Performance Of Carbon Fiber Mesh Embedded Slab

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Abstract- *The purpose of the research was performance of carbon fiber mesh embedded slab. To study the construction materials and construction methods design things and standard thing. The carbon fiber is newly introduced in slab so it's very interesting to take this part of work. To cast 1000mm x 1000mm x 75mm carbon fiber mesh embedded slab same size. the load carrying capacity of slabs is tested by laboratory .The main advantages of this slab are to reduce the cost of construction by thickness reduction of structural members.*

Keywords- Carbon fiber, Carbon fiber mesh slab concrete.

I. INTRODUCTION

HISTORY

Thomas Edison initially suggested and patented production and application of carbon fibers for use as filaments in electric lamps in 1880. Those fibers were made by pyrolysis of cotton or rayon fibers. This fiber was very porous and fragile and was replaced by tungsten. He suggested obtaining carbon and graphite fibers from various natural fibers over the next 20 years.

The second time interest in carbon fibers appeared in the middle of the XX century, when adequate material was needed for reactive engine parts. Carbon fiber with its properties has proved to be one of the most suitable reinforcing materials for this purpose, as it is quite heat-resistant, has good heat insulation, is resistant to corrosion against gas and fluid, has high strength and stifles

These fibers were manufactured by heating beams of radius up to size The construction steps are to make a one-layer centering and laying of concrete and laying of carbon fiber mesh and reinforcement laying is 8 mm diameter rod 300 mm center to center and one more slab is without.They were carbonised. This process proved inefficient, as the resulting fibers contained only about 20 percent of carbon and had low resistance and stiffness properties. High temperature treatment enabled new material to reach tensile strength of approximately 330-1030 N / mm2 and elastic modulus up to 40 kN / mm2.Short mono-crystal graphic fiber production technology was proposed in the early 1960s, which allows approaching tensile strength of about 20 kN / mm2 and Young's modulus of up to 690 kN / mm2. These fibers were grown in a voltaic arc at 3600 0C and 0,27 N / mm2 pressure.

Nowadays because of its expense this technology is very rare.A process using polyacrylonitrile (PAN) as raw material was developed during the same time period. This had produced a carbon fiber that contained around 55 percent carbon and had far better properties than fibers based on rayons. The process of conversion of polyacrylonitrile (PAN) quickly became the primary method of carbon fibre production. The characteristics of the first PAN-based fibers were not exceptional, but technology was improved and carbon fibers with a tensile strength of 2070 N / mm2 and a modulus of 480 kN / mm2 were obtained after 10 years (to the 1970s).

The possibility of producing fibers with elastic modules up to 800 kN / mm2 and strengthupto3kN / mm2 has been shown at this time.Experimental work on finding alternative raw materials during the 1970s led to the introduction of carbon fibers made from a petroleum pitch from oil processing. The first petroleum pitch based fibers were made in Japan in the 1970's. These fibers included about 85% carbon and had excellent flexural strength

II. CRITICAL REVIEW

Hamid Sadraie, Alireza Khaloo, HesamSoltani(2019): Slabs of reinforced concrete are common structural elements that may be exposed to impact loading. Although the use of reinforced concrete slabs and the use of Fiber Reinforced Polymer (FRP) as an alternative to traditional steel reinforcement slabs is increasing, the influence of different parameters on their response under impact loads is not adequately assessed. This study explored the effect of rebar material, reinforcement quantity and arrangement, concrete strength and slab thickness on the dynamic behavior of reinforced concrete slabs using both laboratory experiments and numerical simulations. Experimental performance of fifteen 1000 x 1000 mm concrete slabs, including two 75 mm thick plain slabs, five 75 mm thick reinforced concrete slabs, six 75 mm thick reinforced concrete slabs with Glass Fiber Reinforced Polymer (GFRP) bars and two 100 mm thick reinforced concrete slabs under drop weight impact loads. Displacement-time, strain-time, and acceleration-Time response analysis and comparison of different slabs.Finite element analysis and specimen simulation were performed using explicit LS- DYNA software. Results from experiments and numerical models are in good agreement and indicate that increasing the strengthening ratio or slab thickness enhances RC 's behavior slabs under impact loads. By adjusting the quantity and arrangement of GFRP, it is possible to achieve better performance in GFRP slabs than steel-reinforced slabs, which, given the corrosion resistance of this material, can make it an appropriate selection of reinforcing material. Carbon fiber can be used in concrete structures which work in aggressive One of the benefits of carbon fiber is good chemical resistance. Carbon fibers are mostly carbon fibres. Modern fibers' carbon content is usually more than 95 percent. Under common conditions carbon is non-reactive. Carbon fiber is a long carbon polymer chain and has no free bonds necessary for reaction Most low concentration chemicals have had no effect on the fibers.

Mahmoud,M,Eldeeb Kamal , Ghamry Metwally Adel YehiaAkl (2016*)* Investigated the efficiency of using Carbon Fiber Polymer (CFRP) sheets for the behavior of beam-column connections considering a concentrated loaded cantilever beam at its free end. In addition, finite element model using the computer package ANSYS was used to complement the published data. Additional beam – connections to In this study, the columns are classified into 4 groups (A, B , C and D) depending on the percentage of reinforcement at the bottom and top of the beam (percent As). The efficiency of using CFRP has been concluded; the CFRP sheet improves or decreases the beam – column connection efficiency depending on percentage As in the beam. The paper examines the influence of boundary conditions, columns as hinged substrates, And the CFRP efficiency of use. It is concluded that the CFRP sheet improves or decreases the efficiency of the beam – column connection depending on the percentage As in the beam, structures collapse due to the failure of the beam – column connection due to seismic actions in low-rise buildings that occur due to the absence of a lateral resistor system (3–4 floors). In this case, framing action between beam and column is the only path to dissipate the energy of the earthquake (EQ), which is an important matter when such a connection is not designed to withstand such energy considering a hinged support. This research studies the effect of using Carbon Fiber Polymer (CFRP) sheets to repair beam-column connections. The main objective is to reinforce the structure it is affected by. it’s a very good ides with carbon fiber.

C.Tet,Thanasis,C.TriantafillouDionysios,A.Bournas(2019): Two glass fiber enhanced polymer (GFRP) thin-walled panels and square hollow sections (SHS) between them were used to build sandwich structures through adhesive bonding or mechanical bolting. Compression experiments were conducted to understand the modes of failure including global and local buckling, load-bearing capacities, load-displacement curves and load-stress responses. The effects of different connection methods and different spacing values between the sections of the SHS were clarified accordingly. Sudden debonding failure was found on adhesively bonded specimens between GFRP panels and internal SHS columns; while mechanically bound specimens showed evident lateral deformation and progressive failure until the ultimate junction separation failure on the GFRP SHS columns Local buckling has been found on thin-walled GFRP specimen panels with a greater spacing between the two SHS sections. Finite element analysis and analytical modeling were performed to estimate the load-displacement curves and the critical stress for local buckling on thin-walled GFRP panels, where consistent agreements were reached with experimental results

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Hao,Wu,An,Chen,SimonLaflamme.(2018): Glass fibre-reinforced polymer (GFRP) panels have been increasingly used for structural applications due to their light weight, resistance to corrosion and ease of construction. This study evaluates GFRP wall panel seismic performance based on comprehensive shaking table tests and finite element analysis (FEA). The harmonic ground motions of frequencies ranging from 10 to 15 Hz are experimentally subjected to a GFRP wall panel. To simulate gravitational weight, a mass is fixed to the top of the panel. Under a peak base acceleration of 2.1 g the panel stays undamaged. Its FEA is accomplished using Rayleigh damping based Abaqus.The experimental and FEA results are in good correlation. To study the seismic behavior of a Reinforced Concrete (RC) wall, which is validated by results from an existing study, another FEA model is developed. The two FEA models are then used to compare the seismic performance in drift ratio and hysteretic behavior of GFRP wall panels versus RC walls. While GFRP wall panels in multi-story buildings can not replace RC walls due to their low stiffness, their performance is comparable to RC walls for low-rise buildings. GFRP wall panels can therefore potentially be used in low-rise constructions.

John Andrew Wattick ՚An Chen.(2017): Fibre-reinforced concrete (FRC) has been used in numerous types of prefabricated elements around the world, as it has been shown that reductions in production costs and time can be achieved; however, in Uruguay there is little experience of such material. So our study analyzed the feasibility of its use in this country. This paper reports on the development of a simple model of analysis which is useful for designing precast elements of FRC. The efficiency of the model was assessed by applying it to a practical case study with vertical precast concrete The findings suggest that the two sample groups have some similar resistant mechanisms but different synthetic fibres, metal fibres, and steel mesh lateral underprogressive capacities. The cost-efficiency of various panel geometries and reinforcement amounts were assessed with the developed model. The model enabled consideration of the contribution of the fibers to withstand the internal tensile forces of the panels and thus could replace the steel mesh in the panel wyths. It was found that panel reinforcement and geometry could be optimized thereby reducing the thickness of the wytheIn addition to reducing production time, cost savings of up to 10 percent could be achieved by replacing steel mesh with fibres, and more than 20 percent if the geometry was also changed.

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Wenjie Wang Chouw (2018): Polymerofflaxfibrereinforced,impact(FFRP) Reinforced concrete reinforced coconut fiber (CFRC) slabs were investigated in theoretical and throughexperimental studies. Slabs made of plain concrete, CFRC and FFRP-CFRC were constructed and tested under impact loads. Impact results showed that FFRP-CFRC specimens performed better in energy absorption aspects and maintained concrete integrity, compared with PC and CFRC specimens. Another impact test was performed to find the more effective wrapping configuration between three different wrapping designs of the FFRP reinforced CFRC slab, and their parameters , i.e. impact force history, FFRP strain history, deflection history, energy absorption and damage patterns were discussed to assess impact resistance. The theoretical analysis method was used after the experimental study to predict the maximum impact force as well as the maximum deflection, the results of which showed good agreement with the results of the experiment.

ChoaybBelghiat, AliMessabhia, MohamedGuenfoud, OlivierPlé, Pascal Perrotin,(2018): Confined masonry structures are one of Algeria's most widely used construction systems, in which both walls and confining elements contribute to the gravity and seismic load carrying. Several types of containing elements (uniform confines, dented confines) are used, each giving the structure a different mechanical behavior while the density of the wall is considered a key safety factor. The study presented in this paper is an experimental study on two containment types. The originality of the study comes from the size of the tested samples, which included double-panel confined masonry and experimentalpushovertests. First, the study investigates uniform masonry walls and confining. Second, tested are dented masonry walls made up of two panels of Algerian clay bricks. On the one hand, the objectives were to study the impact of the frame / panel connection on the structure's quasi-static behavior as well as the charging and unloading behaviors. On the other hand , the impact of using double panel walls on the mechanism of resisting confined masonry walls should be highlightedThe results indicate that the two sample types show some similar resistant mechanisms but under-progressive lateral loading of different capacities, which may affect the structure's seismic resistance. When double-panel walls are used a mixture of shear-flexural mechanism can be noticed.

FethiSermet ,AnilOzdemir(2016): Punching is one of the most important risks in reinforced concrete structures which lead to abrupt and brittle fracture. Punching effect at the ends of columns occurs during the transmission of loads from the slab to the columns and this effect is just as important as the slab 's resistance to bending. Punching performance of plain, steel fiber and polypropylene fiber incorporating reinforced concrete slabs has been experimentally compared in this paper. As flat slab and normal load were applied, one steel fibre and one polypropylene fibre-reinforced concrete specimens were produced. The dimensions of the test specimens were 1000 x 1000 mm for comparison with other studies, and the slab thickness was selected as 100 mmIn all specimens, reinforcing bars were placed in just the bottom parts of the slabs. Steel reinforcement Ø10 S- 335 was used in the study. The column was decided to be located in the middle part of the slab to provide punching formation. The column shape was selected as circular with a diameter of 150 mm. Results of load- displacement curves were interpreted in the first phase of the experimental study. The punching performance of specimens under normal loads was compared in the second phase, and some suggestions were made

Harun Tanyildizi(2018): The artificial neural network and vector supporting machine were used to estimate the compressive strength and flexural strength of carbon fiber-reinforced lightweight concrete exposed to high temperature with the silica fume. Cement was replaced by three percentages (0 percent, 10 percent, and 20 percent) of silica fumes. They used the carbon fibers in four different proportions (0, 2, 4, and 8 kg / m3). The specimens were heated to 20 ° C, 400 ° C, 600 ° C, and 800 ° C for each concrete mix. After this process, the strength tests were carried out on the specimens. The quantity of cement, the quantity of silica fumes, the quantity of carbon fiber, the quantity of aggregates and the temperature were selected as variables of input for the prediction models. The lightweight concrete's compressive and flexural strengths have been determined as the output variables. The results of the model have been compared with Experimental reports. The best results were obtained from artificial neural network platform. The accuracy of the artificial neural network model has been found to be 99.02 percent and 96.80 percent. Which is more economical compared to wrapping or forming it in a bar shape because it is easier to achieve similar performance and uses less fiber. CFRP reinforced concrete beam samples were tested to fail in four-point bending test. The results obtained are compared with the performance of reinforced concrete made from steel. We can conclude from the research that the CFRP reinforced concrete beam gives the required strength and resistance as designed, with behavior similar to those reinforced with steel bars.

Abraham Christiana,*, Gary Ong Khim Chyea(2014): The study investigated the response of composite steel-concrete panels subjected to air- blast loading. The composite panels consist of fibre-reinforced high-strength concrete on the face of the incident, along with a specially configured steel sandwich as the distal layer that dissipates the imparted blast energy. The novel composite panel's performance is compared with a conventional steel concrete steel (SCS) panel and an ordinary reinforced concrete panel. The composite panel's dynamic response is obtained numerically using a finite element analysis that adopts a simplified modeling approach. Parametric studies are carried out by varying the weight of the charge, the type of concrete and a number of core structures of steel sandwich. In addition , the energy absorption capacity is found by calculating the area of the proposed composite panel under the resistance-deflection curve. Relation between the core structure of the steel sandwich and the capacity to absorb energy, Then, as well as the core design and total panel deflection subject to different blast charges, are derived. Because of the high weight-to-performance ratio and the high energy absorption properties of the composite system, the combination of fibre-reinforced high-strength concrete and cellular steel sandwich demonstrated good potential for use as blast mitigation panel.

Tero Liutu, Petri Himmi, Juri Kvach.(2010): The purpose of the research was to study manufacturing technologies, carbon fiber properties, construction methods, use of this material, compare carbon fiber and structures, use carbon fiber with traditional materials and structures and find out reasons for use in constructionMoreover, my task was to create calculating tool in Excel to estimate the effect of strengthening carbon fiber on the structure. The study was commissioned by Juri Kvach, FM Stroiprojekt. The calculation tool in Excel represents a program that calculates the beam's existing cross-section, finds its ultimate bending moment, and compares this moment to an existing or projected moment. If the moment is not sufficient, it is possible to choose the reinforcing material, its size and number of layers, to calculate the bending moment of improved structure. Calculations of the reinforced with carbon fiber beams show an increase of the ultimate bending moment up to 90 percent from the initial moment of unreinforced-reinforced beams. The reinforcement of high-reinforced beams does not give this effect because the failure model is changed to fragile, which is not allowed for concrete structure

Norazman Mohamad Nor , Mohd Hanif Ahmad Boestamam, Mohammed Alias Yusof(2013): In order to improve its structural life and performance, damaged or old structures sometime need to be repaired or strengthened. There are many ways to reinforce the structures. This research explores the potential of using Carbon Fiber Reinforced Polymer (CFRP) as concrete beam reinforcement. Use of CFRP as reinforcement was explored in this study.

III. RESEARCH SIGNIFICANCE AND CONCLUSION

In this proposed study, the carbon fiber mesh embedded slab provides improved strength by laboratory testing and it gives minimal deflection and failure is more time-consuming compression strength compared to RCC slab also nice it was tested 75 mm thickness which gives more strength so that we can use this carbon fiber mesh embedded slab for small housing building walls and water storage system as well as ect soc this paper is very relevant.

REFERENCES

[1] Askeland, Donald R. 1998. 1998. The Materials science and manufacturing. 3rd Variant. Cheltengham UK: Stanley Thornes (Publisher's) Ltd.

[2] Footbridgehttp:/www.fireco.no/references/Gangbru percent 20 Vesterelven.pdf (accessed April 2010)

[3] Callister, Jr. 2007-William D. Material Processing and Technology. An intro.Seventh Edition. Estados Unidos: John Wiley and Sons, Inc.

[4] Cavette, Chris. How to make things. Week 4-Volume 4. Carbon dioxide. (Accessed on 10 March(2010) http:/www.madehow.com/Volume- 4 / Carbon-Fiber.html

[5] High value insulated wall tiles http:/altusprecast.blade7.com / uploads/1137682951 / downloads-PDF-Docs / AG IWP br

[6] HighPerformance Insulated Wall Panels http:/altusprecast.blade7.com/uploads/1137682951/Downloads-PDF-Docs/AGIWP brochure20d.pdf (Accessed April 27, 2010)

[7] Hota V.S. GangaRao, Narendra Taly, P.V. Vijay. 2007 Reinforced concrete design with FRP composites. Boca Raton: CRC Press Taylor & Frencis Group.

[8] Cherniavsky Vladimir, Khayutin Uliy, Akselrod Evsey, Klevtsov Vladimir, Fatkullin Nikita. 2006. Guide for strengthening of concrete structures by composite materials according to SP 52-101-2003. Moscow: Interaqua LTC.

[9] Cherniavsky V., Osmac P. Construction of concrete and brick buildings by means of composite materials http:/www.interaqua.biz/stat 2.pdf (Accessed April 13)

[10] Marcus, and Paul. 2005. 2005. Carbon fibers, and composites thereof. Boca Raton: Taylor & Frencis Company, CRC Publishing.

[11] Pretopped Double Precast Tees http:/altusprecast.blade7.com/uploads/1137682951/Do PDF-wnloadsDocs / AG TT brochure8b.pdf (Accessed April 27th 2010)

[12] SikaConstructionDocumentLibrary. http://www.sika.com/en/solutions_products/doc_download/constr_docu_library.html (Accessed on 19 of March 2010)

[13] SP 101-2003. Set of laws pertaining to planning and building. Structures consisting of concrete and reinforced concrete without prestress. 2004. 2004. Moscow. Moscow.