Renovation of Sāttankulangarai Narasimhamoorthy Temple-A Case study

Sheeja.K.P
Department of Architecture
College of Engineering Trivandrum
Trivandrum
sheejakp@gmail.com

SyamPrakash V
Department of Civil Engineering
Government Engineering College
Kannur
dr_syamprakash@yahoo.co.in

***Abstract*— Kerala the land of temples, 'the Gods own country', exhibits a unique and simple style of architecture. The Kerala temple architecture has its roots in 'Vastusastra' which is not a religion document but a scientific treatise. The temple architecture is considered as a science of scale and proportion. It is a product of Bakthi cult starting from the dawn of 9th century and received a fillip during the age of Kulasekharas as a part of the activity connected with popularisation of Hinduism. The long unbroken chain of Kerala kings who were the protectors of the Hindu religion was much involved in the construction of temples and its renovation. The contributions of the rulers were strong and solid. Sāttankulangarai Narasimhamoorthy temple, an embellishment in wood crafts of Central Travancore is located at Chengannoor in Alappuzha district. The origin of the temple renovation dates back to the 14th century. This timber temple a masterpiece in wood crafts having its superstructure including the walls made of timber. The Climate Index (decay hazard) was found to be very high and the Equilibrium Moisture content was found to be more than 20% which shows high decay risk of wood. The higher the risk of decay, shorter the expected service life for a given wood product. But the extant timber temple has a history of more than 500 years. Sāttankulangarai Narasimhamoorthy temple has been remarked by Bernier as one of the masterpieces in wood. The renovation of the temple except for the *Srikovil* and *Namaskara mandapa* was recently carried out in 2007 which does not strictly adhere the canons of the traditional treatise.**

Keywords*— *Temple architecture; Timber temples; Decay hazard; Renovation; Wood crafts.

I. INTRODUCTION

Central Travancore in Kerala has timber temples which are an embellishment in wood crafts. The temples have their superstructure including the walls which were made of timber. The *adhishtāna* (basement) was judiciously made of granite. The extant timber temples are the residue of what has lived for the past five centuries. Kerala temples lean heavily on the utilisation of natural products. As wood is available in plenty in this region it was used for structural, protective and decorative purposes. Sāttankulangarai Narasimhamoorthy temple is a *chaturasra* (square) *alpaprāsada* with the deity facing west. As one approaches the gopura of the temple, the simplicity and lightness is reflected in its exterior. The temple renovation dates back to the 14th century according to Archaeological series, IV, pp.161-66 (Sarkar, 1978). The stone inscription engraved at the entrance of the temple from the west is in vattezhuthu, the old Malayalam script is attributed to the 14th century. It states that Devan Sankaran of Melkkadu executed the repairs in the temple and re-congregated it. The ownership of the temple is now with the Nair service society. The temple is a protected monument of Archaeology department under the protected monuments act.

II. COMPONENTS OF THE TEMPLE

A. Gopuram

The temple has a sloping two tiered *gopura* on its northern side which forms the main entrance gateway to the temple as shown in Picture 1. It is constructed in accordance to the human scale. No *gopura* exists on the western side as there is a temple pond on the west side. The wooden ceiling of the *gopura* is decorated in a chequered pattern. The stains were removed during the renovation and clear varnish was applied on the surface.

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Fig 1 Entrance Gopuram

Fig 2 Temple complex

B. Srikovil

The *Srikovil* (*Vimana*) is square, *Sāndhara* type of *Nāgara* style and houses a square *garbhagrha* (sanctum sanctorum) with a *pradakshina patha* all around. The *garbhagrha* having perimeter of 20K 8A (1K=72 cm, 1A=24 cm) has an octagonal *Griva* (neck of the dome) and *Sikhara* (cupola) crowned by a *Stupi*. The *Srikovil* has a perimeter of 37K16A, which faces west and is *Eka yoni (dwaja)*. According to Ayadi shadvarga (Horoscope), the perimeter is found to be auspicious. The quadrangular *chuttambalam* encloses the well decorated *srikovil* in timber as shown in Picture 2. The *srikovil* has a granite *adhishtāna* with different mouldings and above this is a *Vedika* (intermediate member) followed by the *bhitti* (wall), both in timber and the latter is carved with scenes from epics which is noteworthy of remembering the great masters responsible for these masterpieces as shown in Picture 3a & 3b. Above the *Vedika* runs the frieze which has carvings of animal procession as shown in Picture 4, followed by another horizontal frieze of *keerthy mukha* motifs. The horizontal frieze of animal procession is also seen in Ettumanoor Mahadeva temple. Over the frieze are the *jalakas* (jālli windows) which let in diffused light and ventilation and vertical panels carved with scenes from puranas such as Krishna lila, Desavathara, Setubandanam, Ramayana and so on. Teak wood (*tectona grandis*) is used for the walls and rafters. Wood carvings on the wall form an excellent form of wood craft showcasing minute details of various scenes from puranas arranged in horizontal registers. Of all the decorative elements made of timber the *jalakas* (the pierced jālli screen) occupy the maximum space; other elements comprise of vertically aligned panels of *devakoshtas* as shown in Picture 5 and ornamental *kudyastambhas (pilasters).*

The *pranala* spouts out of the *adhishtāna* below the functional door of the northern wall for taking out the water used for ablution. The wall height is 1K-22A and the height of *adhishtāna* is1K-13$^{1}/_{2}$A. The eave projection of the roof is 1K-18.5A. The wall height is less than what is specified in the traditional canons and eave projection is more than the value specified in the traditional texts which helps in providing proper shade and protection of the walls. The sectional elevation is shown in Fig 1.The roof of the *srikovil* is pyramidal topped with copper tiles and has an eave projection of 128 cm (1K 18A). The pitch of the roof is 45^{o} and is crowned by a *thazhikakudam* (finial). The rafters are made of teak wood. The ends of the rafters rest on the *uttara* and the top end is fixed to the *Kūta*. All the rafters are joined to the *kūta* by means of mortise and tenon joint (*ajayuddha* or goat fight joint). The end grains of the rafters are protected with copper shoes to prevent the ingress of water because the end grains are the weak points of water access. Copper tiles are used for covering the roof which has been nailed to the teak wood planks. *Jāla* (additional piece of wood) is fixed to the eave end of the rafter, so that their eaves project almost horizontally from the face of the walls with slight and gradual curve which cuts off the straight down pour of water and makes it flow away from the structure. The fixing is done by means of mortise and tenon joint using six tenons (aru kuduma). The temple has four functional doors each one associated with wooden *dwarapalas* as shown in Picture 6. It is indeed a treasure of sculptural art in wood. The arrangement of panels and myriad of decorative elements bear close similarity with those of murals which was influenced more by the tradition of wood sculpture than any other sculptural art.

Relief carving, pierced carving and sculpturesque carvings are mainly seen in these wood crafts. The sculpturesque carving technique is used for carving figural motifs like *dwarapalas* which are seen on either side of the functional doors of the *srikovil*. The different motifs are carved out in the *thadiuttara* which is an additional wall plate into which the panels of wall are inserted. The walls of the *srikovil* are decorated with high relief and low relief carving technique. Pierced carving is employed for the jālli which is seen on the walls of the *srikovil* as shown in Picture 7. The technique of wood carving was inherited by the carpenters through oral tradition and perfected through practice and experience. This form of artistic carpentry (wood crafts) was well appreciated in architecture.

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Fig 3a Carvings on the wall (Scenes from epics)

Fig 3b Carvings on the wall (Scenes from epics)

Fig 4 Frieze above the vedika

Fig 5 Devakostha

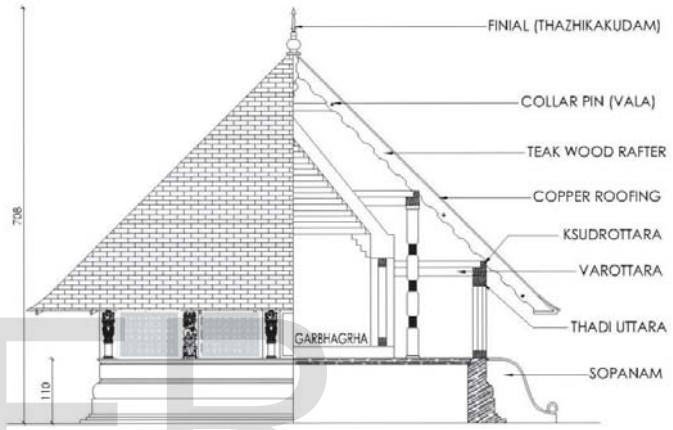

Fig 6 Sectional Elevation of Srikovil

Fig 7 Dwarapala

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Fig 8 Jālli screen

C. *Namaskāra mandapa*

The *Namaskāra mandapa* in front and facing the deity is square in plan of side 5K $21^1/_2$A (425cm). The *Mandapa* is used to offer *pranams* to the deity by the priests after rituals. It has a tiled pyramidal roof as shown in Fig 2. The roof rests on two rows of four granite columns towards the outer side and four granite columns towards the inside. It has a wooden ceiling which is not as ornate as is usually seen in other temples. The columns are raised on a granite *adhishtāna* of height 23A (70 cm).

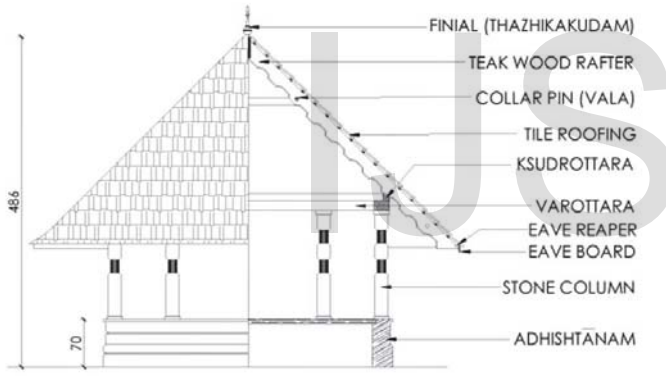

Fig 9 **Sectional** Elevation of Namaskāra mandapa

D. *Agramandapa*

The *agramandapa* of size 727cm x 406 cm is located in front of the *srikovil* which houses the *valia balikallu* forms the entry into the temple. The gable roof rests on sixteen granite pillars of size 20cm x 20cm on either side of the *mandapa*. It has a wooden trellis wall all around which lets in diffused light and ventilation.

E. *Dwaja stambha*

The *dwaja stambha* (flag mast) made of teak wood covered with copper is located in front of the *agramandapa* with a *garuda* on top which is the icon of Vishnu temples. The copper covering is in the form of ribs of the vertebral column.

III. JĪRNODHARANA (RENOVATION)

The concept of *Jīrnodharana* (renovation) has been mentioned in the traditional canons of temple architecture like Prayogamanjari between 10th and 11th century(Ravi Namboodhiri, 21st patala), Isanasivagurudeva paddhati 11th century (Isanasivaguru, 64th patala), Mayamata (Mayamuni, 35th patala), Tantrasamuccayam 15th century (Chēnnās Nārāyanan Namboodhiri, 11th patala), and Silparatna 16th century (Srikumara, Part II, 29th patala). '*Jirna'* means decayed and '*uddharana*' means uplifting.

The process of *Jīrnodhārana* has been mentioned in Tantrasamuccaya and Silparatna the traditional treatise of Kerala temple architecture**.** The process explains about decayed *prāsāda* and idols. If *prāsāda* is destroyed or deteriorated by fire or the idol has been broken, then a new grha is to be constructed. The materials used earlier like stone, wood have to be used for *Jīrnodhārana*. The shape and decoration should be like the previous. The perimeter and height has to be maintained as before. While joining wood pieces especially the new should be joined to the new and old should be joined the old. Old and new should not be combined which is not a good practice. Isanasivagurudevapaddathi also mentions the same principles of renovation. So it can be observed that the concept of *jīrnodharana* mentioned in all the traditional canons is the same.

IV. MODERN PRESERVATION PRINCIPLES

The international community like ICOMOS has framed universally applicable principles and practices for the protection and preservation of historic timber buildings. It states that all interventions which carried out should be reversible and follow traditional methods. The moisture content and other physical characteristics of the replaced timber should be compatible with the existing structure. Craftsmanship and construction technology, including the use of dressing tools or machinery, should, where possible, agree with those used originally. Nails and other secondary materials should duplicate the originals where ever possible. The new members or parts of members should be identifiable from the existing ones but should not stand out. Appropriate traditional or well-tested modern methods may be used to match the patina of old and the new with due regard that this will not harm or degrade the surface of the wooden member. New

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members or parts of members should be discretely marked, by carving, by marks burnt into the wood or by other methods, so that they can be identified later. The removed members and other component of the historic structure should be catalogued and the characteristic samples kept in permanent storage as a part of the documentation.

V. Assessing the Decay Hazard and Equilibrium Moisture Content

The Climate index (decay hazard) of Alappuzha was assessed based on the obtained data. The data collected include daily rainfall minimum and maximum temperature and relative humidity for a period from 1991 to 2012. The Climate index for the particular place was calculated to assess the possibility of decay due to deleterious effects of climate. The above ground decay hazard was estimated by combining rainfall and average monthly temperature and to calculate the Climate index for a given site (Scheffer 1971). The Climate index calculated for Alappuzha was compared with the climate index map for decay hazard prepared by US climatic data centre, which states that the Climate index above 65 is considered to be most conducive to decay risk, an important consideration when wood products are used where they may get wet. The higher the risk of decay, shorter the expected service life for a given wood product.

The Climate index value may be expressed as:-

$$Index = \sum_{Jan}^{Dec}[(T-2)(D-3)]/16.7 \quad (1)$$

T is mean monthly average temperature (expressed in °C)

D is mean number of days per month with 0.25 mm or more of precipitation, and $(T-2) = 0$ if $T < 2$.

By calculating the Climate index for the past 22 years of Alappuzha as per Equation (1), it is noticed that the average Climate index is 190.37 and ranges between 164 and 230 as shown in Table1 and Fig3.

Table 1 Climate Index of Alappuzha

Year	Index	Year	Index	Year	Index
1991	191.79	1999	193.08	2007	188.96
1992	187.68	2000	177.14	2008	193.67
1993	207.59	2001	176.82	2009	184.96
1994	209.08	2002	173.42	2010	215.32
1995	204.88	2003	171.01	2011	171.07
1996	204.42	2004	182.56	2012	164.18
1997	190.13	2005	194.43		
1998	229.23	2006	176.89		

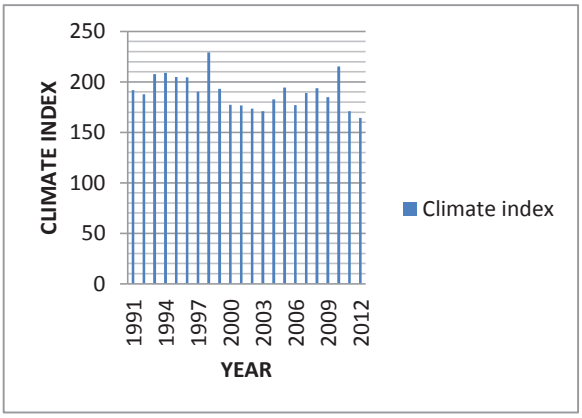

Fig 10 Climate Index of Alappuzha

The moisture content of wood below the fiber saturation point depends on both relative humidity and temperature of the surrounding air. Equilibrium moisture content (EMC) is defined as that moisture content at which the wood is neither gaining nor losing moisture and an equilibrium condition has been reached. If the moisture content is above 20% there is chance for fungal decay. The equilibrium moisture content for Alappuzha districts was assessed.

The moisture content for a particular area was also determined to assess the vulnerability of wood to decay.

$$EMC\% = \frac{1800}{W}\left[\frac{Kh}{1-Kh} + \frac{K_1Kh + 2K_1K_2Kx^2h^2}{1+K_1Kh+K_1K_2K^2h^2}\right] \quad (2)$$

Where h is relative humidity(%/100), and M is moisture content(%)

W, K, $K1$, and $K2$ depend on temperature:

For Temperature T in celcius,

$$W = 349 + 1.29T + 0.0135T^2$$

$$K = 0.805 + 0.000736T - 0.00000273T^2$$

$$K_1 = 6.27 - 0.00938T - 0.000303T^2$$

$$K_2 = 1.91 + 0.0407T - 0.000293T^2$$

Moisture content of wood in equilibrium for Alappuzha (EMC) is calculated as per Equation(2).

h= 91.5/100=0.92

T=26° C

EMC% = 21.4

EMC is above 20%

The value obtained is above 20%, which is not in the safe limits. So it could be inferred that Alappuzha is susceptible to fungal decay

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VI. RENOVATION OF THE TEMPLE

The Narasimhamoorthy temple which has stood for more than 500 years underwent its renovation in 2007 under the supervision of the Archaeology department. The temple did not have a conservation plan. There was no documented history of the temple. The plan of the temple prepared by the author is shown in Fig 4. The *srikovil* and the *namaskāra mandapam* did not undergo any changes except for cleaning and painting works. The elaborate carvings on the teak wood (*tectona grandis*) walls of the *srikovil* were coated with clear varnish which camouflages the original texture of teak. A railing in steel was constructed around the *srikovil* to protect the structure from vandalism which does not blend with the surroundings. The Ladies are not allowed to enter the *chuttambalam*. But the author got the opportunity to enter the temple and witness the renovation. The broken tiles initiated the seepage of water into the structure. The rafters and the beams were decayed by termite attack as shown in Picture 8, were replaced with the new (Picture 9). The end grains of the rafters which were not protected by the *thoovanphalaka* (eave boards) were a decayed by the attack of fungi. The decay caused by weathering also has accelerated the decay. The tiles and the decayed rafters were replaced with new. Microscopic testing of wood samples were not conducted prior to conservation work and the extant carpenters were not able to judge the species of wood correctly which has led to the wrong decision of choosing thembavu (*terminalia tomentosa*) as the new wood for replacement and repair. The old wood used was identified as Jackwood (*artocarpus heterophyllus)* by the author by testing in the wood science laboratory. The Jack wood rafters have been replaced with thembavu. The eave reapers which had undergone decay were replaced. The eave boards and the broken tiles were replaced as shown in Picture 10. The beams which were decayed were also replaced with new. The size of the members have been maintained the same as the previous. The size of the rafters is 4.5cm x 20 cm. The spacing between the rafters is 75 cm. The *koti* (hip rafter) is 27cmx7cm. The *uttara* (wall plate) is of size 20cm x 8.5cm and the *chuttuttara* (minor uttara) is of size 9cm x 5cm. The *kila* (wedge) with which it is fixed is of size 20cm x 5.5cm x 2cm. The *thuvana palaka* (eave board) were also replaced which is of size 16.5cm x 2 cm. The new rafters have been numbered and marked. The jointing technique used for the fixing of the new eave reapers does not match with the traditional joints of the old. The new *jala* fixed on top of the old rafter is shown in Picture 11. The use of new species of wood for the repair of members by replacing the old is against the canons of *jīrnodharana* mentioned in the traditional treatise. The identity and authenticity of the object is lost by the use of new species of wood. The replacement of decayed wood with a new specie wood was also against the conservation practice of the international preservation community ICOMOS and ICCROM which supports the use of existing materials. By using different specie the identity of the object is lost. The identity of the building is related to the substance acquired through its history. As far as possible it should be replaced with the wood of same species. The authenticity of its substance has to be maintained. The eave boards and the tiles were replaced. The beams which were decayed were also replaced. The beauty of the building is not only related to its form but to the 'patina' of its materials. The new timber used stands out from the old timber members. The *namaskāra mandapa* which was destroyed in a mishap was reconstructed in front of the Ganesha shrine outside the *chuttambalam*. The new *kuta* construction is shown in Picture 12**.** Anti-termite treatment is done for the *agramandapa* and the *gopura*. The size of the wooden members was retained. The black colour of the *balikallu* (offering stone) is maintained by applying sesame oil mixed with roasted powdered sesame seeds which retains the traditional practice. The same traditional technique could have been used for the foundation of the srikovil instead of painting it with black cement paint. The white stains which had occurred on the ornamental timber ceiling of the *gopura* due to water seepage as seen in Picture 13 were cleaned with a brush and clear varnish was applied on the ceiling as shown in Picture 14. *adhishtāna* was painted with black cement paint. The renovation was carried out only on the *chuttambalam* and the ancillary structures which had shown signs of decay. The work was done on contract basis by inviting tenders and following the usual contract procedure. The decay of wood was mainly seen in the *chuttambalam.* The documentation of the *chuttambalam* was carried out prior to the renovation work. *Chuttambalam* is a quadrangle with a *sala* type tiled roof construction surrounding the *srikovil*. It houses the *thidapally* (kitchen) where the food is cooked for offering the deity, the *mulayara* (room for germinating seeds for pujas and occasions).

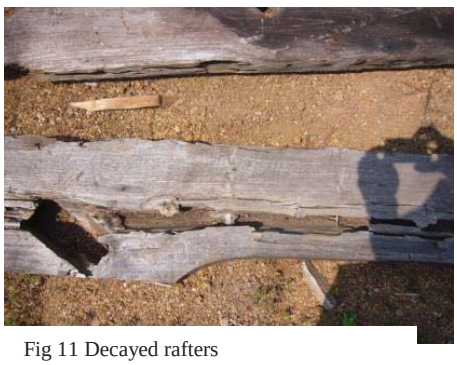

Fig 11 Decayed rafters

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Fig 15 Kuta construcion -Namaskāra mandapa

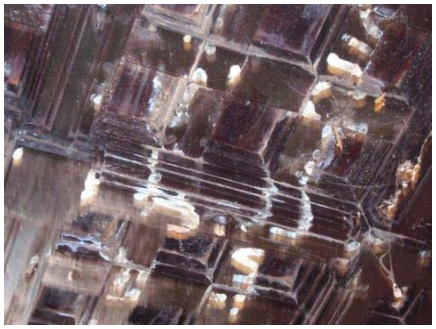

Fig 12 Decayed Beams being Replaced with New

Fig `6 Ceiling of Gopura before Renovation

Fig 13 Old Tiles replaced with new

Fig 17 Ceiling of Gopura after Renovation

Fig 14 New *Jāla* fixed to the old rafter

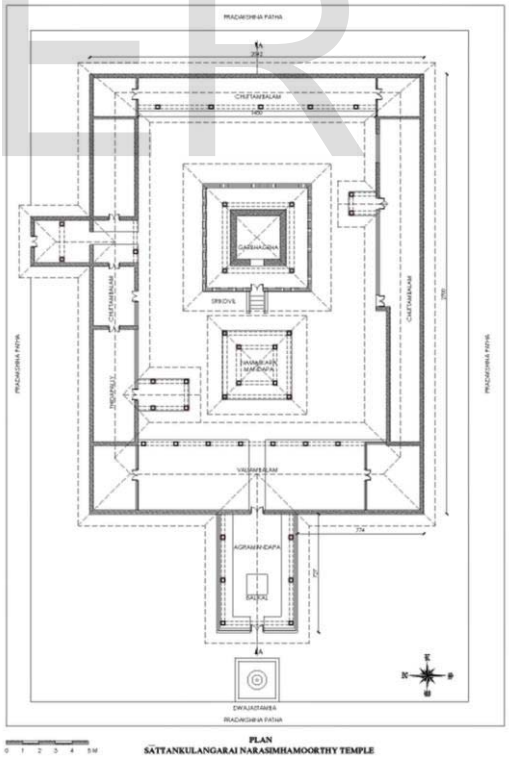

Fig 18 Plan(author generated)

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VII. CONCLUSIONS

The renovation of temple does not strictly adhere to the traditional practices. The traditional preservation techniques, recommends the use of the same species of wood, traditional jointing techniques and even the same traditional tools used for dressing of the material. The new wood used is more identifiable and noticeable and is not in harmony with old. Artificial patina which is a phenomenon followed worldwide and the traditional methods followed in Horyuji temple in Japan can be a solution. It is also recommendable to use second hand timbers of the same specie for repair which has undergone aging in the same pattern as the old. The international preservation community (ICOMOS and ICCROM) also recommends the use of the same material. It is an accepted fact that it is very difficult to follow all the traditional methods of repair in the modern industrial society, but some of the possible methods could be adopted. The coating of varnish applied on the elaborate wood carvings of the *srikovil* has to be removed. The temple should be preserved as far as possible in the way it was handed over to us through history and the material authenticity which is acquired through history has to be retained. It is our duty to rediscover the traditional preservation methods and construction techniques used in temples.

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