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# ESTIMATION OF LATERAL DISPLACEMENT DEMAND ON PRECAST RC STRUCTRUES FOR DESIGN OF CLADDING PANELS

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The current design practice of precast buildings is based on a frame model where the peripheral cladding panels are taken into account in the model only as mass without any stiffness. The panels are then connected to the structure with fastenings, the dimensions and properties of which are defined by using calculations regarding only the claddings. In other words, the interaction between the cladding and the supporting main frame is neglected. Seismic resistant design of claddings needs the a priori assumption that there will be a rather significant interaction between the panels and the frame in case of the slightest load-transferring connection between the two. In this case, the performance of the cladding system primarily depends on the response of the precast RC frame. The type and tolerances of the connections, as well as the allowed rotational and slip behaviours imposed by the geometric constraints, all depend on a sole parameter, which is the top displacement demand of the frame structures. The issue is relatively more complicated in multi-storey buildings but the top displacement of single-storey precast frames still remains as the controlling parameter in detailing of cladding connections.

This paper is aimed to investigate the top displacement demands on RC precast structures so that the design criteria for cladding systems could be found. In order to do this, precast structures that are designed according to EC8 (CEN, 2004) have been analysed by using no claddings in the numerical model (see Figure 1), then adding claddings with connections varying from weak connection to near-full connection. The nonlinear analyses mentioned above have been conducted by using 20 real accelerograms, taken from the study by Bal et al. (2014). The records have been selected by using a special algorithm and set of criteria provided in that publication. According to this, the record selection criteria provide a list of selected records that decrease record-to-record variability as much as possible. A the end of the nonlinear time history analyses, the change in the displacement demand as well as the hysteretic energy consumed in the connection of the claddings and in the RC frame has been presented. The distribution of the base shear forces has also been investigated.

A 3D model of one of the case studies examined is shown in Figure 1. The displacement demand for that model is estimated to be around 18cm, corresponding to 2.4% drift, for a Eurocode 8 acceleration spectrum with 0.36g PGA. The readers are asked to see Yüksel et al. 2014a and 2014b for the details of the panel connections indicated in Figure 1. It was found at the end of the benchmark analyses that the displacement demand is at least halved when cladding are connected to each other at three levels on the sides. This means that in a panel of 2.5m wide and 9m tall, 18cm of sliding tolerance would be needed in average if no panel-to-structure interaction were desired.

The results show that the increase in stiffness and strength of cladding connections increases the tendency of non-synchronized response of internal and external frame increasing thus the roof-to-beam connection forces and need for rigid diaphragm. The results also show that the cladding connections can consume around 10% of the overall hysteretic energy (see Figure 2) even with the

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slightest connection examined in this study, and this ratio can go up to 60% depending on the rood rigid diaphragm properties and the connection strength and stiffness.

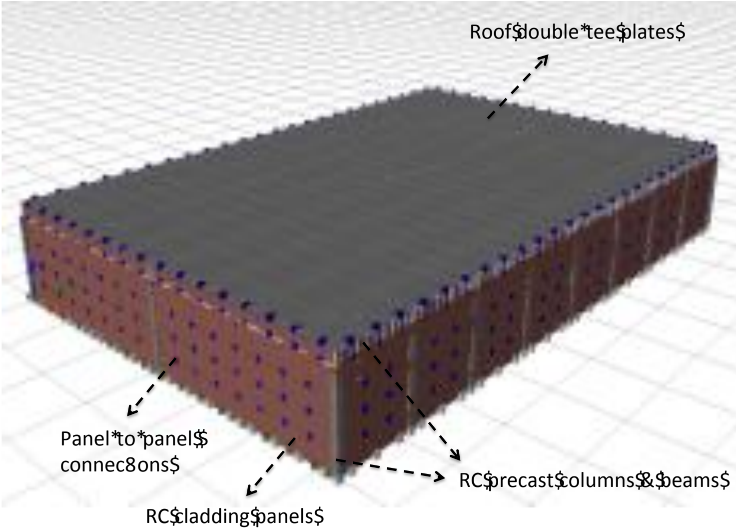


Figure 1. A 3D numerical model of the RC precast structure in SeismoStruct with cladding panels and roofing elements

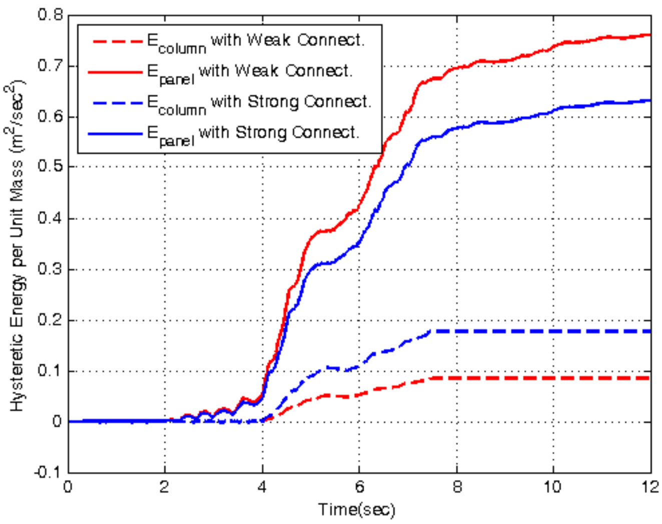


Figure 2. Comparison of the cumulative hysteretic energy consumed in columns and in panel connections versus time in an example nonlinear time-history analysis with weak and strong panel-to-panel connections

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