11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

FINITE ELEMENT ANALYSIS OF DAMPING MECHANISM OF AUTOCLAVED LIGHTWEIGHT AERATED CONCRETE PANELS FOR EXTERIOR WALLS OF STEEL STRUCTURES

Masayuki Kohiyama[1*], Makoto Ohsaki[2], Tomoshi Miyamura[3] and Takuzo Yamashita[4]

[1] Dept. of System Design Engineering, Keio University,
3-14-1 Hiyoshi, Kohoku-ku, Yokohama 223-8522, Japan, kohiyama@sd.keio.ac.jp
[2] Dept. of Architecture, Hiroshima University, ohsaki@hiroshima-u.ac.jp
[3] Dept. of Computer Science, Nihon University, miyamura@cs.ce.nihon-u.ac.jp
[4] National Research Institute for Earth Science and Disaster Prevention, tyamashi@bosai.go.jp

Key Words: *ALC Panel, Rocking Installation System, Plastic Deformation, Friction.*

In designs of building structures, empirical damping models are usually used such as stiffness proportional damping and Rayleigh damping with a conventional damping factor, 0.02 or 0.03. However, a detailed analysis is expected to improve the damping models. In this study, the mechanical behavior of exterior walls made of autoclaved lightweight aerated concrete (ALC) is investigated using finite element analysis.

A specimen of ALC panels and a loading apparatus are modeled using solid elements, rigid beams and multi-point constraints, which reproduce a rocking installation system used in tests of components[1] of a real-scale four-story steel structure for shaking table tests of E-Defense, National Research Institute of Earth Science and Disaster Prevention[2]. The finite element analysis software, E-Simulator, is employed to simulate static alternately repeated cyclic loading with incremental deformation amplitude up to the drift angle of 0.02 rad.

Figure 1 shows the lateral load–deformation angle relationship in the simulation result. The force drastically increases at a deformation angle of about 0.015 rad because the corners of the ALC panels come to contact with a ruler steel angle. In addition, the resisting force caused by friction is not negligible even when the deformation angle is very small.

Figure 2 shows the equivalent plastic strain distribution of the ALC panels (a) around the upper O-bolt and (b) in the panel corner part; the plastic deformation is observed mainly in these two parts in each panel.

The transition of energy is shown in Fig. 3. It is observed that energy dissipation owing to the plastic deformation of the ALC panels and the friction between an ALC panel and a ruler steel angle becomes remarkably large when the drift angle exceeds 0.015 rad because of the contact. It is also suggested that, under the condition that the looseness of a joint between an O-bolt and an attachment panel does not exists, the friction energy is almost comparable to the plastic strain energy of the ALC panels.

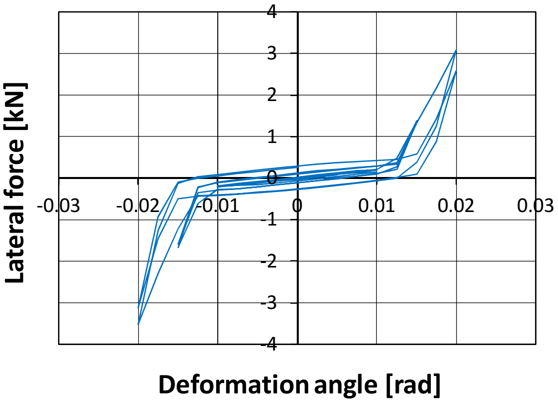
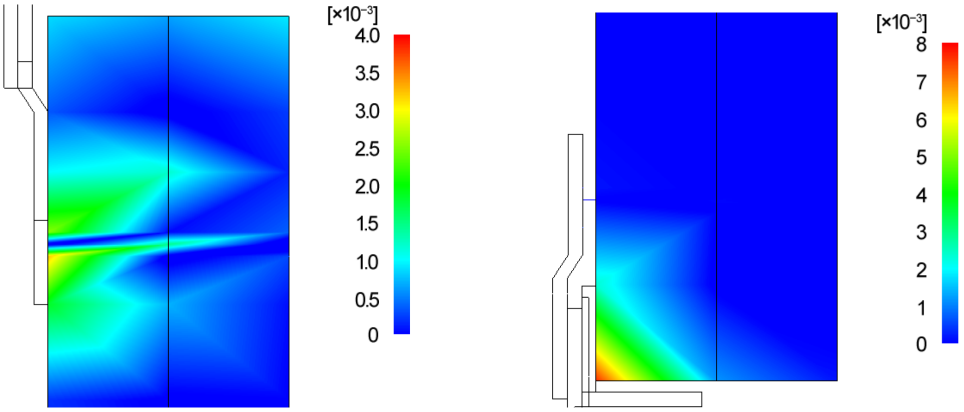


Figure 1: Lateral force–deformation angle relationship



(a) Around upper O-bolt **(b)** At corner of ALC panel contacting lower ruler steel angle

Figure 2: Equivalent plastic strain distribution at a deformation angle of 0.02 rad

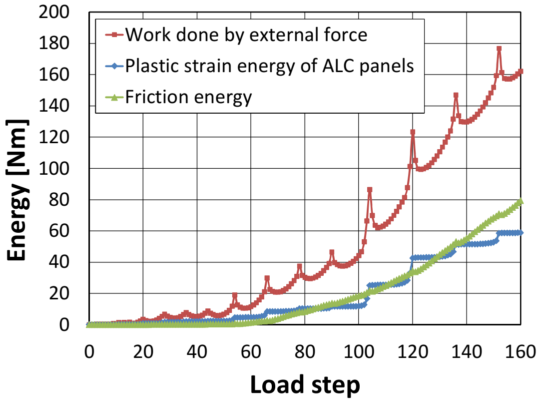


Figure 3: Transition of energy

REFERENCES

[1] Y. Matsuoka *et al.*, Non-structural component performance in 4-story frame tested to collapse, *Proc. 14th World Conf. on Earthquake Eng.*, Beijing, China, Paper ID: S17-01-014, 8 pages, DVD, 2008.

[2] S. Yamada *et al.*, Collapse experiment of 4-story steel moment frame: Part 1 outline of test results, *Proc. 14th World Conf. on Earthquake Eng.*, Beijing, China, Paper ID: S17-01-004, 8 pages, DVD, 2008.