INTO AFRICA: A COMPARISON OF THE METAL, PREFABRICATED STRUCTURES PROPOSED BY AUGUSTE CHOISY (1893) AND JEAN PROUVÉ (1949) FOR THE FRENCH COLONIES

HILARY BRYON
Virginia Tech

In 1949, French engineer and industrial designer Jean Prouvé (1901-1984) developed a housing prototype for the French colonies in West Africa. Three structures were produced and erected: one in Niamey, Niger in 1949 and two in Brazzaville, the Republic of Congo in 1951. The aluminum, prefabricated, modular structures were designed to be easily transported, assembled, and dis-assembled.

These former "maisons coloniales," now labeled Maisons Tropicales, have been much discussed, exhibited, and curated since their rediscovery and salvage from ruin in 2000.[1] The portrayals inevitably laud Prouvé's innovative and modern approach, yet the record of such industrialized advances precede Prouvé's proposal; there is at least one French precedent to Prouvé's design in the late 19th century.

In the early 1890's, French engineer and architectural historian Auguste Choisy (1841 - 1909) headed a team to develop a system of building construction for French colonies in tropical climates. The modular structures were partially prefabricated, framed with a light metal skeleton, easily transported, and quickly fabricated on site.

The similarities between Choisy's plans and Prouvé's prototypes are striking. Comparing the formal arrangements, constructive systems, and fabrication techniques of Choisy's colonial constructions and Prouvé's *Maisons Tropicales* proposed more than fifty years later reveals not only the limits of Prouvé's design innovations, but fittingly the legacy of this tectonic approach upheld within the broader lineage of French *constructeurs*.

CHOISY'S COLONIAL CONSTRUCTIONS

In 1889 the architectural historian and engineer Auguste Choisy was appointed Vice-President of the permanent council for Public Works

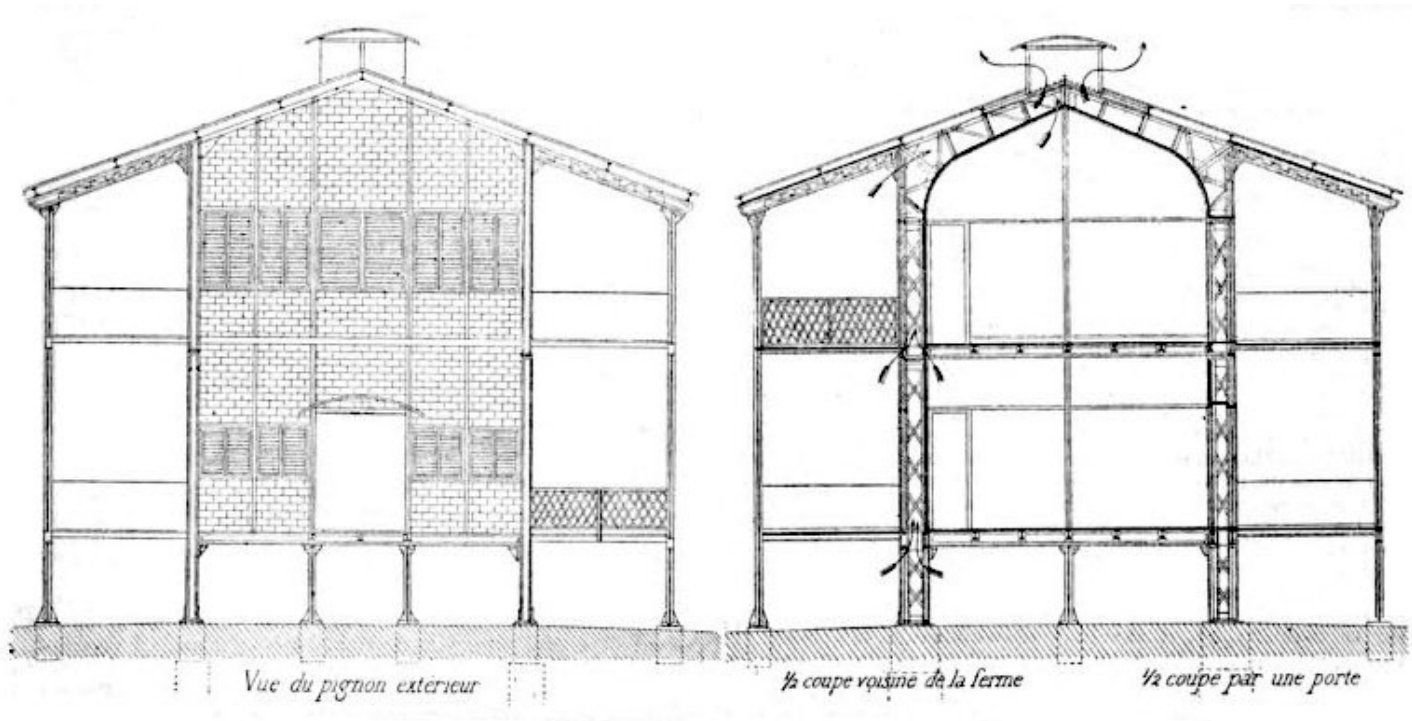

Figure 1. Elevation (left) and half-sections (right) of the Governor's administration building in Diégo-Suarez, Madagascar from "Constructions Civiles," *Le Génie Civil XXII* (1892), 21.

in the Colonies. The committee oversaw the quick construction of safe housing and other types of buildings for soldiers, administrators, settlers, and concessionaires in the first phase of colonization.[2] Under Choisy's direction, civil engineers Bernard and Labussière drew up plans for government buildings, hospitals, and prisons.[3]

Formal Principles

Choisy and his design team developed general rules to guide all building typologies for French colonial constructions. The formal strategies were primarily directed toward defense against tropical heat and humidity; they included: double partition walls, ridge vents tied to the open wall cavities, large verandas, high floor to ceiling heights, cross ventilation unimpaired by internal walls, and elevating buildings above the ground.[4] Other environmental factors further influenced the plans, particularly those relative to possible systems of construction or fabrication. It was necessary to address scarce or unskilled local labor; scarce, expensive, or poor quality material resources; rapid deterioration of wood; varied transportation means such as rail, ship, and road; and speed of fabrication--without compromising the overall quality of edifices that stood as representatives of French rule.

Construction System

A modular frame and fill construction system was developed to respond to these climactic and environmental factors. Choisy proposed a metal skeleton, prefabricated in France and transported to remote destinations as needed. This ensured rapid construction paired with high quality. De Dion trusses provided the primary vertical to horizontal structural system. To facilitate assembly, only bolts were used and to prevent damage in shipping, protrusions, such as angles and furring, were detached and packaged separately. Due to manual slave labor, the length and weight of the iron members were limited to 5 or 6 meters and no more than 300 kilograms (660 pounds).[5]

Choisy and his men argued that conceptually the most vital component of their system was the doubled partition walls; the depth of the structural skeleton of de Dion trusses easily allowed for separate interior and exterior in-fill facing materials while preserving a cavity for air circulation within.[6] (See Figure 1, right). Metallic partitions of iron or steel were contemplated but dismissed as metal's loss of heat by convection is minimal and its heat transmission by conduction and radiation is great.[7] Thus, the team proposed using enclosure materials that are nonconductive and non-radiating, and furthermore, that the exterior facing wall should be thicker than the interior facing wall. Brick was preferred due to its exceptional insulating properties.

On-Site Fabrication

Given the off-site, pre-fabricated frame, the building of the colonial constructions on-site proceeded quickly. The metal skeleton supported the roof and the cross-section of the de Dion truss system not only allowed for double walls, but also a double roof whose outer surface was finished with corrugated metal panels which were both light and spanned longer distances without a significant secondary support structure. The inner ceiling surface was finished with stucco or wood planking. Walls and floors were simplified to infill set within I or angle iron frames. In Madagascar, the outer side of the double walls were formed by single flat bricks (11 cm deep) while the inner walls of single field bricks, and the floors by an iron and wire mesh lattice covered by cement.[8] Precast, metal framed cement slabs were attempted but arrived from France too damaged. Even though late 19th century industrialized practices in France could produce many of the desired building components, the rough transportation network to remote tropical lands proved prohibitive. Nevertheless, Choisy's hybridized off-site, on-site solution, in which the precise structural frame facilitated construction using the resources available in each country and alleviated the necessity for skilled workers or even the highest quality materials, reflects a constructeur's approach that is paralleled by Jean Prouvé.

PROUVÉ'S COLONIAL HOUSES

In 1947, French designer Jean Prouvé was commissioned by the "French colonial authorities to design affordable, prefabricated housing for colonial officials in West Africa."[9] Prouvé had been experimenting with prefabricated structures from the late 1930's.

Prouvé's earliest housing prototypes consisted of steel framing with various infill materials. Indeed, his initial efforts closely parallel Choisy's frame and fill proposition. Prouvé investigated the typology in demountable barracks for the Corps of Engineers in 1939 and for the 6 x 6 meter vacation pavilions in 1940.[10] These structures were made of steel frames connected with sockets and cotter pins; the various enclosing materials included metal, stonework, wood, and fibrocement. Prouvé's prototypes took an innovative turn in West Africa when two unified forces demanded that his prefabricated designs address more lightweight solutions: air transportation and the developing aluminum industry.[11]

Formal Principles

Whereas Choisy's colonial buildings represented the French government, Prouvé's design work for Africa represented product development for the Aluminum Français company. In fact, the two buildings built in Brazzaville and connected by a walkway were the company's office and lodgings. Despite the novel use of aluminum in the three *maisons tropicales* erected in Africa, one can identify Prouvé's continued use of many formal principles also used by Choisy, namely: roof ridge venting, large verandahs, cross ventilation unimpaired by internal walls, and elevating the buildings above the ground. Such formal strategies follow from the shared demands of tropical heat and humidity. Other environmental limitations were also similar, such as scarce or unskilled local labor; scarce, expensive, or poor quality material resources, and

rapid deterioration of wood. The single most significant difference between the conditions of the late nineteenth century and mid twentieth century resided in transportation means, specifically air transport. Air travel allowed external resources to be more easily conveyed into the most remote locales and the airplane itself proved to be a model for lightweight, industrialized prefabrication techniques. Yet, despite these new measures, Prouvé's formal principles are not significantly differentiated from those of Choisy.

Construction System

Likewise, Prouvé's frame and fill construction system for his *maisons tropicales* made small adjustments to respond to the new mode of transportation and material. Similar to Choisy's approach, Prouvé developed a kit of parts with dimensional modularity, however there were other limits imposed by fully pre-fabricating the buildings in France. Transportation, material, and weight demands resulted in a more highly articulated and thorough level of standardization.

As in Choisy's colonial constructions, Prouvé used a structural steel frame, yet "all but the largest structural elements were aluminum. No piece longer than 4 meters, which corresponded to the capacity of the rolling machine, or heavier than 100 kilos, for handling by two men."[12] Furthermore, "everything was as flat as possible to fit efficiently in the hold of a cargo plane."[13]

ENDNOTES

1 Robert Rubin calls Prouvé's solution "highly original" and notes the house's "radical originality" in the Yale Exhibition Catalogue, *Jean Prouvé: A Tropical House,* February 14-May 6, 2005.
2 Charles Lucas, "Les Constructions Coloniales," *La Construction Moderne*, 12 Aout 1893, 533.
3 To see the plans for Choisy's different typologic solutions, reference: *Le Génie Civil* XXII, pp. 21-22, 41-43, 89-91, 176-178, 189-190, 410-412.
4 Bernard et Labussière, "Constructions Civiles," *Le Génie Civil* XXII (1892), 21.
5 Bernard et Labussière, "Constructions Civiles," *Le Génie Civil* XXII (1892), 22.
6 Henri de Dion developed the truss for the Galeries des *Machines* of the Universal Exposition in Paris in 1878. He eliminated the need for tie-rods by melding the principal rafters and the vertical supports with a circular connection arch. See Sigfrid Giedion's *Building in France, Building in Iron, Building in Ferro-Concrete*.
7 Bernard et Labussière, "Constructions Civiles," *Le Génie Civil* XXII (1892), 22.
8 Bernard et Labussière, "Constructions Civiles," *Le Génie Civil* XXII (1892), 22.
9 D.J. Huppatz, "Jean Prouvé's Maison Tropicale: The Poetics of the Colonial Object," *Design Issues* 26 (2010), 35. 10Olivier Cinqualbre , "Portable and Demountable Dwellings and Manufactured Homes Produced by the ateliers Jean Prouve", *Jean Prouve: La Maison tropicale*, 17-29.
11 Olivier Cinqualbre, "The Tropical House", *Jean Prouve: La Maison tropicale*, 32-33.
12 Robert Rubin, *Jean Prouvé: A Tropical House*, Yale: 2005, 4.
13 Robert Rubin, *Jean Prouvé: A Tropical House*, Yale: 2005, 4.