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XIXth CENTURY BRICKS ARCHITECTURE: RATIONALITY AND MODERNITY

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The analysis of clay brick architectural works in Europe between the middle of the XIXth century and the beginning of the XXth century shows that they already exploited the material's technical and formal possibilities, and they followed the constructive rationality tendency prevailing in the beginnings of the industrial era.

These works reveal enough connections among themselves, so as to be able to assemble them under the common name of "XIXth Century Bricks Architecture", a name beyond nuances of style characteristic of each region or country.

This paper analyzes the most significant values of the Bricks Architecture which allow it to be understood as a step towards modernity.

1. INTRODUCTION

During the last decades of the XIXth century, it was developed in Europe an interesting architecture whose common characteristic was the clay brick.

In Spain, historians named it with the generical label of "neo-mudéjar"¹ architecture, associating it with ancient architectures where it was possible to show the exposed brickworks. With this label, it seemed that the theoretical concepts related with style, form, and even date, were immediately solved.

But if we analyze this architecture with more rigour, taking into account also the technological, constructive and compositive aspects, we shall notice almost immediately it encloses much wider concepts. The label appears to be too limited as to encompass all of them, because it refers only to a formal characteristic of some of the significative works, from the bullfighting Plaza of Rodriguez Ayuso & Alvarez Capra (1874), already demolished, till the bullfighting Plaza Monumental de las Ventas (1932) (See Fig. 1).

1. "Mudéjar" is the architecture carried out by christians in the moorish regions of Middle Age Spain. "Neo-mudéjar" is the modern architecture that recreates the ancient "mudéjar" themes (e.g. facing brickwork, horse-shoe arches, etc.).



Figure 1
Monumental Bullfighting Plaza, Madrid



Figure 2
XIXth century Bricks Architecture:
technique and form, by J.M. Adell

If we renounce to the partial view that divides architecture according to styles, we shall be able to see clearly the identity which characterizes a way of building, that from now onwards we can simply call XIXth CENTURY BRICKS ARCHITECTURE.

2. THE BRICK: A MODULAR ELEMENT

Let us analyze the implications of the word "bricks" in order to be able to enter in depth in this Architecture, which is self-defined by the name of the material it is built with.

The brick has been used all along history, but in the XIXth century it begins to have an importance of its own, because it resumes in itself a whole industrialization process that is characteristic of these years.

The use of these ceramical parallelepiped units, during the XIXth century, has the connotation of a series of technical and formal breakthroughs, that will have even a symbolic progress value in their mode of use.

During this century, the great technological breakthroughs of the Brick Industry are accomplished. The ancient burning operation is substituted by circular or straight continuous industrial kilns. The roller mills, pug mills, etc., which use extruding or pressing technologies, will improve productivity enormously. The result will be a prefabricated element with defined and controlled physical characteristics.

Even if not all bricks will have exactly the same measures, a modulation process begins. Due to it, the ancient proportions -more or less square- will be slowly abandoned. An standardization of forms and dimensions begins, till it will be established the proportion of "the length twice the width".

Moreover, new types of elements appear, as a direct result of the industrialized manufacturing systems: hollow bricks, perforated bricks, pressed bricks. Towards the end of the century, even the conglomerated prefabricated materials begin to rise as an alternative, as they don't need to undergo a burning process.

On the other hand, it is necessary to remember that during this period, the traditional measuring systems will be subject to an standardization process. The ancient measuring units ("sogas" -cords-, "varas" -yards-, "pies" -feet- and "palmos" -palms-...) of each region, will be substituted by the Metric System, as a new, unique and universal measuring system.

The result of all this transformation was that "the brick" came to be considered as a "new material" with the characteristic of being a "modular unit", that began to be understood as the "basic element" of a whole "conceptual structure" that allowed to "rationalize the architecture composition" according to "constructive principles". The architecture of this period was built with this new understanding of the brick, using widely varying styles, everytime architects wanted to bet for a "modernity option" with the use of a "traditional material", "transformed by the industrial revolution".

3. RATIONALITY: FROM LINKING TO BONDING

In order to understand the evolution happening in the masonry constructive organization, going from "trabazón" (linking) to "aparejo" (bonding), let's study the following real case:

In the Madrid 1857 Building Ordinances, quoted by Fornés & Gurrea in their "Art of Building" (2), which were also applied in Valencia and Seville, it was established that the bricks to be used in any construction works should be a foot long, a quarter wide, and two inches thick. These measures depended on the "vara" (yard) submultipla -a third of a yard equaled a foot, a fourth of a yard equaled a "quarter"-, and they conditioned the proportions of the unit bed face, where the length was not twice the width. In Castille, the metric value of the yard was 864 mm.

This type of unit imposed by the Ordinances rendered impossible, due to the 3:4 proportion of its bed face, to alternate the disposition of the brick "length-wise" (stretchers) and "width-wise" (headers) in the brickworks. For a good execution of the wall it was enough to contemplate the "trabazón" (linking), both in the wall front surface and in its thickness, that is to say, to avoid the joints vertical continuity through a regular placement of the bricks.

It astonishes us that in the book "Art of Bricklaying" by Juan de Villanueva, published in Madrid in 1827 (based on the book "Art and Uses in Architecture" by Fray Lorenzo de San Nicolás, in 1667) it was not found the term "aparejo" (bond) but only the term "trabazón" (link). The diagrams of this book confirm the use of the brick whose proportions were established by the Ordnance, with the impossible alternance of stretchers and headers within the same brickwork.

During the restoration of ancient buildings, bricks one foot long and quarter wide have been found, as a confirmation of these facts.

The impossibility of alternating units "length-wise" and "width-wise" will cause that, when bricks will be standardised, and the new proportion will be "the length twice the width", the "aparejo" used in Madrid will be th "aparejo a tizón" (headers bond), going on with the same traditional way of linking (See Fig. 2).

Knowing the Architecture of the preceding period, it can be verified how in Madrid there was no tradition of leaving any facing brickworks.

The Architecture of preceding periods has used the brick as a cumulative material, that would conform the wall through a linking process. Then, where is the difference? Why, in the XIXth century, priority is given to the material, as a defining feature of an architecture? Simply because in this case brick is used with such rationality that gives a special conceptual structure to this architecture, both from a technical and a formal viewpoint.

During all the XIXth century, just because the brick acquires fixed proportions, the constructive process of linking leaves way everywhere to the bonding process.

Bonding is a combinatory technique, that substitutes the addition process by a series of logical laws which give to the walls built according to them formal characteristics of its own, so as specific load bearing characteristics.

It is towards the end of the XIXth century when it is gained consciousness that the generical name of bonding in brickwork, meaning "adequate disposition of the brickwork units", also acquires in each particular case a "specific value", determined by each one of the different possible ways of regularly placing the units in the brickwork, also assuring the linking.

Due to this fact, books appear all over Europe, establishing some of these combinatory laws; in the beginning, these laws are defined simply with numbers, as in the case of the french book "La brique ordinaire au point de vue decoratif" (3) where the bond patterns named 1, 2, ..., 6 are depicted.

The fact of verifying that in specific places -countries or regions- it is common to build brickworks assembling the bricks always in the same way, leads to associating the name of the "bond pattern" with the "name of the place". Thus we know the english, french, flemish, belgian, dutch, american, ..., bonds.

In Madrid, as the research published in the book "XIXth CENTURY BRICKS ARCHITECTURE: TECHNIQUE AND FORM" (4) proves, every building constructed during this period had the brick placed "a tizón" (headers) in the brickworks (due to the reasons already discussed). Such a circumstance, together with nationalistic reasons, led to establish a synonym between "aparejo a tizón" (headers bond) and "aparejo a la española" (spanish bond).

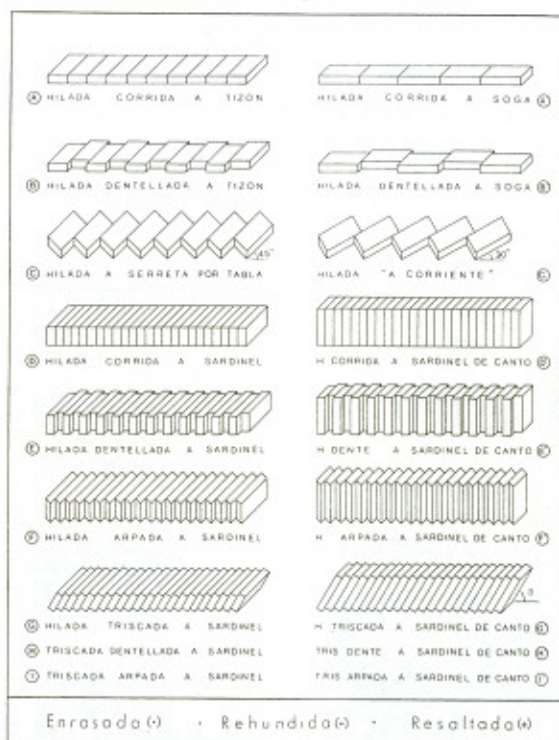


Figure 3 - Types of brick courses

The Madrid Bricks Architecture, that exposes outwardly the brick "headers" and thus the maximum number of joints, shows a surface with a maximum subdivision according with the unit modulation.

The headers bond allows more ornamental possibilities than the bond pattern obtained combining stretchers and headers. This technical fact makes the Bricks Architecture "a la española" outstanding form the viewpoint of its formal richness, comparing it with the other Bricks Architectures of this period, which used other bond patterns.

If we analyze the combinatory process rendered possible by the prismatic unit, from a geometric and constructive viewpoint, we can see that it becomes almost infinite, following simple rules of brick assembling (see Fig. 3). Besides the usual ways of placing the brick in the masonry,

horizontally and vertically, combining its width and its length, which give place to the denominations of "a tizón" (headers bond), "a soga" (stretchers bond), "a sardinel" (rowlock bond), or "sardinel de canto" (soldiers bond), it also exists the possibility of placing it in a slant way called "triscada".

In all those cases, besides, the brick courses can be "corridas" (continuous run course), "dentellada" (tooth course) or "arpada" (seesaw course).

The plastic feature of the brickworks wall surface can be also enriched using the possibilities of "sinking in", "flattening" or "projecting out" the courses, relatively to the wall surface, thus adding attractive nuances of light and shade.

The cromatic feature can be emphasized using bricks of different "colours" in the afore mentioned dispositions.

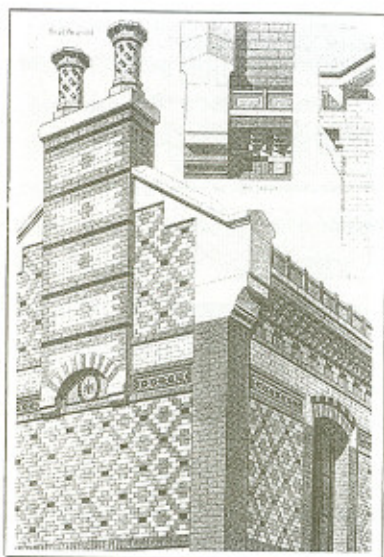


Figure 4

La Brique et la Terre Cuite, 1880 and 1889, Paris
P. Chabat. Gardener House

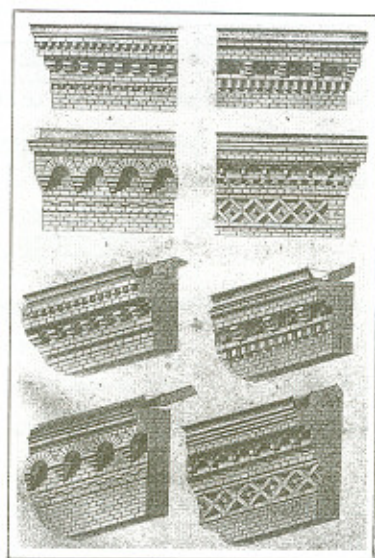


Figure 5

Bricks Architecture, 1875, Barcelona
Fleischinger/Becker. Cornices.

4. EUROPEAN BRICKS ARCHITECTURE: A WAY TOWARDS MODERNITY

The formal result of this combinations of an abstract kind leads will serve for constructing in Europe the so-named XIXth century Bricks Architecture. It will include buildings so different between themselves as the Madrid Bullfighting Plaza, the Berlin School of Architecture by Schinkel, or the model of a gardener's house published by Chabat in "La brique et la terre cuite" - Paris 1880-89-, in order to enable any builder to construct it. (See Figure 4).

There were important ideological differences between these buildings: some of them chose gothic as a figurative model, other ones romanic or moorish, that is to say neo-middle age models.

But all of them are the result of intellectual currents that were born during th XIXth century as an answer to the questions about modernity asked during the XVIIIth century and, which is more important, they are a direct way for understanding the Architecture that will be made during the XXth century.

Really, this XIXth century Bricks Architecture can be considered as a popular response to the classicist cult architecture. In it, the master craftsmen and bricklayers express their freedom, respecting the simple laws of the bond, and they conceive "their architecture", enriching it with moral and local values.

Someone speaks about their constructive sincerity: "Leave your walls flat and bare, do not plaster them with lies"... -John Ruskin writes- (6).

It is associated in a literary way even with socialist theories (William Morris), and it reflects the autochtone traditions of every place of Europe, in a moment when nationalisms are becoming so strong.

An architecture made with facing brickworks will be found, with the same rationality in the building process, in such different places as London or Milano, Berlin or Madrid. Even if we think about the american Architecture, we shall see how this influence also got across the Atlantic, and became an architecture of popular character, as it is reflected by some buildings of Memphis, of Chicago, or by the Bullfighting Plaza of Bogotá.

The graphic publications carried out in this epoch were a very important vehicle for the difussion of this way of understanding architecture. Among the most significative works we have the book by Fleischinger, published in Berlín in 1864, and again, later in 1875, in Barcelona, with the title "Brick Architecture" (see Figure 5).

This kind of books were mainly a collection of plates where it was expressed the grammar of the brick language, ordered according to its elements. They described in a simple way the constructive technique of each one of them, and as an ending to these combinations, they offered models that the builder could directly reinterpretate.

The plates of these works, most of them printed in colour, enriched the imagination of the craftsman-bricklayer, because he found in them the rules that would allow him to ideate his own creation.

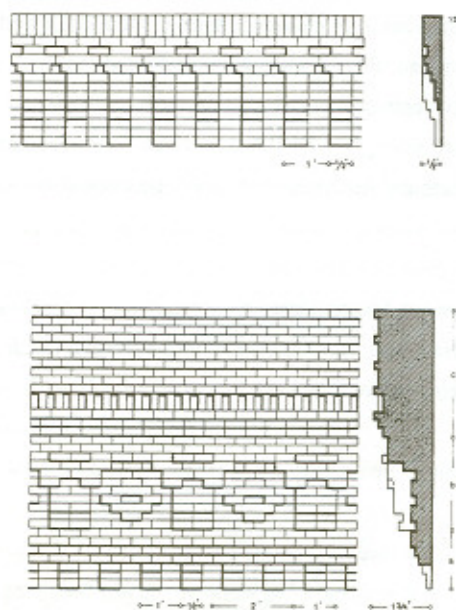


Figure 6

a) Brackets cornice

b) Three-part overhanging cornice with 33 courses

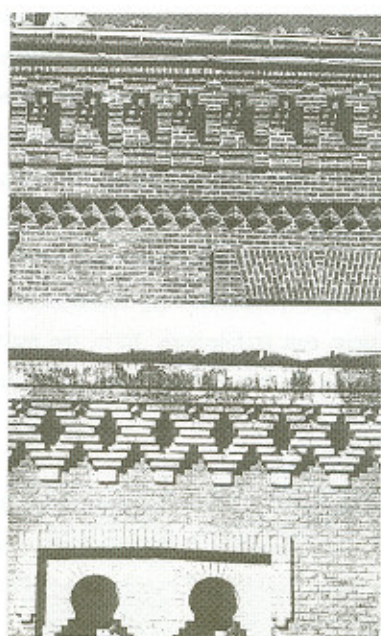


Figure 7

Cornice with tooth courses

5. THE LOAD-BEARING WALL AND THE BRICK ARCH

Respecting this rational play of unit articulation, together with the bricklayer's freedom for expressing his own feelings against the classicism's academical rigidity, we must take into account other conditionants that cause an architecture with such different styles to have, however, some common characteristics, both from a technical and from a formal viewpoint.

One of them refers to the load-bearing characteristics of the brickwork masonry; the other one, to the way of making openings in this material.

Bricks Architecture is normally conceived with load-bearing wall structures, for any kind of buildings, from a church or a museum, till the most humble house.

XIXth century Bricks Architecture proposes a masonry homogeneization, with a progressive decrease of its thickness, thanks to the regularisation of its units and joints. This allows to obtain the maximum wall compressive strength.

During the last decades of the XIXth century, cast-iron structures are combined with load-bearing

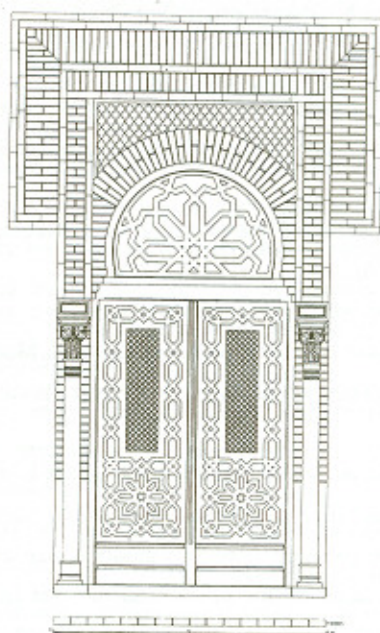


Figure 8
Moorish arch with alfiz

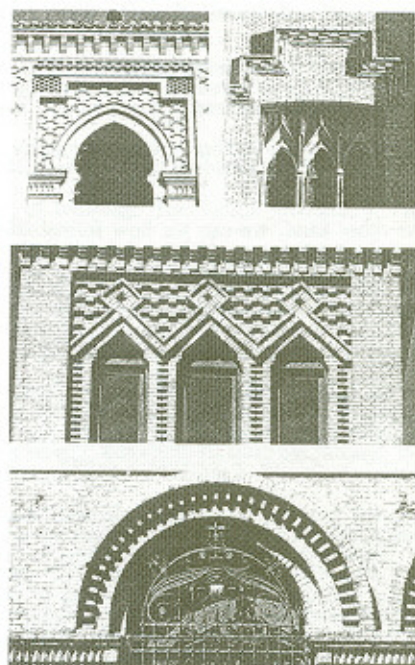


Figure 9
a) Moorish arch b) Ring-leaves arch
c) Straight 45° arches
d) Bonded arch with projecting and sunken arch rings

masonry. Both of them will become progressively independent, specially in industrial buildings. The structural character of the XIXth century load bearing wall will influence the building general design. It will have a direct influence on the façades composition.

The wall thickness, the solid/void rhythm, the formal signaling of the floor-dividing lines as lines where the slabs are supported, and of the cornices as a protection of the façade from the overhanging roof, will become important ornamental themes, thus confirming again the rationality and freedom of this architecture. (See Figures 6 and 7).

The cornices construction tests the ceramic bending strength, as the brickworks units overhang more and more, without using any steel elements. This fact limits the masonry total outward projection to barely two feet, with a maximum height of 35 courses of growing projection.

It is significant that it is described in detail how to make openings in the brickworks, as one of the most characteristic themes of this architecture.

In Bricks Architecture, the building process is used for profiting from the material expressivity,

developing a technical-formal discourse based on the brickworks execution technique.

The bricklayer experiments with this creative freedom, combining one after another "modillones" (bracket courses), "dentellados" (tooth courses) and "arpados" (seesaw courses) of different extension and rhythm, giving singularity, originality and personality to each construction work.

On the other hand, we can see how formal reasons, rather than technical ones, become more important for defining the arches form (See Figure 8).

The structural solution used for closing the wall above an opening is usually the same: an arch, which forces the brickworks above the opening to work only under compression stress. Moreover, it allows the builder, when establishing its form, to put into it any of the different historical or regional stylistic particularities.

The arch is built with a refined bricklaying technique, and its construction becomes in itself an ornamentation process, where each element "roscas" (rings), "dovelas" (voussoirs), "salmeres" (starting voussoirs), "claves" (key bricks), ... are the most important motifs of the building construction and composition. According to the technical and formal trade-off that has been accepted we shall find different arch forms: "straight", "circular", "curved" and "mixed" (curved plus straight lines). Within these forms, we can also find different constructive organizations: "de roscas" (ring arches), "aparejados" (bonded arches), and "de hojas" (ring-leaved arches). All this together with ornamental brick mouldings.

The expressive richness of the technical-formal discourse of the arch acquires greater extent because it is possible to use the brick grammar in several planes, that go from the arch's "guardapolvos volados" (projecting arch rings), till the "arquivoltas" (sunken arch rings) which give to the opening a horn-like depth, going through the own arch's "front" on the wall surface.

In all arches, the starting unit deserves special attention, together with the "buttresses" and the "key closing", either with "single-unit voussoirs" or formed by several bricks, "fishbone-like", "indented", "purse-like", etc. (See Figure 9).

The voussoirs are made with great care, observing the arch geometric characteristics, controlling either the distribution of the varying width of the joints, or the different shape of the voussoirs.

It is common to create a frame around the arch, called "alfiz", enriching it with some ornamental brickwork.

Due to the evolution experimented by these two themes (the load-bearing wall, and the arch), the later architecture will abandon these constructive techniques, and this formal repertoire. New techniques and materials will be used, leaving aside the evolution possibilities of the brickwork masonry.

This first one, because it becomes a closing wall, made usually of two leaves, lighter and lighter, the resistant frame being separated from the masonry.

The second one, due to the appearance of lintels, which substitute the arch, thanks to their bending strength capability.

Already in the XXth century, steel becomes decidedly part of architecture; laminated steel and reinforced concrete frames revolution the way of building. The tensile strength of these new building materials make it possible to change the rational vertical composition of the façade imposed by the solid/void rhythm, arches and buttresses, substituting it by an horizontal composition for the treatment of the masonry openings, whose construction had been freed from structural strength.

Only now, almost entering the XXIst century, there is again an appreciation of the masonry values, combining steel with masonry materials wisely, enriching its qualities through the use of "reinforced masonry".

However, these changes don't make us to forget our admiration, with some homesickness, of the work carried out by so many Architects and Master Craftsmen who devoted their history and time to a work often anonymous and little valued, searching the maximum expressivity with brickworks, following the schemes of a modular element. This paper renders due homage to them.

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