FINITE ELEMENT ANALYSIS FOR SIMUALTION OF LARGE-DEFORMATION BEHAVIOR OF STEEL-CONCRETE COMPOSITE FRAMES

○Feng Zhou・Tomohiro Matsumiya・Keiichiro Suita・Khalid M. Mosalam・Masayoshi Nakashima

1. Introduction

Steel-concrete composite construction has been widely used in recent decades, since it takes advantage of the high tensile strength of steel and the high compressive strength of concrete.

To obtain the behavior of steel-concrete structures for inelastic and ultimate load conditions up to collapse, a full-scale steel moment resisting frame with reinforced concrete (RC) slab has been conducted for testing under large lateral deformation simulating earthquake-like loading at Kyoto University. Meanwhile, a commercial finite element computational package called DIANA was adopted for simulating experimental behavior of the tested composite frame.

2. Computational modeling

The steel beams and columns shown in Fig.1 are modeled using two-node straight beam elements based on the Bernoulli theory. To account for the RC slab with the profiled sheet, an equivalent thickness of 127.5mm, equivalent to the 90mm constant slab thickness plus one half of the profile depth, i.e. 37.5mm, is assigned to the shell elements to simulate the RC slabs. Line interface element is employed to represent the shear studs between steel beams and RC slab.

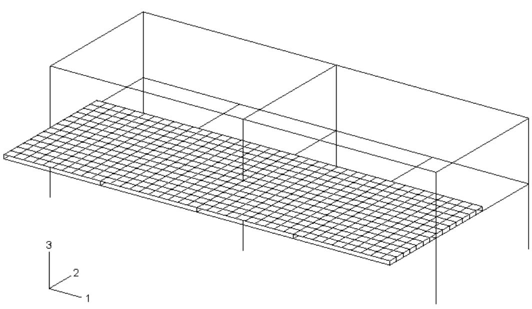

Fig. 1 FE model of test structure

Concrete is modeled using total strain formulation following the coaxial stress-strain concept (known as the rotating crack model) in which the stress-strain relationships are evaluated in the principal directions of the strain vector. Unloading and reloading is modeled with a secant approach, as shown in Fig.2. In this way, the concrete model can be used for cyclic loading analysis.

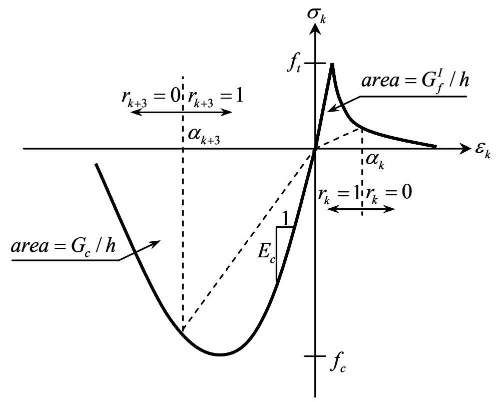

Fig.2 Unidirectional concrete material in principal directions

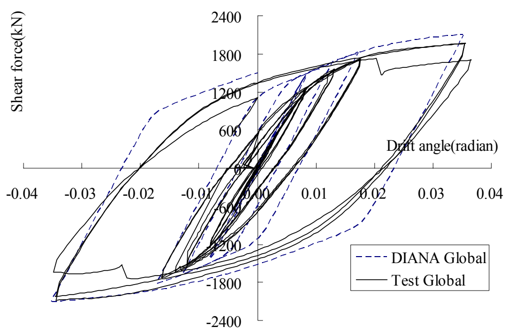

Fig. 3 Comparison between test and analysis results

Fig. 3 shows the relationship between the total forces versus the overall drift angle, plotting the curves for loading from the amplitude of 0.005 to 0.04. Here, the total force was the sum of the loads applied by the two jacks. The analysis results are in good agreement with the test results except for two drops at the test hysteresis loop due to fractures of beam ends which is not modeled in the present computational model. A separate study is underway in which the effect of facture is taken into account.