

## DEPLOYABLE CONCRETE TECHNOLOGIES FOR PAVEMENTS

By  
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FHWA Resource Center, Atlanta

PRESENTED AT THE  
" VIRGINIA CONCRETE PAVEMENT CONFERENCE"

Richmond, VA  
March 6, 2008

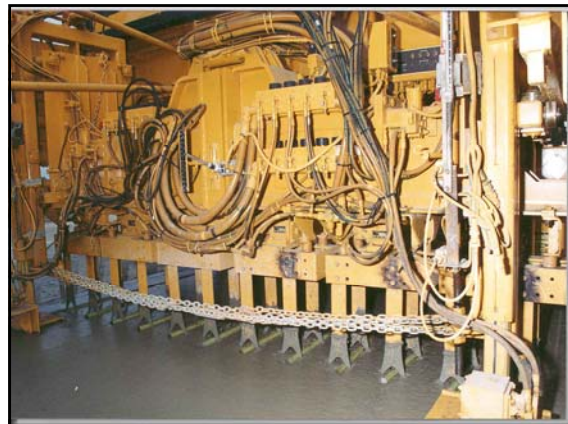
### Notice

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- The US Government does not endorse products or manufacturers.
- Trade or manufacturers' names may appear in this presentation only because they are considered essential to the object of this presentation.

### DISCUSSION TOPICS

- **EQUIPMENT AND CONSTRUCTION**
- QUALITY CONTROL
- DESIGN
- SOFTWARE
- WIDE PCCP SLABS

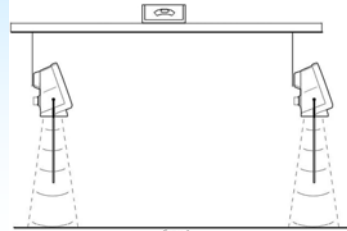
### DOWEL BAR INSERTER



**GSI**

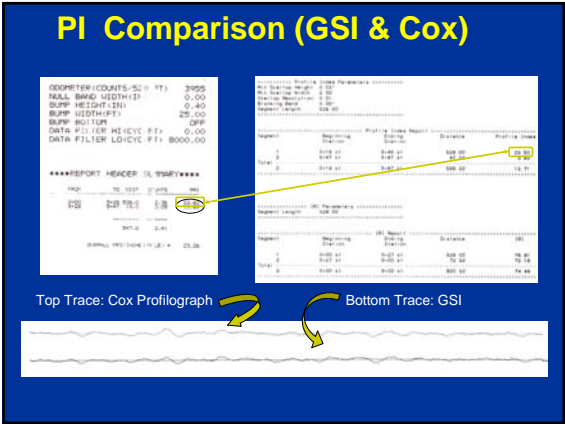
**GOMACO Smoothness Indicator  
"Revolution in Profiling"**


**GSI  
GOMACO Smoothness  
Indicator**



**GSI taking readings behind a Paver**








## STRINGLESS PAVING


**Goals:**

- A. Control of slipform paving train without stringline
  1. X - Y - Z axis control
  2. Meet smoothness criteria
- B. Control of as many as 4 companion machines
  1. Placer Spreader (s), Texture / Cure machine (s)
  2. Redundancy with back-up in case of failure






### Control System



Laser kept within 500 ft of paver  
(1000 ft range)


### Control System



Note GPS Receiver No 1

Laser Receiver (Tracking)  
Mounted on paver

### Control System

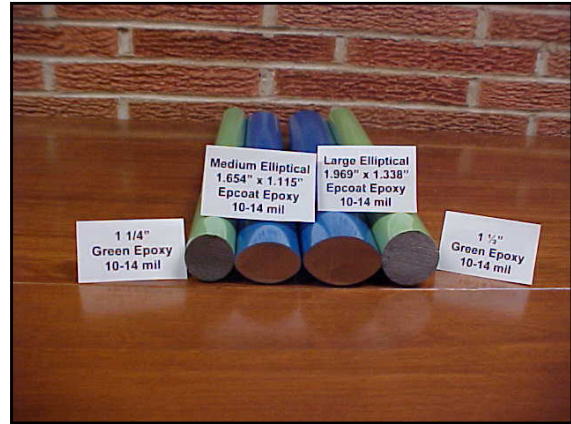


Left to Right  
Computer  
Sensor I/O's  
Monitor  
Foreground - Keyboard



# Elliptical Dowels

American Highway Technology



## Why Consider Elliptical Shapes

Reduce Bearing Stress

Engineer Dowel Spacing

Reduce Cost

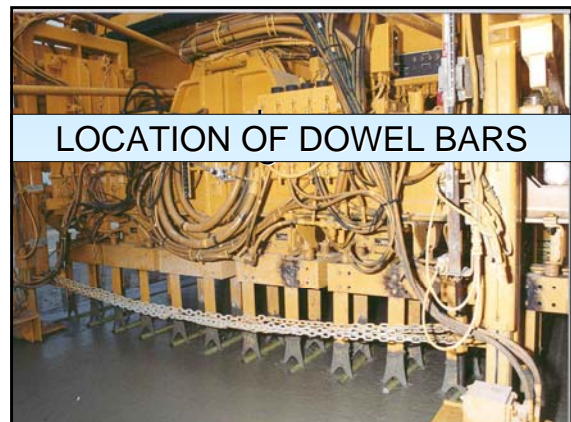
## Dowel Bar Test Results

Dowel Bar Type & Average Concrete Bearing Stress

Dowel Bar Description	Concrete Bearing Stress
1.25 inch round steel	2,048 psi (1.23 sq in)
1.5 inch round steel	1,568 psi (1.77 sq in)
Large elliptical steel	1,147 psi (2.08 sq in)
Medium elliptical steel	1,611 psi (1.43 sq in)

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## MIT SCAN

## MIT-Scan

Developed by Magnetic Imaging Tools, GmbH  
Based on the principles of pulse induction  
Advantages

- Works on fresh or hardened concrete
- Real-time, automated data analysis
- Very accurate
- Reliable
- Efficient (1-2 min per joint)

```

1) MIT 020H
Gorttasse Str. 41-43,
D-01217, Dresden,
GERMANY
EEM Consultants
2155 Green Vista Dr, Suite 203
Sparks, NV 89431

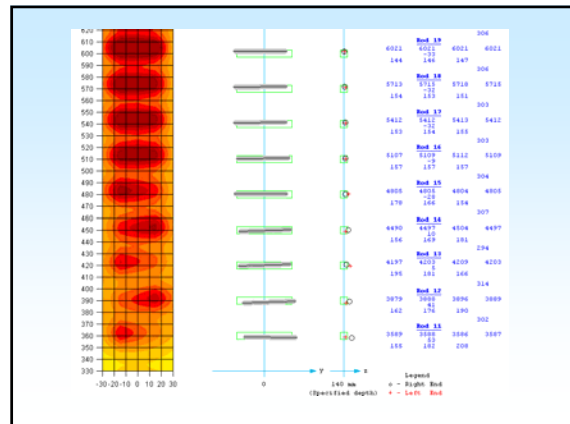
-----Bar 1-----
x-Location: 6.7 in ( 169 mm)
Depth: 6.06 in ( 154 mm)
Misalignment:
Horizontal: 0.31 in ( 8 mm)
Vertical: 0.22 in ( 6 mm)
Position errors:
Side Shift: -0.56 in ( -14 mm)
Depth: -0.59 in ( -14 mm)

-----Bar 2-----
x-Location: 19.2 in ( 486 mm)
Depth: 5.97 in ( 152 mm)
Misalignment:
Horizontal: 0.22 in ( 6 mm)
Vertical: 0.04 in ( 1 mm)
Position errors:
Side Shift: -0.59 in ( -15 mm)
Depth: -0.46 in ( -12 mm)

-----Bar 3-----
x-Location: 31.2 in ( 791 mm)
Depth: 5.89 in ( 147 mm)
Misalignment:
Horizontal: 0.34 in ( 9 mm)
Vertical: 0.16 in ( 4 mm)
Position errors:
Side Shift: -0.97 in ( -25 mm)
Depth: -0.29 in ( -7 mm)

-----Bar 4-----

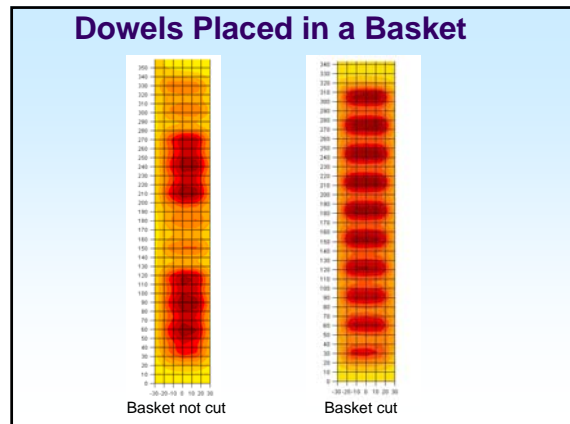
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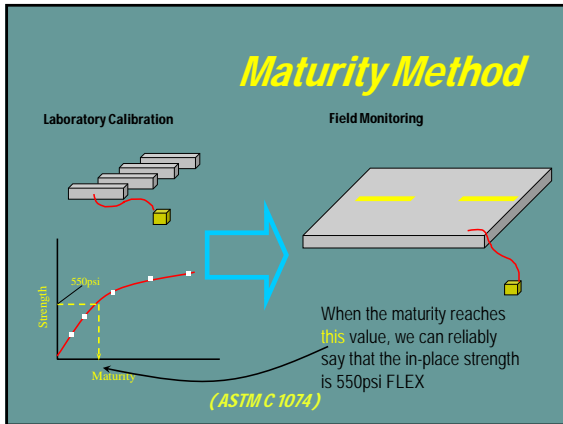



### Dowels placed in baskets


The current software does not analyze dowels placed in baskets that are uncut  
Good quantitative results can be obtained if the basket is cut


- Approximate results with general calibration
- More accurate results with calibration to specific basket type
- For accurately placed bars (placed within typical placement tolerance) the error is less than +/- 5 mm.





- ## Reestablishing Maturity Curve
- ### Factors Affecting Maturity
- Cement
  - Fly Ash
  - Admixtures
  - W/C ratio
  - Mix type
  - Aggregate gradation
- 

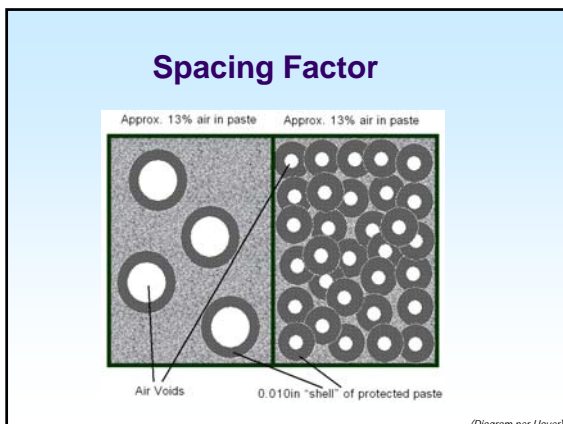




## Air Void Analyzer (AVA)

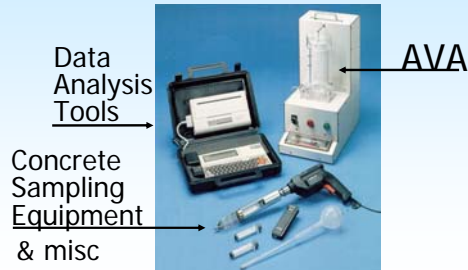
An apparatus that measures the air-void characteristics of fresh concrete

A 2002 Focus Technology



- ## Air Void Analyzer allows ...
- More control of air-void characteristics in fresh concrete
  - Quantify the air-void structure in the field
  - Rapid QC/QA testing, useful for concrete placed in extreme climates

## AVA Equipment



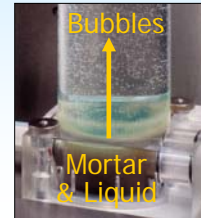
(Photo Courtesy of)

## How the AVA works

A cement mortar sample is placed in the analysis liquid. They are stirred together.

The air bubbles contained in the mortar are released.

Large bubbles rise to the surface faster than small ones.



(Photo Courtesy of)

## AVA Limitations

Equipment is sensitive to vibration. Testing needs to be performed in a quiet environment, like a permanent structure.

Small sample size

Air characteristics are calculated based on assumed volume fractions. Sample excludes aggregate larger than 6 mm (0.24 in).

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NCHRP

# M-E PDG

Mechanistic-Empirical Pavement Design Guide

WWW.TRB.ORG/MEPDG

This software is for review only and should not be used for design. This software was developed under NCHRP 1-37A and 1-402. Distribution of this software must be approved by NCHRP.

developed by

APPLIED RESEARCH ASSOCIATES, INC.

TRANSPORTATION

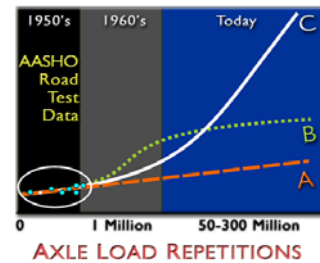
ASU

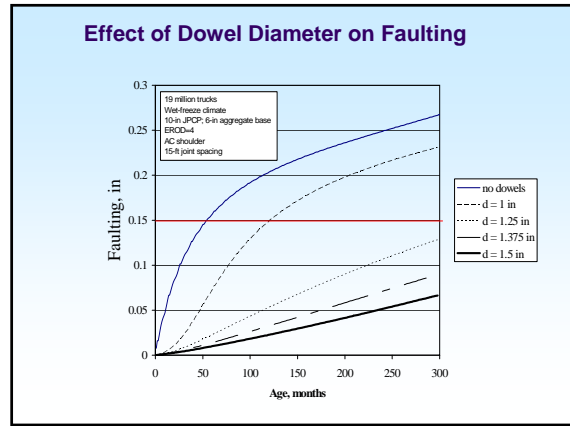
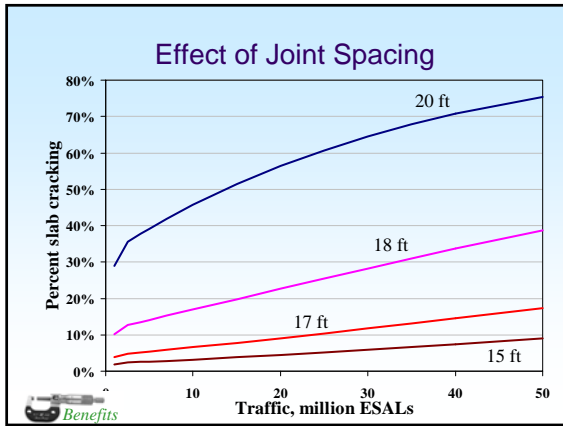
Version 0.910

Last Built September 11, 2006

## Limitations: Huge Extrapolation

### PAVEMENT THICKNESS





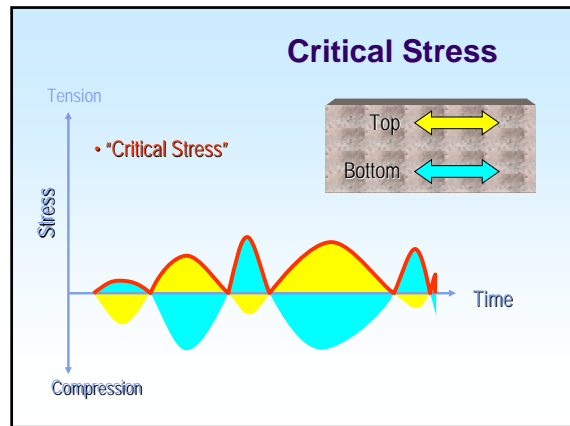
- ### DISCUSSION TOPICS
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# HIPERPAV II

THE TRANSTEC GROUP

### What is it?

♦ High PERformance Concrete PAVing  
 an integrated computer system that analyzes material, environmental, design, and construction variables

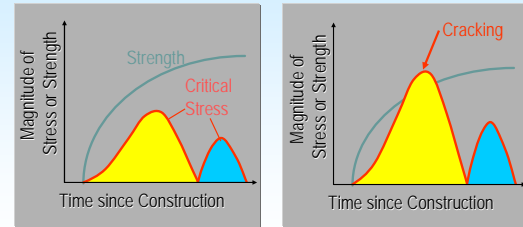




## What are typical uses?

- Predict responses in cold and hot weather paving
- Predict potential strength gain for tight closures and opening to traffic
- Determine effects of design parameters on stress development
  - Joint spacing, thickness, base type
    - Determine optimal mix characteristics
    - Forensic studies – crack development

## JCP Stress and Strength Development



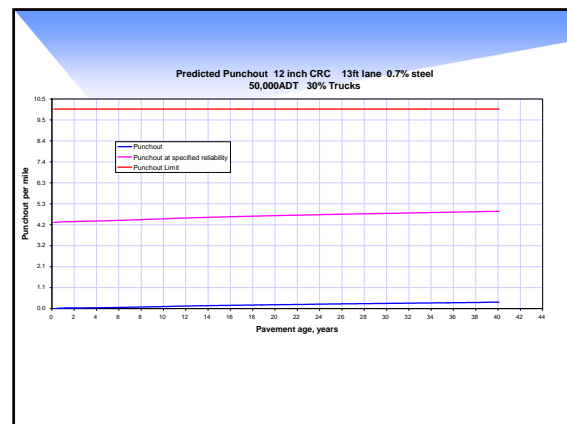
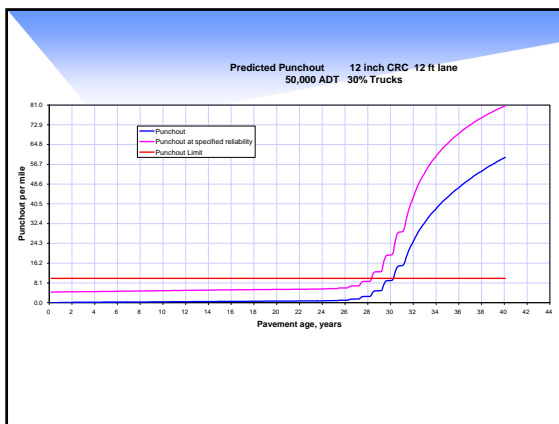
Scenario #1  
Cracking should not occur

Scenario #2  
Cracking may occur

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## WIDENED LANES



**CRC WIDENED LANE**  
(50,000 ADT 30% TRUCKS 90% RELIABILITY)

THICKNESS	% STEEL	YRS TO FAILURE		ESAL'S	
		12 FT WIDE	13 FT WIDE	12 FT WIDE	13 FT WIDE
10	0.70	14.3	30.3	76 MILLION	191 MILLION
12	0.70	28.3	40+	175 MILLION	281+ MILLION
10	0.65	12.3	26.3	64 MILLION	159 MILLION
12	0.65	24.3	40+	145 MILLION	281+ MILLION

Thank You!