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AN EXPERIMENTAL STUDY ON USE OF ROAD DEMOLITION WASTES AS RECYCLED MATERIALS IN PAVEMENT CONSTRUCTION

Pratham Poonia, Rishab Malik, Mohd. Anas

Guided by Dr. Shashi Bhusan Suman

ABSTRACT

The world's population has increased in recent decades, so as a result of this, the construction sector is also growing very rapidly. The construction sector is producing lots of construction and demolition waste. This C&D waste is very harmful to our environment and also to the economies of developing countries. In the Roads and Highway construction the - granular course layer such as GSB (Granular Sub Base) and WMM (Wet mix macadam) are the most important layer. With the use of these layers in Flexible Payment Road a stable surface can be formed. The constructions of roads consume natural valuable resources like aggregate, which is costlier. The use of recycled aggregate instead of virgin aggregate helps in reducing the demand of extraction. If a new Road is formed over the existing road or if bridge is constructed over the existing road due to increasing in day to day traffic demand than for the construction of newly road the valuable aggregate of existing road can be utilized as secondary aggregate in the replacement of virgin aggregate. In this study it also believed that magnificent preservation of natural and valuable resources would be attained from the inclusion of secondary and tertiary materials in road construction.

I. INTRODUCTION

Recycling of aggregate as Road Demolition Wastes is a process in which existing road aggregate is reused for new road construction. Use of secondary (recycled) aggregate in road construction is not very usual in India and other developing nations.lt is required to reduce the usage of virgin aggregate. In continuation of this step the RD aggregate could be used in the replacement of new material.In this paper the secondary aggregate is contracted from the granular of dismantled roads. For a developing nation the highways and road infrastructure is an constitutive requirement for economic growth. Among this Aggregate is an important part of pavement structure. This should be of appropriate physical property as define in IRC codes. In the road construction and it's design the important role of the pavement layer is to forward wheel of vehicles to the sub grade. In this load transfer process, the aggregates have to take stresses coming reason to the vehicles wheel load of the traffic. Therefore it is required to use aggregate that has significance properties to the highway engineers. The aggregates are further divide based on their physical characteristics such
as-gradation, size, shape and texture.

1.1 IMPORTANCE OF THE STUDY

The study "An Experimental Study on Use of Road Demolition Wastes as Recycled Materials in Pavement Construction" has been selected to determine the applicability of granular course of existing RD materials in new road construction. This will help realize the economics of road construction and save environmental degradation by reducing mining and pollution.

Material cost alone accounts for over 60% of total construction costs, of which total costs account for approximately 30%. We can use RD aggregates instead of new aggregates in highway construction and provide economic benefits to the project. In order to make full use of R D. aggregates, the suitability of R.D. waste in different types of pavement components need tobe discussed.

1.2 RESEARCH OBJECTIVES

The final cause of the study was to evaluate the suitability of RD materials in new road construction. The main side of the discussion includes-

(1) To collect the material for study.

(2) Investigate various characteristics such as water absorption, Aggregate Impact Value, gradation. Fl &EI property to determine their suitability in G.S.B and W.M.M material.

1.3 Future Scope of Work

Currently, due to the huge prosperity of the construction industry and the environment, mining has a big problem, and this problem may increase exponentially in the future. Therefore, it is. a noble idea to recycle the aggregate obtained from RD waste. In this study, the test results pointed that the mixture of G.S.B and W.M.M. using RD aggregates complies with MORTH specifications. This study may expand in the following directions-

The comparison of RD material shall also be utilized to study with the properties of other mixtures, such as asphalt and gravel.

The effect on economic part may also part of future analysis that might help to determine the financial benefits by using RD material in the replacement of new material.

II. LITERATURE REVIEW

2.1 According to Tavakoli (1996)-

There are various tract that can be utilized to increase the strength of the RD aggregate.

From the results obtained, the RD aggregate has the same engineering and durability performance as new aggregate. The characteristics strength of the RD aggregate are affected by some inorganic pastiche, the ratio of coarser aggregate to finer aggregate, and the ratio of the top size of the aggregate in the RD aggregate.

2.2 Limbachiya and Leelawat (2000) -

Ethically to their test results, superseding 30% of the coarser RD aggregate has no impression on the strength of the newer aggregate. It was underlay that the p (relative) of the RD aggregate was lower and the water absorption capacity was lesser than that of the newer aggregate.

2.3 Sagoe, Brown and Taylor (2002) -

It is indicated that difference between the characteristic of RD aggregate and new aggregate (unified from natural ways like from mountain) is relatively parochial than indirect for laboratory crush RD aggregate mixture.

2.4 Mandal, Chakaborty and Gupta (2002)-

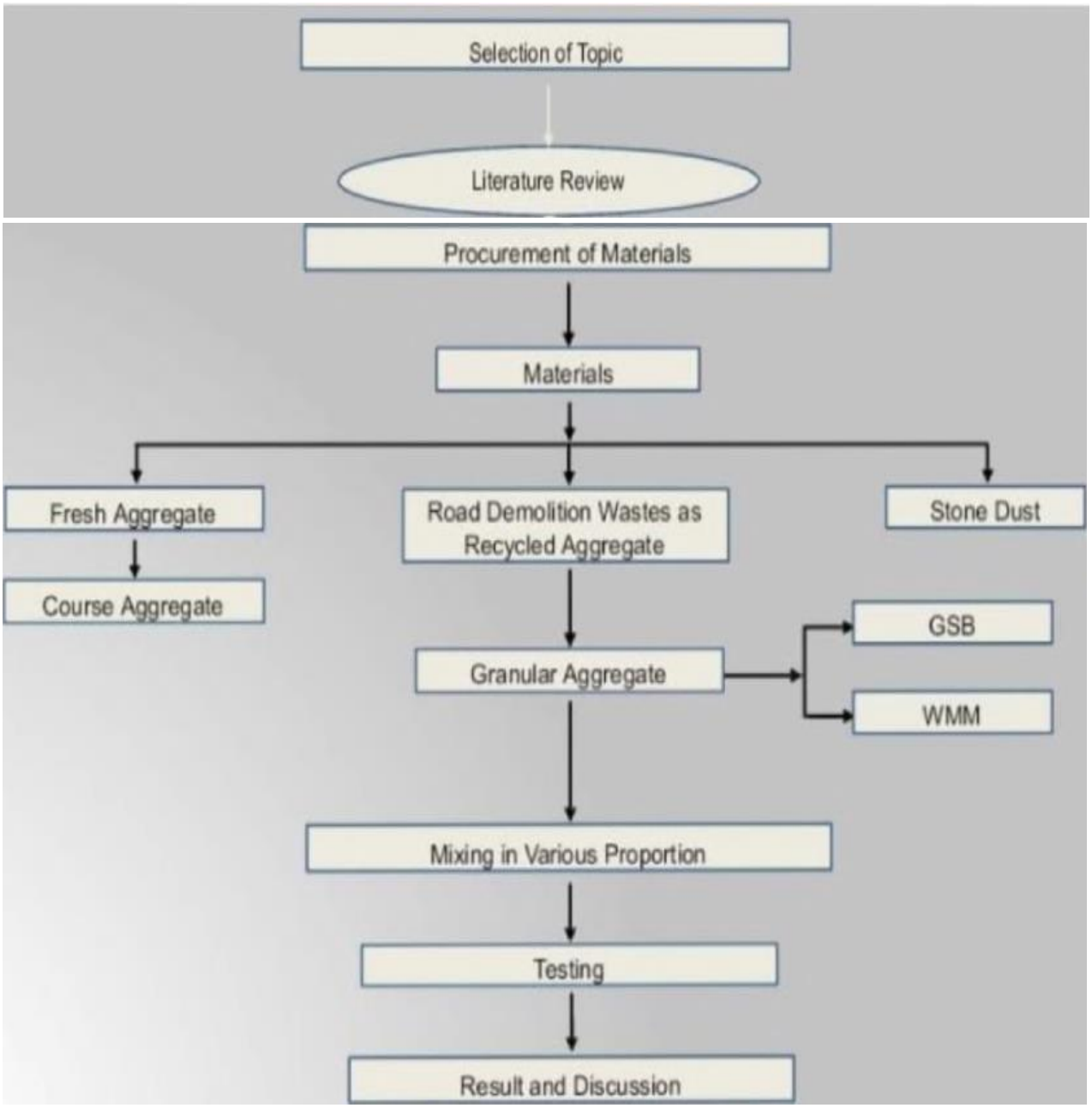
They adduced that the characteristics and characteristics of RD (secondary) aggregates were insufficient compared to new (virgin) aggregates. It appeared that as the replacement amount recovered increased similarly the strength of compressive increased.

2.5 Florida Division of Transportation (FOOT)-

The amount of wear in Los Angeles required to be lower than 45%, and the stability of the sodium sulfate test need to be inferior to 15%. The code recommends that for RD aggregates to be used as a base material for flexible pavements.

III. METHODOLOGY

Detailed study of the experimental work on Road Demolition Wastes as Recycled Materials has been discussed in this chapter. Job mix formula (gradation), proctor test, C.B.R. test, permeability test for G.S.B. and W.M.M. have been studied by adding Road demolition wastes as recycled aggregate with stone dust in different ratio.



4. MATERIAL USED

The materials used for developing the road layers of fresh G.S.B. and W.M.M. after addition of recycled aggregate of road demolition have been described this way.

5. TEST RESULTS & DISCUSSION

Road demolition waste in form of granular courser were taken for gradation test and other physical tests such as water absorption test, Atterberg limits test, combined RI. and E.l, A.I.V., M.D.D. &O.M.C. and C.B.R. test for the conformation of specification required for construction of new G.S.B. and W.M.M.layer.

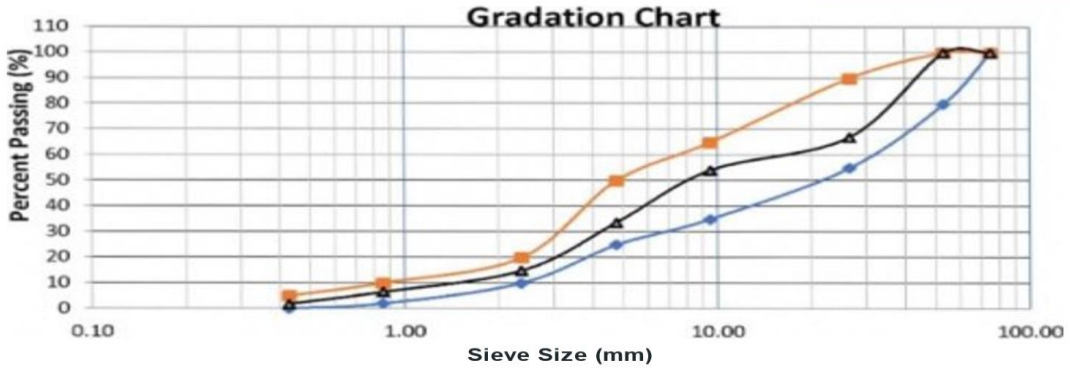
Tests for GSB Material -

5.1. Gradation Test

The result for Improved GSB Material after addition of 20% of 40mm fresh aggregate with acquired road demolition wate as shown in table –

Practical Gradation

Practical Gradation				Wt. of Initial Sample (gm)=	20000	
Sieve Size	Weight Retained	Weight Retained	Cumulative Retained	Cumulative Passing	Acceptable Limit As perMORT&H	
(mm)	(gms)	(%)	(%)	(%)	Lower Limit	Upper limit
75	0	0	0.00	100.00	100	100
53	0	0	0 00	100 00	80	100
26.5	6598	32.99	32.99	67.01	55	90
9.5	2578	12.89	45 88	54 12	35	65
4.75	4105	20.53	66 41	33 60	25	50
2.36	3755	18.78	85 18	14 82	10	20
0.85	1647	8.24	93 42	6 58	2	10
0.425	970	4 85	98 27	1 74	0	5



5.2 Water Absorption Test (IS 2386Part3)

Sr. No.	Description	Sample 1	Sample 2	Sample 3	Average %
A	WI. of SSD Material in gm	2037	2084	2055	0.68
B	Wt. of Oven Dry material in gm	2022	2069	2043	
C	Absorption (A -B) B x 100 (%)	0.74	0.72	0.59	

The results of average of three samples were found 0.68% which is under limit of Max. 2% specified by IS code 2386 (Part 3) : 1963. So. the amended modified G.S.B. material passes the test.

5.3 Aggregate Impact Value (IS 2386-Part4)

S. No.	Description	Units	Trail 1	Trail 2	Trail 3	Average
1	Wt. of Oven Dry Sample (12.5mm Passing and 10mm Retained) (X) gm	gm	365.5	366.7	363.3	365.17
2	After Impact Test - Wt. of 2.36mm Sieve Retained Fraction (Y) gm	gm	270.4	268.2	265.4	268.00
3	After Impact Test - Wt. of 2.36mm Sieve Passing Fraction (Z) gm	gm	95.1	98.5	97.9	97.17
4	A.I.V. = (Z/X)x 1(M)	%	26.02	26.86	26.95	26.61

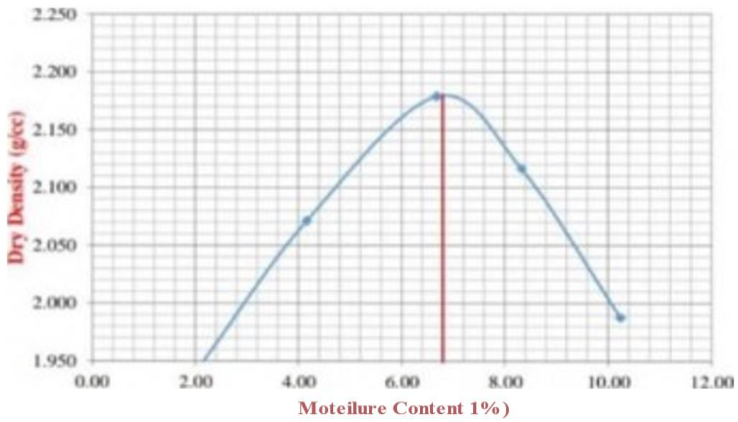
5.41 Atterberg Limits(l_l_,PL ft Pl) IS272OPart4

S. No.	Determination Detail	L.L				P.L.		
		1	2	3	4	1	2	Avg.
1	Penetration Depth	16	19	21	26	N.P.		
2	Vessel Identification No.	B21	B22	B23	B24			
3	Wt. of Blank Vessel, gm (A)	23.8	23.9	23.9	23.9			
4	Wt. of Moist Soil + Vessel, gm (B)	50.08	54.71	54.88	58.23			
5	Wt. of Dry Soil + Vessel, gm (C)	46.21	49.61	49.42	51.6			
6	Wt. of Waler, gm D = (C-B)	3.87	5.1	5.46	6.63			
7	Wt. of Dry Soil, gm E = (C-A)	22.41	25.71	25.52	27.7			
8	% M.C, = (D/E) x 100	17.27	19.84	21.39	23.94			

5.5MDD & CMC

It shows the physical characteristic of material. With the help of M.D.D. and O.M.C.G.S.B. layer can be laid with proper compaction. The % compaction value (F.D.D.) can be achieved with respect to M.D.D. The "Modified Proctor Test" was used followed by IS code 2720 (Part- 8):1983 and two samples were tested and the different values of dry density were determined by adding different0* of W.C.

Trail No.	1					
Wt. of Mold W (gm)	7968					
Volume of Mold V (in cc)	2250					
11 Assessment No		1	2	3	4	5
2| Wt. of Mold + Moist Soil	Gm	12445	12822	13198	13126	12898
3] Wt. of Moist soil	Gin	4477	4854	5230	5158	4930
4| Bulk Density	gnVce	1.99	2.16	2.32	2.29	2.19
5| Vessel No.		1	2	3	4	5
6| Wt . of Vessel	Gm	75.70	77.60	77.50	73.60	76.90
7| Wt. of Vessel + Moist soil	Gin	244.51	275.39	284.59	298.25	279.33
K| Wt. of Vessel + Dry Soil	Gin	240 99	267.49	271.62	280.99	260.53
9| Wt. of Water	Gm	3.52	7.90	12 97	17.26	18.80
10] WI.Of Dry Soil	Gm	165.29	189.89	194.12	207.39	183.63
II] M.C.	%	2.13	4.16	6.68	8.32	10 24
12] Dry Density	gm/ce	1.948	2.071	2.179	2.116	1.988



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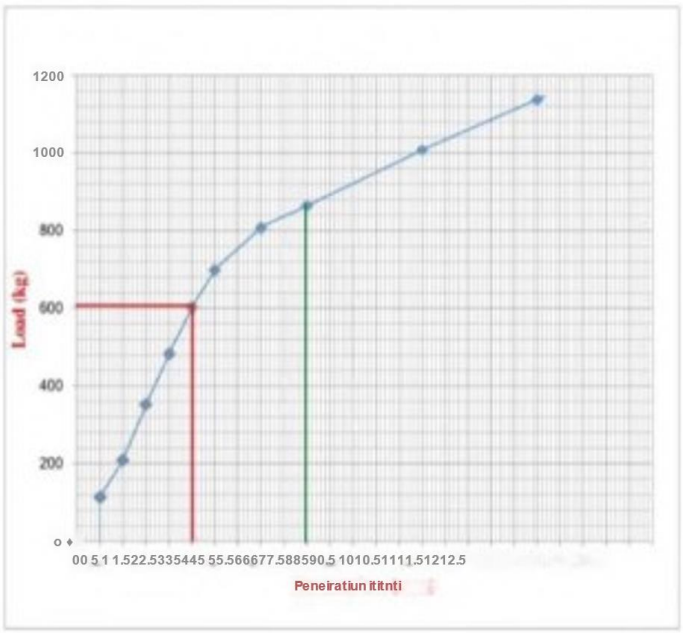
5.6 CBR Test

It is an important test for flexible pavement as it is used in the design part of pavement. The thickness of layer can be defined which required to wear the vehicle load without pavement failure. For finding C.B.R. value of amended / modified G.S.B. material. three samole were taken and the orocedure was followed

Table 4.9 ; Load Penetration Tert Data

Load Penetration Tert Outa						
Penetration (mtn)	Mold No. 1		Mold No. 2		Mold No. 3	
	Proving Ring Reading	Corrected Load (kg)	Proving Ring Reading	Corrected Load (kg)	Proving Ring Reading	Corrected I a tad (kg)
0	0	0	0	0	0	0
0.5	26	HIM	26	112 84	24	104 16
1	48	20832	49	21266	48	208.32
1.5	81	351 54	85	368.9	84	364 56
2	111	481.74	125	542.5	III	481.74
2.5	139	603 26	144	624 96	141	611 94
3	161	698.74	162	703.98	158	685 72
4	186	807.24	190	824.6	191	828.94
5	199	863.66	21)	915.74	205	889.7
73	232	1006.88	235	1019.9	232	1006.88
10	262	1137.08	250	1085	254	1102.36



Applied Loud Iki;iVs Penetration imm

6. Wet Max Macadam

Wet Mix Macadam(WMM) work includes laying and compacting clean, crushed, graded aggregate and granular material premixed with water to a dense mass on a prepared GSB layer or existing pavement as per the requirement of the project.

: Physical Requirements of Courser Aggregate for W.M.M.

	Test	S.No Test Method	
1	Los Angeles Abrasion value Or A.I.V	IS Code:2386 Part-4 IS : 2386 Part-4 or IS : 5640	40% (Max.) 30% (Max.)
2	Combined F.I. & E.I. (Total)	IS Code: 2386 Part-1	35% (Max.)*

: Grading Requirements of Aggregate for W.M.M.

Sieve Designation	% by Wt. passing Sieve
53.00 mm	100
45.00 mm	95 – 100
26.50 mm	-
22.40 mm	60 - 80
11.20 mm	40 - 60
4.75 mm	25 - 40
2.36 mm	15 - 30
600.00 micron	8 - 22
75.00 micron	0 – 5

7. CONCLUSION

In this experimental programme the RD waste material or secondary aggregate is used as a replacement of natural aggregate for construction of new G.S.B. and W.M.M. layer, the sieve analysis of RD waste material conducted and the results were not found under specified limits of MORT&H for both G.S.B. and W.M.M. Accordingly some modifications were made in RD waste and tests were performed for adapting its specification defined by MORT&H and I.S.Codes.

The conclusive outcome of this experimental study for utilization of RD waste in construction of new granular layer is mentioned below

J.iGranular Sub Base -

RD waste of granular course was used for construction of new G.S.B. layer with addition of 20% 40mm course aggregate. The required physical tests were performed including sieve analysis and the results obtained from testes were found in specified limit.

The conclusive results of physical test of amended / modified G.S.B. material obtained from testes are as below -

• The sieve analysis of RD waste material was not found in limits of MORT&H but after addition of 20% of 40mm course aggregate, the test results shows the required limits.

• The water absorption percentage for amended / modified G.S.B. aggregate was obtained 0.68% which is under limit of Max. 2% specified by IS code 2386 (Part 3): 1963

• For Atterberg Limits, the value of average liquid limit comes out 20.85% which was found below 25% specified by IS code 2720 (Part -5): 1985.

• The plastic property was not shown during test. So. the Plasticity Index is denoted as Non - Plastic (NP).

• The A.LV. of amended / modified G.S.B. material was found 26.61% which is less that 40% specified by IS code 2386 (Part -4): 1963

• The Max. Dry Density was found 2.185 gm/cc.

• The O.M.C. was found 6.80%

• The average value of C.B.R. were found 44.42% which shows that the amended / modified RD material can be used for construction

7.2Wet Mix Macadam -

RD waste of granular course was used for construction of new W.M.M. layer with addition of 10% 40mm course aggregate and 1% stone dust. The required physical tests wereperformed including sieve analysis and theresuits obtained from testes were found in specified limit.

The conclusive results of physical test of amended / modified W.M.M. material obtained from testes are as below-

• The sieve analysis of RD waste material was not found in mid-range limits of MORT&H but after addition of 10% of 40mm course aggregate and 1% stone dust, the test results shows the desired limits.

• The water absorption percentage for amended / modified W.M.M. material was found 0.28% for 40mm aggregate. 0.98% for 20mm aggregate. 0.74% for 10mm aggregate and 0.46% for stone dust which are under limit of Max. 2% specified by IS code 2386 (Part 3): 1963

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