Finite Elements for Simplifed Concrete Analysis in 3D (FESCA 3D)

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Introduction

What? Nonlinear finite element-based tool for the analysis and design of 3D concrete structural elements

Why? Versus existing commercial FE software:

- a simpler, more user friendly model
- allowing for a better understanding of structural behaviour
- leading to safer and more efficient designs
- appropriate for educational purposes

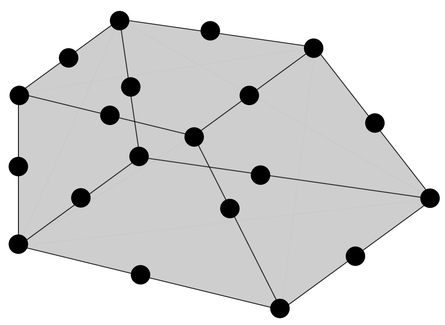
How? Self-developed code in MatLab

Description

Finite Elements

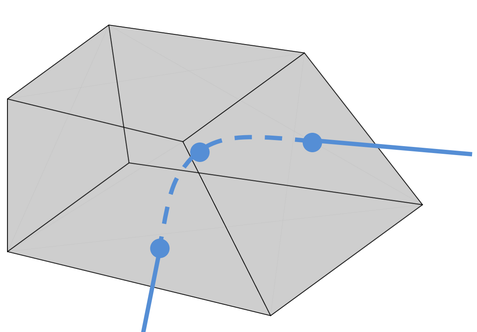
Concrete

20-node hexahedron



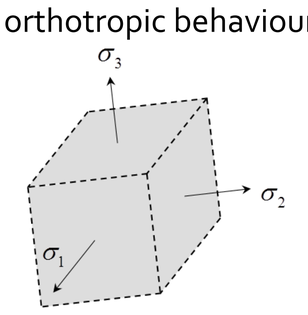
Reinforcement

3-node bar



Simplified Concrete Analysis

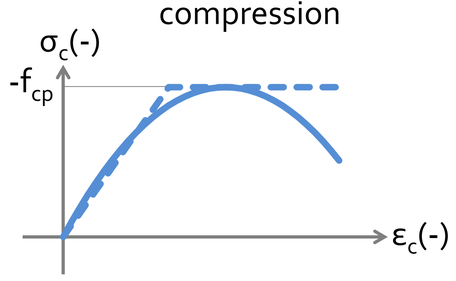
- 3D orthotropic behaviour



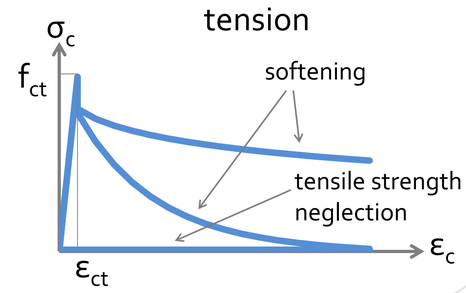
- smeared cracking

- support and load conditions easy to define: fixed, constant stress, implicit steel plate

compression



tension



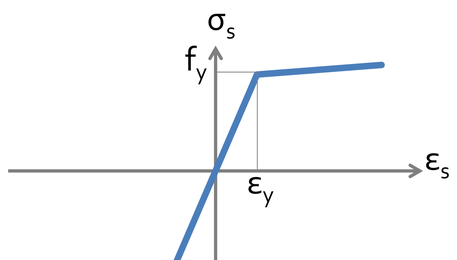
- embedded representation

- curved rebars

- concrete bond: perfect or slip

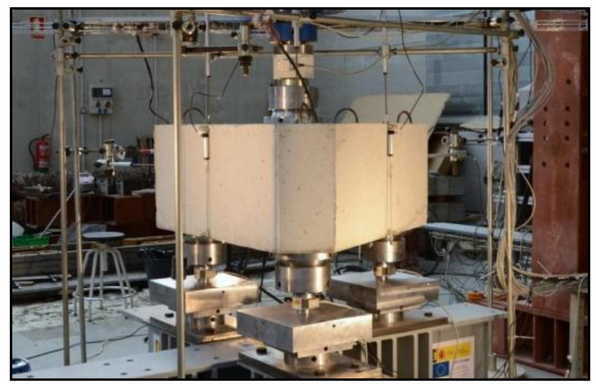
- mesh independent of reinforcement layout

multilineal stress-strain law



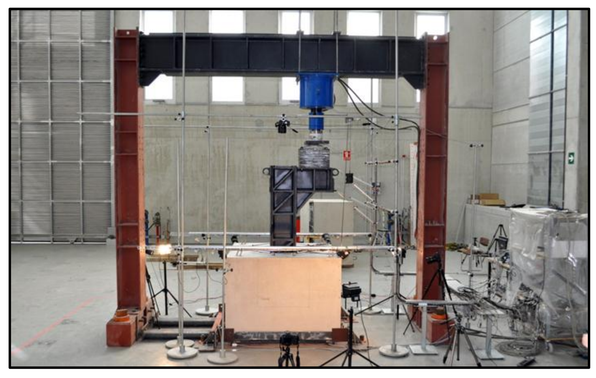
3D

pile caps



Lucía Miguel's experimental program

socket base foundations



Moisés Gutiérrez's experimental program

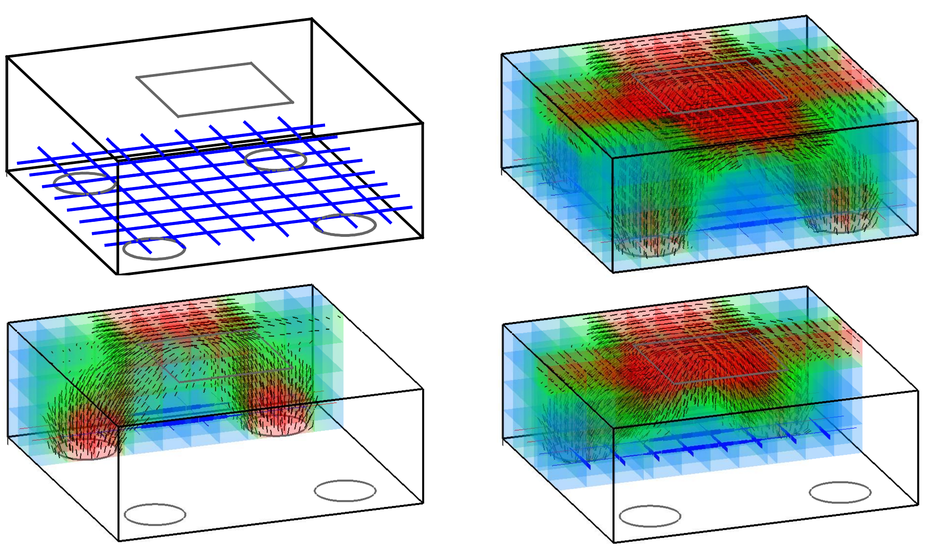
...and other 3D structural elements

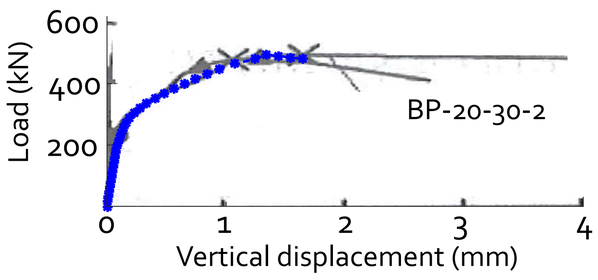
Analysis & Results

Four-pile cap under central vertical load

(specimen from K. Suzuki, K. Otsuki, T. Tsubata, Influence of bar arrangement on ultimate strength of four-pile caps, Transactions of the Japan Concrete Institute 20 (1998) 195-202)

Compressive stresses



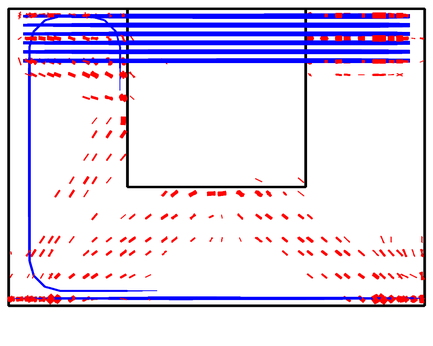


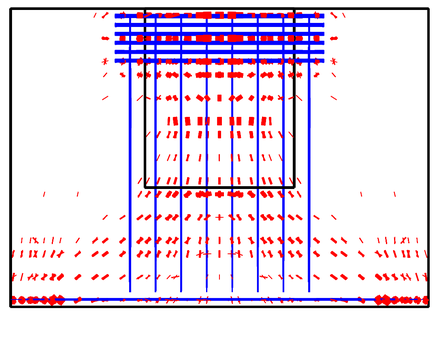
experimental
vs.
numerical

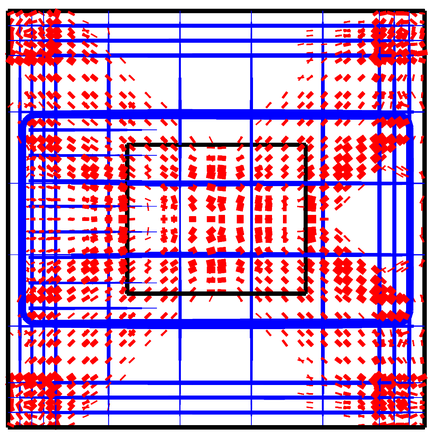
Socket base foundation under horizontal and vertical load

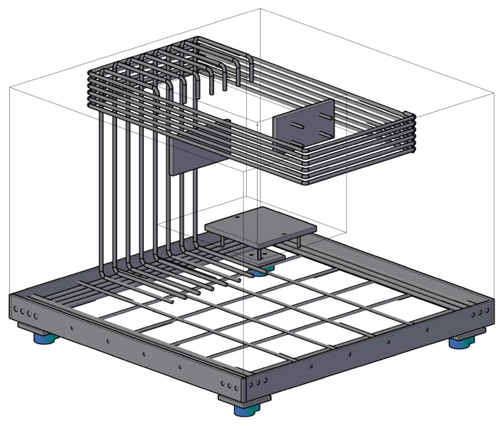
(experimental program undertaken by Moisés Gutiérrez, Pedro Miguel, Luis Pallarés)

Compressive stresses









Reinforcement layout designed by M.Gutiérrez

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