A STUDY ON RECYCLED BITUMINOUS PAVEMENT MATERIALS USING BITUMEN VG-30

P V S Koteswara rao[1], P.Suresh Babu[2] and R. Srinivasa Kumar[3]
[1]Assoc Prof, civil Engg dept,Matrusri Engg College;[2]ResearchScholar OsmaniaUniversity, Hyderabad;[3]Asst. Professor, Dept. of Civil Eng. University College of Eng. Osmania University, Hyderabad.

ABSTRACT: In general, any good road construction requires large quantities of construction materials from natural resources. Continuously utilization of natural resources particularly the stone aggregates creates future shortfall and environmental imbalances. In view of utilization of reclaimed asphalt pavement (RAP) for recycling of bituminous pavements has got significance now. With the above serious concern, the present study has been carried to use of recycled bituminous pavement (RAP) with new aggregates collected from quarry materials and mixed with bitumen (VG-30) grade. The prepared several combinations of trail mixes of Dense Bituminous Macadam (DBM) mixture sample were then tested conducted as per MORTH (2013) specification. It has been observed that mix combination of 40% of RAP with 60% of new aggregates is within the specified limits of MORTH (2013) Specifications[1]. Hence it is found that RAP can be used in place of new formation of roads in Urban & Rural roads.

1. INTRODUCTION

In order to reduce the usage of natural aggregate, recycled asphalt pavement can be used as partially or fully replacement of new materials. The Reclaimed asphalt pavement (RAP) is the term used to collect from existing old pavements by milling equipment. RAP material is tested with the bitumen extraction test, identify bitumen percentage and aggregate gradation and the obtained material is reused by suitably blending with processed new aggregate and bitumen There has been considerable research carried out on the reusability of RAP over the past 1980s and this has grown considerably over the past years as the various agencies [2-7], Central and State Governments have recognized the need for greater sustainability in construction . As an example of Indian practice, Clause No.519.2.1, MORTH also recommends to reuse of RAP for production of bituminous macadam (BM) and dense bituminous macadam (DBM) by suitably blending with new bitumen and the aggregates subjected to the maximum proportion of RAP materials used is limited to not greater than 60%.

With the above importance, the present research work is under taken and the details of objectives and scope of the study are as follows.

2.0 OBJECTIVE AND SCOPE OF THE STUDY

2.1 Objectives

The objectives of the present study are listed below:

(a) To study the suitability of RAP materials for production of DBM by partial replacement with natural aggregate by conducting required laboratory tests
(b) To determine the strength characteristics of the blended RAP material by conducting Marshall Stability Tests and determine its compliance with MORTH Specification (2013).

2.2 Scope of the study

The following are the details of scope of the work.

(a) Investigation the prospects of recycling of the RAP material obtained from exiting old bituminous pavement NH-202.
(b) To evaluate engineering properties of the RAP samples collected from NH-202.
(c) To blend the aggregates to meet the standard graduation requirement of DBM as per MORTH 2013.
(d) Determination of optimum percent replacement of virgin aggregate by the RAP.
(e) Determination of strength characteristics of RAP as DBM mix by conducting Marshall Stability Test with the following trail mixes.

3. EXPERIMENTAL PROCEDURE

The details of methodology and the steps followed in the laboratory evaluation of RAP are brief below:

Source of RAP materials are from deteriorated surface NH-202 at Ghatkesar junction in Hyderabad and evaluate its engineering properties by conducting bitumen extraction test, sieve analysis and other tests on the aggregate obtained from the RAP as per standard specifications.

Fig. 1 Collection RAP material and bitumen extraction test on RAP

After conducting the above tests RAP, analysis is carried out to examine the inherent characteristics of RAP so as to o determine optimum proportion of different sizes of natural aggregates required to be added to the extracted RAP materials and optimum bitumen. To validate the experiments results with MORTH & MS-2 Specifications were adopted.

The engineering properties of the natural aggregate used and the aggregates obtained from the RAP are tested and the details are presented in Table 1. The new natural aggregate was procured form a stone crusher near Hyderabad.

Table 1 Summary of the Test results of Natural aggregate and Aggregate Obtained from RAP material.

Physical	Test	Specificatio	Test Results	
		MORTH	Natural Aggregat	RAP Material
Impact Valu	IS:238((Part IV	27% Max.	21.73%	22.26%
Water Absorptior	IS:238((Part II	2%	27-12 mm	0.547
			5-0 mm	0.879
Specific Gravity	IS:238((Part II	2.5-3.2	27-12 mm	2.680
			5-0 mm	2.556

The engineering properties of the bitumen used for preparing the Marshall mix samples are presented in Table 2

Table 2 Physical properties of bitumen (VG-30) used

Property	Bitumen test resul	Requirement as per IS 73:2006[8]
Penetration value (mm)	62 mm	40 (min)
Ductility (cm)	86.50 cm	40(min)
Specific gravity	1.020	0.98-1.02
Softening point	49.40 C	47 C(min)

Trial Marshall-mix samples of the proposed DBM were prepared by varying proportion of RAP material as 35%, 40%, 50% s 65%, 60% and 50% with new aggregates, and the each sample was mixed with bitumen (VG-30) content of 3%, 3.5%, 4%, 4.5% and 5%.

The Marshall test data of the above samples were drawn for Unit weight Vs Bitumen Content, Air Voids Vs Bitumen Content, VMA Vs Bitumen Content, VFB Vs Bitumen Content, Marshall Stability Vs Bitumen Content and Flow Vs Bitumen Content.

4. TEST RESULTS

The suitability of reusability RAP in DBM was evaluated and the details are as follows:

Marshall test results obtained on the DBM Grading II design mix proportioned with 35%, 40% and 50% of RAP are presented Table 4, Table 5 and Table 6, respectively. Summary of Marshall test results obtained with optimum bitumen content for the RAP proportions used are presented in Table 7.

Table 4 Marshall stability test results of DBM with 35 % RAP

Bitumen %	Density	Stability	Air Voids	VMA	VFB	Flow
3.00	2.340	27.25	7.80	14.13	44.80	3.87
3.50	2.348	28.57	6.75	14.26	52.67	4.13

4.00	2.345	33.83	6.16	14.81	58.43	4.20
4.50	2.343	29.88	5.55	15.34	63.84	5.07
5.00	2.354	28.57	4.39	15.39	71.46	5.33

Table 5 Marshall stability test results of DBM with 40 % RAP

Bitumen %	Density	Stability	Air Voids	VMA	VFB	Flow
3.00	2.309	27.74	8.93	15.15	41.04	3.73
3.50	2.313	30.43	8.08	15.44	47.70	5.93
4.00	2.316	32.39	7.28	15.79	53.90	4.50
4.50	2.337	29.11	5.71	15.45	63.03	4.97
5.00	2.330	30.98	5.31	16.16	67.14	6.33

Table 5 Marshall stability test results of DBM with 50 % RAP

Bitumen %	Density	Stability	Air Voids	VMA	VFB	Flow
3.00	2.311	25.07	9.17	15.49	40.82	4.20
3.50	2.313	27.98	8.39	15.86	47.08	4.60
4.00	2.318	25.14	7.51	16.13	53.42	5.60
4.50	2.329	26.78	6.34	16.15	60.73	6.60
5.00	2.248	25.19	8.93	19.50	54.19	7.00

Table 7 Summary of Marshall test results obtained with optimum bitumen content for the RAP proportions used

Mix Proportion w RAP %	Bitumen (%)			Density (g/cc)	Stability (kN)	Air Void (%)	VMA (%)	VFI (%)	Flow (mm
	Existing	Additional	Overal						
Mix-I (35%)	4.40	0.75	5.15	2.337	26.45	4.96	16.62	70.19	5.57
Mix-II (40%)	4.40	0.25	4.65	2.347	28.57	5.18	15.34	66.23	4.95
Mix-III (50%)	4.40	0.85	5.25	2.314	24.99	5.87	17.51	66.5	5.88

5. CONCLUSIONS

Based on the laboratory experiments carried out in this study, the following conclusions have been drawn:

For the materials used in this study, it was found that, the proportion of 40% RAP material and 60% of virgin material by weight, proved to be optimum. The engineering properties of this RAP substituted mix are found to be satisfactory and comparable to that of the 100% virgin material.

Hence it is concluded that the experimental results showed that, the RAP materials can be used effectively together with the virgin material such that, the RAP materials utilization is environmentally favourable and energy saving. Further, milling of RAP from the old existing urban roads can result to maintain the top levels of roads in an urban area will be within the limit as before overlay, so that, urban drainage problems can be eliminated.

REFERENCES

1. MORTH (2013), “Specifications for Road and Bridge Works: (Clause 519 Recycling of Bituminous Pavement", Ministry of Road Transport and Highways (MORTH), Indian Roads Congress, New Delhi, pp.242-250.
2. Riddish A. Shah and Jayesh hai R. Pitroda, (2011), Recycling of Construction of mate-rials for sustainability, Journal

of National Conference on Recent trends in Engineering & Technology.

3. Ravi Patel, Chetna M Vyas and Darshana R. Bhatt (2013), Experimental investigation for Re-cycled Coarse aggregate replaced for natural Course aggregate in Concrete, International Journal of Civil, Structural, Environmental and Infrastructure Engineering and Development, Volume 3 issue 2.
4. Betenson W. D. (1979), Recycled asphalt concrete in Utah, Proceedings of the Association of Asphalt Paving Technologists, Vol.48, , pp.272-295.
5. Mallick B. R., lecture notes, A 3-day workshop on recycling and other pavement rehabilitation methods, IIT Kanpur, 8-10th February, 2005, pp.58-350.
6. Ikeda, T., and Kimura, M., Recent developments in recycling asphalt pavements in Japan, Proceedings of 8th international conference on asphalt pavements, Seattle, Washington, 1997, pp. 99-106.
7. Epps J.A., Terrel R. L., Little, D. N. and Holmgreen R. J., Guidelines for recycling asphalt pavements, Proceedings of the Association of Asphalt Paving Technologists, Vol.49, 1980, pp.144-176.
8. IS.73-1992-Paving Bitumen Specification, BIS, New Delhi, 2nd Revision.