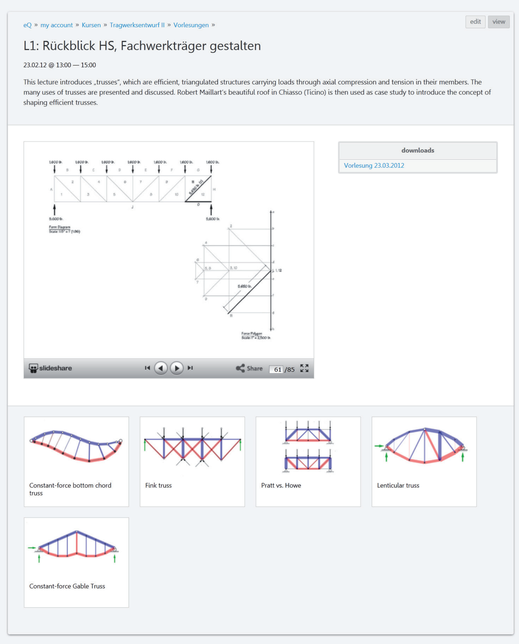
eQUILIBRIUM

BLOCK RESEARCH GROUP

An interactive, graphic statics-based learning platform for structural design

Prof. Dr. Philippe Block & Dr. Tom Van Mele, D-ARCH

Lectures

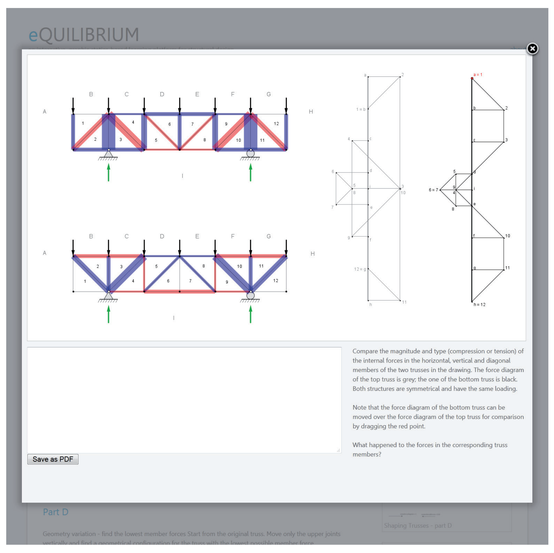


>> Lectures are available as interactive slideshows and downloadable notes pages

>> Links to relevant interactive drawings in the repository (loaded in modal screens such that drawings can be explored without leaving the lecture page)

>> Links to the “topics” section of the website for background information

Exercises



>> During the exercises, the different concepts, principles and techniques of structural design introduced in the lectures are put into practice under guidance and supervision of the teaching team

>> The use of interactive, parametric drawings allows explorations of structural behaviour that go beyond the possibilities of pencil and paper, through which the students develop an intuitive understanding of the relationship between form and forces in structural systems

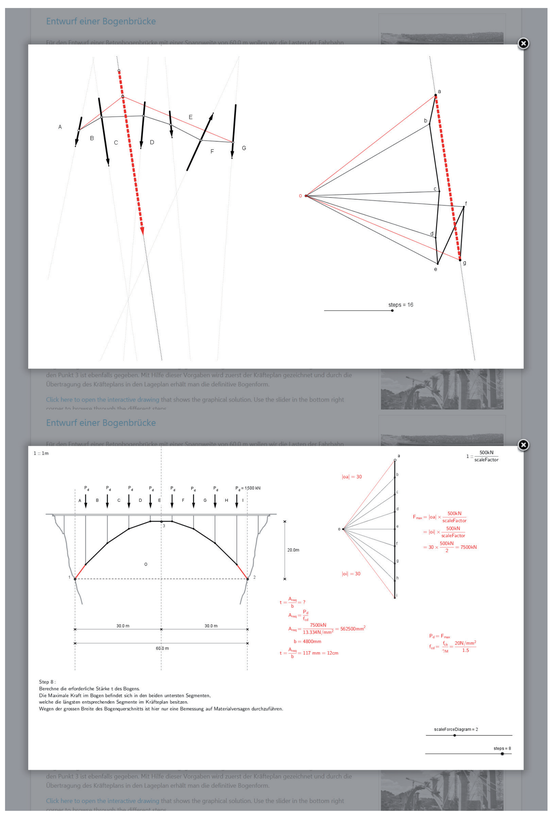
Design Projects

Design projects are an important aspect of the cognitive learning strategy of eQUILIBRIUM:

>> Learnt concepts, principles and techniques are applied to the students‘ own design problems

>> Students learn to choose and develop an appropriate, efficient and expressive structural system for a given design challenge

Self-Study



Facilitate continued active learning outside course hours by providing:

>> continuous access to all course-related material

>> step-by-step tutorials for drawings and exercises

>> interactive example exams and exercises

>> downloadable tools for graphic statics in GeoGebra

>> background information about graphic statics, geometric construction and structural design

Timeline

2010	2011	2012	2013	2014	2015
Platform development - continuous maintenance and development of the custom-designed web development framework and content management system written in PHP; integration of the latest HTML 5 and CSS 3 standards and technnologies					
Trials - user interface trials - isolated trial exercise sessions	eQUILIBRIUM 1 - restricted access to lectures, exercises and projects for students in Structural Design I & II - public access to interactive drawings and example exercises	eQUILIBRIUM 2 - step-by-step example exercises - graphic statics tutorials - GeoGebra tools	eQUILIBRIUM 3 - GeoStat integration - public courses - user contributions	- interactive translations of key reference works on graphic statics in the “books“ section - extension and development of the “topics“ section	
		Trials - graphic statics functionality added to GeoGebra	GeoStat 1 - 2D support - integration in eQUILIBRIUM platform - layer & object managers		GeoStat 2 - 3D support - use for student projects in Structural Design I & II

Didactic concept and technology

eQUILIBRIUM is an interactive, web-based platform driven by a content management system and web development framework specifically designed for teaching structural design using interactive graphic statics-based drawings. It provides students with a fully integrated learning environment, in which they can actively develop an intuitive, geometry-based understanding of structures and learn how to use the relation between form and forces to design efficient and expressive structures. Currently the eQUILIBRIUM framework is being extended with the required functionality to enable full integration of the student design projects in the eQUILIBRIUM platform. This entails the development of a state-of-the-art graphic statics drawing tool, GeoStat, which allows constructive alignment of all learning objectives and performance assessments within eQUILIBRIUM. GeoStat will be an online CAD drawing environment for graphic statics built on the parametric geometry engine and interface of GeoGebra.

Graphic statics is a powerful method for equilibrium design and analysis developed at ETH Zurich in the 19th century by Professor Carl Culmann. By using force polygons and simple geometric construction techniques, this graphical method provides intuitive, visual information about the relationship between form and forces in a structure, and rapid and accurate solutions for both analysis and design.

Geogebra is an open source and freely available geometry and algebra tool with a dynamic, graphical user interface. The graphic statics constructions are created in GeoGebra and then exported to an applet and embedded in a web page. Both in GeoGebra and in the applets, the objects making up the construction can be dynamically changed, allowing the “relation between form and forces” to be interactively explored with real-time, intuitive and visual feedback.

Team

eQUILIBRIUM	Structural Design I & II
Philippe Block	Philippe Block
Tom Van Mele	Gianni Birindelli
Claudia Ernst	Michaela Burch
Lukas Ballo	Marcel Aubert

Target Group

Architecture students

Structural Engineering students

Architecture professionals

Structural Engineering professionals

Researchers

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Innovedum Anlass, 7. und 21. November 2012

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