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Utilization Iof Irecycled Iaggregate Iin Iwet Imix Imacadam I(Wmm)

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ABSTRACT : ***his study planned to build up a system for appropriate use of recycled aggregate in wet mix macadam (WMM) course got from construction waste of highway during the road maintenance and construction This will help in accomplishing economy in development of roads just as saving money on condition debasement in term of diminished mining and less pollution. Different lab tests were led to discover the likelihood of utilizing recycled aggregate from various sources in India, as the substitution of fresh aggregate. Various tests was done to decide the properties of the fresh and recycled aggregate. The test outcomes demonstrated that the specific gravity of the recycled aggregate is 2.53 and elongation index record as 12.5 % which is close to fresh aggregate. The maximum dry density (MDD) and optimum moisture content (OMC) of recycled aggregate is 2.06 and 9% and for fresh aggregate it is 2.04 and 8 %. The permeability for the material utilized in present research is 3-6 minute for 1 to 10 cm depth and 3-7 minute for 1 to 10 cm depth. From the test it conclude that the recycled aggregate is also usable in various application of the roads, where there is a repetation of loads is low as compared to roads with high repetation of loads value.***

KEY WORDS: ***Recycled aggregate, Wet mix macadam, Road construction, Economy, Fresh aggregate***

I. INTRODUCTION

The Recycling of aggregate is a procedure in which utilized aggregate is used again in a useful way for new development. Utilization of reused aggregate isn't exceptionally regular in India and other countries. There is a large requirement of the aggregate because of fast development in the construction work. In order to reduce the usage of fresh aggregate, the recycled aggregate can be used as a replacement material. Recycled aggregate utilized in the present study is acquired from the mass of destroyed roads. The general advancement of a nation relies on a good and well-connected road network. In 1999, modern, business and city strong waste represented around 13 %, 6 % and 8% individually of aggregate [1] So, use of these recycled materials or its replacement with traditional materials may be beneficial for the environment. The process of producing aggregates materials have been causing extreme disruption to the environment [2] and to the economic owing to the severe depletion the natural resources.

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The properties of aggregate are of considerable significance to the highway engineers. The aggregates are categorized based on their size, shape, texture, and gradation. Different pavement mixes (such as bituminous macadam, dense bituminous macadam, semi-dense bituminous macadam, and bituminous concrete) require separate gradation as has been specifying by various agencies like B.S.I, IRC, and A.S.T.M.

Poor acceptability of recycled material

Acceptability of recycled material is not so high due to a poor image associated with recycling activity in India. Customer specifications do not permit the use of materials recycled from waste. Cost of disposal of waste from the construction industry to landfill has a direct bearing on recycling operations. Low dumping costs prevalent in India also act as a barrier to recycling activities.

II. HISTORY

The utilizations of recycled aggregate in the development regions have more opportunity. There are different test used to locate the characteristic properties of recycled aggregate and these properties compared with fresh aggregate with discover its reasonableness in development. Limbachiya and Leelawat [1] discovered that reused aggregate had lower relative thickness and water absorption capacity as compared to fresh aggregate. As indicated by their test iresults, ithere iwas ino iimpact iwith ithe isubstitution iof i30% icoarse irecycled iaggregate iutilized ion ithe iquality iof ifresh iaggregate. iMandal, iChakaborty, iand iGupta i[4] ifound ithat ithe icompressive istrength isomewhat iincreased iwhen ithe iamount ireplacement iof irecycled iincreased. iThey iconcluded ithat ithe iproperties iand icharacteristic iof irecycled iaggregate ihave isufficient ideficiency iwhen icompared ito ithe ifresh iaggregate. iAccording ito iTavakoli i i[5], ithe iproperties irelated ito istrength iof irecycled iaggregate iwas ieffected iby isome iimpurities isuch ias ithe iratio iof icoarse iaggregate ito ifine iaggregate. iBehiry i[6] showed that the optimum moisture content is increased from 9.5% to 14.7% for 0 % to 100 % replacement of recycled aggregate and for natural aggregate, it is 11 %. In unsoaked CBR, the mix having 0 % recycled aggregate has the highest CBR value (85%) where the CBR value gradually decreases to 62 % as the RCA reaches to 100 %. Rustom, et al. [7] showed that the concrete made with recycled aggregate collected from construction and demolition waste has a compressive strength (28days) of 27%, which is less than the strength of the concrete made with fresh aggregates. The above study of literature shows that there are various experimental works has been done on recycled aggregate in roads and building construction work but there is no study which deals with the use of recycled aggregate in the base course of highway i.e wet mix macadam (WMM).

III. MATERIAL iUSED iIN iSTUDY

The development of WMM construction depend on well graded particles of various sizes. Recycled aggregate have been gathered from State Highway - 7 and fresh aggregate is gathered from Yamunanagar quarry. In present work the composition of WMM taken as 40 mm, 20mm, 10 mm aggregate and stone residue. In present work 20 mm aggregate utilized as reused aggregate and fresh aggregates.

IV. METHODOLOGY

(a) Aggregate Impact Test

The aggregate impact value shows a general proportion of the resistance of aggregate to an sudden stress or an impact, which in certain aggregates differ from its resistence from a moderate compressive load. The result of impact test on fresh and recycled aggregate is appeared Table-1. The outcome shows that impact value of fresh aggregate is slightly more than the recycled aggregate value, yet at the same time the impact estimation of recycled aggregate is genuinely high to use in WMM development. IS 2386 code is utilized to decide the impact value for the recycled and fresh aggregates.

(b) Water Absorption Test-

Water absorption gives a thought regarding the quality of aggregate. Table-1 show water absorption value for recycled and fresh aggregate. Result indicates higher water absorption value for recycled aggregate when compared with fresh aggregate for example 1% for recycled aggregate and 0.475 % for the fresh aggregate. According to standard water absorption capacity for recycled aggregate is in allowable permissible limit, so can be utilized for WMM development.

(c) Bitumen Extraction Test-

This test is utilized for quality affirmation, process quality control and research exercises. The bitumen content is taken as a percent by dry weight of extracted aggregate corrected for asphalt mix moisture content and extractor error.. The Table-1shows the outcome for the bitumen extraction value. The test shows bitumen content value turns out to be 1% for the recycled aggregate.

(d) Particle shape and size test-

The aggregate shape is dictated by the rates of flaky and elongated particles contained in it. The outcome from the test is given below which is in the satisfactory range.

Elongation index = 15 % for fresh aggregate

Elongation index = 12.5 % for recycled aggregate

(e) Specific Gravity Test-

The specific gravity of aggregate is much of the time required for calculation of a several quantaties, for example, void ratio, degree of saturation, unit weight of aggregate and unit weight of soil in different states. Results for the specific gravity of various materials utilized in present work are exhibited in Table-1. The estimation of specific gravity of these materials lies between 2.52 to 2.73, which is satisfactory range for utilizing the aggregates for roads pavement development.

MIX DESIGN OF WMM

Mix design of WMM with various types of materials is prepared. A sample is prepared by using 20 mm fresh aggregates and another sample is prepared using 20 mm recycled aggregates. The mix design is done by an analytical method and presented in graphical form in figure 1 and figure 2. In figure 1 & 2 pink and blue line show the upper and lower limit of the adopted value and middle yellow line show the adopted value for WMM in recycled and fresh aggregate.

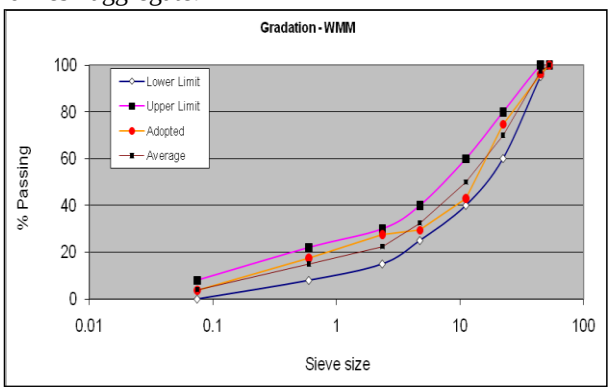

Fig.1. Grade mix with recycled aggregate

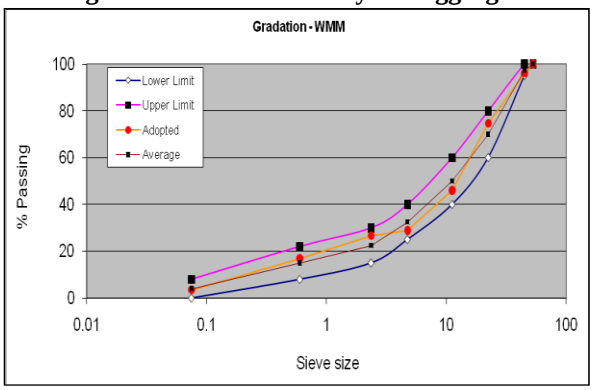

Fig.2. Grade mix with fresh aggregate

Tests on WMM

Standard Proctor compaction test is utilized to decide the maximum dry density and optimum moisture content for various materials as appeared in Fig. 3 for WMM with fresh aggregate and Fig. 4 for WMM with recycled aggregate. The maximum dry density (MDD) for fresh aggregate is 2.06 and optimum moisture content (OMC) is 9%. In the case of recycled aggregate, MDD is 2.04 and OMC is 8%. From tests it is extremely certain that the MDD and OMC with recycled aggregate are close to the estimations of fresh aggregate. So the recycled aggregate can be utilized for roads pavement development where redundancy of burden is less.

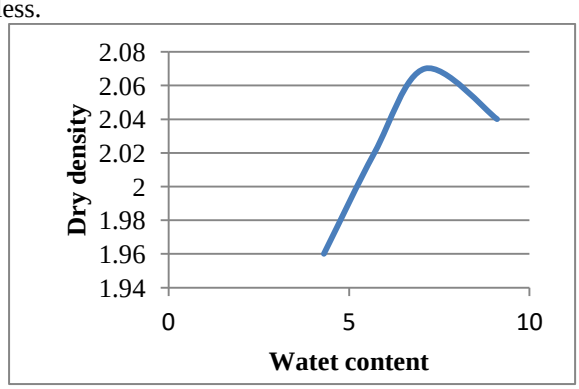

Fig.3. MDD and OMC for WMM recycled aggregate

California bearing ratio (CBR)

The CBR test is very important for the design of pavement thickness.

The test is performed by estimating the pressure required to penetrate in soil sample with a plunger of standard area.
Sometimes a curve with initial upward concavity is obtained, indicating the necessity of correction as for the above curve. In this case, the corrected origin is established by drawing a tangent from the steepest point on the curve. The heap values relating to 2.5 and 5.0 mm penetration values from the amended starting point are noted. From the bends it might be noticed that the CBR value for WMM with recycled aggregate is not exactly the incentive for fresh aggregate.

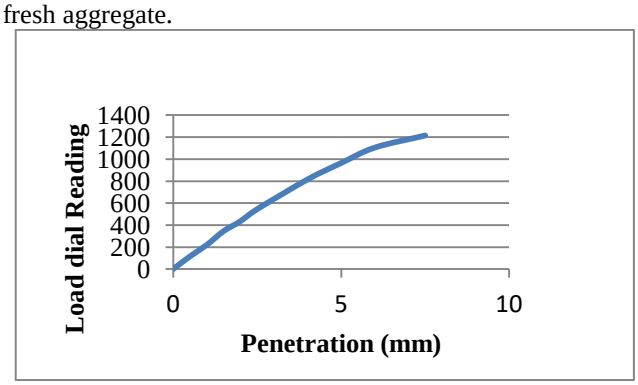

Fig.4. CBR curve for fresh aggregate

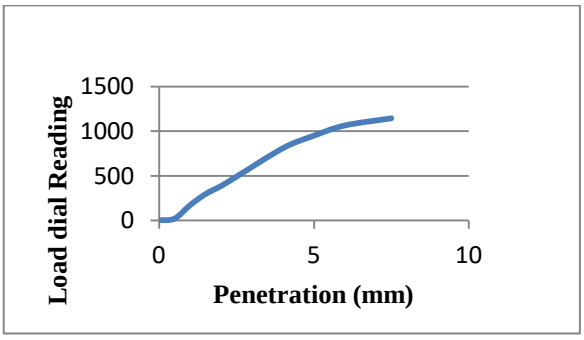

Fig.5. CBR curve for recycled aggregate

Permeability test

The learning of the permeability is fundamental in the arrangement of many building issues including stream of water through soils. Permeability of WMM is extensive significance particularly when recycled aggregate is utilized in the development of WMM. The coefficient of permeability is accounted at 27°C. Table-2 demonstrates the outcome for permeability for the fresh and recycled aggregate in WMM. It reason that the blend that is set up with recycled aggregate take additional time when compared with fresh aggregate

V. CONCLUSION

The following conclusions are drawn from the present study:

The utilization of recycled aggregate in road development in WMM won't just accomplishing economy in the road construction, yet in addition decrease the mining process.

WMM granular mixes prepared are found to meet the MORTH requirement of gradation. The MDD of WMM utilizing the selected material is observed to be 2.07 gm/cc for recycled and 2.09 gm/cc for fresh aggregate.

The specific gravity of recycled aggregate, fresh aggregate and stone dust is found to be varying between 2.50 to 2.72.

From the impact test it is found that the strength of reused aggregate isn't much lower than the new aggregate. The impact value is seen to be 14.81% for fresh aggregate and 12.26% for reused aggregate.

The water absorption limit of recycled material is observed to be more than fresh aggregate. The water absorption of virgin aggregate is 0.48 % and for recycled aggregate it is 1.0%.

The amount or percentage of bitumen found in recycled aggregate is observed as 1%.

Recycling aggregate from the demolition projects can save the cost of transporting the material to the landfill, and the cost of disposal.

The Permeability result demonstrates that if there should arise an occurrence of WBM the permeability of recycled aggregate is more than the fresh aggregate.

New and reused aggregate is striven for necessary aggregate properties for example aggregate impact effect and water retention, which are of centrality from roads improvement point of view. These properties are inside sensible purpose of restriction for both the reused aggregate and new aggregate. The impact effect and explicit gravity of the aggregate is additionally in passable farthest point. After the test and by taking a gander at the properties we find that it is important to use the reused aggregate rather than virgin aggregate.

Table 1.Test Results on Fresh and Recycled Aggregates

Sr. No.	Test	Results	IS Specification	Method of Test
1	Impact Test (i) Fresh Aggregate (ii) Recycled Aggregate	14.81% 12.26 %	10- 20 % for strong	IS:2386 Part IV
2	Bitumen Extraction Test	1.0 %	Max %	IRC : SP 11-1988
3	Water Absorption (i) Fresh Aggregate (ii) Recycled Aggregate	1.0 % 0.47 %	Max 2%	IS:2386 Part III
4	Specific Gravity (i) Recycled Aggregate 20 mm (ii)Fresh Aggregate 20 mm	2.53 2.70	2.5-3.0	IS:2386 Part III

5	Particle size and shape (i) Elongation Index (fresh aggregate) (ii) Elongation Index (recycled aggregate)	 15 % 12.5 %	IS:2386 Part I
6	Permeability Test (i) For Fresh aggregate (ii) For Recycled aggregate	 6 (For Ist 5cm and 3 minute for next 5 cm) 7 (For Ist 5cm and 3 minute for next 5 cm)	ASTM D3744
7	California bearing ratio test (Fresh Aggregate) California bearing ratio test (Recycled Aggregate)		IS:2720 Part 16

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