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IRREGULAR SLAB TYPE STRUCTURES CONSISTING OF PRECAST ELEMENTS CONNECTED BY ENERGY DISSIPATERS

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Precast elements provide a versatile tool to construct especially one story industrial type buildings in a relatively short time. Theoretical and experimental research programs are going on to have more reliable cost effective structures consist of all precast elements in the earthquake prone areas. In addition to the beams and columns the slab elements and claddings are manufactured as precast elements to compose the building. Special attention has been exercised on the special connections of precast elements simply it is known that ***Beam to column, beam to cladding, cladding to foundation, cladding to cladding, beam to slab and slab to slab connections*** may cause drastic changes on the seismic response of the building. This is even pronounced for the *slab type structures* because of the in plane deformations of the first story slabs.

A special type of energy dissipating steel connectors which can be utilized for putting together some of the above mentioned precast elements have been tested in the *Structural Dynamics and Earthquake Engineering Laboratory of Istanbul Technical University* (STEELAB) within the framework of a research project called SAFECLADDING .This is a long term international project which is being supported by the European Commission .

Diaphragm action of a *slab type structure* consisting of precast elements with one or two dimensions which are connected to each other by energy dissipaters has been parametrically investigated in the complementary paper presented in 2ECES, [1].

Shear walls in short direction at both ends of the classical slab type structures cannot be used for certain structural configurations namely if it has only one exterior side. At this side of the building where shear wall panels can be placed so that a tubular part can be formed with relatively high torsional rigidity using similar panels in order to resist the big torsional moment due to earthquake forces, see Figure no. 1.

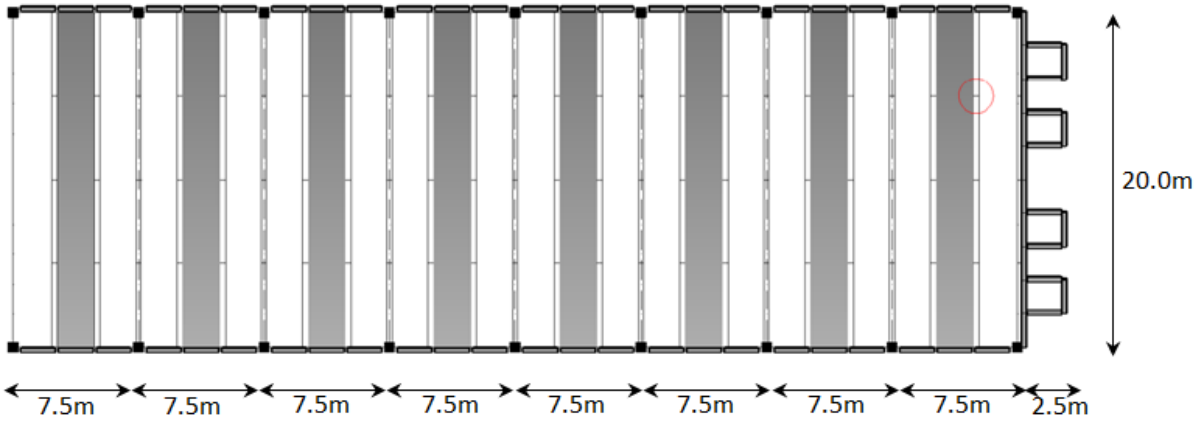

Figure 1. Story plan and features of the building

In this paper, the effects of individual connectors on the overall response of this type irregular simple one story precast structures subjected to selected earthquake records [2], have been parametrically investigated. For this purpose, a special structural model has been prepared using the very well-known computer program SAP2000 [3] taking into consideration all kind of material and geometrical nonlinearities. Some of the geometrical features of the model used are given in the figure no 1 as well.

This prototype has been prepared keeping in mind the following properties:

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1) Depending on the lateral rigidity of the connectors one can create three different type of connections namely ***isolated connections*** which will be very loose connections, ***integrated connections*** which will be very stiff connections or the connection will display a behavior in between these extreme cases. All these connectors could be utilized to join the slab and panel elements to each other and to join the slab and panel elements to beam and column elements as well .

2) Using the lateral rigidity of the claddings one can create a slab type structure which has two shear walls at each long side and frames in between as it is shown in figure no 2 simply controlling the lateral stiffness of steel connectors.

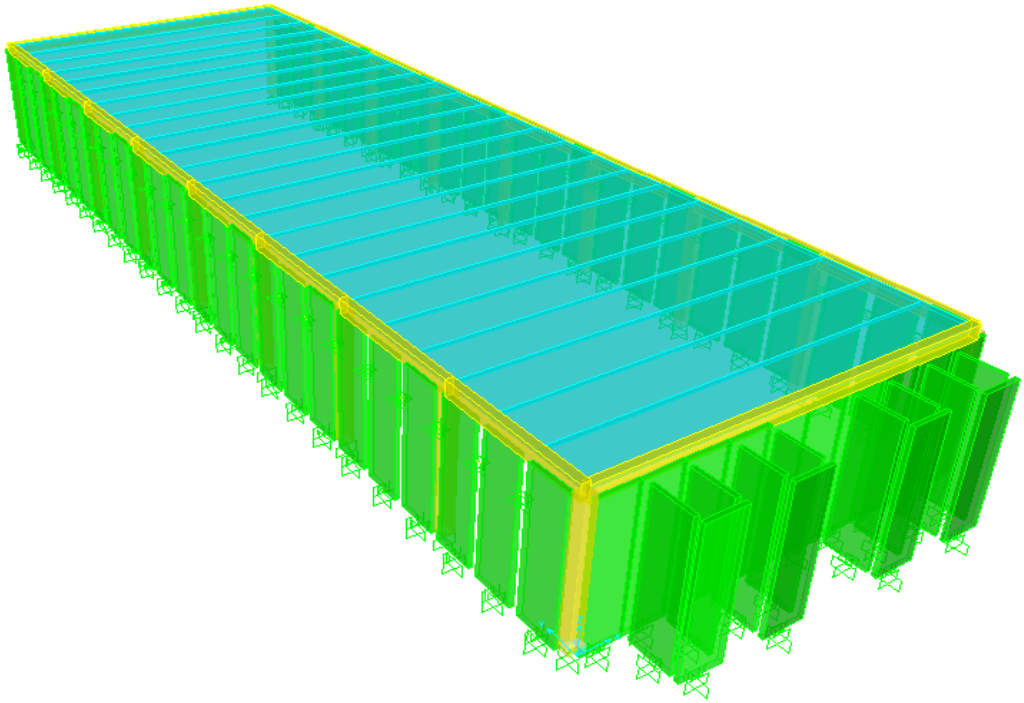

Figure 2. General view of the slab type structure which has two shear walls.

3) There will be no difficulty to resemble hinged, rigid and semi-rigid connections between beam to columns, between slab to beam, between slab to slab etc.

A sample to the connectors so called ***steel cushions*** tested in the lab is presented in Figure no 3.

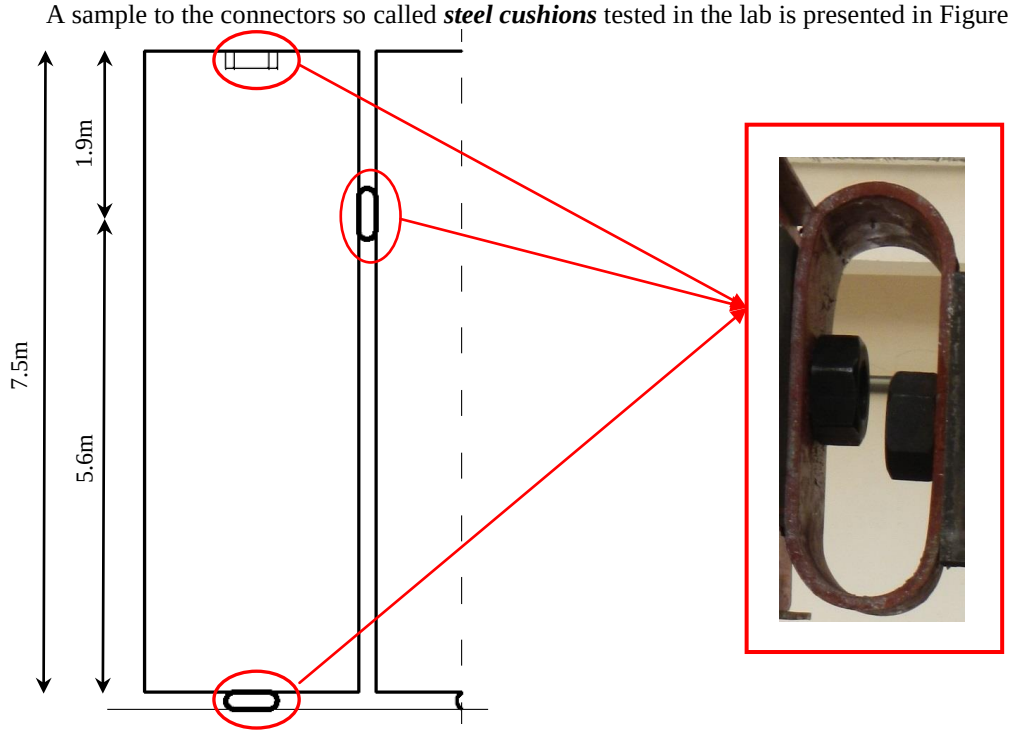

Figure 3. A sample of steel cushion

For the analytical representation of the test data the very well-known WEN model has been adopted. In figure no 4 the experimental and analytical results are shown together to prove the eligibility of the analytical model in this parametric work.

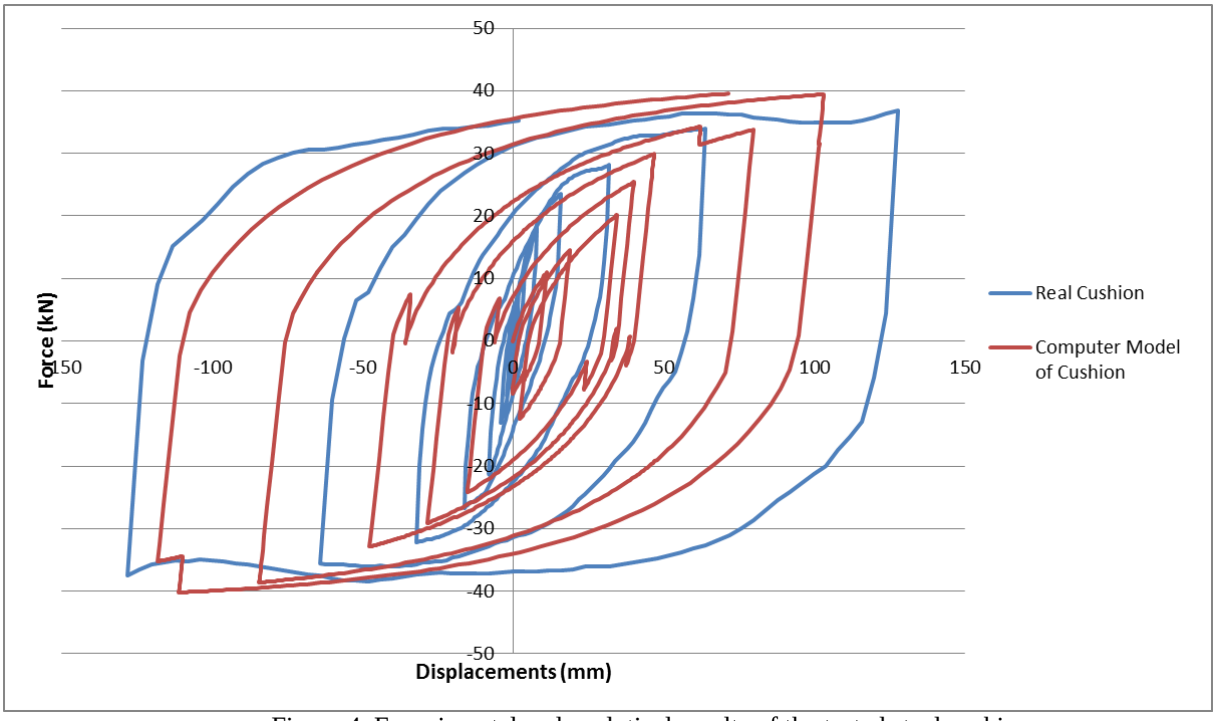

Figure 4. Experimental and analytical results of the tested steel cushion.

At the end of this parametric study, the following early results have been achieved.

1) The demand of torsional resistance of this type irregular structure is reduced by using special energy dissipating connectors between slab and cladding elements for controlled transfer of the inertia forces to the foundation system.

2) The flexibility provided to the structure by energy dissipating connectors increases the chance of a proposal for a cost effective design procedures not only for retrofitting of the existing industrial buildings but also for new constructions.

3) Hysteretic energy dissipated at each connection indicates to what extent effective will be the connector used in that particular location. This is going to be a chance for having adopted the concept of energy based design for retrofitting the existing and new precast simple structures.

REFERENCES

[1] Karadoğan H F et al., "Diaphragm action of slab type structure consisting of precast elements connected by energy dissipaters", *Second European Conference on Earthquake Engineering and Seismology*, Istanbul, Turkey, 24-29 August 2014.

[2] Bal I E et al., "An engineering approach for structural-oriented earthquake record selection", *Second European Conference on Earthquake Engineering and Seismology*, Istanbul, Turkey, 24-29 August 2014.

[3] SAP2000 V15.0, Structural Analysis Program, CSI Berkeley, 2011.