International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

RETROFITTING BY USING FRP LAMINATES

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ABSTRACT:

The present work deals with a study on the improvement location of retrofitting buildings in symmetrical high rise building. Position of shear walls in symmetrical buildings has due considerations. The seismic retrofitting of reinforced concrete buildings not designed to withstand seismic action is considered. After briefly introducing how seismic action is described for design purposes, methods for assessing the seismic vulnerability of existing buildings are presented. The presentation is illustrated by case studies of actual buildings where traditional and innovative retrofitting methods have been applied.

Keywords: Staad pro, beam, columns, slab.

1. INTRODUCTION:

The Seismic retrofitting of constructions vulnerable to earthquakes is a current problem of great political and social relevance. Most of the Italian building stock is vulnerable to seismic action even if located in areas that have long been considered of high seismic hazard. During the past thirty years moderate to severe earthquakes have occurred in Italy at intervals of 5 to 10 years. Such events have clearly shown the vulnerability of the building stock in particular and of the built environment in general. The seismic hazard in the areas, where those earthquakes have occurred, has been known for a long time because of similar events that occurred in the past. It is therefore legitimate to ask why constructions vulnerable to earthquakes exist if people and institutions knew of the seismic hazard. Several causes may have contributed to the creation of such a situation. These are associated to historical events, fading memory, greed, avarice, poverty and ignorance. Among historical events particularly relevant are wars, epidemics, and natural disasters which may limit, in a significant way, the available resources of a country. In such circumstances there is a tendency to build with poor materials and without too much attention to good construction techniques and safety margins.

A situation of this kind occurred in Italy and in Japan after the Second World War and similar situations have occurred in Italy many times in the past. In such a situation it is possible that the phenomenon of fading memory occurs and past memories are easily erased. In Italy commercial profits often result from the employment of poor material and workmanship rather than of the optimal utilization of the production factors. The depressing situation of poor quality control and material acceptance also

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falls into this framework, which, in most cases, results only in paperwork devoid of substantive value. Marginal propensity to expenditure sometimes ensures that even the owner prefers a low quality product to save resources for more immediate needs. Among causes arising from ignorance there may be both an inadequate knowledge of the seismic hazard and design errors due to insufficient knowledge of the earthquake problem; also the inability to correctly model the structural response to the seismic action. While considerable progress has been made in recent years by the research community in dealing with the above problems, it has become more difficult to transfer the results to the seismic engineering profession and the situation can only deteriorate in the near future. Recent changes in the curricula of engineering schools are leading to a general impoverishment of the basic knowledge and operational capabilities of our engineering graduates. A final cause of vulnerability is connected with the maintenance of constructions; it is obvious that if a construction is not regularly maintained, much as happens for a motorcar, the mechanical properties of the materials may undergo local and global degradation with a significant loss of resistance of the structural members and of the entire construction. Also, changes in service conditions, often made arbitrarily, may lead to substantial changes in the structural behaviour resulting in a degradation of the structural response to the expected loading conditions. On the basis of what has been presented so far, it is not surprising that in areas long known to be subject to the seismic hazard it is not infrequent to find constructions vulnerable to earthquakes.

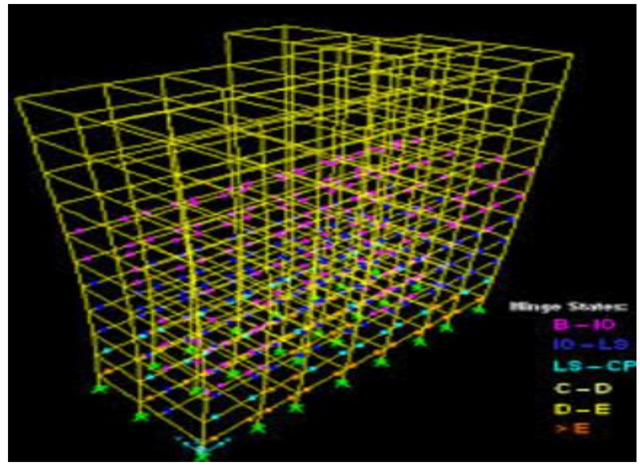

Figure 1.1 Type of Retrofitting of g+12 building

These constructions need to be retrofitted to allow them to withstand the effects of the earthquake ground motion expected at the site considered. In the following sections some procedures used for the evaluation of the seismic resistance and vulnerability of reinforced concrete buildings will be described together with traditional and innovative techniques of seismic retrofitting of the same structures. The paper ends with a description of the seismic retrofitting of two reinforced concrete residential buildings in the village of Solarino, near Syracuse, in Sicily. The buildings belong to the Institute Autonomo Case Popolari (IACP) of Syracuse. As will be clear from following arguments the aim of the paper is not to discuss in depth the state-of the-art of seismic retrofitting, but rather to give a general overview. The aim is also to focus on a few specific procedures which may improve the state-of-the-art practice for the evaluation of seismic vulnerability of existing reinforced concrete buildings and for their seismic retrofitting by means of innovative techniques such as base isolation and energy dissipation.

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2. LITERATURE SURVEY

1) Rajandre Desai, Rupal Desai. The authors have submitted this case study paper at," Workshop of low cost housing and community participation in construction," at Cebu Philippines, in reference to 1992 Latur earthquake. They have pointed out the fact of majority of houses collapsed, were from low cost category. About reasons of the collapse they strongly opine that, these traditionally constructed were, with broader stone masonry, in poor mortar, and heavy roof improperly clamped to peripheral walls. Further, they enlightened the issue, why the houses in rural area are built in 'traditional manner' They state that, the use of Socio-Eco friendly pattern and materials, in the construction of these houses, is evolution based on wisdom and experience of centuries of respective areas, not only in Kachchh but all over the country. Most of the material used in construction of traditional buildings are more economical, easily recyclable and produces no or less pollution.

2) Joseph M. ,Barcci , Sashi K Kunnath Seismic Performance and Retrofit Evaluation of RCC Structures The authors opine that, in high rise buildings, reliance only on the inertia force developed by roof or top stories, as design criteria will be underestimation. The authors then carried out dual analytical experimental shocking table study and recorded the seismic deficiencies incorporated and tabulated the results. A retrofitted model was tested with same parameters and results were tabulated. Authors concluded the study as :- Using ADRS format, comparison of various proposed seismic retrofitting schemes can be done, as in this case study, for relative improvement in strength and deformation demands and capacities of original and modified structure. Thus one can ascertain the best suitable method for adoption.

3) Sekar T.; Ramaswamy S.N.;Nampoothari N.V.N. Study on Strengthening of Brick Masonry Structures in Fire Work Industry against Accidental Explosion. (AJCE, V.13, no.6.2012 p.743. Authors have published this paper with the aim to suggest retrofitting measures for safe guarding work force and explosives contents stored in single storied structures in explosive producing factories. The explosion creates seismic type simulations and the major dominating action in single storied structures is due to horizontal force. After carrying out the experiments on models authors concluded and recommend to provide seismic protective bands at roof level, RCC Columns at jambs of door. Retrofit Corrosion Control for Author carried out experiments on corrosion of reinforcement. The rate of corrosion due to chloride ingress was found 3.5 mm/ yr. as against that of humidity or water.05 mm /yr. He further, observed that, though the corrosion control systems have been installed, they were defunct for want of maintenance and awareness. The corrosion of reinforcement steel results in reduction of size and in turn the strength, endangering the structure and the life of users.

[4] Kevadkar M.D., Kodag P.B. (IJMER). The authors have stressed the need of "Lateral Load Analysis" as these loads can develop high stresses, produce sway movement or cause vibrations. It is therefore important for such structures as well as for new structures to possess strength for vertical and lateral forces. Further,

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they discuss the methods of strengthening like, provision of shear wall, steel bracing. They compared steel bracing to shear wall method and conclude as steel bracing is preferable to shear wall. Seismic analysis of Steel Braced Reinforced Concrete Frams. Authors have observed damages like fatigue and wear-tear, which they contribute as a result of increase in volume and weight of traffics on the bridges. The RCC framed structures had deficiencies like ground floor left open for parking, culminating into a soft story behavior, under reinforced for seismic resistivity. The main variable studied were the number of CFRP layers in the test zone, the presence of column damage, and the level of applied axial load. In the conclusion they state CFRP jacketing has ease of installation, can increase ductility and energy dissipation capacity, improve seismic resistance, shear and moment capacities. For higher axial load larger amount of CFRP required.

[5] Mukharjee Abhijit, Mangesh Joshi (2012) Recent Advances in Repair and Rehab of RCC Structures with Nonmetallic Fibers. Authors have explained the advantages of use of FRC's, and express the need to include the design criteria and procedure in BIS Codes, and wide publicity is essential to promote its use. as it efficiently reduces the use of steel and cement, the limited resources. Use of FRC's in retrofitting after Gujarat earthquake, and in seismic prone areas have proved that these methods results in better strength without affecting the stiffness factor of the structure as these are very thin, corrosion resistant and last important but not the Earthquake Damaged Reinforced Concrete Strengthening. The authors are reviewing development of general technique of strengthening and Rehabilitation of the damaged concrete structures. For minor repairs they studied The emphasize on Rehabilitation of RCC Structures by focusing on visible symptoms of the problem and using apt repair material and techniques. The author has further discussed how electrochemical repairs of RC structures are proving to be highly effective in terms of durability life cycle costing. The author concluded the paper with case study of in which FRP wrapping method was applied and the test report shows the strength and load carrying capacity were doubled.

3. METHODOLOGY

PROCEDURE FOR SEISMIC OF RETROFITTING BULDINGS

The most suitable way to plot force displacement curve is by detecting the base shear and roof displacement. The capacity curve is generally made to represent the initial mode response of the structure based on the postulation that the fundamental mode of motion is the major response of the taken structure. This is basically valid for buildings with the fundamental periods of vibration upto about 1 second limit. For more flexible buildings with the fundamental period > 1 second, the analyst should take into account addressing higher mode effects is the done analysis. Classifying each element in model as either primary or secondary Apply lateral story forces to the structure in ratio to the product of the mass and fundamental mode shape This analysis need to also include gravity loads. as level three till first yielding. For each increment beyond yielding, regulate the forces to be

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consistent with changing deflected shape. Similar to above, but include the effects of the higher mode of the vibration in determining yielding in individual structural elements while plotting the capacity curve for the building in terms of first mode lateral forces and displacements. The higher mode effects possibly be determined by doing higher mode pushover analysis. (i.e. Loads may be progressively implied in proportion to a mode shape other than the fundamental mode shape to determine it in elastic behavior) For the higher modes the structure is being both push & pulled concurrently to maintained mode shape. Calculate the member forces for the required combinations of vertical and lateral loads Adjusting the lateral force level so that some elements are stressed to lie within 10% of its member strength Recording the Base shear and the roof displacement. Revise the model using zero (or very small) stiffness for yielding elements. Appling a new increment of lateral load to the revised structure such that another element (or group of elements) yields The actual forces and rotations for elements at the starting of the increment are equal to those at the end of the previous elements. However, each application of an increment of lateral load is a different analysis, which starts from zero initial conditions. Thus, to determine when the next elements yields, it is necessary.

Retrofitting of existing buildings offers significant opportunities for reducing global energy consumption and greenhouse gas emissions. This is being considered as one of main approaches to achieving sustainability in the built environment at relatively low cost and high uptake rates. Although there are a wide range of retrofit technologies readily available, methods to identify the most cost-effective retrofit measures for particular projects is still a major technical challenge. The building was analyzed using equivalent static method (linear static method) and response spectrum method (linear dynamic method) according to the Code. Pushover analysis (non-linear static method) was also carried out to study the deformation of the building The weight and mass of all the brick masonry walls were applied on the supporting beams. When an infill wall is located in a lateral load resisting frame, the stiffness and strength contribution of the infill wall were considered by modeling it as an equivalent diagonal compression strut. In a moment resisting frame, the inclusion of equivalent struts leads to a truss frame model. The beams and columns are connected by rigid joints, but the equivalent struts are connected by pin joints at the beam-to-column junctions. The required properties of an equivalent strut are the effective width, thickness, length and elastic modulus. The thickness is assumed same as that of the infill. The length is available from the dimensions of the corresponding infill panel.

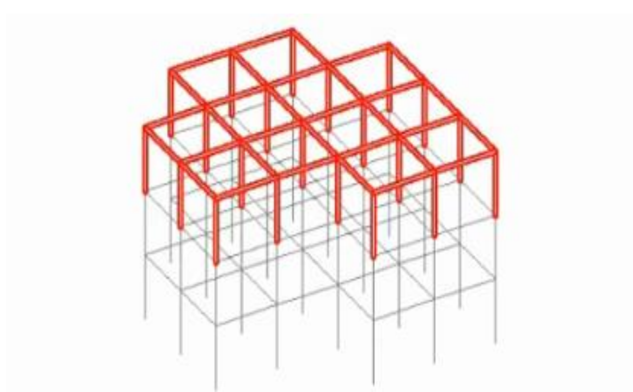

Figure. 1 base structural view of retro fatting building

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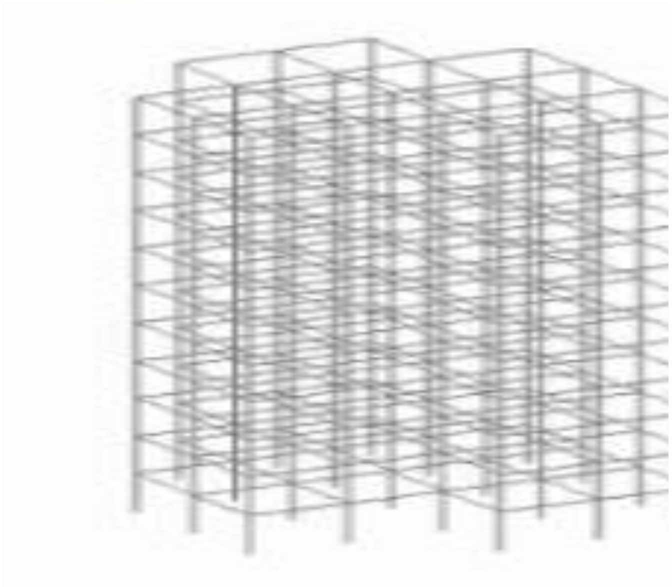

Figure. 2 Basic view of the retro building

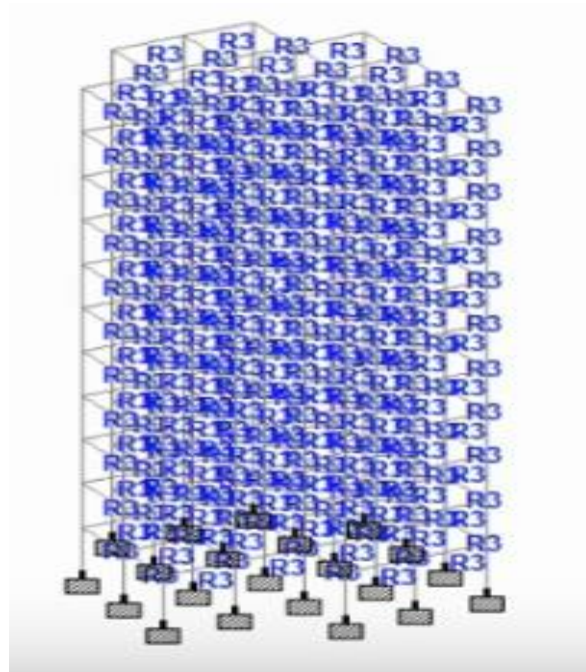

Figure. 4 Live loads

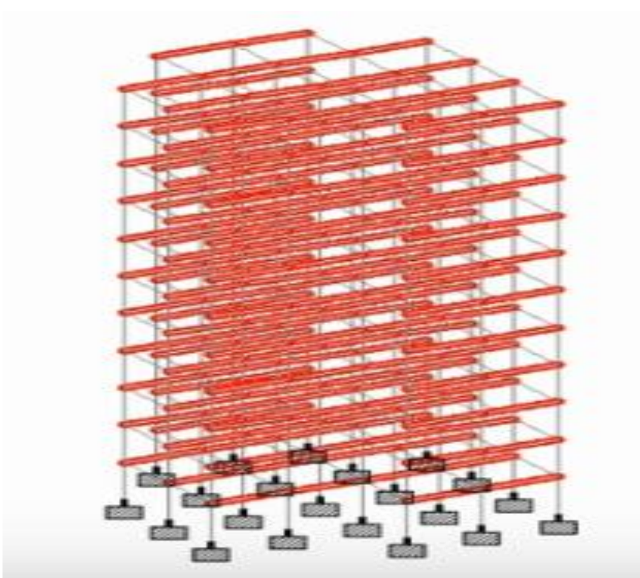

Figure.3 front view of the retrofitting building

Figure.5 top view of the retrofitting building

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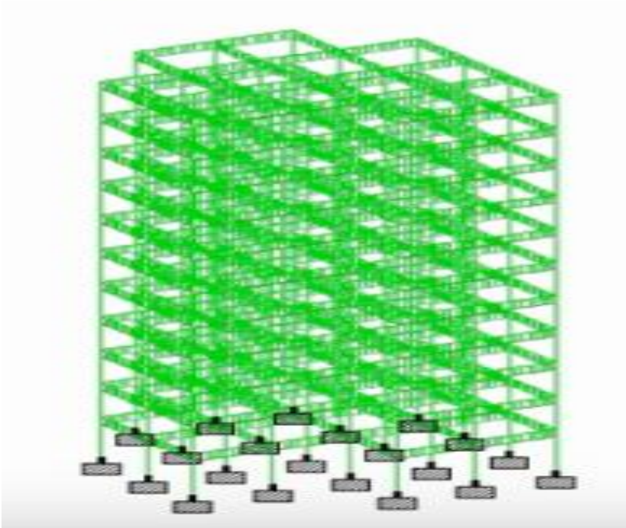

Figure.6 Live loads of the building

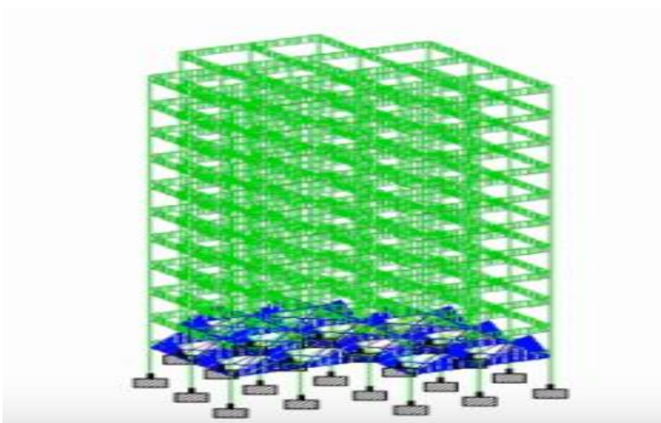

Figure.7 live loads 2

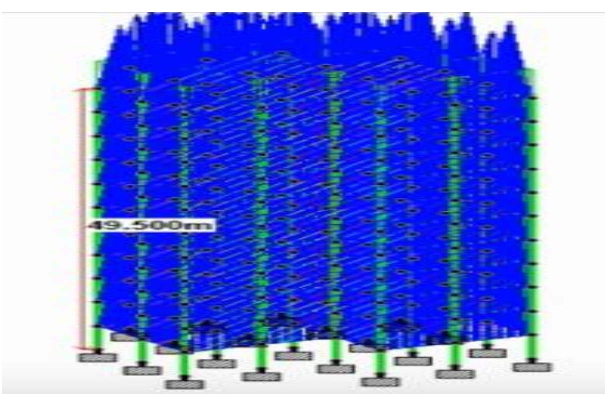

Figure.8 dead loads of retrofitting building

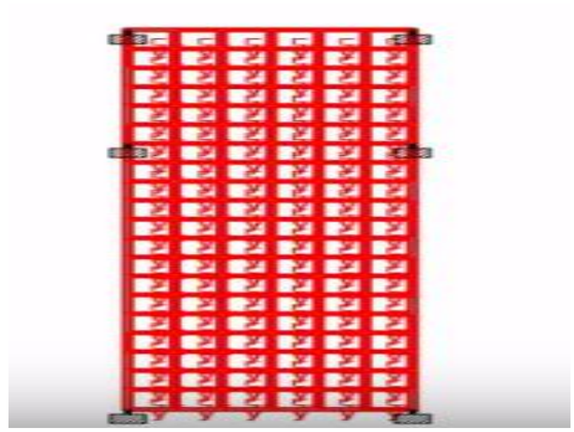

Figure.9 Displacement view of the retrofitting building.

CONCLUSION

After an introduction which explains why there are so many vulnerable structures in areas of high or moderate seismic hazard around the world, the authors consider the specific case of Eastern Sicily. The paper proceeds with an illustrative description of the seismic action and then addresses the problem of evaluating the seismic resistance and vulnerability of engineering structures. The application of the methodology presented to reinforced concrete buildings in Eastern Sicily clarifies the concepts discussed. In particular, the concepts of seismic resistance, seismic vulnerability and seismic over-resistance become easily understood and appreciated. The paper then considers the retrofitting of buildings vulnerable to earthquakes and briefly describes the main traditional and innovative methods of seismic retrofitting. Examples drawn from the professional, editorial and research activity of the senior author are used to illustrate the problems in a simple way. Among all the methods of seismic retrofitting, particular attention is devoted to the method which is based on stiffness reduction.

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This method is carried out in practice by application of the concept of springs in series, leading in fact to base isolation. One of the two springs in series represents the structure and the other represents the base isolation system. The application of the concept to two buildings in Eastern Sicily concludes the presentation. The enhanced resistance of the buildings to the design earthquake clearly shows the effectiveness of the method, while a generally improved seismic performance also emerges from the application. In conclusion it is hoped that the material presented in this paper will be useful in increasing the understanding of the earthquake engineering problem and of seismic retrofitting.

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