JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

EXPERIMENTAL STUDY ON M25 GRADE OF CONCRETE WITH PARTIAL REPLACEMENT OF COARSE AGGREGATE BY WASTE CERAMIC TILES

Er. Urfi Khatoon, Shashank Shekhar Pandey, Prashant Kumar Goyal, Shakti Singh, Sajjad Ahmad, Vikash Maurya

BTECH students, Department Civil Engineering, Kipm college of engineering and technology, Gorakhpur, Uttar Pradesh, India

ABSTRACT

The primary goal of this research is to investigate the strength of concrete with ceramic waste as coarse aggregate. Increased construction activity and continued reliance on conventional concrete marking materials are causing material scarcity and higher construction costs. In this study, an attempt was made to determine the viability of ceramic coarse aggregate as a potential substitute for conventional aggregate in concrete. The ceramic industry is recognized for producing significant amounts of calcined clay waste each year. So far, a large portion is used in landfills. Reusing these wastes in concrete could be an option. So, we prefer ceramic waste to improve the strength and stability of concrete.

Natural aggregates have increased tremendously as a result of increased growth and innovation in the construction industry around us, as has the generation of solid waste from structure deconstruction. As a result, studies show that approximately 20-30% of the material produced in tile manufacturing facilities is changed and discarded. Ceramic tile powder, like ceramic tiles, can be used as a fine aggregate or a partial alternative for coarse aggregate. Crushed waste ceramic tiles and crushed waste ceramic tile powder are used as substitutes for coarse and fine aggregates, respectively. 15%, 30%, and 40% of the coarse aggregates were replaced with ceramic waste broken tiles. In addition to the coarse ceramic tiles. A concrete grade called M25 was designed and tested. Mix design for numerous kinds.

Workability, compressive strength, split tensile strength, and flexural strength tests were performed on various concrete mixes containing varied percentages of trash crushed after 7, 14, and 28 days of curing. It has been discovered that replacing more shattered tiles enhances workability. Ceramic coarse tile aggregate increases concrete strength by up to 30%.

I. INRODUCTION

Earthenware materials are being used in tiles, clean fittings, and electrical items such as separators. Transformers were assembled using this separator bush. The amount of ceramic waste generated by businesses is gradually increasing in handling, transportation, and repair due to its delicate nature. compressive quality was unchanged when artistic trash is used primarily to enhance the typical crushed stone course. To reduce the amount of waste earthenware kept in landfills or anywhere else and contribute to the shared resources, recycling the creative Research has been done on using garbage as totals in concrete. The primary objective of This analysis looks at how cement is presented with the ceramics. utter waste. The chambers made of earth are utilized to store enormous as well as medium-sized towns; a significant advancement regarding the assortment, stockpiling and anything else related to the longer - term treatment of local garbage time frame. In line with this, a growing social and political knowledge of natural problems.

1.1 Historical Background

Despite being a relatively new material, high strength concrete has been steadily developing over the years. Concrete with a compressive strength of 34 mpa was regarded as having good strength in the USA in the 1950s. Concrete having a compressive strength of 41–52 mpa was used commercially in the 1960s. Concrete with 62 MPa was created in the early 1970s. However, given the current situation of the globe, concrete with extremely high strength has joined the long-span bridge and high-rise building construction industry during the past fifteen years. IS 456-2000 has considered compressive strength exceeding 110 mpa for use in pre-stressed concrete members and cast-in-place structures. Recent reactive concrete, on the other hand, may have a compressive strength of almost 250 mpa. Materials that are pozzolanic provide complete support. The relationship between the maximum resistance provided by the concrete sample's compressive strength for the application of any kind of load is the first way that high-strength and nominal-strength concrete differ from one another. The Yankee Concrete Institute classified high strength concrete as having a compressive strength of more than 42 mpa, even though there is no precise way to distinguish it from regular strength concrete.

1.2 CONSTRUCTION WASTE IN INDIA

Solid debris from building demolitions is growing daily in the current construction industry. Ceramic tiles are used extensively in current construction projects and are becoming more and more common in the building industry every day. Among the fundamental building materials utilized in the majority of structures are ceramic items. Wall and floor tiles, sanitary ware, home ceramics, and technical ceramics are a few examples of produced ceramics that are often used. They are mostly made from natural materials that are rich in clay minerals. Nevertheless, despite ceramics' decorative advantages, the environment is plagued by several environmental annoyances due to its waste. Additionally, waste tile made from destroyed building trash is produced on the other side. The ceramic sector in India produces 100 million tons of tiles annually, with 15% to 30% of that amount being trash. We chose these waste tiles as a substitute for the basic natural aggregate in order to reuse them and reduce the solid waste generated from construction demolitions. This waste is currently not recycled in any way, but the ceramic waste is strong, long-lasting, and extremely resistant to biological, chemical, and physical degradation forces. Workability tests were performed for several mixtures with varying percentages of these materials in order to analyse the appropriateness of these crushed waste tiles in the concrete mix. When testing the workability of fresh concrete, the slump cone test is utilized. In order to analyse the strength fluctuation by varying percentages of this waste material, compressive strength tests are also carried out using cubes cast after three, seven, and twenty-eight days of curing. The goal of this study is to comprehend how ceramic solid waste behaves and functions in concrete. 10%, 20%, 30%, 40%, and 50% of the coarse aggregate is replaced by waste crushed tiles.

1.3 OBJECTIVE

a) To investigate the differences in the strength properties of concrete produced using different materials.

b) To replace the natural aggregates in concrete with substitute materials.

c) From an environmental perspective, the substitute materials used in concrete are disposed of safely.

II. MATERIALS REQUIRED

2.1 Cement

2.1 Coarse aggregate
2.2 Fine aggregate
2.3 Ceramic tiles waste
2.4 Water

2.1 Cement

The most significant kind of cement is by far ordinary Portland cement (OPC). Depending on the cement's strength after 28 days, the OPC is divided into three grades: 33, 43, and 53. Cement is referred to as 33 grades, 43 grade, or 53 grade if its 28-day strength is at least 33 N/mm2, 43 N/mm2, and 53 N/mm2, respectively.

Fig.(a): Cement

2.2 Coarse Aggregates

Aggregate larger than 4.75 mm is referred to as coarse aggregate. The original bed rocks contain it. Coarse aggregate comes in a variety of shapes, including spherical, flaky, angular, irregular, or partially rounded. There should be very little dirt present, and it should be free of any organic contaminants.

Fig.(b): Coarse Aggregate

2.3 Fine Aggregate

An aggregate is deemed fine if its size is smaller than 4.75 mm. The granules of sand should be firm and long-lasting, and free of clay or other inorganic components.

2.4 Ceramic Tiles Wastes

Clay is used to make ceramic tiles. The waste from ceramic tiles is strong, resilient, and impervious to physical, chemical, and biological deterioration. These materials' qualities make them an excellent and appropriate option for usage in concrete. Utilizing leftover ceramic tiles in concrete improves the qualities of both fresh and hardened concrete, saves money, and addresses some disposal issues. In concrete, these leftover ceramic tiles are used in place of coarse particles.

Waste tile less than 4.75 mm was not taken into consideration. Crushed tile aggregate that has been kept on a 12 mm sieve after passing through a 16.5 mm filter is employed. In addition to replacing fine aggregate, they were used to partially replace coarse aggregate in percentages of 15%, 25%, 30%, and 35%.

Fig.(c): Ceramic Tiles

III. RESULTS AND DISCUSSION

3.1 WORKABILITY TEST

The quantity of beneficial internal labour needed to completely compact the concrete without bleeding or segregating the final product is a measure of the fresh concrete's quality. One of the physical characteristics of concrete that influences its strength, durability, labour costs, and final product appearance is workability. When concrete is simply put and compacted uniformly that is, without bleeding or segregation, it is considered to be workable. Compaction of unworkable concrete requires more labour; also, completed concrete may exhibit honeycombs or pockets.

3.1.1. Slump Cone Test

Fresh concrete that had been prepared prior to the moulding process was subjected to the slump cone test.

Five different concrete mixtures are made at various periods.

Workability Table 1 displays the results of the slump one test for concrete of M25 grade.

Table 1: Test result for slump cone test

Mix Designation	% Replacement	Workability(mm) M25
M0	0	60
M1	15	65
M2	25	70
M3	30	73
M4	35	78

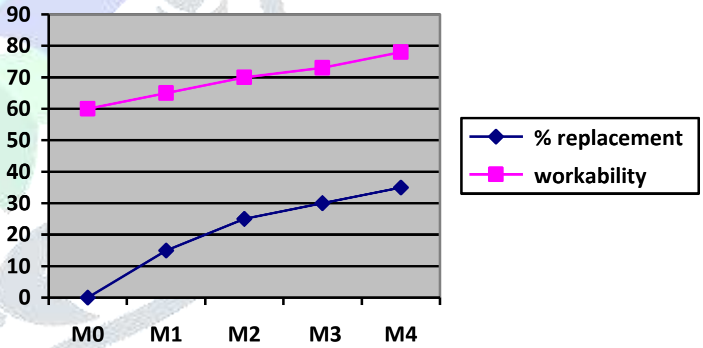

Fig.(d): Workability Test

Fig.(e): Slump cone test

3.1.2. Compaction Factor Test

The compaction factor test was performed on 5 different concrete mix proportions. The results gathered from the compaction factor test regarding the workability of various mixes of M25 grade concrete replacements are presented in the following table.

From this outcome, it was noted that the compactio-n factor of the concrete mix design rises gradually

by 2.5%, 5.4%, 6.8%, and 7.5% at M1, M2, M3, and M4 for M25 grade concrete. Thus, the workabil -ity observed from the slump cone and compaction factor tests are consistently increasing.
Workability improves with a rise in the quantity of waste ceramic coarse tile aggregates.

Fig.(f): Compaction Factor test

Table 2: Test results for compaction test

Mix Designation	% replacement	Compaction factor M25
M0	0	0.80
M1	15	0.85
M2	25	0.85
M3	30	0.87
M4	35	0.88

The workability of M25 grade concrete, assessed through the compaction factor test, resembles that of the slump cone test. The trend of increase for the mixes is quite similar, which will be elaborated on in detail later.

3.2 COMPRESSIVE STRENGTH TEST

The compressive strength of concrete was assessed to determine its strength. A total of 5 cubes measuri ng 150 x 150 x 150 mm were cast and tested at inter vals of 7 days, 14 days, and 28 days, using 4 cubes specimens for each interval following the workabili ty tests. The results are presented in the table below.

Table 3: Compressive strength results of M25 grade of concrete for 7 days,14 days and 28 days

Mix Designation	% replacement	Compressive strength N/mm2		
		7 days	14 days	28 days
M0	0	20.56	28.50	32.00
M1	15	25.03	30.99	35.00
M2	25	28.00	37.06	42.89
M3	30	28.04	37.09	43.31
M4	35	26.10	35.15	38.18

- 17.18%, 34.50%, 36.40% and 25.08% for M 1, M2, M3 and M4 concrete mix design for M25 grade compressive strength after 7days.
- Compressive strength shows increases at certain points while also decreasing at a level of 10%, 31.25%, 32.15% and 8.01% for M1, M2, M3 and M4 M25 grade concrete at 14 days.
- The compressive strength of the M25 grade concrete design fluctuates; at certain points it rises, while at others it falls for 28 days, showing 10.10%, 28.9%, 30% and 15.24% for M1, M2, M3 and M4.
- On comparing the strengths of all mixes, M3 has the highest i.e., 30% replacement of coarse aggregate.

Fig.*(g)*. Compressive strength Test

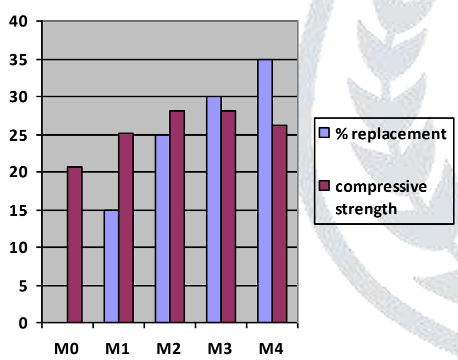

Fig.(h). Compressive strength after 7 days

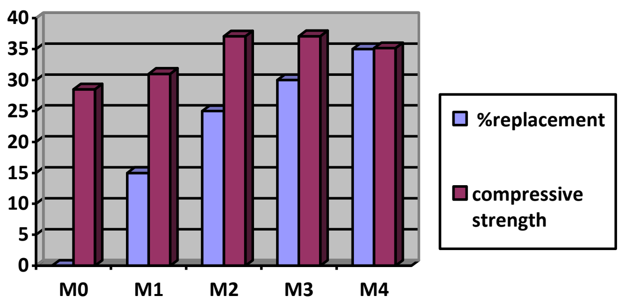

Fig.(i). Compressive strength after 14 days

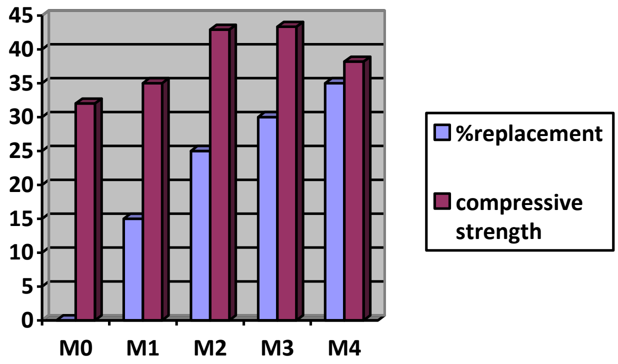

Fig.(j). Compressive strength after 28 days

The outcomes derived from compression testing pro vide a detailed result of the project, as substituting t ile aggregates yields concrete with appropriate char acteristics similar to conventional.

IV. SUMMARY AND CONCLUSION

The primary aim of the research is to develop a con crete that is significantly more stable and long-lasting compared to the traditional mix by substituti ng coarse aggregates. Mix designs for all the materi al replacements have been created and evaluated in terms of strength assessment, and comparisons have also been made.

The ensuing dedications are derived from the empir ical studies on compressive resilience, split tensile r esilience, and bending durability, taking into accou nt the environmental considerations as well:

- The efficiency of concrete improves as the p roportion of tile aggregate substitution rises
- The compressive strength of concrete shows an initial increase when coarse aggregate is replaced with ceramic tile aggregate up to 30%, after which the compressive strength declines with further coarse aggregate replacement due to a reduction in cohesion and workability of the mix.
- The properties of concrete demonstrate a lin ear enhancement with ceramic aggregate replacement up to 30%, followed by a linear decrease thereafter.

- The M2 concrete mix achieved superior results in terms of compressive strength to other mixes. However, mixes containing up to 30% of ceramic coarse aggregate are still viable.

V. FUTURE SCOPE

The potential for research in incorporating recycled aggregates into concrete, particularly those derived from ceramic tile waste, is vast moving forward. Several prospective research avenues that could be explored are listed below:

Ceramic tile waste serves beneficial purpose for flooring in the construction sector.

Ceramic refuse can be easily repurposed and is a cost-effective aggregate for building purposes, which would otherwise be considered entirely waste if not recycled.

A study into the properties of concrete that integrate s a combination of recycled aggregate and tile aggre gate in different proportions can be carried out to en hance the concrete's qualities and also to reduce pol lution or waste production in the building industry. Ceramic tiles have substantial compressive strength rendering them useful for construction.

Incorporating ceramic tile aggregate in concrete enables the assessment of physical characteristics such as durability, permeability, etc., to develop a concrete that is more advantageous than convention -al concrete.

The mechanical properties of concrete that includes marble aggregate "waste" from either manufacturin-g operations or construction demolition can be inve-stigated to improve attributes like permeability; sound resistance can also be examined.

REFERENCES

- Aruna D, Rajendra Prabhu, Subhash C Yaragal, Katta VenkataramanaIJRET: eISSN: 2311163 pISSN: 2321-7308.
- Partial replacement of aggregate with ceramic tile in concrete. SAI CHAND, JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA, vol.5., issue.3, 2017may-june
- PARTIAL REPLACEMENT OF AGGREGATE WITHCERAMIC TILE IN CONCRETE, Amanpreet Sing, Department of Civil Engineering, Guru Kashi University, Talwandi Sabo, Bathinda, Punjab, India, Volume VIII, Issue II, February/2019
- Partial Replacement of Aggregates with Ceramic Tiles and Rebutted Tyre Waste in Concrete, P.Ramanaid , PACE Institute of technology India, Volume 5Issue 3, May-Jun 2018
- Effect of Waste Ceramic Tiles in Partial Replacement of Coarse and Fine Aggregate of Concrete, Hemanth Kumar Ch1,Ananda RamakrishnaK2, Sateesh BabuK3, GuravaiahT4, NaveenN5, JaniSk6, Rajiv Gandhi University of Knowledge Technologies, Nuzvid, AP, India.

IS Codes

- IS: 10262-2019: Concrete Mix Proportioning guidelines, Bureau of Indian Standards, New Delhi
- IS 456-2000: Plain and reinforced concrete code of practice, Bureau of Indian Standards, New Delhi.

Book

- M.L Gambhir, Editor, “Concrete Technology”, McGraw Hill Education Private Limited Publishers, India, (2013).
- M.S Shetty, Editor, “Concrete Technology Theory and Practice”, S. Chand Publishers, India, 2008

BIOGRAPHIES

1. Sayed Tabish Quadri, Assistant professor,

Department of Civil Engineering, GNIOT,

Greater Noida, India

2. Priyanka Kusum, Student,

Department of Civil Engineering, GNIOT,

Greater Noida, India