EFFECT OF BRICK POWDER AS FINE AGGREGATES IN M30 GRADE CONCRETE

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Abstract- The widely used material in infrastructure development and construction throughout the world is concrete and mortar. Sustainable development is picking up prominence around the world these days. The Engineers are feeling the need, on numerous fronts, to insert manageable advancement in approaches, practice, and tasks to verify the planet's future. Adding to this, expanded population and the requirement for more frameworks have tragically prompted the unsuitable consumption of natural materials, expanding measures of development and construction waste and quickened disintegration of the common habitat in numerous spots around the world. A significant role in the mix design is played by natural fine aggregate which is the prime material used to make mortar. River sand is becoming a scarce commodity nowadays. Hence the manufactured sand is playing a major role in the construction industry nowadays. The natural resources due to excessive use are also exhausting very rapidly. Shortage of fine and coarse aggregate may affect construction industry directly, therefore it is necessary to find an alternative material which can replace fine aggregate or coarse aggregate fully or partially so that the damage due to excessive erosion to the environment is prevented. Natural resources are getting depleted at a very fast rate due to excessive use of natural resources in the construction industry. On the other hand environmental pollution is caused due to construction and demolition waste. Reuse and recycle of brick waste can play an important role in the sustainable development. There is a need of policies to practice sustainable development as it is very important in today's world to secure our natural resources. Therefore it is important to find alternate materials so that natural aggregate can be replaced fully or partially and sustainable development can be archived The main objective of this study is to check the workability, compressive strength and split tensile strength of concrete by replacing fine aggregates by brick powder with 0%, 5%, 10%, 15% and 20% replacement for M30 grade concrete mix.

1. INTRODUCTION

India is a developing country, consumption of different materials such as fine aggregate and coarse aggregate is high due to developing infrastructure for the development. Sand has been used as a fine aggregate since ages and is definitely one of the most established and most generally utilized material in this day and age. Fine aggregate is available easily and is also economically feasible. The concrete industry, on the other hand, is one of the real consumers of regular natural resources. Fine aggregate has a big value in concrete and the construction industry. The widely used material in the construction industry is concrete and mortar. The yearly production of concrete is estimated as ten billion metric tons, in which 60–70% of the quantity is aggregate (natural rock), 18% is water, and 15–20% is cementations binder.

Fine aggregate is used enormously in the construction of different projects like airports, highways, skyscrapers, nuclear plants, dams, etc. Also, the demand for these materials is high in privatization and globalization. To meet this high demand for coarse and fine aggregate the increased extraction from the natural resources is required. Fine aggregate is one of the major constituents in mortar. Natural resources are also getting exhausted in meeting this high demand for fine aggregate in the construction industry. The construction industry will be directly affected due to the shortage or non-availability of the natural sand, as natural resources are depleting, finding an alternative material for the partial or complete replacement of natural sand is needed, such that we can prevent the damage to the environment. Else this will lead to an ecological imbalance due to the increasing use of natural fine aggregate. Thus, the need arises to find the partial or complete replacement of fine aggregate for construction industries. Many Researcher's and Engineers are working with their ideas to find an alternative way to partial or complete replacement of fine aggregate so that the natural resource consumption can be decreased. These days sustainable infrastructural development needs a material which can replace natural fine aggregate and should be available easily economically, domestically with a great amount.

Objectives of the study

The center targets of this examination are: To assess the utility of brick dust as a substitution of sand in mortar.

1. To obtain the optimized percentage based on 28days strength.
2. To study the sulphate resistance of the brick dust based mortar.
3. To produce an economical and sustainable mortar.
4. To evaluate the properties of brick dust utilized as fine aggregate in the mortar and to know the material proportions of replacement.
5. To examine the deviation in the quality and strength of the acknowledgment of ideal replacement. To comprehend the viability of brick dust as in quality and strength upgrade.

Aside from these center destinations, the aim of this examination is to be centered around the achievability and powerful utilization of the results on the construction. A complete examination of the results so as to demonstrate the advantage and disadvantages of the replacement of fine aggregate

2. LITERATURE REVIEW

Samanth and Prakhar (2016) replaced coarse aggregate and fine with the recycled and demolition debris in the concrete to study the different properties of concrete. Determined the ratio of the replacement optimum for different properties of the concrete. Studied the alternate ways to partial replacement of fine aggregate and coarse aggregate with different construction waste and brick debris from the demolition site. So that without polluting the environment these wastes can be utilized.

Kumar and Siva (2015) focussed on the usage of ceramic tiles and bricks from building demolition debris, to find a partial replacement of coarse aggregate. Different tests like strength test, workability test were done on the resultant concrete and compared with the conventional concrete. The workability of the concrete decreases to some extent but the strength enhancement and light weight of the concrete can be seen considerably. Finding a partial replacement for sand with demolition waste as an aggregate without altering the properties of the conventional concrete is effectively studied and utilized so that it can contribute towards environmental problems and solid waste management.

Sriharsha and Murthy (2014) casted different samples by replacing the aggregate with demolition debris from old structures, blast furnace slag from iron ore industries. Various

tests were done on the physical and mechanical properties of the concrete. Strength at different replacements was recorded and compared to the different concrete mix.

Muthulakshmi and Nivedhitha (2012) they did experiments and investigated the changes in compressive strength, flexural strength and tensile strength by replacing the natural fine aggregate and natural coarse aggregate with the recycled fine and coarse aggregate. Different partial replacements were made 10%, 20%, and 30%. Tests were done on the concrete and results were compared. They found out that with recycled aggregate the strenght increased at 20% replacement of fine and coarse aggregate. And the flexural strength was decreasing with the increase in percentage replacement of natural fine aggregate and coarse aggregate.

3. MATERIALS USED

3.1 Cement

In this study Ordinary Portland cement of 53 grade (ACC cement) has been procured and has been used. The various tests on this material is conducted on cement.

Figure 1: OPC 53 Grade Cement

3.2 Fine aggregates

Fine aggregate are basically sands won from the land or the marine environment. Fine aggregates generally consist of natural sand or crushed stone with most particles passing through a 4.75mm sieve.

The fine aggregate used in this study is river sand which is obtained from local company and shown in figure

Figure 2: Fine aggregates

3.3 Coarse aggregates

Coarse aggregates are particles greater that 4.75mm but generally range between 9.5mm to 37.5mm in diameter. They can either be from primary ,secondary or recycled sources. Primary or virgin aggregates are either land or marine-won. Gravel is a coarse marine-won aggregate, land-won coarse aggregates include gravel and crushed rock. Gravels constitute the majority of coarse aggregate used in concrete with crushed stone making up most of the remainder.

In this study coarse aggregate of nominal sizes of 20mm, 12mm are used.

Figure 3: Coarse aggregates

3.4 Brick dust

The brick is the most commonly used building material used for constructing walls, columns, roofs, paving floors, etc. a good brick clay contains 20 to 30 percent of silica and the remaining constituents are lime, magnesia, sodium, potassium and iron oxide.

Waste bricks were collected from construction waste near Jagat Farm market and crushed in the crusher to get a finer powder which can be utilised as fine aggregate after proper sieving

Mix design

Final mix for M30 grade concrete

Cement : Fine aggregate : Coarse aggregate: water

1 : 1.86 : 2.89: 0.50 :

4. EXPERIMENTAL INVESTIGATION

4.1 Casting of the specimens

Casting of cubes and cylinders as done for M30 grade concrete, the mix proportion is for which we are casting cubes for normal concrete, with the partial replacement of cement with 0%, 5%, 10%, 15% and 20% of brick powder

Figure 6: casting of samples (cubes and prisms)

4.2 Curing the test specimens

After casting the specimens allow the specimens to hardening process for 24 hours at least after hardening process de mould the test samples carefully without any damage for the various trials of municipal solid waste replacement. Now submerge the de moulded specimens in curing tank generally for this study I adopted water submerged curing (WSC) for 7 days, 14 days, 28 days age for strength calculations

Figure 7: Curing of specimens for 7 days, 14 days and 28 days age

4.3 Compressive strength of concrete

This test was conducted as per (IS516-1959). The cubes of standard size 150x150x150mm were used to find the compressive strength of concrete. Specimens were placed on the bearing surface of CTM, of capacity 200T without eccentricity and a uniform rate of loading applied till the failure of the cube.

Figure 8 : Testing of 10%MSW specimen at 7 days curing

4.4 Split tensile strength

This test was conducted as per IS516-1959. The cylinders of standard size 150mmx300mm were used find the strength of concrete. Specimens are placed on the bearing surface of CTM, of capacity 200T without eccentricity and a uniform rate of loading is applied till the failure of cylinder. The maximum load was noted and the strength was calculated. Split tensile strength testing Procedure from IS5816-1999.

Figure 9:Split tensile strength testing at 14 days curing

5. RESULTS AND ANALYSIS

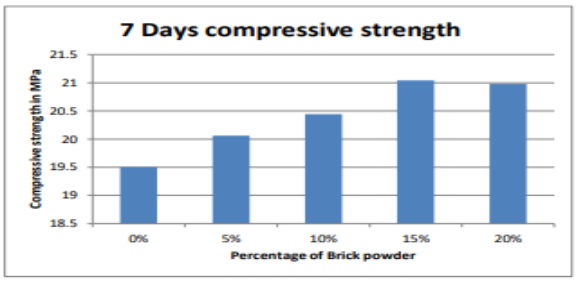
5.1 Slump cone test

S. No	% Brick powder	Slump in mm
1	0%	80
2	5%	70
3	10%	60
4	15%	50
5	20%	40

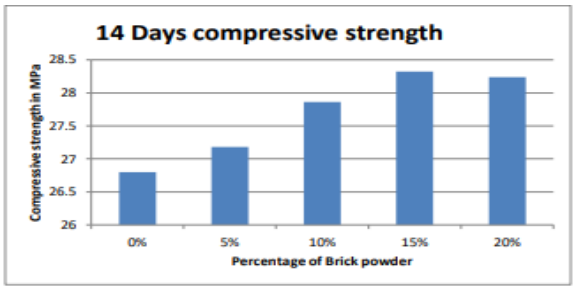
5.2 Compaction factor test

S. No	% Brick powder	Compaction factor
1	0%	0.94
2	5%	0.9
3	10%	0.84
4	15%	0.82
5	20%	0.84

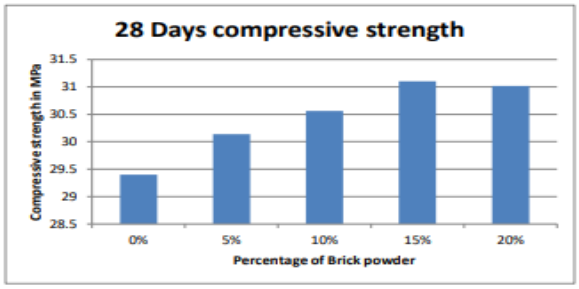
5.3 Compressive strength



Comparison of 7days Compressive strength

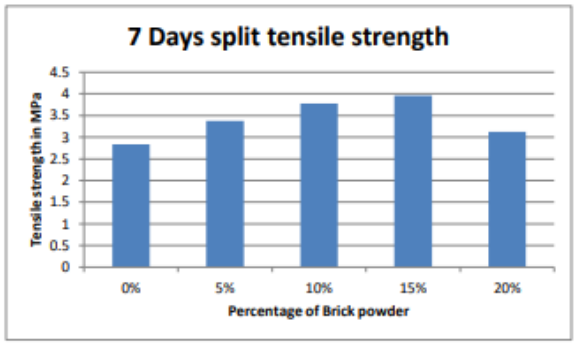


Comparison of 14days Compressive strength

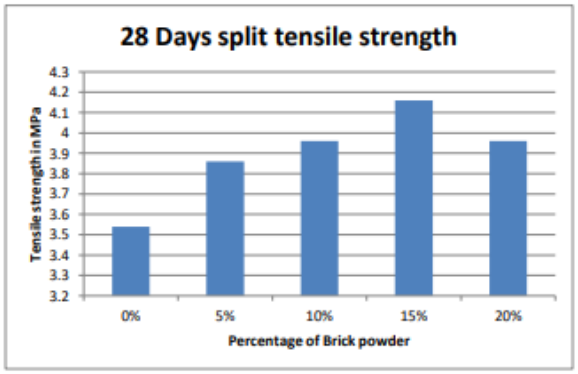


Comparison of 28days Compressive strength

5.4 Split tensile strength



Comparison of 7days tensile strength



Comparison of 28days tensile strength

6. CONCLUSIONS

Based on the study of investigating the use of brick dust in the mortar, the following conclusions were drawn:

1. By partial replacement of fine aggregate with brick dust, we can get an eco-friendly mortar as it subsides the stagnation of demolished brick waste by consuming it properly.
2. The possibility for the partial replacement of fine aggregate with brick debris which is produced during the demolition of construction site exists.
3. The value of slump cone decreases with increasing the percentage of brick powder from 0% to 20% for M30 grade concrete.
4. The value of compaction factor decreases with increasing the percentage of brick powder from 0% to 20% for M30 grade concrete.
5. The maximum value of compressive strength was observed at 15% brick powder replacement for 7days, 14 days and 28 days curing in M30 grade concrete.
6. The maximum value of split tensile strength was observed at 15% brick powder replacement for 7days, 14 days and 28 days curing in M30 grade concrete.

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