CONSTRUCTION TECHNOLOGY OF INTERNAL GYPSUM BLOCK PARTITIONING

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The latest interest in the execution of internal gypsum block partitioning is emerging as an alternative to brick walls. However, there is still great lack of knowledge about its production technology, as well as its behaviour, and the fledgling research is conducted in Brazil on this issue, unlike other countries where its use has a historical tradition. In this context, this paper aims to systematize the existing knowledge on the construction method of internal gypsum block partitioning in multi-floor buildings. The research methodology consisted of examining the state of the art, in an attempt to characterize the materials, components, equipment and tools required to build gypsum block partitioning. The case studies are next discussed to describe the current stage of the process and production design; and to identify the materials, tools and building techniques employed in the service works in progress. The aim is to contribute to the advancement of knowledge of partition production technology and, mainly, to further the development of internal partitioning with gypsum block.

Keywords: Building technology; internal partitioning; gypsum blocks

INTRODUCTION

Internal partitioning using gypsum-based materials, both with gypsum blocks and plasterboard, arrived in Brazil as one of the streamlined building solutions based on integrated planning and on work focusing on quality control of the project (ROCHA, 2007).

In particular, gypsum block partitioning is becoming more attractive mainly due to the benefits announced by the manufacturers, such as, for example (ISOLAVA, 2008; SUPERGESSO, 2008): shorter completion time, larger working area, possibility to install over the final floor, layout flexibility, lighter walls, lighter overload on the structure, dimensional precision and better thermal-acoustic comfort.

Among the benefits announced by one of the top Brazilian manufacturers of gypsum blocks, by good planning of gypsum block partitioning, it is possible to have an average 10% reduction in the structural load, saving in the use of steel and optimizing construction. Their use offers a clean, fast, low-cost, light, resistant and refined finish (BRASIL GYPSUM, 2009).

Although, on one hand, there is growing interest in using gypsum blocks for internal partitioning in multi-floor buildings, especially in cities in Northeast Brazil, on the other, little
is known about its production technology and behaviour, and the studies in Brazil on this subject are still in their early years (LORDSLEEM JR., 2009).

Pires Sobrinho (2009) claims that internal partitioning with gypsum blocks must not be considered a technological innovation in Brazil, since cases have been recorded in multi-floor buildings (over 12 floors) 10 years old or more in the town of Jaboatão, Pernambuco State, Brazil. However, these services were provided without a production design.

After being used for more than 10 years, gypsum block partitioning is restricted to the States in Northeast Brazil, more specifically the States of Pernambuco, Ceará and Sergipe (PIRES SOBRINHO, 2009).

One of the major restraints against disseminating the use of gypsum blocks in other regions of Brazil is the lack of technical-scientific studies on the subject and the absence of technical standards with regard to gypsum blocks, so that their application is not considered very reliable since there are no parameters for their quality control (MOURA, 2009).

The authors of this paper also consider that the distance of gypsite deposits from the main Brazilian consumer centres, namely in South and Southeast Brazil, is an impediment to the use of this type of partitioning. The gypsum complex in Pernambuco is responsible for producing 1.3 million tonnes a year, or 94% of the national production, 61% of which goes to the manufacture of blocks and sheets. Moreover, the fact that the process of internal partition production is not considered in conjunction with the other subsystems of buildings leads to a more difficult integration between the activities involved, and very often the solutions are improvised and contrary to the manufacturers’ recommendations (Figure 1).

![Figure 1: Context of partitioning with gypsum blocks: a) non-rational tears in installations; b) high waste; c) unsuitable finish of rough edges and no expansion joint](image)

In addition, there is a lack of technological know-how on the subject and performance of partitioning in multi-floor buildings by various agents involved in the gypsum block production process: material and component manufacturers, designers, building firms and
production labour, so that its application is not very reliable since no parameters on its quality control are available (CIARLINI et al., 2005; LORDSLEEM JR., 2009; NEVES, 2011).

The authors of this paper believe that this situation in the near future may lead to a rise of serious problems in the manufacturer-client relationship if gypsum block partitioning is built in isolated cases and only used to replace the traditional brick walls.

This article, therefore, will describe the building method of internal partitioning using gypsum blocks, describing the partition techniques in order to help further the knowledge of the technology of partitioning and, principally and to encourage the development of internal gypsum block partitioning.

OBJECTIVE
The prime objective of this paper is to systematise the know-how for the building method of gypsum block partitioning in multi-floor buildings with a reinforced concrete reticular structure.

METHODOLOGY
The bibliography was examined for this study to find in the literature executive and technical characteristics of gypsum block partitioning by consulting gypsum block manufacturers’ catalogues, articles in national and international journals, standards, websites of research institutes and gypsum associations, equipment and tools. From the basic information gleaned from the bibliographic research, it was possible to present the building method for internal partitioning using gypsum blocks, with emphasis on the care required in each stage of execution. The contents herein are part of the dissertation of an author of this article: Neves (2011) – Building method of internal gypsum block partitioning.

CONSTRUCTION METHOD
The building sequence for internal gypsum block partitioning is very similar to that of a brick and block wall. To build internal gypsum block partitioning, the stages listed below must be followed, namely: starting conditions, location of the first row, preparing the surface of the structure to receive the partitions, installing metal rules, marking the first row, raising; top load and final coating. Each of these stages will be addressed below, with emphasis on the recommendations to be followed and the care to be given to the constructive details.

STARTING CONDITIONS
In general, the start of partitioning using gypsum blocks must be delayed as far as possible, beginning the partitioning from the top down, starting on the last floor and concluding on the first, in order to prevent the bending from imposing unintended loading on partitions below (ISOMUR, 2007; PIRES SOBRINHO, 2009).

Installing internal partitioning using gypsum blocks must be one of the last services to be completed. It is preferable to complete the building’s façade, with waterproofing and all frames of the external partitions installed; watertight points of the slabs and roof must also be completed (COSTA; INOJOSA, 2007). Moreover, the same aforementioned bibliography recommends that partitioning not using gypsum blocks and their coating, and the whole
supposedly heavy component (granite, marble or heavy tiles) to be installed on the floor must be completed.

ISOMUR (2007) stresses that, if it is not possible to delay the start of the service, the recommendation is to begin on the top floor without propping the structure and the next floor to be no more than 50% propped, in order to reduce deformations as far as possible (Figure 2). This precaution is also mentioned by Lordsleem Jr. (2000), although specified for brick walls.

![Figure 2: Diagram for starting the service (ISOMUR, 2007)](image)

Whenever work begins, the floor to be partitioned must be clean and waste and dirt-free. All the necessary material and tools for its partitioning must be available on the floor in addition to the production design (TRABANCO, 2005).

**LOCATION OF THE FIRST ROW**

After checking the structure, clean floor and materials and equipment available for completing the service, the first stage is to locate the first row of partitioning, namely, the building stage of partitioning on that floor (TRABANCO, 2005).

Partitioning must be built on the floor and wall with the thickness of the gypsum block to be installed as stated in the design. Partitioning should be built preferably using the plumb line/tracer thread to provide accurate alignment.

**PREPARING THE STRUCTURE’S SURFACE, BRICK AND PLASTERBOARD WALLS TO RECEIVE GYPSUM BLOCK PARTITIONING**

1) Contact of gypsum block partitioning/concrete structure

In order to prevent deformation of the concrete structure, different deformations resulting from the building materials or thermal deformations of the façades from exerting too strong a force on the gypsum block partitioning, causing such damage as cracks and chinks, resilient materials must be inserted between the partition and structure, as provided in the French standard NF P72 - 202 (AFNOR, 1994) and the recommendations of the ASOCIACIÓN TÉCNICA Y EMPRESARIAL DEL YESO - ATEDY (2009).

Expansion joints must be installed when building the partitioning as a buffer for the structural, differential or thermal deformations so as not to exert too much force on the partition. High-
density polystyrene must be glued on the slab, while normal density polystyrene is used on the pillars, beams, walls and the slab base.

The expansion joints must be installed throughout the perimeter of the partitioning, at the contact with the structural elements, as shown in Figure 3. If the design has foreseen bending of more than 15mm, larger thickness of expansion joints must be adopted.

![Figure 3: Expansion joint – detail of expanded polystyrene (Source: author)](image)

In addition to the expansion joints, anchor devices must be installed by drilling the structure with an 8mm diameter bit to a depth of 3-5cm. According to ATEDY (2009), the criterion for the layout of the components for anchoring the partition/structure must be as follows:

- partitioning whose height is 2.5m or less: two vertical anchors must be installed, approximately 70cm from the top and bottom slabs; and
- partitioning whose height is 3.5m or less: an extra third anchor must be installed in the middle of the two slabs.

For horizontal anchoring, the first anchor must be installed 1m away from the vertical structure, and the successive anchors at a distance of no more than 1.20m (Figure 4).

![Figure 4: Diagram of anchor distribution (ISOMUR, 2007)](image)

For suitable expansion and protection of the anchor elements against oxidation, they must be protected with polyethylene foam. The width of the foam must be 20mm and larger than the exposed section of the anchor element (Figure 5).

2) Contact of gypsum block partitioning/brick wall

If the masonry is untreated, the gypsum block can be fixed with gypsum glue directly onto the brick. However, if the wall is already painted or coated it will be necessary to pare it down and clean away the dust to obtain stronger anchorage for the gypsum glue, as illustrated in
Figure 6. A polyester or nylon mesh must be placed in the middle of the contact for the coating using gypsum mass or PVA mass.

Figure 5: Anchor protection using polyethylene foam (ROMERAL, 2011)

Figure 6: Removing existing coating (ISOLAVA, 2011)

3) Contact of gypsum block / plasterboard partition
When the gypsum block partitioning is placed next to the plasterboard wall and is untreated, the partitioning does not require treatment. If the partitioning is plastered or painted, it will have to be scraped. In any case, a polyester or nylon mesh must be inserted in the middle of the contact with the gypsum or PVA mass.

INSTALLING METAL RULES
Metal rules must be installed vertically, joining the bottom and top lines, checking the plumb and alignment using a bubble level and aluminium rule, respectively, and must be installed with the help of wooden wedges at 90cm intervals between them.

MARKING THE FIRST ROW
It is important to stress careful cleaning of all blocks, using a plastic brush to remove the dust at the edges. If the worker fails to take such care, the dust at the ends will prevent good adherence between the block and the gypsum glue.

Standard NF P72 - 202 (AFNOR, 1994) recommends that for wet rooms, such as the kitchen and bathrooms, some services are provided, as follows:

- preferably do the first row using water repellent blocks, or
- make a concrete, mortar or masonry base of at least 2cm above the finalized floor level, on which the blocks will be installed, or
• use a PVC “U” profile with the same width as the block thickness and 2cm in height from the floor level, together with a strip of polyethylene foam on top. The protection from the “U” profile is admissible for partitioning less than 3.50m long.

Figure 7 illustrates how to execute the first row blocks in wet areas, by means of a mortar cradle and PVC “U” profile, respectively.

![Diagram of execution of the first row in wet areas](image)

**Figure 7: Execution of the first row in wet areas - NF P72 - 202 (AFNOR, 1994)**

Gypsum glue must be applied to the bottom and side expansion joints and then install the block (Figure 8), with the male side of the block downward, and cut previously so as to provide greater contact with the expansion joint.

![Image of first row using water repellent block](image)

**Figure 8: Undertaking the first row using water repellent block - blue (Source: author)**

As instructed by Trabanco (2005), ISOLAVA (2011) and Durlock (2011), after installing the first block, gypsum glue is applied to the side of the block already installed and the second block is put in place, separated from the first by approximately 3cm, to slide it to the block already in place, hitting gently with the rubber hammer with the help of a wooden device to prevent damaging the edges of the blocks, to evenly spread the glue between the blocks. All the other blocks in the row must be placed in this same way.

**RAISING THE PARTITIONING**

The second row must begin by placing the middle block to ensure that the partitioning is fixed. Gypsum glue is applied to the top horizontal surface of the first row and side of the block to be put in place. It should be mentioned that the anchors must fit into the cavities of the gypsum blocks.
The partitioning is raised until the last row, which must be between 20mm and 25mm away from the expansion joint, in order to fix the partitioning to the structure. Trabanco (2005) advises that while raising the partitioning care must be taken to completely fill the vertical and horizontal joints of the blocks and to remove excess glue in the joints using a spatula, and may use it to fill possible flaws.

Blocks smaller than half a block next to the doorways and windows must be avoided and it is important on each row to check the alignment and plumb of the blocks using an aluminium rule and plumb bob, respectively (TRABANCO, 2005).

**TOP LOAD**

According to the French standard NF P72-202 (AFNOR, 1994) the top load can be put in place in accordance with two different situations, described in the sequence.

1) Top load to only slightly deformable structures

For the top load when the structure is only slightly deformable, standard NF P 72-202 (AFNOR, 1994) recommends the use of a strip of resilient material with the same width as the partition thickness, inserted between the partitioning and the ceiling. This strip must be glued using gypsum glue and, depending on the type of ceiling material, the following recommendations must be adopted for good adherence between the partitioning and ceiling:

- Concrete ceiling: gluing is done after cleaning the surface and paring it down, if necessary;
- Plasterboard ceiling: the surface must be pared down before gluing.

The remaining space between the partition and strip must be filled with a mix of gypsum glue and white glue or polyurethane foam.

2) Fixing to deformable structures

When the structure is deformable, fixing may be done by filling the space left between the block and the ceiling with polyurethane foam, which must be 1-3cm, as shown in Figure 9 (NF P 72-202 AFNOR, 1994).

In any case, in both the above mentioned situations it is necessary to apply a polyester mesh at the level of the fixing, coating the angles with gypsum glue.

![Figure 9: Fixing top in deformable structures (NF P 72-202 AFNOR, 1994)](image-url)
FINAL COATING
The final coating of the partitioning uses gypsum mass or PVA mass in the joints between each block, and must start only after the stability of the partitioning is guaranteed. The gypsum must penetrate the joints using a metal planer. Next, the surplus must be scraped off to smooth the partitioning at both the horizontal and vertical joints. This scraping must be done some minutes after applying the gypsum or PVA mass in order to obtain a perfectly smooth surface.

FINAL CONSIDERATIONS
Countries such as France and Spain already dominate the gypsum block partitioning construction technology. Brazil still needs to advance the studies in relation to the construction technology of this service, principally to develop in the process of establishing technical standards, an element of confidence and incentive for its use.

The building method described herein must be used with care, and deserves due adjustments as a result of experience and particular aspects of each design, especially when dealing with multi-floor buildings, since this kind of building results in greater deformability of the structure.

The object of this paper was to contribute to technological upgrade by disseminating the state of the art know-how, streamlining construction technology and to form a skilled technical-scientific body to work in the area of internal gypsum block partitioning.

BIBLIOGRAPHIC REFERENCES


