

Towards Adapted Heritage Buildings to Sea Level Rise in Egypt: The Citadel of Qaitbay as a Case Study

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Abstract. The heritage areas carry the identity and culture of our past nations. They tell us what happened to our great ancients and how they obligated the cruel circumstances for their hard living. Heritage buildings remind us of our great roots, which reflect on their architecture and spaces. So, the research aims to put a group of SLR adaptation policies and strategies be maintain on the remains for next generations. The Citadel of Qaitbay has been selected as a case study that classified as category (A) in the value degree. It is obligated to a protection strategy for the shoreline and few modifications inside the citadel to be restored to its good state. The analytical approach will be used in the research. SLR adaptation and conservation mechanisms are vital approaches to preserve the history and culture of nations in the coastal zones. Besides these approaches, it could be integrating with other programs (e.g. special development programs). Soft protection is the main process of SLR adaptation strategies and is more sustained in such areas. The accommodation strategy is considered the rehabilitation process of the building. Retreat strategy is used rarely when treating the heritage areas.

Keywords: heritage building, sea level rise, adaptation, policies, strategies.

Introduction

What remained from ancient lives carries the heritage identity of every nation. These remains tell us the story of how ancients adapted and tolerated their physical and socio-economic aspects. Therefore, they should be conserved from different hazards that threatening their existence to be maintained to the coming generations.

There are many threats to heritage areas resulting from natural risks and human intervention. Natural hazards are various; such as climatic hazards (humidity, heat waves, heavy precipitation, ...), tectonics (earthquakes, landslides, ...), marine actions (SLR, storm surges, saltwater intrusion, erosion, inundation, ...), riverine forces (floods, erosion in stream body, ...). Hazards from human intervention are more damaged and more dangerous, which can be resulting from wars, political conflicts, purposed corruption, urban and population growth, pollution, neglect, unawareness, gaps in land value, unsustainable development, unwise management, etc.

Climate change and its association with sea-level rise 'SLR' have become a fact that increasingly challenge coastal zones all over the world (El-Shahat et. al., 2020). These impacts work on losing each of coastal lands and assets, including the valued items (e.g. natural protected areas, heritage buildings). Therefore, they should be adapted. There are many strategies of adaptation, such as protection, accommodation, and retreat (El-Shahat, 2018).

Used Category, Case Study, and Method:

Based on the value degree of heritage buildings, it could be classified into the followings:

- Category (A): It is allowed to make restoration without any internal or external modification, except in rare conditions.
- Category (B): It is allowed only to make minor internal modifications.
- Category (C): It is allowed to make major modifications with keeping only on structure and elevations of building.

Accordingly, the interfering levels by the adaptation strategies for the three classifications:

- Protection strategy could be used for category (A);
- Strategies of protection and minor accommodation could be used for category (B);
- Strategies of protection and major accommodation could be used for category (C).

The Citadel of Qaitbay has been selected as a case study, which exists in the margin of Pharos Island, and adjacent directly to the Mediterranean Sea as in fig (1). The citadel is classified as category (A) due to its high value, which obligated to a protection strategy for the shoreline and few modifications inside the citadel to be restored its good state. The analytical approach will be used in the research to configure a group of adaptation strategies and policies to sustain coastal heritage buildings.



Fig (1): The recent site of Citadel of Qaitbay (Based on Google Earth).

Sea Level Rise Impacts on The Citadel:

Due to the direct exposure to sea motion as in fig (2), the citadel has witnessed major devastating events from marine actions, such as SLR, tsunami, and storm surges. These hazards have generated an inundation and an erosion of the citadel body. Besides, currents and tides have resulted in severe immigration of sandy soil surrounding the citadel as in fig (3). Recently, waves have caused a big hole in the northern wall of the citadel as in fig (4). There is a saltwater intrusion into the basement floor through openings, which impacted the internal parts and foundation of the building as in fig (5). As well as, the elevation had been eroded in many parts due to high humidity in the atmosphere and high dynamic waves action as in fig (6).

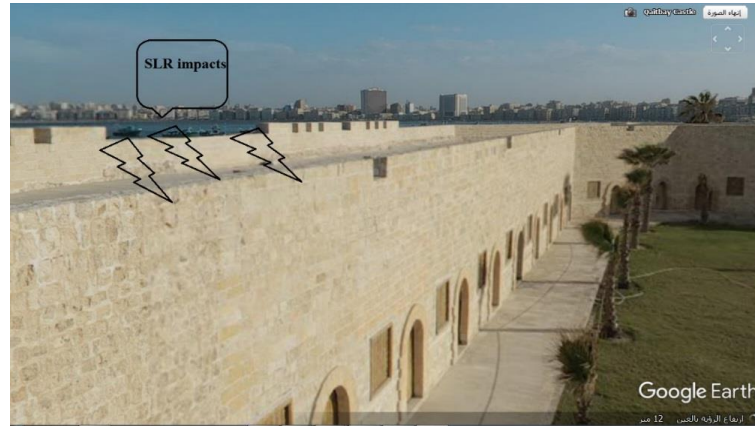


Fig (2): The direct exposure of SLR on the citadel.
Source: Based on photos of Google Earth.



Fig (3): The sand immigration surrounding the citadel.
Source: Based on photos of El-Youm El-Sabea Journal (accessed on 23, Sept 2020).



Fig (4): The hole on the northern wall of the citadel.
Source: Based on photos of El-Youm El-Sabea Journal (accessed on 23, Sept 2020).



Fig (5): Saltwater intrusion inside the citadel.

Source: Based on photos of El-Youm El-Sabea Journal (accessed on 23, Sept 2020).



Fig (6): Erosion in walls due to high alkaline in the air and waves action.

Source: Based on photos of El-Youm El-Sabea Journal (accessed on 23, Sept 2020).

The Local Solutions:

The antiques Minister with the supervision of the organization of shores protection investigates a big project for reinforcement of existed seawall in front of the citadel by blocking the gaps between rocks in the seawall, which resulting in erosion in another adjacent unprotected area. Also, they already constructing drowned breakwaters from 250m distancing from the shoreline with 7-9 m height of the breakwaters to accumulate sand around them, which disturbing the navigation marine paths of boats for creation or fishers. At the scale of the building, there is a restoration to eroded material in some parts only, also there is bumping to the intruded saltwater out the citadel.



The Optimized Solutions:

It is required to make a precise restoration to its lost material than happening now to innovate the citadel. Also, it should make a rehabilitation to the citadel by making more celebrations and social events in day and nights to get feasible money to spend on its maintenance cautiously. It should make a managed plan in emergency cases with many procedures, such as blocking the openings before the periods of storm surges to preserve the internal spaces in a good state.

Due to its high priority to our national inheritance, there will be urgent protection to the shoreline by soft coastal engineering, such as nourishment dunes stabilized with vegetation to keep a livability shoreline, which will raise the tourism. It also should raise people's awareness of the citadel's importance using media and websites to keep on the citadel health by public interest and efforts.

As for the context of the citadel, it should be linked it to the valuables in the surrounding areas, such as Ras El-Tin Palace, Abu Abbas Mosque, Al-Attarin Market, Al-Mansheya Square, traffic stations, Corniche streets, ... This link is recommended by upgraded paths, which should be upgrading their softscape (e.g. trees, water features), hardscape (e.g. pavement, carvings, furnitures).

Moreover, it could be adopted a framework for adaptation as the followings:

- Mapping of future shorelines according to SLR scenarios, topography, and morphology of the area.
- Defining other acceleration forces to SLR risk at the historical area (tsunami, ...).
- Studying socioeconomic aspects of the area to identify local abilities and interesting points (services, shops, ...).
- Studying governmental plans for the area to integrate the efforts of both local authorities and stockholders.
- Intervening by protection strategies after studying the impact of this intervention.
- Activating the building with many supported programs (i.e. social events).
- Activating the conservation mechanisms, for example, using the new material with the same type and shape as the existing one in a heritage building (conservation programs).
- Activating social participation in the preservation of the buildings.

Conclusion:

The heritage areas carry the identity and culture of our past nations. They are socially valued and sensitive areas, which need to be considered. SLR adaptation and conservation mechanisms are vital approaches to preserve the history and culture of nations in the coastal zones. Besides these approaches, it could be integrating with other programs (e.g. special development programs). Soft protection is the main process of SLR adaptation strategies and is more sustained in such areas. The accommodation strategy is considered the rehabilitation process of the building. Retreat strategy is used rarely when treating the heritage areas.

The research recommends the following:

- Assessing the SLR vulnerability to all coastal heritage areas at the national scale.
- Giving priority to strategies to risked heritage areas such as those in low-lying areas.
- Providing and using precise data to make flexible and modified plans.
- Effective plans aim with area condition.
- Encouraging and supporting research studies for vulnerable areas.
- Awareness and education for more national capacity (e.g. individuals, governmental bodies).



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