

## Workshop

### *Tailored Graphic Statics for Low-Carbon Architectural Design*

**when** May, 22~26, 2017

**where** Dep. of Architecture

**who** prof. Corentin Fivet (<http://sxl.epfl.ch>)

(School of Architecture, Civil and Environmental Engineering (ENAC) at EPFL, Switzerland)

### Contents

This one-week workshop presents innovative methods and tools that give the architects the opportunity to control the design of a structural geometry together with its internal flow of forces. Formalized for the first time in the 1860's by Rankine and Maxwell, graphic statics methods have been the tool of choice for the analysis of structures until the second quarter of the 20th century and have been replaced by numerical methods since then. For the last decade however, graphic statics methods are coming back in the education and practice of architects and engineers as a key solution for interactive, user-controlled form-finding, especially when it comes to reduce the amount of required material at the early stages of the design process.

The workshop will start with the basics, introducing the general rules by means of practical examples. Specific methods will then be developed with application to determinate and indeterminate trusses, masonry structures and reinforced-concrete walls. Geometric shortcuts will be emphasized in order to speed up the graphical construction, and hence the wide exploration of structural arrangements in static equilibrium. Implementations of these methods into a parametric software tool (rhino3D and grasshopper) will then be addressed alongside with objective criteria that can be used early in the process to optimize the structure. Historical examples of interactive design processes will also be showcased. The workshop will end with a short design competition where teams of two will develop and defend their design for a roof structure.

At the end of the workshop, participants will be able to:

- reproduce conceptual design strategies to explore structural systems that have a low-carbon impact and are in line with external non-quantitative architectural requirements;
- better determine the degrees of design/geometric freedom of a given structural typology;
- build tailored parametric explorations of conceptual structural systems in static equilibrium;
- better determine how to modify the geometry of a structure in order to enhance its static behavior.

### Program

**DAY 1:** Advocacy/Case studies/Planning/Objectives (lecture 1h30) - First plunge into hand-driven graphic statics (problem-solving 4h) - Some definitions: Geometry/Topology/Equilibrium/Stability/Indeterminacy (lecture 1h30)

**DAY 2:** Introduction to grasshopper and parameterized networks (tutorial 1h45) - Global transformations (lecture 30' and problem-solving 1h) - Form-finding of simply-connected networks (lecture+case study 1h30 and exercises 2h) - Mini group project: release (15')

**DAY 3:** Form-finding of reticulated networks (lecture 1h and exercises 1h) - Static Action and Optimization (lecture 1h and exercises 1h30) - Mini group project: conceptual design (1h30)

**DAY 4:** Further class exercises (2h) - Mini group project: development (5h)

**DAY 5:** Mini group project: preparation of the presentation (3h) - Mini group project: critique (2h) - Happy hour.

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