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Recycled Highway Aggregate as a Partial Replacement with Natural Aggregate

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Abstract

Recycled materials such as aggregates include crushed or orderedinert particles which is obtained from the waste materials like manufacture and destruction wastes. Aim of this study is to summarise and narrate the maximum dry density, optimum moisture content and California Bearing Ratio (CBR) of Granular Sub Base (GSB) and Wet Mix Macadam (WMM) using distinct percentages of recycled aggregates. The examination of 5 batches which is equipped mixes of 0, 15, 30, 45, 60 and 75%,means substitution of recycled aggregate to fresh aggregate by means of modified proctor CBR at most favourable moisture contents. The maximum dry density of recycled aggregate was up to 30%,substitute level was about 0.03 g/cc and that is more than that of referral mix of natural aggregate. California Bearing Ratio of recycled aggregate matrix was about30%, substitution level was about 1.7% less than that of referral mix of natural aggregate. This diminution in strength might be due to slighter strength of recycled aggregate that of fresh aggregate.

Keywords: Recycled aggregate, maximum dry density, moisture content, California bearing ratio, granular sub base.

Introduction

Use of complementary material as aggregate is vital in embryonicinexpensive construction materials and ecologic for developing countries. In India, construction tradegenerateper annum approximately 12-14 million tons of wastes. Manufacture and flattening wastes are generate when any Manufacture or flattening actionheld such as, constructionof roads or bridges, fly over or subway and up gradation etc.Considerablefunction of recycled material and technology in progress of urban infrastructure, the Technology Information Forecasting and Assessment Council (TIFAC) made a techno-market analysis on ‘Utilization of waste from manufacturetrade’.Spotlight of this study was considering the currentinformationabout Indian manufacturetradeand opportunity of recycling wastes generated frommanufacture and flattening. Thisinvestigation was beleaguered toward manufacture trade of housing or building and road construction section.As per this survey, the generalgoverningmotive for not adopting the recycling of waste from manufacturing tradewas “Absence of awarenessto recycling technique” was up to 65to70%; whileup to 30 to 35% were

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even not consciousabout recycling possibilities.Sagoe-Crentsil and Brown (1998) found that the excellence of natural aggregate was based on physical and chemical characteristics of sourcesite, while recycled aggregate refers onfault of debris source. Thereare two methods of sorting or cleaning of recycled aggregate; first one is dry separation method, which involvesremoval of lighter matter from heavier stony materials by means of blowing air or constantly causesa lot of dust and second one iswet separation method, which separates a low density impurity are separate by water jets or float-sink tank and fabricate very clean aggregate.Recycled aggregate hasinferior relative density and less water absorption capacity whereas fresh aggregate has high. As perseveral test results, the strength of fresh aggregate was unaffected while replacement of coarse recycled aggregate was up to 30 to 35%.Sagoe-Crentsil and Brown (1998) found that difference between the feature of new recycled aggregate and natural aggregate is comparatively narrower than reportof laboratory crouch recycled aggregate mixes.Propertiesorfeatures of recycled aggregate have adequatedeficitascompareof fresh aggregate. The twelve five-year plans faces a dearth of aggregates in infrastructure trade and due to large boom in manufacturingtradecurrently and in future, there is a huge predicament of mining and this crisismightbe boost exponentially.That's why; recycling of aggregate from road waste is a gracious idea. Bearing the above facts in mind, thisstudy is to resolve and evaluate maximum dry density, optimum moisture content and California Bearing Ratio (CBR) of Granular Sub Base (GSB) and Wet Mix Macadam (WMM) by using diverse percentages of recycled aggregates.

Materials and Methods

Material and methods: In this study stone aggregate was used. Properties of aggregate was established as per IS-383 (Fineness modulus = 2.78; Specific gravity = 2.67). Grading of aggregate wasas same as Ministry of Road Transport and Highways (MORTH) gradingspecification and was maintained all over experiment. Recycled stone aggregate was obtained from Gopalganj to Chapra State Highway of Bihar State, which is beneath up gradation, was used. Recycled road aggregate was sieved and passing fraction fromsieve was used in study. Value of LOS angle abrasion was significantlyabout40.5% whereas per IS: 2386 (part-4),permissible limit isup to 50%,for base courses like water mix macadam and bituminous macadam;

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aggregate impact value was about29.3%, whereas per IS: 2386 (part-4) or IS: 5640, maximum permissible limit is up to 35%, for bitumen macadam and 38% for wet mix macadam.These values for GSB and WMM were in limit as per given procedure in IS: 2720 (Part-8)-1987, maximum dry density for different mixes (variable % of recycled aggregate) at optimal moisture content.At the time of testing value of CBR wasextremelyreliant on the situation of materials. The test performed on remoldedspecimenwith rammer wasproceeded as per given in IS: 2720 (part-16)-1987. The physical inspection of natural stone aggregate and recycled aggregate was as shown in Fig. 1 and 2.

Fig. 1.The physical view of natural stone aggregate.

Fig. 2.The physical view of recycled aggregate.

Purpose of this study was by means of using different percentages of recycled aggregates in determination and comparesof maximum dry density, optimal moisture content and California Bearing Ratio (CBR) of Granular Sub Base (GSB) and Wet Mix Macadam (WMM).In this study, CBR for 5 batches of mixes arrangedin which 0, 15, 30, 45, 60 and 75% ofrecycled aggregate was used as a replacement of natural stone aggregate at optimal moisture contents. A relative study of mix design for GSB and WMM by job mix formula at distinctsubstitutionforrecycled aggregate as a replacement ofnatural stone aggregate were summarised in Table 1.

Maximum dry density of recycled aggregate matrix was about 30%,substitution level was about 0.03 g/cc which is more than referral mix of natural aggregate (Fig. 3). CBR of recycled aggregate matrix was about 30% substitution level was about 1.7% which is less than referral mix of natural aggregate (Fig. 4). This diminution in strength might be due to slighter strength of recycled aggregate that of fresh aggregate.

Table 1.Maximum dry density and California Bearing Ratio of mix at different level.

Replacement level of recycled aggregate (%)	Granular Sub Base (GSB)		Wet Mix Macadam (WMM)	
	Max. drydensity (g/cc)	California Bearing Ratio (%)	Max. dry density (g/cc)	California Bearing Ratio (%)
0	2.23	32.7	2.26	37.7
15	2.20	29.7	2.24	33.7
30	2.18	28.2	2.23	31.7
45	2.22	32.3	2.35	37.2
60	2.18	26.7	2.22	29.7
75	2.12	25.7	2.19	27.7

Fig. 3.Maximum dry density of mix at different level.

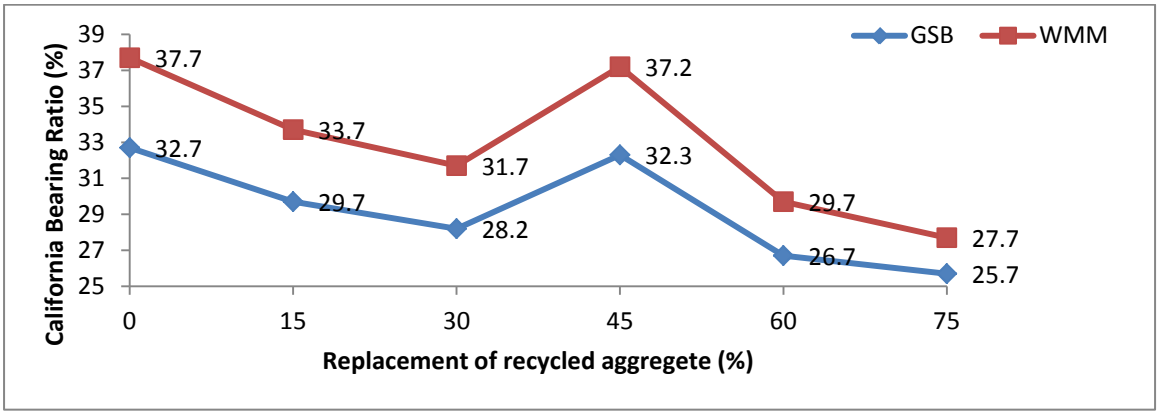
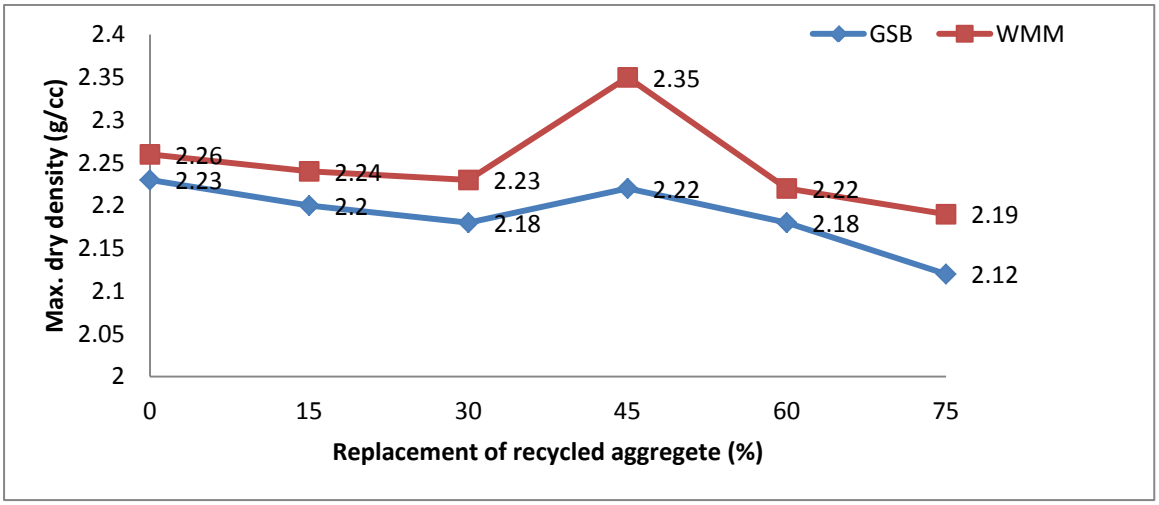


Fig. 4.California Bearing Ratio of mix at different level.



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Conclusion

- Utilization of recycled aggregate in road edifice in GSB and WMM barely used to attain economically in the road project, but also decreasiment in mining pollution.
- Recycling aggregate as offlattening projects is capable tokeepprice of transportation of materials to land fill and cost of dumping.
- The economic investigationmight be helpful in determination ofeconomicalreimbursementvia recycled aggregates to fresh one.

This study can be comprehensive to following directions:

- Features of former mixes like Bituminous Macadam etc. also areconsideredby means of recycled aggregate.
- Out coming of recycled aggregate obtainedby 'heating and rubbing method' (HRM) also integrated in the further studies.

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