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Response Spectrum Analysis of Precast Wall Panelled Building Considering Diaphragm Flexibility

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ABSTRACT— The roofing system, also referred to as a diaphragm, is an important component of the structure of a building. The diaphragm resists the gravity loads imposed on the building through its stiffness in the direction perpendicular to the roof plane. The other function of the diaphragm is the distribution of lateral forces among the elements of the lateral load resisting system (LLRS) of the building. Extreme events such as wind, earthquake, and blast can give rise to the imposition of significant lateral loads on the LLRS. For the distribution of such lateral loads the roofing system relies on its in-plane stiffness. Thus, the in-plane stiffness of the roof diaphragm relative to the stiffness of the LLRS greatly influences the response of the structure to the lateral loads. Precast concrete walls are constructed by casting concrete in a reusable wall mould or form which is then cured in a controlled environment, transported to the construction site and lifted into place. The main function of the precast walls is to speed up the construction process. The objectives of the current study are to investigate the following: the effect of diaphragm flexibility on the ductility demand on the LLRS, the impact of post-yield hardening in LLRS on the response of the system, the distribution of shear forces and bending moments along the length of the diaphragm when the system is subjected to ground motions, the effect of pinching behaviour in LLRS on the total response and behavior of the system, the consequence of nonlinear behaviour in the diaphragm system and the concept of diaphragm acting as the main energy dissipating member during earthquakes. The modelling and analysis of the building with precast wall panels should be done using ETABS.

Keywords—ETABS, Live load resisting system (LLRS), Precast wall panel, Diaphragm flexibility, In plane stiffness\

I. INTRODUCTION

1.1 General

Many buildings in the present scenario have irregular configurations both in elevation and plan. This in future may subject to devastating earthquakes. It is necessary to identify the performance of the structures to withstand against disaster for both new and existing buildings. Now a day's openings in the floors is common for many reasons like stair cases, lighting architectural etc., these openings in diaphragms cause stresses at discontinues joints with building elements. Discontinuous diaphragms are designed without stress calculations and are thought-about to be adequate ignoring any gap effects. In this thesis an attempt is made to try to know the difference between a building with diaphragm discontinuity and a building without diaphragm discontinuity. In multistoreyed framed building, damages from earthquake generally initiates at locations of structural weaknesses present in the lateral load resisting frames.

This behaviour of multi-storey framed buildings during strong earthquake motions depends on the distribution of mass, stiffness, strength in both the horizontal and vertical planes of buildings. In few cases, these weaknesses may be created by discontinuities in stiffness, strength or mass along the diaphragm. Such discontinuities between diaphragms are often associated with sudden variations in the frame geometry along the length of the building. Structural engineers have developed confidence in the design of buildings in which the distributions of mass, stiffness and strength are more or less uniform. There is a less confidence about the design of structures having irregular. Buildings having rigid walls and flexible roof diaphragms (RWFD) are a type of building construction widely used for light industry in the United States; they incorporate rigid in-plane concrete or masonry walls and flexible in-plane wood, steel, or hybrid roof diaphragms

Figure 1.1: Construction stage of a precast wall panellled building

Concrete roof and floor slabs deflect negligibly under the action of in-plane loading and are classified as rigid diaphragms, whereas wood diaphragms can deform more and are classified as either rigid or flexible diaphragms. The flexibility of the diaphragm can have a significant effect on the distribution of horizontal diaphragm forces to the vertical elements (shear walls) that transfer these forces to the foundation. A significant increase in the anchorage forces between the diaphragm and either concrete or masonry walls are also required for flexible diaphragms. Current practice is to consider all wood diaphragms as flexible. Although several building codes have specific criteria for diaphragm classification, considerable ambiguity exists in the application and interpretation of these criteria. Structures with flexible floor diaphragms behave intrinsically different under dynamic lateral loading than structures with rigid diaphragms. However, a clear criterion for determining when a diaphragm is flexible or rigid is not available for application in practice. Flexible-diaphragm systems continue to be analyzed using the same criteria and recommendations as developed for structures with rigid diaphragms, which may not necessarily be a conservative approach. Research has shown that structures with flexible diaphragms may experience higher accelerations and displacements than structures with rigid diaphragms.

Although it is known that properly detailed, reinforced masonry buildings can develop sufficient stiffness and strength, their seismic performance has not been well documented in the past. Therefore, the seismic behavior of masonry structures is still not completely understood. Certain masonry structures have performed well when subjected to strong ground motion and modern masonry construction has also had a satisfactory performance in recent earthquakes. The three-story masonry building has recorded the response from three major earthquakes. However, due to the distance from the building to the epicenter of the earthquake, the base accelerations recorded at the building are relatively low with peak ground accelerations of between 4% and 7% of gravity. However, using static loading, the resulting displacement ratios suggest that the roof diaphragm is flexible and the floor diaphragm is rigid. Consideration of base shear in the resisting walls also indicates the computed values are approximately proportional to the tributary area implying a flexible diaphragm.

Buildings can resist extreme lateral loads through the application of a principle known as diaphragm design. Diaphragms are horizontal members transferring lateral forces to the vertical elements. In case of Building, floor acts as a diaphragm to transfer the lateral loads to columns and walls. The reactions that occurs in the vertical member due to the effect of diaphragm is known as diaphragm action. For flexible diaphragms, the loads should be distributed according to the tributary area .whereas for rigid diaphragms, the load should be distributed according to the stiffness. Semi-rigid diaphragm will come in between the flexible and rigid. In the analysis of multistory buildings subjected to lateral loads, a common assumption is that the floor system undergoes no deformation in its own plan. So it is designed as rigid diaphragms. In most cases, this is quite satisfactory, because usually diaphragm flexibility affects neither overall structural stiffness nor the distribution of forces within a structure. But during a major earthquake, in ductile structures where the diaphragms are designed to remain elastic, So the deflections are likely to include large plastic deformations, increasing the chances of failure. Several researchers found that the rigid-floor assumption is accurate for buildings without shear walls, but it can cause errors for building systems with shear walls. So, an investigation on the effect of diaphragm flexibility in precast wall panels is inevitable.It is a prefabricated structure fabricated at an offsite location and then constructed structures like columns, beams, slabs and walls Panel distance is the distance between two adjacent supports or joints

- Types of walls

There are three types of precast wall systems are available Cladding or curtain wall, Load bearing wall and shear wall. Cladding or curtain walls is Most widely used precast wall and Used as a building envelops.Load bearing wall units oppose loads from different components It can't be removed or dismantled without influencing the quality or dependability of the building.In multi-story structure , large walls and floor concrete panels are connected to each other.When properly joined together these horizontal elements act as a diaphragm that transfer the lateral loads to the walls.In load bearing precast wall system, large panel precast walls are analysed Both horizontal and vertical structure that resist the gravity load

Depending on the wall layout there are three basic configuration of large panel systems are available. Cross wall system, Longitudinal wall system and Two way wall system.In cross wall system , the structural members that resist the lateral forces that are parallel to the plane of the wall.In longitudinal wall system, the walls resisting gravity and lateral loads in the longitudinal direction.In two way system , The walls are placed in both directions of the plane.

- Advantages and disadvantages

The main advantages are, Not necessary to provide joints in the precast construction time.Excellent protection against impacts from explosions and other lateral forces.Low cost when compared to other material having high efficiency and easy to install Less form work.It can be designed to be reused for future building expansions. And the main disadvantages are It offers high initial cost ,It is necessary to arrange for special equipment for lifting and moving, If not properly handled the precast units may be damaged during transportation, It becomes difficult to produce connections between the precast members, Skilled labour and supervision required and Additional erection equipment's are needed.Improperly designed building without considering diaphragm action will result in rocking and bowing from lateral loads and overturning of the foundation.The robustness and redundancy of a structure is highly dependent on the performance of the diaphragms.It have excellent performance in hurricane and earthquake conditions. Diaphragm will carry most of the wind loads, so column size can be reduced. The ability of shear wall to resist complete lateral loads requires a well-constructed roof diaphragm. usually diaphragm flexibility affects neither overall structural stiffness nor the distribution of forces within a structure. But during a major earthquake, in ductile structures where the diaphragms are designed to remain elastic.

- Diaphragm flexibilities

Mainly three types of diaphragms are available, rigid diaphragm ,semi rigid diaphragm and flexible diaphragm The rigid diaphragm can rotate and translate, but cannot deform. It distribute loads to elements which connect to them based on the stiffness of elements. The diaphragm may be considered rigid when its midpoint displacement under lateral load is less than twice the average displacements at its ends. Rigid diaphragms consist of reinforced concrete diaphragms, precast concrete diaphragms, and composite steel deck.in the case of semi rigid diaphragms, It distributes load based on both the stiffness of the vertical elements and on the stiffness of diaphragm itself. It deflect under load and it have sufficient stiffness to distribute a portion of the load to vertical elements considering its rigidity. It is used mainly for transferring the wind load and give the building the ability to behave as its actual behavior.in the case of flexible diphragm,It distribute loads to vertical elements based on the tributary area of the element within the plane of the diaphragm. A diaphragm may be considered flexible when its midpoint displacement under lateral load exceeds twice the average displacement of the end supports. The relative stiffness of the non-yielding end supports is very high compared to that of the rigid diaphragm. Flexible diaphragm consists of roofs or floors sheathed with plywood, wood decking, or metal decks without structural concrete topping slabs and metal decks with lightweight fill

From the codal provision of IS 1893:2018 ,the Section 4.8 defines Diaphragm as a horizontal system, which transmits lateral forces to the vertical resisting elements As per section 7.7.2.2, In case of building whose floor diaphragms cannot be treated as infinitely rigid in their own plane. So the lateral shear at each floor shall be distributed to the vertical elements resisting the lateral forces, considering the in-plane flexibility of the diaphragms. A floor diaphragm shall be considered to be flexible, if it deforms such that the maximum lateral displacement measured from the chord of the deformed shape at any point of the diaphragm It is more than 1.5 times the average displacement of the entire diaphragm. Reinforced concrete monolithic slab-beam floors or those consisting of prefabricated/precast elements with topping reinforced screed can be taken a rigid diaphragm.

In Equivalent static lateral force method, the response spectrum analysis is used so it is difficult to add horizontal forces to the nodes of a building with the flexible-floor diaphragm since it cause mass concentration. Thus, to compare diaphragm flexibilities, dynamic analysis is probably a better choice because the earthquake loading can be applied to the building base without any differentiation of diaphragm flexibilities.For time-history analysis, it is not easy to compare the complex analysis for diaphragm flexibility. The results may differ due to a significant time shift, so comparing them at a certain time will cause error. The response-spectrum analysis does not have the above problems, because only the maximum responses are calculated in this method.

- Scope of the present study

Modelling and analysis of different diaphragm actions of a five storey building and To analyse the Response of the walls under diaphragm flexibility.To find out the Response of the walls under diaphragm discontinuity.To find out the In-plane stresses and force distribution in precast wall panels under the action of diaphragms.To analyse the Flexural , shear, torsional and axial response of cladding panel, load bearing wall and shear wall.To analyse the Response of the wall after cracking due to diaphragm flexibility

II. LITERATURE REVIEW

2.1 General

The commonly used equivalent lateral force (ELF) procedure in the current building code represents a seismic response based on a classical model that is quite different from the actual seismic behavior of low-rise buildings with large flexible roof diaphragms supported laterally by rigid walls or stiff frames. The past seismic performance of these rigid wall-flexible roof diaphragm (RWFD) buildings has been troublesome, and the code requirements for these buildings have evolved mostly as reactions to observed damage with little consideration of how these buildings respond differently to earthquakes than multi-story buildings or one-story buildings with rigid diaphragms. These buildings have diaphragms that dominate the building behavior; yet due to their complex inelastic response, past attempts in accurate modeling have typically been time consuming and elusive. With a numerical modeling framework developed specifically for this building type and that balances numerical efficiency and accuracy, the development of new seismic design methodologies for RWFD buildings may be possible to provide a more rational design approach that is still simple to apply.

The simplistic model assumed by the ELF procedure fails to capture the actual behavior of RWFD buildings. The ELF procedure assumes that the seismic response consists primarily of deforming vertical elements and that the horizontal diaphragm is rigid, i.e. deformation of the diaphragm is not considered. However, for most RWFD structures the primary seismic response is governed by the deformation of the horizontal flexible diaphragm instead of the rigid vertical walls. A more accurate structural model would need to capture the flexible diaphragm dominating the response. Because RWFD buildings typically have excessive strength in the shear walls as compared with the diaphragm, it can be unrealistic to expect (or require) the failure mode to be in the walls instead of the diaphragm; despite the fact that the response modification factor R is selected based on that assumption. Past failures have typically included out-of-plane wall detachments. However, as that failure mode becomes more under control, it is expected that diaphragm damage will be the next dominant form of inelastic behavior, which cannot be captured by the current ELF procedure.

NemaliDeepika, K.SaiSanthosh(2019),Building structures are typically composed of horizontal spanning elements, such as beams and floor and roof decks; vertical elements, such as columns and walls; and foundation elements. Together these elements comprise an integral system that resists both vertical and lateral loads. Seismic design of building systems entails controlling the building displacements, typically by providing resistance to the inertial forces generated by the acceleration of the building mass. Often the great majority of the load is derived from the mass of the roof and floor systems themselves, and resistance is composed of a continuous lateral load path from these spanning elements to vertical elements that have lateral resistance (e.g., walls, braced frames, moment frames), which in turn deliver the forces to the foundation. Diaphragms serve multiple roles to resist gravity and lateral forces in buildings. The floor system commonly comprises most of the mass of the building. Consequently, significant inertial forces can develop in the plane of the diaphragm. One of the primary roles of the diaphragm in an earthquake is to transfer these lateral inertial forces, including those due to tributary portions of walls and columns, to the vertical elements of the seismic force-resisting system.

S.N Tande, S.A Devarshi,(2018), This dissertation presents work targeted to study the effects of diaphragm flexibility on the seismic performance of light frame wood structures (LFWS). The finite element approach is considered for modeling LFWS as it is more detailed and provides a way to explicitly incorporate individual structural elements and corresponding material properties. It is also suitable for capturing the detailed response of LFWS components and the structure as a whole. The finite element modeling methodology developed herein is in general based on the work done by the other finite element researchers in this area. However, no sub modeling or sub structuring of sub assemblages is performed and instead a detailed model considering almost every connection in the shear walls and diaphragms is developed. The studs, plates, sills, blockings and joists are modeled using linear isotropic three-dimensional frame elements. A linear orthotropic shell element incorporating both membrane and plate behavior is used for the sheathings. The connections are modeled using oriented springs with modified Stewart hysteresis spring stiffnesses

Maria koliou, Dominic J Kelly (2018), Seismic design and assessment of buildings are typically carried out assuming the floor and roof diaphragms to be rigid in their own planes, provided they have adequate in-plane stiffness properties. While the rigid diaphragm assumption is appropriate for many construction types, certain structural systems have deformable diaphragms that render the rigid diaphragm assumption questionable. One particular structural system with pronounced diaphragm flexibility is unreinforced masonry (URM) buildings with the floor and roof diaphragms constructed of timber boards and joists. Due to the limited coupling provided by the flexible diaphragms, can be present even though URM buildings are typically low-rise (of generally up to 5 storeys), and their response characteristics can deviate from those typical of rigid diaphragm structures the inelastic response of buildings with flexible diaphragms has so far received less attention than the elastic response. These effects of diaphragm flexibility were found to reduce with the increase in the level of yielding and the initial period of the system. A similar period-dependent behaviour was also reported by Sadashiva et al. [2012] for symmetric systems. Kim and White [2004] conducted a parametric analysis of a nonlinear model initially calibrated to experimental tests conducted on a single-storey symmetric reinforced masonry building with a timber roof. Their parametric analysis indicated the occurrence of the largest in-plane wall displacement when the diaphragm was neither absolutely rigid nor completely flexible.

Bruno Dal Lago, Silvia Bianchi(2017), The flexibility of floor diaphragms has a significant influence on the behavior of building structures. Commonly, in analyzing structures, floor diaphragms are considered rigid. This assumption distributes lateral loads between the resistant elements according to their rigidities, and decreases the degree of freedom that creates easier analysis. However, in steel structures with braced frames and long span floors, diaphragms usually behave flexibly. The seismic responses of such structures vary to the expected response of typical rigid floor structures. Ignoring the effects of diaphragm flexibility can lead to non-economic or unsafe structural design. In this paper, the nonlinear responses of braced steel buildings with flexible concrete block-joist floor diaphragms are investigated under both static lateral load and dynamic ground motion, and they are compared with the responses of structures with the assumption of rigid diaphragms. This study demonstrates that span ratio is an important parameter in the flexibility of floor diaphragms, and if this ratio exceeds three, the variation of results between the two assumptions of flexible and rigid diaphragms may not be ignored. In addition, results show that diaphragm flexibility changes the seismic response of the structures and linear analysis is not sufficient to explain this behavior

Richard Sauce, Robert.B(2015), For RC building Frame which composed of columns, beams and slabs the flexural stiffness of slabs is generally ignored in the conventional analysis. However, in reality, the floor slabs may have some influence on the lateral response of the structures. Consequently, .The diaphragm of a structure often does double duty as the floor system or roof system in a building, or the deck of a bridge, which simultaneously supports gravity loads. Diaphragms are usually constructed of plywood or oriented strand board in timber construction; metal deck or composite metal deck in steel construction; or a concrete slab in concrete construction. The diaphragms are classified as flexible diaphragm or a rigid diaphragm. Flexible diaphragms resist lateral forces depending on the tributary area, irrespective of the flexibility of the members that they are transferring force to. On the other hand, rigid diaphragms transfer load to frames or shear walls depending on their flexibility and their location in the structure. The flexibility of a diaphragm affects the distribution of lateral forces to the vertical components of the lateral force resisting elements in a structure. At the time of design of RC buildings this floor diaphragm is typically modeled as rigid floor diaphragm. This is due to general provisions made in many seismic design codes that floor serve as rigid floor diaphragm and undergoes no deformation in its own plane. It is thus, of the at most importance, that they must be provided with sufficient in-plane stiffness and strength, together with efficient connections to the vertical structural elements.

III. OBJECTIVES

The objectives of the present study are:

- To investigate the effect of diaphragm flexibility on precast wall panelled building
- To study the effect of diaphragm discontinuity on precast wall panels
- To study on in-plane demands in wall panel like principle stresses and inertia forces
- To study the distribution of wall reactions considering diaphragm flexibility
- To study the effect of diaphragm flexibility on cracking of precast wall panels

IV. METHODOLOGY

- Studying the literature reviews for understanding the concept
- Choosing the software and its validation
- Assigning the material properties and modelling the five storey building with diaphragm action
- Analysis of proposed model based on their:
- Response spectrum analysis of concerned model
- Analysis of in plane stresses and forces in x and y directions
- Analysis of in plane axial force and torsion in x and y direction
- Observation of results and discussions

V. VALIDATION

5.1 General

Software validation is a process of evaluating software product ,so as to ensure that the software meets the predefined and specified business requirements as well as the end users demand and expectations.it is also defined as the process of checking or proving the validity or accuracy of something. A five storey building is selected for software validation and modal analysis is done to find out the mode shape

Fundamental Time period, T

$=0.09 \times h \times \sqrt{D}$

$=0.09 \times 15 \times \sqrt{24}$

$=0.275$ sec

Where

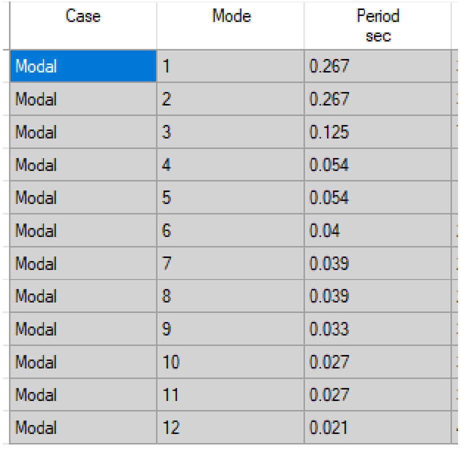
h = height of the building

D = dimension of the building plan

% error = 2.9% < 5%

Hence Software validated

Table 5.1: Fundamental time period



Case	Mode	Period sec
Modal	1	0.267
Modal	2	0.267
Modal	3	0.125
Modal	4	0.054
Modal	5	0.054
Modal	6	0.04
Modal	7	0.039
Modal	8	0.039
Modal	9	0.033
Modal	10	0.027
Modal	11	0.027
Modal	12	0.021

VI. MODELLING

An M30 grade Concrete is provided for the design mix and Fe500 grade steel is also provided then the Beam Size is 230x350 and the Column Size is 350x350.The Slab thickness is considered as 120mm and the Precast wall thickness is considering 230mm then the no. of floors is taken as 5 nos the overall Storey Height is 3m.The Floor Plan is 24m x 24m.Diaphragm with Discontinuity Dead Loads Floor Finish is 1kN/m^2 (IS 875 part 1)Live Loads of Residential Building is 2kN/m^2 (IS 875 part 2) and the Earthquake load for zone 3 (IS 1893, part 1)

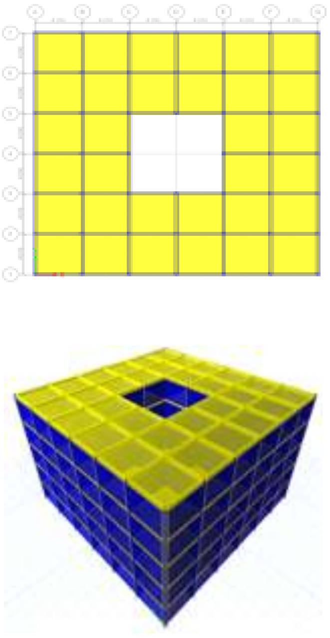


Figure 6.1: Diaphragm discontinuity at the centre of the building(M1)

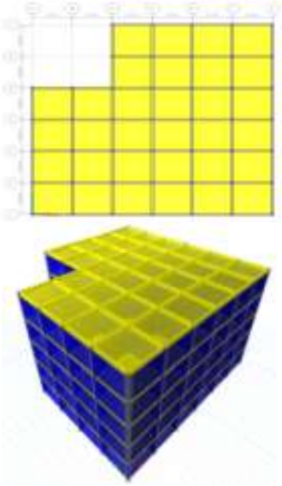


Figure 6.2: Diaphragm discontinuity at the edge of the building(M6)

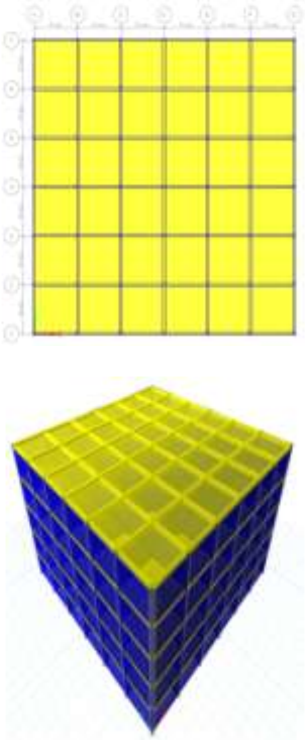


Figure 6.3: Building model without discontinuity(M0)

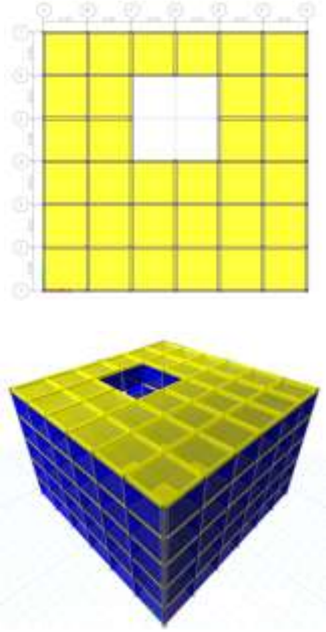


Figure 6.4: Discontinuity of the building not at the exact centre(M2)

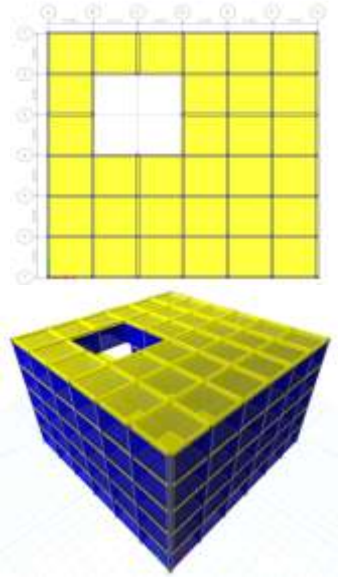


Figure 6.5: Discontinuity of the building not exact at the centre(M3)

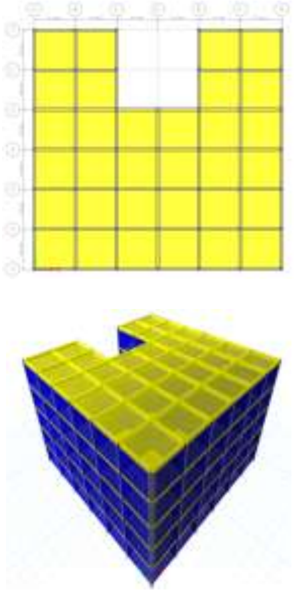


Figure 6.6: discontinuity at outer edge of the building(M5)

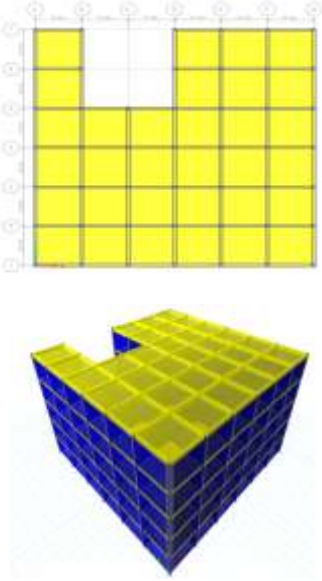


Figure 6.7: Discontinuity at the outer edge of opposite side of the building(M4)

Pier labels are applied to the normal concrete walls to convert it to precast wall. In order to take the handling loads of the crane, precast walls are modelled as shell elements

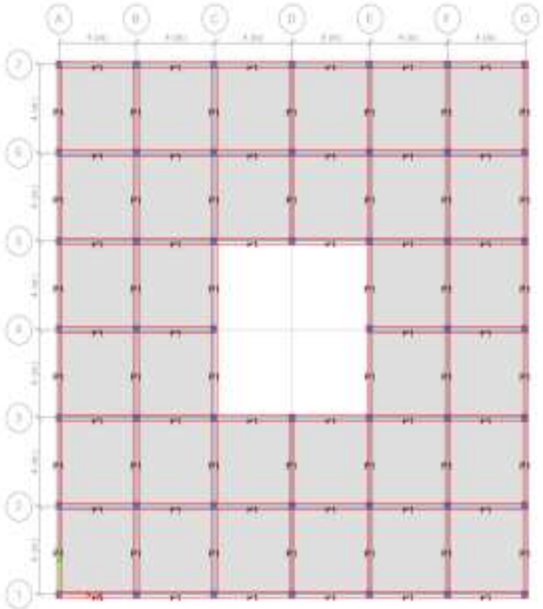


Figure 6.8: Arrangement of pier labels at the centre discontinuity building

Diaphragm's are applied on every floors to compute diaphragm flexibility

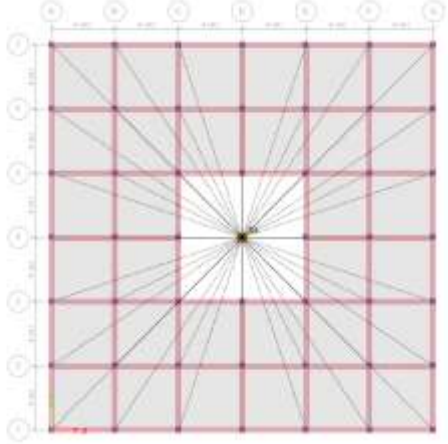


Figure 6.9: Diaphragm action of a building at centre discontinuity

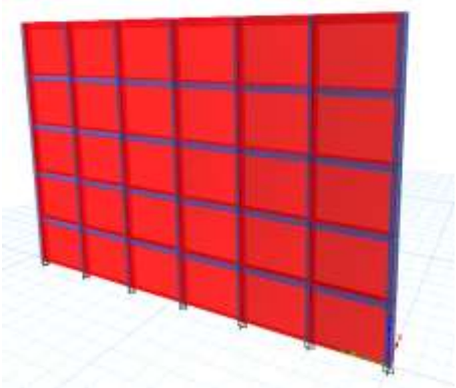


Figure 6.10: Model of a shear wall

Shear walls are modelled as shell thin members to carryloads.Grid of beams and columns is provided to resist strong earthquake effects Pier label is assigned to the wall to convert it to precast wall

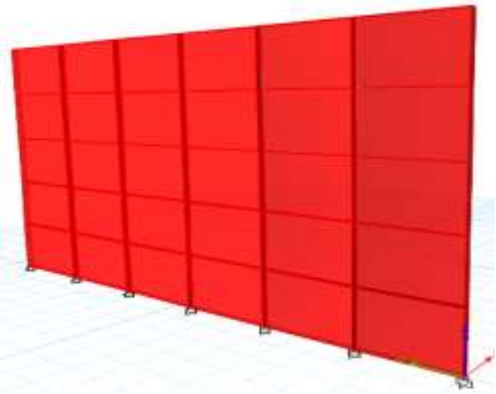


Figure 6.11: Model of a load bearing wall

Load Bearing walls are modelled as shell thin members to carry loads.Pier label is assigned to the wall to convert it to precast wall.Beams and columns are not provided.It is suitable only for low rise buildings

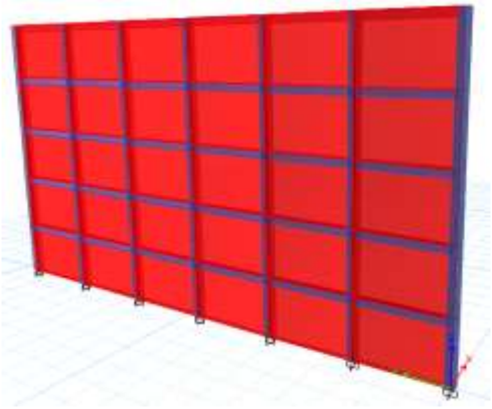


Figure 6.13: Model of a cladding panel

Cladding Panels are modelled as membranes as it doesn't carry loads.Pier label is assigned to the wall to convert it to precast wall.These walls are otherwise called infill walls because it just act as an infill between beam and column

VII. ANALYSIS

7.1 General

The five storey building is analysed with different diaphragm discontinuities and connecting each diaphragm flexibilities with different walls like cladding panel, load bearing wall and shear wall. The response spectrum analysis should be done for the response of the building in shear stress, axial force and torque acting on that building. The magnitude of these properties should be evaluate from the ETABS

7.1 ANALYSIS OF DIAPHRAGM FLEXIBILITY ON PRECAST WALL PANELS

7.1.1 Wall panel in-plane stresses in x- direction

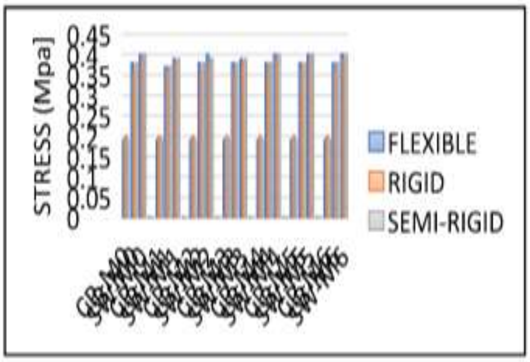


Figure 7.1: Comparison of diaphragm flexibilities connected to cladding panel in x- direction

Inplane horizontal stresses in wall panels are irrespective of diaphragm discontinuity. The in-plane stress on cladding panel is 50% less than load bearing wall. The in-plane stress on shear wall is 5% more than load bearing wall. Flexible and semi-rigid diaphragm induce almost same in-plane horizontal stress to the wall. The in-plane stress on cladding wall with rigid diaphragm is 5% more than the wall under flexible and semi-rigid diaphragm. The in-plane stress on load bearing wall with rigid diaphragm is 6% less than the wall under flexible and semi-rigid diaphragm. The in-plane stress on shear wall with rigid diaphragm is 3% less than the wall under flexible and semi-rigid diaphragm

7.1.2 Wall panel in-plane stresses in Y- direction

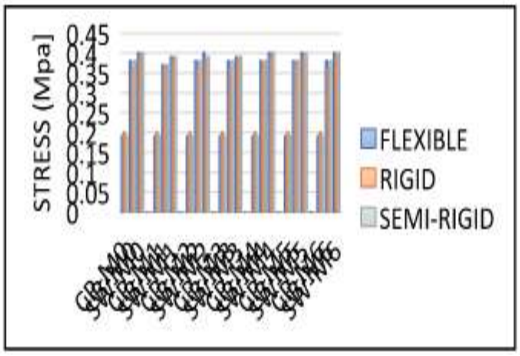


Figure 7.2: Comparison of diaphragm flexibilities connected to cladding panel in y- direction

Inplane vertical stresses in wall panels are irrespective of diaphragm discontinuity. The in-plane stress on cladding panel is 48% less than load bearing wall. The in-plane stress on shear wall and load bearing wall are almost same. Flexible and semi-rigid diaphragm induce almost same in-plane vertical stress to the wall. The in-plane stress on cladding wall with rigid diaphragm is 9% less than the wall under flexible and semi-rigid diaphragm. The in-plane stress on load bearing wall with rigid diaphragm is 10% less than the wall under flexible and semi-rigid diaphragm. The in-plane stress on shear wall with rigid diaphragm is 8% less than the wall under flexible and semi-rigid diaphragm

7.1.3 Bending moment of wall panels

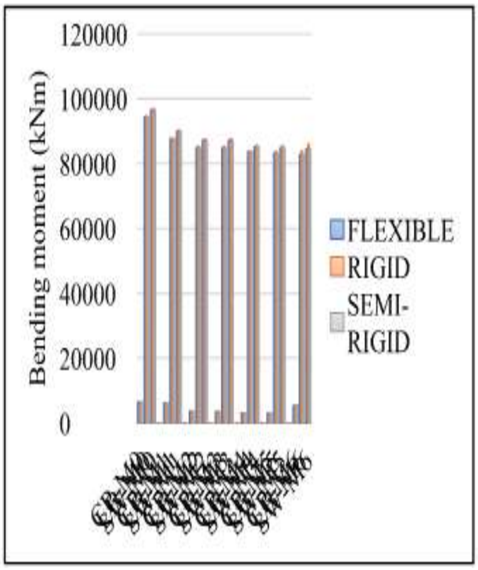


Figure 7.3: Comparison of diaphragm flexibilities connecting to load bearing wall

Bending moment get reduced when diaphragm discontinuity is provided. It is almost 4.5% to 50% depends on the location of discontinuity. Bending moment is almost irrespective of diaphragm flexibility. The Bending moment on cladding panel is 96% less than load bearing wall. The Bending moment on shear wall is only 2% more than load bearing wall

7.1.4 Shear force of wall panels

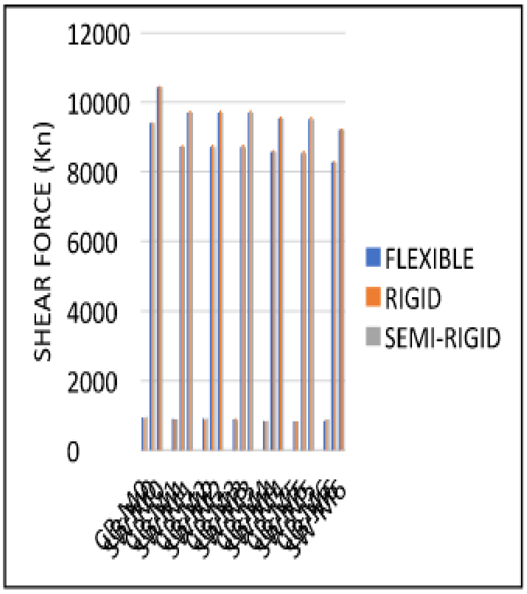


Figure 7.4: Comparison of diaphragm flexibilities connecting to load bearing wall

Shear Force get reduced when diaphragm discontinuity is provided.t is almost 2.5% to 12% depends on the location of discontinuity. Shear Force is almost irrespective of diaphragm flexibility. The Shear Force on cladding panel is 90% less than load bearing wall. The Shear Force on shear wall is 10% more than load bearing wall.

7.1.5 Torsion and axial force of a wall panel

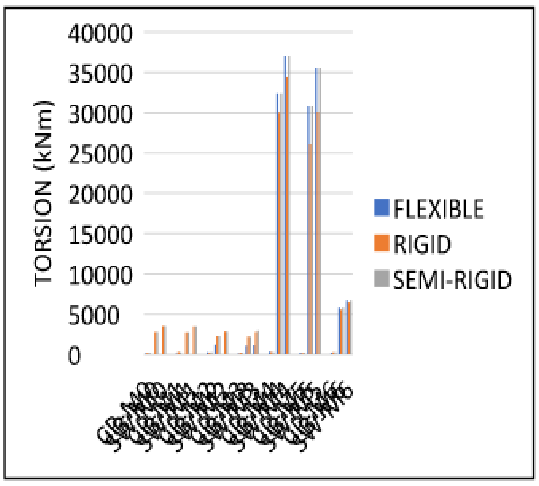


Figure 7.5: comparison of diaphragm flexibilities connecting to shear wall

Torsion on wall panel is very much depended on diaphragm discontinuity. Discontinuity at the edges or sides of the diaphragm induces large amount of torsion on wall panel. Discontinuity at the inner portions of the diaphragm induces torsion only on load bearing and shear walls mostly under rigid and semi-rigid diaphragms. For cladding panels, wall panel torsion is negligible. For models with diaphragm discontinuity at edges or sides induces torsion on cladding panel 99% more than load bearing wall. For models with diaphragm discontinuity at edges or sides induces torsion on shear wall 13% more than load bearing wall

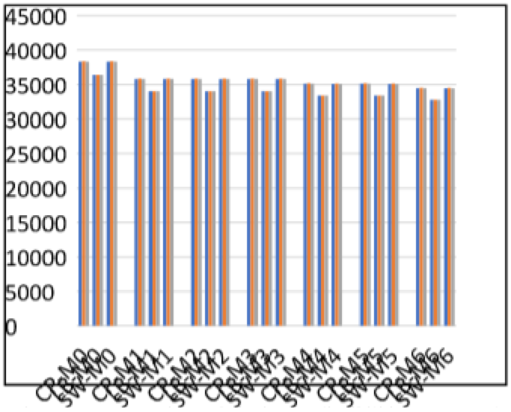


Figure 7.6: comparison of diaphragm flexibilities connected to shear wall

Axial Force get reduced when diaphragm discontinuity is provided. It is almost 6.5% to10% depends on the location of discontinuity. Axial Force is irrespective of diaphragm flexibility. Axial Force is almost same for cladding and shear wall. Axial Force on cladding panel and shear wall is only 5% more than load bearing wall

VIII. CONCLUSION

The rigid diaphragms connected with Cladding Panel, Load Bearing Wall and Shear wall, totally encountered a reduction in in-plane stresses with a range of **5%-33%**, **6%-33%** and **3%-8%** respectively, than semi-rigid and flexible diaphragm

In-plane stresses are maximum along Y direction (**4.75%** higher than X direction) indicating the effectiveness in diaphragm action.The symmetrical aspect in discontinuity had shown the effect on stress and force concentration on wall panels. The magnitude of In-plane stresses and forces in both X and Y direction is topmost for **M4**, **M5** and **M6**.The variation of stresses and forces with position at center region (**M1**, **M2** and **M3**) is very moderate when compared with that at edge, Therefore, the alignment for diaphragm for the central design is not as critical as that for an edge design .Shear always attained its peak value in **M0**, **M1** and **M2**, disclosing the fact that shear tends to concentrate mainly at the centre discontinuities than at the edge

The discontinuity had no major impact on Cladding Panels, as the overall stresses experienced on Cladding Panel is almost half of that experienced for Load Bearing Walls Shear Wall met up with comparatively more in-plane stresses, bending moment and out-plane stresses exceeding Load Bearing Wall with a range of **2%-10%**Load Bearing Wall is subjected to comparatively less axial force than Cladding Panel and Shear Wall Torsion is induced in a greater proportion on the Load Bearing Wall and Shear Wall The extreme distinction between the uncracked and cracked status of **Load Bearing Walls**, indicated its **lower stability**

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