iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** V **Month of publication:** May 2020

DOI: http://doi.org/10.22214/ijraset.2020.5492

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

A Study on Flexural Behavior of Light Weight Composite Beam Section

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Abstract: Lightweight concrete can be defined as a type of concrete which can give same strength in lower weight in comparison with regular concrete. We are working on steel composite beam infilled with light weight concrete. We are using cold formed steel hollow sections infilled with light weight concrete mix and the materials are cement, fine aggregate, foundry sand, coarse aggregate and ceramic waste. By using all these waste materials we want to make this composite section economical, eco-friendly, light weight and having higher strength than normal regular concrete. This extensive research work help us to find out the result of using this waste materials in composite steel beam concrete section. To ensure the result of using this as building material, different types of tests are done on ceramic and foundry concrete cubes, ceramic and foundry concrete cylindrical sections and beams, steel composite beams, and steel composite beam sections infilled with light weight concrete.
Keywords: Lightweight concrete, foundry sand, ceramic waste, cold formed steel hollow sections, composite beam.

I. INTRODUCTION

In this world Civil Engineering is the most important part of human civilization. It is better to say it has started from the beginning from the stone age when man learned to create shelter for them and from then human has made different type of structures, including pyramids by the combination of lots of mathematical calculation. By known or obscure, Civil Engineering was consistently a piece of a human progress. We have improved a lot in this field till now and now we are trying to improve more. Cold formed steel which comprise with light weight solid materials with steel empty area. Its structural behavior depends on individual components. There is no need of additional reinforcing steel for in-filled concrete that's why formwork not needed for CFST beams.

A. Cold Formed Steel

Cold-framed steel is the regular term for steel items formed by cold working procedures did approach room temperature, for example, moving, squeezing, stepping, twisting, and so on. Cold-shaped steel is squeezed at essentially cooler temperatures, frequently even room temperature, which implies it doesn't change structure. It is a more grounded item than hot framed steel and has a smoother appearance. In recent years cold formed steel structural members have gained considerable prominence over hot rolled steel sections. The shapes of cold formed steel developed into a precise process and allows different types of shapes depending on specific requirement of the loading conditions and the utility.

B. Advantages Of Cold Formed Steel

Using cold formed steel as a structural member there are many distinct advantages in constructions.CFS has terrific strength and stiffness and does not crack, split, deform or shift from its place or dimensions. Steel's strength lets in designs with longer spans and different capabilities now not feasible with different materials. Less metal is needed to endure a specific load than different materials ensuing in a lighter body. It is non-flamable and so decreases your insurance quotes and builder's chance. It's far proof against corrosion and releases no unstable organic compounds. Metallic can resist high winds and seismic activity. It's miles 100% recyclable and maximum of the present metal incorporates a excessive proportion of recycled steel. Metallic is durable and could final for many years with little preservation.

C. Light Weight Concrete Materials

Concrete is a composite engineering material. It is a mixture of binding material like cement or lime along with aggregate, water and sometimes admixtures in specific proportions.Adding "lightweight" with concrete it characterized by a lower unit weight. It is made with light weight aggregates like pumice, air cooled blast furnace slag, clays, shales, slate, plastic granules instead of normal aggregates. The concrete with partial replacement of coarse aggregate with ceramic waste and fine aggregate with foundry sand not only increases the tensile strength but also increases shear, compaction and flexural strength. The use of concrete has recently gained popularity as a resource utilization, durable and cost effective.

A concrete mix with waste materials can provide environmental and economical benefits. Leaving the waste materials to the earth legitimately can cause natural issue. Thus the reuse of this Waste material can be underscored. Each waste item has its particular impact on properties of new and hard concrete.

1) *Ceramic Waste:* A ceramic material is an inorganic, non-metallic, often crystalline oxide made from a mixture of minerals, typically silica sand, with a clay binder and some impurities, and up to 30% water.
2) *Foundry Sand:* Foundry sand is perfect, consistently estimated, excellent silica sand, utilized in foundry throwing forms. The sand is bonded to form molds or patterns used for metal castings. Shake-out sand from finished metal throwing are frequently recovered go into the foundry sand process.

D. Advantages Of Light Weight Concrete Materials

Using this lightweight materials the concrete has low specific weight and advanced thermal and sound insulation properties, whilst maintaining adequate electricity.

This composition have better split tensile strength, it can help environment to decrease the effect from waste and elimination difficulty of waste, it has lighter weight, this will increase flexural strength, and these materials are easily available and has corrosion resisting properties.

They have also moisture resistant, more difficult than conventional shape metals.They have low mass density which leads to light-weight components less expensive, Low coefficient of friction.

E. In-filled Concrete

It is a basic composite framework, which comprise with light weight solid materials with steel empty area.Its structural behavior depends on individual components.

The local buckling behavior of in-filled concrete sections is enhanced by the pressure of concrete in-fill when compared to hollow section.

Drying shrinkage and creep are much smaller than ordinary conventional reinforced concrete. There is no need of additional reinforcing steel for in-filled concrete that's why formwork not needed for CFST columns.

II. LITERATURE REVIEW

Ram Kumar, et al (2017), has studied the flexural behavior of cold formed beam with lightweight concrete. Three cold formed built-up sections have been selected, which can be channel segment connected again to lower back with the aid of welding. The beam is to be experimentally examined under two-factor loading and cargo bearing ability of various sections may be as compared.

Mukesh Ghadge, et al (2018), has studied the performance of hollow sections with and without Infill under compression and flexure. The compressive and flexure strength of rectangular ordinary concrete composite phase with mechanical bonding is maximum as compared to the opposite varieties of square and square hollow sections.

Rajeshwari O, et al (2019), carried out a trial and explanatory examination of cement filled steel cylindrical sections is introduced. From this examination study it is normal that, relapse models which were created with least number of investigations dependent on Taguchi's technique anticipated the pivotal burden conveying limit quite well and sensibly well at extreme point.

Prof. B. Rama Rao, et al (2016), carried out a starter appraisal was done on concrete containing waste foundry sand in the degree of 0%, 10%, 20%, 30%, and 40% and squander ended tiles in the degree of 0%, 10%, 20%, 30%, and 40% by weight for M-25 evaluation concrete. It is furthermore found that part versatility increases with increase in level of waste foundry sand and waste terminated tiles up to 20% replacement after that it decreases.

Beena Kumari, et al (2018), discussed about RCC and steel frames have been the most common frame systems for long times whereas composite frame system has also emerged as popular system for high rise buildings for few decades. The use of concrete filled steel tubes in building construction has seen renaissance in recent years due to their numerous advantages, apart from its superior structural performance making a typical composite frame structure.

III. EXPERIMENTAL PROGRAMMES & RESULTS

A. Selection of Materials

The main components of the concrete are water, admixture, cement, fine aggregate, coarse aggregate, fly ash, foundry sand, ceramic and cold form steel.Therefore checking out to look how varying the proportions of cement, water, Foundry sand,ceramic,coarse aggregate, fine aggregate, admixture affect the properties of my concrete.

B. Mix Design of Concrete

Mix design of concrete was done according to IS 10262:2009. Grade of manage concrete turned into chosen as M30 and target slump became 100mm. Conditions for presentation were taken as severe.as a matter of first importance, target quality was determined accepting reasonable estimation of standard deviation.Coarse aggregate & fine aggregate quantities calculated had been primarily based upon the SSD (Saturated surface Dry) circumstance. Concrete mixes with replacement of foundry sand & ceramic waste were designed respectively.

C. Here We Are Using Different Types Of Combination For Concrete Mix

As here we are using different types of materials we need to test for all the materials separately. So at 1st we will test for concrete having only cement, fine aggregate and coarse aggregate. Then replacing fine aggregate or coarse aggregate one by one by different percentage of foundry sand or ceramic. And at last we will take the percentages from the test which is giving the best result and use all of the best results to make our final concrete mix. Compression, flexure and split tests will be done respectively for cubes, beamsand cylinders separately by using all these concrete combination.

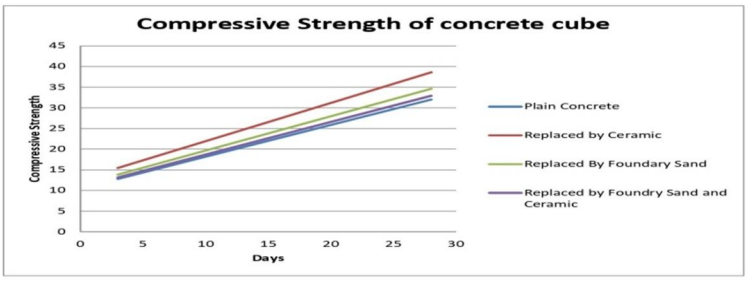
Combinations are as follows:

1) Plain CC Cube,
2) Plain CC Cylinder,
3) Plain CC Beam,
4) CC with fine foundry sand & ceramic waste,
5) CC cylinder with foundry sand & ceramic waste,
6) CC beam with foundry sand & ceramic waste,
7) Steel composite beam infilled with ceramic waste and foundry sand,

After casting, this concretes are stored in moist air for 24 hours then it removed from the molds. Then the concretes kept for submerged in clear water for 3 days & 28 days. Cubes are taken for test after 3 days and rest are tested after 28 days of settlement.

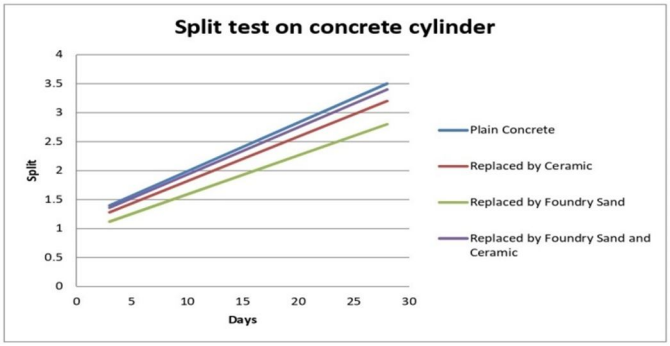
D. Compressive Strength

The compressive strength for different cubes with 20% foundry sand and 15% ceramic waste as replacement, the values are plotted in the diagram at different curing ages. We are found that after 30% replacement foundry sand as a coarse aggregate the compressive strength decreases and for ceramic waste after 20%.



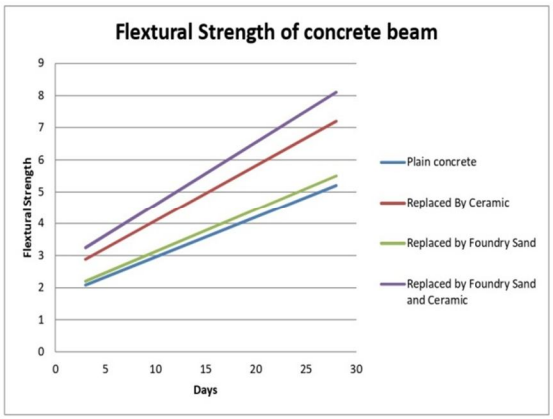
E. Split Tensile Strength

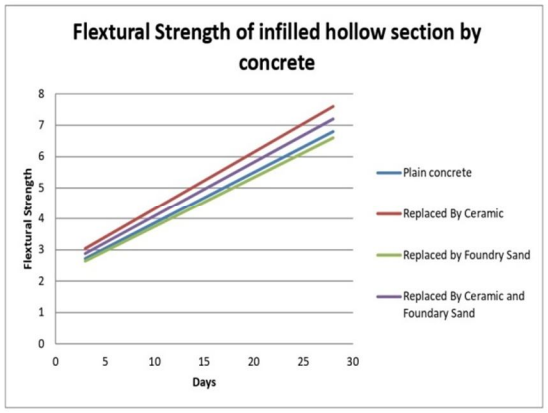
It was found that the split tensile strength of concrete containing foundry sand and ceramic waste the consequences increases. It changed into again that 20% of foundry sand and 15& of ceramic waste showed higher tensile.



F. Flexure Strength

The flexure strength for concrete beam increases replacement with foundry sand and ceramic waste as a waste material in concrete as compared to the normal concrete beam. Then with cold formed steel infilled with ceramic waste and foundry sand the flexure increases as compared to the normal concrete.





IV. CONCLUSION

Based upon the experimental results we can conclude that, waste foundry sand and ceramic waste replacement with fine aggregate and coarse aggregate in concrete mix is successful. With the use of these lightweight materials we can make the concrete light weighted and have higher load carrying capacity. Compressive strength, split tensile strength and flexure strength increases as compared to the normal concrete. From the results we can also conclude that Steel composite beam infilled with light weight concrete has great load carrying capacity.

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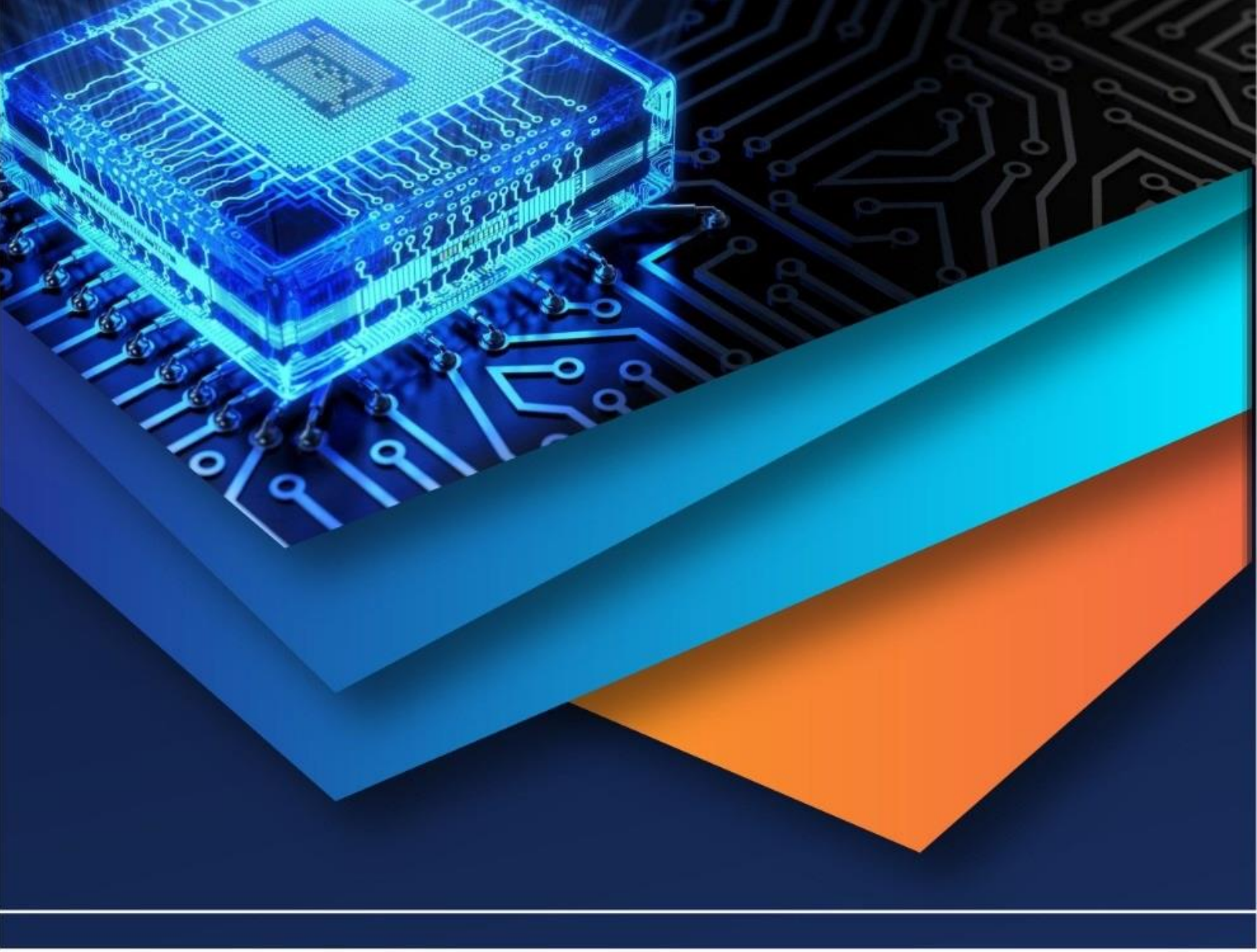

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