

# THE DESIGN OF COATINGS IN CONSTRUCTION COMPANIES

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## ABSTRACT

This work shows the importance of the designs of coatings of facades for businesses of construction of buildings, in particular focusing on companies in the sector of buildings devoted to the production of residential buildings, finishing medium / high in the city of Belo Horizonte, state of Minas Gerais -- Brazil. The text is divided into four main parts: context of the reality of design development; basic recommendations for the design development for the façade coatings; positive impacts of the design development for the construction and others involved, and finally, some conclusions about the theme.<sup>1</sup>

1 - Originally presented at II International Congress on Dimensional Stones – Carrara Italy

## INTRODUCTION

Much has been talked about pathologies of buildings (in a reference to the terminology itself of biological areas) as visible defects and / or invisible that may affect the enterprise, as can be found in [1].

During the process of design development, may occur leaves the designer to observe some basic requirements such as: parameters for the functioning and overall quality of the work, the interactions between different parts of the building, and constructibility. Thus, it is often the emergence of so-called congenital diseases, i.e. diseases constructive generated even at the design stage, as disobedience to the rules of drawing up buildings designs (NBR 13531/95 and 13532/95), generally resulting in the emergence from disease. In this sense [2] presented statistics showing that in European countries, over 40% of all diseases presented in constructions originate in deficiencies related to the projects of buildings. An example could be seen in Figure 1.



Figure 1 – An example of pathology

In Brazil, often, diseases attributed to errors of execution is actually originating on the design stage.

Furthermore, the productive chain which forms the civil construction sector has a wide range of actors and agents of partial products, created during the production process. This causes them to be incorporated different standards of quality and that will affect the quality of the final product. Among the various actors involved, can be mentioned:

- Users, the regions of the country and the specifics of the work;
- The agents responsible for the planning of the venture;
- Those responsible for the preliminary studies;
- The designers of each specialty;
- Manufacturers of construction materials at all stages;
- Those involved in the stage of implementation of the works;
- Those responsible for the operation and maintenance of the buildings, when in use.

## THE VARIOUS DESIGNS IN CIVIL CONSTRUCTION

It is common practice in the activity of constructing buildings that architectural design is the starting point for the development of several others that are needed for an enterprise, and after receiving the approval from the municipality, it becomes a important factor of technical decisions.

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According to [3] “the design should have its development led to aggregate maximum efficiency and technological rationalisation constructive, given the requirements for performance and functionality of the building.”

Meanwhile, activities related to the quality of a product extend from the initial identification of the needs of the contractor to the satisfaction of the end customer. In the continuum that is the activity of construction, is another customer (known as intermediary), which should also have their needs addressed. But if the quality depends on several projects, materials and professionals, we recommend pointed out [4], which sets out a series of quality can be understood as “a conceptual model of the interaction of the activities that affect the quality of the product or service in various stages, covering from the identification of needs to the assessment whether these activities are being met. “

Currently there are already mechanisms for ensuring the quality of materials on both projects, where the ISO 9000 series of standards has reached spread among companies. But in the light of new products coming to market daily that consumers often the designer specifies a particular product and adds “or similar” leaving often to the buyer to decide on the best option. What will import, from a strictly technical, are the characteristics and properties of the product and it can not be an isolated decision, but taking into account the global knowledge of the parameters of performance of the building as a whole.

Specifically on the art of designing, [5] says that, among other questions, it is necessary to “know the most frequent diseases of the object under study, seeking avoid them at the level of details and specifications constructive.” So when the designer (s) (i) (m) ceases to observe basic requirements relating to the functioning and overall quality of the work, interactions between the parts of the construction and constructibility, is the frequent appearance of so-called congenital diseases, that is, pathologies constructive generated even at the stage of design.

As to the planning system, the party less simple and more arduous indicates that the design and construction require planning done by various professionals from different positions within the organization and in various stages of the design of the project. The high planning focuses on the overall goals and limitations run throughout the design. These goals drive the lowest level of the planning process, which specifies each meant to achieve those ends.

The key the size of the performance of the planning system to the level of the production unit is in the quality of outputs of data, or the quality of the design produced by the latest designer.

Craving the improvement of performance of the planning system, it is essential to the analysis of non-conformities

leading the search for its root cause and then improvements can be made in future performance. Measure the performance of the level of the last designer not only implement the changes at this level.

The root cause of poor quality or failures in the implementation of the planned work can be found at any level organizational, process or function.

## THE FACADES COATINGS DESIGN

The disobedience to the recommendations existing technical norms relating to the specifications of materials and techniques executive, too often, leads to diseases of the buildings, which in addition to becoming a great inconvenience to the parties involved (and condominium construction) yet become matters of easy challenge by experts in the event of a lawsuit (since the basic documents in the case technical standards were not followed).

On several occasions the Department of Materials Engineering and Construction of EE.UFMG, through its group of teaching, research and extension in the area of finishing the construction, has already been called to intervene with the construction and condominiums developing laboratory tests and designs, recovery of coatings of facade, and that in a significant number of cases, the deficiencies in design have been identified as the main factor in the occurrence of diseases.

According to [6] so that the facade of coatings may have satisfactory performance in service, several measures should be taken.

Among them there is a need for preparation of a design for implementation of the facade on which is a series of detailed information relating to the specification of materials and techniques executive, as well as the positioning and sizing of the movement and dessolidarization joints. Moreover, you should exercise strict control over the quality of the substrate material, mortar settlement, as well as the very material used in the coating.

Companies of construction of Belo Horizonte, especially those directed to the production of residential buildings, finishing medium / high, facing up constantly with the need for the implementation of facades coated with ceramics (coating noble and high acceptance by the consumer market, usually used in conjunction with other coatings, high standard, such as granite and aluminum). As examples, it is below, in a short form, the stages of preparation, executive design, specification

of materials and definition of technical executive for the service of coating, using and/or stone material:

## A - STAGE OF ELABORATING THE EXECUTIVE DESIGN

In implementing the coating of and/shell or ornamental stone is of paramount importance that the project executive detail the dilatation, movement and dessolidarization joints. [7] According to the absence or badly scaling these together mean flaws in the project that can certainly cause the detachment of the ceramic tile or ornamental stones facades.

The joints should provide sufficient width to be absorbed so resilient (i.e., in the elastic regime) the thermal and hygroscopic events.

The movement joints present position staggered over coating (preferably located in the region of transition structure / masonry) and are depth from the surface to the bottom, filled with materials resilient, and the task of breaking down words into ceramic cloth panels minors and absorb the tensions generated by movements of the structure and ceramic ranges they delimit together. Figure 2 illustrates this kind of joints.

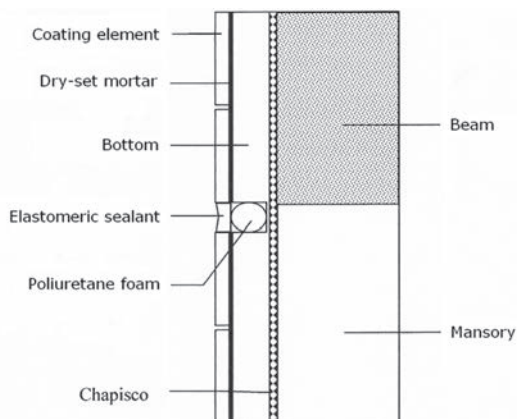


Figure 2 – Example of movement joint

Already the dessolidarization joints are used on the changes of direction (such as corners and protruding), as well as the transition of different coatings, also with the task of absorbing the tensions that arise in these places. Figure 3 illustrates this type of joint.

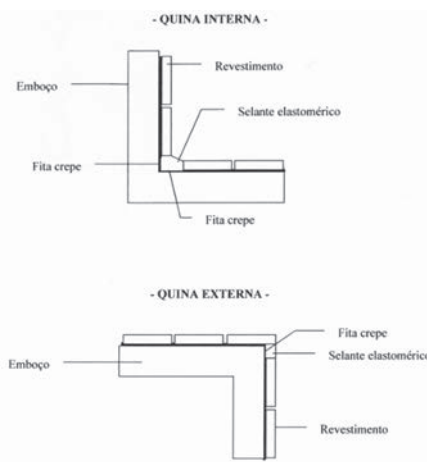


Figure 3 - Examples of dessolidarization joints

## B - STAGE OF SPECIFICATION OF MATERIALS

Being able to be considered as a step in design, the correct specification of materials is vital in the performance of the system of coating used on the facade. Failures in the specification of the various materials that make up the system of coating can be capital in the emergence of diseases such as debondings of tiles.

Also according to the prepare base mortar [7] is a layer of mortar to ensure greater plaster anchor of the masonry / structure. The prepare base mortar used on masonry is usually composed of cement and sand with the materials proportion 1:3, with fluid consistency. Already on the surface of concrete should be used prepare base mortar industrialized or the addition of a resin (preferably the basic acrylic) to prepare base mortar conventional mentioned earlier for use on masonry.

The plaster is the layer of regularization, applied directly over the base, with the task of defining the vertical plane and give support to the next layer, the ceramic and/or ornamental stone coating itself. The plaster must be such that meets the recommendations of resistance, bond strength recommended in the standard ABNT NBR 13,749 (coating of walls and roofs of mortars inorganic - Specification (1996)): in the trial, tearing, to determine the bond strength by pull-off tests, the least 04 values of 06 cps tested should be greater than or equal to 0.30 MPa.

The dry-set mortar (mortar used in the settlement of tiles) must be at least of the type AC-II (also known as dry-set mortars flexible polymeric or with added). To tiles and / or ornamental stones of low water absorption (such as sandstone-porcelanato and / or granites) are still recommends the use of dry-set mortar type AC-III. The recommendations of resistance, bond strength recommended in the standard ABNT NBR 13,755 Coating of

external walls and facades with tiles and the use of dry-set mortar - Procedure (1996)) for tiles settled in facades, using dry-set mortar define that in the trial of tearing, to determine the bond by pull-off tests at least 04 values of 06 cps tested should be greater than or equal to 0.30 MPa.

[8] According to the tiles to be used as coating for facade must also submit specific characteristics. The ANFACER (National Association of Manufacturers of Ceramics) recommends that ceramics pieces to be used in facades present water absorption less than or equal to 6.0%. For pressed tiles, with water absorption of between 3 and 6%, and standard ABNT NBR 13818 (ceramic plates for coating - Specification and methods of testing (1997)) recommend that the plates to be used to present dilation hygroscopic less or equal to 0.6 mm / m. There is still, as positive features, the use of clear cuts, small dimensions (e.g. 10cm x 10cm) claws and poly-oriented in back.

Concerning grouting of mortars, the standard ABNT NBR 14,992 (Mortar the basis of Portland cement to grouting of tiles - requirements and methods of testing (2003)) recommends, for use in facades, the grout type II, which can be applied to tiles with absorption of water less than 3% and in areas whose extensions should use of movement of joints.

### **C - STAGE OF IMPLEMENTATION**

The settlement of the coating system itself must also be the object of a series of care because, flaws in this step will probably lead to a premature detachment of the plates.

[7] Even as the dry-set mortar used in the settlement of tiles or ornamental stones require a minimum length of time from the mixing of the product with water (usually of the order of 15 minutes), with the fundamental observation of open time, which corresponds to interval of time that the dry-set mortar can be extended on plaster without any loss of their power adhesive. For dry-set mortar type-II open time should be at least 20 minutes (reference value, taken in the laboratory), and that this can be verified on site for the settlement of the and/ or ornamental stone coating. The verification of the following indicates time exceeded open: i) observation of bright whitish film on the surface of the dry-set mortar ii) touch the dry-set mortar with the tips of the fingers and no occurrence of dirt in them, and iii) tearing a ceramic or ornamental stone newly settled and no verification of great impregnation of the area of the back by dry-set mortar.

It is also important that after the mortar mixture is completely used in a period less than 2 hours and 30 minutes. In the settlement of ceramic or ornamental stone pieces with dimensions greater than 20 x 20 cm is recommended the application of mortar also

in his back (beyond already applied in plaster with the use of appropriate tool). The drag of ceramic providing the breaking of strings of dry-set mortar and later percussion efficient piece guarantee greater stability of the settlement, since it increases the bond area.

Thus, it appears clear the importance of three steps in the development of specific coating design the facades: executive design, specification of materials and execution. Of course designer responsibility for the first two steps, he could contribute significantly to the stage of implementing the so-called generating design for production, which, according to [9] should point the details executives for use within the executive activities.

## **POSITIVE IMPACT ON DEVELOPMENT PROJECT IN FACADES COATINGS**

Observe that the development of specific design for implementation of the facades lining contributes enormously to the reduction of possible diseases from the non-observation of details exposed in the previous item.

Furthermore, in the current scenario shows that businesses also have a social role in ecological and may not remain disentailed with society where fall and the human being who work. How come happening with companies in other productive sectors, the building industry needs to change the aims, focusing their actions on workers and the environment that surrounds it. Must invest in the improvement of its human potential, seeing it inserted in society and its problems, and also focus on the interference that causes the environment when the option of a building in place and because of the time of its implementation, using the approach the issue of waste (such as consumption of materials and time beyond what is necessary) and generation of pollution.

The experience of the Department of Materials Engineering and Construction of EE.UFMG, through its group of teaching, research and extension in the area of finishing the construction, has clearly shown that, since 1996, works that formally led to execution of their facades with the use of executive design showed satisfactory performance front of requests which a facade is commonly referred (loads of wind, sun, rain, humidity, among others).

It's possible to list some of the benefits for the construction / users who comes of this procedure, namely:

- Sensitive reduction of diseases such as infiltration of moisture and water from rain, debondings and fall of the coatings;
- Where was the preparation of designs not had news of the need for repairs later, unlike several buildings which were not made specific designs for implementation of the facade, which, with some frequency, the Department of Materials Engineering and Construction of EE.UFMG was triggered for testing, reports and designs of recovery (common situation since 1996);
- The absence of rework (come from the need to repair facades with infiltration or collapse of coatings) means the absence of the nuisance to users of buildings (natural when performing repairs to the building occupied), maintaining the good image of the construction in the market, in addition to lower costs of maintenance of buildings.
- Reducing the waste of materials in the form of rubble generated by the corrective actions during construction and the subsequent because, in most cases, several layers of the coating system are not re-usable, generating a significant amount of rubble and various types of pollution and costs (production of noise, dust generation, obstruction of flow of water courses, proliferation of vectors of disease, destruction of layers of soil nutrients, in addition to the cost of materials, its transmission and its deposition).

## CONCLUSION

Once observed a significant interference of the executive design (involving specification of materials and techniques) in the performance of the coatings of facade, denotes to the fundamental importance of carrying it out.

The preparation of a detailed project, consistent and feasible will be possible provided that it is consistent in adequacy of the theory to practice, as well as in its recommendations, taking into account the reality of labour-direct and indirect civil construction.

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