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"Feasibility Study of Construction and Demolition Waste Use in DBM Layer of Flexible Pavement"

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Abstract— The recycling and reuse of waste materials is a topic of global concern and great international interest for those interested in sustainable development and protecting the environment. Construction and Demolition (C&D) waste constitutes a major portion of total solid waste production in the world, and most of it is used in landfills. The need to manage construction and demolition waste (CDW) has led to environmentally-friendly actions that promote the reuse and recycling of this type of waste. The aim of this review is to verify the technical viability of using construction waste as material in the base pavement layers of road surfaces.

Keywords—Construction and Demolition Waste, Recycled aggregates, Standard test

I. INTRODUCTION

Construction and demolition waste can be defined as "waste which arises from construction, renovation and demolition activities which includes excavated materials, concrete, tiles, bricks, ceramics, asphalt, concrete, plaster, glass, metal and steel, plastics, wood, aggregates etc. According to estimate prepared by Govt. agencies involved in construction sector, the construction waste generated annually is around 165 to 175 million tones in India and the top listed cities is Delhi, Mumbai and Kolkata that generated huge quantity of waste (debris). So, the generation this much waste is another big challenge for municipal bodies, which are struggling to deal with millions of tons of garbage. Aggregate" is a collective term for the mineral materials such as sand, gravel and crushed stone that are used with a binding medium (such as water, bitumen, portland cement, lime, etc.) to form compound materials (such as asphalt concrete and portland cement concrete). Aggregate is also used for base and sub base courses for both flexible and rigid pavements. Recycled Aggregates is a term that describe crushed cement concrete or asphalt pavement from construction debris that is reused in other building projects. One of the applications of recycled aggregates from construction and demolition processes are the construction of embankments, sub bases and foundations for roads where unbound materials are used in replacement for natural aggregates.

II. METHODOLOGY

The Construction and demolition waste and recycled aggregate has been collectedas per requirement and grading of aggregates given in IS: 383-1970. According to requirement segregation of aggregate was perform. After segregation aggregate were retains on 10mm sieve and passes from 12.5mm sieve.
The number of test was performed on aggregate to check their properties and to compare its properties with normal aggregates. After comparison we conclude the result. Number of test were performed is listed below:-

- Aggregate Impact Value Test
- Crushing Value Test
- Specific Gravity Test
- Water Absorption Test
- Marshal Stability Test

All above mention tests has been conducted as per standard procedures.

2.1 RESULTS

Test carried out with different proportion of bitumen in natural aggregates, recycled aggregates and construction and demolition waste prepared with these aggregates & bitumen the plotted graphs of Marshall Parameters. 3 nos. of specimens prepared for Marshall Stability value and flow value for each bitumen content. Total 27 nos. of samples are prepared for 4.5, 5 and 5.5 % of bitumen content.

Construction and demolition waste and recycled aggregates are used in the proportion of 20 % by the weight of natural aggregates.

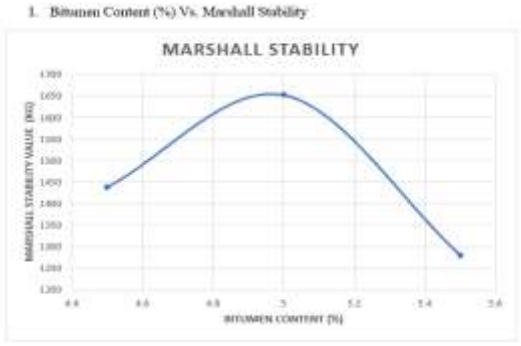
2.1.1 RESULTS OF NATURAL AGGREGATES

Table 1 Values of X-axis and Y-axis of Natural aggregates

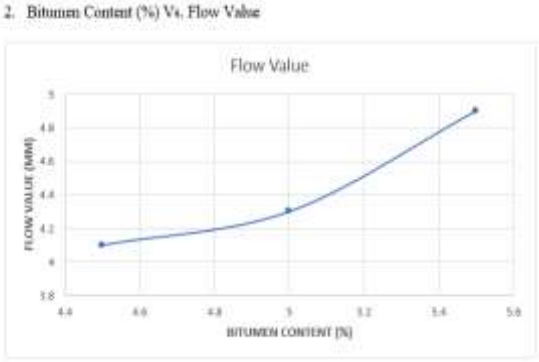
Bitumen Content (%)	Marshall Stability Value (kg)	Flow Value (mm)	% voids in total mix (Vv)	% Voids filled with bitumen (VFB)	Unit Weight
4.5	1438.34	4.1	54.15	50.06	1.286
5.0	1652.4	4.3	51.42	53.85	1.294
5.5	1279.8	4.9	50.34	56.73	1.288

The average value of Marshall Stability value, Flow value, percent Voids filled, % voids filled with bitumen and unit weight with bitumen content (4.5, 5.0 & 5.5 %) are given in table 1.

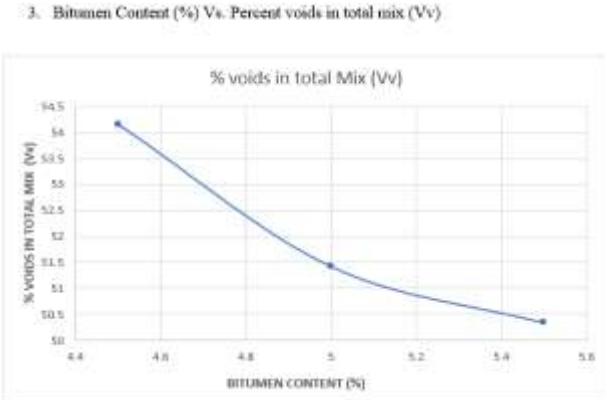
Graphs are plotted with the bitumen Content in X-axis are given below



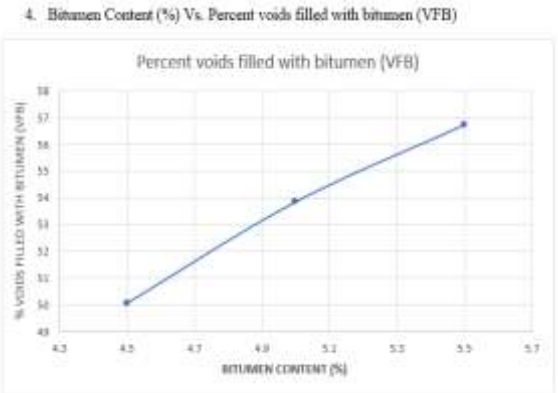
Graph 1: Bitumen content Vs. Marshall Stability



Graph 2: Bitumen content Vs. Flow Value

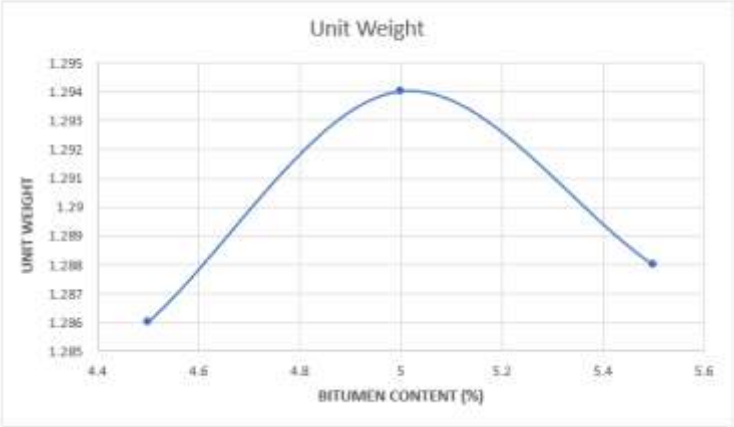


Graph 3: Bitumen content Vs. Vv



Graph 4: Bitumen content Vs. VFB

5. Bitumen Content (%) Vs. unit weight



Graph 5: Bitumen content Vs. Unit Weight

RESULTS OF RECYCLED AGGREGATES

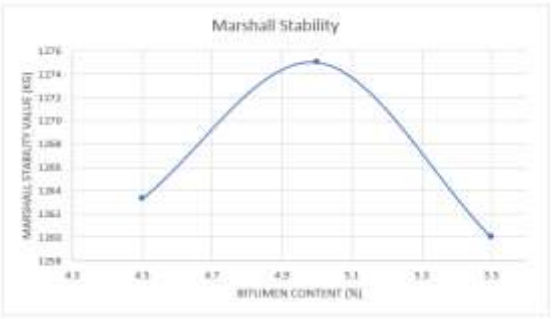
Table 2 Values of X-axis and Y-axis of Recycled aggregates

Bitumen Content (%)	Marshall Stability Value (kg)	Flow Value (mm)	% voids in total mix (Vv)	% Voids filled with bitumen (VFB)	Unit Weight
4.5	1263.3	4.66	54.71	49.68	1.282
5.0	1275	4.74	51.50	53.82	1.294
5.5	1260	5.38	50.61	56.60	1.286

The average value of Marshall Stability value, Flow value, percent Voids filled, % voids filled with bitumen and unit weight with bitumen content (4.5, 5.0 & 5.5 %) are given in table 2.

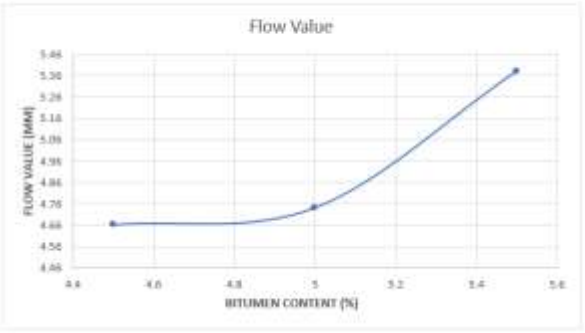
Graphs are plotted with the bitumen Content in X-axis are given below:

1) Bitumen Content (%) Vs. Marshall Stability

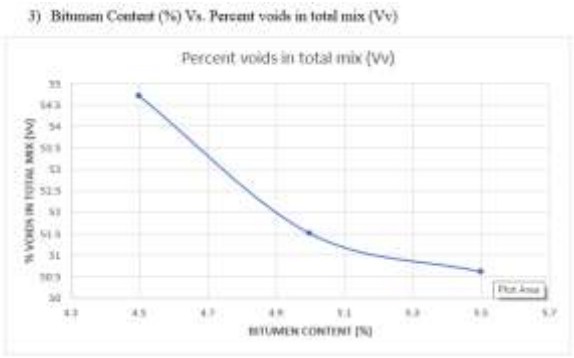


Graph 6: Bitumen content Vs. Marshall Stability

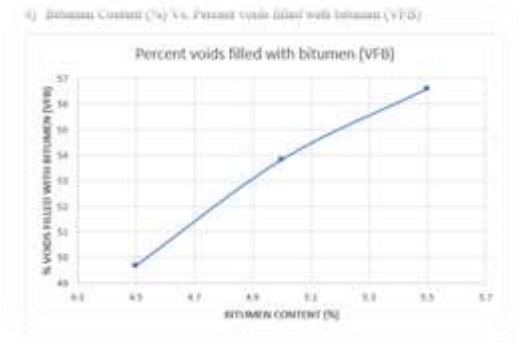
2) Bitumen Content (%) Vs. Flow Value



Graph 7: Bitumen content Vs. Flow value

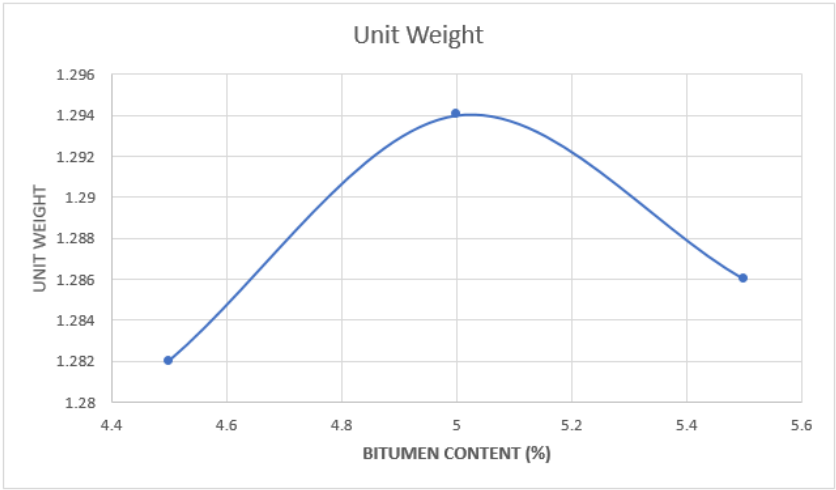


Graph 8: Bitumen content Vs. Vv



Graph 9: Bitumen content Vs. VFB

5) Bitumen Content (%) Vs. Unit weight



Graph 10: Bitumen content Vs. Unit Weight

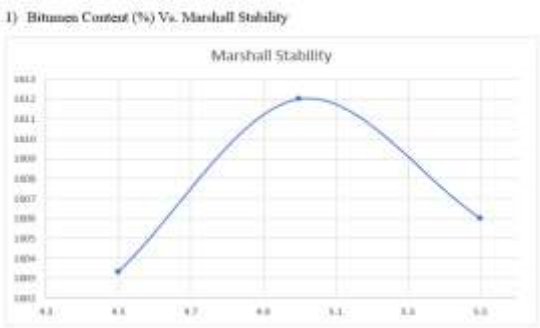
RESULTS OF CONSTRUCTION AND DEMOLITION WASTE AGGREGATES

Table 3 Values of X-axis and Y-axis of Construction and demolition Waste aggregates

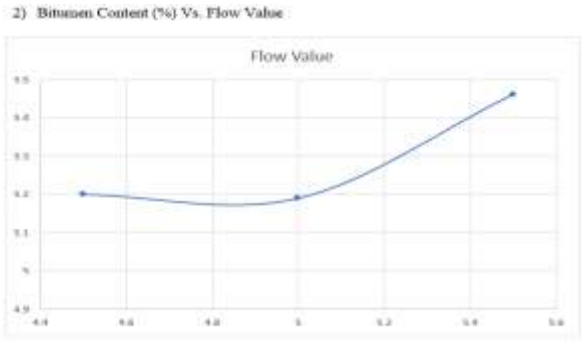
Bitumen Content (%)	Marshall Stability Value (kg)	Flow Value (mm)	% voids in total mix (Vv)	% Voids filled with bitumen (VFB)	Unit Weight
4.5	1603.3	5.2	51.22	52.45	1.302
5.0	1612	5.10	47.76	55.69	1.317
5.5	1606	5.86	46.97	58.43	1.308

The average value of Marshall Stability value, Flow value, percent Voids filled, % voids filled with bitumen and unit weight with bitumen content (4.5, 5.0 & 5.5 %) are given in table 3.

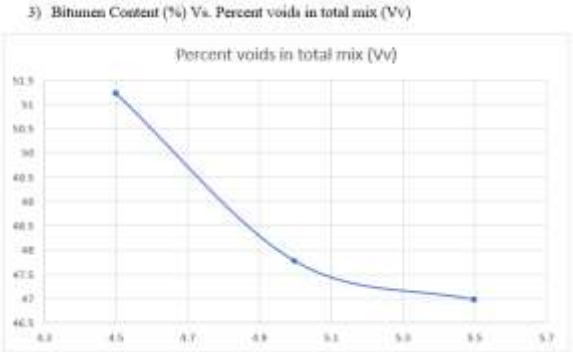
Graphs are plotted with the bitumen Content in X-axis are given below:



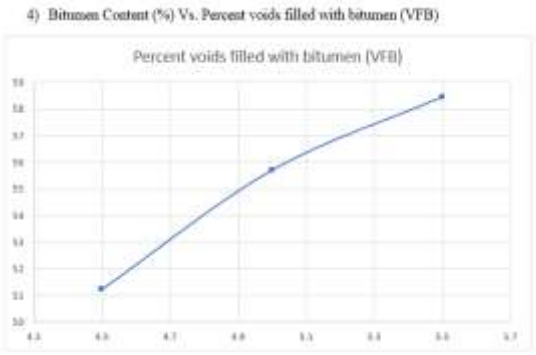
Graph 11: Bitumen content Vs. Marshall Stability



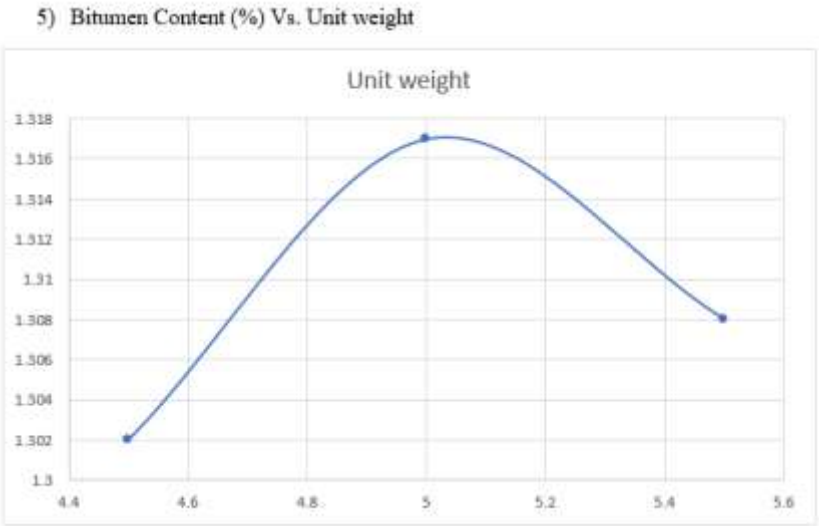
Graph 12: Bitumen content Vs. Flow value



Graph 13: Bitumen content Vs. Vv



Graph 14: Bitumen content Vs. VFB



Graph 15: Bitumen content Vs. Unit Weight

III. DISCUSSION

As above graph no. 1, 6 and 11 shows that the Marshall Stability value for Natural aggregate is 1438.34 kg, Recycled aggregate is 1263.4 kg and construction & demolition waste is 1603.04 kg for 4.5 % bitumen content, While for 5 % of bitumen content of Marshall Stability value for Natural aggregate is 1652.4 kg, Recycled aggregate is 1275kg and construction &demolition waste is1612 kg but for 5.5 % bitumen content of Marshall Stability value for Natural aggregate is 1279.8kg, Recycled aggregate is 1260 kg and construction & demolition waste is 1606 kg.

Graph no. 2, 7 & 12 shows that flow value for Natural aggregate is 4.1mm, Recycled aggregate is 4.66 mm and construction & demolition waste is 5.2 mm for 4.5 % bitumen content,While for 5 % of bitumen content of flow value for Natural aggregate is 4.3 mm, Recycled aggregate is 4.74 mm and construction &demolition waste is 5.10 mm andflow value for Natural aggregate is 4.9 mm, Recycled aggregate is 5.38 mm and construction & demolition waste is 5.86 for 5.5 % bitumen content.

Similarly graph no.3.8 &11 shows that percent air voids in total mix (Vv) for Natural aggregate is 54.15 %, Recycled aggregate is 54.71 % and construction & demolition waste is 51.22 % for 4.5 % bitumen content,While for 5 % of bitumen content ofpercent air voids in total mix (Vv) for Natural aggregate is 51.42 %, Recycled aggregate is 51.50 % and construction &demolition waste is 47.76 % andpercent air voids in total mix (Vv) for Natural aggregate is 50.34 %, Recycled aggregate is 50.61 % and construction &demolition waste is 47.97% for 5.5 % bitumen content.

As above graph no.5.10 & 15 shows that percent voids filled with bitumen (VFB) for Natural aggregate is 50.06 %, Recycled aggregate is 49.68 % and construction & demolition waste is 52.45 % for 4.0 % bitumen content,While for 5 % of bitumen content ofpercent voids filled with bitumen (VFB) for Natural aggregate is 53.85 %, Recycled aggregate is 53.82 % and construction & demolition waste is 55.69 % and for 5.5 % bitumen content, percent voids filled with bitumen (VFB) for Natural aggregate is 56.73 %, Recycled aggregate is 56.60 % and construction & demolition waste is 58.43 % for 5.5 % bitumen content.

IV. CONCLUSION

1. The highest Marshall Stability value of 5.5 % bitumen content for construction and demolition waste.
2. The maximum flow value of 5.5 % of bitumen content for construction and demolition waste.
3. The maximum value of percent air voids in total mix (Vv) of 4.5 % bitumen content for recycled aggregate.
4. The maximum value of percent voids filled with bitumen (VFB) of 5.5 % of bitumen content for construction and demolition waste.

It is concluded that construction and demolition waste aggregate can be used in DBM layer of flexible pavement which minimize the requirement of natural aggregates and can be helpful in controlling the environmental pollution.

REFERENCES

1. Vishal V Panchal, Vinayak B Kulkarni, Avadhut Kulkarni, Akash Kumar, "Use of Construction Demolition Waste in Pavement (International Journal of Advanced Research in Science, Engineering and Technology)," Vol. 4, Issue 12, December 2017, Pages 4956-4964.
2. Yaser Alawi, Rajesh Chouhan, "Experimental Study of Construction and Demolition Waste in Flexible Pavement"(International Journal of Advance Research, Ideas and Innovations in Technology), Volume 4, Issue 2, 2018, Pages 2074 - 2079.
3. Vanishree S. Hadagali, Arjun S. Virupakshi, H G.Hunashikatti, "Partial Replacement of Natural Aggregates and Natural Bitumen by Construction Demolition Waste and Recycled Bitumen", International Research Journal of Engineering and Technology, Volume: 03 Issue: 08 Aug-2016, Pages 519-523.
4. Tong T. Kien, Le T. Thanh and Phung V. Lu, "Utilisation of Construction Demolition Waste as Stabilised Materials for Road Base Applications," http://www.(researchgate.net/publication/267570122_Utilisation_of_construction_demolition_waste_as_stabilised_materials_for_road_base_applications)
5. Shakti Sagar, Deepak Juneja "Effect of Using Demolished Concrete Aggregate in Place of Conventional Aggregate for Patch Work '' International Journal of Civil Engineering and Technology (IJCIET), Volume 10, Issue 03, March 2019, Pages 2046-2055.
6. Ahmad H. Aljassar, Khalifa Bader Al-Fadala, Mohammed A.Ali "Recycling Building Demolition Waste in Hot-Mix Asphalt Concrete. A Case Study in Kuwait" Springer, Pages 112-115.
7. Jagdish Singh, Mukesh Choudhary and Dr. Bharat Nagar "To Study the Effects of Partially Replacement of Aggregate with RAP Material in DBM Design in Flexible Pavement."International Research Journal of Engineering and Technology (IRJET),Vol: 07,Issue: 07,July-2020,Pages 3596-3600.
8. Damyanti Badagha, Pratik Chauhan, C D Modhera and Jayesh Juremalani"Sustainable infrastructure development using waste materials: trends and challenges." National conference on Large Scale

Multi disciplinary Systems of National Significance at Satish Dhawan Space Centre SHAR, ISRO, Sriharikota,(2018).
9. Varun and Sumesh Jain "The Study of Marshall Stability and Flow Parameters of Semi Dense Bitumen Concrete mix with Plastic Waste." International Research Journal of Engineering and Technology (IRJET), Vol: 07, Issue: 08, Aug: 2020, Pages: 2879-2885.
10. Shweta A. Dandekar "Use of demolished waste in rigid pavement: a review." International Journal of Civil Engineering and Technology (IJCIET) Volume 9, Issue 4, April 2018, pp. 1097–1106.
11. Ministry of Road Transport and Highways Specification (2013)
12. IS.383.1970 specification for coarse aggregate and fine aggregate.