Root Cause Analysis for Pavement Failure

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Abstract— Understanding the cause for current conditions is extremely important in selecting an appropriate maintenance or rehabilitation technique. Pavement performance evaluation is an important activity in the maintenance and rehabilitation works. It includes evaluation of existing distresses, road roughness, structural adequacy, traffic analysis, material testing and study of drainage condition.
Key words: Pavement Performance, Structural Adequacy

I. INTRODUCTION

Finding root cause of flexible or rigid pavement is important for selection of proper maintenance techniques which are as follows:

A. Preventive Maintenance

Planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without increasing the structural capacity). Surface treatments that are less than two inches in thickness are not considered as adding structural capacity.

B. Corrective Maintenance

Performed after a deficiency occurs in the pavement, such as moderate to severe rutting, raveling or extensive cracking. This may also be referred to as "reactive" maintenance.

C. Emergency Maintenance

Performed during an emergency situation, such as a blowup or severe pothole that needs repair immediately. This could also include temporary treatments that hold the surface together until a more permanent treatment can be performed.

II. FACTORS INFLUENCING THE PERFORMANCE OF A PAVEMENT

A. Traffic

Traffic is the most important factor influencing pavement performance. The performance of pavements is mostly influenced by the loading magnitude, configuration and the number of load repetitions by heavy vehicles. The damage caused per pass to a pavement by an axle is defined relative to the damage per pass of a standard axle load, which is defined as a 80 kN single axle load (E80). Thus a pavement is designed to withstand a certain number of standard axle load repetitions (E80's) that will result in a certain terminal condition of deterioration.

B. Moisture (Water)

Moisture can significantly weaken the support strength of natural gravel materials, especially the subgrade. Moisture can enter the pavement structure through cracks and holes in the surface, laterally through the subgrade, and from the underlying water table through capillary action. The result of moisture ingress is the lubrication of particles, loss of particle interlock and subsequent particle displacement resulting in pavement failure.

C. Subgrade

The subgrade is the underlying soil that supports the applied wheel loads. If the subgrade is too weak to support the wheel loads, the pavement will flex excessively which ultimately causes the pavement to fail. If natural variations in the composition of the subgrade are not adequately addressed by the pavement design, significant differences in pavement performance will be experienced.

D. Construction Quality

Failure to obtain proper compaction, improper moisture conditions during construction, quality of materials, and accurate layer thickness (after compaction) all directly affect the performance of a pavement. These conditions stress the need for skilled staff, and the importance of good inspection and quality control procedures during construction.

III. TYPES OF PAVEMENT DETERIORATION AND ITS CAUSES

Pavement deterioration is the process by which distress (defects) develop in the pavement under the combined effects of traffic loading and environmental conditions.

Types of distress occur in flexible pavement:

A. Fatigue (Alligator) Cracking

Series of interconnected cracks caused by fatigue failure of the HMA surface (or stabilized base) under repeated traffic loading. In thin pavements, cracking initiates at the bottom of the HMA layer where the tensile stress is the highest then propagates to the surface as one or more longitudinal cracks. This is commonly referred to as "bottom-up" or "classical" fatigue cracking.

Fig. 1: Bad fatigue cracking.

1) Possible Causes

Inadequate structural support, which can be caused by a myriad of things. A few of the more common ones are listed here:

a) Decrease in pavement load supporting characteristics

- Loss of base, subbase or subgrade support (e.g., poor drainage or spring thaw resulting in a less stiff base).
- Stripping on the bottom of the HMA layer (the stripped portion contributes little to pavement strength so the effective HMA thickness decreases)

