

FROM THE CAVE TO THE HUT
On stereotomics and tectonics in
architecture

THE REASON FOR THE TERMS STEREOTOMIC AND TECTONIC.
Regarding their efficacy in making architecture

I am using the terms “stereotomics” and “tectonics”, which Semper calls “categories”, because they are extraordinarily effective in helping to understand “what” we architects do as well as “how” we do it.

They are not, therefore, abstract concepts which can be applied to architecture, like certain philosophical systems which have been used so often in architecture in recent years in an interesting but fruitless debate.

They are eminently “architectural” terms. Understanding that part of the building wishes to belong to the earth (stereotomic) and that part separates itself from the earth (tectonic), or recognizing that the entire building works in continuity with the earth, or on the contrary, that it establishes only minimal contact with it, helps in the production of the new architectural organism.

In seeking to clarify and explain these terms, which I have not invented but rather have learned, I am only trying to communicate something that has helped me in the architecture I have constructed over the past years.

In his book, *Labour, Work and Architecture*, Kenneth Frampton dedicates a chapter to talking about this subject in an effective way. He heads it, of course, with the famous engraving by Father Laugier of the Primitive Hut. He reprinted the text originally published in 1990 in *Architectural Design* under the expressive title, “Rappel a l'ordre, the case for the Tectonic”. Professor Frampton identifies Gotfried Semper, in his most significant works, as the source of these terms.

In the introduction to his book he notes, “Departing from the hypothesis that as far as the relative autonomy of architecture was concerned, built form was as much about structure and construction as it was about the creation and articulation of space, I attempted to recover the 19th century notion of the tectonic in an effort to resist the contemporary tendency to reduce architecture to scenographic effects.”

Later Frampton clarifies: “To evaluate twentieth-century architecture in terms of CONTINUITY and INFLECTION rather than in terms of ORIGINALITY as an end in itself [...] we may return instead to the STRUCTURAL unit as the irreducible essence of architectural form.” And in the subsequent paragraphs, he provides clear definitions of the terms stereotomic and tectonic.

“Aside from these distinctions, Semper was to divide built form into two separate material procedures: into the TECTONICS of the frame, in which members of varying lengths are conjoined to encompass a spatial field; and the STEREOTOMICS of compressive mass that, while it may embody space, is constructed through the piling up of identical units (the term STEREOTOMICS deriving from the Greek term for solid STEREOS, and cutting, TOMIA). In the first case, the most common material throughout history has been wood or its textual equivalents such as bamboo, wattle and

basketwork. In the second case, one of the most common materials has been brick, or the compressive equivalent of brick such as rock, stone or rammed earth and later, reinforced concrete. There have been significant exceptions to this division, particularly where, in the interest of permanence, stone has been cut, dressed and erected in such a way to assume the form and function of a frame.”

“While these facts are so familiar as to hardly need repetition, we tend to be unaware of the ontological consequences of these differences; that is to say, of the way in which framework tends towards the aerial and the dematerialization of mass, whereas the mass form is telluric, embedding itself ever deeper into the earth. The one tends towards light and the other towards dark. These gravitational opposites, the immateriality of the frame and the materiality of the mass, may be said to symbolize the two cosmological opposites to which they aspire: the sky and the earth.

“Despite our highly secularized techno-scientific age, these polarities still largely constitute the experiential limits of our lives. It is arguable that the practice of architecture is impoverished to the extent that we fail to recognize these transcultural values and the way in which they are latent in all structural form.

“Indeed these forms may serve to remind after Heidegger, that inanimate objects may also evoke "being" and that through this analogy to our own corpus, the body of a building may be perceived as though it were literally a physique. This brings us back to Semper's privileging of the joint as the primordial tectonic element, as the fundamental nexus around which building comes into being, that is to say, comes to be articulated as a presence in itself.

“Semper's emphasis on the joint implies that fundamental syntactical transition may be expressed as one passes from the stereotomic base to the tectonic frame, and that such transitions constitute the very essence of architecture. They are the dominant constituents whereby one culture of building differentiates itself from the next.

“There is a spiritual value residing in the 'Thingness' of the constructed object, so much so that the generic joint becomes a point of ontological condensation rather than a mere connection.”

APPROXIMATIONS TO THE TERMS “STEREOTOMIC” AND “TECTONIC”

An attempt at a more precise understanding

I understand STEREOTOMIC architecture as that in which the gravitational force is transmitted continuously, in a continuous structural system, in which

the constructive continuity is complete. It is a massive, stony, weighty architecture, which settles down on the earth as if it had been born there. It is an architecture that seeks light, that perforates its walls so that light may enter. It is the architecture of the podium, the plinth, the stylobate. It is, in short, the architecture of the CAVE.

I understand TECTONIC architecture as that in which the gravitational force is transmitted in a syncopated manner, in a structural system of knots and joints in which the construction is articulated. It is a bone, wood and light architecture, which sets itself on the earth as if raised on tiptoe. It is an architecture that defends itself from the light, that has to look after and veil its open spaces to be able to control the light that pours into it. It is the architecture of the shell, of the abacus. It is, in short, the architecture of the HUT.

Clearly, this distinction is made on the basis of a “structural” consideration of architecture. The central importance of STRUCTURE is more apparent to me every day, as the bearer and transmitter of loads and at the same time as the shaper and organizer of architectural space. Structure is the material answer to gravity which, as I have so often repeated, “constructs space” in the same way that light “constructs time”.

GRAVITY

G, the force of Gravity.

I will not tire of repeating that gravity “constructs 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 structure, of the “structural unity as the irreducible essence of architectural form,” because it is in this sense, in the sense of gravity and structure, that the concepts of the stereotomic and the tectonic have their clearest meaning.

In a STEREOTOMIC architecture, “gravity is transmitted in mass, in a continuous manner, in a continuous structural system in which the constructive continuity is complete,” in which everything works, basically, on compression.

Practically all the history of architecture is made up of buildings in which this is the case. The enclosures were made with massive stone or brick walls, and upon reaching the roof, the arches of domes and cupolas appeared as formal inventions capable of making the whole constitute a closed space in continuity. Then, with the same materials, stone and brick, an attempt was

made to lighten the artifice in order to reach greater heights. The powerful masonries of the Romans, with their “box” or “trunk” structures such as the Basilica of Magencio or in a more sublime manner, that of the Pantheon, gave way to the delicate “basket” structures of the Gothic works. I already noted how the main idea of the Gothic, lightening the stone construction with ribs and vaults, was no more than the will to reach greater height to take greater light from above. It would seem a premonition of what in the 20th century constituted one of the central points of the architectural revolution: the separation of pillars and of enclosure, of the load bearing elements and of the skin.

In a TECTONIC architecture, “gravity is transmitted in a syncopated manner, in a structural system of knots and joints, in which the construction is articulated,” where one ceases to work only at compression and where the “moments” appear. And thus, as the key buildings of earlier historic architecture belong to the category we have called Stereotomic (in their stony, massive nature), another important part of more recent architecture, in buildings made with lighter materials such as wood, belongs to the Tectonic. When permanence in time has been sought, stone was used because of the ephemeral nature of such light materials as wood; until very recently, when steel appeared.

One of steel’s most important qualities is its combined maximum durability with its light nature, in addition to its capacity to resist the concentration of forces that pass through it. It is this capacity to resist structural forces that architects and engineers call “moments”. Mies Van der Rohe knew this well when he erected all of his work with a clearly tectonic character. And the master also knew how ironic it was to look for permanence by means of tectonic elements, which are more perishable than stereotomic elements. Perhaps to confirm that what remain are Ideas, above and beyond forms. As would occur for so many years with his destroyed Barcelona Pavilion, which nonetheless was the object of continual study for everyone, with as great a force as that of the most indestructible Greek temples.

LIGHT

The force of levity

I have written about light so often. And I have always suggested that light in architecture “constructs time” and also that light is the material capable of putting man in relation to architecture. Hence, my insistence that “architectura sine luce nulla architectura est”. Thus, in this sense, in their relation to light, the concepts of the tectonic and the stereotomic acquire their clearest reading.

STEREOTOMIC architecture looks for light. It perforates its walls so that, crossed by the sun's rays, it can trap light within its interior. The windows here will be excavations in the walls in order to carry that light inside. And, until flat glass makes its appearance in large dimensions, skylights cannot be opened in its upper level. Only the Pantheon, a place reserved for the gods, dares to open this upper space to the open sky. Patios, then, will be the intermediary mechanisms to bring light inside buildings, always by means of windows opened in their vertical perimetrical walls.

In many Romanesque churches, the cutting out of windows in the walls and the orientation of the building itself were made on the basis of a study of the sun's course throughout the year, so that the exact quantity and quality of the light, as well as the moment it was going to enter each space, were known.

And if we have pointed out how, in regard to structure, the Gothic achieves a "tour de force" in giving a stereotomic organism the air of a tectonic one, it also does so in regard to light. Gothic architecture opens its vertical vaulting to the highest and fills them with glass to allow light to pour into those generous spaces. The beautiful Sainte Chapelle in Paris is a clear example of what we are saying. And after all, the Baroque is basically a brilliant exercise in this search for light.

In contrast, a Tectonic architecture, pure bone, needs to protect itself from the light that inundates it. If with steel a delicate skeleton was achieved at the limit of minimal expression, it is the added vertical enclosure that serves as mediator between the interior space and the sunlight that now fills it everywhere. Here comes a collation: the beautiful glass skyscraper that Mies Van der Rohe never built. Pure structure, with fine narrow pillars that are superimposed and the freedom in the form of its unmatched floor plan. And a glassing that is a hymn to transparency and whose reflections testify to the formal freedom that it proposes. But all of it requires an effective control of light. Which is precisely what Mies will do afterwards in his paradigmatic Crown Hall at Chicago's IIT: the first half, the lowest part, of its glassing will be translucent. It is this, the TECTONIC, an architecture that defends itself from light, that to control light must veil its apertures.

MY WORKS

When I suggest the usefulness of the terms STEREOTOMIC and TECTONIC, it is because they have been truly useful for me, in generating and later in explaining the architecture I have been making throughout these years. Thus, I have referred to them in many of my texts and drawings from this time. And I have done the same thing in my lectures. Also, the proposals for

some of the works I have designed which were not built (Casa Merigo) and the contests not won (the Library of Alicante, the Philharmonic of Copenhagen) were based very radically on these principals.

Like Casa Gaspar, Casa Merigo turns out to be a weighty Stereotomic box made out of stone open to the sky, on which some light Tectonic boxes of fine steel float. Similar to the DBJC house, now under construction.

The Philharmonic of Copenhagen was like a rock carved in stone, like a great quarry of open stone, a strong Stereotomic piece of stone that contained the auditoriums to "listen" inside it and on top of which a large and light Tectonic box was erected out of transparent glass to "contemplate" the beautiful surrounding landscape.

These may have been the projects that left me with the greatest desire to build. Or the Library of the University of Alicante, where the weighty Stereotomic part housed the thousands of books and served as foundation for the lightweight boxes filled with sunlight, the Tectonic devices where one could read in silence.

But most important for me have been the works built over the past years that testify to the validity of these thoughts.

What is the Casa de Blas if not a light "tectonic" cloud that rises as if on tiptoe on the "stereotomic" base of the bellowing concrete?

And what is the Caja General de Ahorros de Granada (The Granada Savings Bank) if not a large, heavy, empty box turned out on the powerful podium as if wishing to trap light and trapping it all inside... A large stereotomic box that contains another tectonic box inside of it.

And what is the Centro BIT (Technology Center) in Mallorca, if not an ample stereotomic box in Roman stone open to the sky where the white columns that bear the light stone slab of the tectonic organism contained within it dance their delicate dance.

And the stone offices in Almería that are no more and no less than a pure and hard stereotomic box of lumaquela stone, so radical that one must remove the very stones from its tense façade to allow light to enter it.

And the SM offices in Madrid, that are a long tectonic box of stainless steel, like a train which has been stopped on a strong stereotomic foundation of concrete.

I will take a moment here to take a closer look at three constructed works which I consider most representative of these operations of the "tectonic" and the "stereotomic": the Centro BIT in Inca-Mallorca, the Casa de Blas in Madrid and the Caja General de Ahorros de Granada.

Centro BIT (Technology Center) in Inca-Mallorca

From its genesis, the building for the Centro BIT in Inca-Mallorca was a direct consequence of the application of these concepts.

In a triangle shaped terrain and on a relatively sharp incline, everything is resolved in an operation that seeks to resolve all of the problems at once. A podium is constructed that establishes a single principal working floor that from the entrance remains at eye level, satisfying Mies Van der Rohe's most basic dictums. In the back part, thanks to the strong slope, one has direct access to the service basement. As the surroundings are hostile, strong stone walls are erected continuously from the edge of the podium, creating what we have called the 'box open to the sky'. All in stone. All continuous. All weighty. A true cave. A genuinely stereotomic piece.

And alighting on this stereotomic organism, a 6x6 m. frame that organizes everything that is going to be raised there: a forest of white pillars sustaining a delicate slab of exposed reinforced concrete that flies above this structure, providing shade for those working there. Everything light. Like a simple hut. A truly tectonic piece.

And 24 fragrant orange trees that repeat the same arrangement of the pillars, thus materializing the organization of the frame in the patio around which the life of the building takes place. Nonetheless, it is not so important that the triangle be a right, isosceles triangle (although it is more than interesting in terms of perspective that it be the exact half of a square). Or that the interior covering of the box be Roman travertine marble. Or that the outside covering be of local limestone of the Mares. Or many other details. All work together to the good result of the project, but the main thing is the materialization of the heavy below and the light above. The cave below and the hut above. The stereotomic as support for the tectonic.

The operation is evident in the very expressive sketches and plans that were made for the contest and its subsequent development. But the document that most clearly expresses all of the above is probably the constructive cross-section that we developed for the building project.

Casa de Blas

In the case of this house, as well, the first visit to the location was revealing. Recognizing the clear components of the operation in terms of the concepts of the tectonic and the stereotomic was of enormous help in its conception.

On the highest point of a hill, with an incredible view towards the north of the Sierra de Madrid as a distant horizon, the creation of a horizontal plane on which to build imposed itself. For that, a concrete box measuring 9 x 29 m. on the ground and 3 meters high was constructed. The upper floor was the plane we sought. Inside the box, the usual functions of a house were placed, two bedrooms, two bathrooms, kitchen, living room, dining room, a library and a gymnasium. This box was arranged with service facilities in the back and with the serviced spaces towards the front. And a pool was dug at the western extreme of the platform.

On the upper plane, facing the open landscape, we needed protection from the sun and the rain. For that we created a large shade, measuring 6 x16 meters, with a very low covering, only 2.27 meters high, supported by 8 white pillars on the edges, as if it were a large table. And for protection against the cold, we glassed in a rectangle under the covering 4.5 by 9 meters with carpentry-free glass to accentuate its absolute transparency. And that's all. That simple.

In short, we did no more than create a tectonic piece erected on a stereotomic piece. A hut was erected on top of a cave. Although we could also talk about how the landscape remains "underlined" above so that it comes towards us as if we were floating in it. And how, in contrast, within the cave the same landscape appears framed through the square 2x2 meter glass window, as though it moved away from us so that we could contemplate it better.

And Granada.

This dual operation was also proposed for the Caja General de Ahorros de Granada from its conception. First, the enormous 120 x 189 m. concrete podium capable of collecting and resolving in a single stroke the entire plot and its slope of more than 2 heights. In it we "excavated" two gardens, the one in front with linden trees and the one in the back with orange trees. And in the center, we raised a large concrete cube, a huge stereotomic piece in continuity with the podium on which it rests. The walls of this cube, which is really a half cube, are so thick that one can see the depth of the "brisesoleils" with which the two façades to the south are revealed. To sustain the whole

device, we placed 4 large columns measuring 3.30 m. in diameter and 30 meters high inside, in the center. The key is in placing a delicate tectonic box of glass and alabaster within this immense stereotomic concrete crate. It is in that delicate glass box where the offices requested of us were located. The hut within the cave. And then, all of it inundated with light in that surprising “impluvium of light” that is the patio, the immense space that organizes the entire building.

Conclusion

I believe that over the next few years, architectural analysis by means of the categories “tectonic” and “stereotomic”, in fact a mechanism concretizing the issues of Light and Gravity, can be enormously useful to architects both in developing their ideas as well as in erecting the works they create.

Notes

Semper proposes these categories as the “stereotomics of the earthwork” and the “tectonics of the frame”. Following Frampton, we have preferred to avoid redundancy and use simply “stereotomic” and “tectonic”.

During the 1989-1990 academic year, I was *gastdocent* at the ETH in Zurich, coinciding with Professor Frampton there, who gave his class every Monday morning at 10. As I traveled from Madrid on Mondays, I rushed through the airports in order to arrive punctually to this class in which Frampton explained the terms “stereotomic” and “tectonic” with a clarity I wish I had now.

Not only should Kenneth Frampton be credited here, but also Jesus Aparicio. As a Fulbright Scholar at Columbia, Professor Aparicio spoke to me about these subjects which Frampton was extracting from his studies on Semper. The terms “stereotomic” and “tectonic” soon became familiar to the Escuela de Arquitectura de Madrid. In the book *El Muro* (The Wall), originally his doctoral dissertation, Professor Aparicio not only dedicated a large part to these issues, he made them its “leit motif”. We sometimes remarked in jest how the students, more innocent than ignorant, asked us to explain those terms, “stereophonic” and “stereotonic”.

With similar characteristics, there is an interesting study by the architect and professor Ana María León which includes some interesting graphs and illustrations which synthesize the material effectively and which we recommend for those interested in the subject.

Semper’s most basic texts were first translated into English in Wolfgang Herrmann’s very interesting book: *Gotfried Semper, In Search of Architecture*,

published by MIT Press in 1984. The version in Spanish was published as part of the book *La casa de un solo muro* (The One-wall House) by Juan Miguel Hernández León, Professor at the Escuela de Arquitectura in Madrid. Herrmann's remark about Semper's interest in spreading his ideas in English is curious: "He gave a talk at Marlborough House, written in English, incidentally a language he never quite mastered." The old German revolutionary knew well the importance of the media and of the word to spread his ideas.

Labour, Work and Architecture. Kenneth Frampton. Phaidon. London, 2002. (p. 23). This is the same text that appeared in 1990 in *Architectural Design*, no.60/3/4/pp.19-25.

Clarifying to what extent a building belongs to the stereotomic or to the tectonic is of great use conceptually. Thus, the architecture of the masters is so expressive: Isn't so much of Mies Van der Rohe's architecture a clear exercise of the tectonic supported on stereotomic podiums?

The English have a curious expression "gilding the lily" to express the degree to which BEAUTY is something more than the sole perfection of the creation. The expression implies that more can be done to creation, which is only perfect. That something more could be BEAUTY. Since I understand that LIGHT in architecture plays a clear role, acting on the perfection achieved with GRAVITY alone.

I recall here a lovely and simple drawing by Saarinen which Alejandro de la Sota, fascinated by it, drew for us on the blackboard during my first year as an architecture student in 1966-1967. There, in those two parts of the house, one buried and the other emerging, were without being called as such, the concepts of the stereotomic and the tectonic.