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Seismic Performance of Energy Dissipation Beam in Braced Steel Building

Bhabani Sankar Si, P Sonia Patro,
Gandhi Institute of Excellent Technocrats, Bhubaneswar, India
Orissa Engineering College, Bhubaneswar, Odisha, India

ABSTRACT
The aim of this paper is to study the performance of Energy Dissipation Beam (EDB) by varying cross section.The software used for the study is ETABS 2019. The model is analysed using time history analysis. In thisinvestigation, the horizontal ground motion records of the RSN:753, Loma Prieta::Corralit from PEER groundmotion data base have been selected for performing the nonlinear dynamic TH (Time History) analysis. TheEDB acts as a shear fuse. It is implemented in a G+3 storey 3D steel building with V bracing. Four models arecreated forthe study purpose.
Keywords: EnergyDissipationBeam,Timehistoryanalysis.

I. INTRODUCTION

During last two or three decades, the reduction of structural response caused by dynamic effects hasbecome a subject of intensive research [5]. Many structural control concepts have been evolved for this purpose,andquiteafewofthemhavebeenimplemented inpractice[5].Theyincludereductionofundesirablevi brationallevelsofflexiblestructuresduetounexpectedl argeenvironmentalloads,retrofittingexistingstructur es against environmental hazards, protecting seismic equipment and important secondary systems andprovisionofnewconceptdesignofstructuresagains tenvironmental loading[5].
Thebracedframe(BF)hassufficientrigidityandsafety performanceunderstandardworkingconditions[1,2].I ncontrast,underextremeearthquakes,theBFshowsrea sonableductilityandenergydissipation capability that is why EBF becomes widely used in earthquake-prone areas [1, 2]. During theearthquakes, the BF system mainly dissipates seismic energy inputted to the structure through the inelasticdeformation of the energy dissipating beam (EDB), so that the EDB is prone to yield before other members inthestructure [1, 2].
Sheartypeenergy dissipating beams (SEDBs)has beenusedas akey componentof theenergydissipationcapacitysystem invariousBFstructuresasitplaysasignificantroleinresi stingseismicloads[1,2].

1.1 MODELLINGOFBUILDING

1.1.1 Buildingdescription

The study is done in a G+3 storey 3D steel building under time history analysis in ETABS 2019. It has3baysinbothlongitudinalandtransversedirections at5mspacing.ThebeamisofISMB200andcolumnISM B 225 with steel grade Fe345. All storeys are of 3m height. Slab has thickness of 150 mm and concretegrade of M20. The design considerations used are live load 5kN/m, self weight is explicitly captured using steeldensityofvalueFe345gradesteelinETABS2019, designcode-
IS1893(part1):2016,specialmomentresisting frame,importancefactor-1 andseismic zone–zone III[5].

Figure1:Plan

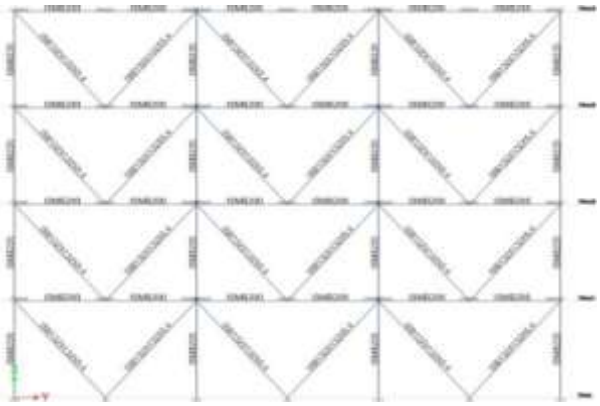

Figure2:Sectionofsteelbuilding showingVshapedbracing

Vbracingisprovidedasshownintheabovefigureexternallyin4sidesofbuilding.

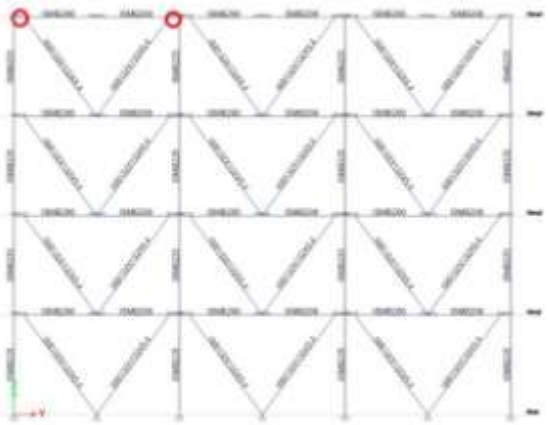

Figure3:Sectionofsteelbuilding showingVshapedbracingandEDBincorners.

The building is modeled by giving V bracing externally in its four sides along With EDB in cornerswhich connecting the bracing and the main beams. The EDB is provided in all beams in the external 4 sides asshown in figure 3. The section used for v bracing is ISB 132×132×5.4. The EDB is studied in three differentcross sections box, I and circle sections.The section property datausedfor EDBwith I section, circle sectionand box section is shown in figure 4, 5 and 6. These sections were selected by keeping the area constant as sameas ISMB 175. The length of the EDB is taken as 300 mm by considering ISMB 175 and this length is selected asper the designcriteria inAISCcode.

Figure4:SectionpropertydataofIsection

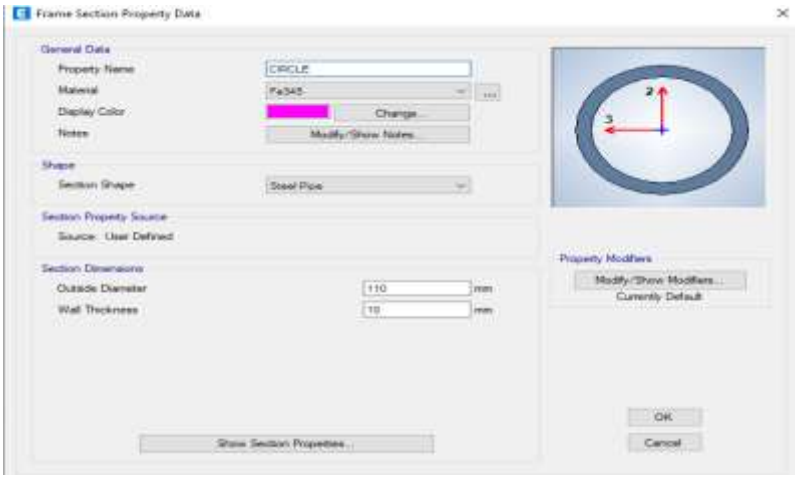

Figure5:Sectionpropertydataofcirclesection

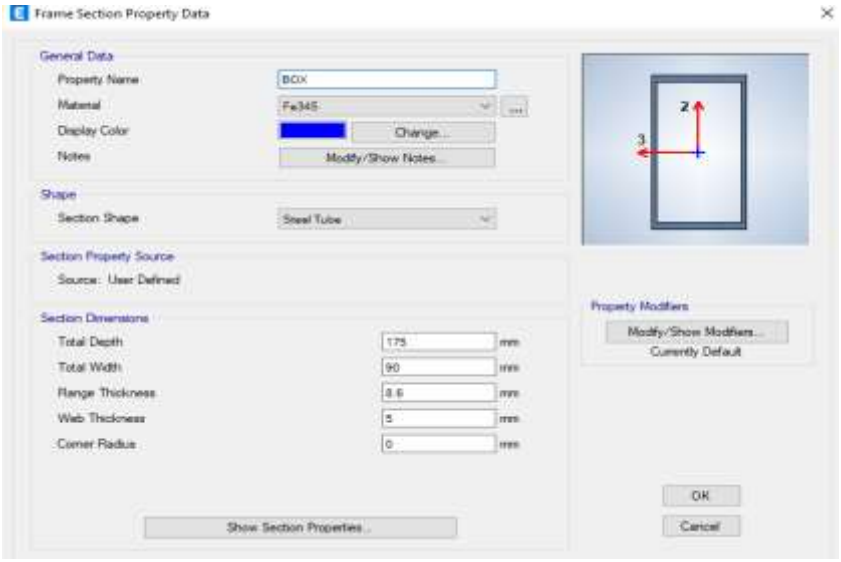

Figure6:Sectionpropertydataofboxsection

1.1.2 Timehistory(TH)functiondefinition

In this study, G+3 storey 3D steel building under time history analysis in ETABS 2019 for studying theeffectiveness of seismic response in the form of base shear, storey displacements drift and time period. In thisinvestigation, the horizontal ground motion records of the RSN: 753, Loma prieta :: Corralit from PEER groundmotiondatahave beenselectedforperformingthenonlineardynamicTH analysis.

Figure7:PGAofcorralitfromPEER

II. RESULT AND DISCUSSION

Forthestudyofseismicperformanceof EDB 4different modelsarecreated,theyare listedasfollows:

(i) Vbracedmodel
(ii) Vbraced modelwithEDB-300 mm-Isection
(iii) Vbracedmodel withEDB-300mm-Circlesection
(iv) Vbraced modelwithEDB-300 mm-Boxsection

The study is done by comparing the performance of models with EDB to the model with V bracing alone.The maximum value of their drift, displacement, base shear and time period results are taken after timehistoryanalysisinbothxandydirection.

2.1 Displacementresults

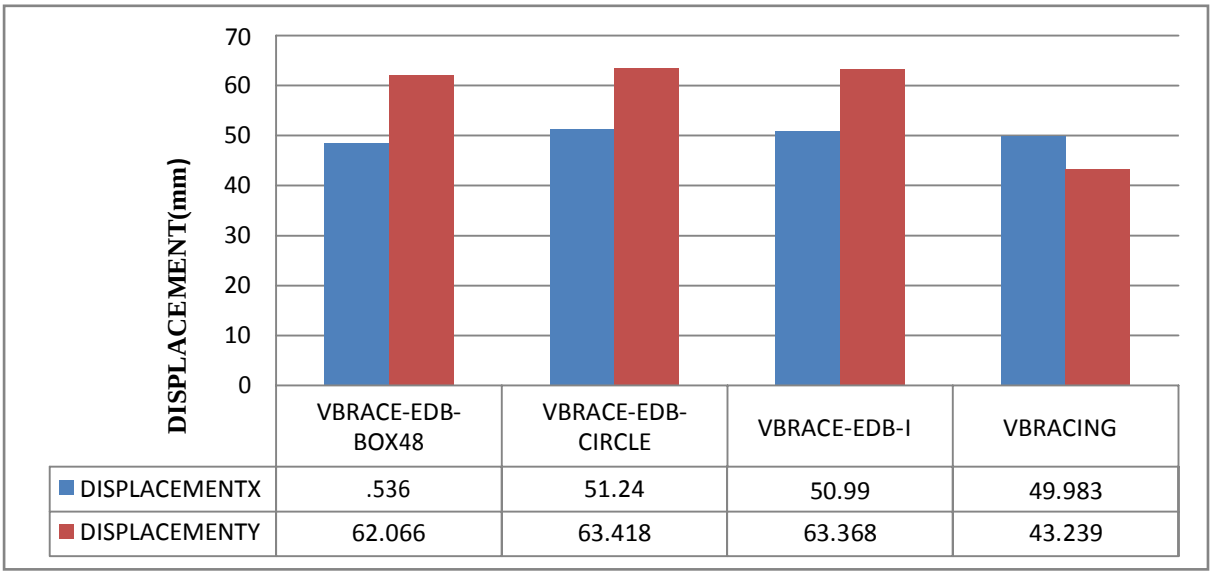

Figure8: Displacement-Vbraced modelwithdifferentcrosssectionsofEDB

ThedisplacementofVbracingwithEDBhavingboxsectionhasthelowestvalueamongmodels.Thereisonlynegligibledifference inthe displacementvaluesofmodels.

2.2 Baseshearresults

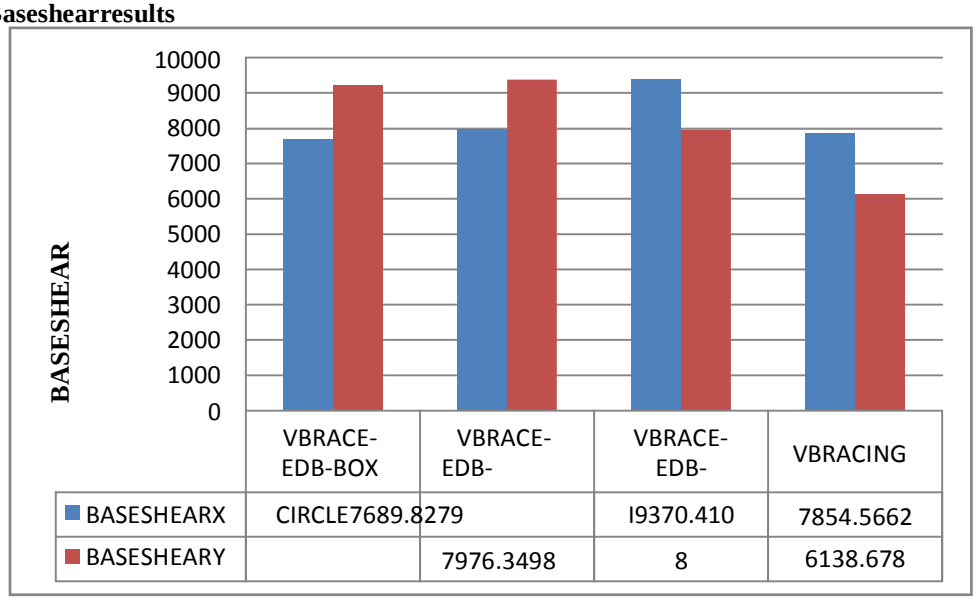

Figure9: Baseshear-vbraced modelwithdifferentcrosssectionsofEDB

ThebaseshearvalueislowestforVbracingwithEDBboxsectionamongallthemodels.

2.3 Driftresults

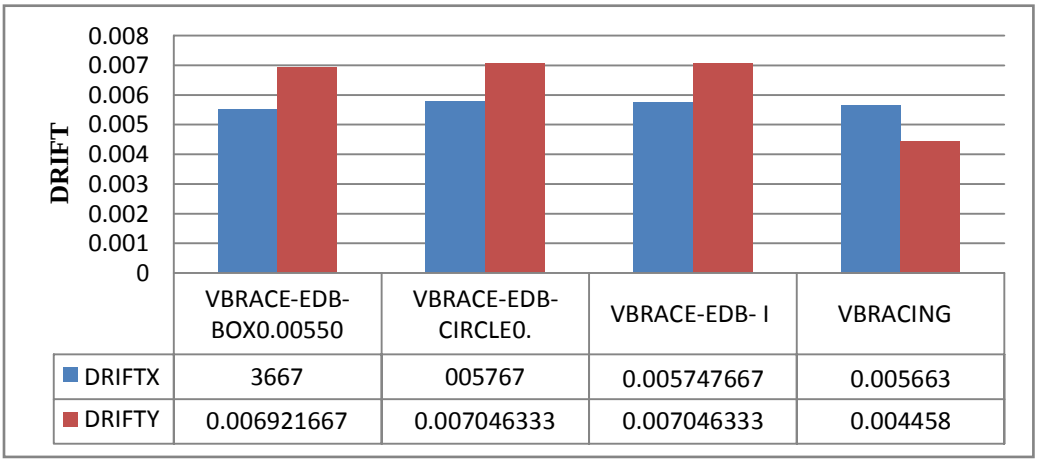

Figure10:Drift-Vbraced modelwithdifferentcrosssectionsofEDB

ThedriftislowestforVbracingwithEDBofboxsection.Allthemodelshavealmostsimilarvalues.

2.4 Timeperiodresults

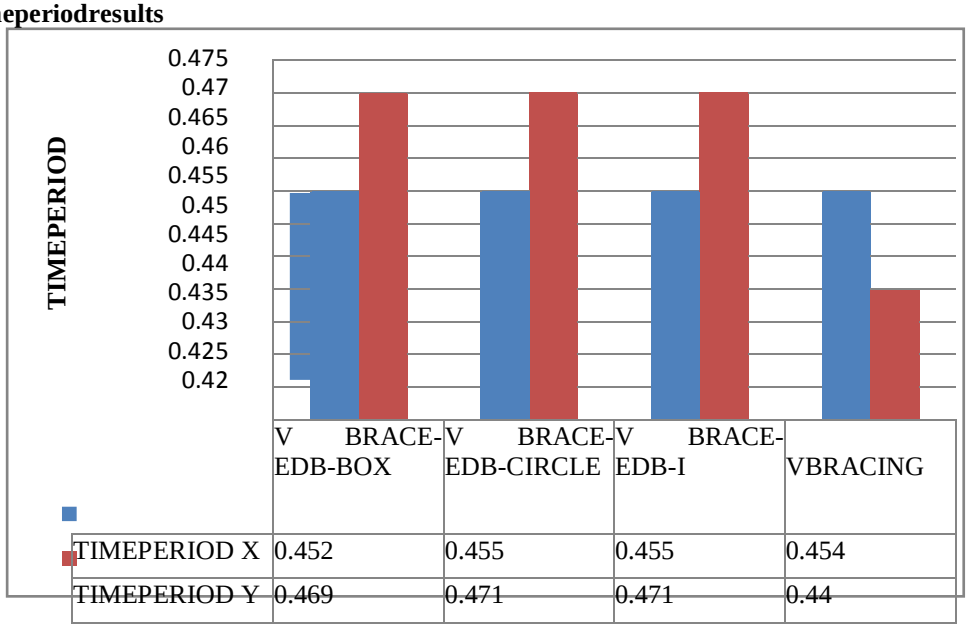

Figure11:Timeperiod-Vbraced modelwithdifferentcrosssectionsofEDB

ThetimeperiodvalueislowestforVbracedmodelwithEDBofboxsection.Allthemodelshavesamevaluesthere isnobigdifference seeninthevalues. Thedifference isnegligible.

III. CONCLUSION

It was observed that the displacement, base shear, drift and time period values of V braced model withbox section gives better values. The displacement has reduced by using box section. The time period is alsoreduced. The base shear value is also lowest for box section. The better performance is given by V braced modelwithboxsection.

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