International Journal of Science, Technology and Management (IJSTM) ISSN (online): 2321-774X
Volume 10, Issue 1, 2023

Remedial Measures and Structural Failures: A Review

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ABSTRACT

Three beams were kept as control specimens. Allthe beams were first tested up to initial crack condition. The control specimens were tested up to ultimate failure. The values of load and deflections were obtained and tabulated. Five methods of repair work was done on the five groups of members. The repair materials used are GPRF of 225 GSM, 300 GSM, 400 GSM, Jute Fiber and Steel Jacket. After curing they were tested up to failure. The values of Load and Deflections were noted. Load Cells are used for noting down the Deflections. From the values obtained it was noted that, out of all the methods applied Steel Jacketing is found to be the most effective and also most economical. So that method is recommended for the concrete repairing work.

brickwork, defects in plaster work, defects in plumbing work, and defects in electrical work etc., which do not affect the safety of structure to a greatextent in grand manner.

REVIEW OF LITERATURE AND NEED FOR RESEARCH WORK

For every thesis it is important to study about what happened previously regarding the topic and what is presently going on related to this thesis. Here the literature is split into two parts. In the first part studies about structural failures is done and in the second portion the literature about remedial measures is done. It has also been mentioned the difference done in the current thesis.

FAILURES OF STRUCTURES

A Study about the. From the study it was stated that the relative displacement, which is displacement of a point on a structure with respect to its original location or an adjacent point on the structure that has also undergone movement, can be an effective indicator of post event structural damage. The available techniques for measuring relative deformations, identify their limitations, and propose areas where further research is needed were also reviewed. Suggestions for current challenges and research opportunities are proposed with emphasis on accuracy considerations, the need for creating a national database of structure information, and methods for large-scale automated assessment.

DimitriosG. presents key parameters that affect numerical modeling of steel frame structures for reliable collapse simulations. The collapse assessment was based on experimental data obtained from a full-scale shaking table collapse test of a 4-story steel moment frame and a blind numerical analysis contest that was organized in parallel with the collapse test. It was shown that (1) there is no clear advantage between three-dimensional (3D) and two dimensional (2D) analysis in the prediction of a side sway collapse mechanism for buildings with a regular plan view as in the case of study; (2) the assumption of Rayleigh damping leads to better predictions of structural response compared with stiffness proportional damping; and (3) accurate prediction of collapse necessitates that *P*-Δ effects always be considered in the analysis.It was also proved that accurate simulation of steel component deterioration is a key factor for reliable prediction of collapse behavior. It was notable that a combination of bending strength increase and delay of local buckling in first-story columns is most effective for the enhancement of seismic performance against collapse.

Experiments were conducted by. It was stated that, losses from water distribution systems were reaching alarming levels in many cities throughout the world. Leakageis often the principal cause of water loss because of ageing and deterioration of these systems,and pressure has been verified to assume a key-role in water-loss management. A simple analytical model based on a beam with elastic constraints was presented to estimate the leak area (from which the leakage is then estimated) in longitudinally cracked pressurized pipes and to evaluate the effect of pressure on the opening area of the crack. The model was calibrated on the results of a three-dimensional finite-element analysis and then validated by experimental results. The validation had been carried out for a wide range of pipes made of different materials (PVC,cast iron, asbestos-cement, and steel) with radii ranging from 27.5 to 110 mm, thicknesses from 1.5 to 12 mm, and crack lengths from 50 to 200 mm. The beam model,

notwithstanding its simplicity, provides reliable leakage evaluations in longitudinally cracked pressurized pipes.

The importance of prestressed concrete method for longer and slender concrete members is explained by JeongYeon Lee. Particularly, pre tensioned Dr Lorenzo Iannucci and Dr Emile Greenhalgh worked . He did experimental and numerical research activities aimed at the development, implementation into an explicit FE code, and validation of a state-of-the-art composite material model for dynamic failure. The developed material model, which can predict the behaviour of UD Carbon Fibre Reinforced Polymer (CFRP) composites, was implemented into LS-DYNA3D for solid brick elements with one integration point. He involved in the

The Study on Fatigue Performance of Composite Patch Repaired cracked Aluminum Plates by D.C. Hart and E.P.Udinski after analyzing the plates reveals that E-Glass epoxy composite patches offer repair method for cracks in sensitized aluminum. Patches are watertight, mitigate crack growth, and eliminate “hot work”. Patched CCT(Centre Crack Tension) specimens were tested in tension-tension fatigue with 0.25 inches aluminum as-delivered and oven sensitized plate. Composite patch repairs increased fatigue cycles to failure by more than 4 times.

REMEDIAL MEASURES

Dr. B. Shiva kumara Swamy conducted an experimental study on nine RC beam specimens with glass fiber reinforced polymer (GFRP). The under reinforced and over reinforced beams were retrofitted with two layers of U-shaped GFRP wrapping on full length of the beam. The beam specimens were tested under two point loading and the load-deflection behavior was observed up to failure. Also the maximum load, the stress strain behaviors and the complete crack pattern were recorded and presented. Experimental investigation reveals that the balanced and over reinforced RC beams retrofitted with two layers of GFRP exhibit more strength and stiffness than the under reinforced RC beams retrofitted with GFRP. The wrapping of beam was done only on three faces of the beam which are soffit face and shear faces (side face) of the beam. Top surface of the beam was avoided and wrapping was not done on the top surface.

An elaborate study was done by D.N.Shindeon the Flexural behavior of R.C.C. beam wrapped with GFRP (Glass Fiber Reinforced Polymer) sheet. A total 8 beams, with (150×150) mm rectangular cross section and of span 700 mm were cast and tested. Three main variables namely, strength, ductility and damage level of R.C.C. under reinforced beam and R.C.C. beam weak in flexure were investigated. The author has concluded that, to increase the flexural strength of the beam, soffit region is only need to cover with the GFRP, it’s not needed to wrapped all around the beam faces. And to increase the shear strength of the beam, shear region (Beam side region) of the beam is covered with the GFRP, it’s is not needed to wrap all aroundthe beam faces.

T.P.Meikandaan, states that, full bottom GFRP sheet wrapping in 70% preloaded beam can increase flexural capacity of the beam by 14%(on ultimate load) as compared to Controlled Beams. It is concluded that the beam gives less warning when compared with the beam strength only at the soffit of the beam, due to invisibility of the initial crack when the beam is wrapped at the side faces of the beam.

Investigations done by T.Manikandan and G.BalajiPonraj reveal that the flexural characteristics of RC beams using GFRP sheets and strips, show great promise in strengthening reinforced concrete structures. The experimental results of RC beams strengthened in flexure with various externally bonded GFRP configurations, showed delay in the GFRP debonding as well as to increase the efficiency of the GFRP strips, additional U- jacket strips or sheets locatedin debonding initiation region. Ten rectangular RC specimens were tested to evaluate the effect of using the additional U shaped GFRP sheets and spaced U strips on the intermediate crack debonding of the laminate. The fibre orientation effect of the side bonded sheet were also investigated. The beam specimens to be rehabilitated were initially loaded to 75% of estimated ultimate load, treated and tested to failure. The parameters considered for the study are ultimateload carrying capacity load deflection failure modes and flexural stiffness of the strengthened beams.

Ezz-Eldeen studied about strengthening and retrofitting of reinforced concrete beams completely damaged due to flexural failure. The strengthening technique consisted of steel wire mesh with and without additional longitudinal steel angles. Twenty four beams 100mm width, 160mm depth and 1250mm overall span (1050mm effective span) were casted and tested under two points loading. All beams were tested and monotonically to failure, and cracks were filledwith ground mortar. The beams were strengthened and retrofitted under the existing deformation

using two and three external piles of expanded galvanized steel wire mesh with square grids inthe form of U-jacket. The investigated parameters were the size of longitudinal steel angles (10x10x3mm,20x20x3mm and 30x30x3mm)which were added at the bottom corners of the beams inside the steel wire mesh. In addition, number

of vertical steel clamps (2, 4 and 6) were used to fix the jacket to eliminate the debonding. The strengthened and retrofitted beams were again tested under two points loading. The results showed that the Strengthening and retrofitting concrete beams using steel wire mesh with and without additional longitudinal steel angles had a considerable increase in load carrying capacity. Retrofitting beams used 2 and 3 steel wire mesh piles only fixed with 2,4 and 6 vertical clamps resulted in an increased beam carrying capacity from 26.59% to 49.55%. Also, increasing the angle size used at the bottom corners of beamsinside the wire mesh increase the beam capacity up to 72.51% and 172.51%. In addition, increasing the number of vertical clamps increases the beam capacity from 26.59% to 49.55%.On other hand, increasing angle size, number of clamps and number of wire mesh piles decreases beams deformation.

Study about Strengthening of RCC Column using Glass Fibre Reinforced Polymer by R.Sudhakar and P.Partheeban showed that it was possible to strengthen the compressive strength of RCC columns with GFRP.

K.P.Jaya and JessyMathai studied about various earthquake occurrences for nearly past thirty years and focused on behavior of beam-columns strengthened using Glass FibreReinforced Polymer (GFRP) and Carbon Fibre Reinforced Polymer (CFRP) subjected to reverse cycle loading. Reinforced columns designed as per IS 456-2000 possess less necessary ductilityto dissipate seismic energy during earthquake. Such beam-columns were seismically deficient and require additional confinement to improve their seismic parameters. Fibre Reinforced Polymer (FRP) composites were increasingly used for that purpose. Hence, experiments were conducted on Reinforced concrete Beam-columns with and without FRP wrapping. One specimen each was tested without GFRP and CFRP wrapping, three specimens were tested with 2 layers,4 layers and 6 layers of GFRP wrapping and other two specimens were tested with CFRP wrapping. The specimens were tested under a constant axial load and reverse cyclic lateral loading. Experimental results indicate a significant increase of ductility and increase in energy absorption capacity of RC beam-column when strengthened by both GFRP and CFRP Jacket.

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