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The Implementation of an adaptive High-rise Building

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The dramatic growth of the human population, forecasted for the next decades will cause a vast increase of the construction activity. Because of a natural limitation of building sites, high-rise buildings will possibly be the preferred building type in the future. Since the 1970s, high-rises became common and popular especially in very dense urban areas like North America and Asia. Up to now there exist 4,223 buildings that are higher than 150 m [1] and each of the past three years was a record year with regard to number and average height of the newly built high-rises [2]. Also, this trend appears to continue. Thus, with their rising number, the question about the sustainability of high-rises becomes more and more important. Due to the limits of available resources, new technologies become necessary. Werner Sobek states that the upcoming building tasks will not be accomplished with the conventional methods of construction [3]. Already, some resources, most important the aggregate sand, which is a main ingredient for concrete, are being consumed at a higher rate than they can naturally be renewed.

The approach of reducing the amount of building material for the construction of new high-rises and minimizing the operational energy for meeting the requirements on building physics shall be investigated by means of implementing adaptive construction elements and adaptive facades.

The Collaborative Research Centre “Adaptive Skins and Structures for the Built Environment of Tomorrow” at the University of Stuttgart copes with all of the above topics. The term of adaptivity in connection with building structures and envelopes was characterized by Werner Sobek. It describes a method where sensors, actuators and control units are implemented in façade and structure in order to oppose physical impacts to the system in an ideal way [4]. In this context a 37 m tall tower will be realized on an experimental platform in Stuttgart within the following years. It will be an experimental building with multiple research opportunities in the fields of structural engineering, building physics, system dynamics, architecture and many more. This includes adaptive structures and envelopes, which will be included and tested on the experimental high-rise building. Upon completion, it will be the largest adaptive structure worldwide and an epitome for a starting transition of the building sector from conservative methods to innovative research solutions.

This paper will depict the necessity of a rethinking of the predominant construction methods in the building and planning of high-rises, as urban density is increasing and global resources are being diminished. Therefore, the content and core research area of the Collaborative Research Centre will be described, as well as the current status quo of the 37 m tall adaptive high-rise and the building concept behind it.

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