R.O.B., Mobile Fabrication Unit 2007-2008

R.O.B. extends the traditional prefabrication processes of construction: the robot knows the protected environment of the production hall and ventures out to the building site. Based on a modified freight container, the R.O.B. mobile fabrication unit can be used anywhere in the world.

Making use of computer methodologies to the design and fabrication process allows for manufacturing building elements with highly specific forms, which could not be built manually.

Credits and Data
Project title: R.O.B.
Client: Keller, M. Ziegelwien, Plannen
Architect: Grimm & Kohler, Architecture and Digital Fabrication, ETH Zurich
Collaborators: Michael Lyssmann project leader, Tobias Rosenstich, Philip Amstutz
Selected experts: Vida Zioberovam, cooperative identity
Model making: Christoph Junck
Selected contractors: Rudolhelm Engineering AG, Zofingen Integration

We use the term digital materiality to describe an emergent transformation in the expression of architecture. Materiality is increasingly being enriched with digital characteristics, which substantially affect architecture's physicial. Digital materiality evokes through the interplay between digital and material processes in design and construction. The synthesis of two seemingly distinct worlds—digital and material—generates new, self-evolving realities. Data and material, programming and construction are intertwined. This synthesis is enabled by the techniques of digital fabrication, which allows the architect control of the manufacturing process through design data. Material is thus enriched by information; material becomes “informed.” This is a new situation and the consequences for architecture will be manifold. Design now incorporates explicit knowledge—the code of its making. In consequence, the understanding of construction becomes a driving force for architectural design. With digital craft we therefore continue and extend the tradition of constructive thinking in architecture.

A digital design culture does not lead into an abstract and intangible realm of geometry and algorithms, but brings architecture closer to the materiality and sensuality of building.

This connection with the material basis and the constructive knowledge of architecture fundamentally challenges prevailing design methods as well as the current building culture.

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Pike Loop, Installation in Public Space, Manhattan, New York, USA, 2009

Pike Loop is a 22 m (72 ft) long structure built out of bricks, the most traditional building material, widely present in New York. It was designed to be built on-site with an industrial robot from a movable truck trailer. More than 7,000 bricks aggregate to form an infinite loop that weaves along the pedestrian island. In changing rhythms the loop lifts off the ground and intersects with itself at its peaks and valleys. The massive weight of the bricks is brought to a delicate suspension. The digitally designed brick structure is further articulated by a weighted compressing and tensioning of the brick bond. Where the loop lifts of the ground the bond becomes stretched and thus lighter; where it brings loads to the ground it becomes jagged and heavier, thus wider and more stable.

Credits and Data

Project title: Pike Loop
Client: Storefront for Art and Architecture in conjunction with the New York City Department of Transportation's Urban Art Program
Architects: Commercio A. Kohler, Architecture and Digital Fabrication, ETH Zürich
Collaborators: Michael Kusinski (project leader), Raphael Bartho, Marcus Gercz
Michael Lynsman, Kirsten Wes, Brett Albert, Galder Cealier, Leonard Koros, Max Pamrcek, Tam Steward

Selected experts: Ramboll Group Consulting Engineers P.C. (structural engineering)
Sponsors: ETH Zürich, Faculty of Architecture, Keller AG-Zürich, Graduate General of Switzerland in New York, Swiss International Airlines, General Shale Brick Inc., USM Modular Furniture, Pro Helvetia, Sila Schweiz AG, Bam Ingenieure Consulting Engineers P.C., Columbia Foundation for Advanced Studies in the Fine Arts, New York State Council on the Arts, New York City Department of Cultural Affairs

This page: General view from the west. Opposite: Close-up. Photo on this and opposite page by Matt Tracy.
Explicit Bricks, Smart Geometry Workshop, Barcelona, Spain 2010
The goal of the four-day workshop was to design a constructive system composed of uniquely formed Styrofoam blocks. The participants were challenged to analyze and test different interlocking systems by making simple prototypes in order to apply the outcome to an overall system. The potential of the fabrication process to gain stability due to friction and interlocking was to be exploited as far as possible.

Credits and Data
Project title: Explicit Bricks
Architects: Gramann & Kohler, Architecture and Digital Fabrication, ETH Zurich
Collaborators: Tobias Boenisch (project leader), Ralph Büschli, Andrea Knoche
Participants: Louis Anton, Paolo Coccone, Konrad Göpfert, Martin Kahn, Elke Kalben, Peter Laks, Alessandro Kaffko, Iren Pfister, Nicole Tadros, César Moreno, Otto Faber

Room-acoustical Information, Research Project, ETH Zurich 2006–2008
This interdisciplinary research project deals with the informing of materials with differentiated spatial and sound-aesthetic properties. Using a series of prototypical building parts as examples, the project explored the potential of informed materials for specifically acoustic spatial design in architecture. The prototypes were fabricated on the robotic research facility. Subsequently, the acoustic properties of the fabricated building elements were measured and evaluated.

Credits and Data
Project title: Room-acoustical Information
Architects: Gramann & Kohler, Architecture and Digital Fabrication, ETH Zurich
In cooperation with: BMF and Swiss Edifice Ltd./architects
Gefördert durch:机床/保罗・胡德斯项目主管, Kart Eger, Joachim, Klaudia Fong, Jürgen Strauss

This page, top: View of experimentation. This page, middle: Prototype panels. This page, middle below: Simulation of 2D omnidirectional propagation with diffuse plane. This page, bottom: Coverage of prototype panels.
Acoustics, ETH Zurich, Elective Course 2008

In this project we investigated adapting a foaming process for the design of acoustic wall panels. The students engaged with the question of how diffuse reflecting acoustic panels affect the perception of space and the synaesthetic experience between hearing and seeing. Applying algorithmic design tools enabled the parametric adaptation of the panels to a variety of different spatial and acoustic situations.

Credits and Data

Project title: Acoustics
Architects: Grimm & Kober, Architecture and Digital Fabrication, ETH Zurich
Collaborators: Ulfos, Ovazda (project leader), Michael Lepers, Raphael Bertrics
Selected experts: Jürgen Aumann (Acoustic), Kurt Eggenschwiler, EMPA (Acoustic)

Industry partners: Giffoni AG, PU-Technik, Meyer
Students: Christian Blumans, Kathrin Blazek, Christoph Hunk, Barone Oswald, Barbara Zerby

Parametric graphical design tool of Spandex

Full plan of Acoustic Panels: 合成繊維壁の断面図
The Sequential Wall, ETH Zurich, Elective Course 2008
This project investigated the architectural and constructive potential of additive digital fabrication in timber construction. We designed a process in which the robot first cut commercially available 570 wooden slats to length and then stacked them in a free arrangement. Such free arrangements allow high-resolution and subtle movements and transitions to be designed. Running counter to the modularity expression of the stacking, straight lines flow seamlessly into curved ones, and on the wall’s surface an inteplay is produced between the rhythmic repetition of the directed wooden slats and the fine gradation of their lengths. In this follow-up course the students were challenged to integrate the functional requirements of an external diabloc wall — for example its loadbearing and insulating behaviour as well as its constructive waterproofing. Functional and formal characteristics were so tightly intertwined that they became mutually dependent. Individual wooden slats that protrude outwards and face down, for example, shield the structural parts from water by channelling it away from the façade, much as pane reeds or slings do.

Credits and Data
Project title: West Fest Pavilion
Client: Hochschule Rastatt-Ramstein, Swabia
Architects: Gramazio & Kohler, Architecture and Digital Fabrications, ETH Zurich
Collaborators: Bernardo Benedetti, Michael Jessen, project leader, Michael Karcher, Michael Leemann, Volker Immervoll, Tom Doudet, Philipp Durrant, Philipp Biedermann, Andreas Jureck, Matthias Kueker, Roger Litzler, Roberto Schuman, Andreas Schuder, Stefan Wach, Franz van Wouw, Selected experts: Basser & Hofmann — Imprezziva and Paul Zürich (Swiss engineering, Italian design & na nagement)
Sponsors: Badische Landesamt für Länderschaft und Natur — Albachtal West Eberhard Ban AG

Opposite: 1/7 Work by Christo von Sicanie, 2 and 3/7 Work by Johan Nautsch, Léopold Geiger, 4/7 Christo von Sicanie, 5/7 Work by Michael de Vore, 6/7 Work by Kalle Dondis, 7/7 Work by Michael Buhler, David Oehms, Simon Fitch, Buma Knevel, Jonathan Oehms. 1, 4 and 5 were produced in semester course and were done in follow-up course. This image: Wooden structure of the West Fest Pavilion. Photo by Roman Klier.

West Fest Pavilion, Temporary Wooden Structure, Wettswil am Albis, Switzerland 2009
The pavilion was conceived as a temporary spatial structure with an integrated bar for a major public event. The wooden structure consists of 1.66 contoured elements made from 572 slats. The entire structure is the functional support, the roof and the skin of the building at the same time. The elements were constructed by a digitally controlled robot that cut and placed the wooden slats according to an algorithmic pattern. The logic of the openings and curves as well as the aesthetic details follow the constructive demands of wood construction.
The Perforated Wall, ETH Zurich, Elective Course 2006

In this project we investigated the architectural potential of perforations in a 1:1 building element. The individual holes could be controlled in terms of four parameters: their position, the angle of their deflection from the surface, their location about their centre, and their size. Their distribution on the wall could be designed through globally acting forces of attraction and repulsion. The deflection from the surface and the size of the holes, on the other hand, were controlled via the color values of a digital image file.

Credits and Data
Project title: The Perforated Wall
Architects: Grimmuz & Koleh
Architecture and Digital Fabrication, ETH Zurich
In cooperation with: FRI ETH Zurich
Collaborators: Daniel Koleh (project leader), Ralph Barisch, Michael Lanzmann
Selected experts: Patrick Stibbe (FRI), August Moll (Hibou Solutions AG), Marcel Schlesier (Hibou AG)

Industry partners: Holcim AG, Holcim Dach AG, Robert AG
Students: Ludmila Eisinger, Chris Keller, Willy Stibol, Lorenz Weingart

Opposite, above: Close-up of a concrete wall fabricated by a digitally controlled robot. The pure, above: General view of work by Chris Keller and Lorenz Weingart on the left, and work by Ludmila Eisinger and Willy Stibol on the right.

The Oblique Hole, ETH Zurich, Elective Course 2005–2006

We confronted the students with the task of distributing 2,000 slanted holes over an irregular polygonal volume. Since this quantity of information cannot be managed with conventional CAD, we developed our own algorithmic tools. The density distribution was achieved through modelling an information landscape that completely enveloped the volume. A large distance between this body and this surface generated a high density of holes, and a small distance a small density. A further tool enabled the students to orient the holes towards positions that could be placed freely in space.

Credits and Data
Project title: The Oblique Hole
Architects: Grimmuz & Koleh
Architecture and Digital Fabrication, ETH Zurich
Collaborators: Henrik Hansen (project leader), Tobias Nonnestein, Daniel Koleh

Students: Christian Herber, Matthias Bernhard, Matthias Buder, Masoum Carvaz, Oliver Schaller, Christian Forestier, Stefan Fenn, Raphael Gans, Matthias Helbing, Martin Ihla, Michael Hinterhubler, Marco Klimbacher, Michael Klesis, Matthias Kohler, Katsunori Kosai, Renato Lazor, Carmen Leonberger, Gregor Manteng, David Thomas Mathul, Leonida Mayer, Siobhan O'Sullivan, Natalie Pomer, Patrick Schreider, Dominik Sigg, Lukas Sonnberger, Máté Tóthó, Lorenz Weingart

Unfolded plan / Unterteilung