ROBOTIC TECHNOLOGIES FOR A NON-STANDARD DESIGN AND CONSTRUCTION IN ARCHITECTURE

Research project
Ref: PTDC/ATP-AQI/5124/2012

REPORT Task 1.1.3

Survey: Architecture
March 2014

Research Institutions:

U.PORTO UNIVERSIDADE DO PORTO FACULDADE DE ARQUITECTURA
CENTRO DE ESTUDOS DE ARQUITECTURA E URBANISMO CEAU
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Institutions:
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Period:
July 2013 - March 2014

Note:
This is the work produced in the scope of a Research Project without any commercial intentions. The purpose of this document is to register and monitorize the developed work.

Index

Architecture

Introduction

In the scope of the introductory activities of the project (T1.1, T.1.2 and T1.3), the present task surveys architectural projects showing pertinent issues regarding material, formal (geometry) or constructive aspects. These projects should thus raise interesting challenges to be tackled by means of robotic technologies.

The work is structured around the analysis of bibliographic and electronic references. Looking for identifying a set of relevant case-studies in the theme, the survey focus its attention in the:

- Local and global contexts;
- Traditional and contemporary approaches.

The negotiation of these topics provide directions in which new architectonic approaches may be held possible by the use of such flexible technologies like robots. By analyzing each architectural project regarding its material, formal or constructive singularities, a new interpretation may be thought and formulated. Therefore, the referenced examples can serve as inspiration for innovation, for instance, in terms of more accurate, cheaper, or increasingly complex geometry realizations.

When looking into tradition, it is important to identify architectonic realities, which have lost their preeminence overtime, for instance, due to the increased cost of human labor. This category encompasses vernacular and erudite processes, which have a strong possibility of being revived, along with its positive qualities such as material and structural optimization, decoration or customization.

These case studies are used as directions through which practical testes can be conceived and materialized with robotic technologies.

Structure

Recognizing these principles, the current survey was structured in 6 categories dedicated to specific building construction materials. Although the project will not take into account all of them, it was decided to develop a broad survey considering the following six situations:

- **Concrete**
  This is the most used material in building construction. The XXth century saw some of the most inventive explorations of concrete in architecture, both at the structural and ornamental levels. Today, innovation in the application of concrete occurs through direct intervention on it, the production of molds or the customization of its composition. A recent trend consists in the exploration of “3d printing” processes.

- **Ceramics**
  Bricks are one of the oldest material in architecture, and it has been used both as a structural and a decorative material. Hestnes Ferreira is a Portuguese architect who dedicated a special attention to bricks on his built worlk. Together with the traditional brick vaults built in Alentejo, these can be interesting references to explore by means of robotic technologies.

- **Wood**
  The use of wood in architecture has a structural and a decorative dimension attached to it. Industrial processes have ruled its production and application in architecture. The Serpentine Gallery project by A. Siza and E. Souto de Moura is an interesting example that can inspire the way tradition and new technologies can collaborate.

- **Stone**
  Stone, as a structural material, has suffered a loss of attention due to the emergence of lighter and cheaper materials, which are easier to be customized. However, new digital fabrication processes has challenged new ways of cutting stone, adding more flexibility to the process.

- **Cork**
  The application of cork as a facade material in architecture is a recent innovation. Due to its remarkable physical and ecological properties, this is an interesting solution for the current times. However, current industrial processes are still rooted in standardization. Robotic fabrication has the potential to overcome this condition and open new avenues for design exploration.

- **Metal**
  Metal has been a target of research in what concerns to fabrication techniques (e.g. perforation, cutting, stamping, folding or bending). These example show some of the formal possibilities of such material, which have in robotics a tool to augment those possibilities.

Conclusion

Following this extensive survey, some paths were decided worth exploring, such as:

- Brick
  Revisiting Hestnes Ferreira's work (e.g. vaults, walls, corners...)
- Wood
  Rethinking Álvaro Siza and Souto Moura's Serpentine pavilion.
- Cork
  Design freeform structures and customized building panels
- Concrete
  Produce customized molds and concrete compositions.

A range of tests will be executed, in which these possibilities ought to be explored. Furthermore, prototypes of final solutions will provide a clear insight on the feasibility of each study.

With this task, the research team acquired a critical understanding about the way geometry, materials and construction methods can interplay to define innovative built references in architecture. This accomplishment is an important condition for theoretically framing the set of critical design and construction research experiments to be challenged by robotic fabrication.

Palmira Chapel

Felix Candela
Cuernavaca, Mexico 1959

Description

Chapel designed by Spanish-born architect Felix Candela, manipulating the complex geometry of a hyperbolic paraboloid and built with in-situ poured concrete in a wooden formwork.

Relevance

On a construction standpoint, the materialization of non-standard geometries in architecture, using traditional construction technology (formwork) can be used to identify traditional shortcomings and point to new possibilities in future developments.

References

- Garlock, M. Moreyra (2008): Felix Candela: Engineer, Builder, Structural Artist (Princeton University Art Museum Monographs), Yale University Press
- Basterra, A.; Chamizo, t Gutiérrez, E. (2001) Félix Candela y el borde libre, el caso de la capilla de Palmira en Cuernavaca. Revista *Bitácora Arquitectura*, nº 5. Mexico D.F. pp. 38-47Websites

Images

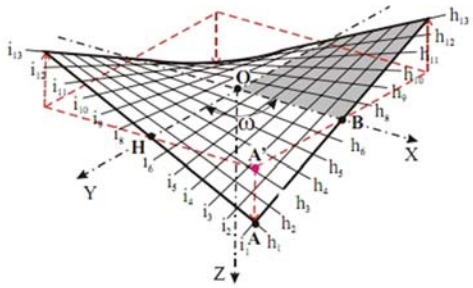
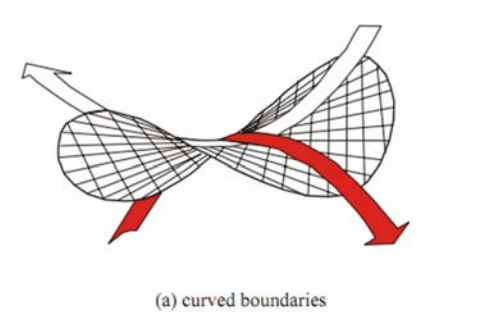
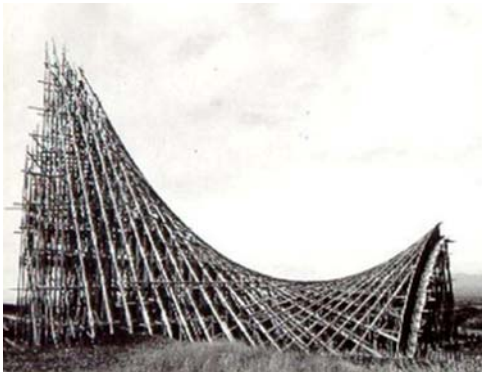


Diagram of Hyperbolic Paraboloid, straight edges



Diagrams of Hyperbolic Paraboloid, curved edges



Scaffolding and formwork

Scaffolding and formwork close-up

Interior view

Exterior view

Palazzetto dello Sport

Pier Luigi Nervi, Annibale Vitellozzi
Rome, Italy 1957

Description

Sports arena built for the 1960 Olympic games with 61 meters in diameter and composed of a thin-shell concrete dome with ribbed concrete reinforcements. The construction process involved cast in place elements and the precast, patented “rhomboidal element” as lost formwork for the ribs, with 19 different types, producing 1620 elements.

Relevance

The logic of material savings expressed in the ribbed geometry and thin shell dome has the potential to be applied in robotic concrete 3d printing without the need for formwork or component repetition.

References

- Iori, T. Poretti, S. (2005): Pier Luigi Nervi’s Works for the 1960 Rome Olympics, Actas del Cuarto Congreso Nacional de Historia de la Construcción, Cádiz, 27-29 enero 2005

T.1.3
Survey

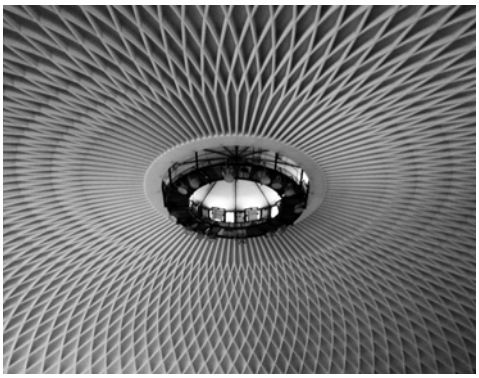
Architecture
Concrete

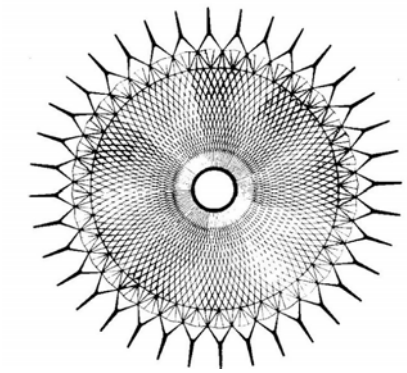
Images

Construction


Rhomboid elements during construction


Interior view


Interior view


Dome plan

Centro de Estudios Hidrográficos

Miguel Fisac
Madrid, Spain 1960-1963

Description

The Center for Hydrographic Studies (Centro de Estudios Hidrográficos) is a building complex consisting of an administrative tower an open-plan workshop and laboratory, highlighting the architect's first use of hollow beams, composed of the prefabricated and post tensioned concrete bone structures (huesos).

Relevance

The shape and joints of the repetitive constructive bone element can be parametrically explored, surpassing its modularity and fabricated with a 6-axis robot, directly through concrete printing or indirectly through formwork milling.

References

- *Centro de Estudios Hidrográficos*, in "AV Monografías / Monographs", 2003, n. 101
- Raspall, F.; Imbern M. Choi, W. (2013): Fisac Variations: An Integrated Design and Fabrication Strategy for Adaptable Building Systems. Open Systems: Proceedings of the 18th International Conference on Computer-Aided Architectural Design Research in Asia (CAADRIA 2013)

T.1.3
Survey

Architecture
Concrete

Images

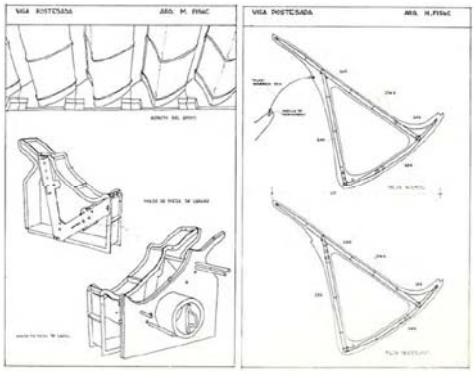


Diagram of bone structures

Prefabricated, unassembled, bone structures

Exterior view

Interior view

Teatro Municipal Miguel Fisac

Miguel Fisac
Seville, Spain 2000

Description

Teatro Municipal Miguel Fisac is located in the urban center of the small town of Castilblanco de los Arroyos, in Seville. It is an example of the material exploration in concrete present in Miguel Fisac's works since the late 60s. The external facade walls of the complex are made of cast in situ white concrete panels from polystyrene flexible formworks resulting in the characteristic textured facade.

Relevance

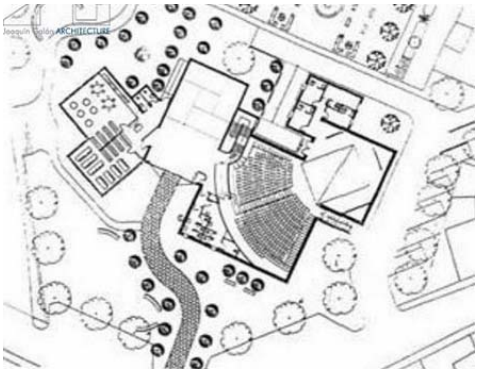
The Theatre and Library in Castilblanco de los Arroyos is one of the last built works from Miguel Fisac and a very good example in his exploration into the expressive nature of flexible formwork for concrete.

References

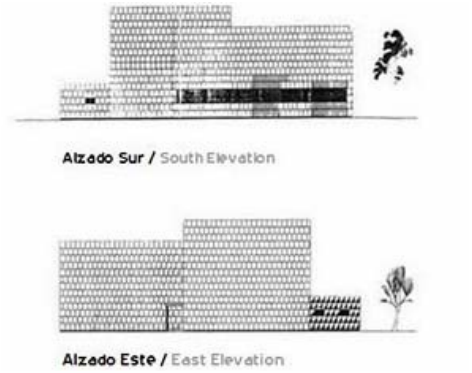
T.1.3
Survey

Architecture
Concrete

Images

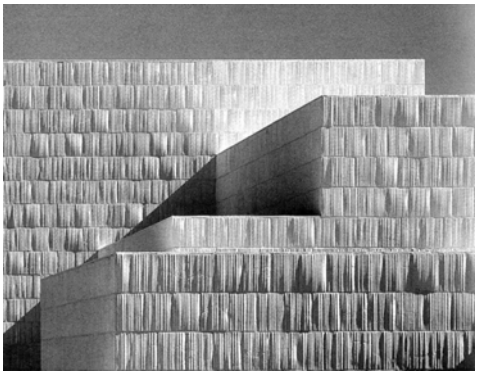


Plan



Elevations

Exterior view



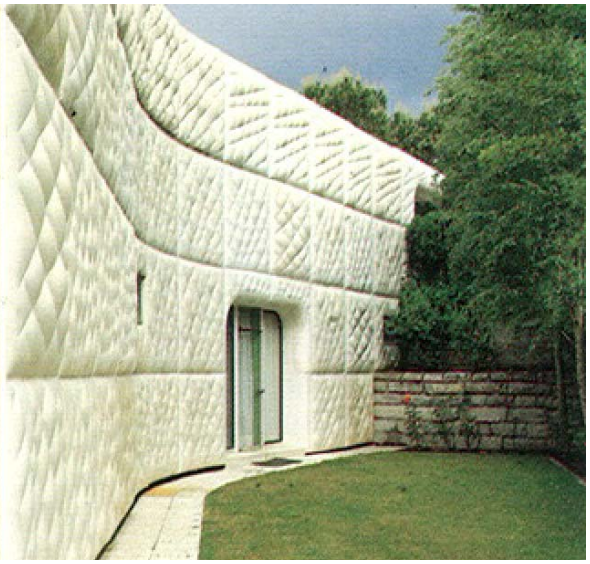
Exterior view

Facade detail

Facade detail

House in La Moraleja

Miguel Fisac
Madrid, Spain 1973



Description

The commition brief asked for a single family house for a couple with seven children in a 2600m2 site, through which passed a substantial amount of air traffic from the nearby airport of Barajas.
The exterior walls were built with cast-in-place white concrete panels, with flexible plastic molds that lend its malleable appearance and soft texture to the finished concrete surfaces.
Due to the acoustic problem present on the building site, the panels were specially designed to incorporate and seal the window glazing.

Relevance

One of many works from Miguel Fisac, built with flexible formwork for concrete panels, experimenting with soft textures and the expression of the liquid quality of concrete.
With the aid of robotic digital fabrication, flexible formwork for concrete can be explored further in more complex textural patterns and forms.

References

- http://storiesofhouses.blogspot.pt/2006/05/house-in-la-moraleja-madrid-by-miguel.html
- Documentos de Arquitectura Nº 10, Colegio Oficial de Arquitectos de Andalucía Oriental,1989

T.1.3
Survey

Architecture
Concrete

Images

Plan

Exterior view

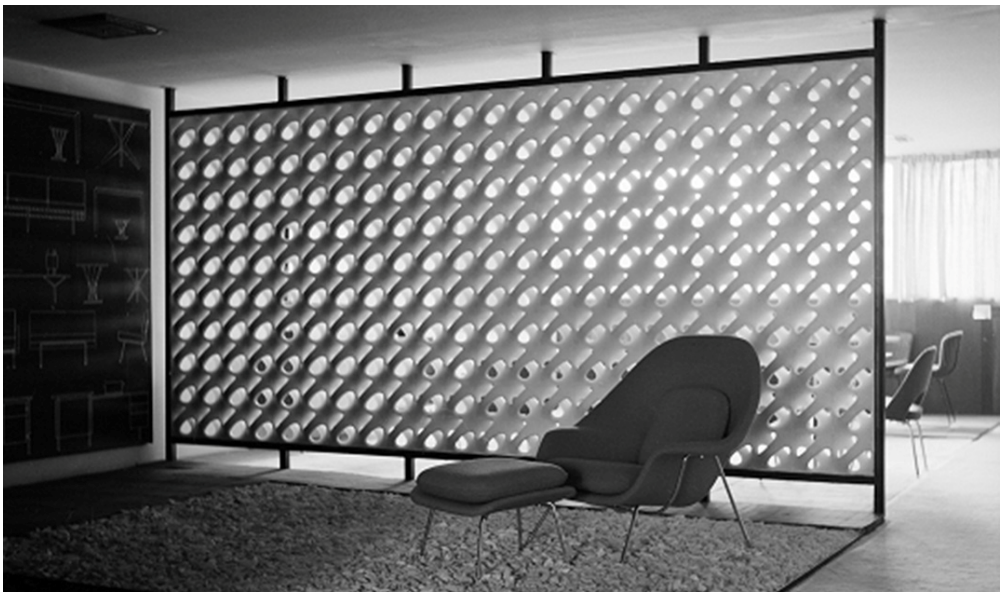
Exterior view

Exterior view

Exterior view

Continua Screens

Erwin Hauer
Various Locations 1950-1959



Description

Continua is a collection of sculptures on the subject of “infinity” and “continuity” that find some usage as architectural screens in the shape of light diffusing perforated walls. Originally made in cast plaster or concrete and more recently in mdf, resin and steel. They are usually composed of geometrically complex, interwoven modular components.

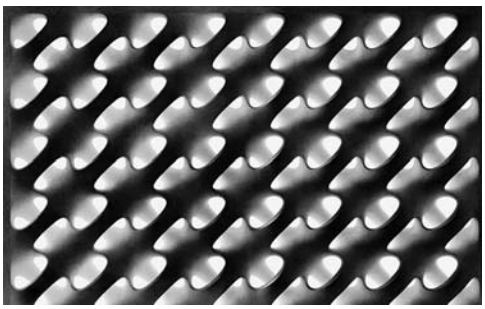
Relevance

Various methods of digital fabrication with 6-axis robots could be used to further explore the concept with non-repetitive modularity.
Also, the traditional molds could be reworked for fabrication with a 6-axis robot, instead of relying on the expensive, time-consuming milling of other materials.

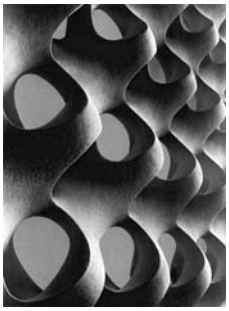
References

- Hauer, E. (2004): Erwin Hauer: Continua-Architectural Screen and Walls, Princeton Architectural Press
- http://erwinhauer.com

Images

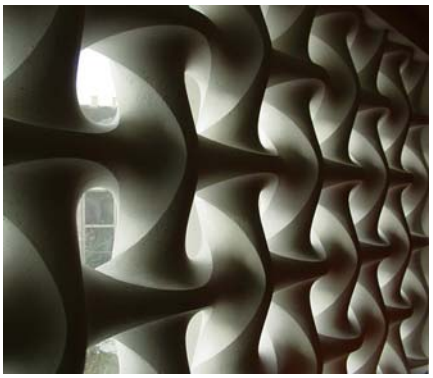


Design 1



Design 1 - Detail

Design 2



Design 2 - Detail

Modular components

Modular component

Mumbai Airport Terminal

SOM
Mumbay, India 2013

Description

Extension to the Chhatrapati Shivaji International Airport in Mumbai, incorporating a complex concrete roof, supported by 30 columns. The geometry of the concrete coffers varies in shape and dimensions, creating a continuous decorative pattern with openings, filled with colored glass to filter exterior light.

Relevance

Reinterpretation of the constructive and tectonic elements of a concrete vault, incorporating complex regional patterns, textures and light manipulations.

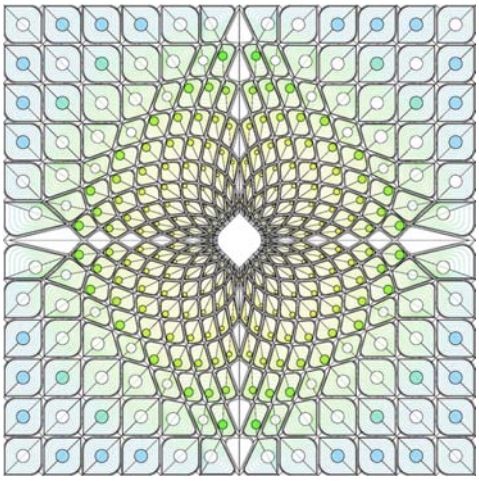
References

- http://www.dezeen.com/2014/02/20/chhatrapati-shivaji-airport-terminal-mumbai-som/

T.1.3
Survey

Architecture
Concrete

Images



Column and ceiling cell plan

Column detail

Interior view

Exterior view

Exterior view

House in Queijas

Hestnes Ferreira
Oeiras, Portugal 1968

Description

The House in Queijas was the first work where Raul Hestnes Ferreira employed bricks in a building façade. It was the starting point for the future use and exploration of bricks in construction by the office.

Relevance

This work reflects an important point in the contemporary history of brick construction in Portugal. The curved shape of the tower can be inspirational for other forms.

References

- Ferreira, H.F. (2002): Conhecer o tijolo para construer a Arquitectura", in P. B. Lourenço and H. Sousa (Eds.), Seminário sobre Paredes de Alvenaria (111-132), Porto, 2002

- http://oeirascomhistoria.blogspot.pt/2010/02/casa-de-queijas-de-raul-hestnes.html

T.1.3
Survey

Architecture
Ceramics (bricks)

Images

Exterior View of the Roof

The House in the cover of a magazine

North Facade

South/East Facade

Youth House

Hestnes Ferreira
Beja, Portugal 1976

Description

The Youth House in Beja explores the use of bricks in the construction of roof Vaults in “Barrete Clérigo” type. This option was influenced by the traditions of the Vaults in Alentejo, which are reported in the “Arquitectura Popular” book. When starting the project, the architect doubted if he could find masons to build the 20 designed vaults. 2 teams from Serpa did it all without any formwork. The major ones have 7.2x7.2m. and required the strengthen of its base, which resulted in the rhythmic brick assembly.

Relevance

This work shows the structural potential of brick in the construction of vaults. It also shows the integration of aesthetics with structural concerns.

References

- Ferreira, H.F. (2002): Conhecer o tijolo para construir a Arquitectura”, in P. B. Lourenço and H. Sousa (Eds.), Seminário sobre Paredes de Alvenaria (111-132), Porto, 2002

T.1.3
Survey

Architecture
Ceramics (bricks)

Images

General view

Public Library in Moita

Hestnes Ferreira
Moita, Portugal 1988

Description

One of the key aspects in the design of the Public Library in Moita is the fact that, according to the author, the design of the constructive elements occurred at the same time as their conception. The material and constructive options are looking for lighting effects. Also, there is a particular relation between the use of brick and the concrete structures.

Relevance

This work shows the aesthetic potential of bricks in the construction of walls and columns.

References

- Ferreira, H.F. (2002): Conhecer o tijolo para construer a Arquitectura", in P. B. Lourenço and H. Sousa (Eds.), Seminário sobre Paredes de Alvenaria (111-132), Porto, 2002

T.1.3
Survey

Architecture
Ceramics (bricks)

Images

Exterior view of the “Corpo das Reservas”

Wall detail

Aveiro Library

Álvaro Siza
Aveiro, Portugal 1994

Description

Situated at the edge of the university campus in Aveiro, the Library building is visually characterized by the interplay of orthogonal and curved exterior walls, clad in regional ceramic bricks.

Relevance

On interesting aspect of the University Library in Aveiro is the exploration of the potential of the ceramic brick as a finishing element in orthogonal and smooth undulating vertical surfaces, which could be further explored with more complex geometries and different patterns through robotic fabrication.

References

- http://alvarosizavieira.com/1994-aveiro-library

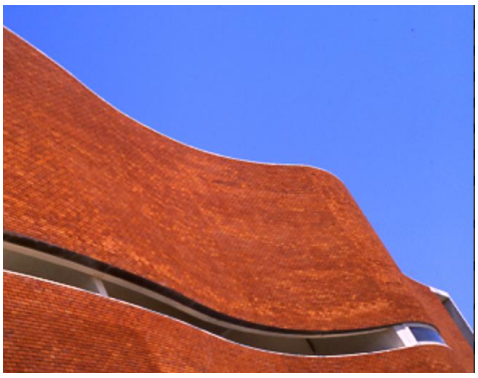
T.1.3
Survey

Architecture
Ceramics (bricks)

Images

Exterior view

Exterior view



Exterior view

Exterior view

Planetário do Porto

José Manuel Soares
Porto, Portugal 1998

Description

The planetarium of Porto is located at the University of Porto's campus III. It is a patio style building, in which a brick wall creates a protective envelope. The exterior façade contains the interesting feature of a protruding ball, symbolizing the planterium room itself.

Relevance

The presence of a non-standard brickwork is clear in this building. It suggests construction techniques in which the very mathematical definition of sphere was key to design the correct offset for the brickwork to be built. Other shapes with not so obvious mathematical translations could be created with digital fabrication/assembly tools.

References

- http://alvarosizavieira.com/1994-aveiro-library

T.1.3
Survey

Architecture
C€Ceramics (bricks)

Images


Exterior view


Exterior view


Exterior view


Exterior view


Exterior view

Alentejo Tile Vaults

Vernacular Architecture
Portugal

II - XX

Description

Thin tile vaults are commonly known as catalan vaults, but are found throughout the Mediterranean. One of the key features of this type of constructions is that does not use centering, relying on the light weight of the terracote tiles and a specific type of mortar that dries quickly fixing the tile on place while advancing towards the center of the vault.

Relevance

Due to the higher cost of human labour in the XX century, this construction technique has almost disappeared. Being a technology that is dependent on a high degree of freedom, robotics could lead the way in reinterpreting this building system.

References

- http://da.ambaal.pt/noticias/?id=4175
- http://abobadilhas.blogspot.pt/
- http://cvc.instituto-camoes.pt/ciencia/e57.html

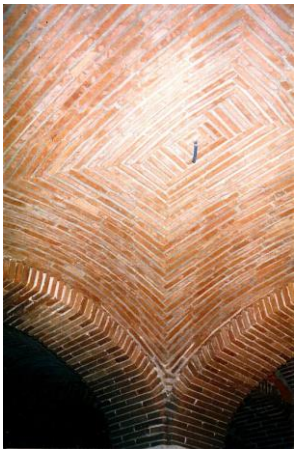
T.1.3
Survey

Architecture
Ceramics (bricks)

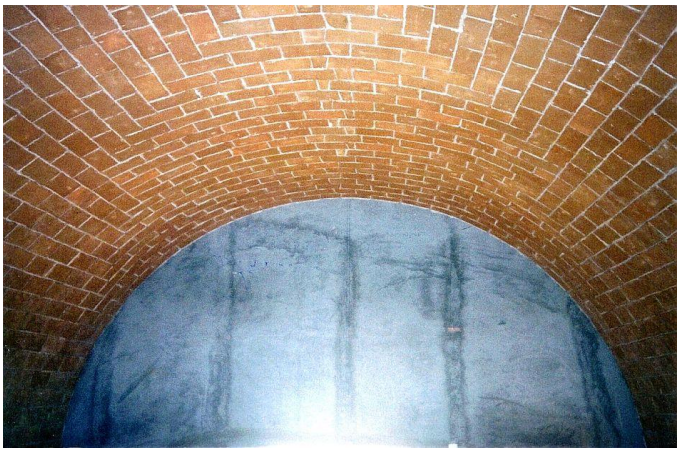
Images

Low height vault covering a room

Balcony topped by a vault



Vault on arches



Barrel vault

Serpentine Gallery

Álvaro Siza + Eduardo Souto Moura
London, UK 2005

Description

The Serpentine Gallery is a wooden frame pavilion made out of hundreds of different wood and acrylic components. Although it looks like a traditional kind of construction, its organic shape and variable building components required the use of computational design and digital fabrication processes.

Relevance

The details of the structure have a potential to be parametrically deployed. Also, with a 6 axis robot, it would be possible to mill less rationalized joints.

References

- Balmond, C.(2005): Serpentine Gallery Pavilion 2005 – Alvaro Siza, Eduardo Souto Moura with Cecil Balmond ARUP. Trolley Books

T.1.3
Survey

Architecture
Wood

Images

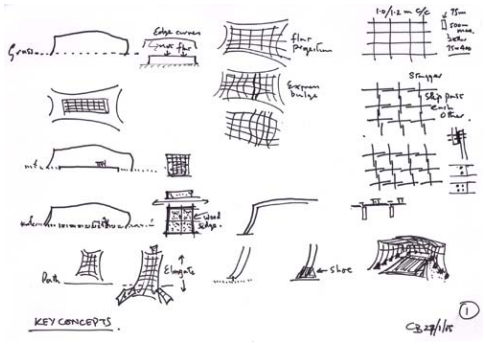


Diagram of variation

Exterior view

Interior view

Detail

Detail

Detail

Gelosias

Traditional Architecture
Braga, Portugal

Sec. XVI

Description

Gelosias is a word that comes from Latin zelosus, meaning “envy”. It is a construction technique derived from the arabs in which wooden rods are assembled to create a permeable curtain which allows to see from the inside but hide from the outside. It is also effective for ventilation in warm weather.

Relevance

This kind of work normally shows great symmetry or patterns; this is due to aesthetics but most importantly to fabrication and assembly efficiency. Digital fabrication is an opportunity to create custom fittings so that individual patterns could emerge. One other possibility could be the production of more 3D curtains, instead of the 2D example given above..

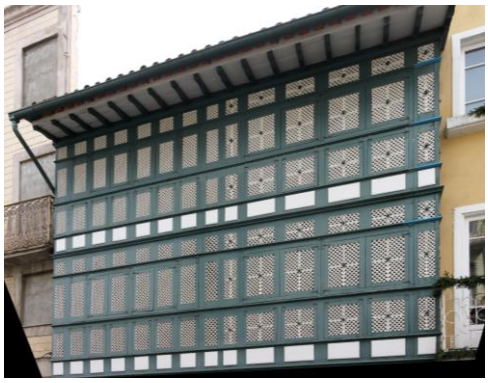
References

- Casas das Gelosias - http://www.igespar.pt/pt/patrimonio/pesquisa/geral/patrimonioimovel/detail/74661/

T.1.3
Survey

Architecture
Wood

Images



General view

Detail

Window

Balcony

Granary reconstruction

José Gigante + Vítor Silva
Guimarães, Portugal 2005

Description

The pre-existing granary stood in a terrain that was, in the meantime, sold, and the owner craved to transfer it to a new location, converting it into a house. Its dimension, however, was unable to fulfil the project's programme. Having to choose between the absolute loyalty to the pre-existent, necessarily requiring extension, or its reinterpretation in a new model that would preserve its essence, this second approach was favoured. And so, the granary was reborn, adding two modules to the four primitive ones and taking advantage of some parts derived from other demolition work

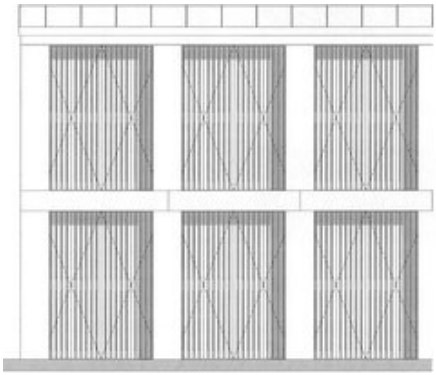
Relevance

The reinterpretation of a vernacular construction model, within contemporary architecture exposes the necessity of understanding traditional materials and their relevance for architecture.
The Interlocking stone joints and repetitive wood elements in the facade can be optimized for different geometries though the use of digital fabrication technologies.

T.1.3
Survey

Architecture
Wood

Images



Elevation

Exterior view

Exterior view

Exterior view

Exterior view

Interior view

Ornithological Observatory

Manuel Fonseca Gallego
Logronõ, Spain 2009

Description

The main concept is to consider the item as a big box beam bounded by four planes, the lower horizontal one and the rest formed by ruled surfaces. The constructive composition of these planes is set with wooden planks arranged irregularly, covering the surface partially, as a “shell”, so we went deep into the dream world of nests, recreating a surreal atmosphere with lights and indoor shadows.
The piece rests on top of the hill and crosses the forest’s mass with a powerful cantilever (12 m approx.), poking surprisingly between the vegetation, surpassing the river’s vertical edge.

Relevance

The Theatre and Library in Castilblanco de los Arroyos is one of the last built works from Miguel Fisac and a very good example in his exploration into the expressive nature of flexible formwork for concrete.

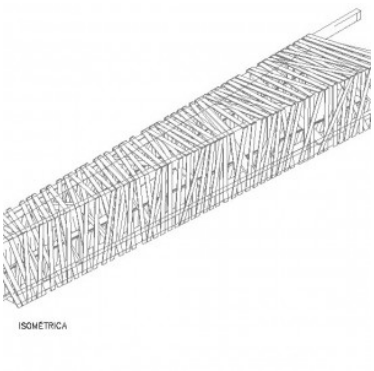
References

- http://www.landezine.com/index.php/2011/08/birdwatch-landscape-architecture/

T.1.3
Survey

Architecture
Wood

Images



Axonometric drawing

Joint detail

Exterior view

Exterior view

Exterior view

Interior view

Metropol Parasol

J. Mayer H.
Seville, Spain 2004-2011

Description

The challenge was to build an attractive structure that could transform the Plaza de la Encarnacion in an unique contemporary urban center. This mega-structure has the main function to help stimulate the square, which includes a museum, a farmers market and some playgrounds for kids, due to its innovative character. The Metropol Parasol was designed to be one of the biggest and most original attached timber-constructions.

Relevance

The details of the joints and structure have potential to be parametrical developed. Due to the extraordinary size of this structure the system of joints could be explored by using robot fabrication.

References

- http://www.jmayerh.de/index.php?article_id=19
- http://www.archdaily.com.br/br/01-27417/metropol-parasol-jurgen-mayer-h-architects

T.1.3
Survey

Architecture
Wood

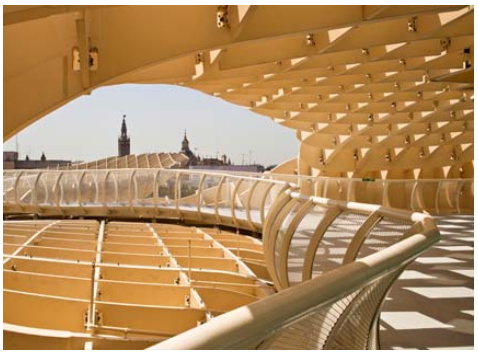
Images

Aerial view

Aerial view

Exterior view

Exterior view



Interior view

Exterior view

Swoosh Pavillion

Students tutored by Charles Walker and Martin Self
London, England 2008

Description

The Swoosh Pavilion is the 2008 AA (Architectural Association School of Architecture's) summer wooden pavilion built annually. The building was designed by the second and third year students by using computational design. The final form works as self-standing structure and was manually manufactured.

Relevance

The details of the joints and structure have potential to be parametrical deployed. Due to the particularly small size of the pavilion, the joints system could be developed as fitting system manufactured by using a Robot.

References

- http://www.arch2o.com/swoosh-pavilion-architectural-association/#prettyPhoto
- http://www.dezeen.com/2008/07/15/swoosh-pavilion-at-the-architectural-association/

T.1.3
Survey

Architecture
Wood

Images

Exterior view

Exterior view

Detail

Detail

Interior view / joint detail

Exterior view

Espigueiros

Unknown
Portugal

18th, 19th, 20th Century

Description

“Espigueiros” or Portuguese granaries are vernacular constructions spread around the country, usually built from wood and stone and in some cases entirely of stone that served the purpose of drying corn or other cereals while protecting them from rodents. Most examples are composed of an elevated structure of stone with wooden slats or ribs, allowing for the flow of air through the structure and protecting the inside from the rain.

Relevance

This simple structure is an important reference in portuguese vernacular architecture. Also, its an interesting example of architectural modulation of environmental conditions (moisture and heat) that can be studied with advanced computation simulation techniques and its repetitive elements can suggest reviewed uses with robotic fabrication in wood and stone.

References

- http://www.monumentos.pt/Site/APP_PagesUser/SIPA.aspx?id=6170
- Veiga de Oliveira; Dias, J.; Galhano, F. (1963) “*Os Espigueiros Portugueses”,* Porto, (IAC)

T.1.3
Survey

Architecture
Stone

Images

Stone example

Stone example

Group

Detail of stone joints

Wooden example with oblique walls

T.1.3
Survey

Architecture
Stone

Vault in the chapel of “Onze Mil Virgens”

António Rodrigues
Portugal 1565

Description

The domes vault of this chapel, along with its nave barrel vault, are a particular example of rigorous stereotomic construction in Portugal. Besides the quasi-perfect geometry that dictates the morphology of this architectonic object (and space), its execution is also very accurate and delicate.

Relevance

The cutting of stone according to accurate three dimensional shapes is a discipline which has seen a decline with other spanning construction systems, which brought direct economic advantages, as well as providing easier systems not dependent to high level training. With robotic technologies, this kind of construction system has strong possibilities to create a comeback, due to the flexibility of its cutting systems.

References

- http://www.monumentos.pt/Site/APP_PagesUser/SIPA.aspx?id=2150
- http://cvc.instituto-camoes.pt/ciencia/e57.html

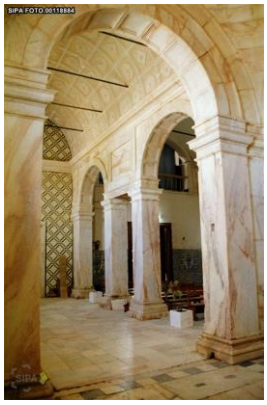
T.1.3
Survey

Architecture
Stone

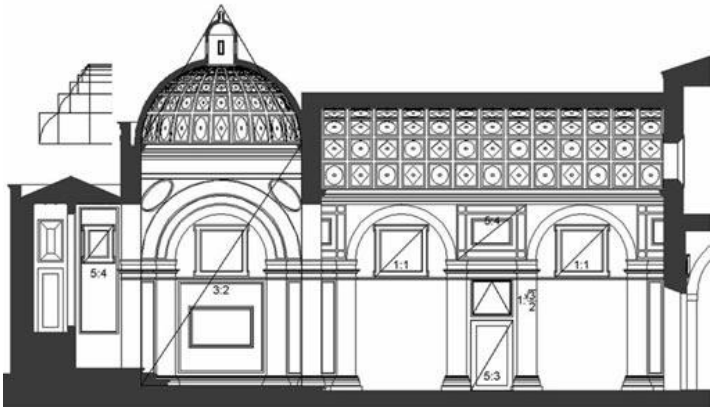
Images

Domed vault

Dome - exterior



Barrel vault



Longitudinal Section of the chapel

Portugal Pavillion for Expo Hannover

Álvaro Siza Vieira + Eduardo Souto Moura
Hannover, Germany 2000

Description

This building was the representative pavilion of Portugal at the World Expo 2000 in Hannover. It was a first in the use of expanded cork agglomerate for the exterior cladding of facades.

Relevance

Using such a malleable material as cork for the external skin of a building arises the opportunity of digital exploration of form. Through milling and contouring, facades made of cork are an exploratory path.

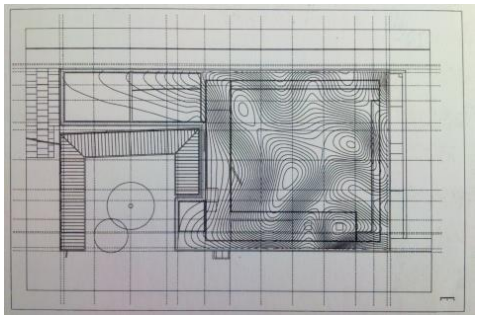
References

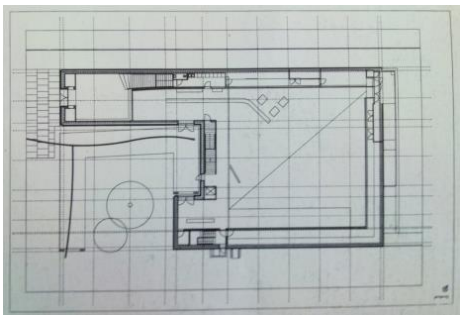
- http://www.arquiteturafotos@blogspot.pt

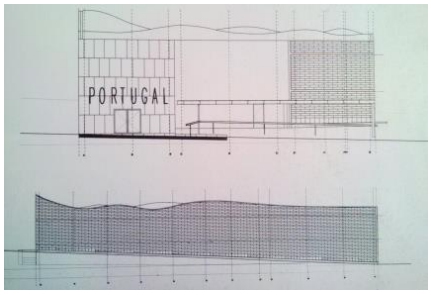
T.1.3
Survey

Architecture
Cork

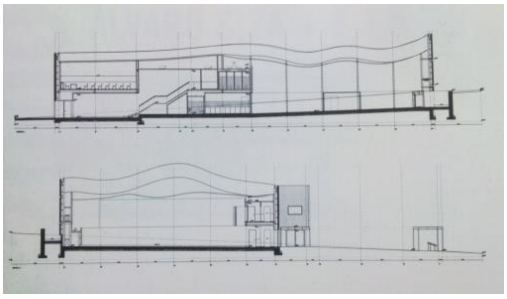
Images


Top plan


Floor plan



Elevations


Sections

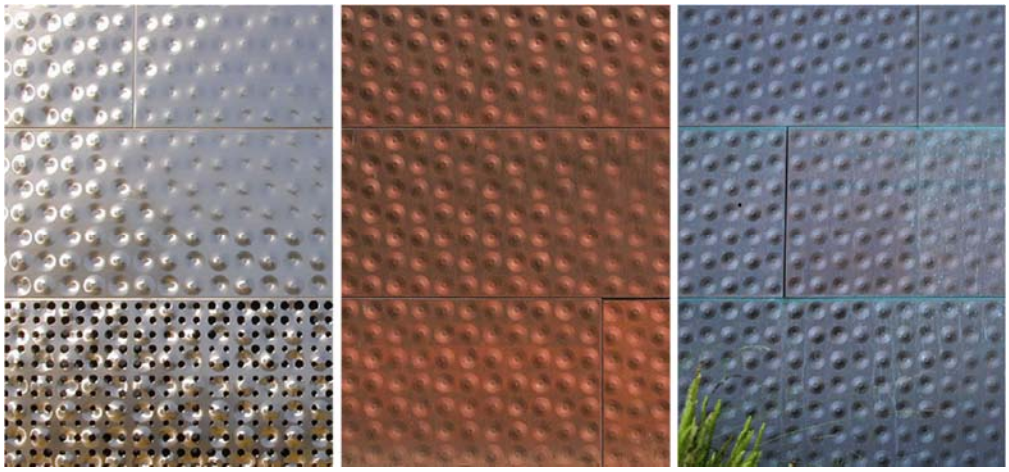

Exterior View


Exterior View

M. H. de Young Museum

Metal Panels

Herzog & de Meuron
San Francisco, California, USA 2001-2005



Description

Herzog & de Meuron worked with Zahner whose engineers and software specialists developed a system, which would allow unique perforation and patterned dimples, variably sized and placed thoughout the exterior. This included over 8000 unique panels whose collective whole formed the pattern of light through trees - literally. This was the first iteration of the Zahner Interpretive Relational Algorithmic Process, or the ZIRA™ Process.
The ZIRA™ Process streamlined the complex series of variable holes in the copper, allowing engineers to run chosen imagery through the algorithmic system, translating it to the thousands of copper plates.

Relevance

1. Development of a software system which would allow unique perforation and patterned dimples with variable sizes
2. Creating perforation patterns from images processed through the algorithmic system

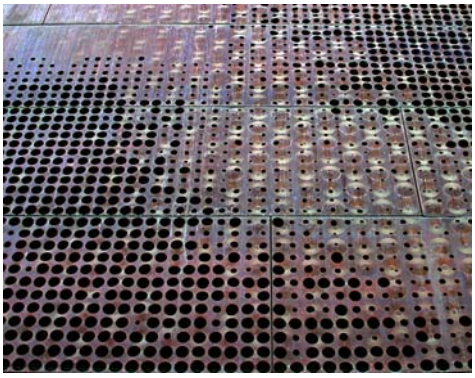
References

- http://www.azahner.com/portfolio/de-young
- http://publicuseofprivatespace.wordpress.com/2012/09/29/assignment-02-content-parametric-methods/

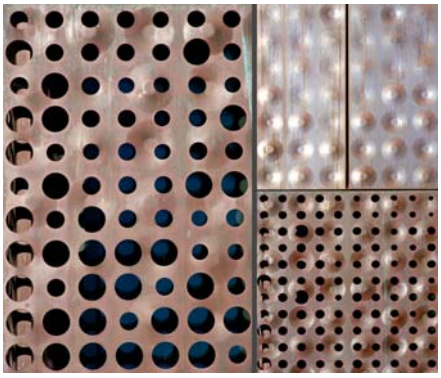
T.1.3
Survey

Architecture
Metal

Images

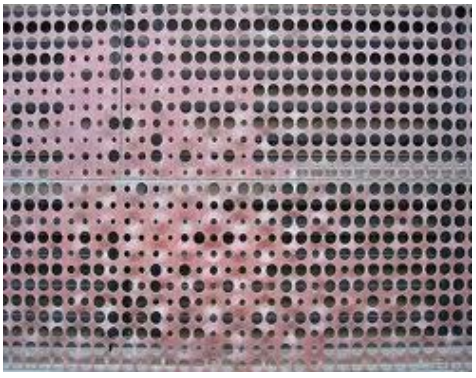


Panel Facade



Panel detail

Panel facade



Panel detail

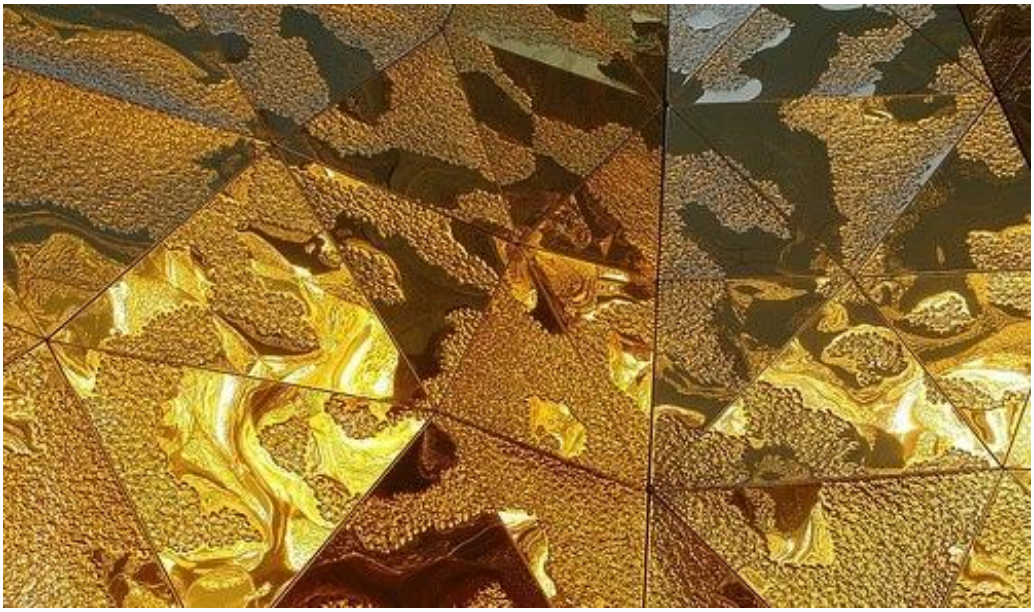
Exterior view

Caixa Forum Barcelona

Metal Panels

Herzog & de Meuron
Barcelona

2000-2004



Description

Though of their surface characterization, these metal panels are reminiscent of the sea theme. Some parts of the sheet metal are smooth, some are roughened, establishing the idea of spleen and clear, of opacity and transparency.
The metal sheet, characterized by being reflecting and crystalline is jagged in triangular shapes, in a patterned geometric skin.
This pattern, of standard triangles is used in flat plans also applied on the perforated parts of the building.
The metal sheets seem like they transferred the façade roughness to their own material, performing a texture of stained and pressed sheets, which creates a hybrid "skin".

Relevance

1. Variation from smooth to roughened surface
2. “Chaotic” pattern from standard triangles

References

- http://buildipedia.com/aec-pros/featured-architecture/barcelonas-forum-by-herzog-de-meuron

Images

Exterior view

Exterior view

Exterior view

Panel detail

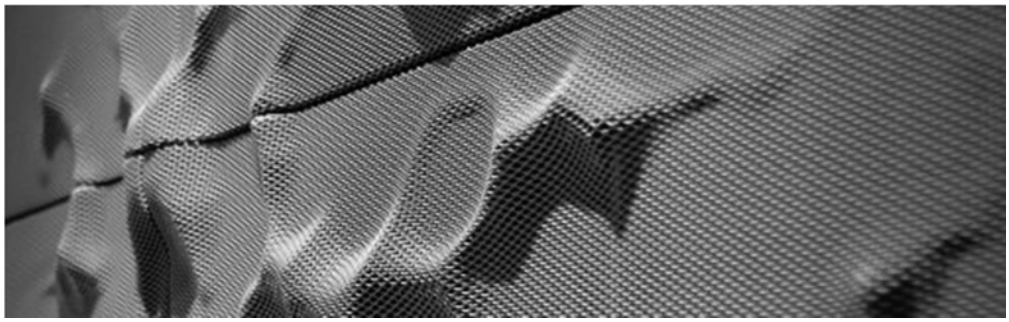
Interior view

Panel detail

Caixa Forum Madrid

Metal Topography

Herzog & de Meuron
Madrid, Spain 2001-2007



Description

The wall and ceiling of the main room of the Caixa Forum Madrid are covered with square plates of drawn aluminum, placed with continuous connections. The surface is modeled as a metal topography.
The topography landscape has been developed using 3D modelling systems. Working on a perforated aluminum mesh, each piece fits its adjacent neighbors perfectly creating a continuous and changing mosaic.
Visual variation is achieved by designing the modular topographical element to be continuous even when rotated by 90 degrees.

Relevance

Metal forming with a complex pattern and precise joints can be further explored through robotic fabrication, specifically with non ortogonal surfaces.

References

- http://blog.bellostes.com/?p=1170
- http://imararquitectura.blogspot.pt/2008/02/herzog-de-meuron-caixaforum-madrid.html
- http://imararquitectura.blogspot.pt/2008/07/blog-post_07.html

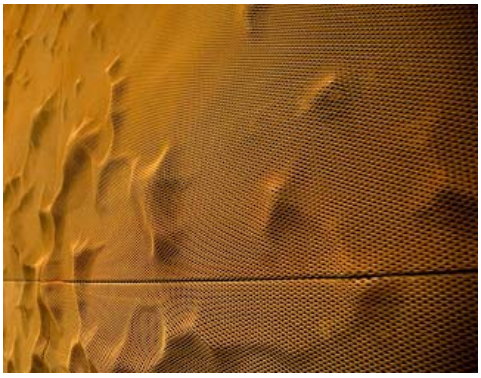
T.1.3
Survey

Architecture
Metal

Images


3D Model


Metal panels


Metal panels


Metal panels

Caixa Forum Madrid

Perforated Corten Steel

Herzog & de Meuron
Madrid, Spain 2001-2007

Description

This rusted cladding (from panels of 800 x 800 x 10 mm), is delicately pressed in front of the opaque parts of the façades to provide a solid cladding, and perforated in the glass parts so that natural light can pass through and create a different texture.
The pattern design was developed so not to compromise the stiffness of the material.
Models and prototypes at scale 1:1 were made in order to verify the final pattern.
The use of Corten steel is both monumental and perforated, heavy and light, wrapping multiple sides to become a counter-intuitive gesture: a steel box.

Relevance

Perforated facades are an increasing design solution in contemporary architecture and not only in can be explored through digital fabrication to achieve more complex patterns in non ortogonal surfaces in a variety of materials.

References

- http://www.swissmade-architecture.com/?seite=Picture&bid=48
- https://ksamedia.osu.edu/item/80905
- http://www.dezeen.com/2008/05/22/caixaforum-madrid-by-herzog-de-meuron/

T.1.3
Survey

Architecture
Metal

Images

Exterior view

Exterior view

Panel close-up

Panel close-up

Interior view

Signal Box

Herzog & de Meuron
Basel, Switzerland 1999

Description

The monolithic, gestural twisting box is completely clad with copper strips that twist to admit daylight at the right locations.
The copper changes drastically in the light and also matches the atmosphere of the place.

Relevance

Using the logic of bending linear materials, parametric software and robotic fabrication can be used to obtain a variety of surface effects and different light modulations from exterior to interior through controlled envelopes.

References

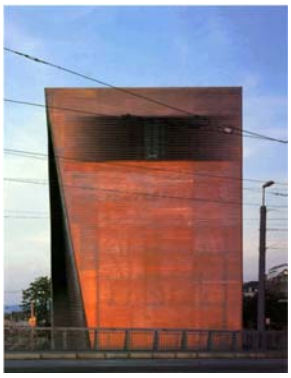
- http://mjobrien.com/ARCH606S09/Herzog_and_DeMuron_Copper_Box_signal_boxes.pdf
- http://www.archdaily.com/256766/flashback-signal-box-herzog-de-meuron/
- http://issuu.com/wanderspace/docs/central_signal_box_autocad_sketchup_rhino_grasshop
- http://www.archdaily.com/256766/flashback-signal-box-herzog-de-meuron/herzog_meuron_central_signal_box_basel_sw_191111_009/

T.1.3
Survey

Architecture
Metal

Images

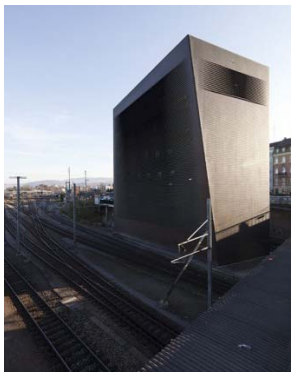

Exterior view


Exterior view


Exterior view


Exterior view


Exterior view


Exterior view