Study on Partial Replacement of Fine Aggregate with Ceramic Waste and Brick Dust in Concrete

G.G. NIVETHA[1], M. PRAKASH[2], M. THAMIZH ILACKIYA[3], H. GOKULRAM[4], A. S. ARJUN MOHAN[5]
[1, 2, 3] *Department of Civil Engineering, CSI College of Engineering, Ketti-The Nilgiris*
[4, 5] *Assistant Professor, Department of Civil Engineering, CSI College of engineering, Ketti-The Nilgiris*

Abstract- ***In these modern worlds of construction, the building materials are essential. Due to the day to day innovation and development in construction field, the use of natural aggregates is increase tremendously. The widely used material in infrastructure development and construction throughout the world is concrete and mortar. Due to excessive production of the river sand, it is banded by the government of INDIA. Thus, replacement of sand becomes need in last decays and partial replacement will contribute to a good point to research area. Number of researches doing work on the replacement of sand by number of materials like waste glass powder, crushed fire brick, ceramic tile waste and etc., This review article about the study of compressive strength in concrete by mixing waste construction materials such as brick dust and ceramic waste as a partial replacement of fine aggregate. This partial replacement of sand is done in different percentage (10%, 20%, and 30%). 10% of sand is replaced with 5% of brick dust and 5% of ceramic waste. Similarly, in the next two mix 20 & 30% of sand are replaced. The abrasion test is carried out at 7, 14 and 28 days. The test result says that 20% replacement of ceramic dust 10% and brick dust 10% gives the maximum compressive strength to the concrete***

Indexed Terms- Fine aggregate, Water, Brick dust, Ceramic waste, Coarse aggregate.

I. INTRODUCTION

Concrete is easily prepared and fabricated in all structural system and it is a composite material. Concrete is created from a three materials mainly fine aggregate, coarse aggregate and cementitious material. Fine aggregate is essential constituent in concrete river sand is most common and suitable for fine aggregate in concrete. The excessive use of river sand it will cause many negative effects like cause erosion harm local wildlife destroy adequate ecosystem and adversely affect tourism. Due to this reason replacement of sand is essential and needs in last two decays.

Nowadays number of researching occurring in world on replacement of sand by number of materials like glass powder, spent fire bricks, crushed bricks, crushed coarse, fly ash etc.., so in our report we partially replace the fine aggregate by ceramic waste and brick dust. People from 7000 BCE have been using brick. Turkey is that country where first brick is found. On that time bricks were dried in sun light. This sun-dried brick is not sufficient strength. But fired brick were very high resistance. In any condition fire brick gave very suitable results. That is why it used in permanent structures.in the construction of building; brick is generally used more than wood than other material. Now these days many types of machineries are available.

Ceramics are often used in the manufacture of wall and floor tiles, bricks and roofing tiles. Sanitary ceramics, as with all other ceramic product, are produces from natural materials which generally contain kaolin, china clay, feldspar, potassium and quartz. Ceramic industry include the following sectors: Ceramic flooring and wall covering ceramic sanitary ware, bricks and roofing tiles, refractory materials, ceramic for technological applications, and ceramic objects for domestic and decorative proposes. Construction industry as the end user of almost all the ceramic materials, is will poised to solve this environmental problem which is partly its own. The use of waste products in concrete is not only economical but also solve some of waste disposal issues. Bricks and ceramic are easily available material, it will be recycled by destroyed building, bridges or any other demolishes structure. In our project we partially replace the fine aggregate with brick dust and ceramic waste to study the compressive strength and to reduce the scarcity of natural aggregate.

II. LITERATURE REVIEW

S. Anisha, R. Mathimalar, M. Ponni in their paper, ’Partial replacement of fine aggregate by using spent fire brick waste". The work was conducted on M20 grade mix. The replacement of fine aggregate of spent fire brick waste in range of 0%, 10%, 20%, 30%. This test result that improves the mechanical properties of concrete slightly since minerals and chemical properties are of brick. This was achieved 25%.

Manoj Kumar, Awadhesh Chandramauli, Ashutosh in this paper, ’Partial replacement of fine aggregate of fire

bricks with fine aggregate in concrete'. As per design mix of concrete M25 and according to IS 10262:2009. Split tensile strength is measured for partial replacement of fine aggregate of crushed fire brick with fine aggregate in concrete at various percentages such as 0%, 22%, 25%, 28%, 31%. This result in optimum tensile strength is gained at 28% partial replacement.

Anayat Ali Allaic in their paper, 'Partial replacement of fine aggregate with brick dust'. As per literature, result indicate that there is a strength enhancement at 15% replacement of the fine aggregate with brick debris. Therefore, we can say that 15% is the optimum replacement that can be achieved compared to conventional mortar and concrete.

Akash Agarwal in their paper, 'Utilization of ceramic waste as a partial replacement of aggregates and its effect on variation of expenditure'. With increase in the percentage of ceramic waste, the compressive strength increases at level of 40%. Usage of ceramic help in reducing the degradation of the environment both by using waste materials as well as by reducing the usage of the natural resources available.

Saswat Hota, Vikas Srivastava, in their paper, 'Partial replacement of fine aggregate with ceramic waste and Demolition waste in rigid pavement'. By using ceramic and demolition waste 40% natural fine aggregate can be saved while making rigid pavement. Ceramic waste increases the compressive strength is more than that of referral concrete.

- PROPERITIES OF MATERIAL

Cement, fine aggregate, coarse aggregate, brick dust and ceramic waste are the various materials used in this project. Before casting the specimen various test of material has been conducted and a study on them is presented in this chapter.

III. MATERIALS

- CEMENT

Cement is defined chemical entry formed from predetermined ratios of reactants at a fairly precise temperature. Cement is obtained from limestone and small quantities of other materials through a heating process in kilns, the process is known as Calcinations. The resulting hard substances called 'clinker', is then ground with a small amount of gypsum to form Ordinary Portland cement.

Table 1: Properties of cement

Sl.no	Properties of cement	Values
1	Specific gravity	3.15
2	Standard consistency	28%
3	Fineness modulus	85%
4	Minimum cement content (kg/m^3)	300

- FINE AGGREGATE

Fine aggregate are essentially any natural sand particles won from the land through the mining process. It is obtained by crushing the waste stones of quarries to the particular size of sand. Aggregate whose particles pass through 4.75mm IS sieve is termed as fine aggregate. The sand used for experimental program was locally procured and conforming zone 1.

Table 2: Properties of fine aggregate

Sl.no	Properties of fine aggregate	Values
1	Specific gravity	2.56
2	Net water absorption	0.5%
3	Fineness modulus	2.18
4	Grading zone	1

- COARSE AGGREGATE

Coarse aggregate consists of aggregate larger than fine aggregate larger than fine aggregate and their size vary from 20 to 4.75mm. These tend to improve quality and bond characteristic and generally result in a higher flexural strength of concrete. It also helps in reducing shrinkage. These aggregates occupy 70-80% of volume of the concrete.

Table 4: Properties of coarse aggregate

Sl.no	Properties of coarse aggregate	Values
1	Specific gravity	2.15
2	Net water absorption	1.0%
3	Fineness modulus	2.58

- CRUSHED CERAMIC TILE

Broken tiles were collected from the solid waste ceramic manufacturing unit and from demolished building. The waste tiles were crushed into small pieces by manually and by using crusher. The required size of crushed title aggregate was separated to use them as partial replacement to the natural coarse aggregate. The title

waste which is lesser than 4.75 mm size was neglected. The crushed tile aggregate pass through 4.75mm are used. Crushed tiles were partially replaced in place of fine aggregate by the percentage of 5%, 10%and 15%, individually.

Table 5: Properties of crushed ceramic tile

Sl.no	Properties of crushed ceramic tile	Values
1	Specific gravity	3.02
2	Net water absorption	1.10%
3	Fineness modulus	92.50%

- BRICK DUST

The brick waste is generated in brick kilns, brick masonry construction sites and during transportation. By recycling brick dust, the problem could be solved up to some extent. The brick is crushed into fine aggregate which is passed through 4.75mm IS Sieve and retained on 150micron. Crushed brick satisfying zone 2.

Table 6: Properties of brick dust

Sl.no	Properties of brick dust	Values
1	Specific gravity	2.31
2	Net water absorption	0.70%
3	Fineness modulus	2.57
4	Grading zone	2

- WATER

Water is the most important and least expensive ingredient of concrete. It plays an important role in mixing, lying, and compaction, setting and hardening of concrete. It acts as a lubricant for the fine and coarse aggregate and makes the mixture workable. Water for construction of concrete structure should be same quality as drinking water. Impurities like suspended solids, dissolved salts organic matter which affects the properties of concrete. These impurities can be changed setting time, hardening strength, durability. Water should be tested from an approved lab.

- MIX DESIGN OF CONCRETE

Design mix of concrete for 25 grade are made as per IS 10262:2009. Water cement ratio and minimum content is taken as per IS456:2000 (table 5). Size of nominal maximum of aggregate is 20mm used. Minimum water content as per IS 10262:2009. Proportion of mix design given below.

Table 7 mix design proportion of M25

Cement	Fine aggregate	Coarse aggregate	Water
1	1.7	2.7	0.5

IV. RESULT

As per design mix of concrete M25 and according to IS 10262:2009. Compressive strength is measured for partial replacement of fine aggregate with crushed brick and ceramic waste in fine aggregate in concrete at various percentages such as 10%, 20%, 30% after 7 days and 14 days curing and found that the optimum compressive strength is gained at 20% partial replacement.

V. FUTURE SCOPE

1. It will slightly reduce the dependency on natural sand.
2. High strength gives in tension as compare to conventional concrete.
3. Brick and ceramic tile are easily available in India, due to which partial replacement is possible and economical too.
4. Fine aggregate is the natural resource and is limited in nature, thus brick and ceramic tile can be best alternative for fine aggregate.

VI. CONCLUSION

1. The maximum size of aggregate should not be greater than 10mm to 20mm.
2. Angular shapes of coarse aggregate are used.
3. The workability of concrete increase with the increase in ceramic and brick aggregate replacement.
4. The properties of concrete increased linearly with increase in brick and ceramic aggregate up to 20% replacement.
5. The usage of brick and ceramic fine aggregate has some effect on the properties of concrete in decrement manner.
6. Brick and tile powder as fine aggregate has more influences on the concrete.
7. The addition of brick and tile powder improves the mechanical properties of concrete.

REFERENCES

[1] S. Anisha, R. Mathimalar, M. Ponni, ‘Partial replacement of fine aggregate by using spent brick waste’, International Journals of Advances

Research and Innovative Ideas in Education, ISSN(O)-2395-4396, Volume-5, Issue-2 2019.

[2] Manoj Kumar, Awadhesh Chandramauli, Ashutosh, 'Partial replacement of fine aggregate of fire bricks with fine aggregate in concrete', International of civil engineering and technology, Volume-9, Issue-3 March 2018.

[3] Anayat Ali Allaic, 'Partial replacement of fine aggregate with brick dust', International journal of technology Innovation in Modern Engineering, e-ISSN:2455-2585, Volume-5, Issue 4 April 2019.

[4] Duaa Jabbar Abdullah, Assist prof. Zenna K Abbas, Dr. Suhair Kadhem, 'Some properties of concrete containing waste brick as partial replacement of coarse aggregate and addition of nano brick powder', International Journals of Advances Research and Innovative Ideas in Education.

[5] Akash Agarwal, 'Utilization of ceramic waste as a partial replacement of aggregates and its effect on variation of expenditure', International Journal of Engineering Research, ISSN: 2321-7758, Volume 5, Issue 3 2017.

[6] Saswat Hota, Vikas Srivastava, 'Partial replacement of fine aggregate with ceramic waste and Demolition waste in rigid pavement', International Journal of Innovation Research in Science, Engineering and Technology, ISSNl2319-8753, Volume 5, Issue 8 August 2016.

[7] Gopinadan Dey and Joyanta Pal (2013), 'Use of brick Aggregate in standard concrete and its performances in Elevated Temperature', International journal of Engineering and Technology, Vol.5, No 4, August 2013.

[8] Chandana S, Katakam B.K, Saha, 'A Study of sustainable industrial waste material as partial replacement of cement'. International Association of computer science and information technology. Volume 28, page 161-166.

[9] IS 10262:2009, Guidelines for concrete mix design proportioning, Bureau of Indian Standard, New Delhi.

[10] IS: 516-1959, Methods of tests of strength of concrete, Bureau of Indian Standard, New Delhi.