Building Concepts Against Airplane Crash

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In Germany safety related buildings of nuclear facilities as well as their equipment are to be designed against earthquake, airplane crash and blast. While the safety of the structure itself can always be guaranteed by structural means, the induced vibrations by these three external load cases may cause severe problems for the equipment. Because the low seismicity in Germany, especially the load case airplane crash is significant for the design of the equipment.

Considerable efforts were attempted in recent years to comprehend the load case airplane crash in an exacter manner and to evaluate realistic floor response spectra for the equipment by improved calculation methods. Beside these analytical efforts, investigations are posted to minimize the induced vibrations by new structural concepts.

The presented paper deals with the latter problem and gives first a survey concerning the development of structural concepts for the load case airplane crash, culminating in the double shell structures that are mostly in use today. Afterwards the idea of spring supports, as it is known for the aseismic foundation of buildings, is further developed to a new spring concept that reduces the induced vibrations in an optimum way for the load case airplane crash and that additionally isolates vibration for the load case earthquake.

For the boxlike nuclear building comparative calculations between the new spring concept and the usual double shell construction are accomplished. Spring-dashpots are used as vibration isolators which do work in horizontal as well as in vertical direction. The structure is modelled as a simple beam in vertical direction, and as a complex beam-grid system with additional elements to comprehend the flexibility of directly hidden plates and panels in horizontal direction. Both models are checked for different airplane crashes and earthquake. The calculations show that the spring concept results in a nearly complete vibration isolation in all directions for the load case airplane crash and in a considerable reduction of the induced vibrations for the load case earthquake.