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Project Summary Report 8179
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Ride Specification Review

http://www.mdt.mt.gov/research/projects/const/ride_review.shtml

Introduction

The purpose of this project was to review the Montana Department of Transportation (MDT) asphalt pavement ride specification and compare it with current literature and state of practice. Upon completion of this review, recommendations were made for improvements to the current ride specification.

What we did

Sierra Transportation Engineers, Inc. (STE) developed a detailed work plan to successfully complete the project. The following specific activities were identified in the project work plan:

- Task A. Review the state's current ride specification,
- Task B. Conduct a literature review,
- Task C. Conduct a state of the practice survey,
- Task D. Develop recommendations, and
- Task E. Develop an implementation plan.

STE has taken a systematic approach to enhancing MDT procedures for collecting and analyzing road profile data. The current MT-422 test method, "Method of Test for Surface Smoothness and Profile", was outdated and needed a revision based on the current MDT practices, and also the findings of this project. STE revised this document.

The Profiler Operations Manual was also delivered. It describes procedures to be followed when measuring pavement profiles using the ICC MDR 4080 / 4097 inertial profilers. STE incorporated items from FHWA, ICC Operation Manual, and MT-422.

Finally, a QC/QA plan was developed for MDT. The purpose of the QC/QA plan was to ensure the procedures used by MDT in the collection and processing of ride data comply with all current MDT guidelines and result in the delivery of a quality data product. The QC/QA plan also provides corrective actions when deficiencies are encountered and encourages actions that support continuous improvement.

What we found

The current ride specification for bituminous pavements was last revised in May, 2003. In its current form, this specification has all the necessary elements of a comprehensive specification and is more developed than the specifications of many other states. Some of the key elements of the current MDT specification are:

- Different project classifications based on opportunities for improving ride,
- Target International Roughness Index (IRI) values for each project classification,
- Provision to provide courtesy testing to assist the contractor,
- Use of a bump criterion to identify areas requiring corrective work,
- Pay factors based on IRI, and
- Payment based on unit price for each type of plant mix surfacing placed in a given section.

There exists an overwhelming amount of information available on smoothness, profile, and

ride specification in the literature. STE's focus was to conduct a literature review to enhance the current MDT ride specification, looking for information on

- Ride specifications & tolerances,
- Available software & indices,
- Methods of acceptance,
- QC/QA procedures, and
- Incentive/disincentive levels.

Over seventy documents related to ride specification were collected and reviewed. Of utmost importance was the information obtained from other transportation agencies' specifications.

STE developed a state of practice survey that was distributed to all 49 states. Every agency was contacted initially by phone to describe the purpose of the survey and then by an e-mail containing the survey itself. A total of 32 agencies responded to the survey.

The activities under Tasks A through C clearly showed there is no unique methodology for project classification schemes. STE agreed with MDT's current practice of separating projects into different classes based on pre-pave IRI and number of opportunities to improve ride.

The target IRI values set in the current specification are directly related to these two parameters. In addition, the number of opportunities to improve the road is rarely a function of pre-pave IRI alone. Many other factors including existing distress conditions, improvements to roadway geometry, and financial constraints have more impact on defining the number of opportunities for roadway improvement than pre-pave smoothness.

Each opportunity to improve the ride includes one of the following:

- Placing a gravel base or surfacing course,
- Placing plant mix bituminous base,
- Placing cement treated base,
- Placing pulverized plant mix surfacing,
- Milling,
- Cold recycling (milling and laydown), and
- Each full 0.15 ft (45 mm) increment of new plant mix surfacing.

Bump identification is a concern for all agencies, including MDT. Using a non-contact type instrument to locate bumps is difficult. Although a profiler collects an enormous amount of data, the data goes through various processes (i.e., filtering) that can diminish the height of a "bump".

MDT stated during the kick-off meeting that on occasion there were problems exactly locating "must grinds". This occurred when profiler operators used stationing (e.g., starting point was 15+00) for the starting point rather than zero (e.g., 0 ft.). The problem with the use of stationing is the DMI recorded stationing will unlikely match the roadway stationing. The roadway stationing is measured along the centerline of the project while the DMI recorded stationing will be along the test lane (e.g., wheel path). MDT also stated when profiler operators used zero as the starting point the MDT Project Managers were easily able to drive to the exact locations of the "must grinds".

STE believes MDT's current method of analyzing surface profile defects using the ProScan software is independent of Profile Index (PI) and also independent of the blanking band. The revised ride specification has no reference to PI and blanking band. It merely states any surface defect greater then 0.4 inches in 25 feet needs to be corrected.

What the researchers recommend

STE recommends the following changes to the current project classification scheme: Create new Ride Specification Category 1 and 2 based on a revised MT-422, "Method of Test for Surface Smoothness and Profile", and better in-place QC/QA procedures. Category 1 projects should have the following attributes:

- Target IRI set at 50 to 55 in/mi,
- Project with two or more opportunities to improve the ride, or single lift overlays with pre-pave IRI < 110 in/mi, and
- The maximum post-pave IRI should not be greater than 90 in/mi.

The new Category 2 projects would have the following attributes:

- Target IRI set at 55 to 60 in/mi,
- Single lift overlays with pre-pave IRI value > 110 in/mi and < 190 in/mi, and
- The maximum post-pave IRI should not be greater than 95 in/mi.

To keep the roadways as smooth as possible, STE recommends

roadways with pre-pave IRI values above 190 in/mi be treated as a Category 1 project with two or more opportunities to improve the ride. However, if for other reasons (i.e., budgetary) only one opportunity is reasonable and/or feasible then MDT should specify the maximum post-pave IRI not be more than 50% of the pre-pave IRI. For those cases, STE does not suggest any pay adjustment factor based on smoothness; however, corrective actions need to be taken at contractor's expense if post paving IRI is greater than 50% of pre-pave IRI.

Based on the literature review and discussions with MDT, STE developed gradual pay adjustment factor relationships to replace the class step functions. Tables 1 and 2 present the new relationships.

Table 1. Category 1 Pay Adjustment Factor Relationship.

IRI (in/mi)	Pay Adjustment Factor
< 35	1.25
35 - 50	1.845 – 17/1000 * IRI
50 < IRI <55	1
55 - 75	1.825 – 3/200 * IRI
75 < IRI <90	0.7
> 90	Corrective Action Required (Initially Assumed as a Zero Pay)

Table 2. Category 2 Pay Adjustment Factor Relationship.

IRI (in/mi)	Pay Adjustment Factor
< 50	1.1
50 - 55	2.100 - 1/50 * IRI
55 < IRI <60	1
60 - 95	1.343 - 1/175 * IRI
> 95	Corrective Action Required (Initially Assumed as a Zero Pay)

STE recommends using only zero as a starting point for all data collection. The starting point (e.g., construction markings) should be well defined in order to locate at a later date. STE also recommends MDT try to initiate data collection with the profiler's photocell in conjunction with reflective tape and/or cones. Using the photocell to initiate data collection may help eliminate errors caused by late or early pendant starts (e.g., starts using keyboard, keypad, or button).

STE investigated constraints of data collection along horizontal curves (i.e., 900 ft radius taken from vendor operation manual). STE recommends MDT continues using the 900 ft curvature of radius as the constraint along horizontal curves.

STE investigated whether 0.2 mile distance is enough for acceleration of profiler for climbing and passing lanes. STE recommends the following criterion: If possible, a profile run should have 0.75 mile (4,000 feet) of run-up distance before testing any roadway, whether it is a climbing lane, passing lane, or ramp.

For bridge structures, STE has the following recommendations:

- If the bridge was not overlaid as part of the project, it should be excluded.
- For any bridge structure and/or approach slabs that have not been overlaid as part of the project, STE recommends measuring pavement sections up to 50 feet from the structure and then resuming measurement 50 feet past the structure. This applies to incentive and disincentive payments.
- STE recommends use of the same bump criteria (i.e., 0.4 inches in 25 feet) used in the ride specification for bridge deck sections.

A number of implementation products resulted from this project, namely:

- Revised MDT Ride Specification,
- Revised MT-422 "Method of Test for Surface Smoothness and Profile",
- Profiler Operations Manual, and
- QC/QA Plan.

The following paragraphs are the step by step activities STE suggests for the implementation of each product listed above:

1. MDT should advertise the existence of a new specification to all its contractors and provide a copy of the specification on the MDT web page for review and download.

2. Within six months after the completion of this project, STE recommends MDT conducts a short one-day seminar for prospective contractors on how to follow the new ride specification during construction projects.

3. As part of the implementation process, MDT should monitor the new ride specification on a select number of projects to assess its workability within the first year after the completion of this project. Then, final adjustments can be made if necessary.

4. Within six months after the completion of this project, MDT should conduct training seminars for office and field personnel involved in profiling activities using the developed documents.

5. Within nine months after the completion of this project all field and office personnel involved in profiling activities should have completed the training.

For More Details . . .

The research is documented in Report FHWA/MT-06-004/8179, *Ride Specification Review.*

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MDT Implementation Status
May 2006

MDT representatives reviewed STE's recommended revisions to the Ride Specification and approved the changes. The revised Ride Specification was then presented to the Montana Contractor's Association and is in the process of being finalized. The new specification will be included in all paving projects starting with the September 2006 bid letting. The revised test procedure, Profiler Operations Manual, and QC/QA plan will also be implemented at that time. An evaluation process will be completed at the end of the 2007 construction season. This process will include the contracting community and will be used to identify any final adjustments required for the new specification. A training session for profiler operators from each District was held earlier this spring. This training will be held on an annual basis in the future.

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