StructuralComponents

Development of parametric associative design tools for the structural design of high-rise buildings

H I G H R I S E

This MSC thesis discusses the development of structural design tools, called StructuralComponents. The objective is to create tools that support the engineer in the conceptual structural design of high-rise structures.

The tools are based on the parametric associative design approach. StructuralComponents is the collection of new features in an existing parametric associative design software application, GenerativeComponents.
Prior to the development of these tools a literature study has been conducted on the typology and behaviour of high-rise bearing structures. This resulted in a classication of modern day high-rise structures.

The development of StructuralComponents is based on a Lego-block and dashboard approach. The Lego-block approach provides versatility and flexibility to the user, the dashboard approach enables the engineer to have all relevant information available in one single view.

An analysis method has been developed that suits the parametric associative nature of the tools. The analysis method is a combination of finite element analysis principles, and classical mechanics which describe the behaviour by the use of differential equations. This approach offers real-time analysis. The parts of the structure are modelled as large blocks and can be used to compose a structural design. The analysis method is considerably more accurate than rules of thumb or basic simplified mechanics, and faster than large FEM models.

The structural design tools can be applied for various design scenarios. One can evaluate multiple structural design alternatives and multiple load cases on the same structure simultaneously. StructuralComponents offers a lot of freedom in terms of possible structural configurations. One can evaluate overall behaviour, but one can also monitor specific values. The user can adapt his output and the display of the output to his own desire. At the moment, StructuralComponents is limited to 2D modelling.

The process of development has shown that the parametric associative design approach offers a lot of possibilities for computational conceptual structural design. Integrating structural intelligence in tools based on this approach enables structural engineers to design more effectively and efficiently, whilst sitting next to an architect, instead of lagging behind in terms of ease and computation.

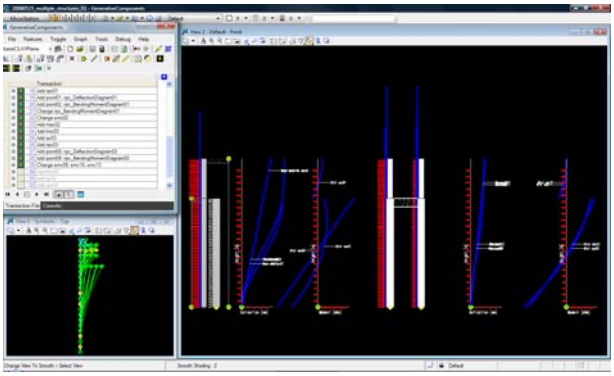
Janwillem Breider

TU Delft / Arup

Jeroen Coenders

TU Delft / Arup

StructuralComponents is a tool that is quicker and easier to use then large FE models, but more powerful than simple mechanics.



The dashboard display shows all relevant information in one view.

structural design lab

ARUP

TU Delft

Delft University of Technology