Comparison between safety formats in nonlinear analysis of a reinforced concrete structure

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The focus of the present work is on the assessment of design value R_d of the load bearing capacity of a reinforced concrete beam by means of a non-linear finite element model and a safety format. The RC structure under investigation is a simply supported beam with a span length of approximately 5.7 m and with nine circular holes in the web, with a diameter of 0.3 m and a spacing of 0.63 m (Figure 1).

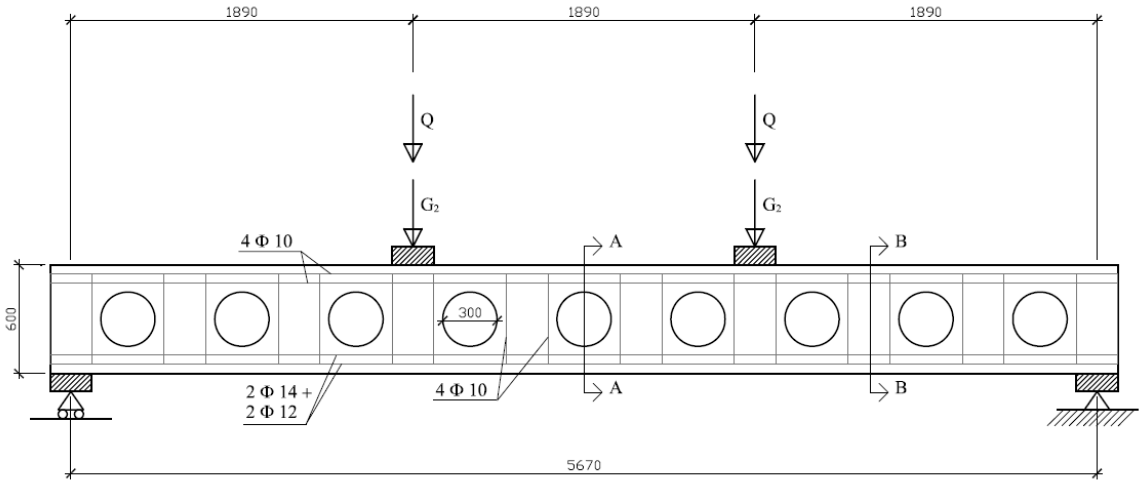

Figure 1. Structural layout

Using the partial factor safety format, the design resistance R_d is obtained by means of a single FE analysis, which is performed using the design values of the material resistances f_d:

$$R_d = \frac{R_{\text{FEmodel}}(f_d)}{\gamma_{\text{Rd,FEM}}} \tag{1}$$

As a first approximation, $\gamma_{\text{Rd,FEM}}$=1.3 has been adopted for 2D FE models.
By using the global resistance safety format, the design resistance is obtained as:

$$R_d = \frac{R_m}{\gamma_R^* \gamma_{\text{Rd,FEM}}} \tag{2}$$

Where R_m is the structural resistance predicted by a non linear analysis performed introducing the mean values of the material properties and γ_R^* is the global resistance factor.
The global resistance format is applied using two different approaches:
- approach A1: non-linear analysis using the mean values of material properties according to EN1992-1-1 and application of the global resistance factor, which is estimated from the resistances R_m and R_k ;
- approach A2: non-linear analysis using the mean values of material properties according to the Probabilstic Model Code and application of the global resistance factor.

The partial factor and the global resistance safety formats are compared and the results obtained with each procedure are discussed.