

Purist Lessons: Constructing the Unrealized Villas of Le Corbusier

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The villas of Le Corbusier from his Purist Corpus (1923-1929) are appropriate for reconstruction using computational tools for how their inherent logic is revealed by this process. Conceived but never built, the following seven design examples are inferred from incomplete and fragmentary original documentation and rebuilt as three-dimensional computer models. The analytic process of reconstruction depends upon available descriptive information, but more significant is the assumption of a design methodology based in geometry and elemental volumes. Understanding the basis of this method and its rules begins the systematic geometric reconstruction of the villas. The record of this process and the role of the machine in representing the object and its cognitive aspects is supported by the syntactic organization of images.

1 Introduction and background

"The Purist elements can be compared to well formed words; the Purist syntax is the application of constructive and modular methods; it is application of laws which organize the pictorial space." - A. Ozenfants et Ch.-E. Jeanneret, "L'Esprit Nouveau", no.4, 1920, p.386.

This corpus of work was isolated from Le Corbusiers Oeuvre complete [1] to serve as the vehicle for reconstruction, using generating rules in modeling a concise design world. Le Corbusiers Purist tradition. The work from this time is characterized by formal continuity that defined and followed a fairly explicit set of generative rules. Two distinct stages were involved in this project: first, the construction of 3D computer models based on a shape grammar formalism; second, the documentation of this archaeological process and provision of an Internet WebSpace resource allowing the interactive exploration of the villa models. The principal contribution of the present study is not only historical reconstruction and visualisation of unbuilt work (Figure 1), but also in the exploration of generative procedures for computational design.

2 Formal model and purist tradition

The generation of form in architectural design tends to become a highly structured process when computational tools are engaged. For this reason, we look to the formally consistent body of work of early modernism and in attempting its digital reconstruction, discover its logic and complementary departures. The early architectural work of Le Corbusier, like his paintings of the same era, can be seen as the assembly of several recognizable elementary forms within a rather precise geometric (and ideological) framework.

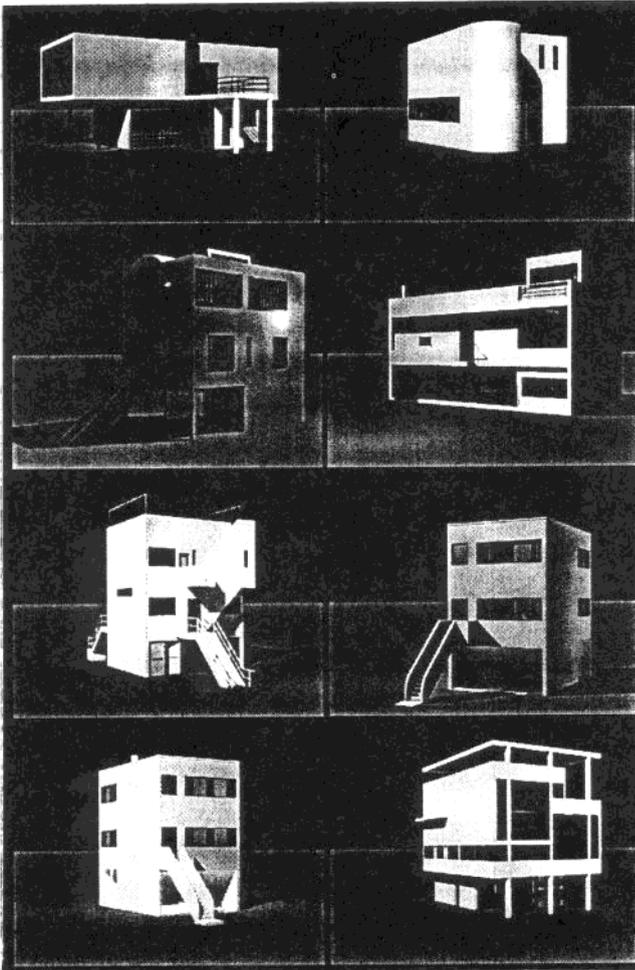


Figure 1 - Perspectives of Seven Unrealized Villas of Le Corbusier(L to R, T to B: Maison Jacquin, 1928; Maison d'Ouvrier, 1922; Maison d'Artiste, 1922; Maison Canale, 1924; Villa Ribot, 1923; Maison et Cantine, 1924; Maison et Cantine, 1924; Maison Baizeau, 1928)

The work from his Purist period is distinguished by the application of regulating lines to guide the formal composition of the plan and elevations. As a method, the making of *les traces régulateurs* is sequential, though it is not as consistent or explicit as is required for the development of a closed computational model. In the analysis of these projects, the attempt has been made to trace the development of the *parti* to its source and conclusion through the notion of a skeleton evolved from an incremental geometric process. The importance of the skeleton is multiplied because it is used for the positioning elementary functional forms in the development of the architectural object. Elementary form is conceptually identical to the *objets-types* of the Purist tradition; objects that were imagined to be ideal objects perfected by human needs, the result of a perfect fusion of geometry and function.

In some cases the sequence of the generating parti can be induced from Le Corbusier's original drawings, but for most it is not so easily discovered. The process begins as generative rules are retrieved from the formal lexicon and the organizing lines (skeleton) of the plan parti are produced as the result of their application. Then the tectonic elements are positioned, often after the alternative arrangement had been explored. The elements may be scaled, rotated, mirrored and even fragmented during this process. In Le Corbusier's design universe the generic procedures are not always as explicit and complete as illustrated here.

The architectural work of Le Corbusier, like his Purist painting, is seen here as an assembly of several recognizable elementary forms. For example: staircase = semi cylinder, balcony = cube, the roof = vault, etc. Elementary forms could be further decomposed and described in terms of their individual attributes. In any given corpus elementary forms fall into two categories: those unique, instantiated only once and those forms which are repetitive. The latter ones might be transformed with modified parameters and thus not easily recognizable. Analysis of the group of projects in terms of degrees of dependence or similarity in elements is then made possible.

A formal model for this design process begins with two fundamental elements: skeletons and tectons: What differentiates them is that tectons are concrete, physical elements and skeletons are abstract organizational rules. The construction line, compositional parti, and in the case of Le Corbusier, *les traces regulateurs*, all fall into the category of skeletons. One can suppose a generation automaton that performs the task of placing the tectons on a skeleton generated from a lexicon. Such procedures are aimed not just at reproducing the given universe of forms but at examining the production of a new one. This model is not simple even when seen as a stable linear process of reading followed by writing. Its complexity is amplified when viewed as a continuous feedback loop from reading to writing and back to reading what has been written, the overlap and coincidence of reading and writing states affords not only feedback but also and feed-forward processes that result in a specific design form.

Le Corbusier utilized a simple and effective technique of transparent overlays that facilitated copying and transforming fragments of compositions, then positioning the transformed new form on its proper locum. Superimposition of the several transparent layers "*...lent itself easily to the creation of visual ambiguity.*" [2] The creation and then resolution of this ambiguity belongs to the realm of the non-mechanistic and non-deterministic aspect of design. Throughout his labours Le Corbusier admits to not merely using, but also reusing the formal vocabulary. In this endeavor the main concern is the design language, its logic and creative transformation. The processes of this type can not be simply mechanical and without reflective contemplation. "*Meditating must accompany all reading and learning; and that requires first making preliminary investigations and then ordering one's thoughts or connecting them by a method.*" [3] The initial development of design concept or the notional sketch for the painting often takes place without explicit help of "*les traces regulateurs*". Le Corbusier seems to apply the regulating lines at the latter stage of design in order to tune the proportion and position of the elements.

The analytical and generative illustrations, attached with this paper are drawn from the Purist tradition of Le Corbusier, and while resonant with his contemporary painting, the examples belong to the realm of architecture. The seven projects examined, reconstructed and illustrated are: Maison d'Artiste, 1922; Maison ouvriers an serie, 1922; Maison Ribot, 1923; Maison Canale, 1924; Maison Cantine 1924; Villa Baizeau, 1928; Maison Jacquin, 1929. This paper's focus is the process of digital reconstruction following generative rules and assumptions. A formal reading of the Maison d'Artiste of 1922 is given only to illustrate the architectural implications of the generative procedure outlined here.

3 Case of Maison d'Artiste

The approach to Maison d'Artiste is through the gate in its front facade and up the single run stair terminating at the entrance door. The simple opening through the blank wall of the facade brings a visitor to the modest space of the salle commune. The more private entrance via the recessed ground level through the garage and up the back stairs leads up to the heart of this project - the atelier. The design for this three story house situated in a serene setting, is urbane in its compactness and its typological similarity to the

shop-house of the Mediterranean world. It is the painters ideal studio, perhaps Le Corusier's house for himself.

The overall form of the project could be described as the horizontal translation of its cross-section profile. To many students of Le Corbusier the most noticeable feature of this project is the roof form. The shallow vault, which in geometrical terms can be seen as an arc translated along the z axis, or a section of a cylinder, was initially recorded by Le Corbusier in his sketch design for Villa au Bord de la Mer, 1916. [4] Maison d'Artiste constitutes Le Corbusiers third usage of this vault, the second being in Maisons Monol. [5]

The other significant elementary forms are: the back staircase - its form is expressed outside as a semi-cylinder, or a vertically translated arc; the main entry stair -the ramp-like plane leading to a blank wall and bridging over the car apron; the gate -nothing else but the translation of simplified cross-section profile along the axis of the main approach with scaling parameters applied. Other forms worth noting are: the balcony - just bigger than door width; the negative space at ground; the square pilotis, sliding industrial door used for garage; and the mobile storage wall dividing the communal living area into private rooms.

The plan parti is classical in its simplicity. Like many Le Corbusier projects in years to come, Maison 'Artiste is derived from a square. The initial square is translated or bisected, with diagonals, arcs and the golden section introduced to etch the skeleton. The parti of the floor plan can be generated as an aggregation of skeletons over sixteen steps. The roof vault, in turn is constructed on the radius of a circle found in the plan, but its center point is casually shifted away from the grid, perhaps to accommodate asymmetric conditions. The resulting skylight window is not obviously perpendicular to the roof surface, but to the line tangent to the vault circle and thus generated by the above "shift". The cross section of Maison d'Artiste constitutes a departure from the logical norm.

4 Conclusion

To understand the design development process, we divide it into two complementary processes: reading and writing. When writing or generating mode is applied the resulting object is developing and growing in its complexity. Writing is seen as an aggregation of formal substitution, beginning with a square and ending with a diagrammatic floor plan. The converse process is applied to illustrate the reading state, where reading is understood as the formal procedure of examining the architectural object, decomposing it or parsing it. The initially complex object is parsed and simplified until the simple square form is produced. In terms of formal substitution the production rule is executed from left to right and bottom up, while in the writing state the process is reverse, that is top down and right to left (Figure 2)

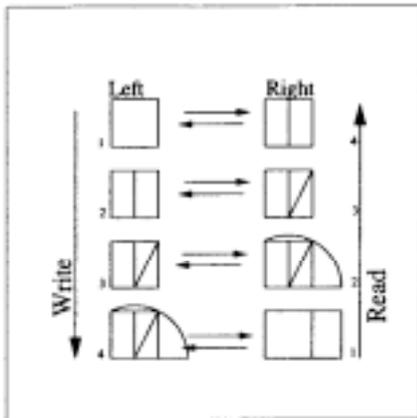


Figure 2- The Reading/Writing Analogy for Design

Any combination of skeletons and tektons in its final state is 'one of a kind' and each purist plan is unique. When parsed and decomposed sequentially skeletons of plan parti display common characteristics and roots. In fact it is possible to generate good part of all seven skeletons with the single grammar. If developed, a shape grammar for generating skeletons of the purist tradition may consist of a dozen rules. The sequence of rule application is what determines the individuality of each plan parti.

The main aspect of design logic and of this search for a purist universe of forms, is rooted in the shape recognition problem. The act of recognizing and selecting eligible shapes, the multiplicity of which are inherent in any form under examination, is a complex one. This process involves identifying and discovering the emerging form and admitting it to the design world for future operations. To a large extent the act of recognizing shape is present in both analytical and synthetical aspects of design. It is the essence of this design process. The "sentences" formed with various degree of similarity to the original one can be created, so if design is a series of operations on a universe of forms then the underlying logic of this process and its art is of central interest (Figures 3, 4, 5)

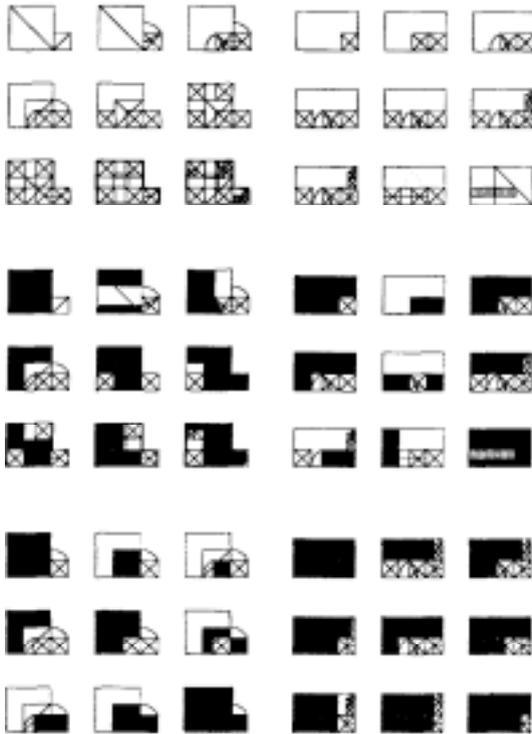


Figure 3 Top: Maison d'Ouvrier, 1922, plan (left) and elevation (right); Sequential Development of Regulating Lines. Middle: Maison d'Ouvrier, 1922, plan (left) and elevation (right); Emerging shapes based on Regulating Lines. Bottom.: Maison d'Ouvrier, 1922, plan (left) and elevation (right). Multiple Readings of Emerging Shapes Based on a Stable Skeleton of Regulating Lines

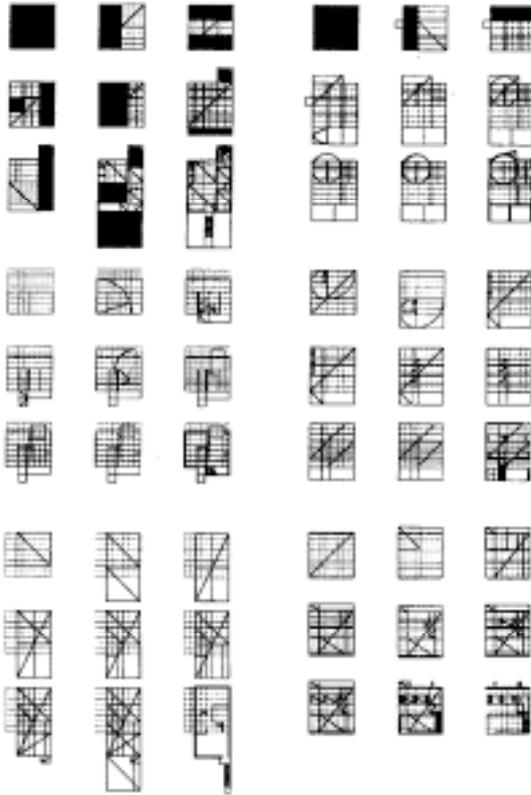


Figure 4 *Top*: Maison d'Artiste, 1922, plan (left) and section (right). Regulating Lines and Emerging Shapes Inferred from Plan and Section. *Middle*: Villa Ribot, 1923, plan (left) and elevation (right); Regulating Lines Inferred from Plan and Elevation. *Bottom*: Maison et Cantine, 1924, plan (left) and elevation (right); Regulating Lines Inferred from Plan and Elevation

Our work parallels that of the archeologist; as archival information was not complete, and the projects only exist in virtual reality, having never been built. In rebuilding them, we are assembling the historical evidence and layers of information into the foundation that makes their reconstruction possible. As archeology, this process in turn revises knowledge and reveals the specific nature of each villa and its role in the overall corpus. A rigorously constructed computer model makes explicit the deep geometric structure and visible its experiential implications. The process of generating the skeleton and placing the tectons is only the means toward the architectural object (Figures 6 & 7). An understanding of the complexity of the object can only be fully experienced over time. Through animation, the skeleton comes to life, intensifying its art and ambiguity (Figure 8). The recent innovation of WebSpace and VRML (Virtual Reality Modelling Language) has offered a further extension of the virtual archaeology program. The seven reconstructed villa models are now available through our World Wide Web site (<http://www.architecture.ubc.ca>) and through the three-dimensional WebSpace browser, visitors to this site from distant locations can interactively 'experience' the reality of these unbuilt works.

The basis of our program is drawn from the history of architecture - it proposes a future for computational design and architectural education through the vehicle of a virtual archaeology.

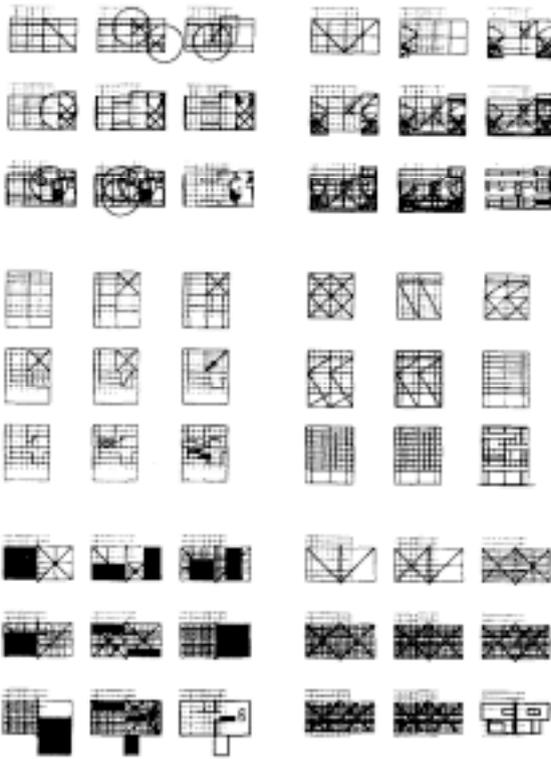


Figure 5 Top: Maison Canale, 1924, plan (left) and elevation (right); Regulating Lines Inferred from Plan and Elevation. Middle: Villa Baizeau, 1928, plan (left) and elevation (right); Regulating Lines Inferred from Plan and Elevation. Bottom: Maison Jacquin, 1928, plan (left) and elevation (right); Regulating Lines and Emerging Shapes Inferred from Plan and Elevation

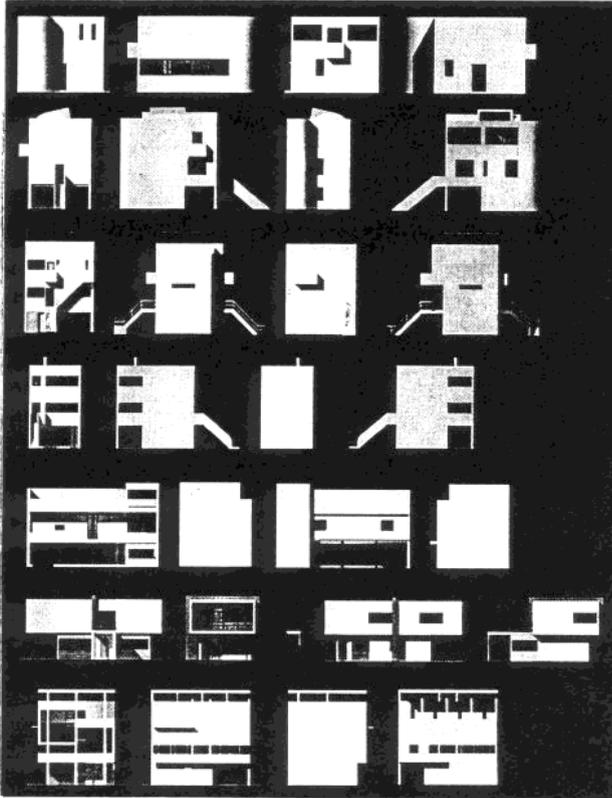


Figure 6: Comparative Assembly of Elevations of Seven Unrealized Villas of Le Corbusier

- Row 1: Maison d'Ouvrier, 1922, (from left to right) front elevation, left elevation, back elevation and right elevation
- Row 2: Maison d'Artiste, 1922, (from left to right) front elevation, left elevation, back elevation and right elevation
- Row 3: Villa Ribot, 1923, (from left to right) front elevation, left elevation, back elevation and right elevation
- Row 4: Maison et Cantine, 1924, (from left to right) front elevation, left elevation, back elevation and right elevation
- Row 5: Maison Canale, 1924, (from left to right) front elevation, left elevation, back elevation and right elevation
- Row 6: Maison Jacquin, 1928, (from left to right) front elevation, left elevation, back elevation and right elevation
- Row 7: Maison Baizeau, 1928, (from left to right) front elevation, left elevation, back elevation and right elevation

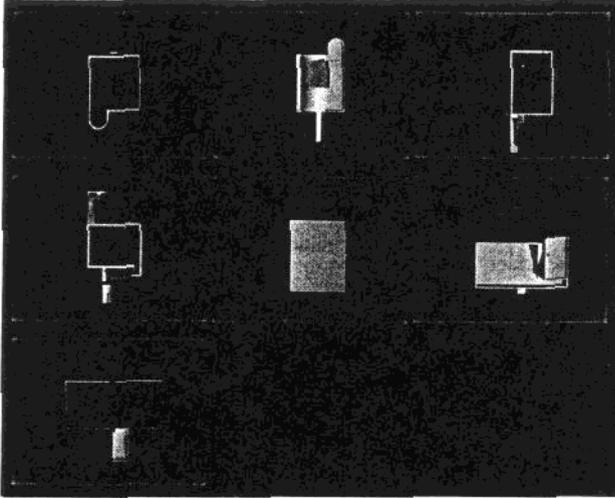


Figure 7- Rendered Roof Views of Seven Unrealized Villas of Le Corbusier (L-R: Maison d'Ouvrier, 1922; Maison d'Artiste, 1922; Maison et Cantine, 1924; Villa Ribot, 1923; Maison Baizeau, 1928; Maison Canale, 1924; Maison Jacquin, 1928)

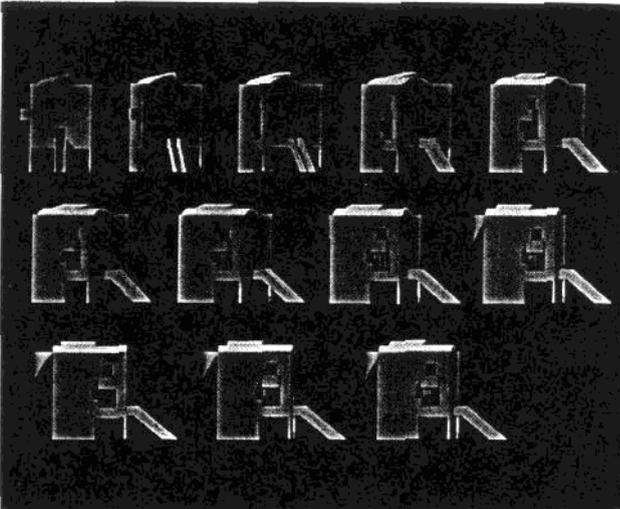


Figure 8 - The experiential component of the Maison d'Artiste emphasizes the compositional parti, as it is revealed over time in an animated sequence.

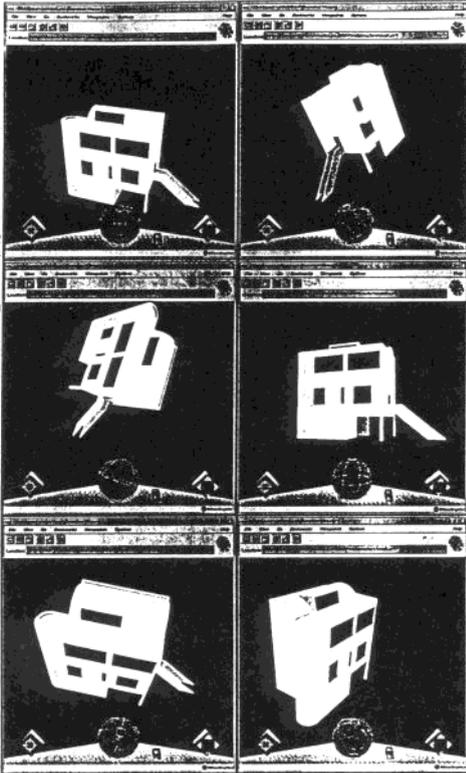


Figure 9 - The villa models as experienced through the three-dimensional WebSpace browser.

5 Endnotes

[1] The primary source for this paper was: Le Corbusier Sketchbooks, Fondation Le Corbusier, New York: Architectural History Foundation; Cambridge, Mass., MIT Press, 1981.

[2] Sekler E.F., The Carpenter Center in Le Corbusiers Oeuvre: An Assessment, Le Corbusier at Work, p.238.

[3] Kant, I., The Concept of Logic, Dover Publishing, New York, 1974, p. 50.

[4] It was an industrial type vaulted ceiling and not expressed outside.

[5] As roof form, the vault is soon to be replaced by flat slab until its re-emergence as Maison Jaoul in 1956. As an element in Le Corbusiers vocabulary cylinder section is ever present and used, though not necessarily as the roof form.

6 Bibliography

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