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Resistance and Sub-Resistances of RC Beams Subjected to Multiple Failure Modes

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Abstract : Geometric and mechanical properties all influence the resistance of RC structures and may, in certain combination of property values, increase the risk of a brittle failure of the whole system. This paper presents a statistical and probabilistic investigation on the resistance of RC beams designed according to Eurocodes 2 and 8, and subjected to multiple failure modes, under both the natural variation of material properties and the uncertainty associated with cross-section and transverse reinforcement geometry. A full probabilistic model based on JCSS Probabilistic Model Code is derived. Different beams are studied through material nonlinear analysis via Monte Carlo simulations. The resistance model is consistent with Eurocode 2. Both a multivariate statistical evaluation and the data clustering analysis of outcomes are then performed. Results show that the ultimate load behaviour of RC beams subjected to flexural and shear failure modes seems to be mainly influenced by the combination of the mechanical properties of both longitudinal reinforcement and stirrups, and the tensile strength of concrete, of which the latter appears to affect the overall response of the system in a nonlinear way. The model uncertainty of the resistance model used in the analysis plays undoubtedly an important role in interpreting results.

Keywords : modelling, Monte Carlo simulations, probabilistic models, data clustering, reinforced concrete members, structural design
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