NORTHWEST
AIRLINES
DTW Midfield Terminal Project
Detroit Metropolitan Airport
2800 Midfield Drive
Detroit, MI 48242

Phone: 734-247-5816
Fax: 734-247-5848

CONTRACT No. MTP2920
TRANSMITTAL No. 00001

DATE: 7/20/2006

To: Wayne County Airport Authority
Planning & Capital Improvement
Detroit Metropolitan Airport
LC Smith Terminal - Mezz
Detroit, MI 48242
Fax: (734) 247-7138
Attn: Wayne G. Sieloff

Project: HWD Testing of Rubblized Taxilane
Reference: Report on Rubblized Area

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Item No.	Copies	Date	Ref. Item	Ref. No.	Description	Status
1		7/20/2006			SME Report of testing of Rubblized Areas	NEW

Attached is the letter and report from Soil and Materials Engineers (SME) on the Heavy Weight Deflectometer testing of the Rubblized sections of Taxiway W1. Although the decision was made to not utilize the Rubblization of existing Runway 3R for its reconstruction, the attached report shows that the concept has merrit and may be appropriate for future work at DTW.

Consistent with the small test locations dug up as part of the Rubblization Testing of the Antigo and RMI areas, the non-destructive testing indicates that the Antigo machines rubblized the entire 17" concrete section very well but the RMI machine did not rubblize the entire 17" section evenly in all areas.

If you have any questions or need additional data from SME, please call me at 734-247-5816.

cc: Contract File, Read File
B. Ruppert (NWA), M. Loeffelholtz (NWA), D. Wellhouse (FAA), D. Kerber (
R. McQueen, E. Lukanen (U of Minn), R. Pattison (RMI), J. Jansen (Antigo)

Signed: W. J. Hoyer
William J. Hoyer
Resident Engineer

/00001 exp

MTP-2920

Soil and Materials Engineers, Inc.
The Kramer Building
43980 Plymouth Oaks Blvd.
Plymouth, MI 48170-2584
tel (734) 454-9900
fax (734) 454-0629
www.sme-usa.com

July 17, 2006

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NORTHWEST AIRLINES
DTW MIDFIELD PROJECT

Mr. William J. Hoyer, PE
Northwest Airlines, Inc.
Midfield Project Office
Detroit Metro Airport
2800 Midfield Drive
Detroit, MI 48242

RE: Nondestructive Testing Rubblized Test Sections
Taxiway W1 DTW
SME Project PP52499

Dear Mr. Hoyer:

We have completed the testing and analysis of the rubblized test sections on Taxiway W1. The test sections were performed to evaluate the effectiveness of rubblizing equipment on the 17 inch PCC section which is predominant on the airport. Two types of equipment were used to rubblize the pavement. A RMI resonant breaker was used on section one and an Antigo multi-head breaker was used on section two. Each of the rubblized sections were overlaid with 3 inches of hot mix asphalt prior to deflection testing. The rubblizing was performed in late April 2006. The pavement section was 17 inches of reinforced PCC over 9 inches of bituminous base over an aggregate base resting on a cohesive subgrade.

On May 2, 2006, SME performed deflection testing on the two rubblized sections as well as on the original concrete pavement. Testing was performed using a Dynatest Model 8081 Heavy Weight Deflectometer. Two lanes were tested on each rubblized section, and one lane was tested on the original concrete section. For analysis of the sections, the load was normalized to 40,000 pounds.

Deflection Data

The deflection data is summarized in table 1. Lanes 1 and 2 represent the RMI section while lanes 3 and 4 represent the Antigo section. Lane 5 represents the original PCC pavement. The average deflection under the load for the RMI section was 18.6 mils. The average deflection under the load for the Antigo section was 29 mils. The original concrete section averaged 4.8 mils under the load. Lane 6 represented the tests taken on the HMA shoulder.

Plymouth
Bay City
Grand Rapids
Kalamazoo
Lansing
Shelby Township
Toledo
Traverse City

The data is presented graphically in figures 1, 2, 3, and 4. The data point at lane 1 105 feet represents the test trench dug to evaluate the rubblizing of the RMI machine, while the data point at lane 4 88 feet represents the trench location in the Antigo section. The trenches had been backfilled with 21AA aggregate with only light compaction.

Back Calculation

The deflection data was analyzed using the TTI program Modulus to determine the elastic modulus of the pavement layers for the rubblized sections. The original PCC section was determined to have the following values:

Layer	Average Modulus, psi	Standard Deviation, psi
PCC	5,584,000	1,984,000
AC	610,000	342,000
Subgrade	47,000	5,000
Error/sensor	1.3%	0.7%

The RMI lanes were determined to have the following values:

Layer	Average Modulus, psi	Standard Deviation, psi
Rubblized	229,000	110,000
Subgrade	55,800	9,600
Error/sensor	10.9%	2.8%
AC	750,000 fixed	

The Antigo lanes were determined to have the following values:

Layer	Average Modulus, psi	Standard Deviation, psi
Rubblized	113,000	42,000
Subgrade	26,600	3,800
Error/sensor	5.0%	3.8%
AC	750,000 fixed	

Discussion

As shown, the deflections were uniform for each piece of rubblizing equipment. The back calculation data indicates that the Antigo machine provided a more uniform result as compared to the RMI breaker. The modulus of the rubblized PCC was 113,000 psi for the Antigo Machine while the RMI produced a layer with 229,000 psi. The error in the measured versus calculated deflection was only 5% for the Antigo date while the RMI data produced errors or 10.9 percent. The higher error for the RMI section indicates that the rubblized layer may have to be subdivided to get a better match of the basins. This indicates that the slab is not rubblized evenly through the entire thickness. Based on the modulus values determined in the Antigo lanes, it appears that the slab has been uniformly rubblized.

Recommendation

Based on the data collected in this test program, it appears that the multi-head breaker is capable of rubblizing the full depth of the 17 inch concrete slab. This is also supported by a project performed at Selfridge ANGB where 21 inches of PCC was rubbilized. The Selfridge project is now about 6 years in service and is still in excellent condition. The data indicates a modulus of 100,000 psi could be assigned to the rubblized layer for the purposes of thickness design. Although, the energy could be slightly reduced and an increased modulus would result.

In a recent paper by the US Army Corps of Engineers (**Rehabilitation of Airfield Concrete Pavement using the Rubblization Procedure, by** Eileen M. Vélez-Vega, see attached) it was determined that the rubbilization process with an AC overlay cost about 40 percent of a remove and replace option. Certainly, for parts of the infrastructure that are less utilized this is a very attractive option.

The key to good performance of a rubbilization project is the uniformity of the process. Since the pavement at DTW is relatively thick and the pavement is supported on a stabilized base, it is a good candidate for rubbilization. As shown in this test the Antigo Multi-head breaker did an efficient job of breaking the concrete. Pavements with less thickness and supported on subgrade may not perform as well.

Based on these test results, we believe rubbilization is a viable process for maintaining the pavement network at DTW. We would anticipate overlay thicknesses to range from 5 to 9 inches depending upon traffic usage areas. A service life of 15 years could be expected with a mill an overlay option available at this point in service. The mill and overlay could extend the pavement life another 7 to 9 years.

We appreciate the opportunity to be of service to you on this project. If you have any questions regarding this information, please do not hesitate to contact us.

Very truly yours,

SOIL AND MATERIALS ENGINEERS, INC

Starr D. Kohn, PhD, PE
Senior Vice President

Attachments: Table 1
Figures 1-4
Vega Paper

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Table 1: Deflection Data

Location	Distance (Feet)	Lane	Deflection (mils) for 40,000 lb Load at						
			0"	8"	12"	18"	24"	36"	60"
RMI Rubblized	0	1	20.7	11.7	7.6	5.4	5.0	4.7	3.6
RMI Rubblized	0	1	17.8	10.5	7.2	5.4	5.1	4.6	3.5
RMI Rubblized	0	2	16.2	10.7	6.3	4.3	4.2	3.9	3.0
RMI Rubblized	25	1	19.1	11.8	7.6	4.9	4.4	3.9	2.8
RMI Rubblized	25	2	15.1	9.3	6.2	4.9	4.7	4.2	2.9
RMI Rubblized	50	1	24.4	12.8	7.0	4.0	3.8	3.8	2.9
RMI Rubblized	50	2	15.8	9.5	6.1	4.4	4.1	3.9	2.8
RMI Rubblized	75	1	29.7	15.8	8.9	5.2	4.6	4.1	3.0
RMI Rubblized	75	2	14.3	8.4	5.3	3.8	3.7	3.4	2.6
RMI Rubblized	100	2	11.6	6.7	4.7	3.8	3.6	3.2	2.4
RMI Rubblized	124	2	15.7	8.7	5.4	4.0	3.9	3.5	2.6
RMI Rubblized	126	1	25.8	17.8	10.7	5.9	5.1	4.6	3.3
RMI Rubblized	139	1	18.4	10.2	6.9	5.2	5.0	4.5	3.2
RMI Rubblized	144	2	16.0	8.4	5.8	4.7	4.6	4.2	3.1
Average			**18.6**	**10.9**	**6.8**	**4.7**	**4.4**	**4.0**	**3.0**
Standard Deviation			**5.0**	**3.0**	**1.6**	**0.7**	**0.5**	**0.5**	**0.3**
Antigo Rubblized	0	3	32.2	22.3	16.4	11.8	10.2	8.2	5.7
Antigo Rubblized	0	4	39.3	24.9	17.0	11.2	9.6	7.6	6.2
Antigo Rubblized	25	3	30.5	21.0	15.7	11.0	9.5	7.1	4.2
Antigo Rubblized	25	4	26.9	17.9	12.9	9.0	7.8	6.0	4.0
Antigo Rubblized	50	3	24.7	16.7	12.6	9.2	8.1	6.4	3.9
Antigo Rubblized	50	4	26.6	17.8	12.8	9.1	8.1	6.6	4.2
Antigo Rubblized	75	3	25.4	16.9	13.2	9.8	8.5	6.6	4.1
Antigo Rubblized	75	4	27.6	19.5	14.7	10.6	9.2	6.7	4.0
Antigo Rubblized	88	4	56.3	46.0	36.9	25.6	19.4	8.8	4.7
Antigo Rubblized	100	3	26.0	17.6	13.3	9.3	7.9	5.8	3.6
Antigo Rubblized	100	4	28.7	20.4	15.7	11.3	9.7	7.0	4.2
Antigo Rubblized	126	4	21.4	13.8	10.0	8.0	7.5	6.3	4.1
Antigo Rubblized	127	3	23.8	17.0	12.7	8.9	7.7	6.1	3.9
Antigo Rubblized	137	3	23.6	15.0	11.6	9.5	8.9	7.0	3.8
Antigo Rubblized	140	4	21.8	13.6	10.2	8.3	7.8	6.4	4.0
Average			**29.0**	**20.0**	**15.0**	**10.8**	**9.3**	**6.8**	**4.3**
Standard Deviation			**8.8**	**7.8**	**6.4**	**4.2**	**2.9**	**0.8**	**0.7**
Original Concrete Pavement	0	5	4.7	4.1	4.1	3.8	3.6	3.2	2.5
Original Concrete Pavement	25	5	4.9	4.4	4.4	4.0	3.8	3.3	2.5
Original Concrete Pavement	50	5	4.7	4.1	4.1	3.8	3.6	3.1	2.3
Original Concrete Pavement	75	5	4.2	3.9	3.8	3.5	3.4	2.9	2.3
Original Concrete Pavement	100	5	4.0	3.8	3.6	3.4	3.2	2.8	2.2
Original Concrete Pavement	116	5	6.2	5.2	4.6	4.0	3.7	3.1	2.3
Original Concrete Pavement	124	5	4.3	4.0	3.7	3.5	3.3	2.9	2.2
Original Concrete Pavement	150	5	5.2	4.5	4.4	4.1	3.9	3.4	2.5
Average			**4.8**	**4.3**	**4.1**	**3.8**	**3.6**	**3.1**	**2.4**
Standard Deviation			**0.7**	**0.5**	**0.4**	**0.3**	**0.2**	**0.2**	**0.1**

Location	Distance (Feet)	Lane	Deflection (mils) for 40,000 lb Load at						
			0"	8"	12"	18"	24"	36"	60"
Asphalt Shoulder	0	6	99.0	93.6	80.3	63.4	53.4	30.3	10.9
Asphalt Shoulder	25	6	91.7	80.7	70.6	57.4	49.1	28.4	10.1
Asphalt Shoulder	49	6	99.0	99.0	88.1	66.3	55.2	29.7	8.5
Asphalt Shoulder	75	6	67.5	60.8	55.2	45.4	39.8	25.1	10.3
Asphalt Shoulder	100	6	99.0	99.0	90.4	67.9	57.8	32.3	9.6
Asphalt Shoulder	122	6	79.6	71.7	65.6	54.9	48.4	29.8	11.0
Asphalt Shoulder	149	6	81.6	72.7	65.9	53.9	46.4	26.9	8.5
Average			**88.2**	**82.5**	**73.7**	**58.5**	**50.0**	**28.9**	**9.8**
Standard Deviation			**12.3**	**15.0**	**13.0**	**8.0**	**6.1**	**2.4**	**1.0**

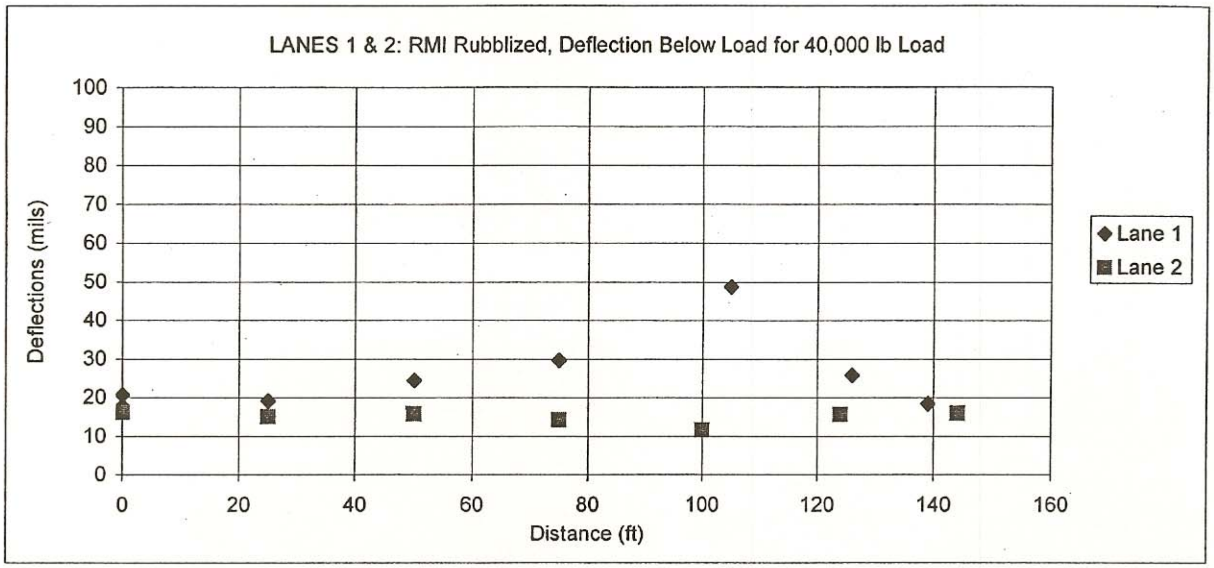

Figure 1: RMI Resonant Breaker Section: Deflection below Load for a 40,000 lb Load

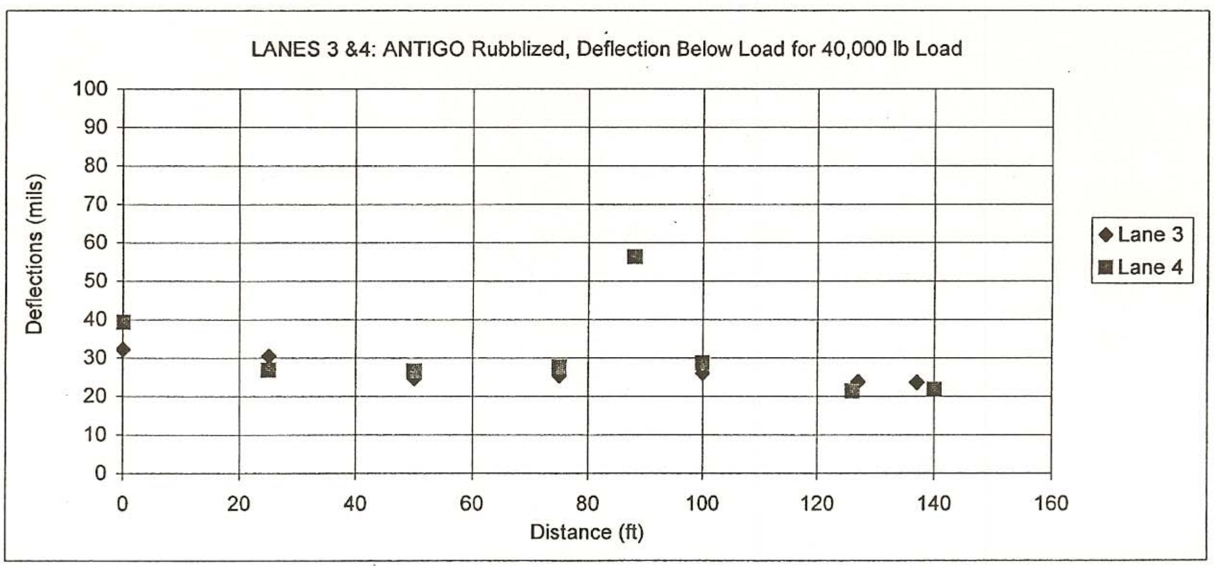

Figure 2: Antigo Section: Deflection below Load for a 40,000 lb Load

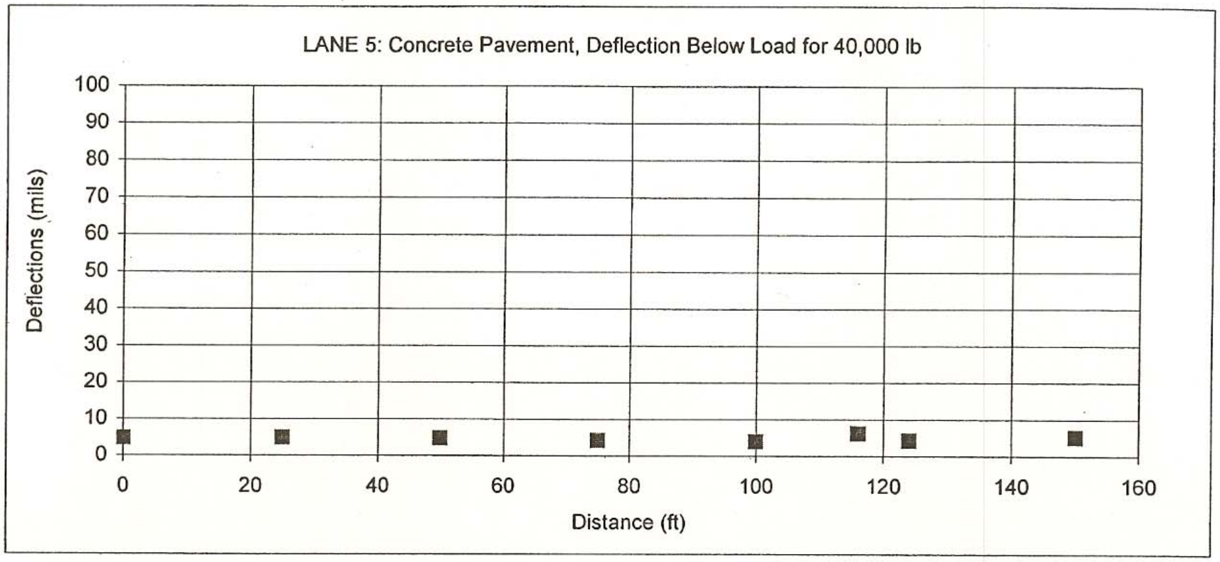

Figure 3: Original PCC Section: Deflection below Load for a 40,000 lb Load

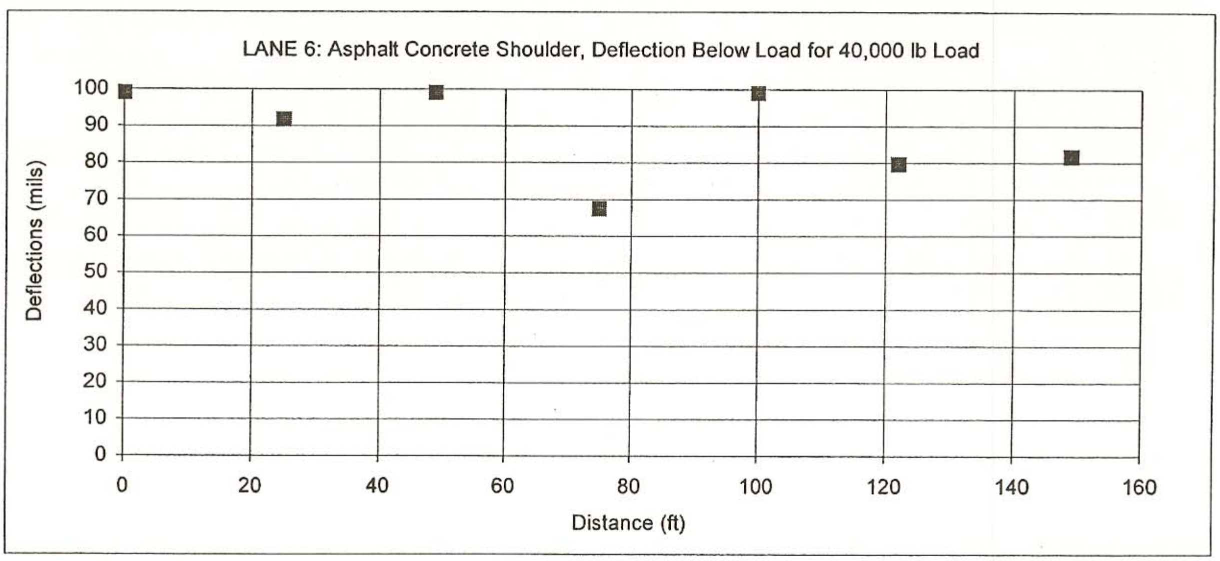

Figure 4: Asphalt Concrete Shoulder: Deflection below Load for a 40,000 lb Load