International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 02 | Feb 2021 www.irjet.net p-ISSN: 2395-0072

COMPARATIVE STUDY ON SEISMIC INDUCED RESPONSE OF MASONRY INFILLED RC FRAMED BUILDING AND MIVAN BUILDING WITH WALL OPENINGS

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Abstract – *In present world due to globalisation, the construction industry has started updating themselves on new innovative ways of working. It has made embracing new advances. One such quickest strategy for development innovation is Mivan structures. The shortage of accommodation of materials is increasing continuously and situation is rising in urban areas. The severity of the problem is critical in metropolitan areas. For undertaking mass concreting it is necessary to have innovative technologies which are capable of fast rate construction. One such technology is Mivan technology. This technology of using formwork system in high-rise building is crucial factor to success the project on time. So the selecting of suitable formwork system affects the entire construction cost, time and quality of construction of high-rise building. So it is preferable to adopt suitably stiffer or flexible system so that the base shear and the lateral displacements are within the limits.*

Key Words: **Mivan technology, Formwork, High-Rise building, Earthquake,**

1.INTRODUCTION

1.1 General

Masonry infill is a main element for construction of masonry frame buildings. These masonry infills are not taken for the design consideration because they do not transmitt any loads that is acting on the structure due to its less rigidity than RCC frame. It will not take up any kind of lateral loads or axial loads that will be acting on structure, hence for the analysis it is generally not considered.

For the rapid progress of work and to make the concreting work easier framed structures are generally used. Only for functional and for aesthetic appearance the masonry structures are generally used as interior and exterior work. Predictions of the position of the masonry loads are most difficult as its position will be changing as per the functional requirements of the building through its lifespan. So it is hard to predict the masonry loads.

1.2 Infill wall

Infill wall is a 3D framed structure used as supported wall to increase the structure lateral stability.The contribution of stiffness from the infill is ignored as infill is a non-structural elements and stiffness is very low. The infill wall also helps to resist lateral load.

Types of infill framed wall

The different types of infill framed wall as follows.

- Infill walls with light steel framed structure
- Infill walls with light steel separating framed structure
- Infill wall with masonry framed structure
- Infill wall with concrete framed structure
- Infill wall with timber framed structure

1.2 Mivan technology

In short time the projects need to be completed quickly and easily. For this, Mivan technology is one of the kind.

In the year 1990's Mivan was developed at Malaysia. For the construction of mass project using repetitive formwork leads to increase in cost, therefore for the cost effective purpose Mivan technology is developed. Mivan gives more productivity, maintenance, quality when used with good materials and proper machineries. Here the formwork is made by aluminium which gives smooth finished surface and fast construction because here slab, column & beams are casted monolithically. These aluminium formworks are very light and repeat up to 250 times.

This idea was generated by Mivan company ltd. The aluminium form work was produced by this company hence the name mivan technology.

General specifications and components of Mivan

The basic elements used in Mivan formwork are the sets of panels, which are shear rail section of extruded aluminium, fully welded to an aluminium metal sheet. These panels are very light in weight with stiffness to weight ratio that is acceptable and also yields minimum deflection under whole loading. These panels manufactured in a particular size and shape to suit the overall requirements of specific types of project. Following is the some of the components that are generally used in construction projects.

1. For Beam components
2. For Wall components
3. For Deck components
4. For Miscellaneous components.

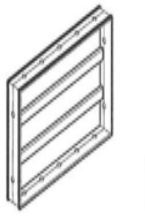


Plate 1.5.1- Wall panel

Plate 1.5.1- Deck panel

Plate 1.5.1-Beam side panel & prop head

2. METHODOLOGY

1. Modellingof 20storey RC Framed Masonry infilled structure with 20 % opening.
2. Modelling of 20 storey RC Framed Masonry infilled structure with 35 % opening
3. Modelling of 20 storey RC Framed Masonry infilled structure with 50 % opening
4. Modelling of 20 storey Mivan structure with 20 % opening
5. Modelling of 20 storey Mivan structure with 35% opening.
6. Modelling of 20 storey Mivan structure with 50 % opening.
7. Comparisons of the results obtained from both RC Framed infilled structure and Mivan structure.
8. Conclusions are drawn.

1 Modelling

Structure modelling is a step that involved the age group and organization of demonstrating fleshly and use full features of a structure. Modelling is the finest method to assessment the expected presentation of a building which is calculated at a first step of expansion without making for a full mounted example. Modelsare similar example which can be different, substituted or removed to maintenance policy making about a building or extra erected structure.

Material Properties of M30

Properties	Values
Concrete compressive strength	30Mpa
Modulus of Elasticity	27386.13Mpa
Poisson's ratio	0.2
Mass per unit volume	2548.538kg/m^3
Weight per unit volume	24.9926 kg/m^3

Material Properties HYSD500

Properties	Values
Modulus of Elastic	200000Mpa
Mass per unit volume	7849.047 kg/m^3
Weight per unit volume	76.972kN/m^3
Minimum tensile strength	545Mpa
Minimum yield strength	500Mpa

Material Properties of Masonry

Properties	Values
Weight per unit Volume	21.068KN/m^3
Mass per unit Volume	2162.493Kg/m^3
Modulus of Elasticity	14000Mpa
Poisson's ratio	0.2
Compressive strength	13.79Mpa

Type of Building	Structural elements	Section Properties(mm)
For 20 Storey RC Framed masonry infilled Structure	Column	700X700
	Beam	300X400
	Slab	200
	Masonry Wall	250
For 20 storey Mivan Building	Mivan Wall	250
	Slab	200

3.6 LOADS

3.6.1 Dead Loads

These are lifelong loads that doing on a structure. They determined by the material description recycled for not the same structural components. The documents and the properties of different materials used for structural components are given in IS 875-1987(part 1)

3.6.2 Live Load

These loads are not forever performing on the building and it rest on usage and tenancy of the building. The Live load is taken to various usage in IS 875-1987(part2).Live load considered for this modelling 3KN/m^{2}for all storeys.

3.6.3 Earthquake Loads

These are the adjacent live loads considered for reading. Here the load of more developments and of uncertantity.Commonly these loads are not in act. The code reflected for orientation is IS 1893-2002(Part 1),

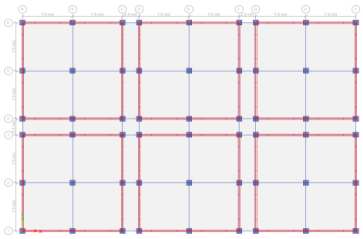


Fig3.0: Plan of the RC Framed Masonry infill structure

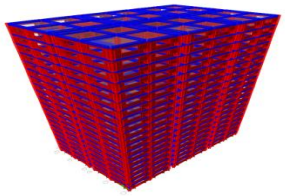


Fig 3.1: 3 D View of the RC Framed Masonry infill structure 20 % opening

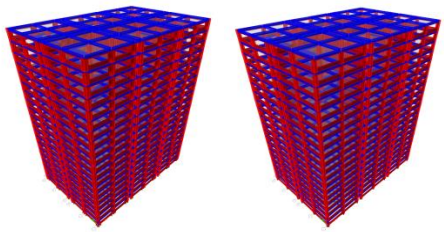


Fig 3.2: 3D View of the RC Framed Masonry infill structure 35 % and 50% opening

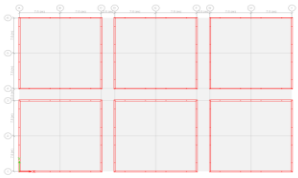


Fig 3.4: Plan of mivan structure

Fig 3.5: 3D View of mivan structure with 20 % opening

Fig 3.6: 3D View of mivan structure with 35 % and 50 % opening

RESUTS AND DISCUSSIONS

Storey displacement

MODEL	Storey Displacement,EQX		
	20%	35%	50%
RC Framed masonry infilled structure	22.8	25.9283	30.43464
Mivan building	19.758	23.3892	27.9224

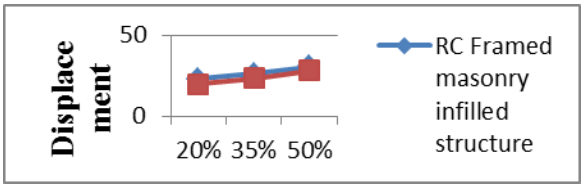


Fig 4.0: Storey Displacement (mm) (EQX) of 20 Storey building

The Storey displacement of Mivan building is increased by 18.37% & 41.32% for 35 % opening & 50 % opening for 20 storey respectively in comparison with 20% opening

The Storey displacement of RC Framed masonry infilled structure is increased by 13.32% & 33.01% for 35 % opening & 50 % opening for 20 storeys respectively in comparison with 20% opening

Table 4.8: Storey Displacement (mm) (EQY) of 20 Storey building

Model	Storey Displacement, EQY		
	20%	35%	50%
RC Framed masonry infilled structure	25.33	29.0037	34.18474
Mivan Building	21.674	25.5038	30.26535

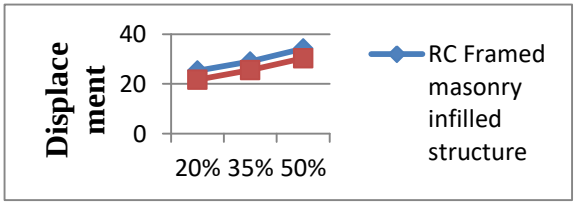


Fig 4.1: Storey Displacement (mm) (EQY) of 20 Storey building

The Storey displacement of Mivan building is increased by 17.67% &39.63% for 35 % opening & 50 % opening for 20 storey respectively in comparison with 20% opening

The Storey displacement of RC Framed masonry infilled structure is increased by 14.50% &34.95% for 35 % opening & 50 % opening for 20 storey respectively in comparison with 20% opening

Table 4.17: Storey Drift (EQX) of 20 Storey building

Model	Storey Drift, EQX		
	20%	35%	50%
RC Framed masonry infilled structure	0.000038	0.000404	0.000435
Mivan Building	0.000341	0.00037	0.000401

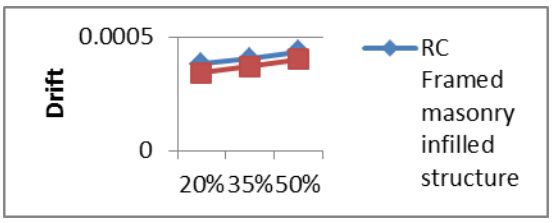


Table 4.4: Storey Drift (EQX) of 20 Storey building

The Storey Drift of Mivan building is increased by 8.5% &17.5% for 35 % opening & 50 % opening for 20 storey respectively in comparison with 20% opening

The Storey Drift of RC Framed masonry infilled structure is increased by 6.3% &14.47% for 35 % opening & 50 % opening for 20 storey respectively in comparison with 20% opening.

Table 4.18: Storey Drift (EQY) of 20 Storey

Model	Storey Drift, EQY		
	20%	35%	50%
RC Framed masonry infilled structure	0.000434	0.000457	0.000486
Mivan Building	0.000379	0.000407	0.000437

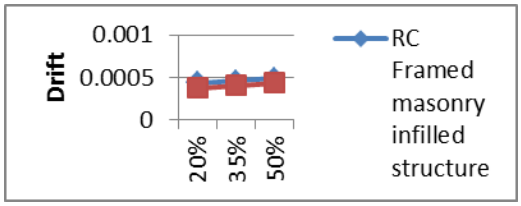


Fig 4.5: Storey Drift (EQY) of 20 Storey building

The Storey Drift of Mivan building is increased by 7.38% &15.38% for 35 % opening & 50 % opening for 20 storeys respectively in comparison with 20% opening

The Storey Drift of RC Framed masonry infilled structure is increased by 5.2% &11.98% for 35 % opening & 50 % opening for 20 storeys respectively in comparison with 20% opening

Table 4.27: Storey Shear (EQX) of 20 Storey building

Model	Storey Shear, EQX		
	20%	35%	50%
RC Framed masonry infilled structure	36928	31899.61	27840.5
Mivan Building	39913.53	35255.62	31141.29

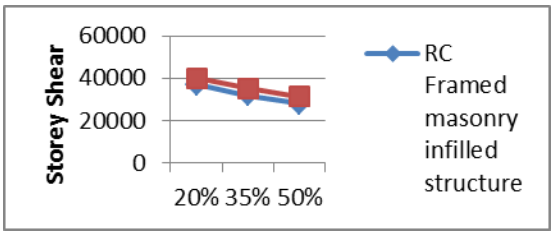


Fig4.8: Storey Shear (EQX) of 20 Storey building

The Storey Shear of Mivan building is decreased by 11.67% &21.97% for 35 % opening & 50 % opening for 20 storeys respectively in comparison with 20% opening

The Storey Shear of RC Framed masonry infilled structure is decreased by 13.61% &24.6% for 35 % opening & 50 % opening for 20 storeys respectively in comparison with 20% opening

Table 4.28: Storey Shear (EQY) of 20 Storey building

Model	Storey Shear EQY		
	20%	35%	50%
RC Framed masonry infilled structure	33598	28813.5	24998.6
Mivan Building	37180.04	32629.2	28635.39

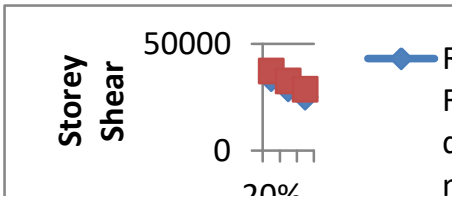


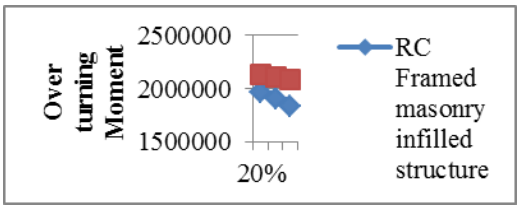
Fig4.9: Storey Shear (EQY) of 20 Storey building

The Storey Shear of Mivan building is decreased by 12.21% &22.98% for 35 % opening & 50 % opening for 20 storeys respectively in comparison with 20% opening

The Storey Shear of RC Framed masonry infilled structure is decreased by 14.24% &25.5% for 35 % opening & 50 % opening for 20 storeys respectively in comparison with 20% opening

Table 4.37: Overturning Moment (EQX) of 20 Storey building

Model	Overturning moment, EQX		
	20%	35%	50%
RC Framed masonry infilled structure	1969217	1909944	1833935
Mivan Building	2127655	2106166	2084893



The Overturning Moment of Mivan building is decreased by 1% &2% for 35 % opening & 50 % opening for 20 storeys respectively in comparison with 20% opening

The Overturning Moment of RC Framed masonry infilled structure is decreased by 3 % &6.86 % for 35% opening & 50 % opening for 20 storeys respectively in comparison with 20% opening

Table 4.38: Overturning Moment (EQY) of 20 Storey building

Model	Overturning moment, EQY		
	20%	35%	50%
RC Framed masonry infilled structure	1791651	1707981	1645298
Mivan Building	1981942	1929024	1877519

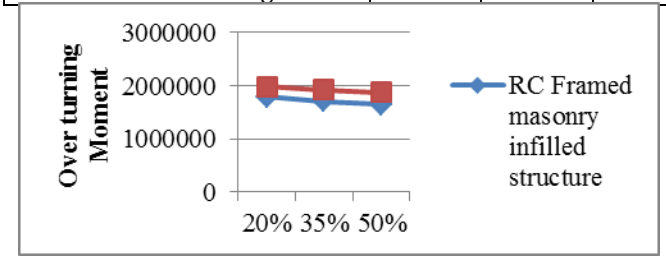


Fig 4.13: Overturning Moment (EQY) of 20 Storey building

The Overturning Moment of Mivan building is decreased by 2.6% &5.2% for 35 % opening & 50 % opening for 20 storeys respectively in comparison with 20% opening

The Overturning Moment of RC Framed masonry infilled structure is decreased by 4.6% &8.16% for 35 % opening & 50 % opening for 20 storeys respectively in comparison with 20% opening

Table 4.47: Storey Stiffness (EQX) of 20 Storey building

Model	Storey Stiffness, EQX		
	20%	35%	50%
RC Framed masonry infilled structure	100115929	96101280	93208632
Mivan Building	115719785	113393817	111114602

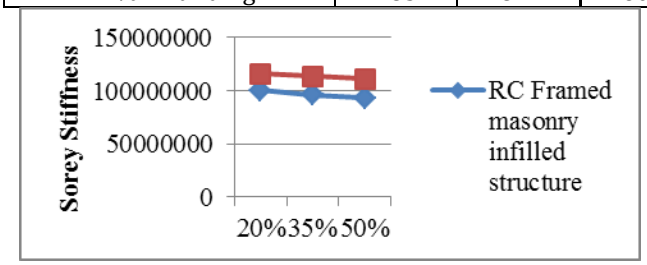


Fig 4.16: Storey Stiffness (EQX) of 20 Storey building

The Storey stiffness of Mivan building is decreased by 2.1% &3.97% for 35 % opening & 50 % opening for 20 storey respectively in comparison with 20% opening

The Storey stiffness of RC Framed masonry infilled structure is decreased by 4.01% &6.89% for 35 % opening & 50 % opening for 20 storey respectively in comparison with 20% opening

Table 4.48: Storey Stiffness (EQY) of 20 Storey building

Model	Storey Stiffness, EQY		
	20%	35%	50%
RC Framed masonry infilled structure	92839759	87575744	83485957
Mivan Building	111922605	107815043	103858230

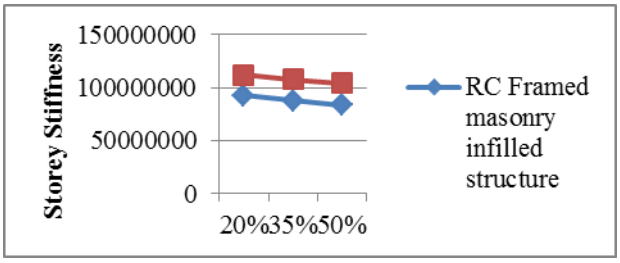


Fig 4.17: Storey Stiffness (EQY) of 20 Storey building

The Storey stiffness of Mivan building is decreased by 3.67% &7.2% for 35 % opening & 50 % opening for 20 storeys respectively in comparison with 20% opening

The Storey stiffness of RC Framed masonry infilled structure is decreased by 5.67% &10.07% for 35 % opening & 50 % opening for 20 storeys respectively in comparison with 20% opening

3. CONCLUSIONS

1. The storey displacement of Mivan structure is increased by maximum amount of 41.32% in static analysis& 45.85%in dynamic analysis of 50% openingwhen compared with 20% opening of mivan structure.

   In general mivan structure has less displacement when compared with RC frame structure.
2. Thestorey drift of Mivan structure is increased by maximum amount of 17.5% in static analysis & 21.4%in dynamic analysis of 50% openingwhen compared with 20% opening of mivan structure.

   In general mivan structure has less Storey drift when compared with RC frame structure.
3. Thestorey shear of Mivan structure is decreased by maximum amount of 22.98% in static analysis & in dynamic analysis of 50% openingwhen compared with 20% opening of mivan structure.

In general mivan structure has more Storey shear when compared with RC frame structure.

4. Thestorey overturning moment of Mivan structure is decreased by maximum amount of 5.2% in static analysis & 11.22% in dynamic analysis of 50% openingwhen compared with 20% opening of mivan structure.

   In general mivan structure has more Storey overturning moment when compared with RC frame structure.

5. Thestorey stiffness of Mivan structure is decreased by maximum amount of 7.2% in static analysis &13.10% in dynamic analysis of 50% openingwhen compared with 20% opening of mivan structure.

   In general mivan structure has more Storey stiffness when compared with RC frame structure.

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