International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 03 | Mar 2021 www.irjet.net p-ISSN: 2395-0072

STATE OF ART: STUDY ON STRUCTURAL BEHAVIOUR OF CONCRETE COMPOSITE BEAM USING FERROCK

KARTHIKA S[1], PRIYADARSHINI G[2], DR. A. LEEMAROSE[3]

[1,2] Student, ME Structural Engineering, SRM Valliammai Engineering college, Chengalpattu, India[12]

[3] Associate Professor, Civil Engineering, SRM Valliammai Engineering college, Chengalpattu, India[3]

ABSTRACT: *concrete, which is second most utility material in structure after water which accounts for about 8 to 10% of total co_2 emissions with the production of cement industry. Reduction of co_2 emission in the atmosphere there is a formation of green concrete concept evolved. This article is a state of art review of research on the use of industrial waste materials (i.e.) Ferrock. Ferrock is a combination of iron dust 60%, fly ash 20%, metakaolin 12%, limestone 8%, it has an ability to supplant OPC and it is best substitute for cement in concrete. Different experimental tests were conducted on concrete when cement is partially replaced with Ferrock and are compared with conventional concrete. It is observed that there is no research was performed in flexural behavior of Ferrock using concrete encased steel composite beam. The main parameter involved in the study was concrete compressive strength and configuration of encased steel section. Associate specimens of concrete cubes and cylinders has been tested for their strength.in addition an analytical method was suggested to predict the flexural behavior of Ferrock using concrete encased steel beam compared with their experimental results of beam.*

***KEY WORDS*:** Ferrock concrete, hot rolled I steel section, encased beam, flexural strength of composite beam

1.INTRODUCTION

In recent days the problem faced by the construction industry is reduction of raw materials. So, we have to take a responsibility to reduce the effect of application of raw materials (concrete) to the environment impact. Globally cement production in 2015 accounted for nearly 8% of total co_2 emissions.in recent days, many of the researchers have an ultimate goal to reduce global warming especially due to the production of cement industry because for each one ton of cement produce more or less eight ton of co_2 which is liberated into the atmosphere. So, the researchers have found that green materials which is used in concrete and it has an ability to absorb co2 in the atmosphere. David stone is the brainy who patented a new concrete technology known as Ferrock. As per the available literature, Ferrock is a binder which consist of iron powder, fly ash, limestone and metakaolin to make the industrial waste materials as novel substances.

The mechanism which is involved in Ferrock as,

$$Fe + Co_2 + H_2o \longrightarrow FeCo_3 + H_2\uparrow$$

The iron among the steel reacts with co2 and water which form an iron carbonate matrix when it dries it exhaust rock like qualities called Ferrock. So Ferrock is carbon negative and it is much stronger than OPC and it is also a best choice to substitute for cement.

Though a concrete has its own tensional limitation and poor ductility. To increase the tensile property of concrete with the help of industrial by products i.e. Ferrock. Ductility is an important characteristic of structure to resist seismic, impact and blast loading.

The present day, demand in construction on parameters such as strength, safety, serviceability, satisfactory and performance expected of a structure apart from economical solutions has also made it imperative to use steel concrete composite construction techniques. In order to design the structural member with maximum efficiency and minimum cost, steel concrete composite techniques are adopted.

Concrete encased steel composite beam has been broadly utilized in building development where the primary steel segments are totally or part of the way encased in concrete. This sort of beam gives higher strength and solidness than supported solid part. The primary boundary engaged with the solid encased steel beam is Ferrock concrete compressive strength and setup of steel segment and furthermore evaluate the impact of this material in the climate.

2.PREVIOUS STUDIES

OSAMA O. EL-MAHDY (2005)-This literature study showed that an accurate modeling for concrete encased steel beams is achieved by using nonlinear 3-dimensional finite element method through the general program DIANA. The analysis has been performed for both linear and 2nonlinear stages of concrete encased steel beams. this work was compared with corresponding one of the previously available experimental works and it showed a capable of good representation for concrete encased steel beams behavior and strength.

Dr.AMMAR A.ALI, SAAD N, SADIK (2005) – In this paper, flexural test were conducted to evaluate the structural behavior of proposed composite beam using I shape steel section with reinforced concrete encasement. specimens were tested under lateral loading and it was analyzed through both elastic and plastic stress distribution on the composite beam. It is found that considering the effect of longitudinal reinforcement in the strength of section which is important to get closer to experimental results.

AHMED YOUSSEF KAMAL (2009) - In this writing considered that encased beam composite development utilizes primary part and this paper shows the impact of upper steel area rib position of encased bar on the beam limit and bar flexibility is examined. Twenty-one essentially upheld encased solid example were tried under horizontal stacking and are contrasted and 3D limited component strategy examination received by ANSYS which shows great concurrence with exploratory outcomes. It was discovered that pliability is high and upper steel flange close to the pressure zone postpones the commencement of solid squashing, as the moving of upper steel rib towards strain zone defers the inception of flexural breaks were noticed.

XIAN LI, HENGLIN LV (2012) - In this paper, study shows that flexural conduct of GFRP supported reinforced encased steel beams and they built up another sort of FRP-built up concrete encased steel (FRP-RCS) composite beams included bendable primary shapes in mix with consumption safe FRP-supported concrete. The test outcomes showed that utilizing encased steel shapes can give a critical improvement in load conveying limit, firmness, malleability and energy retention limit of tried beams were noticed.

ALEJANDRO LANUZA (2017) - In this paper, life cycle examination used to take a gander at the characteristic impacts of ferrock and OPC, focusing explicitly on their obligation to carbon defilement, water use and energy ingestion. This technique fuses a start to finish regular assessment of ferrock age, from the reason for its materials extraction to every one of its means. The results have been stood out from previous existence cycle examination of OPC. This assessment finds that ferrock has both the likelihood to override OPC, and contribute basically to the progression of a plausible future.

D.S. VIJAYAN (2018) - This study proposes to evaluate the ability of ferrock to be used as best possible substitute for cement in concrete. Iron dust which would otherwise endup in landfills is used along with small proportion of limestone, fly ash, metakaolin to make novel substances. This study focusing specially on their contribution to their carbon pollution, water usage and energy consumption. By substituting cement with ferrock in varying proportion as 4-12% in concrete. From the result it is evident that compressive strength, split tensile and flexural strength revealed that 8% ratio of ferrock binder has better result when compared to another ratio.

M PATEL, HARDIK J SOLANKI (2018) – This study shows that utilization of mechanical waste materials saves 14-20% measure of concrete and it answerable for diminishing the ozone harming substances. In their examination they are in supplanted concrete with ferrock in slowly fluctuating extents from 20-30%. Specimens were casted and tried for their mechanical strength. The test outcomes showed that 25.43% substitution gave ideal execution in compression, 17.51% in tension and 25.11% in flexure.

MOHAMMADM.RANA (2018) - In this examination, flexural conduct of another type of designed cementitious composite (ECC) and light weight concrete (LWC) encased steel composite beam is contemplated. Four essentially upheld ECC-LWC encased steel composite beams were tried to research the impacts of ECC cover thickness on a definitive burden conveying limit and disappointment modes. In addition to flexural strength enhancement it is found that the combined use of ECC and LWC could improve the overall ductility of beams and reduce their weights. To complement experimental study, a 3D nonlinear finite element model is developed to simulate the behavior of ECC-LWC encased steel composite beam. Result shows that minimum encasement thickness (50% of depth of beam) encasing the steel flanges was sufficient to produce significant performance improvements in terms of stiffness, ultimate load carrying capacity and ductility.

Dr.SHANMUGASUNDAR (2019) – concrete is most used building material for construction works, which is responsible for 70% of industrial co_2 emission. Many researchers have been done on replacement by green

materials. Oxalic acid act as a catalyst and on reaction with co2 and water produces iron carbonate, which is the hardened product. It can enhance the environment by absorbing the atmospheric co_2 for its hardening process. the work was carried out by varying the oxalic acid catalyst concentrations among the constituents of ferrock mortar mix. From the experimental result the optimum molarity of oxalic acid is found to be 10 moles for the best behavior in compression. It is also found that strength of ferrock concrete is twice that of OPC.

MD. IMRAN KABIR, C.K. LEE (2019)- In this study, the flexural resistance and the bond slip behaviors of ECC-LWC encased steel composite beams were studied experimentally and numerically. Results of parameter i.e. study indicate that the flexural resistance of the composite beams could be much increased by increasing the yield strength of steel section were observed. Furthermore, for a fully encased section, no significant bond-slip will occur at failure even when grade 960 high strength steel is used. In this study suggest that that ECC-LWC cover could prevent both local and lateral torsional buckling.

KAVITA SINGH (2020)-In this paper it was observed that, use of concrete products like green concrete in future not only reduce the emission of co2 in environment but also economical to produce. From the experimental result it was concluded that compressive strength and durability of ferrock concrete is more as compared to conventional concrete up to 20% replacement of cement with ferrock and from above 20% the compressive strength of concrete is decreasing.

3.CONCLUSION:

This study was analyzing the effect of ferrock concrete and encased steel beam under flexure. An experimental investigation on flexural behavior of proposed ferrock using concrete encased steel beams was conducted by testing a three simply supported beam subjected to two-point bending loads. The main parameter considered in the study are concrete compressive strength and members with steel section. Analytical studies were carried out using ANSYS and are compared with experimental results. With the analytical results obtained, the study is further being carried out in second phase of the project. In second phase experimental works (i.e.) beams will be casted, cured and tested according to their curing periods, then the result will be published in second phase of the project.

4.ADVANTAGES:

- The pace of outflow of CO_2 because of concrete creation in the business is decreased.
- As CO_2 is utilized during the solidifying interaction it decreases quite possibly the most hazardous of ozone harming substances.
- As the exploratory examination closes, it is apparent that the strength of ferrock is double that of customary cement.
- The steady expansion of corrosive expands the creation of iron carbonate which individually reflects in expanded strength.
- composite members provide better load carrying capacity than Rcc members.

5.REFERENCES:

1. C.C.Weng, S.I.Yen, M.H.Jiang, “Experimental study on shear splitting failure of full scale composite concrete encased beams”, journal of structural engineering 128(9) (2002), 1186-1194
2. Papayianni E Andtansion. “Production of high strength concrete using high volume of industrial by-products”. Journal of construction materials, 2010, 1412-1417.
3. Ammar A. Ali, Saad N. Sadik, Dr.wael S.Abdul sahib- “strength and ductility of concrete encased composite beams”, Journal of engineering and technology, volume no 30, p.p no.2701-2714,2012.
4. Xian li, Henglin Lv, Shuchun Zhou – “Flexural behavior of GFRP –reinforced encased steel composite beams”, Journal of construction and building material, volume no 28, pp. no. 255-262,2012
5. J. Rosales, M. Cabrera, F. Agrela. “Effect of stainless-steel slag waste as a replacement for cement in mortars. Mechanical and statistical study”, journal of construction materials, 2017, 444-458.
6. ChangzaiRen , Wenlong Wang , Guolin Li, “ Preparation of high performance cementitious materials from industrial solid waste”. journal of construction materials ,2017, 39-47.
7. Alejandro Lanuza Gracia, Ashik Thitira Achaiach, John Bello, Thomas Donovan, “Ferrock: A life cycle comparision to ordinary Portland cement”, ISE 576- Industrial ecology (April 24-2017)
8. Mohammad M.Rana, C.k.Lee, Safat Al-Deen, Y.X.Zhang - “Flexural behaviour of steel composite beams encased by engineered

cementitious composite", journal of constructional steel research, 143, (2018), 279-290

9. Pradeep Jadhav, Vicky Jadhav, Giridhar Narule, shahid mulani, "co_2 absorbing concrete block", IJTEEER vol.2, issue-7,2347-4289
10. V.rajesh, M.patel ,Hardik J Solanki, "Development of carbon negative concrete by using ferrock", IJSRSET,2018.
11. D.S.Vijayan, Dinesh kumar, S Arvindan, Thattil shreelakshmi janarthanan, "Evaluation of Ferrock: A greener substitute to cement", journal of materials 2019.