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Experimental Study on the Replacement of Cement with Marble Dust and Egg Shell Powder and Aggregate with Steel Slag

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ABSTRACT: The civil structures which are build of steel strengthened concrete typically encounter the evil impacts of steel utilization by salt which in turn results in the sudden disillusionment of these civil structures. For enhancing as well as improving the existence cycle of those structures consistent upkeep and fixing is required. There are various ways to deal with point of confinement the mistake of the strong structures made of steel strengthened cement. Concrete is made using cement, sand, water and aggregate but the supply of cement in India is limited. So, the whole construction process becomes costlier when cement is supplied from different country as India is not self sufficient for the production of cement.

During manufacturing of one tonnes Ordinary Portland Cement (OPC) we need about 1.1 tonnes of earth resources. Further during manufacturing of one tones of cement an equal amount of carbon dioxide is released in to the atmosphere which acts as a silent killer in the environment as various forms. In this backdrop, the search for cheaper substitute to OPC is a needful one. Therefore, waste products like egg shells, rice husk, fly ash, etc are being used to minimize the use of cement. Egg shells are agricultural throw away objects produced from chick hatcheries, bakeries, fast food restaurants etc. which can damage the surroundings and as a result comprising ecological issues/contamination which would need appropriate treatment. Egg shell also creates some allergies when kept for longer time in garbage. Use of egg shell waste instead of natural lime to replace cement in concrete can have benefits like minimizing use of cement, conserving natural lime and utilizing waste material. on the other side, . Enhancing the properties of concrete by expansion of waste marble powder is ending up more well known now days since it helps in accomplishing the economy and unrivaled option for the solid fixing, which offers high quality. In this study, The Cement is replaced by Egg shell powder with 6 %, 12 %, 18 % and 24 % replacement and Marble dust with 6 %, 12 %, 18 %, 24 % and 30 % replacement. Further Aggregates are replaced by steel slag with 6 %, 12 %, 18% and 24 % replacement.. As per IS: 10262-1982 mix design was prepared for M20 grade and same design was used in preparation of test samples. After curing for 24hrs the samples were demoulded and subjected to compressive strength test and tensile split test for 7and 28 days.

KEYWORDS : Ordinary Portland Cement(OPC),, Marble Dust , egg shell powder, Aggregate and steel slag.

I. INTRODUCTION

Advancement in construction is blasting businesses all over the world. Working of more noteworthy statures has wind up the dashing rivalries among countries. Concrete is the major significant segments which takes an imperative part in fulfilling the whole procedure. Concrete is one of the mixed materials made out with aggregates, cement and water [2]. Concrete is a one of the mixed material which has generally high strength properties, however altogether bring down elasticity. At show, for an assortment of reasons, the concrete construction industry isn't maintainable. Initially, it expends tremendous amounts of fresh materials which can stay for next ages. Also, the important fastener is Portland cement in concrete, the creation of that is a significant supporter of ozone harming substance discharges that are embroiled in an unnatural weather change and environmental change. Thirdly, many cement structures experience the ill effects of absence of strength which may squander the regular assets. A noteworthy segment of cement will be bond and it is one of the three essential makers of carbon dioxide, a noteworthy ozone harming substance. 900 kg of carbon dioxide are transmitted for each ton of cement. Starting at 2001, the Co2 discharge is 7 % across worldwide by the contribution of Portland cement, to a great extent because of the crushing of limestone and earth at a temperature of 1500°C. The use of cement in concrete is straight forwardly relative to Co2 emanation. Concrete make bestow ozone

harming substances both straightforwardly between the creation of carbon dioxide when CaCO_3 is deteriorated by means of heat, delivering lime, CO_2 and furthermore using vitality, especially from the ignition of petroleum derivatives. There is a developing enthusiasm for diminishing carbon discharge identified with concrete generation from both scholarly and modern areas. Reusing of waste parts adds to vitality reserve funds in cement creation, to preservation of normal assets furthermore, to security of the earth. Thus, at present, the whole development industry is looking for a reasonable and powerful waste item that would impressively limit the utilization of cement and eventually lessen the development cost [3].

Mechanical lavish is the squander created through modern movement and it incorporates any material that is given pointless amid a fabricating procedure, for example, that of industrial facilities mills and mines. It has existed since the start of the mechanical insurgency. As of late, unique consideration has been dedicated to mechanical segments that are wellsprings of contamination of the condition. The business creates extensive volumes of strong wastes, for example, Micro silica, Egg shell powder, Fly ash wind up in waterways, lakes and seaside waters and The transfer of these squanders is a vital issue and this can make hazard general wellbeing, sully of water assets and contaminating the earth [4].

Eggshells are agrarian waste materials produced from chick incubation centers, bread kitchens, and junk food eateries among others which can litter nature and therefore establish ecological issues which require appropriate taking care of. In the consistently expanding endeavors to change over squander to riches, the adequacy of changing over egg shells to gainful utilize turns into a thought worth grasping The fuse of egg shell fiery debris (ESA) in solid won't just tackle the eggshells transfer issue which for instance in the US nourishment industry create around 150,000 tons of shells squander, yet may likewise make development materials more practical [5].

II. EGG SHELL POWDER

Eggshell is for the most part discarded as a waste. The egg shell likewise makes a few hypersensitivities when kept for a more drawn out time in rubbish. Transfer is an issue. It makes bothersome notice which can cause disturbance. The substance structure of Eggshell powder and cement were observed to be comparable. The principle segment of eggshell was calcium carbonate (around 51%). Eggshell involves a couple of usually creating the calcium carbonate layers, the most profound layer-maxillary 3 layer creates on the fringe egg film and makes the base on which palisade layer comprises the thickest bit of the eggshell. The shell itself is around 95% CaCO_3 (or, in other words crucial settling in sea shells). Whatever is left of the 5% fuses, Iron, Phosphorous, Aluminum, Zinc, Sodium, Magnesium, Copper, Potassium, Ionic destructive and Silica destructive. It has a lactosic structure and contains amino acids; in this manner, it is required to be a better than average bio-sorbent and it was represented that a considerable measure of egg shells are conveyed in a couple of countries, as a waste things and organized in landfills consistently. The vertical layer anchored by the common fingernail skin is the best layer.



Figure- Egg Shell powder

Marble Dust Powder

Marble is a building material commonly used in decoration in palaces and monuments given that earliest time. The marble is a metamorphic rock produced by the revolution of limestone which is sedimentary rock by weight and high

temperature in the earth shell by environmental method. Chemically it contains calcite, dolomite or serpentine material which makes the marble as a crystalline rock. Marble is hard, compact and extremely fine-grained metamorphosed rocks accomplished of attractive a spotless polish. Marble is powerful, includes a dignified look and huge demand in manufacture and embellishment. Marble dust concentrate is formed preliminary the limestone dispensation plant life throughout the decisive, determining, and polishing. Throughout this method, concerning 22-28% of the processed marble revolve into the crush form. Each time, million a lot of marble waste, from dispensation undergrowth is unrestricted. The clearance of this dissipate marble on top of soils causes a decrease in permeability and contaminate the greater than groundwater when deposited beside the catchment area. As a result, utilizing this marble dissipate surrounded by the accommodation production itself would make possible to look after the surroundings from dumpsites of marble and conjointly limit the unnecessary subtraction of expected assets of sand. Marble powder was collected from the Soami marble, Kharar, sieved by IS-90 sieve prior to the making of concrete. Marble dust powder shown in Fig.1.2



Fig.1.2 Marble dust powder

STEEL SLAG

Steel slag is taken from the steel industries. It is the wastes produced after the manufacturing of steel in the industries. Slag is mainly used in cement and construction industries and is widely used in road construction. It resembles volcanic rocks such as basalt and granite.



Figure 1.4: Steel Slag

III. OBJECTIVES OF THE STUDY

1. To obtain the optimum percentage of Egg shell Powder for the sustainable development.
2. To obtain the optimum percentage of Marble waste for the enhancement of concrete properties.
3. To compare the compressive strength of concrete by varying the percentage of marble dust, Egg shell powder and steel slag.
4. To compare the Split tensile strength of concrete by varying the percentage of marble dust, Egg shell powder and steel slag.
5. To compare the Flexural strength of concrete by varying the percentage of marble dust, Egg shell powder and steel slag.

IV. SCOPE OF THE STUDY

This study is conducted for the enhancement of the various fresh and strength properties of the concrete cube samples. Various tests: workability, compressive strength, split tensile strength and flexural strength test is conducted in this study.

Ramathilagam.B.H et al did the trial examination on egg shell powder as an incomplete substitution of cement in paver block. To study the behavior of paver block with the percentage variation of eggshell as cement from 0% to 25% at 5% intervals was the main objective of this work. The Compressive and Flexural strength Properties have studied for each mixes. In this experimental work, the w/c ratio of 0.5 was used in M30 grade concrete and in this study, totally 24 numbers of specimen were cast. The specimens consist of 250 x 125 x 85mm size paver block. The eggshell was replaced to concrete by percentage of cement [1].

Monisha T et al did the exploratory examination on concrete utilizing eggshell powder and polypropylene fiber. With the end goal to explain the real issue of transfer of egg shell powder, we need to arrange the egg shell squander securely. The use of polypropylene fiber as extent of 0%, 0.2%, and 0.4% in M 20 concrete mix and egg shell powder upto 20 % as substitution of fine aggregate is discussed in this study. Various strength properties are measured by performing the various types of tests. The quality properties got were differentiated and the customary cement after the relieving time of 7 to 28 days. The result represents that, the egg shell powder used will be generally negligible exertion when taken a gander at with ordinary cement in the concrete [2].

K. UMA SHANKAR J et al did the analysis the concrete by utilization of industrial waste GGBS, egg shell, and saw dust ash. In this test work, egg shell assumes a noteworthy part, as it is utilized in all the mixes of the solid cube shapes. The mechanical wastes are grounded to the fineness of concrete, and the properties of cement, for example, soundness of concrete, water absorption, fineness test, initial setting time, final setting time, and so forth are led on the supplanted test. The tests uncovered empowering results for the examination. The example of mixed concrete comprises of 20% of ESP, half of GGBS and 10% of Sawdust ash. The extent of the main admixtures is to increase their compressive strength. The compression test is directed to find the compressive strength of the concrete from 7 to 28 days quality. Utilizing all outcomes from the compression test, the ideal level of the mineral admixtures is finished and it is utilized for throwing bar examples. The samples are restored typically for 28 days in ordinary consumable water, and tried for their flexural strength. Use of these modern wastes decreases the generation of cement, which thus lessens the natural contamination [3].

Chirag J. Shah et al did the investigation on Future Trend of Supplementary Cementitious Material's for Sustainable Development by Incorporation. This exploration work was tentatively completed to research the impacts of supplanting bond with various waste materials, for example, Quartz Sand (QS), Egg Shell (ES), Rice Husk Ash (RHA), Pozzocrete, and Saw Dust Ash (SDA). This paper involves definite investigation of major supplement materials which are usually utilized & new rising materials of characteristic assets utilized for development action in Indian setting. These materials are by and large side-effects from different procedures or regular materials. They might be additionally prepared for use in cement. A portion of these materials are called Pozzolana, which independent from anyone else don't have any similar properties to cement, however when utilized with Portland bond, respond to shape cementitious mixes [4].

Rawaa A. Al-Safy et al did the experimental investigation on properties of cement mortar incorporating eggshell powder. To study the properties and behaviour of cement mortar using eggshells wastes is the objective of this paper. A significant enhancement in compressive strength was recorded for all ESP-cement mortars at 7 days and 28 days. The highest improvements, (31.63%) and (11.65%), were observed for samples with 10wt% and 5 wt% of ESP respectively. At moderate periods of curing, samples with 1 wt% of ESP have the highest enhancements in compressive strength of about (8.93%) and (1.75%) for 42 days and 56 days respectively. A reduction in compressive strength was observed for all samples at late ages (70 days and 90 days). In terms of flexural strength, the addition of ESP (up to 5 wt %) results in improvement in the flexural strength when compared with the control samples. The highest enhancement (21.20%) was recorded when cement was replaced with only 1 wt% at 7 days [5].

Rohit Kumar [13] surveyed the utilization of marble powder as halfway substitution of bond in solid blend. The creation of less expensive and tougher solid utilizing marble powder can understand to some degree the biological and ecological issues. Along these lines this examination gives a degree to more research which is required to outline efficient and sturdy cement with this strong waste (marble powder). Because of this a Dissertation work is choose to discover the impact of marble powder on the properties of cement by halfway supplanting of bond with marble powder in a solid blend . The impact on solid blend can be controlled by the assistance functionality trial of cement, flexural quality, compressive quality and split rigidity [6]

Anitha .P et al [16] did the Exploratory Investigation on Partially Replacement of Cement with Marble Wastes. This investigation manages the throwing of the solid shapes with changing level of waste marble powder and afterward testing them on Compression Testing Machine (CTM). The focal point of our venture will supplant bond. The progression of solid innovation can diminish the utilization of normal assets and vitality sources and furthermore reduce the weight of contaminations on condition. By and by a lot of marble dusts are created in regular stone preparing plants with a critical effect on condition and people. This task depicts the achievability of utilizing the marble ooze dust in solid creation as halfway substitution of bond and to decrease the expense of the solid by marble powder in the most efficient way. [7]

V. CONCLUSION

After studying the various literatures done by the authors and experimental study, following conclusions are drawn:

1. According to past studies, it concludes that marble Dust and egg shell powder can be used in concrete as a partial replacement of cement.
2. According to past studies, it concludes that Steel Slag can be used in concrete as a partial replacement of cement.
3. The workability for M20 grade of concrete enhanced with increase in % of waste marble powder, egg shell powder up to 18% replacement by cement.
4. The workability for M20 grade of concrete enhanced with increase in % of Steel slag up to 18% replacement by Aggregate.
5. Split tensile strength of beams is also enhanced by adding waste marble powder and egg shell powder with 18 % cement replacement and then moderately decreases.
6. Split tensile strength of beams is also enhanced by adding Steel slag with 18 % Aggregate replacement and then moderately decreases.
7. The compressive strength of beams is also enhanced by adding waste marble dust and egg shell powder with 18 % cement replacement and then moderately decreases.
8. The compressive strength of beams is also enhanced by adding Steel slag with 18 % Aggregate replacement and then moderately decreases.
9. The flexural strength of beams is also enhanced by adding waste marble dust and egg shell powder with 18 % cement replacement and then moderately decreases.
10. The flexural strength of beams is also enhanced by adding steel slag with 18 % cement replacement and then moderately decreases.

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