# FY 2007-2008 Workshops

- The CP Tech Center conducted 17 workshops in FY 2007-2008 in several states across the nation.
- There were 1,264 participants that attended the workshops.
- National training was provided to help train individuals on various aspects of concrete pavement materials and construction practices.

| Date | Location | Length | No. Attendees |
|---|---|---|---|
| **Concrete Preservation & Rehabilitation** | | | |
| August 2, 2007 | Des Moines, IA | 1 day | 15 |
| Dec 12-13, 2007 | Oklahoma City, OK | 2 days | 60 |
| March 24-25, 2008 | Ames, IA | 1 ½ days | 80 |
| **Municipal Streets Seminar** | | | |
| November 13, 2007 | Denison, IA | 1 day | 28 |
| November 15, 2007 | Cedar Rapids, IA | 1 day | 31 |
| **IMCP Workshops & Train the Trainer Workshop** | | | |
| Feb 12-13, 2008 | Appleton, WI | 2 days | 110 |
| Feb 26, 2008 | Kansas City, MO | 1 day | 150 |
| Feb 28-29, 2008 | Macon, GA | 2 days | 45 |
| March 6, 2008 | Salt Lake City, Utah | 1 day | 70 |
| March 11, 2008 | Bismarck, ND | 1 day | 125 |
| March 13, 2008 | Sioux Falls, SD | 1 day | 60 |
| March 26-27, 2008 | Lansing, MI | 2 days | 200 |
| April 16-17, 2008 | Honolulu, HI | 2 days | 100 est. |
| April 24-25, 2008 | Chicago, IL | 1 ½ days | 50 est. |
| **Concrete Overlays** | | | |
| April 7, 2008 | Baton Rouge, LA | 1 day | 60 est. |
| July 1, 2008 | Pierre, South Dakota | 1 day | 40 est. |
| August 28, 2008 | Bismarck, North Dakota | 1 day | 40 est. |

CP Tech Center

# FY 2007-2008 Presentations

- The CP Tech Center presented 57 technical presentations throughout the nation in FY 2007-2008.
- The topics covered were:
  - Overlays
  - CP Road Map
  - CP Tech Center
  - Mix Design Program
  - IMCP
  - Incompatibility
  - Troubleshooting
  - Ternary
  - Sustainability
  - Durability
  - Nanotechnology
  - Surface Characteristics

# FY 2007-2008 Lunch Hour Programs

- Lunch hour presentations were conducted in the six districts around the state of Iowa.
- Each quarter a different topic was presented throughout the year.
- Concrete technology and best practices were presented to DOT Engineers, City Engineers, Consulting Engineers and Contractors.
- There were 577 participants that attended the presentations in FY 2007-2008.

| 3rd Quarter 2007 – Early-Age Cracking | |
|---|---|
| **Date** | **No. of Attendees** |
| July 27, 2007 | 25 |
| August 3, 2007 | 22 |
| August 10, 2007 | 14 |
| August 24, 2007 | 22 |
| August 31, 2007 | 16 |
| September 7, 2007 | 30 |
| **4th Quarter 2007 – Design & Constructability Issues** | |
| October 5, 2007 | 24 |
| October 12, 2007 | 19 |
| October 26, 2007 | 16 |
| November 2, 2007 | 23 |
| November 16, 2007 | 17 |
| December 14, 2007 | 36 |
| **1st Quarter 2008 – Pervious Concrete** | |
| January 25, 2008 | 41 |
| February 1, 2008 | 35 |
| February 15, 2008 | 26 |
| March 7, 2008 | 33 |
| March 14, 2008 | 20 |
| April 6, 2008 | 30 |
| **2nd Quarter 2008 – Concrete Pavement Trouble Shooting-Ph 1** | |
| May 9, 2008 | 39 |
| May 16, 2008 | 20 |
| May 30, 2008 | 23 |
| June 20, 2008 | 25 |
| June 27, 2008 | 21 |

Tech Center

# Example Lunch Hour Handouts

National Concrete Pavement Technology Center

# How Plastic Concrete Becomes Solid

tech transfer summary

October 2006

**PROJECT TITLE**
This summary is based on chapter 4 of the *Integrated Materials and Construction Practices for Concrete Pavements: A State-of-the-Practice Manual* (in draft; to be printed December 2006).

**SPONSOR**
Federal Highway Administration
DTFH 61-01-X-0042

**CO-PRINCIPAL INVESTIGATORS**
Mr. Dale Harrington, Snyder & Associates
Mr. Jim Grove, CP Tech Center, Iowa State University

**TECHNICAL EDITORS**
Dr. Peter C. Taylor, CTLGroup
Mr. Steven H. Kosmatka, Portland Cement Association
Mr. Gerald F. Voigt, American Concrete Pavement Association

**MANAGING EDITOR and CO-PI**
Ms. Marcia Brink, CP Tech Center, Iowa State University

**MORE INFORMATION**
Marcia Brink
515-294-9480
mbrink@iastate.edu
www.cptechcenter.org

**CP Tech Center**
**Iowa State University**
**2711 S. Loop Drive, Suite 4700**
**Ames, IA 50010-8664**
**www.cptechcenter.org**

The mission of the National Concrete Pavement Technology Center is to unite key transportation stakeholders around the central goal of advancing concrete pavement technology through research, tech transfer, and technology implementation.

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the view of FHWA or Iowa State University.

ctre Center for Transportation Research and Education

IOWA STATE UNIVERSITY

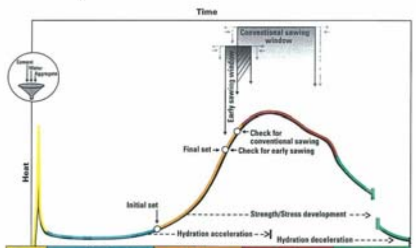
## Problem Statement

Cement hydration is a series of nonreversible chemical reactions between cement and water. During hydration, the cement-water paste sets and hardens.

Hydration is central to the formation of concrete. The chemical reactions taking place during the first few hours influence how the concrete mix behaves when it is being placed and finished. The reactions that occur later govern how strong and durable the hardened concrete becomes. Therefore, everyone involved in concrete paving should understand the basic, practical implications of hydration, especially during the first critical 72 hours. Yet the hydration process is a mystery to many people involved in designing and constructing concrete pavements.

## Objective

The goal of this document is to demystify the hydration process. This summary focuses on the primary chemical reactions of hydration during five stages (see below and pages 2–3), and their effects. With a general understanding of these reactions, everyone involved in concrete pavement projects can help prevent or correct problems.




| | Stage 1 Mixing | Stage 2 Dormancy | Stage 3 Hardening | Stage 4 Cooling | Stage 5 Densification |
|---|---|---|---|---|---|
| | Lasts about 15 minutes | Lasts about 2–4 hours | Lasts about 2–4 hours | | Continues for years |
| Characteristics of concrete mixture | High heat is generated immediately, followed by rapid cooling. | Mixture is plastic, workable, and not generating significant heat. | • Hydration generates significant heat. • Mixture sets, begins to harden, and gains strength. • Stress begins developing in the concrete. | Stress development will exceed strength development if stress is not relieved. | Slab continues to become stronger and less permeable. |
| What engineers, supervisors, and workers must do to ensure durable pavement | Ensure adequate mixing. | Transport, place, and finish the concrete while plastic and workable. | • Begin curing as soon as possible. • Thoroughly apply curing compound. | Saw joints to relieve stress and control cracking. | • Insulate the slab if the air temperature is expected to cool rapidly and significantly. • Protect curing compound as long as possible. |

**Five stages of hydration: mixing, dormancy, hardening, cooling, densification**

---

CONCRETE PAVEMENT
CPTP
TECHNOLOGY PROGRAM

TechBrief

The Concrete Pavement Technology Program (CPTP) is an integrated, national effort to improve the long-term performance and cost-effectiveness of concrete pavements. Managed by the Federal Highway Administration through partnerships with State highway agencies, industry, and academia, CPTP's primary goals are to reduce congestion, improve safety, lower costs, improve performance, and foster innovation. The program was designed to produce user-friendly software, procedures, methods, guidelines, and other tools for use in materials selection, mixture proportioning, and the design, construction, and rehabilitation of concrete pavements.

*www.fhwa.dot.gov/pavement/concrete*

U.S. Department of Transportation
**Federal Highway Administration**

# Early-Entry Sawing of Portland Cement Concrete Pavements

*This TechBrief discusses the creation of contraction joints in portland cement concrete pavements using early-entry saws. It explains the need for joints, provides an overview of traditional joint sawing practices, and describes the early-entry joint sawing approach and associated equipment. A brief summary of studies on the use of early-entry sawing is provided, along with general guidelines for employing early-entry sawcutting technology.*

## BACKGROUND

Joints are placed in portland cement concrete (PCC) pavements principally to prevent the development of uncontrolled, random cracking brought about by environmental forces (temperature and moisture) and concrete shrinkage. These forces are most acute during the first 72 hours after placement as the young concrete is still gaining strength.

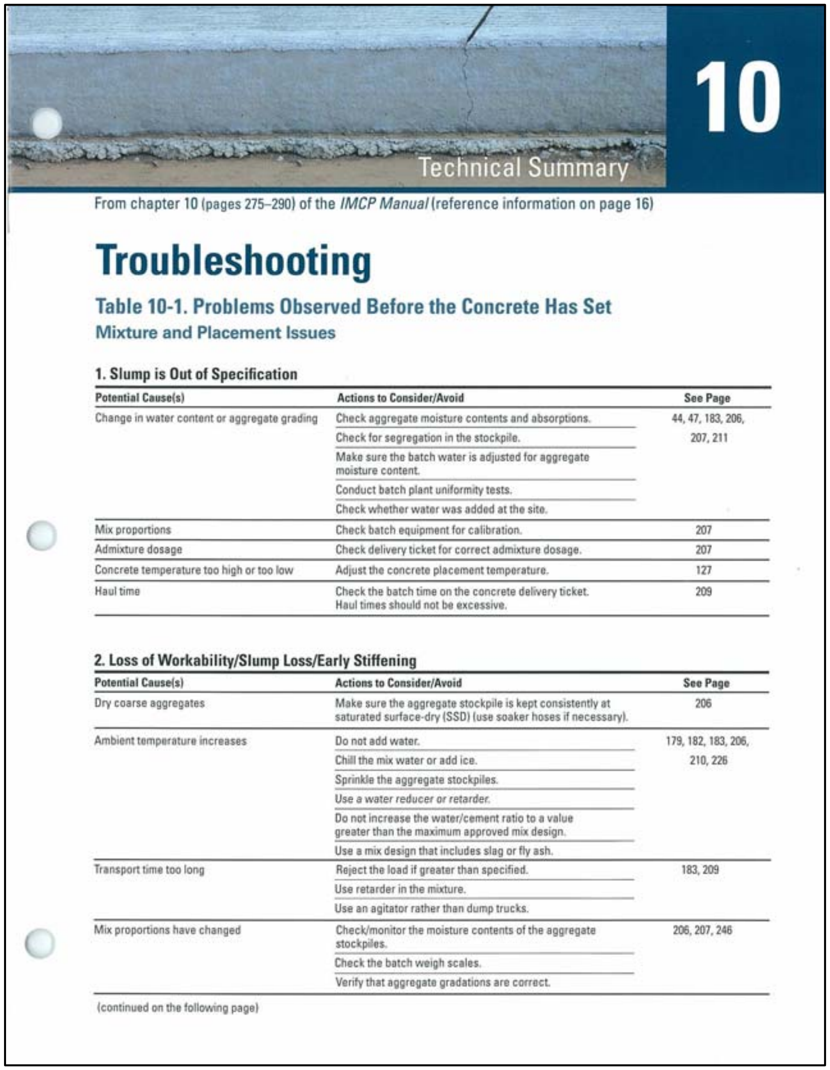
Although there are a number of ways to create joints in PCC pavements, the most common method is by sawing the hardened PCC to an established depth, typically one-quarter to one-third of the slab thickness; this creates a weakened plane, thus encouraging cracking to occur at that location in a controlled manner (see Figure 1a). This sawing must be done before significant restraint stress has developed in the concrete. When sawed to an appropriate depth and at the right time, and when constructed at appropriate intervals within the pavement (typically transverse joints at 4.6-m [15-ft] intervals along the length of the paving project and longitudinal joints at 3.7-m [12-ft] intervals across the width of the paving project), as shown in Figure 1b, these joints provide effective stress relief to prevent the development of random cracking.

Determining the appropriate sawcut depth and timing needed to ensure the formation of the cracks below the weakened plane has proven to be a complicated task (Okamoto et al. 1994). For conventional joint sawing, the depth of sawing is often taken to be one-quarter of the slab thickness for transverse contraction joints and one-third of the slab thickness for longitudinal contraction joints (AASHTO 1993). However, others suggest that the depth should always be at least one-third of the slab thickness (ACPA 1991). Still others advocate that a shallower cut—usually at least 25 mm (1 in.)—may be adequate if the sawing is done early enough (Zollinger, Tang, and Xin 1994; Zollinger 2001).

There is an ideal joint-sawing "window," at which time the joints should be cut, as shown in Figure 2. The goal in timing the sawcutting operation is to saw neither too soon (which will cause raveling of the concrete) nor

Tech Center

# Example Lunch Hour Handouts



10

Technical Summary

From chapter 10 (pages 275–290) of the *IMCP Manual* (reference information on page 16)

## Troubleshooting

### Table 10-1. Problems Observed Before the Concrete Has Set

#### Mixture and Placement Issues

**1. Slump is Out of Specification**

| Potential Cause(s) | Actions to Consider/Avoid | See Page |
|---|---|---|
| Change in water content or aggregate grading | Check aggregate moisture contents and absorptions. | 44, 47, 183, 206, 207, 211 |
| | Check for segregation in the stockpile. | |
| | Make sure the batch water is adjusted for aggregate moisture content. | |
| | Conduct batch plant uniformity tests. | |
| | Check whether water was added at the site. | |
| Mix proportions | Check batch equipment for calibration. | 207 |
| Admixture dosage | Check delivery ticket for correct admixture dosage. | 207 |
| Concrete temperature too high or too low | Adjust the concrete placement temperature. | 127 |
| Haul time | Check the batch time on the concrete delivery ticket. Haul times should not be excessive. | 209 |

**2. Loss of Workability/Slump Loss/Early Stiffening**

| Potential Cause(s) | Actions to Consider/Avoid | See Page |
|---|---|---|
| Dry coarse aggregates | Make sure the aggregate stockpile is kept consistently at saturated surface-dry (SSD) (use soaker hoses if necessary). | 206 |
| Ambient temperature increases | Do not add water. | 179, 182, 183, 206, 210, 226 |
| | Chill the mix water or add ice. | |
| | Sprinkle the aggregate stockpiles. | |
| | Use a water reducer or retarder. | |
| | Do not increase the water/cement ratio to a value greater than the maximum approved mix design. | |
| | Use a mix design that includes slag or fly ash. | |
| Transport time too long | Reject the load if greater than specified. | 183, 209 |
| | Use retarder in the mixture. | |
| | Use an agitator rather than dump trucks. | |
| Mix proportions have changed | Check/monitor the moisture contents of the aggregate stockpiles. | 206, 207, 246 |
| | Check the batch weigh scales. | |
| | Verify that aggregate gradations are correct. | |

(continued on the following page)

introduction to

# CONCRETE OVERLAYS

National Concrete Pavement Technology Center

Despite hundreds of successful projects, some public agencies and contractors hesitate to construct concrete overlays. This lack of confidence may be based on a misperception that concrete overlays are expensive, difficult to build, or appropriate in only a few situations.

States' actual experiences with concrete overlays tell the real story:

1. **Concrete overlays consistently provide cost-effective solutions.** Inch for inch, they are the most effective long-term maintenance and rehabilitation option for existing pavements.
2. **Concrete overlays can be constructed as quickly and conveniently as any other paving solution.** Many factors contribute to their convenience:
   - **The existing pavement does not need to be removed.** In fact, it is factored into the overlay design to continue to help carry some of the traffic load, either as part of the new monolithic pavement (bonded) or as a base to the overlay (unbonded).
   - **Little or no preoverlay repairs are necessary or even desirable in most cases.** If an agency believes extensive preoverlay repairs are required for a specific project, it should probably rethink its choice of overlay design solutions.
   - **Like other kinds of overlays, successful concrete overlay projects require minimal project plans and engineering effort.**
   - **Concrete overlays are placed using normal concrete pavement construction practices.** Attention should be paid to overlay-specific details in this guide.
   - **Many concrete overlays can be opened to traffic within a day of placement** by using nondestructive strength indicators like maturity testing.
   - **Accelerated construction practices can be used throughout the normal construction season** as described in this guide.
3. **Concrete overlays are not only a durable rehabilitation tool; they can also be a cost-effective maintenance tool.** Because of the wide range of overlay thicknesses that can be used, combined with the minimal preoverlay work required, concrete overlays provide cost-effective solutions for almost any pavement type and condition, desired service life, and anticipated traffic loading.
4. **Concrete overlays can serve, in and of themselves, as complete preventive maintenance or rehabilitation solutions, or they can be used in conjunction with spot repairs of isolated distresses.**

For these and and other reasons, concrete overlays are cost-effective, environmentally friendly solutions. They provide societal benefits in the form of reliable load-carrying capacity and fewer and shorter disruptions to traffic for pavement reconstruction. In other words, concrete overlays are sustainable pavement solutions.

## Ultimate Sustainable Pavements

Many concrete overlays have been in service for decades, extending the life of the original pavement structure for 30 years or more.

Because concrete distributes traffic loads over a wide area, the underlying pavement does not experience heavy, concentrated loads. Whenever renewal is required, as long as the original pavement remains stable and uniform and the concrete overlay can be milled and replaced or recycled (mill and fill) in a cost-effective manner, the concrete overlay pavement system can be sustainable for 100 years or longer.

Bottom line: As long as the original pavement is providing some level of structural support, the owner-agency continues to experience a return on its original investment.

## Two Families of Concrete Overlays

In the past, various terms for concrete overlays (e.g., ultrathin whitetopping and conventional whitetopping) have sometimes led to confusion because they weren't used consistently across the country. This guide replaces that terminology with more straightforward terms.

All concrete overlay types can be classified into one of two families: bonded and unbonded. Both bonded and unbonded concrete overlays can be placed on existing concrete pavements, asphalt pavements, or composite pavements (original concrete pavements that have been previously resurfaced with asphalt). Thus, there are a total of six concrete overlay types from which owner-agencies can select the proper solution for nearly any pavement maintenance, resurfacing, or rehabilitation need. The two families generally serve two different purposes: Bonded overlays are for resurfacing and minor rehabilitation, whereas unbonded overlays are for major rehabilitation.

### *Bonded Concrete Overlays*

The purpose of bonded overlays is to eliminate surface distresses on existing pavements that are are in good to fair structural condition. Bonded overlays generally provide resurfacing solutions for routine or preventive pavement maintenance or for minor rehabilitation (see figure 1).

### *Unbonded Concrete Overlays*

The purpose of unbonded overlays is to add structural capacity to existing pavements that are moderately to significantly deteriorated. They are major rehabilitation strategies (see figure 1).

### *Design Differences Between Bonded and Unbonded Overlays*

With bonded overlays, bonding between the overlay and the existing pavement is critical to achieve the desired performance. The bond ensures that the overlay and existing pavement layer perform as a monolithic structure, with the original pavement continuing to carry a significant portion of the load.

Bonded overlay projects, therefore, are carefully designed and constructed to promote bonding between the overlay and the existing pavement.

With unbonded overlays, however, bonding between the overlay and the underlying pavement is not essential to achieve the desired performance. Unbonded overlays are constructed essentially as new pavements, and the existing pavement becomes a stable base for the overlay. Unbonded overlay projects, therefore, are not designed or constructed to promote bonding.

**De-bonding Not Required**

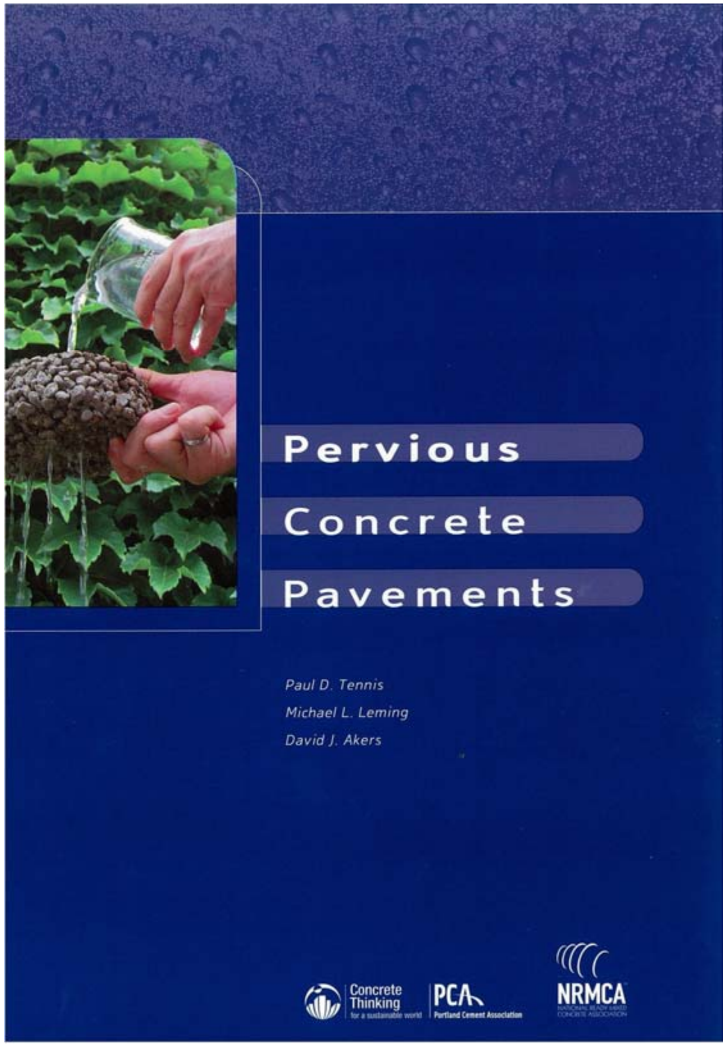
The term "unbonded overlay" can be slightly misleading. It does not mean that an unbonded overlay cannot or will not adhere or stick to the existing asphalt pavement. It means only that because a bond is not necessary to achieve the overlay's purpose, bonding is not actively promoted in its design and construction.

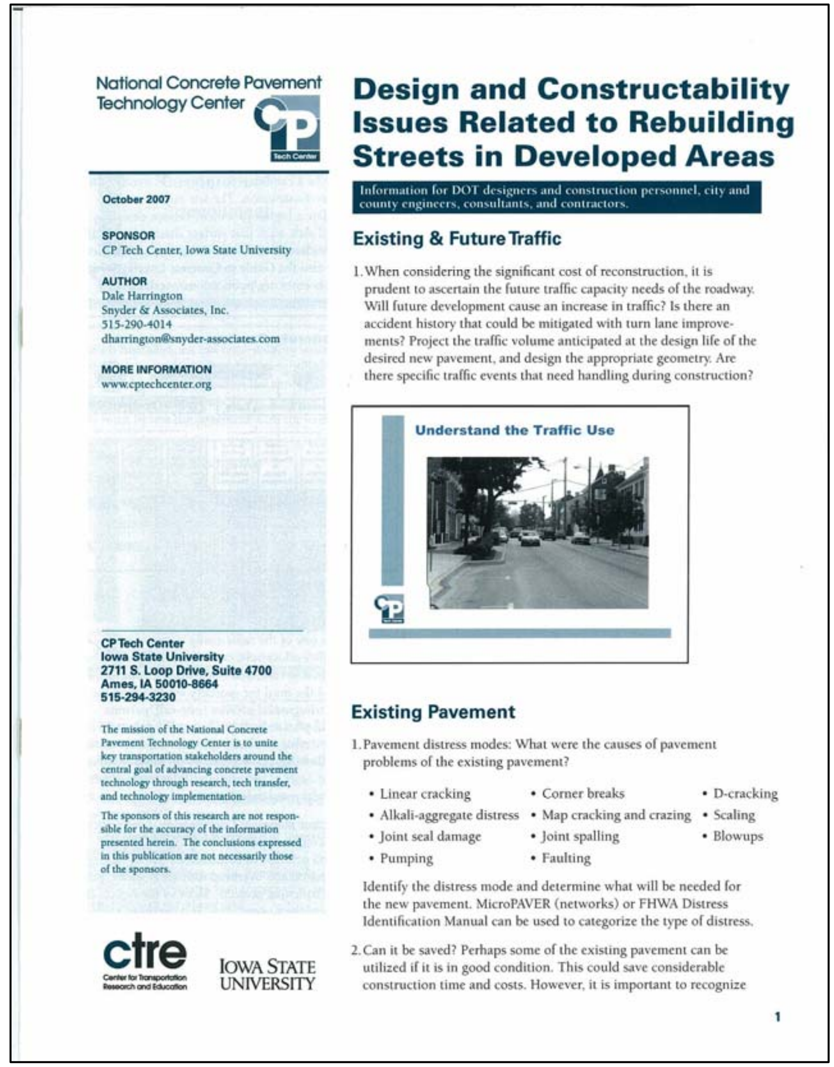
continued on page 4



Tech Center

# Example Lunch Hour Handouts



National Concrete Pavement Technology Center

# Design and Constructability Issues Related to Rebuilding Streets in Developed Areas

Information for DOT designers and construction personnel, city and county engineers, consultants, and contractors.

October 2007

**SPONSOR**
CP Tech Center, Iowa State University

**AUTHOR**
Dale Harrington
Snyder & Associates, Inc.
515-290-4014
dharrington@snyder-associates.com

**MORE INFORMATION**
www.cptechcenter.org

## Existing & Future Traffic

1. When considering the significant cost of reconstruction, it is prudent to ascertain the future traffic capacity needs of the roadway. Will future development cause an increase in traffic? Is there an accident history that could be mitigated with turn lane improvements? Project the traffic volume anticipated at the design life of the desired new pavement, and design the appropriate geometry. Are there specific traffic events that need handling during construction?

**Understand the Traffic Use**

## Existing Pavement

1. Pavement distress modes: What were the causes of pavement problems of the existing pavement?

- Linear cracking
- Alkali-aggregate distress
- Joint seal damage
- Pumping
- Corner breaks
- Map cracking and crazing
- Joint spalling
- Faulting
- D-cracking
- Scaling
- Blowups

Identify the distress mode and determine what will be needed for the new pavement. MicroPAVER (networks) or FHWA Distress Identification Manual can be used to categorize the type of distress.

2. Can it be saved? Perhaps some of the existing pavement can be utilized if it is in good condition. This could save considerable construction time and costs. However, it is important to recognize

**CP Tech Center**
**Iowa State University**
**2711 S. Loop Drive, Suite 4700**
**Ames, IA 50010-8664**
**515-294-3230**

The mission of the National Concrete Pavement Technology Center is to unite key transportation stakeholders around the central goal of advancing concrete pavement technology through research, tech transfer, and technology implementation.

The sponsors of this research are not responsible for the accuracy of the information presented herein. The conclusions expressed in this publication are not necessarily those of the sponsors.

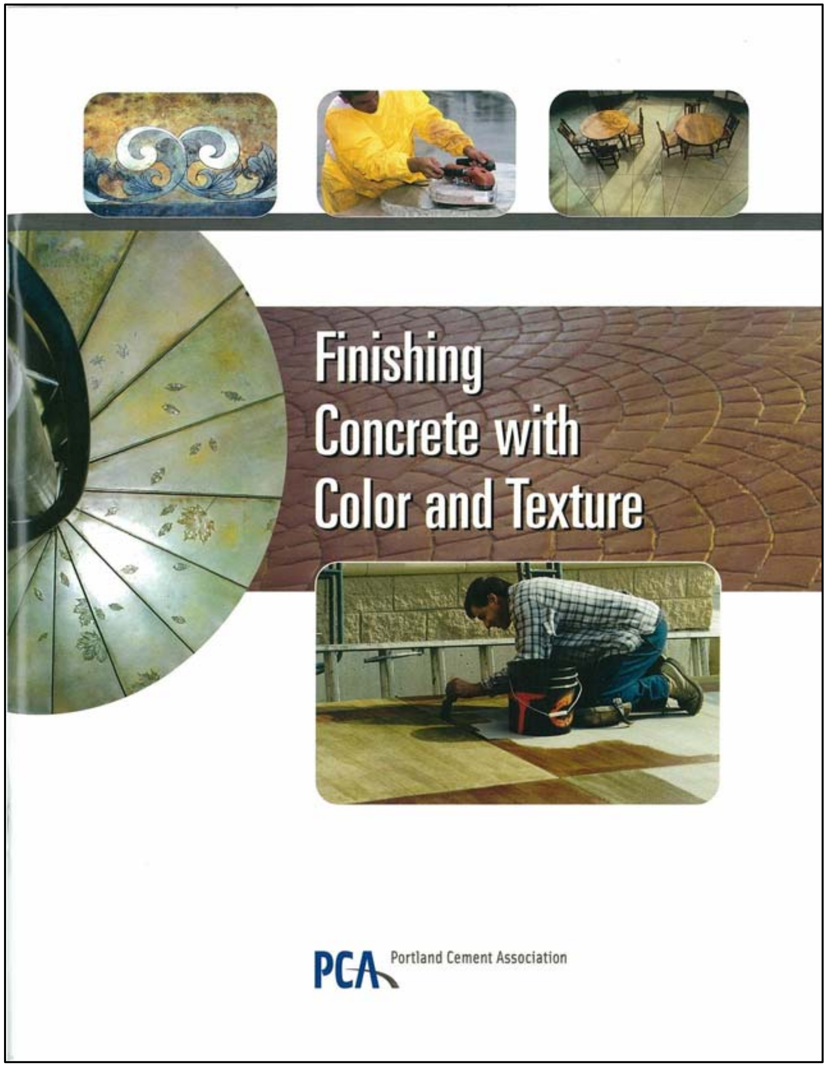
ctre Center for Transportation Research and Education

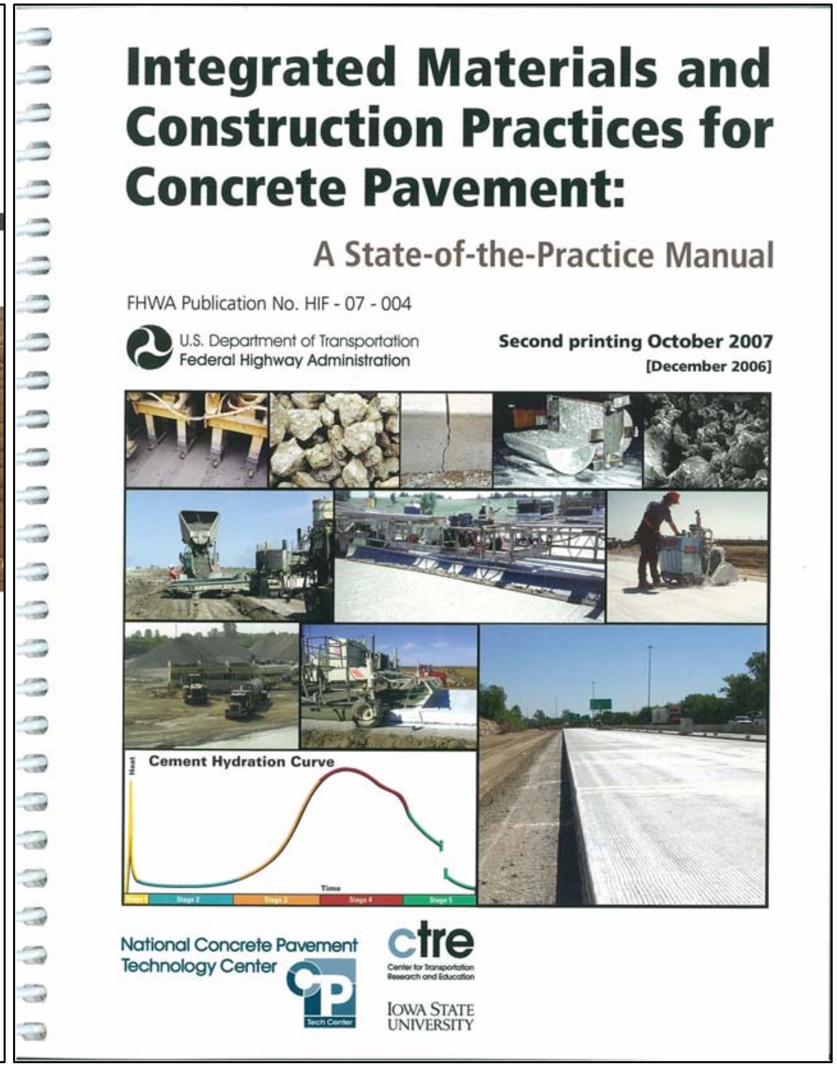
Iowa State University

1

Tech Center

# Example Lunch Hour Handouts




Tech Center