



# VACUUMATICS

## 3D-Formwork Systems

RESEARCH SCHOOL  
INTEGRAL DESIGN OF STRUCTURES

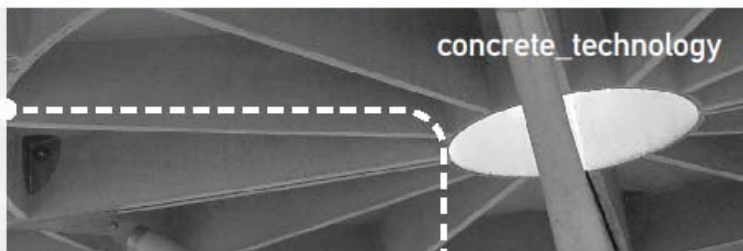
complexity\_in\_design

### SUBJECT

Complexity is a very current phenomenon in architecture with respect to structure and form. The current building industry is mainly rectilinearly oriented, therefore a different approach to design as well as manufacturing is required. From material point of view it would seem evident to use concrete since it is fluid in origin and has practically unlimited form possibilities. The limiting factor at the moment is the manufacturability and adaptability of its formwork system.



concrete\_technology



vacuumatics



### GOALS

To research the structural as well as geometrical behaviour of vacuumatics in a systematic and scientific manner in full collaboration with the latest developments in concrete technology, so as to be applied as fully adaptable 3D-formwork systems.

3d\_formwork\_systems



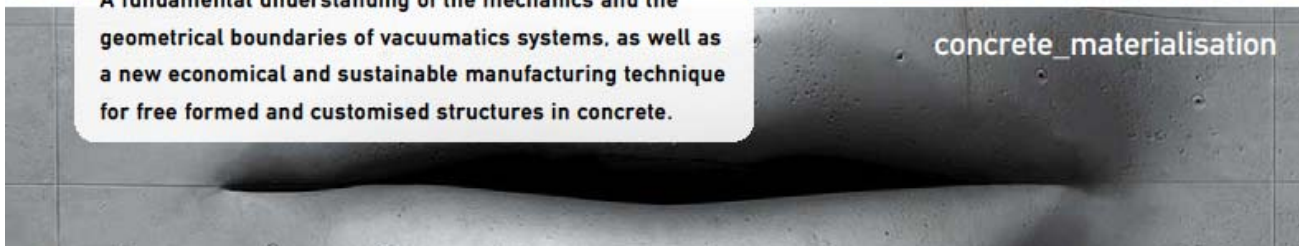
systematic\_research

### EXPECTED\_RESULTS

A fundamental understanding of the mechanics and the geometrical boundaries of vacuumatics systems, as well as a new economical and sustainable manufacturing technique for free formed and customised structures in concrete.



concrete\_materialisation



## VACUUMATICS

### 3D-Formwork Systems



ir. arch. F.A.A. Huijben<sup>1</sup>, prof. ir. F. van Herwijnen<sup>2</sup>, prof. ir. R. Nijse<sup>3</sup>

1. PhD researcher, F.A.A.Huijben@tue.nl

2. Supervisor, F.v.Herwijnen@tue.nl / 3. Supervisor, R.Nijse@tudelft.nl

Eindhoven University of Technology, Department± Architecture, Building and Planning,  
Group: Structural Design, Section: General and Integration, Eindhoven, The Netherlands

#### Subject

Complexity is a very current phenomenon in architecture with respect to structure and form. The current building industry is mainly rectilinearly oriented, therefore a different approach to design as well as manufacturing is required. From material point of view it would seem evident to use concrete since it is strong in cured state yet fluid in origin. Therefore it has practically unlimited form possibilities. The limiting factor at the moment with respect to the feasibility of concrete in the free-form design practice is the manufacturability and adaptability of its formwork system. Any change in shape or texture can be regarded as a complex, time consuming, labour intensive and thus financially unattractive process.

#### Goals

To research the structural as well as geometrical behaviour of Vacuumatics in a systematic and scientific manner so as to be applied as fully adaptable formwork systems, in full collaboration with the latest developments in concrete technology, like UHPC, FRC and SCC.

#### Research Question

To which content can Vacuumatics be effectively applied as a new economical and sustainable manufacturing technique for freely formed and customised structures in concrete?

#### Strategy

The research focuses on three essentially different formwork systems: an addition to standard formwork, an infilled-frame formwork system and a self-supporting closed formwork system. In order to effectively develop these typologies several research topics will be further elaborated concerned with the aspects material, composition, bearing capacity, morphology and contact surface.

#### Expected Results

A fundamental understanding of the mechanics and the geometrical boundaries of Vacuumatics systems, and the development of a new and sustainable manufacturing technique for freely formed and customised structures in concrete.

#### Preferred Partners Applications / Sponsors

ABT Consulting Engineers / Hurks Beton Veldhoven / foil manufacturing industry

#### Prime Publication / Prototyping

- F. Huijben, F. van Herwijnen, G. Lindner (2007), "Vacuumatic pre-stressed flexible architectural structures", *III International Conference on Textile Composites and Inflatable Structures*, Structural Membranes 2007, Barcelona (SP), p.197-200
- F. Huijben, F. van Herwijnen (2007), "Vacuumatics; shaping space by 'freezing' the geometry of structures", *International Conference on Tectonics*, Tectonics: Making Meaning 2007, Eindhoven University of Technology, Eindhoven (NL)
- F. Huijben, F. van Herwijnen (2008), "Vacuumatics: vacuumatically prestressed (adaptable) structures", *6<sup>th</sup> International Conference on Computation of Shell & Spatial Structures*, IASS-IACM 2008: Spanning Nano to Mega, Ithaca NY (USA)
- F. Huijben, F. van Herwijnen, R. Nijse (2009), "Vacuumatics 3D-Formwork Systems: customised free-form solidification", *IV International Conference on Textile Composites and Inflatable Structures*, Structural Membranes 2009, Stuttgart (DE).

#### Research Period

2008 – 2012