

EXAMPLE 5-001

Nonlinear Seismic Response of RC Pier Subjected to Eccentric Axial Force

1. EXAMPLE DESCRIPTION

Figure 1.a shows a layout of the experiment test by Kawashima et al [Ref. 1], in which a pier subjected to eccentric axial load is being on a shaking table with input acceleration time history of Elcentro earthquake shown in Fig. 1.b. The mesh discretization of the building used in ELS is shown in Fig.1.c.

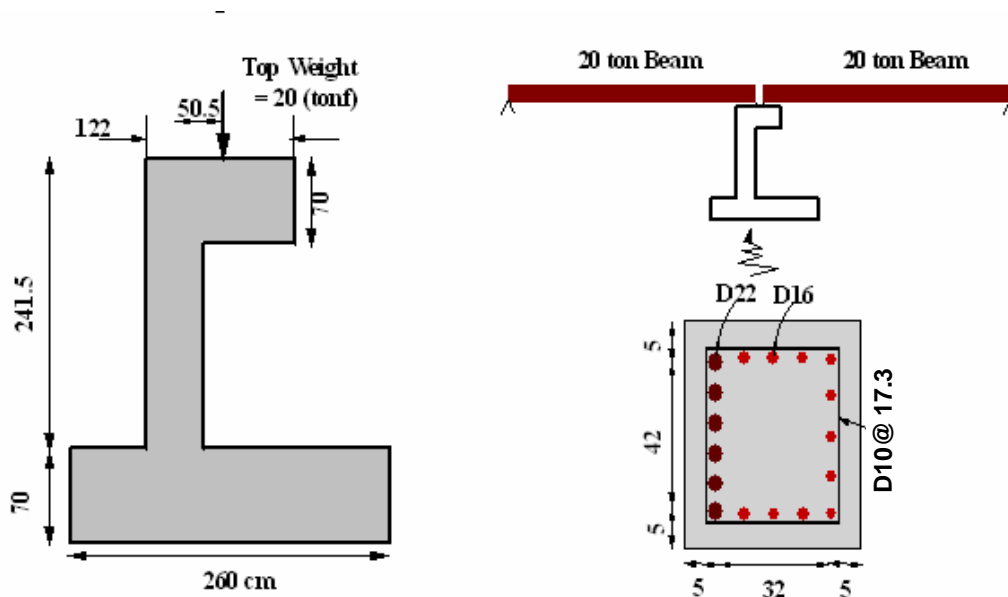


Fig. 1.a Problem geometry

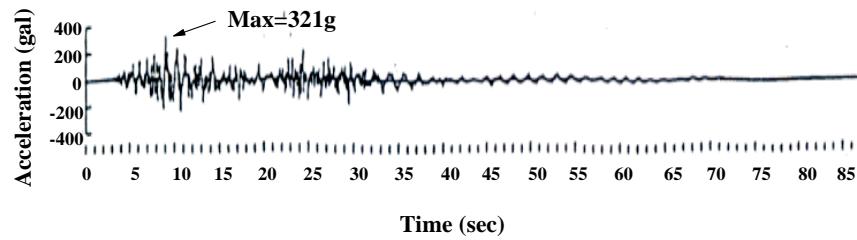


Fig. 1.b Input acceleration time history used in the experiment [Ref. 1].

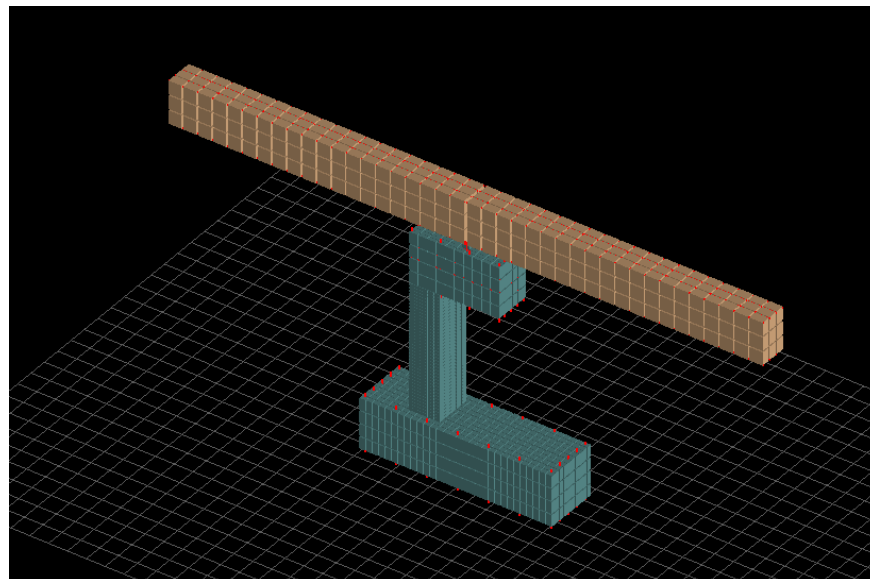


Fig. 1.c ELS mesh.

Fig. 1 Experiment layout and details of tested specimen by Kawashima et al.(1)

2. MATERIAL PROPERTIES

The concrete compressive strength is 5.69 ksi (0.0392 kN/mm²) while the yield stress of steel RFT is 56.9 ksi (0.392 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 shows the calculated response of the pier top point in a comparison to the experimental results. Generally, the behavior is well predicted. A significant residual deformation was obtained (8.27" from ELS and 5.11" from experiment). The results are reasonable and relatively close to reality. The residual

deformations are much affected by concrete cover spalling which was analytically obtained by ELS as shown in Fig. 3.

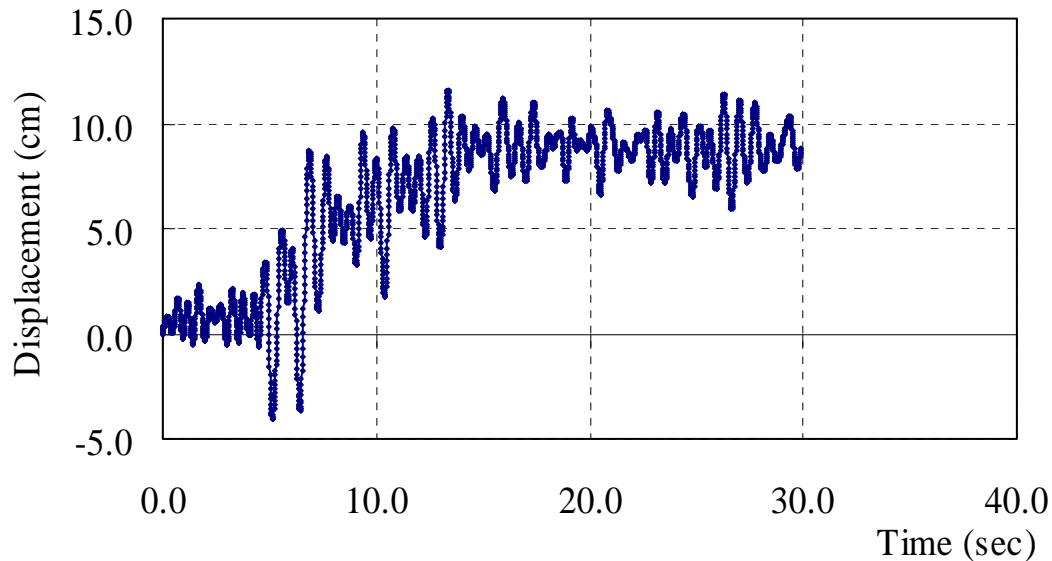


Fig. 2.a ELS results.

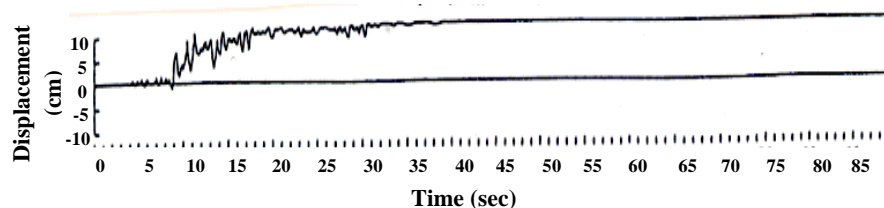


Fig. 2.b Experimental results [Ref. 1].

Fig. 2 Response in time domain.

4. CONCLUSIONS

Based on the analytical and experimental results, it can be concluded that the ELS can successfully analyze and predict the nonlinear behavior of reinforced concrete structures under dynamic loading. The prediction of cover spalling, which is considered as an important phenomenon that causes degradation of strength of reinforced concrete columns, is well predicted by the ELS.

5. REFERENCES

- 1- Kawashima, K., Unjou, S., Nagashima, H., and Mukai, H., "An experimental study on seismic resistance and seismic performance of RC pier subjected to eccentric loading", Technical Memorandum of PWRI, No. 3319, 1995, Japan
- 2- Technical Manual of Extreme Loading for Structures.