|| Volume 8 || Issue 10 || October 2024 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH AND ENGINEERING TRENDS

EXPERIMENTAL INVESTIGATION ON METAKAOLIN AS A PARTIAL REPLACEMENT OF CEMENT

Kapil Bhargava[1] Mahroof Ahmed[2]
M.Tech Scholar, Department of Civil Engineering, Sushila Devi Bansal College of Engineering Indore[1]
Assistant Professor, Department of Civil Engineering, Sushila Devi Bansal College of Engineering Indore[2]

Abstract: **The most generally utilized material for building is concrete. Attributable to the way that 1990 yield of concrete outcomes in a great deal of ecological outflows since it includes the arrival of CO2 carbon, the worldwide creation of concrete has aggregated considerably .In late years, extra concrete elective materials, for example, silicon oxide gases, fly debris, slag, Rice Husk Ash and Metakaolin have been utilized as concrete elective material for expanding HSC with improved usefulness, energy and life span with decreased permeability. From the most recent examination works misusing Metakaolin, metakaolin is a dehydroxylated aluminum silicate, it is obvious that it is a completely profitable pozzolanic fabric and supplements the force boundaries of cement correctly. The popular development in concrete is that of high generally execution concrete (HPC). It is profoundly respected and is utilized in numerous esteemed ventures, for example, atomic force projects, flyovers, multi-story homes, and so forth. Exploration on the fractional replacement of concrete with metakaolin as a totally uncommon portion of HPC for M80 Integrate Grade is finished in this theory report. Metakaolin had replacement levels of 0%, 5%, 10%, 15%, and 20 percent (utilizing weight). The discoveries acquired are diverged from conventional examples (compressive strength, split rigidity, flexural strength, sturdiness).**

Keywords: *Rice Husk, Slag, Fly Debris, Silicon oxide, Metakaolin and Compresssive Strength.*

I.INTRODUCTION:

Concrete is a most commonly used building material which is a mixture of cement, sand, coarse aggregate and water. It is used for construction of multi-storey buildings, dams, road pavement, tanks, offshore structures, canal lining. The method of selecting appropriate ingredients of concrete and determining their relative amount with the intention of producing a concrete of the necessary strength durability and workability as efficiently as possible is termed the concrete mix design. The compressive strength of harden concrete is commonly considered to be an index of its extra properties depends upon a lot of factors e.g. worth and amount of cement water and aggregates batching and mixing placing compaction and curing. The cost of concrete prepared by the cost of materials plant and labour the variation in the cost of material begin from the information that the cement is numerous times costly than the aggregates thus the intent is to produce a mix as feasible from the practical point of view the rich mixes may lead to high shrinkage and crack in the structural concrete and to development of high heat of hydration is mass concrete which may cause cracking. The genuine cost of concrete is related to cost of materials essential for produce a minimum mean strength called characteristic strength that is specific by designer of the structures. This depends on the quality control measures but there is no doubt that quality control add to the cost of concrete.

Composition of Concrete: There are four basic ingredients within the concrete mix:

1. Binding materials like cement or lime
2. Aggregates or Inert Materials

i) Fine aggregate (sand)

ii) Coarse aggregate (stone chips, brick chips)

3. Water
4. Admixture

The formula for producing concrete from its ingredients can be presented in the following equation:

Concrete = Cement + Fine & Coarse Aggregate +Water+ Admixture (Optional)

Truss bridge: In this type of bridge small beams are joined together to carry large amount of loads.

II.OBJECTIVE

The objective of this research is as follows:

1. To review the modeling of the bridge using CSI-BRIDGE 2000 (software) and establish an object based modeling approach. It assigns bridge composition as an assembly of objects.
2. Application of load and its combination to further analyze the bending moment and shear force. Software gives different building code (AASTHO, IRC), by using those vehicle, wind, seismic loading can be calculated.
3. To determine all the variables of design, construction and material relative to the basic structural calculations.

III. LITERATURE REVIEW

- Egwuonwu, William, C {2019}: This investigation work examines the cementitious efficiency of metakaolin, a supplementary cementitious materials (SCM) in the production of high strength concrete. The mix design was carried out using the Absolute Volume method. The metakaolin was used to replace cement at 2.5%, 5%, 7.5% and 10% at various water/cementitious ratios of 0.20, 0.25, 0.30 and 0.35. For all mixes, control mix was designed to establish a comparative basis between mixture blended with Mk and ordinary cement concrete. The super plasticizer was also kept constant in all mixes. water-cementitious ratio and curing ages and the response variables (compressive strengths).
- Venu Malagavelli {2018}: They reviewed on the supplementary materials in the concrete. In this investigation, supplementary materials like metakaolin has been used in the concrete. Concrete having compressive strength 35 MPa is used in the experimental investigation. Mechanical properties like compressive

Strength, split tensile strength and flexural strengths are compared with modified concrete. Apart from that, the modified concrete has been evaluated using non-destructive tests like rebound hammer and ultrasonic pulse velocity. Also a relationship developed between the compressive strength and non-destructive tests. Based on the results, the performance of modified concrete is better than the normal concrete.

- O.Pavithra {2017}: The use of quartz sand as partial replacement of fine aggregate and metakaolin as partial replacement of cement is an economical solution for making the concrete resistant to weathering e.t.c., Experimental work was carried out to investigate the effect of Metakaolin and quartz sand by partial replacement of cement and sand respectively and keeping same water cement ratio. Making 10% partial replacement of cement with metakaolin as constant and 25%, 50% and 75% quartz sand is made partial replacement of fine aggregate

- Sunny A. Jagtap1 et.al {2017}: In this investigation researches are ongoing for the replacement of Portland cement, using many waste materials like fly ash and GGBS. Like Fly ash and GGBS a Metakaolin can also use as a binder with the partial replacement of cement which take some part of reaction at the time of hydration reaction. Cement replacement by glass powder in the range 5% to 25% with an interval of 5% is to be study..

IV. METHODOLOGY

As Cement is halfway supplanted by metakaolin, so in first phase of work 5 batches of various proportions of binders are arranged and cubes, beams 7 cylinders are casted. Results acquired were examined and extent that gave ideal qualities is taken for the following stage.

3.2 Tests on Cement:

3.2.1 Fineness

3.2.2 Consistency

3.2.3 Initial & Final Setting Time of Cement

3.2.1.Fineness test for cement (IS 4031 (Part 1) : 1996)

To determine the fineness of cement by dry sieving 90-micron IS sieve as per IS: 4031 (Part 1)– 1996. Principle of this work is that we find out the percentage of cement whose grain Size is better than specified mesh size.9

Tests on Hardened Concrete for M-20 Concrete

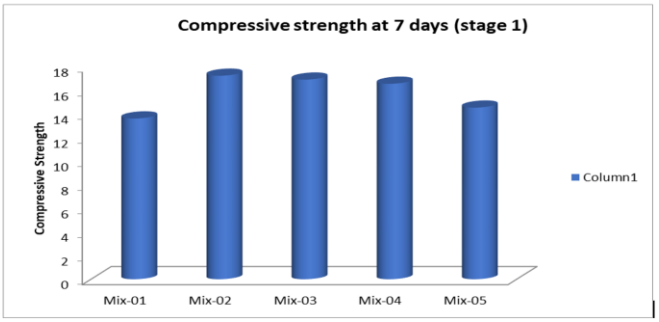
5.2.1 COMPRESSIVE STRENGTH TEST RESULT

A minimum of three cubes are casted in each batch mix for determining compressive strength. Tests are performed at the age of 7 days, 14 days & 28 days of the specimens. Specimens are placed in the test machine as per IS: 516-1959 clause no 5.5.1 page no 11, also loading is applied on the specimen as per the same IS code

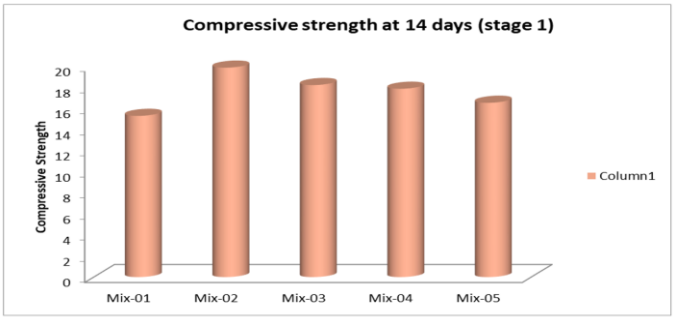
Table: Variation of compressive strength with age (M-20 Concrete)

% of MK	0%	5%	10%	15%	20%
7 Days	13.61 N/mm^2	17.23 N/mm^2	16.90 N/mm^2	16.55 N/mm^2	14.53 N/mm^2
14 Days	15.28 N/mm2	19.85 N/mm2	18.20 N/mm2	17.85 N/mm2	16.52 N/mm2
28 Days	25.59 N/mm^2	29.96 N/mm^2	28.67 N/mm^2	28.17 N/mm^2	27.36 N/mm^2

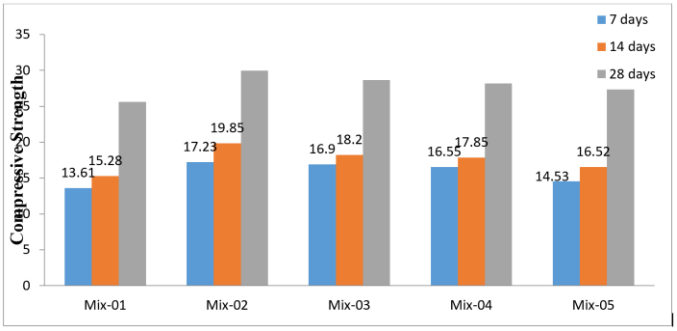
Following Graphs have been prepared for compressive strength



Graph:1. Compressive Strength at 7 days (Stage-1)



Graph:2 Compressive Strength at 14 days



Graph:4 Compressive Strength in N/mm2 at Various age (days) (Stage-1)

V. CONCLUSION

Compressive strength, Flexural strength, Split tensile strength of concrete Mixes made with and without metakaolin has been determined at 7, 14 & 28 days of curing. The strength gained has been determined of metakaolin added concrete with addition of 5%, 10%, 10%,15%, 20% for M20 & M25 grade as a partial replacement of cement in conventional concrete. From the results it is conclude that the metakaolin is a superior replacement of cement. The rate

of strength increase in metakaolin concrete is high. After performing all the tests and analyzing their result, the **following conclusions have been derived:**

1.The results achieved from the existing study shows that metakaolin is great potential for the utilization in concrete as replacement of cement.

2.Workability of concrete decreases as proportion of metakaolin increases.

3 Maximum compressive strength for M20 concrete was observed when metakaolin replacement is about 5%.

4.Maximum split tensile strength for M20 was observed when metakaolin replacement is about 10%.

5.Maximum flexural strength for M20 was observed when metakaolin replacement is about 10%.

6 Maximum compressive strength for M25 concrete was observed when metakaolin replacement is about 5%.

7.Maximum split tensile strength for M25 was observed when metakaolin replacement is about 10%.

8.Maximum flexural strength for M25 was observed when metakaolin replacement is about 15%.

VI REFERENCES

- Egwuonwu, William, C.#1, Iboroma, Z.S Akobo#2 Barisua E. Ngekpe#3 (2019): Effect of Metakaolin as a Partial Replacement for Cement on the Compressive Strength of High Strength Concrete at Varying Water/Binder Ratios SSRG International Journal of Civil Engineering
- (SSRG – IJCE) – Volume 6 Issue 1 – January 2019.Venu Malagavelli, Srinivas Angadi and J S R Prasad: INFLUENCE OF METAKAOLIN IN CONCRETE AS PARTIAL REPLACEMENT OF CEMENT International Journal of Civil Engineering and Technology (IJCIET) Volume 9, Issue 7, July 2018, pp. 105–111, ISSN Print: 0976-6308 and ISSN Online: 0976-6316.
- O. Pavithra*, D. Gayathri**, T. Naresh Kumar: Experimental Analysis on Concrete with Partial Replacement of Cement with Metakaolin and Fine Aggregate with Quartz Sand International Journal of Advance Engineering and Research Development Volume 4, Issue 12, December -2017 e-ISSN (O): 2348-4470 p-ISSN (P): 2348-6406