

EXPERIMENTAL INVESTIGATION ON CONCRETE INCORPORATED WITH STEEL FIBER AND GRANULATED BLAST FURNACE SLAG (M SAND)

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ABSTRACT

In this study, crimped steel fibres and Granulated Blast Furnace Slag manufacturing sand (M-Sand) were used in an experimental study of fibre reinforced concrete. We know that concrete is weak in tension and strong in compression, and that the fine aggregate used in concrete is typically natural river sand. Our goal is to replace the natural sand with manufactured sand and to increase the compressive and tensile strength of the concrete by adding steel fibre. Granulated Blast Furnace Slag M-Sand is used as a fine aggregate to get over the problems caused by over-mining of sand. Gravel crushers generate Granulated Blast Furnace Slag M-Sand, which is homogeneous in size.

Investigating the impact of steel fibres on concrete made with Granulated Blast Furnace Slag M-sand as the fine aggregate is the primary goal of this study, which also aims to create a high- performance concrete. The compressive and tensile strengths of concrete grade M30 with various steel fibre percentages (0%, 0.3%, 0.6%, 0.9%, and 1.2%), respectively, are proposed to be measured and compared.

Keywords Cement Concrete, flexural strength, Strength parameters, water absorption, Workability.

1. INTRODUCTION

Construction sector consumes maximum amount of natural resources and energy. Manufacturing of construction products requires raw materials and energy. Majority of the raw materials are mined from the earth. Natural resources are mined indiscriminately for construction purposes, causing environmental problems. Energy is expended for converting the raw materials into useful construction products. In addition, the construction materials and products are hauled over long distances spending fossil fuel energy. There are many instances where laws have been enforced to preserve precious natural resources and even ban mining of sand from the river beds. Raw material extraction, manufacture of materials, transportation and construction cause environmental damage and greenhouse gas (GHG) emissions. Estimates show that more than 40% of the total energy and 30% of the material resources are consumed by the habitat and related infrastructure some researchers (Ruuska and Hakkinen) estimate that better construction and use of buildings in the European Union would influence 42% of energy consumption and more than 50% of all extracted materials. There is an urgent need for minimizing the mining of raw materials and reducing energy consumption.

To reduce the dependence on natural material as the main source of concrete agricultural waste and animal waste provide an alternative for construction industries. Cattle manure ash or cow dung ash are considered as a waste material which could have a promising future in construction industries as partial or full substitute of fine aggregate. The use of cow dung ash in concrete provides potential environment as well as economic benefits for all construction industries, particularly in those areas where a considerable amount of cow dung ash is produced. The chances of pollution due to cow dung ash will be reduced and it will be cost effective for construction. The use of waste material in new construction helps to save of energy. The use of cow dung ash in concrete mix can also solve the problem of disposing these waste materials. Advances in substantial innovation incorporate the properties of cement for instance functionality, strength, Durability, etc. However, this current circumstance clarifies advance in substantial innovation like Admixtures, Plasticizers, Super plasticizers, retarders. The utilization of these materials has turned into a lift for underlying Engineers to cut down enormous developments in use in a more modest time. In any case, in universally handy, continues in substantial innovation bargains, with an increment in strength and sturdiness of concrete and expanding the functionality to the necessary time. Normal assets are diminishing in all around the world and expanding squanders from enterprises produced all the while. The eco-Friendly and dependable improvement for development comprises the utilization of non-traditional and different waste materials and reusing of waste material for diminishing discharges in conditions and diminishing the utilization of normal assets. The combination of cement principally comprises fly debris for saving the concrete additionally helpful to keep up with the hotness of hydration temperature of cement. A combination of water, aggregate, sand and concrete called concrete, it is a composite material that utilizations in developments and improvements. In this manner decreasing the utilization of regular assets in development like sand, we use saw dust and as a halfway swap for lessening the utilization of sand since sand is a characteristic asset and it isn't effectively accessible all over, so Saw dust and plastic waste is utilized in the substantial as one of the elective materials.

2. LITERATURE REVIEW

To supplement automated search, a manual search was also done. The manual procedure involved searching the reference sections of the papers identified by the automated search and referring the text/reference books. Any relevant references within those papers/reference books were followed up

- **Manuel Contreras Llanes et.al. 2021** carried out research for production of eco-friendly concrete paver units using recycled aggregate as coarse aggregate. They prepared samples containing different percentages of aggregate replacements with recycled aggregates & conducted different tests on paver units. The results explained that up to 50% replacement can be a good solution. The values of water absorption lesser than 6.0% and tensile strength upper than 3.6 MPa were obtained, which are similar to those of a reference sample and within the limit values established by the regulations.
- **Natt Makul et.al. 2021** The proposed strategy could be to sequentially separate demolition waste such as roof finishes, waterproof materials, interior and exterior materials, etc. Closing life cycles is the main approach used for efficient structures for the recycling and reuse of construction and demolition waste in the production and recovery of materials, especially when recycling and reusing materials. In the life cycle, the recycling of recovered materials allows them to be used for new construction purposes, avoiding the use of natural concrete aggregates. Government, design institutes, construction departments and project managers should be involved in the creation and use of RCA.
- **Athanasia Soltana et.al. 2021** produced the cement mortars using the upgraded recycled concrete aggregates (sand granulometry) for the total replacement of natural aggregates and recycled concrete fines activated through a thermal treatment method as a partial cement substitution material. Cement mortar specimens were tested for their compressive and flexural strength, density and water absorption performance. The results showed that the combined usage of upgraded recycled concrete sand for total replacement of primary crushed sand and recycled concrete fines as partial cement replacement material is a promising option to produce cement mortars.
- **Abbas O. Dawood*, Hayder AL-Khazraji, Raad S. Falih 2021** the impact of utilizing polyethylene terephthalate (PET) squanders as an incomplete substitution of normal sand is explored to concentrate on the mechanical and actual properties of cement. Fine total (sand) is somewhat supplanted by comparable weight rates of PET waste particles while keeping up with any remaining extents. Mechanical tests for pressure, parting, flexure, modulus of flexibility, energy ingestion, and hub strain just as actual tests for thickness, shrinkage, and assimilation, are performed. Furthermore, the ultrasonic heartbeat speed is introduced. All examples are noticed for 7, 14, and 28 days. The tests results introduced that the presence of PET particles changed the physical and mechanical properties of delivered cements. Actual properties (thickness and ultra sound speed) step by step diminished as PET proportions expanded, while an expansion in retention rate was noticed. The discoveries additionally uncovered an expansion in energy assimilation and pivotal strain of the specimens with 5%–20% replacement percentages, while the modulus of flexibility diminished as the PET substance expanded.
- **Saranya K (2016)** Owing to shortage of coarse aggregate for the arrangement of concrete, fractional expansion of E-squander with coarse aggregate was endeavored. The work was led on M-25 grade blend. The expansion of coarse aggregate with E-squander in the scope of 0%, 32%, 34%, 36%, and 38%. At last the mechanical properties and sturdiness of the substantial blend examples acquired from the expansion of these materials is contrasted and control substantial blend. The experimental outcomes showed that a critical improvement in compressive strength was accomplished in the E-squander concrete contrasted with customary cement and can be utilized actually in concrete. The reuse of E-waste brings about squander decrease and assets protection.

3. RESULTS

The results got from tests directed on solid clearing blocks have been talked about in this part. Workability

The strength of concrete of a given mix proportion is seriously affected by the degree of its compaction. It is therefore important that the consistency of the mix is such that the concrete can be transported, placed and finished sufficiently easily and without segregation. A concrete satisfying these conditions is said to be workable. Workability is a physical property of the concrete depending on the external and internal friction of the concrete matrix; internal friction being provided by the aggregate size and shape and external friction being provided by the surface. The workability results were found favourable with the mix.

The Compressive-strength of concrete depends on various factors, quality of the aggregate, water-cement ratio, quality of cement, temperature conditions etc. Compressive test is done either on cylinder or cube specimen. Here as per the tabulated results the maximum strength is visible with 30% Ground Granulated Blast Furnace Slag M Sand and increase in any further percentage reduces the strength of concrete while the most appropriate values of compressive strength if

received with 30% Ground Granulated Blast Furnace Slag M Sand and 1.2% Steel Fibre when cured for 28 days as 43.68 N/mm².

The split Tensile Test determines the tensile strength parameter of concrete which is the important basic property. The concrete is good in compression and weak in tension, it develops cracks when subjected to direct tension. Thus, by inducing certain fibres such as steel, the tensile property of the concrete can be enhanced. The maximum strength is achieved with the concrete mix with 30% Ground Granulated Blast Furnace Slag M-Sand as fine Aggregate and 1.2% Steel Fibre at 3.1 N/mm².

The flexural strength of concrete is an important property to be determined especially for changes in the volume of concrete due to temperature variation or shrinkage, for the road slab performed on to the vehicular loads.

The flexural Strength was maximum with 30% Ground Granulated Blast Furnace Slag M-Sand as fine Aggregate with 1.2% Steel Fibre as 4.62 N/mm² and with later addition of m sand proportion led to decrement in strength of concrete cubes.

Mix	Workability mm				
	0.3% SF	0.6% SF	0.9% SF	1.2% SF	1.5% SF
M30	79	82	85	84	83
M30+10% M-Sand+0.3%SF	77	82	83	82	81
M30+20% M-Sand+0.3%SF	77	80	81	80	79
M30+30% M-Sand+0.3%SF	79	83	84	83	82
M30+40% M-Sand+0.3%SF	80	85	86	85	84
M30+50% M-Sand+0.3%SF	79	84	85	84	83

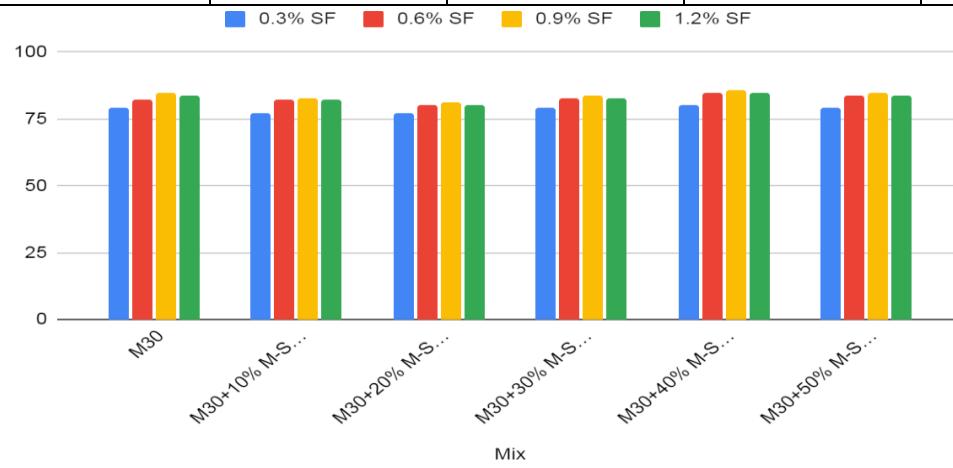


Fig.1 Workability Results

4. CONCLUSION

From the above outcomes it can be seen that when flexural or tensile loads will be applied to structural parts. The total tensile load must be supported by the reinforcing steel in order for it to be used. There are several methods for forecasting the strength of beams reinforced simply with steel fibres, but no prediction equations exist for large SFRC beams because these are anticipated to also include conventional reinforcing bars. The American Concrete Institute recently released a comprehensive reference on design considerations for SFRC. The issue is complicated for beams with continuous reinforcing bars and fibres because of the dual actions of the fibres.

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