

Experimental Investigation in partial replacement of sand by Eggshell and M-sand

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Abstract

Nowadays scarcity of sand is the biggest problem in civil field. The sand is used as the concrete material. The concrete is used mainly in the construction of buildings like residential, apartments and in dams, bridges etc. The construction work is stopped or incomplete due to the scarcity of sand. At this time we need a replacement for the sand. So, to solve this issue we use the used egg shell as the partial replacement for the sand. But only using used egg shell decreases the compressive strength of the concrete. We decided to add the M-sand as an additional ingredient with the used egg shell. The concrete cubes are made using the partial replacement of sand as used egg shell and M-sand. The used egg shell and M-sand are mixed in equal proportion. The concrete cubes consists 0% to 50% partial sand replacement. The concrete cubes were cast, cured and tested. The strength obtained by the concrete mixes containing used egg shell and M-sand aggregates was compared to that of conventional concrete with sand as fine aggregate. It is the best solution for disposing of used egg shell and to solve the scarcity of sand.

Introduction

Concrete is the main material for the construction work. It consist of cement, fine aggregate, coarse aggregate and water. The scarcity of sand is the major problem in construction field. To avoid this problem, we assumed to use egg shell as a partial replacement for sand due to its similar properties with sand. But, the egg shell is not efficient for achieving the strength. So, we decide to mix particular amount of m-sand to achieve the strength.

Egg shell

Egg shell is a waste material. It cannot be decompose easily. The decomposition of egg shell is a major problem in society. It creates bad smell. The egg shell which consist 99% of $CaCO_3$ remaining 5% includes Magnesium, Aluminum, phosphorous, sodium, Potassium, Zink, Iron, Copper, Ironic acid and silica acid. We used this wastage material as a partial replacement for sand in concrete to reduce this wastage.

Table 1: Physical properties of egg shell

Properties	Observation
Specific gravity	0.85
Moisture content	1.18
Bulk Density (g/m ³)	0.8
Particle Density (g/m ³)	1.012
Porosity (%)	22.4 BET
Surface area m ² /g	21.2

M – Sand

In modern technology M – sand is used as a replacement Material for sand. Practically the strength is higher while comparing to ordinary sand. But, it is uneconomical in nature. Therefore we added egg shell with M – Sand to make it economical in nature.

Table 2: Physical properties of M - sand

Properties	Observation
Fineness	2.34
Water absorption	8.16 %
Specific gravity	2.82

Procedure

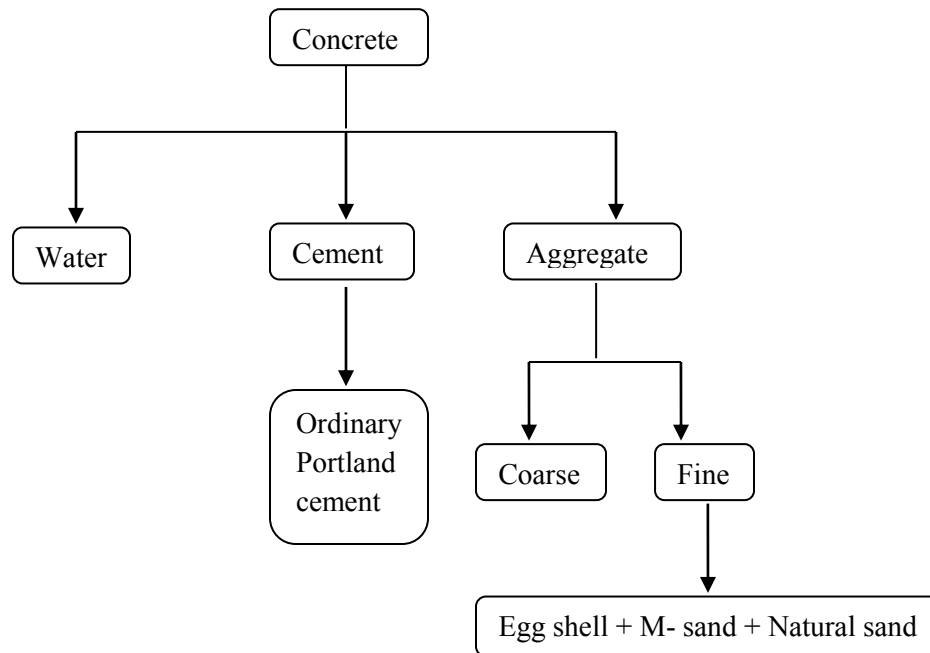


Figure 1: Procedure chart

Mix Design

The Mix design is consist of the information about the proportion of materials to be added in concrete. The mix design is calculated based on the materials using in the concrete. The IS code 10262 – 2009 refers instructions and same conditions to prepare a mix design. We used M20 grade in our Mix.

Table 3: Compression test on partial replacement of Egg shell

ES added in %	FA added in %	Compressive Strength
0	100	20
10	90	19.32
20	80	17.33
30	70	16.42
40	60	9.16
50	50	4.67

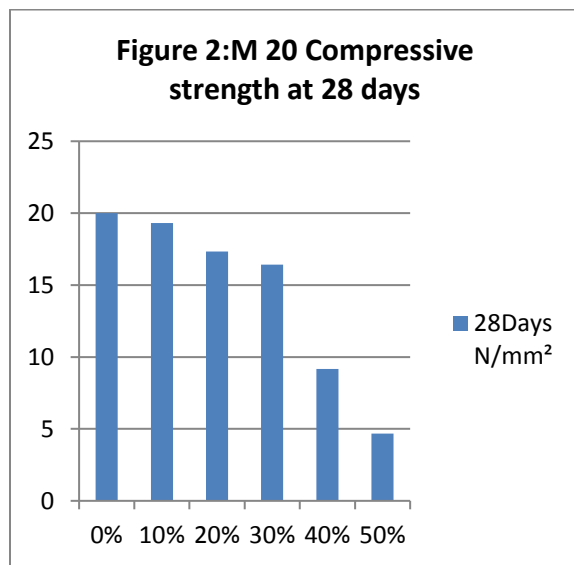


Table 4: Compression test on partial replacement of M - sand

M-sand added in %	FA added in %	Compressive Strength
0	100	20
10	90	21.21
20	80	21.15
30	70	20.92
40	60	26.07
50	50	26.78

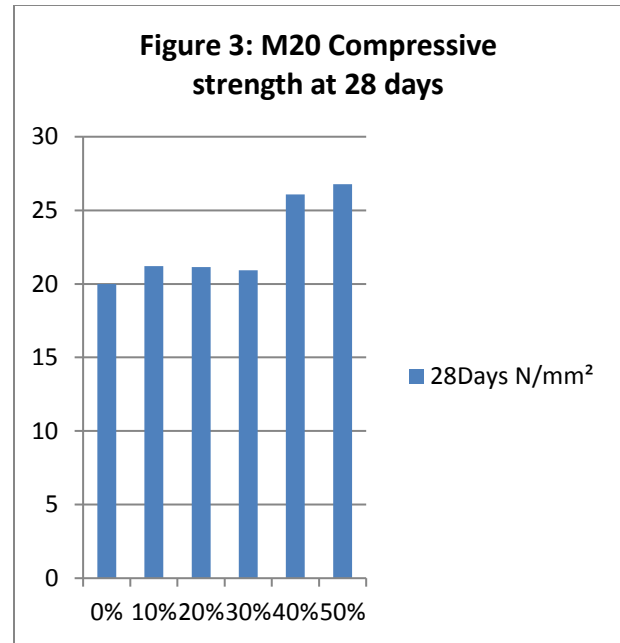
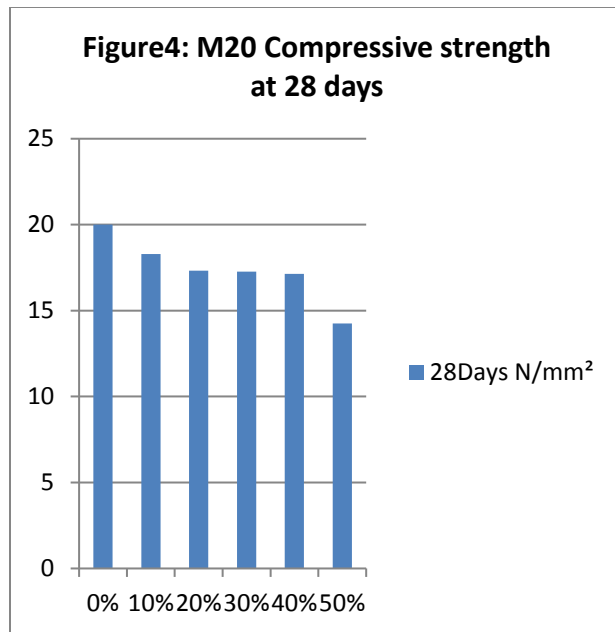


Table 5: Compression test on partial replacement of Egg shell and M - sand

Combined replacement	ES added in %	M – sand added in %	FA in %	Compression strength at 28 days
0	0	0	100	20
10	5	5	90	18.3
20	10	10	80	17.32
30	15	15	70	17.26
40	20	20	60	17.14
50	25	25	50	14.25



Advantages

- ▶ This concrete is economical in nature.
- ▶ The used egg shells are easily available because they are present in large number as a material which cannot be easily decompose.
- ▶ It can be applicable for low load carrying elements like compound walls , handrails, decoration purpose etc.,

Disadvantages

- ▶ The used eggshell does not have capacity to absorb water easily. Therefore, the setting time of the concrete is extended.
- ▶ The specified strength is not achieved.
- ▶ The skilled people are needed.

Conclusion

Based on the result and discussion mentioned above the following conclusion and obtained

The partial replacement of eggshell with river sand gives low strength. At the same partial replacement of M-sand with ordinary sand gives higher strength compared with conventional concrete. But, while mixing of both Egg shell and M-sand as a partial material for replacement of sand in concrete, its gives a lesser strength compared with nominal concrete. As the texture and shape of egg shell is varying with the properties of sand. Hence its application is not desirable in concrete.

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