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Laboratory Rutting Test for Bituminous Mixture at Medium Temperature

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Abstract:

The purpose of this project review is to get knowledge about rutting in flexible pavements, types of rutting, various properties of asphalt bituminous mixture at different temperatures and also to gain knowledge required to conduct the rutting experiment in laboratory by studying various literature reviews and to find out the rutting resistance of asphalt by lab experiments namely Hamburg wheel test, rolling test and non-destructive test. In this report we will get the introduction to rutting, types of rutting, literature reviews of various authors, objectives of the laboratory test being conducted and methodology of the lab test.

Keywords — Rutting, Non-destructive test, Types of rutting, Hamburg wheel test, Rut analyser

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I. INTRODUCTION

Rutting

It is also known as permanent deformation, can be defined as the **accumulation of small amounts of unrecoverable strains** as a result of **applied loading to a pavement**.

- Rutting occurs when the pavement under traffic loading consolidates and/or there is a lateral movement of the hot-mix asphalt (HMA).
- The lateral movement is a shear failure and generally occurs in the upper portion of the pavement surface.
- As a result of rutting, the pavement useful service life is reduced.
- If the rutting depth is significant, water may accumulate in the rutted area, which can lead to vehicle hydroplaning and may create a safety hazard for the traveling public.
- Recently, the potential for rutting has increased rapidly due to the continuous increase in traffic volumes, and the increase

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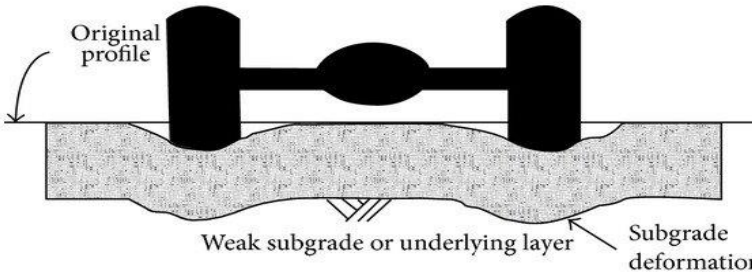
- use of radial tires, which contain higher inflation pressure than other tire types.
- Rutting **doesn't only occur due to the permanent deformation** in the **surface layer**, but it can also happen **due to a plastic deformation** resulted from **over-stressing the base** or the **subgrade layer during compaction.**

The above figures show rutting in flexible pavements.

Types of rutting in flexible pavement

Rutting can be classified into **four main types**:

- **Mechanical deformation** or **subgrade displacement** of the asphalt pavement.



The above figure shows the mechanical/subgrade deformation

This type of deformation occurs when the subgrade layer which is under the flexible pavement layer is weak due to various reasons, this type of rutting occurs even if the flexible pavement layer is built perfectly because when load get transferred the subsequent layer fails causing the failure of the pavement.

- **Plastic deformation** of the asphalt mixtures near the **pavement surface.**

  Plastic or permanent deformation is a material failure of the asphalt pavement in which the mix is displaced from under the tires and typically humps up outside the wheel tracks. The permanent deformation can happen in the form of shoving or corrugation in the pavement surface as shown in figure. Corrugation is a plastic deformation typified by ripples. Shoving is an abrupt wave across the pavement surface. The resulted distortion is usually perpendicular to the traffic direction. Corrugation usually occurs at points where traffic starts and stops. Shoving occurs in the areas where HMA abuts a rigid object.

- **Consolidation** or the **continued compaction** under the **action of traffic.**
- **Surface wear**, the actual wearing away of surface particles by traffic.

II. LITERATURE REVIEW

1.Taha Ahmed Hussien Ahmed**"Investigating the rutting and moisture sensitivity of warm mix asphalt with varying contents of recycled asphalt pavement"** The purpose of this paper is to evaluate WMA paving technologies with various contents of RAP to determine their suitability for use in various applications. This objective was met by conducting an extensive laboratory experiment to assess the durability (i.e. resistance to moisture damage, and rutting) of WMA mixtures produced using different aggregate sources and amounts of RAP materials.

2.AbubekerWorake Ahmed, Amir Arshadi, SigurdurErlingsson, Hussain Bahia.**"Evaluation of rutting performance of asphalt mixtures using Extra-Large**

Wheel Tracking and 2-D imaging technique "This study investigated the application of a two-dimensional (2-D) image analysis technique to evaluate the role of aggregate packing in rutting performance of three different types of asphalt mixtures. The 2-D images are derived by scanning the cross sections of drilled cylindrical specimens taken from asphalt slabs which have been tested using an Extra-large wheel tracking device.

3.Shahbazkhana, M.N.Nagabhushana, Devesh Tiwari, P.K.Jainda **"Rutting in Flexible Pavement: An approach of evaluation with Accelerated Pavement Testing Facility"** In this paper a systematic study on the permanent deformation development involving a flexible pavement designed as per Indian practice. This paper brings out the details of this evaluation study and also features the capabilities and applications of Indian APTF in the issue.

4. Xu Cai, Duanyi Wang, Wenke Huang, Jiangmiao Yu, and Cheng Wan **"Evaluation of Rutting Performance of Asphalt Mixture with Driving Wheel Pavement Analyzer"** One of thecommonly used tests is the simulation test with wheel tracking devices. Here, a new rutting test system has been developed based on the "Driving Wheel Pavement Analyzer" (DWPA) to evaluate the rutting performance of asphalt mixtures. This study conducted three types of rutting tests to validate feasibility, reliability, and accuracy of DWPA test. The results indicated that the DWPA test provided more information on ruts and enabled us to distinguish the performance of materials

5. Qing Lu and John T. Harvey **"Evaluation of Hamburg Wheel-Tracking Device Test with Laboratory and Field Performance Data"** This study focuses on the evaluation of the capability of the HWTD test to determine moisture sensitivity of asphalt mixes and to predict field performance by use of both laboratory test data and field performance data on a large scale.

6. AravindChavani, Kiran Kumar. B **"Effect of Tyre Pressure and Temperature on Rutting Characteristics of Warm Mix Asphalt in Bituminous Concrete Layer"** the objective of this paper is to know the Optimum Binder Content required by each binder for a given WMA and HMA bituminous mix. To determine the number of passes required by various bituminous binders, in attaining 20mm rut depth. To evaluate the rutting performance of Bituminous concrete (BC) Grade-2 mix at varying tyre pressure and temperature on a casted slab specimen with WMA as Sasobit additive and HMA mix

To have comparative evaluation of grade bitumen VG-20 and VG-30 prepared specimen with WMA as Sasobit additive and HMA mix

To identify the bituminous binder that shows high resistance to temperature and tyre pressure prepared specimen with WMA and HMA mix which are the key parameters in causing rutting of the pavement.

III. OBJECTIVES

To determine the **rutting performance, resistance, density** and other important aspects of bitumen at medium temperature required to **reduce the rutting** by conducting various laboratory tests such as rolling test, **wheel tracking test** and **non-destructive test.**

METHODOLOGY

- **Material Procurement:** In this step the materials required for conducting the experiment – aggregates and asphalt binder (in our case bitumen) are decided as per the standards and procured.

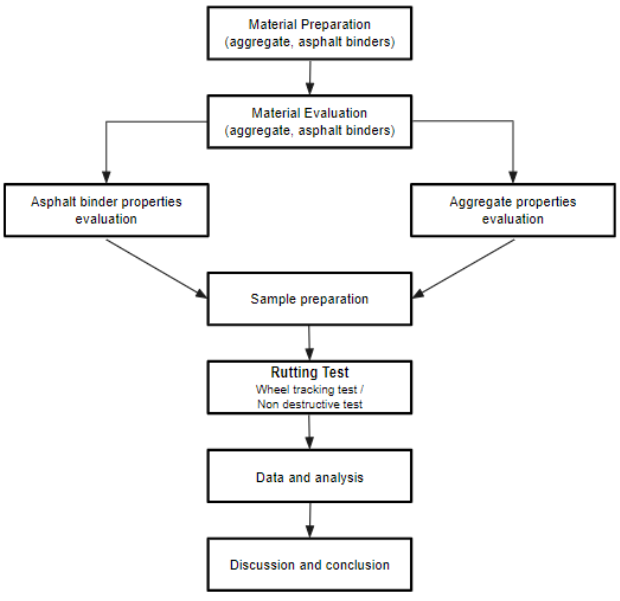
- **Material Evaluation:** the procured materials are evaluated thoroughly in this step and the quality check is done to make sure it satisfies the required standards by conducting some preliminary experiments

- **Evaluation of properties of the Materials:** In this step the physical and chemical properties of both aggregates and bitumen are studied and noted accordingly.

- **Sample preparation:** as the name suggests in this step the sample on which the test is being conducted is prepared as per desired standards.

- **Rutting Test:** There are many types of rutting test that can be conducted in laboratory setup, in our case non-destructive test and rolling test are conducted by using rut and roll analyser and the following outcomes of the test is tabulated.

- **Data and analysis:** The data obtained from conducting the rutting test is analysed and the required calculations are thoroughly carried out in this step.



The above flow chart shows the steps involved in the lab test

IV. CONCLUSIONS

From the obtained data and calculated results, it is compared with the previous studies and the changes obtained from the test results are discussed and negative or positive outcomes are concluded in this following step.

REFERENCES

1) Taha Ahmed Hussien Ahmed **"Investigating the rutting and moisture sensitivity of warm mix asphalt with varying contents of recycled asphalt pavement".**
2) AbubekerWorake Ahmed, Amir Arshadi, SigurdurErlingsson, Hussain Bahia. **"Evaluation of rutting performance of asphalt mixtures using Extra-Large Wheel Tracking and 2-D imaging technique".**
3) Shahbazkhana, M.N.Nagabhushana, Devesh Tiwari, P.K.Jainda **"Rutting in Flexible Pavement: An approach of evaluation with Accelerated Pavement Testing Facility".**
4) Xu Cai, Duanyi Wang, Wenke Huang, Jiangmiao Yu, and Cheng Wan **"Evaluation of Rutting Performance of Asphalt Mixture with Driving Wheel Pavement Analyzer".**
5) Qing Lu and John T. Harvey **"Evaluation of Hamburg Wheel-Tracking Device Test with Laboratory and Field Performance Data"**
6) AravindChavani, Kiran Kumar. B **"Effect of Tyre Pressure and Temperature on Rutting Characteristics of Warm Mix Asphalt in Bituminous Concrete Layer"**

