



# An Experimental Investigation of EGGSHELL POWDER as a Partial Replacement of Cement in Paverblock

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## Abstract:

As the quality of construction material is an important factor which enhances the stability of the structure, an attempt has been made to study the possibilities of using EGGSHELL powder in paver block. Cement was partially replaced by EGGSHELL POWDER at 5% intervals from 0% to 25% by the method of replacement by weight. The function of this admixture is to reduce the water cement ratio and enhance workability. The paver block Curing process is done for 7 days and 28 days, After curing it is checked for its Compressive Strength and flexural strength. It was noted that 13.4% increase of compressive strength at 10% replacement of EGGSHELL POWDER. Flexural strength was also 19.5% increased at the same 10% replacement of EGGSHELL POWDER. The result showed the EGGSHELL POWDER can be advantageous if it was replaced as 10% of cement.

**Keywords:** Eggshell powder, M sand

## I. INTRODUCTION

Concrete is being widely used for the construction of most of the buildings, bridges and it is also known as backbone to the infrastructure development of a nation. At present, for a variety of reasons, the concrete industry is not sustainable. Firstly, it consumes huge amount of natural resource due to which no virgin material will be left for future generation. Secondly, the major component of concrete is cement. Thirdly, concrete structure suffers from durability problem due to which natural resources are wasted.

Therefore, there is a need to find an alternative method so that concrete industry becomes sustainable. Hence, currently, the entire construction industry is in search of a suitable and effective the waste product that would considerably minimize the use of cements and ultimately reduces the construction cost. And also waste by products from agriculture and industry like fly ash, rice husk ash, egg shells, copper slag, quarry dust etc are creating environmental and health concern problems. Therefore, in the present study fly ash and egg shell powder are used in concrete as a partial replacement of cement. In the past, fly ash obtained from coal combustion was simply and dispersed into atmosphere.

Instead of dispersing it into atmosphere or sending it to land fill it can be effectively used in concrete production as supplementary material to cement. Fly ash is an ash produced during combustion of coal. There are two types of fly ash, one is class F fly ash and another one is class C. Class F fly ash contains less than 5% lime and class C fly ash contains more than 10% of lime.

India ranks second in the world with annual egg production. Disposal of these egg shells is a big problem because if they are sent to landfills attracts vermin and causes problems related to human health and environment. Egg shell are rich in calcium and has nearly same composition that of limestone.

Use of eggshell waste instead of natural lime in cement can have benefits like conserving natural lime and utilizing this waste material.

## II. OBJECTIVES OF THIS STUDY

The main objective of this work was to study the behavior of paver block with the percentage variation of eggshell as cement from 0% to 25% at 5% intervals. The Compressive and Flexural strength Properties have studied for each mixes.

## III. MATERIALS

### A. Cement

Cement is a binder that sets and hardens and can bind other Materials together. The cement type 1 grade 33 is used for the casting of the paver block. The compressive strength of cement after 28 days test as per IS specification is 33 MPa.

### B. Fine Aggregate

Aggregate which passed through 4.75 mm IS sieve and retained on aggregate is a granular material, such as sand, gravel, crushed stone, crushed hydraulic cement concrete, or iron blast furnace slag, used with a hydraulic cementing medium to produce either concrete or mortar.

### C. Coarse Aggregate

Aggregate are a component of composite materials such as concrete and asphalt concrete; the aggregate serves as reinforcement to add strength the overall composite material. 10mm sized aggregate are used in the paver Blocks.

### D. Eggshell Powder

It is systematically acknowledged that the eggshell chiefly consists of compounds of calcium. It has proficiently proposed that eggshell comprises 93.70% calcium carbonate (in

calcium), 4.20% organic matter, 1.30% magnesium carbonate, and 0.8% calcium phosphate. Stored egg shell was powdered in flour mill. The grinded egg shells were sieved through the 90 micron sieve size and then packed to use it in the cement replacement.

**Table .1. Property of Materials**

SI.No	Material	Properties	Result
1	Cement	Specific Gravity	3.15
2		Standard Consistency	29%
3		Initial Setting Time	35mins
4		Final Setting Time	10hrs
5	Fine Aggregate	Fineness modulus	0.46
6	Coarse Aggregate	Specific Gravity	2.74
7		Impact strength	21.65%
8		Crushing strength	29.01%
9	Eggshell powder	Specific Gravity	2.56

**IV. MIX DESIGN**

In this experimental work, M30 grade concrete with w/c ratio of 0.5 was used. In this experimental study, totally 24 numbers of specimen were cast. The specimens consist of 250 x125 x85mm size paver block. The eggshell was replaced to concrete by percentage of cement. Table 2 shows they arrived values of mix ratio for conventional concrete.

**Table .2 Mix Ratio**

Cement	Fine Aggregate	Coarse Aggregate	Water
1	2.248	1.709	0.5

**V. RESULT AND DISCUSSIONS**

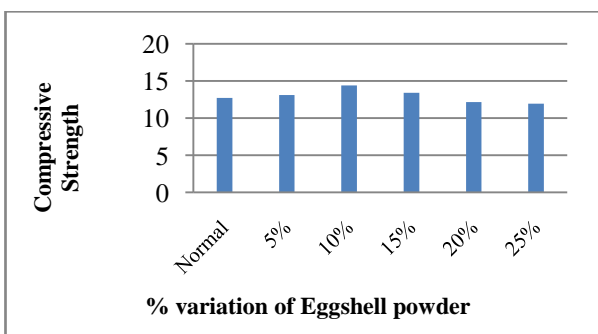
**A. Test on hardened concrete for compressive Strength**

The tests for hardened concrete such as compressive strength were conducted and the readings were noted and also taken the weight of the concrete. The various strength test and weight reduction results were tabulated in table3.

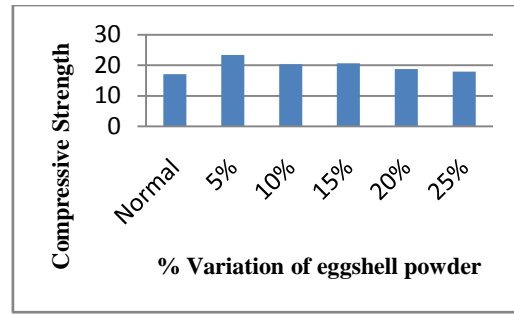
**Table.3. Compressive strength and weight of paver block**

SI.No	% of Egg shell power	Compressive Strength		Weight
		7 Days	28 Days	
1	0	12.7	17.06	5.643
2	5	13.12	23.40	5.726
3	10	14.4	20.32	5.532
4	15	13.4	20.68	5.451
5	20	12.17	18.82	5.717
6	25	11.92	17.92	5.405

Figure 1 & 2 shows the variation of compressive strength of paver block at 7<sup>th</sup> & 28<sup>th</sup> days.



**Figure.1. Compressive strength of paver block at 7<sup>th</sup> day**



**Figure.2. Compressive strength of paver block at 28<sup>th</sup> day**

Figure shows the variation of compressive strength of paver block at 28<sup>th</sup> day. The compressive strength of paver block is increased with the replacement of eggshell up to 10%. Further addition of eggshell leads to the decrease of strength. Therefore the maximum strength is obtained for paver block with 10% replacement of cement using eggshell powder and the strength increment of eggshell admixed paver block is 13.4% higher than the control concrete.

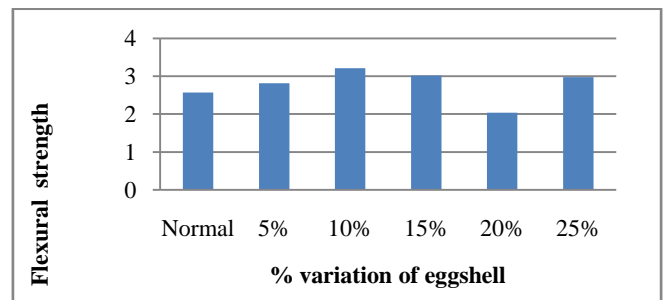
**B. Test on hardened concrete for flexural Strength**

The tests for hardened concrete such as compressive strength were conducted and the readings were noted and also taken the weight of the concrete. The various strength test and weight reduction results were tabulated in table3.

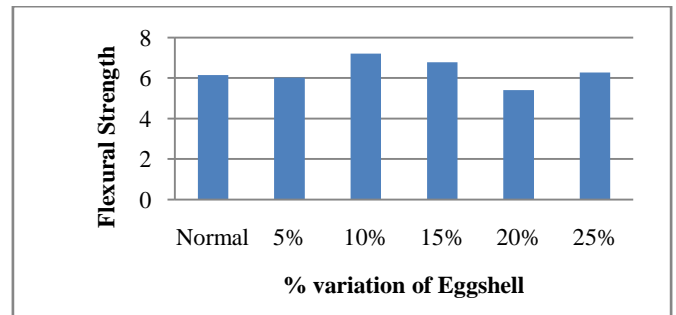
**Table.3. Compressive strength and weight of paver block**

SI.No	% of Eggshell power	Flexural Strength	
		7 Days	28 Days
1	0	2.57	6.15
2	5	2.82	6.03
3	10	3.21	7.21
4	15	3.02	6.78
5	20	2.04	5.4
6	25	2.98	6.28

Figure 3 & 4 shows the variation of flexural strength of paver block at 7<sup>th</sup> & 28<sup>th</sup> days.



**Figure.3. Flexural strength of paver block at 7<sup>th</sup> day**



**Figure.4. Flexural strength of paver block at 28<sup>th</sup> day**

Figure shows the variation of flexural strength of paver block at 28<sup>th</sup> day. The flexural strength of paver block is increased with the replacement of eggshell up to 10%. Further addition of eggshell leads to the decrease of strength. Therefore the

maximum strength is obtained for paver block with 10% replacement of cement using eggshell powder and the strength increment of eggshell admixed paver block is 19.5% higher than the control concrete.

## VII. CONCLUSION

- An experimental investigation study on EGGSHELL POWDER partial replacement of cement in paver block is replacement up to 25%. An Eggshell powder may be found easily.
- The cost of the paver block is reduced as comparative to the concrete paver block. Paver block made by using EGGSHELL POWDER, Cement, Coarse aggregate and fine aggregate have shown a best result. Probably EGGSHELL POWDER is a waste material so it is an effective method in partially replacing cement in paver blocks. It is an effective and useful method.
- From the experimental work result it is clear that egg shell powder alone can be replaced which increases the strength parameters meanwhile reduces the cement usage.

## VIII. REFERENCES

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