DESIGN CONCEPT OF CONCRETE CONTAINMENT VESSELS FOR SHEAR AND THERMAL STRESSES

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SUMMARY

In Japan, "Draft of The Technical Standard of Concrete Containments for Nuclear Power Plant", ("MITI Code Draft",) was published in July 1977, by the Agency of Natural Resource and Energy. Foundamental principles of this standard are based on the ASME Code Section III, division 2, with some modifications made suitable for Japanese conventional ways using allowable stress values established for materials, calculation methods under long and short term conditions and determinations of seismic forces etc. Before the publication of the code draft, feasibility studies to design prestressed and reinforced concrete containments was made, picking up some problematic points to be included in the code. As a result of the studies, it is required to rationalize design methods for thermal stress and shear force.

A committee of investigation, headed by the Central Research Institute of Electric Power Industry of Japan, has been formed to make the study items cleared first, and to establish the experimental study plan to research the effects of thermal loads and tangential/radial shear strength of concrete containment. The details of each test is to be reported independently and this paper is to summarize them and to mention how the present MITI Code Draft should be reviewed and modified, in relation to the results of the tests. According to the MITI Code Draft, the conventional column-beam formula prescribed by AIJ shall be applied only to radial shear and, as for tangential shear, it states that if the main membrane stress given by compounding right-angled two way membrane forces is in tension side, then, the structure shall be reinforced by steel bars. However, practical design methods are not clearly stated.

The experiments for shear show that the failure of the containment is distinctly different from those of column, beam and wall structure, which fails suddenly after cracking by shear. Behaviour of the containments shear failure by horizontal force is more ductile than other structures and we propose 0.18 f'c as the value of maximum allowable shear force as the results of the experiments. The reinforcing method against tangential shear is recommended to follow the ASME Section III division 2 Code. For radial shear, it can be imposed half or more on hoop bar so the reinforcement against radial shear can be reduced much and the reduction ratio may be accepted in the near future.

Other experiments show that the effects of thermal load can be neglected at the ultimate limit state.