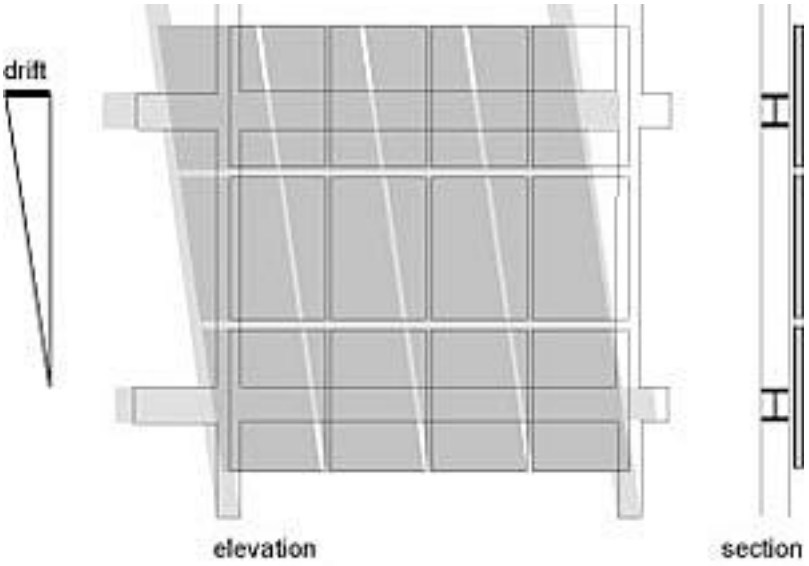
DUAL-WALL FRAME NEEDED IN THE CASE OF STRONG EARTHQUAKES.

The design practice of precast buildings is usually based on a frame mode, where the peripheral cladding panels enter only as masses without any stiffness. The panels are then connected to the structure with fastenings dimensioned with a local calculation on the basis of their mass for anchorage forces orthogonal to the plane of the panels. This design approach does not work, as it was recently dramatically shown by several recent violent shakes, like L'Aquila (Italy) in 2009, Grenada (Spain) in 2010, and Emilia (Italy) in 2012.

New technological solutions for connectors with proper design approaches were urgently required. The research project SAFECLADDING was thus aimed at investigating, by means of a balanced combination of experimental and analytical activity, the seismic behavior of precast structures with cladding wall panels and at developing innovative connection devices and novel design approaches for a correct conception and dimensioning of the fastening system to guarantee good seismic performance of the structure throughout its service life.

The precast structures considered are frame systems made of columns and beams connected with horizontal floor diaphragms. In particular the roofs can provide rigid, deformable or null diaphragms. To this frame system, for the peripheral cladding, a set of wall panels is added that, depending on the type of connections to the structure, may not interfere with the frame behavior or may interfere leading to the interaction between the panels and the frame and to an increased stiffness of the system. In this dual wall-frame system a set of dissipative connections may be present able to attenuate the seismic response.

For new buildings with integrated arrangements of wall panel connections, the structural analysis under seismic action shall refer to the dual wall-frame system that includes in the resisting structure columns, beams, floor elements and a dual wall-frame with cladding panels with their connections to avoid possible failure of the fastening system and the fall of the panels during strong earthquakes.



In short: the dual-wall frame must be able accommodate horizontal drift or deformation of the building structural frame and so secure seismic safety avoiding damage or possible drop-off of the panels.

Seismic design methods for curtain walls have been developed by research into resilient and adhesive materials for panel retention. The later work

has not been specific to seismic issues since protection against wind is also a major factor in cladding design problems. The seismic problem is primarily that of protection from in-plane forces while that of wind is primarily concerned with out-of plane effects. The design of effective resilient glass retention systems contributes to the solution of both.

Of all the elements of the building envelope cladding panels attached to the dual-wall frame structure require the most design and construction attention to ensure seismic safety. These dual-wall frames typically span from floor-to-floor, so horizontal drift or deformation of the building structural frame can create considerable racking forces in panels that are rigidly attached at the dual-wall frame, resulting in damage or possible drop-off. Therefore the attachment of these panels must permit differential movement of the floors without transmitting racking forces to the panels. This is achieved by a flexible connection of panels to structure. So therefore a flexible bonding connection is preferred above rigid connection with screws or rivets.

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