Stress-strain modelling of reinforced concrete membrane sructures

ABSTRACT

In this study, a nonlinear finite element (FE) model is proposed to investigate the behaviour and failure mechanism of reinforced concrete membrane structures. Proven accurate stress-strain relation is incorporated in the model to describe the stress-strain behaviour of the concrete under compression for uniaxial and biaxial stress system. The nonlinearity behaviour of the materials in the compressive stress field is considered for the concrete in the orthogonal directions. The effect of micro cracking confinement and softening on the stress-strain relationship under biaxial stresses are included by employing the equivalent uniaxial strain concept. Tension stiffening effect by concrete in tension is modelled in the ascending and descending parts. The model allows for the progressive local failure of the reinforced concrete materials. The applicability of the proposed FE model is investigated by demonstrating the nonlinear structural response and failure mechanism of a simple deep beam and validated with published experimental work. Good agreement is achieved between the developed FE model and the experimental test results which gives confidence that the approach is fundamentally correct.

Keyword: Nonlinear finite element analysis; Reinforced concrete; Strut; Tie