

EXPERIMENTAL INVESTIGATION AND MODELING OF PRECAST SYSTEMS

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The research group is interested in the characterization of precast reinforced concrete structural elements such as beams, single- or multi-storey columns, columns anchored to the foundation, beam-column joints and sandwich panels, with regard to the serviceability and ultimate limit states.

The research group carried-out lab tests on full-scale specimens and developed numerical models for the interpretation of the experimental results. The tests performed focused on different mechanical problems such as: the long-term behaviour; the evolution of strain distribution in precast reinforced concrete beams constructed by stages; cyclic tests on anchoring systems for columns; cyclic tests on full-scale three and four ways beam-column joints; cyclic tests on columns. Currently, the research group is working on innovative wall systems made of concrete and weak reinforcement and walls made of wooden blocks. Monotonic and cyclic tests have been conducted on full-scale specimens in order to characterize the seismic behaviour also, as well as tests for the evaluation of the performance of thermal and acoustic insulation. The group is also studying the development of a dissipative device, based on carbon wrapped steel tubes, to insert for retrofitting of friction-based beam-column connections in precast reinforced concrete structures designed without seismic criteria. Experimental tests have been carried out in order to characterize the mechanical behaviour of the devices and numerical models have been developed in order to investigate their effectiveness in reducing seismic vulnerability of structures. Design criteria have also been proposed.

After the 2012 Emilia earthquake the research group has been deeply involved in the assessment of seismic vulnerability of precast buildings. The group members performed field surveys during which a significant amount of data on structural damage was collected. These data were analyzed in order to derive fragility models and compared with the results of nonlinear FEM models.



Fig. 1. Experimental set-up for creep test on precast beams (Mazzotti).



Fig. 2. Cyclic loading test on beam-column node in full-scale (Mazzotti).



Fig. 3. Dissipative beam-column connection for precast structures (Reglass and Pollini).

MAIN PUBLICATIONS

Bovo M, Gelsi M, Savoia M., (2015) Calibrazione di una metodologia per la stima degli spostamenti relativi trave-pilastro in edifici a struttura prefabbricata con connessioni ad attrito. 16° Convegno ANIDIS, 13-17 Settembre, L'Aquila.

Minghini F., Tullini N., Buratti N., Ongaretto E., Savoia M. (2015) Curve di Fragilità Empiriche Relative agli Edifici Industriali Colpiti dalla Sequenza Sismica del 2012 in Emilia, XVI Convegno ANIDIS – L'ingegneria sismica in Italia, L'Aquila 13-17 settembre.

Savoia M., Buratti N., Ligabue V., Vincenzi L. (2015) The "Emilia" earthquake: an overview of damages and collapses in industrial precast buildings. New Dimensions in Earthquake Resilience, 2015 NZSEE Conference. Rotorua, Nuova Zelanda, 10-12 aprile.

Bovo M, Savoia M., D'Amico M., (2014) Analisi di vulnerabilità di un capannone industriale prefabbricato mediante diverse tipologie di analisi, 20° Congresso CTE, Milano, 06-08 novembre.

Bovo M, Savoia M., Ligabue V., (2014) Validazione dell'intervento di miglioramento sismico di un capannone industriale prefabbricato mediante diverse tipologie di analisi", Atti del Workshop "Tecniche innovative per il miglioramento sismico di edifici prefabbricati" (Bologna, 22 ottobre 2014), SAIE Built Environment Exhibition - ACI Italy Chapter.

Pollini A.V., Buratti N., Mazzotti C. (2014) Effectiveness of a dissipative beam-column connection based on carbon-wrapped steel tubes. 2nd European Conference on Earthquake Engineering and Seismology, Istanbul, Turchia, 25-29 agosto.

Buratti N., Bacci L., Mazzotti C. (2014) Seismic Behaviour of Grouted Sleeve Connections Between Foundations and Precast Columns. 2nd European Conference on Earthquake Engineering and Seismology, Istanbul, Turchia, 25-29 agosto.

Pollini A. V., Mazzotti C., Savoia M. (2013) Comportamento sperimentale e numerico di un sistema dissipativo per le connessioni di strutture prefabbricate. 15° Convegno ANIDIS, 30/06-04/07/2013, Padova.

Savoia M., Mazzotti C., Buratti N., Ferracuti B., Bovo M., Ligabue V., Vincenzi L. (2012) Damages and collapses in industrial precast buildings after the Emilia earthquake. *Ingegneria Sismica*

3-3, 120-131.

Bovo M., Mazzotti C. (2012) Indagini numeriche su nodi trave-colonna a tre vie per sistemi prefabbricati completati in opera. 19° Congresso C.T.E. 8-10/11/2012, Bologna.

Mazzotti C., Vincenzi L. (2010) Experimental Investigation on a Beam-Column Node of a Multi-Story Precast RC System. 14th European Conference on Earthquake Engineering, 30/08/2010 - 3/09/2010, Ohrid, Republic of Macedonia.

Bottoni M., Mazzotti C. e Savoia M. (2009), Long-term experimental tests on precast beams completed with cast in situ concrete, *European Journal of Environmental and Civil Engineering*, 13(6), pp. 727-744.

Benedetti A., Finotto E., Montesi M. (2007). Modellazione ad Elementi Finiti di Edifici a Struttura Prefabbricata in Zona Sismica, Atti del XII Convegno Nazionale L'Ingegneria Sismica in Italia, 10-14/06/2007. Pisa, Italy.

Vincenzi L., Mazzotti C., Savoia M., Ceccoli C., Ferrari M. (2007). Investigation of ultimate capacity of beam-column joints of precast system. *Studies and Researches* Vol. 27, pp. 93-116.

RESEARCH PROJECTS

Research Project with APE (Montecchio Emilia - RE) for the study of the mechanical behaviour of precast elements completed on site. Coordinator: Prof. Marco Savoia

Research Project with REGLASS (Minerbio - Bo) for the development of dissipative beam-column connections in precast reinforced concrete structures

Research Project with ISOBLOC (Soragna - Pr) for the study of innovative block-formwork systems.

2014-2016: Research project funded by the Department of Civil Protection – Reluis, Task 2.1. "Capacità sismica di strutture prefabbricate e tecniche di intervento" - Reinforced Concrete Structures, Coordinators: Prof. Monti, Prota, Spacone.

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