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Compare of various Types of Zipper Braced Damper with RCC frame

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Abstract: In a present day, the earthquake problem is a huge problem of a society. In this problem so much of loss of structure, human life is occur. The structure is stable in that disaster condition then the loss occur in a small scale due to which the safety of the structure is very important. Many of the structure made in the world overcome this type of problem but it couldn't be affordable for a common man so that we introduced one of the affordable seismic parameter which reduces the excitation of the building.

The chevron braced damper is one of the best damper to reduce the seismic excitation. There are various types of chevron braced damper but we are using one of them for this project. We introduced Zipper Braced Damper in this project. We used G+20 story building in which the zipper braced damper is introduced in two patterns i.e. K damper and K downward damper.

We are using response spectrum method and time history analysis method is used to calculate the results and the story behaviour i.e. story drift, story displacement etc. In this project another method is also used i.e. Pushover Analysis method. We used this all method to calculate the story behaviour in x and y direction. Also in this project we compare the whole results with without damper structure and which type of chevron braced damper is reliable to sustain the loads.

In time history analysis method, we will compare the excitation of the structure with the EL-Centro 1940 data and match the frequency of the structure with this data. In pushover analysis method we used FEMA440 parameter.

Keywords: Chevron braced damper, pushover analysis, time history analysis, response spectrum method.

I. INTRODUCTION

The research carried out in the field of zipper braced frame is mostly focused on G+20 buildings. However, along with the increase in building height and stories number, undesired effects, such as excessive lateral deformation due to the activation of higher modes could drive the building near collapse.

To overcome this drawback, an outrigger truss system(s) are proposed to be added to the elastic ZBF system. In this regard, the stiffness is increased, the strength is increased and the deformability diminishes. Thus, the purpose of this research is to address the behavior of ZBF structures taller than the recommended code limitation. This study is developed for 20 storey building structures, while the influence of higher modes on the seismic response of zipper frame structures is discussed. In addition, the efficiency of adding outrigger trusses at the top floor of the 20storey building, which is a high risk seismic zone, is emphasized. If the lateral deformation cannot be reduced bellow the code limit, a second pair of outrigger trusses is proposed to be added at the mid-height of the 20-storey building. In this research, linear time-history dynamic analyses of 20-storey buildings with and without ZBF damper were conducted by using the SAP-2000 computer program.

II. OBJECTIVES AND SCOPE

The aim of this research project is two-fold

A. To investigate the inelastic behavior of the 20-storey ZBF building structures with elastic zippers located in a high risk seismic zone;

B. To emphasize the influence of various structure type of damper to the zipper braced frame building structure.

III. METHODOLOGY

The ZBF system is defined as a concentrically braced frame in chevron-bracing configuration to which a vertical member, labeled zip-per column, is added with the aim to join the beams of two adjacent floors at the beam-to-brace intersection point. The design criteria for zipper braced frame is to study the behavior of building with K chevron damper downward and K chevron damper. Thus, by adding zipper columns, several braces are triggered to yield and buckle almost simultaneously, while the formation of storey mechanism is prevented.

However, previous studies recommended to limit the height of this system at 20-storey.

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A. Design Methodology Of Zipper Braced Frame Structure

In this project we are follow the following steps:-

1) Set out the grid line with 8m x 8m dimension with the 5 x 3 bays.
2) Draw base plan of building in the SAP-2000 and multiply of the story upto 20th story. Each story height is defined as 3m and the height from base to plinth level is 750mm.

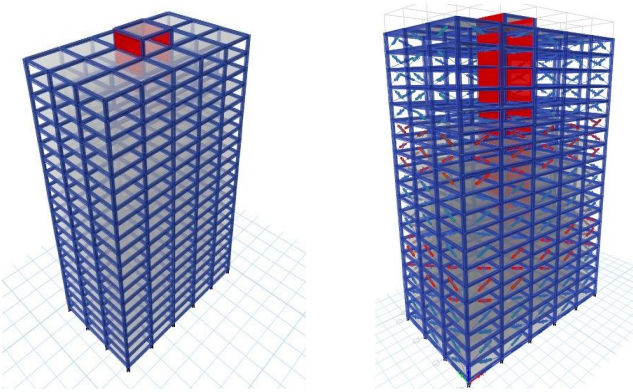

Fig. Base model of building structure.

3) Specify the material properties like M20 for slab, M25 for column and beam, and HYSD bar for reinforcement.

Name	Type	E MPa	ν	Unit Weight kN/m³	Design Strengths
A615Gr60	Rebar	199947.98	0.3	76.9729	Fy=413.69 MPa, Fu=620.53 MPa
HYSD500	Rebar	200000	0	76.9729	Fy=500 MPa, Fu=545 MPa
M20	Concrete	22360.68	0.2	24.9926	Fc=20 MPa
M25	Concrete	25000	0.2	24.9926	Fc=25 MPa

4) Specify the width and depth for column and beam for the building. As we were take 450mm x 600 mm size of column and 400mm x 450mm depth for beam. We apply the material properties for the column and beam and apply to the building.
5) We take torsional constant as 0.7 for column and 0.35 for the beam as we take always 50% by the column. And the moment of inertia for beam and column is 0.01 kN/m2 about 2-2 and 3-3 axis respectively.
6) We introduced the slab portion as 150mm Shell thin thickness with HYSD500 bar.
7) Also we specify the shear wall to the lift duct.

B. Design of Zipper Braced Damper

Go to draw tab and select the links. From this specify the name of the section and weight is taken as 800KN and mass is 250 kg. select the damper type is damper exponential with the exponential of 0.01.

Now go to link tab and applied on the building with two type i.e. K downward and simple K from one corner of building to another corner of building as shown in figure.

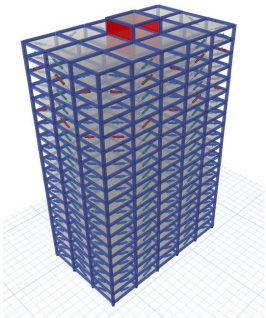

Fig. simple K and Downward K damper

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C. IS1893 2002 Auto Seismic Load Calculation in X Direction

This calculation presents the automatically generated lateral seismic loads for load pattern Ex according to IS1893 2002, as calculated by ETABS.

Direction and Eccentricity

Direction = X + Eccentricity Y

Eccentricity Ratio = 5% for all diaphragms

Structural Period

Period Calculation Method = Program Calculated

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 2] $Z = 0.36$

Response Reduction Factor, R [IS Table 7] $R = 5$

Importance Factor, I [IS Table 6] $I = 1$

Site Type [IS Table 1] = II

Seismic Response

Spectral Acceleration Coefficient, Sa /g [IS 6.4.5] $\frac{S_a}{g} = 0.34$ $\frac{S_a}{g} = 0.34$

Equivalent Lateral Forces

Seismic Coefficient, Ah [IS 6.4.2] $A_h = \frac{ZI\frac{S_a}{g}}{2R}$

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	Vb (kN)
X + Ecc. Y	2800.238	112009.7035	1370.9988

1) *Summary:* In this chapter, we were discussed about the methodology which was to be done in this project. The seismic design and building characteristics are represented in above table. The period of vibration in the various modes to be computed from the elastic dynamic analysis by using the model response spectrum method as implanted in SAP-2000. The period of vibration in the various modes from a linear time history analysis conducted by finite element program. The equivalent static procedure was observed.

IV. RESULT ANALYSIS

In order to validate the proposed design method, results from numerical analyses performed with SAP-2000 (elastic analysis) and finite element programs: ETABS. As presented in Chapter 2, most of the zipper braced frame analyses conducted by following researchers: Sabelli (2003), Tirca and Tremblay (2003, 2004), Leon and Yang (2003)), were performed by using Drain2DX. Thus, for a consistent discussion related to the previous researches, the Drain2DX program, developed at UC Berkeley, was selected as being the first analytical tool. In addition, the second computer program selected to overcome the limitations of Drain2DX was the most popular earthquake engineering simulation platform, OpenSees.

In this chapter we are doing comparative study about the structure with the various type of chevron braced damper i.e. zipper braced damper which is used to diminished the vibration under the seismic excitation. As we discussed earlier that the arrangement of braced damper i.e. k type damper and downward k damper which is arranged in between two columns in all stories. Due to which the following results occur with and without damper.

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V. COMPARATIVE STUDY OF STORY DISPLACEMENT

In this we are compare the story displacement , story drift and time history function for the without damper and with various types of zipper braced damper. From this result we are getting that the story displacement is less in downward K damper for various story but when we see the story drift and time history function the K damper is more efficient to sustain the seismic excitation. The time history function shows that the sinusoidal wave with respect to the frequency in +ve x direction and –ve y direction. When we compare this result the amplitude of the without damper is much greater than that of the K damper. From this analysis we concluded that the K damper is very much effective to sustain the seismic excitation in x and y direction.

	Without damper	downward k damper	With K Damper
Story	X-Dir	X-Dir	X-Dir
	Mm	mm	Mm
Story21	0.013	0.013	0.065
Story20	0.021	0.021	0.08971
Story19	0.02	0.019	0.085954
Story18	0.019	0.018	0.081452
Story17	0.017	0.017	0.076593
Story16	0.016	0.016	0.071
Story15	0.015	0.014	0.066
Story14	0.013	0.013	0.06
Story13	0.012	0.012	0.055
Story12	0.011	0.011	0.049
Story11	0.009	0.009	0.043
Story10	0.008	0.008	0.037
Story9	0.007	0.007	0.032
Story8	0.006	0.005	0.0265
Story7	0.004	0.004	0.0211
Story6	0.003	0.003	0.016
Story5	0.002	0.002	0.01145
Story4	0.001	0.001	0.073
Story3	0.001	0.001	0.0393
Story2	2.93E-04	2.88E-04	0.0146
Story1	2.37E-05	2.34E-05	0.091
Base	0	0	0

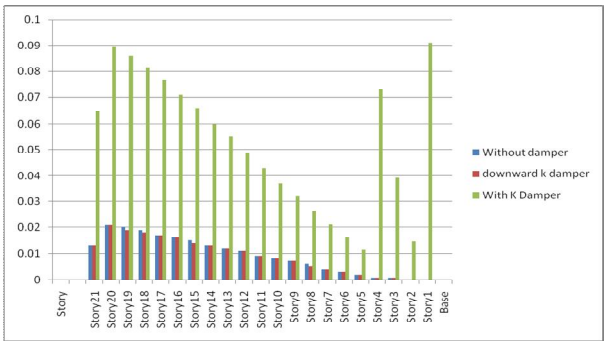

Figure. Comparison of Story Displacement

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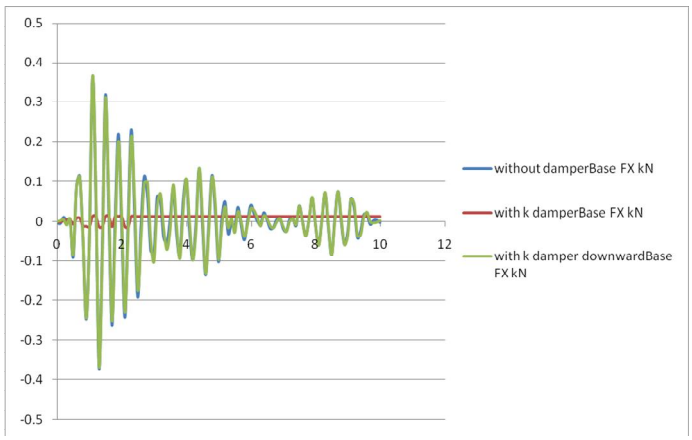

Figure. Comparative study of time history

A. Pushover Analysis

Presently, there are two non-linear static analysis procedures available, one termed as the Displacement Coefficient Method (DCM), documented FEMA-356 and other the Capacity Spectrum Method (CSM) documented in ATC-40(Applied Technology Council) . Both methods depend on lateral load-deformation variation obtained by non-linear static analysis under the gravity loading and idealized lateral loading due to the seismic action.

Capacity Spectrum Method is a non-linear static analysis procedure which provides a graphical representation of the expected seismic performance of the structure by intersecting the structure's capacity spectrum with the response spectrum (demand spectrum) of the earthquake. The intersection point is called as the performance point, and the displacement coordinate dpof the performance point is the estimated displacement demand on the structure for the specified level of seismic hazard.

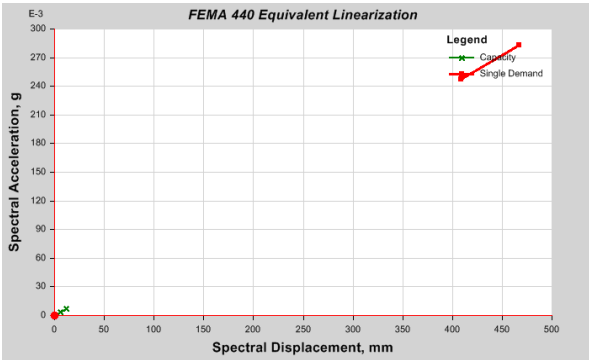

Figure. Spectral Acceleration for Without Damper structure

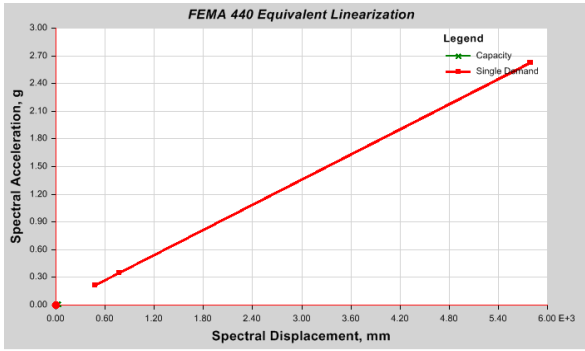

Figure. Spectral Acceleration for K damper

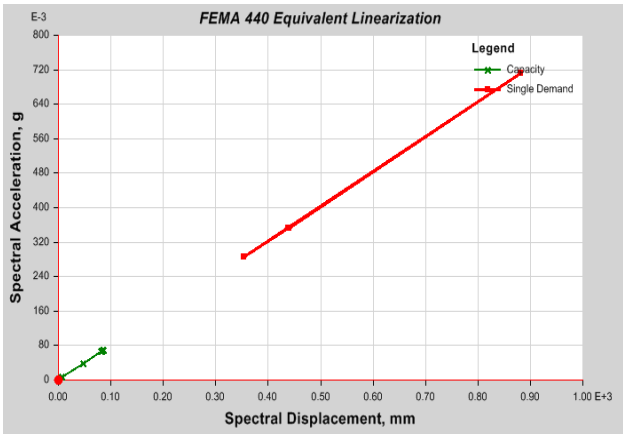

Figure. Spectral Acceleration for K downward Damper

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From this result, the structural model behave shows in graphycally. In this for without damper the PUSH X and PUSH Y load case was applied in the model and we were found that the spectral displacement verses spectral acceleration graph for all the models.
In this, the demand curve for building was very low as compare to single demand. For without damper the single demand is very much high as compare to the demand curve. On contrast with this the K damper having single demand is very much closer to the demand curve and for K downward damper the single demand is much closer than that of demand curve.
From this we were concluded that the K downward damper was amplifies the all displacement rather than that of the without damper and K damper.

1) *Summary:* In this analysis we were performed on G+20th story building with chevron braced damper and without damper then the above results were getting and from this we were concluded that one of the type which were used in this project is K damper which gives more displacement but it gives less story drift and this model of seismic parameter match with the El Centro 1940 data which is beneficial to our project. The pushover analysis is to be done and from this results we were concluded that the K downward damper have a healing power to overcome the displacement of the structure.

VI. CONCLUSION

A. As we were modeled the building of G+20 with and without zipper braced damper. Then K damper is sustained the seismic vibration according to the parameter which input to the software as compare to downward K damper and without damper.

B. As we discussed about the story drift, the k damper gives less drift as compare to downward k damper and without damper structure. So that for the seismic zone we will prefer K damper for reduces the seismic behavior of building.

C. The displacement of the structure is reduced in K damper as compare to the downward K damper and without damper.

D. All parameter is discussed in detail in previous chapter which shows that as the chevron braced damper is used which reduce the displacement, drift and stiffness of the structure.

E. In this analysis the response spectrum analysis was done and the frequency of the model is matched with the El Centro 1940 data. It results that the model which designed sustain that much of vibration which were occurred in 1940.

F. Although the time required to reduce the frequency of the building is 2-5 second that gives the model is stable within a second and it reduces major accident when seismic excitation condition occur.

G. Hinges created in different steps is more in normal frame.as when observed in rcc zipper braced frames it is negligible and nothing in middle floors. Hinges occur only in the base where zipper is not provided.

VII.FUTURE SCOPE

A. We will modeled the structure of different size of column, beam and increases the weight of zipper braced damper.

B. We will used the various types of chevron braced damper with the various arrangement like diamond shape, upward K damper etc. which reduces the seismic behavior of building.

C. We will used another type of seismic data to analyze the time history function and response spectrum function.

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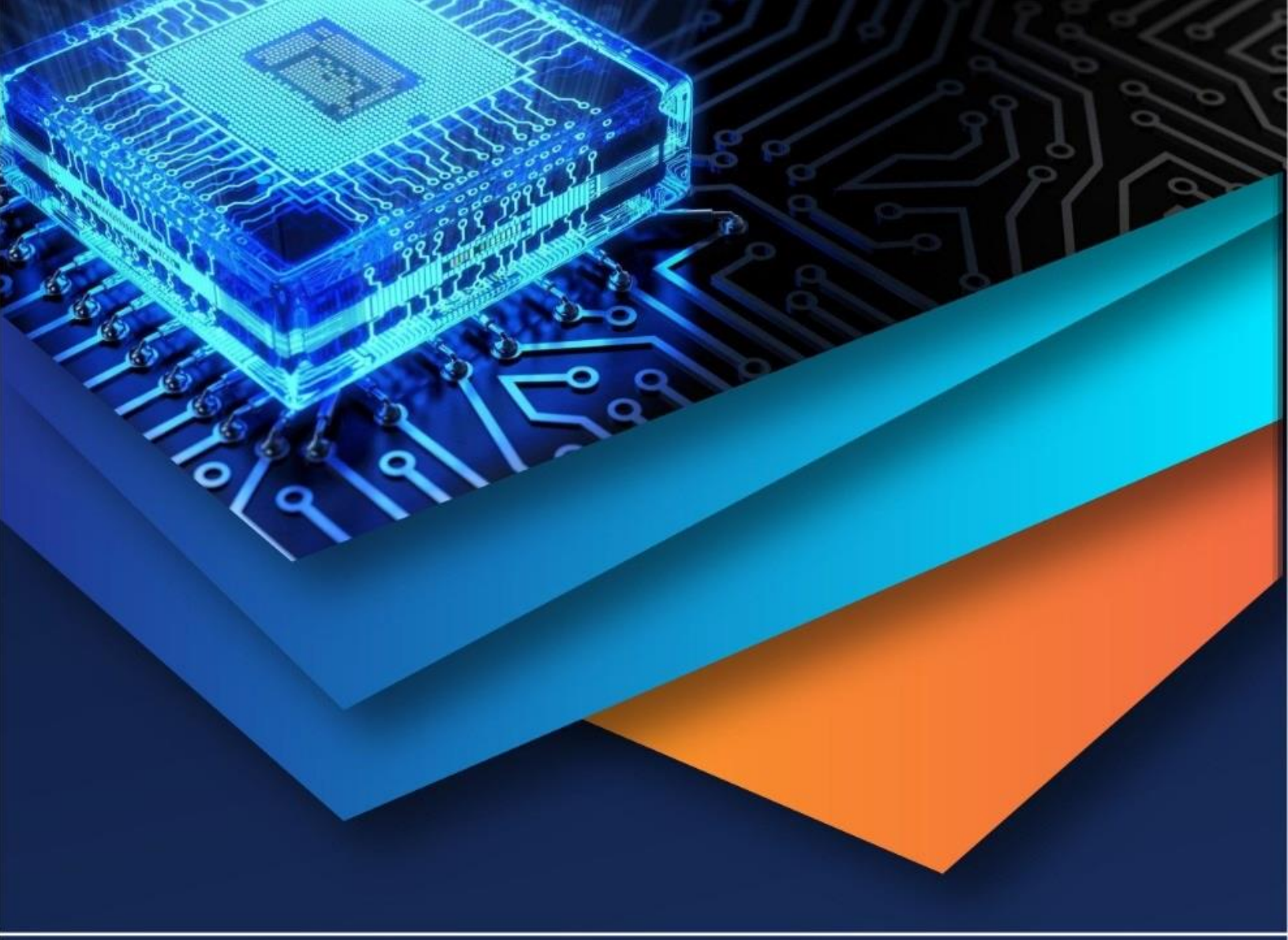

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