



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 2, February 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

9940 572 462

6381 907 438

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An Experimental Study on Strength and Durability Properties of High Strength Fibrous Light Weight Aggregate Concrete Using Mineral Admixtures, Pumice Aggregate

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ABSTRACT: Light weight total cement can be characterized by a kind of solid which remembers an extending specialist for that expands the volume of the blend while giving the extra amounts, for example, proability and less finished dead weight. It is lighter than the ordinary cement. The fundamental strengths of light total cement are its low thickness and warm conductivity. The utilization of light weight concrete decreases oneself weight and assists with building bigger precast units. In this analysis we are going to examine the Mechanical Properties of a light weight total cement M70 utilizing the regular light weight total pumice stone as a substitution to coarse total (0%,10%, 20%, 30%, 40% and half) and expansion of mineral admixture materials Silica smoke, Metakaolin and steel filaments. For this reason alongside a Control Mix, 18 sets are set up to examination the compressive quality, rigidity and flexural quality. Each set includes 9 3D shapes, 9 chambers and 9 Beams. 7, 14 and 28-days Compressive test, Tensile Strength and Flexural Strength tests are to be acted in the solidified state. The test outcomes are appeared on generally speaking quality properties in different path. Along these lines, the quality properties of M70 concrete were considered.

KEYWORDS: Silica Fume, Metakaolin, Light Weight Aggregate, Pumice Stone, Mechanical Properties, Master Grecian, Steel fibres

I. INTRODUCTION

Lightweight concrete have been used as improvement materials since the hours of the Roman Empire. The most dependable sorts of lightweight concrete were made by using Grecian and Italian pumice as lightweight sums. Progressions in lightweight strong creation started in the twentieth century. The standard solid concrete is a mind-boggling material having a thickness of 2696Kg/m³. The dead weight of the structure contained this strong is gigantic stood out from the constrained weight to be passed on, and a for the most part little abatement in dead weight, particularly for people in flexure ex. in raised structures, can put aside trade and work out turn of events.

Light weight aggregates: Light Weight Aggregates might be assembled in the accompanying classes: (i) Naturally happening materials which require further handling, for example, extended dirt, shale and record, vermiculite and so on., (ii) Industrial results, for example, sintered pounded fuel debris (fly debris), frothed or extended impact heater slag, hematite and so forth., (iii)Naturally happening materials, for example, pumice, frothed magma, volcanic tuff and permeable lime stone.

The essential utilization of light weight concrete is to decrease the dead heap of a solid structure, which at that point permits the basic fashioner to diminish the size of sections, footings and other burden bearing components. The light weight solid blends can be intended to accomplish comparable qualities as typical weight concrete. The equivalent is valid for other mechanical and toughness execution prerequisites. Auxiliary light weight concrete gives more effective solidarity to weight proportion in basic components

The porosity of light weight total gives a wellspring of water to inside restoring of the solid that gives proceeded with upgrade of solid quality and sturdiness. This doesn't block the requirement for outer restoring. Basic light weight concrete has been utilized for connect decks, wharfs, shafts, sections . Light weight cement can be made with a blend of fine and coarse light weight total or coarse light weight total and typical weight fine total.

Complete substitution of ordinary weight fine total with a less weight total will diminish the solid thickness by roughly 160Kg/m³. Originators perceive that auxiliary light weight solid won't commonly serve in a stove dry condition. In this

way, basic plan for the most part depends on a balance thickness (a few times alluded to as airdry thickness) the condition where some dampness is held inside the light weight concrete.

II. LITERATURE REVIEW

1. Rajeswari et al., "Exploratory Study of less weight cement concrete: This examination is engaged to decide the quality boundaries of light weight total cement to discover which blend is ideal. The outcomes are contrasted and customary cement. Pressure quality worth is contrasted with typical cement for various substitution of Coarse total by Pumice are half, 60%, and 70%. Most extreme estimation of solidarity is gotten in 60% supplanting of Pumice with coarse total. This sort of cement can be used in divider boards of non load bearing sort for use in precast structures.

2. M.VENKATESAN "Quality Characteristics and Durability Characteristics of Silica smoke and Metakaolin based Concrete. This undertaking manages the properties of cement, with shifting rate substitution of Silica smoke and Metakaolin as a fractional swap for concrete. The blend was gotten by supplanting (35%, 15%); (40%, 10%) and (45%, 5%) mass of concrete by Silica smoke and Metakaolin separately. At last required examples were casted to examine the practices, for example, compressive quality, rigidity and sturdiness. Compressive quality and split pliable test were done for testing the quality properties is directed to check the sturdiness properties of cement. The test outcomes showed that the two admixtures Silica smoke and Metakaolin when utilized at an ideal blend will in general increment the quality and solidness of solid when contrasted and ordinary cement.

3. Geoffrey, et al., "Properties of Pumice Lightweight Aggregate. The properties of volcanic pumice light weight totals got from long not in Mai Mahiu zone in Kenya were tentatively examined and this examination presents the exploratory aftereffects of the examination. Three examples of the lightweight totals were researched and their properties contrasted and those of the ordinary typical total. Further that the solid delivered can securely be utilized for the development of household houses, where burdens are light and high quality isn't required. The pumice totals accessible in this nation can possibly deliver economically low lightweight cement.

III. EXPERIMENTAL INVESTIGATION

The exploratory examination incorporates projecting and testing of 18 sets alongside control blend. Each set includes 9 solid shapes, 9 chambers and 9 bars for deciding compressive, ductile and flexural qualities individually. Pumice stone is utilized in the examination with various rates a fractional substitution to characteristic weight coarse total alongside the shifting rates of the distinctive mineral admixtures like Silica Fume and Metakaolin with likewise utilizing the super plasticizer ace Glanium. 3D square segment measurement is of 15cm x 15cm x 15cm, chamber area measurement is 15cm x 30cm and crystal measurement is 50cm x 10cm x 10cm. The molds are applied with a grease before setting the solid. Following a day of projecting, the molds are evacuated.

Materials

The materials used in this study are given below: 1. Cement (Ultra-tech gold OPC 53 grade) 2. Fine Aggregate 3. Normal Weight Coarse Aggregate 4. Pumice Stone (Light Weight Coarse Aggregate) 5. Water 6. Metakaolin 7. Silica Fume 8. Master Glenium SKY 8630 9. Steel fibers

3.2 Material properties 3.2.1 Cement The concrete utilized was locally accessible brand of Ultra-tech gold (conventional Portland concrete) of 53-grade adjusting to IS 12269. The concrete ought to be new and of uniform consistency. Where there is proof of protuberances or any unfamiliar issue in the material, it ought not be utilized. The concrete ought to be put away under dry conditions and for as brief term as could be expected under the circumstances. Concrete is the principle fixing in assembling of cement.

Concrete can be characterized as a holding material that has strong and cement properties which makes it competent to join with various development materials in shaping a compacted material. Portland concrete is one of the most broadly utilized sorts of Portland concretes.

. Other crude materials may incorporate shale, shells and modern results.

The compound piece of concrete is as per the following:

Blend structure each set having various mixes are done by utilizing IS: 10262 - 2009 strategy. The blend extent acquired for typical M70 grade concrete is 1:1.331:2.172 with a water-concrete proportion of 0.30



Objective:

The primary objects of solid blend configuration are:

- 1.To assume the specified less quality and toughness
- 2.To strong the solid in the best conservative way

- Structure of solid blend requires total information on the different properties of the constituent materials, the suggestion the effect of properties of plastic cement on the solidified concrete and muddled between connection between the factors
- The point blending is to mix the entirety of the elements of the solid to shape a uniform mass and to cover the outside of totals with concrete glue. Hard to choose water/concrete proportion because of variable water assimilation by totals which is commonly done by preliminary blending.
- Pre-immersion of totals is done to maintain a strategic distance from unreasonable ingestion of water by totals.
- Concrete immersed totals will have higher thickness, which is awful in freezing and defrosting activity.
- The uncommon case, totals covered with bitumen to beat the water assimilation issue.

Indian Standard Method of MixDesign

Bureau of Indian standards, recommended a set of procedure for design of Concrete mix mainly based on the work done in national laboratories.

Mix of concrete	: M70
Method used	: BIS of Mix Design
W/c ratio	: 0.30
Maximum size of aggregate	: 20mm
Specific weight of cement S_c	: 3.12
Specific weight of fine aggregate S_{fa}	: 2.62
Specific weight of coarse aggregate S_{ca}	: 2.87
Water content	: 160 lit

From Codebook IS 10262-2009

Target Compressive strength: $f_{ck}^* = f_{ck} + 1.65S$

Where,

f_{ck} = Characteristic Compressive strength at 28 days

S=Standard deviation, for M70 grade $S=5N/mm^2$.

Step 1:

Target compressive strength $= 70 + 5(1.65) = 78.25 N/mm^2$.

Volume of coarse aggregate corresponding to 20 mm size aggregate and fine aggregate

Step 2:

For water cement ratio of 0.5= as the water cement ratio is lower by 0.1,the proportion of coarse aggregate is increased by 0.02 so for water cement ratio 0.30, the volume of coarse aggregate is 0.66

Volume of fine aggregate is $= 1 - 0.66 = 0.34$

The performing slump cone test for this mix proportion, the slump obtained is 28 mm From water- cement ratio,

Cement content = $160/0.30$

$= 533 kg/m^3$



Step 3:

- a) Volume of cement = $Wt \text{ of cement} / (\text{Sp gravity of cement} \times 1000) = 0.169 \text{ m}^3$
- b) Volume of water = 0.16 m^3
- c) Volume of chemical add mixture = 0.00425 m^3
- d) Volume of all aggregates = $1 - (\text{volume of cement} + \text{volume of water}) = 0.6668 \text{ m}^3$

Mass of coarse aggregate = $\text{volume of aggregate} \times \text{volume of coarse aggregate} \times \text{specific gravity of coarse aggregate} \times 1000 = 1157.56 \text{ kg/m}^3$

Mass of fine aggregate = $\text{Volume of aggregate} \times \text{Volume of fine aggregate} \times \text{specific Gravity of fine aggregate} \times 1000 = 709.48 \text{ kg/m}^3$

IV. TEST RESULTS AND DISCUSSIONS

The investigation has been made to assess the impact on mechanical properties of M70 grade concrete made with expansion of concrete with Silica Fume (SF) (0%, 1%, 1.5%, 2% and 2.5%) and Metakaolin, (0.5%, 1%, 1.5%, and 2%) and the supplanting of coarse total with pumice stone in various rates (10%, 20%, 30%, 40% and half) alongside expansion of steel strands in various rates. The point by point organizations and diagrams are introduced as follows.

Table: Test Results for various percentages of mineral admixtures

Design mix	Compressive strength(N/mm ²)		
	7 days	14Days	28days
M ₀	53.08	77.56	79.395
M ₁	54.25	77.97	80.062
M ₂	56.01	78.47	80.781
M ₃	57.25	78.78	81.291
M ₄	50.70	68.37	75.57
M ₅	51.84	72.67	78.85
M ₆	45.89	67.34	72.64
M ₇	40.09	62.09	80.69

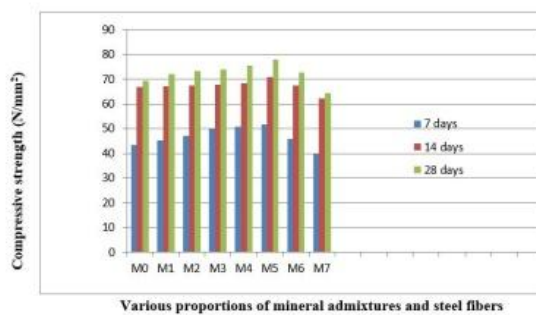


Fig: Compressive Strength for various percentages of Silica Fume, Metakaolin and steel fibers

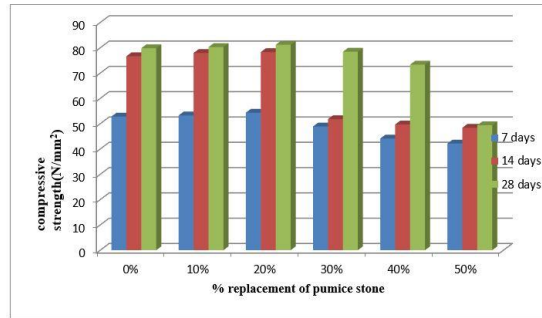


Fig: Showing compressive strengths for various percentages of pumice stone

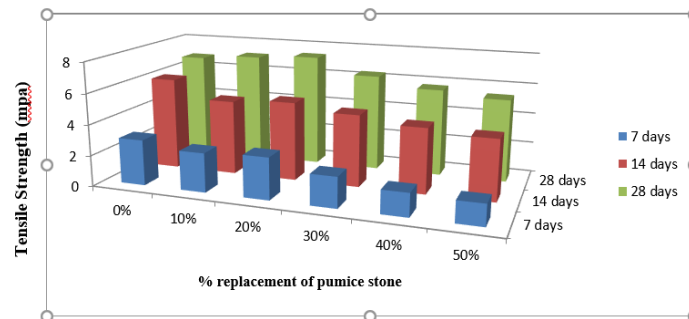


Fig: Graph showing Tensile strengths for various percentages of pumice stone

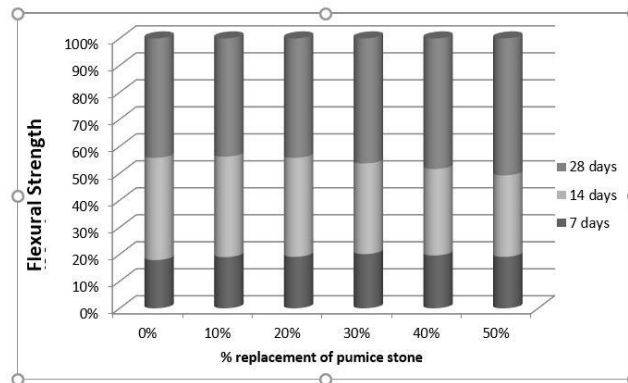


Fig: Graph showing Flexural strengths for various percentages of pumice stone

% replacement of pumice	Weight of cubes	Compressive Strength(Mpa)		
		7days	14 days	28days
0	8.4 kg	53.08	77.56	79.395
10	8.5kg	51.30	74.96	77.28
20	8.02kg	50.73	72.78	70.35
30	7.85kg	48.78	69.95	65.05
40	7.4kg	46.70	65.36	62.35
50	6.96kg	43.44	63.89	60.47

Table: Natural aggregate granite is replaced light weight aggregate pumice for conventional concrete mix.

V. PHOTOGRAPHY



Fig: Mixing of concrete mix, Casting moulds and curing the specimens, Compressive strength of cubes

VI. CONCLUSIONS

In view of the investigation of trial results and conversation there upon the accompanying ends can be drawn:

- Addition of 1.5% Silica Fume and 1.0% Metakaolin and steel filaments 1% to M70 Conventional solid blend, there is an expansion in compressive quality up to 21.3% over ordinary cement.
- Up to 20% supplanting of coarse total with light weight total, the advanced ordinary cement has great compressive quality and quality outcomes are promising up to 30% substitution.
- Split Tensile Strength increments by 16.5% with expansion of 1.5% Silica Fume and 1.0% Metakaolin and steel filaments 1% to M70 Conventional cement.
- Up to 20% supplanting of coarse total with light weight total, the streamlined traditional cement has great Split Tensile Strength and quality outcomes are promising up to 30% substitution.



- Flexural quality increments by 25% with expansion of 1.5% Silica Fume and 1.0% Metakaolin and 1% steel strands to M70 Conventional cement.
- Up to 20% supplanting of coarse total with light weight total, the advanced ordinary cement has great Flexural Strength and quality outcomes are promising upto 30% substitution.
- Though it's anything but a light weight concrete the thickness of cement is decreased by 18.69% for promising quality outcomes.
- Light weight total substitution to the rock coarse total is acceptable upto 10% for regular solid blend and 20% for streamlined ordinary solid blend.
- Light weight total substitution to the rock coarse total is promising upto 20% for regular solid blend and 30% for streamlined ordinary solid blend.
- Durability test results shows there is decrease in quality by 14.04% when course total is supplanted with pumice stone.
- Durability test results show a distinction of 2.46% when contrasted with H₂SO₄ and HCL arrangements.

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