REFLECTIONS ON THE USE OF ARCHITECTURAL CERAMICS IN EXTERIORS

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1. ABSTRACT

Ceramics in their different sizes and characteristics provide a wide range of possibilities regarding their applications as wall cladding and flooring both in interiors and exteriors.

Despite the technical qualities of the product, whose use enables resolving different service situations, in our geographic environment we hardly find any ceramic tilings outside the conventional applications of bathrooms, kitchens and flooring.

This report seeks to identify some of the reasons why this material, which is widely manufactured in Castellón finds scarce use as cladding in exteriors.

2. INTRODUCTION

Since it was first used as fired clay, ceramics has undergone an important evolution until reaching the wide range of products that the industry offers us at the present time.

On analysing any of the catalogues of ceramic products to be found in the market, the great variety of existing products in the marketplace becomes evident. These products offer us many possibilities with regard to sizes and characteristic, suggesting a broad range of applications as floor and wall tilings, in interiors as exteriors.

However a simple visit to the towns in our surrounding leads to quite a different conclusion, differing from that in other countries. Most ceramic tile applications focus on bathrooms and kitchens, as cladding or flooring, in some cases together with some other specific applications as coverings in domains with special uses, and in some facade decorations.

Its use as facade material with decorative functions in past eras has now been taken over by applications in floor and wall tilings, basically in interior design. Use on facades has been relegated to some isolated elements of a decorative nature.

With a view to analysing the reasons for these changes, a brief historical introduction is presented to set out the different uses that have arisen throughout history. It similarly seems interesting to briefly review the products that the industry offers us, as well as the current state of architectural ceramics and their applications. Lastly, by analysing the causes that condition ceramic use and making a comparative study with other cladding materials, it is attempted to identify the reasons that have led to the current situation.

3. CERAMIC USE: HISTORY AND GEOGRAPHY

The evolution of ceramics goes back to the year 4000 B.C. in Egypt; however ceramic tiles were used for the first time as mural decorations around 2700 B.C. in the tombs of the Egyptian Pharaohs.

The Marduk Dragon in Mesopotamia, dating back to the year 604 B.C., is the exterior oldest terra cotta facing that is still conserved.

The spread of ceramics is due to the diffusion of Arabian architecture, which uses ceramic materials as vertical cladding and flooring. One of the moments of greatest splendour were the tilings of the Nazari palaces with ceramic dadoes and flooring.

Fig. 1: XVIIIth century floor, Archpriest Church in Sant Mateu. Castellón.

This preference of Islamic architecture for ceramic tilings led to its spread throughout the areas of Islamic influence, including great part of Europe and Asia.

After a slow decline of architectural ceramics, with the rise of industrial processes, in the XIXth century the use of ceramics as a material for cladding interiors and exteriors appeared again. Its culminating moment was reached with modernist architecture of the end of the XIXth and beginning of the XXth century.

Fig. 2: Pinnacles of the Sagrada Familia. Continuers of the work of Gaudí. End XXth century. Barcelona.

Thus, after the famous Nolla mosaics, one of the moments of highest splendour is found in modernist architecture, where ceramics were used for internal as well as exterior claddings, exploiting the material's vast chromatic possibilities.

This use, based on geometric combinations of plain tiles or decorated tiles, has found in Gaudí and in those continuing his work, one of the most singular representatives of the use of tesserae in forming the so-called "trencadís" (compositions using tile fragments).

After this period of splendour, a new decline set in, limiting ceramic uses in exteriors to skirtings or on ground floors, with aesthetically not very interesting products from our point of view. Similarly, the only persisting use of traditional architecture is in cladding the undersides of jutting balconies.

With the technological improvements that have allowed making higher performing products, tile uses have switched from vertical tilings in exteriors to interior and exterior flooring, with satisfactory results for heavy-duty uses. Their traditional uses as decorative elements on facades have since become minimal.

Thus, according to R. P. Goldberg *"with regard to modern building facades, ceramic tiles have had limited decorative use till now, due to the rather unsatisfactory results of past installations"*. It will be attempted to analyse this circumstance below, trying to provide an explanation for the current situation.

Fig. 3 : Modernist architecture. Casa de les Cigonyes.1912. Plaza de la Independencia. Castellón.

4. CURRENT STATE OF CERAMIC USE

Contrary to what happened at other historical moments, if we stop a moment to observe our cities at the present time, we will notice at once that ceramic uses are relegated to bathroom and kitchen tilings together with floorings, their use in exteriors being almost non-existent. This circumstance might be of some concern, even more so in a geographic environment considered as one of the major producers of ceramic floor and wall tiles.

In other geographic contexts however, different applications can be found from those we are accustomed to, such as outside claddings on buildings of great height. This is the case of the post-modern architecture of some North American, Brazilian or Southeast Asian cities, and even in some towns in the north of Europe.

If we analyse trade publications in architecture considered as reference points for current trends, ceramic usage is found to be quite minor, ceramics being used just in a few works as facing material, usually remaining a domestic material that hardly appears in journals on architecture, though it does in interior design magazines.

Thus, since the magnificent use made by Gaudí or the modernist architects of the turn of the XXth century of these ceramic materials, little progress has been made. There have only been a few isolated

Fig. 4 and 5: Current buildings with fair-face brick facades and stone painting. Castellón.

attempts such as Walden 7 or the Urquinaona Tower, in some cases successfully but in others, with important failures.

5. RANGE OF PRODUCTS AND INSTALLATION TECHNIQUES

Considering the different standards, guides or manuals that typify and classify ceramic products, at the present time we can find a great variety of materials. Of these, in the field of ceramic floor and wall tiles, the following are to be noted: porous wall tiles, stoneware flooring, porcelain tile, rustic stoneware, and terra cotta tiles.

Their characteristics are very different, both with regard to their aesthetic appearance and to their technical properties. Therefore, each is suited for a given application and specific fixing techniques.

Similarly, installation techniques have evolved remarkably from traditional thick bed mortar fixing to thin bed fixing with different types of adhesives, and the possible use of dry fastening systems.

Thick bed fixing	Cement mortars. "Bastard" mortars.
Thin bed fixing	Cementitious adhesives. Dispersion adhesives. Reaction resin adhesives.
Dry fixing	Mechanical fastening systems with special pieces.

Obviously the use of the different materials, as well as the characteristics of the background onto which the tiling is to be installed, will condition the use of one adhesive system or another, or of mechanical fastening.

It seems logical to think that any covering that we wish to solve with a ceramic finish will have its suitable material, and its appropriate installation technique. Therefore, technology will be able to provide an answer to the problems that are posed in the different applications of ceramic materials.

6. CAUSES THAT CONDITION CERAMIC USE

In attempting to seek the reasons for this scarce use of ceramic materials, we will need to analyse the factors that could cause or lead to this tendency.

Lack of knowledge of the products that the ceramic industry offers could be one of the causes of its scarce use.

Analogously, other reasons could be technical deficiencies of the material or of the installation systems together with the difficulty of executing these tilings, and the shortage of skilled tile fixers.

Lastly, another reasons for such minor use could be the aesthetic finish and a scarce social acceptance as facade cladding material, linked in recent times with tile use in low class housing.

Otherwise, economic factors might also tip the scales in favour of other less expensive materials than properly installed ceramics.

KNOWLEDGE OF THE PRODUCT

The recent elaboration and popularisation of the Tile Installation Project, and the Ceramic Tile Guide, together with other manuals and guides have contributed notably to the knowledge of the characteristics of the ceramic products at present on the market.

Their characteristics are very different as regards their aesthetic appearance and their technical properties. Thus each is suited for certain applications and specific installation techniques.

Moreover, the frequent trade fairs of the ceramic sector, CEVISAMA in the case of Valencia, are a suitable stage for the presentation of new products.

For these reasons in the ceramic sector tile fixers, specifiers and users have many sources of information for knowledge of the different materials. And this is providing a better understanding of the different ceramic products for technicians directly involved in specification and installation, as well as for architects and technical building directors.

However this is not the case with tile fixing systems, on which information is also available, but which in some cases is found to be insufficient given the complexity of using certain materials that respond to hidden formulations, which only the producer knows, and regarding which only virtues are highlighted. For this reason, in these cases we inevitably need to trust the good advice of the product's producer or supplier.

As has already been indicated previously, the selection of ceramic materials will depend on the demands of a given service situation, and this material, together with the characteristics of the background onto which it is to be installed, will condition the selection of the adhesive or mechanical tile fastening system.

However, the installation system or the suitable adhesive is always considered a secondary decision, it being the ceramic material that predominates, since this will appear as the finish.

TECHNICAL DEFICIENCIES AND INSTALLATION DIFFICULTY

Linked with the above, the difficulties in specifying fixing materials leads us to one of the most significant problems, the difficulty of tile installation and lack of knowledge regarding the appropriate techniques for correct application.

It seems clear that the ceramic product as well as the group of adhesive materials or mechanical fastening systems do not have any technical deficiencies when it comes to solving any service situations in which a tiling or ceramic flooring is to be installed, in interiors and in exteriors.

The difficulty lies in finding the right material and its appropriate installation. In each case there will be some suitable materials and other unsuitable ones, which if used can cause tiling failure.

The fixing technique will be even more important. Good material incorrectly installed inevitably produces bad tiling. In this sense, factors such as the compositional breakdown of the facade, planning of expansion joints and their thickness, separation between tiles or the thickness of the adhesive material will be of special interest. These should allow compatibility of movement between the background and the tiling: thermal expansion, structural deformation, rheological deformation, etc.

The greatest complexity and the biggest responsibility as regards this problem lies in the selection of the adhesive material and the fixing technique. An inadequate election of the material can lead to tiling failure, but an incorrect fixing system especially in high-rise facades inevitably leads to failure or detachment of the ceramic tiles and therefore not only to tiling failure but to a problem of safety for passers-by.

Though the fixing system is of vital importance, it is one of the least known aspects of ceramics, and hardly recognisable after the tiling has been installed.

By way of note, the substantial difference may be highlighted between fixing small-size tiles, which can be installed perfectly well with an adhesive, and large-size tiles, where the use of mechanical anchoring systems should be considered, obviously requiring ceramic materials that allow this type of fastening.

Furthermore, the lack of a tradition in the tile fixer trade with knowledge of the specifics of using ceramics in facades could be another of the factors that have conditioned its scarce use. That tradition, which has already been lost, had solved the fixing of small-size pieces, but not of large sizes.

AESTHETIC RESULT

"It had a great variety of colours and replaced the coloured marbles used by the oriental peoples to embellish their houses". (Ibn Sa,Id, before 1240-41)

Reading this quote, one could reflect on the excellent aesthetic qualities of ceramics, however, though at the present time there is a wide range of products, these, together with the appearance of the finished tiling, do not respond to current architectural tendencies.

Analysing current building facade finishes we can find a great variety of possibilities, from continuous facings to facades made up of large prefabricated panels.

In continuous facings we can highlight the concrete finishes, single-layer mortars or mortar renders with paint finishes. Some finishes are built up of small-sized items such as fair-face brick and some ceramic tilings can also be considered formally as continuous claddings.

Fig. 6: Continuous facade of fair-face brickwork. Chamber of Commerce. Castellón.1992.

Fig. 7: Mixed facade of ceramic and stone cladding. ASCER building. Castellón. 1995.

Fig. 8: Facade of large prefabricated panels. IMPIVA building. Castellón. 1995.

At the other extreme there are the large-size panels of plastic, metal or wood, appearing as such, with the different elements being perfectly visible even from great distances.

These large-size claddings require modulating all the items to avoid needing to use trims or cutting up pieces of a single size.

Between these two extremes, we find a series of claddings built up of pieces of intermediate sizes, which frequently present conceptual problems for understanding them as continuous or discontinuous coverings.

The facades made with ceramic tiles need to follow a modulation, and in turn also exhibit the difficulty of being conceived as a continuous or discontinuous covering, since the pieces are frequently too large to consider them a continuous facing and too small to consider them as panels with an identity of their own. Evidently this circumstance will depend on the tile sizes used, which range from wall tiles measuring 10x10, to large porcelain tiles with 1cm grout joints.

On the other hand, their use in past decades for cladding the facades of low class housing, with aesthetic results that we now find rather inappropriate, has led to them being considered socially as low prestige materials. Ceramics have only been used as a noble material in a few up-market houses, but generally in small sizes with decorative functions, at the present time involving high labour costs.

Fig. 9: Facade clad with ceramic tiles. House in Sant Mateu. Castellón.

7. COMPARATIVE STUDY WITH OTHER MATERIALS

In the design of a facade or flooring, technical demands due to a concrete service situation and formal or aesthetic demands both play a role in permitting the use of different coverings.

From this starting point, a study can be undertaken of the different alternatives in order to choose an appropriate material and system.

In this sense, we can establish some general classifications of facade coverings, such as: continuous or discontinuous, natural or artificial, claddings or brickwork, or even the implications that cladding failure can have.

CONTINUOUS OR DISCONTINUOUS TILINGS

The first classification, already discussed previously, distinguishes between continuous and discontinuous. Of these, it should be noted that both cases respond to the technical demands of a facing, but with certain aesthetic constraints. Each imposes its own compositional laws: thus ceramics, as a discontinuous element requires modulation of the facing according to the size used, establishing some movement joints and inevitable grout joints between the pieces, which can hardly be hidden.

Therefore when we think of a ceramic facing, we should think of a cladding with discontinuities and we should design the facing with these.

Fig. 10: Facade of porcelain tile. El Puig. Valencia.

NATURAL OR ARTIFICIAL CLADDINGS

In contrast, the distinction between natural (stone) and artificial (ceramic) claddings is rather more conditioned by social factors than by technical ones. Obviously, an artificial material such as stoneware performs much better than most stone materials used as facings, however socially natural stone is considered a nobler or more prestigious cladding.

It is evidently necessary to indicate certain exceptions; the ceramic facades of modernist architecture of the wealthiest classes have a much greater prestige than stone coverings. The cost is also much higher, as a direct consequence of the great amount of labour required. The following quote may be recalled here:

"Granite requires great work to extract it from the mountain, great work to transport it to its destination, work to give it its proper form, work to provide it with a pleasant appearance by polishing and burnishing. And before a wall of polished granite, our heart will experience a respectful heave. Because of the material? No, because of the human Work." (Aldof Loos 1898)

Moreover, if we analyse the most noteworthy buildings in our cities, public buildings or even the offices of some ceramic companies, it can be observed that in the

search for greater luxury, stone materials are sought, whereas when modernity is desired, facades with lightweight wooden or metal panels are sought.

Fig. 11: Office building facade clad with natural stone, painted metal panels and glass.

CLADDING OR BRICKWORK MATERIALS

The consideration of brickwork materials that provide a finish or materials that are exclusively cladding materials such as ceramic tiles is also relevant, because of their cost, as well as the ease of installation and minor risk of later problems.

Thus, we see that on comparing ceramics with other facade materials such as stone coverings, single-layer mortars, fair-face brickwork, etc., in most cases the ceramic has more conditioning factors, with a similar performance.

Fig. 12: Office building facade with fair-face brickwork and ceramic tiles..

With regard to flooring, it could equally be stated that depending on the intended use, the selected material will be either one or another, ranging from terrazzo to natural stone, via ceramics. In general terms, stone and fundamentally granite will be installed in the buildings considered most luxurious or having best technical performance, while terrazzo will go into the most modest buildings and porcelain tile for some special applications.

CONSEQUENCES OF CLADDING FAILURE

Cladding failure, either because of the material or because of the installation system, will never be desirable. However for each of the facings we have previously dealt with, this will have different implications.

Thus, while in a continuous facing such as render, stucco or painting, the consequences will only be of an aesthetic nature, in a discontinuous facing, be it stone or ceramic, the consequences can be much more serious, because detachment of the pieces making up the cladding entails a risk for public health.

In contrast, large size claddings do not have this problem, since they use mechanical fastening systems as is frequently the case with stone slabs. These provide greater safety because a much more profoundly studied, tested system is involved, which is transparent in its working, than fixing with adhesives.

7. CONCLUSIONS

Having analysed some of the possible causes that have led to the proven fact of the scarce use of ceramics for cladding or as flooring in exteriors, we can indicate the reasons that seem most likely:

- Ceramic materials, as well as the mortars, adhesives or dry installation systems present no technical problems; the difficulty lies in the selection of the system and in its installation.
- There is a lack of knowledge of the installation systems and a shortage of skilled workers for installing ceramic tilings on facades.
- The consequences are very serious in the event of cladding failure, and this is therefore an important responsibility for the technicians, which cannot be accepted in every case.
- Socially ceramic tile is not one of the favourite materials for covering facades; it is undervalued because of aesthetically unfortunate applications.
- The sizes that are frequently used, because of their dimensions, bring with them many conditioning factors in facade design.
- The high labour cost conditions the use of small-size pieces.

Thus, some of the possible actions aimed at promoting ceramics in these specific uses could be as follows:

- Dissemination amongst technicians and tile fixers of fixing techniques and of the characteristics of adhesive materials.
- The design of small-size tiles for fixing on facades by means of adhesives, and of other larger size ones for fastening by mechanical systems.
- The promotion of ceramic applications in public buildings and in the representative constructions of the ceramic sector, rewarding good technical and aesthetic results.

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