17 de Junho | 15h00 – 16h00
Faculdade de Ciências e Tecnologia
Universidade Nova de Lisboa
Ed. IX, sala 4.17

palestras de ENGENHARIA CIVIL na NOVA

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Part 2. Advantages of the mixed format in geometrically nonlinear analysis of slender structures

This lecture deals with the advantages in the analysis of slender elastic structures achieved through the mixed (stress and displacement) format with respect to the more commonly used displacement one.

A Newton iterative scheme is usually used to solve the nonlinear equations in large displacement problems. It uses an iteration matrix evaluated at the current estimate. In beam/shell problems, where the membrane stiffness is typically much higher than the flexural one, small changes in the displacements can lead to large changes in the stresses and then in the iteration matrix. For this reason, when a displacement formulation is employed, the number of iterations required to evaluate the equilibrium path quickly grows as the membrane/flexural stiffness ratio of the structure increase while, at the same time, the step size required to avoid loss of convergence drastically decreases. The robustness and the efficiency of the Newton iterative scheme are then penalized in displacement formulations because of a phenomenon that we called "extrapolation locking". This is not a locking of the FE discretization, but of the iterative scheme.

A mixed description, where the stresses are independent variables, is not affected by this drawback. The first part of the lecture focuses on the origin of the phenomenon. Subsequently, a Mixed Integration Point strategy, suitable to be applied to displacement based finite element and isogeometric formulation, is presented. A series of numerical results for shells and thin-walled structures, using a solid-shell formulation, are discussed.

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