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A new Matrix for the Architectural Stratigraphic Diagram

Roberto Villalobos[1]

[1] *Sapienza University of Rome, Department of History, Restoration and Representation of Architecture, Piazza Borghese, 9, Roma, villalobosvillalobos.1889729@studenti.uniroma1.it*

***Abstract* – The stratigraphic diagram, a non-irruptive observing method with its basis in archaeology, is a field-representation layout that describes the relationships and sequences of the excavations' stratigraphic layers by identifying and listing all the elements that make them up. Although it is a first-order approximation tool that provides an overview, the main objective is to change its rigid scheme and suggest a new way of applying it to standing structures in order to generate an entirely novel and complete stratigraphic diagram rather than one diagram per each specific part, which would be useful for the development of a restoration project. The research proposal initially intends to identify and classify the basic relationships of the elements according to their function: structural and decorative, then move on to new incorporation of information about the pathologies, and finally the missing elements as a reconstruction process, all in a single matrix.**

I. INTRODUCTION

The Harris Matrix is the name given to a printed sheet of paper which contains a grid of rectangular boxes where all the elements found in the excavation must be listed. The resulting diagram represents the stratigraphic sequence of the site. It consists in the appreciation and survey of the soils and walls periodization, the strata and all the "finds", *"where the upper units of stratification are younger and the lower are older"* [1]. The early implementation of the stratigraphic method to a standing structure was the stratigraphic analysis of the masonry, which had as its first objective the description and interpretation of the different construction phases [2]. This procedure later derived in *"archeologia dell'architettura"* (archaeology of architecture) when other survey and measurement methods like mensiochronology and archaeometry were added [3]. But, why the archaeology of architecture and the stratigraphic diagram are relevant for an architect? Because the data collected in the stratigraphic analysis constitute the material documents that allow the knowledge of the history of the building but, at the same time, make up the material of the construction that the designer must restore [4].

The application of this procedure must be accompanied by an extensive knowledge of the elements that composed the opera, of the historical background, of the ancient constructive technique, and a familiarity with the diverse typologies [5]. Therefore, it is suggested that the analysis must be done in collaboration with many specialists, or by *"an archaeologist who knows the history of architecture or, better, an architectural historian who has assimilated the conceptual tools of stratigraphic archaeology"* [6].

II. FIRST CONSIDERATIONS FOR THE NEW STRATIGRAPHIC DIAGRAM

The archaeological stratigraphic analysis has as its first consideration the diversity of the record and select only the basic differences between entities and how they are related [7]. Three types of relationships among the elements found in excavations were identified: 1, the units have no physical relationship; 2, they are in superposition; and 3, the units are correlated as parts of a once-whole deposit that has been modified [1]. The objective is to provide a first overview of the area and the features. The first phase of this re-application of the method to standing structures assumes all the connections between the units and reduces the possibilities as much as possible into simple groups, answering the question which are the primary relationships between the elements? To comprehend the question, it is important to understand why the elements are in such a position, and the answer is the function they are fulfilling.

The elements in a construction have one primary function: either structural or decorative. The first one considers all the pieces that support the rest or share the load, even if they are shaped or decorated, and the other includes all the members that provide an aesthetic characteristic. As a result, the units have been classified into two main groups, a taxonomic classification based on the most important quality inherent in each component. For the first time, the archaeological method found a parallel in the architectural, reducing the relationships to a minimum, but it is still possible to include all the parts specialists can identify. This way, the diagram will have the tools to recognize not only the constructive phases [5], but also the stylistic aspects of the structures ordered in different groups according to their position on site.

An implementation of this new method was done over a curtain wall of the Aurelian walls of Rome, specifically on the exterior facade between the towers L39 and L40 during the author's master thesis. A survey and analysis campaign

Fig. 1. Documentation and representation of the Aurelian Walls of Rome. Towers L39-40.

were conducted in order to obtain the state of the monument and to propose a restoration project with re-use purposes. In figure 1 the different steps of the heritage analysis procedure are recognizable: the photogrammetry, the architectural survey, the masonry mapping and the degradation diagnosis, from which it was possible to identify the original material and the subsequent interventions through time, as well as the state of conservation. Meanwhile, figure 2 shows the different phases of construction and intervention after a detailed masonry analysis. The process of documenting the scientific heritage began with an accurate and thorough search of archives and bibliographic materials, allowing for the creation of the appropriate stratigraphic diagram after obtaining all the necessary data. On this first test, the interfaces or contact surfaces were not considered to avoid any complication in the explanation and the production of the scheme. The resulting diagram, in figure 3, shows the elements grouped into decorative and structural. Letters A, B, C and D correspond to the structural materials, in this case represent the Roman concrete used as the inner core of the wall, and the additions of XII, XIX and XX centuries. Opposite, the numbers 1 to 11 belong to the decorative units: bricks and loopholes. Finally, the square

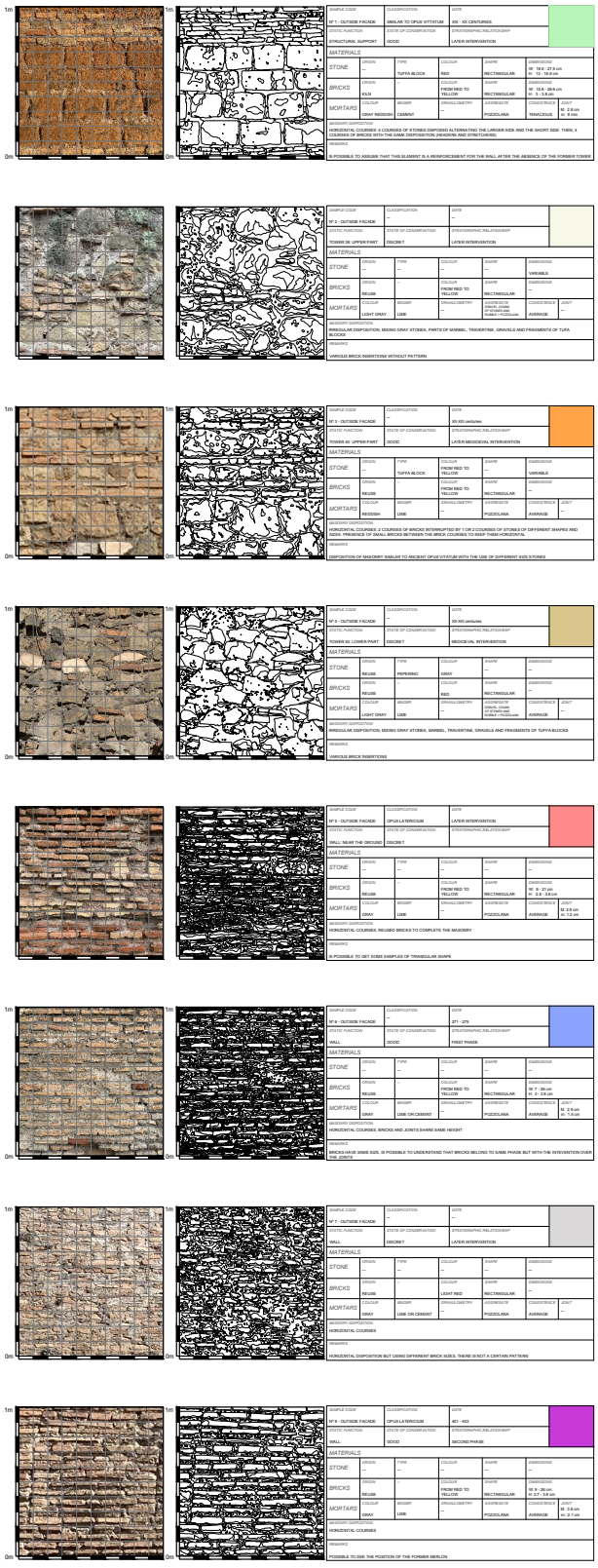

Fig. 2. Masonry analysis.

and triangle help to differentiate the planned phases of

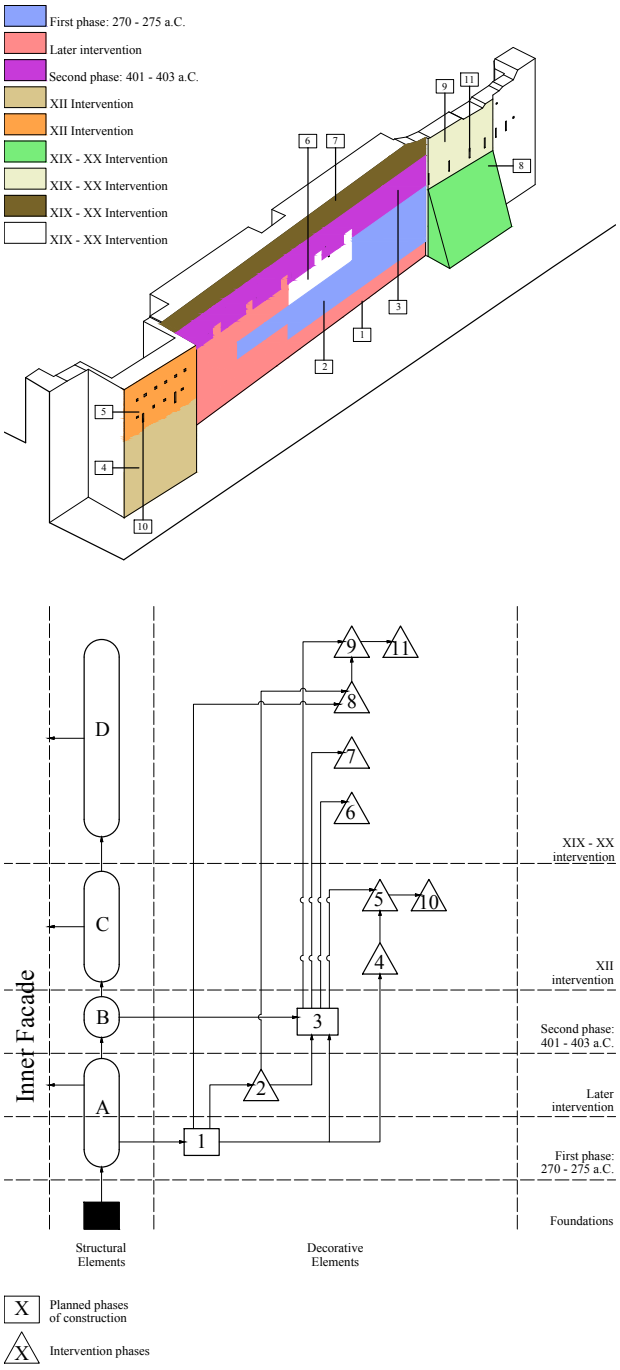

Fig. 3. Resulting diagram.

construction and the intervention phases. It was feasible to link the letter A with the number 1 after an exhaustive investigation and in accordance with the masonry charts since they are both made of original materials: Roman concrete covered in bricks. The same is true for the letter B and the number 3. The other letters and numbers also relate to a certain time period, but it was impossible to tell whether or not they were used at the same execution time.

One of the earliest adjustments to the Harris method focused on the dating of the units and was applied by Professor Martin Davis. He suggested that the "chronological late elements" should be placed above the elements that physically supports [8] in order to provide a better lecture on building stratigraphy, because they were added later, this way the matrix will present the manner in which those elements were disposed. According to his statement, if a column or set of columns were added or replaced after the building was complete, they should be written over the number that is physically above; consequently, the diagram would not illustrate the real order in which the elements are located. Therefore, it is considered for this approach to change the symbol that contains the number and specify in the legend that there is an intervention phase that could have occurred after the following period, in order to present a diagram that accurately represents the reality on site with proper correlation of function and correlation of posterity, anteriority, or contemporaneity [8].

III. A NEW VARIABLE AND THE SCHEME MODIFICATION

The method's evolution has always kept in mind how to adapt the stratigraphic archaeological diagram to heritage documentation and analysis, attempting to use the chart not as a mere list of the elements found on site, but as a tool that can provide the needed information and knowledge to understand the entire monument and each specific part, being useful for the redaction of a conservation project. The idea was to take the method and continue adapting it, it was not about working without a precise and clear methodology in a vague and improvised way, but rather to adapt the methodology to each specific case [2]. Despite the previous step shows a different manner of classify and organize the units of the vertical structures, the information is still the same as that reflected by other proposals to configure the stratigraphic diagram. Therefore, more data must be included in order to obtain a diagram that truly displays all the information resulting from the documentation stage. The new aspect of this proposal is that degradation agents are considered other types of units that are present in constructions since they have the function of "damaging" the elements mentioned above.

The strategy is similar to the one used previously; the goal is to combine all pathology types as much as possible to produce a few groups, with an assumption that they should share similar characteristics or provenances. All the types of pathologies that affected the studied object were obtained from the degradation diagnosis (figure 4). Each description includes the cause, the effect, and the possible method to reverse the problem. Vegetation is the first group, and includes the vegetation on top (1), the ground vegetation (2) and the dried plants: all of them can be removed mechanically and/or by using herbicides. The biological agents like moss or alga must composed a different group since they request another type of

treatment. In this specific case there is just one pathology originated strictly by the presence of water, efflorescence (6) belongs to the second group. A third group is composed by the ones which represent the loss of material by mechanical or chemical processes: loss of mortar (4), blistering (5), deposit (7), soling (8), powdering and weathering (9). It is important that whoever is in charge has prior training on heritage analysis or has participated in previous campaigns (figure 5). Additional categories might be included, such as human-caused afflictions like graffiti or inappropriate integrations, or structural issues like fractures or cracks. The only issue is that, as the analysis becomes more in-depth, more groups will be formed and more information will be displayed in the diagram, which may make it more difficult to read.; the objective is to try to show a first reading of the monument, its elements, and its current state in an easier and faster way.

IV. RE-CONSTRUCTED UNITS

The last part of this paper includes the reconstructed units, which are elements that are no longer in existence but were rebuilt using hypothesis that appeared as the result of the survey of the *"negative stratigraphic units"*, a surface which indicates a missing volume [9]. Emanuel Demetrescu, in his paper *Archaeological Stratigraphy as a formal language for virtual reconstruction. Theory and practice*, mentioned that the missing elements can be re-constructed first by analyzing the physical surface destructed (represented by a negative symbol) or negative stratigraphic units, from which it is feasible to assume that there was a piece that completed the object. A quick example are the broken ancient friezes, a marble fragment indicates that the missing element that completed the frieze was done with the same material. The first type of re-constructed units is called "structural gaps", *"information directly related to a tangible unit"* [9]. A second group is called "non-structural gaps", and refers to the elements that are assumed to have been located in such a position only by the analysis of other sources.

Following with the same case of study, a good example of a negative stratigraphic unit is the surface on top of the Aurelian Wall. If the specialist observes carefully the discontinuity of the current upper part and other parts of the walls, it is possible to assume that there is a missing piece, a structural gap that completed the wall, which can be confirmed by the archives or bibliographic resources. As an exercise and to exemplify a non-structural gap unit, let's consider this curtain wall as the unique preserved remain; only archives would confirm that the upper missing element was a Battlement: a set of parapets and merlons with a rampart-walk at the back. Therefore, figure 6 illustrates the reconstruction of the two phases of construction of the Aurelian Wall, with all the elements obtained from archives and proper documentation, and the completed diagram.

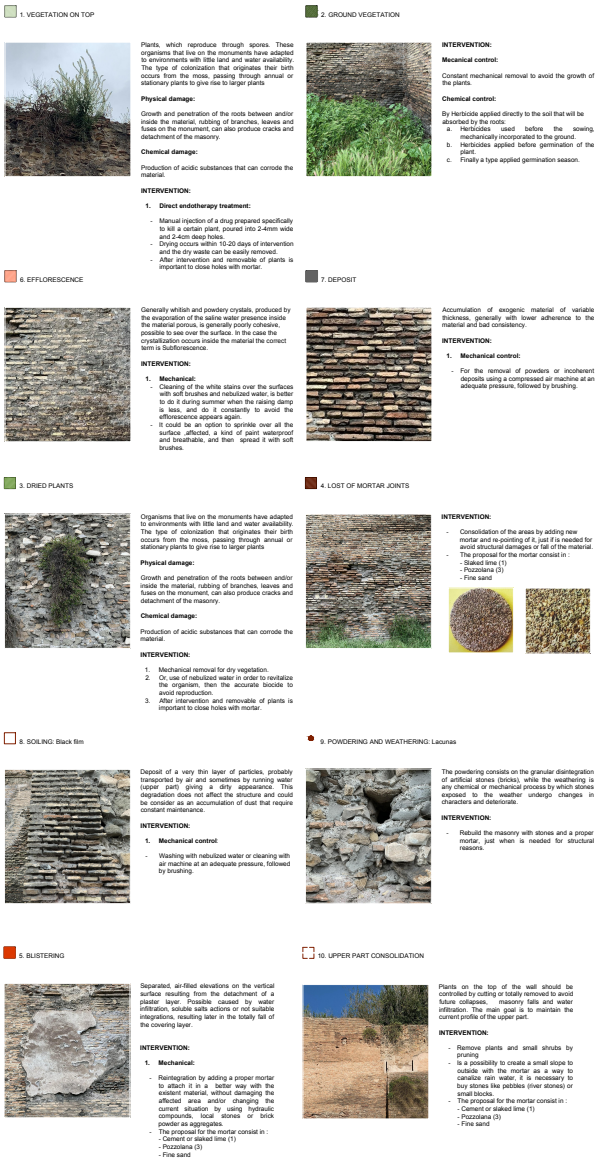

Fig. 4. Degradation diagnosis.

V. CONCLUSIONS

The stratigraphic diagram of architecture makes a contribution by not only identifying the components of the building but also by allowing for their order to be determined by the function based on a chronological sequence. On this basis, it is able to identify the various stages of construction or the subsequent interventions, however, as done in the example, it is a must to write down the elements in the current disposition on site. As a result, the diagram will show an absolute chronological order instead of a relative one. It is up to the specialist to order it from down to up or from left to right; the idea is to adapt the scheme as much as possible to each specific case. On the other hand, the new suggestions include the state of

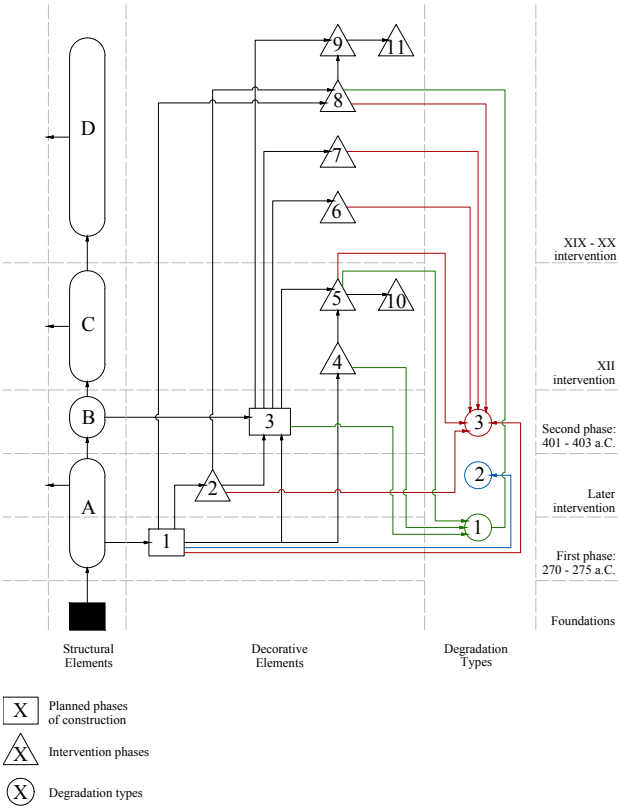

Fig. 5. Stratigraphic Diagram including the types of degradation

conservation and the documentation of the missing elements.

Although it is true that there is a considerable bibliography on modifications to Harris's initial proposal, this theoretical approach looked to fully exploit the diagram's potential by adding as many variables as possible using a case of study simple in the number of units but complex in the way in which the information is placed in the matrix. It is important to point out that the possibilities are many, and in the future more details may be added to meet the objective of achieving a scheme capable of organizing all the information obtained from the heritage analysis and having a global reading of the object, where historians, architects, archaeologists, and others can participate. As mentioned before, the goal of this paper was to change the rigidity through the inclusion of more data and enhance its capacity to manage a greater volume of information, all in a single matrix.

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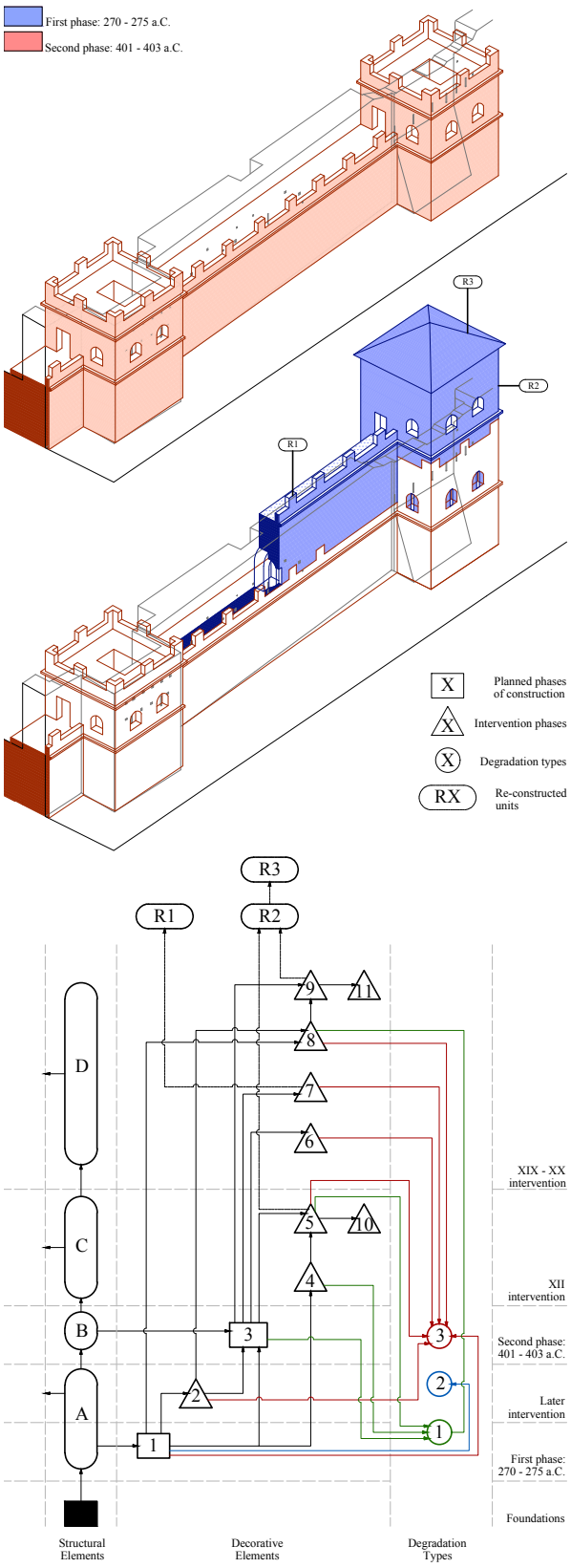

Fig. 6. Aurelian wall phases of construction and final stratigraphic diagram.

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