
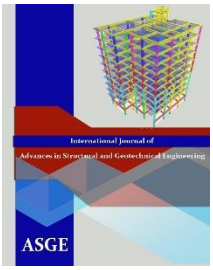


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# *CONTRIBUTION TO THE STUDY OF THE ARCHITECTURAL IMPACT BETWEEN THE ANCIENT WORK AND THAT OF THE 21ST CENTURY: STRUCTURAL ANALYSIS*

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# CONTRIBUTION TO THE STUDY OF THE ARCHITECTURAL IMPACT BETWEEN THE ANCIENT WORK AND THAT OF THE 21ST CENTURY: STRUCTURAL ANALYSIS

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## ABSTRACT

In this work we pinpoint the indicators of the impact during the history of the construction of buildings, in the face of the evolution of the challenges in the coupling of art, civil engineering, urbanism and architecture compared to the ecosystem. Many churches, cathedrals, castles and lodgings, whose relevance and the quintessence of knowledge reservable by these predecessors, cause a questioning with the trivialization of current computers, be the subject of a new look . In the following we demonstrate: (i) The "Yakam Matrix" in ancient architecture, (ii) indicators of 21st century computer-aided architecture and (iii) numerical simulation and perspective of the developing architecture sustainable.

**Keywords:** Yakam Matrix, architectural modernization, colonial architecture, materials, energies, impact, structure.

## INTRODUCTION

The architectural construction activity is very old and its evolution has accelerated, which has given rise to new directions whose impacts and more complex demands are much more urgent. The global competitiveness and development of nations increasingly depend on duplicating, consuming and promoting knowledge and technologies. Architecture and Civil Engineering have been strongly influenced in all countries of the world (development or developing), and are catalysed by internal and dynamic complexities related to the environment and other global challenges. The age of carved and polished stones has evolved into industrialization and thus the prefabrication of materials and in the 21st century, Computer Aided Design (CAD), materialized by the significant development of predictive calculative tools to verify validity and control. This is why Max Scheler asserts that at the limit of ignorance, man has been as much a problem for himself as today. This paper introduces a brief repercussion of ancient architecture to that of the 21st century of some works and their structural analyzes in the interface "Yakam Matrix", its indications and numéral simulations of CAD (Computer Aided Drawing) in the sustainable architecture.

**YAKAM MATRIX**

The establishment of an architectural structure is a solid interacting with the atmospheric area under the effects of external forces, snow, wind and many other effects of airborne shock waves from aircraft and other craft or effects. seismic. This consists of a solid-gas surface ($I_{sg}$). The building is the subject of the actions of the architecture (*a*) and the civil people (engineer) and masons (*m*) hence the interface ($I_{am}$).
The architecture in the design must predict the interface of the social welfare (*s*) and environment (*e*) in an interface ($I_{se}$), that's why a matrix has been proposed

$$\tau = (I_{sg} \quad I_{am} \quad I_{se} \ldots) \qquad (1.1)$$

This matrix has been generalized using five (5) physical states of matter, solid (*s*), liquid (*l*), gas (*g*), plasma (*p*) and colloidal (*c*)? Where we have:

$$\tau = \begin{pmatrix} I_{ss} & I_{sl} & I_{sg} & I_{sp} & \ldots & I_{sc} \\ I_{ls} & I_{ll} & I_{lg} & I_{lp} & \ldots & I_{lc} \\ I_{gs} & I_{gl} & I_{gg} & I_{gp} & \ldots & I_{gc} \\ I_{ps} & I_{pl} & I_{pg} & I_{pp} & \ldots & I_{pc} \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\ I_{cs} & I_{cl} & I_{cg} & I_{cp} & \ldots & I_{cc} \end{pmatrix}$$

This is why the elements of the YAKAM matrix cover many aspects of architecture and civil engineering. Concrete is an interface between cement, water, iron, sand and pebbles :

$$I = \Omega_{ce} \cap \Omega_{wa} \cap \Omega_{ir} \cap \Omega_{sa} \cap \Omega_{pe}$$

Then the structure - fluid interaction phenomena of [A] are part of the vast class of coupled multi - physics problems of architecture, civil engineering and the environment. Although the structure and the fluid do not obey the same behavioral laws, but they interact in a coupled system, leads the aeration and the impact of natural conversion influenced by their efforts on the walls of ancient works and the 21st century are discussed, because the resistance applications of new buildings in SDO (Sustainable Development Objective) is a challenge. The technology of Egyptian pyramid construction is unknown in relation to the Towers (current skyscrapers of Los Angeles) because the hardness and forces exerted in Egypt seem durable and appropriate compared to the collapses of the 21st century.

## HISTORICAL ARCHITECTURAL AND STRUCTURAL ANALYSIS OF OLD BUILDINGS

The old buildings, like the new ones have in common as a basic element that is the point. Every point P defines in 1-D, 2-D and 3-D constitutes the foundation of the architecture, denoted P (Xi) or i ⟦P (X⟧ _i) or i = 1, n and we limit ourselves to n ≥ 3. The aligned points form a line or line segment. The set of straight lines forms a plane and the set of planes forms a volume or wall of the structure (Ω), which is why geometry allowed Friedrich Nietzsche to say that: "Architecture is a kind of oratory of power by means of forms "This oratory is not distinguished only by forms. But also by other factors that take into account the functionality, use and stability of structure. Some works expressing ancient power, which today remains legacies and sources of inspiration for the modern world. Straight lines, curves and surfaces translate and express an architectural potential that still raises unknown questions.

### Ancient works

Comparing the Ancient Theater of Orange of the 1st century BC and the Olympic Theater of Andrea Palladio, completed by Vincenzo Scamozzi in August 1580; Fig. 1 responds to smoothing curves while FIG. 2 by Sketchup.

**The Antique Theater of Orange**


Fig. 1 : Source :Adam Woolfitt/Corbis

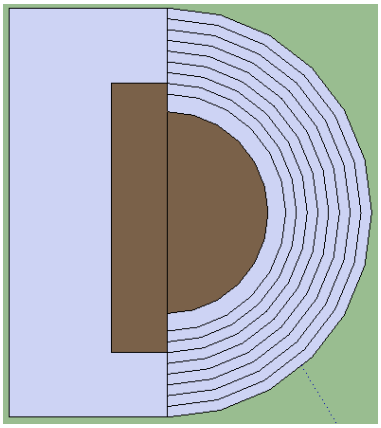


Fig. 2: Source : ShaloomMbambu

From the Roman era, Orange retains many vestiges, such as the theater, erected between the 1st century BC and the 1st century AD During the reign of Augustus, the facade, of a height of 37 meters, was added and the decorations (statues, niches, columns, pilasters) were later sculpted. Well preserved, this theater can accommodate up to 10,000 spectators in the stands. This is why fig. 3 shows "the scalar and the renovation of rights. "

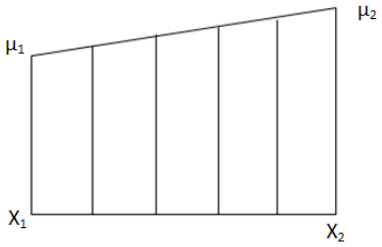
**Teatro Olimpico (Olympic Theater), Vicenza, Italy**

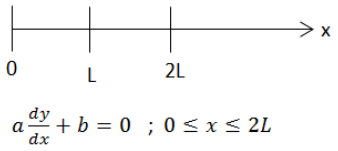

Ultimate work of Andrea Palladio, the TeatroOlimpico ("Olympic Theater") of Vicenza, Veneto, was completed by his disciple Vincenzo Scamozzi, in August 1580. Model of Renaissance theater, the building has a semi-theater -circular facing the stage. The interior walls of the building, in wood and stucco, are richly decorated with colonnades, cornices and statues. This richness of decoration becomes more absent in the 21st century, which exploits the finite elements.

The Torseur in architecture and civil engineering design is the basic element:

$$\{\tau_{(T\to S)}\} = \begin{cases} \vec{R}_{(T\to S)} = \sum_{i=1}^{n} \vec{p_i} = \vec{P} \\ \vec{M}_{A(T\to S)} = \sum_{i=1}^{n} \overrightarrow{(OL)_i} > \vec{p_i} \end{cases}$$

Where R is the resultant and M is the moment. Everything goes from a structure going from x1 and x2 from height 0 to 2L

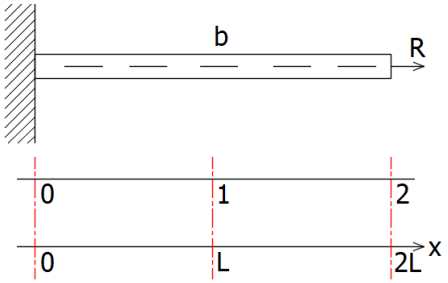



$$a\frac{dy}{dx} + b = 0 \quad ; \; 0 \le x \le 2L$$

Confers the conditions at the borders. The beam beam generalized by:

$$a\frac{dy}{dx}; x = 2L \to R \quad \text{or} \quad u = N_1u_1 + N_2u_2 = [N]\{u\}$$
$$[N] = [N_1N_2]$$
$$\{u\} = \{u_1u_2\}$$




With the nodes, this is why the linear equation with the differential computer equation (EDO) justifies the existence of a unique solution in civil engineering.

$$N_1 = 1 - \frac{x - x_1}{x_2 - x_1} \quad \text{et} \quad N_2 = \frac{x - x_1}{x_2 - x_1}$$

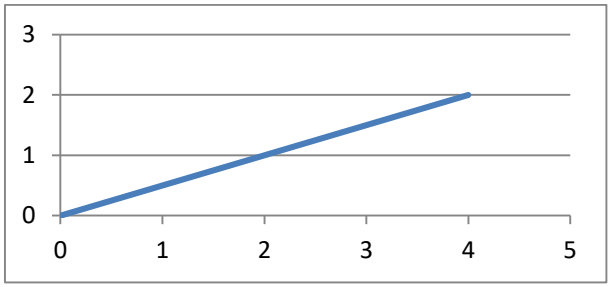
$$a\frac{d^2}{dx^2}[N]\{u\} + b = \varphi$$

$$\int_{x_1}^{x_2} [N]^T \, a\frac{d^2}{dx^2}[N]\{u\}dx + \int_{x_1}^{x_2} [N]^T b dx = 0$$

The calculus gives:

$$\int_{x_2}^{x_2} \left[\frac{dN}{dx}\right]^T a\left[\frac{dN}{dx}\right]dx\{u\} - \int_{x_1}^{x_2} [N]\, bdx - \begin{Bmatrix}0\\1\end{Bmatrix} a\left.\frac{du}{dx}\right|_{x=x_2} + \begin{Bmatrix}1\\0\end{Bmatrix} a\left.\frac{du}{dx}\right|_{x=x_1} = 0$$

This gives us the comparison of the old and the new which applies finite element methods.




$$\frac{a}{L}\begin{bmatrix}1 & 0 & 0\\ 0 & 2 & -1\\ 0 & -1 & 1\end{bmatrix}\begin{Bmatrix}u_1\\u_2\\u_3\end{Bmatrix} = \frac{bL}{2}\begin{Bmatrix}0\\2\\1\end{Bmatrix} + \begin{Bmatrix}0\\0\\R\end{Bmatrix}$$

In ancient Greece, the theater was primarily a religious building. Built on a hillside, the Greek theater has a very simple structure: steps (in Greek kôilon) are spread out in a semicircle around a circular space (in Greek orkhêstra), for the altar of Dionysus, around which is the choir located in front of the stage. The theater of Epidaurus, one of the most perfect, can accommodate up to twenty thousand spectators (20 000).

The Roman Theater does not appear until 1st century BC. AD Located near the forum, it consists of steps (*cavea*) supported by tiered galleries. The stands are themselves divided, divided according to social classes, and separated from the scene (*pulpitum*) by a wall. The scene has a permanent decor (*fronsscaenae*), a high facade carved with niches and colonnades, of which the city of Orange has a very fine example.

**Works of the middle Ages**

In the Middle Ages were developed religious themes (passions) that took place on the forecourt of churches. Gradually, these performances were enriched by secular elements and representations moved on the public squares. The theatrical space was then reduced to an arranged trolley, or, in the best case, platforms on trestles, with a stage frame for the actors, recessed on three sides, and boxes for public defining his place in front of the stage. It was towards the end of the 16th century that the real buildings reserved for theatrical performances appeared in Europe, and at that time the tradition of Italian theater took hold.

We see here that the Orange Theater was considered primarily as a religious building, and it is towards the end of the 16th century, that we find the appropriate buildings for theaters called amphitheaters with the imposition of the theater to the theater. Italian. This brings us to see the impact or the influence that the new architecture undergoes the old one, but the contemporary architecture strongly innovated with the discovery of the new materials (concrete, glass, steel ...) and the sustainable architecture with renewable energies in buildings. Today, several factors come into play when talking about comfort.

So, how do we approach the city, the urban environment? The management of "nature in the city", waste, water has long proved a necessity, but other, even more specific, themes can not be neglected because they now contribute without a doubt to the notion of urban environment: travel and transport, urbanism and architecture, historical and built heritage, air quality, living environment, gardening, aesthetics and urban art, without forgetting industrial risks and noise.

The important thing is not all of the above-mentioned themes: in reality, each one of them is a thread to draw that makes it possible to make young people aware of the stakes, the evolutions, the interrelations, the knowledge of the city and the genius in all its complexity.

This is where the philosophy of "*Yakam Matrix*", which is an interface of all states and several components, comes into play. It is the object and center of a circle that integrates a number of disciplines as a whole in order to achieve a reliable and durable result.

**Cathedral of Brasilia, Brazil (contemporary work)**

Fig. 4 and 5 illustrate the exterior and interior perspective of the Brasilia Cathedral.

fig. 4 : outside perspective of the cathedral

fig. 5 : inner perspective of the cathedral

The Cathedral of Brasilia is located between a residential area and the administrative sector of the Brazilian capital. Designed by architect Oscar Niemeyer in 1958, it has become a landmark of the new city and contemporary religious architecture.

The tower separated from the body of the building, gives the whole an air of sobriety, elegance and lightness. The cathedral, properly speaking underground, reveals only its dome on the outside. Inside, the stained glass windows of the artist Marianne Peretti diffuse a colored light and accentuate the effect of transparency of the building. "Reinforced concrete allows the architect who has the sense of poetry to express himself. The cathedral adorned with 16 curved columns, Its underground entrance is guarded by four imposing statues. This building is 40 meters high and up to 4000 people.

The building's base is circular in shape and approximately 60 m in diameter. His companion glass, roof begins on the ground and has the support of curved columns. Its circular structure prevents the existence of a facade. His boat was sunk more than 70 meters in diameter, despite the longitudinal-circular floor of the cathedral. The interior is decorated with stained glass windows.

Its hyperboloid structure is concrete and seems that with its glass roof will be held in open air, its structure was completed on May 31, 1970 and is based on the hyperboloid, where the sections are asymmetrical. This hyperboloid is the result of 16 columns that weigh 90 tons.

The development of an architectural project consists in composing a whole with an incalculable number of constraints. Among them, ecological concerns are expected to occupy a growing share and it is becoming more and more obvious that they should be integrated if possible globally and from the beginning. If natural light and ambient comfort are among the priorities in the project and at the same time minimum energy requirements are required for both construction and operation, then the architects will be subject to multiple constraints. levels. But this problem is not without evoking also one of the leitmotif of modernity, namely the requirement of light, air and sun, which is a timely news welcome.

**African architecture**

African architecture is marked by tropical and ecological buildings that respect the climate. We show in this part the three (3) works: DR Congo, Ivory Coast and Burkina-Faso.

**Old Lubumbashi Theater (Yenga Group Architects, Claude Strebelle, 1953-1961), now the seat of the parliament**

© Yves Robert

The interest of some African leaders in the field of architecture and regional planning in the colonial legacy is based on the technical value they attach to this building in terms of climate adaptation.

The administrative dimension symbolizes in modern nations the sovereign role of the state in legislation. The value of heritage refers to society's desire for a responsible attitude of the state in terms of heritage, through the establishment of a specific management of this matter (legal status of heritage). In the context of the "DRC", the political and economic realities of the country contradict the work of the National Commission of Historic Sites and Monuments, and its members, very concerned by these issues, would be eager for a renovation of the legal framework in matters heritage protection, in order to bring it up to international standards sometimes already applied in Africa (Senegal, Ghana, etc.).

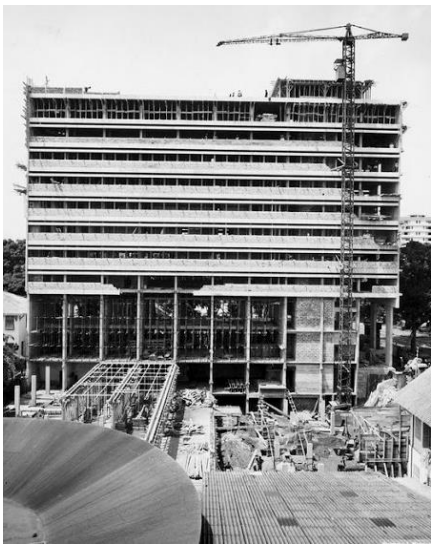
**Headquarters of Société Générale of Côte d'Ivoire, 1965**

In this building, Henri Chomette develops the five points of the new architecture (Le Corbusier)


Source : Pierre Chomette

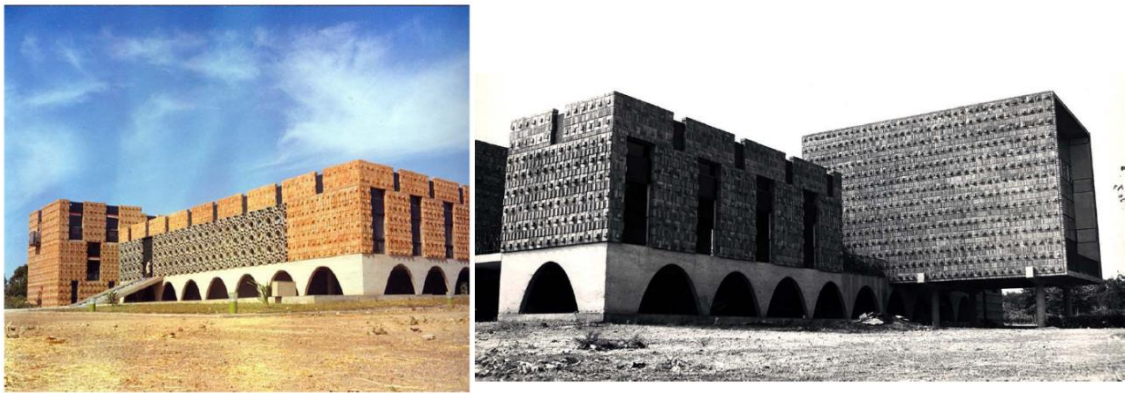
To make the state of the art about the work of Henri Chomette, returns to make the observation of a recurrent ignorance. His works are rarely mentioned and even more rarely analyzed, although they have profoundly influenced contemporary African architecture. In the 1990s (Let's talk about the headquarters of the Société Générale of Côte d'Ivoire inaugurated in 1965 in Abidjan, archives of the BEHC).

With its intricate lattice structure at the 2nd level, it gives the impression of having hands that support the building.



In an article entitled "Haile Selassie's Imperial Modernity: Expatriate Architects and the Shaping of Addis Ababa" published in the Journal of the Society of Architectural Historians in December 2016, Ayala Levin analyzes the involvement of architects and rangers in the urban modernization of Addis Ababa. Abeba wanted by Negus Haile Selassie I. Two Ethiopian buildings by Henri Chomette are briefly commented on to be compared with the works of Italian architect Arturo Mezzedimi (1922-2010) 7 and Z. Enav & M. Tedros, Architects and Town-Planners8. Far from being a first study of the Ethiopian work of Henri Chomette. This building allows for contextualization and reflects recent interest in 20th century architecture, urbanism and civil engineering.

**Residence of France built in 1966 in Ouagadougou in Upper Volta, Burkina Faso**



Source : Pierre Chomette

The BEHCs were thus the theater of close local collaborations, with regard to both the men and the techniques: Refusing to be the building's paperwork, they drew the formwork with the carpenters, paired the bricks, treated the aggregates, assembled the mosaics, molded the bronze with the founders, implanted on the ground their plans of urbanism. Their production shows that renewing with the tradition of the builders, they escaped the scleroses of the speculation and that the leaven of the architecture was well mixed with the dough of the building.

As Chomette reminded us, the use of local materials made it possible to take into account the way of life, to maintain or create jobs, to build local structures, but also to save money: With this local workforce ten years later, in Côte d'Ivoire as well as in France, granite, brick, exposed concrete, wood, metalwork, etc. we're being built as well, and sometimes better. The architects on site and their job, provoked an emulation between companies. They have accepted, in a healthy emulation, to play the game. They have trained the local workforce, induces a real development.

**Tab. 1.Comparative table of old and modern works**

| | Old buildings | Modern buildings |
|---|---|---|
| Shape and volume | Square, rectangle, circular or half circle, cube. | Circular, rectangle, square, cube, sphere |
| Structure | was made in blocks or cut stones | In concrete, steel ... |
| Elevation | Massive facades with small bays | Free facades, large openings with curtain walls, filling varies according to the use or the aesthetics of the building |
| Manpower | Manual and traditional way but with a precise and fast construction | Advanced with machinery and equipment for the transport of materials and prefabricated elements |

This table shows the structural and architectural difference between the old buildings and those of the contemporary.

## ENVIRONMENT

Today, we start asking the question differently. Besides pollutions, urban nuisances (air, noise, waste) or the management of elements of nature, heritage, ... other findings are there: "unsuitability of the city", "uprooting", "place of solitude ".

Environmental problems join social issues: solidarity, respect for others and the environment, individual and collective responsibility, in short, citizenship. These are the issues of an environmental education. "Architecture is to move, construction is to hold", it is said, without the intervention of the Engineer, architecture would be an unexpressed thought. Fifth century after, towards twentieth century, we see a strong evolution of religious building architecture with durable and light materials (glass by example).

The quest for light in architecture was to be motivated by the glass industries of the time who invested heavily in the research and development of new products for architecture and construction. The importance of alliances between European and American glassmakers, which ushered in the era of trade and technology transfer, is important. It was this collaboration that allowed the constant and rapid evolution of the glass industry in Western Europe and North America. Until the beginning of the 20th century, window glass was always manufactured in a traditional and manual way; the blowers formed a mouth-blown sleeve, which was then opened to give a flat glass sheet.

## CONCLUSION

Faced with the many challenges of sustainable development in sub-Saharan Africa and around the world, all the syntheses and reflections described in this book show how much training and knowledge of the various disciplines are a major issue, while the increasing standardization of comfort and ingenuity, the importance of an approach to education ignore the diversity and specificities of constraints and historical, social, cultural, economic, environmental and demographic contexts. MIES VAN DER ROHE says: "Architecture begins when you relate two bricks. This is where everything starts ».

- The ancient and 21st century architecture have the lieus communions on the basis of geometric elements; straight stitches, short, planes and volumes;

- The evolution of materials began with the Age of Cut Stone, the Iron Age and currently composites (such as iron, cement and pebble);

- The architectural impact has many indicators that we classify into three types.

    - Architecture and urbanism that have a philosopher of the well-being of all humanity in global warming in environment and challenge.

    - Antiquity and the 21st century posed the open question of the energy crisis over firewood, oil crisis and currently renewable and green energies to integrate in civil engineering architecture,

    - The economy with the development index contributes to deep inequalities between ancient and modern times to say that the more knowledge increases the more the normal problems recur, as solutions become the new issues.

The YAKAM matrix defines the interactions between architecture design, civil engineering and the environment.

## THANKS

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