# Rutting Characteristics of Bituminous Mixture Exposed to Moisture

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**ABSTRACT**

Rutting is caused due to continuous traffic loading which is a type of common pavement distress. The presence of moisture reduced rut resistance of bituminous mixture as they alter the bond strength of aggregate with bitumen. The minerals present in the moisture also enhances the moisture damage of the flexible pavement. Therefore, this study inquires to judge the effects of liquid in the empty out attitude of bituminous factual, ultimate coarse tiring coat used in India. The rut test was performed using the wheel rut tester after moisture conditioning. The moisture induced stress tester is used to condition the samples. A considerable reduction of rut resistance in the moisture conditioned samples was observed compared to control mix.

**Keywords:** Rutting, Moisture damage, Moisture conditioning.

## 1 Introduction

Flexible pavement is one of the most common road surface treatments used in India. Bituminous mixture is affected by moisture as the minerals in moisture affect the bond strength of aggregate and bitumen [1]. A rut is a gradually developed surface depression that is developed in a flexible pavement as a result of vehicular movement [2]. Each time the vehicle passes, a small permanent distortion is obtained in the pavement. As the pavement ages surface deformation occurs.

Pavements of Hot Mix Asphalt (HMA) is majorly afflicted by Susceptibility to liquid. The effect of dampness can stimulate the decreasing of bond middle from two points aggregate and blacktop cover to increase the liquid feeling on account of the attendance of water. The liquid damage potential of HMA is calculated by Moisture sense test. The moisture induced damage may cause to further deterioration and to produce the distresses in the pavement surface. The pavement layers are to be carefully evaluated against its moisture damage resistance and thereby ensure the design life of the pavement layers [3, 4]. Thus, this study is aimed to evaluate the rut resistance of bituminous concrete mixes conditioned using Moisture Induced Sensitivity Tester (MIST).

## 2 Effect of Moisture on Rutting

Rutting is a term for when constant deformity or combination grows in a blacktop surface over occasion; this is usually proved for one wheel way being carved in the drive. Rutting is the term used to specify the blacktop surface's continuous deformity in the wheel courses. Repeated traffic stowing phases are the main



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causes of empty out and it is big worry and a potential sign of blacktop deficiency cause possibly followed by fatigue breaking and added distresses. The stability of the asphalt mix is a crucial component in how well it resists rutting and should be taken into consideration. However, a specific mix design's performance is also influenced by outside factors like traffic, temperature, and humidity. The rut resistance of a given mix is difficult to precisely because these factors vary frequently. The Superpave mix design approach does not call for a particular performance test for rut resistance because of this.

A meaningful donating component to blacktop rutting is the subgrade soil inflexibility, that is weak on the in-situ liquid content and soil index possessions. The subgrade soil moisture content can change within limits the necessary condition on account of differences in the compaction method working all the while building and differences in the ground water level caused by migratory vacillations. Moisture damage may have an impact on a significant portion of asphalt concrete pavements, speeding up the development of fatigue cracking and wheel path rutting field distresses. Loss of adhesion or loss of cohesion are two types of moisture damage that can occur [5-8]. The combination can be redesigned to contain less moisture-sensitive components, or antistripping additives can be added. Reduced stiffness and load carrying capability in addition to excessive peeling of asphalt pavements are all results of moisture degradation because the asphalt binder and aggregates no longer adhere to one another under heavy traffic loads [9-12].

## 3 Experimental Study

### 3.1 Materials Used

**Aggregate**- Aggregate from TBM quarry, Trivandrum sieved from 13.6mm to 75 microns is used.

**Bitumen**- Bitumen of grade VG30 is used.

### 3.2 Determination of Optimum Binder Content

The mix design of bituminous concrete grade 2 mixture selected for the study was done using Marshall method. Th optimum bitumen content was determined by applying 75 blows on each side which corresponds to heavy traffic. From the binder content Vs percentage air voids graph (Figure 1) the binder content corresponding to 4% air voids was obtained as 5.6.

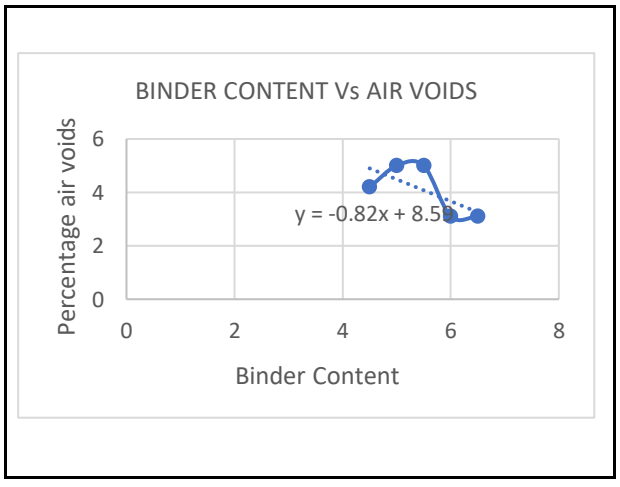


**Figure 1:** *Binder Content Vs Air Voids Graph*

### 3.3 No. of Blows for Intial Air Voids

The quality and life of the pavement are negatively impacted by an air void percentage that is either too high or too low. Any asphalt mix's quality and lifespan are strongly influenced by the amount of compaction

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it receives. Due to the material's high air void content when it is created, it is expected to drop with time, and this densification can be seen as the main reason for rutting during the first few months of use.
Since the study's goal is to examine the mixture's rut resistance when exposed to a damp environment right away. after the construction, the rut test was performed on the samples having 7% air voids.
From the No. of blows Vs Air Voids graph, the No. of blows corresponding to 7% (initial air voids) was observed to be 42.5. The No. of blows for 7% air voids condition was taken as 43.

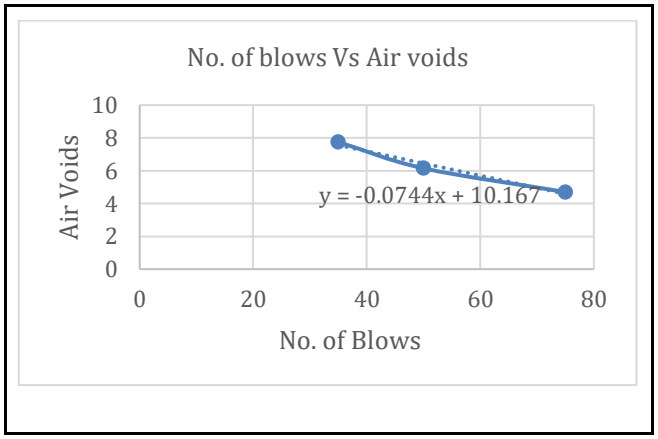


**Figure 2:** *No of blows for 7% air voids*

### 3.4 Mist Conditioning

The mechanics of stripping that occur in HMA pavement layers were imitated by developing a cyclic conditioning system known as the M.i.S.T. By pushing and drawing water through a sample of compacted asphalt in a pressurised cylinder, the M.i.S.T. is a stand-alone device that simulates the action of a car tyre on a road. The testing can be performed at different pressures and temperatures to replicate different traffic and climatic conditions. Due to the unit's total automation, results can be ready in as little as 24 hours. Enter the M.i.S.T. testing chamber with your asphalt core sample, choose your test parameters, and then press the start button. The remainder will be handled by the machine. The asphalt core is eliminated following the test.

### 3.5 Reduction in Rutting Due to Moisture

Reduced stiffness and load carrying capability as well as excessive peeling of asphalt pavements are all results of moisture degradation because the asphalt binder and aggregates no longer adhere to one another under heavy traffic loads. Moisture induced rutting is a major asphalt pavement distress type.
The two primary manifestations of moisture-related distress are softening (cohesion loss) and stripping or raveling (adhesion loss). The tangible break-up of the bitumen and aggregate popular as uncovering is induced for one loss of holding fast betwixt the bituminous substance and the aggregate surface, which is mainly generated apiece action of dampness. Softening is the common misfortune of join stability, substance, and inflexibility provoked by a decline in cohesion generated by dampness combination and venture inside the bitumen.

## 4 Results

The samples accompanying and outside liquid adapting had rust experiment, and the results are presented in figure 3, from the figure, it is clear that the rust resistance is reduced under the moisture conditioned samples.

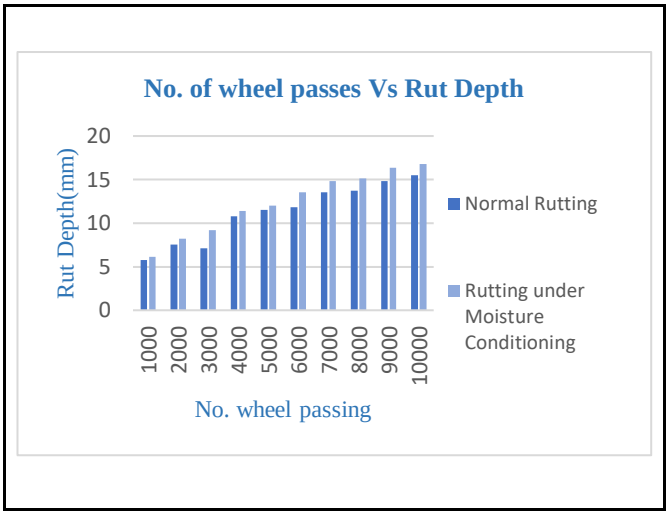


**Figure 3:** *Rut depth*

Figure 3 shows the rut depth of sample under normal rutting and rut depth of sample under moisture conditioning.

## 5 Discussions

- The initial depth of sample under normal rutting was 25.18cm.
- The rut depth from 1000 passes to 10,000 passes ranges from 5.79mm and gradually increases to 15.5mm.
- The initial rut value of sample undergone rutting after moisture conditioning was 20.32cm.
- There is a decrease in initial rut value of sample after moisture conditioning as compared to normal rutting.
- The value of rut depth from 1000 to 10,000-wheel passes ranges from 6.13mm to 16.80mm.
- At each wheel passing the profit of pace of liquid trained sample is above that of usual make concave.

## 6 Conclusions

The rutting is greatly influenced by moisture. Normally rutting increases gradually and in moisture induced sample there is sudden increase in rutting. Also, the initial value of sample depth is much lesser in moisture induced samples as compared to normal sample. For each 1000 wheel passing the advantage of make a space of dampness persuaded sample is above rational sample rutting. This clearly indicates that the bond strength of bituminous mix is affected by moisture. Since it was discovered that water has an impact on how well a pavement performs and how long it lasts during its useful life, analysts have intense on the process of water combination that can cause damage and alterations to bureaucracy of the asphaltic combination.

## 7 Declarations

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