Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

BLOCK RESEARCH GROUP

SuAT Architecture & Sustainable Building Technologies Prof. Dr. Arno Schlüter

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ZJA Zwarts & Jansma Architects

PRESS RELEASE

Amsterdam, September 23rd, 2013

ETH Zurich, Supermanoeuvre and ZJA Zwarts & Jansma Architects complete NEST pre-study.

NEST – A Showcase for Sustainable Construction and Building Technologies (nest.empa.ch)

NEST - a flagship project of Empa and Eawag, in collaboration with the ETH Domain - is a dynamic, modular research and demonstration platform for advanced and innovative building technologies in the heart of the Empa-Eawag campus in Dübendorf, Switzerland, due to be completed in 2015. As a "future living and working lab", NEST consists of a central backbone and a basic grid to accommodate exchangeable living and office modules, allowing novel materials and components and innovative systems to be tested, demonstrated and optimized under real-world conditions.

As partners of NEST, the institute of Technology in Architecture at the Swiss Federal Institute of Technology in Zurich (ETHZ), represented by the Assistant Professorship of Building Structure (BLOCK Research Group / BRG) and the Assistant Professorship of Architecture & Sustainable Building Technologies (SuAT), has joined forces with Supermanoeuvre (sM) and ZJA Zwarts & Jansma Architects in a collaborative effort to contribute to the future of construction by developing "HiLo", a research & innovation unit for NEST in the domain of ultra-lightweight construction, which functions as a duplex penthouse for visitors to the faculty. Within the team, sM are the design architects of HiLo, while ZJA are partners for the design and development of HiLo's thin-shell roof.

The pre-study of HiLo has now been completed, representing a major milestone in the development of HiLo. The next phase, preliminary and construction design, has meanwhile commenced.

HiLo for NEST introduces the following key innovations:

Floor system innovation: Introducing funicular vaulting as a floor system results in an extremely lightweight floor system with savings of more than 70% of weight compared to traditional concrete floor slabs. This also allows for a natural and efficient integration of services and low energy heating – and cooling systems, further saving significant floor height (BRG, SuAT). The system is of a bespoke, modular and prefab nature, made possible through a robotically controlled, intelligent fabrication setup, resulting in lightweight elements that can very quickly be assembled on site (sM).

Integrated roof innovation: The roof system will be very lightweight and extremely thin, less than 70mm, including both a thin shell structure and building systems (SuAT, BRG). The large surface area of the shell is used for heat transfer into the space using a hydronic low temperature heating and cooling system. Custom, doubly curved vacuum insulation will be used to achieve a low thermal transmittance at very small thickness. On top, optimally distributed, high-efficiency thin-film photovoltaic cells are used for solar energy generation (SuAT).

Construction innovation: A highly efficient, reusable and lightweight mixed cable-net and fabric formwork system allows the reintroduction of the efficient, doubly curved thin shell roof structures without the typically associated high labour and resource investments. The formwork system offers a degree of control over the shape such that it can be easily optimized for improved structural behaviour and other criteria compared to traditional geometries (BRG, ZJA).

Adaptive façade innovation: Employing novel soft pneumatic actuators, the adaptive solar envelope consists of static and movable modular elements that are mounted curtain-like in front of the façade. The elements provide solar energy generation, shading and control the visibility and transparency of the façade. In correspondence to changes of the outside environment and demands of the interior, the elements can rotate to provide the desired functionality. The different modes of the modules are controlled based on sensor as well as on occupant input. Adaptive learning algorithms facilitate the continuous improvement of the behaviour and thus the adaption of the modules to their users and environments (SuAT).

Building systems innovation: The proposed energy concept of HiLo targets zero emissions in operation, high efficiency and full integration of system components into structural elements, leveraging their specific attributes.
All the systems for interior climatization as well as energy harvesting are controlled by a building automation system to optimally balance the dynamics and user preferences. Novel user-centred approaches are applied that use methods of machine learning and adaptation under real-life operational conditions (SuAT).

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Note for the editor:

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Appendix
A zip-file containing selected images can be downloaded at:
http://we.tl/3GmT4IJC8Z
Images may be freely used for publication, while noting “copyright EMPA, Gramazio & Kohler 2013”.

BLOCK Research Group, ETH Zurich
www.block.arch.ethz.ch

The BLOCK Research Group (BRG), headed by Assistant Prof. Dr. Philippe Block, at the Institute of Technology in Architecture, ETH Zurich, has three core areas of research: equilibrium analysis and design of vaulted masonry structures, computational form finding and structural optimization of curved surface structures, and fabrication and construction innovation for novel shell structures. Taking inspiration from master builders and learning from the past, the BRG aims to provide appropriate assessment strategies for architectural heritage, develop novel structural design approaches for highly efficient and expressive structural form, and propose and implement new and economic construction paradigms. The new “structural geometry” concepts introduced by the BRG, provide intuitive and geometrical approaches to structural design, bridging the gap between architecture and engineering.

Architecture & Sustainable Building Technologies, ETH Zurich
suat.arch.ethz.ch

Research at the Assistant Professorship of Architecture & Sustainable Building Technologies (SuAT), Assistant Prof. Dr. Arno Schlueter, focuses on new approaches for the design, planning and operation of buildings as dynamic systems to create a sustainable vision for buildings and urban communities. The motivation and aim of research is to realize a CO_2-neutral built environment that efficiently consumes and produces energy while providing high user comfort. Located in Zurich and Singapore (Future Cities Lab), the research is based on the identification and integration of advanced building services, information and communication technologies. Research objective is the development of new approaches, methods and tools to be used in different climate zones and on different scales and stages of the building lifecycle, ranging from component to urban scale and spanning from conceptual design to building operation.

SUPERMANOEUVRE
www.supermanoeuvre.com

SUPERMANOEUVRE is an international award winning architecture and innovation practice. The firm is led by three partners, Dave Pigram, Iain Maxwell and Chris Duffield and operates globally out of Sydney, Australia. The directors have considerable experience in leading roles on internationally significant projects ranging from cultural and government institutions to stadiums and large-scale urban developments. SUPERMANOEUVRE's projects and research have been exhibited internationally including at New York's Storefront for Art and Architecture, the 2008 and 2010 Beijing Architecture Biennales and the partners lectured on the firms work at such institutions as the Architectural Association in London, Columbia and Princeton Universities.

ZJA Zwarts & Jansma Architecten
www.zwarts.jansma.nl / @ZJArch

ZJA Zwarts & Jansma Architects is an international office, located in Amsterdam and specialized in infrastructure, public transport and sport & leisure. Founded in 1990, the office is led by Rein Jansma, Reinald Top and Rob Torsing.
ZJA translates most often complex assignments into unexpected solutions in a distinct manner, based on many years of experience with large-scale building projects. ZJA values their reputation as designers of large scale projects such as highways, bridges, viaducts, tunnels, light-rail -, metro - and train stations, transport hubs and football stadiums, high-voltage pylons and solutions to water related challenges. This all drawing on state-of-the-art technical expertise thanks to amongst others its independent research & development department. In addition, ZJA's office boasts an inspiring, multinational and international network of complementary expertise, ranging from structural engineers, urban designers and acoustic engineers to interior architects, sustainability experts and software developers. In recent years ZJA has expanded her activities to other countries such as Belgium, the UAE, Qatar, Oman and Scandinavia.