





Experimental investigation on concrete subjected to direct shear test

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Abstract

A Structure may be subjected to various environmental and loading condition however, in general the properties determined under one set of condition may not be used to determine the behavior of the material under a different set of conditions. The construction and manufacturing industry now lacking a satisfactory and practical test on materials which demonstrates the relative brittleness of the material and direct shear tests of several concrete mixes & like construction materials. To perform that function, a simple and practical test has been developed. The drop weight direct shear test done by the ACI committee for concrete is often criticized for large variation within the results. This paper recognizes the route and the source of this huge variation. Accordingly suggesting the modification to the ACI test. The evaluation of the proposed modification were made. These values were compared to the current ACI test, by performing direct shear tests on 14 specimens. Studies were carried out on different materials like GGBS (Ground Granulated Blast Furnace Slag), RHA (Rice Husk Ash) and Silica Fume, with replacement of cement and plastics were replaced for fine aggregates. Two types of steel fiber that is crimped and hooked having 30mm length and 0.1 mm diameter. Tests were carried on m25 mix with various materials volume fracture to determine the direct shear resistance for 28 days. The test is exclusively

suitable to the latest and tougher construction materials into the industries such as plastic concrete, fibrous concrete etc. Other material properties such as toughness, stands capacity and fatigue performances also can be predicted with the initial data. Result shows that average number of drops for first crack and ultimate further is observed. It is clear that GS 10/1 and RS 10/1 have higher direct shear resistance from other mixtures. This is due to the addition of steel fibers in concrete mixtures.

Introduction

Aluminum powder metallurgy is the most widely used metal forming process in the aerospace application on its excellent hardness and wears resistance contribution to high damage tolerance [1]. Normally the turning and milling process the standard dimensional like rod, rectangular bar materials used, but for complex materials, industries are preferred the stir casting process [15], [16]. In this modern world, concrete is one of the predominantly used construction material. Which is approximately about 2 to 2.5 billion tons placed each year all over the world [9], [15] (see Fig. 1).

During these past decades, the usage of SCM (Supplementary Cementitious Materials) enhances the effective performance of the Portland cement. Many environmental worries, arising from the high energy consumption and the emission of carbon dioxide allied with the manufacturing process of cement [2], [14]. These troubles have brought extreme pressures to reduce the consumption of cement through the use of Supplementary Cementitious Materials. This led to the usage of new admixture in the construction industries. To identify the shear behavior of structural elements in both unreinforced & reinforced concrete, such as the columns & beams in tangential action, it is important to consider the true shear acting either alone or with tension of the element [4], [6]. The mechanism of shear transfer in concrete is the main focus of the research by developing an experimental procedure. Cement is one of the utmost energy exhaustive construction material and the production of cement brings a very high temperature about 1400°C to 1500°C processing [1], [12]. It also leads to the uncontrolled quarrying of natural resources & excessive emission of carbon dioxide. Many initiatives being made to lower the usage of Portland cement in construction industries [7], [11]. The efforts such as the utilization of supplementary cementations materials in addition to alternative materials usages in place of Portland cement (see Fig. 2).

It is the responsibility of the Civil engineers who design & build more durable structures for longer period. So, the good design methods, needed to prevent

dangerous cracks in concrete elements under the live load or the service loads. In the event, excessive shear load subjected to the concrete member and the concrete sustains an initial crack in the element [5], [8], [9]. The cracks then develop within the concrete member, thus valuing the shear property of concrete elements in detail must be vital. For the evaluation of shear cracking, a simple test method for concrete elements has been developed. This may contribute a lot to shear design studies and research using new reinforcing materials. The easy and simple testing methodology for true shear engages only short & simple work & a UT machine [3], [13]. Un-axial load converted into shear force in the testing process. Provides the shear forces to the all sides of the concrete element. [2]. In this research, two professors made a clear relative analysis on shear performance of high-strength concrete beams. Some of the international design such as ACI, Canadian, AASHTO were used in this analysis, European code. 27 number of reinforced concrete beams without web reinforcement were casted & these beams were tested under three point loading system. In addition to that analysis were made on other similar beams, these beams were about 95 in numbers. These beams having alike c/s dimensions, loading conditions and concrete strength. This had a range of 1 – 6 of shear span-to-depth ratio. Ratio from 0.35% to 1.94% of longitudinal reinforcement (see Table 1, Table 2).

STM has been utilized as an evolving examination means for the design of non-flexural members & the disturbed regions in the structures of concrete. In this method usual flexural theory can't be implemented. The typical non-flexural members, double-corbels and the length of the shear arm to depth ratio at the critical section is every so often lesser than 0.1 STM. These has been mostly used for the design of normal strength concrete [4].

These engineers had made a small experimental research on steel fibers usages. For the improvement of the mechanical properties of concrete, this research work have been carried out. This paper mainly worked to improve the shear strength, this is the one of most significant mechanical property of concrete. This research paper is made to study the improvement of the shear strength of high strength concrete beams [11] (see Table 3, Table 4).

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Section snippets

Cement

Cement is a binder material, it is used in construction process which binds other materials together without getting disintegrated. In this project 53-grade OPC is used for experimental study. Compressive strength of the concrete might get affected when there is a variation in chemical and physical properties of components (see Table 5, Table 6).

Coarse aggregate

Coarse aggregates are naturally available materials such as gravel, crushed rock, natural rock, shales and other materials which possess similar

Casting of specimens

From the M-25 grade mix design the specimens were casted using controlled concrete and by using various admixtures and by-products. The numbers of casted specimens are 28 under both shear and compression. The casted specimens are

1. MIX CC – In this casting by using plain controlled concrete it has been casted.
2. G 10 - In this casting, partial replacement of cement with 10% of GGBS (Ground Granulated Blast Furnace Slag).
3. GP 10/5 - In this casting, partial replacement of cement with 10% of GGBS and Fine

Tabulated test results

As per BIS specifications, workability test like Compaction factor, Slump Cone and Vee Bee Consistometer tests were made on fresh concrete. Similarly 28th day mechanical properties tests were also made on the hardened concrete specimens. Compression test and the direct shear test are the two mechanical properties test made on the hardened concrete specimens.

Conclusion and suggestions

From the results of experimental investigations in the thesis, these conclusions have been made as followed,

- 1] The required shear strength can be achieved in concrete with recyclable by products.
- 2] A notable rise in shear strength can be obtained by incorporating optimum quantity of GGBS and Steel fibers.
- 3] Among all recycled by-product combinations replacement concrete with 10% replacement of GGBS and 1% of Steel fibers has a long life-span.
- 4] (GS10/1) gives significant results when it is being compared

Suggestions

- 1] The present study focused on 14 combinations of cement and fine aggregates replacement. Hence investigations can be made on different target strength using different cement and F.A replacement materials to study the mechanical and durability characteristics.
- 2] The grade of cement can be varied and studied can be made on workability, Strength and durability characteristics.
- 3] Studies on workability, Strength and durability properties can be made by varying the superplasticer dosage, keeping the w/b

CRedit authorship contribution statement

P.R. Kalyana Chakravarthy: Conceptualization. **R. Rakesh:** Validation. **T. Kiran:** Formal analysis. **A. Parthiban:** Resources. **S. Sivaganesan:** Reviewing and Editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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