Retrofitting of RC Beams using Epoxy Injection and Epoxy Bonded Polyester Fibre

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Abstract- **In many seismically active regions of the world there are large numbers of masonry buildings. Most of these buildings have not been designed for seismic loads. Recent earthquakes have shown that many such buildings are seismically vulnerable and should be considered for retrofitting. Different conventional retrofitting techniques are available to increase the strength and ductility of unreinforced masonry walls. This paper reviews and discuses the state-of-the-art on seismic retrofitting of masonry walls with emphasis on the conventional techniques. The paper reviews retrofitting procedures, advantages, disadvantages, limitations, effect of each retrofitting technique. This paper reviews works on repairing of deteriorated reinforced concrete beams. Every structural element should be designed for a particular type of loading as well as for adopting of different types of environment. However many civil structural elements, like reinforced concrete beams are often required to be repaired to restore the structural integrity and to protect the reinforcement from sever weathering condition. Recently repairing is gradually increasing with the increase of age of concrete structures. In some instances it may be more economical to accept the need for maintenance or repair at suitable intervals than to attempt to build a structure that will be maintenance-free under severe conditions for a long period. Several types of materials and techniques are available for repairing of exiting deteriorated reinforced concrete beams. In this paper, causes of deterioration of concrete as well as repairing by using cement grout, mortar, concrete, sprayed concrete or shotcrete, epoxy, ferrocement with mortar, Polyester Reinforced Polymer (PRP) Sprayed polyester Reinforced Polymer (SPRP) and the techniques of applying of these materials and also some resin based materials for bonding agent between interface of old concrete and new concrete are reported. The advantages and disadvantages of these materials, causes of debonding between concrete substrate and new concrete applied on substrate and preventive measures are also discussed.**

Keywords- Retrofitting, epoxy injection , polyester fiber, beam

I. INTRODUCTION

Many of the existing concrete structures throughout the world are in urgent need of rehabilitation, repair of re-construction because of deterioration due to various factors like corrosion, failure of bonding between beam column joints, increase in service loads, etc, leading to cracking, spalling, loss of strength, deflection, etc the need of for efficient rehabilitation and strengthening techniques of existing concrete structures has resulted in research and development of strengthening of structure. Although a majority of concrete structures have performed satisfactorily over the past years but many problems have arised due to improper quality of materials, incorrect specification, faulty design and mistakes in construction process or extreme environmental conditions .Cracks in concrete have many causes. They may only, or they may indicate significant structural distress or a lack of durability, cracks may represent the total extent of the damage, or they may point to problems of greater magnitude. Their significance depends on the type of structure as well as the nature of the cracking. To retrofit the cracks on the reinforced concrete beams has different methods. Here we are using epoxy mortar. For patching holes in extreme temperatures, need an epoxy mortar repair that provide excellent flexibility and strong chemical resistant to structure. This project work focuses to retrofit the reinforced concrete beams using epoxy mortar and also to improve the strength to improve the strength of the beam.

II. SCOPE AND OBJECTIVE OF WORK

Now a days the repair of reinforced concrete structure is a major challenging job for civil engineers .The structure are affected by a lot of stress, Whenever the stress exceeds the limit the structures. Reconstruction of building in a way depletes our natural resourses is not economical. Retroffiting of a structure increases the life span of it with minimum or no usage of natural resourses

- To improve the flexural strength of concrete
- To improve ductility
- To re- duse the crack growth when compared to normal concrete
- To determine the causes of cracks in concrete structures and retrofit the structure
- To improve the strength of the structure using epoxy based material

III. LITERATURE REVIEW

Susanne Heyden (2014):This paper presents the results of an experimental study to investigate the behaviour of structurally damaged full-scale reinforced concrete beams retrofitted with laminates in shear or in flexure. It was found that the efficiency of the strengthening technique by carbon fibre reinforced polymer in flexure varied depending on the length. The main failure mode in the experimental work was plate debonding in retrofitted beams.

Farid and S. Ahmad (2011): This paper presents the result of an experimental investigation on the strengthening of existing cracked Rc members. The beams were then repaired with he application of polymer modified mortar technique an improvement in the load carrying was observed in the beams after the retrofitting

***Alberto Balsamo and Francesa ceroni (2012*)**: An experimental investigation has been carried out on prestressed-concrete beams strengthened in flexure with traditional and different innovative composite externally bonded systems in order to compare their structural performance between them and with respect to unstrenghtened specimens

Nesrene M . Kaseem (2012) : This paper presents an experimental for the structural performance of reinforced concrete (RC) exterior beam-column joints rehabilitated using carbon-fiber-reinforced polymer. The structural performance of the control specimen while strengthening the joints using externally bonded carbon fibre reinforced polymer strips and sheets failed to restore the strengthened joints capacity.

McAdams et al.,(1998) have studied the Epoxy resins were first commercialized in 1946 and are widely used in industry as protective coatings and for structural applications, such as laminates and composites, tooling, molding, casting, bonding and adhesives, and others.1,2 The ability of the epoxy ring to react with a variety of substrates gives the epoxy resins versatility. Treatment with curing agents gives insoluble and intractable thermoset polymers. Some of the characteristics of epoxy resins are high chemical and corrosion resistance, good mechanical and thermal properties, outstanding adhesion to various substrates, low shrinkage upon cure, good electrical insulating properties, and the ability to be processed under a variety of conditions. Depending on the specific needs for certain physical and mechanical properties, combinations of choices of epoxy resin and curing agents can usually be formulated to meet the market demands. However, in terms of structural applications, epoxy resins are usually brittle and notch sensitive. As a result, tremendous effort has been focused on toughness improvement during past three decades.

Benjamin et al, (1958)This latter method allows to organize the sequence of operations so as to control the moving front of the infiltrated resin and discharge the air in the fracture. Moreover, in the final stage the feeding pressure can be maintained at all the ports throughout the polymerization process, counteracting the possi- ble drainage through the concrete pores. In the experimental programme of this study a pro- prietary kit has been adopted (Chereco System® by Cosipi Ltd, Italy), based on customized polyethylene syringes actuated by an adjustable number of rub- ber bands. They are usually loaded with about 40 ml resin and arranged at a 0.2÷0.4 m interval depend- ing on the crack width and depth. This is the most favourable solution to perform a complete saturation while preventing the reduced pot-life which affects a larger mass of polymer. Nonetheless, the immedi- ate replacement of the empty or catalyzing syringes is also possible, thanks to the threaded coupling with the entry ports. The cylinders are also fitted with a stopper which allows to pause the injection in case of excessive leakage or to prevent a reverse flow from the surrounding feed-points. A series of case histories regarding the application of this system to real struc- tures has been collected .

Wen-Cheng Liao, (2010)*:*The main objective of this study was to develop and validate a seismic design methodology for RC SMF which is able to produce structures with predictable and intended seismic performance. Based on performance limit states of target drift and desired yield mechanism, this design methodology accounts for inelastic structural behaviour directly, and practically eliminates the need for assessment or iteration by nonlinear static or time-history analysis after initial design.

IV. PROPERTIES OF ADMIXTURE

Epoxy Resins are thermosetting resins, which cure by internally generated heat. Epoxy systems consist of two parts, resin and hardener. When mixed together, the resin and hardener activate, causing a chemical reaction, which cures (hardens) the material.

Epoxy resins generally have greater bonding and physical strength than do polyester resins. Most epoxies are slower in curing, and more unforgiving in relation to proportions of resins and hardener than polyesters. Superior adhesion is important in critical applications and when “glassing” or gluing surfaces – such as steel, redwood, cedar, oak and teak – as well as other non-porous surfaces. Evercoat Epoxy resins are superior to polyester resins in that they impart exceptional strength in stress areas.

Epoxies will adhere to surfaces where polyesters may ruin them. Examples of areas where epoxy resins products must be used are redwood, hardwoods, styrofoam, some plastic surfaces, and metal. They are generally higher in cost than polyester resins.

Epoxy resins may be mixed with various fillers to thicken them for special applications. In working with epoxies, the resin to hardener ratio is very important and should never be adjusted in an attempt to slow down or speed up the curing process. Where superior adhesion is necessary; Evercoat epoxies will bond permanently to wood, fiberglass, metal, concrete, glass, and many plastics

As a tough coating for protection on window sills, concrete floors, stair treads, shower stalls, and down spouts. To protect metal from rusting. To repair gutters, drain pipes (metal or plastic), pools, roofs, boats, decks, and auto bodies. To repair blister problems on fiberglass surfaces, i.e. blistering on fiberglass boat hulls. To repair aluminum boats and equipment.

Characteristics	Epoxy Resin
Flexural strength	Best
Tensile strength	Best
Elongation %	Lowest
Water absorption	Lowest/Excellent
Hardness	Best
Pot life	14 – 20 Minutes
Working time	½ - 6 Hours
Above water line	Yes
Below water line	Yes
Major Constuction	Yes
General Repairs	Yes
Shelf Life	2 Year +
Catalyst	2-Part System

POLYESTER FIBRES

A manufactured fiber in which the fiber forming substance is any long-chain synthetic polymer composed of at least 85% by weight of an ester of a substituted aromatic carboxylic acid, including but not restricted to substituted terephthalic units

V. SUMMARY AND FUTURE WORK

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