Bharat Bhushan et al. International Journal of Recent Research Aspects ISSN: 2349-7688, Vol. 6, Issue 4, Dec 2019, pp. 23-29

Experimental Study on the Mechanical Properties of Glass Powder and Marble Dust Concrete

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Abstract: **The research work is (was done to) determination of the effect of the use of percentages of glass powder (0%, 6%, 12%, 18%) with cement and fine aggregates will replaced by marble dust (0%,20%,40%,60%) to assess the pozzolanic nature of fine glass powder and Glass Powder when mixed in concrete and compare the difference in performance with other pozzolanic materials are mixed in concrete like silica fume and fly ash. The present study shows that waste glass, if ground finer than 600µm shows a pozzolanic behaviour.**

It reacts with lime at early stage of hydration forming extra CSH gel thereby forming denser cement matrix. Thus early consumption of alkalis by glass particles helps in the reduction of alkali-silica reaction hence enhancing the durability of concrete. Numbers of test were conducted to study the effect of of glass powder (0%, 6%, 12%, 18%) with cement and fine aggregates will replaced by marble dust (0%, 20%, 40%, 60%)on compressive strength, Split Tensile Strength, Flexural Strength & Slump Test. The results showed that The maximum value of compressive strength at 28 days obtained at 18% glass powder and 40% marble powder is 44.15 mpa which is 15.9% higher that control mix. Thus concrete mix containing 18% glass powder and 40% marble powder can be effectively used in structures designed for compression. The maximum value of split tensile strength fo concrete containing18% glass powder and 40% marble powder is 5.76 mpa. The maximum value of flexural strength at 28 days was obtained at 18% glass powder and 40% marble powder is 8.43 which is 38% higher than conventional concrete

Keywords: **Glass Powder, Cement, Ceramic Aggregates Concrete, Mechanical Properties**

I. INTRODUCTION

Manufacturing processes, service industries and municipal solid wastes are the sources of production of numerous waste materials. Concerns related with disposal of the generated wastes have tremendously increased with the increasing awareness about the environment. Solid waste management is one of the major environmental concerns in the world. Waste utilization has become an attractive alternative to disposal because of the scarcity of space for land filling and due to its ever increasing cost. The use of waste products in concrete not only makes it economical, but also helps in reducing disposal problems. Reuse of bulky wastes is considered the best environmental alternative for solving the problem of disposal. One such waste is plastic, which could be used in various applications. According to the World Commission on Environment and Development: sustainability means "Meeting the needs of the present without compromising the ability of the future generations to meet their own needs". Sustainability is an idea for concern for the well being of our planet with continued growth and human development [McDonough 1992]. For example, if we run out of limestone, as it is predicted to happen in some places, then we cannot produce Portland cement and, therefore, we cannot produce concrete; and, all the employers associated with the concrete industry go out-of-business, along with their employees [1-5].

Glass powder

Powder glasses are made from finely ground glass, the main source being broken and unusable bottles and a great variety of other scrap glasses. Special glasses such as old cobalt medicine bottles, cold cream jars, and many other types of glasses from plates, ashtrays, window panes - to name only a few - are occasionally bought new, just for the purpose. Pulverized or merely fragmented, and made into beads, these glasses yield particularly bright colours and shiny surfaces. Modern ceramic colorants, finely ground broken beads, or shards of different coloured glasses from various sources can be added to create a great variety of styles, designs and decorative patterns in many different colures. In addition, glass bead fragments of varying sizes, which have traditionally been used for the manufacture as well as for the decoration of specific types of beads, can now be found in interesting new combinations, and during the past few years in particular, bead makers have taken this tradition yet another step forward by using entire, i.e. whole small beads for making their colorful bead creations [6].

Marble Dust

India is the third largest producer of marble in the world. Marble is cut into the required dimensions during mining and about 5–6 Mt of MD is generated each year through over marble cutting, polishing, processing and grinding. In these operations, an average 20% of the total extracted marble ends up as MD (Gupta, 1998; Mohamed, 2013; Pappu et al., 2007) and is one of the major environmental problems around the world. An approach for the sustainable use of Marble Dust in the construction industry was undertaken in this study, so that environmental threats could be reduced in a scientific manner. Marble has been commonly used as a building material since the ancient times. Consequently, Marble waste as a by-product is a very important material which requires adequate environmental disposal effort. In addition, recycling waste without proper management can result in environmental problems greater than the waste itself [7].

II. LITERATURE REVIEW

Bajad M.N. et al[2011] investigated the strength of concrete containing glass powder when subjected to Sulphate attack and results concluded that highest compressive strength is achieved with 20% of replacement of cement in both the conditions and the strength decreases with increases in percentage beyond 20%.

Ali Ergun (2011). In this experimental work, cement is replaced with diatomite and waste marble Powder separately or together. The concrete mixture was prepared using super plasticizers to reduce water Demands. The various tests results indicates that concrete specimen containing 10% Diatomite and 5% Waste Marble powder gives high compressive and flexural strength as compared to control mix. Also it was found that concrete specimen with 10% Daitomite and 5% Marble Powder gives the best results among all the mixes. Thus it can be concluded that using Diatomit upto 10% and Marble powder uptp 5% sepaprtely or together as cement replacement can positively enhance concrete properties [8].

Dali J.S. and Tande S.N. [2012] concluded that the compressive strength of concrete increases at 20 % replacement of cement by glass powder either subjected to alternative wetting and drying or not.Khatib J.M. et al] studied the utilization of glass powder in concrete production. In their research at water cement ratio 0.5 and at a replacement of cement with 10%, 20%,30%and 40% the highest compressive strength is achieved at 10% replacement and beyond 10% partial replacement it decrees & is less than the control mix [9].

Dhanraj Mohan Patil and Dr. Keshav K.Sangle [2013] studied that if the size of glass powder decreases the compressive strength of concrete increases. The results concluded that particle size ranges from 90 micron gives higher compressive strength than particle size ranges from 90 to 150 micron. He also concluded that initially the increment in compressive strength is less at 7 th day but it meets the required strength at 28thday. The results showed that at 20% replacement of cement by waste glass powder meets the maximum strength compare to conventional concrete.

Pedro Martins et.al (2014). This research works aimed at partially incorporating coarse waste marble aggregate(CMA) in place of natural coarse aggregates in concrete. Concrete mixes with replacement ratio of 20%, 50%, and 100% of natural aggregates with coarse waste marble aggregates. The various tests involved are slump test, specific density, split tensile strength, compressive strength, modulus of elasticity, and resistance to abrasion. The result conclude that compressive strength is moderately affected by incorporation of CMA i.e 10% decreases with 100% incorporation. Split tensile strength is slightly influenced. There is decrease in modulus of elasticity. The increase in incorporation ratio leads to lower wear resistance [10].

Ranjan Kumar et.al (2015). In this research work, waste marble dust powder was used to study the properties of hardened concrete. Cement is replaced by marble dust Powder by varying percentages of 0%,5%.10% and 20%. The laboratory results showed that upto 10% marble dust replacement increases compressive strength and upto 15% replacement by marble dust increases Split Tensile strength and Flexural strength of concrete

Hasan Sahan Arel (2016). This review paper reports on change in properties of concrete by replacing cement with waste marble dust and the use of waste marble as aggregate in concrete. The study of this paper concluded that the marble powder contributes to the compressive strengthof concrete due to presence of $CaCO_3$ and SiO_2 in its chemical structure. It was alos observed that replacing cement by 5-10% marble dust improves the mechanical properties of concrete and reduces CO2 emission by 12%. Waste marble if used in coarse aggregate form, it shows more positive effects on properties of concrete and also lowers the total standard production cost of concrete.

Liwu Mo et.al (2017) In this paper steel slag has been used as supplementary cementeous material and as a aggregate marterial. 60% of steel slag is used as replacement of cement and upto 100% as aggregates replacement. The concrete was exposed to the carbonation curing with 99.9% CO2 for duration period of 1 day, 3 ady and 14 days.the experiments were performed for carbonation front, compressive strength and volume stability for concrete. The results showed that compressive strength of concrete containing slag after carbon dioxide curing has increased.

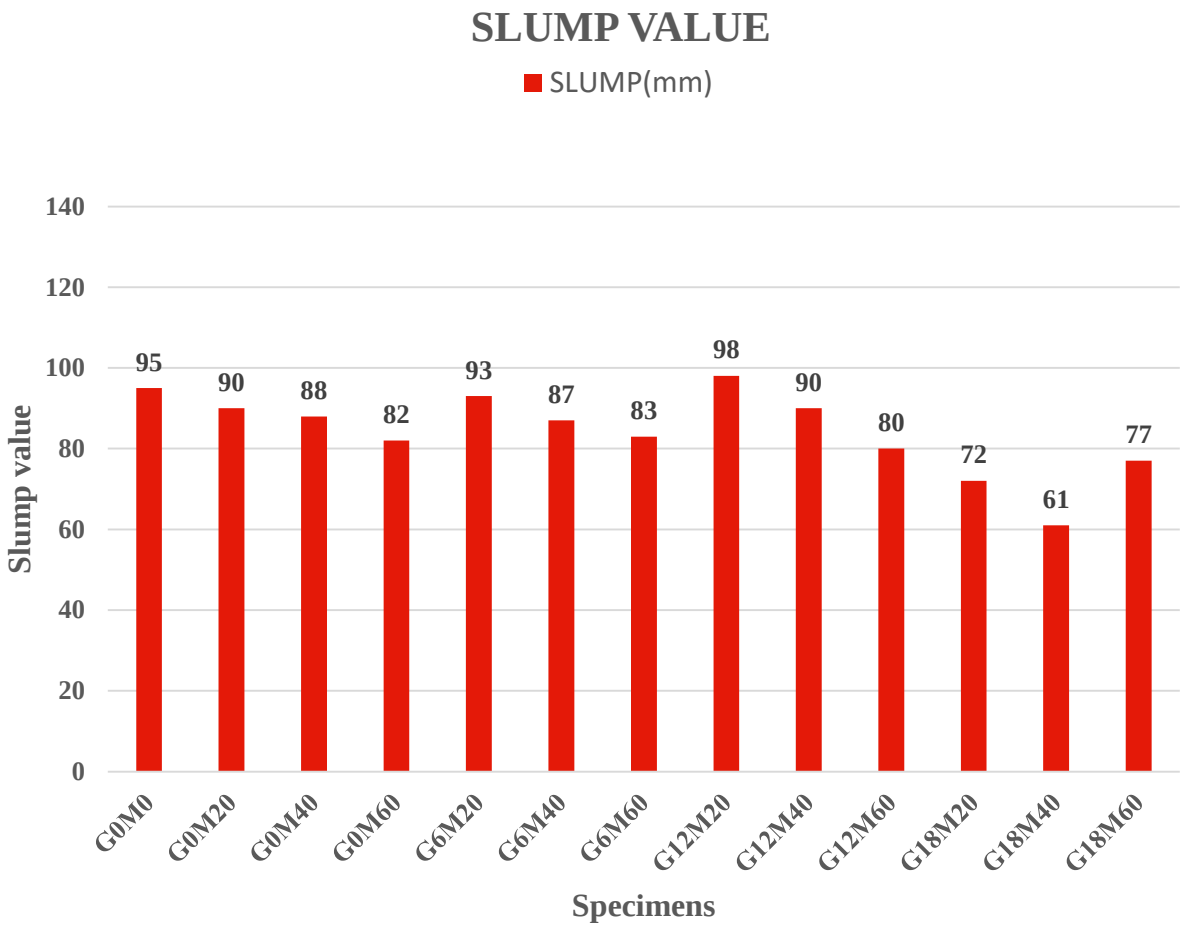
Bassam A. Tayeh (2018): This research mainly aims to determine the impact of using waste materials, such as crushed glass, crushed marble, and burned wood in powder form, as partial replacements for cement on the compressive strength of concrete. Mechanical properties (e.g., compressive strength) and physical properties (e.g., workability and unit weight) were investigated. The powdered waste materials (after passing through sieve #200) were partially replaced with cement by ratios of 10%, 20%, and 30%. Compressive strength was tested on the 7th, 28th, and 56th days. Results showed that workability decreased as the partial replacement

level of glass powder, marble powder, and timber ash increased. The results also showed a decrease in the compressive strength of concrete when the replacement level was increased from 10% to 30% for each waste material.

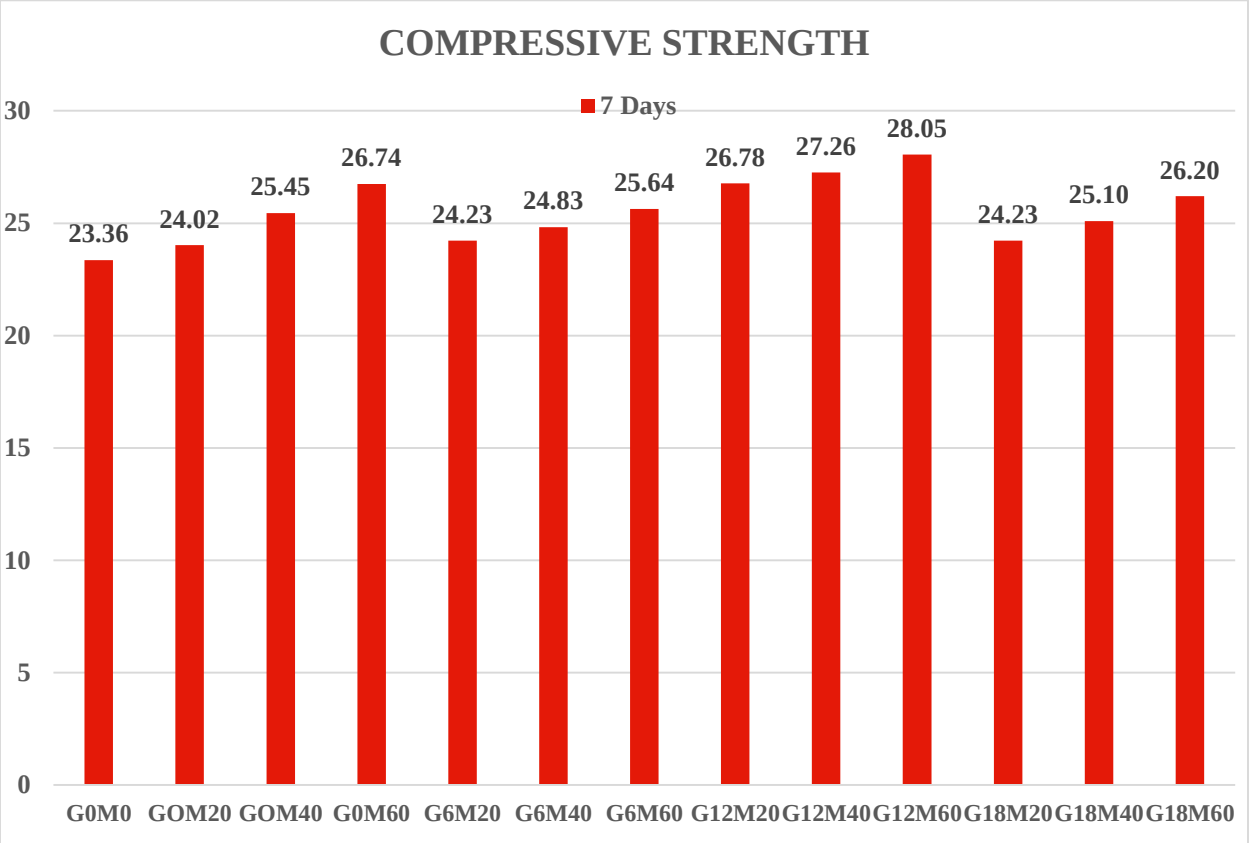
Chetan Thakur,Jagdeep Singh Gahir(2018) This paper studies in quality and toughness of concrete containing marble squander powder tend to decrease for substitution proportions over yet palatable outcomes were acquired underneath that level of substitution. Concerning utilization of silica fume, it was noticed that it enhances the quality and toughness of cement with marble powder by improving the properties in respect to regular cement.

III. STUDY ON THE MECHANICAL PROPERTIES

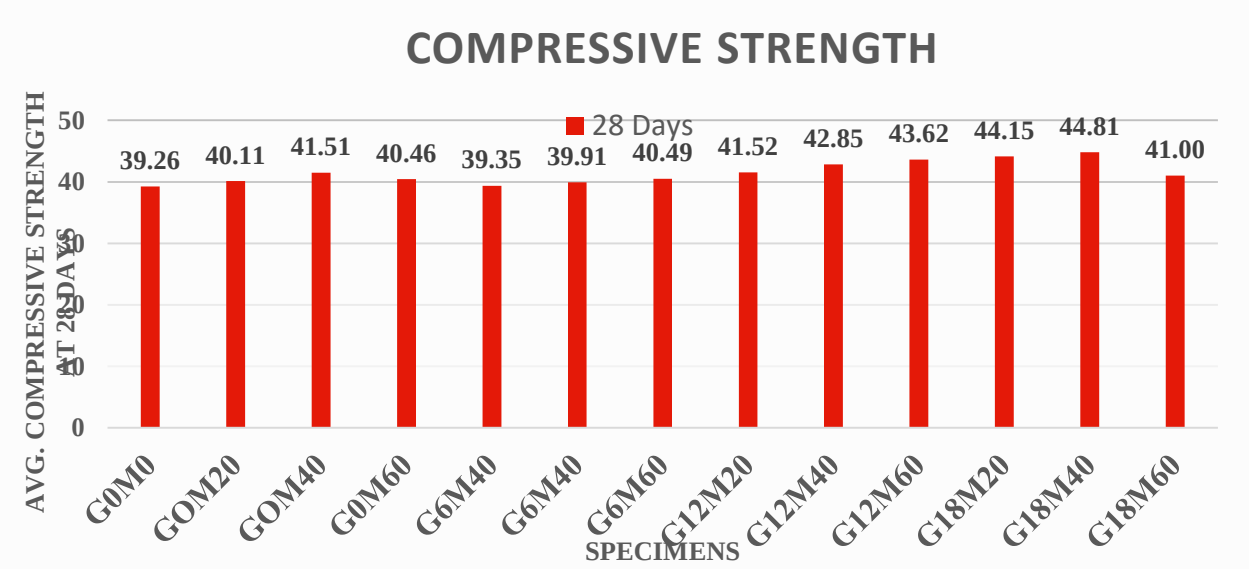
Notwithstanding getting around in distinguishable outcomes from the first solid blend, utilizing marble powder and silica seethe as halfway substitution of bond brought about a concrete lessening which diminishes the hurtful impacts of concrete industry on the earth. In this paper review on different researchers have done very noble work in his area. In this papers i tried to summarize the some of them.



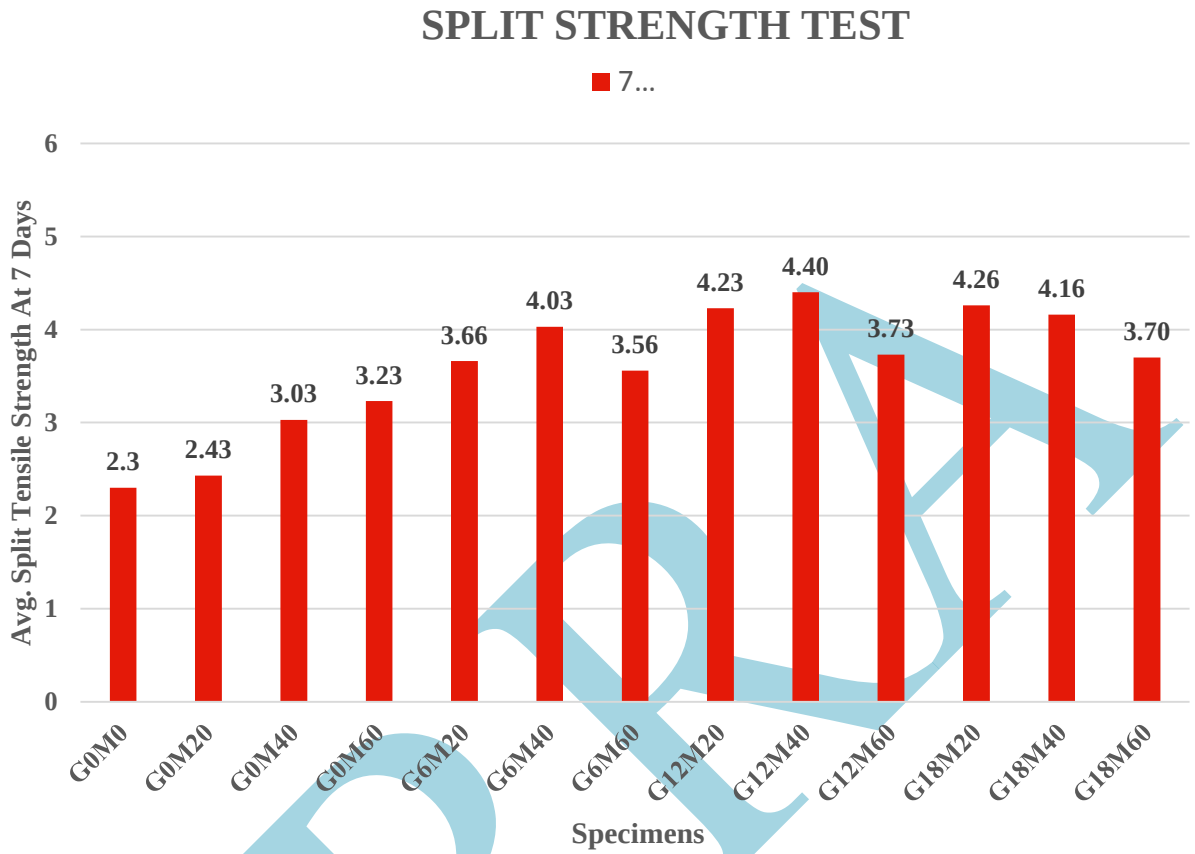
Graph of Slump



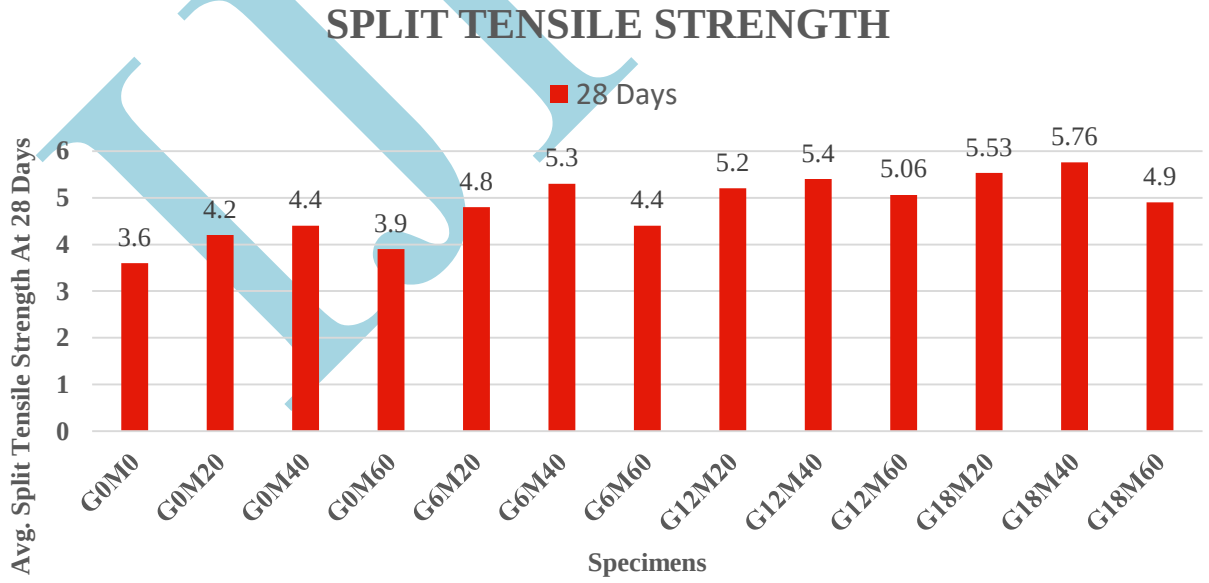
Graph of Compressive Strength At 7 Days



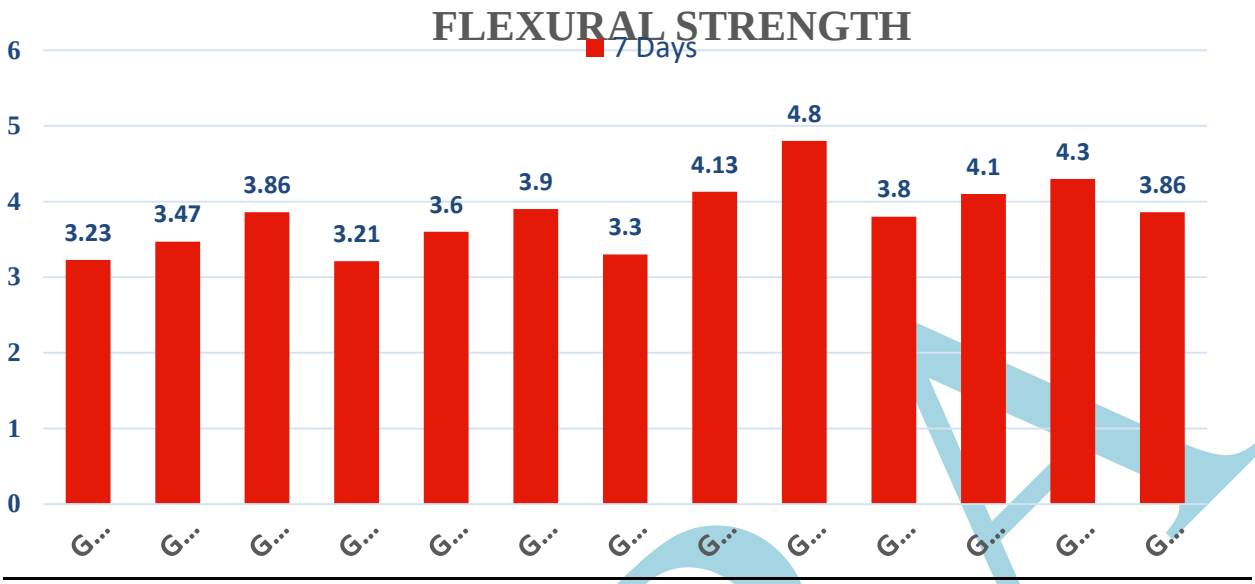
Graph of Compressive Strength At 28 Days



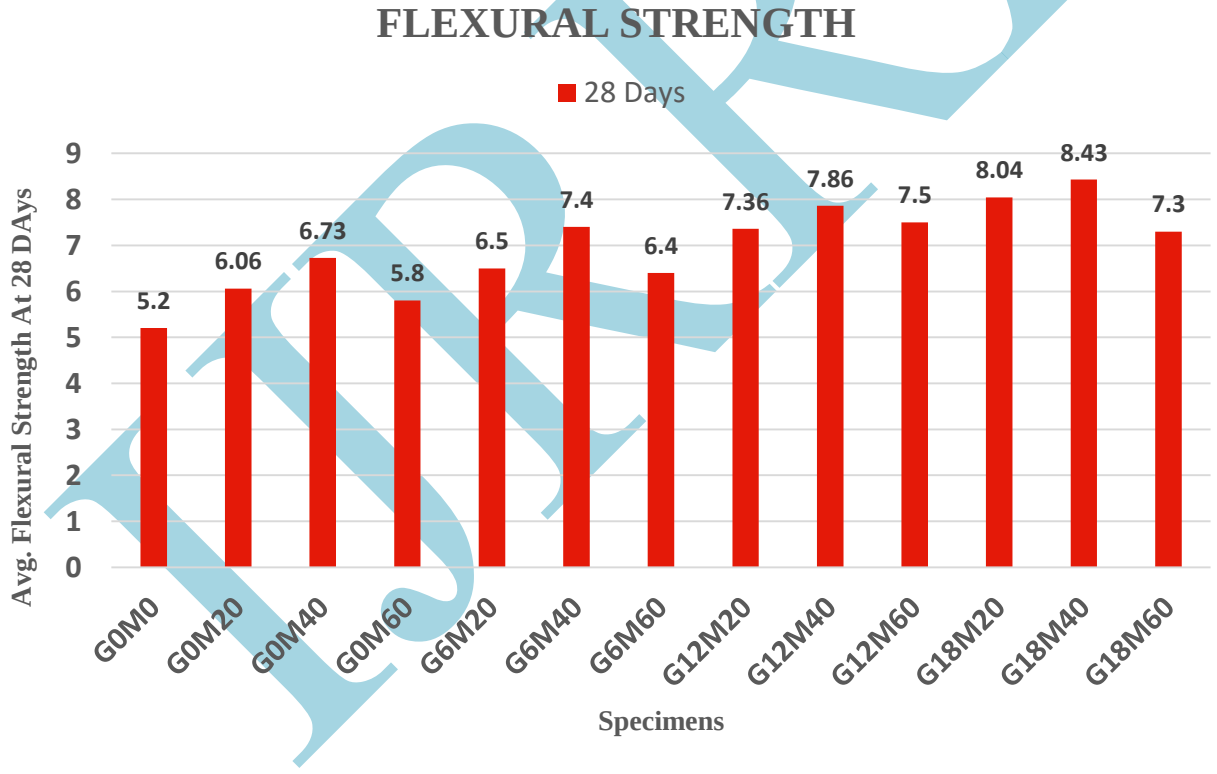
Graph for Split Tensile Strength



Graph for Split Tensile Strength



Graph for Flexural Strength



Graph for Flexural Strength

IV. CONCLUSION

1) The compressive strength results concluded that with increasing percentage of glass powder the strength of concrete increases. This may be due to finer particle size of glass powder.
2) The results also concluded that with increasing percentage pf marble powder the strength increases upto 40% replacement and there is marginal decline in strength above 40% replacement of marble powder.
3) The maximum value of compressive strength at 28 days obtained at 18% glass powder and 40% marble powder is 34.8 mpa which is 15.9% higher that control mix.
4) The split tensile result shows similar results as that of compressive strength. The maximum value of split

tensile strength for concrete containing18% glass powder and 40% marble powder is 5.76 mpa.

5) The results of flexural strength concludes that the maximum value of flexural strength at 28 days was obtained at 18% glass powder and 40% marble powder is 8.43 which is 38% higher than conventional concrete.
6) It can be concluded that concrete containing 18% glass powder and 40% marble powder can be considered as optimum mix in terms of strength and economy.
7) It can be concluded that glass powder as a replacement of cement and marble powder as replacement of concrete can be effectively used in making concrete upto certain limit without compromising its strength parameters.
8) The cost of concrete is reduced due to utilization of waste materials in making concrete.

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