To Compare the Strength of Concrete By Using Combination of Recycled Aggregate And Burnt Brick To Normal Concrete

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Abstract- *Physical proportions of cement, fine aggregate & normal aggregate, normal burnt brick aggregates, over-burnt brick aggregates, Recycled aggregate are carried out. Concrete has captured almost entire construction industry and its ingredients such as cement, manufacture of cement and bricks consume large quantities of natural resources and fuel with C02 to the green house gases resulting in global warming. Therefore, under such critical scenario of shrinkage of natural aggregates resource and ever increasing pressure to reduce construction costs and further construction & dismantling of old structure producing heavy debris needing disposal has made it necessary to invert, discover & think of other alternatives for replacement of coarse aggregate. The present paper aims with to compare the strength of concrete by using combination of of recycled aggregate & burnt brick to normal concrete. To use over-burnt bricks, normal burnt brick as replacement to conventional normal aggregate in different proportions. Brick aggregates & Recycled aggregate can fully or partly replace the conventional coarse aggregate to produce M20 concrete. M20 grade concrete mix with different proportions i.e. [1:1.5:1, 1:1.5:2, 1:1.5:3] are carried out using over-burnt, normal burnt brick aggregates. Cube compressive strength test & split tensile test are carried out for 7 & 28 days. An attempt has been made using brick aggregate & Recycled aggregate concrete to replace normal aggregate concrete. Fine aggregates were replaced with pre-soaked light weight aggregates, vermiculite in this case by 5%, 10% and 15% as internal curing agents.*

Keywords- Vermiculite, SAP, Internal Curing, Compressive Strength, Shrinkage

I. INTRODUCTION

The use and performance of concrete made with broken brick as coarse aggregate are quite extensive and satisfactory for ordinary concrete. Clay and silt along with Manuscript received February 5, 2013; revised June 6, 2013. This work was supported by All India Council for Technical Education (AICTE), a statutory body of Govt. of India. The authors are with the Department of Civil Engineering, National Institute of Technology Agartala, Tripura, India (e-mail: gopinita@ymail.com, joyantanita@yahoo.com). appropriate quantity of sand can be burnt in its natural form as is done in brick-making and the product may be a source of coarse aggregate for concrete. Also in brick-making, a large number of bricks are rejected due to nonconformity with the required specifications. One such major nonconformity is the distorted form of brick produced due to the uneven temperature control in the kiln. These rejected bricks can also be a potential source of coarse aggregate .

Concrete is produced by mixing cement, sand, coarse aggregate and water to produce a material that can be molded into almost any shape. The major volume of concrete is filled with aggregate. Aggregate inclusion in concrete reduces its drying shrinkage and improves many other properties. Aggregate is also the least expensive per weight unit, put it makes the most amount of the weight. It is costly to transport so local sources are needed, but due to geographical constraint this is not available at all places, therefore it necessitates finding other sources and alternatives from local sources. In eastern and north eastern states of India and Bangladesh where natural rock deposits are scarce, burnt clay bricks are used as an alternative source of coarse aggregate. In these places of India brick aggregate are traditionally used as coarse aggregate.

Akhtaruzzaman and Hasnat investigated the various engineering properties of concrete using crushed brick as coarse aggregate. Khaloo studied the properties of concrete using crushed clinker brick as coarse aggregate. In both the above-mentioned studies, investigations were also done by comparing the properties of brick aggregate concrete with those for stone aggregate concrete. Rashid et al. investigated the properties of higher strength concrete with brick aggregate. On the other hand, studies were done by Mansur et al. comparing the properties of stone aggregate concrete with those of equivalent brick aggregate concrete obtained by replacing stone with an equal volume of crushed brick, everything else remaining the same. Cachim studied the

mechanical properties brick aggregate concrete by partial replacement of natural stone aggregate by brick aggregate and it was found that up to 15% replacement there is no reduction of strength. Debbie and Kenai showed that it is possible to produce concrete containing crushed bricks (course and fine) with characteristics similar to those of natural aggregate concrete provided that the percentage of brick aggregates is limited to 25 and 50% for the coarse and fine aggregate respectively. Apart from strength parameter in ambient temperature Khalaf and Devein studied the thermal properties of brick aggregate concrete and it was found that brick aggregate concrete perform similar and even better than granite aggregate concrete in elevated temperature.

II. LITERATURE REVIEW

A) Scotland – About 63% material has been recycled in 2000, remaining 37% material being disposed in landfill and exempt sites. a) The Government is working out on specifications of recycling and code of practice. b) Attempts are being made for establishing links with the planning system, computerizing transfer note system to facilitate data analysis and facilitating dialogue between agencies for adoption of secondary aggregates by consultants and contractors.

B) Denmark – According to the Danish Environmental Protection Agency (DEPA), in 2003, 30% of the total waste generated was Construction & Demolition waste. a) According to DEPA around 70-75% waste is generated from demolition activity, 20-25% from renovation and the remaining 5-10% from new building developments. b) Because of constraints of landfill site, recycling is a key issue for the country. c) Statutory orders, action plan and voluntary agreements have been carried out, e.g., reuse of asphalt (1985), sorting of Construction & Demolition waste (1995) etc.

C) Netherlands – More than 40 million Construction & Demolition waste is being generated out of which 80% is brick and concrete. a) A number of initiatives taken about recycling material since 1993, such as prevention of waste, stimulate recycling, promoting building materials which have a longer life, products which can be easily disassembled, separation at source and prohibition of Construction & Demolition waste at landfills.

D) USA – Construction & Demolition waste accounts for about 22% of the total waste generated in the USA. a) Reuse and recycling of Construction & Demolition waste is one component of larger holistic practices called sustainable or green building practice. b) Green building construction practices may include salvaging dimensional number, using reclaimed aggregates from crushed concrete, grinding drywall scraps, to use as soil amendment at the site. c) Deconstruction means planned breaking of a building with reuse being the main motive

III. MATERIALS AND METHODOLOGY

Ordinary Portland cement of grade 53 in accordance with IS 12269-1987 was used in present study. The properties of cement were found in accordance with IS 4031-1996.The results are shown in Table 1.Micro-silica of average size 150 nm and specific gravity 2.63 was used in the study. Physical and chemical properties of micro silica is given in the Table 2

Table 1: Properties of crushed over-burnt bricks

Sr no	Properties	Result
1	Specific Gravity	2.15
2	Aggregate crushing value	24.5%
3	Aggregate impact value	28.2%
4	Aggregate water absorption	5.6%

Table 2: Properties of cement

Sr no	Properties	Result
1	Consistency	32.25%
2	Initial setting time	60 min
3	Final setting time	480 min
4	Fineness of cement	6%
5	Specific gravity of cement	3.15

Test on concrete-

1)Workability Tests
2)Slump Cone
3) Setting Time Test
4) Temperature Density
5)Workability Tests
6) Slump Cone

Specific Gravity Test-

- Specific gravity test of aggregates is done to measure the strength or quality of the material while water absorption test determines the water holding capacity of the coarse and fine aggregates.
- To measure the strength or quality of the material.
- To determine the water absorption of aggregates
- Specific Gravity is the ratio of the weight of a given volume of aggregate to the weight of an equal volume of water. It is the measure of strength or quality of the specific material. Aggregates having low specific gravity are generally weaker than those with higher specific gravity values.

7 Days compressive strength of over burnt brick aggregate concrete- use brunt brick 5%, 10% & 15%.

Sr no	Ratings	Bulk wt in kg	Failure load in KN	Cross sectional area in mm2	Compressive strength in N/MM2	Compressive strength in N/MM2
1	1:1.5:1	8.807	390	22.5*10²	17.33	17.18
		8.694	400	22.5*10²	17.77	
		8.751	387	22.5*10²	17.18	
2	1:1.5:2	8.02	400	22.5*10²	17.77	17.39
		7.78	390	22.5*10²	17.33	
		7.85	384	22.5*10²	17.06	
3	1:1.5:2	7.97	394	22.5*10²	17.51	17.54
		8.15	385	22.5*10²	17.11	
		7.93	405	22.5*10²	18	

28 Days compressive strength of over burnt brick aggregate concrete- use brunt brick 5%, 10% & 15%.

Sr no	Ratins	Bulk wt in kg	Failuare load in KN	Cross sectional area in mm2	Compressive strength in N/MM2	Compressive strength in N/MM2
1	1:1.5:1	8.830	640	22.5*10²	28.44	28.51
		9.050	625	22.5*10²	27.77	
		8.835	660	22.5*10²	29.33	
2	1:1.5:2	9.020	630	22.5*10²	28	28.66
		8.850	650	22.5*10²	28.88	
		8.830	655	22.5*10²	29.11	
3	1:1.5:2	8.810	665	22.5*10²	29.55	28.81
		9.06	635	22.5*10²	28.22	
		8.84	645	22.5*10²	28.66	

Rate analysis-

Rate analysis for using recycled aggregate & burnt brick-

Sr no	Particular	Unit	Qty	Rate	Total Cost
1	Cement	Bags	7.00	280	1960
2	Sand	Cum	0.6	964.66	578.796
3	10mm metal	Cum	0.20	918.72	17067
4	Recycled aggregate	Cum	0.50	918.72	141.34
5	T & P	Cum	1.00	100	100
6	Burnt brick	No	10	2.5	25
7	Labour (skill & unskill)	Cum	4.00	200	800
8	Water	Lit	189	0.07	13.23
Basic Concrete Rate per Cum					3789 Rs

Normal Concrete for 1 m3-

Sr no	Particular	Unit	Qty	Rate	Total Cost
1	Cement	Bags	7.00	280	1960
2	Sand	Cum	0.6	964.66	578.796
3	10mm metal	Cum	0.35	918.72	321.552
4	20mm metal	Cum	0.55	918.72	505.29
5	T & P	Cum	1.00	100	100
6	Labour (skill & unskilled)	Cum	4.00	200	800
7	Water	Lit	189	0.07	13.23
Basic Concrete Rate per Cum					4278.86 Rs

Rate of materials

10mm metal = 2600 Rs/brass
20mm metal = 2600 Rs/brass
Crush sand = 2730 Rs/brass
Cement = 280 Rs/bag
Water = 700 Rs/tanker (10000 lit)
= 0.07 Rs/ lit.
Burnt brick= 5700 Rs/1000 bricks.
Recycled Aggregate = 800 Rs/brass

Difference in rate analysis-

4278.86-3789 = 489.86 Rs

DIFFERENCE BETWEEN NORMAL CONCRETE AND RECYCLED AGGREGATE CONCRETE-

Normal concrete M20-

Specific gravity of coarse aggregate-2.80 W/C Ratio-0.5						
Properties	7 days			28 days		
	1	2	Mean(N/MM2)	1	2	Mean(N/MM2)
Compressive test	18.03	17.99	18.01	26.2	26.6	26.4
Split tensile test	1.424	1.44	1.432	2.85	2.79	2.82
Flexural strength	2.02	2.08	2.05	3.25	3.09	3.17

Recycled aggregate and brunt brick concrete-M20

Specific gravity of coarse aggregate-1.38 W/C Ratio-0.5						
Properties	7 days			28 days		
	1	2	Mean(N/MM2)	1	2	Mean(N/MM2)
Compressive test	17.18	17.39	17.29	28.51	28.66	28.58
Split tensile test	1.45	1.50	1.54	2.88	2.82	2.87
Flexural strength	2.00	2.05	2.09	3.20	3.15	3.18

Benefits of this concrete-

- There are a variety of benefits in recycling concrete rather than dumping it or burying it in a landfill.
- Save landfill space.
- Conserve natural resources by reducing the need for gravel mining, water, coal, oil and gas.
- When used as the base material for roadways, reduces pollution from waste transport to landfills and dumps.
- Create employment opportunities.
- Drags down material and waste transport expenses.
- Recycling one ton of cement could save 1,360 gallons water, 900 kg of CO2.

Advantages of recycling of construction materials:-

- Used for construction of precast & cast in situ gutters &kerb‟s.
- Cost saving: - There are no detrimental effects on concrete & it is expected that the increase in the cost of cement could be offset by the lower cost of Recycled Concrete Aggregate (RCA).
- 20% cement replaced by fly ash is found to control alkali silica reaction (ASR).
- Save environment: - There is no excavation of natural resources & less transportation. Also less land is required.
- Save time: - There is no waiting for material availability.
- Less emission of carbon due to less crushing.
- Up to 20% replacement of natural aggregate with RCA or recycled mixed aggregates (RMA) without a need for additional testing for all concrete up to a characteristic strength of 65 MPa.,as per Dutch standard VBT 1995, is permitted.

Uses of this concrete-

1) Smaller pieces of concrete are used as gravel for new construction projects.

2) The US Federal Highway Administration may use techniques such as these to build new highways from the materials of old highways.

3) Crushed recycled concrete can also be used as the dry aggregate for brand new concrete if it is free of contaminants. Also, concrete pavements can be broken in place and used as a base layer for an asphalt pavement through a process called rubblization.

4) Larger pieces of crushed concrete can be used as riprap revetments, which are "a very effective and popular method of controlling stream bank erosion."

IV. CONCLUSIONS

1) When greater volume of recycled coarse aggregate and fly ash was used, free shrinkage of the specimens was reduced.
2) Due to use of recycled aggregate in construction, energy and cost transportation of natural resources & excavation is significantly saved. This in turn directly reduced the impact of waste material on environment.
3) Bulk density of brick aggregate (over burnt brick aggregate + normal burnt brick aggregate) is in the range of 1000kg/m³ to 1200kg/m³. Hence brick aggregate can be considered as light weight aggregates.
4) The use of recycled aggregate by partial replacement in construction industry tends to prevent environment.
5) The creep to free shrinkage ratio for RAC was similar to that of normal concrete at 7 days under restrained condition.

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