CERAMIC TILINGS BEFORE THE NEW REQUIREMENTS OF THE TECHNICAL BUILDING CODE

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1. INTRODUCTION

Neither ceramic tilings, as a whole, nor their components have been subject traditionally in Spain to any regulations or, put in another way, to any legally binding standards. At the moment, however, the entry into force of the provisions that lead to the CE mark already affects some of the main components of the system.

Adhesives for ceramic tiles must fulfil the specifications set out in standard UNE EN 12004, with a compulsory CE mark from 1 March 2004. On the other hand, in this context ceramic tile is in a 'period of existence' that finalises in the year 2005; therefore, tile will initiate 2006 with the compulsory CE mark. In this case the reference standard is standard UNE EN 14411 Ceramic tiles. Definitions, classification, characteristics and marking.

The promulgation of the Technical Building Code in Spain will complete this regulation dedicated exclusively to products that will subsequently be incorporated into buildings, with conditions to be fulfilled by the systems that are made up on the building site.

The Technical Building Code develops the so-called 'Basic Requirements of Safety and Habitability' laid down in Law 38/1999 on the Regulation of Building Construction (LOE), specifically in article 3. These Basic Requirements correspond to the so-called Essential Requirements of Directive 89/106 on Construction Products and which, in short, refer to:

1. Structural safety
2. Safety in case of fire
3. Safety in use
4. Salubrity
5. Protection against noise
6. Energy economy

The three first are included in the LOE within the group of Basic Safety Requirements, whereas the rest falls within the so-called Basic Requirements of Habitability. The remaining Basic Requirements of the LOE are not developed in the Technical Building Code, by express indication of the Law itself.

Both the LOE and Directive 89/106 establish that these requirements shall be met by buildings and, therefore, their ensuing repercussion on the systems and products that make up the building is indirect, as a result of which intermediate documents are needed, until reaching specifications for these systems or products. In the case of Directive 89/106 these documents are the so-called 'Interpretative Documents', which serve as a guide for the drafting of 'Harmonised Standards', i.e. those responsible for giving the Essential Requirements a greater technical concretion. In the case of the LOE, the Technical Building Code is responsible for this function.

In view of the documentation known at the moment, the Technical Building Code will be divided into two parts. The first, a compulsory part, sets out each of the requirements in a series of 'basic demands' that are to be fulfilled. The second, a non-compulsory part, consisting of the so-called 'Basic Documents' offers acceptable solutions and methods of verification, which enable designers to establish specifications in such a way that they comply with the initial requirements.

The first part, within the technical and administrative conditions, necessarily features 'the compulsory nature of the CE mark', focusing on the project, demanding in particular a greater degree of specification and control, logically, in aspects relating to compliance with the demands set out in the document itself. On the other hand, it also goes extensively into the conditions of execution of the building work, describing the diverse modalities of product, equipment and systems reception, execution control proper, and the final work documentation.

As already mentioned, the second part goes into greater practical detail, as it seeks to establish criteria with a reasonable degree of detail for the various solutions that the specifications writer will adopt, should he consider this convenient, as an already justified way of meeting the demands established in the first part as compulsory.

This study will review each of the Basic Documents of the Technical Building Code, which, in principle, can influence ceramic tilings, and attempt to describe the aspects that would affect these if the specifications writer decided to use these documents as a way of meeting the corresponding 'Basic Requirements'.

It should be noted, on the other hand, that these documents, although they have circulated in the technical field, are pending promulgation, although, the available information announces the imminence of this event.

The following sections describe, for each of the basic requirements, the considerations that have been considered of interest in regard to their application to ceramic floor and wall tiles.

2. BASIC REQUIREMENT OF STRUCTURAL SAFETY

«The objective of the basic requirement 'Structural safety' (SS) consists of assuring that the building has structurally appropriate behaviour in regard to the foreseeable actions and the foreseeable influences to which it may be subjected during its construction and intended use. In order to satisfy this objective, buildings shall be projected, constructed, maintained and used in such a way that the structure as a whole, the parts that compose it and the non-structural resistant elements shall meet, with appropriate reliability, the basic demands set out below:

Basic demand SS 1: Strength and stability

Basic demand SS 2: Adequacy for service »

For compliance with the foregoing demands the Technical Code provides the five following Basic Documents (BD):

- BD SS-AC Actions in construction
- BD SS-F Laying of foundations
- BD SS-S Steel structures
- BD SS-M Masonry structures
- BD SS-W Wooden structures

As may be observed, these documents are respectively dedicated to different types of structures. However, since the objective refers to non-structural resistant elements [1], the Basic Document dedicated to 'Actions in construction' has been studied to verify its possible consequences for ceramic tilings.

The following table sets out the overload demands to be considered according to the Basic Document on 'Structural safety'. BD SS-AC Actions in construction, in horizontal elements, as a function of the particular category of use, in which a distributed value q_k and a point overload Q_k are established.

1 The Code itself defines as 'non-structural resistant elements' the elements which, without being integrated in the strength mechanisms of the structure, are designed to resist the foreseeable actions and provide stiffness. For example: elements of the deck and facade, stairs, railings, etc.

Category of use		Subcategory of use	q_k kN/m²	Q_k kN
A	Residential areas	Dwellings and areas of rooms in hospitals and hotels	2	2 (1)
		Stairs and landings	3	2 (1)
B	Office areas		3	2 (1)
C	Meeting areas (with the exception of the surfaces pertaining to categories A, B and D	Areas with tables and chairs	3	4 (1)
		Areas with fixed seats	4	4 (1)
		Areas without obstacles that prevent free movement of persons, such as lobbies in public buildings, administrative buildings, hotels; exhibition rooms in museums; etc.	5	4 (1)
		Areas devoted to gymnasiums or physical activities	5	7 (1)
		Areas of agglomeration (concert halls, stadiums, etc.)	5	4(1)
D	Commercial areas	Commercial premises	5	4 (1)
		Supermarkets, hypermarkets or large stores	5	7 (1)
E	Areas for industrial use or storage		Dep. on use (2)(3)	Dep. on use (2)(3)
F	Traffic and parking areas (5)	Light vehicles with a gross weight below 30 kN	2 (3)	20 (3)(4)
		Intermediate vehicles with a gross weight between 30 and 160 kN	5 (3)	90 (3)(4)
G	Trafficable decks	Accessible only privately	1.5	1.5 (1)
		Accessible to the public	Dep. on use	Dep. on use
H	Decks accessible solely for maintenance tasks (6)	Decks with a slope of less than 20º	0.8 (7)	1.5 (1)
		Decks with a slope exceeding 40º	0	1.5 (1)

(1) Square application surface with 50 mm side. (2) The characteristic values of overloads in use must be defined according to the specific characteristics of the building and its use, taking into account, if relevant, the possible dynamic effects. The overloads in use due to stored merchandise are to be determined on the basis of the dimensions of the store, of the bulk specific weight of the merchandise as well as of its angle of internal friction. The values of the considered overloads shall be reflected in the project. The maximum value of the overload in use shall be indicated in the premises involved. (3) Q_k and q_k shall be assumed to act simultaneously. (4) Two concentrated $Q_k/2$ loads shall be considered separated 1.8 m applied on a square surface of 200 mm side. (5) The areas of category F shall be indicated as such. The accesses to areas of subcategory F1 shall be limited by means of constructive measures. (6) For decks with a slope between 20º and 40º, the value of q_k is determined by linear interpolation between the values corresponding to the subcategories H1 and H2 (7) The value indicated refers to the horizontal projection of the deck surface.

Table 1. Reproduction of the table available in the Basic Document of the Technical Building Code: Categories of use and characteristic values of the overloads established in Basic Document BD SS-AC Actions in construction.

Obviously, conventional ceramic flooring does not seem to fit into the Code's 'non-structural resistant elements'; however, certain special applications, such as trafficked raised floors, could be included in this consideration, in which case these values acquire special significance as references for the design of the tile-base assembly.

3. BASIC REQUIREMENT OF SAFETY IN CASE OF FIRE

«The objective of the basic requirement 'Safety in case of fire' (SF) consists of reducing to acceptable limits the risk of building users suffering injury deriving from a fire of accidental origin, as a result of the characteristics of the project and construction of the building, as well as of its maintenance and use.

In order to satisfy this objective, buildings shall be projected, constructed, maintained and used in such a way that, in case of fire, the basic demands are met which are set out below:

Basic demand SF 1: Inner propagation

Basic demand SF 2: Outer propagation

Basic demand SF 3: Evacuation

Basic demand SF 4: Installations for protection against fires

Basic demand SF 5: Action by firemen

Basic demand SF 6: Fire resistance of the structure»

The field of application of this BD is the one established with a general character for the whole Technical Building Code (TBC) in article 2 (Part I) excluding buildings, establishments and areas of industrial use to which is applicable the 'Safety regulation against fires in industrial establishments'.

For compliance with the above demands the Technical Building Code provides the following Basic Document:

Basic document 'BD SF Safety in case of fire'.

This BD establishes the conditions for *reaction to fire* and *resistance to fire* of the constructive elements in conformity with the new European classifications, established by Royal Decree 312/2005, of 18 March, and with the test and classification standards indicated therein.

The classification, according to the *reaction to fire* and *resistance to fire* characteristics of a construction product that does not yet bear the EC *mark* or of a constructive element, as well as the necessary tests for this, must be performed by laboratories that at least meet the requirements set by Royal Decree 1630/1992 of 29 December. These laboratories shall be accredited for conducting these tests by an officially recognised accreditation organisation.

3.1. REACTION TO FIRE OF CONSTRUCTIVE AND DECORATIVE ELEMENTS, AND OF FURNITURE

The constructive elements must fulfil the reaction to fire conditions that are established in the table 2.

Thus we see that the reaction to fire of the constructive elements determines the reaction-to-fire classes.

This BD contains, independently, *Annex B: Equivalent time of exposure to fire,* which establishes the procedure for obtaining the *equivalent time of exposure to fire* that can be used as an alternative of the fire duration to be withstood, regarding both structural and compartmentalising effects.

Situation of the element	Coverings [1]	
	Of ceilings and walls[2] [3]	Of floors [2]
Inhabitable areas [4]	C-s3,d0	E_{FL}
Parking areas	A2-s1,d0	$A2_{FL}$-s1
Corridors and protected stairs	B-s1,d0	C_{FL}-s1
Premises of special risk	B-s1,d0	B_{FL}-s1
Non-watertight hidden areas: small patios, false ceilings, raised floors, etc.	B-s3,d0	B_{FL}-s2[5]

[1] Whenever 5% of the total surface areas of the set of walls, set of ceilings or set of floors of the considered premises are exceeded. [2] Includes the pipes and ducts that pass through the areas that are indicated without fire-resistant covering. [3] Includes those materials that constitute a layer contained inside the ceiling or wall and which is not protected by a layer that is at least EI 30. [4]Includes those where persons stay and those for circulation that are not protected. Excludes the inside of dwellings. The same conditions shall be applied in Hospital use as in the protected corridors and stairs. [5] The bottom part of the cavity is referred to. For example, in the false ceiling chamber, it refers to the material located in the top face of the membrane. In spaces with a clearly vertical configuration (for example, small patios) this condition is not applicable.

Table 2. Reproduction of the table available in the Basic Document of the Technical Building Code: SF 1 Inner propagation - Constructive element classes of reaction to fire.

Further on, this Annex introduces the variable of *characteristic value of the fire load density*, in which it is indicated that the *permanent fire load* corresponds to the coverings and other permanent combustible elements included in the project. This can be obtained from the specific values supplied by the manufacturer of each product or, in their absence, from tables of values for generic materials.

Finally it can be observed that some of the components of the ceramic system could influence the compliance or non-compliance with the requirements established by this BD, although this consideration will be solved once the specific values supplied by the manufacturers are known.

4. BASIC REQUIREMENT OF SAFETY IN USE

«The objective of the basic requirement 'Safety in use' (SU) consists of reducing to acceptable limits the risk of users suffering immediate injury during the intended use of the buildings, as a result of their design, construction and maintenance characteristics.

In order to satisfy this objective, buildings shall be projected, constructed, maintained and used in such a way that the basic demands are met which are set out below:

Basic demand SU 1: Safety against the risk of falls

Basic demand SU 2: Safety against the risk of entrapment or impact

Basic demand SU 3: Safety against the risk of getting caught

Basic demand SU 4: Safety against the risk caused by inadequate illumination

Basic demand SU 5: Safety against the risk caused by situations with high occupation

Basic demand SU 6: Safety against the risk of drowning

Basic demand SU 7: Safety against the risk caused by vehicles in movement

Basic demand SU 8: Safety against the risk related to the action of lightning»

For compliance with the above demands the Technical Building Code supplies the following Basic Document:

BD SU Safety in use.

Of the foregoing demands, the demand directly related to ceramic tilings and concretely to flooring is the first, i.e. the one related to the safety against the risk of falls, which, in addition, directly affects ceramic tile by establishing limiting criteria as far as the slipperiness of floors is concerned.

4.1. SLIPPERINESS OF FLOORS

This document demands for floors in buildings and areas of Health, Educational, Commercial use and areas of Public Concurrence, conditions regarding slipperiness.

To this end, it establishes a certain class of slipperiness for the different areas in the following form:

Dry inner areas

- surfaces with slope smaller than 6% — Class 1
- surfaces with a slope equal to or greater than 6% and stairs — Class 2

Wet inner areas, such as bathrooms, kitchens, indoor swimming pools, etc. [2]

- surfaces with a slope smaller than 6% — Class 2
- surfaces with a slope equal to or greater than 6% and stairs — Class 3

Inner areas where, in addition to water, there may be agents that reduce slip resistance (grease, lubricants, etc.) such as industrial kitchens, slaughter houses, garages, areas of industrial use, etc. — Class 3

Outer areas. Swimming pools [3] — Class 3

The corresponding class is determined as a function of slip resistance value Rd.

Rd is determined by means of the pendulum test of standard UNE-ENV 12633:2003 using scale C in test specimens without wear.

2 The floors around the entrances to the buildings from the outer area are included, except when direct accesses to dwellings or areas of restricted use, as well as closed terraces, are involved.

3 In areas intended for barefoot users and at the bottom of basins, in areas in which the depth does not exceed 1.50 m.

The class of floor is related to the slip resistance value (SRV) in the following way:

Rd ≤ 20	Class 0
20< Rd ≤ 35	Class 1
35< Rd ≤ 45	Class 2
Rd > 45	Class 3

4.2. DISCONTINUITIES IN THE FLOOR

With regard to the discontinuities in the floor, the basic document on safety in use establishes, as a condition directly related to ceramic flooring that there shall be no imperfections or irregularities that involve a difference in level of more than 6 mm and that the floor shall not display any perforations or gaps in which a sphere of 15 mm diameter could be introduced. These aspects are safely met by suitably executed ceramic tiling.

4.3. SAFETY AGAINST RISK OF DROWNING

In swimming pools, beside the conditions established previously as far as the slipperiness of the floor is concerned, it is specified, in relation to the risk of drowning, that the colour of the lining of the basin shall facilitate the view of the bottom.

5. BASIC REQUIREMENT OF SALUBRITY

«The objective of the basic requirement of salubrity consists of reducing to acceptable limits the risk for the users, as a result of the characteristics of design, construction and maintenance of the buildings, inside these and in normal conditions of use, of suffering annoyances or diseases, as well as the risk of buildings deteriorating and of them deteriorating the environment in their immediate surroundings. In order to satisfy this objective, buildings shall be projected, constructed, maintained and used in such a way that the basic demands are met which are set out below:

Basic demand HS 1: Protection against moisture

Basic demand HS 2: Elimination of wastes

Basic demand HS 3: Inner air quality

Basic demand HS 4: Water supply

Basic demand HS 5: Wastewater evacuation»

Of these six demands the one that could, in principle, have a direct relation to ceramic tilings is the demand regarding 'Protection against moisture' taking into account its application in facades and decks, which is why this is addressed in the following lines.

For compliance with the above demands the Technical Code supplies the following Basic Document:

BD HS Salubrity.

In this document, in the sections dedicated to protection against moisture, aspects are featured that could be of application to ceramic tilings when they are applied as wall or floor tiling in facades or decks.

5.1. APPLICATION TO FACADES

5.1.1. Facade stretches

In the case of facades, the document establishes a first division according to whether these have an outer covering or not.

The following table sets out the characteristics of the facades with outer covering as a function of the required degree of impermeability. This degree of impermeability, evaluated from 1 to 5, is a function of the 'pluviometric area' and of the 'degree of exposure to wind', which the document itself establishes in each case.

WITH OUTER COVERING						
Degree of impermeability	≤ 1	C1				
	≤ 2	R1+C1				
	≤ 3	R1+B1+C1		R1+C2		
	≤ 4	R1+B2+C1		R1+B1+C2		R2+C1
	≤ 5	R3+C1	B3+C1	R2+B2+C1	R1+B2+C2	R2+B1+C1

Table 3. Reproduction of the table available in the Basic Document of the Technical Building Code: General conditions of facade solutions.

In the above table 'C' refers to the composition of what it terms the main wythe, which for a rapid understanding in this paper could be simplified as:

C1: wythes of 1/2 foot ceramic brick or similar thicknesses in other materials commonly used in facades

C2: wythes of 1 foot thick.

'B' refers to the resistance to filtration of barriers against water penetration (use of air chambers and non-hydrophilic insulations in certain positions).

B1: non-hydrophilic insulation installed in the inner face of the main wythe or non-ventilated air chamber.

B2: non-ventilated air chamber and non-hydrophilic insulation arranged on the inside of the main wythe or non-hydrophilic insulation arranged on the outside of the main wythe.

B3: The document establishes the need to arrange a barrier with great resistance to filtration (ventilated air chamber and non-hydrophilic insulation).

'R', in contrast, represents the resistance to filtration of the outer covering, which could comprise ceramic tiles, and is graduated in the following form:

R1: The document establishes that *"an adhered continuous covering or discontinuous covering shall be arranged provided with expansion joints in such a form that the distance between contiguous joints is sufficient to avoid cracking of the covering, and each joint of the main wythe coincides with one of these.*

When it is discontinuous it shall have the following characteristics:

- *sufficient fixing to the base to assure its stability;*
- *arrangement on the outer face of the main wythe of a mortar parge coat;*
- *adaptation to the movements of the base."*

In these specifications the possibility is noted, logically, of using ceramic tiling for this solution and the need to consider the adhesion and deformability of the tiling as important parameters when it comes to designing the composition of the system, as set out in the manuals of good practice in tile installation, as well as the need for providing a preliminary mortar parge coat.

For R2 the code adds to the previous specification the need for the tiling to be 'discontinuous rigid mechanically fixed' which provides for an ample use of solutions to which ceramic tilings can adapt, without any type of obstacle.

R3 is reserved for special systems made up of thin plates, sheets, slabs or other discontinuous elements for which it demands characteristics similar to those of R1. It mentions for this solution, in the section on 'thin plates', clay tile products.

On the other hand, although the foregoing table does not include any references to the type of covering (R) for composition B3+C1, it is reasonable to assume that the application of ceramics with ventilated chambers adapt itself, adequately, to this type of solution.

5.1.2. Expansion joints in facades

Given the necessarily general nature of the document, specifications are not established for the movement joints in the outer covering, which need to be established according to their nature, although it does indicate the demand for their provision. (*"The outer covering shall be provided with expansion joints in such a form that the distance between contiguous joints is sufficient to avoid cracking of the covering, and each joint of the main wythe coincides with one of these").*

Since in this document the criteria for the composition and dimensioning of the expansion joints in the main wythe are established, the maximum distance would thus be determined, in an indirect way, between the movement joints of a ceramic tiling.

The following table sets out the maximum distance mentioned between the expansion joints.

Constituent material of the masonry elements	Maximum distance between vertical expansion joints in the main wythe in m.
Fired clay	12
Silico-calcareous materials	8
Concrete	6
Cellular concrete cured in autoclave	6
Natural stone	12

Table 4. Reproduction of the table available in the Basic Document of the Technical Building Code: Distance between expansion joints in the main wythe in facades.

5.2. DECKS

5.2.1. Deck stretches

The Basic Document also establishes the conditions to be fulfilled by decks in the section on protection against moisture. In this building unit it devotes a section to flooring, an element that could comprise ceramic flooring.

For the fixed floor, the document establishes the following conditions:

1 The fixed floor can be made of the following materials: tiles bedded in mortar, mortar layer, natural stone…

2 The material that is used shall have a form and dimensions compatible with the slope.

3 The pieces shall not be installed without mortar.

In relation to the decoupled screed, as another possible deck finish it establishes the following:

1 The decoupled screed may consist of pieces supported by bases, loose tiles with incorporated thermal insulation or other materials of analogous characteristics.

2 The pieces supported on bases shall be arranged horizontally. The bases shall be designed and made specifically for this aim, have a supporting platform to distribute the loads and shall be arranged on the separating layer in the sloped run-off plane.

The pieces shall be resistant to the bending stresses to which they will be subject.

3 The pieces or tiles shall be installed with an open joint.

Both in this case and in the other, attention is drawn to the need to establish mechanisms that favour the elasticity of the tiling system, rejecting an installation with tiles in contact with each other.

On the other hand there is also a reminder of what has been advanced in the document on Actions in Building Construction, when tiles supported on bases are used, apart from establishing the conditions to be met by these.

5.2.2. Expansion joints in decks

The basic document establishes the arrangement of expansion joints in decks at a maximum distance of 15 m and whenever there is abutment with a vertical facing or a structural joint. The joints shall affect the different layers of the deck starting from the element that serves as the resistant base. In the same way it establishes that joint width shall exceed 3 cm.

These joints shall be reproduced when the protection layer is a fixed floor, reducing the maximum distance between intermediate joints until leaving a grid, located at a maximum of 5 m in non-ventilated decks and at 7.5 m in ventilated decks, such that the dimensions of the stretches between the joints keep a relation of 1:1.5 at most.

The document establishes, moreover, the general conditions of the back-up and sealing of these joints, which are similar to those found in the field of ceramics.

6. BASIC REQUIREMENT OF THE PROTECTION AGAINST NOISE

This Basic Document is not included, unlike the rest of the BDs, in any of the latest drafts of the Code known by the authors; however, in view of the interest that it could provoke, we have felt it necessary to comment what has been described in the draft of 29 March 2002.

«The objective of the basic requirement 'Protection against noise' consists of providing the procedures and technical rules that enable verifying that buildings meet the demands established in the TBC relating to the basic requirement of protection against noise, both in the field of newly constructed buildings and in renovations of existing buildings, in buildings and areas with Administrative, Educational, Residential, Meeting, and Health uses.

The conformity to the demands established for the different requirements shall be obtained before occupation of the building by the users. It is therefore in the constructed buildings and prior to the granting of the habitability permit, where are to be applied, when such is the case, the rules and procedures of definitive conformity, in the case of newly constructed buildings. In the case of renovated buildings, conformity shall be obtained, also when such is the case, before initiating new use.

In order to obtain an appropriate evaluation of conformity, the verifications can be made at project level and at finished work level:

a) at project level verifying the products and the design

b) at finished work level in situ through tests.

The verification of ***products and constructive elements,*** *as well as those of the* ***fixtures and general and individual installations,*** *is established in this BD by means of evaluation and, should such be the case, certification of the acoustic properties of said features.*

Verification of the design *shall be performed by means of calculations in accordance with the methods for prediction of the acoustic insulation and for the inner conditioning of premises, established in this BD.*

As a simplified design method the set of accepted solution can be used, provided the limitations established in each case are respected.

Conformity of the finished building *requires experimental verification in situ of the finished building at the instance of the promoter, user or competent Authority.*

In the case of using the predictive method set out in this BD or of adopting constructive solutions from those accepted as valid, this verification in situ will not be necessary, except in specific claims on behalf of the end-users of the building.

In order to satisfy this objective, buildings shall be projected, constructed, used and maintained in such a way that the basic demands are met which are set out below:

Basic demand HN 1: Protection against aerial noise

Basic demand HN 2: Protection against impact noise

Basic demand HN 3: Acoustic conditioning

Basic demand HN 4: Protection against the noise of installation.»

For compliance with the above demands the Technical Building Code supplies the following Basic Document:

BD HN Protection against noise.

In this document, in the sections dedicated to aerial noise and impact noise protection, aspects are considered that could be of application to ceramic tilings when they are applied especially as flooring, as the following shows.

6.1. LEVELS OF ACOUSTIC INSULATION OF IMPACT NOISE

1 The level (of pressure) of impact noise in vertically adjacent inhabitable premises with other, also inhabitable or common premises in the building, shall not exceed 65 dB.

2 The level (of pressure) of impact noise in vertically adjacent inhabitable premises with premises with activity or premises in which installations are housed or any other device that constitutes a necessary source of noise for the operation of the building, shall not exceed 60 dB.

3 The level (of pressure) of impact noise in inhabitable premises underlying a trafficable deck shall not exceed 65 dB.

Insulation between:	Levels of insulation aerial noise in decks:	Identifier
Inhabitable premises – premises with activity	> 60 dBA	A_A (1)
Inhabitable premises – premises with installations	> 55 dBA	B_A
Inhabitable premises – common premises	> 50 dBA	C_A
Premises inhabitable – other premises, different unit of use	> 50 dBA	D_A
Inhabitable premises, same unit of use	> 30 dBA	E_A

(1) *Identifier $_A$: Identifier for constructive solution against aerial noise.*

Table 5. Reproduction of the table available in the Basic Document of the Technical Building Code: Identification of the validity of solutions for aerial noise in decks.

Insulation between:	Levels of insulation impact noise in decks:	Identifier
Recinto habitable – recinto de actividad ó con instalaciones	< 60 dB	A_I (1)
Recinto habitable – recinto habitable ó común	< 65 dB	B_I

(1) *Identifier$_I$: Identifier for constructive solution of impact noise.*

Table 6. Reproduction of the table available in the Basic Document of the Technical Building Code: Identification of the validity of solutions for impact noise in decks.

6.2. THE BD FINALLY MAKES THESE OBSERVATIONS

1 The determining acoustic requirement of the decks is the level of impact noise, since this is more restrictive than the insulation against aerial noise.

2 The demand required for aerial noise is satisfied by selecting the appropriate type of constructive solution. However the protection against impact noise, in contrast, requires care and special solutions. For a standard deck of the ones indicated as satisfactory against aerial noise, this would mean a level of impact noise of the order of 80 dB, which is far above the demanded level.

3 For merely informative purposes, the theoretical-empirical relation between the acoustic insulation against aerial noise and the impact level can be considered: R w + LnT, w = 133.5, which means that lowering this level to the maximum admissible level of 65 dB requires additional reducing solutions of about 15 dB, which for hard floors (like ceramics) can only be obtained by decoupled flooring. If the use of hard floors is not a prerogative it is possible to use hybrid solutions by means of poorer decouplings and 'soft' floors, or by cushioning coverings of the carpeting type, which have few structural repercussions.

4 **In any event, the foregoing solutions by means of an intermediate layer of specific insulation against impact noise need to be completed,** whose suitability should be evaluated in the laboratory. Products of this nature are already available in the market, based on watertight, closed-cell non-reticulated expanded polyethylene which, in a thickness of 10 mm, can provide insulation values up to 20 dB.

6.3. TESTS IN SITU

It has already been mentioned that the experimental verifications are not necessary in the case of using the predictive method indicated in the BD or of adopting constructive solutions from those accepted as valid, except in specific claims by the end-users of the building.

Thus, in this sense, the tests shall be performed on the basis of:

1 The method of measurement in situ of the Impact Noise Insulation shall be the method specified in Standard UNE EN ISO –140/7 – 97 Measurement of the acoustic insulation in buildings and of the construction elements. Part 7: Measurement in situ of the acoustic insulation of floors to impact noise

2 96 ISO 717/2- Acoustics. Evaluation of the acoustic insulation in buildings and of the construction elements. Part 2: Insulation to impact noise.

Finally, it may be remarked in regard to this DB, that although all considerations expressed are based on a draft, which will possibly not match the text shortly to be approved, it does at least bring us a spirit which, although not directly affecting tile or bonding material, does entail a qualitative change in regard to the solutions and systems of the future, which will involve more careful planning and, of course, meticulous installation for compliance with the requirements.

7. BASIC REQUIREMENT OF ENERGY ECONOMY

«The objective of the basic requirement 'Energy economy' consists of achieving a rational use of the energy necessary to use buildings, reducing to sustainable limits energy consumption, and also of obtaining part of this consumption from renewable energy sources. In order to meet this objective, buildings shall be projected, constructed, used and maintained in such a way that the basic demands are met which are set out below.

Basic demand HE 1: Limitation of energy demand

Basic demand HE 2: Efficiency of the thermal installations

Basic demand HE 3: Energy efficiency of the lighting installations

Basic demand HE 4: Minimum solar contribution of bathroom water heating

Basic demand HE 5: Minimum photovoltaic contribution of electric energy»

For compliance with the above demands the Technical Building Code supplies the following Basic Document:

BD HE Energy economy.

The energy demand of buildings is limited as a function of the climate of the locality in which they are located, according to the climatic zoning established in this BD. The energy demand shall be below that corresponding to a building in which the characteristic parameters of the *envelopes* and *inner partitions* that compose their *thermal envelope* are as follows.

The characteristic parameters that define the thermal envelope are classified in the following groups:

- Thermal transmittance of facade walls U_M;
- Thermal transmittance of decks U_C;
- Thermal transmittance of floors U_S;
- Thermal transmittance of envelopes in contact with the ground U_T;
- Thermal transmittance of voids U_H;
- Modified solar factor of voids F_H;
- Modified solar factor of skylights F_L;

- Thermal transmittance of party walls U_{MD}.

In order to avoid imbalances between the thermal qualities of different spaces, each of the *envelopes* and *inner partitions* of the *thermal envelope* shall have a transmittance not exceeding the values indicated in the following table as a function of the climate zone in which the building is located. The limitations of the energy demand are established in 12 climate zones identified by a letter, corresponding to the division of winter, and a number, corresponding to the division of summer.

The inner spaces of the buildings are classified in inhabitable spaces and non-inhabitable spaces.

Inner envelopes and partitions	**AREAS A**	**AREAS B**	**AREAS C**	**AREAS D**	**AREAS E**
Facade walls, inner partitions in contact with non-inhabitable spaces, first metre of the perimeter of floors supported on the ground [(1)] and first metre of walls in contact with the ground	1,22	1,07	0,95	0,86	0,74
Floors	0,69	0,68	0,65	0,64	0,62
Decks	0,65	0,59	0,53	0,49	0,46
Glasses and frames [(2)]	5,70	5,70	4,40	3,50	3,10
Party walls	1,22	1,07	1,00	1,00	1,00

[(1)] Slabs or bases buried to a depth not greater than 0.5 m are included
[(2)] The thermal transmittances of glasses and frames shall be compared separately.

Table 7. Reproduction of the table available in the Basic Document of the Technical Building Code: Maximum thermal transmittance of envelopes and inner partitions of the thermal envelope U in W/m²K.

7.1. DEFINITION OF THE THERMAL ENVELOPE OF THE BUILDING AND CLASSIFICATION OF ITS COMPONENTS

The *thermal envelope* of the building is made up of all the *envelopes* that bound *inhabitable spaces* with the outer ambient (air or land or another building) and of all *the inner partitions* that bound the *inhabitable spaces* with the *non-inhabitable spaces,* which in turn are in contact with the outer ambient.

The *envelopes* and *inner partitions* of the *inhabitable spaces* are classified according to their situation in the following categories:

- decks: they comprise those top envelopes in contact with the air whose slope is less than 60º in regard to the horizontal;
- floors: they comprise those horizontal or slightly sloped bottom envelopes that are in contact with the air, the land, or a *non-inhabitable space;*
- facades: they comprise the outer envelopes in contact with the air whose slope is greater than 60º in regard to the horizontal. They are grouped in 6 orientations according to the angle sectors contained in this BD. The orientation of a facade is characterised by means of angle α, which is formed

by the geographic north and the normal outside of the facade, measured clockwise;

- party walls: they comprise those *envelopes* that are contiguous with other already constructed buildings or that are constructed simultaneously and form a common division. If the building is constructed later the envelope shall be considered, for thermal purposes, a facade;
- envelopes in contact with the ground: they comprise those envelopes different from the previous ones that are in contact with the ground;
- inner partitions: they comprise those horizontal or vertical constructive elements that separate the interior of the building into different areas.

7.2. CONDENSATIONS

The surface condensations in the envelopes and inner partitions that make up the thermal envelope of the building shall be limited in such a way as to avoid mould formation on the inner surface. For this, in those inner surfaces of the envelopes that could absorb water or be susceptible to degradation, and especially in their thermal bridges, the monthly mean relative humidity in this surface shall be less than 80%.

7.3. TESTS AND VERIFICATIONS

Final tests are not prescribed in this Section of the Basic Document, but verifications are, which shall be made in the project, choosing either of the following alternative verification procedures:

- simplified option, based on indirect control of the energy demand of the buildings by means of the limitation of the characteristic parameters of the *envelopes* and *inner partitions* that make up the thermal envelope. The verification is made by comparison of the values obtained in the calculation with the admissible limit values. This option can be applied to new building construction works that meet the requirements specified in this BD and to building works for the renovation of existing buildings;
- general option, based the evaluation of the energy demand of the buildings by means of the comparison of the energy demand with the one corresponding to a reference building that the option itself defines. This option can be applied to all the buildings that meet the requirements specified in this BD.

In both options the presence of condensations in the surface and inside the *envelopes* is limited, and the energy losses due to air infiltrations are limited, for normal conditions of building use.

Finally, it may be noted that ceramic tilings will need to coexist in the future, to a greater degree than now, with insulations as components of the system; however, in this case we are not faced with a technological or technical challenge.

8. CONCLUSIONS

As a result of the performance-based approach of the future Spanish Technical Building Code, direct compulsory specifications for ceramic tilings are not established in this Code, but these will depend on their application to the building, in each case, as building units.

Logically, the usual components of tilings shall meet the requirements of the Technical Building Code with the CE mark, which is established as compulsory, although in the case of the ceramic tile in floorings requirements are added in regard to tile slipperiness.

Although the title of this paper appeared to bode new demands for ceramic tilings, on the basis of the documentation available of the future Technical Building Code, the reader will finally have been able to verify that ceramic tilings readily conform to the demands of each BD, although it should be noted that the new demands will influence, indirectly, the structure of ceramic systems, matching them to a greater extent to the manuals of good practice already existing in the sector.