Qatar Inc.

From fabrication workshops and the world’s largest indoor stadium to carpet shops and schools, the saga of Qatar’s expatriate entrepreneurs charts the country’s “colony to powerhouse” journey.

Qatar’s Building Bonanza

The residential sector continues to take a big chunk of the industry’s QR54.6 billion investment

Lord of the Trains

A series of trains that will make Qatar the largest LNG producer in the world
Digitally inclined – shifting the architectural model

Technological developments are revolutionising the fabrication processes in architecture and the building trade. This may be one solution to Qatar's manpower shortage
The technological developments of recent decades are having fundamental effects on the production conditions for architecture. They influence the way in which architecture is conceived, implemented and perceived. In our architectural practice, we do not regard technology as an isolated phenomenon, but we regard it as an integral condition of the evolution of society, culture, ecology and economy. The word technology designates the early phase in the development of all ideas in natural science before they finally become a commodity or irrelevant. In this phase, techniques appear fresh and exciting, but also foreign and dangerous, because their consequences cannot be foreseen. After a technology has been absorbed by a culture, it loses its appeal. The most radical technological development that concerns us in our practice is the digital one. We do not regard digital technology as a new achievement, but as a reality which has been explored both in theory and practice for more than half a decade. Digital technology is an attempt to formalize non tangible processes, to automate thoughts with the ultimate perspective to create artificial intelligence. From the point of view of architecture, two aspects are interesting. The first one is that the quest for artificial intelligence was not very successful yet, but it led to a surprising rediscovery of the body as a necessary condition for all kinds of intelligence. The second one is that the digital paradigm, the ability to control the processing of discrete values, fostered an enormous variety of complex new realities, such as the internet. None of these realities are truly intelligent, yet they still become very meaningful, because they alter the way society organizes itself. These digital realities change the way we think and act. Gramazio & Kohler is researching the relation between these digital realities and the architectural culture since its foundation in the year 2000. We currently focus on architecture and digital fabrication. We explore the interactions between digital data and physical material, between information and construction. The overlapping of data and material fundamentally changes the production conditions in architecture; material is specifically
In digital fabrication processes, the production of building parts is directly controlled by the design information. Thus, the architecture and building industry towards interesting (non-)standards. In order to research the potential and relevance of these digital design and fabrication methods, we conceived a fully flexible fabrication facility, using an industrial robot on a linear track at the Swiss Federal Institute of Technology (ETH) in Zurich. The robot was selected because it is a universal machine, which is flexible both on the information and material level. This means that its movements are fully programmable and its tools (so-called endeffectors) can be conceived as needed. Combined with its low price, which makes it also an interesting technology for smaller contractors, it could become the PC for fabrication for architecture. In our research, we develop necessary design and fabrication strategies, which make us discover new creative methods for the conception of contemporary architectural realities.

Fabio Gramazio & Matthias Kohler

**Case Study**

**Project name:** Extension building for the Cantonbein Winery, Fläsch

**Client:** Marta and Daniel Cantonbein

**Location:** Fläsch (Switzerland)

**Project from:** 04-2006

**Project to:** 07-2006

**Heading:** Three-dimensional façade

**Building area:** (m²): 425 (Fassadenfläche)

**Project description**

The project is a study for a new building for the elegant Cantonbein Winery in the town of Fläsch, Switzerland, that will include a model of architectural collaboration. Architects Valentiner Bearth and Andrea Deplazes, designers of a number of significant buildings that have been realized in the canton of Graubünden and elsewhere, will become the cooperation of their colleagues Fabio Gramazio and Matthias Kohler, who hold chairs in Architecture and Digital Fabrication at the Swiss Federal Institute of Technology (ETH) in Zurich.

The design by Bearth and Deplazes called for a concrete skeleton construction, slimmer in the profile of its members, with floor slabs and perimeter columns visible on the exterior of the building, which was to divide the gentle slope of the property. The infill walls of the high upper level of the structure were required to allow air to circulate and the interior climate to be regulated by natural means. The question of the interpretation of this assignment led to the cooperation between the two architectural firms. They developed a solution that is exciting in terms of design, method, and technology. The large infill panels consist of solid bricks set in their courses at varying angles in a prescribed composition such that some of the joints between the bricks remain open to permit air to circulate and light to penetrate the building's interior. Each brick’s orientation was determined according to a computer-modeled design intended to evoke an apparently three-dimensional image of circular forms (grapes, perhaps?) through the pattern of the bricks and the resulting play of light and shadows. Each individual brick in the field has a function similar to that of the matrix dot in a printed image. The brick infill panels were made in the summer of 2006 at ETH in Zurich. The bricks are bonded by means of a special adhesive which makes the panel construction resistant even to tension forces. The entire production process for the 300 m² facade was developed at ETH in the context of initial trials in automated wall-building conducted that spring. An industrial robot constructed the panels in a fascinating spectacle: It grasped and turned each brick according to the programmed command sequence, applied precisely calculated lines of adhesive at specified angles to its underside and placed it in its exact position – brick by brick, course by course, panel by panel. Then the finished infill panels were transported from Zurich to Fläsch, where they were installed.

This computer-controlled process was employed with the goal of an extremely individualized result. By digitizing the design drawings of the facades and converting them to the scale of the bricks, they were produced materially and with relentless precision. The process makes a significant contribution to the 'iconic turn', here not in the sense of the image replacing the word, but of the expected flat wall surface or painted decoration giving way to a three-dimensional material image – to 'inform matter', in the words of the architect.

Claude Schmitt

Credits: Architecture: Bearth & Deplazes, Zurich, in cooperation with Gramazio & Kohler, Zurich

Engineer: Jurgen Buchli, Heidenheim

Facade elements: Gramazio & Kohler, Architecture and Digital Fabrication, ETH Zurich, Keil Ag, Ziegelstein, Finsgen