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EXPERIMENTAL INVESTIGATION IN DEVELOPMENT LOW COST CONCRETE BY USING BRICK POWDER AND QUARTZ DUST

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ABSTRACT: *Concrete is generally used construction material today in any structure. Increase in construction activities has lead to an increase in demand for various raw materials in concrete. This lead to researchers to focus on the use of alternate materials as ingredients in the concrete that is in no way inferior to the normal materials used in concrete. By partially replacing the ingredients with different proportions the strength of concrete can be determined. In recent years there has been a great deal of interest and support worldwide in utilizing Industrial and construction demolition waste such as ceramic as well as clay brick debris for production of aggregate material which can be reuse for road base courses and construction backfill materials and also for other engineering purposes. However, they can be also used as supplementary Cementitious materials or even as raw material for alkali-activated binder for producing more valuable binders that can be applied in various building applications. In the present case study Research is being carried out on the utilization of waste products in concrete as a replacement for natural sand and cement. The physical analysis like grain size analysis is carried out to determine the utility size i.e. whether it can be replaced for sand or cement. In this study both fine aggregate and cement is replaced with quartz and clay bricks simultaneously and also fine aggregate alone is replaced with different proportions of quartz and clay bricks. After the experimental analysis and testing it is found that an optimum replacement of 5% of fine aggregate and 5% of cement is possible and also replacing the fine aggregate alone gives better results.*

Keywords: Quartz dust, Brick powder, Concrete sp 25, Compressive & Tensile strength.

1. Introduction:

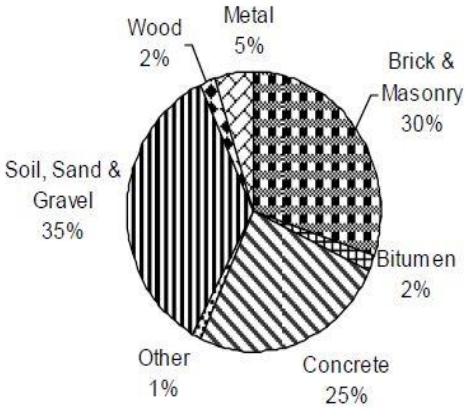
The growing concern of resource depletion and global pollution has challenged many researchers to seek and develop new materials relying on renewable resources. These include the use of by-products and waste materials for building construction. The high cost of regular building materials is a central point influencing development in India. In creating nations where plentiful rural and modern Waste are released these include the use of by-products and waste materials for building construction. Therefore an attempt has been made in this study to utilize the Quartz dust and disintegrated or waste clay brick powder is used as a partial replacement of fine aggregate and cement in the development of low cost concrete. So a study on various strength and durability properties of these materials is carried out. Also suitable measures have to be adopted for attaining the target strength. Quartz is commonly used in the industries for the production of ceramics and glass and the by-product are often dumped as wastes. In India, industries and informal sectors recycle about 15-20% of solid waste in various building material. In developing countries, Quartz dust and brick type waste material can be used as a construction material. It has the advantage of reduction of cost and it also serve as a means of disposal or say recycling of waste. In this paper normal fine aggregates and cement are replaced by crushed clay brick and quartz dust and cubes have been casted to their designed compressive strength and other physical properties.

Infrastructure development across the world created demand for construction materials. Concrete is the premier civil engineering construction material. Two billion tons of aggregate are produced each year in the United States. Production is expected to increase to more than 2.5 billion tons per year by the year 2020. Similarly, the consumption of the primary aggregate was 110 million tons in the UK in year 1960 and reached nearly 275 million tons by 2006. Use of natural aggregate in such a rate leads to a question about the preservation of natural aggregates sources. In addition, operations associated with aggregate extraction and processing are the principal causes of environmental concerns. In light of this, in the contemporary civil engineering construction, using alternative materials in place of natural aggregate in concrete production makes concrete as sustainable and environmentally friendly construction material.

1.2 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 utilising unempirical dumping methods there-by putting harsh pressure on scarce urban land as well as dropping life spans of landfills.

Figure 1. Construction waste



1.3 Objective of research

Objectives of the experimental investigation are as follows:

1) To study the properties of fresh concrete this is cast by using quartz dust and brick powder.

2) To study mechanical properties such as compressive and split tensile strength at the end of 7 and 28 days of curing by partially replacing cement and fine aggregate with quartz dust and brick powder under normal curing with chemical admixture.

3) To investigate the possibility of the combination of quartz dust and brick powder in concrete by determining its compressive and split tensile strength.

4) To reduce environmental pollution by utilizing waste material in concrete.

2. Material and methodology

The materials used in this experiment were Cement, fly ash, Sand, coarse aggregate, coconut shell and water.

Cement: OPC 53 grade cement from a single batch will be used throughout the course of the project work. The properties of cement used are shown in table below.

Table 1. Physical Properties of O.P.C (Ordinary Portland cement)

S.No.	Property	Test Method	Test Result
1	Initial Setting time	Vicat apparatus (IS 4031-Part 5)	42 min
2	Normal Consistency	Vicat apparatus (IS 4031-Part 4)	33 %
3	Fineness	Sieve test on sieve no.9 (IS 4031-part11)	7% Residue
4	Specific Gravity of Cement	Specific gravity bottle	3.05
5	Final setting time	Vicat apparatus	308min

Fine aggregate: Fine aggregate used in the experiments was locally available river sand conforming to IS 383- 1970(6). The physical properties of the fine aggregates were tested in accordance with IS 2386(10).

Table 2.Physical properties of Fine Aggregate

S. No.	Property	Test Method	Value
1	Fineness modulus	Sieve analysis (IS 2386-1963 Part 2)	3.13
2	Specific gravity	Pycnometer (IS 2386-1963 Part 3)	2.6
3	Bulk density (kg/m^3)	(IS 2386-1963 Part 3)	1830
4	Water absorption	(IS 2386-1963 Part 3)	1.02%

Coarse Aggregate:

The coarse aggregate used in this study was crushed granite of maximum size 20 mm obtained from the local crushing plant. The physical properties of the coarse aggregate were tested in accordance with IS 2386(10)

Table 3 Physical properties of Coarse Aggregate (20mm)

S.No.	Property	Test Method	Value
1	Fineness modulus	Sieve analysis (IS 2386-1963 Part 2)	4.23
2	Specific gravity	Pycnometer (IS 2386-1963 Part 3)	2.73
3	Bulk density (kg/m3)	(IS 2386-1963 Part 3)	1340

Brick Powder:

Brick powder is obtained from the demolition squander also the waste bricks are obtained from garbage of a broken building. The collected waste bricks are to be crushed in to powder to get the particle passing through 75 micron sieve to get the grading of cement.

Figure 3. Brick waste samples

Table 4.Properties of brick

Properties	Brick
Specific gravity	2.52
Bulk density	970kg/m3
Percentage of Void	61.58%
Fineness modulus	2.783

Quartz:

Quartz, most ordinary of all minerals is self-possessed of silicon dioxide, or silica, SiO2. It is an vital component of igneous and metamorphic rocks. The size varies from specimens weighing a metric ton to minute particles that shine in rock surfaces. The crushed quartz powder used in the experiments is in a form of white powdered quartz flour, which replaces fine aggregate from the standard concrete. The particle size used ranges from 10 to 45µm.

Figure 4. Quartz powder

Table 5. Properties of Quartz

Properties	Quartz
Specific gravity	2.56
Bulk density	1340kg/m3
Percentage of Void	46.58%
Fineness modulus	3.38

Water:

Normal portable water obtained from Municipal water supply was used for the experiment.

CHEMICAL ADMIXTURE:

CEMCRETE SP25:

The basic components of CEMCRETE SP are synthetic polymers, which allow mixing water to be reduced considerably and concrete strength to be enhanced significantly, particularly at the early ages. CEMCRETE SP is chloride free product.

Colour	Brown
Specific gravity	1.20+0.035
Chloride content	Nil to BS 5075 to I.S:456-78
Nitrate content	Nil
Freezing point	0°C
Air entrainment	Maximum 0.5%

3. Normal concrete Mix design:

Concrete mix design is defined as the appropriate selection and proportioning of constituents to produce a concrete with pre-defined characteristics in the fresh and hardened states.

In the present study M30 grade concrete is used for the water cement ratio of 0.45

Table 7 MIX DETAILS FOR M30 CONCRETE (1:1.58:2.85)
Compressive strength of cubes for 7 & 28 days.

Sample	7days (KN/m²)	28 days (KN/m²)
NC	32.76	36.07
RSCC	37.26	43.27
RSC1	39.12	43.95
RSC2	36.58	41.75
RSC3	38.49	42.07
RSC4	37.22	40.73
RSC5	36.58	40.02

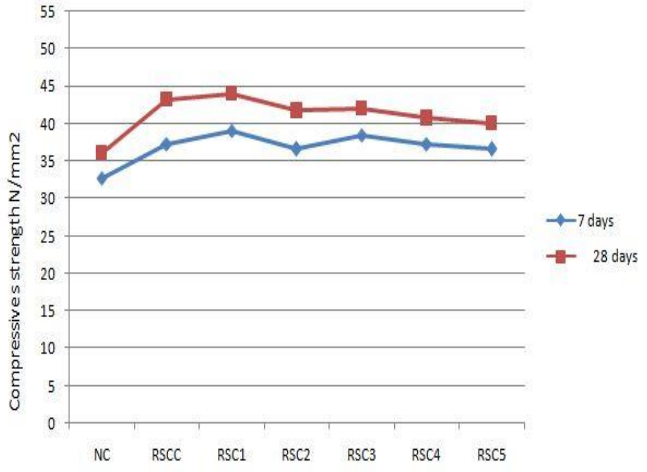


Figure 5.Compressive strength of samples at 7 & 28 days

The following graph showing the values of normal and different replaced proportions of Compressive strength of concrete for 7 & 28 days and it shows that RSCC sample has optimum value and at sample RSC1 which is 5%Quartz + 5% Grog replaced for sand gives high strength when compare with the rest of the samples.

Split Tensile Strength of different proportional of concrete for 7 and 28 days.

Sample	7days (KN/m^2)	28 days (KN/m^2)
NC	2.01	2.38
RSCC	2.82	3.06
RSC1	2.69	2.88
RSC3	2.83	3.02
RSC4	2.38	2.50
RSC5	2.41	2.63

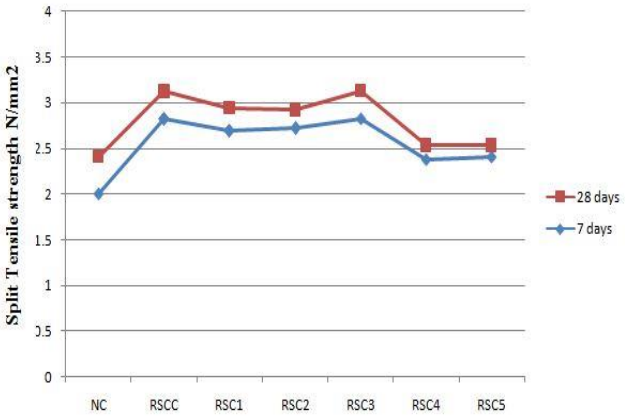


Figure 6. Split Tensile strength of samples at 7 & 28 days

The following graph showing the values of normal and different replaced proportions of Split Tensile strength of concrete for 7 & 28 days and it shows that optimum value and at sample RSC1 which is 5%Quartz + 5% Grog replaced for sand gives high strength when compare with the rest of the samples.

Result:

The Test results shows that the values of normal and different replaced proportions of Compressive strength of concrete for 7 & 28 days and it shows that RSCC sample has optimum value and at sample RSC1 which is 5%Quartz + 5% Grog replaced for sand gives high strength when compare with the rest of the samples.

4. Conclusion:

The purpose of the research is to determine the mechanical properties of concrete specimens in which fine aggregate and cement are replaced with quartz dust and brick powder. And also fine aggregate alone is replaced with different percentage of quartz and brick powder.

1. Optimum replacement is possible at 5% for fine aggregate and cement with quartz and brick powder

2. Compressive strength of concrete with optimum replacement at 7 days and 28 days of water curing is 36.26 N/mm2 and 43.27 N/mm2.

3. Compressive strength of concrete with replacement of sand by 5% quartz and 5% brick powder at 7 days and 28 days water curing is 39.12 N/mm2 and 43.95 N/mm2.

4. Compressive strength of concrete with replacement of sand by 10% quartz and 5% brick powder at 7 days and 28 days water curing is 36.58N/mm2 and 41.75 N/mm2.

5. Compressive strength of concrete with replacement of sand by 10% quartz and 10% brick powder at 7 days and 28 days water curing is 38.49N/mm2 and 43.15 N/mm2.

6. Compressive strength of concrete with replacement of sand by15% quartz and 5% brick powder at 7 days and 28 days water curing is 37.22N/mm2 and 40.73 N/mm2.

7. Compressive strength of concrete with replacement of sand by 15% quartz and 10% brick powder at 7 days and 28 days water curing is 36.58N/mm2 and 40.02 N/mm2.

8. Splitting tensile strength of specimens with optimum replacement at 7 days and 28 days water curing is 2.82N/mm2 and 3.96 N/mm2 which is greater than that of control specimens.

9. The compressive strength results suggest that 5% of both fine aggregate and cement can be simultaneously replaced with quartz and brick powder respectively. It also shows that up to 25% of fine aggregate alone can replace with different percentages of brick powder and quartz.

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6. BIOGRAPHIES:

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