Design of Shear Wall for Regular and Irregular Building using Stadd.PRO

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Abstract- Inferable from the expanding shortage and cost of land, structural engineers are being headed to embrace the vertical development of structures. This need keeps on testing specialists to achieve new height and this progression of increasing height of structures gets more challenge in the type of seismic loads. As the stature of the building increases the impact of the seismic load also becomes severe. It has been seen amid past seismic tremors that structures which are regular in design perform much superior to anything those which have irregular design. In this way, it is constantly attractive to embrace a regular configuration of an elevated structure while designing; however architecturalinterest, customer desire and typical site condition now and again make it highly irregular in plan or irregular vertically. Due the effectiveness of shear wall in opposing horizontal loads, a reinforced concrete shear wall has turned into an imperative structural component finding their application in elevated structures. Be that as it may, a detail structural analysis to comprehend structural behaviour of the building with plan irregularities under seismic loading is fundamental for appropriate design and their better performance. In this way, amid this study a highly irregular building and a regular building is considered with a specific end goal to comprehend the behaviour of a building having plan irregularities. Two distinct instances of building (i) Regular building having rectangular configuration and (ii) Irregular building having L shape configuration, is considered in order to understand the behaviour of an irregular building with simple moment resisting frame having beam, columns and two-way slabs and to study the effect of providing shear wall on the performance of these buildings under seismic loading. Both the regular and irregularbuildings are thought to be situated in zone IV. Linear dynamic analysis through Response Spectrum method is carried out utilizing the standard STAAD.PRO programming bundle. For this the Response parameters considered are 1) Maximum displacement 2) Story drift, 3) Base shear, 4) Time Period. The structures are displayed for seismic prerequisite given by the Indian seismic code IS: 1893-2016 (Part 1). The primary goal of the investigation is to find that by how much amount the story drift, lateral displacement and base shear are influenced.

Keyword- Shear wall,Regular building,Linear dynamic analysis,STAAD.PRO

I. INTRODUCTION

An earthquake might be characterized as the release of elastic energy by a sudden slip on a fault and coming about ground shaking and transmitted caused by slip. It is a standout amongst the most devastating natural hazards normal perils that reason extraordinary death toll and livelihood. The greater part of the misfortuns is because of building collapse or damages. An Earthquake can cause harm not just by virtue of vibrations which comes about because of them yet in addition because of other chain impacts like landslides, surges, fires, and so on. An extensive structural analysis of a tall building is dependably a mind-boggling undertaking, particularly for a high rise building having plan irregularities. For an irregular building having plan irregularities, it is important to use the dynamic method of analysis to get the reaction parameters. For sure, the reaction of any building under the action of seismic forces is exceptionally complex and Response spectrum method of analysis ends up being a superior choice to acquire the reaction of the structure under the activity of seismic forces. Besides, the important earthquake resistantability in a multi-storied building can be accomplished by giving sufficient stiffness, strength and ductility in the building and shear wall gives an ideal mean for accomplishing the fundamental criteria of design [T. Paulay and M.J.N Priestley, 1992]. The information gained through the test and systematic discoveries on shear wall through the course of time, furthermore the comprehension of the seismic response of shear wall has made it conceivable to utilize it proficiently in high rise buildings to oppose earthquake loads. Shear wall is a component which goes about as a vertical cantilever utilized for the most part in multi storied buildings to oppose horizontal forces like wind, storm, and seismic earthquake. These walls are when all is said in done continuous component beginning from the foundation and go up to the most elevated point of the building. In any case, it might likewise be curtailed at middle height. Shear wall can oppose the blend of shear, moment and axial load incited by lateral load and gravity load exchanged to it through other structural members. For buildings more than 30 stories, shear wall has been a fundamental component to guarantee economy and limit the horizontal displacement.

A. Action of shear wall in resisting loads

Utilization of shear walls gives an effective solution to stiffen a structural systemof a building as it increasses the rigidity against horizontal load acting up on the building. Shear wall essentially increases the stiffness and strength of the building toward its orientation. This outcomes in checked decrease in lateral sway of the building. By and large the Shear wall transfers the load to the next component beneath it in the load path. It helps in reducing the side sway of the above individuals like roof or floor. It also keeps the floor and roof framing individuals from moving off their supports when they are stiffenedenough and furthermore diminishes the non structural damages [Waseem Raja Ganai, 2014].

B. OBJECTIVE OF STUDY

Main objective of the present work is to evaluate the performance of an RC building having plan irregularities using response spectrum method of analysis to study the effect of providing shear wall on the performance of the building under seismic loading in seismic zone IV. The specific aims and objectives of the project can thus be summarised as:-

- Structural analysis of four different cases of a G+19 building with and without shear wallin seismic zone IV of India, having different configurations viz. (i) Regular building having rectangular configuration and (ii) Irregular building having L shape configuration.
- Working out the Moment, Storey drift, Lateral displacement and Base shear.
- Comparing the response parameters to study the effect of irregular configuration on the performance of building under the action of earthquake load and also the effect of providing shear wall in seismic zone IV.

II. LITERATURE REVIEW

Chetan Raj [2015] et al, presented in International Journal of Recent Research that Since the advancement of the earth, Earthquakes have caused extraordinary calamities as devastation of property, damage and death toll to the populace. The successful plan and development of quake safe structures have substantially more prominent significance in this nation because of quick modern improvement and grouping of populace in urban areas. In the present investigation, the tremor examination of working with mass and vertical geometric inconsistency is finished by the reaction range and seismic coefficient technique, where normal frequencies, period, base shear, horizontal powers are computed by STAAD-PRO programming and in addition physically by the seismic coefficient strategy. Likewise, the modular mix administer for the reaction range examination is CQC according to the code IS 1893:2002. The techniques incorporate the seismic coefficient strategy (by observational recipe) and modular investigation utilizing reaction range technique for IS Code in which the firmness grid of the building relating to the dynamic degrees of flexibility is created by considering the working as the shear building. The reactions acquired by above strategies are considered for extraordinary zones as specified in IS code i.e. zone V and zone III.Test outcomes including base shear, story shear, hub removals, and horizontal powers are displayed to get successful sidelong load opposing framework.

Nonika.N [2015] et al, presented at International Journal for Research in Applied Science & Engineering Technology (IJRASET) that, it is comprehended that structures which are customary in height (consistent building) perform much superior to those which have inconsistency in the rise (unpredictable working) under seismic stacking. Abnormalities are not avoidable in the development of structures. Be that as it may, a definite report to comprehend basic conduct of the structures with anomalies under seismic stacking is basic for the fitting plan and their better execution. The principal target of this investigation is to comprehend the impact of rising abnormality and conduct of 3-D R.C. Building which is subjected to seismic tremor stack. In the present investigation, a 5 sounds X 5 coves, 16 storied structure with the arrangement of lift centre dividers and every story tallness 3.2 m, having no inconsistency in height and plan is considered as the ordinary 3-D structure to contrast and the unpredictable i.e. delicate story building. Both the general and unpredictable structures are thought to be situated in all zones. Straight unique investigation utilizing Reaction Spectrum technique for the unpredictable building is completed utilizing the standard and helpful FE programming bundle. For this the conduct parameters considered are 1) Maximum uprooting 2) story float, 3) Base shear, 4) Time period.

Zaid Mohammad [2016] et al, Encircled structures built on slope slants demonstrate unexpected auxiliary conduct in comparison to that on the plain ground. Since these structures are unsymmetrical in nature, subsequently, draw in an expansive number of shear powers and torsional minutes, and show unequal appropriation due to differing segment lengths. In the present examination, two distinct designs of slope structures have been displayed and investigated utilizing ETABS v 9.0 limited component code. A parametric report has been completed, in which slope structures are geometrically fluctuated in tallness and length. On the whole, eighteen explanatory models have been subjected to seismic powers along and crosswise over slope incline course and broke down by utilizing Response Spectrum Method. The dynamic parameters got from examinations have been talked about as far as shear powers actuated in the sections at the establishment level, major eras, most extreme best story removals, story floats and story shear in structures, and thought about inside the thought about setups of slope structures. Finally, the reasonableness of distinctive setups of slope structures has been recommended.

Resmitha Rani Antony [2016] et al, presented in International Journal of Scientific & Engineering Research that, amid a seismic tremor, the disappointment of structure begins at purposes of shortcoming. This shortcoming emerges because of intermittency in mass, firmness and geometry of the structure. The structures having this brokenness are named as Irregular structures. The conduct of a working amid a quake relies upon a few factors, for example, firmness, satisfactory sidelong quality, malleability and setup. The structures with normal geometry and consistently dispersed mass and firmness in design and also in rising endure substantially less harm contrasted with sporadic setups. General structures have consistently circulated mass, firmness, quality and basic frame. When at least one of these properties is non-consistently circulated, either independently or in the blend with different properties toward any path, the structure is alluded to as being sporadic. Sporadic structures contribute a substantial part of the urban framework. Vertical abnormalities are one of the significant reasons for

disappointments of structures amid quakes. The point of this examination is to assess the seismic conduct of RC building having distinctive sorts of anomalies, chiefly vertical geometric abnormality and firmness inconsistency. For this investigation, 48 models which incorporate vertical geometric sporadic structures (ventured structures) with and without firmness abnormalities at various levels are demonstrated and broke down. To think about the conduct of the unpredictable structures, reaction range investigation is led. The demonstrating and investigation are completed utilizing ETABS programming. Parameters, for example, era, parallel uprooting and story float are contemplated.

Ravindra N. Shelke [2017] et al, presented in International Journal of Civil Engineering and Technology (IJCIET), numerous structures in the present situation have unpredictable arrangements both in plan and rise. This in future may subject to destroying tremors. On the off chance that, it is an essential examination (RSA) of vertically sporadic RC building. Examination of the consequences of investigation and outline of sporadic structures with normal structure was finished. Three kinds of anomalies to be the specific mass abnormality, solidness inconsistency and vertical geometry inconsistency were considered. The mass unpredictable structures were seen to encounter bigger base shear than comparable customary structures. The firmness sporadic structure experienced lesser base shear and has bigger between story floats. The outright removals got from time history investigation of geometry sporadic structure at particular hubs were observed to be more prominent than that if there should arise an occurrence of standard structure for upper stories, however, bit by bit as we moved to bring down stories relocations in the two structures had a tendency to unite. Lower firmness brings about higher removals of upper stories.to distinguish the execution of the structures to withstand debacle for both new and existing one. This paper is worried about the impacts of different vertical anomalies on the seismic reaction of a structure. The goal of the undertaking is to do Response range.

III. PROBLEM DEFINITION AND ANALYSIS GENERAL

Main objective of the present work is to evaluate the performance of an RC building having plan irregularities using response spectrum method of analysis to study the effect of providing shear wall on the performance of the building under seismic loading in seismic zone IV. The specific aims and objectives of the projectis the structural analysis of four different cases of a G+19 building with and without shear wallin seismic zone IV of India, having different configurations viz.

- Regular building having rectangular configuration without shear wall.
- Regular building having rectangular configuration with shear wall.
- Irregular building having L shape configuration without shear wall.
- Irregular building having L shape configuration with shear wall.

IV. RESULTS EFFECT ON STOREY DRIFT ALONG THE BUILDING HEIGHT

Graphical representation showing variation of storey drift along the building height and the comparisons made between different cases of the buildings B1 and B2i.e. without shear wall, with shear wall is presented from figure 1 to 5 Permissible storey drift in every case is 0.004 times the story height i.e. 0.004x3000mm= 12mm.

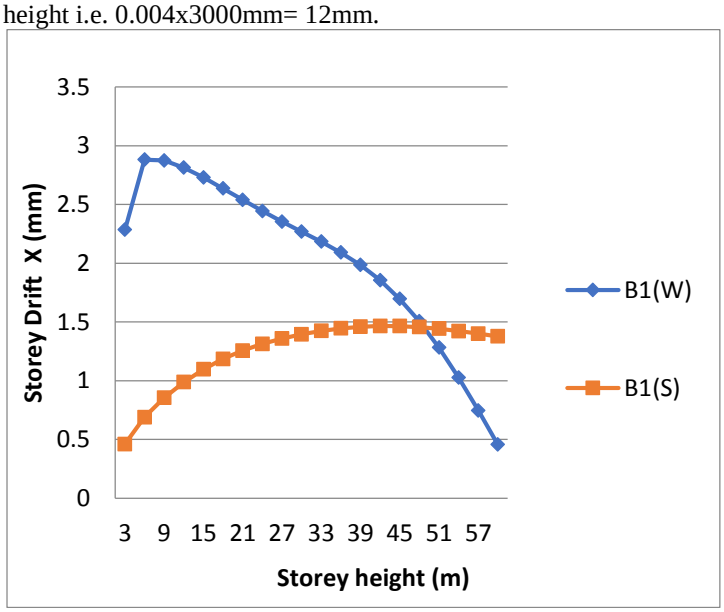

Fig.1: Comparison of Inter-story Drift along X axis v/s Storey Height for Regular building B1 of Rectangular shape of (G+19) stories.

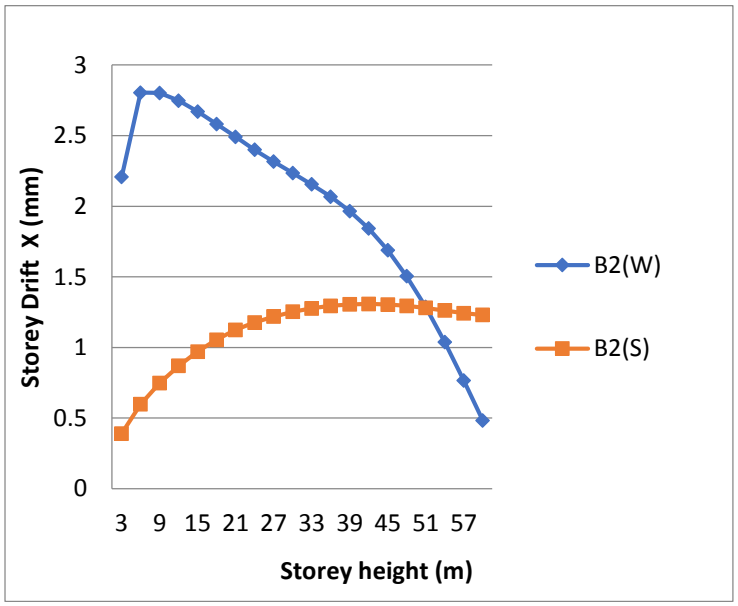

Fig.2: Comparison of Inter-story Drift along X axis v/s Storey Height for Irregular building B2 of L shape of (G+19) stories.

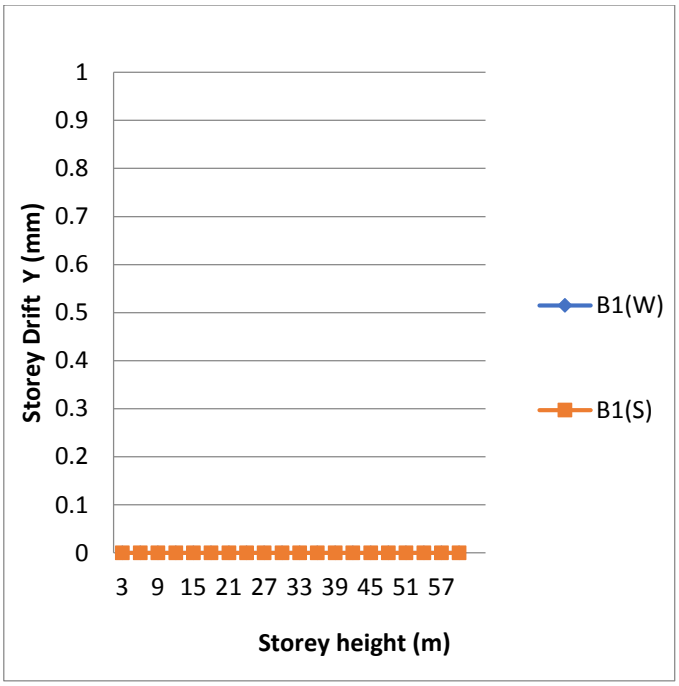

Fig.3: Comparison of Inter-story Drift along Y axis v/s Storey Height for Regular building B1 of Rectangular shape of (G+19) stories.

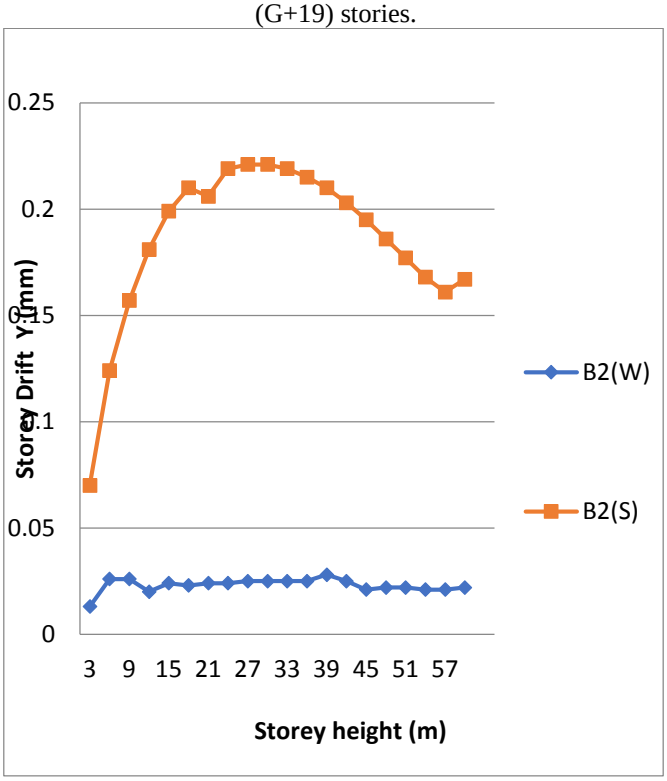

Fig.4: Comparison of Inter-story Drift along X axis v/s Storey Height for Irregular building B2 of L shape of (G+19) stories

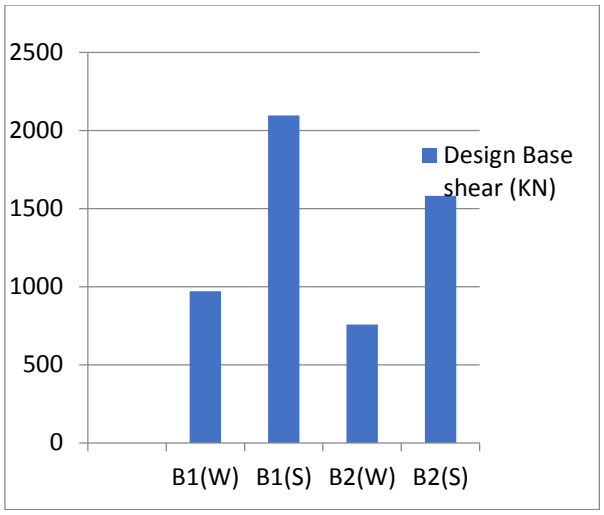

Fig.5: Comparison of Base shear for different cases of the buildings B1 and B2 of (G+19) stories

V. CONCLUSION

In view of the study carried out on one building, it is difficult or not fair to give generalized conclusions. However, following are some conclusions made from the study: -

1. It is observed that the storey drift is well within the permissible limits for all the cases.
2. Provision of shear wall has helped in reducing the storey drift for Regular building having rectangular shape as well as for irregular building having L shape configuration.
3. Buildings having shear wall has shown lesser values of storey drift as compared to buildings without any shear wall.
4. It is observed that the drift in the special moment resisting frame with shear wall up to full height increases with height up to a certain level and then it decreases or remains constant for the both the buildings B1 and B2.
5. It is evident from above that the Irregular configuration of a building can get inter-storey drift along both the horizontal axis, so it is a better option to provide shear wall along both the axis, and also position of shear wall in a building has greater impact on various parameters.
6. It has been observed that the design base shear for building having shear wall is greater that the building without shear wall for both the buildings, it may be due to the fact that the shear wall adds to the modal weight of the structure which increases the stiffness of the structure, so it is evident that the shear wall helps in resisting earthquake load.
7. Hit and trial method based on several parameters like location, cross section, orientation etc is a good practical approach to understand the behaviour and performance of the structure under seismic loads.

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