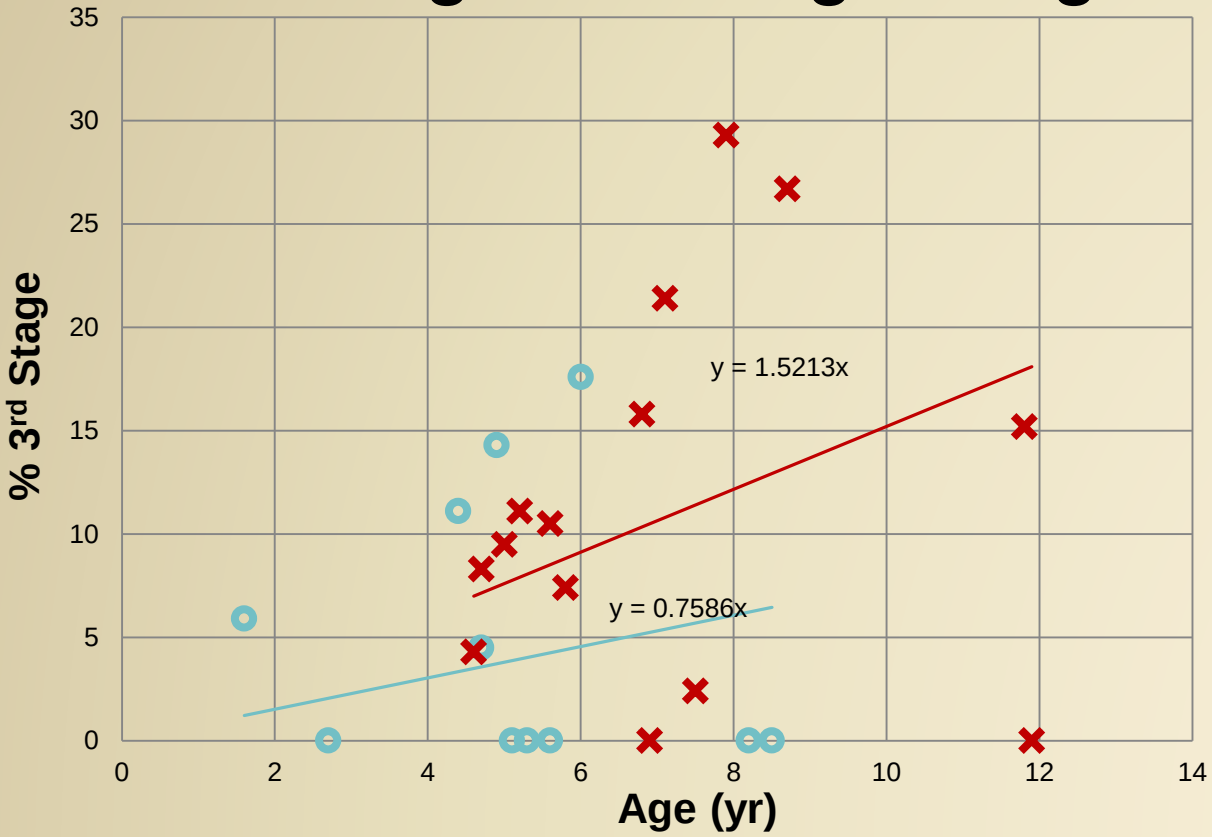
Dowel Bar Retrofit

Slab Replacement

Slab Replacement

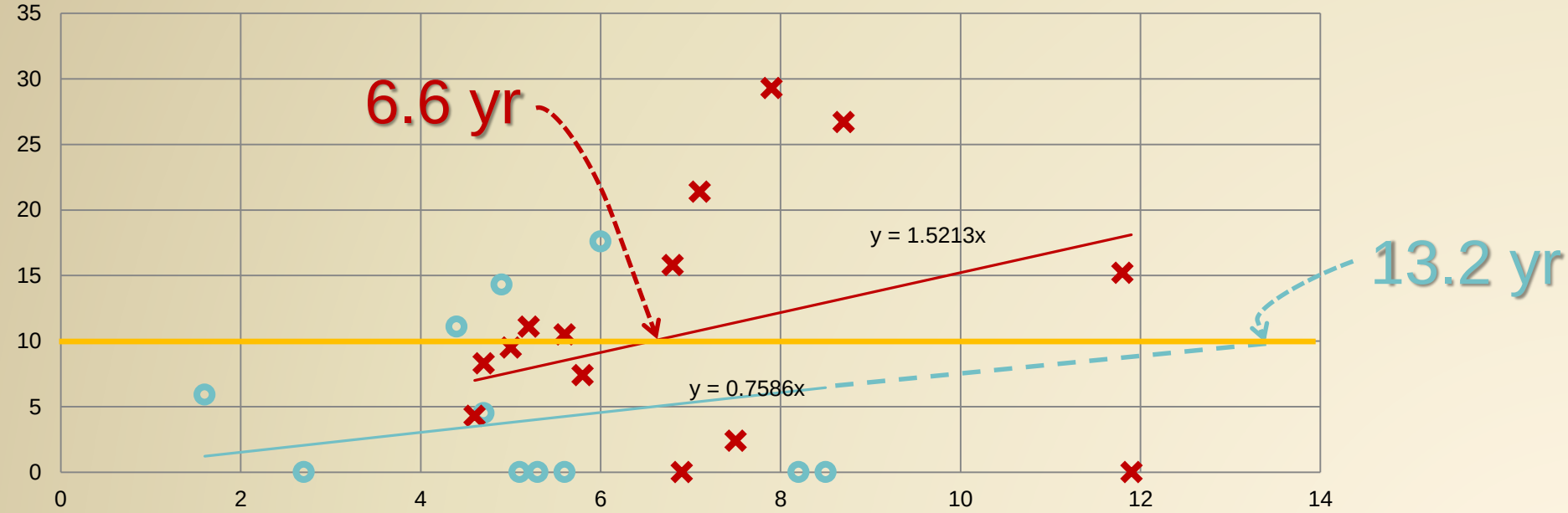
3rd Stage Cracking vs. Age



- Doweled
- Not Doweled
- Linear (Doweled)
- Linear (Not Doweled)

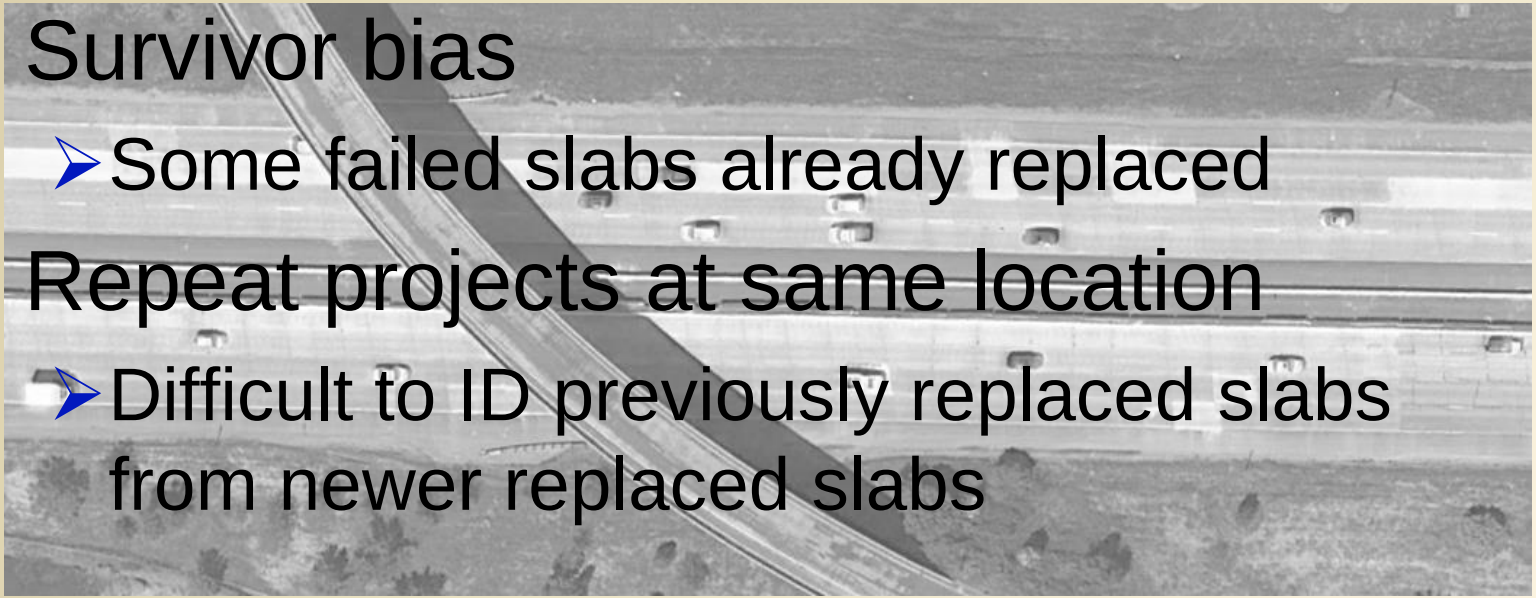
Slab Replacement

3rd Stage Cracking (%) vs. Age (yr)



Slab Replacement

Study Limitations



- Survivor bias
  - Some failed slabs already replaced
- Repeat projects at same location
  - Difficult to ID previously replaced slabs from newer replaced slabs

Slab Replacement

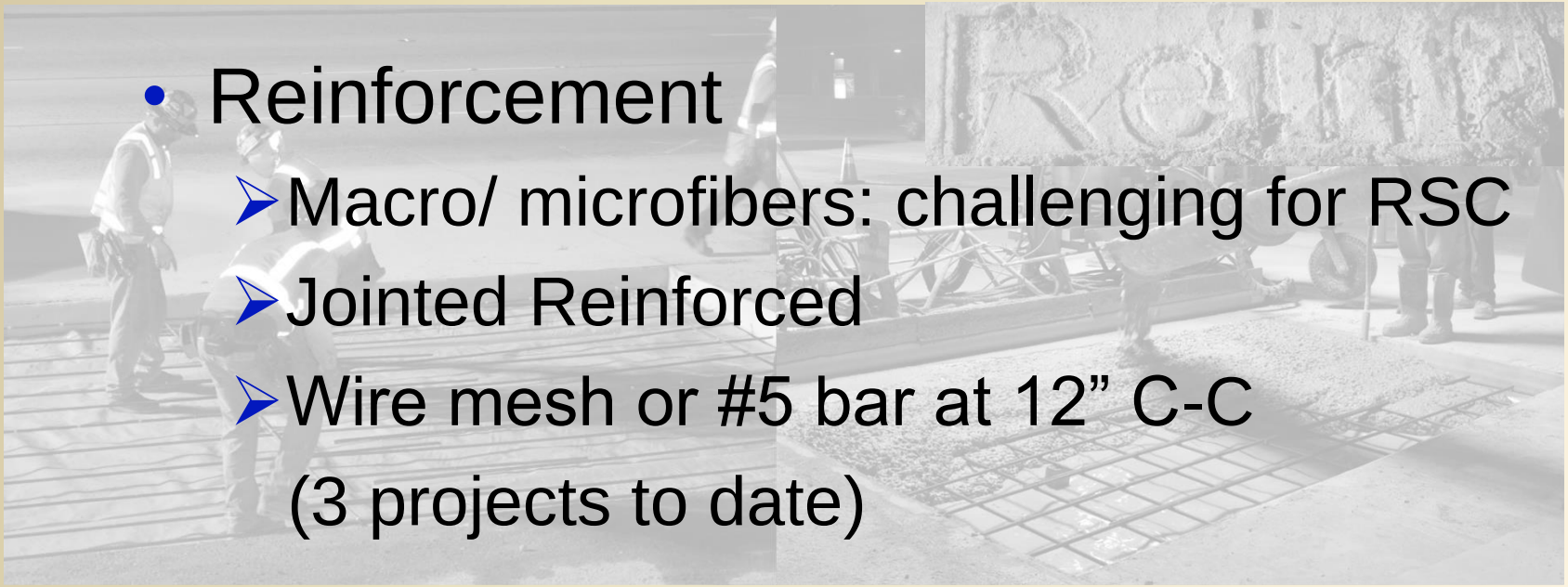
Innovations Being Considered

GOAL: Extend Service Life

- Dowels at all transverse joints
  - Ready to implement, some district interest, no projects to date
- Thicker monolithic pour with dowels
  - Some interest. Validity?

Slab Replacement

Innovations Being Considered



- Reinforcement
  - Macro/ microfibers: challenging for RSC
  - Jointed Reinforced
  - Wire mesh or #5 bar at 12” C-C (3 projects to date)

Slab Replacement

Abrasive Wear & Rutting

GOALS:

- Preserve existing concrete surface
- Maintain concrete thickness

Avoid Grinding!!!

Abrasive Wear & Rutting

Piloted Strategies

- HMA Overlay
- Bonded Wearing Course
- Grinding/ Grooving
- **Lithium Silicate Surface Hardeners?**
- **Polyester Concrete Inlay?**

Abrasive Wear & Rutting

Lithium Silicate Surface Hardeners

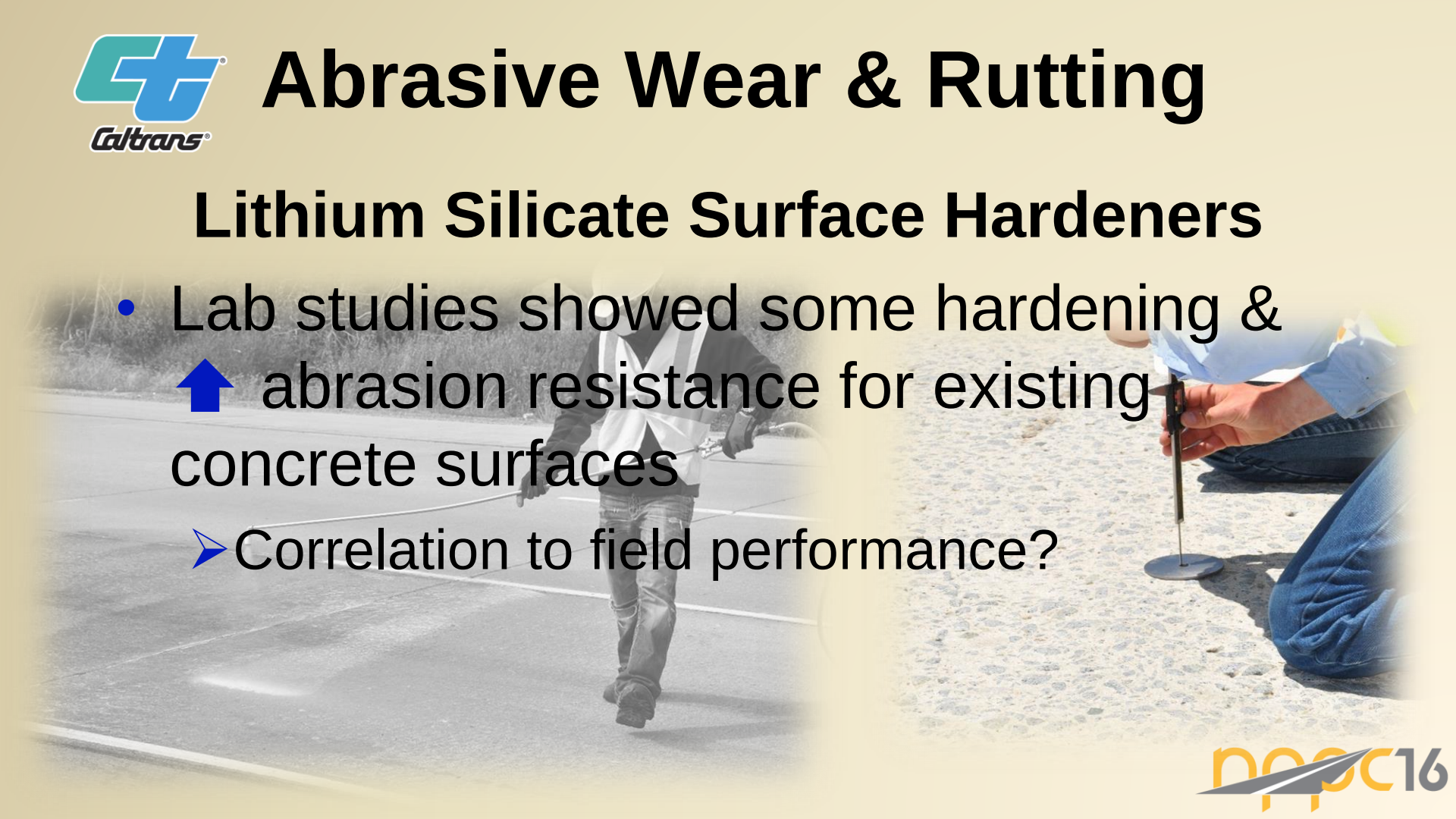
Background

- Lithium penetrates voids in concrete surface
- Silicate reacts w/ free lime in concrete paste
- Densifies & hardens by forming CSH
- Proprietary issues

Abrasive Wear & Rutting

Lithium Silicate Surface Hardeners

- Lab studies showed some hardening & ⬆ abrasion resistance for existing concrete surfaces
  - ➢ Correlation to field performance?



Abrasive Wear & Rutting

Lithium Silicate Surface Hardeners

- Cost Effectiveness
  - Reapplication frequency?
  - Contract vs. Maintenance work
  - **$18K**/ln-mi (full-width) hardener material cost

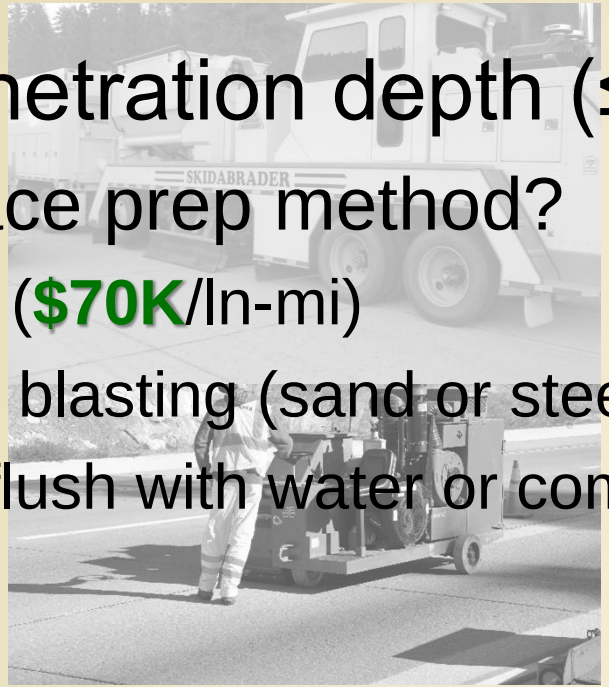
+

Surface preparation, traffic control, OH, etc.

Abrasive Wear & Rutting

Lithium Silicate Surface Hardeners

- Limited penetration depth (≤ 5 mm)
  - Best surface prep method?
    - Grinding (**$70K**/ln-mi)
    - Abrasive blasting (sand or steel shot-**$25K**/ln-mi)
    - Sweep; flush with water or compressed air (low **$**)



Abrasive Wear & Rutting

Polyester Concrete Inlays: Background

- 2 full lane-width polyester concrete overlays were evaluated by CT on I-80 corridor in ‘80’s, along with other material alts
  - Poly conc data, performance results unclear
- CA bridge decks use ¾” poly conc OL
  - Working with material supplier to ↑ resin durability

Abrasive Wear & Rutting

Polyester Concrete Inlays: 2 Sections

FILL-IN

GROUND-IN

Abrasive Wear & Rutting

Polyester Concrete Inlay Prep

1. Diamond grind ¾” min (if req’d)
2. **Abrasive blast (sand/ shot)**
3. **Apply HMWM**

Abrasive Wear & Rutting

Polyester Concrete Inlay Construction

4. Place Polyester Concrete

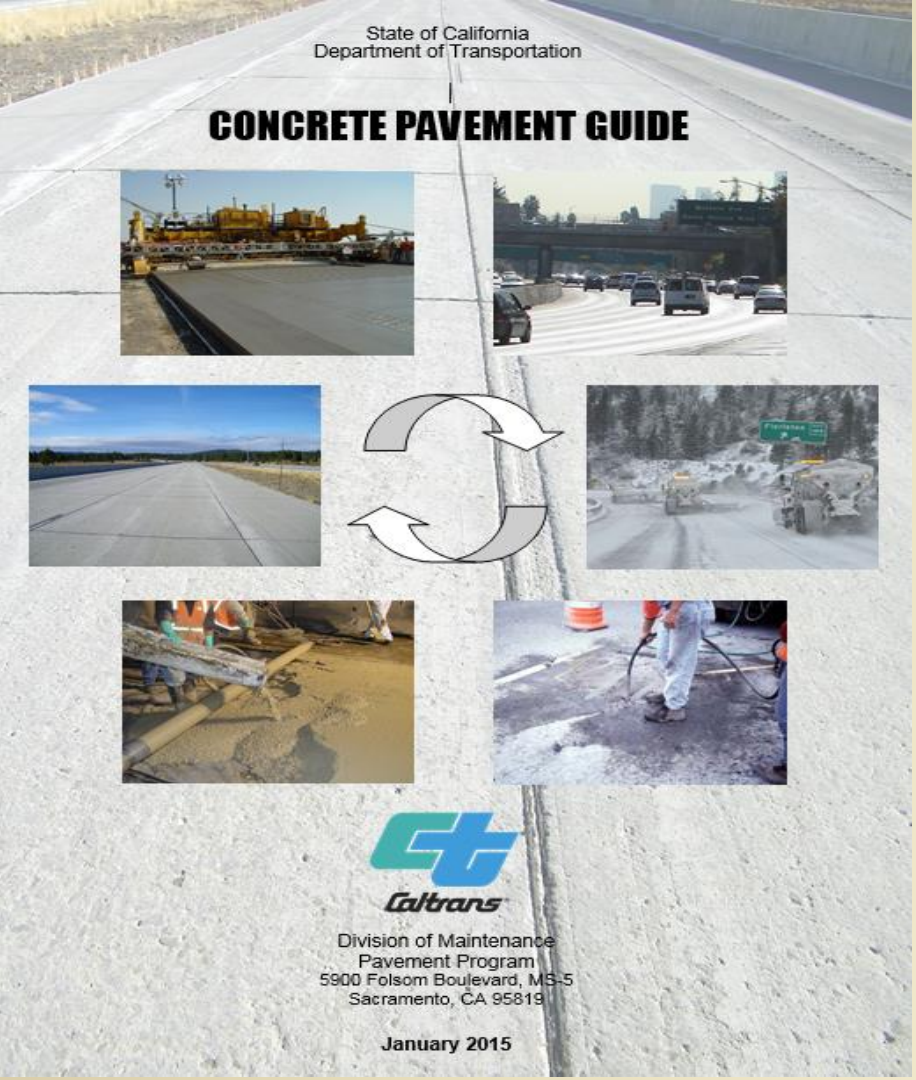
Abrasive Wear & Rutting

Polyester Concrete Inlay Construction

5. Finish Grind Inlays

Summary

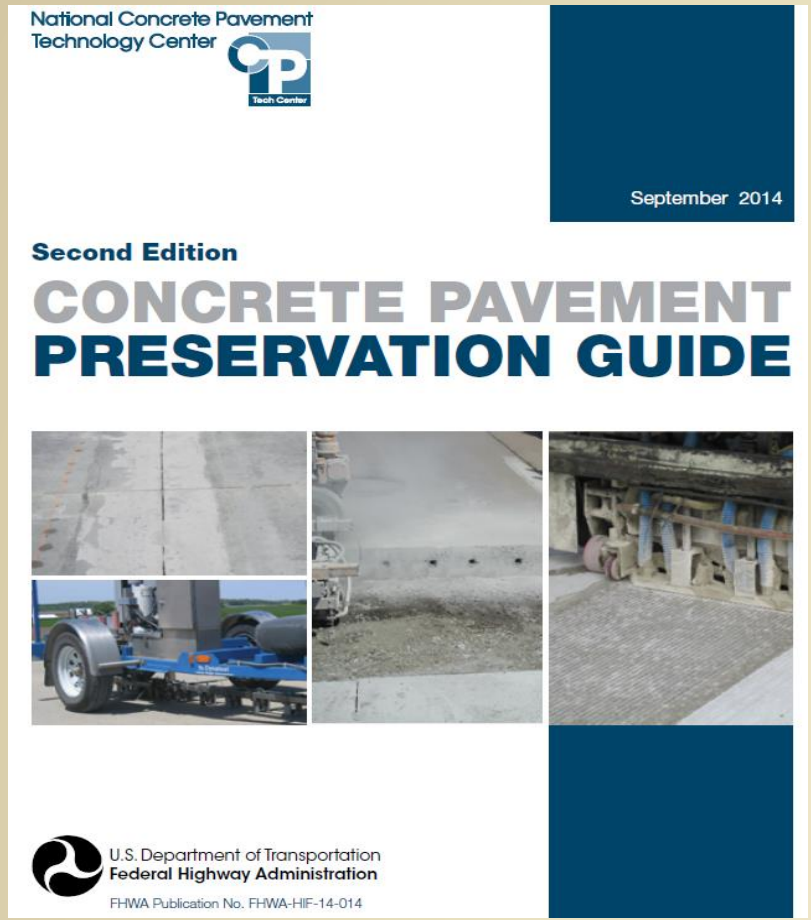
ISSUE	INNOVATION
❑ Spall repair durability	➢ CP Tech Center (2012) ➢ Polyester concrete ➢ Future: AML alternatives
❑ Rapid slab replacement	➢ Rapid strength concrete ➢ Precast panels (nonstandard)
❑ Abrasive wear & rutting	➢ Surface hardeners? ➢ Polyester concrete inlays?



Concrete Pavement Guide

http://www.dot.ca.gov/hq/maint/Pavement/Offices/Pavement_Engineering/Concrete_Pavement_Guide.shtml

Concrete Pavement Preservation



GUIDANCE

http://www.cptechcenter.org/technical-library/documents/preservation_guide_2nd_ed_508_final.pdf

Questions?

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http://www.dot.ca.gov/hq/maint/Pavement/Pavement_Program/index.html