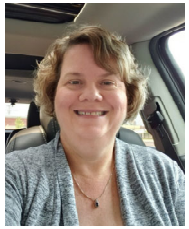
About the Presenter

- **Maria Masten** is the State Concrete Engineer for the Minnesota Department of Transportation.
- Maria has worked at MnDOT for over 25 years, starting at MnROAD and in Pavement Management as a student worker, then transitioning to the Concrete Engineering Unit for the last 22 years.
- She holds a Bachelor of Science degree in Civil Engineering from the University of MN and is a registered professional engineer in Minnesota.
- Maria proudly served as the previous NCC Chairperson and serves on various technical committees related to performance engineered mix designs and concrete materials.



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NATIONAL CONCRETE CONSORTIUM

MnDOT's Experience – Using the MIT-Scan T2/T3 during paving

Maria Masten, MnDOT Concrete Engineer

National Concrete Consortium – Fall 2020 Meeting

September 2, 2020

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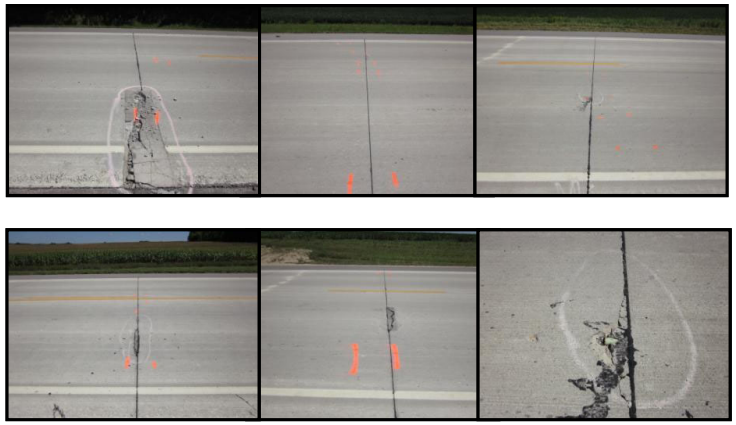
Looking back in time – NCC Spring 2012

Misaligned Dowel Bars



MnDOT Current Use of MIT-Scan T2/T3

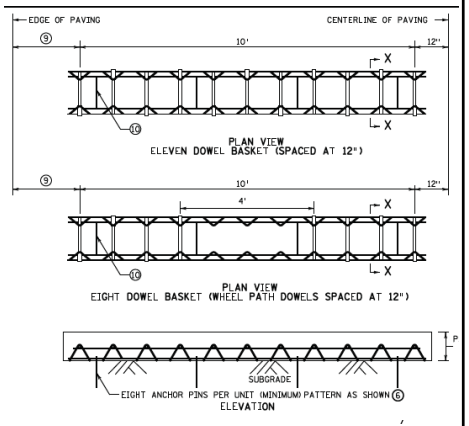
- MnDOT owns 8 MIT-Scan T2 devices
- Used for:
  - Locating Dowel Bars and Tie Bars in Plastic and Hardened Concrete on active concrete paving projects
  - Thickness Measurements in Concrete on Grade and Whitetoppings
  - Steel location for Coring for CPR Investigation
  - Bituminous Thickness (A few projects)

Placing Dowel Bars

- Secure dowel bar assemblies with anchors to hold the dowel bars in the correct position and alignment while preventing movement during concrete placement.
- Fasten the baskets to the substrate surface so that they do not move vertically or horizontally more than 1/4 inch.

Dowel Bar Baskets

- Provide dowel bar assemblies manufactured in single units for the lane widths shown on the plans
- Secure dowel bar assemblies with a minimum of 8 anchors (4 on each side) to hold the dowel bars in the correct position and alignment



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QC Plan for Anchoring Baskets

Why is a QC Plan Needed?

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Increased Risk for Misaligned Dowel Bars

- Concern of baskets being clipped by concrete paving equipment on 12' wide lanes

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Anchoring Basket Timing

- Pre-anchored
- Anchoring between trucks

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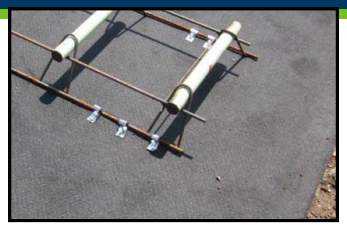
Anchoring Dowel Baskets on Overlays

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Concrete Placement

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Marking the Joint Locations

- Before placing the concrete, mark the location on both sides of each transverse joint as approved by the Engineer.


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QC Plan for Anchoring Baskets

- At least 7 days before the beginning of concrete paving, provide a Quality Control Plan in writing to the Engineer for acceptance that provides a method for keeping the dowel basket assemblies anchored to the grade, the existing concrete, or into the asphalt or bond breaker Layer and into the underlying concrete.

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QC Plan for Anchoring Baskets

Include the following at a minimum:

1) Proposed type and number of fasteners
2) Proposed installation equipment
3) Dowel basket assembly anchoring plan (i.e. Anchored all basket assemblies prior to concrete placement, one lane at a time, anchor all basket assemblies during the concrete placement operation, etc.)
4) Action plan if mis-aligned baskets are identified during concrete pavement placement

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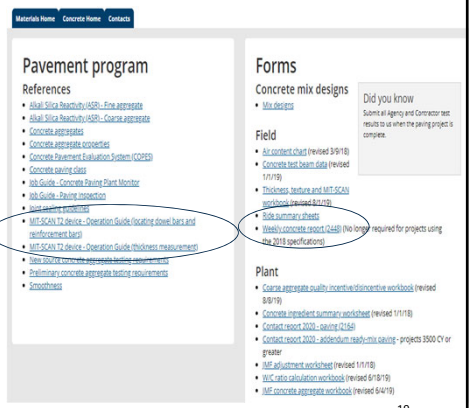
Using MIT-SCAN T2/T3 During Paving

Operation Guide for the MIT-SCAN T2

- Guide to using the MIT-SCAN T2 device for locating reinforcement bars and dowel bar baskets can be found on the MnDOT Concrete Engineering website.
- http://www.dot.state.mn.us/materials/concretepavement.html
- Use the Thickness Texture MIT-SCAN T2 Workbook for determining scanning locations.



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Dowel Bar and Tie Bar Placement Testing in Plastic Concrete

- The Contractor shall furnish a MIT-SCAN T2 or T3 non-destructive testing device.
- Agency and Contractor personnel shall mutually use this non-destructive testing device during concrete pavement construction.

Dowel Bar and Tie Bar Placement Testing in Plastic Concrete

- Contractor performs testing in the Plastic concrete when using a slip form paving machine
- Not required on projects < 3,500 cubic yards
- Perform testing in the presence of the Engineer unless otherwise approved by the Engineer

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Plastic Concrete MIT-SCAN Testing Rates

- The Engineer will identify the MIT-SCAN random testing locations using the MnDOT *Thickness, Texture and MIT-SCAN* workbook in accordance with the Schedule of Materials Control.
- Offset the location of the dowel bar test to the closest contraction joint.
- Before the start of paving, the Engineer will provide the MIT-SCAN report generated from the MnDOT *Thickness, Texture and MIT-SCAN* workbook to the Contractor.
- Unless otherwise approved by the Engineer, perform testing with the MIT-SCAN device in the presence of the Engineer.

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Fill out the Thickness, Texture and MIT-SCAN T2 Workbook **prior to start of the project**.

Go to:

http://www.dot.state.mn.us/materials/concretedocs/Thickness_Texture_MIT-SCAN_Workbook_8-1-19.xlsm

Procedures

Data Entry:

Proir to the start of the project, enter the ENTIRE project into the Data Entry tab to determine testing locations. Enter the Roadway, Direction, Lane, Begin Station, End Station, Lane Width and Thickness Requirement. Enter each lane seperately and completely before entering a new lane.

Below is an example of how to enter an unbonded overlay going under a bridge with two ramps. Note the thickness under the bridge (10 inches) is more than the rest of the mainline (8 inches).

Roadway	Direction	Lane	Begin Station (ft)	End Station (ft)	Lane Width (ft)	Thickness Requirement (in)
I-94	EB	Driving or 1 Lane Rt of Centerline	10+00	60+00	12	8
I-94	EB	Driving or 1 Lane Rt of Centerline	60+00	65+00	12	10
I-94	EB	Driving or 1 Lane Rt of Centerline	65+00	130+00	12	8
I-94	EB	Passing or 1 Lane Lt of Centerline	10+00	60+00	12	8
I-94	EB	Passing or 1 Lane Lt of Centerline	60+00	65+00	12	10
I-94	EB	Passing or 1 Lane Lt of Centerline	65+00	130+00	12	8
I-94		Ramp	0+00	12+00	18	7
I-94		Ramp	13+00	25+00	18	7

If there is a bridge within the lane, enter the lane distance before the bridge, then on the next data entry line enter the lane distance after the bridge.

Once the entire project is entered, click on the **Calculate Sublot Locations** button located on the top right of the page. This will determine the locations of the probing and coring. If you click on the **Calculate Sublot Locations** button multiple times, the random numbers will change each time the button is clicked.

The Field Probing Report, Texture Report and MIT-SCAN T2 Report can be printed and given to the Contractor. The Field Coring Report should be retained by the Agency until the Contractor is ready to core. The MIT-SCAN T2 Report only determines the location of the transverse joints.

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Demonstrating Fastening Method Each Day

- Before the beginning of concrete pavement placement and each day before beginning paving, demonstrate the fastening method to the Engineer for approval.
- The Engineer will suspend paving operations if the Contractor fails to comply with their Quality Control Plan.

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Dowel Bar and Tie Bar Placement Testing in Plastic Concrete

- Locate the dowel bar baskets and tie bar steel using the required walk bridge that spans the entire width of pavement

Plastic Concrete Contractor Testing - 1st Day

On the first day after pavement placement, verify location by:

- Scanning at least 7 doweled transverse joints every 1000 ft (both upstream and downstream side of basket)
- Scanning longitudinal (L1T) joint at a rate of at least 75 linear ft out of every 1000 ft (both ends of tie bars)

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Plastic Concrete Contractor Testing – After 1st Day

After the first day, the Engineer may allow the following reduction if the placement processes is acceptable:

- Scanning at least 4 doweled transverse joints every 1000 ft
- Scanning longitudinal (L1T) joint at a rate of at least 25 ft out of every 1000 ft

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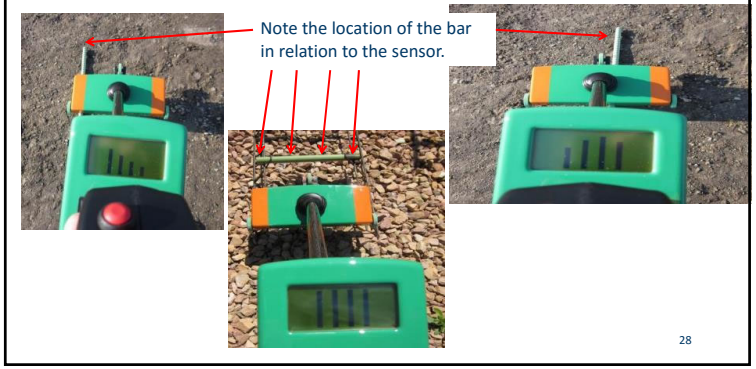
Locating Tie Bars and Dowel Bar Baskets

Four bars shown on the display represent four sensors on the bottom of the device



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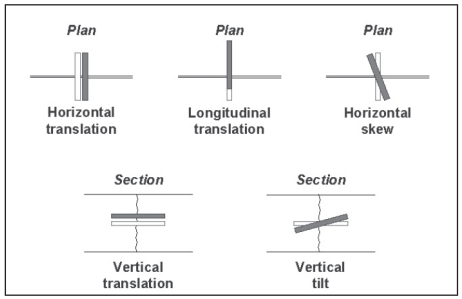
Dowel Bar Placement and Joint Construction

- Construct all joints perpendicular to the grade.
- Place dowel bars parallel to the grade and parallel to the centerline of the pavement.



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Locating Reinforcing and Dowel Bar Baskets in Plastic Concrete

Immediately after Paver

Concrete in Plastic Form

Hover the Device over the Concrete

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Locating Tie Bars and Dowel Bar Baskets

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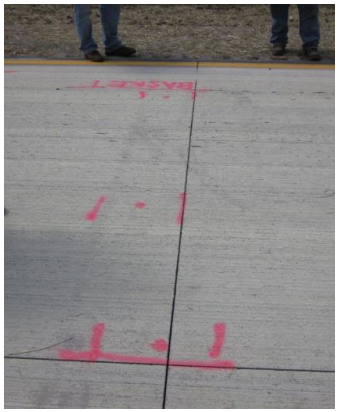
Typical Misaligned Basket Crack



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Misaligned Dowel Bars

Contractor Jig Used to Install Correctly

Dowel Bar and Tie Bar Placement Testing in Plastic Concrete

- Agency observations do not relieve the Contractor of the requirement to properly place the concrete reinforcement and dowel bars as shown in the plans.

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Documentation of MIT-SCAN T2 Results

(2/2016)

Minnesota Department of Transportation

MIT-SCAN T2 Report

S.P.: 8901-23 Engineer: T.Sanders Contractor: TUV Paving

Scan #	Name	Station	Corrected Station	Date Scanned	Within Specification Tolerance (Y/N) - Comments
13.1	TH 10, EB, Off Ramp	0+93		5/8/16	Y
13.2	TH 10, EB, Off Ramp	1+98		5/8/16	Y
13.3	TH 10, EB, Off Ramp	4+14	4+19	5/8/16	Y
13.4	TH 10, EB, Off Ramp	5+58	5+65	5/8/16	Y
13.5	TH 10, EB, Off Ramp	5+97		5/8/16	Y
13.6	TH 10, EB, Off Ramp	8+05	8+10	5/8/16	Y
13.7	TH 10, EB, Off Ramp	9+75		5/8/16	Y
1.1	TH 10, EB, 1 Lane Right of Centerline	10+04		5/5/16	Y
14.1	TH 10, EB, Off Ramp	10+97		5/5/16	Y
14.3	TH 10, WB, 1 Lane Left of Centerline	11+75	11+70	5/5/16	N - Basket was adjusted
14.2	TH 10, EB, Off Ramp	11+86		5/5/16	Y
1.2	TH 10, EB, 1 Lane Right of Centerline	12+14	12+10	5/5/16	Y
14.4	TH 10, WB, 1 Lane Left of Centerline	13+43		5/5/16	Y
1.3	TH 10, EB, 1 Lane Right of Centerline	14+05		5/5/16	Y
1.4	TH 10, EB, 1 Lane Right of Centerline	14+72		5/5/16	Y
14.5	TH 10, WB, 1 Lane Left of Centerline	14+83	14+80	5/5/16	Y
14.6	TH 10, WB, 1 Lane Left of Centerline	15+86	15+80	5/5/16	Y
1.5	TH 10, EB, 1 Lane Right of Centerline	16+29		5/5/16	Y
14.7	TH 10, WB, 1 Lane Left of Centerline	17+59		5/5/16	Y
1.6	TH 10, EB, 1 Lane Right of Centerline	18+21	18+18	5/5/16	Y

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Alignment Tolerances

Alignment Tolerances

- Dowel Bar Baskets
  - Verify the saw cut is centered on the dowel bars (+/- 3 inches)
  - Verify the dowels are anchored parallel to the centerline
- Tie Bar Steel
  - Verify the appropriate number of tie bars have been placed (more than 1 missing per panel)
  - Verify the saw cut is centered on the tie bar (+/- 5 inches)

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Out of Alignment Tolerance

- Dowel Bar Baskets
  - Scan both upstream and downstream from the mis-aligned transverse doweled joints, until at least three (3) joints are in compliance.
- Tie Bar Steel
  - Scan both upstream and downstream from the missing or mis-aligned tie bars, until at least three (3) consecutive panels are in compliance.

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Out of Alignment Tolerance

- If at any time the Engineer determines the dowel bar anchoring or tie bar placement processes are unacceptable due to alignment/tolerance issues, the Engineer may request the Contractor amend the placement process for the operation in question to achieve satisfactory placement of the dowel bars and tie bars.
- The Engineer will consider concrete pavement that fails to comply with the alignment tolerances as unacceptable Work in accordance with 1512, “Unacceptable and Unauthorized Work.” The Engineer, in conjunction with the Concrete Engineer, will evaluate the defective concrete pavement in accordance with 2301.3Q “Workmanship and Quality.”

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Recommendations for alignment tolerances issues

- There is no single recommendation for misalignment – handled on a case-by-case basis
- Determine the severity of the misalignment
  - # of occurrences (random or single areas)
- Contact the Concrete Engineering Unit for recommendations which may include the following:
  - Monetary adjustment for future maintenance
  - Not paying for dowel bars
  - Full Depth Repairs (No partial depth repairs!!)
  - Sawing through dowels

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Is it working?

- No real issues for the last 2+ years with dowel bar baskets
  - *"Everyone much more aware of the issue and inspectors and Contractors are checking the baskets throughout the day where they did not before" – Rob Golish*
- Design-Build Projects
  - MnDOT considers dowel basket anchoring commitment as a scoring criteria
    - Contractors propose increased frequency of testing of plastic concrete
    - Increased warranty
    - Use of MIT-SCAN II (dowel scanner) in hardened concrete

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Thank you again!

For additional information or specs:

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