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REVIEW PAPER ON USE OF FRICTION DAMPERS FOR SEISMIC PERFORMANCE ENHANCEMENT IN EXISTING AND NEW BUILDINGS

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Abstract-Friction dampers are one of the most efficient ways to enhance the seismic performance of structures subjected to high seismic activity. Friction dampers allow the structure to dissipate the energy generated and transferred it to the building thereby avoiding damage to the building. Friction damper operated under the principle of Coulomb damper which transforms the kinetic energy induced by an earthquake into heat through friction. The Pall damper is the most common type of friction dampers used. They are easy to install and have less maintenance. Another important application of friction damper is enhancing the performance of existing buildings that need seismic retrofitting. Apart from enhancing the seismic behaviour of the building they also help in help in reducing the overall cost of the project and contribute to reducing the global warming and carbon footprint thereby contributing positively to the climate.

Keywords— Friction dampers, seismic retrofit, existing building, Seismic performance enhancement

1. INTRODUCTION

1.1 GENERAL

Seismic Dampers are used in damping the oscillations of a building during an earthquake. The friction damper operates by dissipating kinetic energy through friction. The Dampers allow the building to move elastically and dissipate the energy of the earthquake. They are designed to activate prior to member yielding and are reusable after the earthquake has occurred.

There are many types of dampers for buildings, and damping through friction tends to be one of the most efficient methods of dissipating seismic energy. This, in turn, produces substantial savings as structural elements can be optimized for cost savings. Thus the building is able to withstand an earthquake without sustaining significant damage to the structure.scillations of a building during an earthquake. The friction damper operates by dissipating kinetic energy through friction. The Dampers allow the building to move elastically and dissipate the energy of the earthquake. They are designed to activate prior to member yielding and are reusable after the earthquake has occurred.

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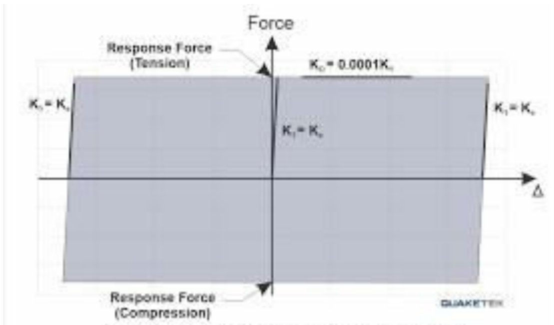
1.2 PRINCIPLES OF FRICTION DAMPERS

Friction dampers allow the buildings to be elastically deformable in both tension and compression, while dissipating the energy of earthquake. Although any two elements in contact and dissipate energy through friction, getting consistent performance is a challenge. The key element is to arrive at the Slip Load required without considerable variations even after multiple cycles.

Friction dampers are not velocity dependent therefore their performance is not affected by variations in the velocity of the building. Since only axial displacement and axial force are required to be addressed thus these can be introduced to any structural design.

1.3 SEISMIC ENERGY DISSIPATION

Friction dampers dissipate the largest amount of energy as compared to other alternatives. This is due to force exerted on the damper is constant after reaching slip load.



Theoretical YRB Hysteretic Loop

Input energy caused by earthquake to structure is presented in the following equation:

$$E = Ek + Es + En + Ed$$

1.4 STRUCTURAL DESIGN / MODELLING

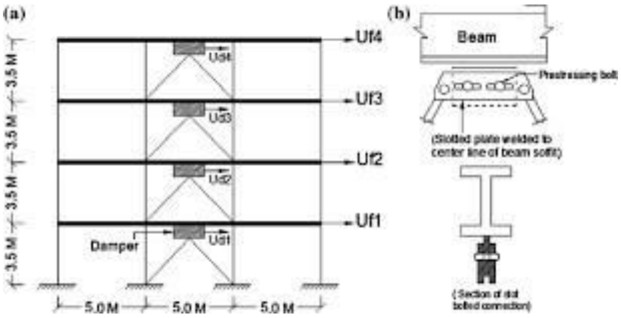
The friction damper is modelled as a yielding brace however in reality during the yielding the damper is slipping. Friction damper can be simply modelled as a fictitious ‘brace link’. The damper acts as a normal structural member under service load and only activates once slip load is reached, at which point the force remains constant until reversing action. They hysteric loop is therefore rectangular and independent of velocity.

The design of friction dampers depends on a few factors mentioned below:

Location of Braces – In initial model damped braces are located where the lateral stiffness in the buildings are proposed. These would typically be places like shear wall locations or moment resisting frames. A uniform and symmetrical distribution of braces will result in more uniform stress distribution.

Number of braces per floor –This depends on the force distribution at base. It can also be governed by architectural constraints.

Equal Braces per floor - It can have Equal Number of Braces per floor. Here the resistance of braces reduces at the upper floors.



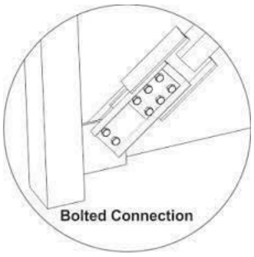
OPTIMUM SLIP LOAD

Optimum Slip Load – This is the force that allows for the maximum energy absorption for a given frame configuration and given lateral force. This is generally below 50% of the storey shear.

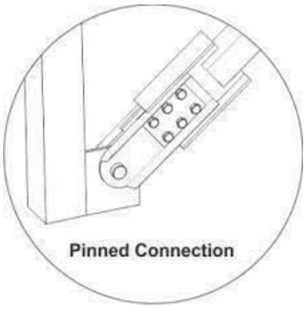
1.6 INSTALLATION

This system can be adopted in any design. The system can be adapted to wood, Steel or Reinforced concrete. Connection design is simple and having multiple options to choose from namely –

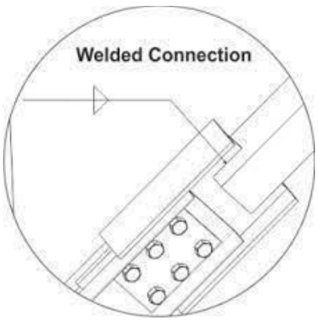
Bolted connections



Pinned connections



Welded connections



The ease of installation in new and even existing buildings allows the dampers to be integrated quickly and with minimal intervention

1.7 PROBLEM STATEMENT

To compare the effect of equal and unequal bracing in a building..

1.8AIM OF THE STUDY

The aim of this particular analysis was to the effect of the location of braces.

1.9 OBJECTIVE OF THE STUDY

The principal objectives of this study are:

Location of braces were observed and finalized as per the requirement.

2. Literature review

It was studied through various literature reviews the advantages and requirement of friction dampers. Literature review by Avatar Pall have been refered.

3. METHODOLOGY

3.1 Introduction

An experimental investigation of friction dampers in buildings was made and it was made to retrofit the building using friction dampers.

3.2 Methodology:

The project study involved two stages. The primary data was gathered through a Literature survey targeted by web searches and review of eBooks, manuals, codes and journal papers. After review the problem statement is defined and sample preparation is taken up for detail study and analysis purposes.

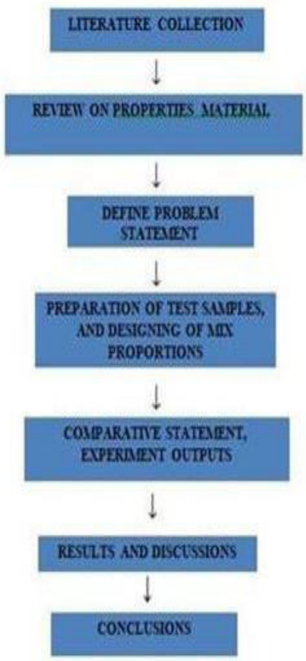


Fig 3.1 Flowchart of Methodology

3.3 Experimental Investigation:

An experimental investigation was done to ascertain the difference between conventional frame section in comparison and building with seismic friction dampers.

4. RESULT

4.1 General

It was found that friction dampers are the most suitable for seismic retrofitting as well as other frames.

5. CONCLUSION

Recently, use of seismic control systems has increased, however selecting best damper and inserting it in building is significant for reducing vibration in structures once subjected to the loading due to earthquake forces. The controlling devices decrease damage considerably by increasing the structural safety, serviceability and avoid the building from total collapse during the earthquake. Thus several researches are being carried out to search the simplest solution. This paper makes an attempt to provide a summary of various varities of seismic response control devices, and highlights a number of the recent developments. The experimental investigations and also analytical investigations applied by varied researchers clearly demonstrate that the seismic control techniques has the potential for enhancing the seismic performance of the structures.

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