THE SPINNED PAVILION
IC D/ITKE FORSC HUNG SPA VILLION 2016-17
INSPIRATION PRESENTATION – CHRISTINE VON RAVEN
ARCH 4/510 - PROFESSOR NANCY YEN-WEN CHENG  SPRING 2017
Aim of a Pavilion Structure with:

- **Maximal span**
- **Minimal required formwork**

Problem:

- Material self-weight is of high concern for larger span structures

Solution:

- Fibre composite materials
  - readily used in highly engineered applications
  - Still barely investigated for architectural applications
- Investigation of natural construction processes of long span fibre composite structures

Radial tetravalent plane net and node details
- extrem light-weight / large-span structure
- 'Seamless' joined material for maximal strength

>> Pérez García, Agustín; Gómez Martínez, Fernando: Natural structures: strategies for geometric and morphological optimization; IASS Symposium 2009, Valencia
BIOMIMETIC INVESTIGATION

- Analyzing of functional principles and construction logics of natural lightweight structures
- Two species of leaf miner moths (Lyonetia clerkella and Leucoptera erythrinella)
- Larvae spin silk “hammocks” stretching between connection points on a bent leaf (images right)
- Basically tension forces

>> Cooperation with the Institute of Evolution and Ecology and the department for Paleobiology of the University of Tübingen
Transfer of **morphological** and **procedural** principles for long span fibrous construction into fabrication and structural concepts.

Concepts abstracted from the biological role models:

- **The combination of a bending-active substructure and coreless wound fibre reinforcement**
  - **Creation of an integrated composite winding frame**
- **Fibre orientation and hierarchy over a long span structure and multi-stage volumetric fibre laying processes**
  - **Generation of complex three dimensional geometries**
TRANSFER INTO DESIGN

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- The combination of a **bending-active substructure** and **coreless wound fibre reinforcement**
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Interface and communication of multiple robotic systems (robotic arms and a drone) helped to create a seamless fibre laying process.

Integrative computational design and construction created by the incorporation of:

- biological principles
- structural capacities
- material behavior
- fabrication logics
- architectural design constraints
Completion: March 2017

Material: resin-impregnated glass and carbon fibre

Area: 26.5 m² ~ 258 ft²

Volume: 58 m³ ~ 2000 ft³

Fibre length: 184 km ~ 114 miles

Weight: 1000 Kg ~ 2200 lb

Overall dimensions: 12.0m x 2.6m x 3.1m ~ 40ft x 8.5ft x 10ft
ANNUAL PAVILIONS

2015-16

Studies on sea urchins and sanddollar led to the transfer of constructional principles and the development of new construction methods for timber plate shells.

2014-15

The waterspider constructs a reinforced air bubble to survive. This is a stable construct that can withstand mechanical stresses, such as changing water currents, to provide a safe and stable habitat for the spider.

BIOMIMICRY & PARAMETRIC DESIGN
CHRISTINE VON RAVEN
Elytron, a protective shell for beetles’ wings and abdomen, has proved to be a suitable role model for highly material efficient construction.

The exoskeleton of the lobster (Homarus americanus) was analysed in greater detail for its local material differentiation, which finally served as the biological role model of the project.
ICD/ITKE Research Pavilion 2016-17

Institute for Computational Design and Construction (ICD) - Prof. Achim Menges
Institute of Building Structures and Structural Design (ITKE) - Prof. Dr.-Ing. Jan Knippers
University of Stuttgart, Faculty of Architecture and Urban Planning
As far not specific quoted all information and images from both institutes webpages

Video Vimeo ICD/ITKE - Forschungspavillion 2016-17

Credits

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