Pakistan Journal of Engineering and Technology, PakJET
Multidisciplinary & Peer Reviewed
Volume: 4, Number: 3, Pages: 27- 30, Year: 2021

Partial Replacement of Coarse Aggregate by Using Pumice Aggregate in Lightweight Concrete-Experimental Investigation

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Abstract- **Lightweight cement has numerous applications in the substantial and development industry these days. Lightweight substantial offers plan adaptability and significant expense investment funds by giving less dead burden, works on seismic underlying reaction, better fire rating, diminished story tallness, more modest size primary individuals, lower establishment cost, and less supporting steel. In this investigation, an endeavor has been made to think about the regular concrete and lightweight total substantial utilizing blend M25. Lightweight cement is made by Partial Replacement of Coarse Aggregate with various proportions of Pumice going from half, 60%, and 70%. This investigation is engaged to decide the strength boundaries of lightweight total cement to track down a great supplanting with the previously mentioned substitutions. The outcomes are contrasted and regular cement.**
***Index Terms*— Pumice, Concrete, Aggregate, Light Weight Concrete, Strength**

I. INTRODUCTION

In the insubstantial arrangement, the coarse total is the less expensive material when contrasted with concrete, and the greatest the economy is gotten by utilizing however much total as could reasonably be expected. Totals likewise further develop the volume dependability and the strength of the subsequent cement. A decent total should create the ideal properties in both new and solidified cement. Concrete is an entire factor material having a wide scope of solidarity and the constituent materials are concrete, fine total, coarse total, and water. In light of exploration utilizing a pumice stone as substitution material. Pumice is a characteristic total of volcanic beginning created by the arrival of gases during the hardening of magma. The cell design of pumice is made by the development of air pockets or air voids when gases contained in the liquid magma moving from volcanoes become caught on cooling. Supplanting pumice stone with coarse total is supposed to be underlying lightweight cement addresses to decrease oneself load of the structure [1].

Probably the most benefit of pumice total cement has a low thickness of cement. Pumice stone is a lightweight total of low explicit gravity. Its water ingestion is higher than the typical coarse total since it is an exceptionally permeable material while contrasting the coarse total. We use Pumice as coarse total by supplanting it and sand as fine total. Pumice is dull or light-dark shaded coarse total, which skims on water. The thickness of pumice is 0.25 g/cm3. Pumice total has warm consideration and has low explicit gravity.

Primary lightweight total cement is a significant and flexible material in current development [2]. It enjoys numerous benefits of dead burden decrease, high warm protection; expands the advancement of the structure, and brings down haulage and taking care of cost [3]. On the off chance that floors and dividers are comprised of lightweight cement, it prompts the economy of construction. It likewise brings down power utilization for the outrageous climatic conditions due to having property of low warm conductivity.

These days lightweight cement is normally utilized in precast and prestressed segments. Lightweight substantial offers plan adaptability and significant expense investment funds by giving less dead burden, works on seismic underlying reaction, better fire rating, diminished story tallness, more modest size primary individuals, lower establishment cost, and less supporting steel [4].

II. LITERATURE REVIEW

Compared with ordinary concrete, the significant diffusion and open microstructure of the entire lightweight structure leads to thinner thickness, higher safety, and lower thermal conductivity of lightweight building materials [5]. It is not easy to spell and has better thermal insulation [6]. LWC has spread too many countries such as the United States, the United Kingdom and Sweden [7]. Lightweight concrete plays an important role in planning, and its use continues to increase. It appears as a substance reminiscent of an expansion expert, who uses it to determine the volume of the mixture [8]. It is lighter than standard concrete and has a dry thickness of 300 kg/m3 to 1840 kg/m3 [9]. Reducing weight by using clear, lightweight materials is especially ideal for buildings. Pumice is a completely lightweight variety, formed by the sudden cooling or flow of volcanic material. During a volcanic eruption, the viscous magma releases pumice. The magma is usually pebble and decomposes into individual non-solid components, especially boiling water.

Processing is simply carried out by mechanical processing, shaking and sieving [10]. Lightweight machines with lower machine performance can be used to process large amounts of concrete. Lightweight pumice concrete also reduces temporary loads on the formwork and formwork [11].

FIGURE 1: Pumice Aggregate

Pumice concrete has high fire resistance-the standard classification of concrete, and will not crack when in contact with direct fire. Pumice concrete has low thermal conductivity. Pumice concrete is subjected to higher acoustic tests. It provides an excellent guarantee for harsh environmental conditions. Such as freezing and thawing [12]. The essential feature of water absorption/desorption of pumice is that the water contained in pumice is not easily available due to the ratio of material to concrete, so it is very important to maintain a longer season. Finally, concrete [13-14]. Mixing is inconvenient because pumice stone looks different from ordinary concrete. The pumice should be sufficiently wetted to appear on the top layer, and then stay on the bottom when there is too much moisture. This will make up for the lack of internal pumice water. This prevents the components from drying out and reduces shrinkage breakage. If ordinary concrete is used, insulation and finishing are performed on the paste. In the case of pumice, a large grain of pumice floats on it. Softening is similar to ordinary concrete. For a large amount of pumice, if the load is concentrated on extraordinary concrete, an extra 24 hours construction tolerance must be given. For example, one of the disadvantages of concrete is its weight. Such a large amount of self-respect will make it a kind of important material that is somewhat wasteful [15]. The low-thickness lightweight concrete reduces its own weight and expands the heat lock. The thickness reduction is achieved by partially using it instead of the full thickness of the concrete. Commitment to use M30 ethyl polycarboxylate mixture to test conventional and lightweight concrete. Lightweight concrete is produced by replacing coarse aggregate with pumice parts with varying degrees of elongation ranging from 20% to half, 80% and 100%. These efforts aimed to select the strength of the pressure coefficient and limit the uncompromising shared nature of lightweight concrete. Specifically, in order to find the best displacement with the last-mentioned alternatives. The results vary, and the normal air entrainment rate in the concrete is essential for the hot mix to allow high temperature development.

Research method Standard Portland cement (Grade 53), according to IS: 81121989, has a normal consistency of 29%. Using specific gravity, the cement modulus is 3.14 and 5% respectively. The use of coarse-grained gravel is in full compliance with IS 383-1.Standards. The potential benefit of free mass thickness and the potential benefit of compression of the total amount are 4.417 kg and 4.905 kg, respectively, the actual performance needs to be confirmed. In the whole evaluation process, according to the identification zone III, the river sand is used as the total fine change. 1) 1963. Determine specific gravity, dimensional modulus and moisture content. All used pumice stones of 20 mm in size. The specific gravity of the entire pumice used is 0.82. Water is an important part of concrete because it successfully participates in the reaction of substances with concrete. In order to remove the mixture clearly, clean water that meets the IS 456-2000 standard is used. In the current study, the M25 variety is used with an obvious mixture called IS 4562000. The significant mixing ratio and significant moisture content of 1 cubic meter are zero. Tab. I shows the mixtures used in the study.

TABLE I: Mix proportions

S. No	**Cement**	**Water**	**Fine aggregate**	**Coarse Aggregate**
Normal concrete	1	0.5	1.58	3.14
LWC	1	0.5	2.88	1.29

Add pumice to the concrete (55%, 60%, and 70%). The degree of zeroing is indicated by a pumice stone in the basic report. For each percentage replacement of pumice in the form of coarse rock, a three-dimensional shape and cavity are assumed. Check the relief of molds and cavities for 7, 14, and 28 days. Then determine the typical compressive strength and versatility of each degree of mixing, which will be discussed in the results and discussion.

III. RESULTS AND DISCUSSIONS

Combined with the preliminary assessment of the compressive strength and versatility of the concrete baffle, conclusions and compliance are drawn from the current research. The results and accompanying discussion are from current research. Examples of blocks are tested for compressive strength after 7, 14, and 28 days

$$f = \frac{P}{A}\ N/mm^2 \qquad (1)$$

The chamber examples were tried for elasticity toward the finish of 7days, 14days, and 28days. The Tensile strength of the example was determined by utilizing;

$$Elasticity = \frac{2P}{\pi LD} \qquad (2)$$

The aftereffects of the elasticity tests on substantial shapes are displayed in Tab.II and Tab. III [(a), (b)], and in Fig. 2 and 3.

TABLE II: Test result of Compression Strength

SI.NO	Percentage replacement of Pumice	Average Compressive Strength N/mm^2		
		7 Days	14 Days	28 Days
1	0%	21.80	24.4	25.7
2	50%	9.35	10.38	13.34
3	60%	15.7	17.24	22.16
4	70%	6.4	6.91	8.87

Figure 2: Compression Test on Cubes

FIGURE 3: Split tensile Test on cylinders

TABLE III (a): Test Result of Split Tensile Strength

Normal Concrete	Average Compressive Strength N/mm^2		
	7 Days	14 Days	28 Days
M $_{25}$	2.314	3.08	3.45

TABLE III (b): Test Result for Split Tensile Strength

SI. NO	%age replacement of Pumice	Average Compressive Strength		
		7 Da	14 Days	28 Days
1	0%	2.314	3.08	3.45
2	50%	1.64	1.99	2.50
3	60%	1.67	2.16	2.56
4	70%	1.40	1.86	2.14

IV. CONCLUSION

Due to the preliminary evaluation of the compressive strength and flexibility of concrete during splitting, the current research ideas and solutions are adopted. The pressure ratio is different from that of conventional concrete, and the entire thickness is replaced by pumice stone. Different ratios (half, 60%, 70%). The strength is best when 60% of the pumice is replaced with coarse aggregate. The compressive strength of concrete mixed with 60% pumice stone is almost the same as that of ordinary pumice stone. This type of concrete can be used for non-structural partitions of prefabricated components.

ACKNOWLEDGMENT

The authors wish to acknowledge the support provided by this research work by the Department of Civil Engineering, The University of Lahore,-Lahore-Pakistan.

REFERENCES

[1] Minapu, Lakshmi Kumar, M. K. M. V. Ratnam, and U. Rangaraju. "Experimental study on light weight aggregate concrete with pumice stone, silica fume and fly ash as a partial replacement of coarse aggregate." *International Journal of Innovative Research in Science, Engineering and Technology*, vol.3, no. 12, pp. 18130-18138, 2014.

[2] Rafi, SK Mohammad, B. Ambalal, B. Krishna Rao, and Mohd Abdul Baseer. "Analytical study on special concretes with M20 & M25 grades for construction." *International Journal of Current Engineering and Technology*, vol.2, pp.338-343, 2014.

[3] Peter, Roshan, and Anantha Kumar. "Experimental investigation of floating concrete structure using light weight (natural pumice stone) aggregate." *World journal of engineering research and technology, ISSN, pp. 118-129, 2016.*

[4] *Grits bumanis, "Mechanical and thermal properties of light weight concrete made from the expanded glass" jsace,issn, no. 26, pp. 2029-9990, 2013.*

[5] *Rao, N. Sivalinga, Y. Radha Ratna Kumari, V. Bhaskar Desai, and B. L. P. Swami. "Fibre Reinforced Light Weight Aggregate (Natural Pumice Stone) Concrete." CONTRIBUTORY PAPERS pp. 155, 2013.*

[6] *K. Guru Kesav Kumar, C. Krishnaveni "Study on Partial Replacement of Aggregate by Pumice Stone in Cement Concrete" THEIJEST, 113 vol. 4, no.3, March, 2016.*

[7] *Sunilaa George, "Experimental investigation of light weight concrete by partial replacement of coarse aggregate using pumice aggregate" vol. 4, no. 5, pp.50, 2016.*

[8] *Gowthama Prasanth.U1,Jeyaraj C2, "Experimental Investigation of Floating slab with Incorporated Pumice stone and Vermiculite"IJIRT, vol. 3, no. 5, pp.223, 2016*

[9] Kenneth, S., and P. E. Harmon. "Engineering properties of structural lightweight concrete." *Carolina Stalite Company, Salisbury* (2006).
[10] Al-Rawi, Kawkab H., Mazin T. Al-Kuttan, and A. Rawa'a. "Some mechanical properties of pumice lightweight aggregate concrete incorporating rise husk ash." *Journal of Techniquse*, vol.22, no. 3 2009.
[11] Ismail, Kamsiah Mohd, Mohamad Shazli Fathi, and N. Manaf. "Study of lightweight concrete behaviour." *Universiti Teknologi Malaysia*, 2004.
[12] N.Venkata Ramana, "Behaviour of Pumice Light Weight Concrete." International Journal of Advance Research in Science And Engineering IJARSE, vol. No.4, Special Issue 01, April 2015.
[13] Uğur, İ. "Improving the strength characteristics of the pumice aggregate lightweight concretes." In *18th International Mining Congress and Exhibition at Turkey-IMCET*, vol. 2003. 2003.
[14] Lakshmi Kumar Minapu1,et.al , "Experimental Study on Light Weight Aggregate Concrete with Pumice Stone, Silica Fume and Fly Ash as a Partial Replacement of Coarse Aggregate, vol. 3, no. 12, December 2014.
[15] Mang,uriu Geoffrey N,et.al, "Properties of Pumice Lightweight" Rogers, vol. 2, no.10, 2012.