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Pavement maintenance procedures with and without milling materials

Rafiqul A. Tarefder [a,1], Mohiuddin Ahmad [a,*], Mohammad I. Hossain [b,2]

[a] Department of Civil Engineering, University of New Mexico, MSC01 1070, Albuquerque, NM 87131-0001, USA
[b] Civil Engineering and Construction, Bradly University, 1501 W. Bradley Avenue, Peoria, IL 61625, USA

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Abstract

This study evaluates maintenance treatment followed by different Districts of New Mexico Department of Transportation (NMDOT). In addition, two case studies on the use of old pavement materials, called the "millings", in maintenance projects are reported. Based on this study, it is observed that none of the Districts have a written procedure for maintenance work. Rather Districts rely on the experience of the maintenance crew for conducting maintenance projects. All Districts prefer to use chip seal for maintenance irrespective of distress conditions of the pavements. Patching and crack sealing are usually done before chip sealing to extend the life of the chip seals. Sand seal, scrub seal, and slurry seal projects are not done by District maintenance crews but by outside contractors. It is also observed that all Districts are interested in using millings in maintenance projects and most have already used millings in at least one maintenance project with some success and failure. Most of the Districts have used coarse fraction of millings in chip seal projects successfully. However, they failed to find a proper way to process the fine fractions of millings. Case Study I shows that fine millings can be used to construct thin overlay when mixed with emulsion in pug mill or hot drums. Case Study II concludes that fine millings can be used as fine/sand seal successfully following the same procedure and using the same equipment as chip seal.

Keywords: Millings; Maintenance; Emulsion; Rutting; Pug-mill

1. Introduction

Maintaining a pavement costs millions of dollars and may be a total waste if proper maintenance type is not applied [1–3]. If pavements are constructed following standard specifications but they are not maintained following any uniform standard or procedure, performance will be jeopardized. In New Mexico, it is not known whether any of the New Mexico Department of Transportation (NMDOT) Districts follow the same procedure for maintenance work, because the NMDOT specification book does not include any maintenance procedure. Therefore, it can be assumed that NDMOT Districts conduct maintenance work based on the experience of their crew. If all the maintenance is done based on experience only, it is possible that the procedure can be lost after retirement of an expert crew or personnel. Also, different District crews might be doing a specific maintenance work (say, chip seal) differently. Therefore, documentation of the maintenance procedures of different Districts across New Mexico and identifying similarities and dissimilarities among District maintenance procedures for a specific type of maintenance treatment is important (maintenance procedure, maintenance method, and maintenance treatment are synonymous and they are used interchangeably in this study). If different Districts perform maintenance work differently, some may use less manpower and money and

* Corresponding author.
E-mail addresses: tarefder@unm.edu (R.A. Tarefder), mahmad@unm.edu (M. Ahmad), mihossain@fsmail.bradley.edu (M.I. Hossain).
[1] Tel.: +1 505 277 6083.
[2] Tel.: +1 (505) 550 6264.
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come up with a higher service life. The opposite is also possible. Therefore, a comparative study may reveal the best maintenance procedure that is less expensive and more effective. For example, if one District finds a specific type of emulsion or binder does not work with a certain type of aggregate and/or maintenance treatment, that information can be very useful to other Districts if there is supporting documentation. In such cases, a face to face interview or survey of District crew can be very useful, which is what has been done in this study.

Use of millings in maintenance projects can save on maintenance costs. Asphalt "millings" are defined as the "old asphalt materials" that are produced due to removal and recycling of an existing asphalt pavement layer to correct and restore the surface to a specified profile. Cost effectiveness, sustainability, and environmental friendliness are the primary reasons for using milling materials. Although NMDOT Districts have used asphalt millings over the years, it is not known which Districts have used millings in what type of maintenance projects, nor it is known whether a specific maintenance procedure (say, chip seal) differs when using virgin aggregates versus millings. It is also not known whether millings are preferable to virgin rock or vice versa. There is a need for determining the optimum use of millings specific to a maintenance method considering the practices, materials, traffic, and environmental conditions in New Mexico. To this end, an attempt is made in this study to examine some of these issues and options of milling in maintenance projects through conducting District interviews. In addition, case studies on the trial use of millings are included herein to assess current state-of-the-practice used in New Mexico regarding millings in maintenance treatments.

2. Objectives

The objectives of this study are to investigate

- The maintenance procedure followed by different NMDOT Districts with/without using millings.
- The effectiveness of the use of millings in maintenance. Two case studies are presented to discuss effective ways of using millings.

3. Maintenance treatments

Six different types of maintenance treatments are used by different Districts of NMDOT. They are described below.

3.1. Chip seal

This type of maintenance work consists of single or multiple applications of asphalt and aggregate over a weathered surface or a prepared base course as the original surface. The thickness of such applications is generally limited to 25 mm (1 in.) maximum. Chip seal is done for the maintenance work of block cracking, over polished aggregate, raveling and weathering and bleeding (with less binder). Chip seal does not expect to provide structural capacity.

Arizona DOT collects the pavement distress data before applying chip seal [4]. Montana DOT (MDT) and California DOT (Caltrans) follow their own manual to construct chip seal [5,6]. These manuals contain detailed procedures as well as specification limit. MDT starts chip sealing on 1st May and continues until August 20th, although the pavement temperature has to be greater than 16 °C (65 F). Caltrans described specific limits of different distresses for which chip seal is to be used. Chip seal should not be used for pavement with Annual Average Daily Traffic (AADT) > 40,000. Caltrans uses equations to determine chip and emulsion application rates and preforms ball penetrometer and sand path test on finished surface to check its quality. National Cooperative Highway Research Program (NCHRP) performed an extensive study on chip seal and published "Chip Seal Best Practices" which contains detailed procedures and specification. Only 18% of US roads are chip sealed using some method/equation. The rest of the pavements are chip sealed using experience only [7].

3.2. Sand/fine seal

The procedure for sand sealing is similar to chip sealing except sand or fine material is used instead of stone chips. Sand seal is often used where a flexible pavement has raveled to the extent that there is significant fine aggregate missing from the surface. It is also used as a pavement preparation treatment to provide a uniform surface before constructing a chip seal and to seal low severity fatigue cracks before constructing an overlay. The maximum thickness of a sand seal is about 4.75 mm (3/16 in.). There is no ASTM or AASHTO standard available for a sand seal mix design. In fact, very few studies are available on sand seal. FHWA described a very short procedure [8]. According to FHWA manual, the binder application rate varies from 0.68 to 0.90 l/m^2 (0.15–0.20 gallon per square yard, gsy) and sand application rate is in between 5.4 and 8 kg/m^2 (10–15 pound per square yard, psy). Sand or fine material sizes used by Washington DOT (WSDOT) vary between 6.4 mm and 9.5 mm (1/4 in. and 3/8 in.) [9].

3.3. Scrub seal

This is placed in situations very similar to that of sand or chip seals. Scrub seals can be applied when the distress level is greater than what would normally be used as a criterion for the application of a sand seal. The major difference in sand seal and scrub seal is, for scrub seal an initial sweeping is done over the applied emulsion before application of the sand or aggregate. After application of the sand or