Life–cycle robustness: prospects and challenges

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Abstract

Life–cycle robustness is achieved when a structural member or a whole system is designed to maintain its intended function and required safety level within its desired life–cycle. The different character of effects that each element will need to undergo (damage, ageing, extreme events, changes in usage) in conjunction with the diversity in the intrinsic material properties, form a demanding problem. Further complexity emerges when one realises that time is not simply a variable, but a factor permeating model choices and uncertainty representation approaches. Different effects on the load side and properties on the resistance side develop differently in time, as does the dependence structure. Spatial randomness of materials, such as concrete, requires careful modelling, even at a meso–scale. For a log–term analysis, where the influence of uncertainty may dominate over predictability, robust design can prove decisive. On the computational side, challenges often appear since the computational costs of simulations and non–linear analyses may quickly prove infeasible. Suitable numerical techniques for small scale sampling, accounting for arbitrary distribution types and dependence structures, are yet to be developed. The realistic prediction of spatial randomness for now fails due to a lack of understanding regarding the physical basis of main input parameters. Within this contribution the authors present the general concept of life–cycle robustness and the expected prospects that arise from its application to fastening systems. A detailed discussion of the afore mentioned challenges and review of the state of the art complement the paper.

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