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Dynamic Analysis of Regular and Irregular RC Building with Dampers and Bracings

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Abstract-*The present work focused on Dynamic Analysis of Regular and Irregular RC Building with Bracings and Dampers. A G+24 storey building Regular and Irregular RC Building consider as per 1893 (part-I) :2002 seismic zones II and V and soil type (II).Response spectrum analysis of has been carried out on Regular RC Building 12 individual models and Irregular RC Building 18 individual models. Results are considered time period base shear and storey displacement.*

Regular RC Building: *consider X- bracing 3% reducing time period than diagonal bracing, bracing+ dampers 25%, middle dampers 14% reducing time period than corner dampers, Because in that systems stiffness is good. Building with X- bracing base shear is 7% more than building with diagonal bracing. Building with middle dampers 6% more and building with bracing + dampers 11% more than building with corner dampers, base shear is maximum in building with bracing + dampers. Lateral storey displacement results consider X- bracing displacement 3% reducing storey displacement than diagonal bracing, therefore X-bracing performance well. Middle dampers displacement reducing 14% than corner dampers, middle dampers performance well*

Irregular RC Building: *Building with re-entrant corner diagonal bracing time period reducing 7% more than building with diagonal bracing at the corner. Re-entrant corner X- bracing time period reducing 8% more than building with corner X- bracing. Re-entrant corner damper 13%, corner damper 3%, building with bracing + dampers time period reducing 17%, more than building with middle damper. In this beam slab system base shear comparing to all other models. where building with corner diagonal bracing base shear increasing 13%, building with re-entrant corner diagonal bracing 12.5%, building with corner X- bracing 17%, building with re-entrant corner X-bracing 18%, building with re-entrant corner dampers 30%, building with corner dampers 13.5%, building with middle dampers 22%, building with bracing + dampers 33.5. Storey displacement reducing result consider plus building comparing and re-entrant corner diagonal bracing 7% more than corner diagonal bracing. Storey displacement reducing result consider re-entrant corner X-bracing 16% more than corner X- bracing. Storey displacement results consider comparing re-entrant corner dampers10.5%, corner dampers 6% more than middle dampers.*

Key words: *re-entrant corner diagonal bracing*, middle dampers, X-bracing, corner dampers, time period, base shear, storey displacement.

1. INTRODUCTION

Dynamic analysis is also consist to the pseudo force increased by a structure associated by a Dynamic load applied instantly e.g. wind, earthquake and blast. A disruptive distress unexpected movement of the earth tectonic plate vibrate the ground, this cause harm to structures such as building. This activity called earthquake. Method of earthquake resistance building using many technic like bracing system, damper system and base isolation etc. There are many types of bracing are there but in this project using diagonal and X-bracing. In this project to find out which bracing is performance good for building and irregular building providing bracing in a different location in that to find out which location performance less displacement and more effectively resist the lateral force against different loads. In this thesis using fluid viscous dampers dynamic energy of earthquake is transferred into heat which is dissipated in the oil. Regular and irregular building using viscous dampers to find out the location of good performance in dampers building.

1.1 REGULAR RC BUILDING:

To perform well in an earthquake, a building should possess four main attributes, namely simple and regular configuration and adequate lateral strength, stiffness and ductility. Building having simple regular geometry and uniformly distributed mass and stiffness in a plan as well as in elevation.

1.2 IRREGULAR RC BUILDING:

Irregularities types are plan and vertical Irregularity, plan Irregularities types are non-parallel, re- entrant corners, torsion Irregularity, and diaphragm discontinuity. In these types consider this project re-entrant corners type, Plus-shape is the most common irregular structures plan wise. This type lateral force resisting of these corners are called re- entrant corners.

1.3 BRACING:

By the addition of bracing systems, load will be transferred out of the frame and passes on to the braces, by passing weak columns while increasing strength.

MATERIAL USED IN BRACES

RCC bracing: In this type of brace using RCC material and these braces working like a RCC beam or column. These braces capably resist load in compression side. Once its earthquake causes cannot use it's again because heavy damaged.

Steel bracing: In this type of bracing commonly used in construction due to its advantages is after causing earthquake it can be reuse. Many type of steel bracing available in marketing I section, channel section, angle section.

1.4 DAMPERS:

Dampers are the devices which are used to absorb or dissipate the vibration caused by the earthquake to the structure and to increase the damping and stiffness of the structure.

FLUID VISCOUS DAMPER:

A viscous damper has oil inside that allows the damper to reduce shaking. When the piston is pushed the oil (fluid) moves out of the way. This allows the pressure inside to stay the same. Dynamic energy of earthquake is transferred into heat which is dissipated in the oil.

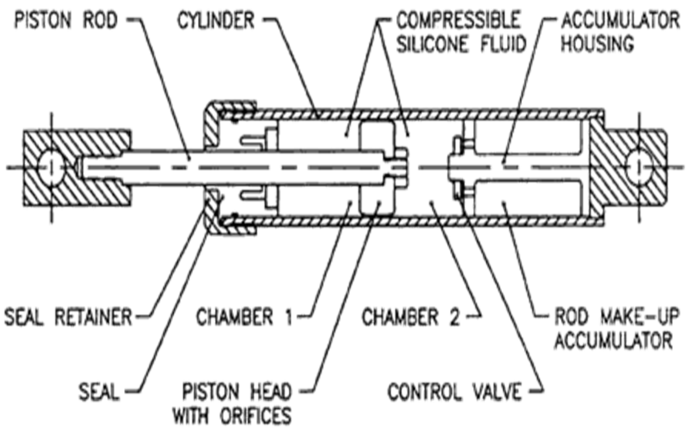

Fig -1: Longitudinal Section of Viscous Damper

2. Analysis of Regular and Irregular Building using different location

2.1 Regular Building:

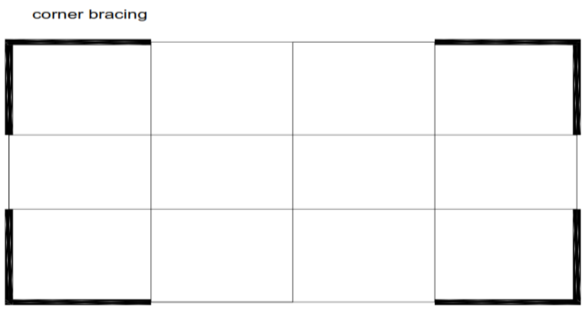

Fig - 2: Building with corner Bracing system

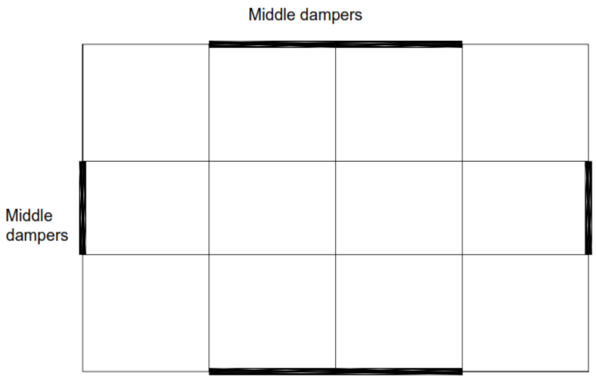

Fig -3: Building with middle damper system

2.2 Irregular Building:

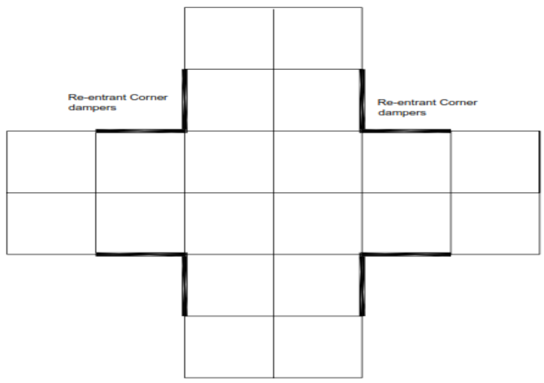

Fig -4: Building with Re-entrant corner damper

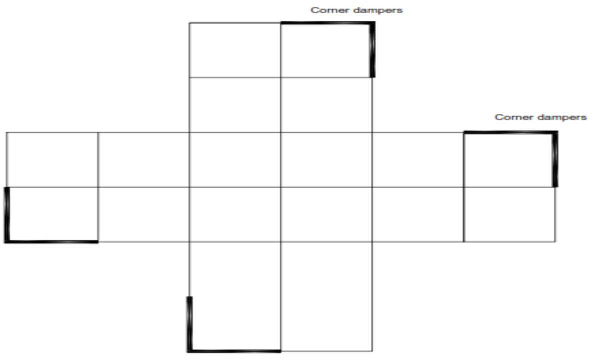

Fig -5: Building with Re-entrant corner damper

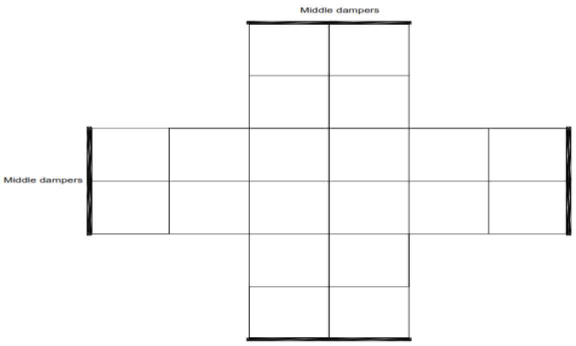

Fig -6: Building with middle damper system

3. Response Spectrum Method

Structure when applying lateral load structure will displace, this displacement structure application of load deflection know as response of the structure. Similarly displacement varying with time will get velocity, velocity varying with time will get acceleration, when structure is loaded it will give three kind of response displacement, velocity and acceleration.

4. OBJECTIVES

1. To conduct dynamic analysis of a regular and irregular reinforced concrete building located in seismic zone II and V.

2. To determine results of time period, base shear and story displacement regular and irregular building with and without viscous dampers.

3. To determine results of time period base shear and story displacement regular and irregular building for different bracing systems.

4. To determine results of base shear and story displacement regular and irregular building for different bracing systems and viscous dampers.

5. MODELLING AND ANALYSIS

5.1 Model Description

Grade of steel Fe 500
Grade of concrete M25
Height between floors 3.0 m
Columns 700x700mm, 500x500mm
Beams 230x600 mm
Concrete Bracings 230x450mm
Slab thickness 150 mm
Seismic zone II & V
Viscous 250KN, 44KG weight
Seismic Intensity (Z) 0.1 & 0.36
Soil Type Medium Soil
Response Reduction R 3
Importance Factor I 1
Total height 76.5m
Regular building area 22x14m
Irregular building area 30x30m

5.2 3D VIEW OF MODELS

REGULAR & IRREGULAR RC BUILDING

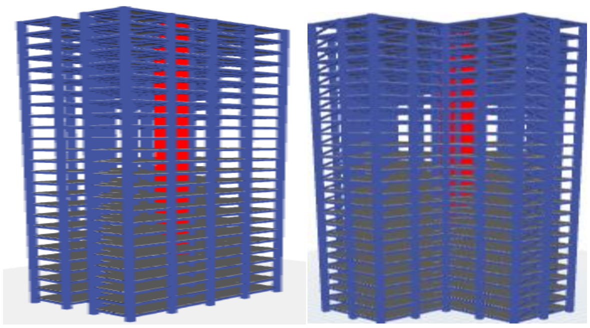

Fig - 7: ETABS model 3-D view of Beam Slab system

6. RESULTS AND DISCUSSION

6.1 REGULAR BUILDING

Different types of models are follows bellow:

Model 1- Beam slab
Model 2- Building with diagonal bracing
Model 3- Building with X- bracing
Model 4- Building with dampers in the middle
Model 5- Building with dampers at the corner
Model 6- Building with dampers + bracing

TIME PERIOD

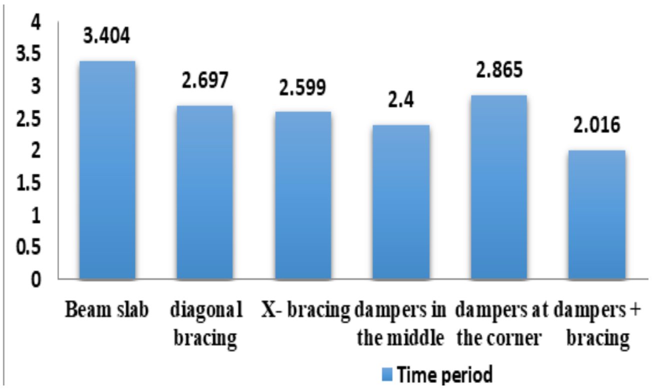

Chart -1: Time period of all structural systems in a second

BASE SHEAR

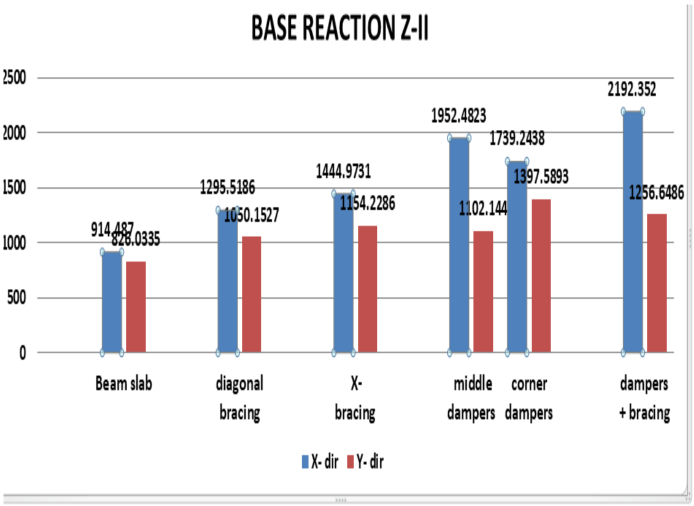

Chart -2: Base Shear of all Systems for different Zone – II in both X and Y direction

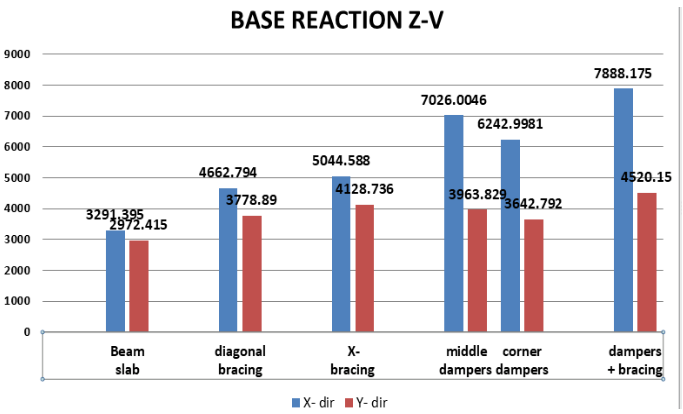

Chart -3: Base Shear of all Systems for different Zone – V in both X and Y direction

MAXIMUM STOREY DISPLACEMENT

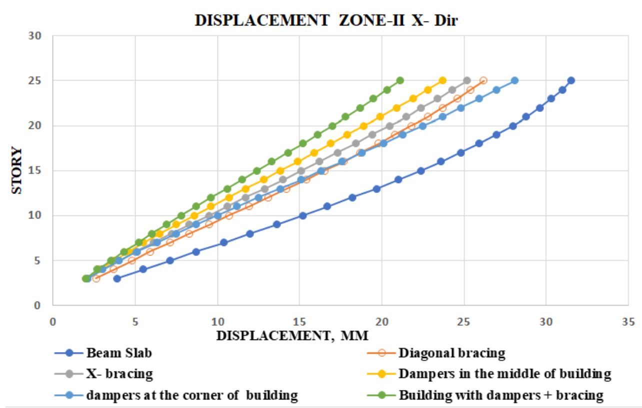

Chart -4: Maximum Storey Displacement in Zone–II for X Direction

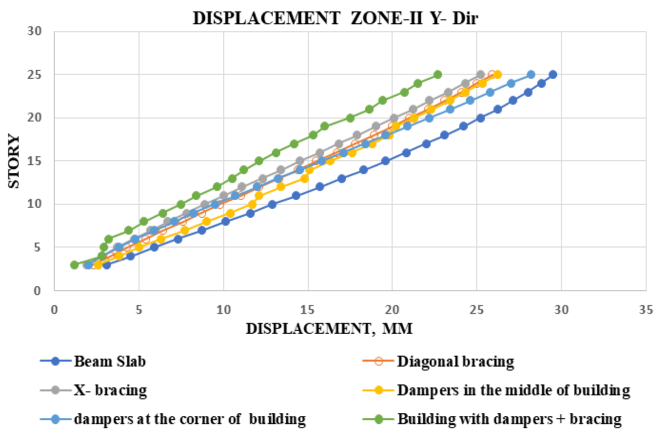

Chart -5: Maximum Storey Displacement in Zone–II for Y Direction

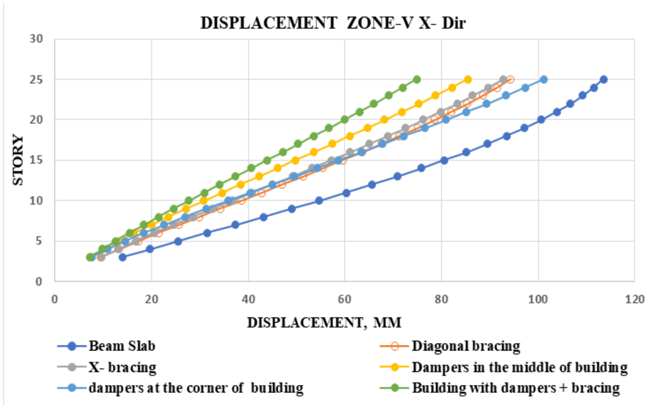

Chart -6: Maximum Storey Displacement in Zone–V for X Direction

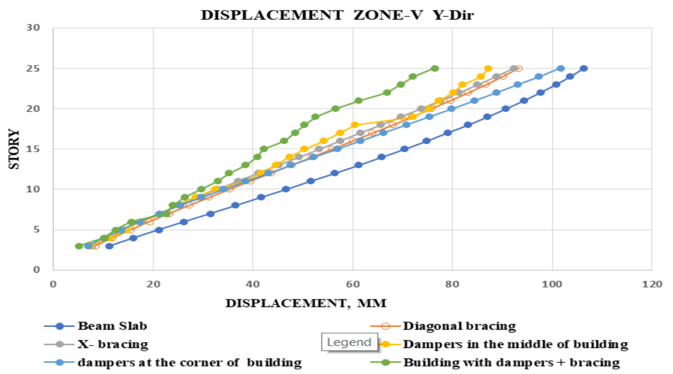

Chart -7: Maximum Storey Displacement in Zone–V for Y Direction

IRRREGULAR BUILDING

Different types of models are follows bellow:
Model 1- Beam slab
Model 2- Diagonal bracing at the corner
Model 3- Diagonal bracing at the re- entrant corner
Model 4- X-bracing at the corner
Model 5- X-bracing at the re- entrant corner
Model 6- Damper at the re- entrant corner
Model 7- Damper at the corner
Model 8- Damper in the middle
Model 9- Damper +bracing

Time period

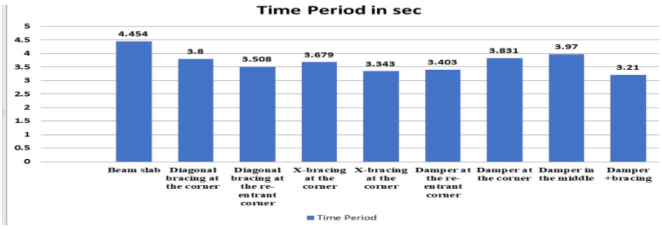

Chart -8: Time period of all structural systems in a second

BASE SHEAR

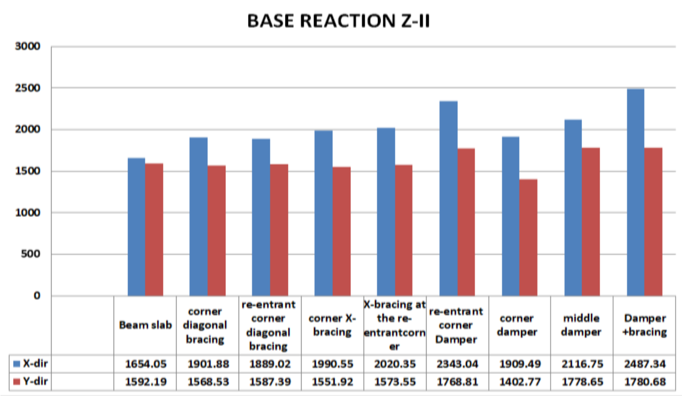

Chart -9: Base Shear of all Systems for different Zone – II in both X and Y direction

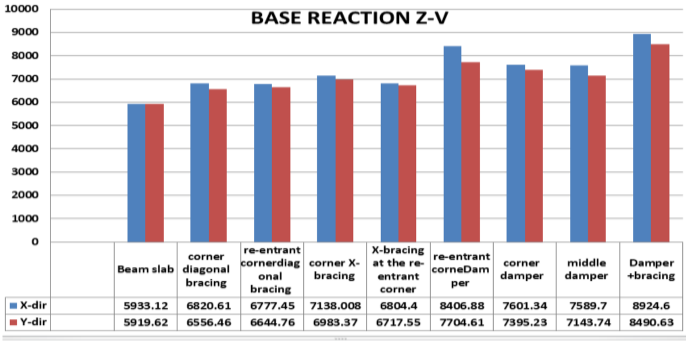

Chart -10: Base Shear of all Systems for different Zone – V in both X and Y direction

MAXIMUM STOREY DISPLACEMENT

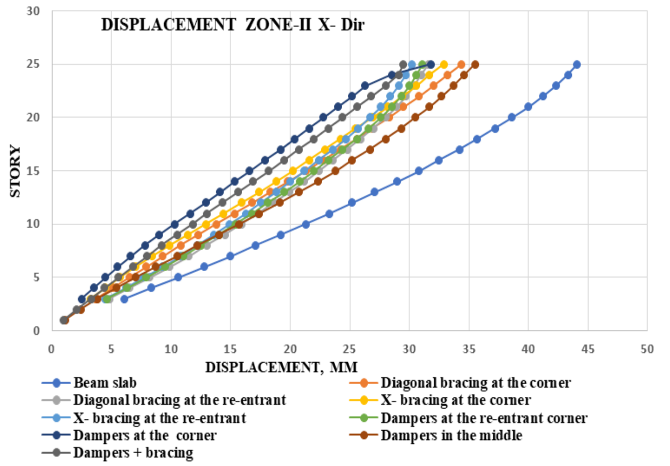

Chart -11: Maximum Storey Displacement in Zone–II for X Direction

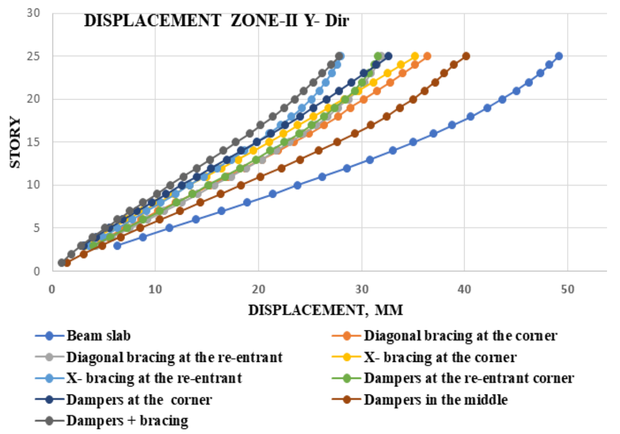

Chart -12: Maximum Storey Displacement in Zone–II for Y Direction

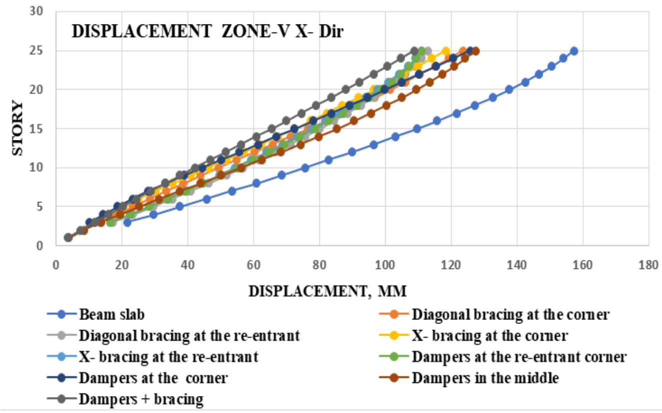

Chart -13: Maximum Storey Displacement in Zone–V for X Direction

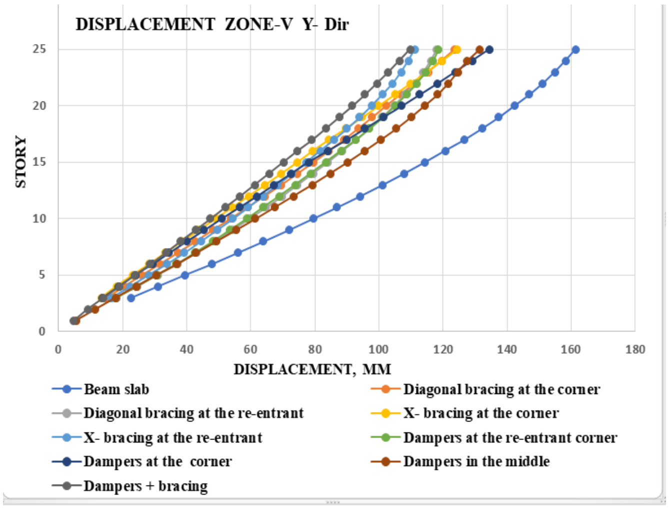

Chart -14: Maximum Storey Displacement in Zone–V for Y Direction

CONCLUSIONS

REGULAR BUILDING:

1. result consider X- bracing 3% reducing time period than diagonal bracing, bracing+ dampers 25%, middle dampers 14% reducing time period than corner dampers. Because in that systems stiffness is good.

2. In this beam slab system base shear comparing to all other models. where building with diagonal bracing base shear increasing 30%, building with X- bracing base shear increasing 37%, building with middle dampers base shear increasing 54%, building with corner dampers base shear increasing 48%, building with bracing + dampers base shear increasing 59%. Base shear is maximum in building with bracing + dampers.

3. Lateral storey displacement results consider maximum storey displacement reducing model is building with bracing + dampers32%. Lateral storey displacement results consider X- bracing displacement 3% reducing storey displacement than diagonal bracing, therefore X-bracing performance well.

4. lateral storey displacement result consider regular building comparing viscous damper providing location configuration middle dampers and corner dampers. Middle dampers displacement reducing 14% than corner dampers, middle dampers performance well.

IRREGULAR BUILDING:

1. Building with re-entrant corner diagonal bracing time period reducing 7% more than building with diagonal bracing at the corner. Re-entrant corner X- bracing time period reducing 8% more than building with corner X- bracing. Re-entrant corner damper 13%, corner damper 3%, building with bracing + dampers time period reducing 17%, more than building with middle damper.
2. In this beam slab system base shear comparing to all other models. where building with corner diagonal bracing base shear increasing 13%, building with re-entrant corner diagonal bracing base shear increasing 12.5%, building with corner X- bracing base shear increasing 17%, building with re-entrant corner X- bracing base shear increasing 18%, building with re-entrant corner dampers base shear increasing 30%, building with corner dampers base shear increasing 13.5%, building with middle dampers base shear increasing 22%, building with bracing + dampers base shear increasing 33.5%.Base shear is maximum in the model building with bracing + dampers.

3. Storey displacement reducing result consider plus building comparing and re-entrant corner diagonal bracing 7% more than corner diagonal bracing. Displacement reducing in re-entrant corner diagonal bracing performance well.

4. Storey displacement reducing result consider re-entrant corner X- bracing 16% more than corner X- bracing. Displacement reducing case re-entrant corner X- bracing performance well

5. Storey displacement results consider comparing re-entrant corner dampers10.5%, corner dampers 6% more than middle dampers. Displacement reducing re-entrant corner dampers performance well.

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