Wood in the architectural work of Jean Prouvé.
An industrial material

The architectural work of Jean Prouvé, however largely dominated by metal, counts a large number of buildings in which the wood material plays a significant role. If the use of wood by Jean Prouvé as an objects designer is well known, its use by Jean Prouvé as a builder is less published and yet deserves consideration.

In fact, we work on a corpus of buildings which illustrates his original way in a renewed use of the material, from the immediate post war until the mid-1960s. His work stands for an iconoclast and unclassifiable design, based on curiosity and inventiveness outside of preconceived architectural styles. It is historically very much ahead of those so-called ' pioneers of wooden architecture in France ' : Christian Gimonet, Pierre Lajus, Roland Schweitzer and Jean-Pierre Watel, who will begin their work with this material after 1965.

Unlike the latter who will develop an architecture 'all wood', that promotes solid wood and the art of carpentry, with imported frameworks and their associated technologies, Jean Prouvé will not cease to imagine wood as an industrial material, that is to say, as a processed product with high added value, used more for its physico- mechanical properties than for its symbolic or sensory load. Its implementation is conceived in industrial dry construction conditions, where the building act consists of an assembly process of prefabricated composite and mass produced elements.

In that, his work with wood does not differ from his more general commitment to imagine an industrial revolution in the construction sector, fully linked with the narrative of modernity (perhaps more than others, however stronger their claim for modernity was). His buildings challenge the uniqueness of the architectural work in favor of the industrial series, performance and economy.This shift from liberal arts toward mechanistic arts, from an artistic work of art to a technical object is an innovative approach that seeks to adapt the architecture to new production methods, new work organization, taken from the world of the industry whose achievements were admired at that

time. In Prouvé's conception, the building is first thought of as a technical object in itself[1].

Support / Close: constructions prefabricated panels

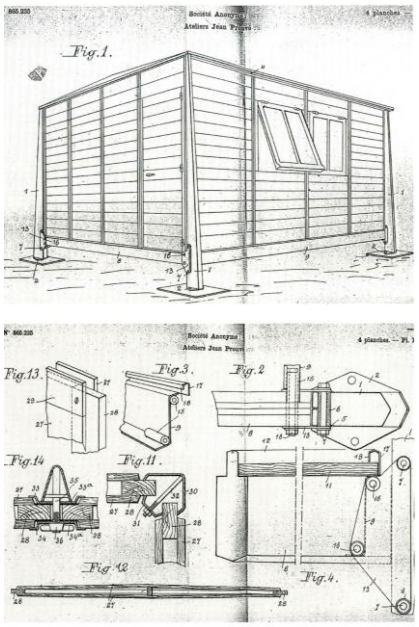

Fig. 1

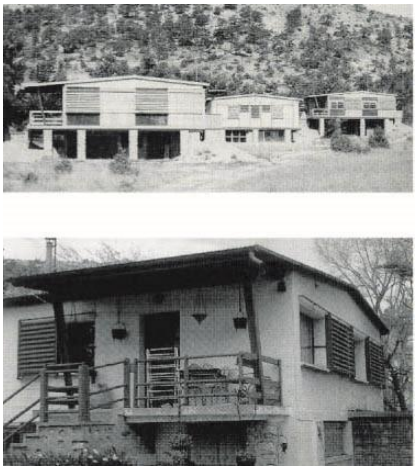

Fig. 2

The work of Jean Prouvé with wood began in 1939 with a removable control barrack entrusted by the French army (fig 1). The commitment is to achieve 275 removable modules approximately 3m x 3m in a month. The scarcity of steel during this period led to keep this material for the structure and think the envelope in modular solid wood panels, incorporating doors and windows, prefabricated and then assembled in situ. This innovative construction system will be patented in August 1939[2]. One can note in this apparently unsophisticated construction, wood panels designed with a curved profile that evokes the metal panels that Jean Prouvé used for the house of Clichy (1936). The panels used in Clichy, are this bulged by the presence of springs inside the pane, swelled to stabilize the sheet into the desired shape, in order to avoid deformations of thin aluminum sheets. The use of curved wood panels for the barracks allows to have thinner assemblies - and thus saving material - while providing satisfactory inertia in the axial part of the panels. The inertia at the connections between the panels will be given by metallic pressure plates. This original and at least surprising solution of curved wood panels confirms that there is in the work of Jean Prouvé a consistency between desire of shape for the material and constructive principles, so that on can not identify which one regulates the other.

After this experience, Jean Prouvé works with Pierre Jeanneret in 1941-1942 to achieve the pavilions F 8x8 and F8x12 for the Bureau Central de la Construction (Central Bureau for Construction BCC) (fig 2). These family homes are made entirely of wood due to the shortage of steel during the war. It consists in prefabricated wood panels, assembled in situ on a masonry base that controls the different soil conditions. The structural system is an A frame, developed o, steel two years ago for the clubhouse SCAL Issoire, and implemented here in a new timber version. As noted by Christian Sumi[3] "Prouvé is thus

[1]However, his revolutionary works prefiguring the industrialization and the production in series have remained prototype units (or very small series), built in a crafty or pre-industrial way and have not allow for the industrialization of the construction they imagined, but simply gave us a view of what it might have been. The reproducible technical object that should replace the unique work becomes a piece of work in itself. The irony of history places now the prototypes of Jean Prouvé in Art galleries, and the architectural community wholeheartedly welcome him in its Pantheon. .

[2]Patent n°849.762 *« construction à ossature métallique démontable »* 21 Août 1939, *in* Sulzer P, *op. cit.*

[3]Sumi Christian, « l'utilisation du bois et la maison BCC » in *Jean Prouvé, la poétique de l'objet technique,* Collectif, Vitra design Muséum, 2004, p. 194 - 196

Fig. 3

Fig. 4

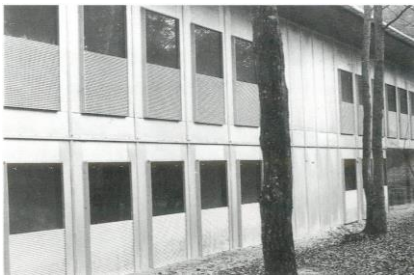

Fig. 5

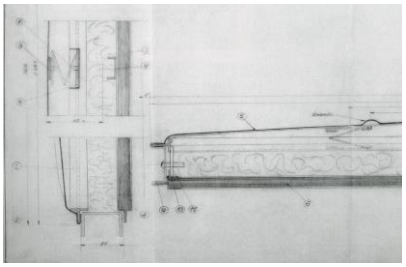

Fig. 6

opposed to proponents of reciprocity between the choice of material and the construction, and experiments on the concept of transfering construction principles from a material to an other." We might add that the design of the axial beam, cut on its connection to the A frame, is typical of metal construction, intended to lighten the beam nicely on the principle of "equal resistance" that Prouvé developed. The same cut on a wooden beam is technically difficult to justify (fig 3). Everything happens as if, as the period required, wood was used here as a substitute for steel and retain its aesthetic, already claiming a "Jean Prouvé style". Once the war ended, Jean Prouvé resume many times the constructive system of an A frame associated with envelopes composed of bearing panels made of a wood (flags for victims of Lorraine in 1945, fig 4) or metal frame (factory Ferembal , Nancy 1947 experimental houses Meudon 1950-1952) and wood siding. The panels were first simply made of two faces of inner and outer plates, attached to a central timber frame, and will gradually become more complex sandwich panels of cross-laminated wood plates, insulated and clad with an outer skin of aluminum, as the Holiday Camp Air France Arbonne in 1954-55 (Fig. 5). Although Prouvé has also made many panels with two faces metal siding, the principle of interior wood siding is recurrent in the field of housing. Furthermore the timber has the advantage of solving the problem of the high thermal conductivity of the metal, a source of internal condensation.

These successive experiments on the facade panels, developed since 1939, led him to file an ambitious patent in 1955 on "construction elements of buildings and the buildings implementing them"[4], that unfolds the principle of composite panels, composed of a core of laminated panels or plywood, with a thin insulatin layer, and a stainless steel cladding. This patent describes in detail the panels themselves and their modes of assemblies, the building then appearing as the result of an industrial "meccano". Successive additions to this patent, until 1957 improve the technical devices in order to increase the thickness of the insulator, by interposing an expanded polystyrene foam between the plywood and the outer metal coating.

Cette From the handcrafted connected timber elements for the barracks for refugees in 1939, to laminated wood core panels, coated with aluminum sandwich panels (insulation - plywood – aluminum) fixed on the lightweight metal frame of the Metropolis House[5] 1953 (fig. 6), progresses in technical systems tend to lighten the panels, working on composite panels, whose successive layers of materials combine to continuously

[4]Patent n°1 138 751 *« éléments de construction d'immeubles et immeubles les mettant en œuvre » du 18 Juin 1955, in* Sulzer P, *op. cit.*

[5]With Henri Prouvé architect

improve the qualities of strength, waterproofing, thermal and acoustic. These wall panels are designed as a technical object in itself but also as an efficient architectural module that allow for numerous combinations, already foreshadowing the later concept of *open industrialization*[6].

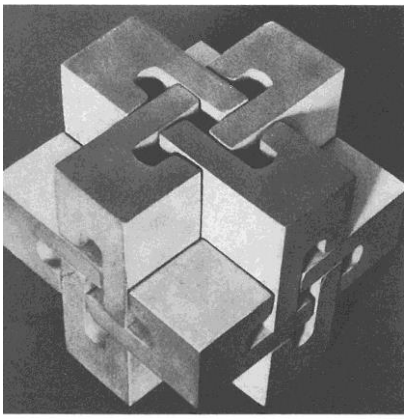

Fig. 7

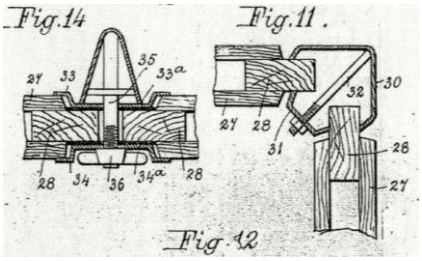

Fig. 8

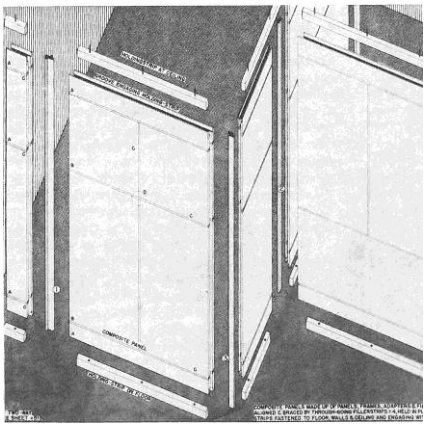

Fig. 9

One can find these studies on panels based construction systems in the work of Konrad Wachsmann, a contemporary of Jean Prouvé, whose career is similar[7]. In Germany and overseas Konrad Wachsmann developed a system of construction with prefabricated wood panels that he especially experimented in the Packaged House System designed with Walter Gropius in 1942. The main difference is that Wachsmann worked exclusively with wood and strived to settle the details of joints between panels with dry timber joints in the tradition of joinery he belonged to[8], up to theorize about 'universal' three-dimensional systems (Fig. 7) in his book *Wendepunkt im bauen* (1959); while the ironworker Jean Prouvé preferred developing joints from the world of industrial metal construction, with metal connecting profiles like those devised for military barracks in 1939 (Fig. 1; fig 8). Nevertheless their thoughts on prefabrication and industrialization led to the development of very close constructive logics, designed ad hoc, project after project by Prouvé, or theorized as a general system of geometric sophistication by Wachsmann (1959). If Prouvé adapts his solutions to the unique architectural choices of individual projects, the constructive system of the General Panel Corporation of Wachsmann presents an 'ideal' constructive model, able to form any type of plan in the logics of industrialization and closed "owner system".

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This system of construction with panels poses the same problem of the corner to both designers: How to connect two perpendicular panels correctly while ensuring continuity of sealing and insulation? If Wachsmann opts for solutions of panels fit together in the corner with profiles (Fig. 9). Jean Prouvé wasn't satisfied with this type of implementation he experienced in his first constructions up to his home in Nancy in 1954. He will find a convincing alternative with the *Maison des Jours Meilleurs* for Father Pierre in 1956. The reversal of the façade and the continuity of the envelope, is carried out with the

[6]Grèzes D. et Charon JP, *Industrialisation ouverte, recherche et expérimentation 1971-1983*, Plan Construction et Habitat, Paris 1983

[7]Both of them born in 1901 and dead in 1980 for Wachsmann and1984 for Prouvé, they went trough the 20st century, and take an active part of the adventure of modernity. Jean Prouvé had a training of a iron craftsman, and Konrad Wachsmann of a joiner. Self-educated, they had no engineering or architecural degrees but they were passionated for the industrialization, through metallic construction for Prouvé and timber construction for Wachsmann, that slowly opened his field of thought to all the materials. Both men were contractors. They became later famous university professors, engaged for the industrialization of construction, in the *Conservatoire National des Arts & Métiers (CNAM) in* Paris or in the *Chicago Institute of Design*.

[8]Wachsmann K. *Wedenpunkt im bauen*, Ed. Verlag, Wiesbaden 1959

Fig. 10, 11

same nature of panels - here bakelited plywood - curved with a radius of about 30cm. (Fig. 10). This continuous and rounded corner solution has an aesthetic coming form the automobile and aircraft industrial production undoubtedly desired by Jean Prouvé.

This technique of prefabricated modular panels, that incorporate doors and windows put in at the factory to save time and quality, will be a chapter of the class Jean Prouvé taught at the CNAM[9] between 1957 and 1970. He designed most of his houses, based on the system, with many variations on the surface coatings, as often in plywood and in metal. He says: " *I found friendly to make people live in wood, it is a material that is easy to maintain, it can be scratched and refurbished, it smells good, it breathes.*"[10] Thus, Prouvé, famous for his use of metal and industrial developments is fully aware of the question of the acceptability of the materials and their sensory qualities. For example, one can identify at least seven houses made from prefabricated wood coated panels and whose roofs are made of laminated wood panels, which will be discussed in more detail in the chapter "span / cover."

As soon as 1954, for his own house in Nancy, Jean Prouvé designs a load-bearing structure composed of heterogeneous modular panels picked up in his workshops in Maxéville just before his departure, in the spirit of Levi- Strauss' handyman[11]. There are wood sided panels from the" Ferembal factory" type assembled with aluminum panels with perforated oculi from the "tropical house" type, proving the potential compatibility of these industrial elements.

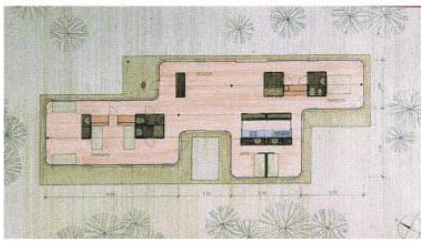

Fig. 12

In 1956, the *Maison des Jours Meilleurs* (fig. 11) introduced the curved thermoformed plywood corners, linking facades made of bakelite plywood coating glued on a chipboard frame core. Again, these panels include doors and windows set up in the factory, reducing the construction site to a place of assembly. Later, he systematized this solution of facade panels connected with curved corners in all its houses, as a kind of optimal industrial solution together with an aesthetic ideal solution. Only the constitution of panels and their coating evolved , aluminum in Epfig[12] in 1958 and Saint Bié[13] in 1961 , mahogany wood in Saint Tropez[14] in 1960 and in Beauvallon[15] in 1962 (fig. 12) , wood-siding in Cordon[16] in 1962.

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[9] Archieri et *Alii*, Prouvé, Cours du CNAM 1957-1970, Mardaga, Sprimont 1990

[10] Extract of the interview of Jean Prouvé from : Gauzit N., Jean P., Pigeat J.P., Schweitzer R. *Maisons de bois*, catalog of the exhibition, Centre Georges Pompidou/CCI, 1979, Pages 57-59

[11] Levi-Strauss C. *The savage mind*, Ed. Weidenfeld & Nicolson, 1966

[12] With Claude Prouvé architect

[13] With H. Baumann et E Remondino architects

[14] With N. Hutchinston architect

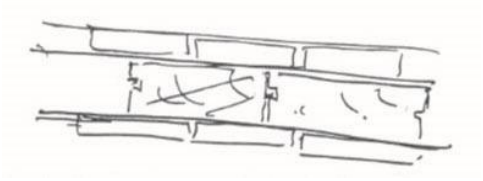
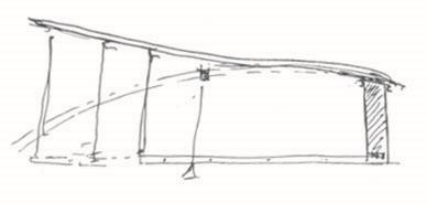


Fig. 13

After the use of solid wood in his first constructions for the army or for the victims of war, Jean Prouvé developed his technical devices incorporating processed wood, industrially produced, as plywood or laminated-wood. The size of these industrial products allows for their integration as facade panels without additional joints. Their isotropic nature (the thread of laminated wood or plywood panels are crossed) allows them to work with equal resistance in both directions of the plane and perfectly brace the facade panels.

Span / cover



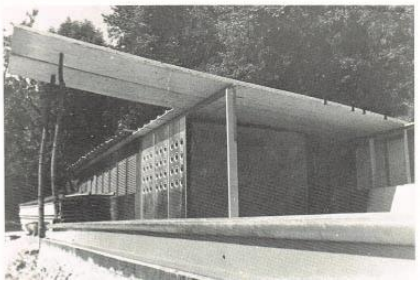


Fig. 14

From 1954, with the design of his own house in Nancy, Jean Prouvé will develop the use of laminated wood panels (Rousseau' panels, fig. 13) for the roofs of its buildings. These Rousseau' panels, named by the manufacturer were originally produced for the construction agricultural silos. Jean Prouvé uses them in a roundabout way as spanning elements. The excellent mechanical strength of the panel eliminates the need for secondary spanning elements, such as rafters, keeping only one or several beams and bear-loading facade panels. Furthermore the roof panels form a surface which is a thin diaphragm of bracing in the plane of the roof. Another advantage of these laminated panels is their underside considered pretty, clean and uniform to form the ceiling of the house, without dubbing. This system allows for gains in the interior height, in the required quantity of material and construction time. All the houses mentioned above have a roof made of these Rousseau' panels, based on modular wall panels[17]. Last, (but not least) these large panels (up to 13 linear meters) have a flexibility which allows the conception of curved roofs , thin concave or convex veils , the parabolic line given by the bending of the material . These curves are more than a slope to drain water, they open for Jean Prouvé a new style of correspondence between form and structure.

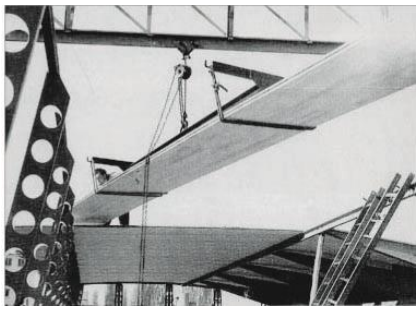


Fig. 15

Starting with his own house design in Nancy, is the opportunity to experiment for the first time the bending of these elements on large spanning, in 1954 (fig. 14). The roof of this house is supported on the back sloped side, on a large piece of furniture made of Rousseau' panels and on the front view side, on modular panels of various type. Between these two ends, 13

[15]With N. Hutchinston architect
[16]With Claude Prouvé architect
[17]It is interesting to see that the sophisticated panels system of the *Packaged House System* of Wachsmann (1942) proposed a spanning solution of an A frame supporting roofing panels and ceiling, still very common in comparison with the Rousseau panels that Prouvé used from 1954.

Fig. 16

Fig. 17

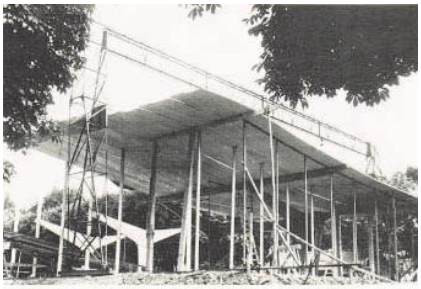


Fig. 18

Fig. 19

meters apart, an intermediate metallic beam gives the point of inflection of the double S shape curve. These laminated panels, 40 millimeters thick are then dressed on the outer face with an insulating layer and an aluminum sheet, thus ensuring waterproofing.

Two other projects with curved roofs of laminated panels were launched in 1956. First the nomadic school for the city of Villejuif whose structure consists of a row of metallic Y crutches put off line to the longitudinal axis and carrying two intermediate purlins (Fig. 15). Laminated panels provide roofing, are continuous from one façade to the other and draw a curve set by the various levels of intermediate supports, on a span of 8m75. These laminated panels are then, like in the houses simply covered with insulation and metal sheets. Inside, they form the visible ceiling of classrooms. Likewise, follow the projects for nomadic churches and Air France holiday camp in Arbonne (fig. 16).

In a similar design but in a different scale, the pump room of the source Cachat in Evian is also made up of a curved roof supported on Y crutches (Fig. 17). Here, the curve of the roof is reversed, the bearing point on the façade being higher than the one on the Y crutches (unlike the nomadic school in Villejuif). However the change in scale, the increase of span, imposed a more complex structure, laminated wood panels in one piece over the entire width of the building are reinforced with wooden beams whose I profile is bent in prefabrication. These beams support rafters below the metallic roofing. Nevertheless, on site construction photographs show that the curve of the roof is obtained with the "natural" bending of the laminated panels according to their supports (fig. 18). The curved beams are installed only after the panels to stiffen the construction. These curved beams are also used to lightly lift the cantilevered panels beyond the last support and restore a continuous line of the roof. Again the laminated panels form the visible ceiling underneath the roof.

Prouvé has also experimented in the Youth Club in Ermont in 1966 (fig. 19), the possibility of using roofing sandwich panels, light, curved and rigid, with an outer surface composed of aluminum , an inner face of plywood and a polyurethane core. This last project is composed exclusively of a succession of barrel vaults, about 1m wide, simply bolted together. Waterproofing was insured by a neoprene joint set up during on site assembly. The eaves of these panels are timber boards, cut to the desired curve. They close the insulating core and serve as a support for bolted joints.
Jean Prouvé justifies the choice of aluminum on the exterior for its resistance to corrosion, while plywood, flexible enough to

follow the curve has a good resistance to knocks and shocks due to domestic practices of the Youth Club. The great constructive simplicity allowed associations to build themselves these projects without skilled labor, all the conception of the building being contained in the prefabricated panel itself , both enclosure and structure, and unique element of the building.

Wood as an industrial material: a doctrine

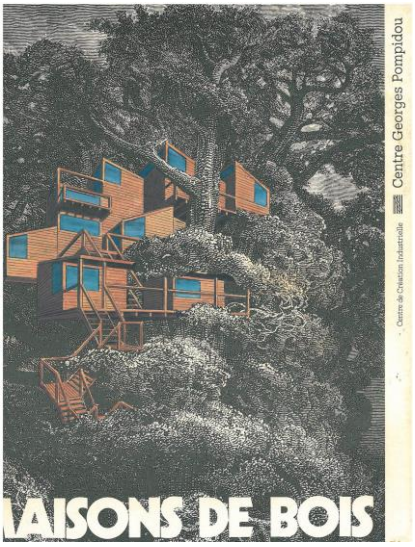


Fig. 20

The use of wood for its physical and mechanical properties, associated with other materials in a logic of complementarity that we have just described, is made explicit in the interview of Jean Prouvé at the exhibition "Wooden Houses" (fig. 20) in the Centre Georges Pompidou -CCI in 1979[18]. Prouvé declares: *"I do not use wood in a traditional way. I use it seeking industrialized elements that are shaped not as the carpenters used to, but by machines ... what matters with wood is having a fibrous material. It is rebuilt by placing the fibers much better, it helps to have huge spans"*

But also shaking architects of the revival of wooden architecture in this exhibition : *"These framed systems are abominable : it is uninteresting in our time to use wood in this way, while there are modern means of hewing allow to get something else . If we must begin to build wooden houses the same way as in the U.S., it has no interest compare to what can be made of a material like this. Here is a significant intellectual poverty form some people".*

His innovative approach is based on technical inventions (including processed wood materials), technology transfers from the metallic constructions and new forms of organization (the industrialization of the building). This approach pretends to be cleared of aesthetic premises and claims to set the problem before answering. In the thought of Jean Prouvé, materials combine, with pragmatism, based on performance to achieve. This approach is very different from the one, common among architects, to use only one material exclusively on behalf of the aesthetic radicalism: "all wood ", "all steel" or "all concrete ". Prouvé constructed with wood rather than in wood. And if an aesthetic emerges - and there is a Jean Prouvé style - it is the one of modernity, fascinated by its technical objects, its cars, its planes, as well as by the new means of production in a design where things and signs are not dissociated[19]. We could say that the work of Jean Prouvé calls first on nature as it is (here the

[18]Extract from the interview of Jean Prouvé from : Gauzit N. et alii. *Maisons de bois, op. cit.*
[19]Latour Bruno, *We have never been Modern*, Harvard University Press 1993.

strength of the wood, its fibrous nature, flexibility, lightness and thermal conductivity) and then as a symbolic representation (here what wood can evoke healthy, green and warm). There is a safe bet that the contemporary environmental requirements, now imposed on the architecture of high performance, particularly in terms of thermal and physics performances, no longer allow us to be satisfied with a symbolic ecology or *greenwashing* and lead us to revise again the lessons of Jean Prouvé.

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