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A Review on Base Isolation of Multi-storied Steel Structure

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Abstract: ***When designing buildings and structures in earthquake prone area, a designer has to provide a predetermined level of reliability and earthquake resistance to structure. Apart from traditional seismic methods for earthquake resistance, analysis of steel braced steel buildings using designed base isolator has to be done which is effective. A seismic isolation is one of the most popular and effective method to protect structure against strong dynamic actions. For such analysis, ETABS software is generally used.***
Keywords: **Steel bracing, Base isolation, Steel structure, ETABS**

I. INTRODUCTION

Steel is one of the most widely used materials for building and structure construction in the world. The inherent strength, toughness, lightweight, excellent rigidity and high ductility of steel are characteristics that are ideal for seismic design. The steel structure is a structure mainly made of steel and is one of the popularly used types of building structures. It is mainly suitable for large span, super high and heavy buildings.

Base isolation of structures is one of the most effective means for protecting it against earthquake forces. It has many types. In the term 'Base Isolation', Base indicates a part that supports or performs as a foundation of structure and Isolation suggests the state of being separate. Base isolation is a type of passive vibration control system. It does not need any external power source for its operation. It mainly utilizes the motion of the structure to develop the desired control forces.

II. LITERATURE REVIEW

Here, a literature review of selected papers from the overall study is documented. This collectively will focus and discuss the study of the subject.

1) Ganachari (2020) studied the effect of Base Isolation on Multi-Storeyed Steel Structure using ETAB software. They explained the advantages of steel structure as compared to RCC structure. Since it is a study article they explained the types of Base isolators briefly. They modelled G+4 Steel Structure with fixed base and Base Isolated. After comparison of these 2 models they concluded with that the fixed base building had zero displacements at base of building. On other hand, the base-isolated building models showed appreciable amount of lateral displacements at base. Also the increase in storey displacement was observed for bottom storey then gradually decreases for top storey of base isolated building as compared with fixed base building model.

2) Chougule And Jadhav (2019) analysed the steel braced symmetrical RCC building with designed I-sectional rubber base isolator. For that purpose they modelled G+15 storied RCC Residential Structure with 20m*20m plan dimension and 3m height of each floor. The modelling and analysis of work was done by using ETAB software. They used X-type bracing arrangement in zigzag pattern.

They designed I-section type rubber base isolator. After provision of I-section isolator, they carried out response spectrum analysis. Once the analysis was completed of building models with fixed base i.e. without base isolator and with I-section base isolator, the obtained results were compared with and without base isolators. It was found that the displacement was reduced by use of base isolators and maximum displacement reduced by I-section of rubber isolator. So that it reduces the seismic effect on building. The maximum storey drifts were reduced by I- section of rubber isolator making super-structure flexible which was better for building resistance. So possibility of damage to building by earthquake was highly reduced by use of bracing and base isolators to structure.

3) Sahoo And Parhi (2018) comparatively studied the effect of earthquake forces with increase in stories in RC building with fixed base and isolated base.

They compared the RC buildings of G+10, G+15 stories building in seismic zone II using ETAB software, combining their effects on different parameters which include storey drift, , storey shear, moment, time period, stiffness, displacement, deformed shape which is caused due to the earthquake load on various plots. It was shown that the damage to base isolated structure will be less as compared to fixed base structure. So that structure can be immediately occupied after actual earthquake.

4) Singh, Lohar, Yadav And Awad (2017) explained bracing and its purpose. Model of G+6 story RCC building with base isolation and cross bracing was made by using SAP2000 software. The frame of structure consists of 5 bays in x-direction with spacing of 5m and 4 bays in y-direction with spacing of 4m and floor to floor height was taken as 3m. After completing the designing of model in SAP 2000 software, analysis was done using linear model time history analysis of cross brace and base isolated structure. They came with conclusion that the base isolation increase flexibility at base of structure; the time period of building for base structure also increases by 3 times; base isolation also reduces acceleration response almost 3 times.

5) Reddy And Ahmed (2017) modeled the steel structure consisting of 6 stories with 3 bays in horizontal direction and 6 bays in lateral direction with the help of STAAD PRO. The storey height was 3m and horizontal spacing between bays was 8m and lateral spacing of bays was 6m. They designed steel moment resisting frame as per SP6. For the analysis purpose they used both equivalent static method and response spectrum analysis. They compared the results of both the method.

6) Anusha And Kumar (2016) analyzed the steel building against earthquake loads. The structure consists of 6 stories with 3 bays in x-direction and 6 bays in y-direction was taken and analyzed it by both equivalent static method and response spectrum analysis and designed. The storey height was 3m and spacing between bays in x-direction was 8m and in y-direction was 6m. The steel moment resisting frame of building was designed as per SP6. The Load Combinations was taken as per IS 1893-2002: 1.7(D.L. + L.L.); 1.7(D.L. + EQ.); 1.7(D.L. – EQ.); 1.3(D.L. + L.L. + EQ.); 1.3(D.L. + L.L. - EQ.). They used STAAD PRO software for assigning the load combination and also for analysis part. They analyzed the structure by both equivalent static method and response spectrum method. Afterwards they compared the results. It was seen that the steel take off or cost of steel used was less in lateral force method as compared to response spectrum method. Also storey shear found by response spectrum method was less than that found by lateral force method.

7) Govardhan And Paul (2016) explains the design of elastomeric bearing. The tests conducted on isolators are Characterization tests, prototype tests and production tests. They compared the material properties used for fabrication i.e. Steel and Lead. The isolators were tested for compression and shear requirements as per requirements of ISO 22762-3(2010). Tests were carried out using Universal Testing Machine and Quasi Static Testing Facility. The testing of Laminated Rubber Bearing with and without lead core was taken. From these tests and comparison, it was found that energy dissipation was much high in LLRB as compared to LRB which was measured by calculating area under the curve. The difference in energy dissipation was 80 to 85%. So that LLRB were used in earthquake prone areas.

8) Dalal And Desai (2013) studied the different lateral load resisting system for multi-storey building. They took building for the Surat. As per IS 1893:2002, they took seismic zone and other details for analysis. They used ETAB 9.7.1 software for analysis purpose. The models of building ranging from G+40 to G+100 stories at an interval of 10 stories were prepared with 4 bays in x-direction and 4 bays in y-direction also with bay width of 10m and storey height of 3.36m. These models are further analyzes by using 3 types of bracing types viz. Double diagonal bracing (X), Inverted-V bracing and V-bracing frame. Also they analyzed for different shapes of building i.e. square, octagonal and circular. After analysis they came up with conclusion that inverted v-bracing was found to be most efficient bracing type than x-bracing and v-bracing type. Also the octagonal shape building was proven to be most efficient shape than that of common shapes like square shape and circular shape building as far as resistance to the earthquake load and wind loading. Also triple layer mega bracing was most efficient than double layer mega bracing due to earthquake and wind loading.

III. CONCLUSION

After reviewing all these papers, it can be concluded that base isolated structure gives improved performance against seismic vibrations than conventional structure. In base isolated structures, the decrease in formation of plastic hinge formation is more than in fixed base structures. The essential and governing characteristics of a perfect base isolation system are mainly energy dissipation, isolation and restoring mechanism. But some types of isolators like friction base isolators are proving to be effective only under the particular excitations and/ or structural characteristics. It is shown that under design conditions, all base isolators can significantly reduce the acceleration transmitted to super-structure.

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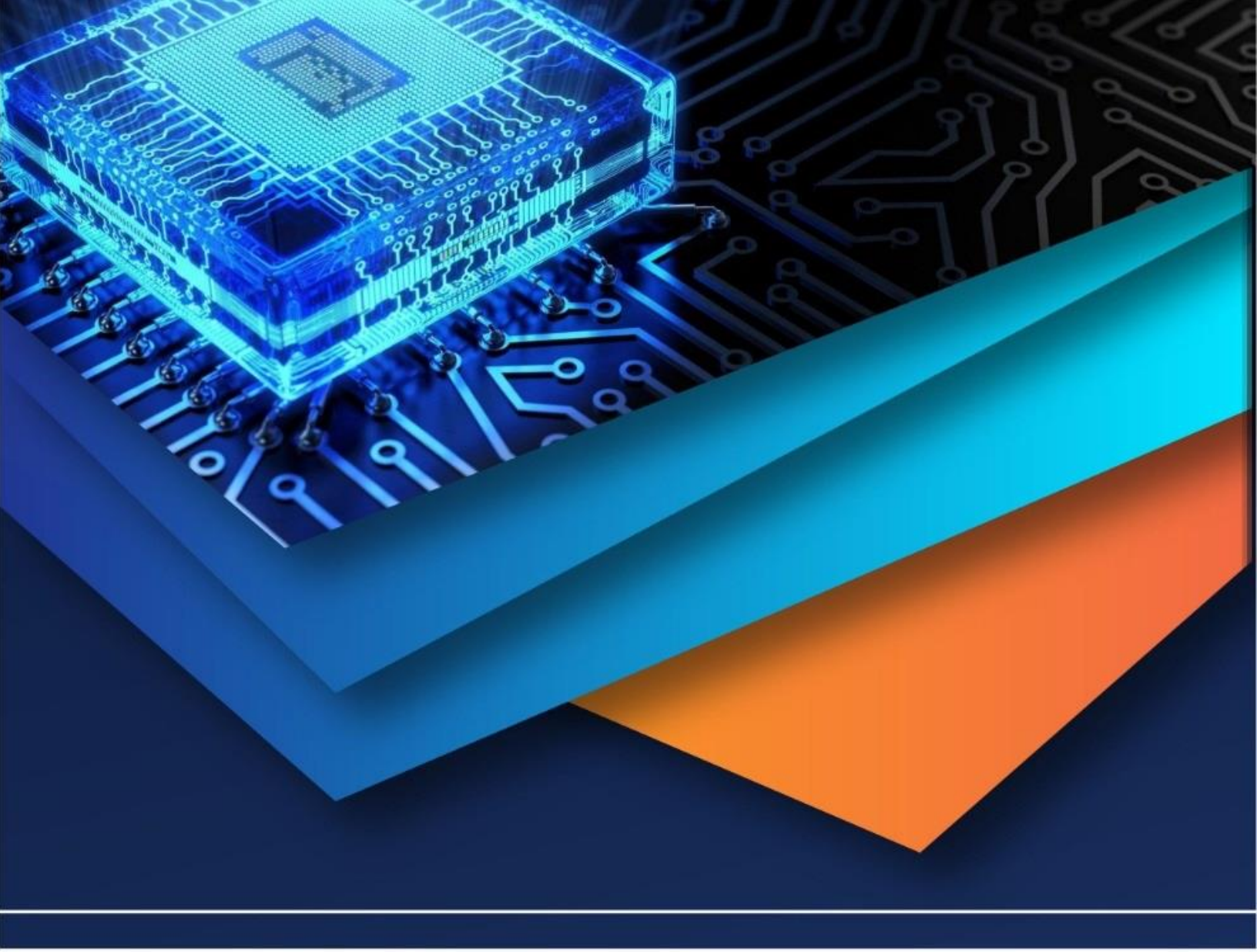

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