Analysis And Design of Steel Hospital Building Subjected To Seismic Forces By Using The NDMA of India Guidelines

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Abstract- *Steel-concrete Steel systems for buildings are formed by connecting the steel beam to the concrete slab or profiled deck slab with the help of mechanical shear connectors so that they act as a single unit. In the present work, In the present work, Steel hospital building are considered for investigation of G+7 storey according to IS1893:2016 and by using NDMA guidelines which is arranged in earthquake zone III. For modelling of Steel structures, Response Spectra Method of Analysis is utilized and ETABS software is used. It shows comparison of various aspects like Base shear, storey drift, joint displacement and storey displacements of Steel buildings considering various analysis results. To compare the parameters. The proposed approach for analysis of hospital building by NDMA guidelines is useful to provide structurally safe solution from disasters.*

Keywords- Hospital building, NDMA guidelines, Storey Drift, Storey Displacement, Base shear, Joint Displacement.

I. INTRODUCTION

The rules on Hospital Safety have been created with the vision that every single recuperating office in India will be essentially and for all intents and purposes safe from calamities, to such a degree, that the risks to human life and establishment are constrained. The general point of the rules is to standard catastrophe counteractive action, moderation, readiness and reaction exercises into the wellbeing part in our nation, with explicit spotlight on emergency clinics; to such an extent that medical clinics are better arranged as well as completely practical following calamities and can react immediately to the restorative necessities of the influenced network. The Steel clinic building is broke down by utilizing IS: 1893-2016 and NDMA rules. In this examination the correlation of story float, story relocation, base shear, segment and pillar powers are determined by utilizing IS: 1893-2016 and NDMA rules of Steel medical clinic building. The seismic recovery process plans to improve seismic execution and right the inadequacies by expanding quality, firmness or distortion limit and improving associations. Subsequently, a proposed retrofit usage can be said to be effective on the off chance that it results an expansion in quality and pliability limit of the structure which is more prominent than the requests forced by tremors.

Seismic Analysis is a subset of basic examination and is the figuring of the reaction of a structure to quakes. It is a bit of the method of auxiliary plan, tremor building or basic evaluation in districts where seismic tremors are inescapable. Seismic auxiliary examination strategies can be separated into two fundamental classifications, static investigation and dynamic examination. These two primary classes can be isolated into two principle sorts of examination, the direct and non-straight investigation. The contemplated structure in this paper is a run of the mill seven-story model of an emergency clinic building. The structure is contained a Steel auxiliary casing. The general arrangement measurement is 59m × 20 m with 28 m in tallness. Planned Steel segment, steel bar with giving extra side plate, RC structure retrofitted with RC jacketing structure. This arrangement was unequivocally successful in reducing the torsional impacts and growing the seismic execution of the "as-fabricated" structure.

II. IDENTIFY, RESEARCH & COLLECT IDEA

The overall aim of the guidelines is to mainstream disaster prevention, mitigation, preparedness and response activities into the health sector in our country, with specific focus on hospitals; such that hospitals are not just better prepared but fully functional immediately after disasters and are able to respond without any delay to the medical requirements of the affected community

An earthquake is the vibration of the earth's surface that follows a sudden release of energy in the crust. During an earthquake, the ground surface moves in all directions. The most damaging effects on buildings are caused by lateral movements which disturb the stability of the structure, causing it to top or to collapse sideways. The guidelines on Hospital

Safety have been developed with the vision that all hospitals in India will be structurally and functionally safe from disasters, such that the risks to human life and infrastructure are minimized .In the case of seismic design of the lateral force-resisting system, the design problem can be reduced simply to the problem of providing adequate force and deformation capacity to resist the seismic demands. Also seismic evaluation will determine which are the most vulnerable and weak components and deficiencies of a building during an expected earthquake.The seismic rehabilitation process aims to improve seismic performance and correct the deficiencies by increasing strength, stiffness or deformation capacity and improving connections.Thus, a proposed retrofit implementation can be said to be successful if it results an increase in strength and ductility capacity of the structure which is greater than the demands imposed by earthquakes.

Site Selection

The following sites shall be prohibited for locating a hospital:

- Liquefiable ground;
- Hill slopes (Stable or unstable), or land adjoining hill slopes known to have rolling debris;(whether sloped or flat)
- Flood or tsunami prone areas;
- Adjoining unsafe buildings and structures; and
- Poor accessibility in post-disaster situations.

When existing hospitals are located in any of these vulnerable locations, no future expansions shall be permitted in the hospital campuses.

III. STUDIES & FINDING

Structure	Steel hospital building as per IS 1893:2016
No of stories	G+7
Storey height	3.5m
Height	30m
Plan	59mx20m
Type	Regular
Grade of Steel	Fe345
Slab thickness	150 mm

Table 4.1Steel Beam dimension for IS: 1893-2016 model

MARK	SIZE	Tf (mm)	Tw (mm)
A	ISMB600	20.2	12
B	ISMB550	19.3	11.2
C	ISMB500	17.2	10.2
D	ISMB450	17.4	9.4
E	ISMB400	16	8.9
F	ISMB350	14.2	8.1
G	ISMB300	12.2	7.5
H	ISMB200	10.8	5.7
I	ISMB175	8.6	5.5
J	ISMB150	7.6	4.8

Table Steel Column dimension IS: 1893-2016 model

Mark	Size
Column	ISMB500

Note: -Column Concreting / Encasing should be done before Casting Deck Slab

Live load	4kN/m^2
Roof Live	1.5kN/m^2
Floor finish	1kN/m^2

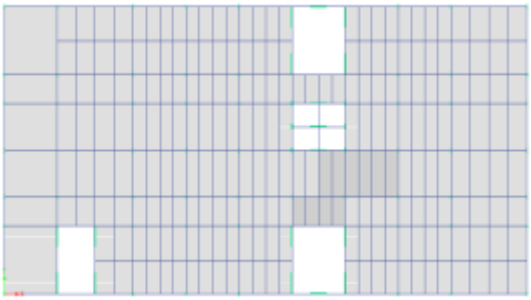


Fig Plan of hospital building

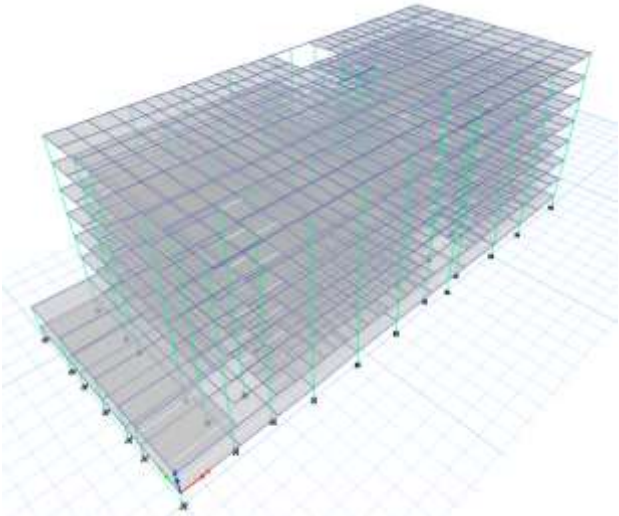


Fig 3D- View in Etab

IV. PEER REVIEW

J.Sankar et al. [1],analysed RC plane frames of G+3 storey building for four earthquake zones. Story drift, story displacement, bending moment and shear force variation for different zones was carried out. Story drift was increased from zone II to zone V in force is required in order to design with supporting elements, from which the forces get transferred to the framework. The construction period of a structure is much than its expected life,therefore, return period of 50 years may be considered for arriving at the both the directions X and Z. Amount of story drift depends up on the amount of earthquake effect and also on the displacement of the story. For buildings, Earthquake zone factor for construction stages/period of a structure depending on its importance.The stability of a structure shall be checked both with and without the earthquake loads.

AmirahmadFathieh and OyaMercan [2], designed multi-story modular steel buildings by considering realistic constraints posed during the modular construction. It analysed the multi-story modular steel buildings with nonlinear static pushover and incremental dynamic analyses [IDA] in two and three dimensions. In multi-story modular steel buildings structures each module has its own individual concrete slab and the connections between these slabs are provided through the horizontal connections. Hence, instead of having a single diaphragm, separated diaphragms (one for each module) should be considered at each story floor when modelling a MSB structure. This will also result in a more realistic representation of the braced frame lateral stiffness; and, thereby, provide better predictions of the building drifts and periods. It conclude that Comparing the 2D and 3D models and according to both IDA and nonlinear pushover analysis, the structural capacity against incipient collapse of the 3D model was found to be lower than that of the 2D model. This is because the 2D model fails to account for the torsional response, hence overestimates the structural capacity.

Zhichao Lai, et al. [3], studied 6-story Steel Special Moment Frames subjected to frequent occurrence earthquake and design basis earthquake ground motions. Also studied 12-story Steel Special Moment Frames subjected to frequent occurrence earthquake, design basis earthquake and maximum considered earthquake ground motions. Dynamic analysis of Steel frame done by nonlinear time history method.It conclude that the non-linear time history analysed also indicated that the higher modes had greater influence on the 12-story Steel Special Moment Frames than the 6-story Steel Special Moment Frames, and also the maximum inter story drifts for both the 6- and 12-story high strength Steel Special Moment Frames were less than 1%, 1.5% and 3% when subjected to frequent occurrence earthquake, design basis earthquake and maximum considered earthquake ground motions.

Bhavin H. Zaveri, et al. [4], carried the comparison of steel, RCC and Steel building by considering five storey building. It was compare by various aspects like seismic performance, deformations, resultant forces and moments, cost, weight and fire performance. It conclude that in high rise building the Steel building most suitable than steel and RCC building because it produces less displacement and resists more structural forces. It also seen that Steel structures are resulted into lighter construction than traditional concrete construction as well as speedy construction. So completion period of Steel building is less than RCC building.

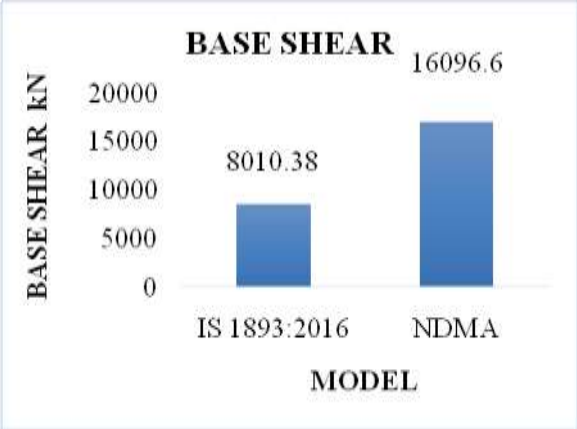
Rehan A. Khan and T. Naqvi [5], studied the seismic reliability of five storey steel frame building by considering the uncertainties inherent in the modelling, analysis procedure, material properties, capacity of the frame, ductility effect and seismic input. The structure stimulation was conducted using structural analysis programme (SAP) by 3D frame analysis. It seen that the difference in the probabilities of failure due to change in soil condition is not only influenced by the soil characteristics but also by the structures period which governs the spectral acceleration. Probabilities of failure are determined for different values of PGA and the probability of failure is determined by considering the gravity load to remain constant.

Nitish A. Mohite, et al. [6], carried out comparative analysis of RCC and Steel-Concrete-Steel of 11 storey building includes roof deflections, base shear, storey drifts, for the building and axial forces and bending moments for column and beam.Seismic behaviour of building under seismic forces as per IS 1893-2016 are designed. Static Method of analysis explained in ETABS software is used and results are compared for different parameters. It conclude that the shear forces in main beams in Steel structure are increased by average 39.43%as compared to R.C.C. framed structure while in secondary beams in Steel structure are reduced by average 14.39% as compared to RCC framed structure. It was observed that steel-concrete-Steel building was found to be more safe and economical and better option.

V. IMPROVEMENT AS PER REVIEVER COMMENTS

Base shear is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure, which is shown in the figure .The results noticed that base shear of Steel hospital building as per NDMA guidelines was double than as per IS:1893-2016

because full zone factor value is considered in horizontal seismic coefficient value in NDMA guidelines, which indicates that less seismic weight which gives better seismic response during earthquake.



Based On Storey Displacement of the Structure

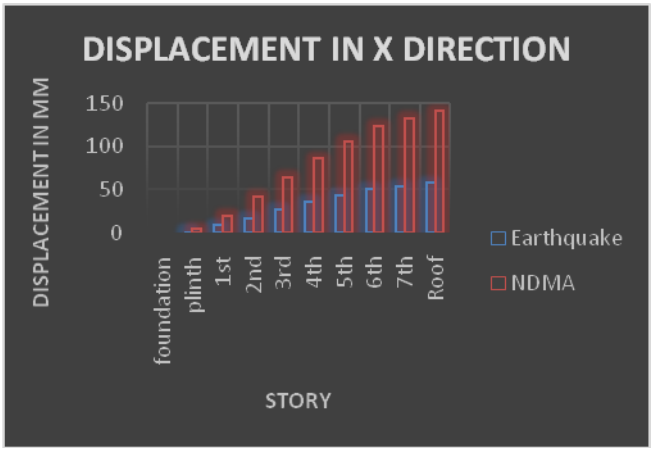


Figure Storey displacement in X-direction

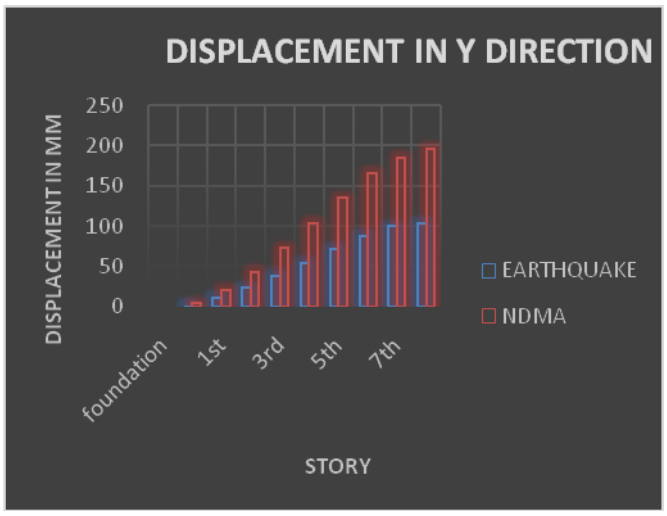


Figure Storey displacement in Y-direction

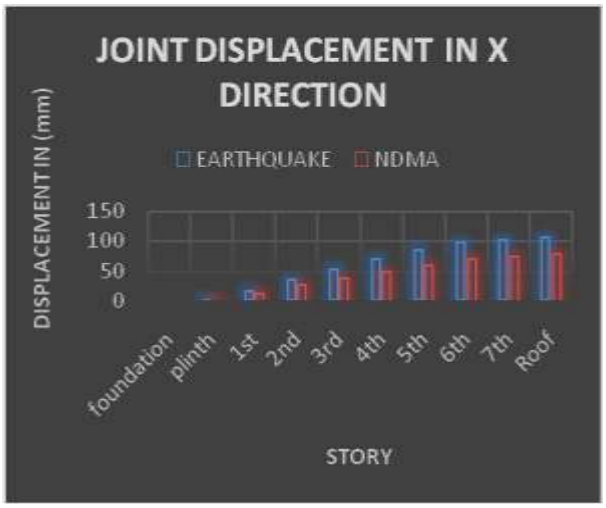


Figure Joint displacement in X-direction

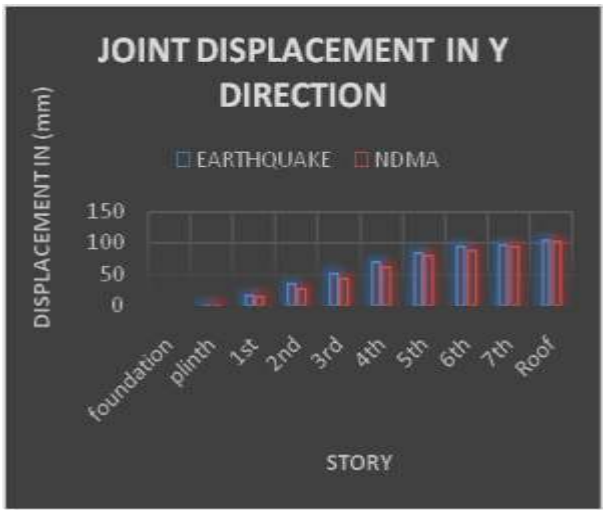


Figure Joint displacement in Y-direction

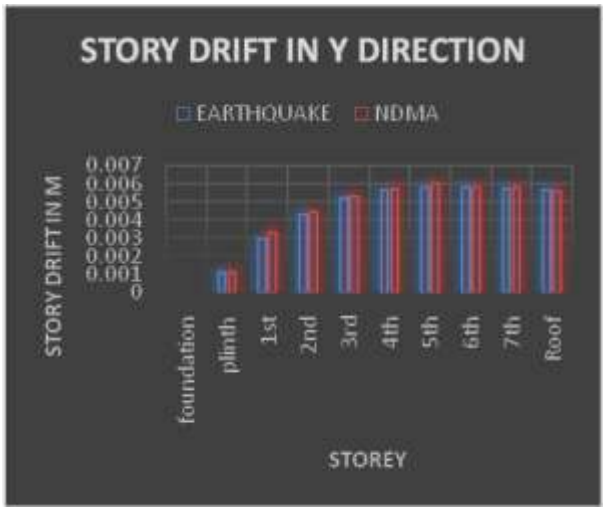


Figure Storey drift in Y-direction

VI. CONCLUSIONS

From the study Analysis and Design of Steel Hospital Building Subjected to Seismic Forces by Using NDMA Guidelines are concluded below

- Steel structures are best solution for high rise buildings and they are resulted in speedy construction.
- Steel structures are resulted into lighter construction than traditional concrete construction as well as speedy construction. So completion period of Steel building is less than RCC building.
- The reduction in the self-weight of the Steel hospital building as per IS: 1893-2016 is 29.25 % with respect NDMA guidelines due to increase cross sectional area of NDMA guidelines hospital building due to increase in cross sectional area of NDMA guidelines.
- The reduction in the seismic weight of the Steel hospital building as per IS: 1893-2016 is 14 % with respect NDMA guidelines which indicates that less seismic weight which gives better seismic response during earthquake.
- Base shear value of Steel hospital building as per NDMA guidelines is double as compare to IS: 1893-2016 because full zone factor value is considered in horizontal seismic coefficient value in NDMA guidelines.
- Steel hospital building as per IS: 1893-2016 is having the less value of storey drift as compare to that NDMA guidelines before and after increasing size of column & beam in both X-direction and Y-direction.
- Storey drift in hospital building by using NDMA guidelines before increasing size of column & beam is having double story drift as per IS: 1893-2016 in X-direction and Y-direction due to increase in base shear value.
- Storey drift in hospital building by using NDMA guidelines after increasing size of column & beam is 48% and 36% having less value as per IS: 1893-2016 in X-direction and Y-direction due to increase in base self-weight of structure

REFERENCES

[1] J.Sankar, E.V.Raghava Rao &N.Chennakesavulu, Design of G+4 hospital building for earthquake resistance, IJESRT, 5(12), 2016, 2277-9655.

[2] AmirahmadFathieh and OyaMercan, “Seismic evaluation of modular steel buildings”, elsevier, 122, 2016, 83-92

[3] Zhichao Lai, Zhihui Huang and Amit H. Varma, “Seismic Analysis and Behaviour of High Strength Steel Special Moment Frames”, Structures Journal,16,12 April 2016, 2352-0124

[4] Bhavin H. Zaveri and M. Nakashima, Numerical and Experimental Evaluation of Seismic Capacity of High-Rise Steel buildings Subjected to Long Duration Earthquakes, elsevier, 89, 2011, 959–967

[5] Rehan A. Khan and T. Naqvi, Reliability Analysis of Steel Building Frame Under Earthquake Forces,International journal of emerging technology and advanced engineering, Volume 2, 8,August 2012, 2250-2459