CERIS : Civil Engineering Research and Innovation for Sustainability

Numerical analysis of coupling beams subject to cyclic loads with stress field models

PhD student
Miguel Carlos Pedrosa Ferreira

PhD program
Civil Engineering (IST, University of Lisbon)

Supervisor
João Almeida (CERIS, IST, University of Lisbon)

Co-supervisors
Miguel Lourenço (IPS-ESTBarreiro)

Period
2013-2021

Funding
-

Summary

Seismic assessment and design of structural concrete elements in D regions are essential to ensure an overall response with appropriate strength and ductility levels. The missing knowledge of the cyclic deterioration can lead to blind use of prescribed methods without knowing its assumptions or the use of simplified models without considering the cyclic effects.

The cyclic response generates itself a resistance reduction, which is noted by the inability to obtain the same force-displacement pair in different cycles. In general, the response to repeated cycles presents a lower force compared to the first cycle, in which a new maximum of imposed displacement is reached. Also, the structure' response to a displacement increasing does not always reach the level of resistance obtained previously, evidencing cyclic degradation.

The study of the origin and sequence of phenomena that cause the cyclic deterioration are one of the objectives of this dissertation. The coupling beam elements are the main scope of study, due to its importance in seismic resistant systems. In order to enphasize the cyclical deterioration aspects, reinforcement detailing without diagonal bars were mainly considered. This choice makes it easier to extend the knowledge acquired to other important discontinuity regions, as well as to carry out the analysis of existing structures with conventional detailing, only with longitudinal reinforcement and stirrups.

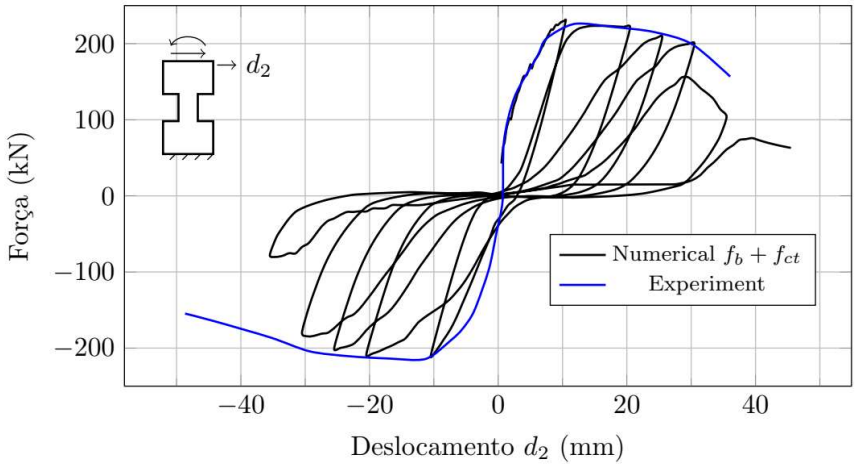
The experimental tests performed and published cover a multiplicity of factors, which makes it difficult to interpret the influence of each parameter or option taken in the definition of the tested elements.

A numerical tool for cyclic analysis, considering appropriate behavioural models, is essential for the study these regions response. In this work this methodology was developed, based on continuous stress field models, in which explicit bond modelling was fundamental for the simulation of the effects of cyclical actions.

The developed model is applied and validated with the study and numerical simulation of experimental tests.

Keywords

Coupling beams, cyclic analysis, stress field models, cyclic deterioration, material models with cyclic behaviour.



Cyclic response of a couple beam with L/h = 1.4.