iJRASET
International Journal For Research in Applied Science and Engineering Technology



# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 8 **Issue:** VI **Month of publication:** June 2020

**DOI:** http://doi.org/10.22214/ijraset.2020.6191

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
*ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429*
*Volume 8 Issue VI June 2020- Available at www.ijraset.com*

# Comparative Analysis of Bitumen Content in Flexible Pavements of Sub-tropical Climate Zone of India

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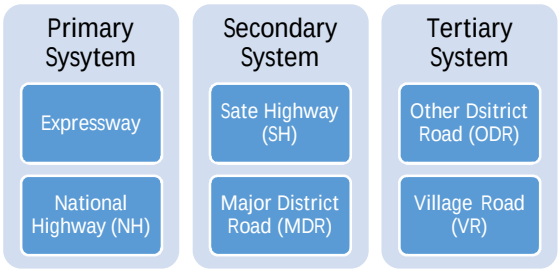
***Abstract:*** ***In this paper IS code method is used to determine the optimum bitumen content for the given samples of different roads of subtropical climate zone of India. The analysis and testing has been done as per IS code- IRC: SP 11-1988 (Appendix-5) and ASTM D 2172. According to this IS code, all the samples should be tested in the lab with the help of bitumen extractor machine for the same five disturbed samples of bituminous intercity road of subtropical climate conditioned road has been collected from Gwalior city. The results of samples are compared together and with the actual gradation % of bitumen content described in IS-code. As per the analysis the binder content found out be 4.52%, 4.12%, 3.92%, 4.9% and 4.32% in sample 1,2,3,4 and 5 respectively.***

***Keyword: Sub-tropical Climate Zone Roads, MDR, Bituminous Road analysis by IS Code.***

## I. INTRODUCTION

Basic objective of determination of bitumen content of these five different roads is to find out % of bitumen content and quality of roads according to IS-codes. There are total five samples taken by the students of Vitm, Gwalior for lab testing. Sample1 is taken from basically Thatipur road, Gwalior (M.P). The weight of sample should be taken 500gm for the lab test of bitumen content. Sample2 is taken from Suresh Nagar road, Gwalior (M.P). The weight of sample is also same (500gm). Sample3 is taken from village road of Girgaon, Gwalior (M.P). The weight of sample is taken 500gm. Sample4 is taken from DD Nagar road, Gwalior (M.P) and Sample5 is taken from city road of Gwalior (M.P). Weight of sample for both the samples should be taken same as 500gm for lab testing.

### *A. Types Of Roads*




### *B. Purpose Of The Investigation*

Normally bitumen mix is used in the construction of flexible pavement to serve the following needs.

*1)* Structural Strength
*2)* Surface Drainage
*3)* Surface friction.

## II. LITERATURE REVIEWS

R.P. Panda (2017), Optimum bitumen content (OBC) calculated by alternative methods developed from the samples. Forty five samples collected both from State Highways and National Highways, Odisha. The results of alternative methods are comparable with the actual consumption of the bitumen obtained from extraction test.[1]

Ankur Gupta (2017), It was observed that the marshall stability values was increased with increasing bitumen content and were achieved higher values for VG-40 grade bitumen than VG-30 grade bitumen, at VG-30 grade bitumen at 4.50% of bitumen content. This showed that the marshall stability was increased by approx... 5% with VG-40 binder grade than VG-30 grade.[2]

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Jon Smith (2004), Test variability is high, as the result tends to be sensitive to small variation in individual asphalt samples. Results therefore, tend to fall into broad bands that may overlap between mixes of normally different performance levels. Users should not attempt to ascribe specific numbers to particular levels of field performance other than the use of broad characteristic values.[3]

*A. Determination of Binder Content for Asphalt Mix*

To determine the binder content in the asphalt mix by cold solvent extraction IRC: SP 11-1988 (Appendix-5), ASTM D 2172.
Exactly 500 grams of representative sample were placed in the bowl of extraction apparatus (W1). Added benzene to the sample until it is completely submerged. Dry and weigh the filter paper and place it over the bowl of the extraction apparatus containing the sample (F1). Sufficient time (not more than an hour) is allowed for the solvent to disintegrate the sample before running the centrifuge. Run the centrifuge slowly and then gradually increase the speed to a maximum of 3600 rpm.



Fig 1.1 Bitumen extractor of RES Lab

## III. METHODOLOGY & SAMPLE DETAILS

(a.) Percentage of binder in the total mix,

=W1-(W2+W3)/W1*100.

Where, W1=weight of sample taken.
W2=weight of sample after extraction
W3=increased weight of filter paper (F2-F1)
(b.) The result obtained shall be reported as the percentage of binder content in the mix to the nearest second decimal.

| S.No. | Sample no. | Road Name | Details |
|---|---|---|---|
| 1. | S-1 | Thatipur Road | MDR |
| 2. | S-2 | Suresh Nagar Road | MDR |
| 3. | S-3 | Girgaon Road | MDR |
| 4. | S-4 | DD nagar Road | MDR |
| 5. | S-5 | City Centre Road | MDR |

## IV. RESULTS AND ANALYSIS

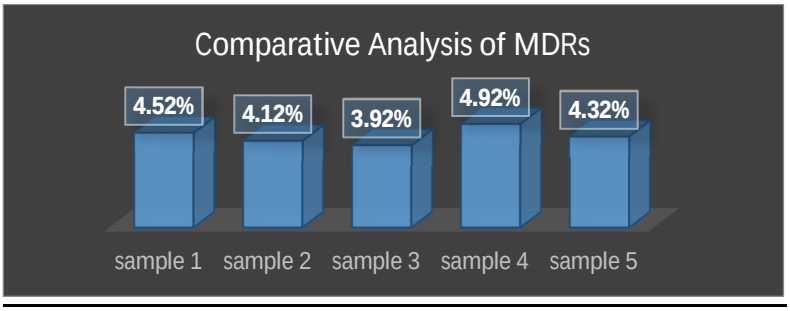
The details of experimental studies taken up to fulfil research objectives are being mentioned here. The details of results shows that the Sample-4 (DD Nagar Road) which is a ODR is having requisite binder content i.e. 4.92% as per IRC: SP 11-1988 (Appendix-5), ASTM D 2172.

Table 1.1

| S.No | Particulars | Sample1 (Thatipur Road) | Sample2 (Suresh Nagar Road) | Sample3 (Girgaon Road) | Sample4 (DD Nagar Road) | Sample5 (City Road) |
|---|---|---|---|---|---|---|
| 1. | Weight of Sample Before Wash (W1) | 500gm | 500gm | 500gm | 500gm | 500gm |
| 2. | Weight of Filter Paper Before Wash (F1) | 9.4gm | 9.4gm | 9.4gm | 9.4gm | 9.4gm |
| 3. | Weight of Sample After Wash (W2) | 477gm | 479gm | 480gm | 475gm | 478gm |
| 4. | Weight of Filter Paper After Wash (F2) | 9.8gm | 9.8gm | 9.8gm | 9.8gm | 9.8gm |
| 5. | Weight of Binder E-W1-W2-(F2-F1) | 22.6gm | 20.6gm | 19.6gm | 24.6gm | 21.6gm |
| 6. | Weight of Aggregate (G) (W1-E) | 477.4gm | 479.4gm | 480.4gm | 475.4gm | 478.4gm |
| 7. | Binder Content H= EX100/W1 % | 4.52% | 4.12% | 3.92% | 4.92% | 4.32% |

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Table 1.1
Compartive Analysis of Sub-Tropical Climate Zone Mdr's Bitumen Content




From the above table and graph of final results of samples from the lab testing, it can be seen that the % of bitumen content in all 5 samples of roads are different. The average theoretical requirement of % of bitumen content is 1-4%, 4-5% is good and 5-7% is classified in the higher grade roads According to IS-codes. Sample1 which is taken from Thatipur road having 4.52% of Bitumen content which is good according to IS-codes. Sample2 which is taken from Suresh Nagar road having 4.12% of Bitumen content which is also classified in good category according to the IS-codes parameters. Sample3 is taken from Girgaon road which having 3.92% of Bitumen content which is average Bitumen content according to IS-codes. Sample4 is taken from DD Nagar road, having 4.92% of bitumen content which is good according to IS-codes. Sample5 is taken from City road of Gwalior, having 4.32% of bitumen content which is good according to the IS-codes of Bitumen content of flexible pavements.

## V. CONCLUSION

The condition that we got from the experiment, it's shown that the % of bitumen content of all samples are different. The alternative method developed in the present paper for calculating the % of bitumen content from the samples only. The model is justified using 5 field samples obtained from different region of Gwalior, (M.P), and India. The variation of values of samples show from 3.92% to 4.92%.

| S.No | Particulars | Weight in gm. |
|---|---|---|
| 1. | Weight of Sample Before Wash (W1) | 500 gm. |
| 2. | Weight of Filter Paper Before Wash (F1) | 9.4 gm. |
| 3. | Weight of Sample After Wash (W2) | 475 gm. |
| 4. | Weight of Filter Paper After Wash (F2) | 9.8 gm. |
| 5. | Weight of Binder E=W1-W2-(F2-F1) | 24.6 gm. |
| 6. | Weight of Aggregate (G) (W1-E) | 475.4 gm. |
| 7. | Binder Content H= EX100/W1 % | 4.92% |

By the lab testing of all these 5 samples we found that the % of bitumen content in DD Nagar road, Gwalior is high and good in comparison of all other road samples.

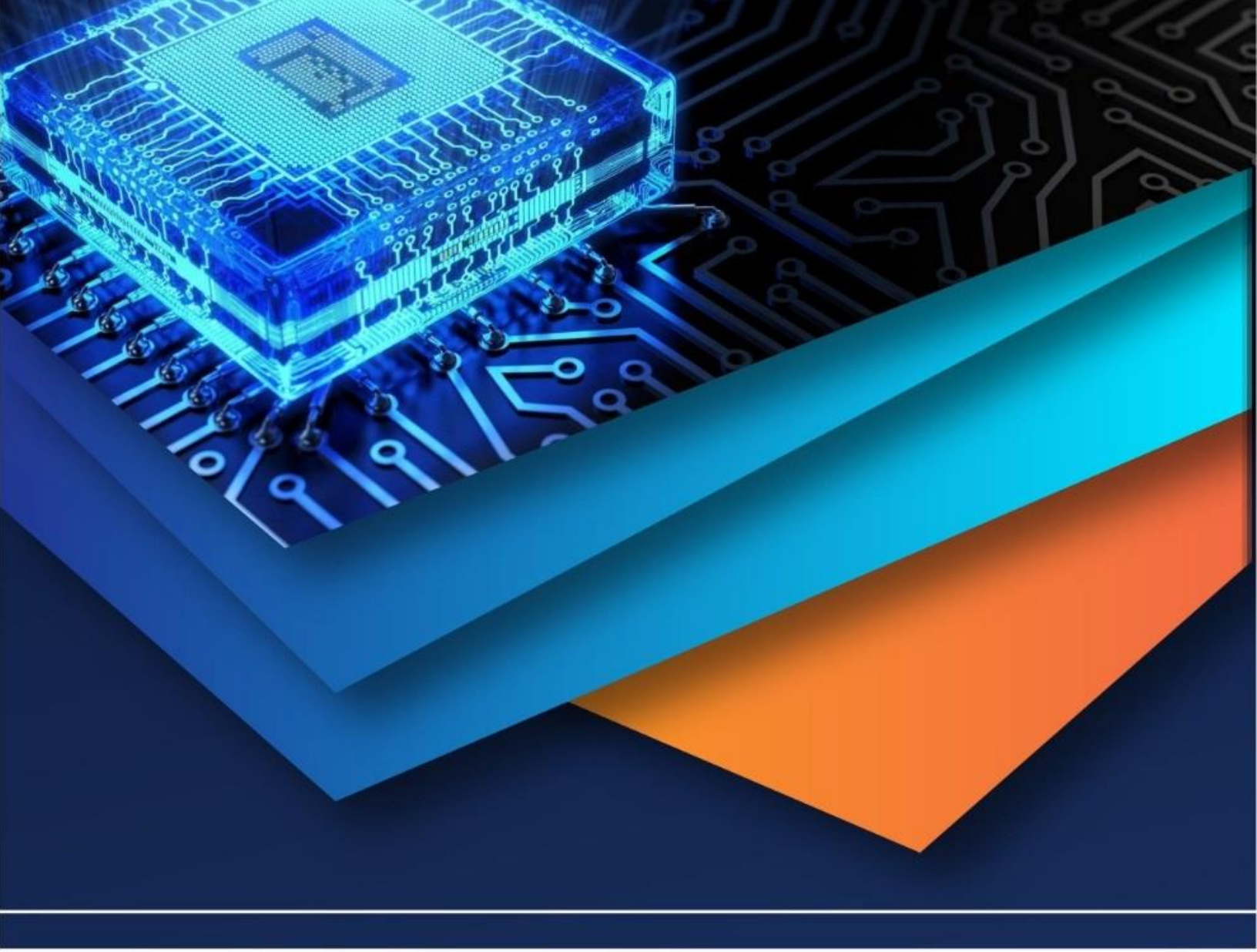
## VI. RECOMMONDATIONS

The present investigation is useful in understating the sustainability and the % of bitumen content of Asphalt pavement samples of bituminous road of subtropical climate condition. As we can see that the % of Bitumen content for different samples are different but sample-4 which is taken from DD Nagar road (MDR) having requisite percentage of bitumen content in comparison of all other samples of roads of the same city. So we recommend to the PWD (Public Works Department) that all the future subtropical climatic roads should be designed as per the IRC: SP 11-1988 (Appendix-5), ASTM D 2172 as the rood sample-4 is designed.

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