# CERAMIC CLASSROOM, A UNIVERSITY LEARNING EXPERIENCE FOR THE TECHNICAL ARCHITECTS OF TOMORROW

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# ABSTRACT

During the 2006/2007 academic year a collaboration agreement was signed by the Spanish Ceramic Tile Manufacturers' Association and Jaume I University to start running a "Ceramic Classroom" in the same way as has been done at other universities under the so-called "Ceramic Chair'. The objectives of this Ceramic Classroom are to make an in-depth study of the ceramic materials used to make tiles and the techniques used for installing them, leading to better quality use of these materials by perfecting the knowledge of the future technicians responsible for specifying them and monitoring their installation.

To do this, beyond the general activities, which included a visit to CEVISAMA by Technical Architecture students, a free-choice subject called Ceramic Cladding Materials has been organised, which has a theoretical component developed through 14 conferences and a practical component in which students do a research project or documentary compilation on some specific aspects of ceramics.

In order to develop the theoretical part, experts from different fields have become involved to cover the history of ceramics and the associated industry, raw materials and manufacturing processes, the resulting materials and their regulatory classification, installation techniques, adhesive materials and malfunctions of the resulting tilings, and lastly, unique applications from both the point of view of manufacturing at the service of architecture, and research for the design of new products.

It was concluded from this training experience that students were very significantly involved in the subject matter. They were certainly made particularly aware of the uses of these materials and given the skills to achieve successful results both from a formal and a technical point of view, leading necessarily to improved quality of ceramic tilings.

*This presentation describes and analyses the content taught and the results of the works carried out by the students.* 

# 1 INTRODUCTION AND HISTORY

As has already been analysed in the paper presented at Qualicer2006, the technicians responsible for ordering and managing the installation of ceramic tilings are given a generalist training at university, meaning ceramic wall and floor tiles are given a relatively low weight as a consequence of the need to cover different materials and construction techniques used habitually in current buildings.

Discipline of the degree	Créditos		Construction Materials	Créditos	Créditos	
Construction Materials	18	8%	Introduction	0,5	3%	
Construction and history	31,5	14%	Properties	2,0	11%	
Basic sciences	21	9%	Natural stones	1,5	8%	
Graphic expression	24	11%	Ceramics and glass	1,5	8%	
Estimates Organisation	130,5	58%	Conglomerates	2,0	11%	
			Conglomerates	1,5	8%	
Installations			Concrete	3,2	18%	
Structure			Metallic materials	2,3	13%	
			Organic materials	2,3	13%	
TOTAL	225	100%	Synthetic materials	1,2	7%	

Table 1.

Table 2.

This means that specific training in ceramic materials accounts for just 0.64% of the training given to a technical architect.

On the other hand, ASCER, the Spanish Tile Manufacturers' Association, has been developing initiatives for some years now to reinforce the training and awareness of architecture students in the field of ceramic wall and floor tiles, and has thus encouraged the creation of ceramic classrooms.

The first of these classrooms was developed at the International University of Catalonia, and was directed by Vicent Sarrablo, the purpose of which was to allow specific training for architectural students in ceramic wall and floor tiles.

Likewise, the University of Alicante created a Ceramic Workshop, and at the Polytechnic University of Valencia a Ceramic Chair, all of which were provided for architecture students.

With the introduction of the Technical Architecture course at the Jaume I University, seeing it was necessary to give specific training to technicians responsible for managing building works in the field of ceramic tilings, the Ceramic Classroom was created, to reinforce the students' activities involving ceramic wall and floor tiles.

With this background, in June 2006 a collaborative agreement was entered into between the Jaume I University and ASCER, which was given the name "Aula Cerámica" or Ceramic Classroom, for the purposes of providing training in the area of ceramics:

- In-depth study and diffusion of the use of ceramic tiles in construction.
- Incorporating technical and practical knowledge of ceramic products and their aesthetic uses in the training provided to future technical architects, focusing the training on traditional materials and showing the latest innovations in the sector.
- Allowing future architects and building professionals to make contact with the business world in general, and the ceramic wall and floor tile sectors in particular.
- Researching into new formats, new products and new applications. Proposal of interesting variations to professional architects and builders and sounding out new markets for manufacturers.
- Giving information about the most representative international buildings where ceramics have been used
- Associating ceramics with new technologies.
- Studying and strengthening the elements making up the architectural heritage built with ceramic wall and floor tiles.
- Strengthening the creation of lines of research referring to the use of ceramic materials in architectural constructions.

#### 2. DEVELOPMENT OF ACTIVITIES

In order to achieve these objectives, beyond serving as a channel for diffusion for all the events related to ceramics produced in the city of Castellón, some specific activities have been developed for technical architecture students.

Among these activities a free choice subject has been developed and entitled "Ceramic Cladding Materials", and complementary activities have been developed in the architectural graphic expression course, including enabling students to visit interesting events for achieving training objectives.

#### 2.1. THE CERAMIC CLADDING MATERIALS SUBJECT

This free-choice subject is worth 4.5 credits, equivalent to 45 hours of learning, and is split into a theory section involving 14 conferences given by experts in the ceramic sector, both researchers and manufacturers, and a practical task performed by the students.

The different subjects covered at the conferences range from raw materials and manufacturing materials to installation on the works and changes undergone by the floor and wall tiles.

## 2.1.1. The historical origins of ceramics

Vicent Estall, director of the Museu de Ceràmica d'Onda (Onda Ceramic Museum), spoke about the historical evolution of ceramics until the beginning of industrialisation. During this talk, he made reference to both the first daily objects

made with ceramics, to the containers and recipients and to the ceramic wall and tiles used since the beginnings of architecture to the present day.

# 2.1.2. Raw materials and manufacturing ceramic materials

Gonzalo Silva from the ITC made an analysis of the raw materials used to manufacture ceramics, as well as the manufacturing processes necessary to obtain the different ceramic wall and floor tile products offered on the market.



Figure 1. Vicent Estall. Samples of ceramic materials.

# 2.1.3. The wall and floor tile industry

Manuel Gonzalez Cudilleiro, who has had a long career in the sector as secretary general of ASCER analysed the current situation of the ceramic industry, to define the current types of product found on the market, with their applications and expressive and functional possibilities.

# 2.1.4. Ceramic materials and regulations

Alejandra Miralles, with her experience on standardisation committees of ceramic products, representing ASCER, explained the classification of different ceramic walls and floor tiles, together with the evolution of the regulations that has taken place and has developed into the current European standards on ceramic materials, both for classifying the materials and the properties it regulates for the purposes of quality control.

# 2.1.5. The Ceramic Tile Guide

Juan José Palencia, guide coordinator, and Gonzalo Silva explained the latest edition of the Ceramic Tile Guide as a tool for choosing and specifying ceramic materials, adhesive, grout and installation systems on works.

# 2.1.6. Systems for installing rigid modular floor and wall tiles

José Luís Porcar, Director of the Ceramic Production Institute, made an analysis of all the rigid modular wall and floor treatments, one of which is ceramics. He compared the advantages and disadvantages of all of these, and in particular the precautions and pathologies relating to tile installation, making special reference to system planning, grouting and appropriate selection of materials.



Figure 2. Alejandra Miralles. Regulatory development.

# 2.1.7. Mortars, adhesives and grouting materials

Ángel Rojano, with his experience in the ceramic adhesive sector, analysed the factors to be taken into account when choosing ceramic adhesives, together with the regulations and other collateral conditioning factors such as dirt and environmental conditions that can lead to the failure of a well-planned solution and with a good selection of materials.

#### 2.1.8. Pathologies in ceramic wall and floor tiles and complaints. Sales scripts

Carlos Soler dealt with the most frequently encountered pathologies facing manufacturers with complaints from users, which are mostly a consequence of a bad choice of materials, or defective installation. He also presented a technical sales script, which highlights the need to give complete, precise information about the floor or wall tile, its applications and the way it must be installed.

# 2.1.9. Installation systems and on-site fitting

The Professional Association of Wall and Floor Tilers, represented by its manager Matías Martínez and Jesús Sánchez, one of its members, showed the view of fixers aware of the need to do quality work, the pathologies encountered when contracting and installing wall and floor tiles as a consequence of the preference for low costs and quick performance as opposed to the quality of the final result.

# 2.1.10. Control of ceramic wall and floor tile jobs

Juan José Palencia and Teresa Gallego analysed the practical guides on ceramic wall and floor tiles and pointed out the gap existing in the field of installation control, showing a diagram of the content that should be featured in a works control guide, as well as the system for developing this control on site, in an efficient manner by the employees in charge of Surveillance of the Work.

# 2.1.11. Ceramic systems for Façades

Carlos Sanchís gave a speech on the different non-conventional systems available for fitting ceramic applications such as raised floors, industrial floors, multi-layer systems and personalised wall and floor tiles, to focus on ceramic façades with different anchoring systems, either visible or hidden, and different direct or mixed adherence systems. He pointed out the virtues of these systems and the drawbacks that can occur in some cases.



Figure 3. Jesús Martínez, PROALSO conference.

# 2.1.12. Manufacturing at the service of architecture

Toni Cumella and Pepe Castellano showed the creations of both companies specialising in unique applications such as the Spanish Pavilion at the Aichi exhibition in 2005 or the future Spanish Pavilion at the Zaragoza 2008 Exposition. They also talked about the possibilities offered by different systems for moulding and creating ceramic tiles, as well as the possibilities provided by the different manufacturing processes.

# 2.1.13. Architecture and ceramics

Javier Mira, with his experience with ALICER, showed all the expressive capabilities of ceramics by showing unique examples of interior and exterior wall and floor tiles. Examples which in many cases have been landmarks in the evolution of ceramic design because of their innovative design and because they have opened up new applications.

# 2.1.14. New ceramic applications for architecture

Javier Portolés showed us the most advanced design strategies of ceramic companies, destined to generate new materials where production and sales are not the core values, rather other parameters, such as quality, exclusive design, customisation for certain social groups, or comfort. He also showed some examples of these new products, including comfortable floor tiles, dry-installed floor tiles, wall and floor tiles for a specific social sector and limited editions of floor and wall tiles.



Figure 4. Ceramics of the Spanish pavilion at the Aichi Expo

# 2.2. STUDENTS' WORK

In addition to attending these teaching sessions, the students developed research works or gathered information on a variety of ceramic subjects, including:

- History, use and selection of tiles
- Raw materials and pressing of ceramic powders
- Ceramic manufacturing process and the resulting products
- Energy saving methods for the ceramic sector
- Porcelain tile
- Selecting ceramic tiles for interior floors
- Installing ceramic floor and wall tiles. Systems
- Comparative study of ceramic and wooden floors
- Thin-set fixing of ceramic tiles
- Adhesives for ceramic wall and floor tiles• Pathologies in wall tiling and flooring
- Controlling ceramic wall and floor tile jobs
- Ceramic wall and floor tile materials
- Analysis of the content of Web pages of ceramic floor tile manufacturers belonging to ASCER
- Ceramics and architecture
- Architectural integration of photovoltaic panels

- Analysis of the information necessary for performing the Analysis of the Life Cycle of ceramic wall and floor tiles
- Ventilated façades

All this is designed for the 35 second-year students taking this subject to receive comprehensive training in the field of ceramic floor and wall tiles, acquiring knowledge directly by attending conferences, through their own research or by searching for information.

## 2.3. VISITS TO CEVISAMA AND CONSTRUMAT

Another of the activities carried out to strengthen training and raise awareness among the students in the ceramic floor and wall tiling area was the visit they made to CEVISAMA, where the students at different stages of their training in Technical Architecture visited, as a group, the PROALSO Tile Fixers' Competition, the ceramic design competition and the institutional stands.

The students also freely visited manufacturers' stands and attended design and architecture conferences.

Likewise, a visit was organised to the International Construction Fair in Barcelona, CONSTRUMAT 2007, where special attention was given to innovations in ceramic wall and floor tiles and their aesthetics.



Figure 5. Technical Architecture Students at Universitat Jaume I. CEVISAMA 2007.

# 2.4. ACTIVITIES IN THE GRAPHIC ARCHITECTURAL EXPRESSION COURSE

It was decided to provide an exercise to raise students' awareness of floor and wall tiles during the first year of the course as part of the Graphic Architectural Expression subject.

This exercise consisted of designing a floor in a space of  $4.00 \times 3.00$  metres with a border of floor tiles and a centre area comprising laid diagonally floor tiles.

To do this the use of two colours of  $40 \times 40$  cm tiles was required.

The results of their work are shown in another presentation at this congress given by teachers Alba Soler and Beatriz Sáez.





## 2.5. STUDENTS' EVALUATION

To determine the students' satisfaction with the Ceramic Cladding Materials subject, a questionnaire was distributed at the final conference to evaluate not only the students' level of satisfaction, but also to discover which subjects had proven most and least interesting to the students:

	Not at all	little	Good	Quite a lot	A lot	Evaluation in themed blocks	Of great importance	Of little im- portance		
Satisfaction with the subject?						History	1	19		
	0	1	9	10	4	Raw Materials	0	17		
Did it meet your expectations?					Manufacturing	0	10			
	0	3	11	8	2	Installing	20	0		
Good organisation?					Unique applications	19	0			
	0	5	7	10	2	New products	17	0		
The three conferences receiving the best assess-					Manufacturing at the services of architecture					
				ss-	Ceramics and Architecture					
menus.						New ceramic applications				

Table 3.

This shows that the students were particularly interested in matters referring to installation and innovations giving rise to new ceramic products or new applications.

With regard to the general assessments it is worth pointing out the high level of satisfaction felt by the students, generally responding to the expectations they had of the subject

To understand the students' evaluation of their visits to CEVISAMA and CONSTRUMAT and the activity carried out in the Graphic Expression subject, no surveys were conducted, however, in both cases the students remember these experiences as intense and say they will not forget them easily.

# 2.6. ACHIEVING THE OBJECTIVES

With all the activities developed throughout the 2006/2007 academic year we believe we have achieved the objectives initially set for raising awareness of ceramics among technical architecture students.

This diffusion was basically among all the students on the Technical Architecture Course at the Jaume I University; it has been intensified for graphic expression students and mainly for the Ceramic Cladding Materials subject, who can certainly now be qualified as experts in ceramic wall and floor tiles.

# 3. FUTURE ACTIVITIES

Planning the activities for future courses take place before thinking about the different levels of training of the students throughout the Technical Architecture course, therefore, for the 2007/2008 course activities are suggested for all final year students, as well as specific activities for each of the courses.

## 3.1. VISIT TO CEVISAMA

Aimed at all the final year students, in the same way as last year this will consist of a visit to the Ceramic and Glass Fair of a group of students that will visit the stands considered to be of most interest because of their contributions to innovation and because of the specialised fitting systems of these wall and floor tiles.

# 3.2. CERAMIC TILING COMPETITION

A ceramic tiling competition is suggested with three levels of difficulty, for students on each of the degree courses:

# **1st Level: first-year students**

Subject: Designing and setting out a ceramic tiling.

The competition will consist of resolving the graphic design of a tiling to provide an edge and the formats of the pieces used.

The presentation will be made to a panel where the solution provided and its virtues will be explained. Smaller number of pieces to be cut, symmetry...

# 2nd Level: second-year students

Subject: Design, setting out and prescribing materials for a ceramic tiling.

The competition will consist of the graphic resolution of the design of a tiling that will consist of a perimeter and the formats of the pieces used, and defining in a brief

report the characteristics of the ceramic materials, fixing materials and grout needed to provide this solution, as well as the constructive solution.

The presentation will be made to a panel and a brief report defining the solution provided and the characteristics of the materials used.

## 3rd Level: third-year students

Subject: Ceramic tiling project.

The competition will consist of providing a specific solution to an outside ceramic tiling, providing design solutions and the documentation referring to the materials, construction solutions, economic valuation and planning the work.

The presentation will be made to one or two panels and a report will be made defining the solution provided with all the information necessary for presenting a tender for the work.

#### 3.3. THE CERAMIC CLADDING MATERIALS SUBJECT

It is expected the free choice subject will be repeated for the 2<sup>nd</sup> year students on the course, placing more emphasis on the subjects relating to installation and new ceramic applications.

The conference programme foreseen is as follows:

- A visit to a ceramic wall and floor tile factory.
- The Ceramic industry and the products it makes.
- Ceramic Tile Guide.
- Installation process system.
- Adhesives and fixing materials.
- PROALSO, demonstrating systems for ceramic installation.
- Visit to CEVISAMA.
- Lecture by an expert from Qualicer on pathologies in ceramic tilings.
- Pathologies in tilings and complaints from manufacturers.
- Control of ceramic wall and floor tile jobs
- Ceramic façade systems.
- Manufacturing at the service of architecture
- Ceramics and the architect in unique applications.
- Architecture and ceramics.
- Seminar on floor and wall tile installations.

In the same way as on the earlier course, the students will do a research or documentation task on ceramic materials, preferentially on installation or singular applications of these floor and wall tiles.

# 4. CONCLUSIONS

As conclusions of the activities carried out during the 2006/2007 course and the plans for the 2007/2008 course, we can indicate that these represent an important quantitative and qualitative increase in the training of future architects in the field of ceramic tilings.

Going back to the initial table of disciplines in the qualification, the Ceramic Cladding Materials subject provides 4.5 of the 225 training credits of the technical architect, accounting for 2% of the training, which is therefore a substantial increase in comparison to the 0.64% of specific training in ceramic floor and wall tiles received by a technical architect.

Beyond the qualification of the content provided, it is interesting that the persons giving the conferences are top level experts in the ceramic floor and wall tile area.

With regard to the other visits such as the CEVISAMA visits and ceramic tiling competitions, it is interesting to note what raising awareness means to the students, as **the problem we encountered the first time will not be left unnoticed**. In this sense, if the students have a first experience in the classrooms, it is certain that when they develop their professional activities they will not fail to notice situations that would have been resolved with appropriate planning or diligence.

# REFERENCES

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