

Antigo

Modified Rubblization



Presented by Matt Shinnars, Antigo Construction, Inc., 3/2/16

MAPA 60th Annual Asphalt Contractors' Workshop

Rubblization defined

“The intent of rubblizing concrete pavement prior to a pavement overlay is to produce a structurally sound base which prevents reflective cracking by obliterating the existing pavement distresses and joints. . . . It is not a typical granular material and it is not an engineered material like crushed aggregate base course.”

*From “Rubblizing Concrete Pavement” section of Wisconsin DOT
Construction & Materials Manual*

Obliterating the existing pavement distresses and joints



Early research

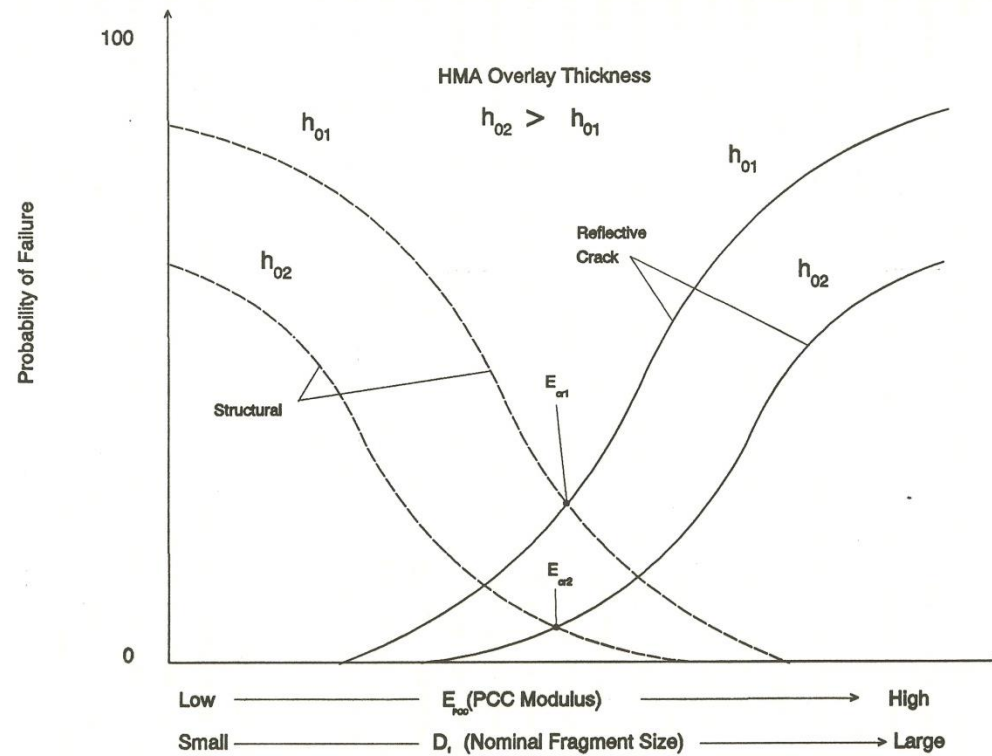


FIGURE 62 INFLUENCE OF PCC FRACTURED MODULUS AND HMA OVERLAY THICKNESS UPON STRUCTURAL AND REFLECTIVE CRACK FAILURE

Typical rubblized particle sizes

- Most specifications require surface particles in 2" to 4" range
- Most specifications require particles at depth in 6" to 12" range

Typical modulus values

- 1000 ksi is typical threshold for crack & seal today
- Recent FWD analyses typically report modulus values for fully rubblized concrete layer in the 50 to 100 ksi range for typical 9- to 12-inch thick highway pavements

Localized failure – weak subgrade



Rubblized particle size consideration & “modified rubblization”

The particle size acceptance criteria are generally met when rubblizing over subgrade/base providing fair to good support. At times it is impossible to meet these criteria when support is fair to poor. It is often counterproductive to try to achieve small particle sizes in these situations because the resulting rubblized concrete layer would not provide adequate structural support for the overlay. Experience has shown that a “**modified rubblization**” that employs less fracture energy in order to produce a somewhat stiffer rubblized concrete layer (larger concrete particle sizes) will maintain enough of the concrete layer’s strength to support construction operations and the new asphalt overlay and still effectively eliminate reflective cracking.

WisDOT addresses modified rubblization in engineer guidance

“Attention must also be paid to constructability. Even if it is possible to produce small particle sizes, the resulting layer must still provide a working platform for paving operations and a stable foundation for the pavement overlay. In cases of isolated, very weak subgrade, subgrade correction may be appropriate. **Another way to compensate for weak subgrade is to modify the rubblizing pattern to produce larger particle sizes** which maintain more of the existing concrete pavement’s structural support. Experience has shown that **segments of twelve to eighteen inches in the lower half of the slab are still effective for eliminating reflective cracking.**”

From Section 3.50 “Rubblizing Concrete Pavement” of the Wisconsin DOT Construction & Materials Manual

WisDOT addresses modified rubblization in rubblization specification

“The engineer may direct or allow larger maximum particle dimensions.”

From “Section 335 Rubblized Pavement” of Wisconsin DOT 2014 Standard Specifications

Keys to a successful modified rubblization project

- Achieve full-depth slab fracture while maintaining good particle interlock
- Maintain adequate structural support in rubblized concrete layer to compensate for low subgrade support
- Minimize construction traffic on rubblized concrete until at least the first lift of asphalt is placed

Characterizing full rubblization & modified rubblization

Antigo uses the following descriptions to describe the range of fractured slab techniques performed with the MHB Badger Breaker®:

Full rubblization: typically 2" minus particles at the surface, typically 6" to 12" particles at the bottom of the slab.

Modified rubblization – significant spalling: 12" minus particles at the surface, significant surface spalling, surface appearance ranges from smooth to pulverized, 75% of the particles at the bottom of the slab are 15" minus size.

Modified rubblization – occasional spalling: full-depth and clearly visible cracks, crack spacing of 12" to 18", occasional surface spalling.

Crack & seat with MHB: full-depth, hairline cracks at the surface (sometimes only visible with the aid of water), crack spacing of 24" to 36", minimal surface spalling.

Full rubblization



Full rubblization



Modified rubblization – significant spalling



Surface after rolling with grid roller



More significant surface spalling



Modified rubblization – occasional spalling



Clearly visible cracks



Antigo's Modified Rubblization Spec

Antigo Construction Family of Companies



MODIFIED RUBBLIZATION SPECIFICATION

Antigo's Modified Rubblization Spec

Description

(1) This section describes modified rubblization and the rolling and seating of existing concrete pavement to create a stable construction platform for a pavement overlay either with or without an intermediate base layer.

General

(1) Use a self-contained, self-propelled multi-head breaker. Use 10-ton or heavier rollers and roll at 6 feet per second or slower. Run vibratory rollers at an engineer-approved frequency and amplitude. A roller pass is defined as down and back in the same path.

(2) Before rubblizing, saw full-depth joints and completely sever load transfer devices to isolate the rubblized area from areas not to be rubblized. Saw jointed pavements at an existing transverse joint. Do not damage adjacent pavement during rubblization. Repair damage to the adjacent pavement caused by contractor operations as the engineer directs.

Modified Rubblization

(1) Fracture the concrete full-depth and uniformly across the pavement width. The engineer will designate one of the two categories of modified rubblization as described below:

Modified Rubblization—significant spalling

Achieve 12-inch minus size particles at the surface, significant surface spalling, and a surface appearance that ranges from smooth to pulverized. 75% of the pieces at the bottom of the slab shall be 15" minus in size. The pavement surface should look similar to the surface in the following two pictures:



Modified Rubblization—significant spalling

Antigo's Modified Rubblization Spec



Modified Rubblization—significant spalling

Modified Rubblization-occasional spalling

Achieve 12-inch to 18-inch sized pieces identified with clearly visible cracks at the surface. Occasional surface spalling may occur. The pavement surface will typically look similar to the surface in the following two pictures:



Modified Rubblization-occasional spalling

Antigo's Modified Rubblization Spec



Modified Rubblization-occasional spalling

(2) The engineer may direct or allow larger maximum particle dimensions if existing pavement or sub-grade conditions require larger particles in order to create a stable construction platform.

(3) Do not damage pipes, valve boxes, manholes, and other fixtures. Repair any damage that occurs as the engineer directs.

(4) Remove any reinforcing steel exposed at the surface by cutting below the surface and disposing of the steel. Do not remove unexposed reinforcing steel.

Rolling/seating

(1) Roll the rubblized area using two passes with a vibratory steel roller. The engineer may adjust the number of passes to achieve the desired seating and stability.

(2) Remove loose asphaltic patching material, joint fillers, expansion material, or other similar materials from the compacted surface. Also remove pavement or patches that have a maximum dimension greater than or equal to 6 inches that are either not well seated or are projecting more than one inch above the surface. Dispose of removed material.

(3) If paving with no intermediate base layer, roll the entire surface additionally, unless the engineer directs or allows otherwise, as follows:

1. One pass with a pneumatic-tired roller.
2. One pass with a vibratory steel roller.

Antigo's Modified Rubblization Spec

Measurement

(1) The owner will measure Modified Rubblization by the square yard acceptably completed.

Payment

(1) The owner will pay for the measured quantity at the contract unit price under the following bid item:

<u>DESCRIPTION</u>	<u>UNIT</u>
Modified Rubblization	SY

(2) Payment is full compensation for rubblizing; removing exposed steel; rolling; disposing of removed material and repairing damage to pipes, fixtures, and the adjacent pavement.

(3) The owner will pay separately for sawing under a Sawing Concrete bid item.

NOTE: This specification is a modification of the Wisconsin DOT standard specification, Section 335 Rubblized Pavement. This specification was created by Antigo Construction, Inc. to assist those interested in specifying modified rubblization.

Break & seat with MHB – Ohio DOT



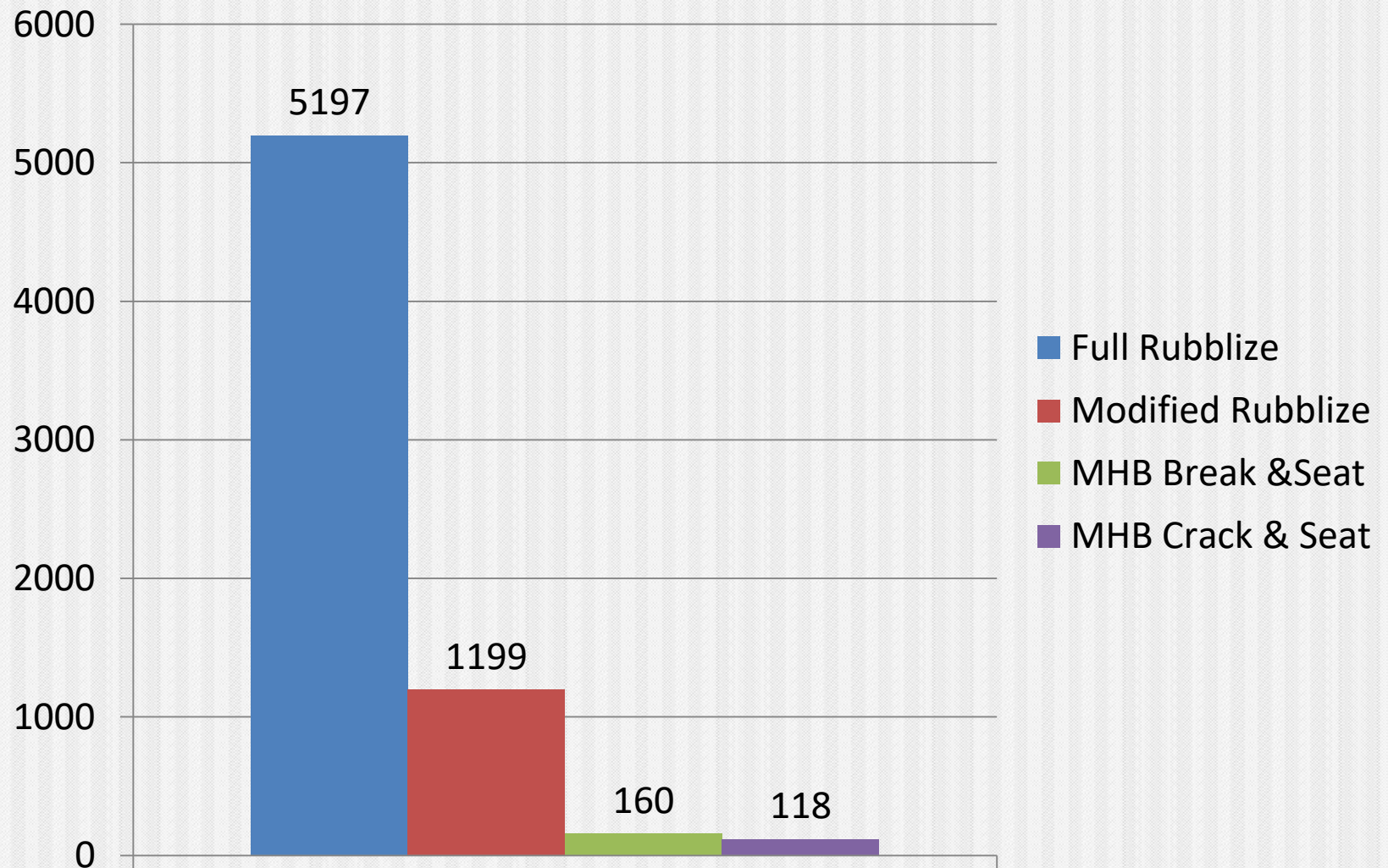
Crack & seal with MHB – Iowa Counties



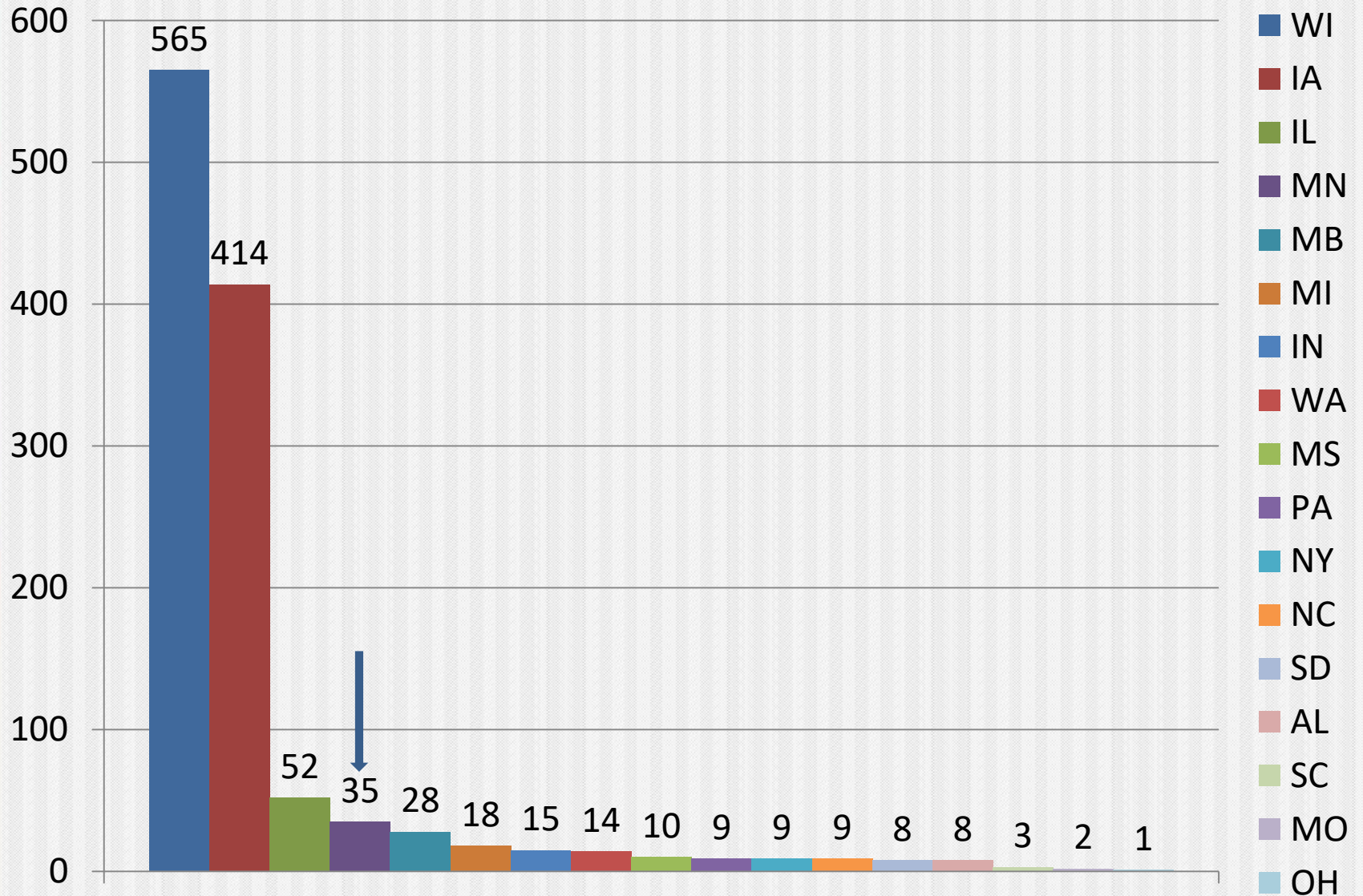
Visible hairline cracks



Lane miles by level of fracture performed by Antigo



Lane miles of modified rubblization by state



Crushed stone layer over rubblized



RAP layer over rubblized



MN modified rubblization projects

Roadway	Location	County	Year	Lane miles	PCC Type	New Base	HMA O/lay
CSAH 88	Carlisle	Otter Tail	2004	8.60	8" JPCP	4" CABC	3.5"
CSAH 4	Beaver Creek	Rock	2006	8.40	7-9" JRCPP	6" CABC	7.5"
16th Ave NE	Austin	Mower	2009	0.40	8" JPCP	2" CABC	6"
CSAH 16	e/o Brush Creek	Faribault	2011	8.20	7-9" JPCP	6" CABC	6"
CSAH 16	TH 22 - Freeborn C.L.	Faribault	2012	6.20	7-9" JPCP	6" CABC	6"
CSAH 6	n/o Blue Earth	Faribault	2015	2.80	7-9" JRCPP	6" CABC	6"

Faribault County Rubblization Spec, 2015

S-11 (2104) RUBBLIZE CONCRETE PAVEMENT

S-11.1 After the Milling operation is complete, Rubblizing Concrete Pavement shall commence. Rubblizing Concrete Pavement consists of using a self propelled multiple head concrete breaking machine capable of rubblizing the in-place 9"-7"-9" x 20' concrete pavement. The machine shall be capable of controlling the striking force so as to break the concrete into pieces up to 9 inches in size. The force used shall be only what is needed to obtain this 9-inch and less specification. The operation shall then be followed by a tandem vibratory steel drum roller outfitted with steel Z-bars on one roller.

S-11.2 The intent is to break the concrete pavement, compact the concrete rubble and cover the concrete rubble with Aggregate Base on a daily basis.

S-11.3 Prior to placing aggregate base all protruding rebar shall be removed or cut at the surface and all rubber or flexible debris shall be removed. This operation shall be incidental to Rubblize Concrete Pavement and no direct compensation shall be made therefore.

S-11.4 No public traffic is allowed on the broken (rubblized) concrete. Minimize construction traffic on the rubblized concrete.

S-11.5 After the pavement has been rubblized and prior to covering with aggregate, test holes may be dug so as to allow the Engineer to ensure that full depth rubblization is occurring. There shall be a minimum of three holes per mile. The Engineer shall determine the location of the test holes. This operation shall be paid for as pay item 2321.601, Tractor Mounted Backhoe hours.

CSAH 16, Faribault County, 2012



CSAH 16, Faribault County, 2012



CSAH 6, Faribault County, 2015



CSAH 6, Faribault County, 2015



Survival Analysis for Composite Pavement Performance in Iowa

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ABSTRACT

This study investigates the performance of composite pavements composed of a flexible layer over a rigid base. Four composite pavement rehabilitation methods are involved in the research: mill and fill, structural overlay, rubblization and heater scarification. Survival analysis is used to evaluate the four methods by three pavement performance indicators: reflective cracking, International Roughness Index (IRI), and Pavement Condition Index (PCI). It is found that **rubblization can significantly retard reflective cracking development in composite pavements compared with the other three methods**. No significant difference for PCI is seen in the survival analysis for the four rehabilitation methods. Heater scarification shows the lowest survival probability for both reflective cracking and IRI. Further, parametric survival models are employed to analyze the influence factors on the reflective cracking for the four composite pavement rehabilitation methods. Traffic level is found not to be a significant factor for reflective cracking development. Overlay and removal thickness can significantly delay the propagation of reflective cracking and the soil type can influence the use of rubblization in the field. However, **modifying the rubblization pattern may compensate for a weak subgrade**.

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To whom it may concern:

The Webster County Secondary Road Department completed pavement rehabilitation projects in 2010, 2011, and 2012. The scope of work included modified rubblizing of existing Portland cement concrete pavement, followed by crushed stone interlayer, and followed by HMA resurfacing.

Fort Dodge Asphalt was the prime contractor, who sublet the modified rubblizing of existing Portland cement concrete to Antigo Construction.

The inspectors and I were very satisfied with their coordination, methods and equipment used, and their quality of work. All projects are performing very well.

Sincerely,



Randall J. Will, P.E. & P.L.S.
Webster County Engineer

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