Translucent Glass Mortar

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***Abstract*-In order to make the concrete industry sustainable, the use of waste materials in the place of natural resources is one of the best alternatives. In this paper an investigation was conducted to study the use of waste glass as an alternative material applied as a partial replacement of fine aggregates in manufacturing fresh mortar. Fine aggregates were replaced by waste glass aggregate as 20%, 30% and 40% by weight for mortar mix 1:3. The mortar specimens were tested for the compressive strength at 7 and 28 days of age and the results obtained were compared with those of control block of mortar. The test results shows that the replacement of fine aggregate by fine glass at level of 30% by weight has a significant effect on the compressive strength of the mortar blocks as compared with the control sample because of pozzolanic nature of fine glass. And also to introduce translucency for aesthetic effect optical fibers are embedded in it.**

Keyword: Mortar block, Pozzolanic, Waste glass, Fine Glass, Coarse Glass.

I. NTRODUCTION

In developing countries like India, where tremendous projects for industrialization in conjunction with rapid urbanization are vigorously increased to improve the standard of living, the major problem is the increase in the domestic and industrial waste. The disposal of wastes has become a major problem in India, especially the disposal of waste glass which is generated from domestics and industries in the country. Quantities of waste glass have increased in the recent years due to an increase in industrialization and the rapid improvement in the standard of living. Unfortunately, the majority of waste glass is not being recycled but it is rather abandoned and hence it is the cause of certain serious problems such as improper utilization of natural resources and various environmental problem. For these reasons, we have conducted this study through the basic experimental research in order to analyze the possibilities of crushed waste glass as fine aggregates in mortar. If a large amount of waste materials generated is used instead of natural materials in the construction industry, there would be some benefits like conservation natural resources, disposing of waste materials (which are often unsightly) and also make the valuable land free for other uses. Glass is a common product that can be found in different forms like bottles, jars, windows and windshields, bulbs, cathode ray tubes, screen etc. Due to the limited availability of landfill space and also stringent environmental regulations, many waste glasses are attempting to develop efficient, economic and environmental sound alternatives for utilizing this waste glass. Therefore, it is a challenge for the engineers to convert this waste glass to useful building materials.

II. MATERIALS

The materials used for this experimental work are cement, sand, water and fine waste glass aggregate.

A. Sand

The aggregates are important constituents in the concrete. They give body to the mortar.The manufacture sand of size 1.5mm-4.75mm was used for the experimentation.

B. Water

Potable water was used for the experimentation

C. Cement

Portland pozzolano cement was used in this experimentation conforming to IS-12269-1987.

D. Waste glass

The broken glass was used as waste which was supplied from windows glass market. The Fine Glass (FG) Aggregates are produced and separated by IS sieves glass 90μm – 2.36mm

Fig.1.Fine Glass Aggregate

III. EXPERIMENTAL WORK

A. Casting Of glass mortar

In this research, mortar mix 1:3 according to IS 2250:1981 of masonry mortar was used. Total four series of mixtures of 1:3 proportions were prepared in the laboratory trials. The four mixtures in series includes a control mixture using standard sand with zero percent glass aggregate (GA). The cement and water proportion in the mixes was constant to determine the effect of fine glass

(FG) The replacement of fine aggregate (FA) with FG were at levels from 20%, 30% and 40% by weight. In the mixing process of mortar, waste glass, fine aggregates and cement content (all dry) were mixed for 1 min in mixer. Then, water was poured into mixer for another 3 min. The temperature of the water and that of the test room at the time when the mixing operation is being performed was 27 ± 2° C. Afterward the fresh mixes were fed into the steel moulds with internal dimensions of 70.6 x 70.6 x 70.6 mm. The steel moulds were filled with material to about one third height and the layer compacted by tamping it with the tamping rod in a uniform manner over the mortar surface in such a way to produce full compaction of the mortar with neither segregation nor excessive laitance. The moulds then filed two by third and then be completely filled and the upper layer of the mortar compacted in a similar manner. Then, excess in the surface of the mortar struck off plane and leveled the top of the mould using a trowel. The specimen was marked for later identifications. Mortar cube then removed from the mould after 24 hrs and cured in clean water until the time of test. The temperature of the storage water was 27 ± 2°C. The specimen was tested at an interval 7 and 28 days.

Fig.2.Picture of sample testing (a) Specimen before testing (b) Specimen after testing

B. Casting Of TGM

The main idea of TGM is that,the high numerical aperture optical fibers are directly arranged in the concrete and the optical fiber which is used as sensing element and optical transmission element. Since light can transmit in the optical fiber, different shape of TGM can be fabricated by distributing certain amount of optical fibers regular pattern in the mortar. Plastic optical fiber is an excellent media to transmit the light at specific wavelengths which has been widely used in illumination facility or architectural appearance lighting. TGM was made by embedding optical fibers in mortar and replacing 30% of fine aggregate with glass pellets, ie. the mix with greater compressive strength obtained from first set of casting. Proportion for mortar cube was selected as 1:3. The first step was to make mould with perforations. The mould was be made with the size 70.6 x 70.6 x 70.6 mm with cast iron. The optical fibers run through these holes from one end to the other and then mortar was made to set in it with the fibers inside. The light falling on one side of the block gets transmitted to the other side through the optical fibers running from one end to the other. Optical fibers generally act as a hollow cylindrical waveguide which transmits light along its axis by the principle of total internal reflection of the optical fiber strands. This property is used and optical fibres were embedded in the estimated quantity. Moulds of same size with perforations were used.

Fig.3.a) Mould with perforations b) Optical fiber embedded in the sample

C. *Compressive Strength Test On* Blocks

The test was conducted on universal testing machine(UTM) as per IS 2185 part 1-1979. Three specimens were taken for the testing. Specimens cured in water were tested after keeping it for 1 hour for surface drying. The dimensions of the specimens were taken to the nearest 0.2 mm and their weights were noted before testing it. Age of specimen at the time of testing was 7 and 28 days. The load were applied without shock increasing continuously till the specimen breaks down and no greater load can be withstand. Compressive strength of specimen was calculated using the formula,

$$\text{Compressive strength} = P/A \quad (1)$$

Where, P = maximum load applied in Newton

A = cross sectional area of the specimen in mm^2 Average of three values is taken as compressive strength

D. Light Transmittance Test on Specimen

Light measuring equipment and setup:-Various light measuring equipment's is available like Lux meter, however, a simple Lux meter can be made in a laboratory using simple components. The light transmittance through the sample can be measured by measuring the current corresponding to the light. Which can be measured by using photo diode or a Light Dependent Resistors (LDR). The use of photo diode require a separate sensor which would increase the cost of the project. The most apt choice would be LDR.

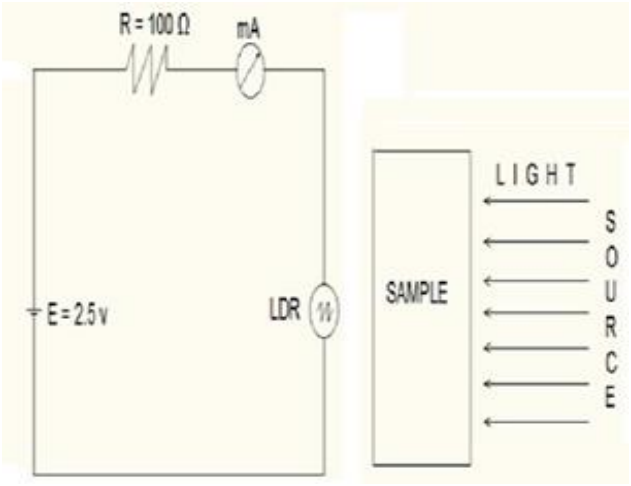

Fig.4 :Circuit diagram

As shown in the above figure 4, the LDR measures the light transmitting through the sample and converts it into the current, which is measured in milli amperes (mA). So two readings are taken, one without sample (A_1) and one with sample (A_2). The source of light here taken is 200 W incandescent bulbs, a resistance of 100 Ω is applied in the circuit and a uniform DC voltage of 2.5 V is kept between the circuits. To ensure no light is escapes throughout the test, a box made up of plywood is made. The light source is fixed at the top of the box and LDR is placed at the bottom. The sample is placed between source and LDR and test is conducted.

Light transmittance = $100 - [(A_1 - A_2)/A_1] \times 100$ (2)

IV. RESULTS AND DISSCUSSIONS

A. *Compressive Strength Of Cube*

TABLE.1 COMPRESSIVE STRENGTH OF CUBES REPLACING FINE AGGREGATE BY GLASS AGGREGATE

% Replacement Of fine aggregate	7 day compressive strength N/mm^2	28 day compressive strength N/mm^2
0%	19.5	30.75
20%	22	32.83
30%	24.05	36.5
40%	22.15	34.62

B. *Compressive Strength Of TGM*

TABLE.2 COMPRESSIVE STRENGTH OF TRANSLUCENT GLASS MORTAR

TGM with 30% glass aggregate	**7 day compressive strength N/mm^2**	**28 day compressive strength N/mm^2**
	22.12	36.15

C. *Light Transmittance Test On Specimen*

Using equation 2 the amount of light transmittance is computed and on an average 50% light transmittance was obtained

V CONCLUSION

Translucent glass Mortar blocks were prepared in the laboratory using broken glass as aggregate.the compressive strength obtained is found to be maximum for 30% replacement. The provision of optical fibres along transverse direction will gave ornamental effects through its translucency. The translucent glass concrete structures will become very common in the near future due to its easiness in construction and the availability of raw materials. This actually makes construction more environmental friendly due to the usage of waste glass.

ACKNOWLEDGMENT

We convey our sincere thanks to our guide Er. Aarlin K Mathew , Er. Reshma Theresa (HOD of Civil Department) and our parents and friends for their sincere support and constant guidance. Last but not theleast, I thank the almighty for his constant blessings showered on me.

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