

## **SAFETY AND REDUNDANCY OF ADAPTIVE BUILDINGS STRUCTURES**

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### **ABSTRACT**

The last three decades there has been extensive pioneering research done on adaptive structures. Studies on buildings and civil structures that are able to adapt to different environmental conditions. The focus of the presented study is the safety and redundancy of adaptive building structures.

Safety is the state of being “safe”, the condition of being protected against types or consequences of failure, damage, accidents or any other event which could be considered non-desirable. The application of an adaptive structure gives new elements in the design of a structure compared to a traditional structure that has to be elaborated. There are additional components added that must be checked on safety and reliability, but at the same time can these additional elements also provide an additional safety option. In this paper is the failure of the active elements considered as the possibility of extra redundancy because of the active elements.

A fail-safe concept for a structure means that a structure must not fail due to the failure of single elements and alternative load transfer mechanisms are available. For adaptive structure this means in addition to the individual structural elements also the active system must be fail-safe. This means that even if it loses the active control, the stability must be ensured. The first considered additional safety issue is the possibility that all the active elements do not function correctly at the time that the actuations are required.

The second additional safety consideration is according to the NEN-EN 1991. On buildings in consequences class CC3, a risk analysis must be performed in the design process. This analysis must consider the probability and consequences of any unfortunate event. Design analysis is made to avoid disproportionate damage to the structure from an accidental cause. Within the analysis of unfortunate events, the active frame can contribute in dealing with exceptional load cases.

These considerations will be discussed and presented with a case study of a high-rise building.