EXPERIMENTAL INVESTIGATION IN DEVELOPING LOW COST CONCRETE BY USING BRICK POWDER AND QUARRY DUST

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ABSTRACT:
Recycled aggregate are comprised of crushed, graded inorganic particles processed from the materials that have been used in the construction and demolition debris. One of the major challenges of our resent society is the protection of environment. The use of aggregates from construction and demolition debris (wastes) is showing prospective application in construction as alternative to primary (natural) aggregates. It conserves natural resources and reduces the space required for the landfill disposal. The aim of this project is to determine the strength characteristic of aggregates like brick powder and quarry dust for application in high strength structural concrete, which will give a better understanding on the properties of concrete as an alternative material to coarse aggregate in structural concrete. Further, this work is to determine and compare the workability, compression strength, indirect tensile strength, flexural strength and modulus of elasticity properties of concrete with that of natural aggregate concrete. To attain the planned objectives of the present investigation, M25 grade concrete is taken and the replacement values viz, 0%, 25%, 50%, 75%, 100% were considered. A total of 60 cubes, 40 cylinders, 10 beams were casted to determine the properties mentioned as above The development of compressive and tensile strengths of recycled aggregate concrete at the age of 7,14 and 28 days; the development of flexural strength and static modulus of elasticity at the age of 28 days are investigated. The parameters which were investigated for recycled aggregate concrete and compared with natural aggregate concrete as per BIS specifications found to be decreasing gradually as the percentage of recycled aggregate are increased.

1.0 INTRODUCTION:

Construction and Demolition Waste in India:

With quick urbanization the quantum of construction & demolition waste (C&D Waste) is continuously increasing. While it is estimated that the construction industry in India generates about 10-12 million tons of Construction and Demolition (C&D) waste annually, efforts to manage and use this waste is very petite. This has led to Private contractors utilizing unempirical dumping methods there-by putting harsh pressure on scarce urban land as well as dropping life spans of landfills.

Figure 1 Construction waste

APPLICATIONS OF QUARRY DUST:

There are many applications of quarry dust. Discussed below are applications in construction, processing, and landscaping and recreational applications: Application of quarry dust in construction In the construction industry, quarry dust is used as an aggregate substitute especially for sand in a concrete mixture. The application

of quarry dust can reduce the cost of construction. In the Centre for Housing Planning and Building built a number of low cost houses using quarry dust. The research done for the cost of construction proved that using quarry dust is cheaper than sand. Quarry dust is also used in the construction of sub base in highways.

Application of quarry dust in processing In India, quarry dust is used to produce concrete blocks. It is mixed with chalk and gypsum to produce blocks. The used of quarry dust in producing concrete blocks is also applied in South Africa. Quarry dust is also used to produce tiles

2.0 LITERATURE REVIEW

Kathiresan M, Gunasekar M. (2017) Brick is one of the most common masonry units as a building material due to its properties. The rapid growth in today's construction industry has obliged the civil engineers in searching for more efficient and durable alternatives far beyond the limitations of the conventional brick production. Many attempts have been made to incorporate wastes into the production of bricks and recycling such wastes by incorporating them into building materials is a practical solution for pollution problem. So the proposed system is to the invention of waste marble sludge powder and bottom ash as the replacement of clay bricks regarding the strength and durability studies. In our project, totally 100 number of bricks are to be casted with partial replacement of marble sludge powder. The percentage of replacement is carried out in this work as 0%, 5%, 10%, 15% and 20% by total volume. The strength and durability test of bricks is to be calculated.

Anbalagan et al., (2016) Majority of the people prefer burnt bricks for the construction purpose which emits nearly about 1 ton of CO2. The usage of environmental friendly, structurally sound and in expensive materials was used in the ancient centuries. The stabilized bricks are the one which have a low embodied energy of 0.42 MJ/kg and low carbon foot print. This paper presents the strength of theForming a glassy material, which, upon cooling, displays high strength and durability properties. High temperatures required to melt SiO2 mean high energy cost associated with brick In addition to cost, challenges facing the modern brick industry include shortages of raw material and environmental impacts of production. The feasibility of using waste material as a brick body was investigated, where several possible waste additives, including slag, biological waste, and waste container glass, were considered. A literature review was conducted in order to assimilate past work and experimental results. The results of several testing programs were compared and the feasibility of further work in the addition of waste additives to bricks was Its soda content, amorphous glassy structure, and availability, waste glass was determined to be a feasible option for addition. The specimens with glass additions exhibited an increase in compressive and flexural strength, a decrease in the initial rate of absorption, and an increase in firing shrinkage. The determination of feasibility of adding slag or biological waste to bricks was hindered by a lack of comparable data; however, the limited comparison available suggested the necessity for additional, directly comparable testing programs. As a result, an experimental program was developed to investigate potential benefits in terms of strength, absorption, and durability of bricks associated with the addition of waste glass, as well as economic and environmental gains as a result of the process

Venkatesan et al., (2015) based on experimental investigations concerning compressive strength and water absorption of the Brick, the following results were obtained, Compressive strength decreases on increase in percentage of wood ash as compare to charcoal brick. The different percentage of wood ash and charcoal (5%, 10% & 15%) are added with cement and sand. The compressive strength for both bricks are decreased. In that charcoal brick has maximum compressive strength ie.,(11.07 N/mm2 for 15 % of charcoal) than wood ash brick (7.9 N/mm2 for 15%

of wood ash).The water absorption for both the bricks are increases with percentage of (5%,10%,15%).In that the charcoal brick has less amount of water absorption ie.,(4.45% for 15% of charcoal) than wood ash brick(15.80% for 15% of wood ash).Thus from above study, this project concluded that, with the addition of charcoal in the cement and sand, the compressive strength of bricks increases and water absorption decreases than wood ash bricks.

SafwanKhedr et al., (2011) Marble and granite slurry cement bricks yield similar mechanical, in terms of compressive strength, and physical, in terms of density and absorption, properties. There is a positive effect of granite slurry on cement brick samples that reach its optimum at 10% slurry incorporation. Absorption is the major drawback of slurry incorporation in cement bricks according to the ASTM C55 where water absorption requirement is full filled only at Zero, 10 %, and 20% slurry samples for grade S. The accelerated hydration, endued by heating, compensatedthe detrimental effect of volumetric changes associated with temperature variation. Most cement brick samples, including the control, are of normal weight according to both the Egyptian specifications and ASTM C55.All cement brick samples tested in this study comply with the Egyptian code requirement for structural bricks. This is not true when compared to ASTM C55. Instead, 10% and 20%

Virendra Kumara at al., (2015) Granite sludge powder generates in processing activities of granite stone, such as cutting, polishing and finishing process. This contributes of about 30% wastage in these processes. As granite sludge powder is non- biodegradable waste, it has to be effectively disposed without creating environmental hazards. In our present study the objectives are to prepare Granite Sludge blocks of size230×110×70(mm) for varying mix proportions such as 20%, 30%, 40%, 50%,60%, and 70% for granite sludge powder and sand, by keeping lime 8% and gypsum 2% as constant. To find Mechanical properties such as Compressive Strength, Flexural strength and Water absorption, where maximum compressive Strength value for 7 days of 5.54 MPa, maximum flexural strength of 2.17 MPa And maximum breaking load 4.33kN was obtained for A3 block type. Water Absorption of granite sludge blocks increases with increase in addition of granite Sludge powder in mix proportions, yet it is in limit as per IS code specifications. Utilizing granite sludge powder for manufacturing of granite sludge masonry Blocks is one of efficient manner to minimize the disposal problems of granite Sludge powder.

3.0 METHODOLOGY

Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. One of the most important factors for producing workable concrete is good gradation of aggregates. Good grading implies that a sample fractions of aggregates in required proportion such that the sample contains minimum voids. Samples of the well graded aggregate containing minimum voids require minimum paste to fill up the voids in the aggregates. Minimum paste will mean less quantity of cement and less water, which will further mean increased economy, higher strength, lower shrinkage and greater durability. Aggregate comprises about 55% of the volume of mortar and about 85% volume of mass concrete. Mortar contains a size of 4.75 mm and concrete contains aggregate up to a maximum size of 150 mm.The design concrete mix involves the determinate of the most rational proportion of ingredients of concrete to achieve a concrete which is workable in its plastic state and will develop the rare qualities when hardened. A properly designed concrete mix should have minimum possible cement content without sacrificing the concrete quality in order to make it concrete mix.

Chemical constituents of Portland cement

MINERALS	PERCENTAGE
Lime (CaO)	60 to 67 %

Silica (SiO2)	17 to 25 %
Alumina (Al2O3)	3 to 8 %
Iron oxide(Fe2O3)	0.5 to 6%
Magnesia (MgO)	0.1 to 4%
Sulphur trioxide(SO3)	1 to 3%

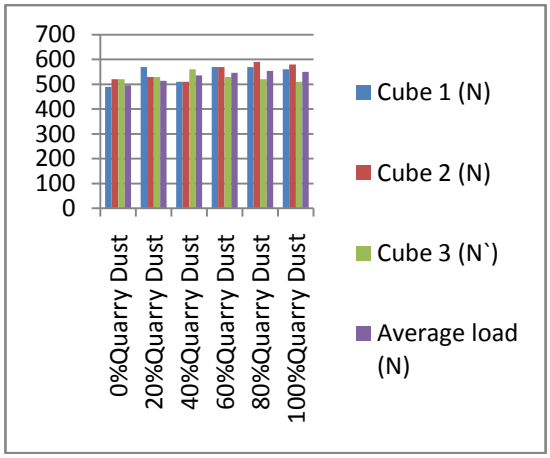
Figure: Loading of cylinder

Figure: Loading of cylinder

Splitting of cylinder

Table showing Compressive strengths at 14 day for every mix

sample	Cube 1 (N)	Cube 2 (N)	Cube 3 (N`)	Average load (N)
0%Quarry Dust	490	520	520	496.2
20%Quarry Dust	570	530	530	513.5
40%Quarry Dust	510	510	560	536.5
60%Quarry Dust	570	570	530	546.5
80%Quarry Dust	570	590	520	553.5
100%Quarry Dust	560	580	510	550

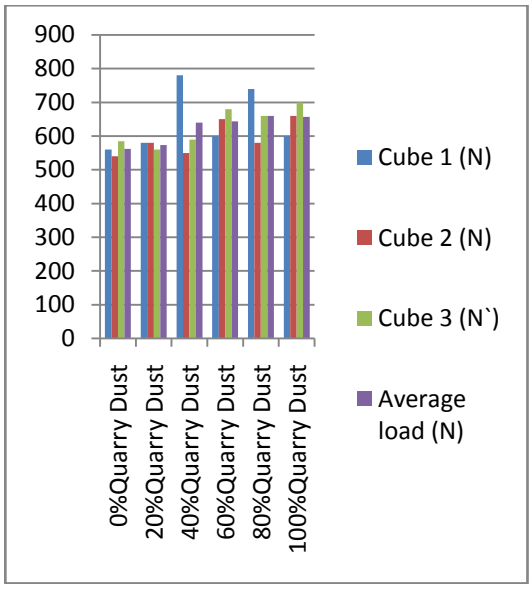


Graph: Compressive strengths at 14 day for every mix

28 Day Strength: Table showing cube crushing value at 28 days for every mix

sample	Cube 1 (N)	Cube 2 (N)	Cube 3 (N`)	Average load (N)
0%Quarry Dust	560	540	585	562.00
20%Quarry Dust	580	580	560	573.30
40%Quarry Dust	780	550	590	640.00

60%Quarry Dust	600	650	680	643.33
80%Quarry Dust	740	580	660	660.00
100%Quarry Dust	600	660	700	656.66



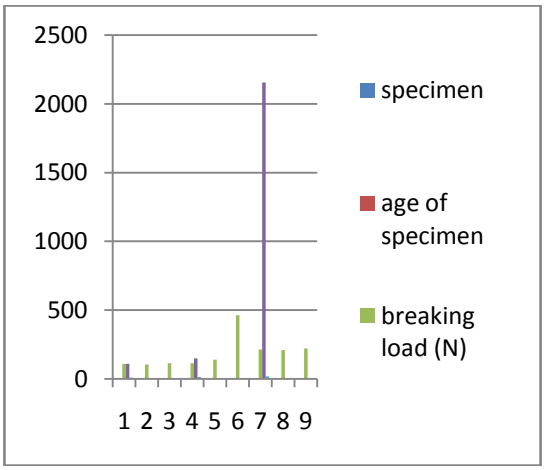
Graph: Cube crushing value at 28 days for every mix

4.0 RESULTS

Mix Design A mix M25 grade was designed as per Indian Standard method and the same was used to prepare the test samples. The design mix proportion is done in TableConcrete is the most widely used building material in the world due to its versatility, low cost and durability. Fine aggregate is an essential component of concrete. The most commonly used fine aggregate is natural river sand.

Compressive strength of (0%) concrete

Specimen	age of specimen	breaking load (N)	Strength (N)	Average Strength (N/mm^2)
1	7 Days	108.81	109.25	9.659
2		105.74		
3		113.2		
1	14 Days	114.6	149.17	13.19
2		139.12		
3		464.23		
1	28 Days	215.20	2155.55	19.05
2		210.31		
3		220.48		

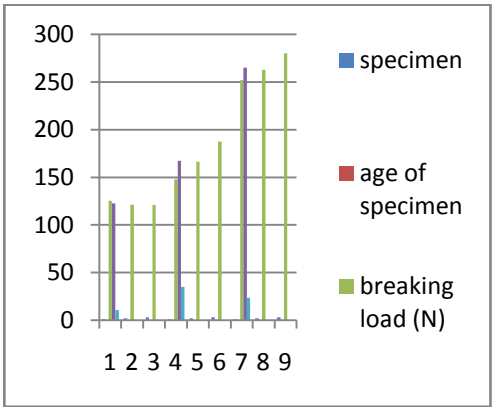


Graph compressive strength of (0%) concrete

Compressive strength for 25% replacement of Brick powder

specimen	Age of specimen	Breaking load (N)	Strength (N)	Average Strength (N/

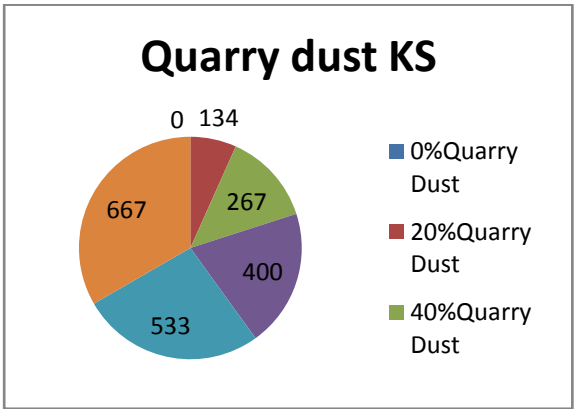
				mm^2)
1	7 Days	125.40	122.58	10.83
2		121.40		
3		120.96		
1	14 Days	147.70	167.15	34.78
2		166.22		
3		187.53		
1	28 Days	252.04	264.97	23.42
2		262.76		
3		280.12		



Graph Compressive strength for 25% replacement of Brick powder

We get the volume ratio as 0.18m 3 :0.27m3 : 0.54m3 With the density of 1460 Kg/m3 for sand and 1765 Kg/m3 for quarry dust, the mass of each material in 1m3 of concrete can be found. When this mass is multiplied by the price of each material per Kg we can get the price of making 1m3 of concrete while using the various proportions of materials. A summary of the cost analysis for this project is presented in the tables below;

sample	Quarry dust KS	Sand KS	Total price KS
0%Quarry Dust	0	710	710
20%Quarry Dust	134	568	702
40%Quarry Dust	267	426	693
60%Quarry Dust	400	284	684
80%Quarry Dust	533	142	675
100%Quarry Dust	667	667	667



Graph the cost analysis Quarry Dust different %

CONCLUSION:

From the experimental study of concrete with brick powder, which was partially replaced with cement, the following conclusions were achieved. The replacement of brick powder was made in percentages of 5%, 25%, 50% and 75% of the weight of cement. The workability of concrete was not affected due to the

addition of brick powder. After curing of 28 days, the cubes were tested for compressive strength which showed that 40% of the strength was attained for 5% and 10% replacement of brick powder with cement and the compressive strength results were equal to the conventional concrete for 50% and 75%.After the curing of the concrete it was found that the concrete got a reddish colour which increased the aesthetical view of the concrete. Thus the partial replacement of cement with brick powder has helped to increase the compressive strength of the concrete. There is no decrease in the compressive strength of the concrete due to replacement of brick powder in cement at the proportion of 5% , 25%, 50% and 75%.It also gives good aesthetical view to the concrete when compared with the conventional concrete. So the replacement of cement with brick powder in concrete is really advisable.

REFERENCES:

1. M. Usha RaniJ. Martina Jenifer (2016), "An Experimental Study on Partial Replacement of Sand with Crushed Brick in Concrete," IJSTE - International Journal of Science Technology & Engineering | Volume 2 | Issue 08

2. Aeslina Abdul Kadir, Noor AmiraSarani.(2012) "An Overview of Wastes Recycling in Fired Clay Bricks" International Journal of Integrated Engineering, Vol. 4 No. 2 (2012) p. 53 -69

3. Alaa A. Shakir, Ali Ahmed Mohammed.(2013) "Manufacturing of Bricks in the Past, in the Present and in the Future: A state of the Art Review" International Journal of Advances in Applied Sciences (IJAAS) ISSN: 2252 - 8814, Vol. 2, No. 3, pp. 145~156

4. FadhluhartinibtMuftah, MohdSyahrul (2010) "The Properties of Special Concrete Using Bottom Ash as Partial Sand Replacement" International Journal of Sustainable Construction Engineering & Technology Vol 1, No 2,

5. MamtaRajgor, JayeshkumarPitroda (2013). "Stone Sludge: Economical Solution for Manufacturing of Bricks" International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278 -3075, Volume -2 Issue -5

6. B.VenkataSrinivasarao (2018),"Experimental Investigation In Development Low Cost Concrete By Using Brick Powder And Quartz Dust",International Research Journal of Engineering and Technology, ISSN: 2395-0056,Volume: 05 Issue: 02

7. B. Felekoglu, K. Tosun, B. Baradan, (2006), "The effect of fly ash and limestone fillers on the viscosity and compressive strength of self-compacting repair mortars," Cement and Concrete Research, vol. 36, no. 9, pp. 1719–1726,

8. H. A. F. Dehwah,(2012) "Corrosion resistance of self-compacting concrete incorporating quarry dust powder, silica fume and fly ash," Construction and Building Materials, vol. 37, pp. 277–282,