

Analysis and Execution of WBM and Bituminous Premix Roads

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ABSTRACT: Road Transport is vital to India's economy. India's road network carries over 65 percent of its freight and about 85 percent of passenger traffic. Flexible pavement is composed of a bituminous material surface course and underlying base and sub base courses. W.B.M is one type of flexible pavement. When a fast moving vehicle passes over a W.B.M road, the slurry of Murom is sucked out by the pneumatic wheel tires. The stone pieces get disturbed and finally the road surface is disintegrated. Thus the W.B.M roads are not suitable for fast moving vehicles with the wheel Tires. These roads are suitable for slow moving iron wheeled traffic only. In order to overcome this problem now-a-days we are applying bituminous layers above the W.B.M to make it better to take the loads, avoid the sucking out of the binding material and to increase the life of the pavement. The thickness off the bituminous layer is depends upon the traffic.

KEYWORDS: Bituminous material, W.B.M, Bituminous layer, Traffic.

I. INTRODUCTION

Flexible pavements are so named because the total pavement structure deflects, or flexes, under loading. A flexible pavement structure is typically composed of several layers of material. Each layer receives the loads from the above layer, spreads them out, and then passes on these loads to the next layer below.

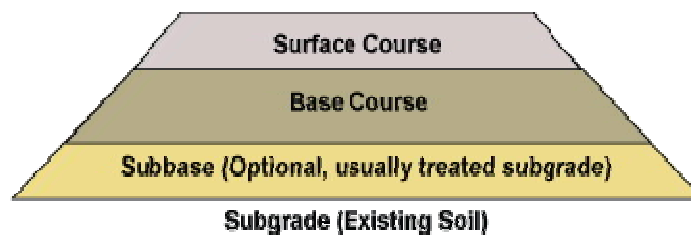


Fig.1. Typical section of a flexible pavement, showing order of layers like surface course, base course, sub base course and sub grade soil.

W.B.M pavement layers are made of crushed or broken aggregates mechanically interlocked by rolling and voids filled with screening and binding material with the assistance of water. The strength of a W.B.M course is due to the mechanical interlocking of the aggregate particle and the cohesion between the aggregates particles due to cementitious film of soil moisture binder. The thickness of the each compacted W.B.M layer is 10cm to 7.5cm. It can be used as sub-base, base, surfacing layer Surface is better than earthen road but rough as compared to bituminous or concrete roads. It can be used as Base Course for Bituminous or Concrete roads. In our country W.B.M roads is used as both finished surface for minor roads and as a good base course or superior pavements carrying heavy traffic.

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II. STUDY AREA

The area selected is from Nellorepalem to Vinjyamur, the total distance between these two villages is 9 kilometers. Two lane roads without median are proposed to lay with thickness 575 mm and 7.0 M width.

Technical Features of the Project

Project Length : 9 kilometres
No. of Lanes for Main Carriageway: 2 No's
Main Carriageway width : 7 M
Thickness of the pavement : 575 mm

Pavement Layers

Semi dense bituminous concrete : 25 mm
Bituminous concrete : 50 mm
Water bounded macadam : 300 mm
Granular sub-base : 200 mm

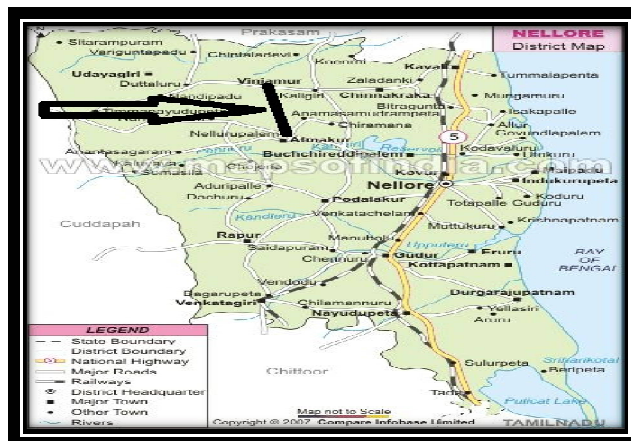


Fig.2.The project is located in Nellore district in Andhra Pradesh state. It's a road connecting two places, Nellorepalem to Vinjyamur.

III. ANALYSIS AND DESIGN

1. Design Traffic:

For estimating the design traffic, the following information is needed:

- Initial data in terms of number of commercial vehicles per day (CVPD).
- Traffic growth rate during design life in %
- Design life in number of years.
- Vehicle damage factor
- Distribution of commercial vehicles over the carriage way

2. California Bearing Ratio Test (CBR):

This test was developed by the California Division of Highway as a method of classifying and evaluating soil-sub grade and base course materials for flexible pavements. CBR test, an empirical test, has been used to determine the material properties for pavement design. It is a penetration test wherein a standard piston, having an area of 3 in 2 (or 50 mm diameter), is used to penetrate the soil at a standard rate of 1.25 mm/minute. The pressure up to a penetration of 12.5 mm and it's ratio to the bearing value of a standard crushed rock is termed as the CBR. The ratio at 2.5 mm penetration

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is used as the CBR. In some case, the ratio at 5 mm may be greater than that at 2.5 mm. If this occurs, the ratio at 5 mm should be used. The CBR is a measure of resistance of a material to penetration of standard plunger under controlled density and moisture conditions.

CBR value is expressed as a percentage of the actual load causing the penetrations of 2.5 mm or 5.0 mm to the standard loads mentioned above.

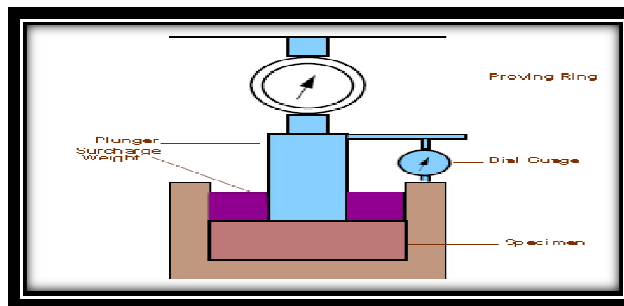


Fig.2.C.B.R equipment. It is used to find out the bearing capacity of the soil. Here we are using this equipment to know the bearing capacity of the soil.

Tests have been done at 3 places of study area and values are entered in table given below. We got the values like 4.2, 3.6, 3.7, 3.0, 3.5 from these values 4.2 is highest among them and we are taking it for design purpose.



Fig.3. Pits for C.B.R tests. Generally pits are made to perform the C.B.R tests to know the inner bearing capacity of the soil.

TABLE I. CBR Values. This table clearly shows the C.B.R values , which are used to find out the bearing capacity of the soil.

Penetration in mm	Proving ring Reading No. Divisions			Corrected load 2x Value of One division in (kg)			Standard load		CBR% $\frac{3}{4} \times 100$			Height value
	1	2	3	1	2	3	4	5	1	2	3	
0	0	0	0	0	0	0						
0.5	5.5	5	4.8	13.5	13.5	13						
1.0	11	12	12	27.5	30	30						
1.5	14.4	15.8	16	36	39.5	40						
2.0	17	19	19.5	44.5	47.5	48.5						
2.5	19.8	23	23	49.5	57.5	57.5	1370	3.6	1.2	1.2		
3.0	22	25	26	55	62.5	65						4.2%
4.0	23.8	26.7	27	59.5	66.75	67.5						
5.0	24.7	30.5	29	61.75	76.25	73.5	2055	3	3.7	3.5		
7.5	30.2	31.8	36	72.5	81	90						
10.5	32	39	40	80	97.5	100						
12.5	35	42	42	87.5	105	105						

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The design traffic is 2415 which is greater than 1500, so the thickness of the pavement from the graph of CBR value 4.2% for the number of commercial vehicles 2415 is 550mm.

C Binding Material Murom

Binding material to be used for W.B.M as filler shall consist of a fine grained material passing 100 % through 425 micron sieve. If limestone formations are available nearby, limestone dust or canker nodules may be used as binding material. Application of binding material may not be necessary, where the screenings consist of crushable type material like Murom or gravel.



Fig.4. Typical section of a W.B.M. pavement is shown in the above figure and laying of aggregates for W.B.M. roads. The water is poured on the soil for a good compaction; usually the water is added by checking the optimum moisture content of the soil. The aggregates are placed in order, so that no bumps are formed later due to heavy compaction.



Fig 5. Laying of aggregates for W.B.M. roads and typical section for a bituminous, W.B.M. pavement. After placing the heavy aggregates, in the next process the small aggregates are placed and they are compacted by the road rollers. After attaining the good compaction, the bituminous is sprayed and leveled.

IV. THICKNESS OF LAYERS

Sub-Grade:

The top soil or sub-grade is a layer of natural soil prepared to receive the stresses from the layers above. It is essential that at no time soil sub-grade is overstressed. It should be compacted to the desirable density, near the optimum moisture content.

For a given soil, the CBR value and consequently the design will depend largely on the density and moisture content of the sample. A minimum dry density corresponding to 2% should attain in the field and recommended moisture content

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should be 12% wet of optimum moisture content. The moisture content and dry density is below the minimum levels hence, there is no need of compact the soil.

Sub-Base Course:

The sub-base course is the layer of material beneath the base course and the primary functions are to provide structural support, improve drainage, and reduce the intrusion of fines from the sub-grade in the pavement structure.

Sub-base materials comprises natural sand, Murom, gravel, literate, kankar, brick metal, crushed stone, crushed slag, crushed concrete or combinations thereof meeting the prescribed grading and physical requirements.

The thickness of the sub-base should not less than 150 mm for design traffic less than 10msa and 200mm for design traffic 10msa and above. Hence the cumulative standard axle load is 15.88 msa; therefore the sub-grade is 200mm.

Base Course:

The base course is the layer of material immediately beneath the surface of binder course and it provides additional load distribution and contributes to the sub-surface drainage. It may be composed of crushed stone, crushed slag, and other untreated or stabilized materials unbound granular base which comprise conventional water bound macadam, wet mix macadam or other equivalent granular construction conforming to IRC specification.

The recommended minimum thickness of granular base is 225 mm for traffic up to 2msa and 250 mm for traffic exceeding 2msa. Where W.B.M construction is adopted in the base course for road carrying traffic more than 10 msa, the thickness of W.B.M base shall be increased from 250 mm to 300 mm i.e., 4 layers of W.B.M grade II and III each of 75MM compacted thickness.

For ease of construction with corresponding reduction in the sub-base thickness keeping the overall pavement thickness unchanged as deduced from the design chart. Hence the cumulative standard axle load is 15.88 msa, so the thickness is 300mm.

Bituminous Surfacing:

Surface course is the layer directly in contact with traffic loads and generally contains superior quality materials. They are usually constructed with dense graded asphalt concrete (AC). It provides characteristics such as friction, smoothness, drainage, etc. Also it will prevent the entrance of excessive quantities of surface water into the underlying base, sub-base and sub-grade.

The thickness of the dense bituminous macadam is 50mm because the total thickness of the pavement is 550mm, in that 200 mm sub-grade and 300 mm W.B.M and remaining portion is DBM.

Bituminous Concrete:

It is a thin surface treatment used to water-proof the surface and to provide skid resistance. Where the wearing course surface adopted in open graded premix carpet of thickness up to 25mm, the thickness of surfacing should not be counted towards the total thickness of the pavement as surfacing will be purely for wearing and will not add to the structural capacity of the pavement. The grade of bitumen will be selected keeping in view the traffic, rainfall and other environmental conditions. Use of high performance mixes binders are recommended in heavily traffic situations.

Therefore the total thickness of the pavement if we conclude the seal coat will be 575mm.

V. CONCLUSION

1. By laying the bituminous layer over W.B.M layer it will increase the life span of the pavement by avoiding the sucking of the binder which is the main reason for the strength of the pavement, safety for the user and decrease the maintenance cost of the road.
2. By using W.B.M roads the project cost is decreased, because we are using 35-50% of the material which is available locally.
3. We can decrease the environment impact by using recycle pavement material, dust, building demolition material.

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4. W.B.M road is more economical than W.M.M road, The cost of W.B.M for 100M is nearly 1, 30,000 rupees 1,40,000 rupees whereas the cost of W.M.M for 100M is nearly 1,70,000 rupees of minimum thickness 225MM, but construction process is little bit late than W.M.M.
5. Earthen roads and gravel roads, life span is less than the W.B.M roads. If we lay the improvised W.B.M roads give more comfortable, safety for the road users and maintenance of the road decreases.

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