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Robustness assessment of precast concrete connections using component-based modelling

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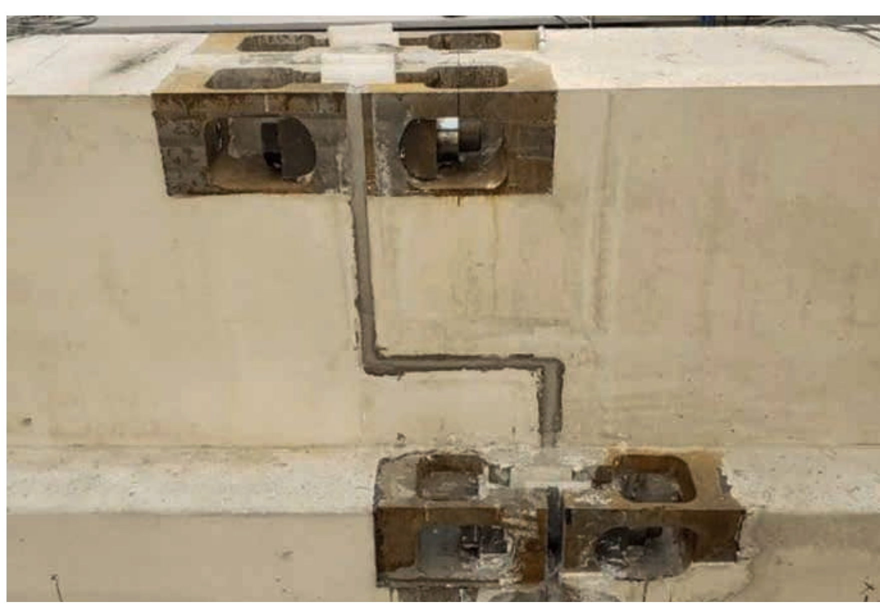
Employing highly optimised precast concrete product-based building solutions increases on-site productivity through elimination of formwork and reduction in propping as well as reducing waste, accidents and embodied carbon. The construction related benefits of precast concrete product-based building solutions are maximised by eliminating structural topping and designing connections between members for ease of assembly. A key challenge in the design of precast concrete buildings is the achievement of robustness under accidental loading. In this paper, sudden column removal is used to assess the robustness of a precast-concrete building system without structural topping. In this case, the development of an alternative load path under sudden column removal relies on the joint response. Joint behaviour is replicated using a component-based design procedure which captures localised failure modes. Robustness is evaluated using a ductility-centred approach and quantified in terms of the pseudo-static resistance. Two types of connection are considered for the provision of continuity at a critical half-lapped joint. The first is a plated connection which was designed initially to meet the tying requirements outlined in Eurocode 2. Under sudden column removal the plated connection's deformational capacity is limited, which in turn reduces the pseudo-static resistance. An alternative bracketed coupler connection is proposed in which the ductility supply is controlled through debonding of reinforcement. The design concept for the bracketed connection is validated with test results from two full scale sub-assemblies. The experimental results are used to validate a component-based numerical model which is subsequently used to investigate the influence of boundary conditions, and debonding length on the pseudo-static resistance following sudden column loss. The paper shows that the pseudo-static resistance can be significantly enhanced by flexure and compressive membrane action. Consequently, the authors suggest that connection design in precast concrete structures without topping should be based on a realistic assessment of the ability of the structure to develop alternative load paths following instantaneous column removal rather than simplified tying rules.

→| Read the full paper at **https://doi.org/10.1016/j.istruc.2023.105689**



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