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Earthquake resistance construction's techniques: Base isolation, Viscous damper

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Abstract: The earthquake is the very serious problems which affect human being life in different ways. Also, in earthquake prone areas infrastructure and buildings has many kinds of damages. And its major reason is lateral movement of tectonic plates. The Earthquakes movements such as lateral movement of the earth beneath the base of buildings are prevented by two methods, these are Base Isolation Methods and Seismic/Viscous Damper. The present project deals with

1. Base Isolation Techniques
2. Energy Dissipation Devices: Fluid Viscous Damper

The primary goal of the aforementioned techniques and their earthquake-prevention strategies are explained in this project. The current project focuses on earthquake-resistant constructions. Because of this, RC frames aid in earthquake resistance. The current study is concerned with ways to withstand earthquakes, how reinforced concrete structures may withstand them, and the major methods used to do so.

Keywords: Base Isolation system, Energy Dissipation / Fluid Viscous damper

I. INTRODUCTION

1.1 General:

Earthquake gives many damages to infrastructures. Infrastructure is severely damaged by earthquakes. Structures are made to withstand kinetic forces. These forces may absorb energy while also being deformable. In the event of an earthquake, these buildings could flex beyond their elastic limit. It demonstrates that buildings built using these techniques can occasionally be vulnerable to powerful earthquake shocks. The goal of structural designers is to attempting to determine which structural system types can endure powerful vibrations. Alternatives include the implementation of specific structural protection measures to lessen the negative impact of these dynamic forces. By absorbing or isolating a portion of the input energy that would otherwise be passed to the structure itself, these systems function.

1.2 Earthquake resistance by base isolation & viscous dampers:

Viscous Dampers are the energy isolation devices which are used to resist lateral forces acting on the structure. Dampers are used to mitigate the buckling of columns and deflection of beams and to increase the stiffness of the structure. Viscous Damper is provided to mitigate the deformation and vibration of RCC structure during earthquake.

This study deals with the performance evaluation of various type of passive control devices such as dampers technique

1.3 Aim:

This study aims to focused on base isolation & viscous dampers technique which is most frequently and most preferred for the earthquake resistance

1.4 Objective:

1.The main objective behind this study is to understand the basic concept of earthquake.

2.To understand the earthquake resistant Design criteria.

3.Comparative study between the structure with base isolation or viscous dampers & without base isolation or viscous dampers & find absolute displacement.

4.Testing the performance of above techniques.

5.Study on IS codes which are used in earthquake resistant design.

II METHODOLOGY

2.1 Flow Chart:

Step 1: Study on earthquake & measurements

Step 2: Study on the earthquake resistance techniques

Step 3: Study on Base Isolation & Viscous Damper

Step 4: Making of framed mini model for testing

Step 5: Testing of mini model

Step 6: Result & Conclusion of Study

Step 7: Future scope of study

2.2 Energy Dissipation Devices:

Commonly used Seismic Dampers

2.2.1 Friction Pendulum Bearings (Because of this, there won't be a torsion moment and the isolation system's Centre of mass and rigidity will coincide.)

By adopting base isolation, the building's movement may be altered such that the earth can move beneath it without sending seismic waves into the structure. The base structure and the ground surface must come into touch. A building will have a zero period since it is completely stiff. There will be no displacement between the base structure and the ground stratum when the ground surface moves because the acceleration that is first produced in the base structure will be equal to the acceleration of the ground surface. The ground surface and the building both move equally.

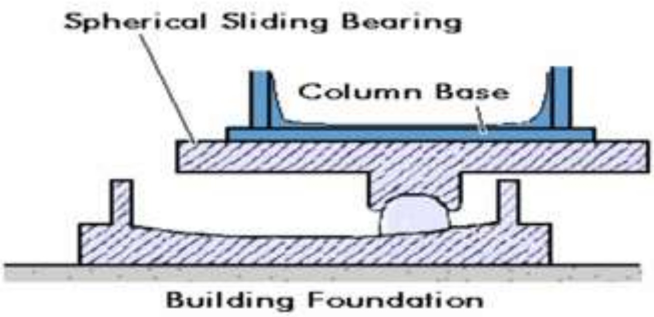


Fig. No. 1.1 Friction pendulum bearing section

2.2.2 Viscous Dampers:

The basic shock absorber used in automobiles is a fluid viscous damper. The piston moves the fluid inside the viscous damper by transferring energy to it. The fluid that is moving inside the damper absorbs the kinetic energy and turns it into heat. In the case of vehicles, this refers to the fact that a shock at the wheel is dampened before it reaches the driver's compartment. According to this scenario, buildings will experience less damage and horizontal displacement during an earthquake since their column footings lie on bases that are isolated from one another and their columns are linked to dampers.

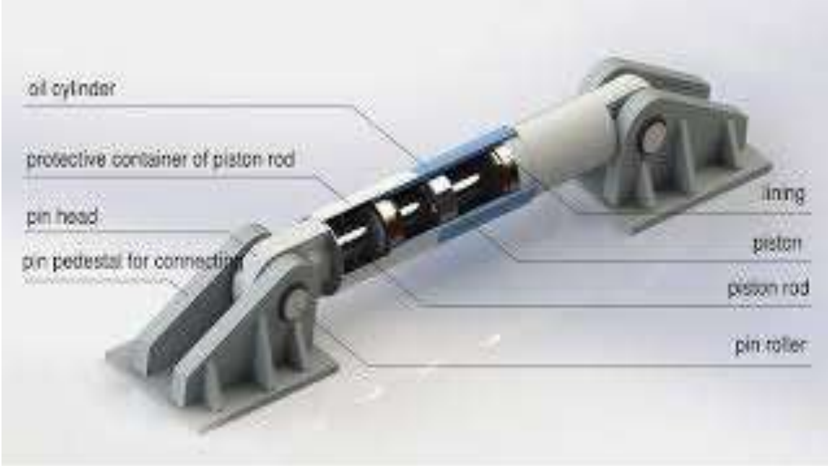


Fig. No. 1.2 Viscous Damper

III.TESTING

3.1 Mini Model

- The steel used to construct the building model.
- The tiny model's measurements are: 28 cm in length, 20 cm in breadth, and 19.5 cm in slab height.
- The column's diameter is 3 mm.
- The slab is 3 mm thick.
- The structure weighs 6.98kg when dampers are utilised.
- Damper load capacity: 5 kg
- The shake table can support up to 25 kg of weight.
- 25Hz is the maximum frequency.
- The G+2 building was utilised for the experiment

3.2 Testing Machine

- Shake Table: 30 cm diameter (Company-Milenium Technology)
- Load Capacity: 25kg
- Frequency interval rate: 0.5 Hz
- Amplitude or Displacement: In 'mm'
- Signal converter machine & Accelogram
- Software: Kampana 2.7
- Testing Location: Ajeenkya D Y Patil College of Engineering, Lohegaon, Pune


Fig. No. 1.3 Testing of Model on Shake Table

IV. RESULT

4.1 Set 1. Framed structure without base isolation or viscous damper

Table 1 Framed structure without base isolation or viscous damper

Channel -X Frequency (Hz)	Channel 1-X Displacement (mm)	Channel 2-X Displacement (mm)	Channel 3-X Displacement (mm)
0.5	48.14	43.19	39.41
1	46.22	39.42	38.21
1.5	41.64	37.57	35.96
2	38.52	35.28	25.93
2.5	35.23	27.85	25.47
3	33.32	26.43	24.23
3.5	31.83	24.18	18.84
4	30.97	24.05	19.22
4.5	27.15	21.35	18.71
5	23.31	17.04	14.59

Fig 1.4 Amplitude & frequency without base isolation or viscous damper

4.2 Set 1. Framed structure with base isolation or viscous damper

Table 2. Framed structure with base isolation & viscous damper

Channel -X Frequency (Hz)	Channel 1-X Displacement (mm)	Channel 2-X Displacement (mm)	Channel 3-X Displacement (mm)
0.5	45.42	38.79	33.16
1	44.76	37.83	32.20
1.5	35.64	32.57	25.96
2	30.46	27.28	23.93
2.5	26.27	21.71	19.14
3	25.32	20.72	18.45
3.5	22.91	18.97	15.64
4	21.92	17.12	14.13
4.5	22.48	17.31	14.78
5	20.52	14.92	12.73

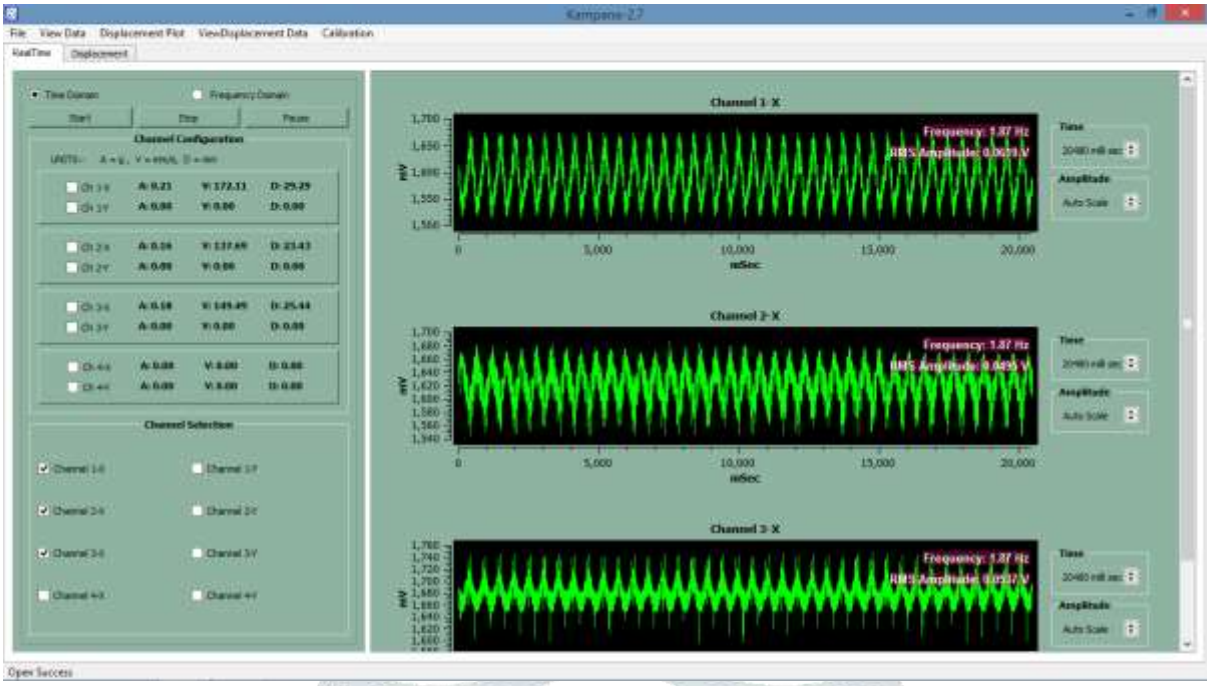
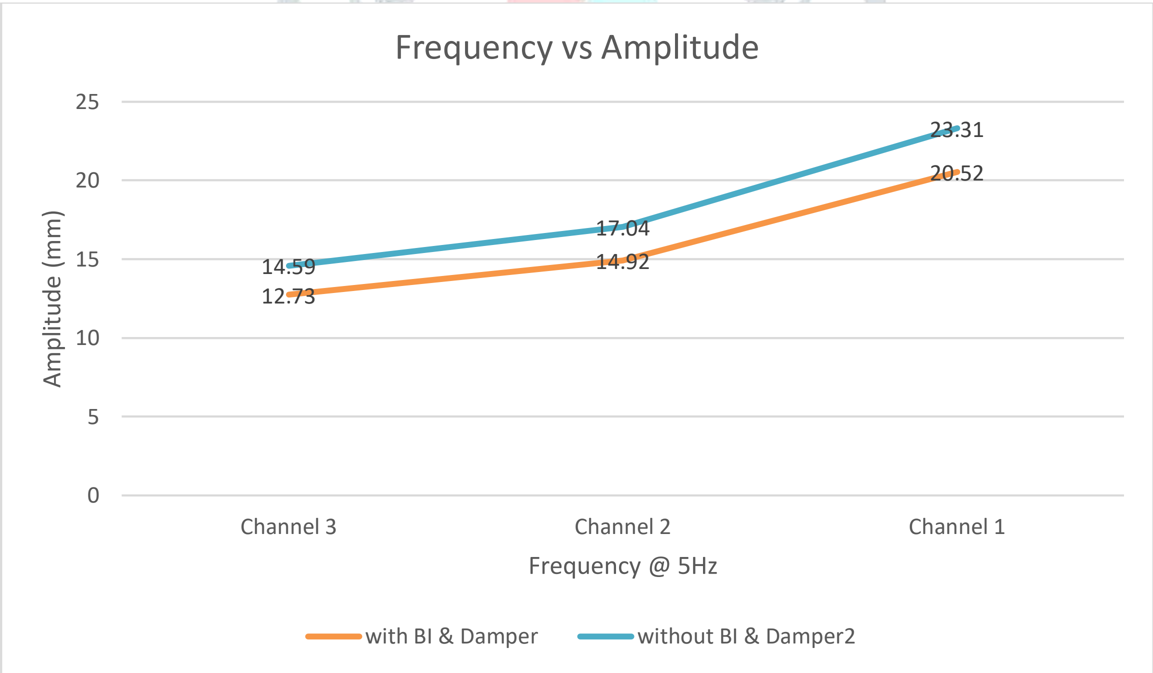
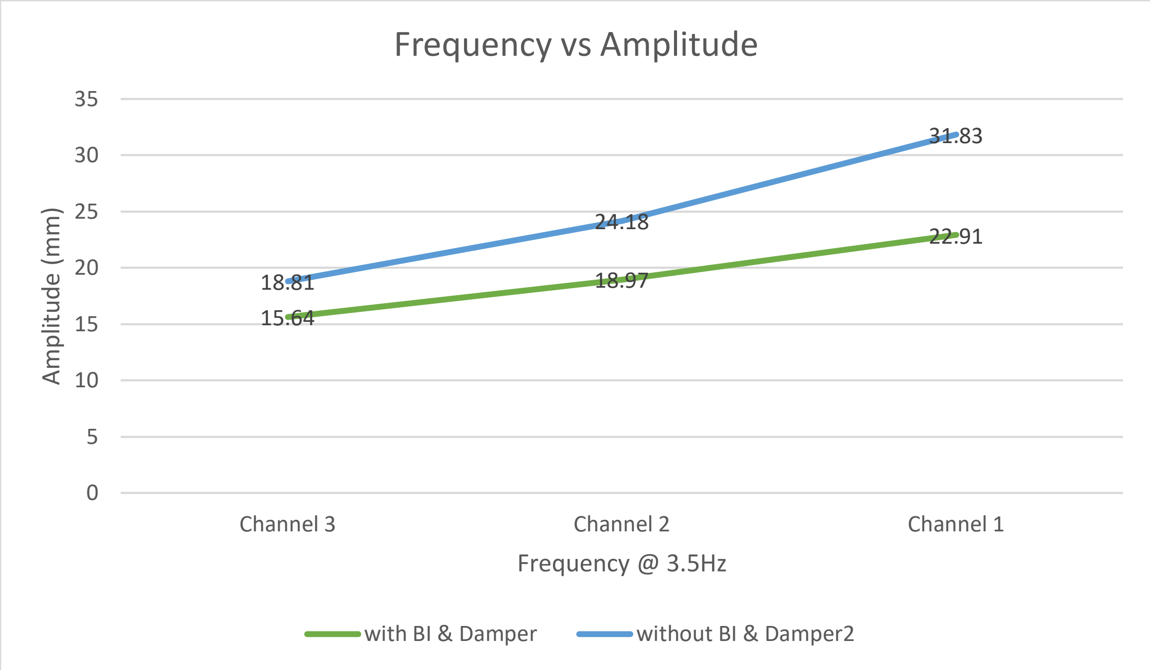


Fig 1.5 Amplitude & Frequency with base isolation & viscous damper



Graph 1. Frequency vs Amplitude



Graph 2. Frequency vs Amplitude

V. CONCLUSION

1. After fixing base construction with the base isolator, the structure grows by around 10%.
2. During an earthquake, base separated structures lessen stresses and displacement.
3. RC Frame is safe after damper is installed to Floor from base & Damper reduce twisting movement.
4. After application of damper is much better when we provide same number of dampers to first 2 to 7th stories.

VI. FUTURE SCOPE

1.Economize the isolator section and reduction in permissible displacement at time actual of earthquake.

2.Determining the seismic behaviors of structures by using different arrangements of isolator devices in the field of their locations in the building.

3.Analysis of seismic behaviors of the structures using the dampers properties and their performance.

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