

EXAMPLE 3-001

Reinforced Concrete Deep Beam Subjected to Cyclic Load

1. EXAMPLE DESCRIPTION

Figure 1 illustrates a reinforced concrete deep beam subjected to cyclic loading [Ref. 1]. Dimensions, reinforcement details and loading setup are shown in Fig.1.a. The ELS model of the problem is shown in Fig. 1.b.

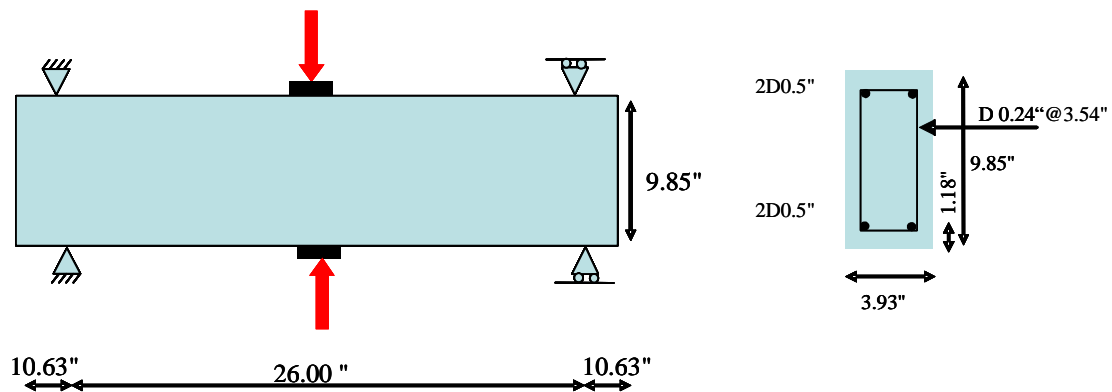


Fig. 1.a - Problem geometry

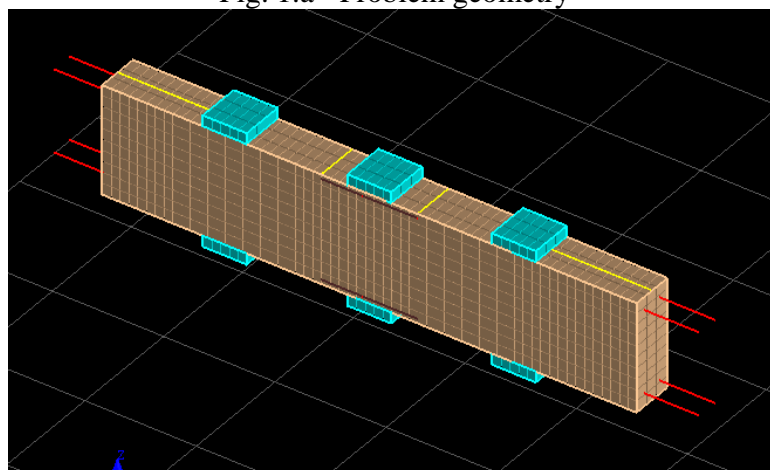


Fig. 1.b ELS model

2. MATERIAL PROPERTIES

The compressive strength of concrete is 7.91 ksi (0.055kN/mm²) while the yield stress of the reinforcement is 51.77 ksi (0.36 kN/mm²).

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 analytical load-deflection curve compared to the experimental one. As seen in Fig. 2, the analytical results are in good agreement with the experiments, despite some discrepancy in the hysteretic loops. The behavior is reasonably predicted in the elastic stage, post cracking stage, post-yielding stage. The overall response could be generally well predicted by ELS. As seen in Fig. 3, the observed experimental cracking pattern of the beam agrees well with the ELS® results.

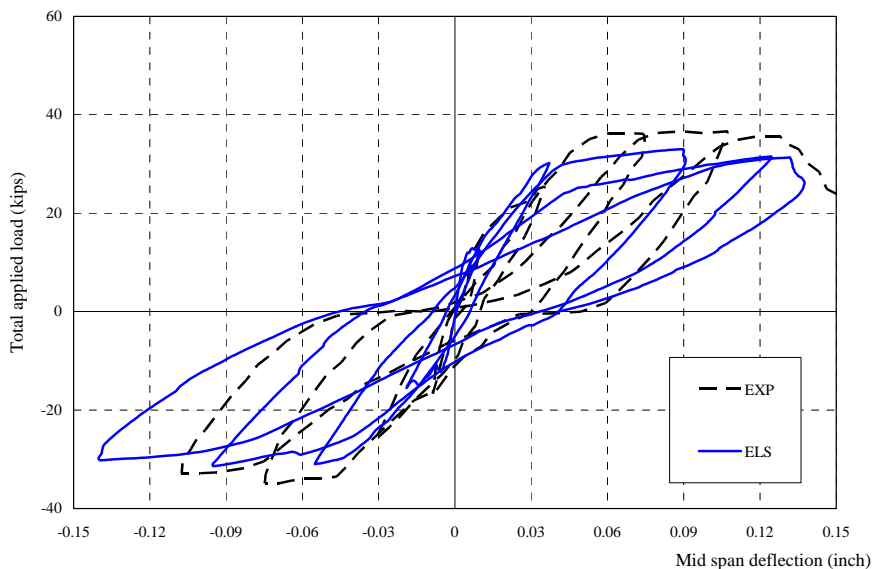
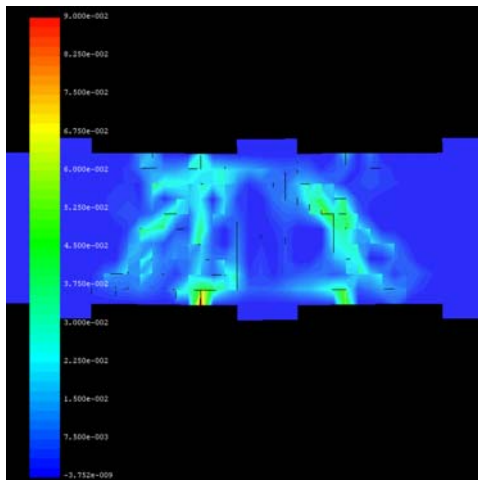


Fig. 2 Load-deflection predicted by ELS in a comparison to the experimental results



ELS



Experimental

Fig. 3 Principal strain contours (in 1_Dir) predicted by ELS at applied load -30.6 kips (at output frame 1105) in a comparison to the experimental cracks

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 nonlinear behavior of reinforced concrete structures under cyclic loading.

5. REFERENCES

- 1- Thammanoon denponangpan “Effect of reversed loading on shear behavior of reinforced concrete”, www.kochi-teck.ac.jp/library/ron/2000/g/1035013.PDF
- 2- Technical Manual of Extreme Loading for Structures.