

REHAB 2014

Proceedings of the International Conference  
on Preservation, Maintenance and Rehabilitation  
of Historical Buildings and Structures

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Edited by

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Sérgio Lira  
Cristina Pinheiro

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## Stabilization of a façade: a mix of intuition, science and political action

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**ABSTRACT:** The subject of this paper is a ruin of a two-story house adjacent to the City Hall and Jail of Maragogipe, an important city of Bahia from the historical and cultural viewpoint. The study has technical, urban, environmental, and conceptual implications. As the construction is in a protected zone, we had to consult IPHAN (Institute of National Historical and Artistic Heritage). They determined that the house was to be treated as a ruin. Our technical report reflects our conceptual disagreements, but our project was developed to reinforce the ruins, with the possibility of later modifications, if common sense would prevail. The proposed system of structural metallic reinforcement could easily be incorporated into an eventual volumetric recomposition of the building including a roof, a component that would allow the occupation of the empty space and also would facilitate the conservation of the original façade. To the studies, we employed photogrammetric techniques.

### 1 INTRODUCTION

It is common sense that a restorative intervention that focuses on the stabilization of a building or a ruin is basically a technical activity, based in science and structural calculation. But, as Croci emphasizes, a high dose of intuition is necessary throughout the process, combined with empirical components of knowledge (Croci, 1986). In fact, the solutions to be used in restoration always take a strong component of empiricism, as it has never turned away from the process. The fact that empiricism has given part of its reign to science does not imply on its disappearance from the scene of epistemology, as science itself takes into account the knowledge and the empirical observations (Oliveira, 2011). Regarding our activity, Torraca indicates that the scientific intervention in the elaboration of new techniques of restoration is not easy and the technical progress is generally due to the “savage” experimentation of the restorers rather than organized investigation projects (Torraca, 1986).

The attitudes which are necessary when facing the need to consolidate a monument, sometimes extrapolate the necessity of taking into consideration technical procedures: it is imperative

to go through political ways, in a broad sense, to solve problems of conservation of artifacts that are representative of our memory.

It is also necessary that the elegance of the solution is not forgotten while evaluating all the technical procedures to be adopted in an intervention, as well as its discrete interference on the image of the building to be restored, respecting the logic of its original conception. Sanpaolesi used to say that the specialist in restoration should have a technical and a scientific formation, but also should be careful while using words and acting, as well as in human relationship; and should also have enough courage to affirm something with conscience, taking into account his freedom and someone else's freedom (Gurrieri, 1981).

### 1.1 *The problem*

The city of Maragogipe (or Maragogipe, as some people want) is one of the most important of the region of the Recôncavo of Todos os Santos Bay, especially by local traditions and the important role they played in the history of the State of Bahia. The lands of the county were included in the former Captaincy of Paraguassú, initially an allotment granted to D. Álvaro da Costa, son of the second Governor-General D. Duarte da Costa, by letter dated from January 16<sup>th</sup>, 1557, confirmed by the Royal Charter of March 12<sup>th</sup>, 1562 (Sá, 1982).

In the early years of colonization there was a strong defensive appeal in the deployment of settlements, combined with the search for easy management of displacements by "water highways". Thus, the primitive city must have been born by the lagoon's shore, but from the seventeenth century on, the nucleation of the city changes its focus, seeking the parish Church of S. Bartholomew, built on a hill. It is around this new center that was built, in the eighteenth century, the City Hall and Jail, symbols of power and administration of the Village, which was established the category of strict preservation zone (Bahia, 1982).

This historical overview is motivated to emphasize that the trajectory of Maragogipe has its roots established in a remote past and secular traditions. Such information enables us to assess better the cultural value of its built heritage. Using it, regardless of their state of stability or ruin, is the best way to preserve it for future generations.

This paper presents reflections on the understanding of the concept of a ruin and an intervention which was established by IPHAN (Institute of National Historical and Artistic Heritage) for the façade of the manor of Maragogipe and presents a proposal to stabilize it for subsequent reintegration.

### 1.2 *The building*

The building we see today, the object of our study of preservation, is in a state of almost total ruin. It was still standing in 1982, when it was registered in the *Inventory of the IPAC-SIC*, that documented the Recôncavo of Todos os Santos Bay (Bahia, 1982). It is a two storey house, which was very important to the ambience of the square where the City Hall and Jail is placed and to its immediate vicinity, only separated to it by an alley (Fig. 1). It is primarily a building of environmental value: urban and volumetrically important. The building has two floors in the center and just one in the two lateral wings, all covered with gable roof ending on cornices.

It is possible to note, through the documentation of the inventory and the photogrammetric survey executed by us, that the architectural organism has changed over time, to reach the current composition in approximately bilateral symmetry. In fact, the authors of the *Inventory IPAC-SIC* imply that dates entered in the doorways of the property indicate the period in which the original buildings were interconnected and converted into a cigar factory: 1892 and 1895 (Bahia, 1982).



Figure 1. Left wing of the building.

The current situation of the property is embarrassing (Figs. 2-3). Abandoned, it had one of its side wings recovered and used as a commercial point, and the rest was left aside, to be consumed by the ruin. This has brought losses of major consequence to the image of the square, not only for the loss of volume of the building and its significance to the urban fabric, but also due to the fact of having one of their wings restored, contrasting grotesquely with a melancholic abandoned ruin.



Figure 2. Central wing of the building, seen from inside.



Figure 3. Situation of the building nowadays.

## 2 CONCEPTUAL AND TECHNICAL CONSIDERATIONS OF THE PROPOSAL

Although the façade does not show strong signs of rotation, it is in reasonable risk of collapse and total loss of the image of the old building, which is a key part in the ambience of the whole square. It is indicated in a document emitted by IPHAN that these remaining elements of the old cigar factory in Maragojipe should be treated as a ruin, getting the necessary consolidations to survive. Thus, our study moved in the direction of strict compliance with the order, although we do not agree with this idea. In view of the situation, some considerations were necessary because a conservative or restorative intervention should always be product of critical reflection.

The condition of leaving a building as a ruin, expected in the modern culture of restoration (and also in the thought of the Romantics of the nineteenth century) can be applied, but after being subjected to a critical approach, as in restoration, the maximum *casus ad casum* is extremely significant. Such a decision of IPHAN may come from misinterpretation of Chapter 5 of the text *Theory of Restoration* of Brandi, because he says that there is also an indirect intervention that refers to the space-environment of the ruin, and that for the architecture it becomes an urban problem (Brandi, 1977). So, it is fundamental to consider not only the building itself, but the harmony of the ensemble, which obviously a ruin does not provide.

The conservation of a ruin in a private property, in practice, will lead to the final destruction, as this becomes an obstacle to the valuation of the property and to its full use. The main factor considered by the inventory and by those who observe the property, from a critical point of view, is that its value is mainly environmental: urban and volumetrically important, as already mentioned. It is sufficient to look at what's left of the building to conclude that the remains of the ruin do not match with the harmony of the whole ensemble and the building shape will be completely compromised.

From the point of view of structural improvement, we could create independent structures that bear the façade, but stabilization would certainly be more effective if we could have articulated this façade to the body of the new building. Furthermore, the conservation of the façade isolated will be extremely problematic since it will not have a protective cover, and thus it will suffer from the injuries of the time. The tension of crystallization of soluble salts, which have seriously attacked the walls, reducing the thickness and compromising its stability and mortars, will continue its destructive action. Remains of the ruin will always be a constant danger to passers-by and to users of the building that will be constructed beyond the façade, because even stabilized in its totality, isolated fragments can break off from the ensemble, causing accidents.

In the process of stabilization (or even if the façade is incorporated into a new wall structure), prudence recommends embedding the cornice in a belt of concrete, which will be bound to the support pillars that are going to be built. On the other hand, in one of the side wings of only one floor, part of the brick cornice collapsed. The same image shows that the discharge arch collapsed. If the gap is not completed, the opening, which has no lintel, will crumble, as soon as the arched wooden lintel disappears due to decay. It will also be strange, from the formal point of view, if we leave a reinforced concrete belt passing over the gap caused by the lack of the cornice. Thus, it is important that the reinstatement of the gap shall be made, as it is not only the re-interpretation of the figure drawn by an artist, but continuity of a cornice, whose profile is not being invented. By a purist concern, one can even highlight the part reintegrated with differential treatment. Therefore, it is a legitimate reintegration, not a fake historical style.

The use of a façade, whose building was ruined, by incorporating it into a new building, is not an unusual procedure. The IPHAN has approved dozens of them in the historic center of Salvador, including the houses numbers 47, 49 and 51 of Gregório de Mattos Street, with excellent results from an urban point of view. Besides that, the ruined building is not classified as cultural heritage. It is not recognized by its great historical value to merit treatment as a ruin. What is listed in the area is the City Hall and Jail and its environment. But it is important to take into account that a ruin in the neighborhood of a classified monument is not the best ambience, from the urban point of view.

The proposed project was developed with structural steel reinforcement allowing the possibility of later modifications, if common sense would prevail. To attain this purpose, we have designed a system of structural metallic reinforcement, which could easily be incorporated into an eventual construction of a new building appropriating the old façade, including a roof. This component would allow the occupation of empty spaces and would also greatly facilitate the

conservation of the original façade, which is meant to be in harmony with the major urban complex of the City Center. To obtain a detailed study of the remaining façade, we have employed photogrammetric techniques.

### 3 THE PHOTOGRAMMETRY

The survey of the façade has used the resources of digital terrestrial photogrammetry, in which pictures are rectified by eliminating the effects of perspective and distortions of the images, producing orthophotos that are sized and inserted into CAD (Computer Aided Design) programs. Thus, accurate measurements are obtained from the elements, resulting in a faithful representation of the façade, in digital and printed plans. The lower control points were leveled 1.00m above the main door's sill. From this marking, the upper points have been aligned with plumb. In total, twenty control points were used.

The studied façade comprises distinct properties that were interconnected and unified in the late nineteenth century, perceiving the change of inclination in the plane of the façade of the last building. For this reason, we chose to generate orthophotos of each building individually, and then they were associated by using the control points as reference.

The photographs were rectified in PhotoModeler Scanner software, using at least three photos with the camera positioned at different angles from the façade and, preferably, one perpendicular and two inclined. The total number of frames in order to obtain an image with no perspectives varies according to the size of the façade, the area covered by each photography and eventual obstruction by objects. The result of the survey is shown in Figure 4.

Comparing the photogrammetric cadastral survey (most accurate) with the old register, it was observed that the total length of the façade, about thirty meters, and the height of the building are equivalent. The major differences were noted in positioning the upper and lower frames and in the detail level achieved due to the use of orthophotos. These photos, after rectification, also allowed the accurate mapping of the façade's damage, for preparing the consolidation project.

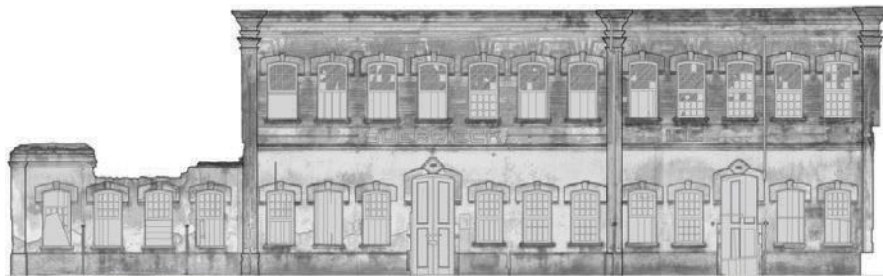


Figure 4. Façade obtained from orthophotos.

### 4 DIAGNOSYS OF THE PATHOLOGIES

The photogrammetric survey has shown that the central façade is inclined, but it still stands because the center of gravity of the system remains within the middle third of the base. No one can, however, ensure its stability, without the necessary reinforcement, if there is a strong rain, especially with the vibration of frequent vehicle traffic.

The inside of the building completely collapsed. This is due mainly to the fact that when the cigar plant was installed, the partition walls of the old houses were removed and the roof, without receiving maintenance for years, collapsed, taking what was left of internal partitions.

The façade that remains practically intact is made with bricks and lime and sand mortar, according to tests carried out in laboratory. In those parts where is noted the phenomenon of "leprosy of materials", due to the presence of soluble salts, it was identified the presence of sulphates, a very expansive salt. Due to the distribution observed in these lesions, some can be



attributed to capillary rising, but those in the higher part of the *façade*, must be originated from contaminated material (bricks, sand or mixing water). This phenomenon caused by salt crystallization is exacerbated in the presence of water, which dissolves these salts, causing them to "travel" through the porosity of the material, crystallize once again and cause more damage to the wall elsewhere. It means that if the *façade* is exposed to weathering, it will degrade still more easily, even if stabilized.

Many frames disappeared and just a few still have the complete closure elements: guillotine, dumping windows and shutters. Their design can, however, be rescued from the existing ones. But, if the *façade* is to be treated as a ruin, it does not justify, in principle, retaining them or making new ones, based on the remaining models. On the other hand, if a new building is to be constructed in the place, especially if it is to be used for commercial purposes, for security reasons, it should be installed grilles on the ground floor. The windows above, for reasons of stability of the *façade*, should be immured.

## 5 FAÇADE CONSOLIDATION

To prevent rotation and collapsing of the *façade*, it was proposed a system, consisting of metal pillars fastened to the *façade* with threaded rods fixed with epoxy resin by longitudinal steel beams (Oliveira, 2011) embedded in a block of reinforced concrete foundation. The walls shall also be fixed at a higher level with a reinforced concrete belt. The structural system is shown in Figure 5.

A support system of the wall from the inside, with inclined propping, would be effective, but these elements do not consist of an elegant solution and would create a certain problem with the utilization of space within the property.

The option of using metal profiles, rather than concrete pillars, as already used in ancient ruins of Gregório de Mattos St. 47, 49 and 51, in the historic center of Salvador, is based on rapid implementation, as well as easy connection by welding.

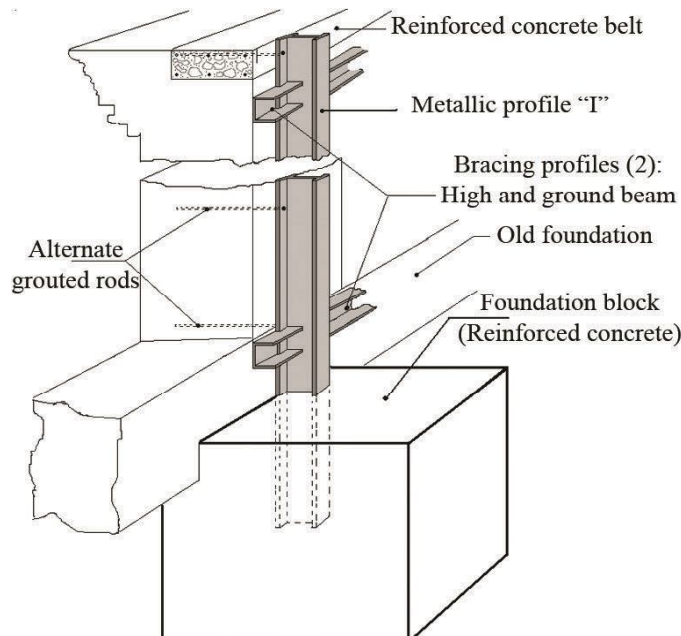


Figure 5. Croquis of the stabilization process proposed (intuitive conception).

In restoration project and structural consolidation of ancient buildings, it is rarely necessary the detailing of structural fittings as would be required in a project of steelwork run for a new building. The reason is based on the dimensional irregularity of the old walls, which implies an individual adjustment of each piece at the old building, and also due to the surprises that appear in the progress of the work. The details of the locking system of the masonry were divided into four parts: locking beams, pillars, a reinforced concrete belt and foundation blocks.

### 5.1 Bracing beams

The bracing beams will be arranged in three levels: at the level of the main front cornice, below the level of the first pavement and as a ground beam. The profiles used will be type U203x27.9kg/m, which attends the deformation parameter, the bending moment and shear in both directions (X axis and Y axis).

The profiles will be stuck in neutral axis fixed in the masonry by using carbon steel threaded rods one-half inch in diameter, fastened with nut. In the thinner walls, the hole for fixing the profile should have, as a minimum, 30cm depth. The fastening system of the masonry profile is shown in Figure 6.

The connection of the final part of the corner profile to the masonry will be as shown in Figure 7. The bar will be welded to a metal plate, held by stainless steel threaded rods and nuts. The irregularity in the support of the plate to the masonry will be resolved with the use of mortar.

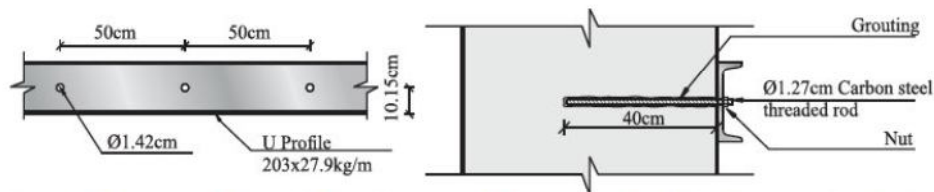


Figure 6. Locations of holes in the fastening system of the masonry U profile and cross section showing the attachment.

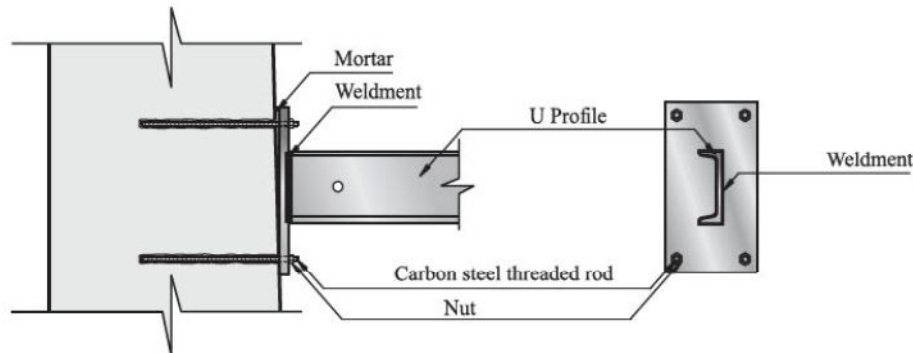


Figure 7. Support of the end of the U-profile in masonry.

### 5.2 Pillars

The metal pillars proposed, calculated to flexion-compression, in W-profile (Type I) 360x79kg/m, will be grouted in the masonry throughout its length with threaded rods of carbon steel, half an inch in diameter, fastened with nut and set in concrete bases. Any gaps between the rectilinear profile and uneven walls should be filled with cement mortar 1:3 to prevent water penetration, as well as the best adjustment of the piece on the wall. The connection of the pillars to the bracing beams is shown in Figure 8.

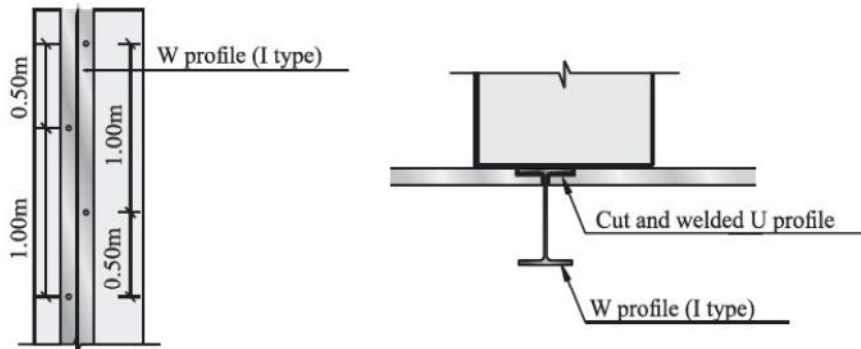


Figure 8. Spacing of the mounting holes in the masonry pillar and detail, in plan, of the U section profile in the vicinity of the pillar and its weld.

### 5.3 Reinforced concrete belts

The project also provides the placement of reinforced concrete belts on the top of the masonry for clamping. The belts will be assembled longitudinally, with amended accrued irons pieces, and transversely, with 6.3mm diameter iron stirrups spaced 15cm. The belt shall be attached to the masonry with steel rebars that will penetrate the masonry 30cm (Fig. 9). The distance between these linkages is 50cm.

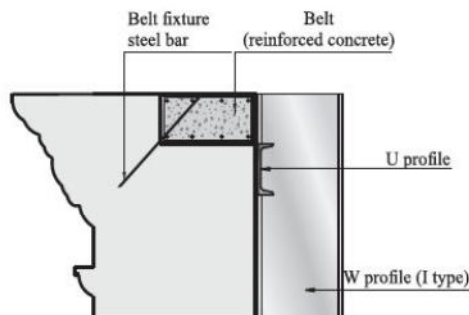


Figure 9. Detail of the belt for masonry.

### 5.4 Foundation block

The pillars will be embedded in blocks of reinforced concrete cast on site, as shown on Figure 10. Since there is no data of soil and foundation existing in the vicinity of the ancient wall, the proposed scheme shall be revised. Soil conditions, verified after opening the pits, may recommend the application under the block of a concrete reinforcement slab or other form of deep foundation.

The concrete block that will be used as foundation for the pillar should go forward a level below the plane supporting the foundation of the façade, with a steel mesh in the periphery to tighten the system. It is also proposed to place metal substructures welded between the pillars, running below the floor level, and shielded with concrete.

Not being of special steel, and staying in the open, the metal structures supporting the ruin should receive anticorrosive treatment. The process involves sanding the pieces beforehand and applying as protection a primer epoxy, then paint against rust, in graphite gray. Special caution should be observed in the weld joints to prevent problems, because the process of welding induces corrosion. It is strongly recommended that any intervention on the façade should be preceded by temporary propping.

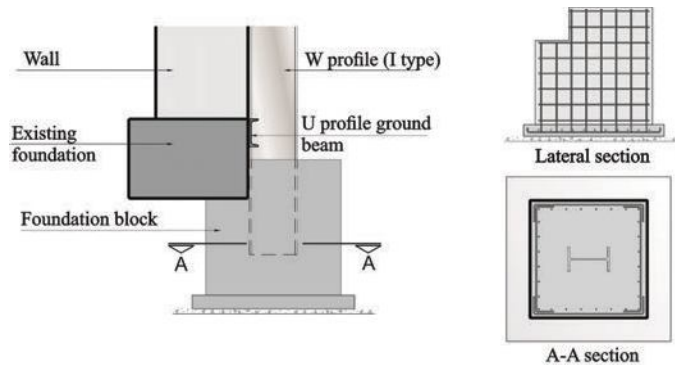


Figure 10. Iron reinforcement of the block.

## 6 CONCLUSIONS

The professionals that experience the daily problems of the structural consolidation of ancient monuments, at least in the case of Brazil, frequently face conflicts associated to bureaucratic decisions that have to be outlined with the employment of the technique and of the imagination. The paper has presented one of them.

On the other hand, the wise principle of reversibility that Cesare Brandi left to us, whose application is relative when considering the building heritage, acquires a situation of partial reversibility, in the suggestion that was presented (the metallic profiles can be cut and unscrewed). Besides that, it was demonstrated that the old principle of reversibility has to be understood as the application of a solution of reinforcement which has a flexible character that allows alternatives for future projects.

The solution showed in this study also allows the future rescue of the same structural logic of the primitive building, if the common sense prevails in future decisions of the institutions that deal with national heritage. In a new project, it can be used wood or metallic beams supported by steel elements in the new pavement of the first floor. In any case, the rhythm of the beams must be the same used in the old wood pavement. Nevertheless, the solution allows the future restorer to employ a reinforced concrete slab supported on the reinforcement steel beams.

With this proposal, it is expected that, in the future, the dignity of the environment and of the area of the main square of the historical center of the town of Maragogipe will be rescued. Besides that, the memory vestiges of the original materials from the primitive construction will be conserved, and surely in the future a wisely elaborated restoration project will emphasize them.

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