Seismic strengthening of reinforced concrete beams by post-tensioning with anchorages by bonding

Summary

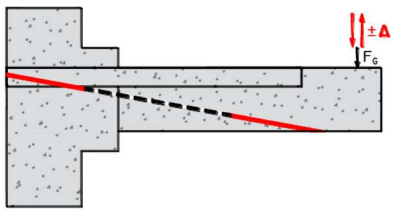
RC moment resisting frame buildings are one of the most used structural systems in seismic prone regions. These structures dissipate energy by concentrating the inelastic behaviour (i.e. the damage) in the plastic hinge regions of the structural elements, that form preferably on the beams ends. Since Capacity Design has been part of the Design Codes for some years now, some moment resisting frame buildings have suffered seismic events. Although in most of the cases the ductile performance of structures has successfully preserved the human lives and no collapse has occurred, deficiencies regarding the residual capacity and high level of post-earthquake damages have surfaced. The importance of other solutions that offer higher cost-efficiency and are more resilient has emerged.

Some studies have shown that damage limitation leads to high seismic performance of structural systems even. This technology was developed at first for application in precast industry, PRESSS program. Considering the vast amount of existing structures built following the Capacity Design and the advantages of Damage Avoidance Design, strengthening by post-tensioning with adhesive anchorages is proposed in this dissertation as a promising intervention for improving the seismic behaviour of ductile beams. This solution takes advantage of self-centering capacity of unbonded PT strands, whereas development of bonded anchorages turns this solution suitable for application in residential / business frame buildings. The results obtained from four RC beams tested experimentally will be presented herein, including one reference and three strengthened specimens. The strengthened beams had reduced residual deformation and enhanced load capacity.

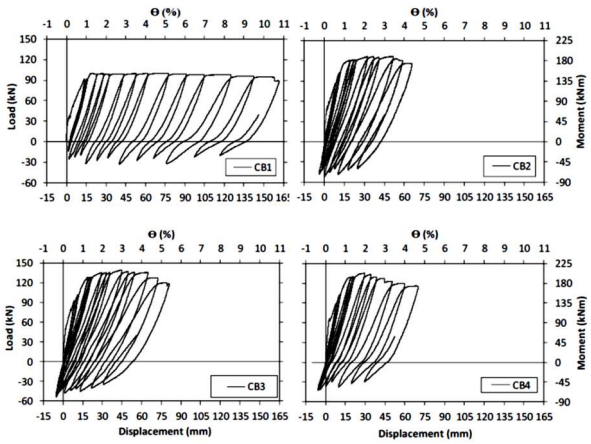
The behaviour of the beams tested experimentally was also studied through numerical analysis. The attained results show that strengthening by post-tensioning with bonded anchorages represents a suitable intervention for reducing the impact of seismic events. Reduced damage of structural elements in RC frame after a seismic event leads to reduced (or absence) cost of repair and building downtime.

Keywords

RC moment resisting frames, plastic hinges, gravity load, cyclic loading, seismic strengthening, post–tensioning with bonded anchorages.



Specimen CB2.



Load-displacement diagrams for specimens CB1, CB2, CB3 and CB4 (up to failure).

PhD student
Helisa Hehuran Muhaj

PhD program
Civil Engineering (FCT, Nova University of Lisbon)

Supervisor
Carla Marchão (FCT, Nova University of Lisbon)

Co-supervisors
Válter Lúcio (FCT, Nova University of Lisbon; CERIS, IST, University of Lisbon) and Ana Sousa Gião (ISEL, Polytechnic Institute of Lisbon; CERIS, IST, University of Lisbon)

Period
2015-2020

Funding
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