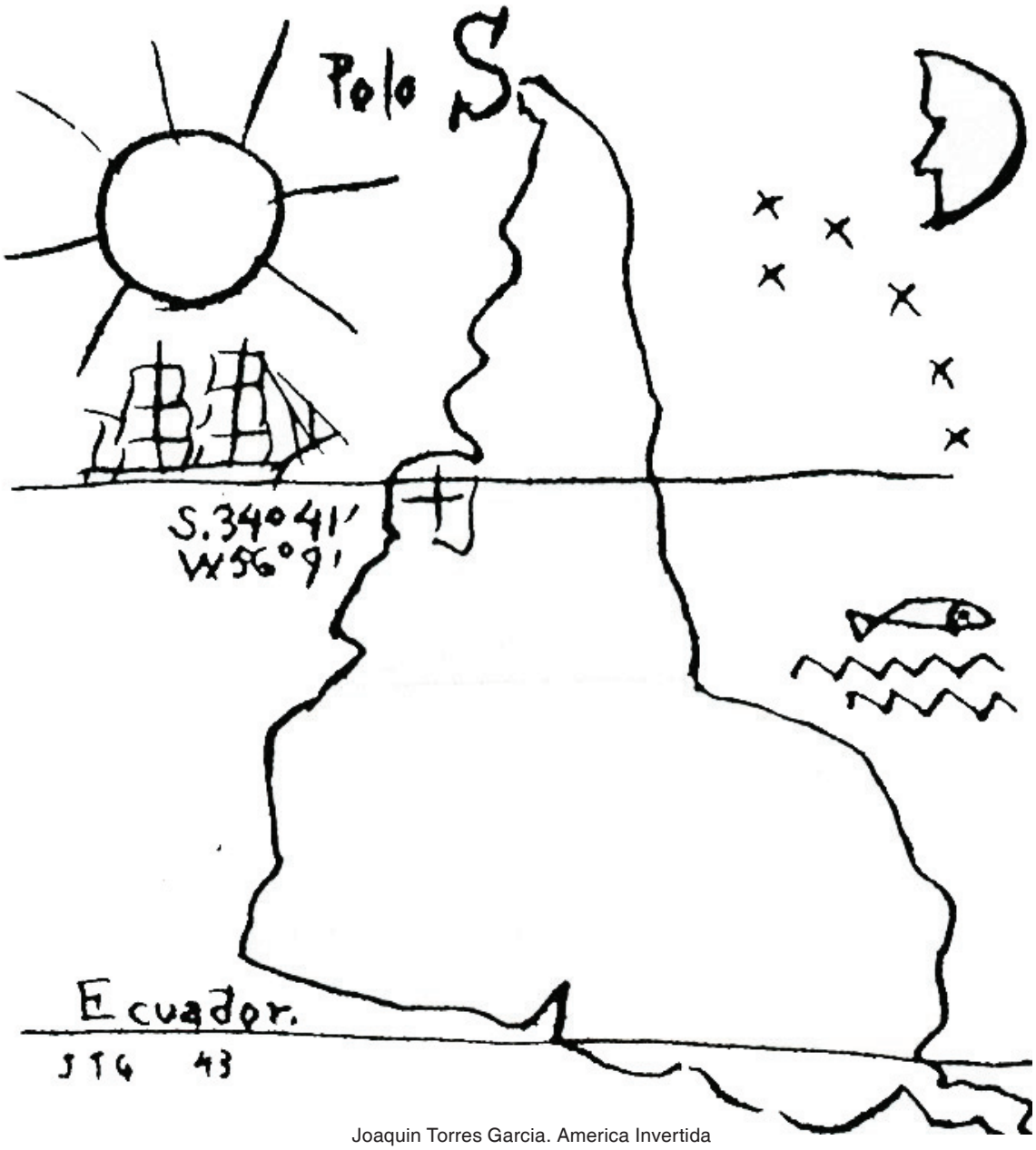
APPROPRIATE TECHNOLOGIES

Technological Culture in Modern Latin American Architecture



Joaquin Torres Garcia. America Invertida

Prof. Renato D'Alençon, Gastdozent

Sommer Semester 2009 Seminar at Habitat Unit TU-Berlin.

DAAD

Fachbezogene Partnerschaft mit Hochschulen in Entwicklungslaendern project, sponsored by DAAD

TUB-PUC Energy and Building Teaching - Research Group
Technische Universität Berlin
P. Universidad Católica de Chile

Technische Universität Berlin

P. Universidad Católica de Chile

Editor
Prof. Renato D'Alencon
Habitat Unit
Facuty VI - Planning Building Environment
Technische Universität Berlin
Strasse des 17. Juni
10623 Berlin
www.habitat-unit.de

Layout Design
Natalia Spörke

Layout
Natalia Spörke

APPROPRIATE TECHNOLOGIES

Technological Culture in Modern Latin American Architecture

Prof. Renato D'Alençon, Gastdozent
Sommer Semester 2009 Seminar at Habitat Unit TU-Berlin.

Contents

APPROPIATE TECHNOLOGIES
Technological Culture in Modern Latin American Architecture

0 Syllabus

The Seminar will address the question of technology being set in a particular social and cultural context by examining the work of 6 relatively unknown Latin-American Architects of the XXth century. Their building and writings, focusing on structural, tectonic and environmental issues, stand for a creative architectural synthesis of international trends and local conditions, which were often much contrasting those of the original "models". The work will include a review of the relevant literature and critical study of the built work, and will conclude with a written paper summarizing the work of the semester.

APPROPRIATE TECHNOLOGIES
Technological Culture in Modern Latin American Architecture

SYLLABUS

Prof. Renato d'Alençon.
Sommer Semester 2009 Seminar at Habitat Unit TU-Berlin.
Revised as of April 20th, 2009

The Seminar will address the question of technology being set in a particular social and cultural context by examining the work of 6 relatively unknown Latin-American Architects of the XXth century. Their building and writings, focusing on structural, tectonic and environmental issues, stand for a creative architectural synthesis of international trends and local conditions, which were often much contrasting those of the original "models". The work will include a review of the relevant literature and critical study of the built work, and will conclude with a written paper summarizing the work of the semester.

1. CULTURE AND TECHNIQUE IN ARCHITECTURE

Technology is a prevailing feature in contemporary society, yet its cultural role has been scarcely addressed in a critical perspective. A well settled, commonsensical notion of technology prevails, that of technology as equivalent to progress, driving development and supported by an autonomous, natural evolution which univocally impacts on society.

At the same time, Architecture is a discipline that -with the aim of providing shelter for men- notoriously articulates technologies and social context. Several of the properly technological aspects of architecture, under the influence of the above described simplified, deterministic tone are neglected in the trade, assumed not to have enough academic relevance and are thus often excluded from our critical agenda. Although the production process of Architecture has been traditionally considered as a parameter in the development of the architectural project, it has rarely been in the conceptual and critical core.

The idea that technology and architecture belong to separate realms is relatively new. Starting the second half of the eighteenth century, according to Banham (1969), Architecture is conceived as separate from building technology. The generalization of this concept has had enormous impact on the theory, criticism and practice of architecture. This separation is based on an explosive development of new technologies from the industrial revolution, which has resulted in a progressive technical expertise and a complexity that requires new disciplines in the compartmentalization of fields that were previously under the eaves of Architecture, or simply did not exist.

These contesting issues are evident in the context of "underdeveloped" countries, where the relation to technological innovation is mediated by international networks that convey technological development as "coming" from "developed" societies. In spite of the general trend, a relatively small number of Architects and their work can be explored for the sake of documenting in a built work the struggle of technology as it is put in a specific cultural context.

2. LATIN AMERICAN MODERNISM

When we talk about modernism, we are not only referring to the modern movement in architecture, however diverse recognizable at least in the trade. Instead, we are rather referring to the general change in the paradigms of society, culture and economy that took place along the XXth century, beginning actually the XIXth. The general characteristics of such changes are quite known: secularization, industrialization, technology. The trust in these changes took the last part of the XIXth century to develop, but by when it was already well settled in the first decades of the XXth, major changes had taken place.
Architecture followed the lead of social changes, finally abandoning the prescriptions of the Academies and turning into the aesthetics of the industry, pervasive by means of its broad success. The written work of Le Corbusier in "Vers une Architecture" is a very explicit testimony of this. Even if the Modern Movement eventually spread to become canonical, it had a scattered beginning, with a variety of expressions based on the same sensibility. Cubists, Futurists, Rationalists and many other blur together to our post-modern eyes, usually confused behind the mottos of the International Style.
Just as mainstream Modern Architecture was not homogeneous, the changes brought about by modern times to architecture in other contexts bear specific qualities worth noting. The disciplinary and institutional transformations resulting from the process of modernization in Latin American countries were particularly interesting, as they corresponded with the construction of the identities of young countries, many in a process of explosive development. The Seminar will address these questions by examining the relevant literature and conducting a critical review of the built work of 6 relatively unknown Latin-American Architects:

Joao Filgueiras de Lima / Lelé, Brasil
Clorindo Testa, Argentina
Eladio Dieste, Uruguay
Eduardo Catalano, Argentina / USA
Carlos Raúl Villanueva / Venezuela
Amancio Williams, Argentina

They are, if not peripheral figures in their own countries, at least scarcely known in the panorama of international modern architecture. But maybe the most important thing is that these architects where focusing in a substantial issue of modernization in their work: the innovations in technology.
Forced by their specific technological horizons, their work strongly integrates the "objective" parameters of technology in most peculiar ways, leading to surprising results. By studying the built work of these architects, we will attempt to unfold the details of this articulation of technology to (or by means of) a specific social context.

3. CONTENTS

The Semester will be organized around 4 Topics to be studied and discussed by the students. These are expected to be reflected in critical positions regarding the cases of study:

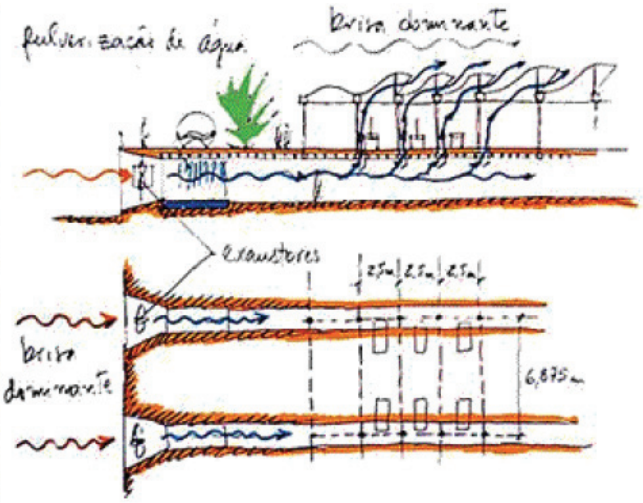
1. Introduction
2. Technology in a critical perspective beyond architecture, technology is examined as a cultural arena, and the assumption of tecnology to be neutral or autonomous is questioned.
3. Modernity, global and local perspectives and processes of appropriation the process of industrialization has presumably opened the gap between central, industrialized societies and peripheral, underdeveloped ones. Does this hold true today? Can alternative models be identified?
4. Technology as a critical core for architecture: structures, tectonics and systems even if not prevailing, Architecture has been developed discourses and practices that critically emphasize environmental performance, structural concepts, and tectonic logics.

5. Research Methods in Architecture. Tools and Limitations of research in Architecture are to be discussed as a parallel methodological approach.

CASES OF STUDY

Joao Filgueiras de Lima / Lelé

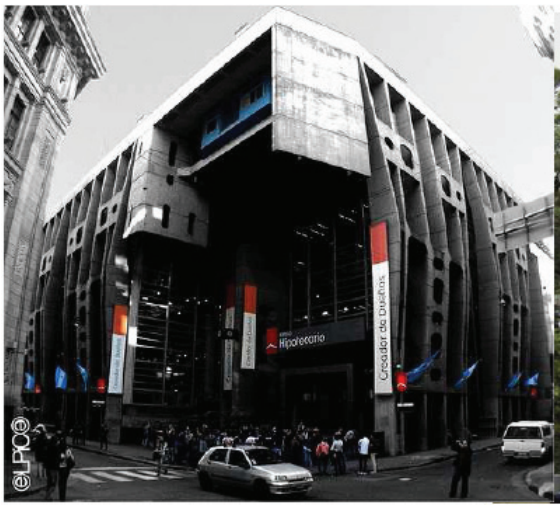
The architectural work of Lelé is strongly characterized by the pursuit and of rationalization and industrialization of architecture. He developed methods methods and procedures for pre-fabrication of constructive elements unprecedented at the time in his country. In addition, Lele´s work systematically approached questions of environmental comfort, and run a factory producing pre-fabricated components and was contractor for the maintenance of the buildings.



(Images: Hospital Sarah Kubitschek Salvador, Bahia)

Clorindo Testa

In his work he was one of the leaders of the rationalist movement and was one of the pioneers to the brutalist movement in Argentina. His work was strongly influenced by his simultaneous work as a painter, which is reflected in the strong plastic emphasis in his buildings. During his career as an architect Testa built a reputation as an innovative and paradigm breaking designer, who regurlarly redefined the conventions of his age.



(Images: Banco de Londres, Biblioteca Nacional, Buenos Aires)

Eladio Dieste

Dieste, who was educated as an engineer, is widely reputed for his work on structural ceramic vaults and walls, applied to wide a range of structures from grain silos, factory sheds, markets and churches, all of them in Uruguay. A particular innovation was his Gaussian vault, a thin-shell structure for roofs in single-thickness brick with one single steel traction rod below, that derives its stiffness and strength from a double curvature catenaries arch form that resists buckling failure.

(Images: Marketplace Wharehouse Durazno)

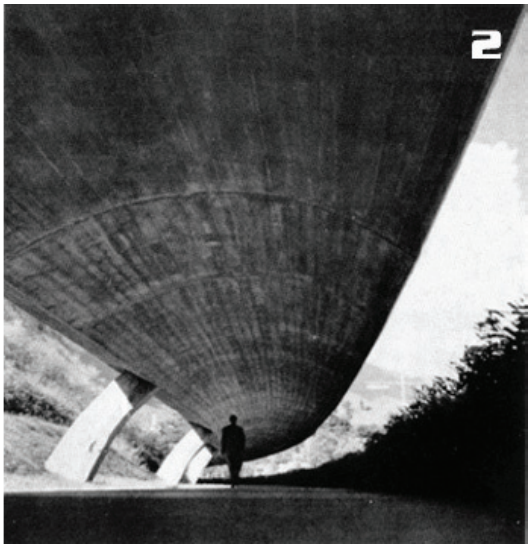
Carlos Raúl Villanueva

Villanueva was the most prominent Venezuelan architect of the 20th century. He played a major role in the development and modernization of Caracas and other cities across the country, contributing to the construction of the image of Venezuela. Among his most important works is the Ciudad Universitaria in Carcas, a work where he attempts to blend modern art and architecture. The Campus was declared World Heritage Site by UNESCO in 2000.

(Images: Auditorium and Pathway Ciudad Universitaria Caracas)

Carlos Raúl Villanueva

Villanueva was the most prominent Venezuelan architect of the 20th century. He played a major role in the development and modernization of Caracas and other cities across the country, contributing to the construction of the image of Venezuela. Among his most important works is the Ciudad Universitaria in Carcas, a work where he attempts to blend modern art and architecture. The Campus was declared World Heritage Site by UNESCO in 2000.



(Images: Auditorium and Pathway Ciudad Universitaria Caracas)

Amancio Williams

Also inn the work of Williams the conception of the structure is strongly rooted in the overall concept of his designs. Among them, the House over the Brook in Mar del Plata, one of Williams's few built works, best represents his design synthesis and craft. Williams also took a role in disseminating the ideas and realizations of the Modern Movement, and was involved in the construction of the house of Dr. Currutchet in Mar del Plata, by Le Corbusier.

(Images: Casa del Puente Mar del Plata and Monument Park Vicente López, Bs As)

4. OBJECTIVES

The goals of the Seminar are:

1. Read and write a substantive summary on the topic. Take an individual position about the questions at stake.
2. Conduct a monographic research on specific architect's work that can be understood in the culture-technique framework
3. Structure, elaborate and present a relevant argument based on both on literature review and the own analyses.

5. METHODS

The work will be organized along two parallel lines: Case study work and Reading / Writing Work. The assignments of both lines will alternate, as to have specific topics under discussion in the Seminar at any given point of the Case Study work. Thus, the critical positions developed by reading the literature of the semester should substantially feed the Case Study. The specific work includes:

Reading and written Discussion

Reading of assigned articles and writing of a Brief Reading Report (ca. 150 words) to be discussed in Class and completed by individual readings outside the list. These need to be properly referenced and/or quoted. Reading Reports need to be submitted to dalencon@daad-alumni.de the night before deadline.

Case Studies

The Case Study is not limited to Documentation and Information on the given cases. Further input, such as retrieval of relevant references, specific analyses regarding the focuses for each case (environmental, structural, tectonic) are expected. These will be presented in an intermediate presentation.

Writing

The final Paper (ca. 4000 words) should further elaborate an articulated argument departing from the topics examined along the semester, based on specific cases of study work and analyses. It will be first presented as a proposal and discussed in two preliminary appointments upon request and finally presented and submitted for evaluation.

7. CALENDAR

Week	Date	Topic / Assignments / Deadlines
1	T 21 Apr	1. Introduction General introduction to the Semester and the Study Cases Reading Assignment 1
2	T 28	Reading Assignment 1 Report Deadline and Discussion Research Assignment 1. Basic Case Study Documentation
3	T 05 May	2. Technology in a critical Perspective Technology v/s culture and the contemporary condition Reading Assignment 2 Research Assignment 1 Review
4	T 12	Research Assignment 1 Presentation (P1), and Documentation Brochure of Study Cases (PPT and A3) Research Assignment 2. Cases Study Analysis Brochure of Study Cases and References (A3)
5	T 19	Reading Assignment 2 Report Deadline 3. Tectonics, Structures, Systems: critical core for architecture Reading Assignment 3
6	T 26	Research Assignment 2 Review and Discussion
7	T 02 Jun	Reading Assignment 3 Report Deadline 4. Modernity, global / local perspectives and processes of appropriation Reading Assignment 4
8	T 09	Research Assignment 2 Presentation (P2), and Documentation Brochure Analysis (PPT and A3)
9	T 16	Reading Assignment 4 Report Deadline 5. Research Methods in Architecture Research Assignment 3. Final Paper (A4, 4000 words + images)
10	T 23	Independent Work. Res. Assignment 3 Review Appointment 1
11	T 30	Independent Work. Res. Assignment 3 Review Appointment 2
13	T 07 Jul	Presentation Preview. Synthesis of P1 + P2 + FP
14	T 14	FINAL PRESENTATION (FP). PPT Presentation and Paper Draft Prof. Herrle and Guests Critics

1 Joao Filgueiras de Lima / Lelé, Brasil

The architectural work of Lelé is strongly characterized by the pursuit and of rationalization and industrialization of architecture. He developed methods methods and procedures for pre-fabrication of constructive elements unprecedented at the time in his country. In addition, Lele´s work systematically approached questions of environmental comfort, and run a factory producing prefabricated components and was contractor for the maintenance of the buildings.

“TOWARDS A REGIONAL FUNCTIONALISM- THE ARCHITECTURE OF LELÉ”

Daniel Korwan

ABSTRACT

Is modernism about style? Or is it about science? And where does the regional have it’s place in this concept? The answers to this questions have always been a struggle between the old and the new world, between engineer-architects and artists.

Although being based on science rather than on aesthetics the modern architecture of the Brazilian architect Joao Filgueiras Lima (Lelé) does not clearly match any of the existing tracks. His science based modernism is said to deliver better environments for the user and at the same time achieves a high architectural quality. To achieve this he developed multipurpose performative prefabricated elements that were used in the hospitals of the Sarah network throughout brazil, adapting to the given climate. Are they extending the term functionalism? A regional functionalism?

Keywords: modernism, regionalism, science, prefabrication

„To make architecture more human means better architecture, and it means a functionalism much larger than the merely technical one. This goal can be accomplished only by architectural methods – by the creation and combination of different technical things in such a way that they will provide for the human being the most harmonious life“ (Frampton 2004, p. 171)

Alvar Aalto, 1960

0 A new kind of modernism?

The Sarah Kubitschek hospitals by the Brazilian architect Joao Filgueiras Lima (Lelé) are scarcely known outside Brazil. Nevertheless they are a compelling piece of architecture both complex and simple and deliver a high environmental comfort without the use of active technological systems. The work of Lelé follows a very scientific approach to architecture that is at the same time far away from what is commonly known as functionalism. Hence the question is how this science based modernism can be embedded in any of the existing threads of modernism that have shown up throughout history. It is apparent that it strongly differs from the way modernism developed in the 1920s in Europe but nevertheless what is specifically regional or Brazilian about it? How does it fit into the given social and cultural situation and how does it fulfil the specific requirements of Brazil as a then developing country?

Lelé's modernism is mainly based on an in-depth analysis of the surrounding climate - and as such is following the old tradition of the engineer-architect as once presented by protagonists like Viollet-le-Duc. Having this expression it strongly separates itself from the European modernity of aesthetics that sought to develop a new style for the machine age. This difference is caused by one specifity in Lelé's work which one could call performative typifcation: a prefabrication under the aspect of performative capacities that emerged from the local climate, a prefabrication that is dealing with more than aesthetics, costs and tectonics, that is instead creating a regional functionalism.

1 Modernism and Architecture

In order to better understand the background of modernisation and its impact on architecture it is helpful to take a closer look at the tendencies in the outgoing 19th and beginning 20th century:

Several tracks of modernism

According to Kenneth Frampton the language of classical architecture was based on a free and undisturbed expression of the actual architectural volume while secondary elements such as staircases were hidden behind the facade. By contrast the elements of the architectural language of the modern

era in the early 20th century were exactly those former hidden elements. The appearance of a building was now structured by staircases, elevators and so on. While the old approach suppressed empirical facts and the power of reason, the new one only aimed at an expression of a building's utilitas and the way it had been built – two extreme positions that create a dialectic (Frampton 2004, p.9).

However there is not one single path of modern architecture. Instead several tracks of modernisms developed simultaneously, both influencing and rejecting each other under names like functionalism, purism, constructivism and many others.

In a very general view this early 20th century modernism can be separated into two broad fields: an aesthetic path seeking for a new style for the machine age and a scientific path. Again those two paths form a dialectic: Whereas the first is about the mere application of technology and innovation, the second is about understanding these influences.

A modernism of aesthetics or a modernism of science

The mostly European protagonists of this aesthetic modernism were seeking for what Reyner Banham calls a new aesthetic that fits to the machine age (Banham 1984). As a result the shape of the architectural object became a question of style whose answer was best to be universal and international. The logical consequence was the emergence of an International Style and not of an international architecture or an international technology. Besides its universalistic claim this architecture neglected the specificity of a given place and reduced technology to a mere application without completely understanding about the consequences.

This approach is represented throughout the work of Le Corbusier in the 1930s that was based mostly on modular facades made of glass and steel. One of them shows the problems of this concept: The double-layer curtain-wall glass facade for the Tsentrosoyuz building in Moscow (1929) figure1 was inspired by a system he had previously applied in Switzerland. However while it worked in his home region it failed to serve during the extreme Russian winter (Frampton 2004, p. 155).

(fig. 1)reference: http://www.flickr.com/photos/smallritual/2319101043/
Caption: Tsentrosoyuz Building, Le Corbusier (Moscow 1929)

Le Corbusier had the idea of a hermetically sealed office building for around 3000 people. As he was aware of the problems of huge glass surfaces he developped a technical system to condition the air, making the building theoretically independent from its place. Warm (during the winter) or cold (during the summer) air was conducted into the building, using the facade as a "neutralising wall": mechanical circulation in the interstice of the facade was said to guarantee a continous temperature of 18° at the inner window-layer. Although it was generally sound this system could have lead to severe problems during the winter when the warm fresh air in the interstice would produce condensation water or even frost. However this was never proofed as Le Corubiser's idea was rejected. Instead a conventional heating system in combination with an interior shading device was realized within the original architectural shape – which never worked properly (Jesberger). The system did not fail because of a false concept but because of a naïve trust in technology: The building design was unseperably linked with the availability of these high-tech systems. As soon as those gadgets were left out the whole building was no longer working properly.

Opposing to this approach was the faction of the scientists. Their tradition dates back to Viollet-le-Duc who was seeking a usage of materials according to their attributes and specificities. Thereby he degraded form to a secondary condition what lead to an architecture of visible construction. Interestingly he also called for a return to regional construction principles instead of an abstract international style (Frampton 2004, p.57).

A compelling definition of this scientific approach to technology can be found in the work of his coeval Franz Reuleaux, a German engineer. According to Reuleaux for hundreds of years architecture had been the work of individual artists – he uses the term Naturismus for this era - that created beautiful artefacts.

Nevertheless given the new time of complexity he wanted this position to be replaced by an architecture of science according to the principles of his alternative system, the Manganismus. This approach which is a necessary prerequisite for further development seeks for the comprehension of systems, understanding how things work, what they are comprised of and most important: how they influence each other. The personal mastership of the invidividual is thus to be replaced by objective principles (Reuleaux in: Weihe 1925).

As both Emily Thompson (Thompson in: Galison 1999) and Reyner Banham (Banham 1984) identified this scientific approach to be something that mostly appeared in the United States (while at the same time Europe was dominated by the aforementioned aesthetic approach) hence sound examples can be found in the work of American architects such as Adler and Sullivan. According to Frampton, Adler was one of the last engineer architects who was able to proof his competence in a wider technological field. In his Auditorium Building in Chicago (figure2) he implemented sophisticated construction technology that led to unconventional forms.

(fig. 2)reference: http://www.flickr.com/photos/repowers/118592126/
caption: Auditiorium Building, Adler & Sullivan (Chicago 1889)

However those were not a result of tectonic constraints but were applied in order to achieve an acoustical performance: Four concentrical elliptic arcs widen the noise both in horizontal and vertical direction (Frampton 2004, p. 47). While a semi-circle would reflect the sound waves from the stage to a single spot, the combination of an elliptic shape and arragement of these archs guarantee that sound waves from can reach any spot of the pit as well as of the tier. The height of these archs is a result of the attempt to avoid an echo and at the same time to amplify the noise as much as possible, another benefit is the mass of the archs which reduces the volume of the space and thus the reveberation time. figure3 While these archs also carry heating and ventilation systems it is interesting to mention that they form only a secondary tectonic structure that is hanging from huge iron trusses (Morrison 2007, p101ff.).

(fig. 3) reference: http://www.flickr.com/photos/repowers/118592051/

When it comes to the role of science in the architecture of the following era, typfication and prefabrication are two crucial keywords. Applied for mainly economic reasons and tectonic purpose they amplified the trend away from the single masterpiece of an artist to a universal reproducible element. However nowadays they are closely linked to the failures of modernism: mere functionalism, neglection of place, culture and the human being itself.

The grid and the pathway

The concept of critical regionalism, first mentioned by Alexander Tzonis and later developed further by Kenneth Frampton emergeded several decades after the aforementioned concepts. It can be seen as one further way of dealing with modernism that at the same time had learned from its failure. It does accept universal standards and the benefits of modernism but wants them to work only as a framework that is then to be filled with locally influenced content in order give place back its role in architecture (Frampton 1983).

2 An alternative way? The Architecture of Lelé

The parameters that let the work of Lelé stand out from the crowd and especially oppose it to the work of the aforementioned Brazilian modern movement are the two following:

The prefabrication of elements which creates the fundament for the achievement of environmental comfort (air, light, green) through architectural means and thus an architecture that is characterized through an abdication of active technical systems and instead focusses on the specificity of the site.

The architectural language that Lelé developed is based on modern construction techniques that he got to know during a visit of the Soviet Union. However Lelé did not only apply those techniques, instead he tried to further develop them and thereby adapt them to his local context. This can be seen in his studies on reinforced mortar where he was seeking for a material that could replace the heavy reinforced concrete and thus be transported much easier and cheaper.

Though the part of his work that distinguishes him mostly from the functionalists is the focus on the development of multipurpose elements that fulfil several requirements.

Instead of offering universal parts he was seeking to develop a genotype whose phenotype developed according to the given local conditions: Lelé is using the system – or genotype – of the shed roof in many of his buildings however they are never alike: their orientation their opening size, the shape of the curve etc. differ depending on the place of their application.

The second aspect delivers the reason for this typfication: The parts are not thought to be cheap and tectonic, they fulfil further purposes - following the tradition of Adler and Sullivan arches - and thus carry performative capacities: As we will see in the example of the Sarah Kubitschek hospital a beam is never only a beam.

Nevertheless the question is in which way – besides the climate – Lelé reacts to the local situation, to the urban structure and to the given cultural and social background? In other words: is this architecture Brazilian or could it – with a new phenotype – emerge elsewhere in the world?

Given these questions it seems interesting to see if Lelé's work fits in the aforementioned concept of critical regionalism – which will be tested using the case study of the network of the Sarah Kubitschek hospitals with a focus to the first one in Brasilia.

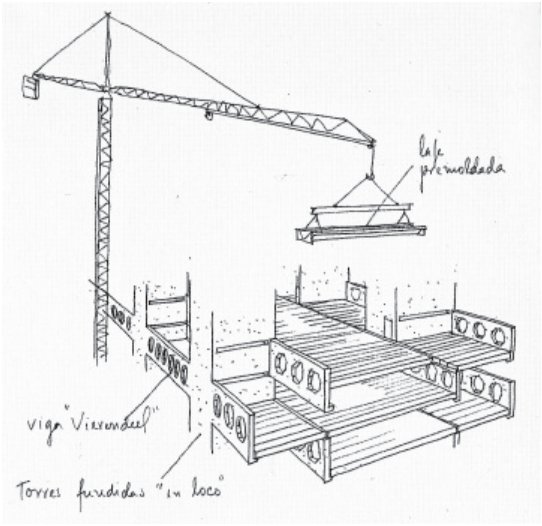
3 A critical approach to scientific modernism - the case study of the Sarah Kubitschek hospital in Brasilia

The Sarah Network is operating several hospitals for socially disadvantaged people with orthopaedic problems in all parts of Brazil. Since the erection of the first building in Brasilia in 1979 all further hospitals were designed and built by Lelé. (figure4)

(fig. 4) reference: hotographer: Julian Weyer
caption: Hospital Sarah Kubitschek, Lelé (Brasilia 1979)

The outer shape of this first Sarah Kubitschek in Brasilia was apparently influenced by the brutalist movement. It consists of a high-rise building with staircases that recall the image of a skyline of chimneys as well as a flat building with shed roofs. As such it resembles to the image of a factory and one could expect a factory-like interior and a taylorized organisation with a patient being not a human being but a piece. However its interior qualities outdo those of most other hospitals of that era: It delivers natural light and air in any possible part of the buildings – hence the only sealed parts are the surgery and the x-ray rooms.

The mentioned staircases of the high-rise infirmary building carry huge 1 storey high Vierendeel beams that are arranged with an offset every two storeys. Figure 5

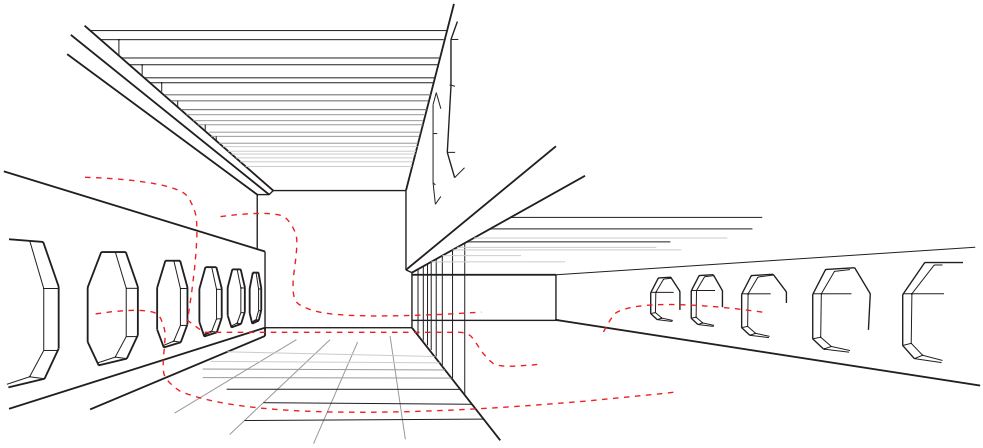


(fig. 5) reference: Latorraca, Giancarlo (Ed.): João Filgueiras Lima Lelé. - Lisboa : Ed. Blau, 2000
caption: Vierendeel Beam

These beams do not only carry the ceilings, they are also responsible for the interior quality of the building: Their construction delivers octagonal voids that provide the rooms behind with light while the offset protects the interior from excessive sun penetration. At the same time they allow the creation of a loggia-like exterior space equipped with trees and bushes that transfers the garden to the floor and creates a buffer zone between the patients and the surrounding city. Figure 6

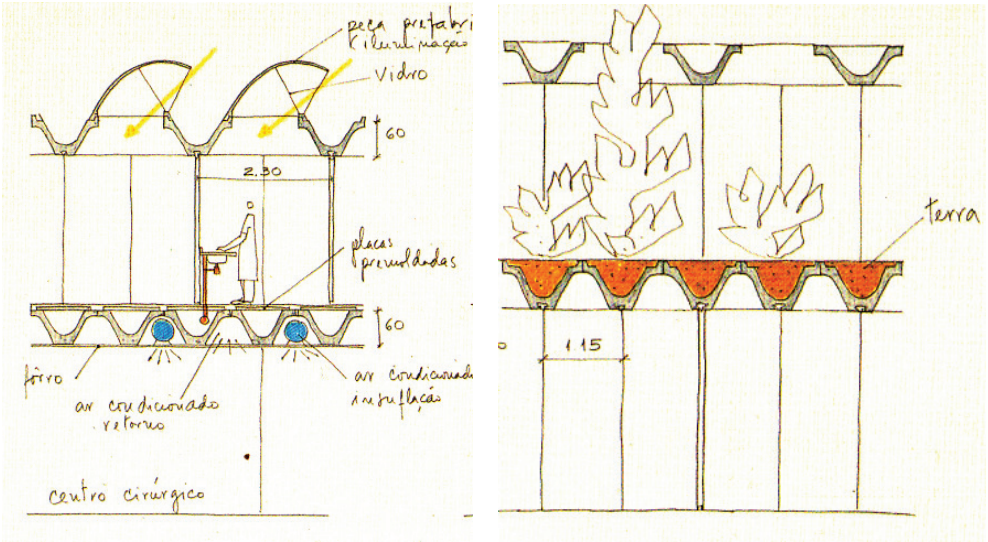
(fig. 6) reference: photographer: Julian Weyer
caption: Balcony of the Sarah Kubitschek Hospital in Brasilia

Additionally they allow a better cross ventilation. Figure 7



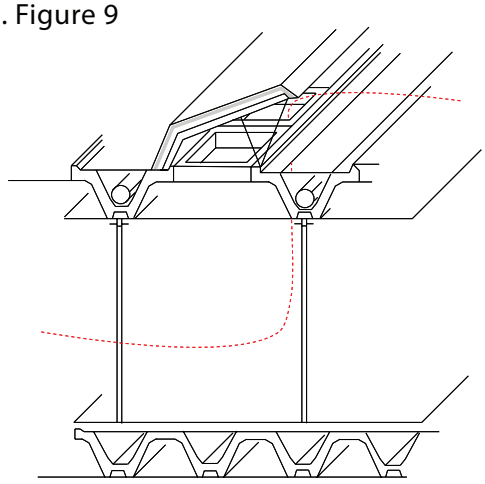
(fig. 7) reference: Caitlin Mills-Sheehy
caption: Cross ventilation in the infirmary building.

Both the high-rise and the flat building are equipped with smaller v-shaped beams which are arranged next to each other to form a slab. like their larger brothers they are also not only a tectonic element: they can carry the soil for the green roof that makes the whole building look like a park and insulates the interior. They carry the pipes and cables for technical systems of the buildings. And by simply sparing one of them out light and fresh air can get into the building figure 8.



(fig. 8) reference:Latorraca, Giancarlo (Ed.): João Filgueiras Lima Lelé. - Lisboa : Ed. Blau, 2000
caption: different applications of the v-shaped beam

An additional element that is repeatedly used in Lelé's architecture is the shed-roof. While its shape evolved during the years and according to the relevant climate, the principles remained the same: Not only does this type of roof deliver natural light to the rooms beneath. By using the suction effect in combination with air intakes and an underground distribution passage they are also able to guarantee natural ventilation – increasing both psychological comfort and physical health. Figure 9



(fig. 9) reference: Caitlin Mills-Sheehy
caption: natural ventilation through the shed roofs

In order to see if this building matches the concept of critical regionalism it is necessary to first make clear several relevant parameters of this concept as defined by Kenneth Frampton which are amongst others (Frampton 2994, p. 272).

- a critical attitude towards the process of modernism without rejecting its progressive and emancipatory aspects
- rejection of an uncritical universal use of technical systems such as air condition sys tems.
- Taking into consideration the site conditions such as topography, light and climate
- the development of an architecture that focuses on the urban place rather than the architectural space, that prefers the small instead of the big plan.

Additionally a prerequisite exists in the form of a necessity of prosperity and a pursuit for cultural, economic and political independence. The fact that Brazil as a back then newly-industrializing country with a colonial past was seeking for a national identity is certainly manifested in the erection of the new capital Brasilia.

As shown in the case of study, the work of Lelé oscillates between the use of up-to-date technology and construction techniques on the one side and low tech systems to achieve environmental comfort on the other side. It adapts foreign technology where it seems necessary but at the same time keeps in mind the Brazilian context by trying to keep costs low and to avoid the use of maintenance intensive active systems that would also create a dependency from the manufacturer of technical gadget.

According to Frampton the rejection of uncritical universal use of technical systems should lead to a new role of the opening: it should be a delicate transitional zone between inside and outside that matches the specific conditions of the site, the climate and the light (Frampton 2004, p. 272). An account that is perfectly fulfilled by both the shed roofs that are always facing to the lee side, and the Vierendeel beam with it's garden behind.

While they seem to fulfil most of the given parameters, the Sarah Kubitschek hospitals neglect one crucial issue: the role of place and the urban structure. Being UFOs the hospitals stand for themselves as solitaires, as an architectural space that avoids integration into an urban context.

4 Towards a regional functionalism?

As previously shown the architecture of Lelé is hardly to be classified by known categories. It matches with functionalist tendencies in many ways, and still it is more than mere rationalisation and prefabrication. Given its anthropocentric approach in many ways it seems to be a worthy successor to the work of Alvar Aalto but again it separates from him due to its formal strength and continuity.

It fulfils many of Kenneth Frampton's parameters of a critical regionalism but it is lacking the crucial factor of place – as well as it seems to be lacking further cultural roots and identity. Adolf Loos says that culture depends on a continuity with the past – especially when it comes to matching patterns of type building (Frampton 2004, p. 81). But can this be fulfilled in a former colony? As such it is likely to be difficult for Brazil to search the past for a Brazilian style. It runs danger to fall back to either an anachronistic kitsch or nostalgia – or to the colonial heritage.

However it is possible to do this step as it can be seen in the work of ATBAT-Afrique in Casablanca in the 1950s that was supervised by the later team X members Georges Candilis and Schadrach Woods. Although these masterplans obviously are not free of problems the individual house seems to be a good example: In their Semiramis apartment building they tried to adapt modern construction techniques and materials as well as shapes to a developing country. At the same time they had in mind the specific local cultural and religious tradition: by implementing narrow lanes and open courtyards to a „modern" multi-storey building they not only transfered the ancient Arab city to a high rise building, they also delivered the private and secluded space for women (Avermaete 2005). figures 10+11

(fig. 10) reference: Avermaete (2005)
caption: Semiramis Bulding, Candilis & Woods (Casablanca)

(fig. 11) reference: Avermaete (2005)
caption: secluded space in the Semiarmis building

Nevertheless Lelé's Architecture remains outstanding, especially while taking the fact that its most important aspect, namely the performative typfication, the development of multipurpose prefab-elements which have both a tectonic and environmental performance is a an up to date issue, a welcome alternative or at least an alternative path to so-called „sustainable" high-tech architecture. A new functionalism, a regional functionalism.

Bibliography

Avermaete, Tom: Another Modern. The Post-War Architecture of Candilis-Josic-Woods. Rotterdam: Nai, 2005

Banham, Reyner: The Architecture of the well-tempered environment. London: Architectural Press, 1984.

Frampton, Kenneth: Die Architektur der Moderne. Eine kritische Baugeschichte. Stuttgart: dva, 2004

Frampton, Kenneth: Prospects for a critical regionalism. In: Perspecta Vol 20, Yale, 1983

Jesberger, Steffen: Le Corbusier - Architektur & Natur, http://www4.architektur.tu-darmstadt.de/powerhouse/db/248,id_15,s_Papers.fb15

Morrison, Hugh: Louis Sullivan – Prophet of modern architecture . New York: Norton, 1998

Reuleaux, Franz: Kultur und Technik. In: Weihe, Carl: Franz Reuleaux und seine Kinematik. Berlin: Springer, 1925

Thompson, Emily: Listening to/for Modernity: Architectural Acoustics and the Development of Modern Spaces in America. In: Galison, Peter Louis (Ed.): The architecture of Science. Cambridge: MIT Press, 1999

“SARAH KUBITSCHEK HOSPITAL, BRASILIA; João Filgueiras Lima-LELÉ”

Caitlin Mills Sheehy

ABSTRACT

Professor of Architecture, Norma Evenson stated that Brasilia’s “essential purpose is to exist where it is,” suggesting a need for regional aesthetic that would reflect Brazils desire for an independent modern future. How has this idea been translated into an architectural manifestation for the original Sarah Kubitschek Hospital in Brasilia?

the 'heavy' precast elements sit on one another creating the modern sillhouette image 2; Latorraca, 2000

Introduction

The process started from Gomèz to create an "educated and prosperous" nation reaches its Brasilia's purpose to exist where it is (Underwood, p148, 1994), is due to its drive to break free from its colonial history. In Brazil's desire to negate its history of plantation slavery, it needed a capital to represent a transition from the past. Most importantly, it had to physically embody the idea of neutrality, suggestive of the socio-economic equality the country strived for. In using the humble material of concrete (ref. image 3), allowing for climatic conditions to impact on the design strategies and highlighting its regional context, Brasilia was able to embody its social and economic requirements through architectonic means. As an architect trained during the design phase of Brasilia, Lelé was able to reflect on the political drive leading to the construction of the city and the constructional language created by Oscar Niemeyer, integrating these ideas into the design of the Sarah Kubitschek Hospital. His strict observations of the site and its climatic conditions, the modularity of the pre-cast structure and the implementation of passive design strategies, all added to the successful linkage between the design of greater Brasilia and that of Sarah Kubitschek Hospital Brasilia.

r **Critical Regionalism**

The architectonic translation of one group's emancipation from another has come to be known at critical regionalism. In this case, the design of architecture is based on identifying the situation, the problem at hand and the specific conditions at play, giving a broader understanding to the resolution rather then relying purely on dogma. As a result, architecture is able to compose a distinct identity related to its inhabiting group and, their programatic requirements based within the cultural, geographical and socio political environment. In doing so, critical regionalism has both political implications and political motivations.

President Kubitschek in his desire to build a new Brazil in the late 1950's, looked to architecture, "It is [architecture] a strong affirmative expression of our culture...and precise expression of the creative intelligence of modern Brazil" (Papadaki, p7, 1960). This idea that a culture can be represented through its architecture was discussed as early as Vitruvius in 25BC. In his text De Re Architectura, the concept that buildings are shaped by the physical constraints of the climate, the site and the internal program are presented along side their political relevance. The force of political intervention in a groups emancipations, forges a distinct collaboration between design and politics, as there needs to be a specific construction of the groups identity. Supporting this idea Alexander Tzonis in is lecture The Never Ending Challenge of egionalism, states, "a normative entity...has to be identified, made visible, if not 'constructed'" (Tzoni, lecture, 2005). President Kubitscheks desire to build Brasilia exemplifies critical regionalism as a representation of a definitive group, located in a definitive habitat that is breaking away from absolutist rule can be honoured through its architectural expression. The power and strength of the architecture as a piece of propaganda in the unification of a group is shown by Kubitschek at the inauguration of the city. "[Brasilia is] more than a mere aesthetic

trend, and above all more than the projection into our culture of a universal movement, [it is] a solution which takes carefully into account climate and scenery, perhaps the most original and precise expression of the creative intelligence of modern Brazil" (Brillembourg, BOMB 67, 1999).

Critical regionalisms presence in Brasilia

"Buildings, urban compositions and landscapes - assumed not only a political propagandist role but also a new economic role as advertisers of regional commodities" (Tzoni, lecture, 2005), giving architects the power to feed emotions of a people, such as nationality, in their use of materials, site and composition of the structure (ref. image 3). Architecture ultimately needed to support the conditions of life, and create a sense of familiarity or of being at home. Despite claiming this, the American historian Lewis Mumford also countered that architecture needed to embrace universal design if it was able to offer a better solution to the problem. Niemeyer and Costa's Brasilia took both of these aspects into account. Their proposal for Brasilia looked towards innovative design to reflect the countries social and economic modernization "while the same time working hard to circumscribe them within local precedents, resource potentials and environmental constrains" (Tzoni, lecture, 2005).

Working in a similar vain, the design of Lelé's Sarah Kubitshek hospital successfully embodies regionalism as it strictly follows the thermal implications of the site (ref. sketch 1) and relies on the construction techniques of pre-molded concrete used heavily throughout the development of Brasilia (ref. image 4). Similarly to the work of Costa and Niemeyer, his design implements modern ideas taken from travel to Europe, and particularly through the eastern block countries, in the 1950s. In Brasilias desire to be a statement, distinct architectural style was developed throughout the city. Oscar Neimeyer and Lelé created a strong visually consistency of concrete, pre-fabricated forms with vast spanning internal open space allowed the city be unique and therefore identifiable(ref. image 1&6). In this drastic architectural move it can be said that Brasilia had emancipated itself from colonial Europe and the European

architecture that dominated the rest of Brazil.

In conjunction with this movement, there was a dramatic shift in architecture away from academically driven design. This was "most certainly the result of the demands of an economic determinism which is in force..which is incompatible with any kind of forms, old or new. The building now [1960] tends to reflect the nature of the organization of which it is an instrument" (Papadaki, p25, 1960). Stano Papadakis statement on the emergence of Oscar Niemeyer's distinct architectural form relates to the importance of a cities materiality being determined by regional and economic conditions. Through Lelé's adherence to designing buildings in order to affect the people that are contained within he created a language of his own based on context and site with a strong commitment to social, economic and environmentally 'sustainable' values.

defined supe-blocks of concrete line the streets leading to Niemeyer's Congress building image 3; Castroni, Brasilia, 2008

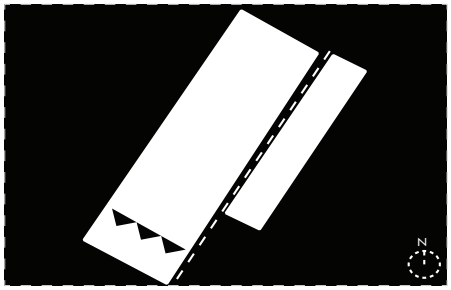
Lelé's connection to Brasilia's regional aesthetic

Lelé's architectonic contribution and links to greater Brasilia are evident in his design of the Sarah Kubitschek Hospital Brasilia. The materiality, climatic conditioning and ideologies present in the building are all advantageous in making the design specifically Brazilian. Yet at the same time, Lelé has been able to imbed unique styles of construction, differing from that of Niemeyer. Original formulations of passive design solutions and distinctive social references ultimately make his designs particular, individualizing his style and therefore creating interest in his work.

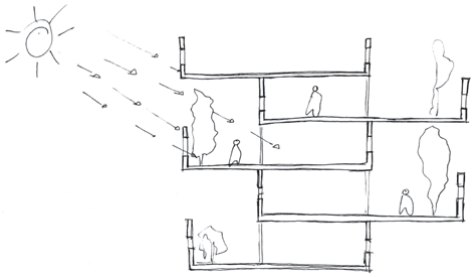
Pre-molded Architectural Forms; their role in the quick construction of Brasilia and successive use in the Sarah Kubitschek Hospital

Pre-molded architecture is arguably the most important and widely used material condition in the construction of Brasilia. The drive for quick construction undeniably led to the need for ways to cope with the scale of the city and the speed at which it needed to be built. As Lelé stated, the two and a half year timeframe did not allow for the construction of housing superblocks out of lumber, as the sheer scale of a plank of wood versus the size of the plan were

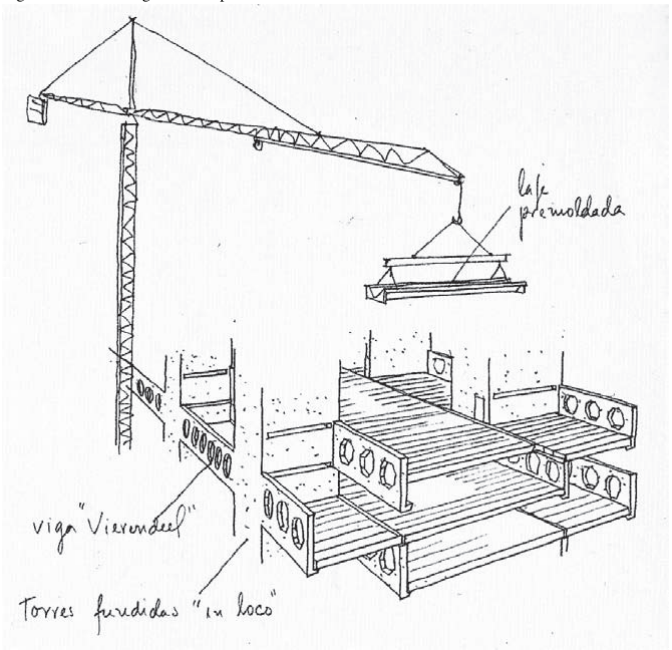
ncomprehensible (ref. image 3). Lelé and Oscar Neimeyer looked to Europe and how they solved vast housing problems with the use of pre-molded architectural forms. In conjunction with the construction requirements of Brasilia, Neimeyer also emphasized the push towards reinforced concrete construction because of plastic nature and capability of spanning vast free spaces allowing for a feeling of 'freeness' and open plan. More importantly though was the social aspect of implementing pre-molded architecture into the construction of Brasil. As Roberto Pinho said in his interview of Lelé "the option of pre-molded - especially in a country of Brazils dimensions, with housing and social problems that have also the necessity for producing architecture for an extraordiary number of people - has to be the option for the collective, for the social" (Latorraca, p23, 2000). In its ability to be quickly constructed and the lowering of costs due to its repetitive modularity, pre-molded concrete allows more houses to be built for less money and in shorter periods of time. Supporting this idea Lelé agreed that the housing problem facing Brazil; twelve million people are without permanent homes, would not be able to be solved without the use of pre-molded modulated housing, stating, "if we do not recur to industrialized means, the civilized solution of this problem will become always remoter" (Latorraca, p24, 2000).



sketch 1;
*the orientation of the building allows sun and light to be captured within



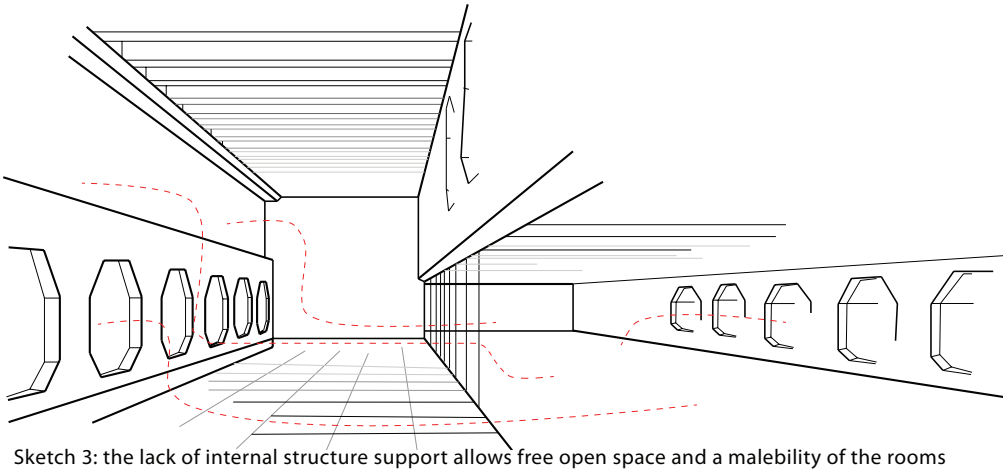
sketch 2; Daniel Korwan



*the pre-fab elements fit toegther quickly and easily, allowing a shorter construction time

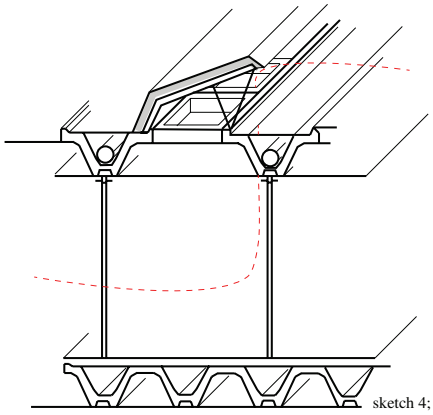
image 4; Latorraca, 2000

In looking at the structure of the Sarah Kubitschek hospital, it is undeniable the links between Lelé's experiences in working on the pre-molded construction of Brasilia in the late 1950's and the pre-cast elements at play within the internment block of the hospital. The strict use of standardized constructional elements (ref. image 4) allowed for an efficient and quick installation, reduced labor costs and ensured a standardized quality and finish. Most importantly, the standardized forms had aesthetic links with regional architecture being developed within Brasilia and allowed for vast open plan spaces (ref sketch 3 and image 6). The use of the structural element eliminated pillars in the infirmary, increasing the openness and freeness of the space and therefore increased its condition of flexibility. This idea holds closely to Niemeyers initial support of reinforced concrete and the development of an architectural language of modulated concrete in Brasilia, "Oscar was very much attached to the use...of reinforced concrete, total freedom somewhat in Le Corbusier's line" (Latorraca, p21, 2000).

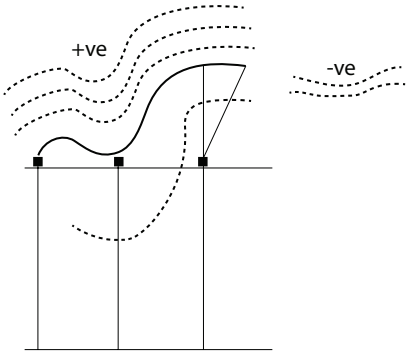


Sketch 3: the lack of internal structure support allows free open space and a malebility of the rooms

Lelé's use of modulated reinforced concrete, rather then another material, allowed for large sweeping rooms without a reliance on internal columns and walls, while keeping a visual consistency within the city of streamlined modernist buildings. While Niemeyer also worked with these vast open spaces, his aesthetic, as seen in the Cathedral de Brasilia, relied on strong curvature, fabricating an organic futuristic appeal to his distinctive forms. As Steven Holl stated, "the place (Brasilia)—its shapes, its forms—still exudes the futuristic optimism of its inception and communicates the possibility of making a new country" (Jana, Steven Holl's Wonders slideshow, 2007). While Lelé worked with the same idea of prefabricated elements his achievement of a 'futuristic' silhouette that fitted within the city was done through the alternating of the vierendeel beams creating internal rooms stacked through the centre of the high-rise, with double height terraces on either side (ref. sketch 2). Furthermore, "the use of a single continuous structural element for the walls and roof has an appeal to architects as having unifying force and to the technologist as the only clear solution providing economy of means " (Papadaki, p23, 1960). This clever use of structural elements to create visual consistency in conjunction with the structure of the building, indulged a division of internal rooms stacked through the centre of the high-rise, with double height terraces on either side. The exterior wall is then able to give privacy from the surrounding urban environment while at the same time allowing for generous amounts of natural sunlight for the patients and their recovery. Ultimately Lelé created a unique silhouette that reflected on the needs of the patient while working within the material presence prevalent within Brasilia.



sketch 4;



sketch 5;

specificity of climatic conditions of the city; shed roofs maintaining 'regionality' in their design and implementation in the hospital

Lelé's design for the Sarah Kubitschek hospital in Brasilia worked with innovative techniques to increase the efficiency and quality of the services while reducing costs and building time. The best example of Lelé's innovation within the hospital, was the design and implementation of the shed roofs. Constructed from prefabricated concrete, the shed roofs acted at a natural ventilation and light source, the 'motor' of the building ref. sketch 4&5). The building aims to function as an organ itself, that works in the support of human resources and the recuperation of the patient, as well as naturally maintaining its own ingestion and exhaust of

air. These sheds also allowed for one of the most important aspects of the hospital; that its physical manifestation and layout needed to work with the latest tecnological improvements within different aspects of the medical field.

The openings of the shed roofs are orientated to the south (ref. sketch 1), allowing the suction effect to take place. Here the cooler air outside the opening drops allowing the hot air to come out of the opening and sit on top; meanwhile the cool air sinks and replaces the internal hot air. These shed roofs fit perfectly within the modulated pre-modled forms of the structure. By sparing out one prefab beam Lelé is able to deliver space for shed roofs while simultaneously using the gap to allow zenithal lighting in the ambulatory area, achieving natural lighting and ventilation through the one constructional element. The specific shape of the shad roof also takes into consideration Lelé's aim of needing to always work the latest of technological advances into the building, rather then with each advancement having to build a new hospital. The voids between pre-fab elements provide a space to run the HVAC systems for the surgery and xray area. In conjunction, the voids are cleverly left external to any cladding to allow for the easy maintenance and replacement of all the mechanics of the buildings. This idea is also consistent with Oscar Neimeyers vision for the city, where modernity and modern technology needed to be at the forefront yet take a role front and centre. In contrast to Lelé, Niemeyers articulation of technology is a significant factor in the overall visual outcome of the building, instead focusing on "recurrent types of a restricted morphology defined as much by the choice of volumes and by their mode of association" such as the "immense mega-structure (more than 300 metres long) of the Supreme Court (Brasilia, 1991-95) juxtaposes the oblique prisms of the courtrooms with the parallelepipeds on piles that house the offices" (Archibel, Portrait of the Month, 2007).

Kubitschek Hospitals. The combined effect of ambient temperature, relative humidity and air motion in Brasilia means the city sits within the thermal comfort zone the majority of the year, with some need for solar heating in the cooler winter months and ventillation during the hotter months. Lelé has employed the use of shed roofs throughout his Sara Kubitschek hospitals in order to acheive this consistent thermal comfort zone. These sheds work through weight and pressure associated with the heating and cooling of molecules of air. The precision needed to achieve such an affect highlights the specificity of the design for the site and its climatic context, subsequently giving the design its 'Brazilian-ness'.

Ideology and social response to Brasilia; aiming to create an architecturally neutral city

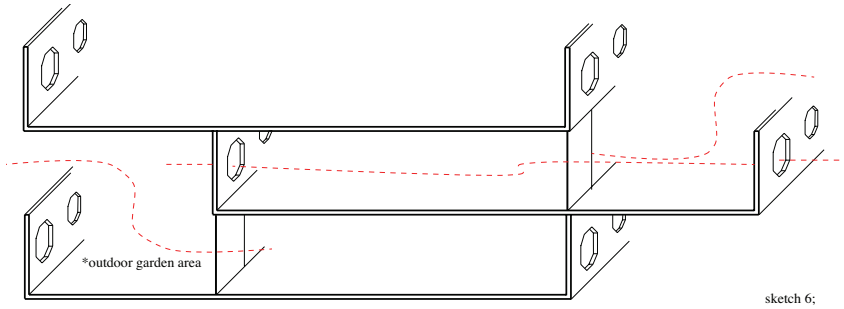
Likewise, when talking about modernity and modern times Oscar Neimeyer stated that it had "opened up to humanity the right and just path of a society free from class distinction, more beautiful and with less suffering (thus creating) indispensable basis for the modern city wherein the old discrimination can no longer prevail" (Underwood, p101, 1994). Supporting this idea is the ideology reflected in The Sarah Kubitschek Network Hospitals, which is a specialized health care center that "treats the patient as a human being who is not merely the object upon which techniques are applied, but rather, is the agent of that action"(www.sarah.br).

The physical manifestation of such goals can clearly be seen in the internal layout of the Kubitschek Brasilia Hospital. The large vierendeel structural beams meant a reduction of pillars within internal spaces, giving the rooms flexibility but also removing divisions between patients and therefore social classes (ref. sketch 6). The hospital carefully integrates the architectonic concepts with the organizations principles in the rehabilitation of its patients. A significant part of this is the hospitals vast open spaces, which is a reflection of the factors that affect the health of the local population, "...testimony to this integration is the hospitals

ample airy spaces, with solariums and gardens designed to humanize the hospital environment and the infirmaries" (www.sarah.br).

The architectonic concept of flexible open space also meant each sector is able to grow without effecting the internal circulation of the building, again adding to the 'human' element of the hospital.

In conjunction with the structure of the hospital, Lelé designed the furniture for the hospital as he believed it was an integral part of his design. He also believed strongly in adapting new medical technologies to the Brazilian market without having to use commercial companies, therefore making it more accessible to the socio-economically depressed population. Supporting his aim to simplify the medical services in their adaptation for the Brazilian socio-economic conditions was Lelé's belief that "...there was an enormous distortion in hospital space during the fifties. It was then that started the post-war technological boom and all the big largest armament producing companies want over to hospital equipment production... as from that time on, hospitals only gave importance to that so called technological function' (Latorraca, p20, 2000).



sketch 6;
free open space and a malebility of the rooms also allowed for strong cross ventillation reflecting on the climatic aconditions of Brasilia

Lelé saw hospitals as technologically driven spaces, where the architect needed to understand the functionality of the equipment, but in this understanding it can often loose its 'humanness'. ThereforeIt was through his drive that Lelé designed the Sarah Kubitschek hospital was designed to incorporate medical research and innovations, produce and manufacture medical equipment adapted to Brazilian conditions and provide follow up training to the various medical technicians. In essence technology was considered a fundamental component of the services provided at the hospital. in line with; "-Producing prototypes and manufacturing equipment required for the medical techniques to attend to the innovative proposals of the hospital plan.

-Creating know-how adapted to Brazilian conditions of major importance for complementing the training of technicians at various levels.

-Promoting a stimulus and indirectly to control the quality and adjustment of hospital equipment which would come to be manufactured in Brazil"(Latorraca, p125, 2000).

Conclusion

President Kubitschek, reflected that "modern architecture in Brazil is more than a mere aesthetic trend...it has in fact put at our service the means with which to find the best possible solution of our city planning and housing problems, a solution which carefully takes into account climate and scenery. It is, furthermore, a strong affirmative expression of our culture, perhaps the most original and precise expression of the creative intelligence of modern Brazil" (Papadaki, p7, 1960) (ref. image 5&3). In his support of the modernity of Brasilia's designs, Kubitschek is bringing to light its cultural success in its strive to solve the social problems of the past in its push for a modern future. As an architect, Lelé was designing for a 'culture' with a human context and not just an undisclosed set of participants. In his translation of this ideal into a physical form he had successfully linked the hospital to its climatic surroundings and most importantly the social and visual language at play within Brasilia. It is Lelés specificity and 'connectedness' with the greater Brasilia architecture that he has been able to create an economically, socially aware, and visually successful design.

image 5; Latorraca, 2000

image 6; Castro, Brazilian Supreme Court, 2007

BIBLIOGRAPHY

Archibel, Oscar Niemeyer; Sculptor of spaces, Portrait of the Month, http://www.archibel.be/archi1. php?templang=3&id=575, 2007

Brillembourg, Carlos, A Day in Brasilia, www.bombsite.com/issues/67/articles/2211, BOMB issue 67, Spring 1999

Castroni , Marco, Brasilia: the evolution of a modernist masterpiece, The Downtown Creator; Architecture in the Information Age, /downtown-creator.net/, July 31, 2008

Castro, Luiz, Brazilian Supreme Court and the National Congress - Brasilia - Brazil, http://www.nowpublic. com/brazilian-supreme-court-and-national-congress-brasilia-brazil, August 29, 2007

Jana, Reena, Architecture According to Holl, www.businessweek.com, April 2, 2007, 4:47PM EST

Latorraca, Giancarlo, Joao Filgueéiras Lima - Lelé¨. Lisboa, Ed. Blau; Sao Paulo; Inst. Lina Bo e P. M. Bardi, 2000

Lima, Joao Filueiras, CTRS; Centro De Technologica Da Rede Sarah, Brasilia, Fundacao Bienal/ Pro Editores, 1999

Papadaki, Stano, Oscar Niemeyer, New York, George Brazilia Inc. 1960

Sarah Kubitschek Network Hospitals Website, www.sarah.br, Brazil

Tzonis, Alexander. The Never Ending Challenge of Regionalism, (lecture given at the University of Cordoba, March, 2005) www.tzonis.com/Bibliography/text_the_never_ending_challenge.htm

Underwood, David, Oscar Niemeyer; and the Architecture of Brazil, Rizzoli International Press, Hong Kong, 1994

2 Clorindo Testa, Argentina

In his work he was one of the leaders of the rationalist movement and was one of the pioneers to the brutalist movement in Argentina. His work was strongly influenced by his simultaneous work as a painter, which is reflected in the strong plastic emphasis in his buildings. During his career as an architect Testa built a reputation as an innovative and paradigm breaking designer, who regurlarly redefined the conventions of his age.

“REJECTING THE INTERNATIONAL STYLE. SEARCH FOR IDENTITY THROUGH AN INTEGRATED STRUCTURE. SEARCH FOR IDENTITY THROUGH TECTONIC”

as seen in the competition for the Bank of London and South America, Buenos Aires, Argentinia, in 1959

Jantje Engels

ABSTRACT

This essay elaborates upon the difficulty to design contemporary buildings appropriate to function and society. This is done with the case study of the Bank of London and South America emphasized by some relevant literature.

Keywords:
search for identity, structure, tectonics, space

Introduction

Clorindo Testa won in collaboration with S.E.R.P.A. the competition for the Bank of London and South America in Buenos Aires, Argentina in 1960.[1]

The Bank of London and South America was based in Argentina since the 1880s and was in need of an expansion. The new building should contain the biggest branch outside Great Britain, the architectural statement was therefore of utmost importance.

The staff architect of the Bank of London, Gerald W. Wakeham, organized the competition and invited a selective group of Argentinian based architects. He aligned a brief with this exclusive competition. The competition was addressed but to four Argentinian based architectural firms. A remarkable fact was the big amount of responsible people involved despite the minor four firms.[2]

The four invited architects were asked to base their design on conceptional, functional and structural requirements. The new building should inherit a design statement appropriate to the global reputation of the Bank. Efficiency, transparency, flexibility and integrity must play an important and timeless role in the building. Concerning the style the so called International Style and a past reflecting style, e.g. neoclassical style were prohibited. To guarantee spatial flexibility for later generations the number of columns had to be reduced to a minimum on the ground floor and the office spaces should be designed on a modular system. [3]

Clorindo Testa, in collaboration with S.E.P.R.A., won the competition due to their integrated approach to the planning requirements as well as the connection between the urban street and the building. The other participants designed glazed neutral boxes referring very much to the International Style. They were not able in creating a distinctive building and did thus not fulfill the requirements .This incapacity by three quarters of the invited architects can be seen as a proof for the difficulty to hand in an appropriate answer to the design task.

Biography Clorindo Testa

Clorindo Testa (1923) Italian born of Argentinian nationality has always been engineer, architect and artist at the same time. He is educated as architect in South America and spend three years in Italy on his artistic career.

Testa is very well known for his art and architecture in Latin America and has been influencing for many generations. His buildings unify distinctive structures and a sculptural appearance due to his integrative talents. The architect is known for his preference of collaborating with different types of people. He is changing his partners for nearly every project. In collaboration with S.E.P.R.A. he designed two well known buildings in Buenos Aires: the Bank of London and South America and the Public Library of Buenos Aires.

The Bank of London and South America

The bank of London and South America occupies a whole corner block in the narrow financial district of Buenos Aires. Clorindo Testa, to put it in his own words 'designed a box within a box'. [4] Two different types of construction realize the spatial distinction between the public and private part. The two first floors designed for the customers are double cantilevered constructions enabling a continuously big open space on the ground floor. The next four floors for the employees are suspended off the roof. Two smaller floors on top for the management conclude the building envelope.

(1) S.E.R.P.A.: Santiago Sanchez Elia, Diego Peralta Ramos and Alfredo Agostini

(2) The four firms involved consist out following people: A.L. Jacobs and A. J. Falomir, S.G Follet and Follett in association with Dodds & Cattaneo, De la Maria Prins Olivera, and Clorindo Testa, Santiago Sanchez Elia, Diego Peralta Ramos and Alfredo Agostini (S.E.P.R.A.)

(3) Author not published (1963): Bank headquarters in Buenos Aires, in Architectural Review (1963 Feb.), v. 133, p. 122-124

(4) Melllilo, A. (2007) Clorindo Testa Interview part I, http://www.youtube.com/watch?v=eV3ZpXmRWE0

The design of the outer wall strengthened the continuity of the space inside. This wall is a load bearing structure and attracts attention through its sculptural and plastic concrete character. Each facade consist out of three concrete curtains slightly bulging towards the street. The size and shape of those curtains differ per height, reaching the ground they are ten meters smaller than close to the roof. The plastic character is realized through rounded openings in the concrete facade that appear on three different levels. The thickness of the wall, the slightly rounded shape and the different depth sized openings underline the sculptural aspect of the building. The specific contrast of the weight of a concrete and the lightness of a perforated facade gives the Bank of London a distinctive expression. Furthermore the facade stands out because of the unity of functional and decorative aspects.

The actual separation from inside and outside, the glass aluminum facade stands apart of the concrete wall. Due to the layering of vertical walls and the lack of horizontal devices the continuity of space is not only experienced on the ground floor but also in the empty space between all floors.

Approach I:

Technology stimulates architecture without doubt. The double cantilevered and suspended floors of the Bank of London and South America would not have been possible without the progress of technology some decades earlier. To become aware of the influence of technology upon architecture is the intention of the following chapter.

Integrated Structure

In 'Construction and its Spatial Implication' by Siegfried Giedion, the author elaborates on the history of structural engineering. In the 19th century engineering was a precise task: the flow of forces in steel construction could be easily calculated and controlled. With the development of reinforced concrete in the beginning of the 20th century and the widespread usage in civil engineer projects the design changed automatically. A tendency could be stated to involve more parts of the building in the load bearing structure. The former linear structures turned into sophisticated integrated structures. This has had consequences of the calculation and the dimension of the building structures. [5]

Technology and modernization

Technology has been interpreted as the catalyst for modernization. This can especially be observed in the underdeveloped world, whereas the modernization occurred in a smaller time frame in comparison with faster industrialized countries. Technology is expressed in many different facets. One facet is the building technology conveyed by material and machine developments.

Technical modernization and progresses in the architectural style do not have to occur simultaneously. A difference can be observed in the American and European development towards technology. American modern architecture developed rapidly with and after the invention of new materials. The invention was necessary for the American culture to manage new situations and styles. Europe on the other hand developed a new architectural language without the usage of new materials and technological progress. [6]

Latin America and the relation between technological development and architectural style seem to be a different story. Latin America has been financially dependent on other countries since the beginning of the 19th century. The industrialization occurred not from the inside but was imposed and stimulated from the outside, especially from Great Britain. The existence and importance of the Bank of London in Buenos Aires can be seen as a relic of the

(5) Giedion, S. (1964) Space, Time and Architecture, Architecture in the 1960s: Hopes and Fears, Harvard: University Press, p. 24
(6) Galison, P., Thompson, E. (1999): The Architecture of Science, Cambridge: MIT Press, p. 253-280

financial dependencies between Great Britain and Argentina. The European neoclassical style influenced the urban image of Buenos Aires until the 40s of the 20th century.

Jorge Glusberg about the Bank of London and South America: "(…) the outstanding feature of this work is created by its structure" [7]

"(…) an architect does what he does but he is hoping all the while to be able to accomplish other things which as yet can't be done because the technique [...] still can't be absorbed by the market." [8]

In the early 1960s the Bank of London and South America convinces with an exposed concrete structure that operates on several levels. The structure has a load bearing function, a brise-soleil device and a decorative expression. Several technological progresses laid the foundation for this building and played consequently an important role.

The invention of reinforced concrete some five decades earlier, first applied in the bridge structures by Robert Maillard in Europe. This new combined material influenced the design of structures in general, as more explained in chapter 'Integrated Structure'. The invention of aluminum glass facades made it possible to separate the two facade layers and to create this distinctive space experience in a six story high building. The availability and refinement of fiber enabled the rounded shaped holes in the concrete structure that create the sculptural character of the facade.

Besides the political and financial matters the creativity of Clorindo Testa and the architects of S.E.P.R.A. contributed very much to the final design. Walter Gropius said the following concerning creativity:

"To have the gift of imagination is more important than all technology, which always adept itself to man's active will." [9]

The design for the Bank of London and South America provided a discussion over the whole world. "[...] no-one, expected such a persuasive contribution to the development of architecture to come from one supposedly so far removed from the hub of architectural innovation." [10]

Approach II

In the following part I am going to confront the International Style versus the Regional Style. This is done because of the prohibition of the International Style as part of the competition brief.

Between the staff architect Gerald W. Wakeham and his team a discussion about the International Style must have taken place. Unfortunately this discussion or the people involved in can not be tracked down and the existence of the discussion rests as an assumption.

Whether or not the discussion took place it is important to know what the International Style was about and what kind of architectural reactions were stirred.

Part I: International Style versus Regional Style

Henry Russel Hitchcock and Philip Johnson discovered the 'International Style' on a study trip through Europe and America. They showed their architectural research in an exhibition at the MOMA and stated that the International Style follows certain principles. The principle

(7) Glusberg, Jorge (1984): Sánchez Elia, Peralto Ramos, Agostini y Clorindo Testa, Banco de Londres y América del Sud, casa central, Buenos Aires, Argentinia, 1959 – 1966, Tokyo: GA, p. 11

(8) Bayón, Damián (1977): The changing shape of Latin American Architecture, Conversations with ten leading architects, Bath: The Pitman Press, p. 18

(9) Gropius, Walther, 1917

(10) Cuadra, M. (2000): Clorindo Testa, Rotterdam: NAi publishers, p. 11

are the usage of thin surfaces enclosing volumes and spaces, the preference of regularity as design symmetry and the non existence of any decorative aspects. The 'International Style' flourished in the 1950s all over the world. A counter reaction to the mainstream International Style can be found in the Critical Regionalism. The English Brutalism of the 50s is one possible outcome of the Critical Regionalism.

As I elaborated in 'Technology and modernization' Great Britain has financially played a role in the history of Argentina. In addition to that, the headquarters of the Bank of London were in London and the staff architect of the Bank of London and South America was of British nationality as well.

The influence of the British architectural style Brutalism, formulated first in 1954 by Peter and Allison Smithson however can not be followed in the work of Clorindo Testa. He has never referred to the Smithson's as a source of inspiration, but he was indeed very much devoted to the late Le Corbusier and the expression of concrete facades.

"Our functionalism means accepting the realities of the situation, with all their contradictions and confusions, and in trying to do something with them. In consequence, we have to create an architecture and a town planning which – through build form – can make meaningful the change, the growth, the flow, the vitality of community." [12]

This statement by the Smithson's can nevertheless be transferred to Clorindo Testa's work. Testa wanted to create distinctive and meaningful pieces of architecture. His works do show the same concrete roughness as the work of the Smithson' s and other brutalist architects.

The link from the Brutalism to Critical regionalism can be drawn through following statement:

" (…) They were not interested in creating pure forms and spaces, let alone intellectual entities, but in building thoroughly material and real structures bound to a place and to the soil, made of genuine materials and worked by human hand, with all the typical imperfections that entails, using tools and shuttering whose traces were to be as legible as the conventionally hidden technical fittings. In their view, architecture should not be perceived in purely intellectual presenting themselves starkly, in all their harsh reality and brutal honesty. The wanted truth and objectivity in building and authenticity in material and structure. In doing so, they also created a new aesthetics." [13]

According to Kenneth Frampton Critical Regionalism is engaged in a coherence of traditional and progress orientated foundation based on certain political tolerant circumstances. This type of architecture looks back by quoting and developing a ultural tradition and establishes at the same time a new criterion for building typologies. [14]

The Critical Regionalism stands critical against the progress of modernization but does not withdraw from technological advances. As the Bank of London is clearly a modern construction with new materials and structure systems involved.

Back then Argentina was searching for an independent cultural identity. The building, though build for an international organization, but designed by a local architect, is a political statement of independence. At the same time this architectural statement becomes a disengagement from Great Britain.

The bank of London and South America belongs also to the Critical Regionalism due to the specific architect. Clorindo Testa showed his interest in local concrete tradition and

(11)Russel Hitchcock, H., Johnson, P. (1932) The international style (Architecture), New York: W.W. Norten & Company
(12) Forty, A. (2000): Words and buildings, A vocabulary of Modern Architecture, London: Thames & Hudson, p. 110
(13) Cuadra, M. (2000) Clorindo Testa, Rotterdam: NAi publishers, p. 12
(14) Frampton, K. (1980) Modern Architecture: A critical history, London: Thames&Hudson, p.263 - 273

combined successfully his knowledge of structures with his artistic needs.

One last thing ascribed to Critical Regionalism, even though it should be part of all architectural styles is the importance of the actual space-time experience in the building itself. In Frampton's view the experience can never be replaced through information.

Approach III

To relate the case study of the Bank of London to literature and to combine technological with scientific aspects I chose to elaborate on different research methods.

Part II: Interpretative flexibility

In 'The social construction of facts and artifacts' Pinch and Baker intend to proof that the study of science and technology might benefit from each other. They start by outlining two main systems of research, namely EPOR, the 'Empirical Programme of Relativism' and SCOT, the 'Social Construction of Technology'. The former is a widespread established demonstration of the social construction of scientific knowledge, the latter is a relatively new way of describing the history of the development of technological artifacts.

EPOR focuses on the empirical study of contemporary scientific developments as well as scientific controversies. Three stages can be identified. First of all, the scientific solution is open to more than one interpretation. Secondly, the erasing of the interpretation variety occur due to social imposed rules, the so called 'closing mechanism'. Finally a link can be drawn from those 'closing mechanism' to a broad cultural context. The last stage nevertheless has not yet been theoretically developed.

SCOT describes a technological artifact as an alteration of variation and selection. The development can only be seen as a multi directional model. Due to the authors the SCOT approach is a more realistic one, since a multi directional model takes all outcomes - the successes and the failed studies – into account. [15]

Considering the design competition of the Bank of London and South America both approaches EPOR and the SCOT will be applied.

The competition was a selective invitation of four architectural firms. The staff architect Gerald W. Wakeham was confronted with four different designs, thus four different solution reacted on one design problem. To be honest, three of those four design did indeed look quite alike. Wakeham then chose the winner of the competition and presented the design to the public. The tumult under the public must have been big, since the public opinion even reached the news. Evidently the public opinion had no influence at all on the realization of the building. Some small alterations were made, but the overall design stayed more ore less the same and was only a couple of years later realized.

Three of those four design entrees stayed unrealized. The fact that they have been made shows a distinctive opinion about contemporary public building in Argentina at that time. They are important remains of a cultural tradition. The most innovative and spectacular design is chosen as the winner, even though the cost and labor involved must have been more in comparison with the other mainstream buildings. This choice is in favor of Gerald W. Wakeham. He must have foreseen the specialty and power of Clorindo Testa's design and made the realization possible. The map aligned shows the relationship between the four different designs.

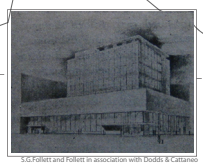
(15) systems, New Directions in the Sociology and History of Technology, Cambridge: The MIT Press, p. 17 – 50

The Bank of London and South America
Buenos Aires, Argentina
1959 - 1966

Calle Reconquista 101

source: photographer unknown;
http://www.igougo.com/journal-j9027-Buenos_Aires-Bill_in_Argentina_-_BUENOS_AIRES.html

Gerald W. Wakeham

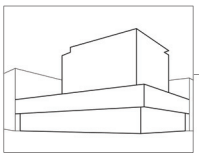

S.G.Follett and Follett in association with Dodds & Cattaneo

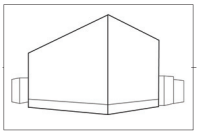

De la Maria Prins Oliveira

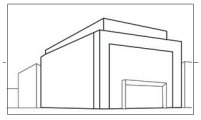

A. L. Jacobs and A. J. Palomir


Clorindo Testa in collaboration with S.E.P.R.A.

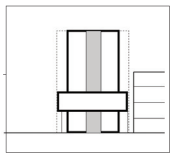
source: Author not published (1963): Bank headquarters in Buenos Aires, in Architectural Review (1963 Feb.), v. 133, p. 122 - 124 (all four images)

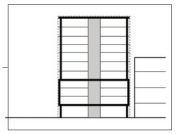


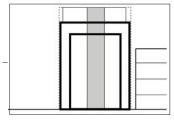


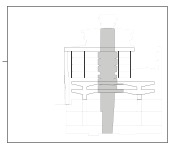


source: Jantje Engels (all three images)









source: Jantje Engels (all four images)

Conclusion

The Bank of London and South America convinces through the multifunctional and complex structure. The design was inspired by the International movement of technology, but developed a distinctive expression by itself. The building incorporates a statement both useful for the bank company as the young country in upheaval. Gerald W. Wakeham can be seen responsible in the realization of the Bank of London and South America by deciding this specific design as the winning entree of the closed competition.

Bibliography

Bayón, Damián (1977): The changing shape of Latin American Architecture, Conversations with ten leading architects, Bath: The Pitman Press, p. 18

Cuadra, M. (2000): Clorindo Testa, Rotterdam: NAi publisher

Frampton, K. (1980): Modern Architecture: A critical history, London: Thames&Hudson, p.263 – 273

Forty, A. (2000): Words and buildings, A vocabulary of Modern Architecture, London: Thames & Hudson, p. 110

Galison, P., Thompson, E. (1999): The Architecture of Science, Cambridge: MIT Press, p. 253-280

Giedion, S. (1964) Space, Time and Architecture, Architecture in the 1960s: Hopes and Fears, Harvard: University Press, p. 24

Glusberg, J. (1999): Clorindo Testa: Painter and Architect, Buenos Aires: Libros Books, p. 128

Russel Hitchcock, H., Johnson, P. (1932): The international style (Architecture), New York: W.W. Norten & Company

Author n.p. (1963): Bank headquarters in Buenos Aires, in Architectural Review (1963 Feb.), v. 133, p. 122-124

Manser, M. (1968) Building an image abroad, 2 Bank in Buenos Aires, http://vads.ahds.ac.uk/diad/article.php title=234&year=1968&article=d.234.34

Melllilo, A. (2007) Clorindo Testa Interview part I, http://www.youtube.com/watch?v=eV3ZpXmRWE0

"THE BANK OF LONDON AND SOUTH AMERICA. A COVERED SQUARE LIMITED BY THE URBAN FRAMEWORK"

Federico Quijano Telly

ABSTRACT

It is possible to say that new building materials and building techniques as well as the role of technology in the making process and final result of architecture, can be a platform for innovation in this practice and an opportunity for new spatial configurations. With this in mind, this paper will focus its analysis on Clorindo Testa's Bank of London and South America, arguing that the building's structure achieved by technological advances and the special use of certain materials such as concrete, aluminum and glass, enables a continuity of space between interior and exterior. This is an innovation in terms of construction and spatial configuration because it involves the existing urban structure into the design and arrangement of the space of the building.

Introduction

In 1959 -1960 a competition was organized in Argentina to rebuild the existing Bank of London and South America, an old building from the 1880's that was located at the core of the financial center of the city, surrounded by narrow streets in a very dense context (Image 1).

(Image 1)

The contest was won by the architects Sánchez Elía, Peralta Ramos, Agostini and Clorindo Testa whose design best answered the requirements of the design brief presenting an innovative building that could relate very well to the context but could also make a statement in terms of new architectural possibilities. The head office of the Bank of London and South America was opened in 1966 (Image 2).

(Image 2)

Within this chronological frame it is possible to outline different aspects that influenced the work of the architects like architectural movements, technological developments within the context and social conditions of the time. By doing this, it would be easy to point out certain important elements that allowed the building to have the structural configuration necessary to enable continuity between interior and exterior space.

Influenced on an international level and on an "indirect" way by the Modernist Movement and the architectural work of Le Corbusier and Mies van der Rohe - among others – and in a direct way by some lectures given by Le Corbusier at the Facultad de Arquitectura de Buenos Aires about urbanism - where he presented some proposals for his Master Plan -, this group of architects conceived a totally new building for the time, the place and the type of client they were working for. In more local terms, they also tried to use international design languages to solve regional problems of identity and urban configuration following the guide lines of the new paradigm of the office building, its relation to the urban context and its meaning within the city.

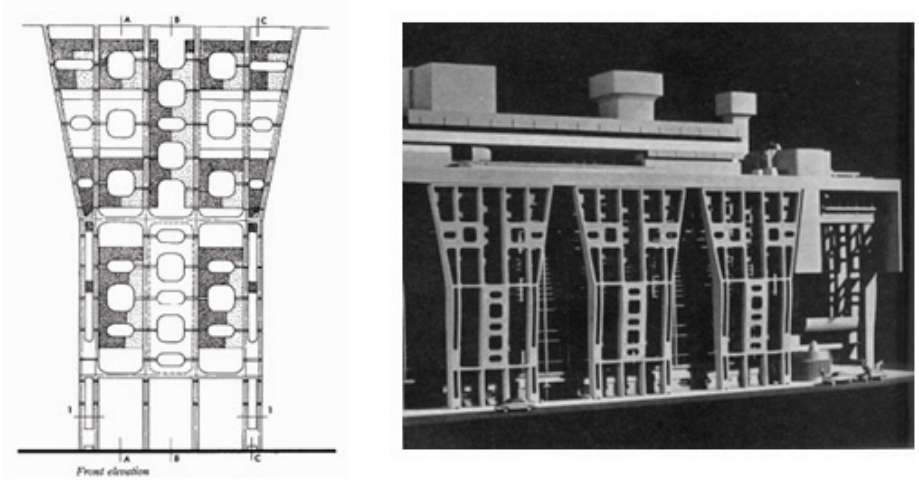
The office building _ Considerations

Since the 1950's, and as a consequence of the end of World War II, there was a shift in technology and technical processes. This change influenced architecture as well. Because of this, the office building gained an important character as main role player on the city configuration. Architects like Le Corbusier gave a new meaning to this type of buildings, specially the high rise buildings, by integrating them into mayor urban design plans and making them crucial for the new image of the city. These were the new representative structures of the time and as such, they represented an opportunity to make a statement in architectural terms, dictating for example new ways of construction or of relation to the context and the people.

It is clear that before the War, there were also high rise buildings and important and representative office buildings, but it wasn't until after the War that the new technologies and building materials allowed the construction of new structures and the configuration of new spaces. Other important aspect is that the economy change and the structure of the city was modify.

"Within a few years, as social and economic emphasis shifted away from the manufacturing sector to the service sector and as information became the main commodity, the office building type assumed an even more decisive role than the one it had played in the invention of the modern city." (Ábalos et al. "Tower and office: from modernist theory to contemporary practice". Chapter 2 (1992))

The Modernist Movement toke this shift as starting point, creating new ways of space configuration under specific aesthetic parameters defined by the materials used and the new building techniques. New materials like glass and concrete, which are going to be very important for this particular analysis, gain prominence in the construction and allowed different relations within the buildings. They also permitted the creation of new forms and spatial dialogues. In a more robust way, the Brutalism movement that was very important in Argentina and from which Clorindo Testa is a perfect example and maybe the most representative one, developed the use of these materials for the facades and the ornamental elements. In the case of the Bank of London and South America, Testa achieves to manipulate the concrete in a very sculptural way following geometrical patterns (Image 3).



(Image 3)

It is important to mention the artistic background of the architect. His work is always influenced by his art and these two aspects are always present in his craft. The colors he uses to configure different elements of the building are a perfect example of his pictorial approach to architecture, and the way he plays with the different materials and surfaces, also demonstrate a very sculptural approach to this practice. He experiments with the principle of the spot and the void and starts developing spaces from a very artistic line of work. (Image 4)

(Image 4)

Other aspects, like the exposure of the building's functions and the understanding of the building as a machine, which eventually developed into the "machine aesthetic" concept, played an important role in the understanding and expansion of new architectural expressions. Clearly influence by this ideas, the proposal of Clorindo Testa plays with this elements as well as whit the new materials already mentioned.

The new structures had a different character than the existing office buildings. They were open and followed a modular order. They also incorporated the functions of the building like ventilation and illumination into the design making them part of the system as a whole.

"The technical floor, the suspended ceiling, and the structural system were thus incorporated within an integrated entity that determined the flexibility of the overall space. The section of this building volume, its spatial rationality and economy, the degree of freedom it offered in the design of energy systems, and its exterior appearance or presence became themes explicitly examined in contemporary architectural practice. The concept of the building as a product of repetitive "planes that separate" – the Dom-ino ideal – gave way to a concept of the floors as "three dimensional cavities that contained". The structural system of the cavities was their only stable element; with the dematerialization of the walls, the structural system became the sole possible representative of verticality, the resultant compatibility among its load-bearing, technical, and spatial structures." (Ábalos et al. "Tower and office: from modernist theory to contemporary practice". Chapter 2 (1992)).

As quoted, the structural system of the buildings gained extreme importance and several analysis and trials were made to identify new ways of creating structures, also new ways to distributed weight and forces. Architects started to play with voids as part of the volume and the structure and integrated organic elements into their work. No longer were columns and beams the only possible building technique, tetrahedral configuration of beams became a new possibility and thanks to new materials, structures with floating levels became possible (Images 5 – 6).

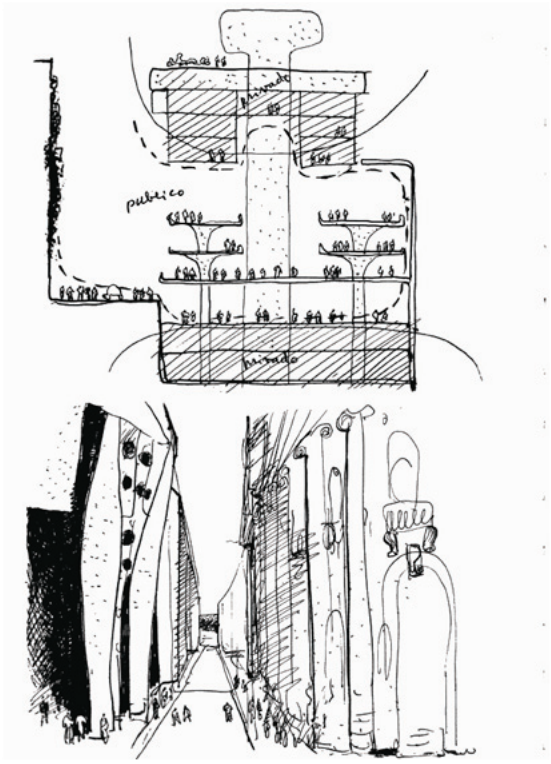
(Image 5)

(Image 6)

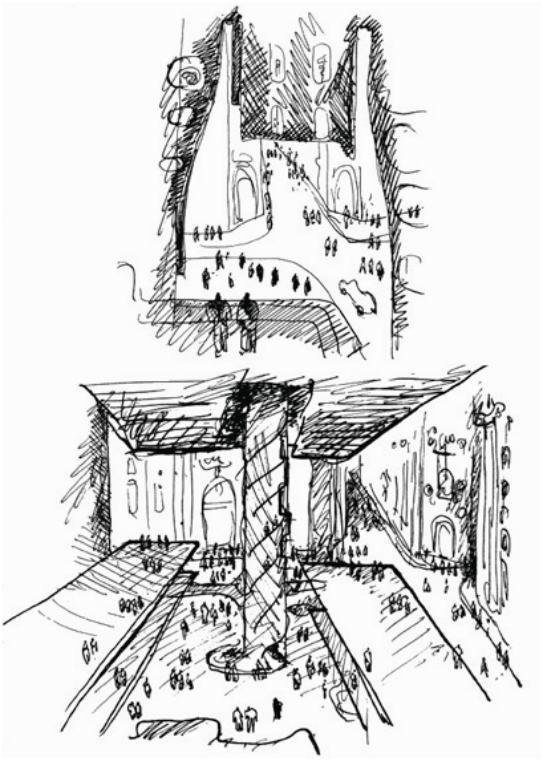
"In Gothic times, architects built in solid stones. Now we can build with hollow stones… The desire to express voids positively in the design of a structure is evidenced by the growing interest and work in the development of space-frames. The forms being experimented with come from a closer knowledge of nature and the outgrowth of the constant search for order" Ábalos et al. "Tower and office: from modernist theory to contemporary practice". Chapter 2 (1992))

The importance of the void as design element is a key aspect to understand the work made by Clorindo Testa for the Bank of London and South America since the game with this element is what enables the building to function as continuation of the external space. He reaches this sensation through visual connections and floating elements as part of the structure of the building.

"Even the earliest sketches for the design suggested the idea of the building as a void, as an absence, and not as an object." (Glusberg, Jorge. Banco de Londres y América del Sud, casa central. 1983). (Image 7 – 8)



(Image 7)



(Image 8)

Private Space _ Public Space

The city of Buenos Aires can be seen as an amalgam of architecture. From colonial to baroque and neo classical to rationalist, the typologies are extensive. This phenomenon is not only present on the buildings, but also on the urban layout along the city. The buildings conceived under Brutalism parameters, as well as the public surrounding spaces, show a consideration of these two elements as part of the whole design. To refer one example, Clorindo Testa also considers this issue on the public Library building, which is a public building, but has similar elements in relation to the Bank of London and South America, in terms of their relation to the urban context, regardless of the private character of the last one.

However it would be possible to say that in Buenos Aires private and public spaces are clearly demarcated and differentiated from each other. In the specific context where the Bank is located, there are not a lot of public places. Only narrow streets and a mayor city square close-by. This was one of the main aspects considered for the design of the building, the surrounding area and its characteristics and the way to implement them into the final design proposal.

The idea of creating a continuation of the public space was to integrate the new building into the urban landscape, but not to have a real open space inside the building. The architect plays here with an element of public – private ambiguity in order to make the bank more welcoming for the people and to clearly differentiate the space for the costumers from the space for the workers.

"Architecture is a mode of communication and a symbol in space. These architects see architecture as the common task of designer and dweller. Their work reflects a view whereby the urban structure is seen in both formal and socio-cultural terms." (GA 65 (1984), S. 2.)

The socio-cultural relations also play an important part during the design process. Not only in terms of the relation between the citizens or general public and the Bank, but also inside the Bank among the employees. A clear hierarchy must be established where the delimitations of rank are understandable and the different functions of the Bank are completely comprehensible.

All these considerations are a good example of what the architect realizes with this public – private space ambiguity. Although he has to create a logical private space separated from the streets, he also has to integrate the building within an existing context and make obvious a function of service for the people. He delivers a solution that not only works on a formal level, but also on a socio-cultural and semiotic plane.

"Testa has designed buildings which are something more than consume objects; through such buildings, he demonstrates his potentiality as a creator of visual forms. Nevertheless, his more important works reflect the importance that he attaches to the existing urban structure, not merely from the formal point of view but, above all, as a socio-cultural fact." (GA 65 (1984), S. 3.)

Interior and Exterior _ The Role of the Structure

The Bank of London and South America has an impressive structure. On one hand, it sets a new way of building. The traditional way of building in Argentina consisted on a simple structure of columns and beams that supported the mass of the building; Testa presents a

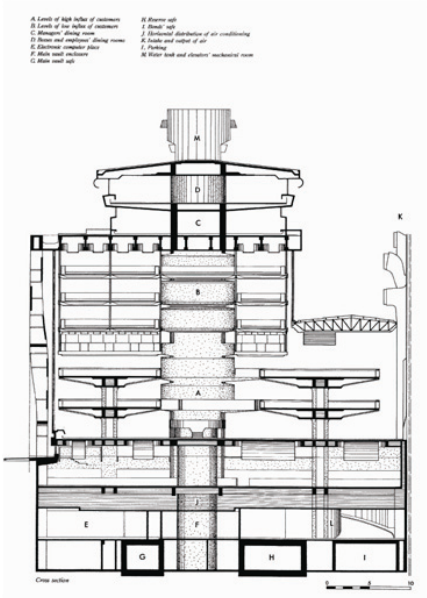
a new way that involves a central body with floating levels. Although this new technique wasn't really followed as much, it did raise an important concern over Argentinean architecture and signed a breaking point in the history of the country.

On the other hand, the structure allowed new spatial configurations never seen before in Buenos Aires. According to the requirements of the contest, there was a need to communicate integrity, efficiency and confidence with the building, because these were the values of the Bank; but there was the condition that no clichés could be used in order to send this message out to the public. Innovation was a key factor for this design and hence the important of the new structure.

Through the design of the building one can see several ground-breaking mechanisms, for example the fact that the building is integrated to the urban landscape as a place of continuity and openness, this fact alone already situates the building on a new layer never seen before. The Bank is located on the corner of two narrow streets, Bartolomé Mitre and Reconquista. Each one of these streets has about 10 meters wide. This issue was used as an advantage for the design, since the idea was to integrate these streets into the internal space of the building. This was accomplished by the organization of the structure and some other architectural elements, and the final result was a building that functions as a covered plaza.

"The public square actually exists in the sense that the real limits of the large internal space of the Bank of London and South America are defined by the frontages of the building which virtually allow the streets to enter this huge public space. In spatial terms, there is no division between interior and exterior. When one walks through the buildings, the walls that limit it disappear. One sees – as a boundary – the frontages of the buildings situated across the street. In other words, the building suggests a covered square because it involves a space limited by the urban framework." (GA 65 (1984), S. 4.)

To be more precise, the structure of the building functions as one whole space. The building has three basements and six upper levels that are connected through a center staircase which holds the elevator boxes and dominates the structure and main hall of the building (Image 9).

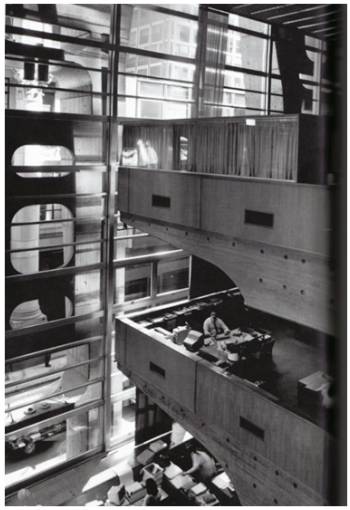


(Image 9)

The structure has three main components: the sealing, two walls and the already mentioned perimetral column. This organization gives the building a sensation of openness and continuity that is not common to other private/financial/office buildings.

To give a better description of the structure and the function of the building, it is appropriate to quote Jorge Glusberg who describes perfectly the structure and function of the building:

"… An area of almost 25.000sqm is enveloped to a height of 26m, because the building should function within an enclosing envelope and its different zones should be created for use by bank staff and customers. The areas to be used by the costumers relate to the external space as an extension of the adjoining streets in terms of lighting." (Glusberg, 1984) This characteristic is achieved thanks to the glass walls that configured the envelope of the building. (Image 10)



(Image 10)

"Within this enclosed volume, six main working levels are linked by a pair of vertical circulation groups, one for the bank staff, and the other for the costumers. " (Glusberg, 1984) The differentiation between working/private areas and public areas within the building is also an important reference to understand the way the flux are planed and the way the spaces are related to each other. "The upper floor levels and one additional small area are suspended from the main roof grid by steel hangers on a 3m x 6m module. This design feature permits the freedom of spatial creation which characterizes the building. The enclosing envelope is demarcated by the main roof grid and the two party walls. The volume is completed by the system utilized on the two frontages: a glass inner structure and a perimetral concrete structure, which provides an extremely attractive visual feature.

The roof is partly supported by these columns which serve as a brise-soleil and have particular relevance as an architectural statement. Thus, the outstanding features of work are created by its structure. The main entrance to the building is established at the corner of the site. It forms a transition area and is emphasized by an enormous reinforced concrete screen which limits the space and the views from the inside. The exposed concrete, a distinctive feature of the building, is treated with exceptional care throughout.

The module employed for the roof grid served to order the outer column spacing. In the three basements, extending to a depth of 14 meters, there is a conventional structure of columns and beams, which are also of reinforced concrete. However, attention must be drawn to the enormous circular "pit" which centralizes the relation between the ground-floor spaces and the first basement level and is a fine example of the imaginative resources employed in the design." (Glusberg, 1984) (Image 11)

It is clear that the organization of the building and the configuration of the structure are extremely important for the architectural statement of the building. It is an office building, well divided by functions but has a clear connection to its context and to the different users.

(Image 11)

Conclusion

According to the analysis of structural elements, building techniques and building materials of the Bank of London and South America, it is clear that various architectural movements influence the work of Clorindo Testa. Modernism, Brutalism and even Rationalism played an important role along the design process of the building. As consequence of these influences, it is possible to see innovative aspects in terms of construction and space configuration.

In this paper I have also stated the role of the office building as key historical element that enable the development and construction of the Bank of London and South America. I have also mentioned the importance of public and private space and spatial configuration for a private building with a more or less public character, and I have talked about the structural elements that make out of this building the piece of architecture that it is.

All of the above in order to answer the main question posted at the beginning of the paper on how the building's structure achieved by technological advances, and the special use of concrete, aluminum and glass, enables a continuity of space between interior and exterior and provides the building with a sense of openness and lightness.

As a conclusion I can say that the architect achieves this goal in a very unique way incorporating new elements into the design and breaking building paradigms for his time, creating a master piece of architecture that is connected to the urban landscape but that goes beyond pure regionalism.

Bibliography

Glusberg, Jorge (1983): Clorindo Testa, pintor y arquitecto. Library of the International Union of Architects, Ediciones Summa, Buenos Aires 1984.

Testa, Clorindo. Glusberg, Jorge (1977): Hacia una arquitectura topológica. Ediciones Espacio Editora, Buenos Aires 1977.

Banham, Reiner. The Architecture of the Well-tempered Environment.

GA 65 (1984): SEPRA y CLORINDO TESTA. Banco de Londres y América del Sud, casa central. A.D.A. EDITA Tokyo, Japan 1984.

Ábalos, Iñaki. Herreros, Juan (1992): Tower and office: from modernist architecture to contemporary practice; edited by Joan Ockman. A Buell Center. Columbia book of Architecture. The MIT Press. Cambridge, Massachusetts 2003, pp. 39 – 100.

John Law, 'Materialities, Spatialities, Globalities', published by the Centre for Science Studies, Lancaster University, Lancaster LA1 4YN, UK. http://www.comp.lancs.ac.uk/sociology/papers/Law-Hetherington-Materialities-Spatialities-Globalities.pdf

Arte Latinoamericano Moderno – Departamento de Historia del Arte. Universidad de los Andes – Mérida Venezuela. http://vereda.saber.ula.ve/historia_arte/artelatinomode/argentin.htm

Arquitectura en línea – Banco de Londres (1959) banco Hipotecario Central (2000). http://www.arquitectura.com/arquitectura/latina/obras/testa/bancolondres/bancolondres.asp

Construir y decorar.com
http://www.construirydecorar.com/scripts/areaservicios/noticia/nota.asp?IdSeccion=6&IdNota=6373

http://www.arquitectura.com/arquitectura/latina/obras/testa/bancolondres/bancolond¬res.asp

http://www.mimoa.eu/projects/Argentina/Buenos%20Aires/Banco%20de%20Londres

Banco Mendoza http://www.flickr.com/photos/istvan/62023103/

http://picasaweb.google.com/clorindotesta/EDIFICIObancolondres#

"BANCO DE LONDRES – A FLASH IN THE PAN OF TECHNICAL INNOVATION IN ARGENTINA"

Ingrid Rojas

INTRODUCTION

New Brutalism, an architectural tendency that originated in Europe, triggered some significant developments in Argentine's architecture during the 1950s until the 1970s. Emphasising the search of poetical elements in the use of light, the creation of big spaces, and the application of technologies as well as materials available, it was both innovative and appropriate in the historical and cultural context of Argentina at that time. In particular, concrete— then the most readily available material— was used as principal building material, formed with striking repetitive angular geometries. Buildings of concrete can be characterised by its rough, blocky forms and forthright exposure of the buildings' functions ranging from structure and services to their human use. Banco de Londres y América del Sur[1], built by Clorindo Testa between 1959 and 1966 in the centre of Buenos Aires, is considered the most representative building for this new way of making use of the available building material in Argentina and for its novel technological and stylistic characteristics. What has been the heritage of this bold, original and internationally recognized architectural masterpiece of Clorindo Testa.

The Bank of Londres from Clorindo testa located
Buenos Aires on the southern shore of the Rio de la Plata.

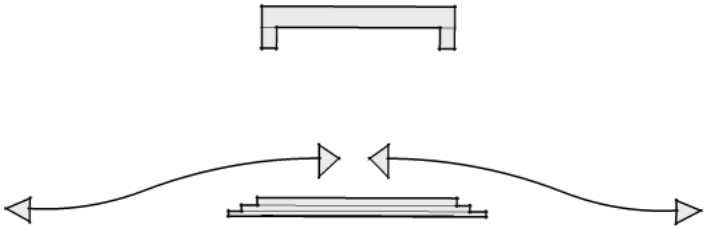
HYPOTHESIS

The design of Banco de Londres has introduced technical innovation in Argentina both in terms of (1) its interaction with the urban context and (2) its building structure. However, due to practical considerations ephemerality these innovations prove to be a 'flash in the pan' without being able to exert a lasting influence on Argentine architecture and technology.

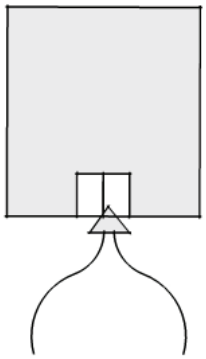
(1) In the following referred to as ‚Banco de Londres'.

1.Interaction with the Urban Context

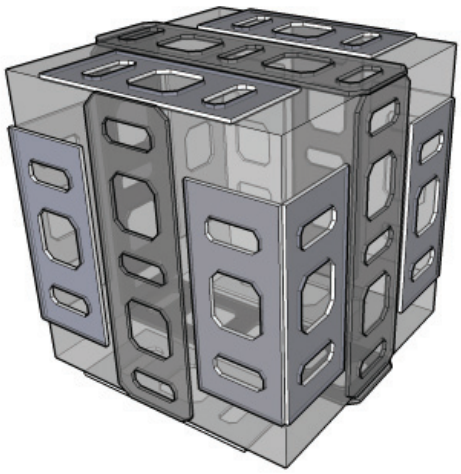
The first innovative mechanism of Banco de Londres consists in its integration with the urban context as a space of continuity (see graph 1 and 2). Instead of being an enclosed space, as it was characteristic for the majority of institutional buildings in that time, it broke with the traditional concept of building in Argentina. The principal idea was the penetration of the city into the building, without barriers between interior and exterior space [2]. As graph 3 and 4 illustrate, how Clorindo Testa succeeded in making the building an integral part of the urban setting by making it a visual enlargement of the surrounding narrow streets. Banco de Londres was not intended to be like any other conventional building, but should rather serve as a sort of covered plaza, a publicly accessible space. In contrast to this concept of penetration of the city into the building, institutional buildings in Argentina have traditionally been closed and protected, like an impenetrable 'black box' for the onlooker by creating a barrier from the surrounding context. Comparing the Banco de Londres of Clorindo Testa in Buenos Aires and the Bank of Mendoza (see graphs 5 and 6) demonstrates very clearly how the new openness broke with a firm tradition of seclusion.



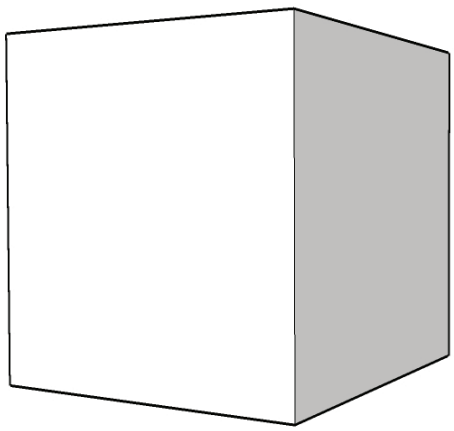
(Image 1) Banco de Londres´s schema of continuous open Space



(Image 2) Traditional concept of building in Argentina, namely enclosure space.



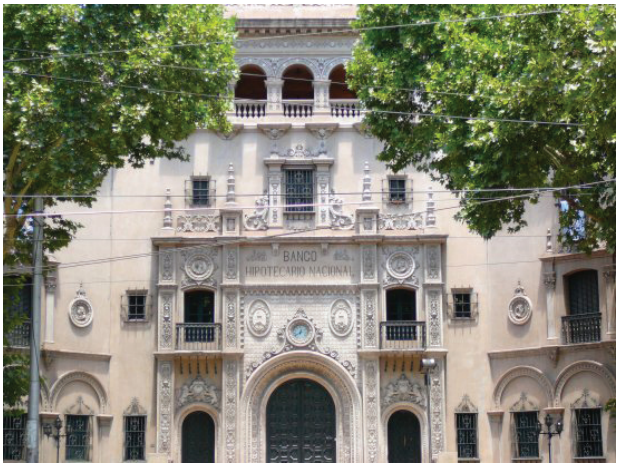
(Image 3) Schema in comparison to a normal volume, treated as a whole transparent light, block secure but accesible to the context,



(Image 4) Schema of Volume,close heavy it keeps itself open apart of the context

(2) Jorge Glugsberg, Clorindo Testa, pintor y arquitecto, Library of thr international Union of Architects, ediciones Suma, Buenos Aires, 1983

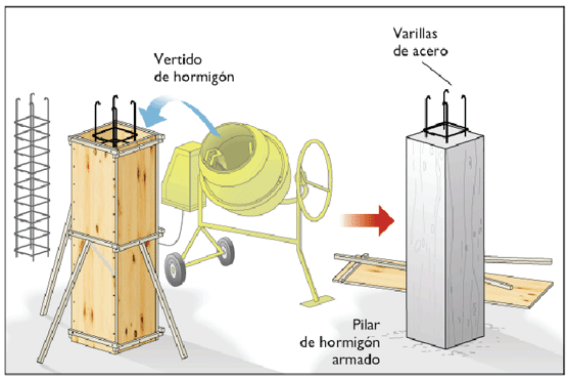
(Image 5) Banco de Londres schema of continuous open Space



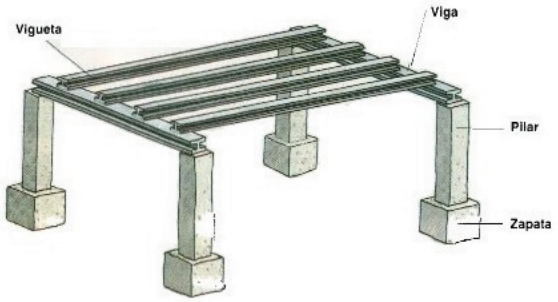
(Image 6) Traditional concept of building in Argentina, namely enclosed, protected space.

2.Characteristics of the Building Structure

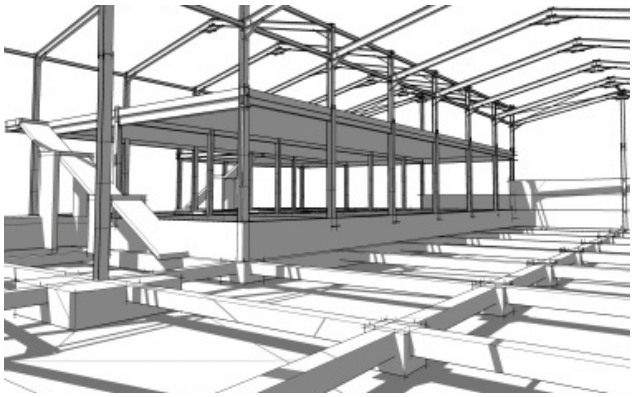
Another outstanding technical innovation of Banco de Londres is represented by the building's structure. is illustrated in graphs 7-9.



(Image7) Traditional Building in Argentina wooden casts for poured reinforced concrete



(Image 8) Traditional concept of building in Argentina, concrete columns and beams



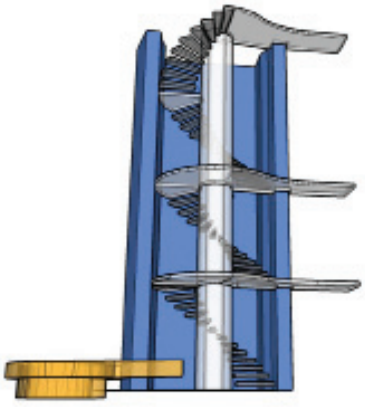
(Image9) Traditional structure construccion in argentina was carachterized by simple columns and beams organized without any spetial treatment, thought only to support the mass of the rest of the building.

The structural design of Banco de Londres sharply contrasts with the traditional approach by creating a voluminous interior body lightly structured by various seemingly floating levels. As shown in graph 10, the building has three basements and six working levels[3].

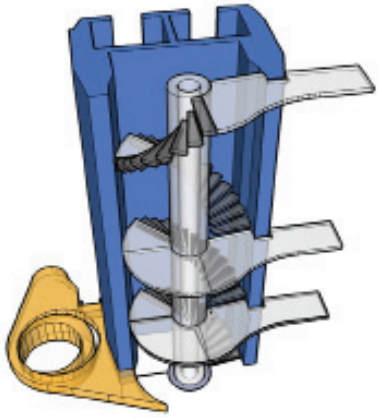
(3) http://wwx.baunetz.de/sixcms_4/sixcms/detail.php?object_id=38&area_=1085&id=65577

An overall area of almost 25,000m2 is enveloped to a height of 26m. The areas inside the building are created for use by bank staff and customers. The main entrance is located in the intersection of the streets, conformed transition spaces are emphasized by a pendent concrete screen, imitating the visual sensations from the interior. [4]

The six levels inside the building divide the enormous interior space without disrupting the notion of having only one central hall, which is a fundamental component of bank institutions. In contrast to the fragmented, partitioned and closed structure of traditional buildings, this allows for the interior space to be open and completely released of columns. However, attention must be drawn to the colossal circular "pit" which centralises the relation between the ground-floor spaces and the first basement level which is a fine example of the imaginative resources employed in the design (see graph 11 and 12).

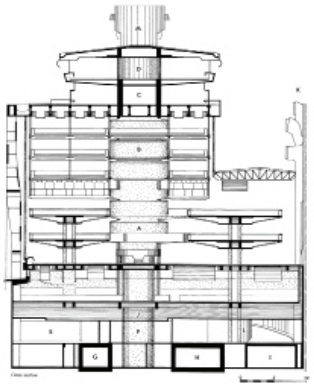


(Image 11) Circular "pit" centralizes the relation between the ground-floor spaces and the first basement



(Image 12) Elevators boxes, part of the main central structure

10. six upper working levels



10. basements

Thus, Clorindo Testa managed to break with the conventional construction system of conventional storeys or floors at different levels, such as the "hall" which is a spatial continuum materialized with concrete in a formal repertoire.

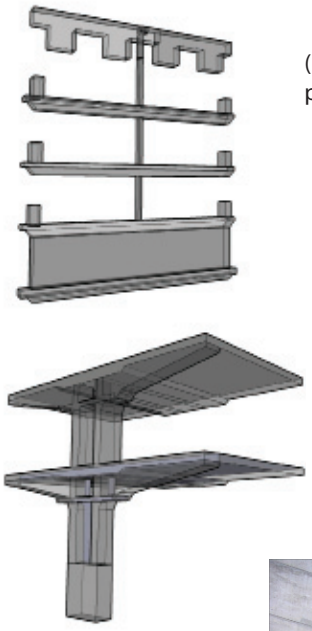
The six working levels are linked by a pair of vertical circulation groups. The upper floor levels and one additional small area are suspended from the main roof grid by steel hangers on a 3x6m module. This design feature permits the characteristic freedom of spatial creation while the enclosing envelope is demarcated by the main roof grid and two-party walls. The volume is completed by the system utilized on the two frontages: glass inner structure and a perimetral concrete structure, providing an extremely attractive visual feature [5] (See graph 14).

(4) Jorge Glugsberg, Clorindo Testa, pintor y arquitecto, Library of the international Union of Ar chitects, ediciones Suma, Buenos Aires, 1983

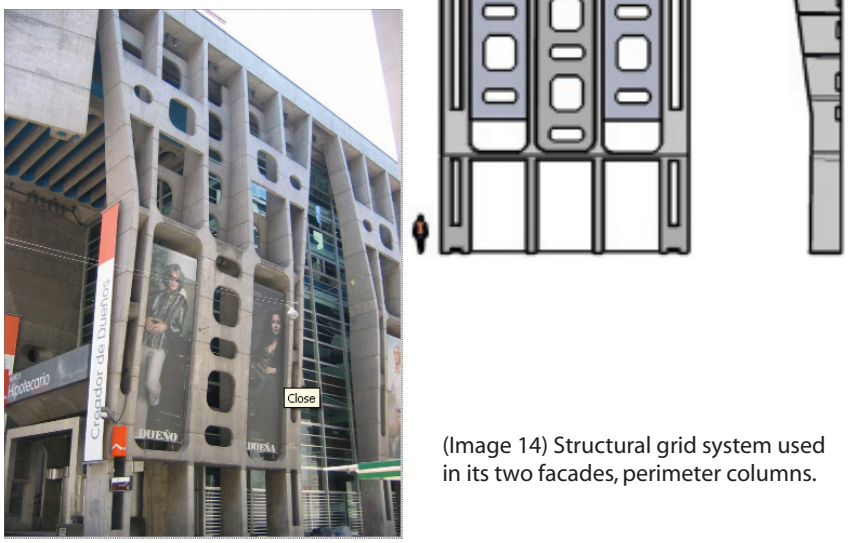
(5) Jorge Glugsberg, Clorindo Testa, la peste en Ceppaloni, Ediciones Centro de Arte y comunicacion , Buenos Aires, 1978.

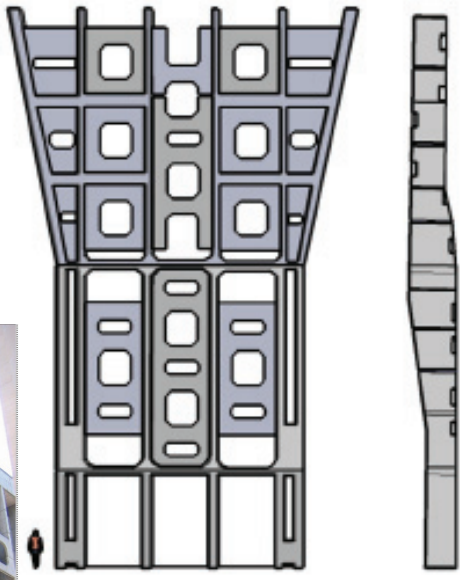
The structure— embodied mainly by the spiral staircase in the main hall and the cantilever intermediate levels— defines the free internal space and dominates the visual work as a whole. The malleability of the concrete also enabled structural details to become structural objects, on the other hand the forms adopted for the air conditioning, lightning, colour and textures support the creation of the covered plaza mentioned above.

The curtain wall (See graph 14) developed by a complex grid serves to support the wall of glass and aluminium, even though the aluminium has in this case no main feature because it is subordinated to the glazing glass curtains. Thereby, the roof is partly supported by these columns which, at the same time, serve as a brise soleil and this permanent sun-shading technique constitutes another remarkable structural feature.



(Image 14) Horizontal beams, upper levels slabs hanged on principal structure of the roof by ironed strains





(Image 14) Structural grid system used in its two facades, perimeter columns.

The main entrance of Banco de Londres is emphasized by a reinforced concrete screen. The module Testa employed for the roof grid served to order the outer column spacing. The three basements extending to a depth of 14m are built with a conventional structure of columns and beams, also of reinforced concrete.

The Bank of London suggests the exhibition of constructive processes, as a new ornamental notion, introducing a new way of constructive language, such as reinforced concrete, brick, glass and iron[6]. In this context, the structure of the building has a fundamental expressive role. It emphasises the borders of the horizontal beams, particularly dominating in stern spaces. Furthermore, the structure facilitates the sculptural treatment of columns with double and triple levels as well as porticos and stairs.

6) Clorindo Testa and Jorge Glugsberg, Hcias una arquitectura topologica, Ediciones Espacio Editora, Buenos Aires, 1978.

In sum, the building's exceptional structure works as a unique space[7]. This schema is conformed and delimitated by three principal elements: the block roof and two intermediary walls. The whole volume is completed with the structural system used in its two facades, namely perimeter columns. The roof is partly supported by these "columns" and is also a handy protector screen against sun reflects. The special treatment of concrete sculpturally caste, was also carefully treated by the time of setting the wooden casts following geometrical figures and strengthening the innovative character of the building. Considering the scarcity of advanced technologies and material production in Argentina by that time and the means to produce and frame concrete (manually!), Testa's accomplishment can hardly be overstated in his historical and cultural context.

3. Impact of the Technical Innovations in Argentina

Though Banco de Londres represents an innovative way of resolve structure made of reinforced concrete, using columns and beams in a way unknown in Argentina in the 1960s, retrospectively it is safe to say that the overall impact was very limited. As the abovementioned technical innovations had to stand the test of reality, several practical problems emerged that deterred other architects from replicating these elements. First, Banco de Londres was confronted with many maintenance problems. For example, the concrete facade did not age well in a damp, cloudy and maritime climate such as that of Argentina.

So over the years, the building became streaked with water stains; rust was leaching from the steel reinforcing bars, and even moss and lichens started to grow. Second, the fact that Structures of poured concrete tend to be expensive to build and maintain, while they prove to be very difficult to modify. Apart from these practical problems, a new generation of architects soon started rejecting the"brutality"of the building structure, deeming it inappropriate for public spaces. These architects started to incorporate European vanguardist architecture and new techniques. However, despite its short life span, Francisco Bullrich rightly points out that there can be "no doubt, this [Banco de Londres] is the first work which called the attention of public interests and opened an architectonic conscience in the country." [8]

Although the Brutalist movement was largely dead by the mid-1980s, having largely given way to Structural Expressionism and Deconstructivism, it has experienced an updating in recent years. Many of the rougher aspects of the style have been softened in newer buildings, with concrete facades being sandblasted to create a stone-like surface, covered in stucco, or composed of patterned, pre-cast elements. Many modernist architects have been doing just that in many of their recent projects. Some observers see a movement on the horizon triggered by LiTraCon a new type of translucent concrete. But there are no signs of a broad-based revival. So far, the only replication of Testa's innovations in Argentina is The National Library which was built by Testa himself.

CONCLUSION

Banco de Londres was a highly innovative piece of architecture in its historical and cultural context. On the one hand, its integration in the urban environment allows for a deep penetration of the building by the surroundings and facilitates a unique interaction between interior and exterior spaces. On the other hand, Testa clearly broke with the conventional building structure, by using one central pit and creating open spaces with cantilever levels. Despite the worldwide attention, Banco de Londres received in its time, both practical considerations and the fugacity of New Brutalism as architectural movement prevented the technical innovations to exert a broad-based influence.

(7) Banco de Londres, Una escultura en hormigón, http://www.construirydecorar.com/scripts/areaservicios/noticia/nota.asp?IdSeccion=6&IdNota=6373

(8) Francisco Bullrich- Arquitectura Latinoamericana, http://www.construirydecorar.com/arquitectura/Latina/obras/testa

BIBLIOGRAPHY

Jorge Glugsberg, Clorindo Testa, pintor y arquitecto, Library of the international Union of Ar chitects, ediciones Suma, Buenos Aires, 1983

Jorge Glugsberg, Clorindo Testa, la peste en Ceppaloni, Ediciones Centro de Arte y comunicacion , Buenos Aires, 1978.

Clorindo Testa and Jorge Glugsberg, Hacia una arquitectura topologica, Ediciones Espacio Editora, Buenos Aires, 1978.

Francisco Bullrich- Arquitectura Latinoamericana, http://www.construirydecorar.com/arquitectura/Latina/obras/testa

http://wwx.baunetz.de/sixcms_4/sixcms/detail.php?object_id=38&area_=1085&id=65577

Banco de Londres, Una escultura en hormigón, http://www.construirydecorar.com/scripts/areaservicios/noticia/nota.asp?IdSeccion=6&IdNota=6373

http://www.arquitectura.com/arquitectura/latina/obras/testa/bancolondres/bancolondres.asp

http://www.mimoa.eu/projects/Argentina/Buenos%20Aires/Banco%20de%20Londres

banco mendoza http://www.flickr.com/photos/istvan/62023103/

3 Eladio Dieste, Uruguay

Dieste, who was educated as an engineer, is widely reputed for his work on structural ceramic vaults and walls, applied to wide a range of structures from grain silos, factory sheds, markets and churches, all of them in Uruguay. A particular innovation was his Gaussian vault, a thin-shell structure for roofs in single-thickness brick with one single steel traction rod below, that derives its stiffness and strength from a double curvature catenaries arch form that resists buckling failure.

"ARCHITECTURAL AS A LOCAL PROCESS"
THE LEARNING OF ELADIO DIESTE

Geilon Cannarozzi

"Eladio Dieste has been a champion of the need to develop appropriate technologies, without limitations or barriers to professional achievement. Instead of adopting solutions foreign to this environment and contrary to local needs and resources, we should accept the challenge of searching for alternatives more in harmony with the social and economic context of the place" [1]

Keywords: Product, process, community, cultural identity, social values, technology, globalisation,

(1) Morales, Carlos. 1991. Profile: Eladio Dieste. In MIMAR 41: Architecture in Development. London: Concept Media Ltd.

Introduction

In the nova day's run for technology, the global mood is at producing, discovering new materials and constantly innovating in Architecture. The context of global capitalisation has given priority to efficiency, production and often an unequal distribution of natural resources.

Uruguayan architect Eladio Dieste shows threw his entire work how it is still possible to use one of the most ancient construction material (brick) in a contemporary way, sparing matter, time and energy. An architecture that would "make sense" to its inhabitants in a social way, not only threw its materiality, but as a global process.

Dieste chose to constantly improve the process of research and construction in order to give it a social value. It appears today that in architecture, the process of design is often neglected and only remains the product.

Questioning

Analysing Eladio Dieste's ideas, philosophy and productions, and assuming they can be considered as an architectural process, in which way can his work reveal designing methods that could be or are used in contemporary developed countries?

Plan

After introducing Uruguayan Architect Eladio Dieste, we will first of all try to understand, thanks to his influences (artists, architects, family, cultural identity, …) where Dieste's ideals and convictions come from.

Then, threw the analysis of his working methods, and more precisely the case of the Atlantida church we will understand how Architecture can be seen as a process that serves a humanistic ideal: Man.

Finally we will try to relocate these facts into the 21st century globalised society, comparing Dieste's "process architecture" to nowadays "product architecture" sold as an object.

Vocabulary analysis

Process stands for all the phases of a projects creation, starting with the design philosophy and methods, use of materials, constructions techniques, maintenance during use and recycling after.

Product must be understood as a production of 21st century globally capitalised societies, implying: mass standardisation, world-wild advertisement, but most of all erasure of cultural belonging, etc…

(It is understood that we are here selecting the worst aspects of capitalism, given that they are the ones most eager to thwart architecture's social issues.)

1. Architecture seen as a humanistic process

1.1 Eladio Dieste, a short biography

"End does not justify means. You don't know the end. We have an image of our goals, but they will never be realized if in our actions we betray the principles that will shape and form these goals." [2]

Architect and Engineer
Eladio Dieste

Nationality
Uruguayan

Birth – Death
10th December 1917, Artigas, Uruguay
29th July 2000, Montevideo, Uruguay

Architect's Complete Bibliography

Dieste, Eladio Depósito Julio Herrera y Obes en el puerto de Montevideo, Obradoiro, Col. Oficial Arquitectos de Galicia, N 11, 03/1985.

Dieste, Eladio La estructura cerámica, Ediciones Escala, Bogotá (Colombie), 1987

Dieste, Eladio Pandeo de láminas de doble curvatura, Ediciones de la banda oriental, Montevideo (Uruguay) , 1985

Short Biography

Eladio Dieste is one of the major actors in the use of reinforced ceramics to create curved architectural spaces. For most of his career, he built storage buildings, factories and small sport facilities in Uruguay.

At the same time architect, engineer and practical builder, Dieste innovated in structure, precisely because he did not accept the limits of existing practice and codified rules. Moreover being a rationalist and a poet (like his father), he was a goodhearted and hardworking man, with a pronounced sense for justice.

Uruguay has never had a lot of natural resources, and post war years where difficult. Because of this context and thanks to his convictions, Dieste applied a rigorous design philosophy to all of his works. He would call it "*economia en un sentido cosmico*".

Be effective, always try to lower costs, but in a social and cultural way". Still, these methods and ideals never kept him away from his religious and poetical vision of architecture "**A profond order of the world must be manifest in our built work"**

(2) Pedreschi, Remo, 2006, The Structural Behaviour and Design of Free-Standing Barrel Vaults of Eladio Dieste, presented at Second International Congress on Construction History, Cambridge University

He controlled the principles of shell structures, and the continuum surface structure theory. But not only did he have a very good understanding of their mathematical and physical background, he also knew how to take advantage of them in order to create architecture. And that is what made him a pioneer in his domain.

1.2 Context and Influences for a social way of building

Uruguay, a country marked by its history

Located in the South eastern part of America, Uruguay is a small Country, with very few inhabitants (3,46 Million) of whom 50% live in the capital Montevideo. Most of the population is European descent, and the main religion is Catholicism, even though the country has no official religion, church and state being separated.

The country won its independence in 1828 in a 3 way struggle between Spain, Argentina and Brazil, and is today a constitutional democracy, also considered as the least corrupt country in Latin America. Which is a big victory considering its heavy history.

In the late 1950s, Uruguay started facing inflation and great unemployment, because of less demand for agricultural products in the world market. The country was then confronted to the Tupamaros, a violent guerrilla movement who took place in the 1960s. Accordingly, the government leaded by Jorge Pacheco declared a state of emergency in 1968, leading to a suspension of civil liberties.

It is first in 1984, after mass protest from the population that dictatorship in Uruguay ended.

Uruguay has a long agricultural tradition, which plays an important role in its history and identity. But today, even though its economy still relies on agriculture (11%), it has focused on new areas such as technologies, and they have been for the past years the first software exporter in Latin America.

Growing up in a revolutionary context

As we can see, Eladio Dieste was a man with strong principles, which always stood at the birth of his productions. In order to understand these principles it is necessary to look back in his life.

E.D.'s father immigrated to Uruguay, in 1895 where he lived as an immigrant. The young son grew up with a big influence from his father, Republican, mason, integrated in the literary circle of the city. Dieste moved to Montevideo in 1933 to complete his studies. He got quickly integrated to the intellectual circles of the capital. Largely influenced by artists such as Joaquin Torres Garcia or his uncle Rafael Dieste, the young Eladio faced the revolution of Uruguayan artists defending values such as Art synthesising instinct, spontaneity and senses with geometry and reason. He described his Art as "the revelation of the mystery of the world"

Before integrating the faculty of engineering in Montevideo, Dieste all ready had a deep sensitivity for the world surrounding him, and a high concern for local values. Long after his studies he confesses: "I studied engineering because […] I am fascinated by the possibility of understanding reality through the physical mathematical language. "

Dieste wasn't just an engineer trying to improve structures. He studied brick and wanted to understand how to use it. But he wasn't only concerned about sparing matter by improving structure, most of all he was trying to understand matter, discover its nature. In his

personality lied the basis of his convictions. He was **a philosopher wanting to understand the world threw the mathematical language.**

Dieste: The Architect and the Humanist

Dieste was an intellectual humanist. He cared about Manhood all of his work was a function of Men. As influenced by locals, he constantly kept in his mind that a project should take into account the habits of its users and the structural and constructive ability of its workers.

"*Each of Eladio Dieste's work represent a process of search and discovery; Everything, including materials, forms, spaces, possible techniques in a depressed economy, building traditions, available labour, is subject to that continual investigation process which has resulted in an exquisite formal sensitivity, a profound technical and constructive rationality and a realistic attitude to local economic and production possibilities*" [3]

As of this point, architecture doesn't necessarily become a process as of the opposite of product, but it starts making sense seen by local populations, as it requires their participation.

1.3 A Building process sustaining communal values

Dieste's methods rely to ancient practice of construction, as in Middle-Ages when bridges or houses were built by the villagers, or as for Gothic cathedrals. The construction was a communion of workers, every man was a piece of the process, a process that made sense because it was integrated into its site, and had a social function, along its construction, and as a built entity. The most relevant example is probably the church of Atlantida built in the 1960s.

"*The church of Atlantida was like a son to us, a son who was born little by little. Because if you had to carry bricks, Eladio came to us and we had to carry bricks. He was always checking every brick, and if something did not go well he would demolish it and rebuild it. We were great friends*"

Olimpia Torres

Dieste's buildings stand as the accomplished design of a community. It proves that somewhere else than in entrenched Aboriginal small villages, the idea of building its own environment is still possible.

"part of modern disenchantment is to be the absence of a clear expression, the fact that things display a tightly fitting which is the negation of what we call brotherhood which we supposed to and of course must be in the works of Man"

1.4"Economia en un sentido cosmico"

In order to get a better understanding of Dieste's way of thinking, convictions and working methods, it appears necessary to consider Architecture as a process. To be more precise, we must look at the construction period of a building, as part of its lifetime, In a more poetical way, "the birth" "life" and "death"

(3) Morales, Carlos. 1991. Profile: Eladio Dieste. In MIMAR 41: Architecture in Development. London: Concept Media Ltd.

Dieste says:

"End does not justify means. You don't know the end. We have an image of our goals, but they will never be realized if in our actions we betray the principles that will shape and form these goals."[4]

A lot of architecture today is thought as an "end", the process is neglected; only result count. Architect Eladio Dieste reminds us that if we keep betraying our principles to serve the end of the process, Architecture will just fit in the global capitalisation context, remaining a product, an object. Now why is that?

The process of construction is basically what relies a building to its site. Who is going to build, and how? These are important issues architects must deal with. Architects such as Dieste show us that threw the simple choice of a material such as brick, it is possible to influence on the choice of workers and working methods.

These decisions are the result of Dieste's convictions. He applied them, in order to generate an architectural process that would correspond to his ideal of fairness. Now if architects forget their convictions, they will at some point let others decide for them. What is left then?

Choosing a local material, and giving work to locals is on thing; convincing a client that it is worth it, rather than using a prefabricated product, maybe cheaper, but imported is a lot more difficult. This is when technology comes into the equation.

"*These techniques are not based on morally unjust for workers incompetent and poorly paid, but on the contrary, on a rational use of human effort and the principle of avoiding the waste of material, behind which, ultimately, there is also human effort"*

Dieste used his engineering skills in order to work with brick in a total new and efficient way. This is what made his work worthy and interesting for promoters. We can see threw the "Dieste model" that certain factors must be respected in order to associate the words "social" and "efficient" , therefore "attractive" in a building process. For instance choosing a material with a mechanical potential, and spending enough time explaining locals how it must be used.

On the other side, born and raised in Uruguay Dieste spent his entire life in this country. His values came from his education and the social ideals he learned from it. If he was constantly trying to make his structure lighter, using a cheap material, it is not only because he wanted to, but mostly because he HAD to, as designing architecture for a relatively poor country.

If architecture can seems to have social values in rich countries, where it doesn't have to, it is mostly because the law forces it to be so. Behind every project hide principles, values, convictions that reflect themselves into the design process and methods, more than into the final appearance of the construction.

(4) Anderson, Stanford Eladio Dieste: A Principled Builder, in Seven Structural Engineers; pp. 30-47.

2. The Atlantida church case study

2.1 A unity of form function and matter

The program was quite unusual for Dieste, even though the Atlantida church was one of his earliest realisations. As an engineer, mostly dealing with warehouses and factories, he had to confront his theories to a highly symbolic space.

Dieste focused on a few important architectural themes, such as light, space and form, using the bricks qualities to create a unified mass. Unity is the right word to characterizes this creation. Unity of form, unity of space and unity of materials. The entire space seen from the inside bends itself in several directions, giving the impression of being one unique curved entity.

Unity and harmony are the key words to understand the project. Structure is space, like in any of Dieste's designs, matter is structure, or expresses itself through the structure it embodies. Space answers to the basic need of the program, which is to have one big continuous volume. And at the same time reaches it's highly symbolic function threw the particular mood brick creates.

All the aspects of the project fit together, form, function, structure, material, and finally the process of construction, efficient and social orientated.

2.2 Using double curved vaults, mathematics sparing matter

Following his ideal that matter could resist threw form, Dieste was searching for the ideal church roof form, Dieste chose to use a double curved vault, and apply it to bricks.

The equation defining the curve has two separated variables. That means, the 2 curves that define the 3 dimensional structure are independent. This simple data is what made the structure revolutionary.

The S shaped curve can modify its shape within certain limits, because it is integrated in a catenary curve. Imagine the S shaped curve as a 2 dimensional line that slides along the catenary curve, generating a 3 dimensional structure. As long as the second curve is catenary, its profile introduces enough compression so that the S shaped curve can easily change shape.

One of the problems with a thin vault that has a high span - which is exactly the Atlántida church roof's case – is that it has to face buckling. Dieste used the advantage of the double curved surface (2 independent profiles) by searching the best "S shaped profile" that would bring a maximum of buckling strength in the vault. These thinking and working methods express perfectly Dieste's idea of matter resisting through form.

Brick would never have been able to cross such big distances, if it hadn't been used in such a structure that takes advantage of its physical qualities.

2.3 Brick, the starting point

Dieste worked only with reinforced brick structures, which is a structure in which reinforcing rods are concealed in the joints. He hated the fact that using brick with simple construction methods, could be seen as a sign of under development, and gave numerous skills to defend his point of view

In numerous conferences he kept listing the skills of the most ancient construction material. The skills divide up in 4 categories: construction, economy, environment and social

Construction skills	- high mechanical skills - small and easily movable, no need for large camions - lighter - in a brick vault, over 90% of the material is al ready hardened at the time of construction; it absorbs water from the mortar accelerating solidification and the time where the formwork has to stay in place. - requires a small amount of cement - brick is easier to shape into a double curved surface than concrete
Environmental skills	- regulates internal climate environment by absorbing humidity - good acoustic response - better thermal insulation
Economical skills	- because made of earth, lighter than concrete, reduces the costs of it's scaffolding - the cheapest and most spread material in Uruguay
Social skills	- no need for skilled personal - brotherly relationship between local builders - each brick carries the mark of its maker, a building component intimately related to the human hands that formed it

Through his particular use of brick in most of his constructions, Eladio Dieste proved that a humble material can still be an innovation for social, cultural, economical and artistical innovation

Each one of Eladio Dieste's design is intimately related to a particular structure, but also to its construction methods and costs. The product reflects the process, it forms stands for a research in order to use matter in the best way. And every single brick is the work of a community of workers. In this way, we may consider Dieste's church as a learning in itself. This is what the architect always wanted. Form speaking for itself, expressing an idea, a process.

Even though he mostly produced in Uruguay, Dieste remained convinced that his principles could be applied outside of his underdeveloped country

"*These solutions underdeveloped, that is, are very suitable for poor countries but may also be valuable in the developed world*"

That is why we may think learning is possible from Dieste's method compared to how, in our contemporary developed societies, architecture is processed and sold.

3. Dieste's lesson to the contemporary architecture

How can this example stand as a piece of knowledge for developed countries, expanding their megalopolises more and more? Seen from a practical point of view, its sounds difficult to use local materials for 90 storage buildings, or teaching workers how to build a curved façade. Eladio Dieste's methods work because they where applied in a particular context.

"Eladio Dieste has been a champion of the need to develop appropriate technologies, without limitations or barriers to professional achievement. Instead of adopting solutions foreign to this environment and contrary to local needs and resources, we should accept the challenge of searching for alternatives more in harmony with the social and economic context of the place"

We may ask ourselves: what are then the ideological bases, and theoretical working methods we could learn from his work?

3.1 Architecture seen as a product

Architects all have at some point their personal "signature". Zaha Hadid, Frank Gehry, Coop Himmelb[l]au or Rem Koolhaas express a very strong identity in their designs, and often are chosen because of it. Their identity has become a sails argument. Cities use "known names" in order to improve their image, and international reputation, attracting more and more tourists.

In this way a building can be seen as a pair of Nike shoes. Why do people buy Nike shoes? Anna Klingmann explains: "Nike proliferates new means of identification that are no longer bound by the specificities of culture, tradition or location. It constitutes a complex manifold of experience, lifestyle and effect. " If architects win competitions thanks to their signature more than because of a good project adapted to the needs of a site, then Architecture becomes a product.

Now why is that?

Once again, Anna Klingmann sais "We recognize those who share interests and tastes with us around the globe through the icons they wear and use" If customers of architecture are cities, then buildings can be seen as the product that expresses the belonging of a city to a bigger community of cities, rich and wealthy. A design is sold as an image, in hope to transform cities into icons.

3.2 Valorising process, a hope for a social and sustainable architecture

In this context, Architecture seems to loose its cultural identity. Technology then only serves financial means, making the architectural product an alien to its site. Sellers could use the argument, that in order to remain competitive, it is necessary for them to import materials, fasten their construction methods and so on.

But this is when the model of Dieste comes into light. He showed how it was possible to create structures answering high spans, which were necessary for the program. High spans accomplished with local materials, and easy methods, capable of being learnt by local semi-professional workers. He developed and entire process based on the improvement of a material he chose to use, never forgetting the respect of a site, and his guideline "resistance threw form".

3.3 Questioning the future about Architectural process

The question is simple:

Is it possible, by reproducing such studies on other materials in the way Uruguayan Architect Eladio Dieste did it, to sell Architecture as a process and not only as a product?

Will the argument of a fully social sustainable process convince buyers against jewellery from the latest Hadid or Gehry? A project that maybe isn't as "sparkly" but in accordance with it's site, respecting local resources and helping local populations?

A project that starts with a deep understanding of what matter is.

A project with a serious philosophical background.

Bibliography

Morales, Carlos. 1991. Profile: Eladio Dieste. In MIMAR 41: Architecture in Development. London, published by Concept Media Ltd.

Anderson, Stanford Eladio Dieste: A Principled Builder, in Seven Structural Engineers; pp. 30-47.

Pedreschi, Remo, 2000, Eladio Dieste, Thomas Telford Publishing, London

Pedreschi, Remo, 2006, The Structural Behaviour and Design of Free-Standing Barrel Vaults of Eladio Dieste, presented at Second International Congress on Construction History, Cambridge University

Diehl, K.-L. , June 1992, Die bewehrten Ziegelschalen von Eladio Dieste, published in "Bautechnik", , n. 6 v. 69

Klingmann, Anna, May 2006, Architektur und Brands: Plädoyer für eine Marke der Nachhaltigkeit, published by Telepolis URL http://www.heise.de/tp/r4/artikel/22/22667/1.html

Klingmann, Anna, June 1998, Architecture as a Product published by TransID, Nr.3 URL http://www.klingmann.com/pdf/ArchitectureasaProduct.pdf

"PROBLEMS OF IMPORTING DIESTE´S MASONRY SHELLS IN AN INDUSTRIALIZED SOCIETY"

Mesi Koponen

ABSTRACT

In this essay I will address the main issues and problems in importing Dieste's masonry shells in an industrialized society and for widespread use. The goal of the paper is to map the present situation, and evaluate the process of introducing new inventions in the rigid western system. I will focus on the use of Dieste's shell structures, as these have raised the most interest in Europe and North America so far, and are the most published. Eladio Dieste has been relatively published in Europe, but has only recently been noted for his structural innovations. In this paper I will attempt to trace the problems hindering wide spread use of masonry shells. First I will concentrate on the properties of brick. I will try to map the problem points in using brick these days, especially compared to concrete, but also bring up benefits of brick that are often ignored. Here I will also discuss prefabrication, which is a major issue in making brickwork economical in industrialized countries.

With complex forms like shells and inhomogeneous material like brickwork decisive aspects to consider are legislation and the actual design process of masonry shells. Engineers are generally reluctant to work without building codes, which makes it difficult to introduce innovations stemming from outside existing codes and inward looking research community. Procedures handling these structures in the design process often include using design methods and software not commonly used by most design offices. However, progress and intense research is being made and many of these problems may be solved in the near future.

My conclusion is that many of the problems in using masonry shells could be overcome with a slight shift of attitude when it comes to using brick and non-planar structures. The technology is almost there, all that is needed is the will.

KEY WORDS : Masonry, Shell, Eladio Dieste, Martin Speth

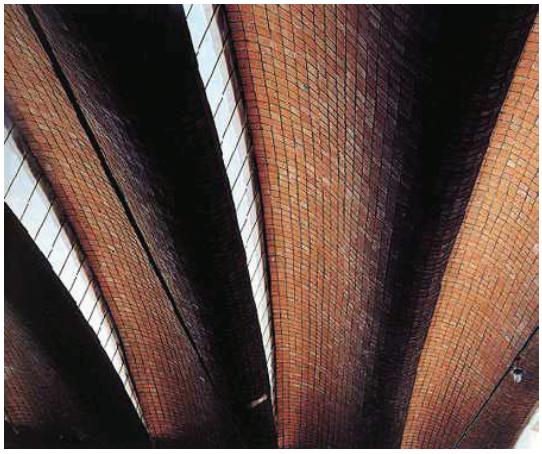
1 Introduction

1.1. Introduction to the Masonry Shells of Eladio Dieste

Engineer Eladio Dieste lived and worked mainly in Uruguay. His buildings include warehouses, silos, bus shelters and small scale churches for the working class. Regardless of their humble purposes, Dieste's buildings possess an inherent elegance, and are repeatedly discussed for their architectural qualities. Often aesthetics and economy rule each other out in the design process, but in Dieste's case they stem from the same origin: structural rationality.

Uruguay is a country of few natural resources [1] and a history of protectionist policies [2] . There are no metals, no fuel or timber available; the dominant resources are the vast land areas between dense urban centres. The most appropriate building material in this context is brick. Striving for economic structures, Dieste chose to use masonry as the material for his buildings, his techniques often proving to be both cheaper and more beautiful than the alternatives.

In his writings Dieste discards the prevailing tendency of engineers to base their constructions on planar parts [3]. Being easily calculable, planar structures offer simple and seemingly rational solutions to structural problems, but are often the detour in terms of actually resisting loads with form, thus needing more material in construction. Dieste bases his structures on three dimensional surfaces, resisting force by form. Especially Dieste's shell structures present this economy through form. A shell is a structure that consists of a single or double curved surface. The curved form offers multiple stress paths, which practically means that less material is required, and many different load types and distributed loads can be supported. Dieste's shells can span up to 50 metres with minimal bracing as can be seen in the Julio Herrera and Obes warehouse at Montevideo Docks; no vertical support was needed for the shells.



ill. 1. Eladio Dieste's Gaussian vaults at the warehouse at Montevideo Docks. Source: Federico Stratta, Foto Club Uruguayo

1.2. DIESTE'S SHELLS IN EUROPE

Articles about Dieste's work have been published in Europe at a steady pace. However, the focus has mainly been on the architectonic qualities of Dieste's buildings and not on their structural innovations. The Church of Christ the worker was published in several prominent architecture magazines in 1961, and Dieste's work was exhibited at the Internationale Bauaustellung of 1984 about architecture in Latin America in Berlin. [4]

In the 1990's at the Ninth International Brick masonry conference in Berlin (1991), a paper written by Dieste himself and a paper about him, written by K.L. Diehl, an architecture

(1) Shields, 2004, p 21
(2) Rivarola Puntigliano, 2003, p 40
(3) Dieste, 2004
(4) Catalogue for the Bauaustellung of 1984, p 15

historian, were presented. In 1991 Dieste had a retrospect exhibition in Berlin at the Akademie der Künste. The exhibition gained some attention from architectural press, but was not noted for its scientific qualities, nor published in the engineering press.[5] Throughout the 1990's more and more was written about Dieste, and extensive works about him by Remo Pedreschi in 2000 and Stanford Anderson in 2004, also highlighted the structural innovations of Dieste, and attempted to evaluate the meaning of Dieste's structural work in a contemporary context. Finally, in 2007 a study by Martin Speth, Professor of structural design from the University of Hannover, was published. This study is a rigorous attempt to adapt Dieste's shell structures to be used in Germany. Dieste is also mentioned as inspiration in research from Massachusetts Institute of Technology and the University of Edinburgh.

It is a question worth asking why Dieste's technology has not raised interest in Europe before now, almost a decade after his death. As mentioned earlier, in this paper I will attempt to illustrate both the problems and benefits of applying masonry shells in industrialized countries. The paper concentrates on two aspects of masonry shell construction, which I find are the crucial ones: economy and practice; how feasible are these structures, and how ready are designers to use them these days?

2 Brick as contemporary building material

2.1 Masonry in the Shadow of Concrete

Regardless of its long history in building, brick seems to impose some problems on the contemporary builder. Reinforced brick has been extensively researched during the twentieth century, and in most countries building codes have been established. However, the focus on the research on reinforced brick has been mainly to prove reinforced brick to have the same qualities as reinforced concrete [6]. When used in planar frame structures, reinforced brick behaves relatively similar to reinforced concrete, but there are some difficulties:

-Brickwork is more difficult to reinforce using conventional brickwork bonding.

-Brickwork is weaker in shear and more complex in behaviour.

-The physical properties of brickwork are anisotropic in nature [7]

-The specimens used to determine the physical properties of brickwork are dependent on the size, shape, and orientation of the bed joints, whereas standard, universal test specimens, such as the cube or the cylinder, have long been established for concrete. This creates problems both for researchers in comparing results, and for legislators in defining standards and tolerances.

-Relative to concrete, brickwork is more sensitive to workmanship, which may become critical in highly stressed reinforced brick structures or in conditions where shear is significant. [8]

2.2 Benefits of brick

There are however qualities to brick that could in certain cases justify its use over concrete and steel: [9]

(5) Pedreschi, 2004, p 214
(6) Pedreschi, 2004, p 214
(7) exhibiting properties with different values when measured in different directions (Encyclopedia Merriam Webster)
(8) Pedreschi, 2004, p216
(9) Pedreschi, 2000, p 30

-Brick is lighter than concrete, which reduces the costs for the supporting structure and foundations.

-Building a brick vault, 90 % of the material is hard at the time of construction. Brick also absorbs the moisture from the mortar and thus makes it possible to remove the moulds rapidly.

-Brickwork weathers and ages well.

-Brick helps create a pleasant microclimate: its hygroscopic nature helps to control humidity.

-Brickwork does not use much cement, which is more expensive than brick.

-Brickwork is easier to shape into double curvature forms than concrete.

Especially the last point is important when it comes to shell structures. With concrete expensive three dimensional moulds have to be made, with brickwork two dimensional ribs are enough to guide the mason in his work. The curved surfaces can be created just by varying the dimensions of the joints, applying the same amount of mortar to every layer.

It seems that due to the rigid building regulations and lagging research the good sides of brick are often forgotten. Concrete and steel are considered as the building materials of the industrialized society, brick is seen as vernacular and imprecise. Brick could however be a valuable alternative to concrete because of its environmental qualities. Brick has better insulating capacity than concrete and steel and is a better option in terms of CO2 emissions. Brick is also still a cheap material.

In the next chapter I will take a closer look at what is hindering masonry shells from common use. This includes prefabrication, legislation and design process, which represent the character of the problem; it has more to do with the attitudes towards brick than the actual qualities of brick.

3 difficulties in introducing masonry shells

3.1 prefabrication

Another issue in adapting Dieste's methods to an industrialized context is the need for prefabrication. In Uruguay, Dieste had the benefit of cheap labour, but in Europe workforce costs are usually more significant than material costs. Prefabrication is considered one way to reduce labour costs. In Italy, since the 1950's, the prefabrication of masonry shells was a way to keep up the competition with other building materials. Shells spanning up to 30 metres were prefabricated in a highly commercial and established system. [10]

Professor Speth experimented with a prefabrication technique, building actual shells for testing purposes. A flexible formwork that could be used to all sorts of curved elements was developed. Traditionally, masons use a straight string to guide the laying of bricks. The formwork created by Speth and his team consists of spatially curved, thin steel rods held at the free end of cantilevering slide bars. The slide bars were clipped into a steel frame, and positioned on the lines of a computer plot to achieve high geometric precision[11]. Working with this framework is relatively easy, which was proven by using masons on their first or second year of masonry school, and changing the team every two weeks[12]. To achieve the structural performance needed, highly adhesive mortar must be used. The prefabricated units could be removed after twenty four hours. Two suspension belts were used for transportation. The arches were supported by two thin timber ribs while quick-setting, non-shrinking mortar was

(10) Daguerre, 2003, p 61
(11) Speth, 2004, p 225
(12) Speth, 2007, p 186

applied between the prefabricated parts. The shells were then covered by trass plaster and hydrophobic paint to protect them from rain. [13]

Prefabrication is probably one of the most pressing issues when it comes to building shells with brick, to establish a certain precision and save in labour costs. There are however examples of competitive systems developed, as in Italy, and new methods are being researched, so it seems that this problem could be solved. One case worth noting is also replicas of Eladio Dieste's churches that were built in Spain in the 1990's. Building the churches, prefabrication was not considered to be cheaper than manual labour. [14]

3.2 Legislation and design

Industrialized countries often have established methods of building, and innovations are difficult to push through the system. It is easier for a designer to get building permits and persuade clients with pre-accepted solutions rather than to go through the laborious process of developing new solutions. In this chapter I will address the position of masonry shells first in building codes and then in the personal design process of engineers and architects, as these are the major issues determining the acceptance of any structural solution.

ill. 2. The prefabrication mould used to construct the masonry shells of Martin Speth.

Source: Speth, Martin. Schalentragwerke aus unbewehrtem Mauerwerk. Shaker Verlag, Aachen, Germany 2007

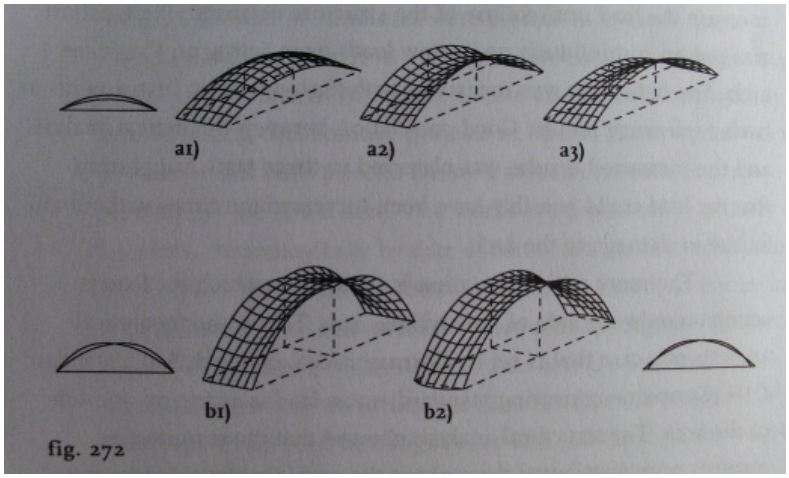
3.2.1 Building codes

According to Remo Pedreschi, the research community is often inward looking, acknowledging only results by peers of the community[15]. Research aims to refine existing work, to improve existing methods of calculation or building codes. He presents an example of this: of the papers presented at ten International masonry conferences from 1967 to 1994, the bulk of them were from Europe or North America. Engineers are reluctant to work without appropriate building codes, and introducing new codes is a long and bureaucratic process.

One problem with including shell structures to European building codes is the requirement of being able to calculate, when the structure will fail, which is very complex because of the inhomogenous nature of masonry and the complex form of the shell, and for which sufficient methods are yet to be formed. This is very important, as brick shell structures crash suddenly without any apparent warning signs[16].

(13) Speth, 2004, p 229
(14) Pedreschi, 2000, p 190
(15) Pedreschi 2004, p 215
(16) Speth, 2004, p 224

Especially tensile stress perpendicular to the bed joints should be avoided. This is why bending momentum parallel to the span of the arch caused by moving or asymmetric loads poses the largest threat to the shell. Speth and his team from the University of Hannover had constructed a series of masonry shells and performed various tests on them. Speth attempts in his research to create morphological groups with tested shell shapes for the help of designers. The gathered data has been organized and listed as guidelines of the performance of the different shapes. In the tests both the capability of the shells to carry considerable symmetric loads, and surprisingly, asymmetric loads, were proven. The results showed the underestimation of the capabilities of brickwork so far. However, without appropriate calculation methods concerning the failure of the structure, the full potential of brick shells cannot be utilized in construction. [17]



ill.4. Morphological group of shells tested by Martin Speth.

Source: Speth, Martin. Schalentragwerke aus unbewehrtem Mauerwerk. Shaker Verlag, Aachen, Germany 2007

ill. 3. Testing the shells constructed by Martin Speth and his team. Speth, Martin.

Source: Schalentragwerke aus unbewehrtem Mauerwerk. Shaker Verlag, Aachen, Germany 2007

3.2.2 Design process

The complexity the form finding process of a shell structure keeps causing problems to engineers and architects. Design is an evolutionary process, with constant re-evaluation of results. In the case of shell structures, this includes a lot of work. Engineers are often educated to deal mainly with planar structures that are easier to master. [18]

The optimal shape for a shell structure depends on the loads it has to carry. The cross section of the optimal form is a funicular curve, the negative or positive form of a chain loaded with weights. The funicular shape for a self carrying structure is a catenary. [19]

(17) Speth, 2007, p 198
(18) Dieste 2004, p 185, Pedreschi 2004, p 213
(19) Allen, 2004, p 115

A catenary curve resembles a parabola, but is mathematically far more complex; it is defined by a system of two mathematical, implicit equations, which can be solved iteratively.[20] Self-sustaining forms like membrane or funicular shapes cannot be found by classical, elementary geometric procedures, due to the intrinsic relationship between forces and form typical for structures resistant by form. [21]

One widely used solution for shell form finding is to use physical models. This method was employed by Gaudí, Frei Otto and Heinz Isler. The design of shell structures thus requires different planning methods than architects are used to. The immediate determination of the shape is left to the physical process; designer becomes a participant in the process rather than a creator. Both making and measuring models for reliable information is also time taking. A physical model can be brought into digital form by stereographic photography, but the measured data still has to be mathematically corrected, so the mistakes of the model will not be amplified to the final structure. [22]

Difficulties in the design process with shells are acknowledged by the contemporary research community, and there is high interest in solving them. Lately many computer programs have been developed for the aid of designers. A program directly dedicated to finding funicular shapes working in pure axial compression has been developed by P. Block and J. Ochsendorf from MIT. The program offers a real-time possibility to optimize a desired shape, using projective geometry, duality theory and linear optimization. It basically functions like graphic statics, but for three dimensional forms.[23] This program could highly increase the use of shell structures, because it gives fast and clear results and is relatively simple to use.

There are also programs for evaluating the behaviour of brick under different loads. One of these, recommended by Martin Speth [24] , is the FEM Modellierung system meant for testing the capabilities of materials, which might soon be able to solve the problem mentioned about introducing proper codes for masonry shells [25].

Since double curved surfaces are not easy to present in drawings, Griffith and Sass from the department of Architecture Massachusetts Institute or Technology have developed a computer program used for the production of physical models of double-curved walls built from interlocking masonry units [26]. The model is produced by a 3D printer. This fast production method allows designers to quickly print and evaluate the shape in question thus simplifying the design process and the discourse with colleagues and clients.

Already these programs solve many of the problems concerning the form finding for shells, making it simple to evaluate and compare results. It is likely that numerological methods for estimating the behaviour of brickwork will be introduced in the near future. Of course it might take some time until this software will become established in design offices, but the interest in developing more and more complex forms in contemporary architecture seems to be there.

(20) Wendland, downloaded 16.07.2009
(21) Wendland, downloaded 16.07.2009
(22) Wendland, downloaded 16.07.2009
(23) P. Block & J. Ochsendorf, downloaded 19.07.2009
(24) Speth, 2007, p 94
(25) Groth, downloaded 19.07.2009

4 Conclusion

This paper has attempted to trace the contemporary use of Eladio Dieste's masonry shell structures. It seems, that although brick has long been regarded as inferior material to concrete, its inherent benefits are being discovered again. There are many issues to solve, like prefabrication and appropriate building codes, but given the research that is being made about masonry shells, these problems could soon be overcome. Brick will not overthrow concrete, but might find its place in building double curved surfaces, because expensive formwork can be avoided. The time also seems to be ripe for Dieste's forms, which are ot simple for designers to handle. The computer aided technologies for the designing of complex structures created lately, and the growing awareness of the benefits of three dimensional structures is hopefully going to ensure this potential made use of by more and more designers.

Bibliography

Allen, Edward in Innovation in Structural Art. Princeton Architectural Press, New York 2004.

Anderson, Stanford ed. Innovation in Structural Art. Princeton Architectural Press, New York 2004.

Barthel, Rainer. Eladio Dieste: Form und Konstruktion. Verlag das Beispiel, Darmstadt, Germany 2001.

Block, P. and Ochsendorf, J. http://web.mit.edu/masonry/papers/block_ochs_IASS_2007.pdf downloaded 19.07.2009

Dieste, essay Architecture and Construction in Innovation in Structural Art

Daguerre, Mercedes ed. Eladio Dieste: 1917-2000. Mondadori Electa spa., Milan 2003.

Griffith, Kenfield and Sass, Larry http://ddf.mit.edu/papers/08_griffith_sass_caadria_2006.pdf downloaded 16.07.2009

Groth, FEM-Modellierung, downloaded 19.07.2009

Pedreschi, Remo. Eladio Dieste: The Engineer's Contribution to Contemporary Architecture. Thomas Telford, London 2000.

Shields, Charles J., Uruguay, Mason Crest Publ, Philadelphia, 2004

Speth, Martin. Schalentragwerke aus unbewehrtem Mauerwerk. Shaker Verlag, Aachen, Germany 2007.

Wendland, David http://elib.uni-stuttgart.de/opus/volltexte/2001/761/pdf/wendland.pdf downloaded 16.07.2009

Puntigliano, Andrés Rivarola, Mirrors of change, Akademitryck AB, Edsbruk, Sweden, 2003

Catalogue for the Bauaustellung of 1984, 1984 Berlin

A catenary curve resembles a parabola, but is mathematically far more complex; it is defined by a system of two mathematical, implicit equations, which can be solved iteratively.[20] Self-sustaining forms like membrane or funicular shapes cannot be found by classical, elementary geometric procedures, due to the intrinsic relationship between forces and form typical for structures resistant by form. [21]

One widely used solution for shell form finding is to use physical models. This method was employed by Gaudí, Frei Otto and Heinz Isler. The design of shell structures thus requires different planning methods than architects are used to. The immediate determination of the shape is left to the physical process; designer becomes a participant in the process rather than a creator. Both making and measuring models for reliable information is also time taking. A physical model can be brought into digital form by stereographic photography, but the measured data still has to be mathematically corrected, so the mistakes of the model will not be amplified to the final structure. [22]

Difficulties in the design process with shells are acknowledged by the contemporary research community, and there is high interest in solving them. Lately many computer programs have been developed for the aid of designers. A program directly dedicated to finding funicular shapes working in pure axial compression has been developed by P. Block and J. Ochsendorf from MIT. The program offers a real-time possibility to optimize a desired shape, using projective geometry, duality theory and linear optimization. It basically functions like graphic statics, but for three dimensional forms.[23] This program could highly increase the use of shell structures, because it gives fast and clear results and is relatively simple to use.

There are also programs for evaluating the behaviour of brick under different loads. One of these, recommended by Martin Speth [24] , is the FEM Modellierung system meant for testing the capabilities of materials, which might soon be able to solve the problem mentioned about introducing proper codes for masonry shells [25].

Since double curved surfaces are not easy to present in drawings, Griffith and Sass from the department of Architecture Massachusetts Institute or Technology have developed a computer program used for the production of physical models of double-curved walls built from interlocking masonry units [26]. The model is produced by a 3D printer. This fast production method allows designers to quickly print and evaluate the shape in question thus simplifying the design process and the discourse with colleagues and clients.

Already these programs solve many of the problems concerning the form finding for shells, making it simple to evaluate and compare results. It is likely that numerological methods for estimating the behaviour of brickwork will be introduced in the near future. Of course it might take some time until this software will become established in design offices, but the interest in developing more and more complex forms in contemporary architecture seems to be there.

(20) Wendland, downloaded 16.07.2009
(21) Wendland, downloaded 16.07.2009
(22) Wendland, downloaded 16.07.2009
(23) P. Block & J. Ochsendorf, downloaded 19.07.2009
(24) Speth, 2007, p 94
(25) Groth, downloaded 19.07.2009

"TRADITION AND INNOVATION – TRACING THE INFLUENCES OF ELADIO DIESTE'S VAULTING TECHNIQUES"

Simon Lovdal

ABSTRACT

The scope of this work is to trace the influences shaping Eladio Dieste's construction techniques. In Europe and the US, the use of reinforced brickwork had several predecessors; towards the end of the 19th and in the first part of the 20th century, engineers in France, Italy, Germany, Spain and the US experimented with and patented different systems for reinforcing brickwork. The architects of the modernismo in Catalonia and the Spanish emigrant Rafael Guastavino in the US applied new scientific methods of calculation to the traditional Catalan vaults, creating unreinforced vaults of impressive performance. It seems that Dieste's original design for reinforced brick vaults where derived from these precedents, and that his Ceramica Armada technique was inspired by a nearly identical solution used by Sanchez del Rio in a 1950s flower market in Italy.

The Atlantída church is the first buidling in which Dieste creatively exploits the possibilities of reinforced brickwork. The solution for the structural system is unique, but has references both to catalan vaulting and Gaudí's school by the Sagrada Familia in Barcelona. Later innovations by Dieste includes the optimization of the shed roof system in projects such as the TEM factory. Heavily inspired by Muncunills textile factory outside Barcelona, Dieste's managed to achieve spans up to 50 metres by applying seemingly minor geometrical and constructive changes to Muncunill's scheme.

The work concludes that Ceramica Armada was in fact not an invention independent of Dieste, but rather a refinement of a system developed in Italy in the early 50s, but that Dieste contributed greatly to this building technique by improving existing techniques and creating constructions of impressive aesthetic qualities and constructive performance.

Keywords: Eladio Dieste, Reinforced Brickwork, Catalan Vaulting, modernismo, Iglesia de Atlantida, Casa Berlingieri, Sanchez del Río, Marceto dei Fiori di Pescia

Thesis

The aim of this paper is to trace the influences shaping the development of Eladio Dieste's construction techniques, investigating both the development of reinforced brickwork techniques in Europe, and the works of the Catalan modernismo. The essay will focus on the development of Dieste's Ceramica Armada, and highlight this through the case studies of the Atlantída Church and the TEM Factory hall.

Background – Uruguay in the 1940s and 50s

The architecture and constructions of Eladio Dieste are characterized by economy of means and structural rationality. In a time when the superstars of engineering devoted themselves exclusively to the new material of reinforced concrete, Dieste ensured himself an existence in obscurity by devoting himself to the development of reinforced brick. His choice to part from the mainstream of architecture was however well founded in societal and economic conditions.

Dieste's education and early career coincided with one of the most prosperous periods of growth in Uruguayan history. Like many other American countries, Uruguay prospered from the influx of highly skilled European workers and intellectuals, fleeing war and persecution in Europe. The liberal and accepting culture of Montevideo in particular made the city a more attractive goal than the more conservative Argentina for artists and intellectuals fleeing the Franco regime (Daguerre 2003; 20). The wars in Europe also forced Latin America to reduce its dependence on European imports, spurring amongst others development of cement production and other facilities in Argentina (Braun 2008). It seems, in other words, that the wars in Europe paradoxically helped promote European culture and technology throughout Latin America. European building technology in particular became more available and competitive, and in large parts of Latin America the architectural trends seemed to lean towards a European-inspired, concrete-based modernism.

At the same time, contemporary art and architecture in Uruguay was also strongly influenced by anti-modernist voices, or more precisely, voices calling for a better, more adapted modernism. The Uruguayan artist Joaquín Torres García was probably one of the most prominent of these, though the search for a local approach to modernism seems to have concerned architects and artists from all parts of the continent.

In Uruguay in particular, the massive use of concrete was one of the most obvious problems related to the import of modernist architecture. Being an underdeveloped country with virtually no natural resources, steel and cement represented expensive imports for Uruguay (Pedreschi 2000; 23-24), and without any notable concrete industry or prefabrication options, concrete construction in Uruguay was often expensive and complicated. Brick represented virtually the only building material that could be produced on a large scale without notable imports, but as in the rest of Latin America, brick had gone from being a symbol of wealth to becoming a symbol of backwardness and poverty (Diehl 1992; 31). Especially in the 50s, when neighbours Brazil and Argentina invested large amounts in developing a modern concrete industry (Braun 2008), concrete seemed to be inevitably associated with modernity and progress (Diehl 1992; 32).

Precedents in Reinforced Brick

When Dieste's work was introduced to Europe in the early 90's, his technique of Ceramica Armada represented nothing new. Although the dominance of concrete meant that load

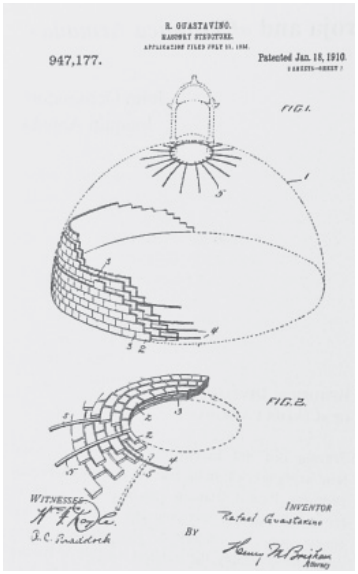
loadbearing masonry of any kind was forced to exist in obscurity, the techniques Dieste applied had numerous predecessors in Europe. In Italy there was even an ongoing tradition for constructing reinforced masonry shells up to 30 meters free span for roofing industrial halls (Daguerre 2003; 63).

The invention of reinforced brickwork appeared in several places around the end of the 19th century.

Engineers in France and Italy experimented with reinforcement systems that seem to be more derived from similar systems in concrete than from the parallel developments in bricks. A system for reinforced concrete was patented by the french engineer Paul Cottancin in the late 19th century, though apart from a church in Montmartre, the system was not widely applied (Ochsendorf & Antuña 2001; 1527-1528).

Developments in Spain and the US derived from the tradition of Catalan vaulting, which had been modernized with great success. Traditionally, a technique involving overlapping layers of thin ceramic tiles had been applied in Catalonia (Speth 2007; 24-25). This technique had in also been popular among the architects of the Catalan modernismo. One of the most impressive examples of this technique can be found in Lluis Muncunill i Parellada's factory building for Vapor Aymerich, Amat i Jover in Terrassa, Catalonia (Speth 2007; 27). The unreinforced brick shed-roof seems to echo Dieste's later solutions for factory halls. Muncunill's shed roof was, however, far from an exceptional creation; at the time of the modernismo, brick vaulting appears to have been widely used as roofing for large factory halls (Daguerre 2003; 58).

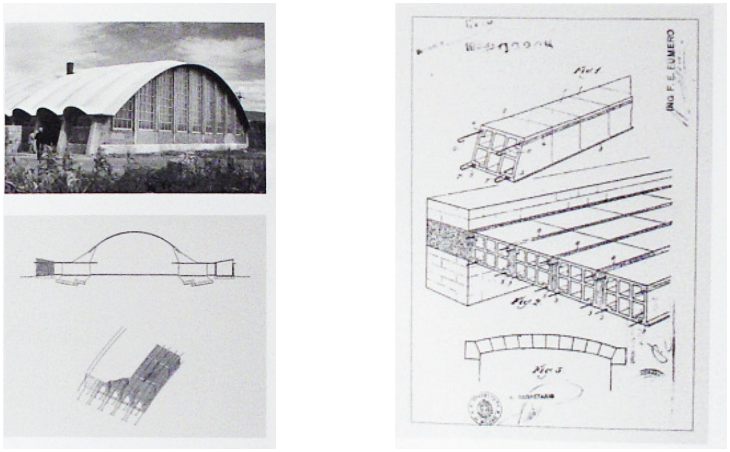
This technique was applied by the master builder Rafael Guastavino, a Spanish emigrant to the US. Being responsible for over 1,000 projects (Speth 2004; 224), Guastavino created large-span, thin-shelled vaults from unreinforced brickwork. What separated the vaults of Guastavino and the architects of the Catalan modernismo from those traditionally created in Catalonia, was that they applied the method of graphic calculation which allowed them to create vaults of much greater efficiency than their predecessors (Barthel 2001; 13). Guastavino's son, Rafael Guastavino Jr., later patented a system of reinforced brickwork, with reinforcement bars running in-between overlapping layers of brickwork (Ochsendorf & Antuña 2001; 1527-1528, and Speth 2007; 29). Later, Spanish engineer Eduard Torroja Miret would also experiment with techniques for reinforcing brickwork for foundations and water-towers, but it was first in the 1952 that Torroja would use these techniques for buildings, his church in Pont de Suert being created out of a form of reinforced brickwork (Ochsendorf & Antuña 2001; 1528).



Illustrasjon 1: Patented system by Guastavino Jr. Illustration: Daguerre 2003.

Source: Guastavino Ochsendorf

From the 1930s and on, a system of reinforced brickwork emerged in Italy, seemingly more inspired by the tradition of Roman brick building than that of the Catalan tradition. Early versions were similar to the German stahlsteindecken (Speth 2007; 31) and the solution later applied by Dieste and Bonet for the Casa Berlingieri. The reinforcement bars were placed in the joints between the bricks, spanning the cross direction of the vault (Barthel 2001; 12). These systems were intended for smaller spans such as ceilings in residential and office buildings, and would probably have been unfit for large spans or constructions involving significant pre-stressing. An illustration done by Eugenio Miozzi in 1936 however shows a system for large-span structures in reinforced brick, intended for covering factory halls and warehouses. In 1938 the same Miozzi constructs a relatively short-spanned reinforced masonry vault, with the reinforcement bars placed between the bricks. This construction seems to have had severe limitations however. One of the first truly long spanned reinforced brick shells were the vaults of the Flower Market in Pescia by Sanchez del Rio, finished in 1950, but here a layer of reinforced cement was added on top of the brick, vastly improving its structural performance (Daguerre 2003: 61-63). Comparing the details from Sanchez del Río's construction with Dieste's hallmark Ceramica Armada, the systems appear virtually identical. The adding of a top layer of reinforced cement represents a significant development, improving the construction on many levels. Not only does it make for less complicated construction, the brick acting as formwork for the cement, but it also improves the structural performance. Dieste himself did not make use of this particular technique until he founded Dieste y Montañez in 1955. By that time, the example of Sanchez del Río would have been well known in Latin America, as it was awarded the International Prize of Sao Paolo ("Premio Internazionale di Sao Paolo", see Daguerre 2003; 61) in 1954, and was subsequently exhibited in Brazil.



Illustrasjon 2: Top: Section and detail of Sanchez del Río's flower market in Pescia.

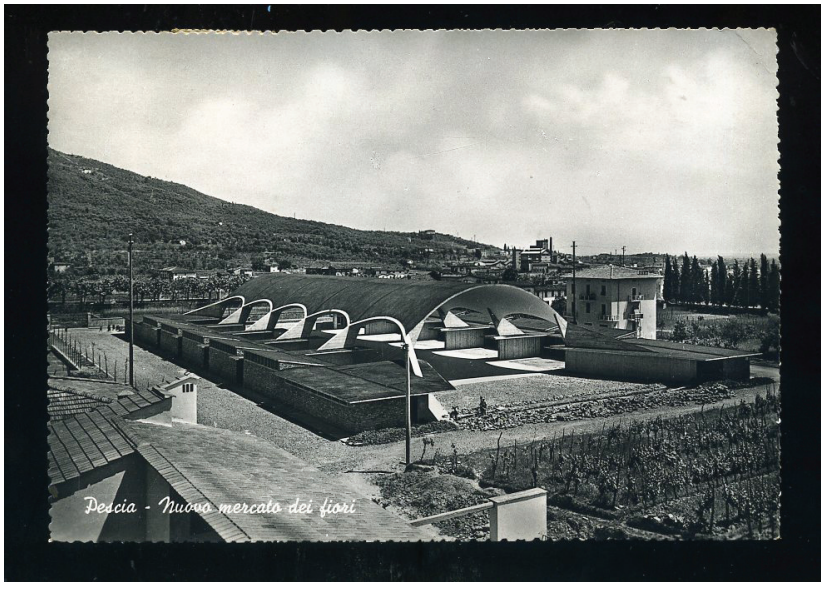
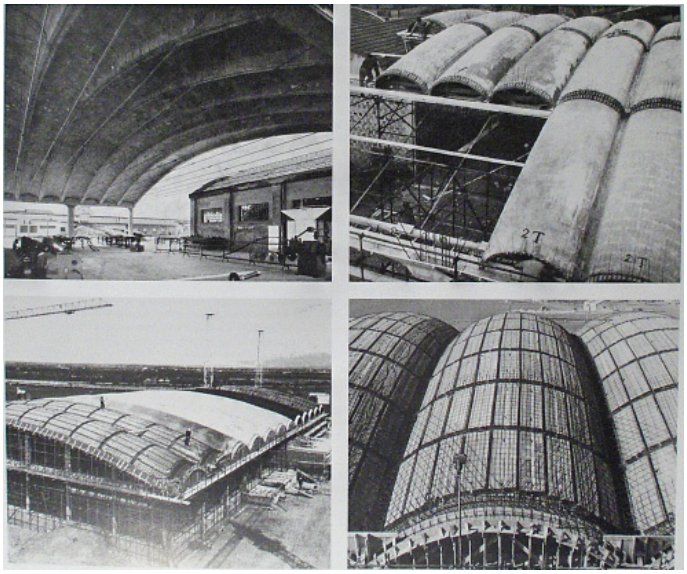


Illustration 3: Miozzi's system. Illustration: Daguerre.

From the 1950s on there were a parallel developments of the system in Italy and Uruguay. Whereas Dieste created works of fairly complex geometry, relying on a high level of manual labour, the Italian development went in the direction of a basic commercial system of reinforced brick vaults, aimed generally at nondescript industrial projects as an alternative to concrete (Daguerre 2003; 61). The increasing cost of labour in Italy meant that the development moved towards prefabricating ever larger sections of the vaults. Franco Paretis industrial halls in Sigonella from 1975 is an example of this (Daguerre 2003; 68), featuring large elements apparently adapted to the limitations of road transport. But even with these measures, brick vaulting struggled to remain competitive, and the techniques developed in Italy seem not to be widely known outside the country.



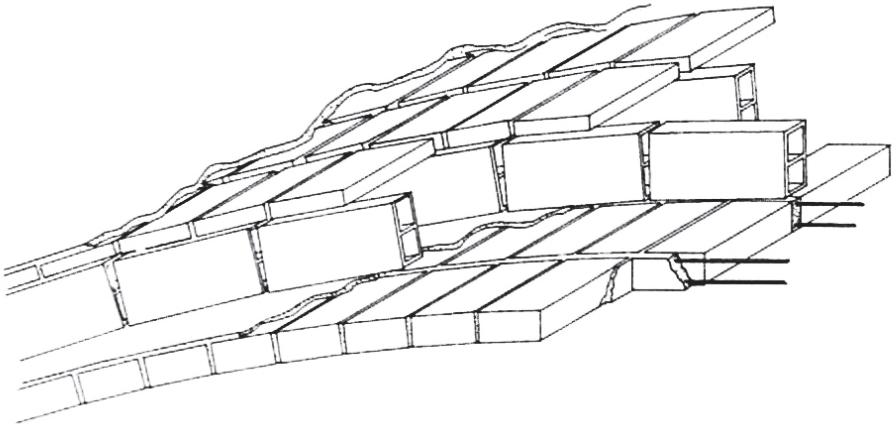
Illustrasjon 4: Examples of Vaults constructed in Italy. Upper left shows Pareti's halls in Sigonella. Photos: Daguerre 2003.

Casa Berlingieri: Early Experiments with Reinforced Brick

It remains unclear what knowledge Dieste had of the European and American precedents in reinforced brickwork. Traditionally, Dieste's Ceramica Armada has been considered an invention independent of its European predecessors (See e.g. Ochsendor & Antuña 2001; 1527). Pedreschi 2000 claims that Dieste's education was focused mainly on the theories of statics and mechanics, and that he had little knowledge of historical building techniques. The legend goes that his involvement with reinforced brick started nearly by an accidental proposal to replace concrete with brick in the Casa Berlingieri. The Catalan emigrant Antonio Bonet, the architect in charge of the project, is supposed to have introduced him to the traditional Catalan techniques of thin-shelled vaulting (Pedreschi 2000; 16).

The short-spanned vaults of Casa Berlingieri represented Dieste's first experiment with reinforced brickwork. The solution chosen for the vaults was however very different from the Ceramica Armada technique he would later use; two thin shells of brick where constructed with a narrow air gap between them to improve the climatic performance of the vault (Barthel 2001; 13). Instead of adding a top layer of cement and reinforcement, the reinforcement bars are placed between the bricks (SEE ILL.) - a solution similar to that of Miozzi in the 30s (see Daguerre 2003; 61), with the same problems in terms of achieving large spans. The vaults where shaped as plain brick vaults, the rise determined by the catenary curve and with tension rods for every third metre to eliminate lateral thrust (Barthel 2001; 12).

Illustrasjon 5: Casa Berlingieri. Photo: Terrazadelmar.com



Illustrasjon 6: Detail of the vaults used at the Casa Berlingieri. Illustration: Barthel 2001.

Although the alikeness of the Italian system seems to contradict the idea of Dieste as working independently of European influences, Dieste's own writings still claim that he in 1946 was unaware of both the Catalan and other precedents: "I had no idea if clay had been used in similar structures, nor had I come in contact with Catalan vaults" (Pedreschi 2000; 16). Barthel 2001 implies that the suggestion of using brick came from discussions on how to improve the rather heavy concrete vaults proposed by Bonnet, and that the final solution came as the result of a joint effort (Barthel 2001; 12). It would seem unlikely that Dieste and Bonet went on to design the vaults without researching already existing solutions on the area, but it is difficult to know what information would have been available to Dieste and Bonet at the time. Seemingly, the development of reinforced brickwork was characterized by parallel developments in several places, the result of the different research projects and solutions gaining little international attention. Theoretically, it is possible that Dieste and Bonet became aware of Miozzi's system, especially considering that Uruguay at the time experienced a notable immigration of educated Italians, but this remains speculation. It is just as likely that the system employed for the Casa Berlingieri was either derived from other sources or an invention of Dieste and Bonet, inspired by the Catalan and other precedents.

Dieste y Montañez: The Discovery of Ceramica Armada

Eight years would pass before Dieste again turned to brick vaulting. After his initial experience with the Casa Berlingieri, he continued to work as a consultant engineer for Bonet and others, engaging himself mainly with the design and calculation of concrete shells (Anderson 2004; 234).

But in 1955 he started the engineering and construction company Dieste y Montañez, and specialized in the construction of large-span brick shells. The technique applied by Dieste y Montañez was different from the one he applied at the Casa Berlingieri, typically consisting of a lower layer of bricks and a thin upper layer of reinforced concrete.

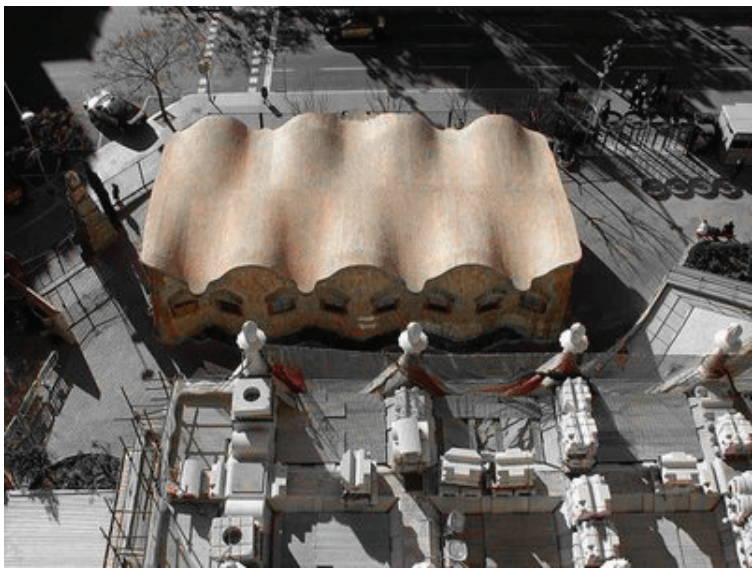
In tracing the influences that shaped Dieste's building technology, one problem is the difficulties in knowing what techniques Dieste would have had knowledge about. His essay Estructuras Céramicas from 1963 however gives some hint as to his inspiration. The essay concerns itself with the works of Dieste y Montañez, and thus does not comment on the early experiment with reinforced brickwork in the Casa Berlingieri. Instead, the essay gives clues as to the inspiration for the later developments of reinforced brickwork for large span constructions. In addition to the references to Catalan vaulting, known to him from his cooperation with Bonet, Dieste also mentions the 1950 market hall of Sanchez del Rio (Daguerre 2003; 61). The system of Sanchez del Rio being identical to the one Dieste later used, this quote seems to finally establish that Ceramica Armada was in fact not an invention Dieste made independent of developments in Europe, but rather the import and refinement of a system developed in Europe.

Although not the inventor of reinforced masonry, Dieste still made significant contributions to reinforced masonry construction. Whereas in Italy, the system applied by Sanchez del Río was developed into a basic system of large span roofing applying simple geometrical shapes and without architectural pretensions, Dieste managed to create a system that produced works of high architectural quality, while remaining extremely competitive. The two examples of Iglesia de Atlantída and the TEM factory hall show two different aspects of the practice of Dieste y Montañez; whereas the Iglesia de Atlantída remains a remarkable example of integration of structure and architectural expression, the TEM factory represents the optimization of a generic construction system. In both cases, Dieste's work remains heavily dependent on the European architectural tradition, though his innovations would have represented substantial contributions to this tradition, had they been acknowledged.

Igleisa de Atlantída and the Gaussian Vault

It was with the Atlantída Church commission, completed in 1960, that Dieste y Montañez realized the full potential of the reinforced brick technology. Originally commissioned only to construct the roofing for the church, Dieste reluctantly took on the role as architect for the project, transforming it from a basic parish church to a work of exceptional architectural quality (Pedreschi 2000; 67). Employing an adapted version of Sanchéz del Río's reinforced brick technology, the Atlantída church more than any other building showed the impressive geometrical freedom reinforced brickwork allowed. The wavy roof dips down to incorporate the tension rods, and the undulating walls work together with an edge beam of reinforced concrete to create a rigid frame structure, eliminating horizontal forces and momentum from the foundations. The unusual shape and seemingly contra-intuitive construction gained Dieste publication in some of the major architectural magazines of Europe, notably Architectural Review and l'Architecture d'Ajour Huit (Anderson 2004). Seemingly unique, the church still has a clear visual likeness to Gaudí's school for the Sagrada Familia project (SEE ILL). But as the Gaudí project utilized unreinforced brickwork and wooden beams, the structural functioning of the construction is somewhat different, and whereas Gaudí consciously searched for richness in his architectural expression, Dieste's goal was always rationality of structure.

Illustrasjon 7: Iglesia de Atlantída. Photo: Flickr.com

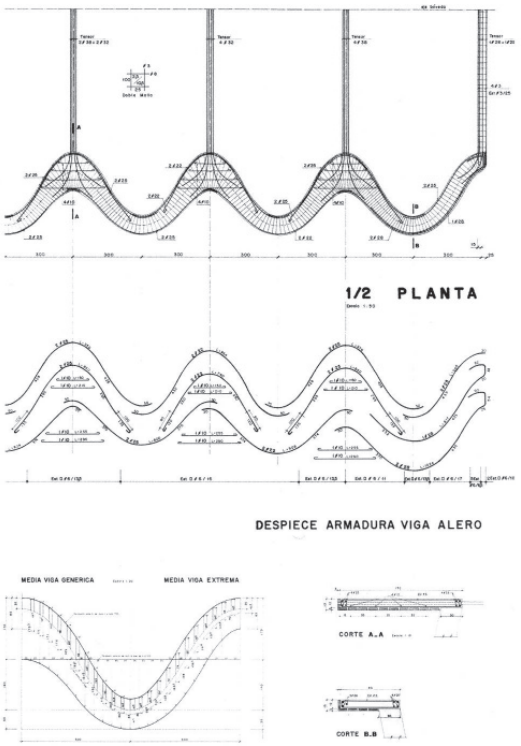


Illustrasjon 8: Gaudí's School near la Sagrada Familia. Photo: Flickr.com

The roofing of the Atlantída church is created by double curvature reinforced vaults, which Dieste named Gaussian vaults. Unique in their appearance, the vaults can to some extent be seen as an adaptation of the Catalan vault to the properties of reinforced brick. Interestingly enough, the construction technique of the vault varies slightly from Dieste's hallmark Ceramica Armada technique. Whereas in later projects, brick would form the bottom surface to serve as formwork for the thin layer of poured cement necessary to protect the steel reinforcement bars, the vaults of the Atlantída church in addition has a second layer of bricks on top of the cement, laid in a pattern overlapping the joints of the lower layer of brickwork (Speth 2007; 38-9). This is interesting, as it represents an obvious quote both to the Catalan tradition and the technique developed by Guastavino Jr. Yet Dieste's structure differs in that it is constructed with formwork rather than gradually constructing the vault by letting the overlapping layers support each other, as in the Catalan tradition. Rather, Dieste created structures that allowed for reuse of formwork modules, allowing each module to be completed at a rapid pace.

As for the undulating walls, the Gaudí school may seem to utilize a similar constructive principle, using undulating walls to take up the lateral thrust of the vaults. Dieste's solution however, uses an edge beam of reinforced concrete to transfer the thrust to the inner undulation of the walls (Barthel 2001; 37), whereas in Gaudí's structure the forces appear to flow directly to the ground. This hidden element adds to the excitement of the construction, as the flow of forces is not obvious visually. Furthermore, whereas the undulation in Gaudi's walls is bigger at the bottom, Dieste's walls slope down to a straight baseline, simplifying the foundations

needed. Dieste's solution elegantly eliminates the need for buttressing and creates a situation where the foundations don't need to handle lateral forces or momentum. In comparison, most works of contemporary engineers such as e.g. Nervi applied solutions leading the lateral thrust to the foundation by following an approximated catenary line.



Illustrasjon 9: Detail of edgebeam in Iglesia de Atlantída. Illustration: Anderson 2004.

TEM Factory and the Shed-Roof

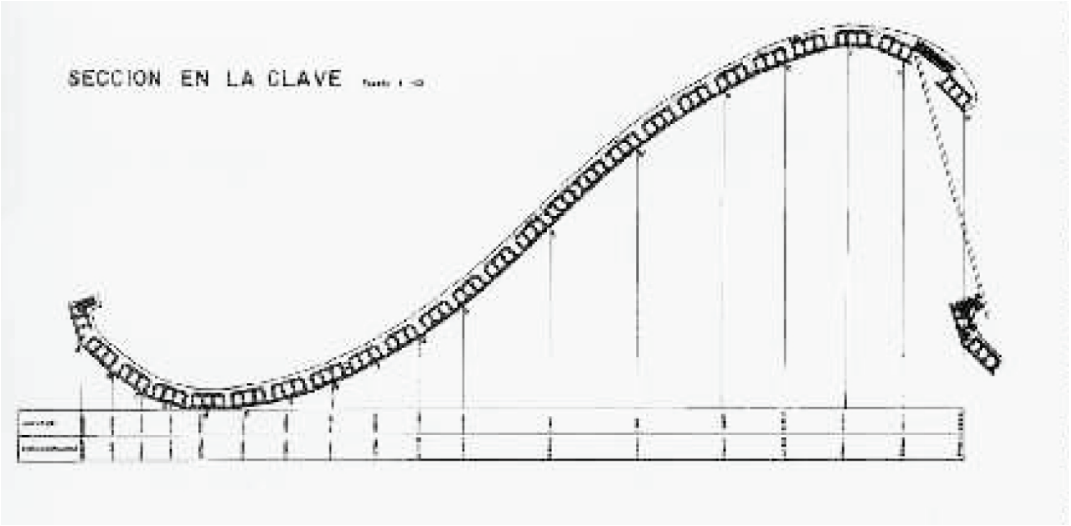
Although many central innovations where already developed by the time of the Atlantída church, the TEM factory built in 1960-62 was where the construction system of Dieste was optimized. Neither the first large industrial commission, nor the first shed-roof constructed by Dieste y Montañez, the solutions developed here where still far more sophisticated than those of previous projects. Being capable of spanning up to 50-metres with only one layer of brick (Daguerre 2003; 182), the system was later used for a number of different projects requiring large free spans and amply lit spaces.

Illustrasjon 10: TEM Factory 1962. Photo: www.mtop.gub.uy.

Whereas the Atlantída church roof was constructed as a sandwich construction with reinforced cement between two layers of brick, the TEM factory roof is a much simpler construction, with only one layer of brick topped with a layer of reinforced cement. Spanning 43 metres (Daguerre 2003; 104), the TEM vaults far exceeds both the previous vaults of Dieste as well as the vaults created in Italy, which were limited to a span of about 30 metres (Daguerre 2003; 63). Dieste had previously applied a similar solution on the Frugoni warehouse, but the vaults constructed there where both much heavier and with 22-metres considerably shorter span (Daguerre 2003; 234). The discontinuous shells of the shed roof not only admit daylight to the factory, but also allows for a very efficient construction; the formwork for one shell can be placed on rails, allowing extremely quick re-setting of forms once one vault is hardened (Diehl 1992; 549).

The form of the roof itself seems again to derive from Catalan precedents. In a textile factory in Terrasa, close to Barcelona, Lluís Muncunill created a shed roof from unreinforced brickwork, laid in the overlapping manner of Catalan vaulting (SEE ILL.). Although both less elegant and of much shorter span, the structure of Muncunill is very similar to Dieste's later shed roofs. An important innovation in the TEM vaults however, is the S-shape which goes up at the lower end of the cross section to increase buckling resistance (SEE ILL.). Also, the clumsy joining of columns and vaults are eliminated, as the vaults of TEM comes down to a straight horizontal line.

Illustrasjon 11: Muncunill's textile factory in Terrasa. Photo: Flickr.com



Illustrasjon 12: Generic section of Dieste's shed roofs. The S-shape greatly improves the buckling resistance. Illustration: Anderson 2004.

Conclusion

The idea proposed by Ochsendorf and Antuña 2003 and others, suggesting that the Ceramica Armada of Eladio Dieste was an invention unique to Latin America, seems unlikely. Although the initial idea might have been proposed without knowledge of the numerous precedents on the area, it is unlikely that such a construction would have been realized without researching already existing solutions. Furthermore, seeing the obvious alikeness between Dieste's Ceramica Armada and the solution applied by Sanches del Rio in the Pescia flower market, together with Dieste's later mention of the Pescia market, it seems clear that Dieste's Ceramica Armada was in fact a European import.

Although not independent of European architectural traditions, Dieste still significantly contributed to reinforced brick construction. Creating a cheap and successful system of shed roofs he ensured that reinforced masonry would be much more used than in it's native continent. Although clearly developed from the system of Muncunill, improvements both in construction methods and geometry enables the shed-roofs to be spanned up to 50 metres without support, thus outspanning the Italian vaults, which were restricted to spans smaller than 30 metres. Furthermore, Dieste's shed roof system creates better opportunities for letting in natural daylight than the plainer rib-vaults built in Italy, and also allows for rapid production by facilitating the re-use of formwork. Dieste, though not inventing reinforced brickwork, thus contributed greatly to its development and proved that brick could not only compete, but often even outperform concrete as a structural material.

BIBLIOGRAPHY

Anderson, Stanford ed. Innovation in Structural Art. Princeton Architectural Press, New York 2004.

Barthel, Rainer. Eladio Dieste: Form und Konstruktion. Verlag das Beispiel, Darmstadt, Germany 2001.

Braun, Ana María. Betonbau und Identität in Argentinien und Brasilien von 1900 bis 1970. Verlag der Technische Universität Berlin, Berlin 2007.

Daguerre, Mercedes ed. Eladio Dieste: 1917-2000. Mondadori Electa spa., Milan 2003.

Diehl, Karl-Ludwig. Bewehrt und eigenwillig. Bauwelt 11 (1992); 546-561.

Diehl, Karl-Ludwig. Lateinamerikanische Ziegelarchitektur als Ausdruck des eigenständigen Weges und als Abgrenzungsversuch zur Architectur der hochindustrialisierten Länder. Ziegelindustrie 1 (1992); 31-39.

Dieste, Eladio. La Estructura Ceramica. Escala, Bogotá, Colombia 1987.

Pedreschi, Remo. Eladio Dieste: The Engineer's Contribution to Contemporary Architecture. Thomas Telford, London 2000.

Torrecillas, Antonio Jiménez ed. Eladio Dieste: 1943-1996. Junta de Andalucía, Sevilla, Spain 1996.

Torroja, Eduardo. The Structures of Eduardo Torroja: An Autobiography of Engineering Accomplishment. F.W. Dodge Corporation, New York 1958.

Speth, Martin. Schalentragwerke aus unbewehrtem Mauerwerk. Shaker Verlag, Aachen, Germany 2007.

4 Carlos Raúl Villanueva, Venezuela

Villanueva was the most prominent Venezuelan architect of the 20th century. He played a major role in the development and modernization of Caracas and other cities across the country, contributing to the construction of the image of Venezuela. Among his most important works is the Ciudad Universitaria in Carcas, a work where he attempts to blend modern art and architecture. The Campus was declared World Heritage Site by UNESCO in 2000.

"THE FINE ART OF TECHNOLOGY AS REGIONALIST ARCHITECTURE THROUGH VILLANUEVA'S WORK"

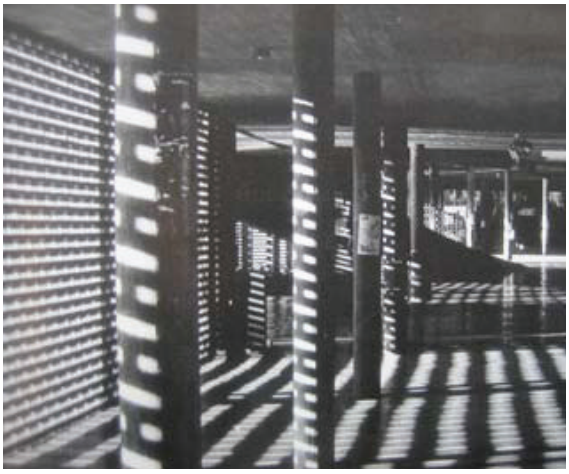
Gilda Convertino

"Architecture is a social act, an utilitarian art, a projection of life itself, linked to social and economic problems and not only to aesthetic norms.

In architecture, form is not what matters most. Its principal mission is to solve human needs. Its expressive and conditional medium is interior space, the serviceable, fluid space that is used and enjoyed by man. It is the womb that envelops life. It is the art of the interior and exterior space, an abstract rather than representational art, but with a function and essence of Cartesian logic."

Carlos Raul Villanueva

Caracas, 22/12/67



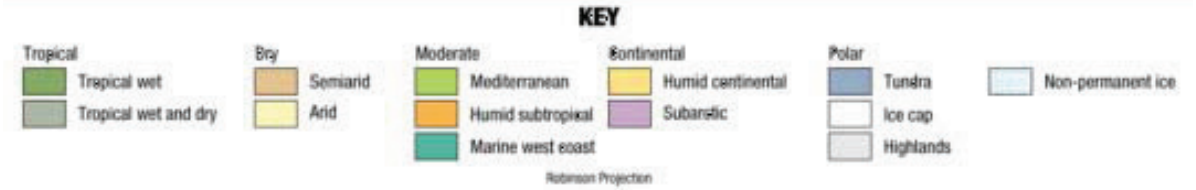
The fine art of technology as regionalist architecture through Villanueva's work

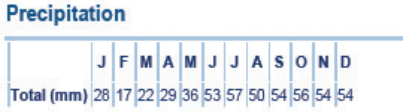
I. Carlos Raùl Villanueva as architect of tropical landscape: Passive design

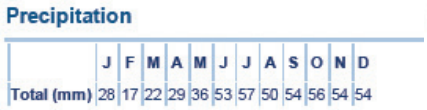
-Reading climate condition of Caracas

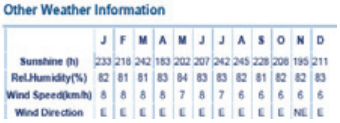
Caracas enjoy a particular position in the Venezuelan valley, in the Nord closed to Caribbean see and surrounded by a steep 2200 m high by mountain range, Cerro Ávila, in the south there are more hills and mountains. Because of these topographical movements of the territory, Caracas has also avariable altitude between 800 m and 1.000 m respect to the see levels.

This particular position influences the climate conditions that identify it as a intertropical clime. In fact studying three elements of natural conditions, precipitation and temperature, it's possible to know that Caracas is included in the equatorial zone, with high humidity levels, low wind and high sunshine levels.









Pictures: 1. Climate classification _ 2. Monthly average levels of precipitation expressed in mm _ 3. Monthly average of minimun and maximum temperature expressed in °C _ 4. Chart about weather information as sunshine, humidity, wind speed and direction

-The choose of materials on the basis of climate exigencies

There is an homogeneity in the building materials and methods throughout Latin America, best explained by what is almost completely lacking. Latin America produces no structural steel and is unable, or at any rate disinclined, to import it. In the countries near the equator the old tradition of masonry construction and the lack of skill at carpentry, combine with the unavailability of timber to make wooden construction, at least in the most heavily populated areas, almost unknown. The characteristic and almost exclusive building material is concrete, reinforced in various ways, the structural shell filled in with rubble or more usually with low grade tile or brick and covered with painted stucco. Where the climate is very dry painted stucco surfaces stand up very well. In damper seabord cities such as Rio de Janeiro and Caracas they are less satisfactory.

Material selection is an important design consideration and in that way architecture is still very much an art in Latin America. The articulate elements in the community expect more from architects than purely functional solutions. Although Venezuela has not a strong and unmistakable hallmark of architectural style, there is some constants that have survived from colonial time and others that have proliferated simultaneously with the economic boom. These are the most noteworthy features:

-The use of the bright colors that are currently fashionable in feminine apparel; these colors frequently

adorn facades, walls and patios of private homes in the region bordering on the Caribbean and

are used very widely in Venezuela.

-The louver or jaoulosie open to air currents

-The dark-brown roof common in all Spanish-American architecturefrom colonial times.

-Enclosed garden with vegetation of staggering color size and profusion.

Some of this traditional characteristics, especially the color, the louvers and a kind of weightness and solidity, were adopted by Villanueva.

Typical facade of the latin american architecture with spring colour

Use of the traditional colours in a project by Villanueva

II. The project of the university city of Caracas: from the exigencies to the functional spaces

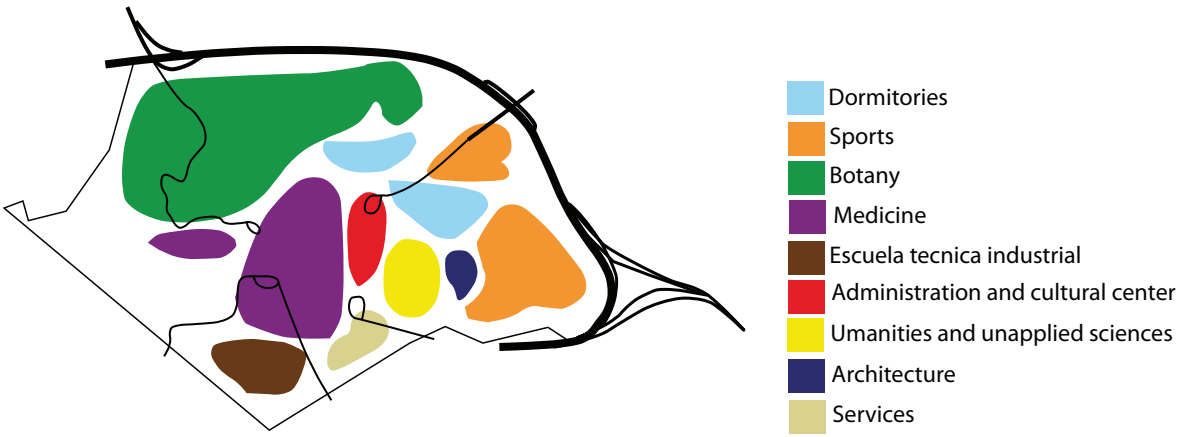
When the old system of university resulted insufficient, after the increase of students and comed the necessity to ensemble the different faculty, already dislocated in the city, the proposal was to create a university city in the periphery of the city, due the anglosaxan model where all the function are in a unique site.

Distributed on a area of 202,53 hectares, of that 129,42 are planned, the project is destined to receive 12.000 students. The university campus presents the opportunity to articulate an alternative vision for architecture and urbanism, re-imagining the university as a laboratory for urbanism.

He becomes a modern ideal city into the city of Caracas and the designers of these campuses channeled a good attention regarding the power of form to create a space separate from the colonial city that surrounded them.

The architect Carlos Raúl Villanueva begins the design of the Central University of Venezuela based on the concept of the alternative city, garden city and ideal city next to the concept of the arts integration. The main principle that ruled this project was to conceive the architecture, sculpture and painting as an integral art.

This way each one of the spaces dealt with the integration of the architecture, painting and sculpture - according to it is the case – and tried to obtain a dialectic form between the fundamental concepts of the work: the integration and the synthesis of the arts. In the case of the synthesis each one of the arts conserves their traditional characteristics. In integration, however, there is no previous frame, is the same attitude of the human work that it is going to give the unitary meaning to it.



Urban project of the university city of Caracas : organisation of the space with the covered place and the Aula Magna in the middle as conjunction of the wohle project.

Typical facade of the latin american architecture with spring colours Use of the traditional colours in a project by Villanueva

Paulina Villanueva defines them as “movements”, where one can get a glimpse at a Villanueva with musical ideas, who weaves notes together in a series, in the case of his architecture a series of spaces, works of art, vegetation and light. In this architecture, light and shade play a big part and can be most clearly distinguished in the covered place, where the itinerary reaches its maximum freshness thanks to the soft comings and goings of breezes which take place in this magical space.

Villanueva’s comprehension of tropical elements, manifests itself profusely in the intermediate spaces, spaces which may be opened or closed off by hollow blocks arranged like lattice, depending on their place or function.

Thanks to Villanueva’s versatile management, equally modern and tropical, the possibilities offered

by the climate become a common theme among the continuous flow of open and half-open spaces, closed in by green or perforated walls, sometimes covered or partially screened in.

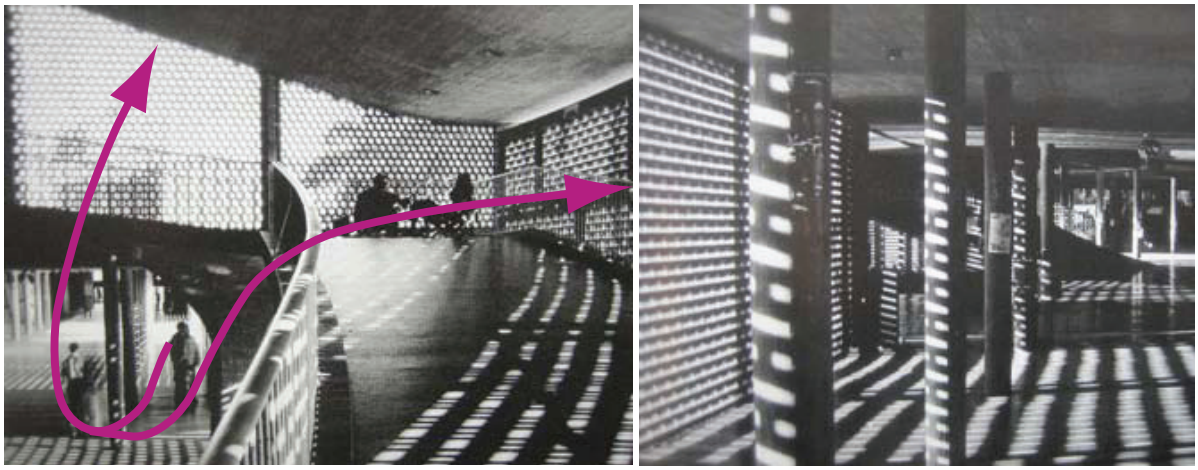
The covered place is the space more interesting of the university city, because is a space of integration, used for crossing or for take moments of relax, is at most a place of light and shadow.

Villanueva understands the environment and works with its singularity and in particular in the covered place under the Aula Magna, where he overthrows the normal conception of a square, creating a place total free with a cover, given by the same structure of the aula.

The tropical light is the element most important to consider in the projection of architectural places.

In fact the rooms are considered as a place of shadow, that need a good ventilation in order to make the rooms more comfortable.

In this sense the perforated wall combines stylistic aspects with a technical aspects, giving to the room an atmosphere played by the light ,and in the same time a free circulation of the air with the formations of currents through the wall.



Example of passive design: the perforated wall between the aula magna and the covered place creates a good atmosphere and creates comfortable spaces, thanks to the circultion of the air and the filtering of the tropical light

In his own words, he wanted to succeed in "the creation of a new architectural-sculptural-pictorial body, where not the minor indecision can be observed, where no crack between the different expressions can be seen. The essence of each of the artistic valuations must be irrevocably obvious."

He believed as well that the arts were the great cultural witnesses of a time period. In the University City he has the opportunity to demonstrate "the spirit of his time", which will lead him to include the works of, preferably, non-figurative artists. The University City is Villanueva's work of art.

To speak of tradition in Venezuelan architecture without speaking of Villanueva would be difficult, for if there is a tradition to be spoken of it was set by him.

The covered place is lobby, meeting point and open museum, finding its great virtuosity in one unique

tune. The covered place is a landmark for open spaces, its interior covets a treasure of colors.

The will to integrate art and architecture is to remain present through the edification of the following buildings. Villanueva has a chance to experiment in every hallway, every auditorium, every cafeteria, every library and every meeting of paths. And so arise skylights, incomplete walls, gardens and interior patios.

Tall buildings bring along the opportunity to develop sunshades in order to protect their façades.

The auditoriums and the libraries, and in the case of the faculty of Architecture, the Sala de Exposiciones, are part of many examples of this continually surprising modernity. Limitations become an illusion with the creation of open classrooms which continue onto the garden.

Groups of students can still be seen laying on the grass and in the Covered Plaza. Making the most of the possibilities offered by the climate has created a feeling of freedom in the air, which can easily be noticed by any visitor who walks among the paths and the covered areas.

Villanueva pieces together his architecture from uncountable influences, all of which are manifested in a loud affirmation, where nothing is missing and nothing is dispensable. His personal way of assembling the "pieces", the architectural elements of elaborate singularity, is what creates the whole.

He resolves the meeting of different elements without discarding his particular structure.

He uses armed concrete in contrast with his intense use of color. The presence of art is continuous.

He uses various light-sifting and ventilation structures. The flowing itinerary through the

ground floors communicated by covered hallways and the strong presence of the vegetation make the visit

become a multi-faceted experience. It can be confirmed that Villanueva's project enriched Venezuelan architecture with enough elements to assure its impact on the country's architectural tradition.

With the University City, Villanueva leaves the mark of a singular modernity; as Sybil Moholy-Nagy said, a version of modern architecture, in this case a tropical one.

The Aula Magna integrated with the covered place as two natural plate in order to favour the natural movements of the air

III. Technology submitted to the aesthetic function

The structure of Aula Magna, in his role of protagonist as main conjunction, answer to the will of free urbanism.

The form adopted for the structural elements are important to this discuss, because are the solution to the necessary choice of a great light and dimensions.

Its volumes, the functionality of the spaces, the integration with the others buildings obeys to a free sculptural setting and functionalistic. This is defined in the structure of aula magna, where the form, definitively plastic, is not only a bearing skeleton.

It's also confirmed by the will to remove from the sight a lot of the elements that support, and to privilege the constructive aspects, and for this reason the sculptural aspect has a great functional purpose.

The structural solution of the aula Magna is defined between the numeric field and the diagram of the forces that corresponds to the covered surfaces, until the conjunction with the esthetic of the form, that integrates the qualities of the structure making also a compromise between the inside and the outside.

The external structure is what mediates the content and the container. It's what permits to answer to the exigencies of the internal space.

A function doesn't oblige to use a unique form, rather the contrary. In the case of the elements that support, the designer has the freedom to choice to scheme of the forces that he consider able to define the form and the materials that satisfy the effort that from it derive.

The portico that include the body of the Aula Magna has his principal structural reference in the scheme of the beam of Vierendeel, that satisfy better esthetical function. The cement beam, as the whole structure, has a height of 5,5 m and a breadth of 49,20 m and is supported by vertical upright 2,091 m high.

This became the skeleton that support the whole structure of the Aula, made with a radial ribs. These lean against the macroportico in one side and against a soft column that define the access of the Aula. The beams that make the ribs have a different section, in function of the stress to absorb. Every rib has a light of 36 m rest on the extremes, and so that with a maximal moment in the middle.

In the side on the entry, the beam support also the hanging marquesina, that define the boundaries in this area. Its support happened with a stretched element, that block itself in the rib, with a triangle system of nerve-tensor-column and answering to an additional moment in the section of the rib, that became more important also in the extreme. The diagram of the forces confirms the geometry of the rib with a minor effort in the extreme of the portico.

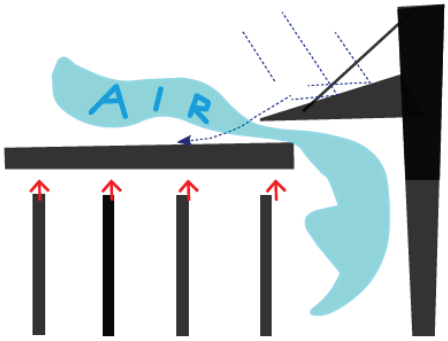
A fine tile (thickness 8 cm) make the union between the ribs that lean on the two extremes.

The balcony has a light of 13,48 m, but the hanged part is only 7,56 and lean on a system of double vertical columns.

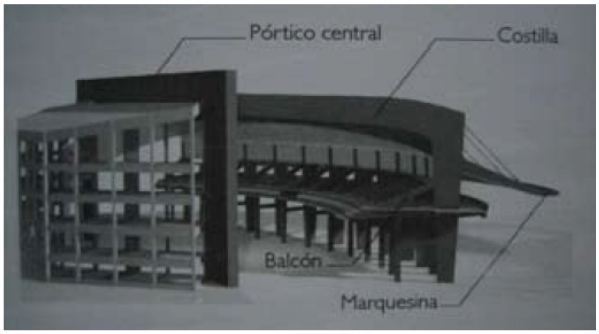
The covred place integrates itself with the structure of the aule through an indipendent system made by pillars. The two parts work together as two natural plate, where one goes over the one other in order to help the movements of the air and not create closed spaces.

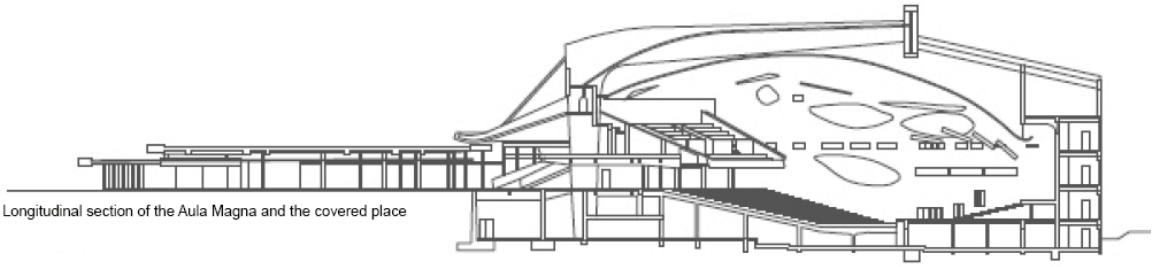
ground floors communicated by covered hallways and the strong presence of the vegetation make the visit become a multi-faceted experience. It can be confirmed that Villanueva's project enriched Venezuelan architecture with enough elements to assure its impact on the country's architectural tradition.

Scheme of the passisive design between the structure of the aula Magna and the structure if the covered place



Structural solution of the Aula Magna in order to have free opened space for the ventilation





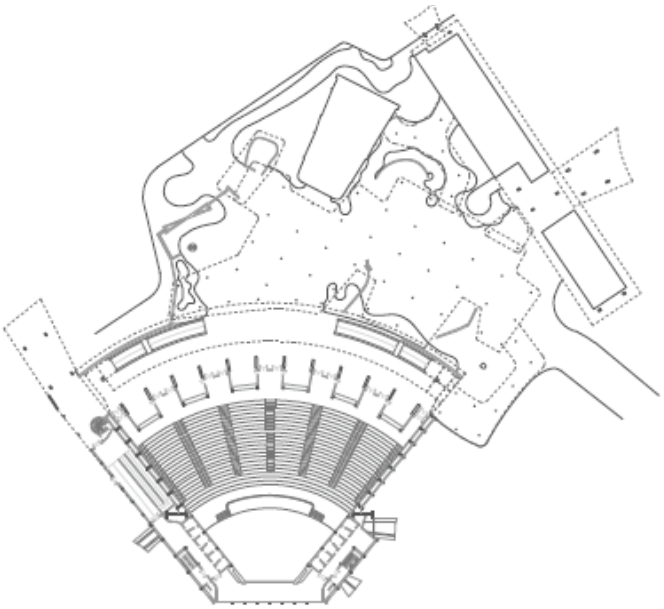
Longitudinal section of the Aula Magna and the covered place

Villanueva marks that using functionally the materials keep to an architecture conceived for the work and for the clime and for a light more definite, it's possible to realize an harmonious unity with the landscape.

This relationship with the naturalness defined by Villanueva, can be defined as an esthetic of the place conceived starting by the articulation of the spaces, by the design of the volumes and façade and the pedestrian passage.

A lot are the solutions used by Villanueva to defense against the sun, the rain and the light of the tropics: patio and corridors, sidewalks, terrace, eaves, shutters, brise-soleil, crossed ventilation, trellis to quell the severity of the sun, the insistence of the warmth, the protection by the downpour and the sudden rain.

Also the dynamism given up with the asymmetrical disposition of the buildings; the audacity of the form and of the structures concretely conceived in full view as sculpture; the creation of an internal place, complete, opened, fluid and integrated with the extern and protected against the light and the warmth with the technology of covered place; the integration of the arts with murals, sculpture and glasses, with the acoustical elements by Alexander Calder, make the main work of the university city and show the maturity of Villanueva as a regionalist architect whit an international inclination.



BIBLIOGRAPHY

-Villanueva Carlos Raul / Villanueva Paulina. Carlos Raul Villanueva, Basel; Boston; Berlin; 2000

-Dembo Nancy. Latectonica en la obra de Carlos Raul de Villanueva: aproximacion en tres tiempos.

Caracas univ. Central de Venezuela, 2005

-Hitchcock, Henry Russel. Latin American Architecture since 1945. New York Museum of Modern Art, 1955

-http://www.arquitextos.com.br/arquitextos/arq043/arq043_01_i.asp

-http://www.saber.ula.ve/bitstream/123456789/20462/2/articulo30.pdf

-http://www.aising.it/docs/ATTI%20II%20CONVEGNO/1475-1486.pdf

-http://www.aising.it/docs/ATTI%20II%20CONVEGNO/1475-1486.pdf

-http://www.centenariovillanueva.web.ve/CUC/Bibliografia/Frames_Bibliografia.htm

TU

"THE CIUDAD UNIVERSITARIA: AN ANSWER TO THE VENEZUELA'S SOCIAL CHANGE IN THE SHAPES OF A MODERNIST ARCHITECTURE"

Annamaria Piccinini

1. Introduction: a Modernization process

"…en Venezuela hay arquitectura, pero esto no quiere decir necesariamente que sea venezolana. Ya no creo que pueda afirmarse la existencia de una arquitecture nacional, pero sì creo que con una mayor comprensiòn de nuestro medio y caracteristicas ambientales, asì como de nuestras costumbres y tradicìon y, en fin, lograremos un medio de expresiòn formal arquitectònico que nos diferenciarà profondamente de los demàs" (In Venezuela there is architecture, but this is not necesserely venezuelan. I don't believe we can state the existence of a national architecture, but i do believe that with a major acknowledgment of our customs and traditions, and in the end of the Venezuelan man, we'll achive a mean of formal architecture expression which we'll distinguish us from the rest) (Albizu, p.273)

These are the words of Gustavo Wellis, president of the IX Pan-American architects Congress, pronounced in these occasion which clearly reflect the Venezuela spirit of the time. The fast economical development which Venezuela sees in the 50's due to its oil boom pushes the need to create a nation identity and therefore a nation architectural expression which will symbolize and state this new emerging nation. Buildings and works from XIX century and part of the XX century with colonial and native features are seen as symbols of a "dark and unremarkable" past and are in part destroyed to make place to new architectures. This idea of progress and modern produce the input to realise new works and lead to an open nationalism promoting all that foreign investments which help to enliven the economic and industrial process. The wealth derived from oil exports led to the growth of a middle and working class, which tended to concentrate in several Venezuelan urban areas. This explains why, at the beginning of the thirties, cities like Caracas constituted an attractive context the pioneer work of architects and engineers.

Is in this climate of Modernization that architects like Carlos Raùl Villanueva find themselves engaged to answer this new demands.

2. The socio-economic situation

The process started from Gomèz to create an "educated and prosperous" nation reaches its climax in the time frame of the years '41-'58 with the Government of General Medina ('41) which leads Venezuela in a period of major openness. Is in these years several urban project for Caracas are laid out and many architects like Villanueva get together to found the Sociedad Venezolana de Architectos (SVA).

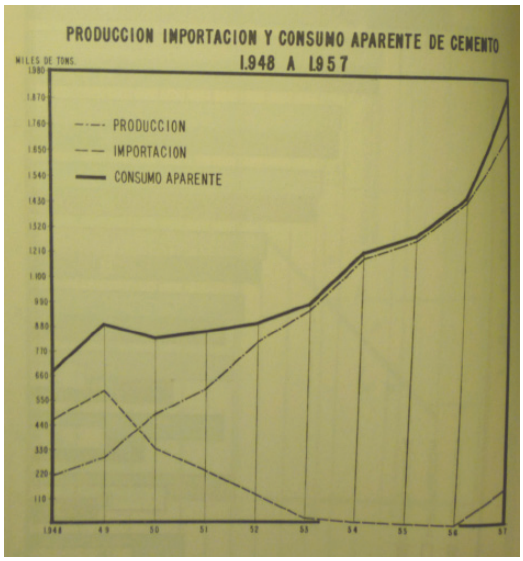
Caracas is all the sudden thrown in a big economic boom started in 1940 when the oil industry represent 94%of the exportation, overthrowing the historical first position of the coffee industry.

This boom leads so many foreign investment and investors, and only in the decade 1941-1950 Caracas has a demographic increase of 31%. This is consequently translated in a strong demand of housing. This migration created the rancho (slum) belt of the valley of Caracas registering in the years '45-58 the highest construction rate of the Venezuelan history. It was strongly believed that by improving the life conditions, the education level and the habit of the citizens a new democratic society would have be built (cfr. Azier Calzo Albizu p. 560)

3. Modernism and the role played by the new materials and building techniques

" Architecture is, 'par excellence', a social act, utilitarian art, as a projection of life itself, linked not only to rules of style but to economic and social problems", these words state Villanueva acknowledgment and social awareness of the technological development. Villanueva was aware of the possibilities of the new materials and in his work he combined his western references (such as Perret) with elements typical of Latin-America.

Therefore a great role in the new Modernist forms pursuit in these years are mostly represented by changes in construction techniques. Looking for both, resistance capacity an construction facility, new materials such as reinforced concrete and steel sections suited these needs. Reinforced concrete became more available after the opening of the Planta Nacional de Cementos in 1907. The production keeps growing until 1957, when Venezuela becomes the 6th country in the concrete industry. By then Venezuela had seven concrete companies. Only in the period between 1948 and 1957 the national production increases of the 814%. In this year we can see that the production covers 99,9% of the national consume (cfr. El Concreto de Obra limpia en la arquitectura venezolana).



This material introduced new challenges in the construction process due to its fluid condition which allows to pour the mixture in different formworks. Another advantage was the capability to absorb tensile stress, in addition to the compressive stress only supported by other materials used in the structures. The needs of more simple designs, construction and maintenance well suited the new forms of the Modernist movement and were supported by a developing mass production and prefabrication industry. This was a mean to satisfy the urging demand for quantity and which made possible such a fast construction process solving the housing deficit.

4. A synthesis: the Ciudad Universitaria

Education, meant both as learning process and infrastructure, is one of the lacks of the Gomez government which Medina tries to overcome. Therefore decree n.408 of September '46 states a new University reform which requires the creation of a new University pole.

Villanueva which is in the mean while become the "State architect" through big projects such "El Silencio" is engaged in 1944 for the realization of the Ciudad Universidad, which is part of a series of major interventions. The Ciudad can be remarked for four main points:

1- vehicles and pedestrians have well defined paths and this allows them to coexist. The Lecorbusieran plan of isolated blocks separated by green are adapted to a more human scale and covered passages are incorporated to proportion the intersections.
2- The modernization of elements considered typologically traditional of the colonial architecture
3- The project becomes an opened air laboratory to experience the new forms and building techniques allowed by the ductility of the reinforced concrete.
4- The synthesis between art and architecture.

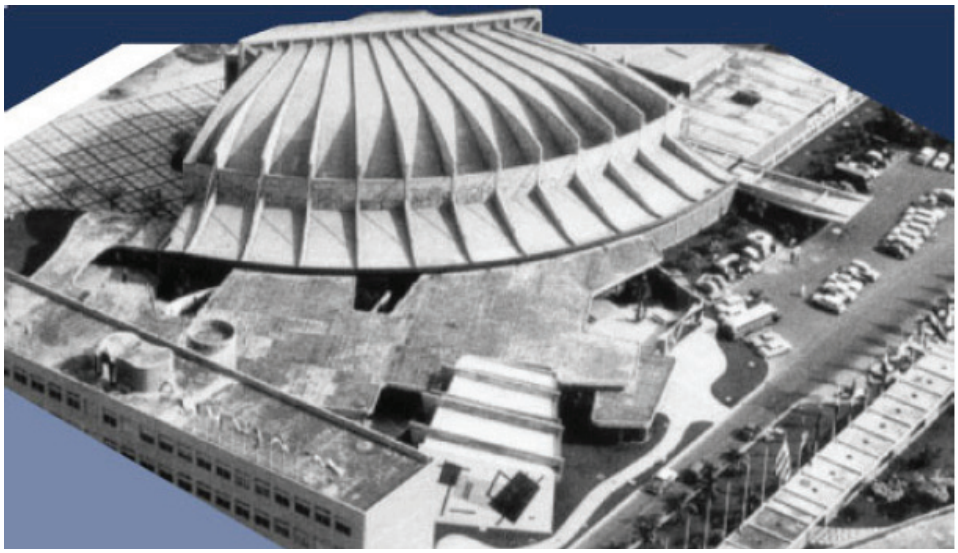
The observation of the plastic elements of the colonial architecture, adapted to the possibilities and needs of the locus and the population, the sobriety and rationality in the use of materials and technologies bounded to the climate and light gave very importance to the role played by the walls, balconies, patios and corridors in the creating of common and shaded areas in an human scale.

A functionalist and rationalist view of architecture leads Villanueva to an honest and noble use of material and technology, resulting in an absolute coherence between the container and the contained.

The Ciudad Universitaria becomes so a rich example of Villanueva's tectonic expression. A leading role has the use of concrete as a malleable material, capable of satisfying the free development of the bea¬ring skeleton form, capable of satisfying the free development of the bearing skeleton form. The emphasis on structure entailed the consolidation of the constructive techniques related to the reinfor¬ced concrete (cfr. Paulina Villanueva p.56).

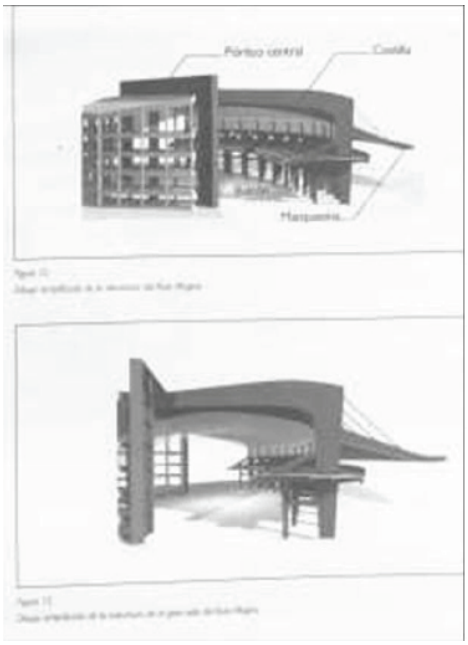
6. In detail: the tectonic expression of the Aula Magna

The Aula Magna Hall is a true architectural, sculptural, and human space., which summarizes the tectonic character of Villanueva's production. "The Aula Magna is a space to be discovered, strongly protected by the structure that acts as its skeleton, sustains it wi¬thout intrusion, and guards an interior of immense and finely tuned resonances".



This is the largest and the most important of the uni¬versity's fifteen auditoriums. The wide, fan-shaped floor plan has seating capacity for more than 2,500 people between the orchestra stalls and the interior balcony that sweeps over them.

The Aula Ma¬gna is connected to the Covered Plaza by a system of double doors between the hall and the vestibule area, and by a large circular cor¬ridor with two pairs of ramps leading up to the exterior balcony. This large, curved arc together with the cantilevered roof that covers this area is connected to that of the plaza, leading a line of light over the modelled concrete surface of the roof. The light and shadow that project over both the surfaces and the people create a space of mo¬vement and an atmospheric sculpture made of emptiness and tran¬sparencies. The roof has a twelve inverted-L columns with a 45-me¬ter spans that lean on a large structural frame with the "drawing" of the exposed structure showing on the beams and the side walls.



The height of the beam in the central frame is 5.5 m all along the horizontal section. The sec¬tion of 5.5 m is preserved in the two vertical columns that com¬plete the frame, profiting from this geometry as it gives stability to the whole. This central fra¬me, 49.2m wide 38 m of free span is, on one side, the support for twelve beams of the cover of the great hall and, on the other side, of the eleven beams of the stage roof. The vertical columns are responsible for transmitting great part of the load from the roofs to the foundations. The total height of the central frame is 26.59m, allowing the height at the front of the stage to be 21.09m.

From one side of this spine derives the ribs that form the roof of the great central space and the marquee and, on the opposite side, those beams that form the roof of the stage. The first set of the ribs make up the fan that opens towards the exterior surface of the roof and that transforms this building into the focal point of aerial views of Ciudad Universitaria. These twelve ribs are suppor-ted, on the end by the central frame previously described and on the other end by twelve columns that define the entrance to the Aula Magna. The beams that are part of this side of the ribcage are of variable sections, which can be explained by the diverse stresses they undergo. Each rib must be considered as a beam of a single span of 36m, supported at its ends. In terms of stress, this translate into a maximum bending moment at the middle and a smaller fixed moments at the supports. On the other hand, at the end, the beam has been used to support the cantilevered marquee. Responding to the stress diagram, the geometry of the ribs is as follow: smaller section on the far end where it meets the central frame and where the negative bending is smaller; bigger, towards the middle section, where the positive bending moment takes place up to the maximum section when it reaches the en¬trance columns where, in addition to the bearing stress, it also has to undertake that of the cables of the marquee.

It was conceived as a large cantilever with a span of 14 meters, composed by twelve beams of variable section with a maximum height of 1.80m at the point where it reaches the columns at the entrance, where the maximum bending moment occurs, down to 0.6m in the free end, where the bending moment is usually mini¬mum. The demanding flexure that these beams

undergo requires an intermediate support, which has been solved by the group of cables anchors at the core of the beam.

The structure of this building, responds with solidarity to the intention of liberation shown in its urban proposal. This is confirmed by the risks taken when solving the long spans, clearly expressing the planes chosen for the tra¬jectory of the forces and reaffirmed by the decision of lea¬ving most of the bearing elements in sight. The brutalist treatment given to the reinforced concrete reaffirms the constructive language uses at the Ciudad Universitaria.

The supporting elements express two attitudes: com¬mitment to urban space and commitment to interior space. "The Aula Magna is conceived in a definitely plastic way and not as a simple bearing skeleton upon which the form rests" (Nino Araque,2000). The struc¬ture is liberated from the traditional hierarchies, giving certain autonomy to the bearing elements. The system can be divided into simples and statically defined sub¬systems. In the exterior, we observe the great central frame, the roof of the space with long spans, the mar¬quee, the supposrt of the stage and its facilities and the skeleton frames. In the interior there is a large balcony and the structure that allows Calder's flying clouds.

The central frame that circles the Aula Magna has its structural-formal point of reference in the wide flange beams where the mass of the material concentra¬tes in the ends (wings) and decreases in the central zone (core), resembling the form of an I section, typical of the steel structures; even if conceived in reinforced concrete. Its geometry and behaviour cor¬responds to the Vierendeel beam, where the parts undergo bending stress and are all made of rein¬forced concrete. These beams need larger sections than those requires by trusses and, although the Vie¬rendeel beam is less efficient than the latter, it com¬plies better with Villanueva's aesthetic aspiration. (cfr.

Conclusions.

"Today's' greatest reformers support a functional architecture, in other words, an architecture that knows how to use with logic and intelligence the materials of each region and, at the same time, makes each one of these materials perform a role and a function perfectly determined in the architectonic overall". These words of Villanueva perfectly synthesis his intent in the creation of a new architecture which reached his best expression in the University campus.

However the Modernist forms become only a mean to state the power and the modernization process of a new emerging nation, which didn't want to be left behind. The use of the new materials such as steel and reinforced concrete responded more to reasons of availability of cement which since 1907 was produced in this country, and to the advantages that the moulding capacity of this material offers than rather to its resistant characteristics. Such a dialogue between the bearing system and architectural space could probably have been also affirmed with other material. However at this time prefabrication and pre-stressed concrete were already commonly used in the construction of bridges, viaducts and other works of infrastructure. Therefore the use of this material was perfectly compatible with the economy and interests of the time and offered the possibility to build works of great breadth, consolidating the resistance of constructors to use new methods more compatible with industrialization.

Bibliography

Azier Calzo Albizu, "Venezuela y el Problema de su identidad arquitectonica". Editorial Torino, Caracas 2007.

Banco Obrero , "Carlos Raùl Villanueva un moderno in Sudamerica". Galería de Arte Nacional, Caracas1999.

Sybyl Moholy Nagy, "Carlos Raùl Villanueva". A.Tiranti, London 1964.

Paulina Villanueva, "Carlos Raùl Villanueva" . Logos, Modena 2000.

"El Concreto de Obra limpia en la arquitectura venezolana ". Asociacion venezolana de productores de cementos, 1970

Nancy Dembo, "La tectonica en la obra de Carlos Raùl Villanueva: aproximacion en tres tiempo ". Universidad Central de Venezuela, Caracas 2006.

5 References and Annex

Bibliography

1a. Introduction. Modernity, Culture and Technique in Architecture

- Berman, Marshall. All That Is Solid Melts into Air: The Experience of Modernity. Penguin, 1988. Chap V.1. Roberto Moses: The expressway world.

- Behrens, Peter. Kunst und Technik. Elektrotechnische Zeitschrift, 1910, 22, pp. 552 - 555.

- Conrads, Ullrich. Programs and Manifestoes on 20th-Century Architecture. Boston: The MIT Press, 1975. Graeff: The new engineer is coming,

- Ellul, Jacques. The technological Society. Ch 5 Human techniques, Part 1 Necessities, pp 319 - 343.

- Frampton, Kenneth: Modern architecture: a critical history. London: Thames and Hudson, 1980. Part I. Cultural developments and predisposing techniques 1750 – 1939, pp. 12 – 41.

- Latour, Bruno. We have never been modern. Boston: Harvard University Press, 1993. Chap. 3.1 The Moderns, victims of their own success to 3.8 The revolutionary miracle. pp49-73

- Giedion, Sigfried. Mechanization takes command: a contribution to anonymous history. New York: Oxford Univ. Pr., 1948. Part VI Mechanization encounters the household, pp 512 – 547.

- Weihe, Carl. Franz Reuleaux und seine Kinematik. Mit e. Aufsatz "Kultur u. Technik" v. F.Reuleaux. Berlin: Springer, 1925.

1b Introduction. Latin American Modernism

- Bullrich, Francisco. Arquitectura latinoamericana 1930-1970. Buenos Aires: Sudamericana, 1969.

- Eliash, Humberto and Moreno, Manuel. Arquitectura y modernidad en Chile / 1925 -1965: una realidad múltiple. Santiago de Chile: Ediciones P. Universidad Católica de Chile, 1989.

- Hitchcock, Henry Russell. Latin American architecture since 1945. New York: Museum of Modern Art, 1955.

- Liernur, Jorge Francisco. Arquitectura en la Argentina del siglo XX: la construcción de la modernidad. Buenos Aires: Fondo Nacional de las Artes, 2001. Introducción.

2. Technology in a Critical Perspective

- Eric Raymond, Eric. The Cathedral and the Bazaar. First Monday v3n3 http://www.first-monday.dk/issues/issue3_3/raymond/

- Law, John and Hetherington, Kevin. Materialities, Spatialities, Globalities. Available at http://www.lancs.ac.uk/fass/sociology/research/resalph.htm

- Pinch, T. J., & Bijker, W. E. (1984). The Social Construction of Facts and Artifacts: or How the Sociology of Science and the Sociology of Technology might Benefit Each Other. Social Studies of Science, 14, 388 - 441.

- Schivelbusch, Wolfgang. The Railway Journey: The Industrialization of Time and Space in the 19th Century. 1977. Chapters 2, 7-9.

- Kenneth Frampton. Techno-science and Environmental Culture: A Provisional Critique Journal of Architectural Education 54, issue 3, February 2001 pp 123-129

- Steven A. Moore. Technology, Place, and the Nonmodern Thesis. Journal of Architectural Education 54, issue 3, February 2001 pp p 130-139.

- Simon Guy, Graham Farmer. Reinterpreting Sustainable Architecture: The Place of Technology Journal of Architectural Education 54, issue 3, February 2001 p 140-148

- Peter Galison. War against the center. In: Architecture and the sciences, exchanging metaphors. Picon and Ponte, Editors. Princeton Architectural Press, 2003.

- Antoine Picon. UNE UTOPIE AMERICAINE, LE MONDE DE BUCKMINSTER FULLER.
http://www.gsd.harvard.edu/people/faculty/picon/fullerutopie.html

3. Modernity, global and local perspectives and processes of appropriation

- Frampton, Kenneth. Prospects for a Critical regionalism. Perspecta, Vol. 20 (1983), pp. 147-162.

- Herrle and Wegerhoff (Eds.) Architecture and Identity. Schriften der Habitat Unit, Fakultät VI Planen Bauen Umwelt der TU Berlin. Berlin: LIT Verlag, 2008.

- Law, John and Hetherington, Kevin. Materialities, Spatialities, Globalities. Available at http://www.lancs.ac.uk/fass/sociology/research/resalph.htm

- Lefaivre, Liane and Tzonis, Alexander. Critical Regionalism: Architecture and Identity in a Globalised World. Munich: Prestel, 2003.

- Tzonis, Alexander. The never ending Challenge if Regionalism [lecture given at the University of Cordoba, March, 2005]. (Available at http://www.tzonis.com/Bibliography/text_the_never_ending_challenge.htm)

4. Tectonics, Structures and Systems: A critical core for architecture

- Ábalos, Iñaki, Herreros, Juan. Tower and office: from modernist theory to contemporary practice. (Revised edition of Spanish original). Cambridge, Mass.: MIT Press, 2003. Chs. 2 Structural development, 3 Evolution of Glass Curtain Wall Construction or 4 The mechanically regulated environment (…).

- Frampton, Kenneth. Studies in tectonic culture: the poetics of construction in nineteenth and twentieth century architecture. Chicago: Graham Foundation for Advanced Studies in the Fine Arts, 1996. Ch 1 reflections on the scope of tectonics, pp 1 - 28.

- Thomson, Emily. Listening to/for modernity: Architectural Acoustics and the development of Modern Spaces in America. In: The Architecture of Science. Peter Galison, Emily Thompson (Eds.). Cambridge, Mass.: MIT Press 1999.

- Banham, Reyner: The architecture of the well-tempered environment. London: Architectural Press, 1984. Ch 7 The environment of the machine aesthetic, pp. 122 - 142

- Fernández-Galiano, Luis. Fire and memory: on architecture and energy. Cambridge, Mass. MIT Press, 2000. Ch 7. Thermal space in Architecture, pp. 212 – 256.

5. Writing and Research Methods in Architecture

- Prof. Dr. Birgitta Wolff. Guidelines for Academic Paper Writing. Available at http://www.ww.uni-magdeburg.de/bwl2/pruefungen/IM-paper-writing.pdf

- Williams, Joseph. Style: Toward Clarity and Grace. Chicago: University Of Chicago Press, 1995.

- Eco, Humberto. Wie man eine wissenschaftliche Abschlußarbeit schreibt: Doktor-, Diplom- und Magisterarbeit in den Geistes- und Sozialwissenschaften. Heidelberg: Müller, 1990.

- Booth, Williams, Colomb. The Craft of Research. Chicago: University of Chicago Press, 2003.

- Groat, Linda: Architectural research methods. Chichester: Wiley, 2001.

- Borden, Iain. The Dissertation: An Architecture Student's Handbook. Elsevier, Oxford; 2nd ed. June 2006.

Case Studies

- Eladio Dieste / Remo Pedreschi. The engineer's contribution to contemporary architecture. London: Telford; RIBA Publ., 2000.

- Eladio Dieste / Stanford Anderson. Innovation in Structural Art. S. O. Anderson (Ed.). New York, NY: Princeton Architectural Press, 2004.

- Die Kunst der Schale, Bewehrte Ziegelschalen des uruguayischen Bauingenieurs Eladio Dieste, Entwicklungen und Versuche. In: db: Lateinamerika, 2/1995. Pages120–129.

- Dieste., Eladio. Eladio Dieste : 1943 - 1996Sevilla : Junta de Andalucía, Consejería de Obras Públicas y Transportes, 2001

- Latorraca,Giancarlo (Ed.). João Filguéiras Lima - Lelé. Lisboa: Ed. Blau; São Paulo: Inst. Lina Bo e P. M. Bardi, 2000.

- Nobre, Ana Luiza João Filgueiras Lima: arquitetura como processo. Available at http://www.vitruvius.com.br/ac/ac016/ac016_1.asp

- Perén Montero, Jorge Isaac Ventilação e iluminação naturais na obra de João Filgueiras Lima, Lelé: estudo dos hospitais da rede Sarah Kubitschek Fortaleza e Rio de Janeiro. Escola de Engenharia de São Carlos (EESC) Iuniversiodade de Sao Paulo, 2006 Available at http://www.teses.usp.br/teses/disponiveis/18/18141/tde-12032007-225829/

- Catalano, Eduardo / Gubitosi, Camillo. Eduardo Catalano buildings and projects; mostra d'architettura organizzata dall'Istituto di Analisi Architettonica, Napoli febbraio 1978 a cura di Camillo Subitosi. Roma: Officina, 1978.

- Catalano, Eduardo. Estructuras de superficies alabeadas: combinaciones de paraboloides hiperbólicos. Buenos Aires: EUDEBA, 1962.

- Catalano, Eduardo. La Constante. Buenos Aires: Eudeba, 1996

- Villanueva, Carlos Raúl / Villanueva, Paulina. Carlos Raúl Villanueva. [Engl. transl. by Gavin Powell]. Basel; Boston; Berlin: Birkhäuser, 2000.

- Villanueva, Carlos Raúl / Moholy-Nagy, Sibyl. Carlos Raúl Villanueva und die Architektur Venezuelas. Stuttgart Hatje Verlag, 1964.

- Dembo, Nancy. La tectónica en la obra de Carlos Raúl Villanueva: aproximación en tres tiempos. Caracas: Univ. Central de Venezuela, 2005.

- Testa, Clorindo / Nederlands Architectuurinstituut Rotterdam. Clorindo Testa, architect: on the occasion of the exhibition of Clorindo Testa, held at the Netherlands Architecture Institute in Rotterdam from 15 September - 5 November 2000. Rotterdam: NAi Publishers, 2000.

- Sánchez Elia, Santiago: Sánchez Elia, Peralta Ramos, Agostini y Clorindo Testa, Banco de Londres y América del Sud, casa central, Buenos Aires, Argentina, 1959 - 66 / text by Jorge Glusberg. Tokyo: A.D.A. Ed., 1984. Global architecture 65

- Testa, Clorindo and Glusberg, Jorge. Hacia una arquitectura topológica. Lima: Espacio Ed., 1977.

- Williams, Amancio / Jorge Silvetti, Ed. Amancio Williams: published in connection with an exhibition of work by Amancio Williams at the Gund Hall Gallery, Fall 1987. New York: Rizzoli, 1987

- Merro Johnston, Daniel. El autor y el intérprete Le Corbusier y Amancio Willliams en la Casa Curutchet. Available at http://www.cafedelasciudades.com.ar/arquitectura_57.htm

- Williams, Claudio. Amancio Williams. Buenos Aires: Archivo Amancio Williams, 1990.

- Cinco proyectos del arq. Amancio Williams. Buenos Aires: Facultad de Arquitectura, Univ., 1955