CHAPTER 5

INVESTIGATION OF THE PRESENT STATUS OF THE DETERIORATION OF SANDSTONE MONUMENTS BY DECAY MAPPING

5.1 INTRODUCTION

This chapter deals with the investigation of the status of the deterioration of sandstone to understand the measures to be taken to conserve the sandstone monuments. “Decay mapping” is adopted for the investigation of the deterioration of sandstone, and specific conservation measures are outlined in detail with respect to each monument, based on the results of decay mapping.

Out of the six temples in the study area, the Kailasanatha temple, the Vaikuntha Perumal temple and the Iravataneswara temple are larger in scale and not taken for detailed study as large surfaces of sandstone have been covered by the application of lime plaster as a protective measure thereby falsifying the historic fabric (“The replacement of historic fabric, no matter how carefully the work is carried out, will have an adverse effect on the appearance of a building or monument, will seriously diminish its authenticity, and will significantly reduce its value as a source of historical information” (Brereton Christopher 1995)). The other three monuments the Matengeswara temple, the Mukteswara temple and the Piravataneswara temple are in a comparatively pristine state and therefore short listed for detailed study.
As a first step, documentation is done for the three temples to understand the architectural style and construction methodology adopted. Plan, elevations and sections are constructed to form the base data for decay mapping of the temples. The qualitative assessment of decay occurring on the sandstone surfaces of the temples is done by decay mapping. Besides, specific conservation measures are outlined in detail with respect to each temple based on the results of decay mapping.

5.2 DOCUMENTATION OF THE TEMPLES

Plan, elevation and section of the three temples under detailed study (the Matangeswara temple, the Muktheswara temple, and the Piravathaneswar temple) are documented. In plan, the temples are square with a pillared hall in front and are covered with a pyramidal roof. The corbelling technique is adopted for roofing the Garbha griha (sanctum), forming a pyramidal tower called the Vimana (Pyramidal roof over the sanctum).

“The temple construction in Mamallapuram and Kanchipuram is the basis for the entire temple construction of Tamilnadu” outlines the renowned Sthapathi (Master sculptor especially with reference to temple architecture) of Tamilnadu, Dr. Ganapathi Sthapathi (Ganapathi Sthapathi 2002). The corbelling technology adopted for the Vimana was perfected in the monuments of Kanchipuram. In this technology, the inner space of tall structures is maintained as a tapering hollow space from the floor to the finial (some times a slab is introduced at one or two levels) with the side walls corbelled in a specific manner. This corbelling technology has worked wonders in South Indian temple architecture, expressed in the creation of Vimanas (Ganapathi Sthapathi 2002).
The mortar used for the bonding of the stone blocks is a thin paste of lime called ‘Saanthu’. This is a very thin layer and the mortar used in construction is visible only on close examination. The jointing technique used was butt joints and the temples are standing by the self weight of the stone blocks.

The plan, elevation and section of the Matengeswara temple are given in Figure 5.1.

The plan, elevation and section of the Mukteswara temple are given in Figure 5.2.

The plan, elevation and section of the Piravataneswara temple are given in Figure 5.3.
5.3 DECAY MAPPING OF SANDSTONE MONUMENTS

“Visual examination clearly has a place. A single examination can give an indication of the state of the stone at that particular moment, but it cannot give any indication of the rate of decay” (Price 1996).

Step I: Elevations of the monuments from the cardinal directions are evolved.

Step II: Each side of the elevation is divided into a grid (Horizontal direction named A, B, C etc., vertical direction named 1, 2, 3, 4 etc., termed as the investigation grid) (The Matengeswara temple - Refer Figures 5.4 to 5.7; The Mukteswara temple - Refer Figures 5.8 to 5.11; The Piravataneswara temple - Refer Figures 5.12 to 5.15 - In these figures the elevations as well as the grid had been split in to parts horizontally for clarity and readability. These figures cannot be referred to, for the height of the monuments).

Step III: Level of decay present in each grid is documented according to Table 3.6 and indicated by a colour code. By documenting the level of decay in all the grids for the whole elevation, a systematic decay mapping for the façade is created.

Step IV: Similarly the decay mapping is done for four sides of the elevations for a monument.
Figure 5.4 Investigation grid - East elevation - The Matengeswara temple - Monument-I
Figure 5.5  Investigation grid - West elevation - The Matengeswara temple - Monument-I
Figure 5.6 Investigation grid - North elevation - The Matengeswara temple - Monument-I
Figure 5.7 Investigation grid - South elevation - The Matengeswara temple - Monument-I
Figure 5.8 Investigation grid - East elevation - The Mukteswara temple
- Monument-II
Figure 5.9 Investigation grid - West elevation - The Mukteswara temple - Monument-II
Figure 5.10 Investigation grid - North elevation - The Mukteswara temple - Monument-II
Figure 5.11 Investigation grid - South elevation - The Mukteswara temple - Monument-II
Figure 5.12 Investigation grid - East elevation - The Piravataneswara temple - Monument-III
Figure 5.13 Investigation grid - West elevation - The Piravataneswara temple - Monument-III
Figure 5.14 Investigation grid - North elevation - The Piravataneswara temple - Monument-III
Figure 5.15 Investigation grid - South elevation - The Piravataneswara temple - Monument-III
5.3.1 Decay Mapping - The Matengeswara Temple - Monument-I

Decay mapping of the Matengeswara temple are given in Figures 5.16 to 5.19. Comparison of the elevations on four sides is presented in Figure 5.20.

5.3.2 Decay Mapping - The Mukteswara Temple - Monument-II

Decay mapping of the Mukteswara temple are given in Figures 5.21 to 5.24. Comparison of the elevations on four sides is presented in Figure 5.25.

5.3.3 Decay Mapping - The Piravataneswara Temple - Monument-III

Decay mapping of the Piravataneswara temple are given in Figures 5.26 to 5.29. Comparison of the elevations on four sides is presented in Figure 5.30.
Figure 5.16  Decay mapping - East elevation - The Matengeswara temple - Monument-I
Figure 5.17 Decay mapping - West elevation - The Matengeswara temple - Monument-I
Figure 5.18 Decay mapping - North elevation - The Matangeswara temple - Monument-I
Figure 5.19 Decay mapping - South elevation - The Matengeswara temple - Monument-I
**FINDINGS:**
Level V Decay - very severe damage is prominent and efflorescence is present below the projections on all sides of the temple. Hence the Decay pattern is similar on the external surface throughout the temple.

**Figure 5.20** Decay mapping - Comparison of the elevations on four sides - The Matangeswara temple - Monument-I
Figure 5.21  Decay mapping - East elevation - The Mukteswara temple - Monument-II
Figure 5.22 Decay mapping - West elevation - The Mukteswara temple - Monument-II
Figure 5.23  Decay mapping - North elevation - The Mukteswara temple
             - Monument-II
Figure 5.24  Decay mapping - South elevation - The Mukteswara temple
- Monument-II
FINDINGS:
Level V Decay - very severe damage is prominent and efflorescence below the projections is similar on all sides of the temple. But the Level IV Decay is more on the east and west elevations than on the north and south.

Figure 5.25  Decay mapping - Comparison of the elevations on four sides - The Mukteswara temple - Monument-II
Figure 5.26 Decay mapping - East elevation - The Piravataneswara temple - Monument-III
Figure 5.27 Decay mapping - West elevation - The Piravataneswara temple - Monument-III
Figure 5.28 Decay mapping - North elevation - The Piravataneswara temple - Monument-III
Figure 5.29 Decay mapping - South elevation - The Piravataneswara temple - Monument-III
Figure 5.30 Decay mapping - Comparison of the elevations on four sides - The Piravataneswara temple - Monument-III

**FINDINGS:**
Level V Decay - very severe damage is prominent and similar on all sides of the temple. Level IV Decay is similar on the finial but it varies on all the other surfaces.
5.4 FINDINGS FROM THE DECAY MAPPING

i) The sandstone surfaces in the temples have **undergone a very severe damage**. The decay level of V is primarily noticed in all three monuments under study. The decay level of the monuments suggests that the conservation measures are **urgent and immediate** to protect the sandstone surfaces from further damage. Figure 5.31 shows decay level V at the plinth level in the Matengeswara temple.

![Figure 5.31 Example of Decay Level V - very severe damage seen at the plinth level - west elevation - The Matengeswara temple](image)

ii) Below the projections, efflorescence is found in all the temples under the study. The sheltered spaces below the projections retain humidity contributing to efflorescence and leading to the loss of material. Figure 5.32 shows decay level IV below projections in the Matengeswara temple.
iii) Sandstone blocks at the plinth level exhibit flaking, scaling and multiple scaling in addition to surface erosion. It is possible that an additional contribution to the flaking and scaling of stone could be due to the salt mobilization through capillary action. Figure 5.33 shows decay level V due to structural load in the Matengeswara temple.
iv) The edges of each of the tiers of the pyramidal roof show loss of carved detail by environmental actions mainly as a result of the flow of rain water. Figure 5.34 shows the absence of projections in the Matengeswara temple.

![Figure 5.34 Pyramidal roof with absence of projections - Section - The Matengeswara temple](image)

5.5 CONSERVATION MEASURES TO BE TAKEN FOR THE MONUMENTS

i) Growth of small plants is present in all the temples under study, leading to minor cracks in stone which may further lead to a fracture of the stone. This invasive vegetation noticed is specific on the Vimanas and should be periodically removed from the temples.

ii) The bio-film formation on the sandstone surfaces is due to the flow of water from the sanctum. This form of decay is common in the northern wall of all the temples due to religious practice. Patinas of biological origins on sandstone surfaces are to be studied arriving at the general
recommendations on the removal of lower order species from sandstone surfaces.

iii) The temples were restored in some portions with lime plaster. The lime plaster had been prepared with fine sand and lime (1:5) with a very small % of cement. At present the use of cement in the lime plaster shows minor hair-line cracks in the visual inspection. It should be monitored for chemical reactions with the sandstone in future. Figure 5.35 shows the preparation of lime mortar during restoration work.

![Preparation of lime plaster](image)

**Figure 5.35  Preparation of lime plaster**

iv) Restoration of the historic fabric can be achieved by removal of the lime plaster on the top portions of the Vimanas. This will also help in preventing the growth of algae. Figure 5.36 shows comparison of the restored surface with original surface.
v) Restoration with lime plaster has been done in places where the sandstone has undergone severe damage. But these details are not restored using authentic records and must be avoided in all future restoration works. Figure 5.37 shows restoration done without following the original detail.

Figure 5.36 Comparison of the restored surface with lime plaster and the original surface of sandstone - The Kailasanatha temple

Figure 5.37 Restoration done missing the original detail
vi) The discharge of water and oil from the sanctum wall causes the formation of bio-film on the sandstone surfaces. This form of decay is common to all the temples under study. Other religious practices like burning camphor, lighting lamps with oil has also contributed to the damage of sandstone. Regular cleaning and maintenance of sandstone surfaces is suggested to avoid irreversible damage. Damages caused by the religious practices are shown in Figure 5.38.

![Image](a) Drain hole on the northern wall ![Image](b) Oil stains on the sculpture

**Figure 5.38** Damages caused by religious practices

vii) The replacement of sandstone is suggested where the sandstone is lost irretrievably by the same construction technique adopted in these temples by using butt joints and lime plaster or by using clamps wherever relevant.

5.6 **SUMMARY**

The investigation done for the temples by decay mapping reveals that the stone material is irretrievably lost in many places. Replacement of
sandstone is suggested as one of the conservation measures. However, the absence of sandstone quarries in Tamilnadu is a constraint to procure fresh sandstone. Therefore there was a need to identify sites from which sandstone could be procured and test its compatibility for restoration works. The next chapter analyses the possibilities to obtain fresh sandstone in Tamilnadu and its compatibility with the sandstone used in the temples.