Verification of JSME Code Case with the pipe elbow tests under dynamic cyclic loading

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The global experience of nuclear power plant accidents caused by large-scale earthquakes has heightened the importance in seismic safety of nuclear power plant. As a result, the International Atomic Energy Agency(IAEA) now demands evaluations for structural integrity verification under beyond-design-basis earthquakes. Especially as for the innovative SMR currently in development in South Korea, there is an ongoing effort to satisfy seismic design criteria of 0.5g. However, the simplified elastic-plastic analysis described in ASME BPVC Sec.III tends to be excessively conservative since it is based on the elastic analysis. A suitable elastic-plastic analysis including elastic-plastic FE simulation is required. JSME CC presents a modeling approach for piping systems that combines solid and beam elements to simulate nuclear power plant piping effectively. In this study, a parametric study for FE simulation for elbow under low-cycle fatigue dynamic loading was conducted by varying the damping ratio, element density, and solid element region for the pipe elbow specimen. By doing so, the appropriate modeling methods (including damping ratio, etc.) from JSME CC were verified. Futhermore, the simulation results were compared with the experimental results conducted for elbow specimen under dynamic cyclic loading conditions to measure the acceleration response and the opening-closing displacement of the elbow and the criteria in JSME CC.