MATES

MICHIGAN DEPARTMENT OF TRANSPORTATION

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TOTAL SHOP PAINTING OF MICHIGAN'S BRIDGES

Total shop painting of new steel bridges is now Michigan's best insurance against corrosion. MDOT has used three different systems of corrosion control on steel bridges in the past 25 years; a) weathering steel, b) shop primer coat with field final coat, and, c) total shop painting (primer and final coats). As a result of detailed evaluations, along with changing economic factors and significant technological advances in bridge paint systems, the Department has adopted the total shop painting system. Although no figures are available for direct long-term comparison, it is apparent that total shop painting costs less than other alternatives, and a significantly extended paint life is anticipated due to painting under more ideal, controlled conditions in the shop rather than out-of-doors. The final test of the total shop painting system will be its life-cycle costs calculated in the future.

Weathering Steel (1965-1980)

The cost and difficulty of painting bridge steel in areas of high traffic volume caused the Department's attention to be focused upon a then-new alternative to paint, weathering steel. This specially alloyed steel forms a dense adherent coating of surface 'rust' after exposure to the weather which would supposedly not corrode further, but act as a protective coating in the same manner as paint. In the early days, it appeared to eliminate painting and expensive maintenance with only a 2 to 3 percent increase in the cost of the steel. In 1965, MDOT built its first weathering steel bridge with few initial problems, and weathering steel was adopted for use statewide in 1969. Routine maintenance inspections in the middle 70s, however, began to reveal a pattern of excessive rusting under leaking joint areas on many urban structures. Soon, other areas of heavy rusting on weathering steel bridges became evident. A comprehensive evaluation of weathering steel was initiated in 1977, a number of problems were identified, and it became evident that weathering steel structures would have to be painted after all. Since painting was found to be necessary, and cheaper steels with equal strength could be used, the advantages of weathering steel were no longer there. Its use as an unpainted material was suspended in 1980.

Shop Primer Coat + Field Topcoat (1978-1982)

After the problems arose with weathering steel, MDOT reverted to a more traditional system, having the structural steel primed in the shop, and the final coat applied in the field. Prior to applying the topcoat, it was necessary to touch-up the primer after erecting the structure due to damage from handling or weathering. Some readily observed advantages of this system included the low cost of surface preparation, since large automatic blasting machines could be used for shop blast-cleaning; all surfaces were readily accessible for easy priming; shop environment was controllable; quality assurance inspection was better since no scaffolding, etc., was necessary; and, field top coats were supposed to be applicable with little additional clean-up. Unfortunately, the primer used at the time was found to be easily contaminated (by salt, oil, soil, concrete, etc.) during shipping, handling, storage, erecting, and construction of associated concrete components. Few precautions were taken in handling the material, as the handlers, erectors, and concrete workers knew another coat was going to be applied. Additional complex problems arose as to who was to incur financial liability for repainting contaminated areas or handling and shipping damage, as fabricators, general contractors, painting subcontractors, etc., all pointed at one another.

Total Shop Painting (1983 to present)

MDOT's first bridge with total shop painting was built in 1981. That job turned out to be a limited success, apparently because of resistance to change. Fabricators tended to think of themselves as welders and not painters; and, painting was regarded as more of a nuisance than a profit making operation. Construction workers did not treat the steel like it was a finished product, and this necessitated many expensive repairs. Suspecting that a lack of long-term commitment on the part of MDOT may have caused many of the problems associated with the first job, the Department made a commitment to require shop painting for a minimum of two years, and the process was taken more seriously by the industry. Two fabricators began to set up paint areas initially, later more would follow, and now most of them are equipped to do the work. About 40 bridges were completed in the interval between 1983 and 1985. Based on experience with these structures, MDOT made a long-term commitment to total shop painting in 1985.

In 1983 an inorganic zinc-rich primer was used with an epoxy top coat, and an additional urethane top coat on the fascias. Problems developed in the application of two top coats of the same color. Further, the epoxy paints seemed to have an almost 'magnetic' attraction for dirt particles, and the bridges became very dirty in non-repaired areas on their interior portions, at an early age. Therefore, the color of the intermediate coat was changed to white to help ensure proper coverage of the urethane top coat, and urethane was used on all of the steel rather than just the fascias. This system worked quite well but it still needed improvement if it was to resist damage during transit. The inorganic primer was not quite as hard and durable as it might have been, and in 1987 organic zinc-rich primer was substituted for the inorganic, as organic zinc-rich can be applied in a thicker coat. This system had worked well in field applications on existing bridges for five years prior to this, and had been found to provide much more abrasion resistance for the total system. It also allowed the use of only one specification and one paint system for both shop and field painting, thus avoiding some confusion in preparation of the jobs.

The Department feels that the advantages of total shop painting outweigh any disadvantages. It is easier to inspect, since the beam is not erected; it appears at this time to be cost-effective; primer or intermediate coats are not contaminated from shipping, handling, and construction of decks or other items; it is much easier to maintain quality in the shop than in the field; and, surfaces inaccessible after erection are completely coated.

There are some disadvantages. Obviously, it requires a high level of technical competence to get the system started and to address the complaints (unfamiliarity with a new system will naturally generate some problems during start-up). The finished product requires care in handling, in storing on the job site, and in erection.

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Other state transportation departments have shown an interest in MDOT's experience with total shop painting and many have contracted recently for bridges coated with the same system. The cost effectiveness has been demonstrated by the lower initial cost compared to previous systems, and a bonus should be realized in the extended paint life that is anticipated from a paint system that is applied in the shop, under more ideal conditions. Statewide bridge painting crews have been established in each MDOT District to perform regular maintenance on the shop painted bridges and keep them in good repair. This was done to ensure good maintenance of all newly painted structures, and on this basis the Federal Highway Administration has agreed to fund bridge repainting jobs under certain circumstances on the Interstate rehabilitation program. Michigan is one of the few states using Federal funds for bridge painting. We anticipate that this program will extend the initial coating life to 25 years or more. The true measure of the effectiveness of total shop painting will become evident in the years to come in terms of lower costs for the total life cycle.

-Jon Reincke

TECHADVISORIES

The brief information items that follow here are intended to aid MDOT technologists by advising or clarifying, for them, current technical developments, changes or other activities that may affect their technical duties or responsibilities.

NEW MATERIALS ACTION

The New Materials Committee recently:

Approved the following for trial installations:

Koppers Rubber Wear Guard Railroad Crossing
Wooden Peg - PEG6S
Gemco Wheel Stops

Approved the following products:

Flambinder Dust Palliative
Sure Grip Utility Grout

It should be noted that some products may have restrictions regarding use. For details please contact Don Malott at (517) 322-5687.

PERSONNEL CHANGES

A dozen new technicians have joined the Division to help us continue to provide services to the Department, other transportation agencies, and the highway industry. In the Testing Laboratory's Bituminous Section, we welcome **Kevin Beauchamp, Herb Clanton, Vicki Helmer, Terry Jacobsen,** and **Charles Lecureux.** The Research Laboratory has acquired three new techs, **Andy Bennett** in the Materials Research Unit, and **Elwin Drake** and **Kevin Hackman** in the Structural Services Unit. In the Geotechnical area, we are pleased to have on board **Bill Dillinger, Rick Ferguson, Steve Green,** and **Elden Tervo.** We all recognize that the technicians are the backbone of our organization, we're delighted at the caliber of those who work for M&T and know that these new members will become as valuable as their predecessors were. Glad to have you with us!

In other changes, **Alan Robords** has joined us as a geologist in the Materials Support Unit of the District Support Section, replacing Kim Elias, and we're pleased to have him with us. Also this month, **C. D. 'Dave' Church,** head of the Division's Administrative and Technical Support Section, returns from Washington, D.C. to resume his duties here. For the past year, Dave has been on loan, serving as Assistant to the Director of the Strategic Highway Research Program (SHRP). **Larry Holbrook,** who has been acting in Dave's position during his absence, has transferred to the Engineering Services Division, where a new position has been set-up to take advantage of his specialized expertise in statistical analysis and the law. Larry has been with the M&T's Research Laboratory Section for over 28 years in the statistical analysis area, and his talent and experience will be missed. We wish him well in the challenge offered by his new position.

SPECIFICATION UPDATE

Heaters Used in Cold Weather Protection of Concrete, 5.03(14), dated 9-6-88. This supplemental specification was recommended by the Federal Highway Administration based on information in the American Concrete Institute "Manual of Concrete Practice." It is intended to minimize the harmful effects caused by carbon dioxide in contact with curing concrete, by venting heaters and any internal combustion engines to the outside of enclosures.

Penetrating Water Repellent Treatment of Structural Concrete Surfaces, 5.09(7b), dated 10-5-88. This supplemental specification refers to a Prequalified Materials List in lieu of the tests of treated concrete specimens. Prequalification will be more efficient because the time required for the tests is extensive.

Soft Particles, 8.02(11), dated 10-12-88. The definition of soft particles has been revised to match that in MDOT's "Procedures for Aggregate Inspection" as follows:

> Soft particles include shale, siltstone, friable sandstone, ochre, coal, particles which are structurally weak or are found to be non-durable in service, and may include clay-ironstone particles.

Aggregates Used In Top Course Bituminous Mixtures, 7.10(8e), dated 10-12-88. This specification has been rewritten to limit the amount of structurally weak particles permitted in the aggregate. Also, percentage by weight has been changed to percentage by particle count to allow the deleterious particle content to be determined on the Aggregate Wear Index sample.

Sealing Contraction Joints When Spaced 20 Feet or Less Apart, 4.50(17), dated 10-25-88. This new specification permits the use of a silicone sealant for sealing closely spaced contraction joints.

Hourly Rate for Leased or Rented Equipment Used on Force Account Work, 1.09(9), dated 10-27-88. The change is that 10 percent will be added to the hourly rate used in computing payment for leased or rented equipment used on force account work.

CORRECTION:

Please note the last entry in 'Specification Update' in last month's MATES (issue No. 24), "Filler Walls for Bridge Piers, 5.03(11c). Our proofreader obviously nodded, as the word 'pins' appeared rather than 'piers.'

This document is disseminated as an element of MDOT's technical transfer program. It is intended primarily as a means for timely transfer of technical information to those MDOT technologists engaged in transportation design, construction, maintenance, operation, and program development. Suggestions or questions from district or central office technologists concerning MATES subjects are invited and should be directed to M&T's Technology Transfer Unit.

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