

# Adaptive Reuse

## Structural Design and Building Recycling



RESEARCH SCHOOL  
INTEGRAL DESIGN OF STRUCTURES

# Speerpunt BOUW

### Subject

Structural Design and the Adaptive Reuse of Existing building Structures

### Goal

To simplify the structural design process of a building project that includes adaptive reuse.

### Expected Results

An inventory of the pitfalls of the adaptive reuse of various building structures originating from 1900 to 1970. Conclusions about the suitability of those different buildings for adaptive reuse. And a standardized structural design method for adaptive reuse projects that takes those pitfalls and opportunities into account.



### Introduction

As a result of increasing population density around the world, the amount of developable open space (greenfield sites) that is available for construction is decreasing, and city planners can less and less afford the existence of brownfields. There is pressure on unremunerative real-estate to make way for new real-estate development. However, some of those buildings are protected by monument protection acts. Together with environmental concerns over the use of raw materials (e.g. sand, limestone for cement, fossil fuels) and the simple wish to save money, this is currently leading to a tendency of building recycling: reusing existing building structures for new functions.

The design of a building that includes existing structural elements is more complex than the design of an entirely new building. Besides the architectural, monumental and spatial problems, there are also various structural problems. The properties of the building materials are different from those of new materials; they vary with age and are sometimes unknown. The design specifications and design rules for old structures were different from what we are used to today. And the makeup of the existing structure is not always fully known or visible.

The main question of this research is: *What is the influence of the adaptive reuse of existing building structures on the structural design process?*

# 3TU.

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## **Adaptive Reuse Structural Design and the Adaptive Reuse of Existing Building Structures**



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### **Goals**

To normalize the structural design process of a building design project that incorporates the adaptive reuse of existing building structures.

Research Question

What is the influence of the adaptive reuse of existing building structures on the structural design process?

### **Strategy**

This can be broken down in the following sub-questions:

1. What are the differences between a normal structural design and a structural design that incorporates adaptive reuse? Which of these differences are deemed problematic by engineers in the field?
2. What are the consequences for adaptive reuse of the advancement of science in structural engineering? Over the years there have been various changes in the way buildings were designed. Examples are fire safety, ponding and probabilistics. Thus, an existing structure will not always fulfil the requirements for new buildings. What more changes can be noted and what are the consequences?
3. What are the consequences for adaptive reuse of the advancement of material sciences? Common present-day new building materials have different properties from new materials in the past. Modern concrete and reinforcement steel are stronger but less ductile, laminated wood has appeared, lime-sandstone work is nowadays glued rather than masoned. Different materials decay at different rates. How does this relate to presentday strengths?
4. How can the structural design of adaptive reuse projects be improved?

### **Expected Results**

An inventory of the pitfalls of the adaptive reuse of various building structures originating from 1900 to 1970. Conclusions about the suitability of those different buildings for adaptive reuse. And a standardized structural design method for adaptive reuse projects that takes those pitfalls and opportunities into account.

Preferred Partners Applications / Sponsors

The intention is to co-operate with structural engineering firms in order to collect realistic project data, and to test the resulting design method in practice.

### **Research Period**

2008 – 2011