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Research Article

Optimizing The Flexural Behavior of Low-Cost Material Slab Panel Using Coconut Coir Fiber and Rice Husk Ash

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ABSTRACT

The steady increase of population density in urban areas of many developing countries like India, from the past decade, has posed a challenge to civil engineers. High-rise buildings serve as workplace accommodations as well as residential buildings. Aesthetic demands of such high-rise buildings are not usually compromised with; Architects in the recent times come up with buildings of irregular shapes which are visually pleasing but can prove to be structurally deficit if they are not designed properly. In the event of an earthquake, these buildings do not respond similar to regularly shaped buildings since the distribution of forces within these structures vary considerably. The lateral displacement of the structures should be carried gradually with the height in order to ensure good seismic performance of the structure which otherwise can cause irrevocable damage. The general approach towards analysis and design of a structure is made under an assumption that the base of the structure is infinitely rigid and consequently restraining the displacements and rotations. Under Seismic loads, the foundations and soil media are subjected to lateral displacements and it influences the superstructure response significantly and imparts redistribution of forces in the structure differing from the forces obtained from fixed base scenario. Hence, the effect of soil-structure interaction has to be addressed and factored into the analysis of a structure. In this thesis, an attempt is made to study the seismic response of an irregular building using E- tabs (V15.2) & SAFE (v12) software. The interoperability of these software facilitates modeling soil-foundation- structure with mutual compatibility. The analysis is performed by equivalent static lad method and response spectrum method as per guidelines of IS- 1893(Part 1): 2002 for Seismic zone V.

Keywords: Slab Panel, Coconut Coir Fiber, Rice Husk Ask, Flexural Behavior.

INTRODUCTION

Concrete is a broadly used construction material for various methods of structures due to its strength and durability [4]. For quite a while it was thought to be an exceptionally though materials requiring practically zero support. Concrete is a complex construction material self-possessed of cement, crushed stones or rock, river- sand and water. The water causes the hardening of concrete through a process is termed as hydration, concrete solidity freezes after mixing with water and settlement due to a chemical process called as hydration [1, 7]. The water responds with the cement which links the other constituents together, ultimately the materials creating like a stone robust. In word, the concrete is recycled more than several manmade materials [6]. So, the use of concrete material is mandatory. In the meantime, shortages of aggregates are also prominently increased now-a-days. In this investigation, there are two locally available materials are used; they are coconut coir fibers and rice husk ash [2]. The coconut fiber termed as coir, when dehydrated encloses cellulose, lignin, pentons and fiery debris in fluctuating rate. In Asia, the development business is yet to understand the upsides of light weight concrete in elevated or high-rise structures. Coconut fibers are not normally utilized as a part of development industry and are regularly dumped as farming waste [6].

In the present investigation, Portland cement is replaced by RHA along with addition of coconut coir fibers at various percentages to concrete, learning flexural behavior and its effect on a slab panel specimen of size 1.4m X 0.6m X0.05m, in comparison to Slabs with that of conventional concrete mix [3].

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OBJECTIVES

The objective of the study is to possible use of Agricultural waste and Industrial waste to reduce the consumption of cement thereby saving base of raw materials, power and surroundings. The attention of the current study is to examine the effectiveness of Rice Husk Ash [RHA] (5%, 10%, 20% & 30%) and Coconut Coir Fiber (0.5%, 1.0%, 1.5% & 2.0%).

•To creating accessible (supply) of materials in detailed quality and quantity at cost economy, and preserving the stability of supply.

•Saving in high inventory income and inventory cost.

•Conserving the flow of manufacture.

•To determine the strength properties, namely flexural strength behavior of different partial replacement and addition with RHA & CCF with comparison of normal concrete slab panel at 28days.

•The study Correlation to first crack load, width of cracking and spacing, deflection load and ultimate flexural load by the cause of extensive replacement and addition with RHA & CCF.

•To determine the flexural behavior of slabs by two points loading using yield line theory for loading pattern in loading frame

METHODS

This segment goes to detailed research of trail investigation that is done, including properties of various materials used and their mix extent. The purpose of interest of system for casting of specimens and their testing technique are in likewise illuminated. To study the flexural behavior on material properties and strength parameters.

HARDENED CONCRETE

a. This slab panel specimen of size 1400mm*600mm*50mm were prepared. Each of two specimens tested for 28 days.

b. To find the flexural strength behavior and compared the results with conventional slab panel by varying percentages of RHA and CCF.

Fig. Slab Panels

Material and methods: In this experimentation, the locally available raw materials used and for binding depiction ordinary Portland cement (OPC) are included, for fine aggregate river sand, crushed stones for coarse aggregate, additional concrete constituent coconut coir fibers and partial replacement for cement rice husk ash are used. Potable water was used for curing and mixing during entire research work [4].

Cement: The cement must progress suitable strength. For this research 53grade ordinary Portland cement, compatible to IS 12269-1989 was used. It must symbolize the suitable rheological performance [2]. The physical properties of cement as showed in below table

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Fine aggregate: For fine aggregate canal sand was used, comparable to IS 383-1970. To remove imported material, to use air dried sand, sieved, and earlier to mixing [2]. The physical properties of fine aggregate as showed in below table

Coarse Aggregate: In present I nvestigation, broken or crushed stones with aggregate size 12.5mm down are considered. The experimental results are tabulated bellow confirming with IS 2386-1963 codes [2]. The physical properties of coarse aggregate as showed in below table

Sl.no	Physical assets	Experimental results
1	Specific gravity	2.74
2	Bulk density for lose FA	1471 kg/m^3
3	Bulk density for compacted FA	1600 kg/m^3
4	Water absorption	0.2%
5	finesse modulus	3.40

Coconut Coir Fiber: Coconut fibers were composed from temples, houses and coconut industries to evaluate the properties [2]. The physical properties of CCF as show in bellow table

Sl.no	Physical assets	Experimental results
1	Specific gravity	0.88
2	Water absorption	15%

Rice husk ash: In this research work, RHA or obtained from Rice mill industries. It's freely available from rice mill [8]. The physical properties of RHA are tabulated in table

Sl.no	Physical assets	Experimental results
1	Specific gravity	1.70
2	appearance	Very fine powder
3	color	gray
4	odor	odorless

Reinforcement: Fe500 steel bars of diameter 10mm (longer and shorter span) were used as reinforcement with covering 25mm in slab panel.

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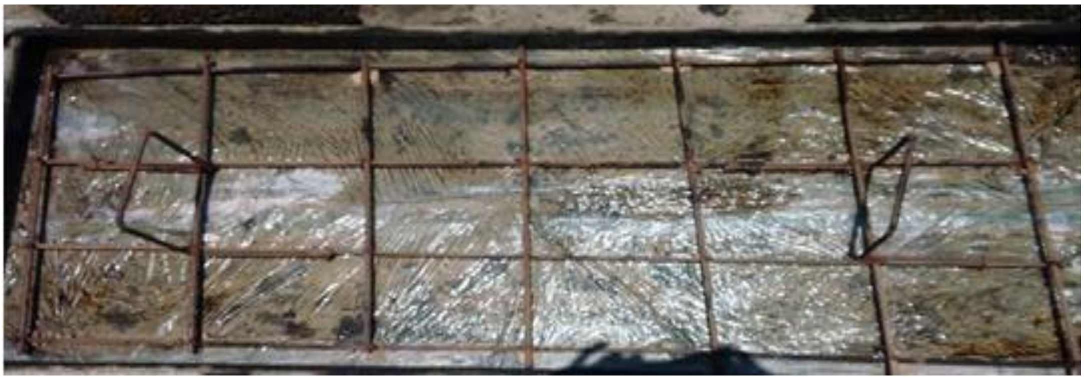

Fig: Reinforcement

Water: Portable water free from salt was used for concrete casting, curing and mixing as per IS456-2000 recommendations.

Super plasticizers: In this present investigation, we use GLENIUM B233 supplied by BASF India Ltd. GLENIUM B233 is another admixture in view of altered poly carboxylic either [5]. GLENIUM B233 is free of chloride and low soluble base. It is compatible with a wide range of bond.

RESULTS

Concrete mix design: Calculation of mix proportion for the present research recommended an Indian standard guideline (IS10262:2009). Mix design calculation for M25 grade of concrete as showed in appendix [5]. The mix design for both Rice Husk Ash and Coconut Coir Fiber concrete as showed in below table.

Mix Proportion for M25 Grade of Concrete

Designation	Cement (Kg/m3)	Fine Aggregate (Kg/m3)	Coarse Aggregate (Kg/m3)	Water In Liter	Super Plasticizer In ML
NCC	350	753	1175	175	1400

Mix Proportion for Rice Husk Ash Concrete

Designation	Cement (Kg/m3)	RHA (Kg/m3)	Fine Aggregate (Kg/m3)	Coarse Aggregate (Kg/m3)	Water In Liter	Super Plasticizer In ML
AS1 (5%)	332	18	753	1175	175	1330
AS2 (10%)	315	35	753	1175	175	1260
AS3 (20%)	280	70	753	1175	175	1120
AS4 (30%)	245	105	753	1175	175	980

Mix Proportion for Coconut Coir Fiber concrete

Designation	Cement (Kg/m3)	CCF (Kg/m3)	Fine Aggregate (Kg/m3)	Coarse Aggregate (Kg/m3)	Water In Liter	Super Plasticizer In ML

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BS1 (0.5%)	350	4.4	747	1163	175	1400
BS2 (1.0%)	350	8.8	742	1155	175	1400
BS3 (1.5%)	350	13.2	737	1147	175	1400
BS4 (2.0%)	350	17.6	731	1139	175	1400

Placing And Compaction

Flexural Load: Originally, the load was applied on any material, and the initial crack was visibly realized to naked eye, and the equivalent load at the time of development of first crack is what is designated as the "Initial crack load". With additional increase in load, this stiffness face of the sampling had on going cracking, which was monitored by crushing of the compression surface. And ultimate main crack at failure load was observed at the top middle face of the sample, the finite ultimate positions of the sample are termed as "Ultimate failure load".

Loading Frame: Testing of slabs are arranged in 500tonnes capability loading frame, which electrically functioned by hydraulic jack. By means of jack, uniformly distributed load on slabs is subjected at center.

Fig: Loading Frame

Loading Frame

Procedure for testing: For testing, the slabs were simply supported and subjected to two-point static loading system by using channel sections. Demec gauge pellets are pasted at the top most compression fiber, at the central of slab and the level of reinforcement of slab to conclude the lateral displacement. And also, LVDT (linear variable differential transformer) to know the vertical deflection on slab panels. There are two LVDT are

using during testing, one is setup for distance of L/3 (at support), and another one at center of slab panels. Then load was applied gradually by manual jack and readings were taken from the loading frame control panel, the initial crack was found by demec gauge and initial load by manual jack. And the procedure was continued until cracks were visible; the load at which the cracks started was noted.

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Marking of Demec Gauge Pellets

LVDT at Center and support

Fig: Loading Frame Control Panel **Fig: Manual Jack**

Fig: Placing of Channel Section

Cracking Growths and Modes of Failure: A crack seems at the bottom surfaces of the slabs when the tensile stresses exceed the modulus of rupture of concrete. The first crack appears at the middle of the slab and gradually develops through the width of the slab. The second crack forms at the right support of the slab consequently at the left support of the slab. Additional development of cracks occurs, on increasing the application of static load. Steel reinforced slabs show the flexural type of failure by the yielding of steel which is then monitored by crushing of concrete.

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Fig: Cracking Behavior

The Graph Plotted for Deflection along the Span for cracking load:

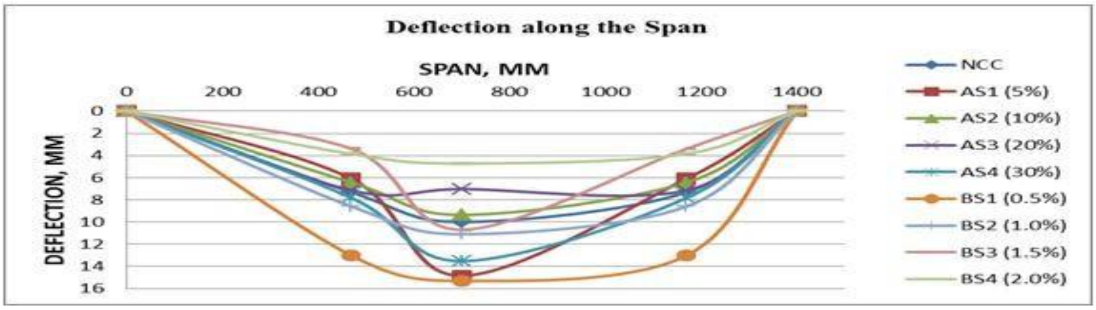

Fig: Line graph for Deflection along the Span of NCC, RHA and CCF Concrete

The Graph Plotted for Deflection along the Span for Ultimate load:

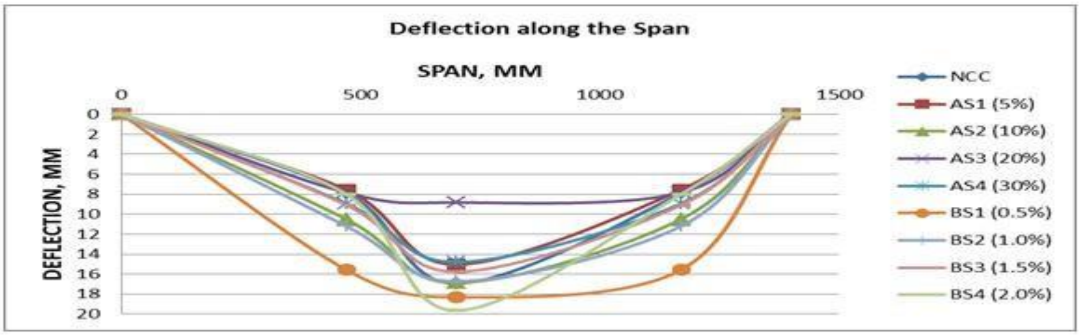

Fig: Line graph for Deflection along the Span of NCC, RHA and CCF Concrete

DISCUSSION

Based on the experimental results, the study carried out on the behavior of flexural load for RHA and CCF concrete, the following conclusions are established:

1. The behavior of flexural load in RHA concrete, the flexural load carrying capacity is to be decrease for 5%, 20% and 30% replacement. So that RHA concrete is not a better replacement for slabs.

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2. The behavior of flexural load in CCF concrete, the results designates that there is a flexural load carrying capacity improvement with 0.5%, 1.0% and 1.5% of CCF concrete addition level. So, CCF concrete retains a number of better abilities that make durable and good building concrete attentions. So that it may be used in structural slabs for 0.5% to 1.5% addition levels.

3. Increase in percentage addition by coconut coir fibers increased flexural load. But, if CCF added more than 1.5%, then flexural load decreased.

REFRENCES

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