Energy Dissipiation Device In Bridges Using Lead Rubber Damper

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Abstract- *Seismic isolation and energy dissipating systems present an effective way to common seismic design for improving the seismic performance of structures. These techniques reduce the seismic forces by changing the stiffness and/or damping in the structures, whereas conventional seismic design is required for an additional strength and ductility to resist seismic forces. The research and development works of passive, active and hybrid devices are ongoing intensively. This paper presents a brief history of isolation techniques and introduces these systems from passive devices to sophisticated ones and completely active systems. By focusing on the passive systems especially base isolation systems, development and progress involved in those are reviewed. A note is also made about applications and the conclusion of the recommended provisions from codes for new buildings and other structures is reviewed. On the other hand, this paper reviews the situation of earthquake protective systems used in Turkey. This technique is not yet very common, but a number of research activities is going on in order to investigate the behaviour of the isolated buildings. Civil engineers, architects, constructors and owners have great responsibilities concerning applications of these systems, but especially the users have sanction, therefore widely use of the earthquake protective systems will be provided by the users' awareness.*

Keywords- Seismic load, Response spectrum analysis, CSI software.

I. INTRODUCTION

The significance of dampers interaction with bridge structure is to find the difference in the displacment of the structure when the a fixed and dampers are placed in between deck and pier, Here equivalent static analysis and response spectrum analysis is done.The latest seismic map of India shown in design IS 1893 (Part 1) 2002 bifurcates India into 4 seismic zones (Zone 2, 3, 4 and 5), were Zone 5 is the maximum level of earthquake where in Zone 2 is for low intensity earthquake. Every zone represent the effects of an earthquake at a place based on the inspection of the affected areas and can also be elaborated using a method like Modified Mercalli intensity scale. The intensity of MSK is broadly associated with the different seismic zones corresponding to the Maximum Considered Earthquake. Zone 5, is one which is referred to the Very High destructive Zone in the IS code, The factor I of 0.36 is assigned to it, which represent the actual peak Hz. ground rate of change of velocity of Z=0.36 g that is generated during MEC level earthquake in the zone.

Features.

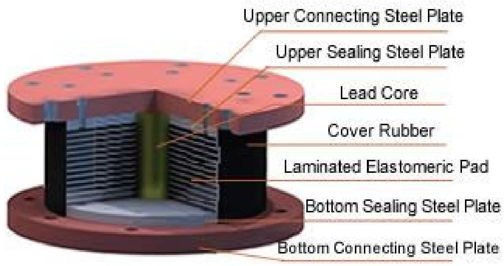
- rigid and tough in vertical direction but free to move in horizontal direction.
- Seismic energy is dissipated by deformation of bearing shape
- Rubber covering helps to maintain the shape and position of a structure.
- Have the potential to modify damping amount just by changing the total number of lead stopper.
- Have excellent vertical load capacity ranging from 6 ton to 1800 ton.
- It decreases the ground acceleration by increasing the structural vibration period.
- Installation process is simple.
- Easy to replace and repair and maintenance is low .

CHOICE OF ISOLATOR.

Lead rubber bearing are developed and used for bridge structure for simply bridges Lead rubber bearing are used and for suspension bridges viscous dampers are used..

Lead rubber damper.

Lead rubber damper used in building and bridges are, very much practical and economical choice for seismic isolation. It is been made up of elastomeric bearing pad which is laminated, and in middle it consist of lead core which is sealed from top to bottom with connecting plates as shown in fig.



II. OBJECTIVE OF THE STUDY

- To analyse the behaviourof bridge subjected to both static and seismic analysis.
- Comparison of bridge for with and without lead rubber bearing.
- To study the displacement value of bridge under static and seismic loads.

III. METHODOLOGY

1. To carry out extensive literature review, to establish the objectives of the study.
2. Csibridge 2017 is used to for modelling and analyses of the bridge structure.
3. Lead rubber bearing is considered and assigned in between deck and pier.
4. Analysing the model for Seismic (Static and dynamic) as per IS 1893 – part 4.
5. Grade of concrete is M30 and Fe500 for steel is adopted for the present study.
6. Conclusions are made based on the performance bridge with and without lead rubber bearing.

IV. DESIGN OF MODEL

The CSI bridge 2017 software is used for analyzing the different structural elements such as suspended bridge, simply supported bridges, hanging bridge and many. It is the most simple software and have a very good user interface. CSI is a structural and seismic engineering software which was founded in year 1975 and it is integrated software which comprises of variety of modeling, analysis and design tool. The results are obtained in an animated mode representing deflection, mode shapes, bending moment and other deformed shapes. This chapter includes the modelling of the 72m long bridge structures. This is an RCC bridge. The types of models are shown here for the easy assessment.

4.1 MODELLNG:

Model 1 – RCC Bridge.

Model 2 – RCC Bridge with Lead rubber bearing.

4.2 DEFINING MATERIAL PROPERTIES :

The material property is essential to be defined while modelling a structure. Both the steel and concrete will be having few properties, which has to be itemized as listed below such as modulus of elasticity of steel, concrete, compressive strength of concrete and also the yield strength of steel.

Modulus of elasticity for steel, E_s = 2,10,000MPa
Modulus of elasticity for concrete, E_c = 27387 MPa
Characteristic compressive strength of concrete, fck = 30 N/mm^2
Yield stress of steel, f_y = 500 N/mm^2

4.4 DEFINING LOADS:

For seismic analysis the major load considered are only self weight and live load.

- Dead load.
- Earthquake Load. (Static and Dynamic).

4.5 MASS SOURCE:

In the seismic analysis, the mass of the structure is considered, as some ratio of the load is acted as lateral force. All the dead load will be considered with a scale factor 1. This value is considered as the seismic weight. This shall be further multiplied with the horizontal seismic co-efficient, to get the base shear values.

Standard Model:

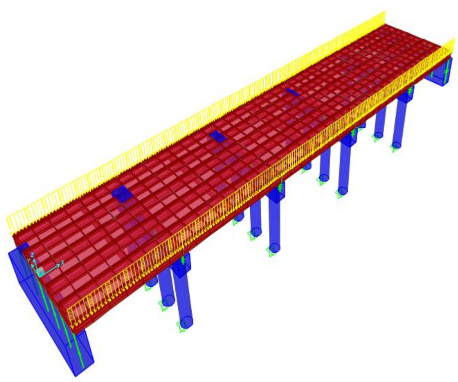


Figure 1: RCC Bridge – Modelled in CSI bridge

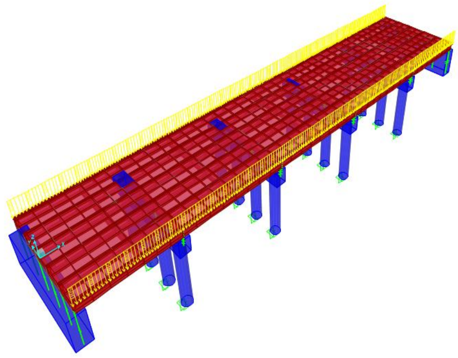


Figure 2: Model 1

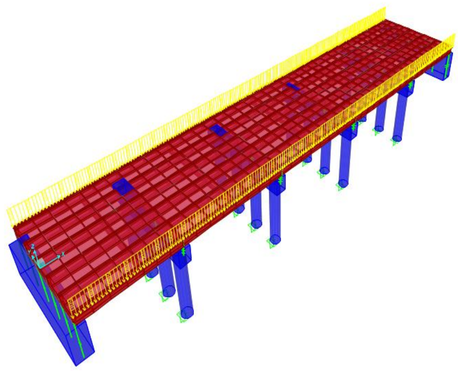


Figure 3: Model 2

4.6 CALCULATION OF LOADS:

Loads considered for the analysis of the diagrid building are:

1. Self-Weight Of The Structure:Self-weight of the structure is assigned by the SAP software based on the material density given as input.
2. Dead Load And Live Load: The dead load is assumed to be 1 kN/m2 and Since the structure is intended to throw out the gas, there will no major live load considered in the structure. The major load will be its self-weight.
3. Seismic Load: Seismic load is calculated as per IS:1893-2002 Part1.

- Zone factor (Z) – II
- Seismic intensity – 0.10
- Silt type – type II
  - Importance factor – I
  - Reduction factor (R) – 5

4.7 LOAD COMBINATIONS:

The load combinations taken are as shown below:

- 1.5DL
- 1.2(DL+EX)
- 1.5(DL+EX)
- 1.5(DL-EX)
- 1.2(DL-EX)
- 0.9DL+1.5EX
- 0.9DL-1.5EX
- 1.2(DL+RSA)
- 1.5(DL+RSA)
- 0.9DL+1.5RSA

V. RESULTS AND COMPARISION

The response of different models will be tabulated from SAP software. The regular model and different structural systems were also studied for different load cases. The model has been validated and the following results are compared.

Comparison of different models:

Response Spectrum Analysis (RSA)

Displacement –RSA

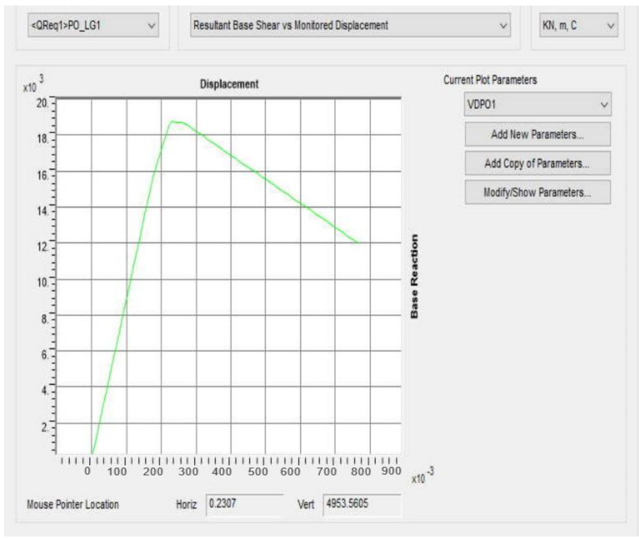


Figure 4: displacement without bearing.

Response Spectrum Analysis (RSA)

Displacement –RSA

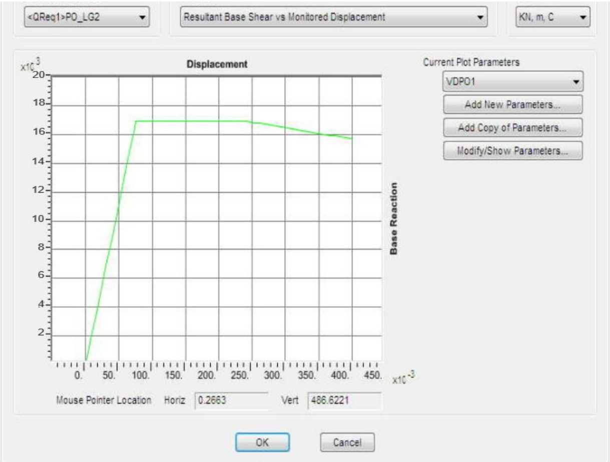


Figure 5: displacement with bearing.

VI. CONCLUSION

Response Spectrum Analysis:

1. The displacement values for response spectrum analysis is compared with model with and witout dampers. There is a difference of about maximum 66.66%.
2. The time period and base shear values will be same for Equivalent static and response spectrum analysis. This indicates, the values of base shear and time period will only dependent on the building mass, height and geometry of structure not on the analysis type.

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