FROM CAVE TO HUT

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Why stereotomics and tectonics in architecture, and their effectiveness for the materialisation of architecture.

In trying to clarify and explain the terms stereotomic and tectonic, not invented but learned, I am simply trying to convey something that has helped me in the architecture I have built over the years.

I use the terms stereotomic and tectonic, what Gotfried Semper calls "categories", because both for understanding what we architects do and how we do it, they are enormously effective.

They are not therefore abstract concepts applicable to architecture, as has been done with some philosophical systems that have so often been used in architecture in recent years in an interesting but sterile debate.

These are eminently architectural terms. Understanding that part of the building belongs to the earth (stereotomic) and that part is detached from it (tectonic), or considering that the whole building works in continuity with the earth, or on the contrary, establishes minimum contacts with it, can effectively help in the production of the new architectural organism.

Kenneth Frampton, in his book Labor work and Architecture, devotes a chapter to these issues in an accurate way. He heads it, of course, with Abbé Laugier's well-known engraving of the Primitive Hut. He takes up the text he published in 1990 in Architectural Design with the expressive title Rappel a l'ordre, the case for the Tectonic, and always makes it clear how the source of these terms is Gotfried Semper, who stated them in his most significant writings.

Frampton notes in the introduction to his book: "On the assumption of what he refers to as the relative autonomy of architecture, built form was as much about structure and construction as it was about the creation and articulation of space. I attempt to recover the nineteenth-century notion of tectonics, in an effort to resist the current tendency to focus only on scenographic effects".

Frampton goes on to explain: "To evaluate 20th century architecture in terms of continuity and inflection, rather than in terms of originality as an end in itself". He continues: "We must return above all to structural unity, as the irreducible essence of architectural form." And in the following paragraphs he clearly proposes the meaning of the terms stereotomic and tectonic.

In addition to these distinctions, Semper divides the built form into two different material procedures: the tectonic of the weft, in which the different parts are combined to form a single spatial unit; and the stereotomic, of the mass working in compression, which, when

it forms a space, does so by superimposing equal parts. The term stereotomic comes from the Greek stereos meaning solid, and tomia meaning to cut.

In the first case, tectonic, the most common material throughout history has been wood, or its equivalents, such as bamboo, reeds and basketry work.

In the second case, stereotomic, the most commonly used material has been brick, or materials that work in compression in a similar way to brick, such as stone or adobe, or reinforced concrete.

There have been very significant exceptions to this division, especially where, on the basis of stability, the stone has been cut and laid in such a way that it takes shape and functions as a weft".

It is obvious that Frampton is referring here to the structural prodigy that is the Gothic in which a clearly stereotomic material such as stone adopts tectonic characteristics in a borderline, almost miraculous situation, constituting a structure where the ribs of the masonry can be distinguished, as a premonition of what the Modern Movement would do centuries later in its breakdown of pillars and enclosure.

Although these facts are so well known to all, they bear repeating. We tend not to be aware of the ontological consequences of these distinctions, that is, of the way in which the fabric of the structure tends towards the aerial, towards the dematerialisation of the mass, whereas when the form of the mass is telluric, it is always grounded deep within the earth.

The first tends towards light, while the other tends towards darkness. These gravitational opposites, the immateriality of the weft and the materiality of the mass, may well serve to symbolise the two cosmological opposites to which they aspire: heaven and earth.

Despite our highly secularised techno-scientific age, these two polarities will still long constitute the experiential boundaries of our lives. It is arguable that the practice of architecture has been impoverished, and to such an extent it has not, that we are wrong not to recognise these transcultural values and the way they are latent in all structural forms.

Indeed, these forms should serve to remind us, according to Heigegger, that inanimate objects should also evoke "being", and that, through this analogy with our own bodies, the body of a building should be perceived as if it were literally a physical being. This brings us back to Semper's consideration of the importance of the joints as the primary architectural element, as the fundamental nexus around which the building comes into being, or rather, comes to be articulated, as a presence in itself". (This reference to Heidegger is taken from his well-known text "Building, Living, Thinking").

Semper's emphasis on joints implies that this fundamental syntactic transition must be understood as a step from stereotomic base to tectonic structure, and that this transition is very essential in architecture. So it is these fundamental components that will mark the various periods of the culture of building. There is a spiritual value that resides in the

"thingness" of the built object, so that the "generic joints" become points of "ontological condensation" rather than a simple connection.

APPROACHES TO STEREOTOMIC AND TECTONIC TERMS

Attempt to be more precise in their understanding.

Stereotomic architecture is understood as that in which the force of gravity is transmitted in a continuous manner, in a continuous structural system and where the constructive continuity is complete. It is massive, stony, heavy architecture. It is architecture that sits on the earth as if it were born from it. It is the architecture that seeks light, that pierces its walls so that light can enter it. It is the architecture of the podium, of the base, of the stylobate. In short, it is the architecture of the cave.

Tectonic architecture is understood as that in which the force of gravity is transmitted in a syncopated manner, in a structural system with knots, with joints, and where the construction is articulated. It is the bony, woody, light architecture. It is architecture that rests on the earth as if on tiptoe. It is the architecture that defends itself from the light, that has to veil its openings in order to control the light that floods it. It is the architecture of the shell. The architecture of the abacus. It is, to sum it up, the architecture of the hut.

It is clear that this distinction is made on the basis of a "structural" consideration of architecture. I see more and more clearly every day the central importance of the structure, which carries and transmits loads and at the same time shapes and organises the architectural space. The structure is the material response to gravity which, as I have often repeated, "builds space", in the same way that light "builds time".

GRAVITY

G, the force of Gravity.

I will never tire of repeating that gravity "builds space". The load-bearing structure not only transmits the loads to the earth, but above all it establishes the order of space. The definition of the load-bearing structure, its establishment, is a key moment in architectural creation. We have already seen how Frampton defends this central role of the structure, of "structural unity as the irreducible essence of architectural form". For it is in this sense, in the gravitational, in the structural, that the concepts of the stereotomic and the tectonic have their clearest understanding.

In a stereotomic architecture, "gravity is transmitted in masse, in a continuous manner, in a continuous structural system where constructive continuity is complete", where everything works fundamentally in compression.

Almost the entire history of architecture is made up of buildings in which this is the case. Massive stone or brick walls formed the enclosures. And when it came to the roof, arches, vaults and domes appeared as formal inventions capable of making everything constitute an enclosed space in continuity. Later, with the same materials, brick and

stone, an attempt was made to lighten the artifice in order to be able to rise to greater heights. The mighty Roman masonry, with its "chest" structures, such as the Basilica of Magentius or, even more sublimely, the Pantheon, gave way to the delicate "basket" structures of the Gothic. I have already pointed out that the main idea of the Gothic, to lighten the stone construction with ribs and plementeries, was no more than the desire to reach a greater height in order to take more light from above. It would seem to be a premonition of what in the 20th century constituted one of the central points of the architectural revolution: the separation of the pillars and the enclosure, of the load-bearing elements and the skin.

In a tectonic architecture, "gravity is transmitted in a syncopated way, in a structural system with knots, with joints, where the construction is articulated", where it stops working only in compression and "moments" appear. And just as the key buildings in the history of past architecture, stony, massive, belong to what we have called stereotomic, another important part of architecture, the most recent, made with lighter materials, belongs to the tectonic field. The ephemeral condition of light materials such as wood means that when the history of architecture has sought to achieve permanence over time, stone has basically been used. Until the very recent appearance of steel.

One of the key points of steel is to combine its maximum durability with its lightweight nature, as well as its ability to withstand the concentration of forces passing through it. The ability to resist the structural stresses that architects and engineers call "moments". Mies Van der Rohe was well aware of all this and built all his work with a clearly tectonic character. And the master was also well aware of how ironic it was to seek permanence through tectonic elements that are more perishable than stereotomic ones. Perhaps to confirm that what remains are ideas rather than forms. As would happen for so many years with his Barcelona Pavilion before it was rebuilt, and yet it was a source of continuous teaching for all, with a force as great as that of the most imperishable Greek temples.

LIGHT

The force of levity

I have written many times about light. And I have always proposed that light in architecture "constructs time", and that light is the material capable of putting man in relation to architecture. Hence my insistence on "Architectura sine luce nulla architectura est". For it is in this sense, in their relationship with light, that the concepts of the tectonic and the stereotomic acquire their clearest reading.

Stereotomic architecture seeks light. It pierces its walls so that, pierced by the sun's rays, it can trap the light inside. The windows here are excavations in the walls in order to bring the light inside. And it will not be possible to open skylights on the upper level until flat glass appears in larger dimensions. Only the Pantheon, a place reserved for the gods, dares to open this upper hole to the open sky. The courtyards would then be the intermediate mechanisms for bringing light into the interior of the buildings, always through the windows opened in their vertical perimeter walls.

In many Romanesque churches, the excavation of windows in the walls, and the orientation of the building itself, was based on a study of the path of the sun throughout the year, so that the quantity and quality of light and the time when it would enter each space was known precisely.

And if we have noted how Gothic in its relationship with the structure makes a "tour de force" to achieve a stereotomic organism with a tectonic air, it also does so in relation to light. It opens up its vertical plementeries to the very top, and fills them with glass to allow light to flood into these generous spaces. The beautiful Sainte Chapelle in Paris is a clear example of this. And then the whole of the Baroque which is basically a brilliant exercise in the search for light.

On the other hand, a tectonic architecture, pure bone, will need to be protected from the light that floods it. If steel had succeeded in achieving a delicate bones at the limit of the minimum expression, it will be the added vertical enclosure that will serve as a mediator between the interior space and the sunlight that now fills it all. This brings to mind the beautiful glass skyscraper that Mies Van der Rohe never built. But it remains forever in our minds. A pure structure with thin, overlapping pillars and an unparalleled undulating floor plan. And a glazing that is a hymn to transparency and whose reflections testify to the formal freedom of that floor plan. But everything calls for effective control of light. This is what Mies would later do in his paradigmatic Crown Hall at the IIT in Chicago: the first half, the lower half of its glazing would be translucent. This, tectonics, is an architecture that defends itself from light, which in order to control it must veil its openings.

CONCLUSION

I think that in the coming years, this mechanism of architectural analysis through the categories of the tectonic and the stereotomic, in short a mechanism capable of concretising the themes of Light and Gravity, can be enormously useful to architects both in developing their ideas and in setting up the works that materialise them.

NOTES

NOTE 1

Semper proposes these categories as: "stereotomics of the earthwork" and "tectonics of the frame" which literally translated would be "stereotomics of the earthwork" and "tectonics of the frame". It seemed simpler to us not to drag out the second explanatory parts as redundant, so we have decided to use, as Frampton does, the terms stereotomics and tectonics directly.

NOTE 2

During the entire academic year 1989-1990, I was a gastdocent at the ETH Zurich, coinciding with a stay there of Professor Frampton, who gave his class there every Monday at 10 am. As I travelled from Madrid every Monday, after the corresponding runs through the airports, I always arrived punctually to those interesting classes in which Frampton explained these tectonic and stereotomic topics with a meridian clarity that I would also like to have here in this text.

NOTE 3

It is only fair to quote not only Kenneth Frampton, but also Jesús Aparicio. Professor Aparicio, during his stays as a Fullbright scholar at Columbia, commented to me on these themes that Frampton distilled from his studies of Semper at the time. The terms tectonic and stereotomic soon sounded familiar at the Madrid School of Architecture. In the book "El Muro", the result of that thesis with which Professor Aparicio became a doctor, he not only devoted an important part of his time to these themes, but they were his "leif motif". Sometimes we would jokingly comment how the students, more innocent than ignorant, would ask us to clarify the terms "stereophonic" or "stereotonic".

NOTE 4

With similar characteristics there is an interesting work by the professor and architect Ana Maria León which includes some interesting synoptic tables with a great pedagogical sense, and which we recommend those interested in the subject to consult and study.

NOTE 5

Semper's most basic texts are translated for the first time into English in Wolfgang Herrmann's very interesting book: "Gotfried Semper. In search of Architecture", published by MIT Press in 1984.

Its Spanish version is published as part of the book "La casa de un solo muro" by Juan Miguel Hernandez León, Professor and Director of the Madrid School of Architecture.

Herrmann's comment on Semper's interest in spreading his ideas in English is curious: "He gave at Marlborough House, written in English, incidentally a language he never quite mastered". The old German revolutionary was well aware of the importance of the media, of the word, in spreading ideas.

NOTE 6

"Labour work and architecture". Kenneth Frampton. Phaidom Ed. London 2002. (page 23).

This text is the same as the one that appeared in 1990 in Architectural Design n.60/3/4/pp.19-25.

NOTE 7

To clarify how much a building belongs to the stereotomic or the tectonic is of great conceptual effectiveness. And so the architecture of the masters is highly expressive: isn't all of Mies Van der Rohe's architecture a clear exercise in tectonic pieces perched on stereotomic podiums?

NOTE 8

The English have a curious expression: "Gilding the lilly" to convey how Beauty is more than just the perfection of creation. This "gilding the lily", which would be the literal translation, wants to express that there is still something more that can be done about creation when it is perfect. That something more is Beauty. The Venustas demanded by Vitruvius. For I understand that Light in architecture plays a clear role in acting on the perfection achieved by Gravity alone.

NOTE 9

I am reminded here of a beautiful and simple drawing by Saarinen that Alejandro de la Sota, fascinated, drew on the blackboard in the 1966-1977 academic year for those of us who were then very young students in the first year of our degree course. There, in those two parts of the house, one buried and the other emerging, the concepts of the tectonic and the stereotomic were already there, without calling them that.