

NCC Dowel Bar Task Force Report

prepared by

**Tom Burnham, Co-Chair
Minnesota Department of Transportation**

**Mark B. Snyder, Co-Chair
Engineering Consultant**

for

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Dowel Bar Task Force 1.0

(formed Spring 2010 NCC Meeting)

Maria Masten, Minnesota DOT

Tom Cackler, CP Tech Center

Mark Brinkman, Construction Materials Inc.

Glenn Eder, WG Block

Jenne Imholte-Decker, Simplex Construction Supplies

Mark Snyder, ACPA-Pennsylvania

John Staton, Michigan DOT

Matt Zeller, Concrete Paving Association of Minnesota

Tom Nicholson, Dayton Superior

Brett Trautman, Missouri DOT

Goal: Standardization of dowel baskets

- Implications for dowel length, basket height, etc.

Guide Report: Summarized state practices and assembled load transfer system design and construction information into a single, practical document



SEPTEMBER 2011

Guide to Dowel Load Transfer
Systems for Jointed Concrete
Roadway Pavements



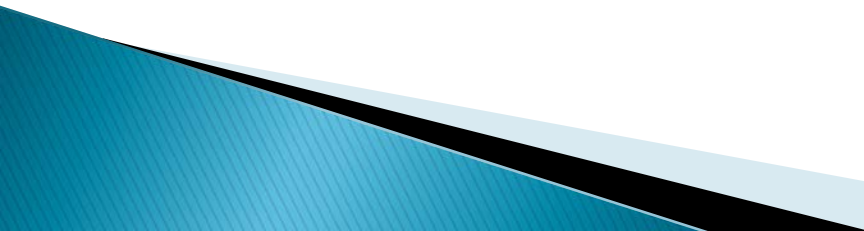
... but it didn't directly address different dowel materials and shapes!



Current AASHTO Dowel Specs

- ▶ M 254 – Standard Specification for Corrosion-Resistant Coated Dowel Bars
- ▶ T 253 – Standard Method of Test for Coated Dowel Bars
 - Oriented toward “organically coated” dowels (epoxy- or plastic-coated)
 - Pull-out Test, Double-shear test
 - No test of corrosion resistance
 - Not directly applicable to alternate materials

Questions:

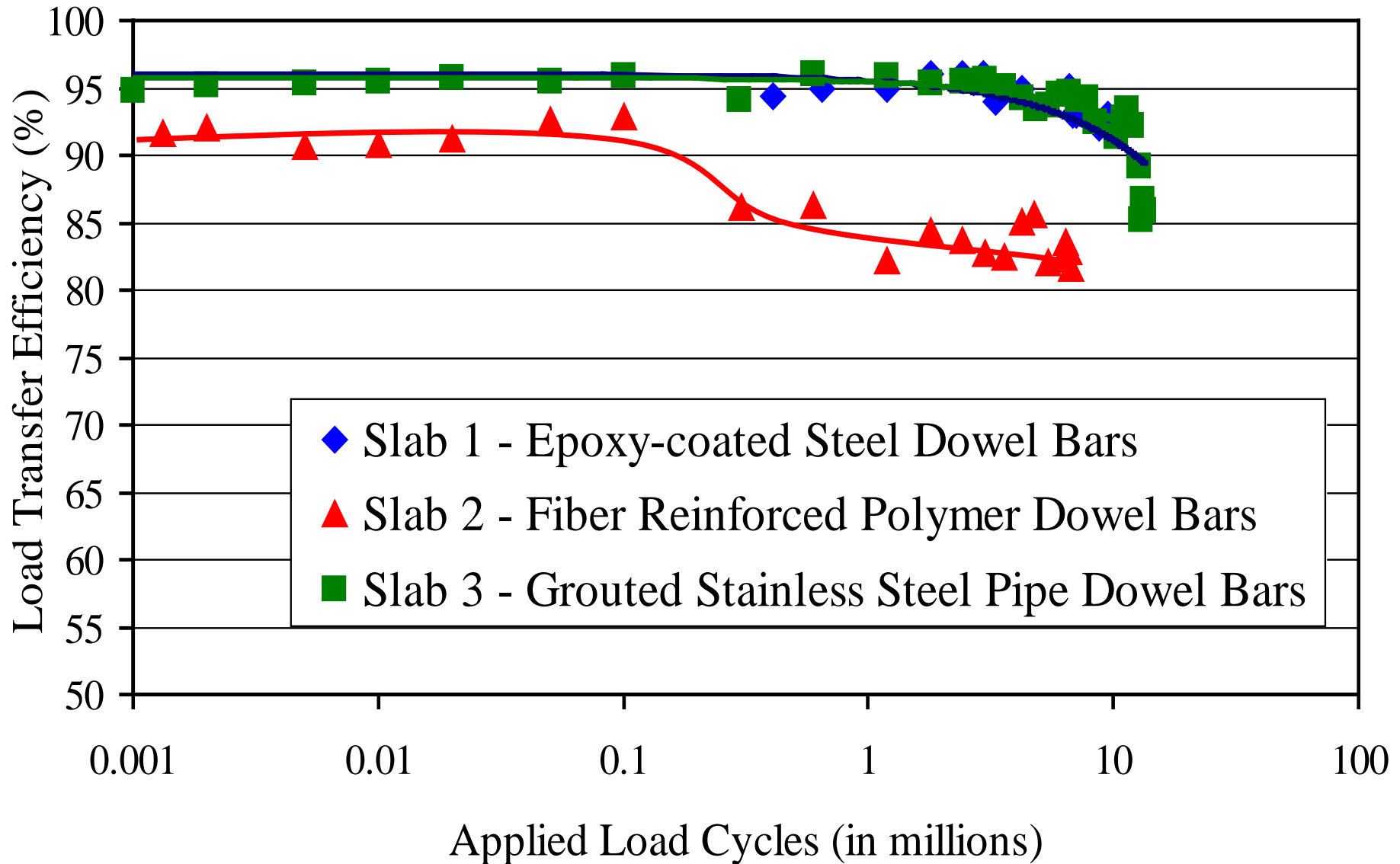
- ▶ Should existing spec be re-written to be all-inclusive or just updated for epoxy/plastic coatings (which suggests the need for a new spec for alternate materials)?
 - ▶ Should spec be performance-based or method-specific?
 - ▶ How to effectively (and fairly) determine relative corrosion-resistance of various coatings and dowel materials (systems)?
 - ▶ How to evaluate structural equivalence of dowels?
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Spring 2014 Proposal

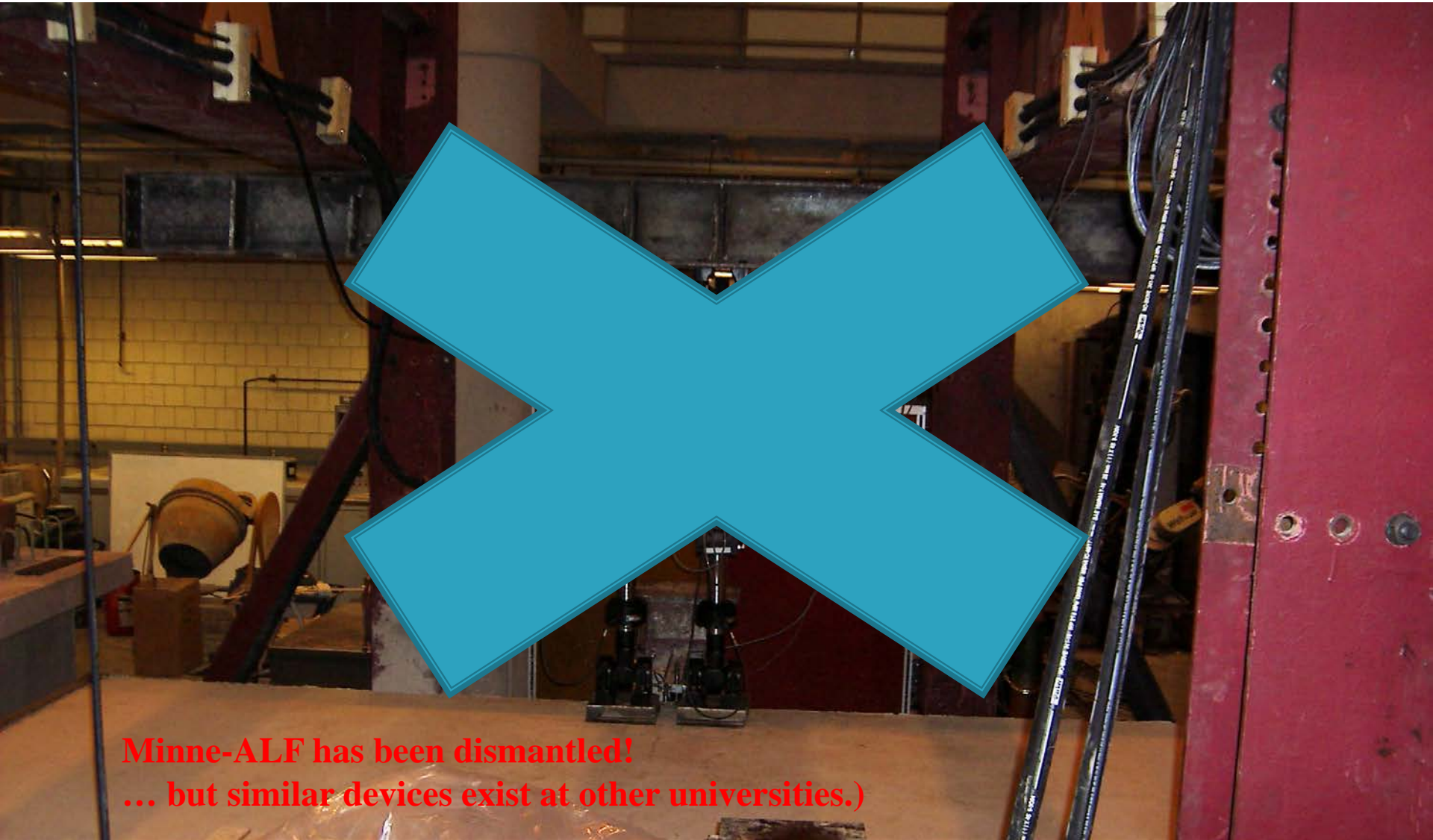
(from Tritsch and McMullen Presentations)

- ▶ Single all-inclusive spec
- ▶ Categorize dowels into Types A, B and C based on:
 - LTE and differential deflection from dynamic load test
 - Corrosion-resistance test (salt-spray)
 - Coating toughness tests (gouge, abrasion, disbondment, etc.)
 - Pull-out test (all meet minimum requirements)

LTE Testing via Accelerated Loading Frame



Accelerated Load Testing – Minne-Alf-2



Minne-ALF has been dismantled!
... but similar devices exist at other universities.)

LTE as a measure of equivalence?

- ▶ LTE is a measure of system behavior, not dowel equivalence.
- ▶ LTE is worthless without overall deflection reference

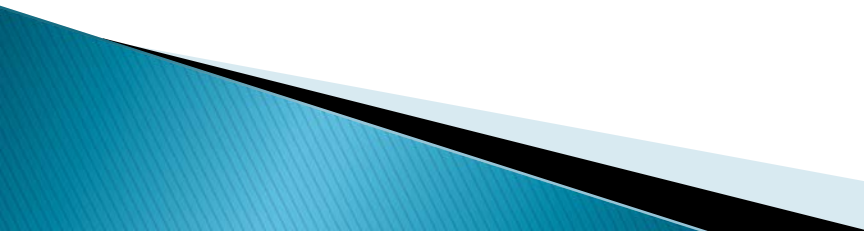
Joint Load Transfer Considerations

LTE vs. Relative Deflection

		LTE, %, for Relative Deflection Equal to				
Support Condition	d_v , mils	$d_{rel} = 0.5$ mil	$d_{rel} = 1$ mil	$d_{rel} = 1.5$ mil	$d_{rel} = 2$ mil	$d_{rel} = 5$ mil
Stiff	4	88	75	63	50	NA
Stiff	5	90	80	70	60	0
Stiff	6	92	83	75	67	17
Stiff	8	94	88	81	75	38
Medium Stiff	10	95	90	85	80	50
Medium Stiff	12	96	92	88	83	58
Medium Stiff	14	96	93	89	86	64
Softer	16	97	94	91	88	69
Softer	18	97	94	92	89	72
Softer	20	98	95	93	90	75

Source: Shiraz Tayabji, Fugro Consultants, Inc.

Basis for System Equivalency

- ▶ Deflection-based Criteria
 - LTE
 - Joint Stability
 - Others?
 - ▶ Bearing Stress
 - Determined analytically
 - High significance in many faulting models
 - Includes influence of slab stiffness, foundation stiffness
- 

Joint Stability

- ▶ ACI 360 definition: "... a joints ability to limit differential deflection of adjacent slab panel edges when a service load crosses the joint ... (t)he smaller the measured differential deflection number the better the joint stability."

Joint Stability

- ▶ ACI 360.R-10):
 - < 0.010 in. (small, hard-wheeled lift truck traffic)
 - < 0.020 in. (larger, cushioned rubber wheels)
- ▶ What is appropriate for road pavements?
- ▶ Should the criterion vary with functional applications (e.g., streets vs highways)?
- ▶ Should the criterion vary with foundation design and environmental conditions (e.g., stabilized vs unbound base, and wet vs dry climate)?

Using Bearing Stress to Assess Dowel Equivalence Analytically

Dowel Type	Diameter (in)	Dowel Modulus, E (psi)	Applied Shear Force (lb)	Dowel Deflection at Joint Face (in)	Bearing Stress (psi)
Metallic	1.5	29,000,000	1940 (12" spacing)	0.0009	1421.4
FRP	1.5	5,600,000	1940 (12" spacing)	0.0015	2185.8
FRP	1.92	5,600,000	1940 (12" spacing)	0.0009	1405.5
FRP	1.5	5,600,000	1260 (8" spacing)	0.0009	1419.7

Other influencing factors: slab stiffness, foundation stiffness, joint width, etc., so it is really a system measure ...

Corrosion Resistance Testing

- ▶ Different factors for various systems
 - Coatings: Impact and abrasion resistance
 - Cladding: Uniformity, thickness
 - Barriers: Durability, permeability, alkali stability
- ▶ Evaluation of corrosion protection
 - Simulation of pavement environment (UC–Davis test)
 - Harsh tests – salt spray, immersion of damaged specimens
 - Corrosion of steel vs cathodic protection
 - Measurement of ion concentrations

Dowel Bar Task Force 2.0

(formed Spring 2014, Jacksonville, FL NCC Meeting)

Tom Burnham, Minnesota DOT – Co-Chair

Bouzid Choubane, Florida DOT

Andy Gaines, Dayton Superior

Clint Hoops, Idaho DOT

Maria Masten, Minnesota DOT

David McDonald, CRSI – EPRIG

Kevin McMullen, Wisconsin Concrete Pavement Association

Rick Meininger, FHWA

Dan Miller, Ohio DOT

Jim Olson, Composite Rebar Technology

Chris Schenk, Jarden Zinc Products

Mark Snyder, Engineering Consultant – Co-Chair

Steve Tritsch, JC Supply

Tom Yu, FHWA

Initial Task Force Goals:

- Examine current standards (AASHTO M254 and T253) and comment on the current industry– proposed changes to the AASHTO standards.
- Identify, evaluate and recommend methods for assessing the relative corrosion– resistance and structural behaviors of dowels with various coatings, materials and shapes.
 - Primary structural test should be something other than accelerated load frame testing (e.g., Minne–ALF).
 - Modified T 253 (e.g., Porter/CPTech, 2006)?.

Target Completion: April 2015 NCC Meeting

Questions? Comments?