

NUMERICAL ANALYSIS OF THE LOCAL AND GLOBAL STRUCTURAL RESPONSE OF A REACTOR BUILDING UNDER AIRPLANE CRASH LOADING

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The structural response of a double walled prestressed concrete primary containment of a PWR submitted to an airplane crash loading, is analyzed numerically in order to evaluate the damage induced to the reactor building and the response of the internal equipments. The airplane initial impact velocity is such that the external wall is perforated by the engine, which impacts on the internal wall with a residual exit velocity.

Analyses performed.

To evaluate the local and global damage, the numerical studies are conducted in two stages :

Stage 1 : the local damage (safety to perforation of the internal wall, loss of the prestress, cracks in the reinforced concrete, tearing of the internal steel liner, etc...) is evaluated by simulations performed with the lagrangian explicit code HEMP-ESI and the specialized constitutive model for reinforced/prestressed concrete REINCON in two steps :

- . Simulation of the airplane crash on, and penetration of the external containment. The loading is composed of an equivalent pressure representing the crashing fuselage, and a rigid missile modelling the engine. The computed exit velocity of the perforating missile and the volume and kinetic energy of the ejected concrete agree with extrapolations obtained from experimental results.
- . Simulation of the impact of the concrete ejecta and the rigid missile with the exit velocity on the inner concrete wall. The local damage as well as the equivalent impact force-time history on the inner wall are computed.

Stage 2 : the global structural response (acceleration spectra at equipment supports) of the double walled reactor building is evaluated with the implicit finite element program PAM-AX3D. Finally, the satisfactory back calculation of the experimental perforation of a concrete slab by a rigid missile is presented to justify the use of the program HEMP-ESI.

Conclusion.

The combined use of advanced numerical methods calibrated by back calculations and extrapolations of known experiments permits a rational and efficient analysis of complex problems such as airplane crashes on nuclear power plants.