CERAMIC ARCHITECTURES

DIGITAL PLATFORM FOR THE TRANSFER OF CERAMIC INNOVATIONS IN ARCHITECTURE

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1. ABSTRACT

The Spanish industry stands out because of its international leadership in sustainability, technology and design, and because of its willingness to collaborate with influential architects and technicians in the development of unique proposals. However, the industry has difficulties in getting across this capacity to meet challenges with excellence, since there are no specific channels of knowledge transfer between the productive and professional sectors.

The lack of competitive dissemination media to support this determined commitment by the Spanish ceramic sector is even more incomprehensible given the value afforded to architecture and design as innovation drivers. Aware of the important benefits which bridging this gap would yield, the Chair in Ceramics at Valencia has built a bilingual digital platform (English / Spanish), for the creation of a database of works that use ceramics as the leading material in their buildings.

Aimed at technicians, students and researchers in architecture and design, CERAMIC ARCHITECTURES (http://www.ceramicarchitectures.com) / ARQUITECTURAS CERÁMICAS (www.arquiteturasceramicas.com) has been conceived as a specialist dissemination medium for gradually providing sound knowledge about the characteristics of ceramic materials and their applications in the field of architecture.

2. NETWORK OF CHAIRS IN CERAMICS

The boom experienced in Spanish science internationally, thanks to the commitment to research and innovation over the last two decades, has been essential to its balanced, diversified and sustainable progress, but this strategy based on knowledge economy still needs more in-depth relations between science and technology. To achieve this aim, knowledge transfer instruments —often relegated to a secondary plane—need to be created, because they are the vehicle which enables society to be made aware of the importance of the research undertaken, thus increasing understanding about this unquestionable activity.

Over recent years, some of the weaknesses in the system have been rectified, by promoting sponsorship in science, technology and innovation, and fostering the contribution of the private sector in the funding and implementation of RDI activities. Currently and thanks to this strategy, Spanish universities have among their priority actions an extensive programme of approximation to the business and industrial sectors, Chairs in Business being the most important model for the strong commitment established between both parties.

In response to this aim and in order to promote new ways for developing ceramic materials applied to architecture, the Spanish Association of Tile Manufacturers (Asociación Española de Fabricantes de Azulejos y Pavimentos Cerámicos, ASCER), since 2005, has fostered with its sponsorship the establishment of a Network of Chairs (http://www.catedraceramica.es) comprising Schools of Architecture at the Universities of Alicante, CIU, Madrid Polytechnic and Valencia Polytechnic, and the School of Building Engineering at Universidad Jaume I, Castellón. Once this link was consolidated, and motivated by the presence of the Spanish ceramic industry internationally, the Association decided to widen it in 2010 by establishing collaborative projects with the Graduate School of Design at the University of Harvard, the Technische Universität, Darmstadt and the School of Architecture at the University of Liverpool.

Currently, with ongoing advice from the Ceramic Technology Institute (Instituto de Tecnología Cerámica, ITC), each of the Chairs is carrying out collaborative and complementary research aimed at conducting in-depth study in this field from different areas of knowledge:

CC Alicante	Energy efficiency and sustainability (Dept. of Installations)
CC Barcelona	Product design and development (Dept. of Building)
CC Castellón	Technical and standards regulations (Dept. of Building)
CC Madrid	Theory of architecture and projects. (Dept. of Projects)
CC Valencia	Innovation and knowledge transfer (Dept. of Projects)
CC Harvard	Digital technologies and robotic production (Dept. of Technology)
CC Liverpool	Daylight control and protection (Dept. of Sustainability)

3. CERAMICS, INNOVATION AND ARCHITECTURE

The soft origin of ceramics, hardened in subsequent processes, is one of its most attractive qualities since it provides ceramics with the complete range for shaping and formulating its technical characteristics. This peculiarity has turned it into the ideal material for continuous reprocessing and, if the extraordinary lessons that tradition provides are taken into consideration, it can be said that it has never stopped evolving over time and has always found the right way of doing so, contributing to the solution of new problems or proposing innovative ways for them to be used.

Currently, this specialization is not only far from exhausted, but also we find ourselves immersed in a technological and creative revolution similar to the one occurring in other areas of the construction industry. Technological, because of the industrial modernization undertaken in the Spanish ceramic sector in order to optimize the resources used, achieving, together with the Italian one, the best energy efficiency ratio in the world per unit of production; and creative, because of the gradual introduction of new digital technologies applied to the design and production process of advanced ceramic materials, which makes them ideal for contributing to the development of sustainable solutions.

Due to their extraordinary qualities, the use of ceramics is experiencing a considerable increase in recent architectural output, which requires it to adapt to new technological and environmental paradigms and to innovate in practically all the stages of the process. On many occasions, these innovations are being proposed by the industrial sector through the launching of new products. But on many others, these are brought about by the professional sector by having to design specific pieces to solve the needs required in projects.

Despite the fact that in recent years there has been a boom in significant works that use unique ceramic materials and, at the moment, it is where the most interesting innovations are taking place; the enormous potential that new ceramics provide is yet to be discovered.

4. NEW CHANNEL OF KNOWLEDGE TRANSFER

The need for implementing architecture that is innovative, responsible and aware of social, cultural, economic and environmental factors opens up a new stage in which it is essential to find channels for bringing the latest advances into the marketplace.

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The lack of competitive dissemination media to back this determined commitment by the Spanish ceramic sector is even more incomprehensible given the value afforded to architecture and design as innovation drivers. Aware of the important benefits which bridging this socio-economic gap would yield, in 2015, the Chair in Ceramics at Valencia decided to spur the creation of a bilingual (English / Spanish) digital platform, in order to compile a specialised database of works using ceramics as their leading material in their buildings.

Aimed at technicians, students and researchers in architecture and design, CERAMICS ARCHITECTURES / ARQUITECTURAS CERÁMICAS (http://www.ceramicarchitectures.com) has been conceived as a specialised dissemination medium for gradually providing sound knowledge about the characteristics of ceramic materials and their applications in the field of architecture.

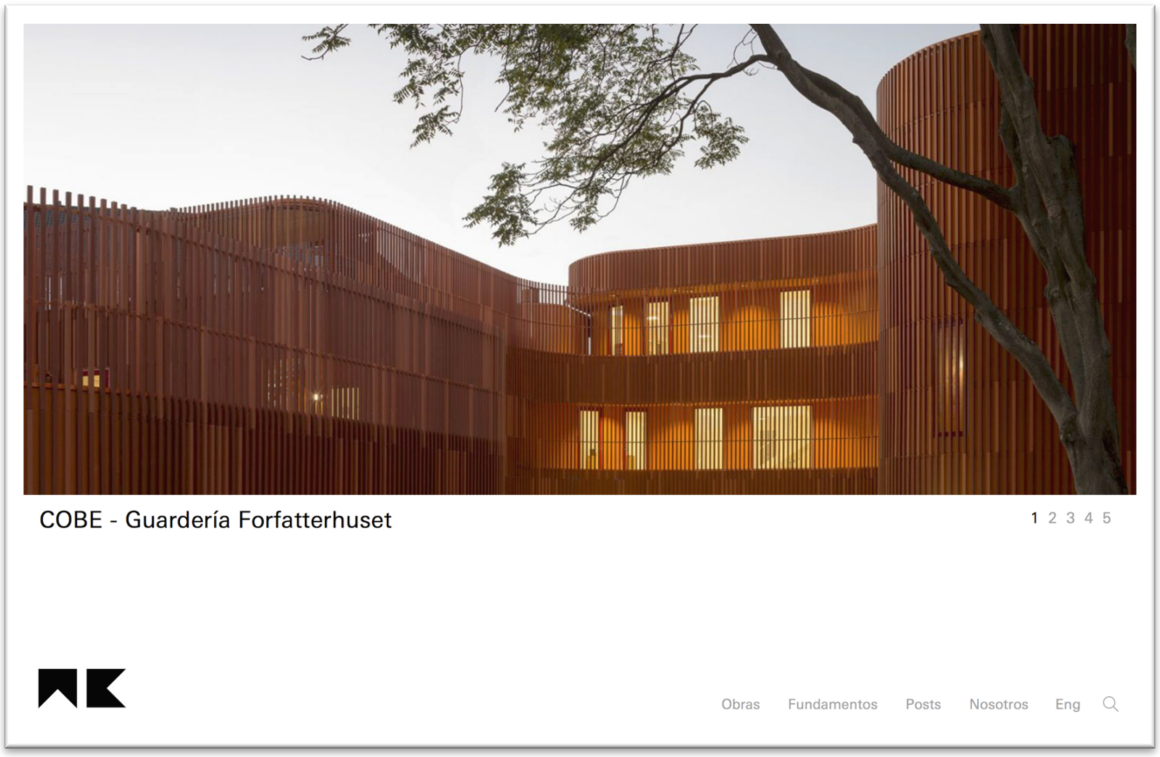

Figure 1. *HOME page of the Ceramic Architectures digital platform*

In this first stage of the digital platform, a set of important national and international works carried out since the year 2000 have been documented and the basics which enable greater in-depth knowledge about ceramic products have been defined. The main data has been structured around these two major areas.

4.1. WORKS

In this chapter about dynamic content, in order to construct a specialised database, a set of projects selected for their quality and interest, and which use ceramics as the leading material in their buildings, has been compiled. Depending on the particular interest of the user, search fields have been established using the data relating to the works: author, use, location and date; and the ceramic material: position, shape, surface treatment and product.

The area devoted to each of the projects selected has been set out in four sections which allow them to be studied quickly and clearly.

- *Images*. Photographic sample of the built project describing the relationship between architecture and ceramic material.
- *Drawings*. Set of graphic documents (ground plans, cross sections, axonometric projections and scale models) which enable the understanding and the analysis of the project.
- *Details*. Information about the ceramic element, installation pattern, manufacturing process of the pieces and implementation on site.
- + *Info*. Data sheet of the project, descriptive and building report, as well as the inclusion of interactive cartography for locating the project and relating it to the rest of the works.

4.2. FUNDAMENTALS

Using language accessible to non-specialist users, in this chapter of fixed content the main industrial processes used in tile production are described, as well as the classification criteria, providing clear, concise and rigorous information inviting influential technicians to delve deeper into the knowledge about the material and helping them to define their technical characteristics.

In order to speed up access to the content, chapter information is set out in five sections relating to the various stages of the productive process:

- *Raw Materials*. List of the major components used and their corresponding milling processes.
- *Shaping*. Description of moulding techniques used by the ceramics industry in the shaping of products.
- *Surface Treatment*. Selection of the most common procedures used for decorating pieces.
- *Firing*. Definition of the hardening process of the material and types of kilns used.
- *Products*. Classification of ceramic coverings according to technical and operational characteristics of the material.

These two major chapters devoted to Works and Fundamentals are complemented by another two sections devoted to news linked to ceramic materials and to reporting on who we are.

- *Posts*. Catalogue of events and latest news relating to ceramic materials, listed in several categories according to type: events, collocation, prizes, research, publications and conferences.
- *About Us*. Complementary information defining the content of the digital platform and at whom it is aimed. In this section, there is a sub-section where users are invited to take part by sending in their projects.

Since its launch two years ago, the incredible potential underlying this initiative has been shown. It has also been shown that it has justified undertaking the important development of the content and the functionality throughout this last year, in order to position it as an undisputed international reference forum due to the relevance of its content. One of the most interesting changes has been the adaptation of the platform to the latest mobile devices, such as smartphones or tablets, through the responsive conversion of the whole website such that it is simpler and more intuitive to consult from anywhere.

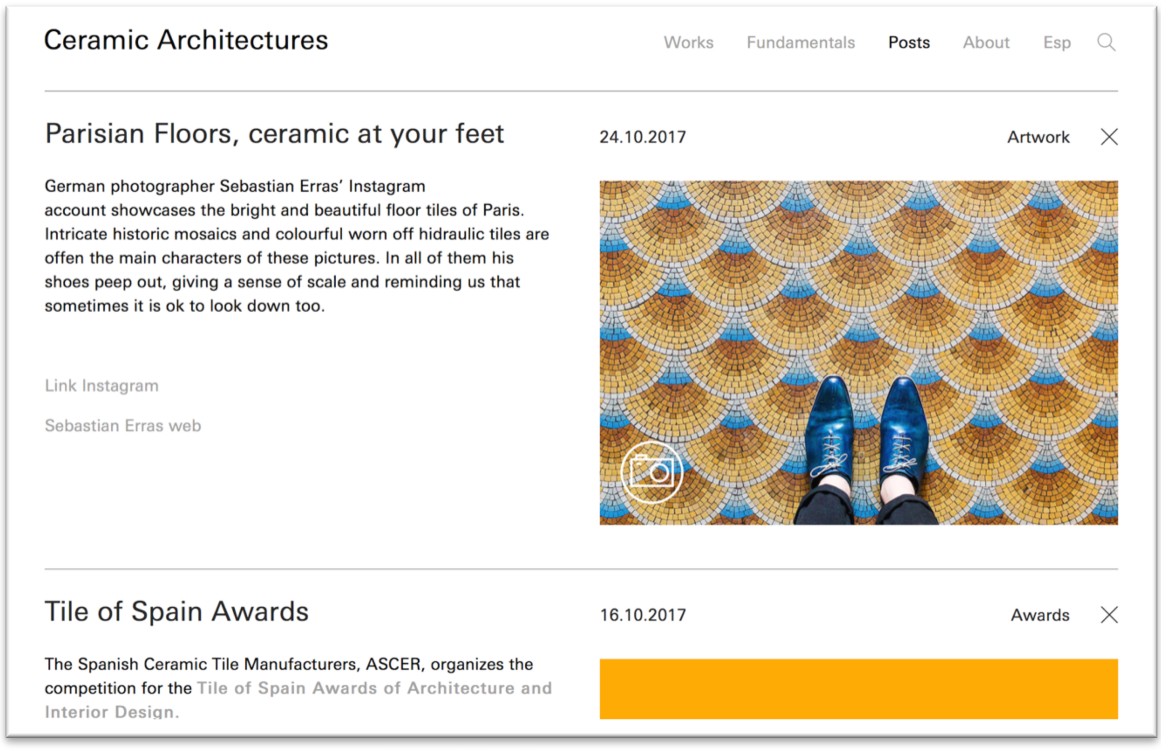

Figure 2. *POSTS section devoted to events and latest news*

5. SCIENTIFIC AND TECHNICAL, ECONOMIC AND SOCIAL IMPACT

It is considered that the international positioning of the digital platform will contribute to the development of the information society, defined as a priority objective in the Strategy Action in the Economy and Digital Society of the National Research Plan, which pursues boosting the adoption of technologies that enable the economy and society to be changed in the direction of a digital environment. It will also yield important social and economic benefits to the Spanish ceramic industry, by making available a specific instrument that values the suitability of these materials for the development of innovative, responsible and sustainable architecture.

5.1. SCIENTIFIC AND TECHNICAL IMPACT

Internationally relevant scientific and technical advances are foreseen, since it is a pioneering project for determining the current state of innovations linked to ceramic materials applied to architecture, by examining recent national and international undertakings, distinguished by their unquestionable quality and backed by specialist critics.

In order to transfer and preserve the collective knowledge developed to create these new ceramics, the most important contributions linked to each of the stages required for implementing the digital platform must be highlighted.

Selection Stage:

- Identification of national and international projects with high added value, in which new ceramic products and/or innovative forms of using them are present.
- Definition of the innovations implemented in the various stages of the productive process: raw materials, moulding, surface treatment, firing, post-production.
- Classification of innovations according to their operational performance, formal qualities and symbolic meanings.

Documentation Stage:

- Creation of a ceramic library of unique bodies, determining their technical performance, geometric definition, covering patterns and installation systems.
- Production of a video library recording the various moulding processes of the new ceramics in order to preserve the technical knowledge developed
- Photographic register of product and development of three-dimensional digital models, for 3D interactive viewing from any angle.

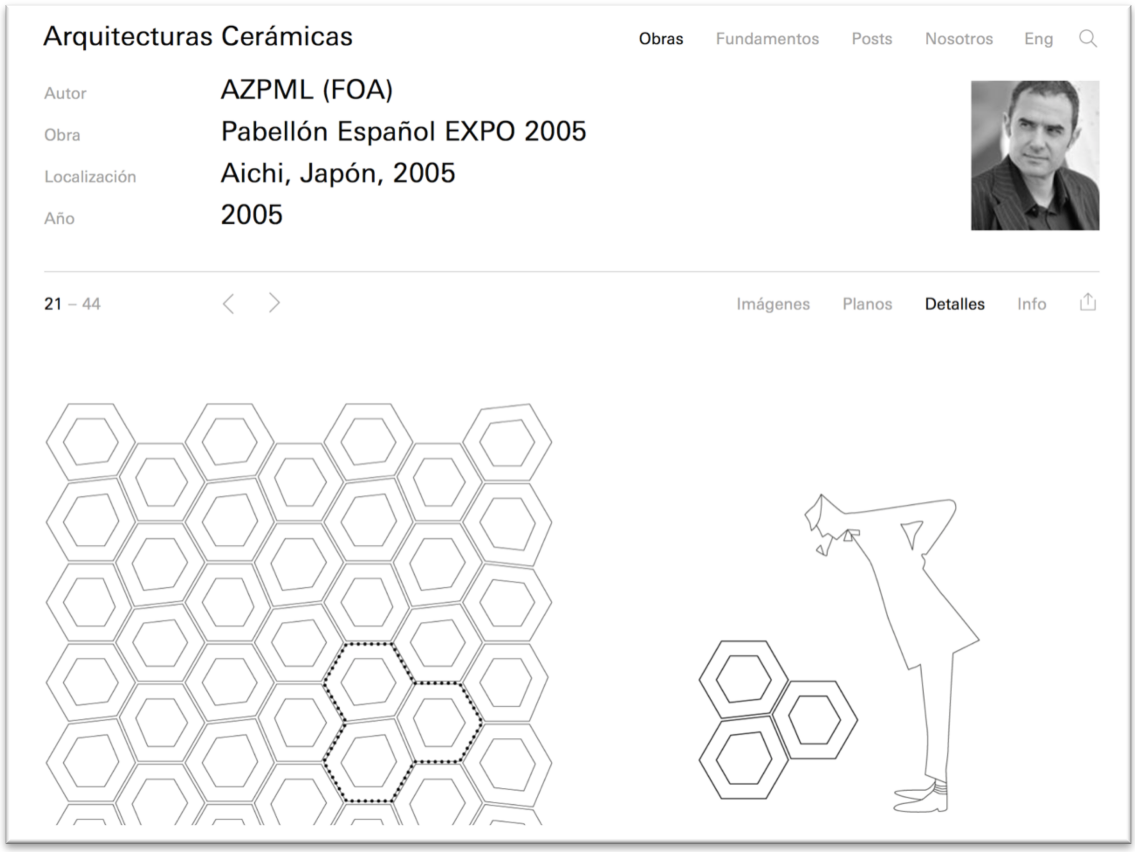

Figure 3. *DETAILS section where the pattern and scale of the ceramic body are shown*

Dissemination Stage:

- Creation of an open access database, specialising in contemporary architecture, which uses ceramics as leading material.
- Archive of currently produced innovations, both in new ceramic products proposed by the industry and the way of utilising them.
- Transfer of the results achieved to the research, industrial and professional production sectors in architecture and design.

5.2. ECONOMIC IMPACT

Due to the latest crisis, a significant shrinkage in the consumption of ceramics has taken place in the domestic market. One of the aims is to activate said market as the recovery of the Spanish economy strengthens. Despite these difficulties, the tile sector has a solid underpinning and an indisputable future thanks to its high degree of internationalisation and the substantial investment in RDI, its priority actions being to maintain Spanish ceramic products at the forefront of innovation, sustainability and design.

Aware of this reality, the launching of the platform could contribute to the development of the economic ceramic sector since it is estimated that:

- Developing an instrument for knowledge transfer in the productive and professional sector, which gives prestige to ceramic materials applied to architecture, will activate their consumption and bring real benefits to the Spanish ceramic industry.
- Positioning the capacity for design of new materials and systems by considering the technological advances and industrial innovation processes will enable competitiveness and growth in the Spanish ceramic sector to be boosted, by placing it at the forefront of the international market.

5.3. SOCIAL IMPACT

The digital platform offers a great opportunity for making the technical advances that are currently taking place known and for studying in depth the exceptional plastic qualities of ceramic materials. However, a warning must be given regarding how, in the latest crisis, part of the industry linked to tile production has been destroyed; this part possessed incalculable knowledge which has been lost with its disappearance. A paradigm change is required to prevent the squandering of a heritage so deeply rooted in its region and one which belongs to the identity traits of its people.

For all these reasons, the project is considered to have great social relevance, since amongst its aims it proposes:

- To vindicate the qualities of ceramics applied to architecture through the study of projects backed by their unquestionable quality and unanimous recognition by specialist critics, using the new generation of services offered by ICTs, which enable information to be shared globally.
- To recover the legacy of all the technical, plastic and cultural knowledge used in the development of the operational, formal and symbolic innovations linked to ceramic materials, in order to avoid their loss since it is not usual to pay attention to the importance of their conservation.

6. CONCLUSIONS

Two years after its launch and taking into consideration the research projects which pursue similar ends, we consider that this is a pioneering initiative that vindicates the qualities of a particular material, in this case ceramics, through the study of projects backed by their unquestionable quality and unanimous recognition by specialist critics.

The worked carried out up to now is of undisputed interest to the industrial, professional and scientific sectors, because of the originality of its approach and the partial results obtained, albeit still very limited to the repercussions of some of the innovations arising in these last few years. For this reason, a new stage is opening up, in which it is deemed necessary to broaden the field of study from the innovations arising at the end of the 19th century, the time when industrialised manufacturing processes were developed and which constitute the current basis for ceramic technology, until those which will determine the advanced ceramic materials applied to architecture in the near future are included.

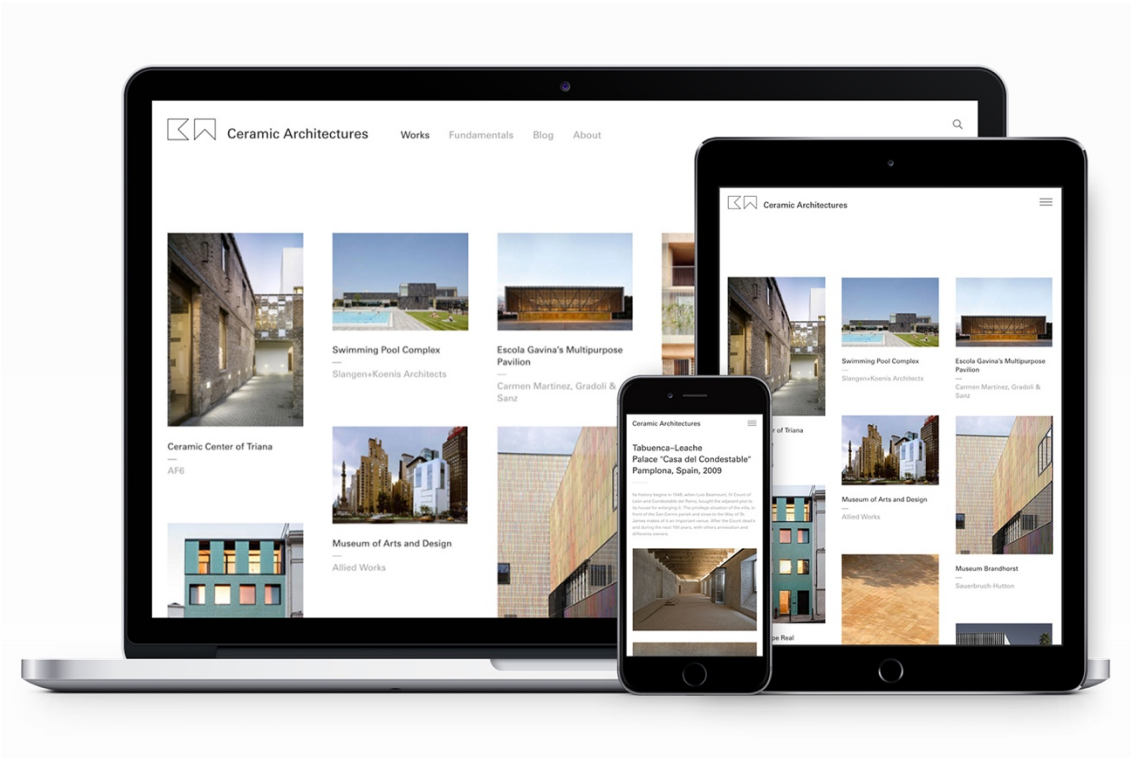

Figure 4. *Adaptation of the digital platform to all mobile devices*

Since starting its activity, the task of the Chair in Ceramics at Valencia has been to determine the innovations arising in ceramic materials applied to architecture, both in manufacturing processes and implementation on site. Driven by the interest arising in the productive and professional sectors, the development of the digital platform CERAMIC ARCHITECTURES is deemed to be extraordinarily relevant for continuing our purpose of transferring the knowledge acquired and contributing, in this way, to the strengthening of Spanish ceramic products, keeping them at the forefront of the international market, and contributing to the development of the information society.

7. ACKNOWLEDGEMENTS

The editorial team of Ceramic Architectures would like to thank all those students who have collaborated with the Valencian Chair of Ceramics for their contribution, since the work undertaken over these years has motivated the creation of this digital platform; as well as the Spanish Ceramic Tile Association (ASCER) for its unconditional support in undertaking the project; and the Ceramics Technology Institute of Castellón for the advice given in the preparation of its content.