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RETROFITTING OF RC STRUCTURE USING FRP LAMINATE

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***Abstract*:** *Retrofitting is modifying existing equipment's or structure with additional or new components or members. Which actually make the old structures more resistant to seismic activity. Retrofitting reduces the vulnerability of damage of an existing structures. Now days the use of retrofitting is expanding like a wildfire. Retrofitting helps to increase the strength, resistivity and overall life span of the structures. Its only aim to strengthen a structures again. As structures lose their strength with the period of time. Retrofitting is processes of adding new features to older buildings and weaker buildings. Retrofitting is best and economic option to make existing inadequate building safe against future hazards like-earthquake. It was also observed that retrofitting also helps in regaining the strength of the structure which lost its strength in fire. The normal concrete structure easily gained strength by wrapping FRP sheets in 2 or more layers. The strength can be further increased by increasing number of wrappings.*

Keywords:- Retrofitting , FRP Laminate , slump test, Compressive strength,

I. INTRODUCTION:

Retrofitting is modification of existing structures to improve the performance and durability of the structures. Day to day retrofitting techniques are required for concrete structures which are vulnerable to damage and failures by deterioration by several earthquakes, fire, bomb blasting andchemical attacks. In the past thirty years mode rate and severs earthquakes occurs around the world every years, such events leads to the damages to concrete structures as well as failures. Thus our aim is to focus on a few specific procedure which may improve vulnerability of existing reinforced concrete buildings. It isof outmost importance for historic monuments, area prone to sever earthquake& tall or expensive structures, Repairing and strengthening of old structures using advanced material are a contemporary research in structural engineering field. The traditional method is by steel jacketing, thin layers of heavily reinforced concrete or pre-tensioned steel cables covered with thin layer of concrete. Numerous structures situated in seismically dynamic zones are not equipped for withstanding seismic activity as indicated by current code

and arrangements. Besides, ongoing tremors in urban regions have obviously exhibited a criticalness to overhaul and fortify these seismic inadequate structure.

A huge measure of research work has been done lately to create deferent fortifying and recovery systems to enhance the seismic execution of structures. A few fortifying techniques like an expansion of new auxiliary components; outside post-tensioning, steel plate holding and so forth has been connected in the past by shifting the level of progress. Among these techniques, seismic retrofit with FRP materials has increased prominent acknowledgement from the structural building network as of late. Retrofitting with FRP materials is an actual sound and financially effective repair innovation and is currently broadly being utilized as a seismic retrofitting technique everywhere throughout the world. This paper introduces an agent review of the current condition of utilizing FRP materials as a retrofitting method for the structures not intended to oppose seismic activity. It outline the extensions and employments of FRP materials in the seismic reinforcing and in addition the seismic retrofitting plans for steel structures. The favourable circumstances alongside the plan rules and the confinements of FRP applications for seismic retrofit are additionally incorporated into this. FRP composites are now increasingly used in the construction industry and offer considerable potential for greater use in buildings, including large primary structures. In recent years mores complex applications have been developed to satisfy the desire for more features in building design. FRP composites have numerous advantages in construction industry such as offsite fabrication, modular,constructions, reduced mass, improved thermal insulation.

II. EXPERIMENTAL PROGRAM :

Fibre reinforced polymer (FRP):

FRP is a recently developed materials for strengthening of RC and masonry structure. The main advantage of FRP is the high strength to weight ratio and high corrosion resistance. FRP plates are two to ten times stronger than steel plates while their weight is just 20% of that of steel. FRP composites are formed by embedding continuous fibre matrix in resin matrix. The resin matrix binds fibre together and also provides bond between concrete and FRP. As we can see in fig(1) and fig(2).

Figure (1) FRP Sheet

Figure (2) Use of FRP Sheet

Epoxy adhesive:

Epoxy is a common used for strong adhesives which are required to be used for bonding – two materials or surface together. Epoxy adhesives are usually two component systems I.e. two compounds (resins) that need to be mixed together and cured either at room temperature or at elevated temperatures. Epoxies are created by polymerizing admixture of two starting compounds, the resin and the hardener. When resin is mixed with a specified catalyst, curing chains react at chemically active sites, resulting in an exothermic reaction. Covalent bond between the epoxy groups of the resin and the amine groups of the hardener (catalyst) that arise from this combination afford for the cross- linkage of the polymer, and thereby dictate the rigidity and strength of the epoxy. Epoxy adhesive generally used for coating; ex-coating of FRP on column or beams, now a day's a wide range of epoxy resins are produced initially. Epoxy provides the use of the strongest bond epoxies are known for their excellent adhesion, chemical and heat resistance and have very good structural insulting properties. As we can see in fig(3).

Figure (3)Use of Epoxy Adhesive

Materials:

The material used in present investigation were locally available in Bihta, Patna (Bihar) and physical properties were found through various laboratory tests conducted in concrete technology lab, NSIT, Bihta**.**

Fine Aggregate :

Ordinary sand available in Bihta, Patna. Having the following characteristics has been used.

Specific gravity : 2. 66

Fineness modulus : 2. 41

Unit weight : 1. 675gm/cc

Water absorption : 0. 43%

Bulking : 25%

Sand after sieve analysis confirm to zone- II as per IS 383-1970.

Coarse Aggregate:

Locally available black crushed stone (Pakur stone) in Bihta with maximum nominal size of 20 mm and 10mm have been used as coarse aggregate. The physical properties for the coarse aggregate as found through laboratory test according to IS 2386-1963 is resulted as :

Aggregate crushing value = 24%
Aggregate impact value = 29%
Specific gravity= 2. 64
Water absorption = 0. 94%
Unit weight= 1. 60gm/cc
Fineness modulus= 6. 15

Cement :

OPC (Ordinary Portland Cement) is mainly use for retrofitting. Because OPC 53 grade cement is the most preferred building and construction materials for projects that require high tensile strength. The heat of hydration, however is further supported in by higher than that in OPC 43.

Specific gravity= 3. 15
Consistency = 31. 5%
Soundness = 2. 8

Reinforcement :

The reinforcement of steel present in the concrete is used to take up tensile stresses in reinforced concrete beams. It's one type of bar that provides ductility to any structural members like column, beams, slab, etc. Reinforcement have ductile behaviour which increase strength of building and give sign before any member fail. Due to the provided reinforcement reinforced concrete can also withstand a good amount tensile stress. Reinforced concrete has a high compressive strength compared to other building materials.

III.Mix design:

Volume of concrete = 1 Cu. M.

1 Cum = 1000 ltr (in volume)

Volume calculation for materials:

Cement Content = 368 / 3. 15 X 1000 = 0. 117 Cu. M.

Water Content = 140 / 1. 00 X 1000 = 0. 140 Cu. M.

Admixture= 1. 80 / 1. 17 X 1000 = 0. 0015 Cu. M.

Aggregate= 1- (cement volume+ water volume+ admixture volume)

=1 – (0. 117 + 0. 140 + 0. 0015) = 0. 742 Cu. M.

Now we got a volume of each material for use in concrete.

Now convert material volume into weight.

Convert Volume into Weight for Concrete Mix

Mass of coarse aggregates 20 mm = 0. 742 X 0. 60 X 0. 50 X 2. 885 X 1000 = 642. 2 Kg. Say 642 Kg.

Mass of coarse aggregates 12. 5 mm = 0. 742 X 0. 60 X 0. 50 X 2. 857 X 1000 = 636 kg. Say 636 Kg.

Mass of fine aggregates = 0. 742 X 0. 40 X 1. 00 X 2. 723 X 1000 = 808. 2 Kg. Say: 808 Kg

Mix Proportion per CUM. of M30 Grade of Concrete Mix Design

Cement: 368 Kg

Water: 140 Kg

20 mm: 642 Kg

12. 5 mm: 636 Kg

sand: 808 Kg

Dosage of admixture by the weight of Cement= 0. 45% of cement weight: 1. 80Kg

IV. METHODOLOGY:

1)In this project work first of all we would do material testing like-slump cone test as per IS1199-1959.

2)Then after mix design of M30 as per IS 10262-2009.

3)GFRP fibre are used for wrapping by the help of epoxy which is used as adhesive for our project and the ratio of epoxy and hardener used is 1:5.55 as per specification

4)We would wrap at an angle of 0º generally wrapping is done at 0º angle we would do the same.

5)Then after we would hit the sample up to temperature is around 400º the after it is rapidly cooked by using normal water.

Or,

After all these we would test the samples, wrapped with FRP.

6) All the above step's followed by discussion of result.

7)And at the end we get conclusion of our project.

V. PURPOSE :

Retrofit in structure is done to increase the survivalist functionality. The applications include different types of bridges, buildings, industrial structures, transport structures in urban areas, earth retaining structures and marine structures.

Retrofitting of RCC structural members is carried out to regain the strength of deterioted structural concrete elements and to prevent further distress in concrete.

VI. Testing:

Slump cone test:

Slump cone test is to determine the workability or consistency of concrete mix prepared at the laboratory or the construction site during the progress of the work. Concrete slump test is carried out from batch to batch to check the uniform quality of concrete during construction .

The slump of the concrete is measured by measuring the distance from the top of the slumped concrete to the level of the top of the slump cone. The result of the slump test is a measure of the behaviour of compacted inverted concrete come under the action of gravity.

M30 grade of concrete mix design procedure with OPC 53 cement.

It measure the **consistency or moisture of the concrete**, which gives an idea of the workability of the concrete mixture. As we can see in fig(4).

Fig(4)Lab work of Slump Cone Test

Tensile Strength Test:

The tensile strength of concrete is the ability of concrete to resist tensile force or stress applied to it. The tensile strength of concrete is measured by the units of force per cross-sectional area. As we know that the concrete performance is compression good, but weak in tension force.

Tensile strength is an important property of concrete structure are highly vulnerable to tensile cracking due to various kinds of effects and applied loading itself. However, tensile strength of concrete is very low in compared to its compressive strength.

Fig(5)Lab work on Tensile Strength Test

VII. RESULT AND DISCUSSION :

The experimental result are given below:

1) Result of Slump Cone Test :

50 - 75mm mix is stable, cohesive, and workable and had a true slump of about 75mm. so it has achieved desired workability by satisfying the requirement of 50-75mm slump value.

2) Result of Split Tensile Strength Test:

As the aspect ratio increases the split tensile strength in following 3 days, 7 days & 28 days increases as shown in fig(6).

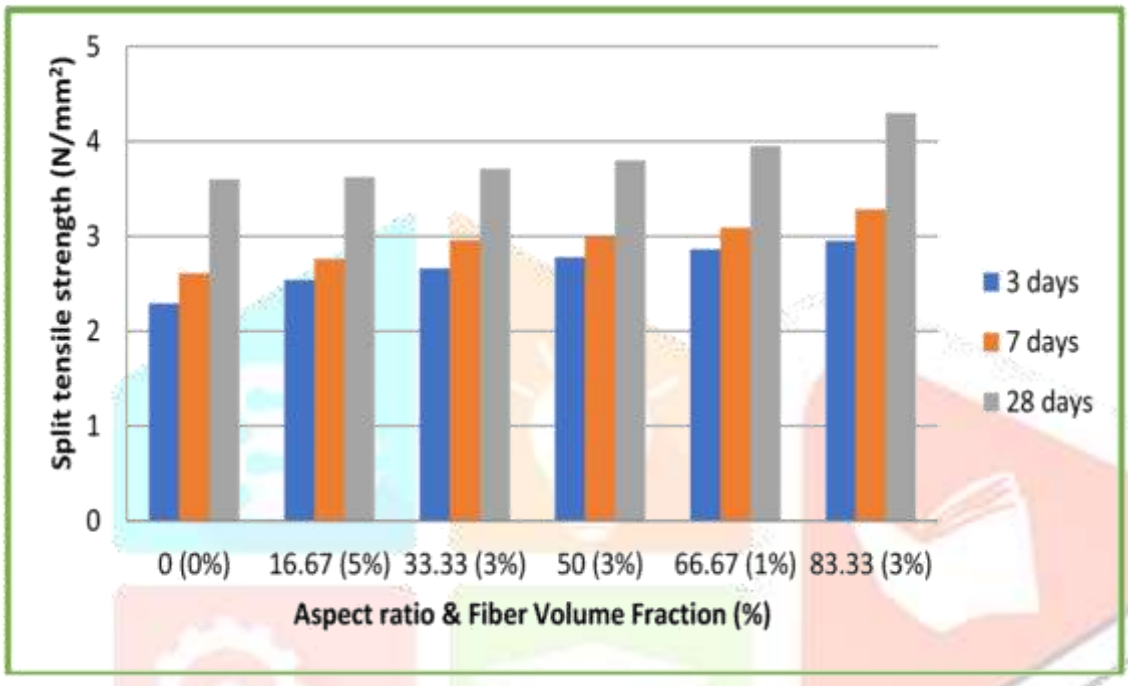

Fig. (6) Result of Split Tensile Strength Test

VIII. CONCLUSION :

With the conclusion of laminates we can overcome with difficulties of old methods of retrofitting and strengthening.

- FRP does not show any yielding or plastic behavior.
- FRP composites have tensile stiffness lower than that of steel.
- FRP resist to corrosion.
- Heavy equipment is not needed for this application commendable thermal insulation .

- In this paper an understanding of the properties and performances of fiber reinforced polymer (FRP) has been developed through the study of their different applications for structural retrofitting.

- Design guidelines and recommendations should be made more readily available to ensure more rapid and effective applications of FRP as a seismic material.
- This innovative technique shows a great potential when disruption of traffic or activity of the building is not possible or only for a limited time.
- Repairing and strengthening of old structural using advanced materials are a contemporary research in structural engineering field.

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