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BEAM STRENGTHENING WITH BASALT FIBER EXTRA REINFORCEMENT

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Abstract: Basalt bars for concrete reinforcement called Basalt Fiber Reinforced Plastic (BFRP) is a new material, so it is necessary to identify the differences and limitations of their use in the concrete structures in relation to traditional steel reinforcement of concrete structures. Simply supported beams under flexure, reinforced with BFRP bars, compared to the reference beams with steel reinforcement. The tested beams were made of M25 concrete and reinforced with basalt bars with 8 mm 6mm and 4mm diameter having and tensile strength evaluated from the tensile tests. The analysis of the beam deflection and cracking behaviour has been presented. The results show the different character of the load-deflection relationship of basalt reinforced beams compared to traditionally steel reinforced beams, as well as the significant influence of the type and quality of anchoring on the process of basalt bars tensile process.

Keywords: Fiber, Bar, Reinforcement, Extra, Strengthening, Economical

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INTRODUCTION

Basalt is the most communal rock type in the earth's shell. Basaltic Molten rock is commonly formed by direct melting of the earth's layer, the region of the earth Below the outer crust,(K L Kudyakov, V S Plevkov, and A V Nevskii, 2015) Strength and deformability of concrete beams reinforced by non-metallic fiber and composite rebar)

Fig: 1 Basalt fiber (Source: Google image)

Fig: 2 basalt fiber bar & steel bar (Source: Google images)

The Market is always striving to find new and better materials to produce new or improved products. Energy conservation, the atmosphere, corrosion risk and sustainability are significant factors when a product is changed, or a new product is manufactured,(Fareed Elgabbas, Patrick Vincent, Ehab A. Ahmed, Brahim Benmokrane (2016) Experimental testing of basalt-fiber-reinforced polymer bars in Concrete beams). One of the solutions might be a new material which is also durable, light and with least risk of corrosion. Aircraft, ships and the automobile manufacturing are always trying to change lighter units without losing material strength to make energy preservation. In this sense the energy required to produce basalt fiber is around 5 KWh/kg while for carbon steel product is about 15 KWh/kg. Other Benefits of the basalt bar are that its weight is one-third of the weight of steel and the thermal development coefficient is very near to that of concrete,(F. Elgabbas, E. Ahmed and B. Benmokrane(2013) Basalt Frp Reinforcing Bars For Concrete Structures.)

OBJECTIVE

Our main goal in this project is provide basalt fiber bar in alternative of ordinary steel bars and find the most economical way to use basalt fiber reinforcement in the beam and increase the strength of beam. And calculate least no of reinforcement bar of basalt fiber to get the optimum strength of the beam.

SCOPE OF STUDY

They are non-corrosive, contain 80% fibres and have a tensile strength three times that of the steel bar usually used in building construction. Wherever corrosion problems exist, basalt fiber composite bars have the possibility to replace steel in reinforced concrete. Role in the construction of civil engineering plays strength; stiffness and resistance to Environmental factors, composite resources based on FRP become an excellent replacement for conventional steel reinforcement. Basalt bars of BFRP group have some advantages comparing to steel reinforcement and other FRP complexes, such as glass GFRP (glass fiber reinforced polymer) or carbon CFRP (carbon fiber reinforced polymer).The chemical preparation of basalts, which are made BFRP basalt fiber, is rather different. In addition to the chemical configuration, mechanical properties of basalt fibers originating from different sources are varied possibly due to the different chemical components and processing situations such as the temperature of the fiber manufacture.

LITERATURE REVIEW

Investigation on Concrete Beams Reinforced with Basalt Rebar as an Effective Alternative of Conventional R/C Structures

Research defined in this paper is aimed at investigational analysis of the limit states of strains and stresses in concrete beams reinforced with flexural basalt fiber composite bars (BFRP) to determine the strength restrictions and acceptable cracking and deflections of such essentials.
The investigation package contained a bending test of three model beams with bottom reinforcement made of BFRP bars (diameter of 8 mm) and, for comparison, a bending test of three basically maintained reference beams with a traditional bottommost reinforcement made of in the form of a traditional bottom three steel bars with a diameter of 8 mm. All the experienced beams have the subsequent dimensions: b x h x L = 80 x 140 x 1200 mm. During the tests, the beams were simply maintained on two supports with a span of 1000 mm. near the supports in all the beams steel stirrups for shear having a diameter of 8 mm have been provided. The middle part of beams did not include any upper reinforcement and stirrups. Top reinforcement bars in the regions of supports of all tested beams consisted of two steel bars with a diameter of 8 mm.

It has been stated in this study that in contrast to the bilinear stress-strain requirement for a steel reinforcement, basalt reinforcement has a linear requirement until the whole the beam section load capacity has been exhausted. It was noted that critical load for tested beams reinforced with BFRP bars was much better than the carrying capacity of beams with conventional steel reinforcement, which arose from the different degrees of mechanical reinforcement in both types of beams.

Strength and deformability of concrete beams reinforced by non-metallic fiber and composite rebar

Manufacture of durable and high-strength concrete structures with unique properties has always been crucial. Therefore, superior attention has been paid to non-metallic composite and fiber reinforcement. This article defines the investigational research of strength and deformability of concrete beams with dispersed and core fiber-based reinforcement.

Portland cement of M500 class was used as a hydraulic binder. Water-cement proportion equals to 0.65. As the longitudinal rebar reinforcement composite FGRP brand of "MONSTER MOD" with an exterior diameter of 6 mm and 10 mm was used. Fiberglass rods have ribbed surface for bonding with concrete. There were also used reinforcing steel rods of class A400. As the transverse reinforcement reinforcing wire of Bp500 class was used. Introductory experimental testing of tensile strength and deformability of fiberglass rods showed that the reinforcement has a high tensile strength up to 1200MPa, the longitudinal deformation of the rods is in the range from 2 to 3%, and modulus of elasticity is 35 - 45GPa.The outcomes of the tests enabled to obtain mutual crack formation patterns and failure of beams reinforced with steel, fiberglass rods Ø6 mm and fiberglass rods Ø10 mm. Study of cracking and failure schemes showed that disruption of elements went by the cross-section, normal to the longitudinal axis with the development of the main crack within the area of clean bending. During the tests, the slip in the concrete of steel and fiberglass rods has not been identified.

BASALT FRP REINFORCING BARS FOR CONCRETE STRUCTURES

The increasing use of fiber-reinforced polymer (FRP) bars inspires utilizing new fiber types, such as basalt fibers, relatively than the commonly used fibers. However, extensive researches are needed to evaluate the short- and long-term features of these newly developed bars. The examination included physical and mechanical characterizations of two different products of deformed BFRP bars (type A and type B) of 8 mm-diameter and one product of BFRP tendons of 7 mm diameter. The test outcomes confirmed that the developed BFRP bars meet the physical and mechanical properties necessities of CSA S807-10.

"Ordinary Test Method for Apparent Horizontal Shear Strength of Pultruded Reinforced Plastic Rods by the Short-Beam Method". "Standard Test Method for Flexural Properties of Fiber Reinforced Pultruded Plastic Rods". In design, the BFRP bars and tendons displayed maximum strain at failure ranging from 2.4% to 2.7% which is higher than the minimum value of 1.2%. According CEB-FIP (1978) the bond strength between prestressing steel bars smaller than 32 mm diameter in normal-weight concrete with compressive strength of 35MPais about 4 M Pa for deformed bars and lowers than 2 MPa for smooth bars.

The bond strength of the BFRP tendons gained herein agrees with what has been reported for steel tendons. The results obtained herein contribute to unindustrialized and enhancing the physical properties of the BFRP bars under investigation. New generation of these bars are presently available and the complete characterization and structural difficult in concrete member will be conducted shortly. This work will contribute to introducing these new products the FRP design codes.

Performance Evaluation of 3-D Basalt Fiber Reinforced Concrete & Basalt Rod Reinforced Concrete

To regulate the ultimate failing load, to study the load deflection behaviour, to observe the bond strength, to measure the strength in the concrete. The fibers used in this investigation were basalt fibers, which were supplied by Research & Technology Inc. The information about the fibers, as providing by the manufacturer is as follows Diameter of fiber, 12 pm Length of fiber13 mm (0.52 in) Beams were tested at7 and 28 days for the static flexural strength (ASTM Cl0l8). The span length was 300 mm (12 in). This test is a deflection-controlled test. The rate of deflection was kept in the range of 0.005 to 0.01 mm (0.0002 to 0.0004 in) per minute as per ASTM Cl018. The load at first crack and the supreme load reached were noted for each beam. From the load and deflections gained, load-deflection curves were drawn from which the toughness indices and the residual strength factors by ASTM method and equivalent flexural strength by the Japanese Standard method were calculated.

The tests designated that there was insufficient bond strength and the bars experienced a gradual slip after the ultimate load was reached. The basalt bar had a very high tensile strength. The bar did not have a yield point and it had a brittle failure. It was a very rapid and explosive kind of failure. The failure observed in the beams was a ductile failure, due to a gradual slip of the bars, thus preventing a brittle failure.

Experimental testing of basalt-fiber-reinforced polymer bars inConcrete beams

New materials, such as fiber-reinforced polymer which is non-corrodible by nature, can be used, especially in harsh environmental situations, to reject corrosion problems. The advances in fiber-reinforced-polymer (FRP) technology have spurred interest in introducing new fibers, such as basalt, in adding to the commonly used glass, carbon, and aramid. Recently, new basalt-FRP (BFRP) bars have been developed, but research is needed to describe and understand how BFRP Bars would behave in concrete members. Basalt-fiber-reinforced polymer (BFRP) bars 10, 12, and 16 mm in diameter were used as tension reinforcement in the experienced beams. It should be Mentioned that, the mechanical properties of BFRP bars were determined using nominal cross-section areas of 79, 113, and201 mm2 for the 10, 12, and 16 mm diameters, individually.

The BFRP-RC beams showed typical bilinear behavior for strain and deflection until failure. The pre-cracking response and cracking loads of all the beams were nearly unaffected by the reinforcement ratio, since they are governed by the gross concrete segment. After cracking, however, the increase in stiffness or reduction in reinforcement strains was proportional to the reinforcement ratio. The higher the reinforcement ratio, the higher the stiffness and the lower the strain at the equal load level.

Investigation of Structural Members With Basalt Rebar Reinforcement As An Effective Alternative Of Standard Steel Rebar

This research deals with the learning of the flexure behavior of beams reinforced with Basalt bars in contrary with the steel bar reinforced beams and equating the stress strain behavior and strain characteristics. Basalt bars commonly known as Basalt Fiber Reinforced Polymer is an innovative component, and hence the differences and limitations of their bondage with concrete in structural members in evaluation with conventional steel reinforcement of RCC members are recognized. The project presents some experimental results of research by considering a flexural member (beam), reinforced with basalt bars, in contrary with the nominal steel reinforced beams and testing under loading frame of 500KN capacity. The two grades of concrete involved are M30/40, while the reinforcement is done with 8 mm diameter basalt rebar and subjected for flexural strength evaluation. The various deflection patterns and nature of crack formation has been illustrated. The results incorporate the difference in the load-deflection pattern of BFRP beams with that of minor control beams with steel reinforcement.
Tests were conducted for 6 no. of BFRP reinforced concrete beams and their flexural strength behavior and concrete strains were tested and their percentage efficiency was studied. From investigational study, it is observed that the beam specimen M30 grade reinforced with BFRP bars has increased flexural behavior up to 23% and load carrying capacity up to 12% and beam specimen with both BFRP and steel presented increased flexure strength up to 27% and load carrying capacity up to 15% in comparison with control beams of the same grade.

MATERIALS AND METHOD

Materials: basalt fiber& bar, cement, sand, water, reinforcement steel, aggregate.

Method:

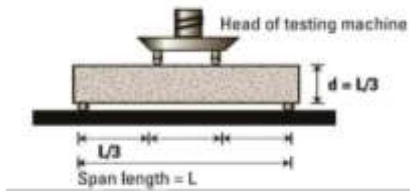

Fig:3 Two point loading test(Source: https://civilblog.org/2015/06/24/flexural-strength-test-of-concrete-is516-1959)

Beam mould of size 15 x 15x 70 cm (size of aggregate is less than 38 mm)
Tamping bar (40 cm long, weighing 2 kg and tamping section having size of (25 mm x 25 mm)
Flexural test machine– The bed of the testing machine shall be provided with two steel rollers, 38 mm in diameter, on which the specimen is to be supported, and these rollers shall be so mounted that the distance from centre to centre is 60 cm for 15.0 cm specimens or 40 cm for 10.0 cm specimens. The load shall be applied through two similar rollers mounted at the third points of the supporting span that is, spaced at 20 or 13.3 cm centre to centre. The load shall be divided equally between the two loading rollers, and all rollers shall be mounted in such a manner that the load is applied axially and without subjecting the specimen to any torsional stresses or restraints.

RESULT AND DISCUTION

It was noted that critical load for tested beams reinforced with BFRP bars was much better than the carrying capacity of beams with conventional steel reinforcement, which arose from the different degrees of mechanical reinforcement in both types of beams. The outcomes of the tests enabled to obtain mutual crack formation patterns and failure of beams reinforced with steel, fiber glass rods Ø6 mm and fiber glass rods Ø10 mm. Study of cracking and failure schemes showed that disruption of elements went by the cross-section, normal to the longitudinal axis with the development of the main crack within the area of clean bending. The results obtained herein contribute to unindustrialized and enhancing the physical properties of the BFRP bars under investigation. The higher the reinforcement ratio, the higher the stiffness and the lower the strain at the equal load level. The results incorporate the difference in the load-deflection pattern of BFRP beams with that of minor control beams with steel reinforcement.

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