

Damage mechanics model for fracture process of steel-concrete composite slabs

Abstract

Composite slab construction using permanent cold-formed steel decking has become one of the most economical and industrialized forms of flooring systems in modern building structures. Structural performance of the composite slab is affected directly by the horizontal shear bond phenomenon at steel-concrete interface layer. This study utilizes 3D nonlinear finite element quasistatic analysis technique to analyze the shear bond damage and fracture mechanics of the composite slabs. Fracture by opening and sliding modes of the plain concrete over the corrugated steel decking had been modeled with concrete damaged plasticity model available in ABAQUS/Explicit module. The horizontal shear bond was simulated with cohesive element. Cohesive fracture properties such as fracture energy and initiation stress were derived from horizontal shear bond stress versus end slip curves. These curves were extracted from bending tests of narrow width composite slab specimens. Results of the numerical analyses match the experimental results accurately. This study demonstrated that the proposed finite element model and analysis procedure can predict the behavior of composite slabs accurately. The procedure can be used as a cheaper alternative to experimental work for investigating the ultimate strength and actual fracture and damage behavior of steel-concrete composite slab systems.