In House Research
NDOR Research Section

Evaluation of PCC Pavement Thickness Determination by MIT-T2 Scan

Nebraska Department of Roads

Research Project:
Evaluation of PCC Pavement Thickness Determination by MIT-T2 Scan

Location: In- House Research

Project Site Location: Fremont Bypass Hwy 275, Van Dorn Street between 9th street and Highway 77 and I-80 Westbound at 56st Interchange

Starting Date: 06-18-2008

Completion Date: 06-23-2008

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Figure2. NDOR Personnel field testing

Introduction:

Nebraska Department of Roads received the MIT-Scan-T2 (Device for Nondestructive Testing of Pavement Thickness) as a loan by The Federal Highway Administration's (FHWA's) Concrete Pavement Technology Program (CPTP). This program enables the State DOT's to evaluate new technologies. The MIT-Scan-T2 measures the thickness of a pavement in a non-destructive manner, using a magnetic tomography technology.
Traditionally, the thickness measurement is performed by taking cores and measuring the height of the core by ASTM C 174 method. This Quality Control/Quality Assurance (QA/QC) measurement is a time consuming/destructive process of in place-concrete.

The instrument can measure thickness to a depth of 18 inches. It uses a reflector disc zinc steel clad material, which is placed on the foundation coarse before the concrete placement. The disc must need to be placed with a nail in order to be remaining in-situ of placement. The discs are trace by the MIT-T2 Scan equipment and it's displaced the thickness reading in metrics. The steps of equipment use are described in Figure 1.

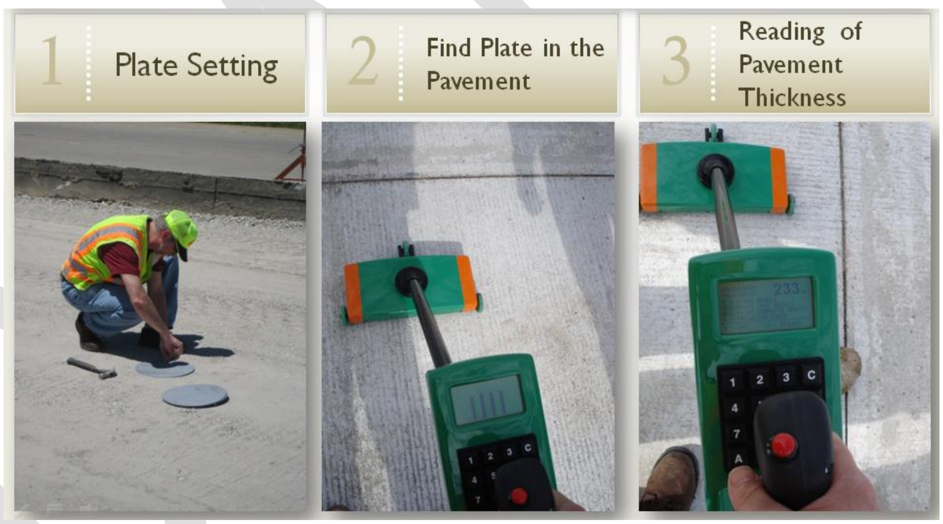

Figure1. Steps of Equipment Use

Purpose of In-House Investigation: The principle objective of this investigation is to find out if NDOR can pursue other methods for measuring thickness. Traditionally, this measurement has been performed by taking cores and measuring the height of the cored PCC. Because coring is a time-consuming and destructive process, only a small number of cores are taken to evaluate thickness of in-place concrete. The purpose of this project is to evaluate the capabilities of this equipment to correlate readings from core measurements with an accuracy a $\pm$0.25 inch to verify thickness.

Objective of this Investigation:

- The ability to trace the reflector disc in-situ concrete placement.
- The MIT-Scan-T2 reading correlation with the actual core thickness reading.
- The friendliness of functionality, applicability and ease of equipment use.

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Field Evaluation: This evaluation was based on three field performances. The first field evaluation was part of a paving operation in Fremont, Nebraska at Highway 275; this pavement was designed for a 9 inch doweled pavement. Eight steel plates were evaluated by the MIT-Scan-T2. The reflector disks were placed 7 ft from the edge of the slab as shown in Figure 3 and Figure 4.

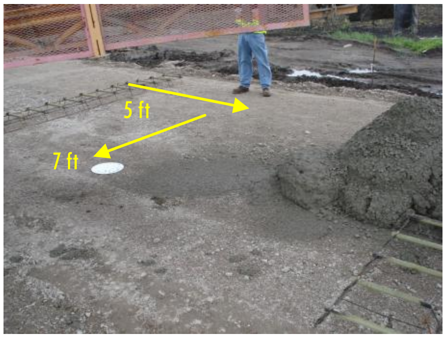

Figure3. Plate location

Figure4. Plate location

The plate's locations are listed in the following Table along with the MIT-Scan_T2 and 9 point core reading (ASTM C 174) results. NDOR Specifications require the core to be less than 0.25 inches from design thickness. If the core thickness is greater than 0.25 inches, then there is a payment deduction for the deficient pavement thickness.

Table.1.- Field Information

Plate	Stations	Thickness Reading MIT- T2-Scan (mm)	Thickness Reading MIT- T2- Scan (in)	9 Point Core Reading (in)	Difference between MIT-T2 Scan and 9 Point Core Reading (in)
1	49+07	273	10.74	10.49	.26
2	48+22	253	9.96	9.70	.26
3	47+95	277	10.90	10.67	.24
4	45+00	220	8.66	8.44	.22
5	44+62	229	9.01	8.75	.27
6	44+00	216	8.50	8.31	.19
				Average	**0.24**

This first trial has proven that the equipment is user friendly, lightweight and able to identify the plate locations. Its ease of use and the fact there is no calibration required, saves time with less data to input. However, the MIT-SCAN-T2 requires pre-planning and placing of reflectors over the base coarse prior to paving. The evaluation has shown the MIT-Scan-T2 can be able to correlate with the 9 point core reading with an average of 0.24 inches resulting from 6 data points made in the field.

The second and third evaluations were part as a paving operation at Van Dorn Street between 9th street and Highway 77 and I-80 Westbound at the 56th street interchange both in Lincoln, Nebraska. These two pavements were design for 9 inch and 13 inch doweled pavement. The results for the MIT- T2 Scan reading conducted in the field for these two locations are represented in the Table 2 and Table 3. These tables describe the numbers of readings performed in the field and the comparison between thickness readings by the 9 point count core reading and the MIT-Scan-T2 reading.

Table 2. Reading Comparison between MIT-T2-Scan and Core Measurement at I-80 Westbound at the 56th street Interchange

Plate	Stations	Thickness Reading MIT- T2-Scan (mm)	Thickness Reading MIT-T2- Scan (in)	9 Point Core Reading (in)	Difference between MIT-T2 Scan and 9 Point Core Reading (in)
1	918+00	335	13.189	12.990	0.199
2	917+00	332	13.071	12.860	0.211
3	916+00	335	13.189	13.030	0.159
4	915+00	334	13.150	12.920	0.230
5	914+00	343	13.504	13.240	0.264
6	913+00	337	13.268	13.050	0.218
7	912+00	333	13.110	12.890	0.220
8	911+00	340	13.386	13.140	0.246
9	910+00	338	13.307	13.070	0.237
10	909+00	330	12.992	13.150	-0.158
				Average	**0.24**

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Table 3. Reading Comparison between MIT-T2-Scan and Core Measurement at Van Dorn Street between 9th street and Highway 77

Plate	Stations	Thickness Reading MIT- T2-Scan (mm)	Thickness Reading MIT-T2- Scan (in)	9 Point Core Reading (in)	Difference between MIT-T2 Scan and 9 Point Core Reading (in)
1	33+17	240	9.449	9.372	0.077
2	34+17	240	9.449	9.322	0.127
3	35+17	237	9.331	9.200	0.131
4	36+17	237	9.331	9.183	0.147
5	37+17	237	9.331	9.222	0.109
6	38+17	237	9.331	9.189	0.142
7	39+17	237	9.331	9.172	0.159
8	40+17	245	9.646	9.500	0.146
9	41+17	237	9.331	9.183	0.147
10	42+17	242	9.528	9.156	0.372
11	50+09	240	9.449	9.328	0.121
12	51+09	240	9.449	9.356	0.093
13	52+09	239	9.409	9.306	0.104
14	53+09	240	9.449	9.406	0.043
15	54+09	244	9.606	9.500	0.106
16	55+09	240	9.449	9.383	0.066
17	56+17	243	9.567	9.533	0.034
18	57+17	243	9.567	9.511	0.056
19	58+17	244	9.606	9.606	0.001
20	59+17	243	9.567	9.361	0.206
21	60+22	238	9.370	9.461	-0.091
22	61+22	240	9.449	9.328	0.121
23	62+22	237	9.331	9.228	0.103
24	63+22	249	9.803	9.683	0.120
				Average	**0.15**

Evaluation Summary:

- The equipment was simple, easy, and quick to operate
- The reflector disc zinc steel clad material could be made locally
- MIT-T2-Scan was able to correlate the cores with an average of
  - 0.15 in for 9" pavement which represents about 1.73 ~ 2% to correlate to thickness in situ,
  - 0.24 in for 13" pavement which represents about 1.82 ~ 2% to correlate to thickness in situ,

Based on the Results of this limited study, further research should be pursued to

- Develop a procedure for maintaining the integrity and randomness of the thickness verification with the equipment
- Develop a correction factor if any to apply to the MIT reading in order to correlate to the actual thickness found from the cores reading
- Compared results with current pavement thickness acceptance procedures on actual projects and develop cost analysis

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