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KARUNGUZHI FORT, INDIA - A CASE STUDY ON CRITICAL REVIEW AND ANALYSIS

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Abstract

Karunguzhi fort is a heritage site and it was built on the bank of Kiliyar River in the 17th Century A.D by the Mohammedans. This fort is built in black granite with lofty brick walls and surrounded by Rampart wall. The heritage fort is in dilapidated condition and was used as a godown to store grains collected as tax from the small (Jamindars). The present fort is in ruines in an area spread across 15 acres. The fort has high potential as adaptive conservation by using it for educational tourism on ecosystem and its protection, local culture, show casing ancient fort, godown to store grains facilities as evidenced through archeological studies.

Keywords*: Karunguzhi Fort; Heritage; Structure; Fort; Bricks; Lime mortar; Conservation; Preservation.*

Introduction

The site is situated in Kanchipuram district at a distance of 82km from Chennai at Latitude 12º32' N; Longitude 79º54' E. In 1750 A.D, this fort was under the control of the French and later in 1759 A.D when the British Commander Sir Thomas Eyre Coote captured the Wandiwash fort, the British captured the Karunguzhi fort. In 1780 A.D, Hyder Ali invaded this fort and again in 1781 A.D. Sir Thomas Eyre Coote with the commander Davis captured the fort with the help of 1000 Soldiers. In the year 1782 A.D, the fort was demolished as per the order of the then Madras Governor. This site is a protected monument as declared by the state government. The Fort is built of bricks and lime mortar and presently remnants of ruined fort exists.

They have reported various experimental investigations performed on old and modern bricks, involving both hand-made and machine-made. They recommended that the universal compression test to be the most appropriate method to represent the characteristics of heat resistant material such as brick [1].

Due to the ancient technology of production and materials added in the mortar, the ancient Subramanyaswamy temple still exists in good condition under the sea for 10 centuries and its recent rediscovery [2].

FTIR analysis provides the principal constituents like Calcite, Aragonite, Vaterite, Magnesite, Portlandite, CSH (calcium silicate hydrate) and CASH (calcium alumina silicate hydrate) phases, and organics used could be identified in the aged lime mortars [3].

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The main factors damaging the historical building in Rashid are the air pollution, ground water, salts, variation of temperature, rains, and biological factors. The nanomaterials improve the physical and mechanical properties of red bricks in historical building and overcome the ordinary materials [4].

The petrographic study of the wall of enclosure of the Monastery Galata confirms the prevalent presence of the sedimentary rocks from the open pits of Repedea and Scheia Formations. In the composition of carbonate rocks from Iasi area there are mostly oolitic and grainstone limestones. The rocks from the building of the Galata Monastery - Iasi is a useful step and necessary for all the specialists involved or interested in the preservation and restoring of the historical buildings [5].

Natarajan et al. [6] who carried out rehabilitation of St. Lourdes Church at Tiruchirapalli which was built about 280 years later to Danish Fort observe that local materials bricks and lime mortars were used in the restoration work, which enabled bringing back the ancient glory and recommend complete water proofing of roof vaults plaster surfaces and to reduce water related deterioration of heritage structures to enhance functional life these buildings.

The Danish Fort, a 400 year old structure structure is located at very severe coastal environment which require constant vigil and scientific approach to assess present and future conditions through non-destructive testing, model studies of structural elements, characterization of major construction materials used such as in-situ bricks, lime sand mortar, further studies and suitable interventions are required towards checking and controlling dampness. Increasing life of such brick structures will help to design and construct modern residential and commercial structures with more design life, thus reducing environmental impact on quarrying of natural resources and cutting trees [7].

A special aspect for actual or future interventions of restoring is the identification of natural resources referred to the extraction of the compatible rock with physical and mechanical characteristics, petrographic, mineralogical and esthetical characteristics specific to the geomaterials used for the initial construction [8].

An important issue is the cleaning of the depositions on the wall surface, laser cleaning method being recommended especially when assisted by simulation in COMSOL for estimation of laser parameters [9].

The formations with pronounced destructions and alteration were taken and macroscopic analysis was performed in situ, following possible endogenic and exogenic causes that affected the status and integrity of the construction in study [10].

The need to regulate and reduce the expansion of urban structure in the context of heritage, and the necessity for Managing natural and cultural heritage sites as an integral part of local and national management plans, in accordance with the laws and regulations [11].

The repair process requires the existing condition of the structure to be identified and its causes of its deterioration. It is also necessary to define how ongoing deteriorative factors should be monitored given the effects of such processes on the rehabilitation of the structure [12].

There is tremendous educational and practical potential to be realized in the area of restoration. An architectural, engineering, management as well as social approach is required for such type of endeavour. Proper education and training for such kind of works is today‟s need. Involvement of more practitioners and technical professionals is required. The potential of this field needs to be realized by integrating and contextualizing the spheres and work of conservation, not only as a self-contained science or technological endeavour but also as a social practice [13].

Below is a complete study on the restoration and rehabilitation of heritage buildings. The existed problems and its reported solutions are finely reviewed. An effective solution for the reported problem is formulated based on tradeoff between cost, lifetime, and adaptability of the

solution. Hence this paper delivers its usefulness to those who as an objective of doing repair and rehabilitation in a heritage building [14].

The repairs and rehabilitation of damaged structures it is essential to carryout detailed condition assessment of the building with nondestructive and destructive tests so that suitable remedial measures and repair techniques could be employed [15].

This paper attempts taking stock of the existing site conditions, highly dilapidated fort walls damaged by war, natural calamities like cyclone, heavy and dense vegetation growth.

Experimental Investigation

Non-Destructive Test (NDT) s at the fort site were conducted on intact bricks employing rebound hammer (make: Consal, Model No. CSS-073). Bricks from the fort site were collected for performing different type of tests in the laboratory. Brick samples from fort walls, soil samples and nearby bore well water sample were collected respectively at the site. On bricks samples - water absorption, compressive strength, efflorescence, and dimension test were conducted at laboratory. For soil samples - nitrogen (N), phosphorous (P) and potassium (K) test were conducted. For bore well water sample - colour (Pt-Scale), turbidity (NTU), pH, dissolved oxygen (DO), chloride (Cl), nitrate (NO_3^-), sulphate (SO_4^{2-}), total hardness (TH), total dissolved solids (TDS), faecal coliform bacteria count (F. Coli.) and biochemical oxygen demand (BOD_5) test were conducted. These tests were conducted adhering to the Bureau of Indian Standards and according to other researcher's methods as applicable for easy comparison.

Non-Destructive Tests

Non-Destructive Tests (NDT) was carried out using rebound hammer at 24 locations as shown in Tables 1-4 at the Fort site. Column chart.1 shows the compressive strength values of fort walls at karunguzhi fort. Figure 1 displays the in-situ testing of bricks using the rebound hammer.

Table 1. Compressive Strength Values in the Karunguzhi Fort

Sl. No	Fort Wall ID	Location	Rebound Hammer Value	Compressive Strength (N/mm^2)	Sample Standard Deviation (N/mm^2)
1.	FW - 1	Northern side inner fort wall	36	33.60	
2.	FW - 2	Northern side inner fort wall	34	30.00	2.07
3.	FW - 3	Northern side inner fort wall	36	33.60	
4.	FW - 4	Northern side outer fort wall	32	26.50	
5.	FW - 5	Northern side outer fort wall	34	30.00	3.35
6.	FW - 6	Northern side outer fort wall	30	23.30	
7.	FW - 7	Southern side inner fort wall	36	33.60	
8.	FW - 8	Southern side inner fort wall	32	26.50	5.57
9.	FW - 9	Southern side inner fort wall	38	37.50	
10.	FW - 10	Southern side outer fort wall	40	41.60	
11.	FW - 11	Southern side outer fort wall	38	37.50	2.36
12.	FW - 12	Southern side outer fort wall	40	41.60	
13.	FW - 13	Eastern side inner fort wall	36	33.60	
14.	FW - 14	Eastern side inner fort wall	38	37.50	2.25
15.	FW - 15	Eastern side inner fort wall	36	33.60	
16.	FW - 16	Eastern side outer fort wall	36	33.60	
17.	FW - 17	Eastern side outer fort wall	40	41.60	4.00
18.	FW - 18	Eastern side outer fort wall	38	37.50	
19.	FW - 19	Western side inner fort wall	38	37.50	
20.	FW - 20	Western side inner fort wall	40	41.60	5.88
21.	FW - 21	Western side inner fort wall	34	30.00	
22.	FW - 22	Western side outer fort wall	32	26.50	
23.	FW - 23	Western side outer fort wall	38	37.50	5.57
24.	FW - 24	Western side outer fort wall	36	33.60	

(a) Northern Side Wall (b) Southern Side Wall

(c) Eastern Side Wall (d) Western Side Wall

Fig. 1. Performing NDT using Rebound hammer at Karunguzhi Fort walls

Table 2. Laboratory Tests

Sl. No	Parameter	Protocol	Unit	Results
1.	Water Absorption	IS 2386 (Part 3): 1963	%	11.10
2.	Compressive Strength	IS 3495 (Part 1): 1992	N/mm^2	12.20
3.	Efflorescence	IS 3495 (Part 2): 1992/ IS 3495 (Part 3): 1992	%	26
4.	Dimensions	IS 1077 - 1992	mm	Length = 230 Width = 110 Height = 76

Table 3. Soil Sample Test

Sl. No	Parameter	Protocol	Unit	Results
1.	Nitrogen (N)	IS 10158 - 1982 Reaff 2003	mg/kg	232
2.	Phosphorous (P)	IS 10158 - 1982 Reaff 2003	mg/kg	71
3.	Potassium (K)	IS 10158 - 1982 Reaff 2003	mg/kg	1081.59

Table 4. Bore Well Water Sample Test

Sl. No	Parameter	Unit	Results	Tolerance Limit (X_0)	Excessive Limit (X_e)
1.	Colour (Pt-Scale)		CL	5	25
2.	Turbidity (NTU)	NTU	3.7	5	25
3.	pH		7.68	7.5	6.5 if pH < 7.5 8.5 if pH > 7.5
4.	Dissolved oxygen (DO) @ 30° C	mg/L	5.8	10	3
5.	Chloride (Cl)	mg/L	263	250	1000
6.	Nitrate (NO_3)	mg/L	58	45	100
7.	Sulphate (SO_4)	mg/L	203	200	400
8.	Total hardness (TH)	mg/L	760	200	600
9.	Total dissolved solids (TDS)	mg/L	1986	500	1500
10.	Faecal coliform bacteria count (F.Coli.)	MPN/100mL	6	1	100
11.	Biochemical oxygen demand (BOD_5)	mg/L	4.3	0	30

Site Investigation

Figure 2 shows the location map, Figure 3 shows the site plan, Figure 4 shows contour map of the fort. Figures 5 show critical conditions of fort walls and the damages incurred.

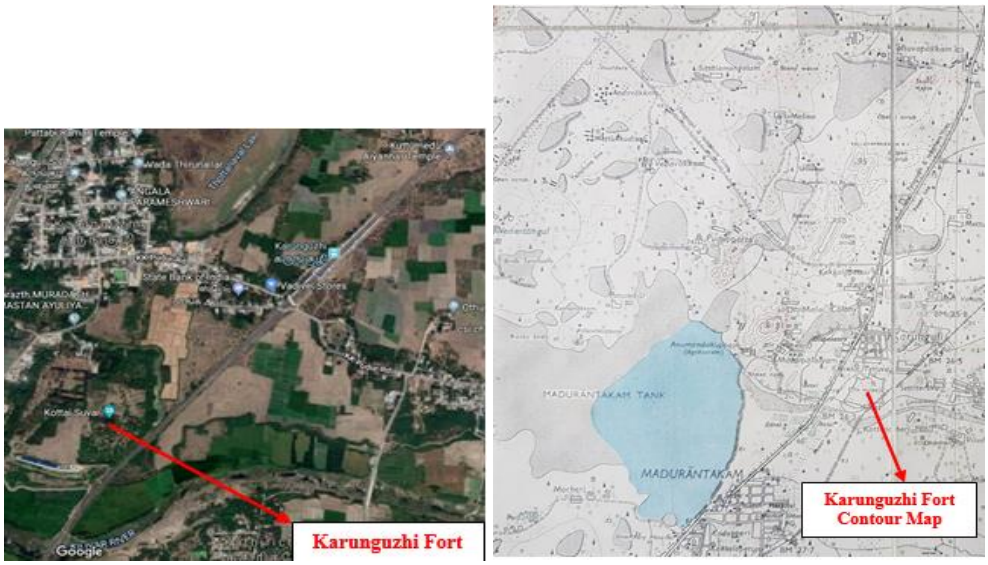

Fig. 2. Location and contour map of Karunguzhi Fort [16]

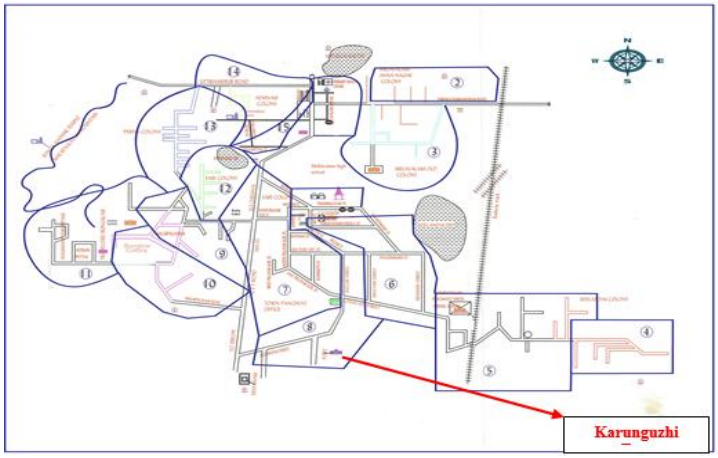

Fig. 3. Site Plan of Karunguzhi Fort (Town Panchayat, Government of Tamilnadu)

The front entrance as seen from the northern side of the fort (Fig. 5a) is lofty brick walls with vegetation growth and dilapidated fort brick walls (Fig. 5), which can be classified as open exposure to severe environment. Once entered the site, fallen pieces of brick walls, completely eroded walls due to weathering action and alternating wet and dry conditions are witnessed. There are sections of walls which appear that any time, they may fall and even there are portions, which oscillate due to cyclone. There are few sections of walls which are intact, comparing these portions with other fallen and eroded wall sections. All the parts of fort walls could not be accessed due to glass pieces, bushes, fear of snakes and other insects.

Fig. 5. Karunguzhi Fort: a. Northern Side View; b. Southern Side View; c. North-Eastern Side View; d. North-Western Side View; e. Western Side View; f. Inside view of the fort

Discussions

Central Public Work Department, Government of India, Guides on heritage buildings defines conservation as, "all the processes of looking after a place so as to retain its historical and/or architectural and/ or aesthetic and/ or cultural significance and includes maintenance, preservation, restoration, reconstruction and adoption or a combination of more than one of these." And, recommends on heritage structures and sites as it observes," Adaptive reuse of buildings has a major role to play in the sustainable development. When adaptive reuse involves historic buildings, environmental benefits are more significant, as these buildings offer so much to the environment, landscape, identity and amenity to the communities to which they belong" [17]. Indian National Trust for Art and Culture Heritage highlights the human angle for heritage as, "The Archaeological Survey of India (ASI)" had asked INTACH to prepare guidelines to relax some of the stringent conservation laws that govern the structures in the country so that some decent facilities and infrastructure can come up around them; further, to involve local residents in the conservation effort. However, the fort site is an existing heritage structure, but due care is to be given for restoring and conserving the heritage value without severely affecting the environment. Further, the very conservation effort is made in adaptive reuse of this site for educational purpose, so, showcasing best practices are required to be followed [18].

It is recommended to compare few case studies in USA and the Kochi Fort that tourism can help preserve built heritage and revenues from tourism can fund and sustain conservation efforts. Further, proposes a more contextualized approach that locates historic preservation within the broader framework of sustainable regional development [19]. Through a case study

demonstrated the importance of rehabilitation of historic structures using appropriate construction techniques including possible alternative rehabilitation approaches to ensure the preservation of these structures [6]. They observe that, "Restoration involves investigating, diagnosing, and correcting deficiencies and deterioration of any structure. Identification of common defects and problems faced in old structures and devising a systematic approach towards handling these issues is civil engineer's obligation" [13]. It found that sediments are of medium sand, moderate to poor graded. They also reported that kaolinite clay as predominate followed by illite, smectite and chlorite. They proposed that kaolinite would have formed through chemical weathering of pre-existing rocks adjacent areas. Their findings and observations are important as may have bearing on availability of local clay and lime used in the construction works [20]. They observed that many archeological sites and monuments in Kanchipuram district in the past have withstood the vagaries of time to tell us the story of their inception, beauty, grace, love, and passion. They noted Kanchipuram like other places is facing problems like negligence from several sections and stakeholders, lack of public awareness, inadequate infrastructure facilities and inappropriate roads connectivity. They argued that it is our first and foremost duty to educate the public and others to keep these heritage sites and structures intact. They recommended that optimum usage of these sites for educational tourism as a basic requisite to both save the monuments, sites and to educate [21].

Conclusion

The Karunguzhi fort which functioned in the past as a godown to store grains collected as tax from the Jamindars,

now stand today as a neglected site, but duly acknowledging its importance by the government as a heritage site. There is strong interest from locals visiting the dilapidated fort, and tourists and photographers, give hope is generating revenue to off-set the conservation and maintenance cost. This site due its proximity to one of the research scopes on ecosystem, which add educational and research value of the site apart from a heritage site. This site could be developed as an educational site.

Going through the various documents, reports alongside our site visits and investigation, it was found that the fort is an example of the brick construction using binding materials as lime mortar. Most of the fortress has fallen and the remaining portions were found with heavy growth of vegetation. The fort was a double-barreled wall construction and core filling brick was used. Similarly, against plinth beam, brick lime concrete and random rubble stone was embedded, which is seen on the north-western side of the fort. Hence, it can be developed as a heritage tourism spot ecosystem facility. This is important as the site has been neglected for quite long leading to present state of condition.

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