Study on Reclaimed Asphalt Pavements

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***Abstract*- Now a days because of good infrastructure and their good facilities in roadway structures, the demand of aggregate is increased and because of limited aggregate the Recycling of Asphalt Pavement is the best option to give good result with benefits. While a number of factors drive the use of Recycling asphalt pavements, the primary factors are economic savings and environmental benefits. Aggregates form a bulk of the material required for bituminous concrete pavements. Aggregate being a natural material is being fast consumed and is causing a shortage of resources required for rapid infrastructure development. Also on the other side with the new trends in construction industry there is a generation of solid waste in the form of demolished structures. Today, science and technology has a responsibility of innovating new trends which are both economical and eco-friendly. Recycling reduces the amount of construction debris going into landfills. With the help of recycling asphalt it uses the natural resources and sustains the asphalt pavement. Old demolished concrete structures can be recycled to obtain recycled aggregate (RA). This can be used along with the natural aggregates effectively in various infrastructure need so that we attain a balance between demand and supply of construction material thereby reducing the impact on nature. The present investigation aims in the strength variation of bituminous concrete surface course in which recycled aggregates are used in partial or full replacement of natural aggregates.**

***Index Terms*- Asphalt Recycling, Pavement Recycling Methods, Hot Mix Plants, Wet Mixed Macadam, Gradation Test.**

I. INTRODUCTION

While most of the developed nations have standardized the procedures and have made significant advancements in the bituminous pavement recycling techniques and in utilization of recycled materials in pavement construction to reduce the carbon footprints and to promote sustainability in pavement construction, we in India are yet to make any significant advancement and here pavement recycling is still in nascent stage. Although, in India, more than 90 percent of the pavements are bituminous pavements yet during their rehabilitation and maintenance, either the old pavement materials are being removed and dumped in a landfill or a new layer is paved on top of the existing pavement thereby, resulting in burial of the limited non-renewal resources. India with its 33 lakh kilometers of road network is the second largest in the world. Nearly 60 percent of freight traffic and 88 percent passenger traffic is carried by the roads and annual growth is projected at 12-15 percent for passenger traffic and 15-18 percent for cargo traffic. Government of India has also set an ambitious target of achieving 30 kilometer length of road construction per day. Apart from the investments in developing new roads, state transport agencies spend rupees worth thousands of crores annually to maintain and rehabilitate existing pavements. Pavement recycling is a logical and practical way to conserve our diminishing supply of construction materials and to reduce the cost preserving our existing pavement network. Recycling of pavements by re-using the existing materials will protect natural resources for future generation. Thus, the significance of adopting bituminous pavement recycling techniques for road construction in India cannot be overemphasized.

1.1 NEED OF STUDY

- The demand of aggregate to construct pavement is more & more so to recover it and for the optimization of natural resources.
- To overcome the problem related to dumped materials, and recycle of dumped material and conserve the natural resources.
- To minimize the adverse effects on environment

1.2 OBJECTIVES

- To use the Recycled material as filling material without doing any analysed and test in low lying areas.
- To use the Recycled material as WMM after investigating and then adding the missing sieve size material.
- To investigate the Recycled material and after carrying out Marshall Tests.
- Reprocess the Recycled material to certain percentage of mixing with fresh aggregate and virgin bitumen.

2. MARSHALL MIX DESIGN

The Marshall test is carried out both for fresh mix as well as RAP mix. Bruce Marshall, formely Bituminous Engineer with Mississippi State Highway Department formulated Marshall Method for Designing bituminous mixes.

Marshall's test procedure was later modified and approved upon by U.S.Crops of Engineers through their extensive research and correlation studies. ASTM and other agencies have standardized the test procedure. Generally this stability test is applicable to hot mix design of bitumen and aggregate with maximum size 2.5 cm. In India, bituminous concrete mix is commonly designed by Marshall Method.

In this method, the resistance to plastic deformation of cylindrical specimen of bituminous mixture is measured when the same is loaded at the periphery at a rate of 5 cm per minute. The test procedure is used in the design and evaluation of bituminous paving mixes. The test is extensively used in routine test programme for the paving jobs. There are major features of the Marshall method of designing mixes namely, (i) Density-Voids analysis (ii) Stability-flow test

The stability of the mix is defined as a maximum load carried by a compacted specimen at a standard temperature of 60 degree C.The flow is measured as the deformation in units of 0.25mm between no load and maximum load carried by the specimen during stability test. (The flow value may also be measured by deformation units of 0.1mm).In this test attempt is made to obtain optimum binder content for the aggregate mix type and traffic intensity.The apparatus consists of a cylindrical mould, 10.16 cm diameter and 6.35 cm height, with a base plate and collar. A compaction pedestal and hammer are used to compact a specimen by 4.54kg weight with 45.7 height of fall. A sample extractor is used to extrude the compacted specimen from the mould. A braking head is used to test the specimen by applying a load on its periphery perpendicular to its axis in a loading specimen by applying a load on its periphery perpendicular to its axis in a loading machine of 5 tones capacity at a rate of 5 cm per minute. A dial gauge fixed to the guide rods of the testing machine serves as floe meter to measure the deformation of the specimen during loading.

The coarse aggregate, fine aggregate and filler material should be proportioned and mixed in such a way that the final mix after blending has gradation within the specified range. Approximately 1200gm of aggregates and filler are taken and heated to a temperature of 175 to 190C. Bitumen is heated to a temperature of 121 to 145oC and the required quantity of the first trial percentage of bitumen (say 3.5 or 4.0 percent by weight of the material aggregates) is added to the heated aggregate and thoroughly mixed at the desired temperature of 154 to 160 degree C. The mix is placed in a preheated mould and compacted by a rammer with 50 blows on either side at temperature of 138oC to 149oC. (Suitable heating, mixing, and compacting temperature are chosen depending upon the grade of the bitumen).

The weight of mixed aggregates taken for the preparation of the specimen may be suitably altered to obtain a compacted thickness of 63.5+3.0 mm. Three or four specimens may be prepared using each trial bitumen content. The compacted specimens are cooled to room temperature in the mould and then removed from the mould using a specimen extractor. The diameter and mean height of the specimen are measured and they are weighted in air and also suspended in water. The specimen are kept immersed in water in a thermostatically controlled water bath at 60+-1 degree c for 30 to 40 minutes.

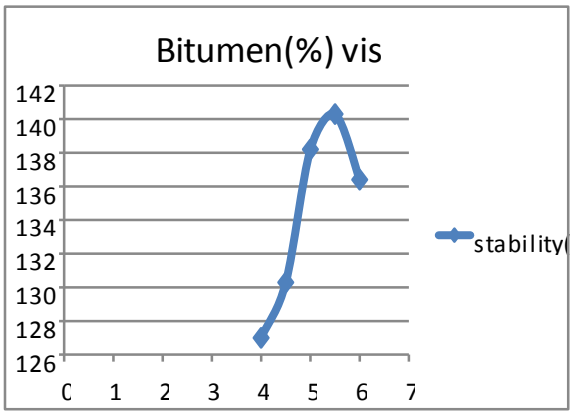
The specimens are taken out one by one, placed in the Marshall Test head and tested to determine Marshall Stability value which is in the maximum load in kg before failure and the flow value which is the deformation of the specimen in 0.25mm units upon the maximum load. The corrected Marshall Stability Value of each specimen is determined by

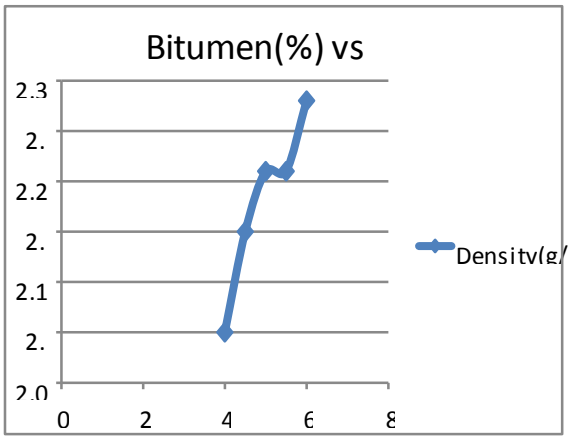
applying the appropriate correction factor, if the average height of the specimen is not exactly 63.5mm.

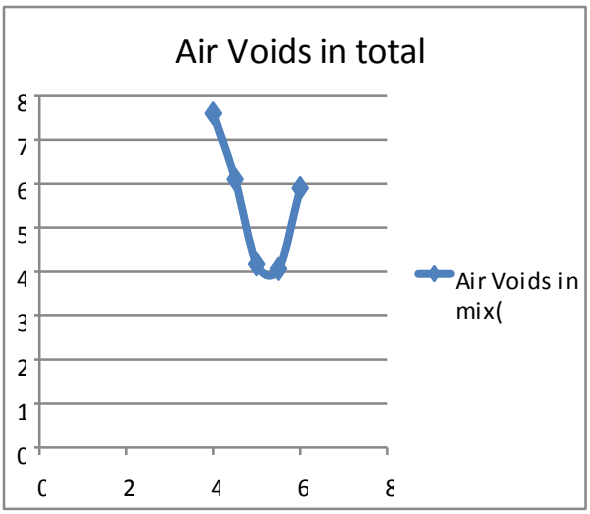
The above procedure is repeated on specimens prepared with other values of bitumen content, in suitable increments, say by 0.5 percent,upto about 7.5 to 8.0 percent bitumen by weight of total mix. The bulk density, percent air voids, voids in mineral aggregates and voids filled with bitumen are calculated using the different relationships.

The average value of the above properties are found for each mix with the different bitumen contents. Graphs are plotted with the bitumen content on the X-axis and the following values on Y-axis.

Sample no.	Bitumen%	Stability (kg)	Flow(0.25mm units)	Density(g/cc)	Air voids in total mix,$V_{(\%)}$
1	4	1270	22	2.1	7.6
2	4.5	1303	17.6	2.2	6.1
3	5	1382	14.3	2.26	4.17
4	5.5	1403	10.3	2.26	4.06
5	6	1364	10.3	2.33	5.9





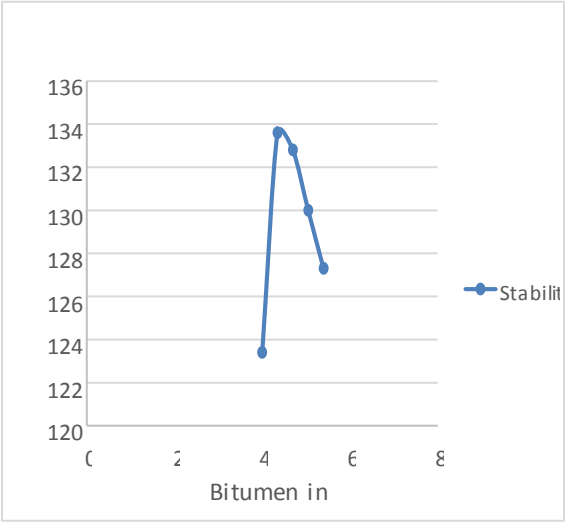


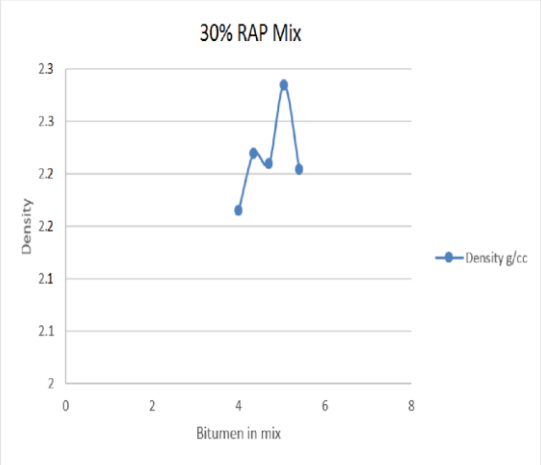
2.1 Analysis of Marshall Test results for different RAP percentages

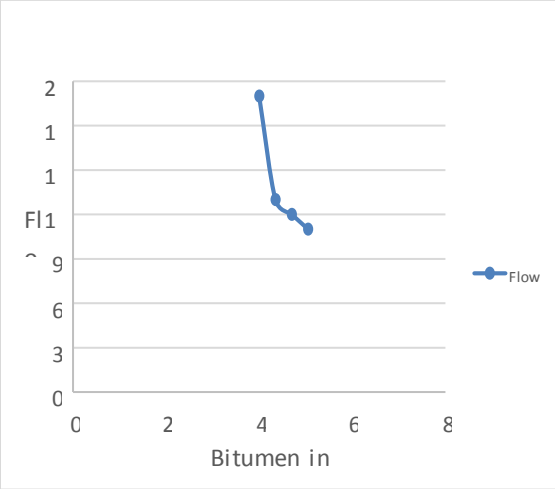
The variations of properties of mixes having definite proportion of RAP are given below table,

Bitumen %	RAP %	Bitumen mix %	Stability kg	Flow 0.25 mm units	Density g/cc	Vv %
4	30	4	1234	20	2.2	5.9
4.5	30	4.35	1336	13	2.2	4.0
5	30	4.7	1328	12	2.2	4.0
5.5	30	5.05	1300	11	2.3	5.5
6	30	5.4	1273	19	2.2	7.0

Marshall Test results for RAP as 30% by weight of fresh mix.



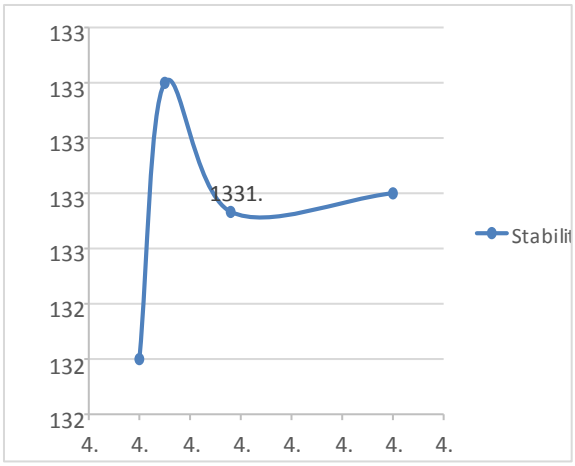




Design Graphs For 30% RAP mix

3. RESULTS

	Max Stability	Density	Vv%=4%	Flow Range
Fresh mix without RAP	5.5	6	5.5	10-14
20% RAP	4.8	5.2	4.6	12-14
30% RAP	4.35	5.05	4.52	12-13
40% RAP	4.3	4.9	4.3	11-14



Design graphs for stability

4. CONCLUSION

Recycling Asphalt is a new technology with the help of which bituminous pavements can be constructed at a reduced cost as it involves the usage of old bituminous pavement materials. Also it ensures optimization of resources and supports sustainable development. Optimal percentage of material depends upon the composition of bituminous material and type of layer in which it is to be used Numerous transportation agencies have been recycling Asphalt in unbound base and sub-base layers for many years. Old Asphalt for use in base and sub-base layers can be characterized by performance-related parameters and properties including those needed for pavement design, such as grading, shear strength beneath static tri-axial loading and permanent deformation under repeated tri-axial loading. As a result of the analysis it is found that the RAP added bituminous mix given competitive as compared with the fresh bitumen mix. Therefore RAP can be used to certain limit in the maintenance of roads as an alternate to overlays.

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