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EFFECTIVE USAGE OF EGG SHELL POWDER AND CERAMIC WASTE POWDER IN CONCRETE

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ABSTRACT

This paper reveals the scope of waste in construction industry. Various industrial and agricultural wastes generated and its volume increased day to day. One of the practices involved to overcome such conditions is the usage of such waste products in construction materials technology. In this present study, cement is partially replaced by the combination of egg shell waste powder and ceramic waste powder in the production of concrete. Concrete made from basic ingredients alongwith such wastes were cured for 7, 14 and 28 days and tested. Various engineering parameters of the concrete mix determined such as workability, compression test, split tensile strength and flexural strength. All results obtained shows permissible values with the variation of percentages usages of ESP and CWP.

Keywords: Mix, Strength, Concrete, Curing, Workability, Engineering Properties, ESP, Industrial Wastes.

I. INTRODUCTION

Infrastructure development involves the Construction sector like the construction of bridges, multi-storey buildings, roadways and many more. One of the prominent sectors is to reuse the wastes generated in our construction world. Wastes can be used in concrete production by partially replacing the main constituents by weight at certain content or ratios. It is the way where we can help to maintain the sustainability of the environment at some extent. One way to emphasise on the reduction of cement production i.e. to reduce the emission of harmful gases during the manufacturing of cement which causes greenhouse effect is the reuse of above waste products as construction materials. Materials depending upon their chemical constitution can be used in the production of concrete mix for the production of sustainable concrete. In our research work, waste products such as Egg shells and ceramic tiles both in powdered form can be used to partially replace the cement content in the concrete mix design.

II. LITERATURE REVIEW

In this Section, we found the cement is partially replaced by Egg Shell Powder and Ceramic Waste Powder with the percentage variations of (0%, 10%,15%,20% and 25% as ESP) and (0%, 5%, 10%,15% and 20% as CWP) respectively for the sustainable construction. Following are the literatures researched to cover our work.

Hardik Patel (2015) worked as ceramic powder used as cement replacement partially in concrete. He defines the ceramic wastes from ceramic industry can be used as partially replaced cement content by wt. of cement as 0%, 10%.20%, 30%, 40%, 50% and 60% in concrete for M 25 grade. He concluded that 30% becomes the optimum replacement percentage by weight of cement with ceramic waste powder to get the desired results.

Pavan Hiremath et.al (2016) have done study over the additional impact of Egg shells on the mechanical properties of concrete. The goal of the current work is to examine how egg shell powder, utilised as a filler material, affects the mechanical behaviour of a glass fiber-reinforced resin matrix. Utilising 50 weight percent fibre and 5 weight percent egg shell powder with the remaining matrix material, various composites are created. Hand-layup is the method used to create composites. Study is done on the mechanical and physical qualities. The outcomes are contrasted for various filler material percentages.

Dr. M. Swaroopa Rani (2016) made a study on ceramic powder waste in concrete. In this study, ceramic waste powder was used in place of regular Portland cement in proportions of 0%, 10%, 20%, 30%, 40%, and 50% by weight for M-40 grade concrete. The compressive strength was then calculated.

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N. Parthasarathi et.al (2017) have been done work on the topic as experimental study on partial replacement of cement with egg shell powder and silica fume. The goal of this research study is to investigate the usage of egg shell powder and silica fume as a restricted cement additive. Along with silica fume replacements of 2.5%, 5%, and 7.5% of cement weight, egg shell powder replacements of 5%, 10%, and 15% are also made. An experimental study looked at the strength characteristics of egg shell-based concrete using tests for split tensile strength, compressive strength, and flexural strength. The strength of the concrete is found to increase with the addition of egg shell powder and silica fume, and ultimately a comparison is done for the enhanced strength of concrete with egg shell and silica fume.

III. OBJECTIVES

1. Effective use of Egg Shell and Ceramic Waste for constructional work.
2. The optimum usage of ESP and CWP for the partial replacement of cement in M30 grade concrete.
3. To find out the fresh concrete properties as workability of the mix.
4. Calculate the hardened concrete properties of the mix as compressive, split tensile and flexural strength parameters of the concrete mix.
5. Comparison of conventional concrete mix with different replacement mix of the concrete.

IV. MATERIALS

Cement: OPC 43 grade cement was used in our study to investigate the strength parameters of the concrete.

Sand: Locally available sand of zone II as fine aggregates was used in our study.

Coarse Aggregates: A coarse aggregate of 20mm size from locally available crusher was used to carry out our experimental study.

Egg Shell Powder: As it contains lime as maximum content, thus it can be used to replace cement partially for the concrete production.

Table 1: Chemical composition of Egg shell powder

S. No.	Composition	Percentage (%)
1.	CaO	53%
2.	MgO	1%
3.	SiO_2	1.5%
4.	Al_2O_3	0.28%
5.	Fe_2O_3	0.36%
6.	Cl	0.011%

Ceramic Waste Powder: Ceramic waste tiles having chemical composition which mainly contains silica. Thus, it can be useful to be used as construction material which also helpful to reduce the wastage.

Table 2: Chemical composition of ceramic waste powder

S. No	Ingredients	Chemical Composition
1	SiO_2	63.5
2	Al_2O_3	17.9
3	CaO	5.9
4	Mn_2O_3	0.02
5	Cl	0.0054
6	SO_3	0.098
7	K_2O	2.08
8	P_2O_5	0.16
9	Na_20	0.68

V. RESULTS AND DISCUSSION

The results analysis obtained using tests Slump cone test, compression, Split tensile and Flexural tests on M30 grade concrete prepared by partially replacing cement with egg shell powder and ceramic waste powder are shown graphically below:

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1. Slump Cone Test

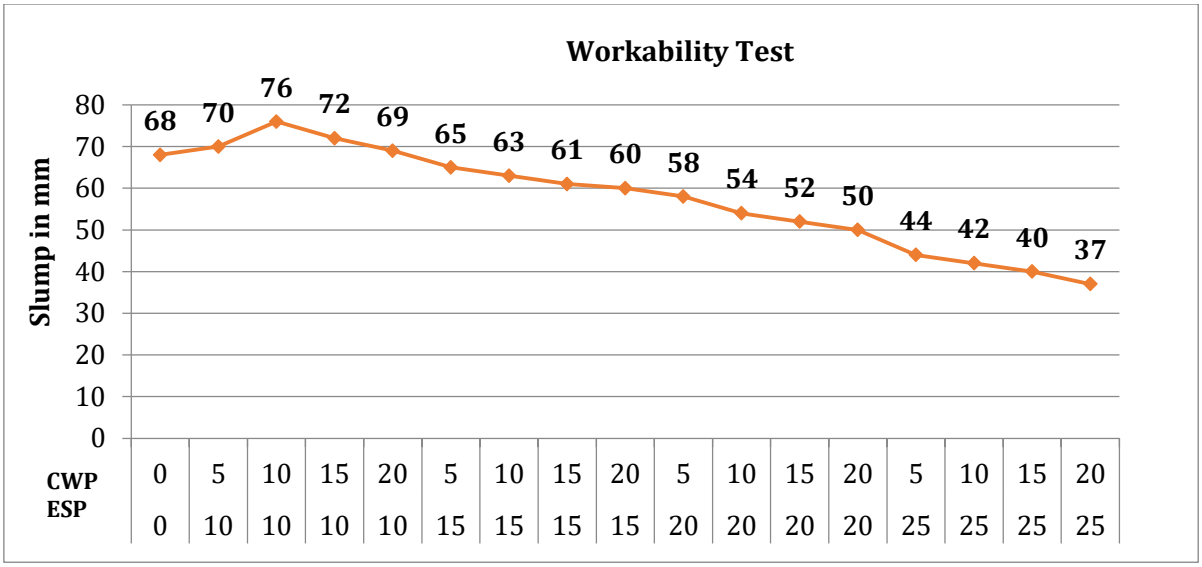

Figure 1: Slump Cone Test – Workability

2. Compression Strength Test

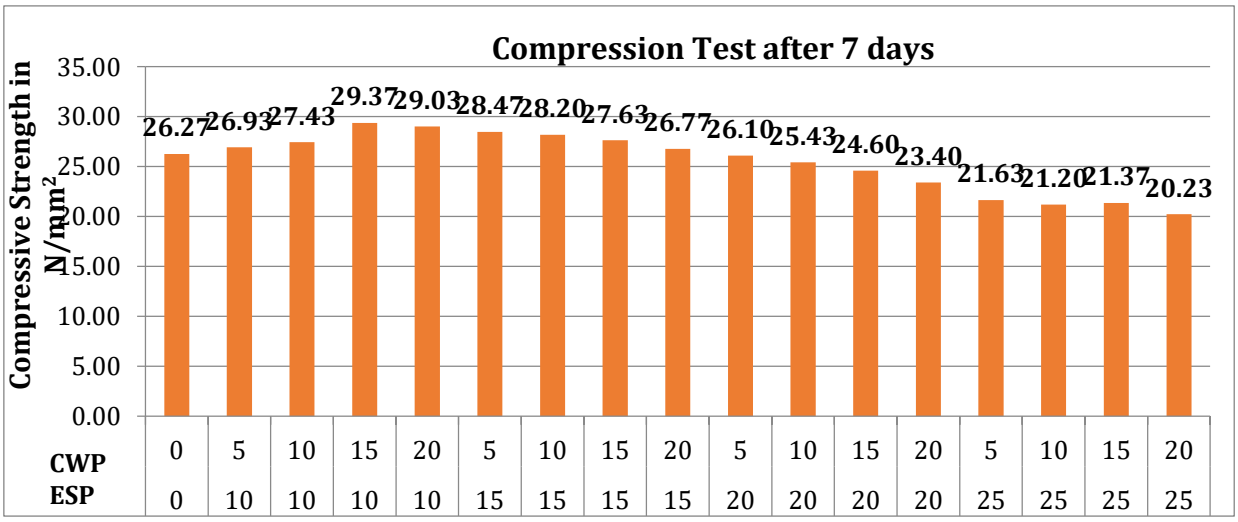

Figure 2: Compressive Strength Test after 7 Days

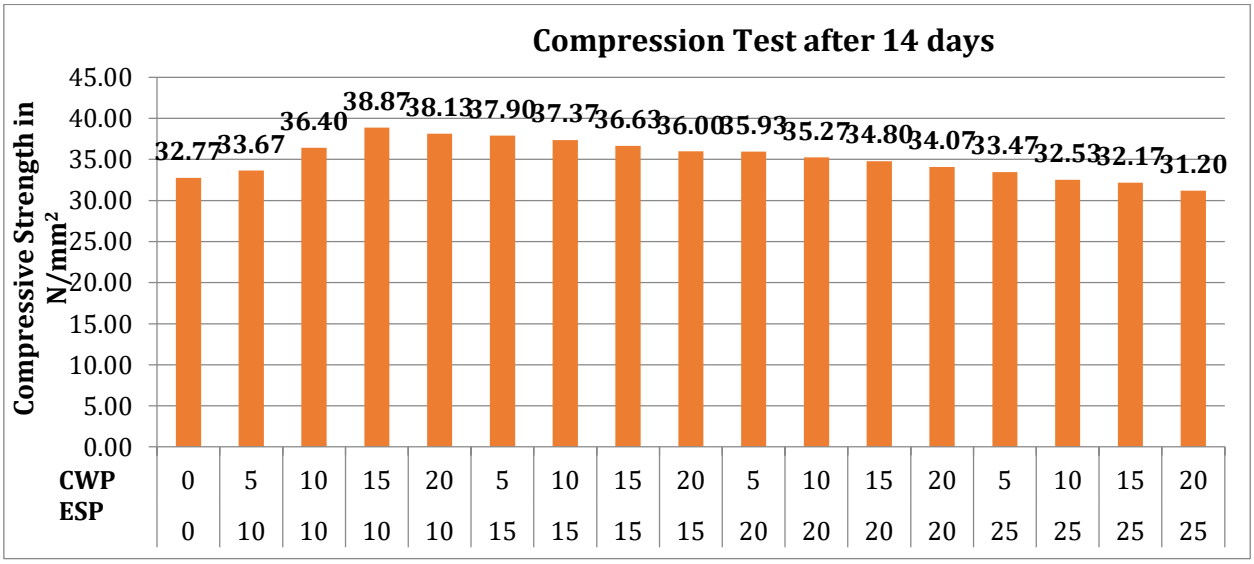

Figure 3: Compressive Strength Test after 14 days

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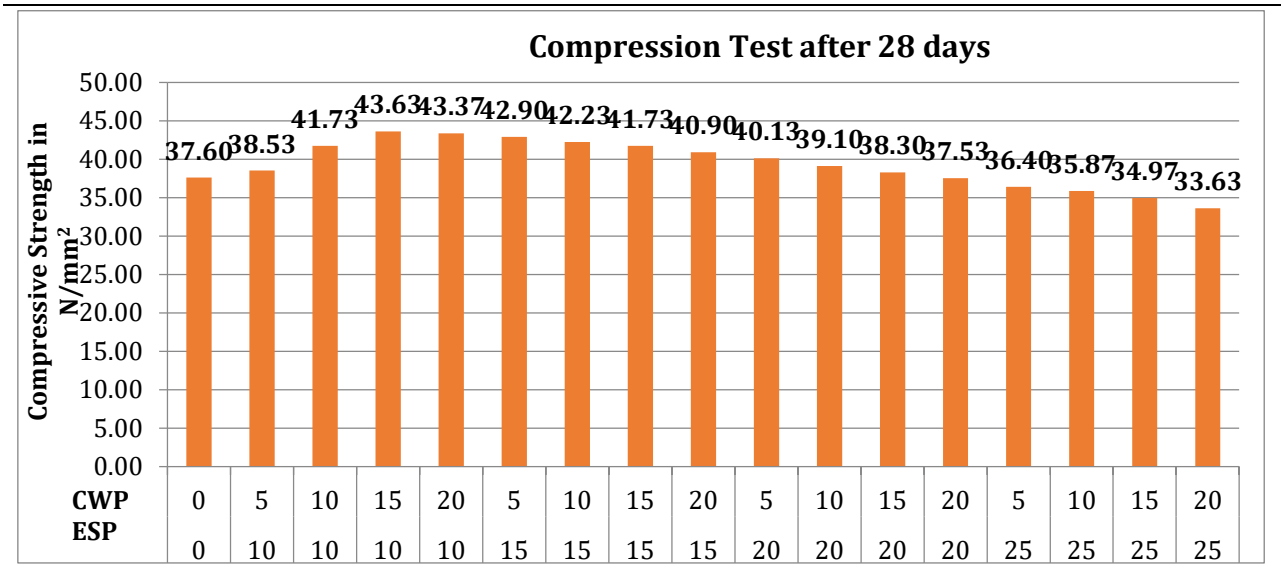

Figure 4: Compressive Strength Test after 28 days

3. Split Tensile Strength Test

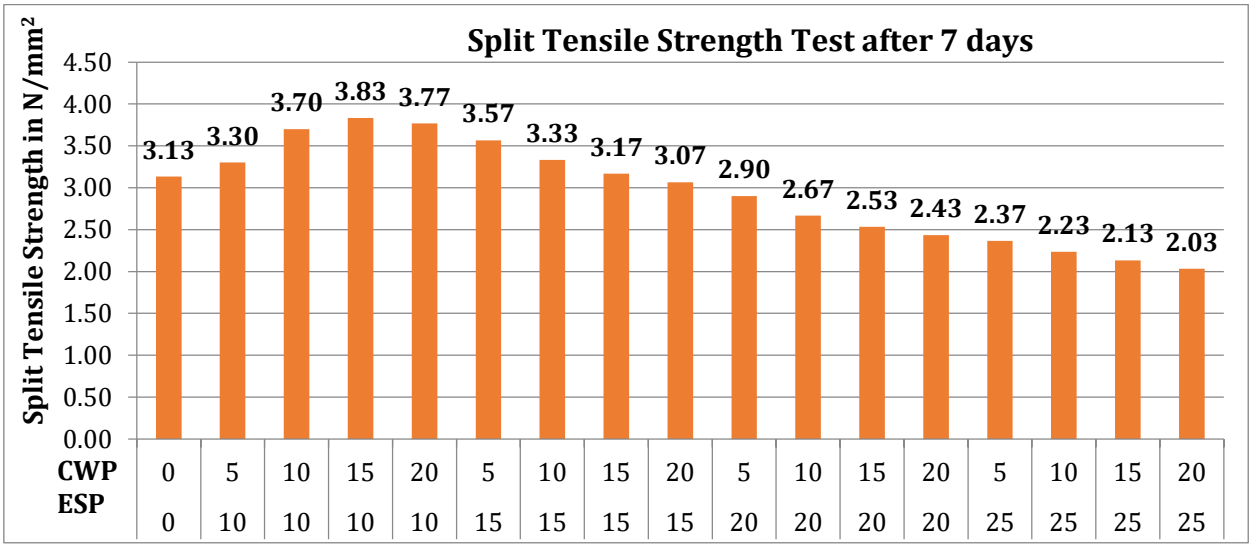

Figure 5: Split Tensile Strength Test after 7 days

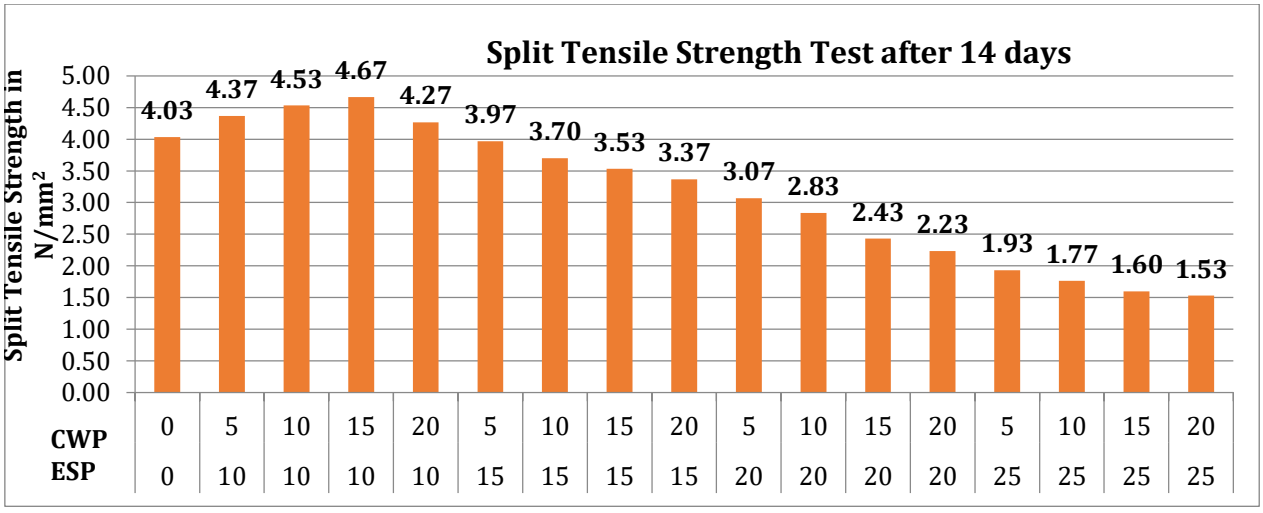

Figure 6: Split Tensile Strength Test after 14 days

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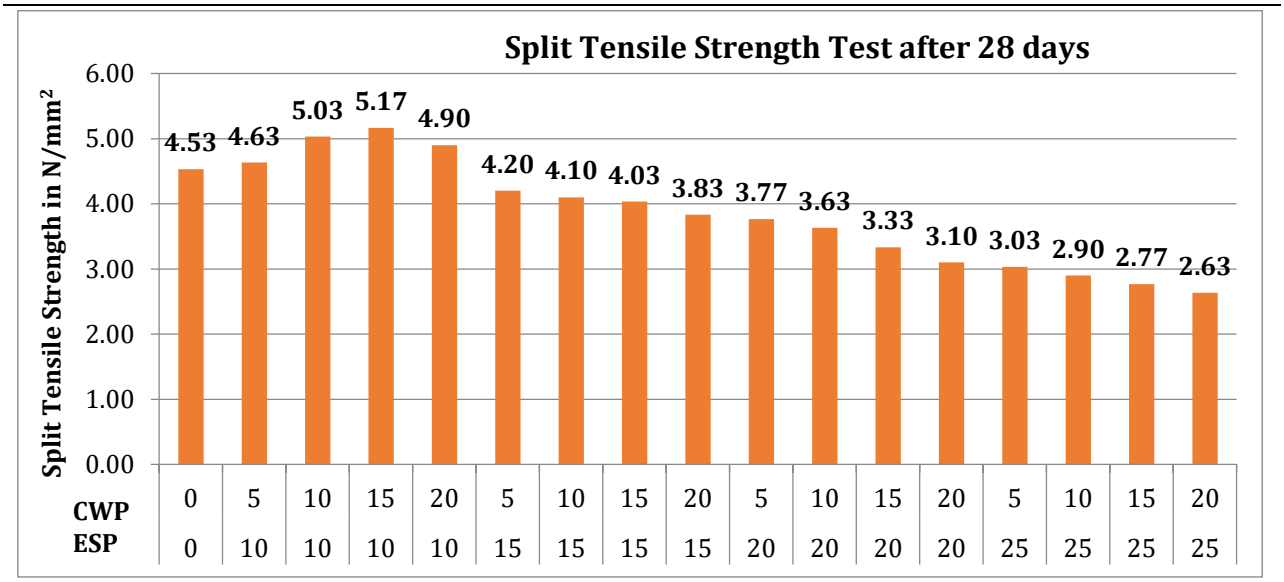

Figure 7: Split Tensile Strength Test after 28 days

4. Flexural Strength Test

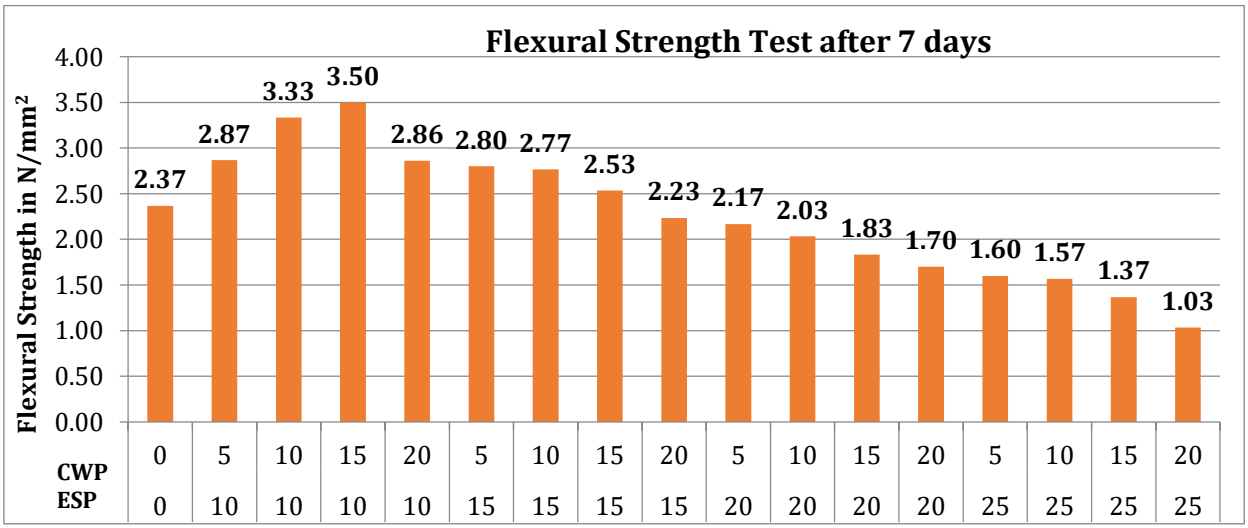

Figure 8: Flexural Strength Test after 7 days

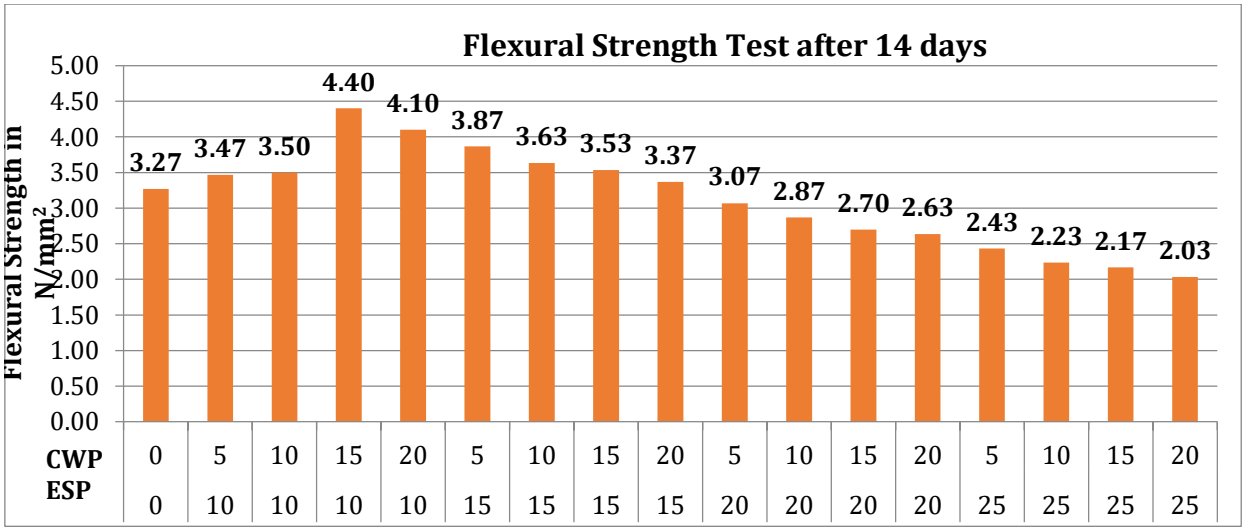

Figure 9: Flexural Strength Test after 14 days

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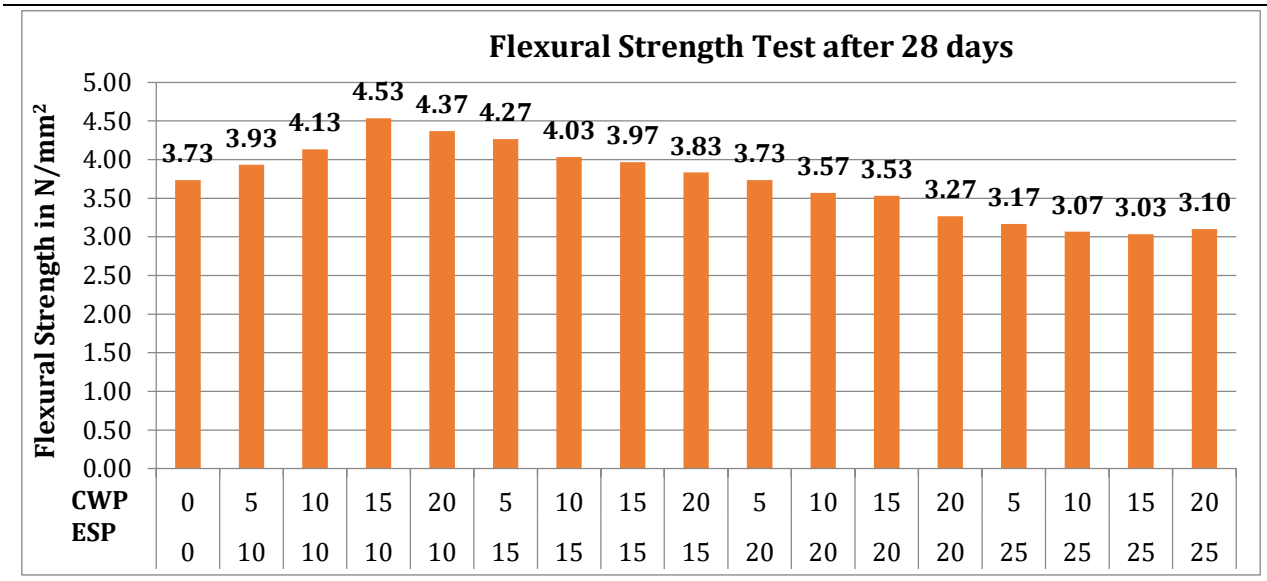

Figure 10: Flexural Strength Test after 28 days

VI. CONCLUSION

1. All The wastages as Egg shell powder and ceramic waste powder will be used as construction materials.
2. The workability results also concluded that with the increase in percentage of Ceramic Waste Powder and Egg Shell powder workability of concrete mix decreases. This may be due to higher water absorption property.
3. The Slump value increases 68 mm to 76 mm after that the values gets degraded.
4. The Compressive Strength of Concrete mix after 7days, 14 days and 28 days of curing increases gradually by replacement of cement with Ceramic Waste Powder and Egg shell powder becomes maximum as 29.37 N/mm^2, 38.87 N/mm^2 and 43.63 N/mm^2 when ESP is 10%, CWP is 15%.
5. The Split Tensile Strength of mix achieves maximum value of 3.83 N/mm2, 4.67 N/mm^2 and 5.17 N/mm^2 when ESP is 10%, CWP is 15% is added to concrete mix after 7, 14 and 28 days of curing, respectively.
6. The Ultimate Flexural Strength observed maximum with ESP is 10%, CWP is 15% i.e. 3.50 N/mm^2, 4.40 N/mm^2 and 4.53 N/mm^2 of mix after curing of 7days, 14 days and 28 days, respectively.

VII. REFERENCES

[1] Amarnath Yerramala (2014) “Properties of concrete with eggshell powder ascement replacement” The Indian Concrete Journal October 2014.

[2] Hardik Patel et.al (2015) “Use of Ceramic Waste Powder in Cement Concrete” International Journal for Innovative Research In Science and Technology (IJIEST) Volume 2 Issue 1 2015.

[3] Kiran Kumar Poloju (2016) “An Experimental Study on Compressive Strength of Sustainable Concreteusing Ceramic Waste as Partial Replacement of Cement” Kiran Kumar Poloju et al./ Elixir Civil Engg. 107 (2017) 46954-44956 22 May 2017.

[4] Parthasarathi et.al (2017) “Experimental Study On Partial Replacement Of Cement With Egg Shell Powder And Silica Fumen” Rasayan J. Chem. Vol. 10 | No. 2 |442 - 449 | April - June | 2017ISSN: 0974-1496 d.o.i. http://dx.doi.org/10.7324/RJC.2017.1021689

[5] Vaibhav R. Shirodkar (2020), “The Effects of Nano Materials and Egg Shell Waste Material on the Physical and Strength Properties of Floor Tiles”, International Journal of Creative Research Thoughts (IJCRT), Volume 8, Issue 6 June 2020 | ISSN: 2320-2882.

[6] X. F. Li (2020), “Effect of Eggshell Powder on the Mechanical and Durability Properties of Cement Mortar”, Proceedings of the Sustainable Concrete Materials and Structures in Construction 2020, Lecture Notes in Civil Engineering 157, https://doi.org/10.1007/978-981-16-2187-1_14.

[7] R.Johnson Daniel (2021), “Experimental study on concrete using waste ceramic as partial replacement of aggregate”, Materials Today: Proceedings 45(2021) 6603-6608, https://doi.org/10.1016/j.matpr.2020.11.772.