IMPROVE TECHNIFICATION AND LCA QUALIFICATION OF WORKERS IN CERAMIC SECTOR WITH THE SUPPORT OF BIM APPLICATIONS

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REPORT 1.2.1

BEST PRACTICE REPORT ON METHODS, SKILLS AND COMPETENCES IN RELATION TO CLAY PRODUCTS

BUILDING WALLS WITH CERAMIC BLOCK

Consortium members: Associação Portuguesa da Indústria de Cerâmica (APICER), Centro Tecnologico da Cerâmica e do Vidro (CTCV), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Asociación Española de Fabricantes (Hispalyt), Institute of Entrepreneurship Development (iED).

Content

1. INTRODUCTION

1. Background

The BIMclay project was born with the purpose of producing and developing didactic materials based on the BIM methodology, which address the challenges related to Life Cycle Analysis (LCA) of clay products, to serve as a training base for professionals in the ceramic sector. To this end, it is necessary to define and compile the most suitable execution systems and placement methods for clay products.

The first task of the BIMclay project "O1. *Establishment of common learning outcomes on clay placement methods, Life Cycle Analysis (LCA) and regulations*" encompasses a number of specific tasks among which we find the elaboration of this report "*Building walls with ceramic block*".

This best practice report addresses the establishment of skills and competencies, as well as the definition of the most sustainable and environmentally friendly implementation processes.

2. ENVIRONMENTAL CONSIDERATIONS

The Environmental Product Declarations (EPDs) are the clearest, most rigorous and internationally accepted way to provide the environmental profile of a product throughout its life cycle.

The EPD "***Ladrillos cerámicos cara vista. Pieza "U" según la Norma UNE-EN 771-1***" (*Execution of self-supporting façade with ventilated and non-ventilated brick exposed face*) has been verified and published in AENOR's GlobalEPD program.

The EPD of ceramic face bricks has been carried out according to the LCA methodology with quantified environmental information of its entire life cycle. That is to say, the EPD of ceramic face bricks is of the "cradle to grave" type, as can be seen in the following table, which includes the life cycle stages considered.

Etapa de producto	A1	Suministro de materias primas	X
	A2	Transporte a fábrica	X
	A3	Fabricación	X
Construcción	A4	Transporte a obra	X
	A5	Instalación / construcción	X
Etapa de uso	B1	Uso	X
	B2	Mantenimiento	X
	B3	Reparación	X
	B4	Sustitución	X
	B5	Rehabilitación	NR
	B6	Uso de energía en servicio	X
	B7	Uso de agua en servicio	X
Fin de vida	C1	Deconstrucción / demolición	NR
	C2	Transporte	X
	C3	Tratamiento de los residuos	X
	C4	Eliminación	X
	D	Potencial de reutilización, recuperación y/o reciclaje	MNE

X = Módulo incluido en el ACV; NR = Módulo no relevante; MNE = Módulo no evaluado

This EPD has been developed and verified according to the UNE-EN 15804 and UNE-EN ISO 14025 standards and the Product Category Rules (PCR) for fired clay products used in the construction of AENOR's GlobalEPD programme.

The EPD functional unit is defined as 1 tonne of ceramic facing brick with an average reference service life of 150 years.

The EPD details the formulation to be used (conversion factor) to transform the functional unit from a ton of ceramic facing brick to a square meter of wall.

3. CONSTRUCTIVE CONSIDERATIONS

The ceramic block masonry system is a one sheet cladding system, formed by ceramic blocks of lightened clay, with vertical perforations and a vertical tongue and groove joint, placed with a horizontal mortar joint and a vertical bone joint.

The different types of execution considered are:

Building type 1: Wall construction with continuous mortar joint: The pieces are assembled without interrupting the laying of the wall to achieve maximum soundproofing while maintaining very acceptable thermal properties for interior solutions. This is the most appropriate type of assembly for partitions with acoustic and thermal requirements. This type of mortar tendel is also indicated for blocks with a thickness of less than 23 cm.

Building type 2: Construction of a wall with a 30 mm thick, interrupted mortar joint. The most common assembly of blocks that provides adequate insulation to meet the thermal requirements in facades of the CTE in most cases. This type of mortar joint is also indicated for blocks with a thickness greater than 23 cm.

Building type 3: This type of mortar laying is suitable for exterior single-leaf block walls where the thermal insulation requirements are so high that the mortar laying with interrupted joint cannot be met. The interruption of the mortar string means that the thermal bridge of the joint is broken, improving the thermal insulation of the wall. In addition, filling the mortar line with an interrupted joint with a band of insulating material specifically for use in pieces provides a more effective thermal bridge break than simple interruption. This type of mortar bed is also indicated for blocks with a thickness greater than 23 cm.

Building type 4: This type of mortar layer is suitable for interior and exterior walls where rectified blocks are used. This type of mortar tendel is called thin joint because it involves a thickness of less than 3 mm, so the thermal transmittance of the wall is significantly reduced. This type of mortar layer is suitable for single block walls.

CERAMIC BLOCK AND SPECIAL PIECES

Bloque cerámico de arcilla aligerada con una geometría específica que le confiere características singulare Ceramic block of lightened clay with a specific geometry that gives it unique characteristics.

Starting from a mixture of clay, with lightening additives, which are gasified during the firing process at more than 900 ºC without leaving any residue, a fine porosity is created which is homogeneously distributed in the ceramic mass of the block. This special constitution of the

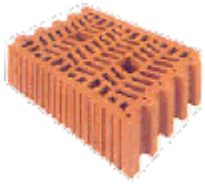
ceramic material, together with a geometry of the piece specifically studied, confers to the block singular characteristics, with possibilities of use unknown until now, obtaining that walls of a leaf have equivalent or superior benefits in some aspects, to the walls composed of several layers, since they reunite in a single material all the set of characteristics demanded in a modern construction.

The system of pieces of the ceramic block has special pieces for the execution of particular encounters. The main piece of the series conceived to develop the walls, called the base piece, has modular measures for the traditional piece of 30 cm in length and 19 cm in height, presenting itself with various thicknesses (14, 19, 24 or 29 cm).

There are different pieces of blocks for the development of the singular points of encounter with complementary elements of the factory work, as well as to make the dimensional adjustments that are necessary to adapt to the formal characteristics of any type of wall and its possibilities of modulation.

- Base piece

- Medium piece



- Adjustment piece or vertical modulation

- Termination piece

- Corner piece

- Lintel piece

- Adjustment piece or horizontal modulation

- Platelet or patch piece

- 135º angle piece

4. CONSTRUCTION PROCESS

1. Mortar bed on the foundation for levelling

The continuous mortar bed for placing the first row of blocks may be thicker than the rest of the tendons, in order to compensate for irregularities in the level of the floor. This will ensure that the first row is perfectly horizontal, which is necessary so that the successive rows are also horizontal.

To avoid rising damp, an asphalt sheet is laid before the levelling layer. Important overlapping and welding of the asphalt sheet joints.

2. First line

On the mortar, the wetted blocks will be placed vertically, not scrubbed, making a stop with the tongue and groove, and will be hit with a rubber mallet, to make the mortar penetrate perfectly into the holes of the blocks.

This operation is necessary to achieve the perfect sewing of the factory. The vertical joint must not be open at either end.

The thickness of the mortar layer before laying the blocks will be about 3 cm.

Finally, when placing the blocks, a mortar bed of 1 to 1.5 cm should be left. That is, the difference up to 3 cm of mortar placed must penetrate the holes in the blocks.

First, the corner blocks and the hole jambs are placed; then, the rest of the blocks that will form the walls are laid out, leaving the possible adjustments in the central parts of the panels.

Adjust the length of the wall to that defined in the project by means of modulation pieces of 5 or 10 cm thick, or with the least possible number of pieces cut with suitable mechanical means. The

vertical joint between the base piece and the cut piece will be made by means of mortar cords. For horizontal factory fitting, the EPS fitting piece can also be placed in the middle of the panel.

3. Application of the mortar

Building type 1:
Execution of wall with 30cm continuous grip mortar joint, the use of the guide will be dispensed with.

The use of a mixed mortar with a compressive strength of 100 kp/cm2 is recommended, with a volumetric dosage 1 cement: 1/4 lime: 4 sand. It is of great importance the adequate granulometric distribution of the aggregate.

Building type 2:
Execution of a wall with a 30 mm thick, interrupted mortar joint, in order to have a sufficient amount of mortar on the tendencies, place a 3 x 5 cm rule in the central position in the row.

Use the ruler as a guide to level the mortar. Once the mortar is flush, the guide is set aside to allow the execution of the upper row

The use of mortar slides is also possible. With this type of tool, the execution of the string can be carried out much more quickly.

Every 100 blocks placed, remove one to check the correct execution of the horizontal joint:

- Separation between mortar bands of 1 to 3 cm.
- Thickness of the tendel once the blocks are settled from 1 to 1.5 cm.
- The mortar must have penetrated the holes in the blocks to achieve a perfect sewing of the pieces.

Building type 3:
Optionally, if we want to increase the thermal insulation, we can place a valid insulating strip (consult the manufacturer), which will be useful in the case of requiring higher thermal performance.

Building type 4:
The thin-set mortar layer is applied using a metering roller. Before application, the blocks must be moistened so that they do not absorb water from the biker. If the mortar dehydrates, it does not set and also loses its ability to add to the mortar and its mechanical resistance. It is advisable to wash the dosing roller when it is no longer being used to remove dry mortar residues.

4. Successive lines

Place plumb sights at distances of no more than 4 m and always at each corner, gap, break and mochette.

Mark the vertical modulation, indicating the levels of the slab, as well as those of the parapet and lintel of the openings.

Adjust the modulation by varying the thickness of the mortar joints (between 1 and 1.5 cm), using vertical trim pieces (9 or 14 cm), or pieces cut on site with suitable means.

In general, do not use material other than the block to level. However, perforated brick may be used in those sections of wall located in non-inhabitable areas.

Place the rows while maintaining the wall's lock. The minimum distance between vertical joints is 7 cm.

5. Formation of holes in the wall

Form the jambs with special pieces (stockings and end pieces). For non-load-bearing walls, cut base pieces can be used with suitable means, which will be regularised with mortar before applying the coating.

The lintel must be supported on each side of the walls by at least 15 cm for non-bearing walls and 30 cm for bearing walls.

The loading of the lintels shall normally be carried out with the U-shaped lintel piece of the block, other constructive solutions specified in the project being admitted.

6. Connection between load-bearing wall and structure

Arrange a reinforced concrete strap at the junction of the slab with the block's load-bearing wall.

The support of the slab can be made on the blocks or on the L-shaped cut lintel.

If the slab is supported directly on the blocks, place a thin plastic sheet (polyethylene, kraft paper, etc.) or blind the holes with mortar on the last row, to prevent the blocks from becoming solid when the slab is concreted.

Rest the floor on the wall of the block at least 2/3 of the thickness of the wall and always more than 14 cm.

7. Connection between enclosure wall and structure

Leave 2 cm of separation between the crest of the block enclosure wall and the slab, filling it later with an elastic element with adequate fire resistance.

Support the blocks of the first row in the forging at least 2/3 of its thickness.

When necessary, according to the indications of the project, a joint of horizontal movement will be made.

8. Connection between enclosure wall and pillar

Place a sheet of polyethylene foam, 5 mm thick, between the faces of the pillar and the pieces of the enclosure. If it is necessary to reinforce the thermal insulation, a 2 cm insulator should be inserted instead of the polyethylene sheet.

Place the 9.6 cm plate for the external covering of the pillars.

Incorporate a round of galvanized or stainless steel (6 mm in diameter and 120 mm in length) every 3 rows in the width of the external band of mortar of the horizontal joint.

Lateral anchorages will be placed on the pillars, at least 3 on each side, avoiding their placement at the beginning and at the coronation of the enclosure.

9. Covering of the front of the structure

The front of the structure will be resolved with tiles (4.8 cm, 9.6 cm or other available thickness), or other ceramic pieces, if they have been specified in the project.

THERMOARCILE LOADING WALL: The platelets (4.8 and 9.6 cm thick) can be used as a lost formwork bottom. The 4.8 cm tile can also be placed with high adherence mortar by means of continuous thick-bed gluing. In addition, the L-shaped lintel can be used.

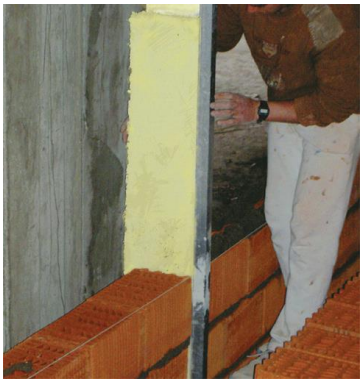
CLOSING WALL: The 4.8 cm thick tiles will be joined to the edge of the floor with high adherence mortar in a thick layer. In those cases where the vertical alignment of the slab faces does not comply with the admissible tolerances, a metal angle must be placed, mechanically fixed to the slab edge, to support the upper row block. The front of the slab shall be resolved with 9.6 cm plates, in this case.

10. Movement joints

Create the separation between walls, which is necessary to create the movement joint with special pieces (stockings and finishing pieces).

In non-bearing enclosure walls, the separation between vertical joints will be a maximum of 12 m. The maximum distance between the movement joint and a corner of the building will be 6m.

In roof and wall panels exposed on both sides, the maximum distances shall be reduced by half.



5. SUMMARY. STEPS TO FOLLOW IN THE CONSTRUCTION PROCESS

1. Mortar bed on the foundation for levelling
2. First line
3. Mortar application
4. Successive lines
5. Straps and cuts

6. REFERENCES

Training course for installers of the Ceramic Block https://www.hispalyt.es/cd%20rom%20Colocacion/inicio.htm