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NON LINEAR ELASTIC CROSS SECTION MODEL BASED ON THE GLOBAL DEFORMATIONS ANALYSIS

ABSTRACT

The evaluation of the structures' reliability is affected by different types of uncertainties, which may be classified as physical, statistical and model uncertainties. The last group results from the hypothesis and simplifications adopted for the calculation models.

It is well known that most of the steel structures present nonlinear behaviour before they attain their ultimate limit states and, occasionally, before their serviceability limit states. Consequently, an efficient analysis of a steel structure should take in account all the relevant factors contributing for this nonlinearity. These factors may result from the second order effects associated to the deformed configuration of the structure or from the nonlinear behaviour of the materials. As far as it concerns these last ones, it should allow to follow the evolution of plasticity along the cross sections and length of the structural members, take in account the influence of the residual stresses, and make a correct evaluation of the material's hardening influence on the structure's behaviour.

The cross section model presented on this paper is a semi-analytical method, developed for the study of two dimensional steel structures made of linear members. It allies the lightness and rapidity of the "cross section models" with the accuracy of the numerical methods, fulfilling the exigencies mentioned above.

The control variables are the global deformations of the cross section. The calculation of the section's efforts and stiffness is developed analytically for all possible combinations of global deformations evolution. The resulting expressions, written in a non dimensional form, enable a fast computation of these variables, which makes this model specially suitable for the application in reliability studies.

The basis of this model in its generalised form is introduced, and the analytical expressions for a simplified version are presented in detail. The performance of the model in geometrical and material nonlinear analysis is illustrated by comparing its results to those obtained by other authors, in analytical and experimental studies of some simple structures.