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# An Experimental study on Green Concrete by partial replacement of construction materials from recycling applications

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**ABSTRACT**: In the present research, most of the concrete materials has been partially or fully replaced by waste materials or other products. Cement which contains majority of silica content is partially replaced by Glass and than by glass & fly ash which undergoes pozzolanic reaction and helps in increasing strength of concrete. The same is replaced by waste materials in different proportions i.e 15%, 30% & 45% and it is found that compressive strength of concrete increases upto certain limit and the extent upto which cement can be replaced. Sand is mostly used from the natural river source and is being replaced by manufactured sand which is made in industries. The results were compared with concrete made of natural sand and it is concluded that compressive strength of concrete increases using Manufactured sand with full replacement of natural sand. Coarse aggregates has the highest proportion in concrete and is being replaced by Construction and Demolition waste/recycled waste either partially or fully i.e 60%, 80% & 100%.. Further, from the results , it is concluded that Cement can be replaced by glass and glass & fly ash (in equal proportion) upto 30% and Coarse aggregate can be replaced by recycled aggregate upto 80% . So, further test has been done to check the physical and chemical properties of concrete by replacing cement with Fly ash & glass and replacing coarse aggregate with recycled aggregate in different proportions. From the results, it is being concluded that cement can be replaced by glass and glass & fly ash and coarse aggregate by recycled aggregate upto 55%.

**KEYWORDS:** Glass, Flyash, M Sand, Recycled aggregate, compressive strength.

## I. INTRODUCTION

It is a known fact that, concrete industry is major producer of CO2 emission these days. For any construction, major constituents are cement, aggregates, sand , steel, bricks, mud, clay, wood etc.. For the adaptability and suitability of the changing. environment, the concrete shall. be such. that it protects the environment, consere natural resources, economize.energy , does not harms the environment and leads to proper utilization of energy

### 1.1 Project Implementation

- NOMINAL CONCRETE
- SAND REPLACED BY MANUFACTURED SAND
- CEMENT REPLACED BY GLASS IN 15%, 30% & 45%.
- CEMENT REPLACED BY GLASS AND FLYASH IN 15%, 30% & 45%.
- COARSE AGGREGATES REPLACED BY C & D WASTE/RECYCLED WASTE IN 60%, 80% AND 100%.
- CEMENT IS 30% REPLACED BY GLASS & FLYASH AND COARSE AGGREGATES REPLACED BY C & D WASTE IN 40%, 55%, & 70% PROPORTION (PROPORTION TAKEN– BASED ON THE RESULTS OF ABOVE TEST RESULTS).

### 1.2 PROPERTIES OF MATERIALS

1.2.1 CEMENT

- Consistency : 32%
- Fineness : 2
- Soundness : 1mm
- Specific Gravity : 3.145

1.2.2 FINE AGGREGATE

- Fineness Modulus: 2.7
- Specific Gravity : 2.53

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- Bulk Density: 1848 Kg/$m^3$
- Zone : II

1.2.3 COARSE AGGREGATE

- Impact Value : 15%
- Crushing Value : 18.16%
- Specific Gravity : 2.68
- Water Absorption: 0.5%

1.2.4 RECYCLED COARSE AGGREGATE

- Impact Value : 25.5%
- Crushing Value : 28.2%
- Specific Gravity : 2.49
- Water Absorption: 2.7%

1.2.5 M SAND

- Fineness Modulus: 2.6
- Specific Gravity : 2.57
- Bulk Density: 1870 Kg/$m^3$

## II. RESULTS & DISCUSSIONS

Based on the physical and chemical properties of the material used, compressive test was performed by making cubes of size 150mm x150mm x150mm . Material replaced and mixed by weight of concrete materials.

The Compressive strength test done is evaluated as

| Mix Design | 7 Days | 28 Days | Average Strength | Target Mean Strength | Result |
|---|---|---|---|---|---|
| Nominal Concrete | 20.7 | 38.77 | 36.12 | 31.6 | Pass |
| M sand | 23.32 | 37.175 | 36.53 | | Pass |
| 15% Glass | 21.3 | 37.55 | 35.15 | | Pass |
| 30% Glass | 20.7 | 32.7 | 32.5 | | Pass |
| 45% Glass | 16.8 | 29 | 27.44 | | Fail |
| 15% Glass & Flyash | 23.99 | 29.08 | 38.01 | | Pass |
| 30% Glass & Flyash | 23.01 | 33.83 | 34.68 | | Pass |
| 45% Glass & Flyash | 20.21 | 30.72 | 30.98 | | Fail |
| 60 % Recycled Aggregate | 22.18 | 37.7 | 35.91 | | Pass |
| 80 % Recycled Aggregate | 20.18 | 32.8 | 31.92 | | Pass |
| 100 % Recycled Aggregate | 16.875 | 29.85 | 27.9 | | Fail |
| 30 % Glass & Flyash with 40% recycled aggregate | 21.32 | 33.9 | 33.35 | | Pass |
| 30 % Glass & Flyash with 55% recycled aggregate | 20.5 | 31.8 | 31.75 | | Pass |
| 30 % Glass & Flyash with 70% recycled aggregate | 18.98 | 29.03 | 29.13 | | Fail |

**Comparison of 7 Days and 28 Days Compressive test results of Green Concrete with Nominal Concrete**

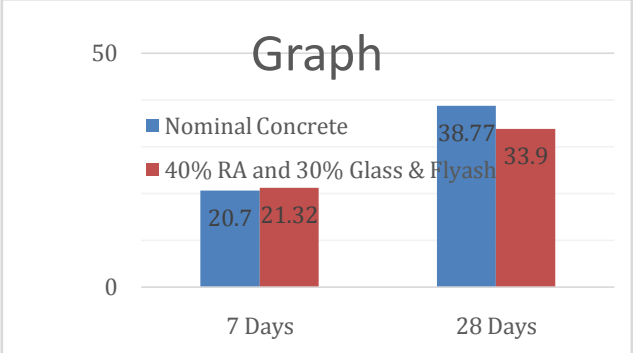


Fig-1 Graphical representation of 7 days and 28 days strength of Nominal and M sand concrete

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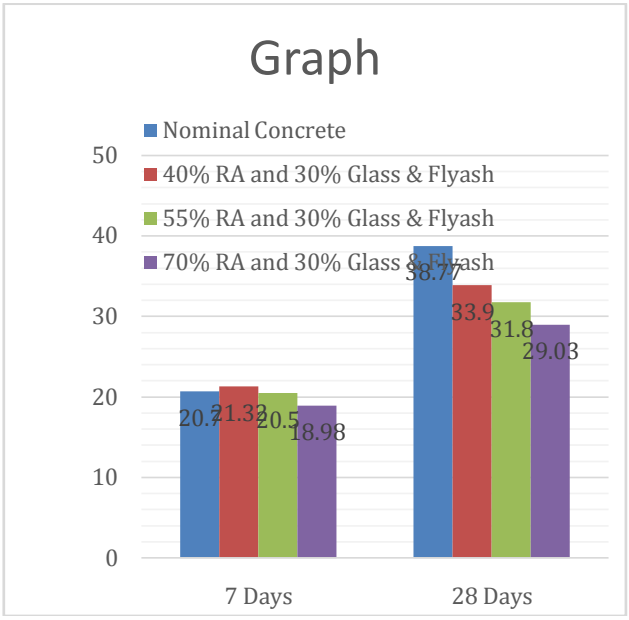


Fig-2 Graphical representation for nominal and 15%, 30% & 45% glass replaced concrete

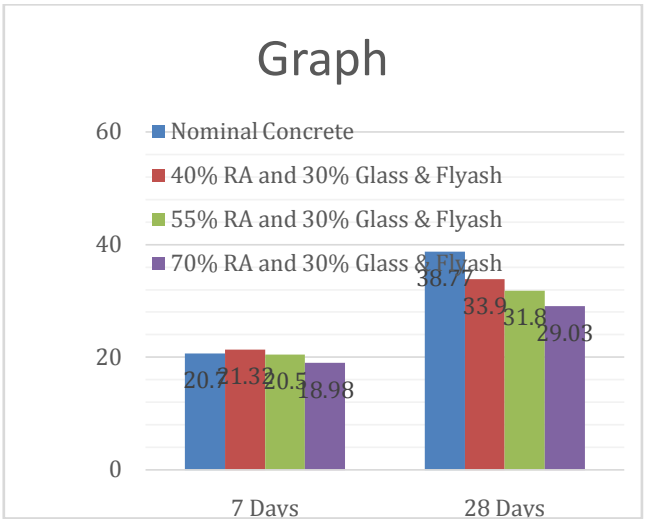


Fig -3 Graphical representation for nominal and 15%, 30% & 45% glass & fly ash replaced concrete

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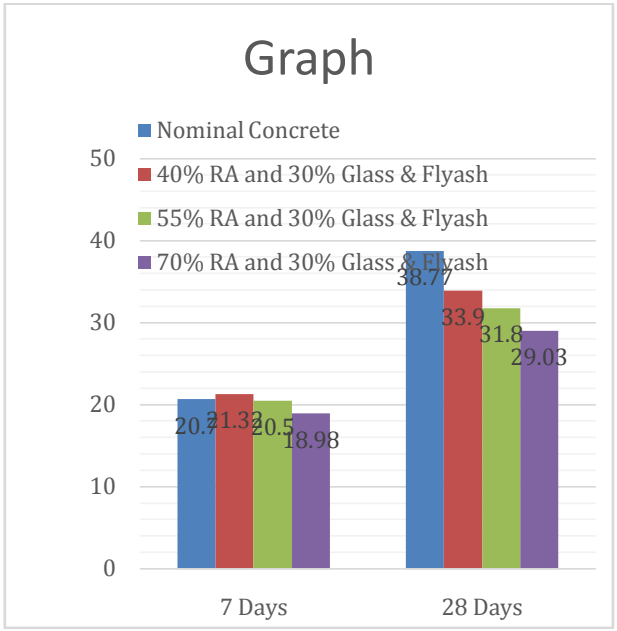


Fig-4 Graphical representation for nominal and 60%, 80% & 100% recycled aggregate replaced coarse aggregate

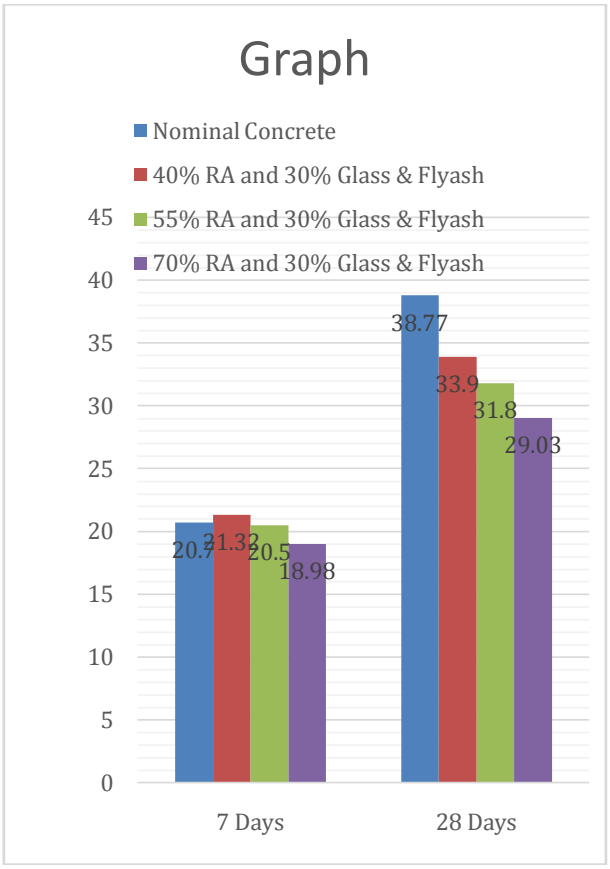


Fig-5 Graphical representation for nominal and with 30% replaced cement with Flyash & glass and 40%, 55% & 70% recycled aggregate replaced coarse aggregate

## III. CONCLUSIONS

From the above test results it can be concluded that

- Compressive strength of M Sand was found more than that of conventional nominal concrete.
- The Cost comparison shows that concrete made of M sand is cheaper than Natural sand concrete.
- Replacing cement with glass upto 15% is suitable as glass undergoes pozzolanic reaction with the by product.
- Compressive strength of concrete when is cement is replaced by glass upto 30% found more than target mean strength required as per standard IS codes.
- 45% replacement of cement with glass can not be used .
- The compressive test results with 15% replacement shows replacing cement with glass and fly ash provide greater strength as the test results are more than target mean strength.
- The compressive test results with 30% replacement shows replacing cement with glass and fly ash provide greater strength as the test results are more than target mean strength, 30% replaced cement concrete. Thus this mix design gives satisfactory results for Compressive test.
- 45% replacement of cement with glass& fly ashcan not be used .
- 60% replacement of coarse aggregate with recycled waste shows good compressive strength results
- It can be concluded that the maximum content upto which coarse aggregate can be replaced by recycled aggregate is about 80%.
- 100% replacement of coarse aggregate with recycled aggregate can not be used.
- Compressive strength when cement is 30% replaced by Glass & fly ash and coarse aggregate with 40% recycled aggregate found more than target mean strength. Hence can be used.
- Compressive strength when cement is 30% replaced by Glass & fly ash and coarse aggregate with 55% recycled aggregate found more than target mean strength. Hence can be used
- Compressive strength when cement is 30% replaced by Glass & fly ash and coarse aggregate with 70% recycled aggregate found less than target mean strength. Hence cannot be used

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