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Comparative Study of the Strength Properties of the Concrete with Partial Replacement of the Coarse Aggregate with Pumice and Over Burnt Bricks

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ABSTRACT- Concrete is the universally accepted material for its adverse properties with high usage of the concrete for all type of the works in the world, it leads to depletion of natural resources like river sand, and granite. Which are the components of the concrete as fine aggregate and coarse aggregate in this project M30 grade concrete is taken in which 10%,20%&30% of coarse aggregate is replaced with over burnt bricks and 10%,20%and 30% of coarse aggregate replaced with pumice by volume. And the compressive, flexural and split tensile strength properties at 7,28& 56 days and the unit weights of the concrete compared. In order to safe guard the natural resources, alternate material like over burnt bricks, pumice considered in the present project.

KEYWORDS- Partial Replacement, Coarse Aggregate, Pumice,Over Burnt Bricks

I. INTRODUCTION

A. *Light Weight Concrete*

Structural lightweight concrete has an internal density (unit weight) of 1440 ~ 1840kg / m3 compared to normal weight concrete with density of 2240 ~ 2500kg / m3. For structural use, the concrete strength must be at least 17.0 MPa. The concrete mixture is made of lightweight coarse aggregate. In some cases, some or all of the micro aggregates may be lightweight products. Lightweight aggregate used in structural lightweight concrete is a lightweight shale, clay or slate pumice material usually fired from a rotary furnace to develop a porous structure. Other products such as air-cooled blast furnace slag and hematite are also used. There is a different class of unstructured lightweight concrete made from other aggregate materials and with higher air voids in cement paste matrices (eg cellular concrete). These are typically used for insulation properties. The main use of structural lightweight concrete is to reduce the dead load of concrete structures, and structural designers can reduce the size of pillars, foundations and other load bearing elements. Structural lightweight concrete mixtures can be designed to achieve similar strength to normal weight concrete. The same is true for other mechanical and endurance performance requirements. Structural lightweight concrete provides more efficient strength-to-weight ratio of structural elements. The mild cost of most lightweight concrete is offset by a reduction in the size of the structural members, reinforcement of the steel and reduction in the volume of concrete, thus reducing overall costs.

II. OVER BURNT BRICKS

Bricks are the most important part of development work and are used by humans for a long time. Its history dates back to the earliest times of human civilization. Many world-renowned archaeological excavations provide a wealth of information on brick usage in many parts of the world. A few years ago, bricks were made in warm places and hardened with simply sunlight. The sun-dried mud-brick hand was made and used in pre-porcelain neolithic times. The oldest brick use case was first discovered in southern Turkey. The Sumerian palace in Kish, Mesopotamia, is another excellent example of the use of ancient bricks.

The brick burned in the 5th century BC was used as part of the city of Babylon. The ancient Egyptians also used sun- dried clay bricks in world-famous sites. During the Roman Empire, the use of bricks spread throughout Europe spreading to Italy and the Byzantine area. 11th

In the development work, the use of blocks spread from this land. After the great fire in London in 1666, the city was rebuilt with most of the block structures. Bricks in the United States have been used in Virginia since 1611, and Sundried bricks have been made and used centuries in Central America, especially in Mexico. Brick walls that are only visible in the mid-18th century are again popular. A beautiful example of brick was found in India in the 20th century.

B. *Pumice stone*

Pumice stone is a textural material formed from rapidly cooling viscous molten rock by trapping gas bubbles which results in a foamy whipped glass. The word pumice is derived from Latin word pumeu, that meaning foam. It is even formed in deep undergrounds and when the magma erupts from a vent by forming the gases which leaves a frothy structure. The transformed magma is the amorphous rock or pumice. Pumice is found in various textures such as pyroclastic flows, accumulated drifts, and piles at the river banks by the action of wind. The pure pumice is obtained in a floating mass or near the shore as it saturates by sinking and near the water bodies by the action of wind.Pumice is an amorphous plentiful rock that is found all over the country where not all pumice is ideal for refining and use in industry. In ancient days many innovative techniques are adopted in concrete mixtures with pumice by Greeks and Romans. The majority of the ancient structures were built with the pumice stone. It is not a localized product by its varying characteristics. The market demand of pumice is high because of its Mohr scale hardness, purity level, whiteness and the ability of the company that mines and refines. There is an increasing demand of pumice stone particularly for water filtration, chemical spill containment, manufacturing of cement, horticulture and in pet industry.

III. MATERIALS USED

- Cement: OPC 53 Grade Deccan cement was used for this survey. We assessed the quantity required for this work and purchased the entire quantity and stored it in the casting shop. The following tests were performed according to the IS code.
- Fine aggregate: used in this investigation was clean river sand and the following test was carried out in sand according to IS: 2386-1968. Fine adjustment sizes less than 4.75 mm are considered fine aggregates.
- Coarse aggregate: Dried angular coarse aggregate of 20 mm maximum sized and 10 mm minimum size locally available was used for experimental work.
- Water: Water is an important ingredient in concrete because it is actively involved in chemical reactions with cement. This is due to the strength imparted to the cement gel and the workability of the concrete,
- Over burnt bricks: Because many bricks are chosen for fire, many bricks are rejected or discarded due to incompatibility is an uneven form of brick created by the high temperature control of the kiln. These bricks can also be a real source of coarse aggregate.
- Pumice stone: Pumice stone is a textural material formed from rapidly cooling viscous molten rock by trapping gas bubbles which results in a foamy whipped glass. The word pumice is derived from Latin word pumeu, that meaning foam.

Figure 1: Over Burnt Bricks

Figure 2: pumice stone

Table 1: Composition of good brick earth

INGREDIENTS	PERCENTAGE
Silica	50-60%
Alumina	20-30%
Lime	10-15%
Magnesia	<1%
Other Ingredients	1%

Table 2: chemical composition of pumice

Oxide composition	Oxide composition
SIO_2	71.91
AL_2O_3	12.66
Fe_2O_3	1.13
CaO	1.46
Mgo	0.32
Na_2O	3.45
K_2O	4.30
Calcification lons	4.53
Specific Gravity	0.81

Mix design: in this study we are using the M30 grade mix design

IV. RESULTS AND DISCUSSION

The comparative study reveals that partial replacement of coarse aggregate with pumice and over burnt bricks enhances compressive and flexural strengths of concrete. pumice improves workability, while over burnt bricks enhance the interlocking effect. optimal replacement ratios achieve a balance between strength and structural performance, promoting sustainable resource utilization in concrete production.

Table 3: Compressive Strength Test Values for over burnt bricks

S.No.	Over burnt bricks partially replaced	Average compressive strength (N/mm2)		
	(%)	7Days	28Days	56Days
1	0%	25.41	32.31	40.16
2	10%	39.40	49.60	46.61
3	20%	36.58	38.10	38.03
4	30%	37.19	36.43	36.32

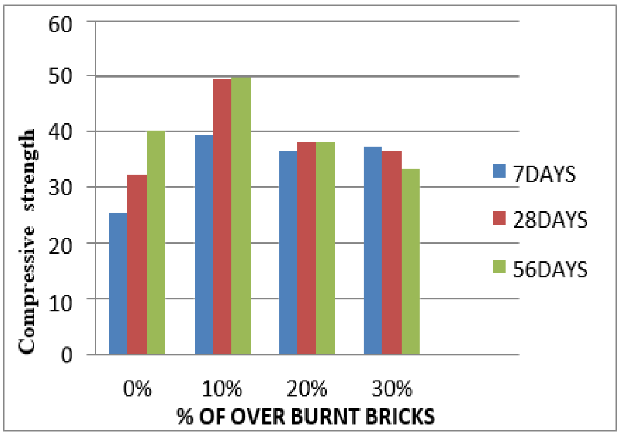

Figure 3: Variation of Compressive Strength gives the higher strength for the replacement 10% for 7, 28 and 56 days by over burnt bricks

Table 4: Compressive Strength Test Values for pumice stone

S.No.	Pumice stone partially replaced	Average compressive strength (N/mm2)		
	(%)	7Days	28Days	56Days
1	0%	25.41	32.31	40.16
2	10%	36.79	41.85	41.78
3	20%	32.47	37.83	37.87
4	30%	35.35	36.97	33.28

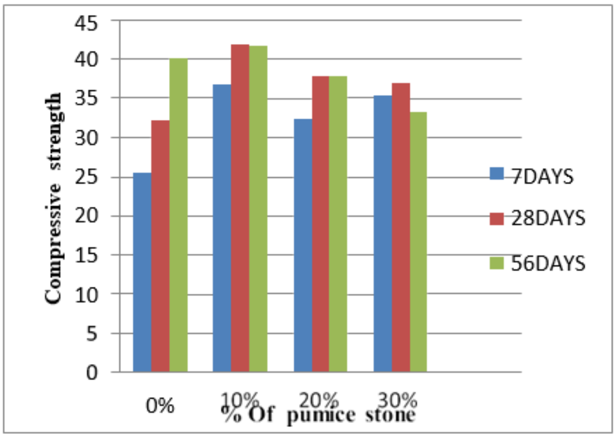

Figure 4: Variation of Compressive Strength gives the higher strength for the replacement 10% for 7, 28 and 56 days by pumice stone

Table 5: Split Tensile Strength Test Values for over burnt bricks

S.No.	Over burnt bricks partially replaced	Average split tensile strength (N/mm2)		
	(%)	7Days	28Days	56Days
1	0%	2.15	3.68	3.76
2	10%	2.20	3.69	3.85
3	20%	1.94	3.36	3.56
4	30%	1.66	2.81	3.31

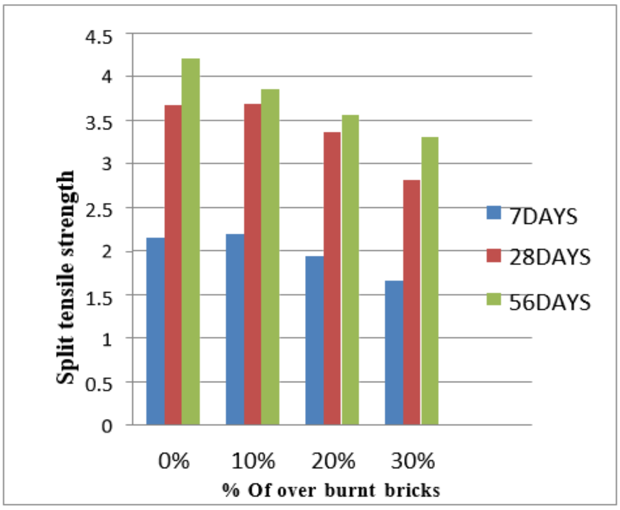

Figure 5: Variation of Split tensile Strength gives the higher strength for the replacement 10% for 7, 28, 56 days by over burnt bricks

Table 6: Split Tensile Strength Test Values for pumice stone

S.No.	pumice stone partially replaced	Average split tensile strength (N/mm2)		
	(%)	7Days	28Days	56Days
1	0%	2.15	3.68	3.76
2	10%	2.25	3.80	3.92
3	20%	1.98	3.46	3.92
4	30%	1.69	2.89	3.44

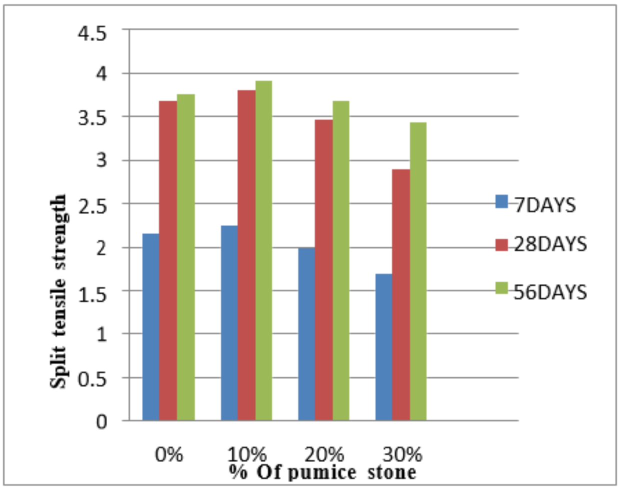

Figure 6: Variation of Split tensile Strength gives the higher strength for the replacement 10% for 7, 28, 56 days by pumice stone

Table 7: flexural Strength Test Values for over burnt bricks

S.No.	Over burnt bricks partially replaced	Average flexural strength (N/mm2)		
	(%)	7Days	28Days	56Days

1	0%	3.10	3.88	3.94
2	10%	3.17	4.39	4.43
3	20%	2.95	4.25	4.29
4	30%	2.86	4.18	4.22

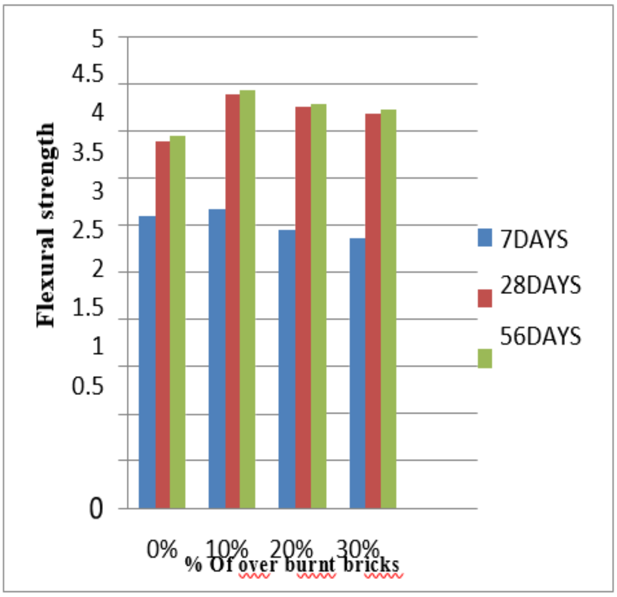

Figure 7: Variation of Flexural Strength gives the higher strength for the replacement 10% for 7, 28, 56 days by over burnt bricks

Table 8: flexural Strength Test Values for pumice stone:

S.No.	Pumice stone partially replaced	Average flexural strength (N/mm2)		
	(%)	7Days	28Days	56Days
1	0%	3.10	3.88	3.94
2	10%	3.14	4.30	4.32
3	20%	3.01	3.88	3.96
4	30%	2.95	3.87	3.88

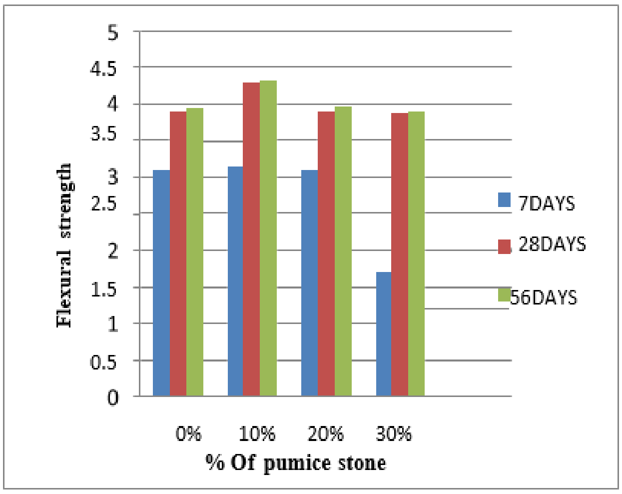

Figure 8: Variation of Flexural Strength gives the higher strength for the replacement 10% for 7, 28, 56 days by pumice stone

V. COMPARISON OF OVER BURNT BRICK AND PUMICE CONCRETE

The comparison of the both over burnt brick and pumice concrete, the 10% results are getting more. The over burnt brick concrete get more result when compared to pumice stone concrete. Like compressive strength, flexural strength and split tensile strength.

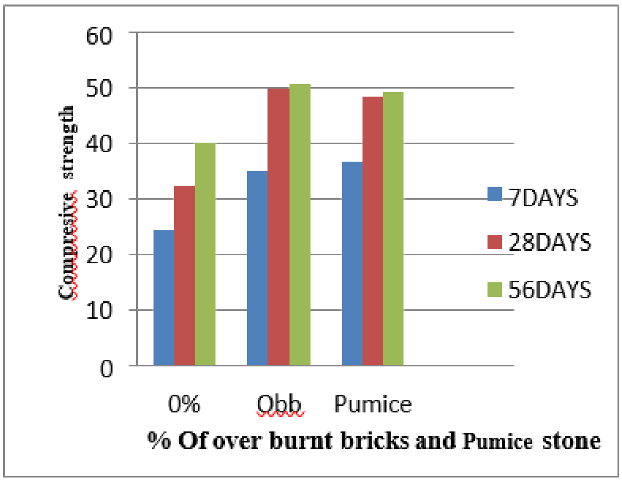

Figure 9: Comparison of compressive Strength of over burnt bricks and pumice concrete for the replacement 10% for 7, 28, 56 days

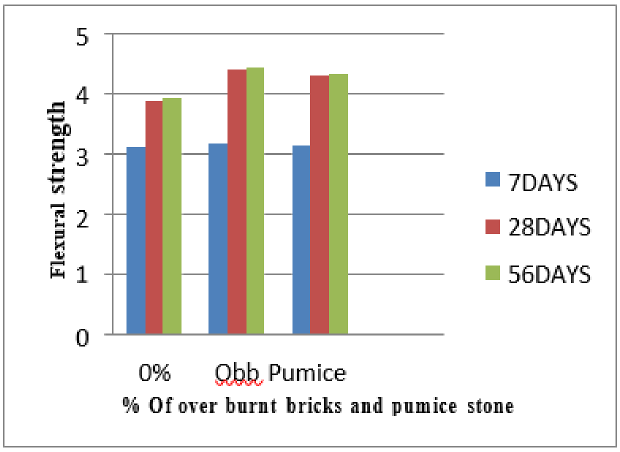

Figure 11: Comparison of flexural Strength of over burnt bricks and pumice concrete for the replacement 10% for 7, 28, 56 days

VI. CONCLUSION

- Use of over burnt bricks and pumice stone as coarse aggregate in concrete results in the increased strength properties, which may be because of the internal self-curing of the over burnt bricks and pumice, which are soaked in water before mixing in concrete.
- Over burnt brick aggregate is giving higher strength of 10% when compared with the pumice concrete.
- Over burnt brick aggregate is giving increased percentage of compressive strength, flexural strength and split tensile strength of 10%, 20% and 30% respectively, when compared with the strength properties of the pumice concrete.
- The unit weight of concrete is greatly reduced in over

burnt brick concrete and pumice concrete with a percentage of 17.44%, 24.62%.

- Using reduction in this self-weight of the structure, there will be a lot of reduction dimensions of the structural members, as well as the material.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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