

EXAMPLE 2-004

Reinforced Concrete Slab under Point Load

1. EXAMPLE DESCRIPTION

Fig. 1 shows a reinforced concrete slab subjected to a single concentrated load at its center [Ref. 1]. The displacement control is applied till reaching failure. Dimensions, reinforcement details and loading setup are shown in Fig. 1.a. The mesh discretization of the slab used in ELS is shown in Fig.1.b.

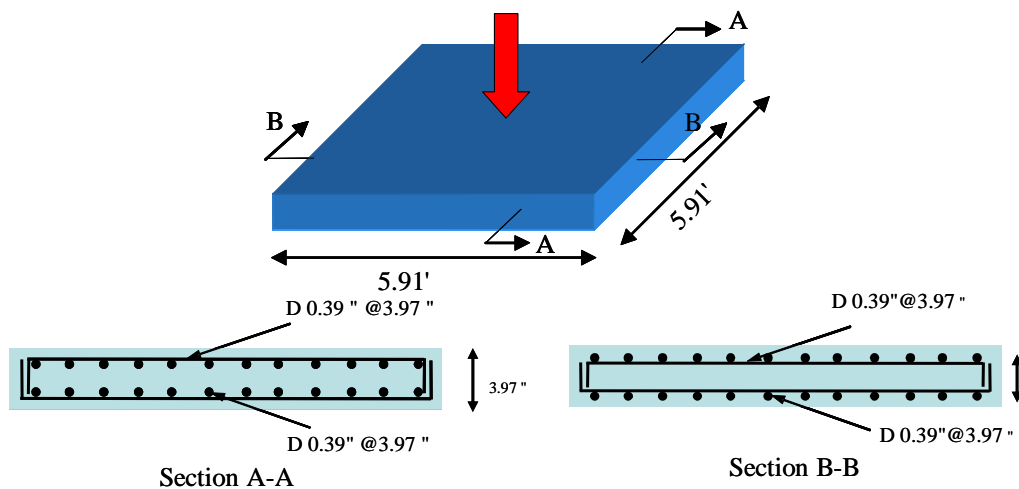


Fig. 1.a Problem geometry

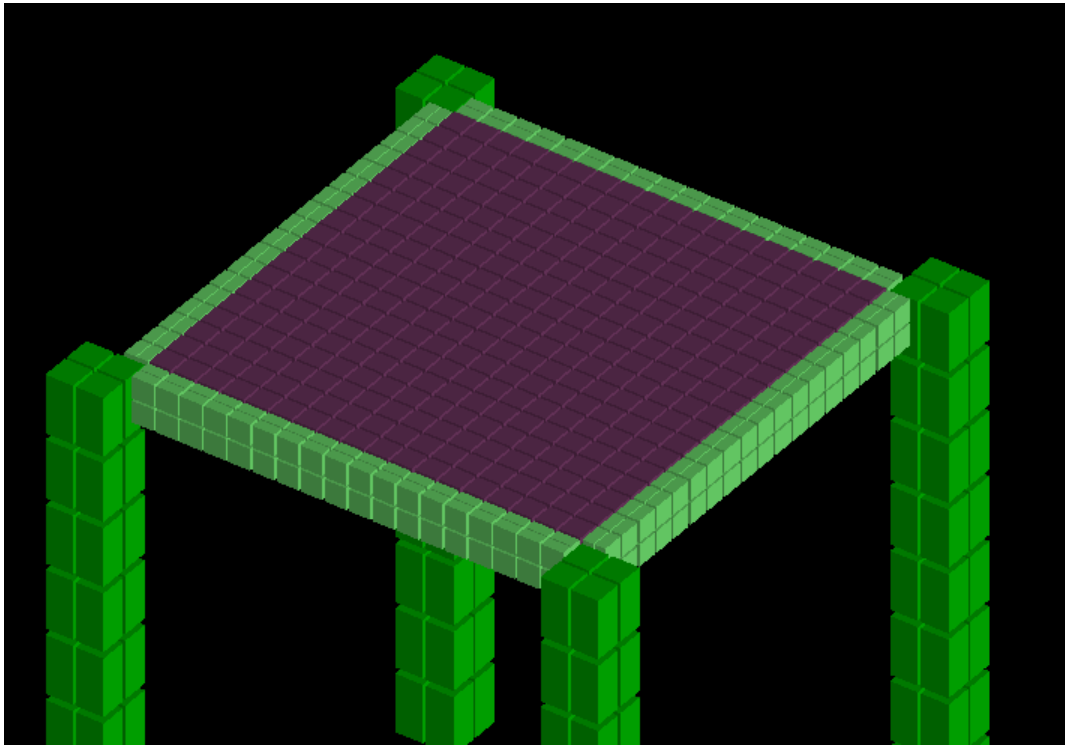


Fig. 1.b ELS mesh

Fig. 1 Reinforced concrete slab under point load

2. MATERIAL PROPERTIES

The compressive strength of concrete is 5.37 ksi (0.037 kN/mm^2), while the yield stress of the reinforcement was 55.11 ksi (0.38 kN/mm^2).

The applied element method follows a discrete crack approach, in which, the material is represented by a group of springs located at the surfaces of the element. The springs represent the axial and shear behavior of the material. For more details about material constitutive models refer to the ELS® technical manual.

3. RESULTS

Figure 2 illustrates the load-deflection analytical results compared to the experimental ones. As can be seen, the results are close to the experiments. The behavior is well predicted in the elastic stage, post cracking stage, and in the post-yielding stage. In other words, the overall response could be successfully obtained by ELS.

Figure 3 shows the calculated principal strain contours. The principal strains represent a good representation of crack localizations. Figure 4 shows the observed experimental cracking pattern of the top and bottom faces of the slab. The experimental cracks are generally in a good agreement with the ELS results.

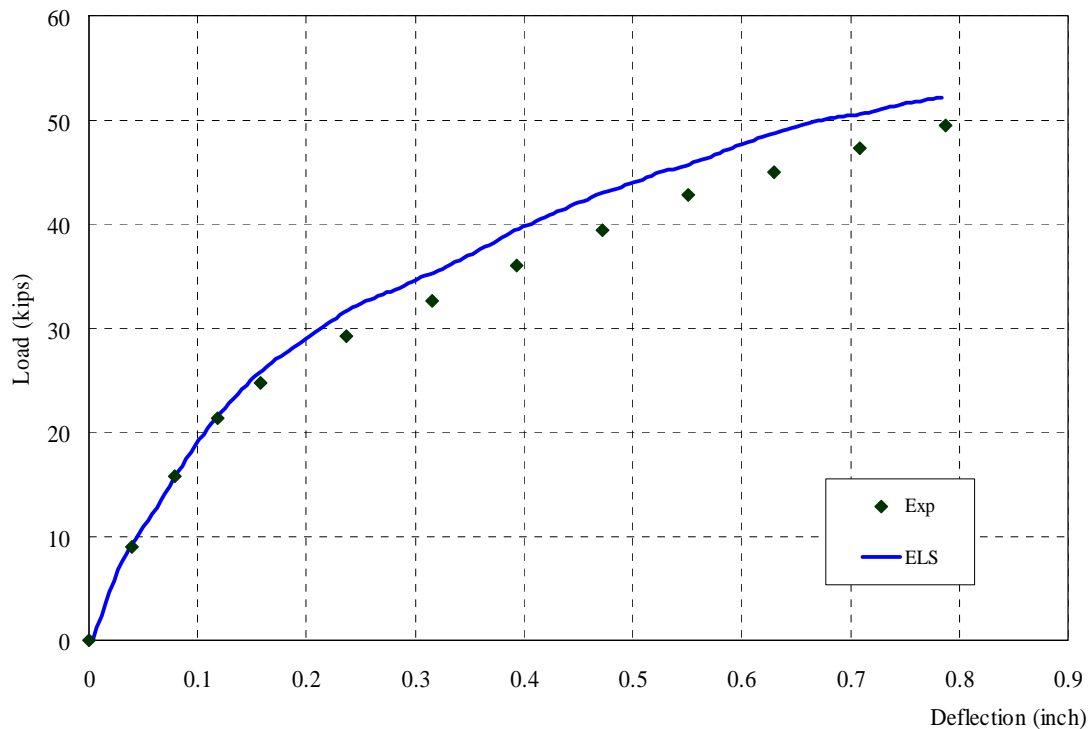
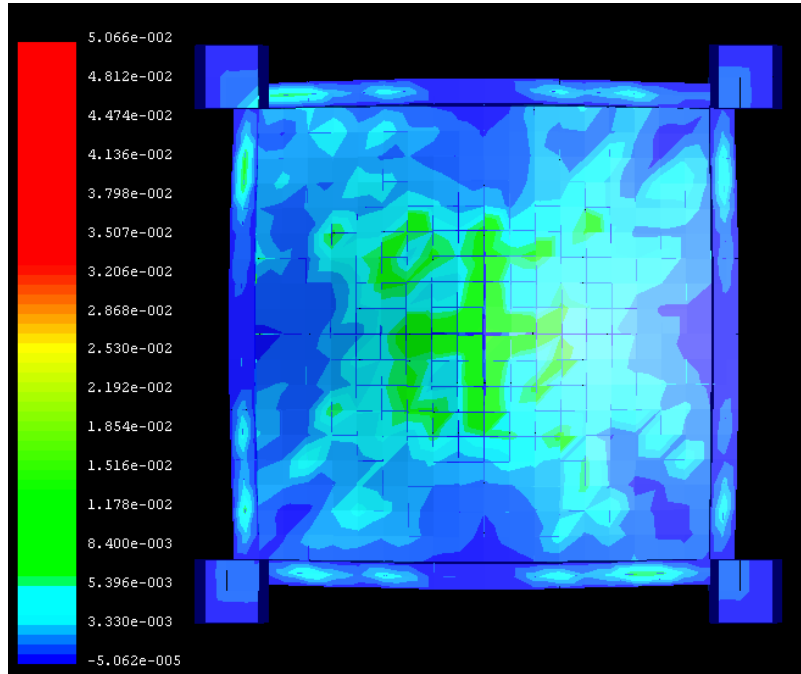
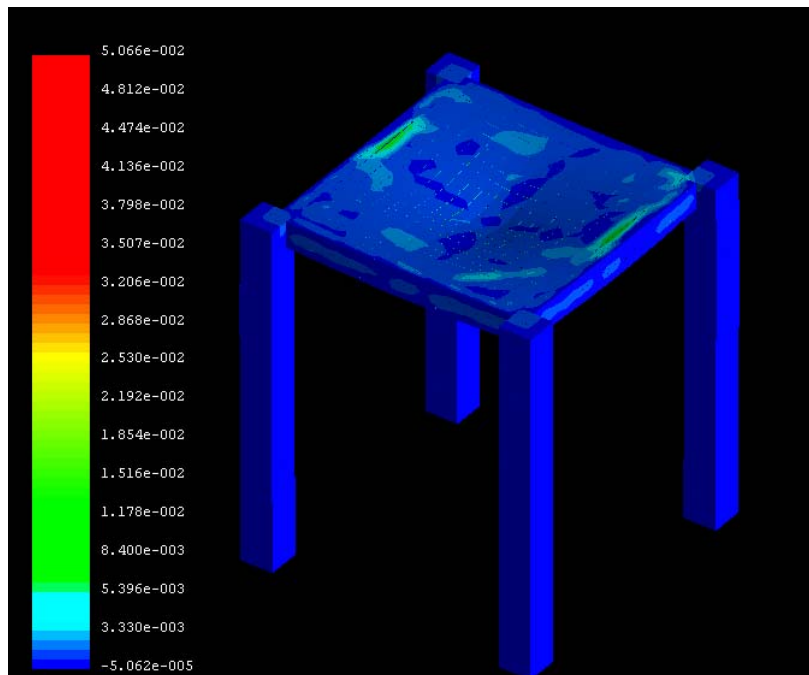


Fig. 2 Load-deflection predicted by ELS in a comparison to the experimental results

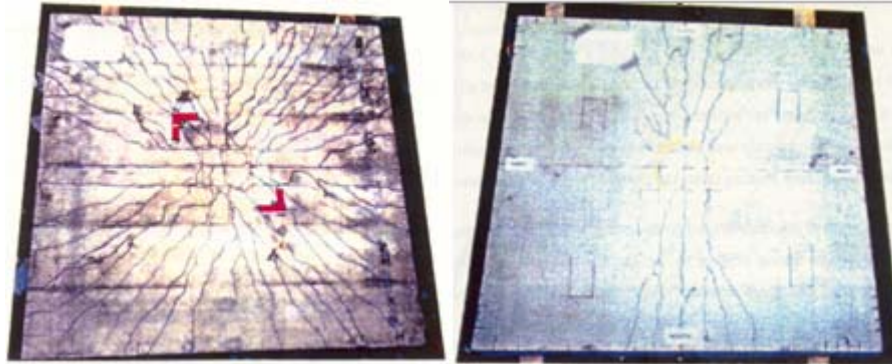


Bottom Face



Top Face

Fig. 3 Calculated principal strain contours



Bottom Face

Top Face

Fig. 4 Observed experimental cracking pattern

4. CONCLUSIONS

Based on the analytical and experimental results, it can be concluded that the ELS can successfully analyze and predict a close-to-reality behavior of reinforced concrete structures in the elastic, post-cracking and post-yielding stages.

5. REFERENCES

- 1- IRAWAN P. "Three dimensional analysis of reinforced concrete structures" Ph. D. dissertation, The University of Tokyo, 1995.
- 2- Technical Manual of Extreme Loading for Structures.