ANALYSIS AND DESIGN OF REINFORCED CONCRETE FRAMES UNDER RETROFITTING CONDITION BY USING STEEL BRACINGS

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ABSTRACT:
Steel bracing is able to improve progressive collapse resistance of reinforced concrete (RC) frames, but the bracing design is typically based on seismic retrofitting or lateral stability. There is no approach for design of steel bracing against progressive collapse. To this end, a retrofitting approach with steel braces is proposed based on analysis of macro finite element (FE) models with fiber beam elements. The FE models were initially validated through the experimental results of a braced frame and then used to investigate the effects of pertinent parameters on the progressive collapse resistance of planar frames. The results suggest the braces should be placed at the top story. Thereafter, macro FE models are built to investigate the dynamic responses of the three-dimensional prototype RC frames under different column removal scenarios (CRS) and show the necessity of retrofitting. Accordingly, the design approach of steel bracing is proposed with incremental dynamic analysis (IDA) and assuming independent contribution of braces and frames to resistance. Finally, the fragility analysis of the frames under a corner-penultimate-exterior CRS is conducted through IDA and Monte Carlo simulation, and the results confirm the validity of the proposed design approach for retrofitting RC frames

KEY WORDS: **Earthquake Strengthening, Retrofitting, Steel Braced RC Structures, Seismic Performances, Analysis.**
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I.INTRODUCTION

To make existing structures modification more resistant to soil failure due to earthquakes, ground motion, or seismic activity that was known as seismic retrofitting. Seismic retrofitting need is well acknowledged with large earthquakes with our recent experiences near urban centers and with better seismic demands understanding on structures. For seismic protection many structures were designed without reinforcement and adequate detailing, prior to the modern seismic codes introduction for developed countries (Japan, US etc.) in 1960s and for many other parts of the world (China, Turkey etc.) in late 1970s. The various research works are carried out in view of imminent problem. Around the world, for rehabilitation, seismic assessment and retrofit the State-of-the-art technical guidelines have been published. For other natural hazards the retrofit techniques outlined are also applicable such as sever winds from thunderstorms, tropical cyclones and tornadoes. The structures are used to reduce the seismic hazard with structural improvements that was predominantly concerned the current practice of seismic retrofitting, it is similarly essential from non-structural elements to reduce the losses and hazards. As an earthquake proof structure, there was no such thing that was important to keep in mind, although enhanced greatly the seismic performance through proper subsequent modifications or initial design.

In Indian scenario, most commonly found the EC framed building, among the total buildings in the country a major percentage was constituted. In addition, as compared to the masonry buildings, it may be easy in vertical expansion and such buildings are constructed due to its superior seismic performance. Due to the increased access and awareness to raw materials, the construction of RC is clearly on the rise even in the rural parts of India. However, during earthquakes in India, there was extensive damages that was suffered by these RC buildings also, concerned was raised over their safety and incumbents safety as well. During earthquakes in India, as the main reason of RC buildings failure identifies poor workmanship (wrong detailing and defective concreting). During past few earthquakes, the RC buildings various damage patterns reviews are made here under the frames.

II. LITERATURE SURVEY

James O. Jirsa and Marc Badoux.et.al [1]. " for Seismic Retrofitting there is a RC Frames Steel Bracing." J. Struct. Eng., 10.1061/(ASCE)0733-9445(1990)116:1(55), 55-74., for retrofitting the steel bracing systems use is seismically inadequate, that was examined by the reinforced concrete frames. For stiffening and strengthening in existing buildings an excellent approach was provided by the diagonal bracing for lateral forces. To collapse prevention, from drift control ranging a variety of retrofitting objectives can be achieved. In retrofitting structure the force path can be determined by the designer, and adjust the stiffness and strength as need. Under lateral loading of cyclic, particularly with weak short column frames to gain understanding into the braced frame behavior an analytical study is performed. The braces inelastic buckling detrimentally influences the braced frame inelastic cyclic behavior. By using braces instability can be prevented, at low axial loads that yield in buckle elastically or compression. Described a weak short columns with the advantages of braced frames altering beams. A more failure mechanism of favorable (ductile) frames are produced that reduces the strengthening of beam. With beam alterations, the bracing was combined that can significantly improve the braced frame inelastic behavior.

Mahesh Bagade, Nitin Bhojkar.et.al [2], “Steel Bracing System is Used for Seismic Evaluation of High-rise Structure”. In this paper, different types of bracing with reinforced concrete (RC) buildings seismic analysis is studied. As per IS 1893 for seismic zone a G+9 building is analyzed III: 2002, a STAAD Pro software was used. In this paper, considered the main parameters to compare the buildings seismic analysis they are base shear, lateral displacement, axial force, story drift. To the structural stiffness, the X type of steel bracing contributed significantly and reduces the maximum frames inter-storey drift. The displacement structure capacity, with the strength capacity and lateral stiffness was improved by the bracing system.

Mahmoud Reza Maheri A. Sahebi.et.al [3], “In reinforced concrete frames, steel bracing is used”. In concrete-framed structure the use of steel bracing was investigated in this paper. Through a test’s series the investigation is carried out that was conducted on a number of model frames. To increase the concrete frames in plane shear strength the different diagonal bracing arrangements with degree of effectiveness was determined by the object of the tests and to observe the compression braces and tensions relative behavior. Proper connections important questions are considered between the concrete frame and steel brace. Due to steel bracing the frames in plane strength increases considerable that was indicated by the test results. With proper connection the overall conclusion is noted between the frame and brace, in seismic areas to shear concrete framed buildings the steel bracing could be a supplement or viable alternative.

Islam Nazrul, Nauman Mohammed.et.al [4], the braced response was evaluated by "Different Type of Bracing System (A Software Approach) with Multi-storey RCC Structure Behavior" , to seismic loads the un-braced structure subjected and efficiently, for resisting the seismic load a suitable bracing system was identified. After the bracing systems application the structure displacement decreases that was concluded with different types of structural systems after the structural analysis. In the lateral displacement, the maximum reduction occurs after the cross bracing systems application. Bending moments will be reduced by bracing system and in columns, it shear forces. Through axial action transferred the lateral load to the foundation. Compared to the other specified bracing systems, the cross bracing systems performance is better. To retrofit the existing structure, the steel bracings can be used. After the application of the bracings, significantly, the existing structures total weight will not change

Prakash K.B, Anant Desai, Viswanath K.G.et.al [5], "Seismic Analysis of Steel Braced Reinforced Concrete Frames" Investigated using steel bracing on the reinforces concrete (RC) buildings seismic performances rehabilitated. For peripheral columns, the bracing was provided. For seismic zone IV as per IS 1893-2002 a four storey building is analyzed using STAAD Pro Software. Along the height of RC fame, the various types of steel bracing effectiveness on the rehabilitated buildings seismic performance was studied. In terms of story drifts and global, the buildings performance was evaluated. To sixteen storied, eight storied and twelve storied buildings, the study was extended. In lateral displacement the percentage reduction is found out. It is found that to the structural stiffness, significantly the X type of bracing contributes and the maximum inter-storey frames drift was reduced.

III. SEISMIC RETROFITTING OF RC COLUMNS

Rapidly increasing the population in light of present situation, the multistoried buildings has became inevitable with the land area that was remaining constant. With increasing height these buildings become more and more slender, increases the effect of lateral winds and earthquake ground motion. Lateral displacements were produced depending on its present condition that may leads to failure or exceed the permission limits. To increase the structural efficiency, the existing structure modified with new or additional components that is known as retrofitting. Seismic hazards are reduced predominately by concerning the retrofitting with structural improvement.

Different techniques of retrofitting include wall thickening, addition of shear wall, bracing, base isolation jacketing of columns and beams, etc. Acting the loads on the structure mainly that consists of lateral loads and gravity loads in high and medium rise structures. Due to earthquake, wind and blast etc are the lateral loads. To these occasional loads, laterally to perform satisfactorily there should have a sufficient strength and stiffness to the structure. In recent years, RC framed structures seismic strength increases that was commonly used the steel bracing, either for undamaged structures strengthening or for structural damaged rehabilitation by earthquake, the revision made necessary by standard practice codes in the loading or structural design. Compared to other conventional upgrading techniques, steel bracing appears to be attractive by considering its relatively low cost and due to easy construction. Because of inadequate lateral resistance, seismic retrofitting are in need to a large number of existing reinforced concrete frame structures.

To retrofit a building, there has a reasons that is not merely damage of structural elements and poor quality of materials serves. For retrofitting change of valid building codes, change of environmental conditions, and change of the buildings function could also be the reasons. From each field by the experts must be conducted the retrofitting. The main role was played by an engineer in most retrofitting process. The structural capacity was analyzed and assessed by an engineer. To strengthen the structural deficiencies the best retrofitting techniques are must be suggested and designed by the engineer. To identify the insufficiency possibility of the building capacity, the role of the novice is restricted.

Following measures are involved by the retrofitting structure:

- Its stiffness and/or strength was increased
- Its ductility was increased
- The seismic forces were reduced.

For its seismic capacity normally a building after being evaluated against the damages that was judged for its seismic retrofitting necessity or otherwise. For retrofitting the building requires appropriate strategies, seismic retrofitting will be worked out and for proper retrofitting measures the proposals are made. The proposed retrofitting strategies are duly incorporated that was analyzed and modeled by the building in order to check the measures adequacy. This process is called 'Re-Analysis'.

IV. RESULTS & DISCUSSION

COMPARISION OF BENDING MOMENTS AND AXIAL FORCES

(a) BENDING MOMENTS (Mx):

Table 1: BENDING MOMENTS MX

S.No	NormalRCC structure	Model1 (KN-m)	Model 2 (kN-m)	Model3 (kN-m)	Model 4 (kN-m)
1	252.6	498.98	582.7	600	428
2	125.3	223.61	304.7	370	356
3	153.01	188	214.2	190	212
4	112.4	162.5	260	200	124
5	100.7	127	230	251	300

(b) BENDING MOMENTS (My):

Table 2: Bending Moments MY

S.No	NormalRCC structure	Model1 (kN-m)	Model2 (kN-m)	Model3 (kN-m)	Model4 (kN-m)
1	15.07	28.25	32.5	25.7	33.6
2	5.3	12.79	17.3	19	15.6
3	10.2	16.78	18	15.6	21.3
4	3.2	9.84	5	7.53	13.152
5	1.26	4.2	6.2	6	2.3

(c) AXIAL FORCES

Table 3: Axial Forces FX

S.No	NormalRCC structure	Model1 (kN)	Model 2 (kN)	Model3 (kN)	Model 4 (kN)
1	423	603	1933	1688	2892.7
2	321	545	869	955	1857
3	225	300	566	423	1582.2
4	174	201	365	382	978
5	168	277	545	605	625

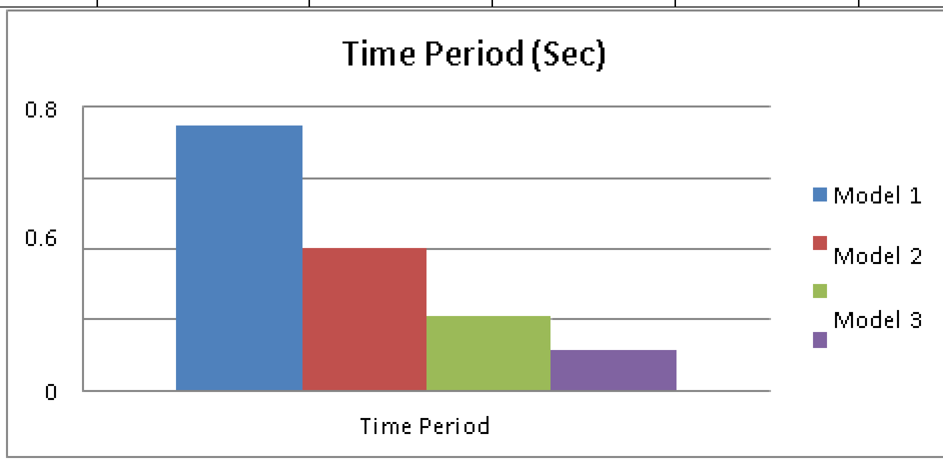

Fig. 1: Time period comparison

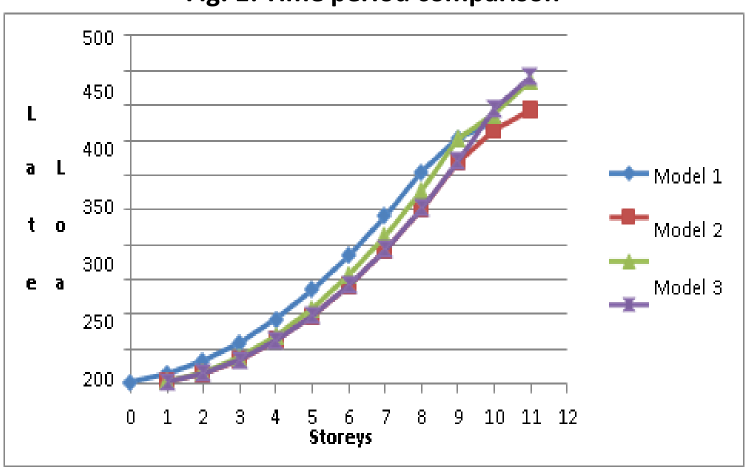

Fig 2: Storey vs. Lateral loads on each storey

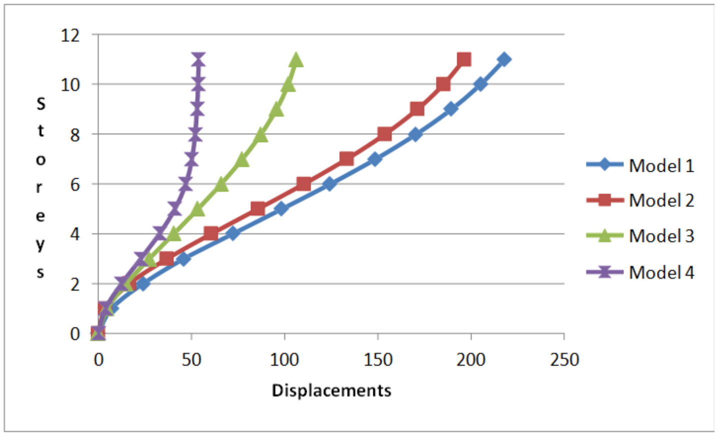

Fig 3: Storey vs. Displacements

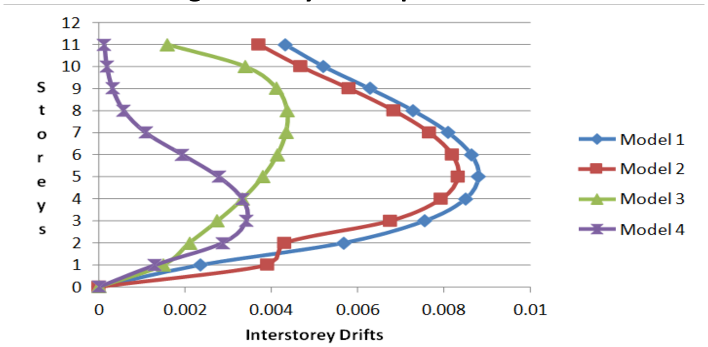

Fig. 4: Storey vs. Inter storey Drifts ratio

V. CONCLUSION

Here, in present study some of the important conclusions are presented. In Model 1 (Zone 3, upgraded the structure), increases axial forces and moments were observed. Therefore, to take the loads, we can say that the existing columns size is not sufficient, hence, to make the structure safe, increased the column sizes accordingly. Compared to the normal RCC structure, the entire jacketing model has been observed that it has less time period, and compared with steel jacketing and RCC, we can say that FRP jacketing model is more stiffer, but in FRP, the last time period was found. When compared to normal structure of RCC (Model 1), the displacement and drifts ratio is reduced drastically in Steel Jacketing (Model 3) and FRP Jacketing (Model 4) models that was observed from the drifts and displacements ratio graphs. Hence, observed the jacketing of FRP, RCC and Steel's significant effect. Therefore, the jacketing model of FRP, RCC and Steel has better performance. Hence, in increasing both deformation capacity and strength of the retrofitted columns, we concluded that the FRP jacketing is more effective.

VI. REFERENCES

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