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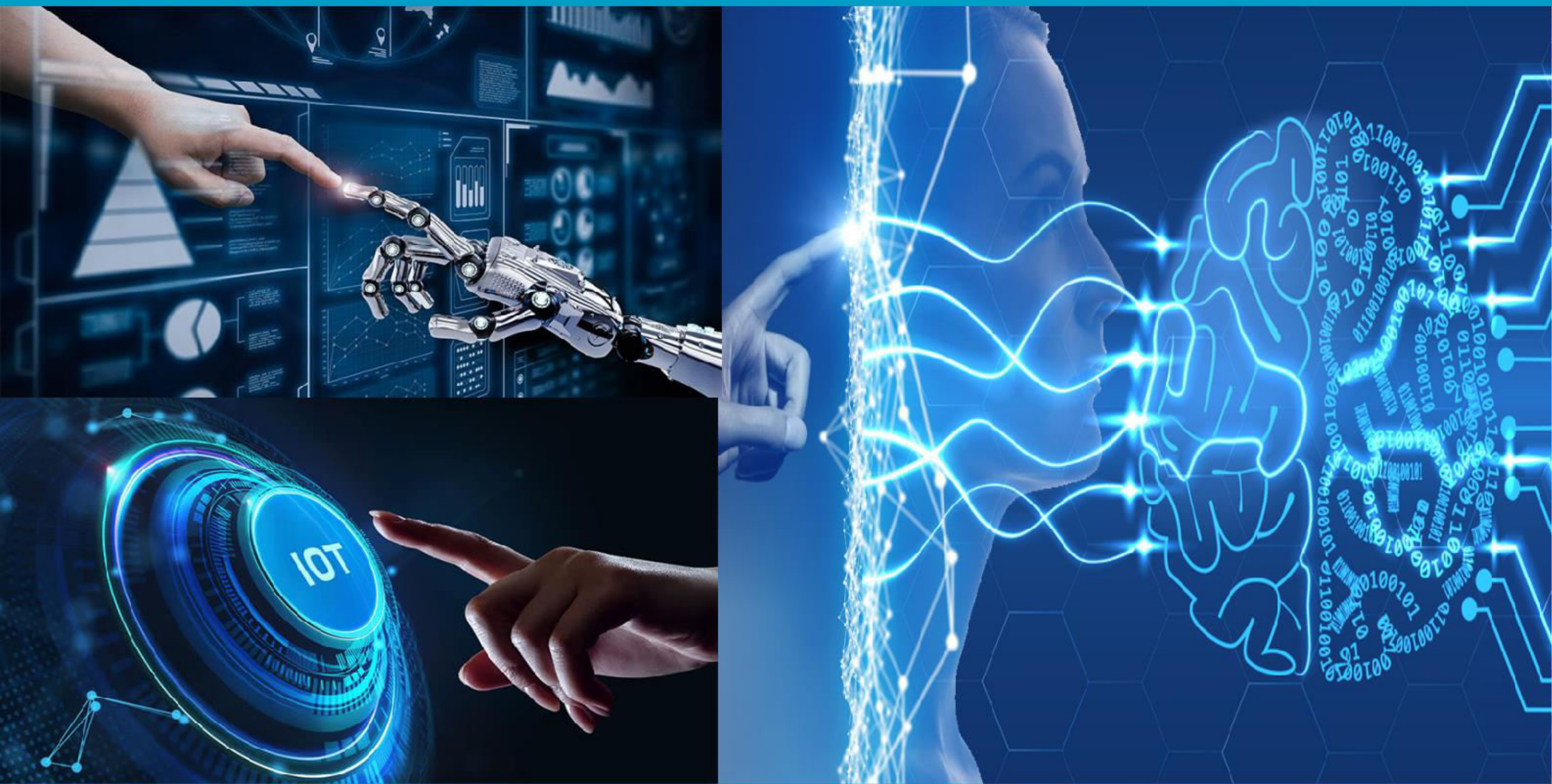

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Retrofitting of Reinforced Concrete Frame using Steel Bracing

Geeta Sharma, Monika Jakhar

M. Tech (Structural Engg.), MRIEM, Rohtak, India

MRIEM, Rohtak, India

ABSTRACT: In this paper, there is consideration given to the analytical use of steel braces as a means to strengthen low, medium, and relatively high reinforced concrete frames. The load-controlled pushover analysis provides a method for estimating the ultimate lateral-load capacity of the reinforced frame. In addition to this, you may investigate the impacts that the pre-post tension had. The outcome is the product of parameter work that was done for this study's modification of the existing R/C frame-structure in order to boost seismic lateral resistance. The lateral load capacity may be increased by a factor of twenty by using a steel X-brace brace system and a steel frame that encloses the frame bay without being attached to the R/C frame structure already in place. Appropriate C frame syntax. This is determined by the height-to-width ratio. “The ratio of the frame's height to its breadth in the lateral-load direction is one of the most important factors determining the efficacy of this rehabilitation procedure. When the base thrust remains constant, increasing the frame height causes a quicker rate of change in the axial load that the R/C support must bear. It becomes smaller with time. It is possible that the lateral-load capacity of a reconstructed R/C frame-structure may be increased by a factor of 2.5 when the steel X brace and the steel-frame brace system that surrounds it are used. In order to ensure that the axial load of the column is effectively transferred, preload is supplied to the vertical steel components of the brace system. It is to the advantage to preload data so long as the R/C column compression corruption mode is active. Increasing the preload is harmful because the mode of failure is shifting from compression to tensile as it fails. A steel X-bar that does not have endmembers connected to the R/C frame may perform the same function just as well. Boost the available space. Brace systems are required if R/C connections are used with large rebar. It presents a problem in terms of practicality. This demonstrates that some of the most onerous components of the plan may be modified.

KEYWORDS: R/C frame, steel X-bar with endmembers, reinforced concrete

I. INTRODUCTION

In the past, the majority of reinforced concrete buildings were created with the sole purpose of withstanding the force of gravity. In addition, this structure was designed to be able to withstand lateral forces that are potentially much lower than those that are currently permitted by the legislation. It is possible for the column's strength and ductility to be drastically reduced if the lap joints of the longitudinal reinforcements are inadequate and there is a lack of confinement in the bent hinge zone. Repairing these buildings to the appropriate standards will protect them from the effects of seismic activity. As a direct consequence of this, researchers are presently examining and implementing seismic repair techniques for seismic structures.

Recent earthquakes have shown how urgently structures that have seismic flaws need to have those flaws fixed in order for them to function at levels that are acceptable. Strength, stiffness, and ductility can all be improved in currently used construction methods in order to achieve this goal. In this industry, research and development have made significant strides in recent years. "Before deciding on the most effective strategy for restoration, it is essential to conduct a thorough assessment of the condition of existing structures and how they react to earthquakes. This can be accomplished through the utilisation of linear static techniques, linear dynamic methods, nonlinear static methods (pushover analysis), and nonlinear dynamic methods." The findings of a comprehensive building inspection will help determine the best course of action for the rehabilitation of your property. In the past, the majority of reinforced concrete structures were designed with the sole purpose of withstanding the force of gravity. Additionally, it is constructed to withstand lateral forces that are a great deal less intense than those that are permitted by the existing regulations. It is possible for the column's strength and ductility to be drastically reduced if the lap joints of the longitudinal reinforcements are inadequate and there is a lack of confinement in the bent hinge zone. Repairing these buildings to the appropriate standards will protect them from the effects of seismic activity. As a direct consequence of this, researchers are presently examining and implementing seismic repair techniques for seismic structures.

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Recent earthquakes have brought to light the necessity of repairing structures that are seismically unsound in order to bring them up to the required level of performance. Strength, stiffness, and ductility can all be improved in currently used construction methods in order to achieve this goal. In this industry, research and development have made significant strides in recent years. The condition of existing structures and how well they can withstand earthquakes should be carefully evaluated before settling on the most effective strategy for their restoration. Using linear static techniques, nonlinear static methods (pushover analysis), linear dynamic methods, and nonlinear dynamic methods, one is able to evaluate the seismic performance of existing structures. The findings of a comprehensive building inspection will help determine the best course of action for the rehabilitation of your property. There are two primary categories of rehabilitation treatments, namely: Rehabilitating both the individual components and the entire structural system [1]. The purpose of member-level hygiene is to enhance the performance of some of the more vulnerable elements of the structure, such as columns, walls, and beams. An illustration of this strategy is the use of steel jackets with fibre composites, as shown in the previous sentence. The global appearance of the static system as a whole will be modified as part of the system-level renovation [2]. The fact that the underlying system won't need to be fixed is the primary benefit of utilising this approach. Because steel braces are frequently connected between existing members at vertical, the gravitational load that is already being carried by existing structures is not significantly increased by the brace system. It is hoped that the redesigned framework will result in a greater foundation force. Nevertheless, an examination of the foundation is required. under lateral loads and increase the stress that is placed on the existing foundation where the braces are located. In addition, the building will not be significantly altered as a result of the installation of an exterior steel system.

II. RESEARCH ANALYSIS

In this study, we used rebar braces to reinforce a reinforced concrete frame using a different technique. The key benefits of the suggested alternative to present practise include the prestressing of steel components and the beam-column joints of the current frames do not connect steel braces to reinforced concrete frames. The axial compressive load of existing reinforced concrete frame columns has been decreased by placing prestressed steel components next to those columns. Due to a lack of lateral reinforcement and insufficient stacking splices at splice levels, connecting beams and columns to existing structures is typically problematic. These faults lead to the beam-column connection being lost.

1.1 ComputerModeling

The SAP 2000 combined programme for organizational examination and design was used to model the frame [14]. Three fundamental groups of structural elements make up each model. The steel X brace system that attaches to the reinforced concrete tube frame in each bay is one of them, as is the inner steel-frame, the steel-frame inserted the frame-bays, and the steel-frame that is placed inside the frame. In order to mimic the impacts of earthquakes on structures, load-driven pushover studies were carried out utilising the lateral-load distribution of inverted triangles. Each model of the finished structure was examined using the SAP 2000 stage analysis feature. The modelling of reinforced concrete tubular frames, the addition of steel elements, their prestressing at a specific ratio to the existing axial loads of nearby reinforced concrete columns, the addition of steel elements to beams and columns, and additional lateral-loads are the main phases of phase analysis. Steel beams for progressively adding model brace and pushover analysis. Since rebar rehabilitation procedures could be used on this structure in reinforced of the concrete frame construction, regardless of the number of floors, spans, oppressiveness of strength of the concrete, column size, etc., many parameters were taken into account in this research. The building stock in Turkey is taken into account when choosing these properties. The variables that were chosen for examination and deemed important are listed in (Table 2.1).

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Table 2.1 Selected parameters for the rehabilitation of R/C frames by steel X-bracing.

Parameter	Range of Parameter					
Building Height (# of Stories)	3		5		8	
Building Grid Dimensions (m)	4	6	4	6	4	6
R/C Column Section Size (cm)	30x30	40x40	40x40	50x50	50x50	65x65
Concrete Strength (MPa)	C16, C20 C25, C30	C16, C20 C25, C30	C16, C20 C25, C30	C16, C20 C25, C30	C16, C20 C25, C30	C16, C20 C25, C30
Bracing System Preload Ratio (% of R/C Column Axial Load)	0, 10 20, 30	0, 10 20, 30	0, 10 20, 30	0, 10 20, 30	0, 10 20, 30	0, 10 20, 30

The figure of floors in the structure, the strengthened concrete skeleton system's plane dimensions (span width), the concrete's strength class, the size of the columns in the system, and the quantity of prestress used are all factors. All steel brace columns were researched and chosen for this investigation. a controlled variable that is used. Three-story, five-story, and eight-story reinforced concrete frames have been chosen as low, medium, and relatively high-rise building frames, respectively, based on the majority of Turkey's building stock. “A selection of concrete strength classes C16, C20, C25, and C30 with typical oppressiveness of strengths of 16 MPa, 20 MPa, 25 MPa, and 30 MPa were used for the investigation. Rebar typically has a 420MPa yield strength.

For convenience, it is assumed that the average floor height is 3.0 m and that the live and dead loads are both 1.0 t/m2. Important matters Every bay width and the number of floors in the building have their own unique maximum values that are allowed by design requirements.” Finally, it is anticipated that each column will have vertical reinforcement covering around 1% of its cross-sectional area. The majority of design code requires this as a bare minimum. In essence, the seven structures below are looked at. S3-B4:

A three-story frame with a 4-meter-wide single bay. S3-B6: A frame with three stories and a single bay that is 6 metres wide. S5-B4: A five-story frame with a 4-metre-wide single bay. A five-story frame with one 6-meter-wide bay is described as S5-B6. S8-B4: A 4-meter-wide single bay and an 8-story frame S8-B6: Single bay and bay, 8 stories, 6 metres wide S3-2B4: A 4-meter-long bay and two stories. Frame.

BF: Only the bare-frame (R/C). P0: Each bay's steel X braces in the R/C frame are reinforced. The ends of the stanchions are attached to the margins of all steel, thus no fastening or pretension is needed. P10: A steel X brace strengthens each RC frame bay. All-around steel edge rods with joined ends, no anchors, and a 10% prestress. P20: A steel X brace strengthens each RC frame bay. Strut ends are attached to the steel edges all around with a 20 percent preload, no fixation, and no fixation. P30: A steel X brace strengthens each RC frame bay. Steel edge bar all around, no anchor, 30% prestress, and strut end coupling. Note: A steel X brace reinforces each R/C frame bay. There are neither fixations nor tensions. The brace only has vertical steel edge members joining its ends. WA: Steel X bracing are used to reinforce each bay of the RC structure. zero preload. The R/C frame is fastened to the brace end. UA: Steel X bracing are used to reinforce each bay of the RC frame. The RC frame's strut ends are free of tension or attachment. SUA: A stronger steel X bracing is present in each R/C frame bay. The RC frame's strut ends are free of tension or attachment. The steel bracing system's horizontal, vertical, and diagonal components must be chosen differently for each case. The components remain the same while considering potential alternative rehab solutions for a certain structure. The SUA rehabilitation programme, which chooses heavier equipment components, is the lone exception to this rule.

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The final stress ratios for the columns in the rehabilitation programmes for the UA and NB are identical to those in the WA and P0 plans, respectively, at the final shear load levels. "The minimal ratio of the steel profile is determined in order to fully use the inherent capacity of the base R/C frame. Therefore, the failure of the original R/C frame always determines the ultimate capacity of the reconstructed structure, with the exception of the UA. It is believed that the concrete used in the R/C frame and the steel used in the brace system have elastic moduli of 24.8 GPa and 200 GPa, respectively. It is assumed that the steel has a yield point and fracture strength of fy = 235MPa and fu = 360MPa, respectively." Utilizing the design code AISC, the maximum load capacity of the bracing system under lateral-load is determined [15] requirement, and the maximum load capacity of the R/C frame is calculated using the design code ACI [16] standard. applied to.

III. RESULTS ANALYSIS

3.1 Bare-frames Capacities

The lateral weight capability of each R/C bare border was assessed in order to determine the reference value. The non-frame (BF) type's maximum lateral-load capacity is shown in Figure 4.1-4.4. The statistics show that reinforcing concrete improves its resistance to lateral-loads. Additionally, we discovered that the relative gradient was worse the larger the field.

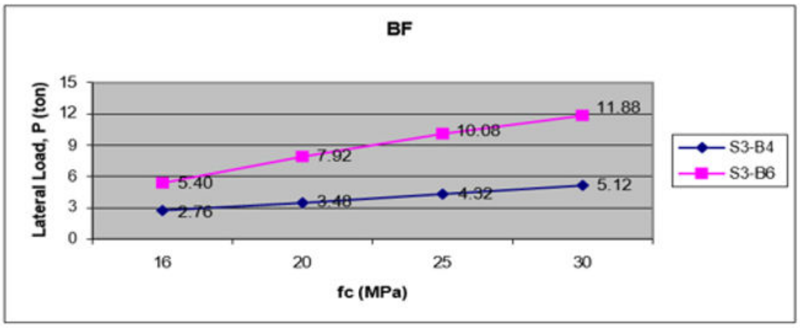

Figure 3.1 Influence of concrete strength on the ultimate lateral-load capacity of Bare-frames of S3-B4 and S3-B6

3.2 X-bracing Steel enclosed frames with the steel-edge member provide structural support.

The effects of prestress on the brace system were investigated using a strengthened material frame with a steel X brace and steel edge members. The brace system's frame, which joins the ends of the diagonal brace, is prestressed around its columns.

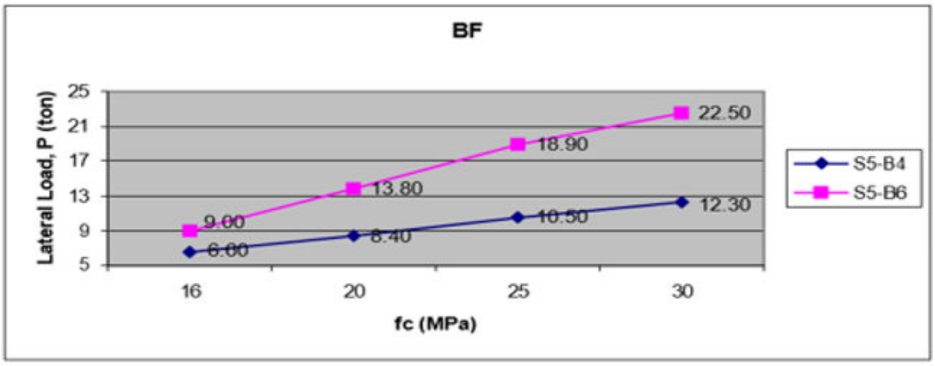

Figure 3.2 Influence of concrete strength on the ultimate lateral-load capacity of Bare-frame of S5-B4 and S5-B6.

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3.3 Single-Bay Three-Storey Frames

Steel X brace, steel edge member, and reinforced concrete frame (P30) for no prestress "(P0), 10% prestress (P10), 20% prestress (P20), and 30%" prestress the closed frame of was evaluated. To sustain the surrounding frame, the steel-framework has been prestressed. According to the concrete strengths of C16, C20, C25, and C30, the variations in the final lateral strength of the reconstructed frame-structure are depicted below.

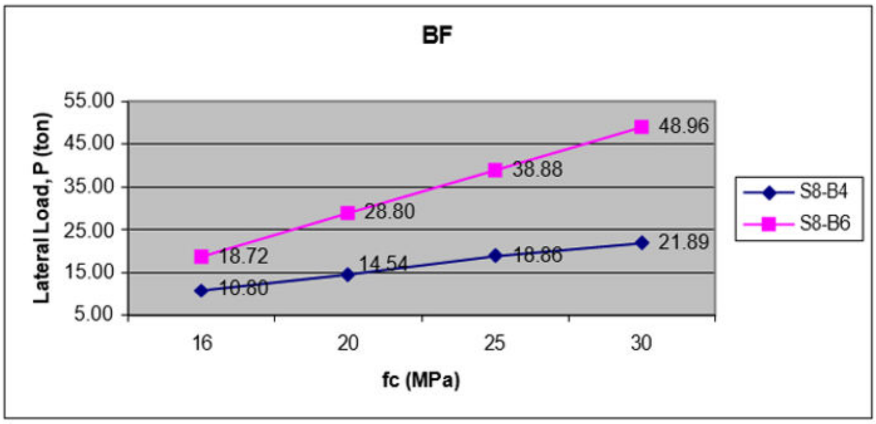

Figure 3.3 Influence of concrete strength on the ultimate lateral-load capacity of Bare-frame of S8-B4 and S8-B6

3.4 Single-Bay Five-Storey Frames

The single-aisle three-story reinforced concrete frame-structure strengthened using a closed steel-frame X brace system used the same concrete strength class and prestress level as the single-aisle five-story reinforced concrete frame-structure. A summary and explanation of the findings are provided below.

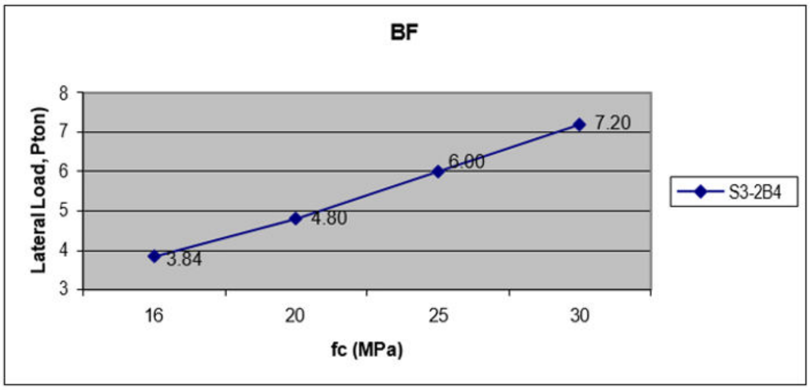

Figure 3.4 Influence of concrete strength on the ultimate lateral-load capacity of Bare-frame of S3-2B4

IV. CONCLUSIONS

In this work, there is consideration given to the analytical application of steel braces as a means to reinforce low, medium, and rather high reinforced concrete frames. The load-controlled pushover analysis provides a method for estimating the ultimate lateral-load capacity of the reinforced frame. In addition to this, you can investigate the effects that the pre-post tension tension had. In the first chapter, a comprehensive literature review is carried out on the steel brace system, which is one of the techniques for system-level rehabilitation that is frequently employed. a lack of beam connection between the reinforced concrete frames and the steel braces, as well as a lack of prestressing of the steel components The fact that joining to columns is only a proposed method rather than one of the methods that are generally recommended in existing frameworks is the primary advantage of this method. "The prestressed steel profile that was placed adjacent to the reinforced concrete frame columns that were already there helped to reduce the axial compressive load that was placed on those columns." Beam-column connections in the majority of already-built structures suffer from frequent problems as a direct consequence of the absence of lateral rebar as well as lap joints, both of which are accompanied by insufficient connection lengths. As a consequence of these errors, the interaction between the beam and the column is diminished. With this method of repair, the steel beam and the frame are not

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connected. Instead, the already-existing reinforced concrete frame is allowed to remain in its place at these essential points. In Chapter 2, a fundamental mathematical model of the framework is presented. This model was examined and created with the help of the SAP 2000 statics and design programme. Each model is comprised of the following three fundamental groups of structural elements: One of them is the inner steel-frame, which is inserted into the frame bays. Another one of them is the steel-frame that is placed within the frame. Another one of them is the steel X brace system that is attached to the reinforced concrete tube frame in each bay. Studies using load-driven pushover with the lateral-load distribution of inverted triangles were carried out so that the effects of earthquakes on structures could be simulated. In order to evaluate each model of the finished structure, the stage analysis functionality of SAP 2000 was utilised. "The ultimate lateral-load capacity, which is controlled by the existing R/C frame structure, is computed in Chapter 3, after these model structures have been analysed, and the design has been confirmed for the parameters that were chosen," Calculations are made and displayed graphically in order to compare the relative lateral load capacity of the refurbished structure to the load capacity of the original shell structure.

REFERENCES

1. Anindya Dutta, Ph.D, S. E, “Design of Concentrically Braced Frames,” April 2008.
2. Godínez-Domínguez E. A, Tena-Colunga. A, “Behavior of Moment Resisting Reinforced Concrete Concentric Braced Frames (RC-MRCBFs) in Seismic Zones,” The 14th World Conference on Earthquake Engineering, Beijing, China, October, 2008.
3. Viswanath K.G, Prakash K. B, Anant D, “Seismic Analysis of Steel Braced Reinforced Concrete Frames,” International Journal of Civil and Structural Engineering, Integrated Publishing services Volume 1, No 1, 2010.
4. Chinwuba. A, Akinloye. A, “Comparison of Wind-Induced Displacement Characteristics of Buildings with Different Lateral-load Resisting Systems,” doi:10.4236/eng.2011. Published Online, March 2011
5. Siavash. K, “Optimal Conceptual Design of High-Rise Office Buildings,” A thesis presented to the University of Waterloo in fulfilment of the thesis requirement for the degree of Doctor of Philosophy in Civil Engineering, Waterloo, Ontario, Canada, 200.
6. Karthik. K. M, Vidyashree. D., “Effect of Steel Bracing on Vertically Irregular R.C.C Building Frames under Seismic Loads,” IJRET: International Journal of Research in Engineering and Technology, pISSN: 2321-7308, Volume 04, June-2015
7. Umesh. R. B, Shivaraj M, “Seismic Response of Reinforced Concrete Structure by Using Different Bracing Systems,” International Journal of Research in Engineering and Technology, pISSN: 2321-7308, Volume: 03, Sep-2014.
8. Viswanath. K.G, Prakash. K.B, Anant. D, “Seismic Analysis of Steel Braced Reinforced Concrete Frames,” International Journal of Civil and Structural Engineering, Integrated Publishing services, Volume 1, 2010.
9. Massumi. A, Tasnimi. A. A, “Strengthening of Low Ductile Reinforced Concrete Frames Using Steel X-Bracings with Different Details,” The 14th World Conference on Earthquake Engineering October 12-17, 2008, Beijing, China.
10. Keyvan. R, “Seismic Behavior of Steel Off-Diagonal Bracing System (ODBS)
11. Utilized in Reinforced Concrete Frame,” Journal of Structures, Hindawi Publishin Corporation,Volume 2014, April 2014.
12. Maheri. M.R, Akbari. R, “Seismic behaviour factor, *R*, for steel X-braced and knee-braced RC buildings,” Engineering Structures 25 (2003) 1505–1513, May 2003.
13. Maheri. M. R, “Internal Steel Bracing of RC Frames,” 3rd International Conference on Concrete & Development.
14. Maheri M. R, Ghaffarzadeh. H, “Seismic Design Basis for Internally-Braced RC Frames,” The 14th World Conference on Earthquake Engineering, October 12-17, 2008, Beijing, China Comparative study on the response of RC frame-structure braced with different steel bracing systems (AAU/AAiT,SCEE MSc Thesis) ,2016 77

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