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RE-USE PROPOSALS AND STRUCTURAL ANALYSIS OF HISTORICAL PALACES IN EGYPT: THE CASE OF BARON EMPAIN PALACE IN CAIRO

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ABSTRACT

The Palace of Baron Empain in Cairo is a unique architectural masterpiece of its kind. Edward Empain, a rich Belgian, built it in 1911 influenced by the architecture of the famous Cambodian temple of Angkor Wat. The palace is composed of three floors (basement, ground and first) and a roof, it is surrounded by a garden from all sides. It suffered from neglect for decades, and recently appeared initiatives for its restoration and re-use. This paper aims to provide a proposal for the re-use of the palace. For this purpose, the palace was visually inspected and the signs of damage were documentated and explained. A re-use proposal was developed in which the ground floor is re-used as a small museum after being furnished on the historical style. The first floor is re-used as a museum and/or a motel. The roof is re-used in holding cultural seminars, and as a place for distinctive imaging types. The palace garden is to be re-used similar to its historical usage as an open space for celebrations and parties. The basement is re-used as a service floor for the visitors. To support this re-use proposal, a 3D numerical model of the palace was created and the new expected loads were applied on it. It was found that the palace's walls and foundations can sustain the new loads. The slabs were found to be unable to sustain the new loads at certain places and further investigation and analysis is needed to judge its actual capacity.

KEYWORDS: Historical palaces, Deterioration, Re-use, Intervention, Structural Analysis, Baron Empain palace, Heliopolis

1. INTRODUCTION

Egypt has a large number of historical palaces. A considerable number of them were built during the regime of Mohamed Ali Pasha (1769-1849) and his family who ruled Egypt from the beginning of the 19th c. till the mid of the 20th c. Some of the historical palaces of Egypt have been reused to host cultural events such as Beshtak palace (14th c.) and Amir Taz palace (14th c.) in Cairo. Some others have been reused as presidential palaces such as Abdeen palace (19th c.) and Koubbeh palace (19th c.) in Cairo and Ras El-Tin palace (19th c.) in Alexandria. Some other palaces have been reused as museums such as the palace of the Prince Mohamed Ali (20th c.) in Cairo. Some palaces have been re-used as governmental administration buildings such as Princess Fokia palace (20th c.) in Cairo.

Despite of the previously mentioned efforts from the Ministry of Antiquities for preserving the historical palaces of Egypt by finding an appropriate new function for them, there are many un-used palaces that are suffering from neglect. Some of those are Al-Gawhara palace (19th c.), Al-Sakakini palace (19th c.) and Said Halim palace (19th c.) in Cairo (Figure 1) among others. The high cost of restoration works is one of the reasons behind this neglect. It should be also mentioned that a large part of Egyptian cultural heritage is suffering from lack of maintenance even after being restored (El-Derby and Elyamani, 2016; Moustafa et al., 2015).

The studies carried out so far on historical palaces of Egypt are still limited and more research is needed. A brief is given about some of these studies. Ibrahim (2016) studied the historical palaces in Minya city (south of Egypt) and gave proposals for the re-use. The re-usage of interior spaces of historical palaces to work as culture palaces was studied by Abdullah (2016). Hemeda (2012; 2013) carried out the characterization of the construction materials and the inspection of the foundation soil of Habib Sakakini palace (19th c.) in Cairo. Ibrahim (2009) addressed the re-use of some of the palaces of Mohamed Ali's family. Megahed (2009) carried out a documentation of the palace of Abdel-Maged Pasha in Minya (20th c.). Moustafa (2008) investigated the conservation of the historical palace of Haiat El-Nefos in Minya and its re-use.

Re-use of neglected historical structures and giving them a function is an efficient way for their conservation. The new function, preferably, should be similar to the historic one. However, other functions not similar to the historic ones should be also considered, if deemed appropriate and no significant changes are needed. The aim is to conserve the authenticity of the historic structure to the extent possible by minimizing any interventions necessary for the new function. It is also necessary to study well the needs of the surroundings of the historic structures. This helps in addressing which function could the historic structure could have. In the literature, there are successful cases in which the re-use played a clear role in conserving neglected historic structures (Ljla and Brostrom, 2015; Amayu, 2014; Nikolic et al., 2014; Conejos et al., 2011; Dedross, 2010; Langstone et al., 2008; Freund de Klumis and Munsters, 2005).

The re-use of historical structures necessary needs safety checks calculations. For this purpose, structural analysis plays an important role. It helps in understanding the structural behavior under different current and expected loads from new usages after re-use. As well, it is an efficient tool for identifying the weakness places where strengthening intervention is possibly needed. In designing the strengthening, a numerical model could be used as a virtual laboratory in which the different strengthening proposals may be simulated to reveal its efficiency. There are many successful cases in the literature in which structural analysis have been used as an efficient tool in the study of historical structures. The structural safety of the cathedral of Mallorca, one of the largest built cathedrals worldwide, was successfully assessed under seismic loads using a FE model (Elyamani et al., 2017a, Elyamani et al., 2017b, , Elyamani, 2015, Caselles et al., 2012, Elyamani et al., 2012). Elyamani (2009, 2016) studied the structural behavior of the spire of Barcelona cathedral under wind and earthquake loads using a FE model for the spire. The reader is referred to other cases such as Saloustros et al. (2015); Pela et al. (2014); Ademovic et al. (2013); and Roca et al. (2013) for similar studies.

This paper gives a proposal for the re-use of one of the most famous palaces in Egypt; it is the Baron Empain palace in Heliopolis, Cairo. To support this proposal a detailed structural analysis of the palace was carried out. One of the reasons behind the fame of Baron Empain palace all over Egypt is the case of Satan worshippers in mid of 1997. More than 100 young Egyptians were arrested and caused of practicing Satanism (Abdel-Wahed, 1998). It was a public opinion case that attracted a lot of attention. The arrested people were practicing these activities in Baron Empain palace. One of their activities was scarifying animals, and till today, there is a room in the palace where all the walls are stained with blood, possibly of animals scarified during these activities. The room is known now as the room of blood, Figure 2.

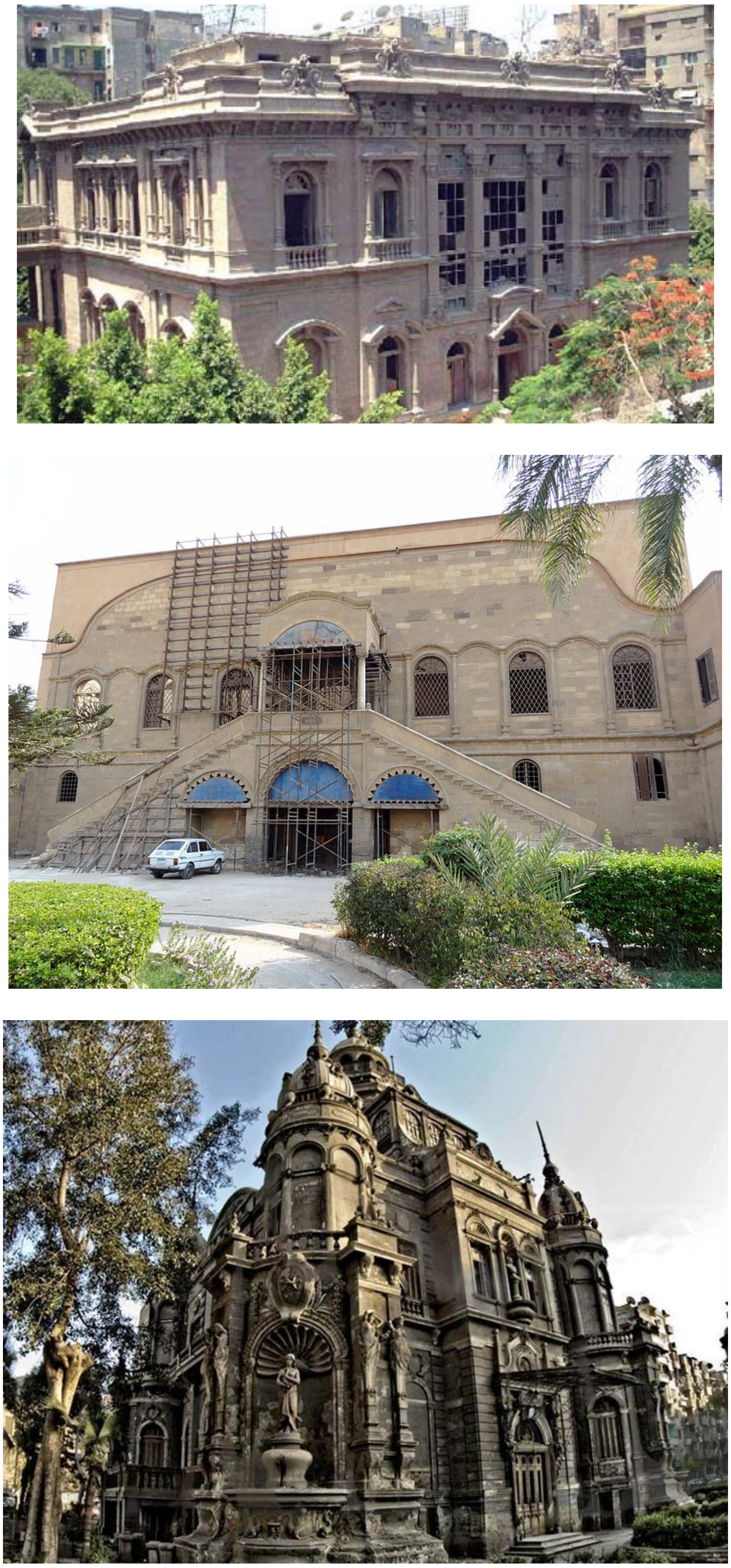


Figure 1. Examples for un-used Egyptian palaces suffering from neglect and deterioration: (a) Said Halim palace, (b) Al-Gawhara palace, and (c) Al-Sakakini palace.

Figure 2. Two photos inside the room of blood in Baron Empain palace showing the stained walls with blood of, possibly, sacrificed animals during Satanism activities in 1997.

2. DESCRIPTION OF THE PALACE

The Baron Empain palace (Figure 3 and Figure 4) is located at Heliopolis district in Cairo. This district is at ten kilometers northeast of Cairo and is very near to Cairo international airport. Heliopolis was created from 1905 to 1913 by the Baron Empain and Boghos Nubar. They decided to create a new district built to European technical, functional and sanitary standards to be suitable for the bourgeois class lived in Egypt at that time (Mercedes Volait et al., 2003). The palace was constructed in 1911. It is composed of three floors and a roof. Additionally, it is surrounded by a large garden from all sides as can be seen in the layout in Figure 5.

The basement floor (Figure 6-a) is divided into many spaces connected together by corridors and doors. It was the residence for the servants of the palace at the past. It can be reached from the garden via two doors as indicated in the figure using red arrows. A small spiral stair and an elevator connect the basement to the ground floor. The elevator, as well, connects the rest of the floors to the basement. The ground floor (Figure 6-b) can be reached from three entrances as shown in the figure. It is divided into three main spaces: the reception hall at the middle, the dining room to the right and the billiard room to the left. The first floor (Figure 6-c) is reached from the ground floor using the main stair of the palace. It is composed of four rooms and each room has its own balcony and bathroom. The roof is an open area and has a dome at one of its corners.

Figure 3. Global view of Baron Empain palace looking at the rear façade and the front and rear gardens.

Figure 4. Global view of Baron Empain palace looking at the front façade.

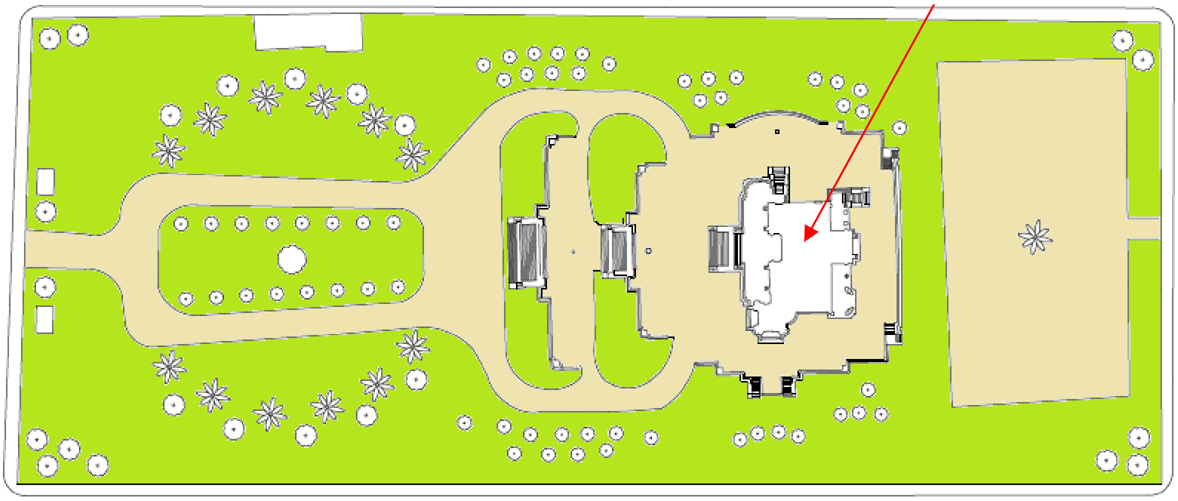
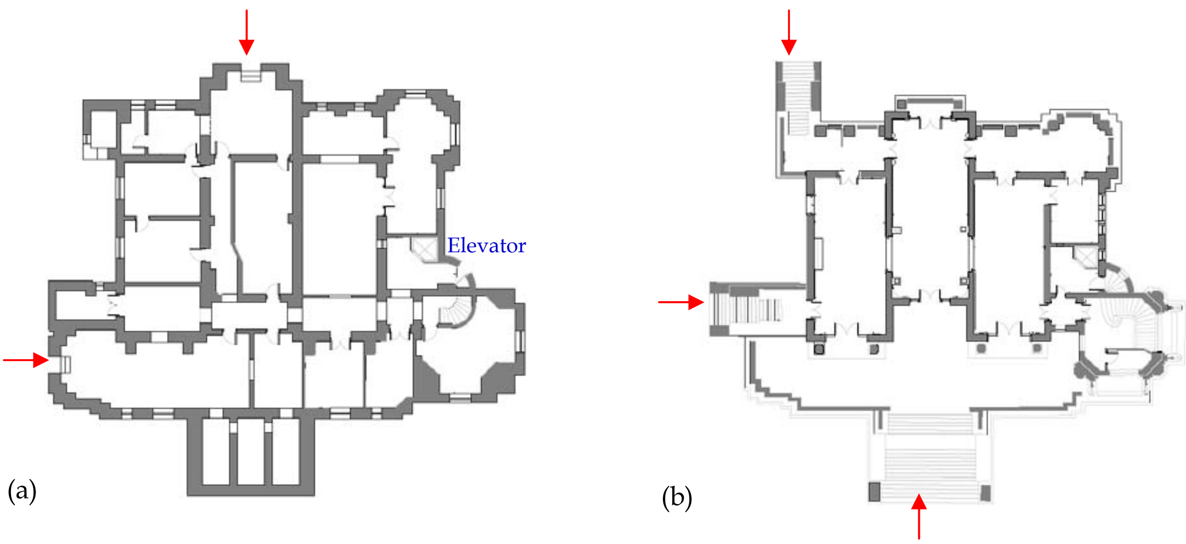


Figure 5. Layout of Baron Empain palace and the front and rear gardens.



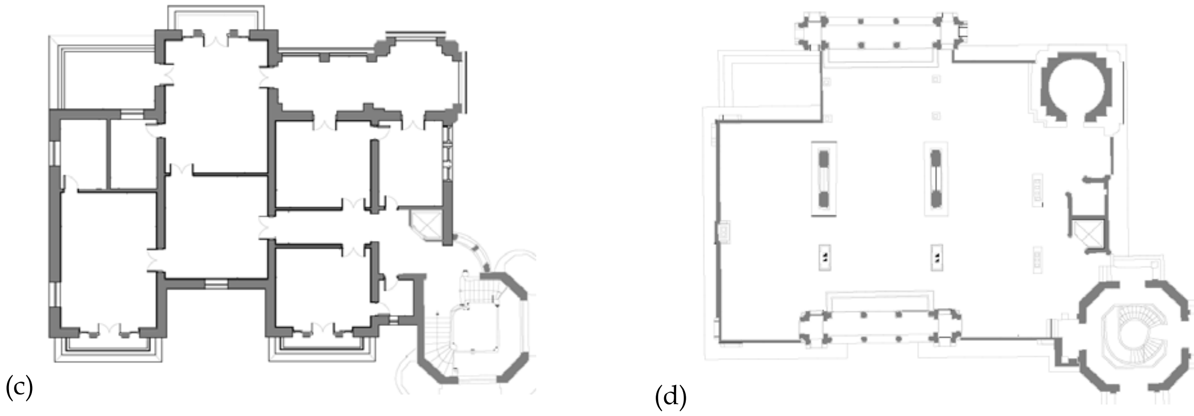


Figure 6. Architectural plans of the palace: (a) basement floor, (b) ground floor, (c) first floor and (d) roof.

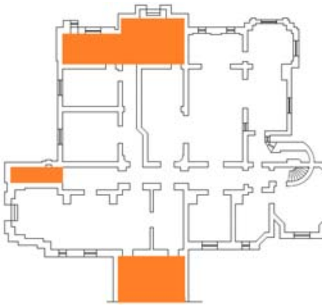
3. EXISTING DAMAGE

The different structural elements of the palace were visually inspected for detecting the existing damage. Based on this inspection, it was observed that the palace does not suffer from any series structural problems. No series deformations or cracks were noticed in the walls or the ceilings.

The only obvious noticed damage was the falling down of the concrete cover of some parts of the ceilings of the basement and the first floors, Figure 7. No such damage was observed in the ground floor ceiling. For the first floor ceiling, the infiltrated rain water may be the reason of such damage. The parts of the basement floor ceiling that are suffering from such damage are these parts of the stairs connecting the palace with the garden. Those parts are directly exposed to rain water and this may be the reason of the falling down of the concrete cover.

Other non-structural damage was observed. This included the harmful anthropogenic actions by writing on the walls using sprays which distorts them (Figure 8-a), broken glass of doors and windows (Figure 8-b), deterioration of the wooden finishing of floors (Figure 8-c), deterioration of doors (Figure 8-d), falling of plaster (Figure 8-e) and deterioration and missed parts of the roof flooring (Figure 8-f).

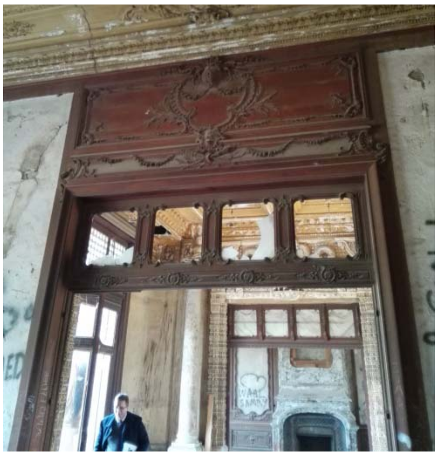
(a) ***(b)*** ***(c)***



(d) *(e)* *(f)*

Figure 7. Falling down of the concrete cover of ceilings: (a) first floor ceiling damaged parts, (b) and (c) samples from damage, (d) basement floor ceiling damaged parts, (e) and (f) samples from damage.

(a)



(b)

(c)

(d)

(e)

(f)

Figure 8. Non-structural damage: (a) anthropogenic actions, (b) broken glass of doors, (c) deteriorated wooden floor's finishing, (d) deteriorated door, (e) falling plaster and (f) deteriorated roof flooring.

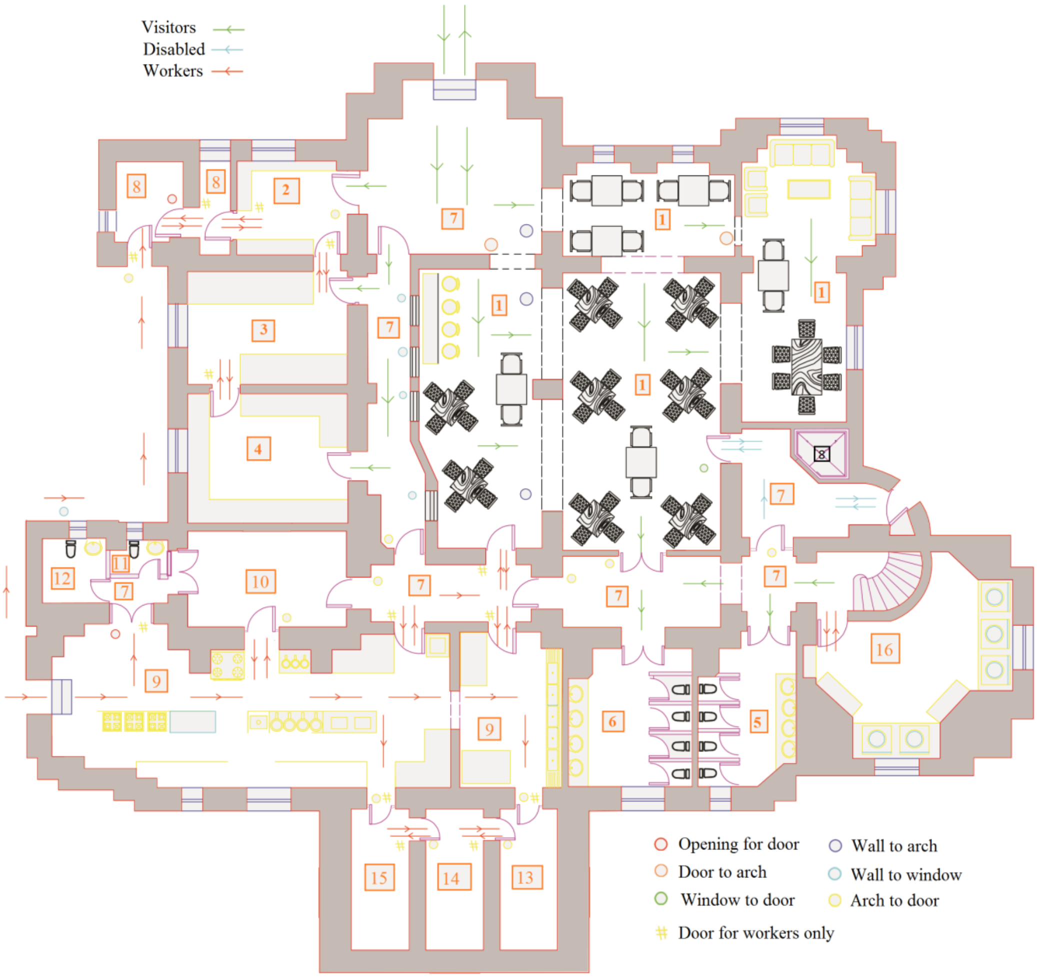
4. PROPOSAL FOR RE-USE

4.1 Basement floor

The proposed re-use of this floor is shown in Figure 9. The floor will serve the visitors of the palace. This re-use proposal is not far from the historical usage of this floor. It accommodated in the past the kitchen of the palace, the water boilers and the rooms of the servants. In the current proposal, it will accommodate a restaurant (spaces 1) that can serve about 60 clients. The necessary kitchen (space 9) will be placed at the back of the palace with required storage (space 10) and fridges with different cooling temperatures (spaces from 13 to 15: fridge 1, fridge 2 and fridge 3). The kitchen will serve also the parties and celebration events taken place in the palace's garden. The basement will accommodate also a book shop (space 2), a shop for souvenirs (space 3), and a bazar (space 4). Storage spaces for these shops are provided (spaces 8). Toilets for visitors of the palace or clients of the restaurant are considered (space 5 for women and space 6 for men). As well, toilets for female and male workers are provided (spaces 11 and 12). A laundry is included in this floor (space 16) for cleaning services of the motel.

The privacy of both of the visitors (green arrows in Figure 9) and the workers (red arrows in Figure 9) is considered by carefully assigning certain paths for each of them. In addition, the disabled visitors (blue arrows in Figure 9) will have their own entrance from a side door. After entering, they can use the same paths for normal visitors. The normal visitor can enter the floor from the front door. Then, she/he can turn left to enter the restaurant or turn right to enter the book shop. Alternatively, she/he can keep walking forward and then turn right to enter the bazar or the souvenirs shop. Workers in the kitchen and the supplies for the kitchen are served from a side door. Some of the doors are only allowed for workers. These doors are between spaces that are allowed only for workers.

This re-use proposal will need some changes in the walls of the basement floor. Necessary changes are shown in plan using circles with different colors beside every part of the walls to be changed. Some walls will be opened carefully to allow access between different spaces with or without adding doors (red and blue circles). Some walls will be provided with small openings to work as windows between spaces (light blue circles). Some of the already existing openings in the form of arches will be provided with doors to separate between spaces (orange circles). Some of the already existing windows will be enlarged to work as doors to allow access between spaces (green circles). Some arches will be provided with doors (yellow circles).



1: Restaurant
2: Book shop
3: Souvenirs
4: Bazar
5: Women W.C.
6: Men W.C.
7: Distribution
8: Shops storage
9: Kitchen
10: Kitchen storage
11: Female worker W.C.
12: Male worker W.C.
13: Fridge 1
14: Fridge 2
15: Fridge 3
16: Laundry

Figure 9. Proposed re-use of the basement floor.

4.2 Ground floor

Figure 10 shows the re-use proposal of the ground floor. This floor will be re-used to be like a museum. The floor will have three main spaces. Space 1 includes the reception hall, the dining room and the billiard room. This recalls again the historical usages of these spaces as they were when the Baron Empain and his family occupied the palace. The furniture would be designed by experts in the field to be similar to the historical one used at that period of time. The idea has been already applied on other historical structures such as in Casa Mila in Barcelona and in the palace of the Prince Mohamed Ali in Cairo, Figure 11. Furnishing these spaces on the historical style gives the visitor an impression of returning back in time for a century to feel how the people were living at that time.

Space 2 will be equipped with modern LCDs. These LCDs will display short documentary films about the Baron Empain, the construction of Heliopolis and the palace. Regarding spaces numbered 3, both of them are looking at the back garden of the palace. Therefore, they could be used as a background for taking memorial photos for the visitors. It is proposed to provide the palace with a professional photographer for this purpose that can take instantaneous photos with reasonable fees.

The visit path will be organized so that the visitor after entering from the main entrance of the palace can turn to the left to visit the billiard room and then goes to the reception hall and finally to the dining room. Afterwards, the visitor will choose either to go downstairs to the basement floor or to go upstairs to visit the upper floors. Alternatively, she/he can visit space 2 to enjoy the documentary films, previously referred to. Then, she/he can go to space 3 for having a look on the back garden or to take memorial photos. Finishing that, the visitor can go down to the back garden using the side stairs. It can be noticed in Figure 10 that the two doors of space 3 are exit only doors. This is meant to organize the entrance of the visitors to that space to allow the photographer enough time to adjust and take the photos for the visitors.

Very limited changes will be made to the walls of that floor. Only one door will be opened to allow access to space 2 for the normal visitors and as well for disabled (indicated with small black triangle in Figure 10). Regarding disabled, they can reach that floor using the lift of the palace after entering from the side door previously mentioned in the re-use of the basement floor. The bathroom near to the palace's stair will be furnished specifically to serve disabled.

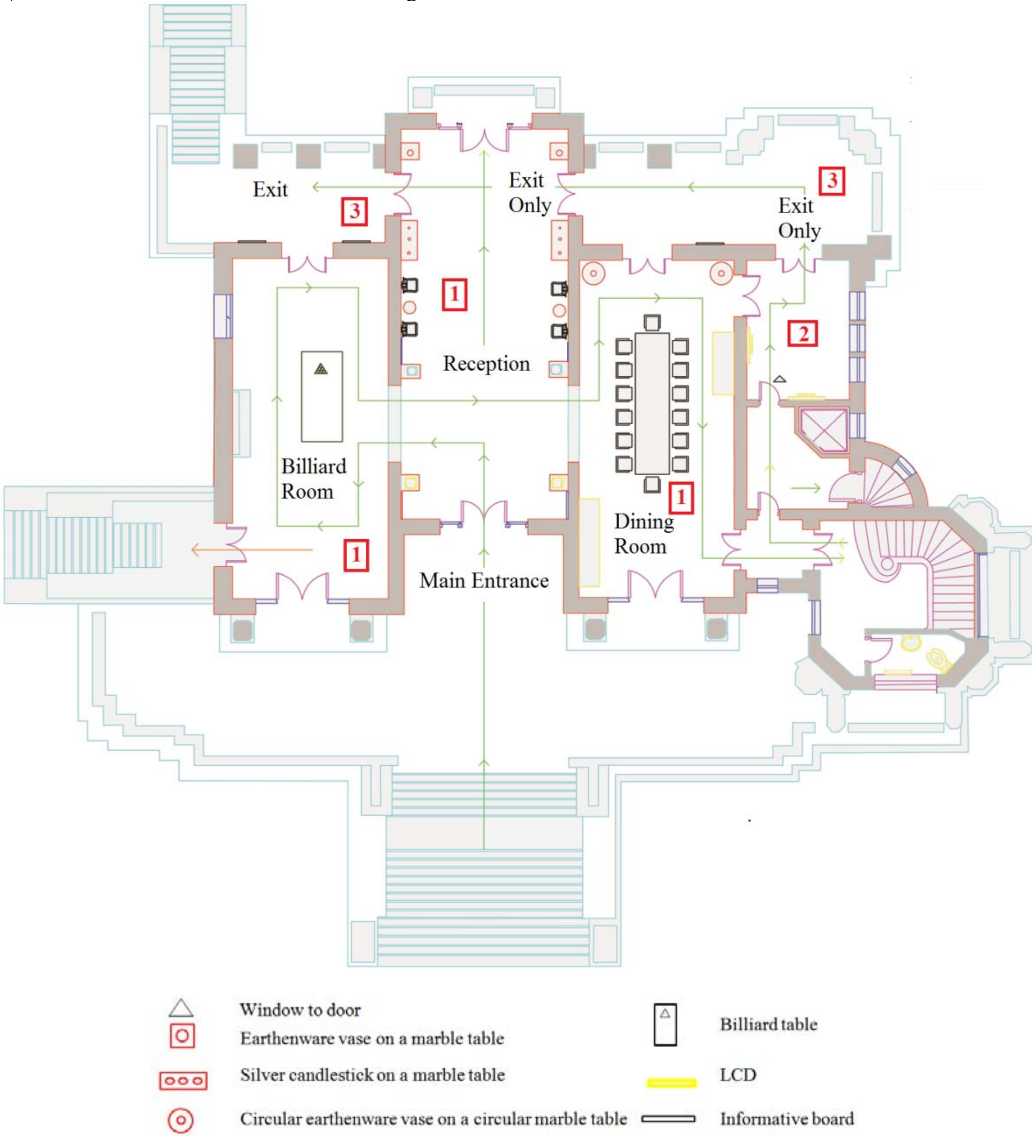


Figure 10. Proposed re-use of the ground floor.

(a)

(b)

(c)

(d)

Figure 11. Furniture inside reused historical structures: (a) and (b) interior of Prince Mohamed Ali palace (Cairo, Egypt), and (c) and (d) interior of Casa Mila (Barcelona, Spain).

4.3 First floor

It is proposed to reuse this floor to be either a museum (same idea as ground floor) or a motel. In both cases, the rooms will be furnished as bedrooms. Only in the first case, it will be necessary to furnish the rooms and its corresponding bathrooms on the historical style. For the second case modern furniture would be used. Figure 12 explains the re-use proposal. The spaces from 1 to 4 in the figure are corresponding to the bedrooms occupied by the Baron Empain and his family in the past. The space B is a balcony.

The visitor after reaching this floor can visit each space and see the style life of that historical period. The visitor can take photos for the front and rear gardens from this floor when being in any of the spaces B. As well, group visitors can take group memorial photos in the large balconies corresponding to rooms 1 and 3. Disable can reach this floor using the palace's lift.

In case the floor will be a motel, the four bedrooms could be rented. The floor can be rent as a whole to accommodate family visits. The visiting family will occupy the rooms and experience the life of the Baron and his family for one night. This in turn will offer good income to the Ministry of Antiquities which is the current palace's owner. The kitchen in the basement can offer necessary services to the motel. The necessary change in the walls of this floor is indicated in the figure using blue circle. It is proposed to close three openings of doors.

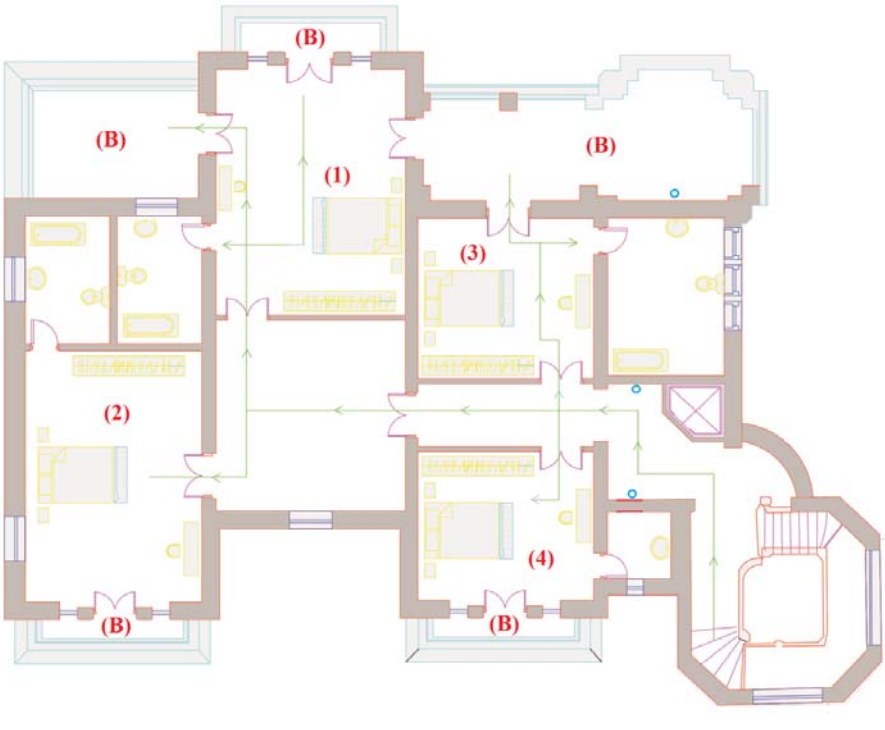


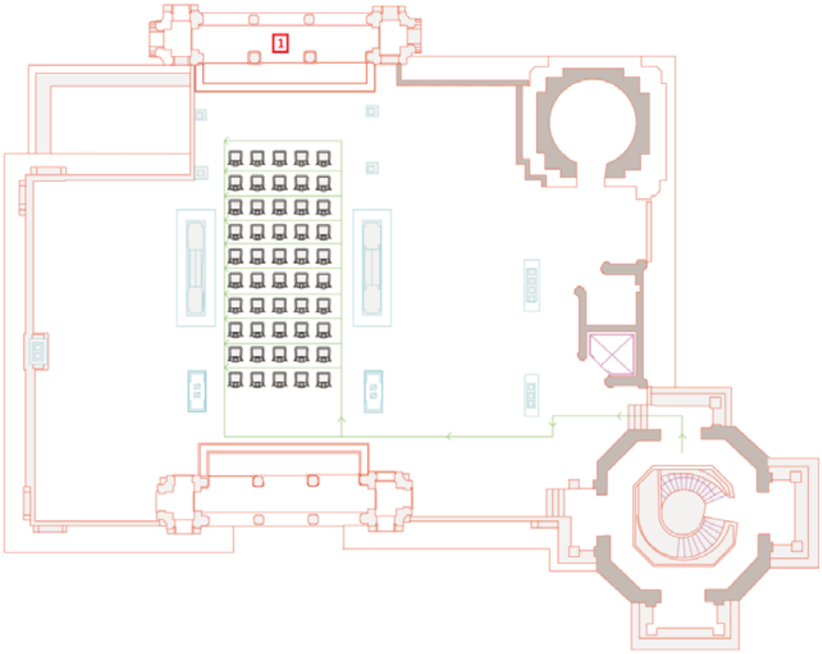
Figure 12. Proposed re-use of the first floor.

4.4 Roof

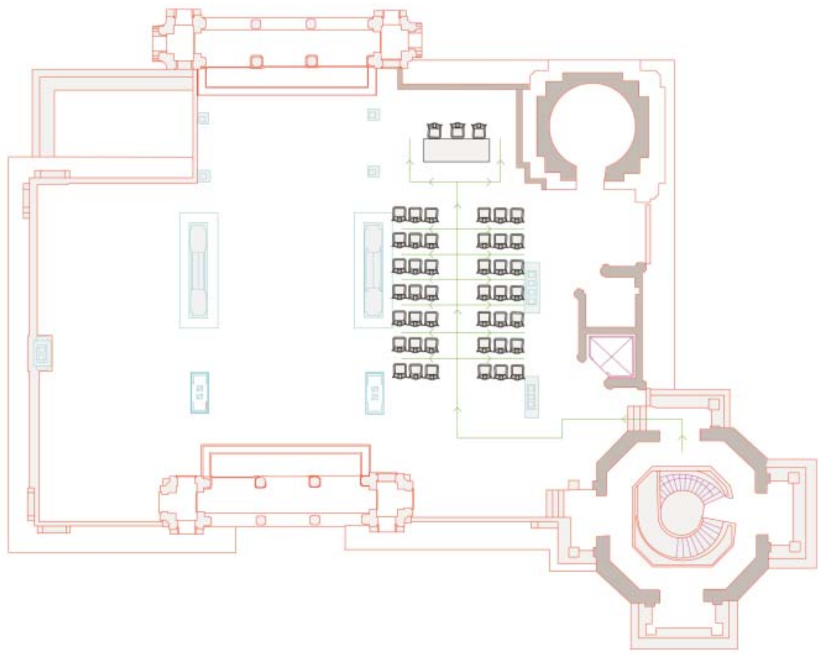
The roof will do a function similar to the one it had in the past. It will accommodate cultural events. Two proposed furniture arrangement are shown in Figure 13. For the case "a", the audience will occupy the middle part of the roof. Up to 50 persons would be accommodated. The part named "1" in the figure will work like a stage for the event.

In the case "b", the audience will occupy a side part of the roof; up to 40 persons could be accommodated. This organization is suitable for cultural events like seminars and lectures. The event guests will have a table and three chairs in front of the audience.

In both proposed re-use, it is meant not to occupy the full area of the roof with the furniture. The audience will enjoy the empty parts of the roof during the break time during the event. This free space will allow them to enjoy taking photos, chatting, and seeing the front and the rear gardens of the palace and as well the surroundings of the palace.



(a)



(b)

Figure 13. Two furniture for the proposed re-use of the roof (a), and (b).

5. STRUCTURAL ANALYSIS

5.1 Description of the numerical model

A Finite Element (FE) model of the palace was created using the software SAP 2000 version 15 (CSI, 2011). This software has a friendly user interface and has been successfully used in the structural analysis of several historical structures such as El-Derby and Elyamani (2016), Beeson et al. (2015), Alexakis and Makris (2013), Behnamfar and Afshari (2013), Brandonisio (2013), Celik et al. (2008).

The aim of this analysis was to evaluate the safety of the ceilings, the walls and the foundations under the expected loads after re-use proposal. As discussed before, the palace will be re-used to accommodate high live loads if used as a museum.

The 3D model is shown in Figure 14 (top). The walls and the ceilings were modeled as shell elements with an average size of 0.5×0.5 m². The columns and the lintels were modeled as frame elements. Not all the parts of the palace were modeled. The tower, the dome, the walls of the lift room, the parapets and the short walls at the roof were not modeled for the sake of simplicity. Instead, there weights were considered as loads, Figure 14 (bottom). At the base, all the joints were restrained against the translation in the three directions x, y and z. the FE model composed of 15746 joints, 510 frame elements and 15360 shells.

The FE model comprised the two materials of the concrete for ceilings and the brick masonry for the walls. The used mechanical properties are summarized in Table 1.

These properties were determined based on the mechanical tests carried out on samples taken from the concrete ceilings and the masonry walls and tested in laboratory.

The considered loads were the dead load (DL) and the live load (LL). The DL included the self-weight of the different structural elements and a load of 150 kg/m² for the flooring on the ceilings. The LL was taken as 500 kg/m² as per Egyptian code of loads (ECP-201, 2012).

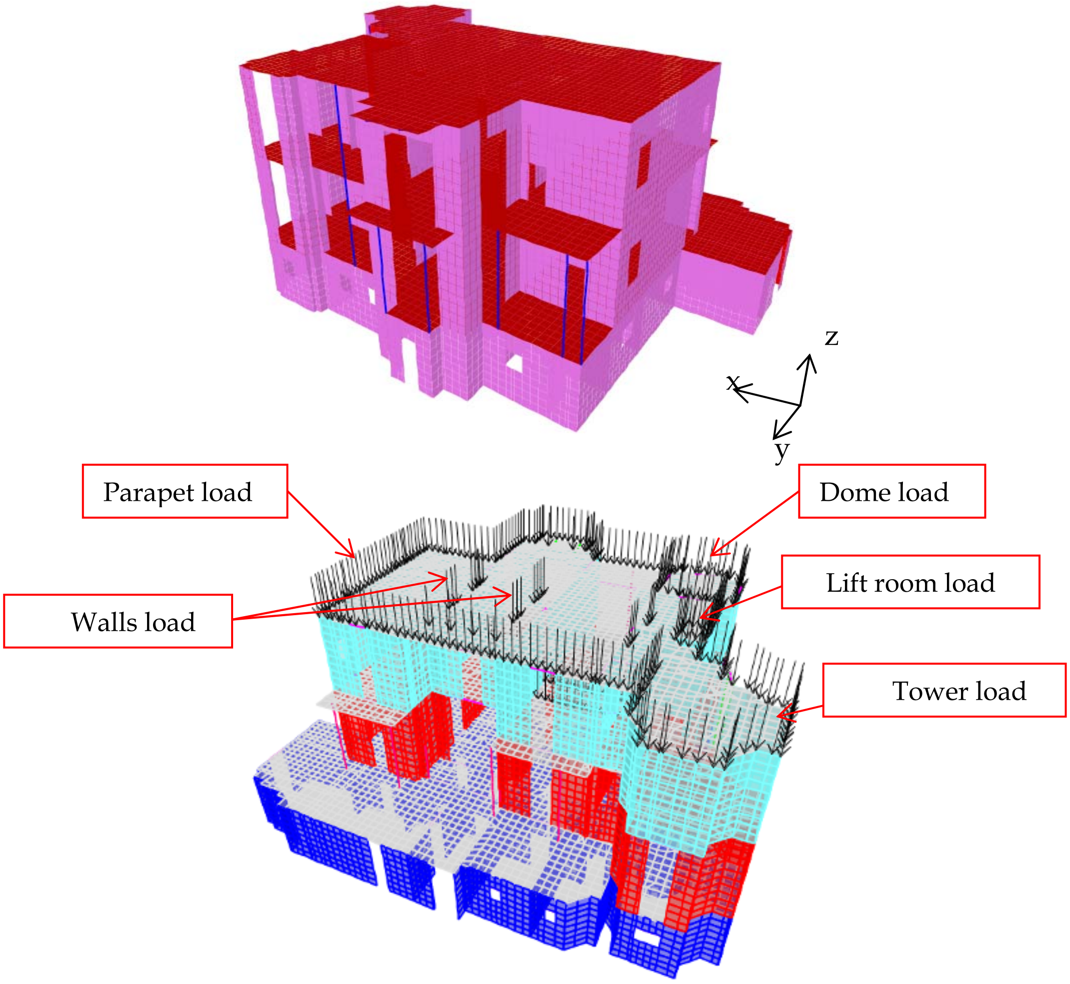


Figure 14. 3D model of the Baron palace (top) and the applied loads for un-modelled parts (bottom).

Table 1. Mechanical properties of Baron palace's construction materials.

Material	Density (kg/m³)	Young's modulus (MPa)	Poisson ratio	Compressive strength (MPa)
Concrete	2500	15227	0.3	14.3
Brick masonry	1800	4100	0.3	5

5.2 *Results of the structural analysis*

5.2.1 Deformations

The deformations were evaluated in the walls and the ceilings under DL only and DL+LL for comparison purpose. Figure 15 shows the deformations in the walls. For the case of DL only, the walls of the basement and the ground floors had small deformations (below 1.5mm). For the first floor walls, only the tower's walls and some of the walls at the middle had higher deformations. For the case of DL+LL, the deformations of the walls of the basement and the ground floors increased, however, they were still below 1.5mm. More parts of the walls of the first floor had deformations above 1.5mm.

For the ceilings, the maximum deformations were observed in the middle, as expected, Figures 8-10. For the basement floor ceiling, the deformations under DL only exceeded the value of 1mm in two spans only, Figure 16 (left). For DL+LL, three more spans had deformations higher than 1mm, Figure 16 (right). The deformations in the ground and first floors' ceilings were higher than those of the basement floor ceilings because the spans are higher. Values more than 4mm were observed for the case of DL+LL, Figures 18-19.

5.2.2 Bending moments in ceilings

The bending moments were evaluated in the ceilings in the two directions of x and y under DL only and DL+LL, Figures 12-14. As expected, the maximum positive bending moments were observed in the ceilings' mid-spans, and the maximum negative bending moments were observed at the sections just near to the walls supporting the ceilings. Always, the negative moments were higher than the positive ones. The basement floor ceiling was found to have lesser bending moments than those observed in the ground and the first floors ceilings in both of x and y directions because the spans of the basement floor ceiling are shorter thanks to the intense walls supporting this ceiling in both of x and y directions.

To help specify more accurately the bending moments in ceilings, Table 2 reports the maximum noticed bending moments in all ceilings under DL and DL+LL. As can be noticed, the bending moments in x direction were always higher than those in the y direction. This occurred because the ceilings behaved as one way slabs in the x direction that was shorter than the y direction.

To assess the safety of the ceilings, it was necessary to know the amount of reinforcement per meter. It was possible to see in the places where the concrete cover fell down that there is a mesh of reinforcement of mild steel in both x and y directions. The spacing was approximately 20 cm in the both directions. However, it was not possible to determine the diameter of the used reinforcement. Therefore, a number of diameters (Φ) were assumed and the resisting moment of the ceiling was calculated, Table 3. The steel yield strength was assumed as 2400 kg/cm2. It can be noticed that the resisting bending moment is lesser than the expected bending moments. Hence, it is recommended carrying out a careful investigation of the actual reinforcement and the corresponding resisting moments before any re-use of the palace.

5.2.3 Compressive stresses in walls

As mentioned in Table 1, the compressive strength of the brick masonry walls was determined as 5 MPa. The principle compressive stresses in walls are plotted in Figure 22 for the walls of the different floors. As can be observed, the compressive stresses for the case of DL+LL are far from the compressive strength. This in turn showed an elevated safety in the walls under the expected loads from re-use.

5.2.4 Stresses on soil

The average stresses on soil were estimated assuming that the walls of the palace are supported on a strip footing. The footing width equals the wall width plus 2X, where X is the length of the part of the footing outside the wall, Table 4. Reasonable values were assigned to the distance X and the average stresses were evaluated, Table 4. The boreholes carried out on the foundation soil revealed that the soil is sand with an estimated bearing capacity of about 15 t/m^2. Comparing the obtained values in Table 4 with the soil bearing capacity, it can be noticed that the foundations seem to be adequate to the increased loading from re-use. However, more investigation and in-situ test pits should be carried out to the check the state of conservation of the foundations.

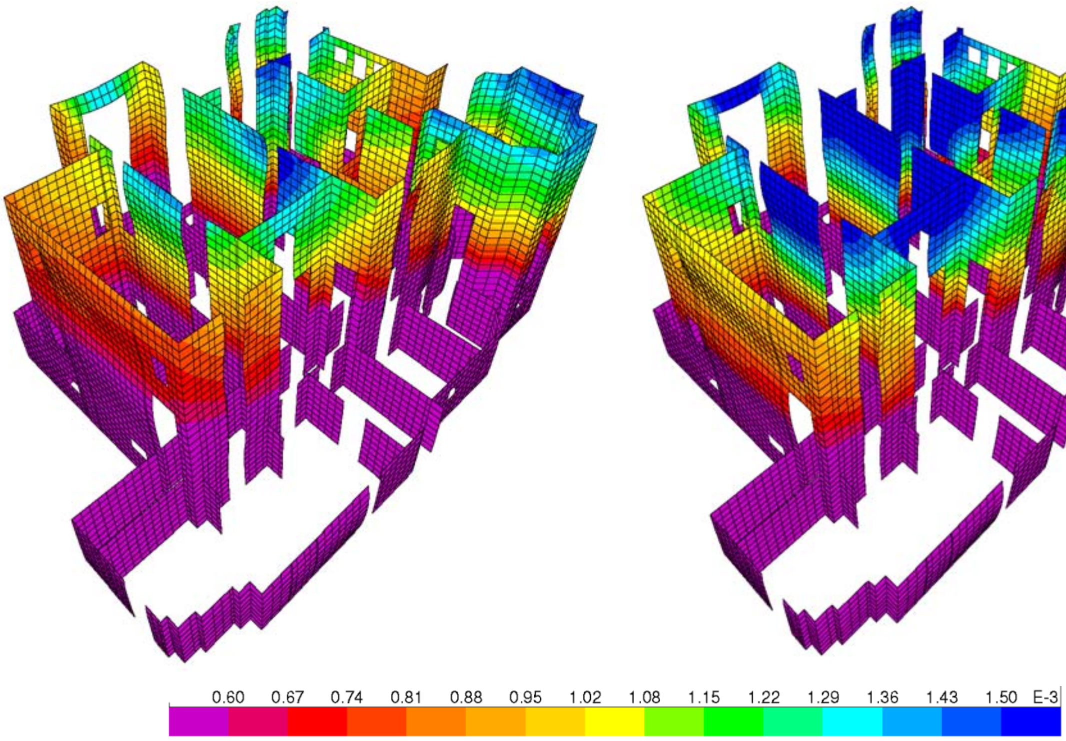


Figure 15. Deformations (m) in the walls: DL only (left), and DL+LL (right).

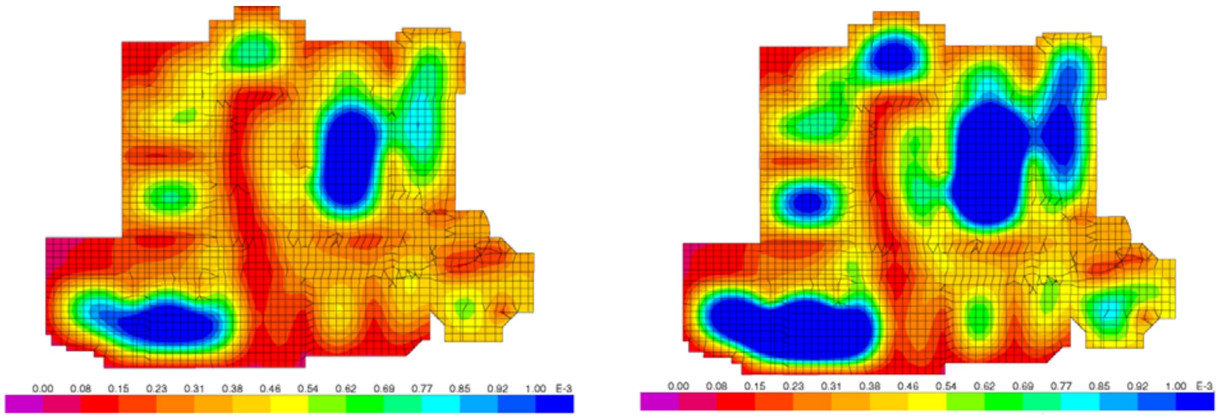


Figure 16. Deformations (m) in the basement floor ceiling: DL only (left), and DL+LL (right).

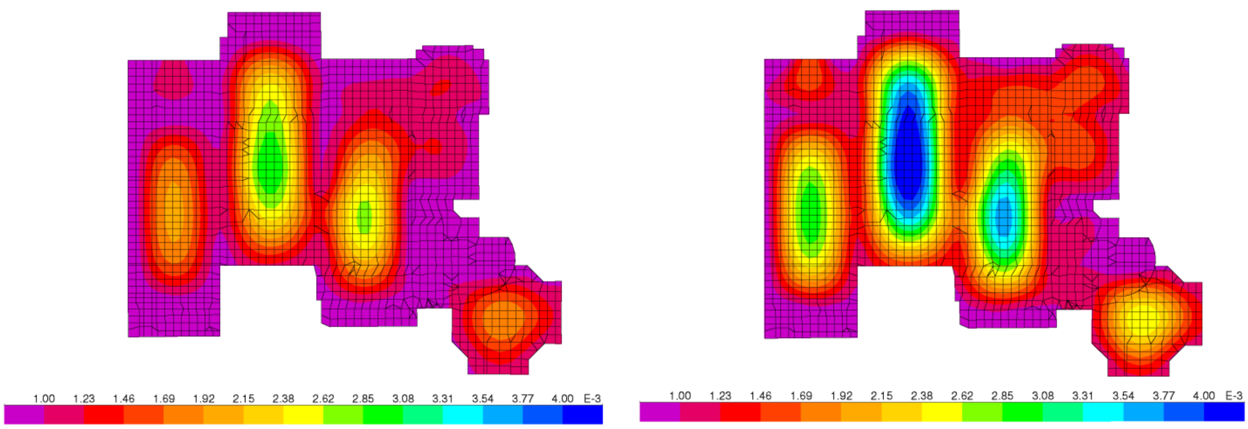


Figure 17. Deformations (m) in the ground floor ceiling: DL only (left), and DL+LL (right).

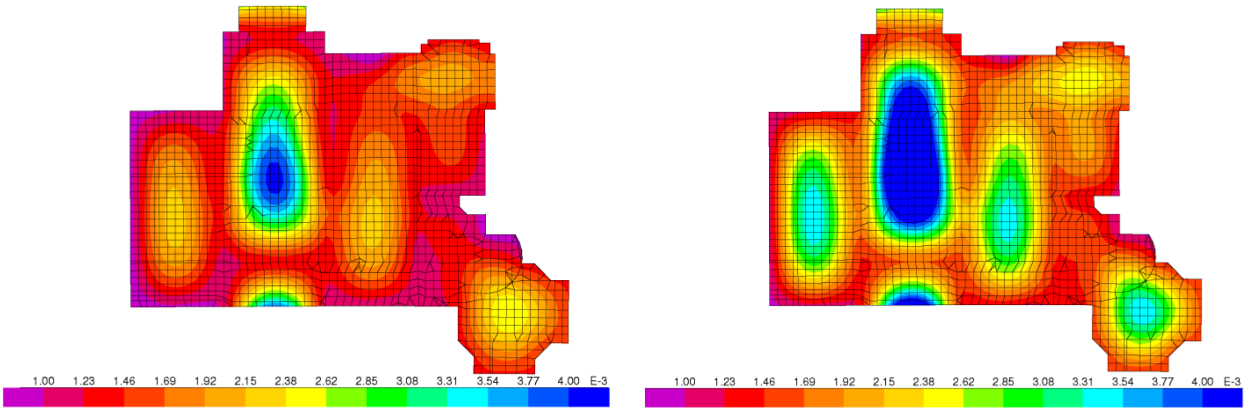


Figure 18. Deformations (m) in the first floor ceiling: DL only (left), and DL+LL (right).

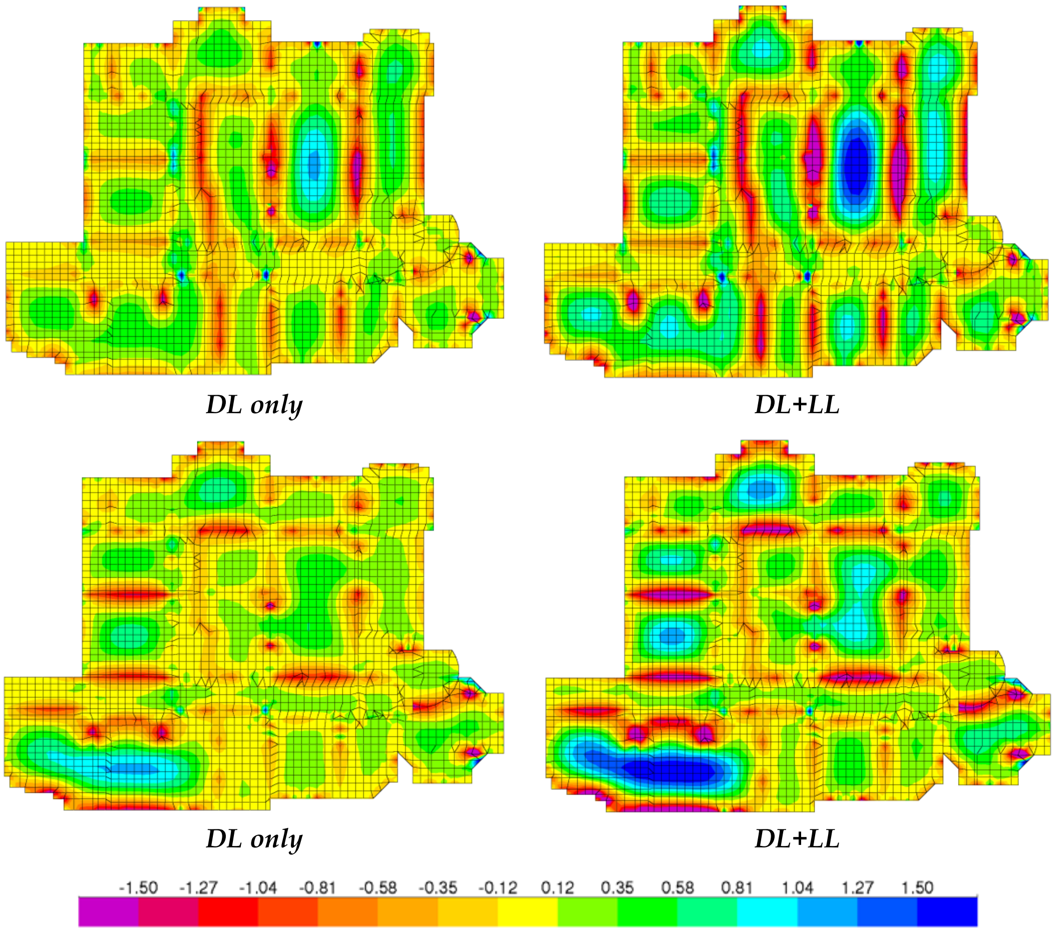


Figure 19. Bending moments (t.m/m) in the basement floor ceiling under DL only and DL+LL: in x-direction (top) and in y-direction (bottom).

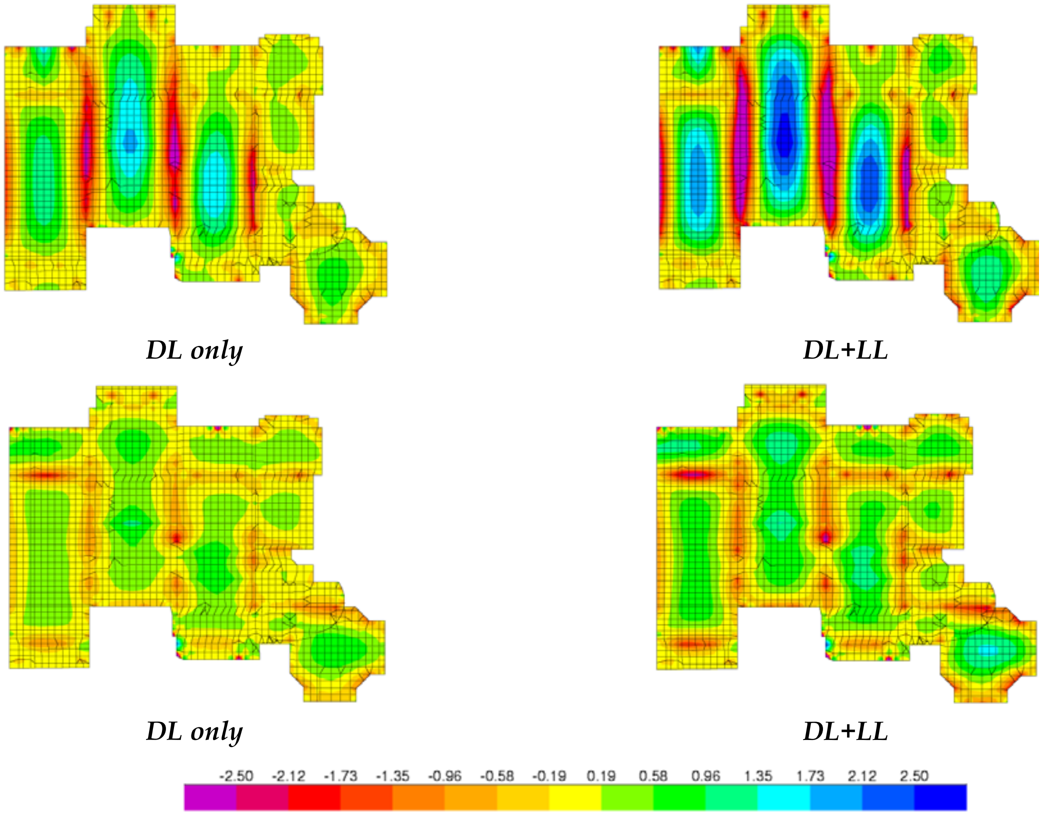


Figure 20. Bending moments (t.m/m) in the ground floor ceiling under DL only and DL+LL: in x-direction (top) and in y-direction (bottom).

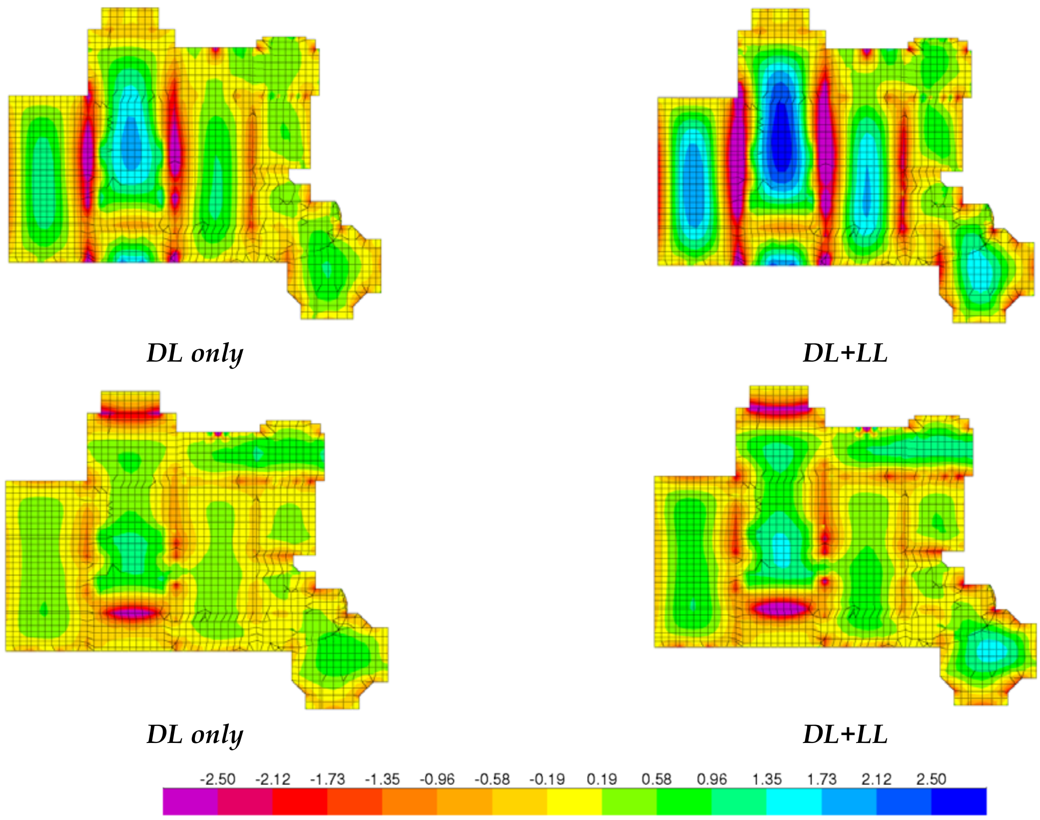


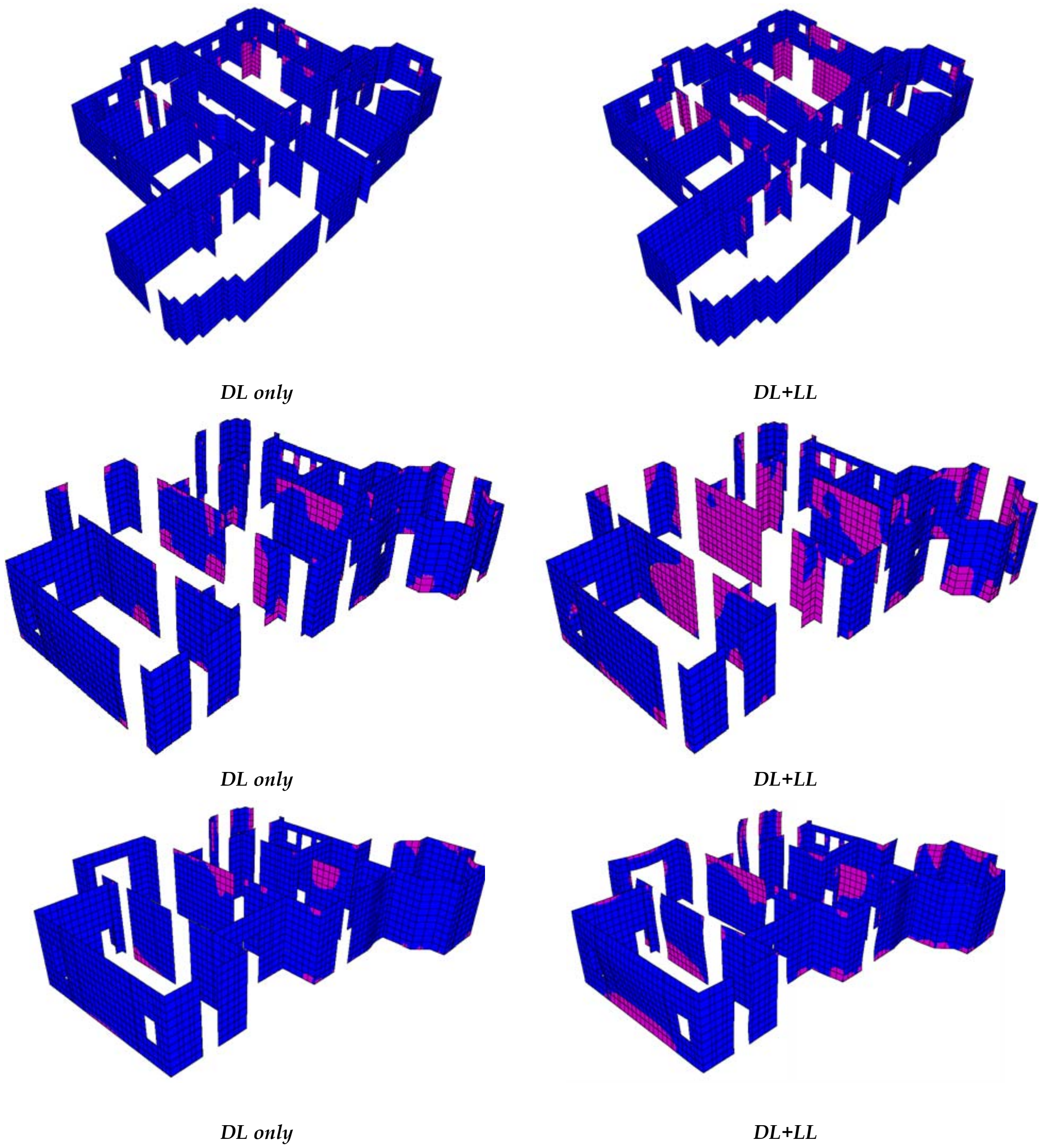
Figure 21. Bending moments (t.m/m) in the first floor ceiling under DL only and DL+LL: in x-direction (top) and in y-direction (bottom).

Table 2. Maximum observed bending moments (t.m/m) in ceilings.

Ceiling	DL only				DL+LL			
	Mx		My		Mx		My	
	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
Basement	1.1	-2.3	1.1	-1.2	1.8	-2.8	1.7	-1.8
Ground	1.9	-2.8	1.1	-1.3	2.7	-4.0	1.4	-2.0
First	1.9	-2.7	1.1	-2.6	2.7	-4.3	1.4	-3.0

Table 3. Estimated resisting bending moments (t.m/m) of ceilings.

Reinforcement	5 Φ 10 /m	5 Φ 12 /m	5 Φ 16 /m
Resisting moment (t.m/m)	1.2	1.7	2.9



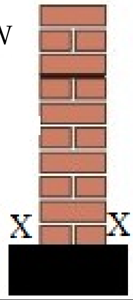
DL only ***DL+LL***

DL only ***DL+LL***

DL only ***DL+LL***

Figure 22. Principle compressive stresses in walls: basement floor walls (top), ground floor walls (middle), and first floor walls (bottom). Stresses in blue are below 0.5 MPa and in magenta are between 0.5-1 MPa.

Table 4. Estimated average stresses on soil.

Strip footing shape	Load	Reactions at base (t)	Average stresses on soil (t/m²)			
			X=0.25 m	X=0.30 m	X=0.40 m	X=0.50 m
	DL	3636	12.6	11.5	9.8	8.5
	DL+LL	4310	14.9	13.6	11.6	10.1

6. CONCLUSIONS

The paper presented integration between re-use proposal and structural analysis of Baron Empain palace in Egypt dating back to 1911. The palace suffered from neglect for decades and recently is under consideration by authorities to be restored and re-used. The proposal was to use the basement floor to provide services for the visitors, the ground floor to be a museum, the first floor to be either a museum or a motel and the roof to hold cultural events and seminars. A 3D numerical model of the palace was created and analysed under new expected heavy live loads. It was found that the walls and the foundations could sustain the new additional loads. For the slabs more investigation of the existing reinforcement is needed to know exactly its diameter and spacing before carrying out any strengthening intervention. The presented research is a step in an ongoing research on the historical structures in Egypt dating back to the 20th century.

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