StructuralComponents – a Toolbox for Conceptual Structural Design

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Summary

Only a small number of tools for computational composition and definition of a structural concept of a building does exist. StructuralComponents provides the designing structural engineer with a toolbox for conceptual design based on a parametric and associative design approach. Structural principles are embedded into the design tools, enabling the engineer to generate various design alternatives in a short period of time, and judge these alternatives based on structural performance. The concepts can be adapted relatively quickly and analyses are rerun directly to study the influence of design parameters. The toolbox has been developed using .NET, an object oriented programming environment, and consists of several independent modules, which can be plugged together. This offers flexibility and versatility to the user, making the toolbox usable for multiple design projects.

Keywords: Parametric and associative modelling; computational tools; conceptual design; modular programming; structural design tools; structural engineering; tall building structures.

1. Introduction

In the current design practice, a relatively small amount of tools exists to compose, define, explore, communicate and visualise design concepts during the early design stages. Computers are frequently used for simulation, drawing and analysis purposes, but hardly to support design on a conceptual level. One reason could be that the knowledge of the design requirements and constraints during these early stages are usually unpredictable and imprecise, making it difficult to develop computer-based systems. Another reason could be that a design concept is based on a creative and dynamic process and therefore hard to capture among a multi-disciplinary design team.

1.1 Computation and parametric and associative design

Computational design tries to drive and understand design based on numerical principles and uses the computer to do so. A parametric and associative design approach (short: parametric modelling) is a design approach based on the consistent relationships between adaptable parameters. The design parameters remain changeable while their associated design logic stays constant.

Computation and parametric modelling provide alternative processes for traditional early stage design approaches. With the growing development of computational design tools, new possibilities arise, allowing a more integrated design process, whereby the engineer and architect communicate by means of design tools. By integrating design intelligence into these tools, it will be possible to better support early design decisions. This is especially interesting during the early design stages, since the impact of choices made during these stages is often high and of great influence during the rest of the design process. Throughout later stages it becomes laborious and costly to compensate for poor design choices made at the beginning of the design process. On the other hand, little information is known at this stage to base decisions on, making it desirable to consider a wide range

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