In practice, precast concrete structures are often being designed by manual methods and linear finite element analysis in the ultimate limit state. This practice leads to suboptimal structures, and the behaviour of the in situ cast joints are unaccounted for. More accurate and efficient means of design are therefore needed, and a framework based on finite element limit analysis is being developed. In this paper, a one-dimensional multiscale joint element is presented, and a mechanical model is proposed as the yield function of the macro element. The scope of the model is to capture the behaviour of joints in three dimensions subjected to triaxial stress, and the resulting mathematical optimisation problem fits the format of semidefinite programming. The presented joint element is analysed and a real size example of a four-storey stairwell subjected to shear and torsion of precast concrete is presented. The influence of the joints on the behaviour of the stairwell is assessed.