Strengthening of RC Short Column with Partial Replacement of GGBFS in Cement

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Abstract— The manufacturing of cement causes the environmental pollution. In the present study the ground granulated blast furnace slag is used as partially with cement it will reduce the environmental pollution. The GGBFS is the by product from the iron industry, it's a waste material. The dumping of GGBFS On ground also causes the environmental pollution. The utilization of GGBFS in concrete also reduces the pollution. In the study the cubes are casted to find out the optimum percentage replacement of GGBFS with cement. Based on the optimum percentage the columns are casted. They are tested under axial compression test. After testing the columns are strengthened by using GFRP sheets. The wrapped columns are again tested under axial compression test. From the test results the load carrying capacity of wrapped and unwrapped columns are compared. Finally the numerical analysis is carried out. More over the comparative study is made between the experimental and numerical results.

Key words: GGBFS, GFRP sheet

I. INTRODUCTION

A. Ground Granulated Blast Furnace Slag

Blast furnace slag is a by product of iron manufacture industry. Iron ore, coke and limestone are fed into the furnace, and the resulting molten slag floats above the iron a temperature of about 1500º C to 1600º C. The molten slag has a composition of 30% to 40% silicon dioxide (SiO_2) and approximately 40% CaO, which is close to the chemical composition of the Portland cement. After the molten iron tapped off, the remaining molten slag, which mainly consists of siliceous and aluminous residues, is then rapidly water quenched, resulting in the formation of a glassy granulate. This glassy granulate is dried and ground to the required size which is known as ground granulated blast furnace slag (GGBFS).

The production of GGBFS requires little additional energy compared with the energy required for the production of Portland cement. The replacement of Portland cement with GGBS will lead to a significant reduction of carbon dioxide gas emission. GGBFS is therefore an environmentally friendly construction material. The GGBFS can be used to replace as much as 80% of the Portland cement when used in concrete. GGBFS concrete has better water impermeability characteristics as well as improved resistance to corrosion and sulphate attack. As a result the service life of the structure is enhanced and the maintenance cost is reduced. High volume eco friendly replacement slag leads to the development of concrete which not only utilize the industrial waste but also saves significant natural resource and energy. This in turn reduces the consumption of cement.

B. Glass Fiber Reinforced Polymer (GFRP) Sheets

Glass fiber is called fiber glass. It is material made from extremely fine fiber of glass fibreglass is light weight, extremely strong, and robust material. The glass fiber reinforced polymer is classified into three types. They are

- Chopped Strands Mat (CSM)
- Uni-Directional Cloth (UDC)
- Woven Roving (WR)

Nowadays the use of externally bonded fibre-reinforced polymers (FRP) has become increasingly popular for civil infrastructure applications. FRP can be applied to strengthen slabs, beams and columns of buildings and bridges. The FRP wrapping is to increase the strength of structural members even after they have been completely damaged due to heavy loading conditions. Before repair the structural member it is necessary to removing loose debris and filling in cracks with mortar or epoxy resin. The most commonly used techniques to strengthening the members are flexural strengthening or shear strengthening. The FRP sheets or plates are applied to the tension face to the member for the flexural strengthening of a beam. The FRP strengthening increases the beam strength and its stiffness and also decreases the deflection capacity of the member.

The FRP strips are applied at the bottom (tension) faces for strengthening the slab. The strengthening result in better flexural performance, until the tensile resistance of the slabs is taken by the tensile strength of FRP. The effectiveness of FRP strengthening mainly depends on the performance of the resin chosen for bonding. The side bonding or U-wraps is used for shear strengthening of member. The columns are wrapped with FRP around their perimeter, as with closed or complete wrapping. This strengthening results in higher shear resistance and it results in increased compressive strength under axial loading. The polymerization or addition polymerization is generally used to generate the polymers. The process of alter the material properties or combined with various agents of polymers the result is referred to as a plastic. The composite plastics used the fiber materials to enhance the strength and elasticity of plastics and the fibre-reinforced plastics are under this category. The matrix referred to as original plastic material without fiber reinforcement. They are tough but relatively weak plastic that is enhanced by stronger stiffer reinforcing filaments. The fiber-reinforced plastic strength and elasticity depends on the properties are the matrix, their volume relative to one another, fiber, fiber length and orientation within the matrix. A laminated structure is used to characterise the two dimensional fibre-reinforced polymers by in which the fibres are only aligned along the plane in y-direction and x-direction of the material. This means in z-direction that no fibres are aligned in the through thickness, this lack of alignment on through thickness can cause a disadvantage in processing and cost. The conventional processing techniques used to fabricate composites cause the costs and labour increase, such as, autoclave and resin transfer moulding, wet hand lay-up, require a high amount of skilled labour to stack, cut and consolidate into a preformed component. The three dimensional fibre structures incorporate fibres in the x-direction, y-direction and z-direction. The manufacturing of three-dimensional orientations from industry's need to reduce fabrication costs, to improve impact damage tolerance and to increase through-thickness mechanical properties, all were problems associated with two dimensional fibre-reinforced polymers.

To suit specific design programs FRP allows the alignment of the glass fibres of thermoplastics. The orientation of fibres increases the resistance to deflection and strength of the polymer. The strongest and most resistive to deforming forces when the polymers fibres are parallel to the force being exerted, and are weakest when the fibres are perpendicular is a glass fiber reinforced polymer. The perpendicular fibres of weak spots can be used for connections and natural hinges, but when production processes fail to properly orient the fibres parallel to expected forces can also lead to material failure. When forces are exerted perpendicular to the orientation of fibres the strength and elasticity of the polymer is less than the matrix alone. The resin components made of glass reinforced polymers are UP and EP, the orientation of fibres can be aligned in two-dimensional and three-dimensional weaves. This means when the forces are possibly perpendicular to one orientation, and parallel to another orientation; this eliminates the potential for weak spots in the polymer.

For design of FRP that require a measure of modulus of elasticity or strength that non-reinforced plastics and other material choices are either will suited for mechanically or economically. The primary design consideration for using FRP is to ensure that the material is used economically and also that takes advantage of its structural enhancements specifically. A material weakness perpendicular to the fibres is also caused due to the orientation of fibres. Thus the use of their orientation and fibre reinforcement affects the rigidity, strength, and elasticity of a final form and also the operation of the final product itself. The fibber orientation direction is either, unidirectional, 2-dimensional, or 3-dimensional. The degree of flexibility, strength, and elasticity of the matrix also affected during manufacturing. The direction of forces with fiber orientation display greater resistance to distortion from these forces. Using more dimensions avoids avoid any specific weak points due to the unidirectional orientation of fibres. The geometric shape and design of the final product can be magnified or diminished the properties of strength, elasticity and flexibility through. These include design consideration such as ensuring proper creating multifunctional geometric shapes and wall thickness that can be moulding as single pieces, creating shapes that have more material and structural integrity by connections, reducing joints, and hardware.

Depending on the degree of strengthening and exposed faces of the member FRP can be applied in several configurations, this includes: U-wraps (U-jackets), and side bonding, closed wraps (complete wraps). Side bonding involves FRP applying to the sides of the beam only. The least amount of shear strengthening due to failures caused by de-bonding from the concrete surface at the FRP free edges. The FRP is applied continuously in a 'U' shape around the sides and bottom (tension) face of the beam in the U wrap. The use of closed wraps is desirable as they provide the most strength enhancement if all faces of a beam are accessible. Closed wrapping involves FRP applying around the entire perimeter of the member, such that there are no typical failure mode is rupture of the fibres and free ends. The FRP can be applied along the length of the member as a discrete strips or continuous sheet as, having a minimum spacing and width for all wrap configurations.

II. METHODOLOGY OF STUDY

The methodology of the project work is shown in figure 2.1. This is discussed below.

- Material properties like specific gravity, fineness modulus, setting time will be studied for fine aggregate, coarse aggregate, cement.
- IS method of Mix design will be made for concrete as per IS 10262.
- Four numbers of RC columns will be cast and out of which one is considered as control and other three columns are partially replaced based on optimum percentage of GGBFS with cement.
- The all columns are artificially corroded by using accelerated corrosion technique.
- The corroded RC columns will be strengthened by using GFRP laminates.
- Experimental and Theoretical investigations will be made on strengthened corroded RC columns and results will be compared.

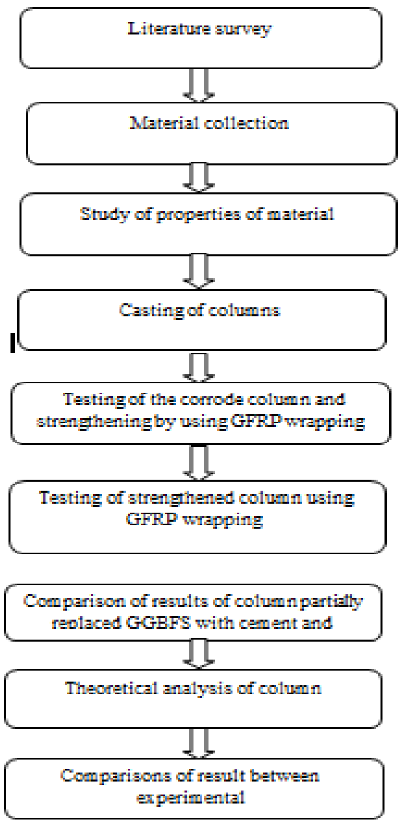

Fig. 2.1: Methodology for the project

III. Material Specification

The materials used to cast the specimen are described in the chapter. The material to be collected is cement, fine aggregate, coarse aggregate, steel reinforcement, GGBFS and GFRP sheets.

A. Concrete

Design concrete mix is to be used for casting the specimen. M20 grade concrete is selected for the column specimen with characteristics compressive strength of 20 N/mm2. The designed mix proportion is 1:1.5:3. The material for making concrete are selected as follows.

B. Cement

Ordinary Portland cement 53 grade with specific gravity of 3.15 is to be used.

C. Fine Aggregate

The fine aggregate was passing through 4.75 mm sieve and had a specific gravity of 2.65. The grading zone of fine aggregate was zone II as per Indian standards specification (IS 383).

D. Coarse Aggregate

The maximum size of coarse aggregate used for his investigation is 20mm and the specific gravity is 2.7.

E. Water

Water should be potable and free from acids, oils, alkalies and other organic impurities.

F. Reinforcement

HYSD bars of 12mm diameter are used as longitudinal bars for column. The lateral ties are to be of 8mm diameter.

G. Ground Granulate Blast Furnace Slag (GGBFS)

The GGBFS used o make specimen should be passed through 90 micron IS sieve. The specific gravity of GGBFS is 3.12.

H. Properties Of GGBFS And Cement Chemical Composition

GGBFS comprises mainly of CaO, SiO2, AL2O3, MgO, it contains less than 1% crystalline silica, and contain less than 1 ppm water soluble chromium 1V. It has the same main chemical constituents as ordinary Portland cement, but in different proportion. The chemical composition of GGBFS is shown in table 3.1.

Chemical composition	Portland cement	GGBFS
CaO	65%	40%
SiO_2	20%	35%
AL_2O_3	5%	10%
MgO	2%	8%

Table 3.1. Chemical composition of GGBFS and CEMENT

Because of the chemical similarities the GGBFS can be replaced for Portland cement mixes by as much as up to 95%.

I. Physical Properties

The physical properties of GGBFS are shown in the table 3.2.

Physical properties	GGBFS
Colour	Off white powder
Bulk density(loose)	1.0-1.1 tonnes/m^3
Bulk density(vibrate)	1.2-1.3 tonnes/m^3
Surface area	400-600m^2/kg
Specific gravity	3.15
Soundness	3.5
Initial setting time	150 min

Table 3.2. Physical properties of GGBFS

J. Gfrp Sheets

Continuous fiber reinforced materials with polymeric matrix (FRP) can be considered as composite, heterogeneous, and anisotropic materials with a prevalent linear elastic behavior up to failure. Normally, Glass and Carbon fibers are used as reinforcing material for FRP. Epoxy is used as the binding material between fiber layers.

For this study, GFRP sheet was used during the tests i.e., a bidirectional FRP with the fiber oriented in both longitudinal and transverse directions, due to the flexible nature and ease of handling and application, the FRP sheets are used for shear strengthening. Throughout this study, E-glass was used.

K. Epoxy Resin

The success of the strengthening technique primarily depends on the performance of the epoxy resin used for bonding of FRP to concrete surface. Numerous types of epoxy resins with a wide range of mechanical properties are commercially available in the market. These epoxy resins are generally available in two parts, a resin and a hardener. The resin and hardener used in this study are Araldite LY 556 and hardener HY 951 respectively.

IV. Specimen Details

Totally 4 columns to be casted in which one is control column. And another 3 column GGBFS partially replaced in place of cement. The column to be designed as short columns. A square cross section is adopted for the column with a cross sectional dimension of 100mm x 100mm. the length of the column is 600mm. All the columns to be tested under axial compression test. The maximum diameter of longitudinal bar the column is taken as 12mm diameter and 8mm ties are used.

V. Literature Review

The studies of literatures were done, based upon which the study is to be carry forward. The articles were collected from several national and international journals along with some dissertations.

Devaseenaa et al. (2015) examine the effectiveness of glass fiber reinforced polymer (GFRP) wrap on corrosion damage high strength concrete columns. A total of fourteen specimen of 150 mm diameter and height of 600 mm were cast and tested. GFRP wraps were used with different configuration such as CSM, UDC, and WR. The wrapping was done with 3mm and 5 mm thickness for each material. The columns were tested under monotonic loading up to failure, in a loading frame of capacity 2000 KN. Necessary measurement was taken for each load increment. The result concluded that GFRP wrapped corrosion damaged concrete columns showed considerable enhancement in the deflection, load carrying capacity and ductility than the control concrete columns.

Kaya et al. (2015) discussed the effectiveness of a glass fiber reinforced polymer based technique for retrofit of buckled steel piles or columns. Thirteen buckled short steel columns with varying degree of section loss were repaired and tested to failure under axial compression. The system consists of a GFRP jackets which is formed on site and subsequently filled with an expansive concrete. The results indicates the repair system restore the capacity of the columns to between 69% and 104% of the capacity of the undamaged control column. The effectiveness of the repair technique is sensitive on construction and installation quality. The presence of air voids in the concrete due to incomplete filling of the jacket resulted in a reduced improvement of the axial capacity of the repaired columns. The incomplete sanding of the GFRP jackets resulted in an inadequate bond between the GFRP layers causing premature deboning and a reduced capacity of the repaired columns.

Muhammad et al. (2015) used 14 columns with 150 mm diameter and 300mm height have been casted and test under the axial compression test. Strain gauge was longitudinally and transversely attached onto the GFRP tubes to investigate the actual strain at respective location. The failure mode depends largely on the configuration of GFRP tubes. The results shows the concrete column reinforced with laterally wrapped solid GFRP tubes achieved the highest strength and the ductility. The perforated GFRP tubes have been found effective in integrating concrete core with concrete cover.

Bhuvaneshwari et al. (2015) presented the viability of using externally bonded glass fiber sheet along with cementitious to rehabilitate beam members with corroded rebar's. Four point bending test were carried out. The GFRP is used for wrapping technique. Flexural behavior of beams showed that the effect of strengthening in corroded beams increased the ultimate stiffness, load carrying capacity and energy absorption. Wrapping in beam reduce the deflection. Present strengthening using cement based composites as binder is found to be efficient, similar o epoxy binder in retrofitting reinforced concrete members with corroded bars.

Arivalagan (2014) this research work evaluates the strength and strength efficiency factor of hardened concrete by partially replacing cement by various percentages of ground granulated blast furnace slag for M 35 grade of concrete at different ages. From this study it can be concluded that, since grain size of GGBS is less than that of ordinary Portland cement, its strength at early ages is low, but it continues to gain strength over a long period. The optimum GGBS replacement of cementation material is characterized by high compressive strength, low heat of hydration, resistance to chemical attack, better workability good durability and cost effectiveness. Test results shows that the incorporating 20% and 40% GGBFS is highly significant to increase the compressive strength of mortar after 28 days and 150 days respectively. The optimum percentage level of 20% GGBS replacement to the weight of the cement is taken with the M35 mix ratio of 1:1.6:2.907:0.41 which gave better results when compared to control mix.

Vinayak et al. (2014) research work focus on strength characteristics analysis of M20 grade concrete with replacement of cement GGBS 20%, 30%, 40% and 50% and compare with plain cement concrete. A cube compression test was performed on standard cubes of plain and GGBS of size 150x150x150mm at 28 days of immersion in water for curing. The maximum compressive strength achieved is 32.59 Mpa at 30% of GGBS replacement and those achieved for 20%, 40% and 50% for concrete is 31.11 Mpa.

Sonali et al. (2014) investigate the pozzolanic material such as GGBS and RHA in concrete by partial replacement of cement. The materials are used to provide economic construction material. The durability tests such as acid resistance test, chloride attack test, and permeable void test are carried out. The workability of concrete has been found to be decreased with increase of quarry sand in concrete. The workability of concrete was decreased with increase of RHA but the GGBS increases the workability of concrete. It is observed that combination of GGBS and rise husk with QS concrete will be durable compared to control concrete.

Mahesh Patel et al. (2013) investigating characteristics of M35 concrete with partial replacement of cement with ground granulated blast furnace slag and sand with crushed sand. The cubes and cylinder are tested for both compressive and tensile strengths. It is found that by the partial replacement of cement with GGBS and sand with crushed sand helped in improving the strength of the concrete substantially to normal mix concrete. GGBS can be used as one of the alternative material for cement. From the experimental result 50% of cement can be replaced with GGBS.

Yogendre et al. (2013) presents an experimental study of compressive and flexural strength of concrete prepared with ordinary Portland cement partially replaced by GGBFS in different proportion varying from 0% to 40%. I was observed from the investigation that the strength of concrete is inversely proportional to the % of replacement of cements with ground granulated blast furnace slag. It is concluded that the 20% replacement of cement is possible without compromising he strength with 90 days curing. The GGBFS is used passes 90% through 90 micron sieve. The 20% replacement of GGBS with OPC results in 14% reduction in cost of concrete. The durability of concrete is increased due to inherent property of GGBS o protect concrete against chemical corrosion.

Mohd.shariq et al. (2013) concluded the time dependent static elastic model of concrete containing GGBFS. The static modulus of elasticity was determined at the ages of 3, 7,28,56,90,150, and 180 days for twelve concrete mixes using he cylinder specimens of plain and GGBFS concrete. The amount of cement replaced by GGBFS varied from 20% to 60%. The 28 days static elastic modules of plain concrete has been attained by the GGBFS concrete with cement replacement of 20% and 40% within 90 days but it not attained even in 180 days for 60% GGBFS concrete.

Rahul Ravala et al. (2013) studied the Glass fiber reinforced polymer has significantly enhance the strength and durability of concrete by forming good adhesive bond between concrete and wrapping material. Present experimental investigation mainly emphasizes on effectiveness of external GFRP strengthening for RC column of circular, square and rectangular shape having same cross area. Total 15 column of 1 meter height were cast. 9 columns were control and rest 6 column were strengthened with GFRP one layer wrap having 20 mm of corner radius. Columns were designed using IS 456:2000 provisions. Design of GFRP wrapping was done using 440.2.R.08 provision. Stress strain behavior revealed that the strength gained from FRP confinement for circular columns. Square and rectangular section columns are found to experience minimum increment in strength as compared to that of circular columns. GFRP wrapping increasing the axial load carrying capacity by addition confinement to the concrete without increasing the original volume.

Khaled et al. (2012) focused the FRP strengthen beam exhibits increased stiffness over the unstrengthed specimen and increasing in the yield and ultimate strength. The efficient technique for strengthening corroded concrete beams are the use of FRP sheet is an that can maintain structural integrity and enhance the behaviour of such beam. The epoxy adhesive is used to seal the longitudinal cracks due to corrosions. U shaped GFRP sheets are used for wrapping the specimen.

Mohamad et al. (2012) investigate the ten short circular columns was designed to study the effect of corrosion, high degree of temperatures, and sulfate attack on the structural behavior of the axially loaded short circular column. The accelerated corrosion technique were used on corroded the columns. Columns reinforced laterally by recycled GFRP stirrups are less susceptible to both corrosion and sulfate attack in comparison with column laterally reinforced by steel stirrups. The load carrying capacity of column laterally reinforced by recycled GFRP stirrups and exposed o corrosion or sulfate attack was slightly higher than those of column reinforced by steel stirrups. Failure mode of columns with GFRP stirrups is less brittle than that of columns with steel stirrups.

Hany et al. (2012) studied the methodology for the design of concrete column with rectangular or circular cross section using GFRP bars and ties. Interaction diagrams are developed assuming ha GFRP longitudinal bars only effective in tension. When subject to compression, they can be replaced with the equivalent area of concrete as if they were no present in the cross section. The unified strength reduction factor formulation for the interaction diagram can be based on the present ACI 440.1R-06 values established for flexure. To avoid exaggerated deflection a limit of 1 percent is present is imposed on the maximum design strain of longitudinal bars.

Biddah et al. (2006) studied the GFRP pultruded grating is available and is mainly used to build walkways to be used in corrosive condition. The modulus of elasticity of the FRP grating alone is relatively low thus, limiting the service load at a small fraction of ultimate load. Adding a layer of concrete to the GFRP grating significantly increase the stiffness of the system where the GFRP grating function as reinforcement for the concrete. The deflection was measured by means of LVDT placed at mid span section. The modulus of elasticity and flexural strength of the GFRP were determined by using flexural test according to ASTM D790.

Olivova et al. (2008) studied on structural behavior of reinforced concrete columns strengthened with carbon fiber sheet and strips in per cut grooves. The studied included a pull out test for assessing the bond characteristics of a GFRP strips. The observed behavior of the confined columns was similar to the unconfined columns. Increases in the lateral deflection of the confined columns resulted in the concrete failing in compression and rupturing the FRP confining jacket at mid height. The deflection shape of the columns at peak load symmetrical and there no local buckling in the columns.

Jinbo li et al. (2009) focused he effectiveness of simultaneous application of the carbon fiber reinforced polymer sheet and steel jackets to upgrade corrosion damaged reinforced concrete column. A total of 14 RC columns were tested under combined lateral cyclic displacement excursions and constant axial load. The variable studied in this program included effectiveness of different strengthening techniques as well as effect of degree of corrosion, axial load, CFRP sheets and steel jackets. It was showed that strengthening corroded RC columns with combined CFRP sheets and steel jackets was effective in enhancing seismic performance of the column and resulted in more stable hysteresis curve with lower strength degradation as compared with un strengthened ones.

Shariq et al. (2008) concluded the incorporating 20% and 40% GGBFS is highly significant to increase the compressive strength of mortar after 28 days and 150 days respectively. The strength of concrete at given age he rate of strength developed are depends upon the characteristics mix proportions of the age in concrete. This shows that the pozzolanic activity of GGBFS contributed the rate of gain of strength at lateral age. Ten numbers of cubes for each mix were prepared and 15 cm size cubes for all the mixes. Among GGBFS based concrete 40% replacement is found to be optimum based on age of curing.

Wang H.Y (2008) reviewed that effect of GGBFS on concrete properties at elevated temperature. A total of 588 test specimens were prepared with three water to binder ratio and six different GGBFS content. The test specimens were cured for 28 days and then subjected to seven different elevated temperature of up to 1050 0 c for 4 hrs. At water o binder ratio of 0.23 an increasing GGBFS content greatly increases the HPC compressive strength under elevated temperature (10500c). Thus the fire resistance of HPC is greatly improved when cement is replaced with GGBFS. The result shows that an elevated temperature treatment can increase the absorption capacity for the low w/c ratio (0.23) specimen with a proper GGBFS percent replacement.

Panesar et al. (2007) examines the laboratory deicing salt scaling performance of concrete containing varies amount of GGBFS as cement replacement. Scaling resistance of the formed surface differs from that of the finished surface of concrete containing GGBFS. Accordingly, two statistical models were derived to predict their respective mass loss due to surface scaling. Using experimental results of concrete tested in accordance with ASTM C 672 and MO LS 412. Resistance of concrete containing GGBFS to salt scaling improves with age .

Ashraf biddah (2006) investigated that replacing the steel reinforcement of concrete with pultruded I shape glass fiber FRP structural section. GFRP pultruded grating is commercially available and is mainly use to build walkways to be used in corrosive conditions. The modulus of elasticity of the FRP grating alone is relatively low thus limiting the service load at a small fraction of the ultimate load. Adding the layer of concrete to the GFRP grating significantly increases the stiffness of the system. The deflection was measured by means of LVDT placed at mid span section. The concrete use for encasing a structural FRP grating not only increases its stiffness, but also prevents local buckling failure of the grating I section.

An cheng et al. (2005) investigate the durability of GGBS concrete and the corrosion behaviour of reinforced concrete beams under various loading ratio were investigated. The direct current (1 mAcm-2) was applied o accelerate he corrosion process. Open circuit potential and direct current polarization resistance were obtained o evaluate the rebar corrosion. Deflection and residual loading rigidity of the beam were measured at the end he experiment. In addition rapid chloride penetration test and permeability test were conducted on GGBS concrete. Test results indicate that partially replacement of cement by GGBS has inhibiting effect on both total charge pass and permeability. Slag addition and sustained loading have significant effect on corrosion rate and flexural rigidity of concrete beams.

Han seung et al. (2003) studied the structural behavior of reinforced concrete column damaged by rebar corrosion and he retrofitting effects of damaged RC columns strengthened with carbon fiber sheet. In the experiment a cyclic horizontal loading test was carried out using RC columns damaged by different degree of rebar corrosion and strengthened with CFS. As a results it was revealed the deterioration of their structural behavior was mainly caused by the decline in the confining effect due to the falling of the concrete cover and reduction of mechanical properties of corrosion rebar. In addition the test proved that shear strengthening using CFS is a very effective retrofit technique that prevents bond splitting crack and shear rack from growing and improves he ductility of RC columns with corroded rebar’s due to the confining effect of CFS.

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Pantazopoulou et al. (2001) introduced he method of repair alternative for corroded columns. Several small size concrete columns with various reinforcement configurations were subjected to accelerated corrosion condition in the laboratory. After a target level of steel loss was attained the column were repaired using a variety of repair alternative. The repair scheme consider jacket the damaged specimen with glass fiber wraps. In combination with grouting the voids between the jacket and the original lateral surface of the specimen with either conventional or expansive grout. To product E glass fiber material from exposure to alkali activity of the fresh grout, and to reduce the supply of the fresh grout and water to the mechanism of corrosion.

Ronald et al., (2000) studied the effectiveness of using fiber reinforced polymer wrap (FRP) wrap with fibers oriented in the hoop direction for rehabilitating corrosion damaged columns. The results of the accelerated corrosion experiments indicate that wrapping reduced the corrosion depth in the reinforcing bars by 46% to 59% after 190 days of testing. Both glass and carbon fiber are equally effective in slowing down the corrosion and did not display any significant damage due to the impact test.

VI. Conclusion

Serviceability is essential in the case of concrete structure. Durability of structures depends upon several factors. Corrosion of reinforcement is one of the major problems which cause durability issues. This study is meant for the evaluation of compression behaviour of GGBFS concrete and GFRP strengthened concrete. Based upon the Indian standards and ACI codes, the test specimens were designed. By the next step the specimens are to be casted according to the design and to be tested for axial bending. The study of compression behaviour of GGBFS incorporated column and GFRP strengthened columns will help to introduce the same in compression members which are exposed to aggressive environments.

A. Scope Of The Study

– To find the optimum percentage replacement of GGBFS with cement.
– To reduce the pollution due to cement production.
– To reduce the pollution due to GGBFS dumping.
– To reduce the cost of the concrete.

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