Using discrete optimization methods in decision support
for structural design

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Structural design is a complex process of several stages that is used for the design and development structural plans. The stages of this of this process (planning, design and detailing) have to be performed sequentially, each stage using the output of the previous one as its input. As these stages are complex even separately, efficient solution methods can be useful to aid the decision-making processes of civil engineers. Early decisions in the design process (such as topology and material combination choices) affect the future steps and overall performance (such as energy demand or costs). These effects are not known in advance and can only be estimated. Providing multiple possible design suggestions by quick heuristic algorithms can help with quantifying the effects of these early decisions.

In this presentation, we will introduce heuristic optimization methods for the design stage of the above process. These methods use preliminary designs as their input and aim to improve their quality through several local transformation steps. Different constraints are considered during this process, and the solution is optimized by taking multiple different cost objectives into account. As each local transformation step shifts a feasible solution into another one, multiple possible solutions are visited in the solution space. The best ones are saved and presented by the system as possible suggestions.

To measure the quality of these resulting suggestions, we also develop a mathematical model that is able to calculate the cost-wise optimal solution. The quality of our suggestions will also be compared to this solution.

**Keywords:** structural design, local search, mathematical model, decision support

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