Classification System for Egyptian Heritage Buildings

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Abstract - **To create a classification system for heritage buildings, it is essential to delve into the architectural components of the buildings following a specific procedure. First, the different objects' properties (including their architectural style, geometric characteristics and ratio, condition, construction method, cultural value, material, color, reflectance characteristics) are identified. Second, creating a systematic framework that identifies the lifestyle of each element, stating the grouping principle of heritage elements and the design composition of tables that identifies the geometrical form, material and functional features whether insulation or load tolerance. This paper presents the challenges in creating a unified classification system for an Egyptian heritage palace built in 1896 with different architectural styles; i.e Rocco, Baroque, Islamic and even architectural customized elements with Royal slogan; through different historical periods, where multiple elements and sections were detached and attached to the place during its lifetime. The formulated classification system can be generalized in similar heritage buildings built in the same era.**

Keywords - **Building Elements, Built Heritage, Classification, Conservation system, HBIM, Library, Modeling-Restoration.**

I. INTRODUCTION

Several research efforts have discussed the classification of heritage components. Saleeb et. al. [1] discussed development of a classification system suitable for heritage components after comparing current classification systems in origin, type of components, no. of schedules, level of depth, properties of components, and date of creation, analyzing the suitability and the deficiencies in using them for heritage structures and the most suitable classification technique.

A Classification typology was provided by Lagomarsino et. al. [2] related to heritage components damage in a historical building while providing examples of the different classes and their classified components after declaring a classification evaluation criteria. This was with emphasis on the architectural elements and suggesting proper restoration techniques. Similarly, a general classification was identified to derive a seismic failure plan for each building component. Finding the relationship between different classification types and types of buildings according to the class of damage and the behaviour intensity enabled lagomarsino et al. [2] to identify the classes according to their own seismic action, focusing on the heritage macroelements scale only.

The Problems and difficulties in classifying world heritage were specified by Sun [3] who was able to provide guidelines to comply with the possible successful classifications, trying to find heritage recognizable matters and associated different elements which is reflected in their conservation strategy. More into concern is the cultural heritage with varying state and classification plan. Others discussed the cultural heritage related information handling in a comprehensive integrated manner as shown in Figure 1; in which heritage information is preserved and presented in a soft digital format [4]. Challenges are identified and a strategy is developed to be able to combine the different related heritage information in a clear comprehensive accessible soft formate for interested parties. Named as eCHNH website, the portal was created to include the developed strategy of different heritage information control.

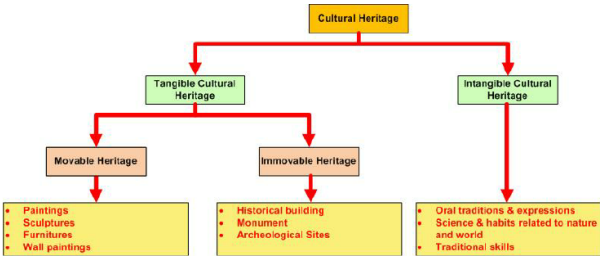

Figure 1: Cultural Heritage classification [4]

The significance of creating a "Monumental Protection Program" the MPP was explained by Abulnour [5] in which it begins with classifying the monuments according to criteria such as scarce heritage degree, importance, threat reveal level, and conservation status. Those monuments include both artifacts and landscape architectural monuments. However, conservation requirements should be analyzed including that deterioration status and the exposed threats to come up with a plan for the restoration process. The research emphasized on updating the heritage protection rules and regulations to be able to protect the Egyptian monuments effectively.

The importance of 3D heritage documentation process was demonstrated by Orenia et. al. [6] and they recommended creating a database for the architectural elements of any heritage structure, in which they defined architectural macro-elements into structural, non-

structural, and decorative objects in a hierarchical composition. The different elements' parameters and materials are recognized as well in order to gather different types of data to create a strong database for heritage information to link 3D documentation experts with heritage conservation entities.

Classification of heritage sites adopted by Lempert [7] for the sake of deeper culture intake by all related parties, in which this classification would serve as an effective guideline. He created a classification model and applied it on heritage sites "Generic Khmer sites" that included classification parameters summarized in the abandoned, Deteriorated, Maintained, and Transformed classes. Those classes reflect nature and human interference on heritage. They reused the model created on different heritage sites with some modifications such as type of heritage, specific uses, memories, and the connection to current society.

Reviewing and analysis of world-spread heritage buildings in concern to their sustainable retrofit were optimized by Khodeir et. al. [8]. The Egyptian Heritage was categorized and planned to integrate BIM technology in the sustainable heritage retrofitting with emphasis on the legislation significance in supporting the retrofit. The research proposed the Cultural classification model shown in Figure 2. They suggested a stronger heritage classification system to be utilized in Egypt to facilitate the heritage listing and conservation towards a sustainable framework.

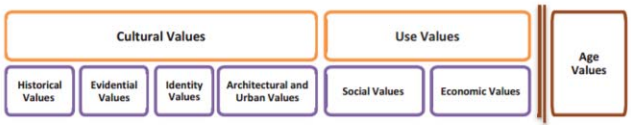

Figure 2: Cultural classification model [8]

III. METHODOLOGY

Tosson Palace is considered as a case study which is located in Shubra (Road El-Farag) as depicted in (Figure 3). Tosson Palace in Road ElFarag – Cairo, Egypt, is one of the state heritage assets that is totally neglected and is under severe damage at the moment. It is advocated to be documented in a BIM format as applied by most recent heritage conservation entities. Several research efforts [9-11] highlighted the significance of HBIM (Heritage Building Information Modelling) in terms of conservation and renovation.

In the classification of Tosson palace built heritage elements, all the artistic components remained in the place were identified. Those elements were differentiated into separate classified components according to their load bearing as following; Artistic heritage components which are solely structural elements, Artistic heritage components which are not solely structural elements, and Artistic heritage which are not structural element (with their own seismic load) i.e, Furniture elements.

Classification of the palace's different architectural elements is recommended to abide to the Uni-class 2015 system with special modifications required to tailor the heritage elements in the palace, thus more advanced specific classification system is required.

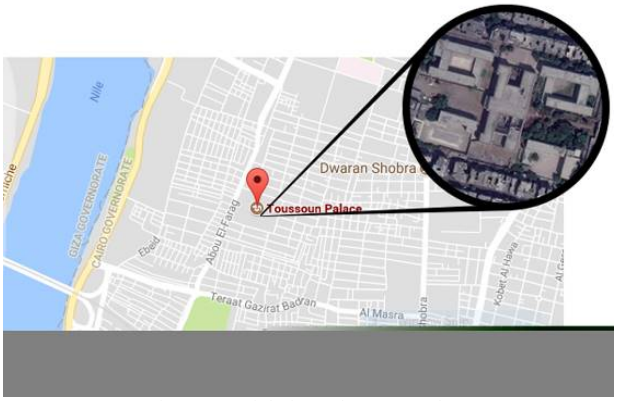

Figure 3: Ariel view of Tosson palace

The Ceiling

Now, the palace ceiling is all covered with a flat grooved ornamental surface, but some halls are only covered with wooden panels that were painted with oil colors (see Figure 4). Valuable attached and non-attached ornaments in the palace appeared in the ceiling and in some furniture as well, as shown below in Figure 5.

Figure 4: Ariel view of Tosson palace

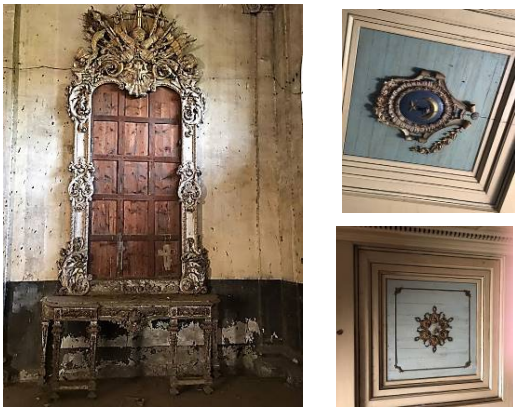

Figure 5: Different ornaments inside the palace

Regarding the palace flooring, all rooms had the same flooring level and mostly covered with marble while or wooden tiles. The palace is considered one of the most remarkable English constructions at that time, whether

for the general palace planning or the different ornamental elements inside the palace.

Palace Entrance

The outer palace architecture consists of a huge fence with a middle gate constructed with a half circled upper part. Above the three palace main entrances, there is a second floor wooden terrace overlooking the palace garden. Largest terrace is the one above the middle gate as shown in Figure 6.

Figure 6: Palace Front Entrance

The palace Architectural heritage is divided into vertically attached elements, horizontally attached elements and openings. Architectural components with their own seismic response, as furniture elements, have been divided into Assets leaning on horizontal/vertical structural elements, those protruding from vertical/Horizontal structural elements, and those hanging/drawn on horizontal structural elements (see Figure 7).

III. RESULTS

The palace Architectural heritage is divided into vertically attached elements, horizontally attached elements. Architectural components with their own seismic response, as furniture elements, have been divided into Assets leaning on horizontal/vertical structural elements, those protruding from vertical/Horizontal structural elements, and those hanging/drawn on horizontal structural elements. An architectural classification hierarchy for the components is proposed as shown in Figure 7.

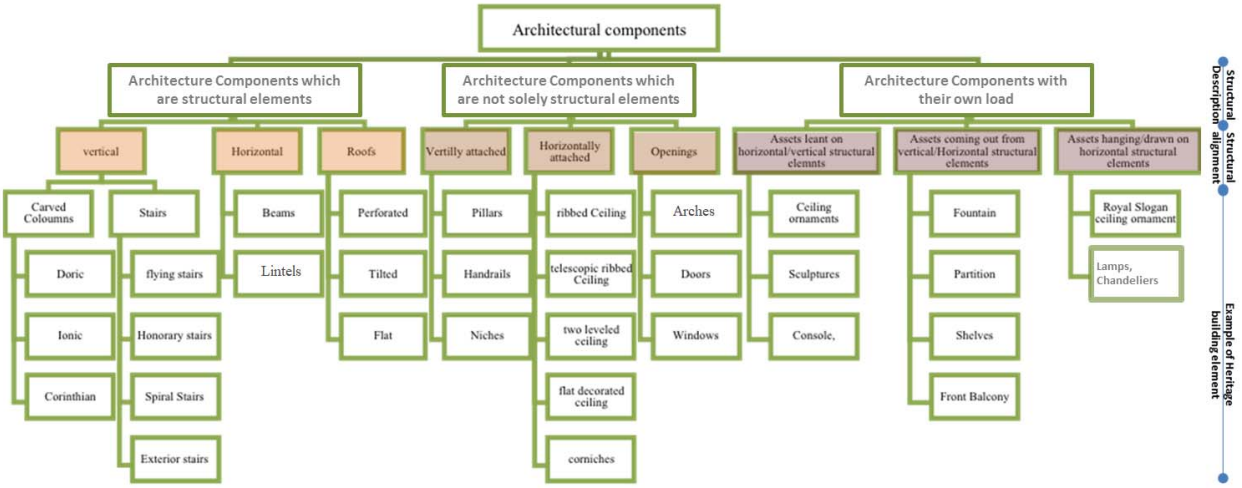

Figure 7: Classification components

In the classified section named “Artistic components which are considered structural elements alone”, given a code “SR”, this includes vertical, horizontal, arched and roofed type heritage components that are given sequential codes “SR-1, SR-2, SR-3”. Then, a letter or two is added for the material coding in the classification system e.g. “S” for stone, “GW” for Glass with Wood, “L” for cladding and so on, hence continuing the coding in three parts as “SR-1-S” for example. Subsequently another significant part in the coding is added in each classification section that indicates the function of the component; whether stairs, columns, carved ceiling, vaults or Furniture elements. Those are identified in the fourth part in the coding and usually carry the first or second letter of the name of the component function itself followed by the code of the architectural style of the component; Hence configuring the final code to consist of the structural type code, the location direction code number, material name, name of element function, and the architectural style. In the previously mentioned arranged order, each partial code is added to the other code, and abbreviated according to their class names as shown in Figure 8.

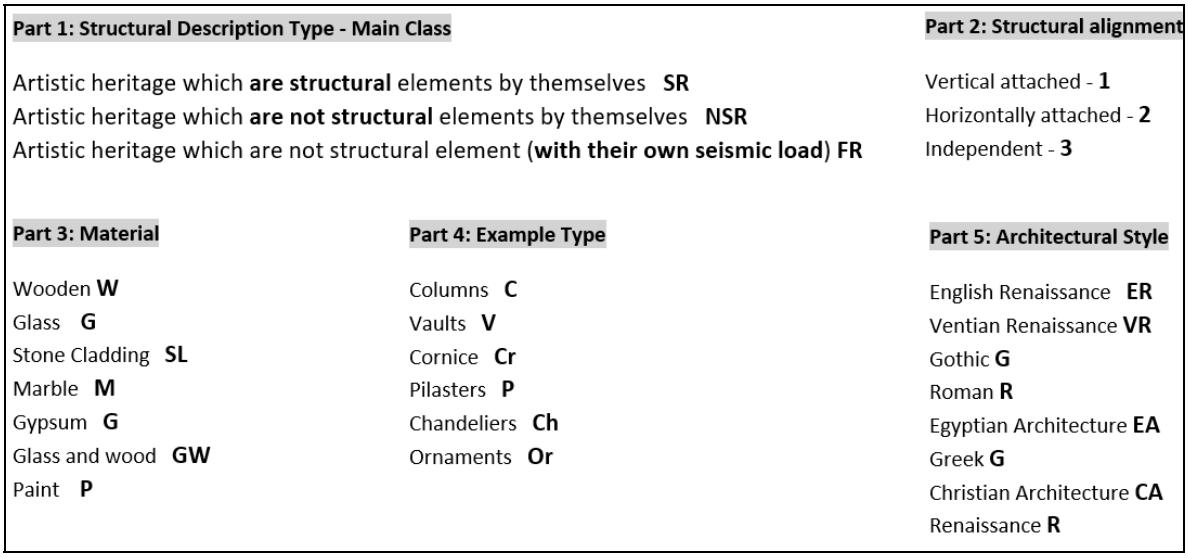

Figure 8: Classification coding abbreviation

In the Classified section "Artistic heritage which are not structural elements by themselves", given a code "NSR", it includes "elements attached to vertical structural elements", "elements attached to horizontal /arched elements", and "openings". In the class of "elements attached to vertical structural elements" coded "NSR-1", materials are identified such as stone cladding, gypsum, marble, wooden, Glass or combination between more than single material (coded as SL, G, M, W, and GL). For those attached vertically that includes pilasters, cornice, cladding (coded as P or C, CL), and a combination of European architecture styles are obvious such as English Renaissance and Venetian Renaissance (coded as ER, VR).

In the classified section named "Artistic heritage which not structural element (with their own seismic load) e.g. Furniture elements", given a code "FR", this includes heritage components protruding from horizontal elements or leaning against or hanging from structural elements coded "FR-1, FR-2, FR-3" progressively. Then a letter or two is added for the material coding in the classification to be able to continue the coding further in three parts like "FR-1-S" for example. Then another significant part in the coding is added in each classification section that indicates the type of element; whether Fountain, Balcony, Shelves, Console etc. Those are identified in the fourth part in the coding. An example classification table would be similar to that shown in Table I.

TABLE I
CLASSIFICATION SYSTEM

Class	code	Sub-class	code	material	code	Example Type	code	Architecture style	Code
Artistic heritage which are structural elements by themselves	SR	Vertically attached	SR-1	*Material code could be the first or second letter of the material name embedded within the coding structure	SR-1-…..	Columns	SR-1-…..-C	English renaissance	SR-1-…..-C-ER
		Horizontally attached	SR-2		SR-1-…..	Vaults	SR-1-…..-V	Venetian Renaissance	SR-1-…..-V-VR
		Roofs	SR-3	Wooden	SR-3-W	Arched or tilted	SR-3-W-A	Gothic	SR-3-W-A-G
Artistic heritage which are not structural elements by themselves	NSR	Vertically attached	NSR-1	Glass	NSR-1-G	Pilasters	NSR-1-G-P	Roman	NSR-1-G-P-R
		Horizontally attached	NSR-2	Stone cladding	NSR-2-SL	Cornice	NSR-2-SL-Cr	Egyptian Architecture	NSR-2-SL-Cr-ER
		Openings	NSR-3	Marble	NSR-3-M	Window& doors	NSR-3-M-W	Greek	NSR-3-M-W-Gr
Artistic heritage which are not structural element (with their own seismic load) such as Furniture elements	FR	Not connected	FR-1	Gypsum	FR-1-Gy	Portrait	FR-1-Gy-Pr	Not applicable on a style	FR-1-Gy-Pr-NA
		Direct connection	FR-2	Glass &Wood	FR-2-GW	Chandeliers	FR-2-GW-Ch	Christian architecture	FR-2-GW-CA
		Indirect connection	FR-3	Paint	FR-3-P	Ornaments	FR-3-P-Or	Renaissance	FR-3-P-Or-R

A classification system suitable for architectural buildings is identified and formalized to support similar heritage type buildings. The classification system (partial) is shown in Table II. It is worth noting that the classes and sub-classes are shown in title and in added code as well as a photo that represents the component, allowing the table to be more illustrative and easier to utilize.

IV. CONCLUSION

Architectural Heritage in Egypt is considered a wealth that requires special attention, documentation and conservation effort. The classification system provides a sustainable documentation strategy and acts as a necessary step in the conservation strategy. The classification system proposed is created taking a case study into consideration - "Tosson palace", which

requires minor modifications to adapt to different architectural assets. However, this acts as a guideline to similar heritage assets and encourages documentation authorities to create more sustainable work concerning Heritage in general. Additional steps are required to create a deeper conservation strategy, and further research is recommended to include the classification damage of the heritage elements.

ACKNOWLEDGMENT

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TABLE II
SAMPLE OF TOSSOUN CLASSIFICATION SYSTEM

class	code	sub-class	Code	Materials	code	Element	code	Architecture style	Photo
Artistic **assets which are structural elements** by themselves	SR-1	vertical structural assets	SR-2-C-CM	Concrete with marble cladding			SR-2-C-CM-GD	Greek Columns (Doric)	
			SR-2-C-CS	Concrete with Stone cladding	SR-1-C	carved columns	SR-2-C-CS-GI	Greek Columns (Ionic)	

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