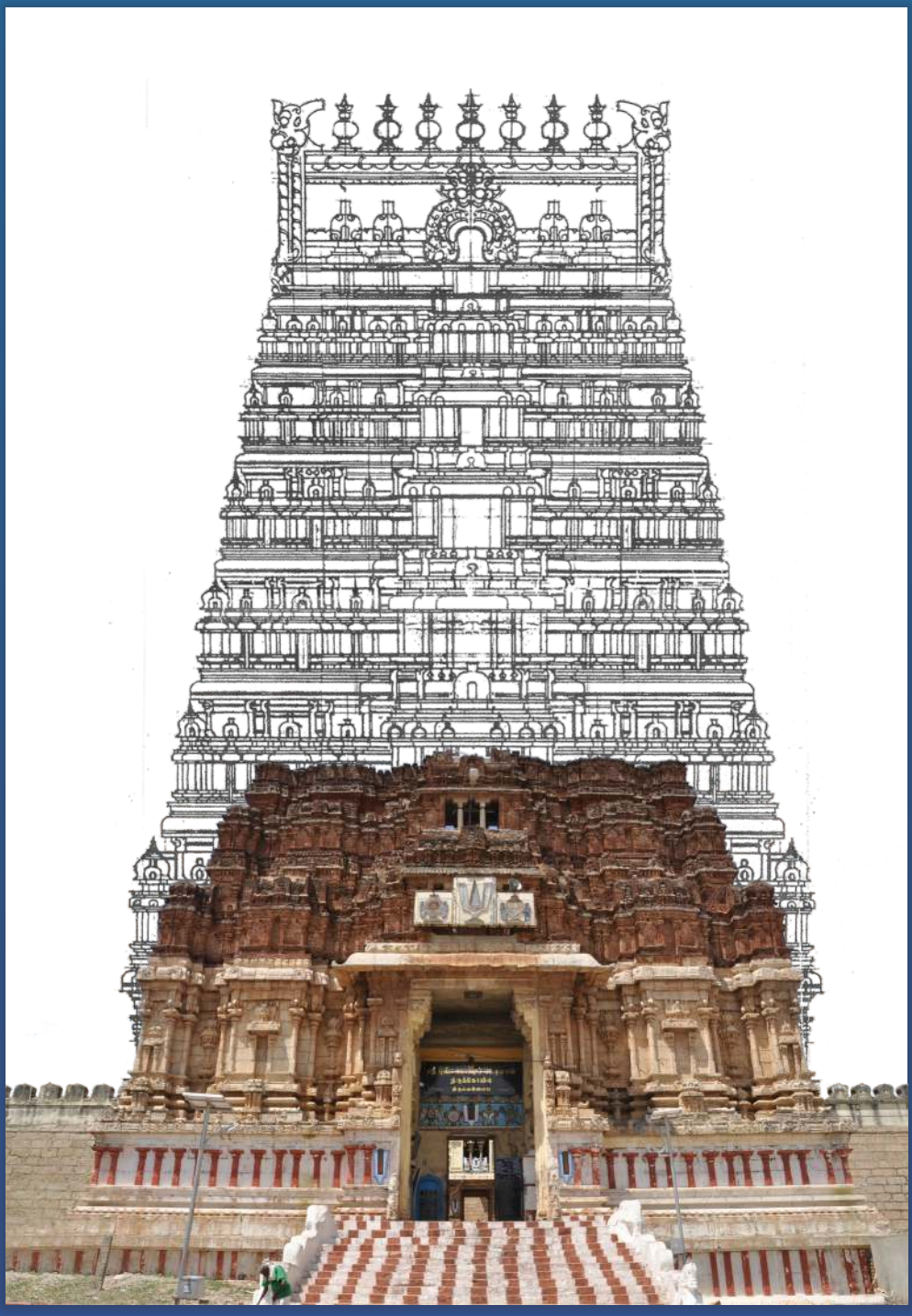
Arulmighu Shree Pundarikatcha Perumal Thirukoil
RajaGopura Thiruppani

15 December 2016

REPORT - 1



THIRUPPANI DONORS

Shri V S Jayabal M.Tech **Dr S Velumani M.D**

Computer generated view of the RajaGopuram is shown in comparison with the existing RajaGopuram

ARULMIGHU THIRU PUNDARIKATCHA PERUMAL THIRUKOIL
RAJAGOPURA THIRUPPANI - FINAL REPORT
15 December 2016

REPORT - 1

SUBMITTED

TO

The Secretary
Department of Information and Public Relations
Government of Tamilnadu, Chennai

The Commissioner
Hindu Religious and Charitable Endowment
Government of Tamilnadu, Chennai

ADC Thiruppani
Hindu Religious and Charitable Endowment
Government of Tamilnadu, Chennai

The Joint Commissioner
Sri Ranganatha Swamy Thirukoil
Srirangam

BY

Shri V S Jayabal M.Tech **Dr S Velumani M.D**

DONORS TO THE
ARULMIGHU THIRU PUNDARIKATCHA PERUMAL THIRUKOIL
RAJAGOPURA THIRUPPANI

CONTENTS

1. INTRODUCTION

The unfinished Rajagopuram at the northern entrance has been an eye sore and deep disappointment to the thousands of pilgrims visiting the temple in the last several hundred years.
With the blessings of

SRI PUNDARIKATCHA PERUMAL,
GODDESS PANKAJAVALLI THAYAR,
ALWARGAL, ACHARAYARGAL,
STHALA ACHARYA PURUSHARGAL,
BUTTERGAL, PANDARIKAL and
SRIVAISHNAVARGAL

We [shri V S Jayabal, DR S Velumani and all our family members] were drawn in to reconstruct the rajagopuram for reasons best known to

PERUMAL AND THAYAR.

With our earnest prayers to the DIVINE COUPLE seeking their blessings,
we proceed with the work.

2. TEMPLE HISTORY

The Pundarikatcha Perumal temple at Thiruvellarai, a small village 17 kilometers from Srirangam, is one of the oldest Shri Vaishnava temples dating back to the Thretha Yuga and pre RAMA and Dasaratha period. Known as NEELIKAVANAM in those days, SRIMAN NARAYANA appeared before King Sibi as VARAHA Moorthy and later gave dharsan as PUNDARIKATCHA PERUMAL to MAHALAKSHMI THAYAR, Rishi Markandaya and King Sibi. The temple was constructed by King Sibi in Thretha Yuga who also brought 3700 vedic pundits from his UNDHERVEDHI kingdom [the present Kashmir and Gangetic plains] for the daily, weekly, fortnightly, monthly and annual poojas and festivals. Since then multiple prakarams were added. As on today it is a pancha prakara chethra [temple with five prakarams] with 16 sannadhis and 5 theerthas [holy lakes].

Aerial view of the third prakaram

3. TEMPLE PLAN

Thiru Pundarikatcha Perumal temple in Thiruvellarai has five prakarams and hence called pancha prakara chetra. The main sanctum sanctorum where Pundarikatcha Perumal gives dharsan is surrounded by first prakaram. From the second prakaram we have to ascend 24 steps through either utharayana or dhakshinayana entrance, as per the utharayana or dhakshinayana periods, to reach the sanctum santorum.

Thayar sannidhi, Dasavadhara sannidhi, Garudalwar sannidhi, Uyakondar sannadhi, Engal alwan sannidhi, Chakkarathalwar sannidhi, Lakshmi Narasimhar sannidhi, Andal sannidhi, Periyalwar sannidhi, Anjanayar sannidhi, Nammalwar sannidhi are present in the third prakaram.

The fourth prakaram houses the Manavala Mamunigal sannidhi and Ramanujar sannidhi is present in the fifth prakaram. The fourth prakaram is surrounded on both inner and outer sides by majestic compound walls, measuring as high as 50 to 60 feet in height.
The proposed Rajagopuram is in the center of the northern compound between fourth and fifth prakarams.

The towers that surmounts the sanctum is generally called the VIMANA and the towers on the outer walls or the vestibules are called the GOPURAM. Gopurams and Vimanams speak about the artistic development of our culture over a long period of time. Built to be viewed from a distance, each Gopuram tells us a story by itself.

The base of the existing Rajagopuram in Thiruvellarai is a one storeyed stone structure. Above this stands two storeyed brick super structure. When completed this Rajagopuram will have seven storeys and will be nearly 110 feet in height.

Existing Gopuram in the Northern Entrance

4. DETAILS OF THE PRELIMINARY WORK DONE

19th February 2014

We submitted the application form to the Commissioner, Hindu Religious and Charitable Endowment Department for permission to complete the incomplete Rajagopuram. Shri Dhanabal the then Commissioner guided us to the do the construction with ancient lime mortar and not with the present day cement mortar.

Shri V S Jayabal, being an Indian Institute of Technology - IIT - Madras alumni, with his national and global contacts got in touch with IIT - Madras the very next day.
Dr Devadas Menon and in particular Dr Arun Menon of the structural engineering department readily agreed to help and guide us technically as they felt an opportunity of this magnitude, in terms of length, breadth and height of an existing structure to be built with lime mortar technology, is unlikely to be available in the near future.

Since then Dr Arun Menon an UNESCO consultant and coordinator of the National Center for Safety of Heritage Structures – NCSHS - took an extraordinary interest, has visited Thiruvellarai a few times with his team members to study the Rajagopuram in multiple dimensions namely

- CONDITION MAPPING
- TOTAL STATION SURVEY – TOPOGRAPHY/CONTOURS
- GPR AND TRIAL PITS
- RADAR SURVEY ON STONE MASONARY AND BRICK MASONARY
- CORE DRILLING THROUGH STONE MASONARY AND BRICK MASONARY
- COMPRESSION STRENGTH TEST ON EXTRACTED MATERIALS
- CHARACTERISATION OF LIME MORTAR
- STRUCTURAL ANALYSIS AND ASSESMENT

and gave recommendations on

- RIGID FLOORS /TYING,
- GROUTING OF KALKARAM,
- STRUCTURAL HEALTH MONITORING AND
- QUALITY CONTROL ON MATERIAL SAMPLES

The final IIT - Madras report is enclosed in the enclosure (Page No. 26)

August 2014

The structural engineering team from the National Institute of Technology Trichy has studied and submitted their report which is enclosed in the enclosure (Page No. 83)

January 2015

Shri Kannan the then Secretary to Department of Information and Public Relations and Shri K T Narasimhan, archaeological consultant to the Tamilnadu Government, has made a site inspection and presented their reports enclosed in the enclosure (Page No. 94)

July 2015

The Chief Sthapathy Tamilnadu government has inspected and his report is with the HRCE department. A signed copy of the Rajagopuram drawing is enclosed in the enclosure (Page No. 98)

December 2015

The HRCE Department gave a conditional approval to the Rajagopuram construction i.e. the gopuram may be constructed after obtaining the clearance from the IIT - Madras. A copy of the order is enclosed in the enclosure (Page No. 99)

May 2016

A Memorandum of Understanding was signed between Sri Pundarikatcha Perumal Rajagopura Thiruppani Committee and National Center for Safety of Heritage Structures NCSHS and Indian Institute of Technology, Madras. A copy of the MOU is enclosed in the enclosure (Page No. 101)

June 2016

An interim report has been submitted by us.

October 2016

This the final report with all necessary details are submitted

4th PRAKARAM BEFORE RENOVATION

Three years earlier the fourth prakaram was full of unwanted and harmful thorny plants and bushes. There were also trees particularly close to the compound wall damaging the foundation. Due to the dense plants and trees the prakaram was infiltrated with ants and insects some which were even poisonous, with the result the devotees did not go round the fourth prakaram.

East prakaram - Before renovation

East prakaram - Before renovation

4TH PRAKARAM AFTER RENOVATION

The trees and bushes close to the outer compound were removed, nicely filled with good soil and covered with granite for a width of four to five feet giving an excellent plinth protection.

16 feet width and nearly 2,000 feet long pradhachnam / walking passage was laid alround the fourth prakaram. The floor of the above passage was made of unpolished granite slabs measuring approximately 6 to 7 feet long, 2½ to 3 feet width and 3 to 4 inch thickness so that the devotees can go round the temple. On both side of the passage 18 inches width seating arrangements were made in a continuous manner so that the sevarthees either can sit and relax or can have a short nap.

South east prakaram - Before renovation

South east prakaram - After renovation

West prakaram - Before renovation

West prakaram - After renovation

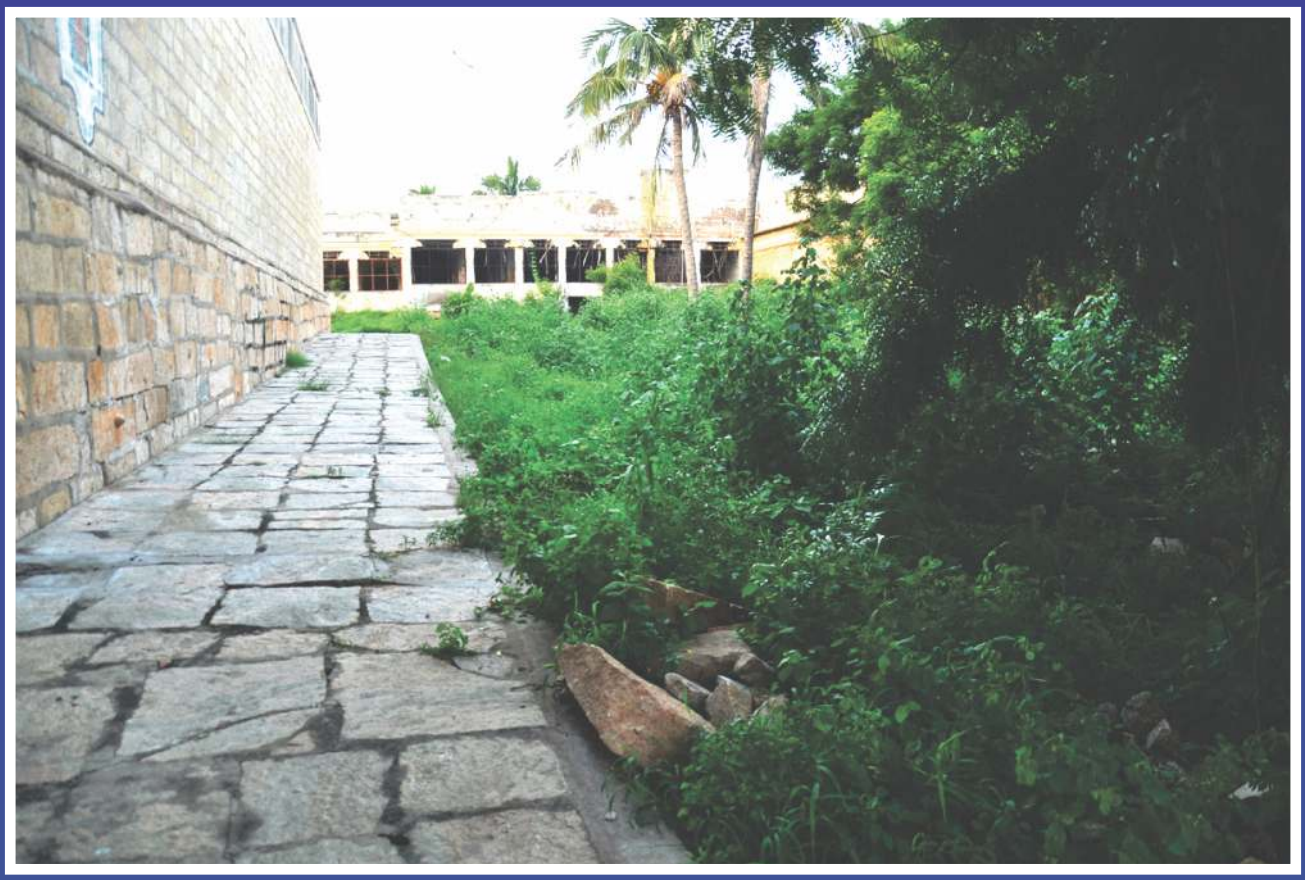
South west prakaram - Before renovation

South west prakaram - After renovation

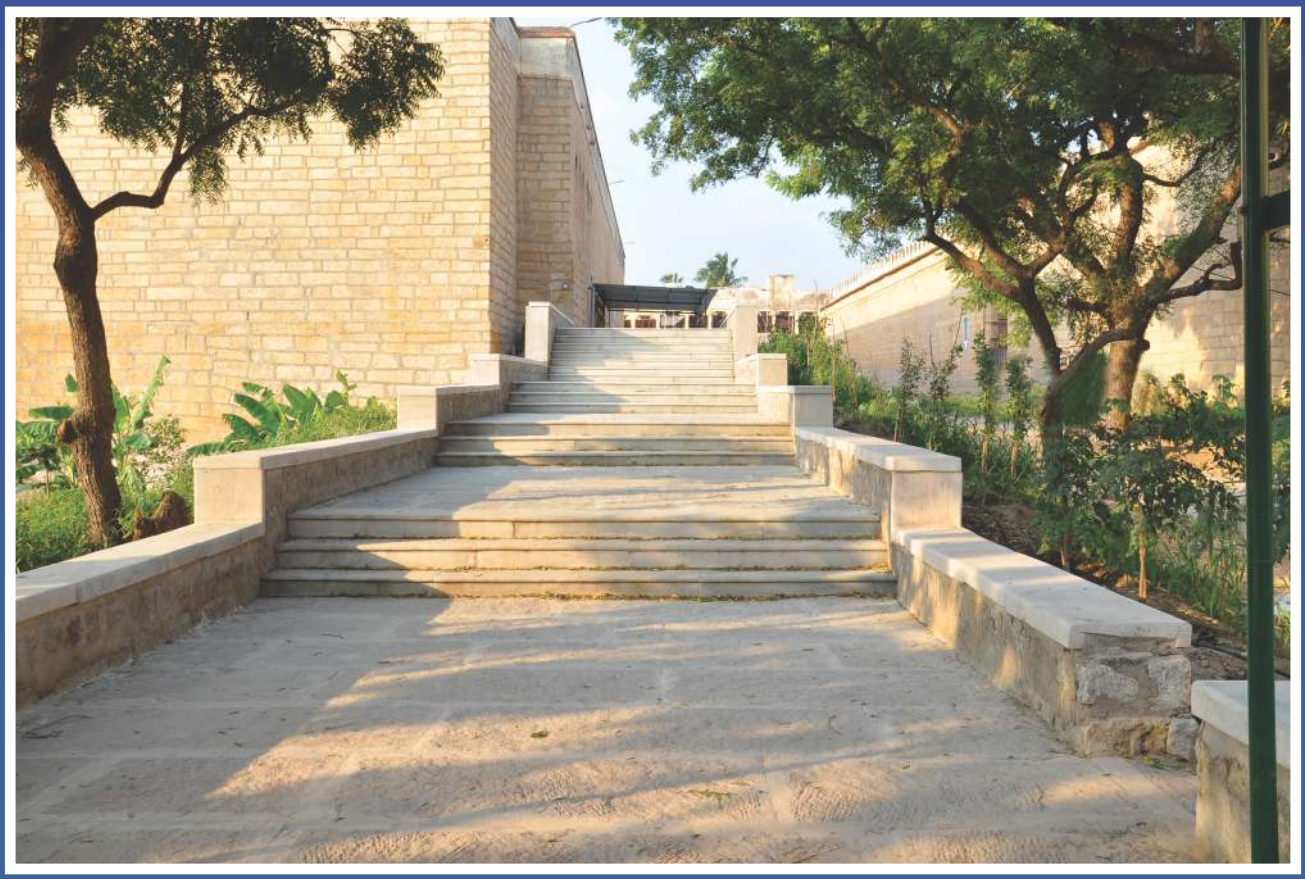
North prakaram - Before renovation

North prakaram - During renovation

North prakaram - After renovation



East prakaram - Before renovation



East prakaram - After renovation

600 to 700 multiple varieties of shade giving and fruit bearing trees like ficus benghalensis [indian banyan], ficus religiosa [arasa maram], ficus racemosa [atthi maram], bassia latifolia [illuppai maram], callophyllum inophyllum [punnai maram], coconut tree[thennai maram], syzygium cumini[naval maram] mangifera indica [mamaram], aegle marmelos [vilva maram], terminalia catappa- indian almond [badam maram] etc And
nearly 2000 plants belonging to Ocimum tenuiflorum, holy basil [thulasi], East indian rosebay, tabernaemontena divaricata[nandhia vattam], Nothapodytes nimmoniana [arali], Jasminum sembac [malligai poo], Mimusops elengi [maghilamboo], Nyctanthes tristis [pavalamalli] which can be used for daily poojas were planted.

Vilva maram, sthala virucham, was planted in a specially erected ornamental stone cubicle.

All these are maintained by two specially trained gardeners one for trees maintenance and the other for collecting the thulasi leaves and flowers for daily poojas in the temple, both the persons financially supported by the gopuram donors.

Thiruvellarai is basically a dry place and keeping this in mind extensive arrangements were made for rain water harvesting. Not a single drop of rain water falling anywhere in the first four prakarams are wasted, all are collected and diverted to various places in the fourth prakaram so that the entire temple complex sub soil is recharged with rain water. In addition drip irrigation and sprinkler systems are erected for better water management especially in summer months.

A Pushkarini approximately 60 feet x 35 feet dimensions in the north east corner and a Ghosala to maintain and grow culturally and religiously important traditional cows are in the pipeline. There is a proposed plan to make panchakavyam form the milk, curd, ghee, urine and cowdung of the traditional cows which is yet to be approved.

The hitherto unused east and west entrances were cleaned, stone passages were laid and ready for use by pilgrims once the north entrance is closed for the gopuram work. Further the pilgrims can go round the temple in a pradhachnam [clockwise direction] all because of the extensive work undertaken in the last three years in the fourth prakaram.

All the above works are a prelude to the gopura thiruppani which is of a broader scope and higher importance.

Traditional lime mortar preparing arrangement in process

Picture of the bricks with measurements

5. RAJAGOPURAM RENOVATION

LIME MORTAR

Lime is produced by burning limestone [Calcium Carbonate Ca Co_3] in a kiln at temperature > 850° C, which drives of CO_2 held within lime to produce Calcium oxide CaO, a highly reactive solid named quicklime. CaO on contact with water reacts exothermically to produce slaked lime [Ca $\{OH\}_2$] or hydrated lime or lime putty. Lime putty has to be sieved to remove any unburnt/unslaked particles which has not reacted or overburnt as these will not carbonate properly. This gradually takes up CO_2 from air and changes back to Ca Co_3, a setting known as carbonation. Lime putty mixed with sand makes lime mortar. This then hardens into an artificial stone made up of grains of sand embedded in a mass of $CaCo_3$.

We plan to purchase Lime stone from pollachi. It will be broken down, sprinkled with water, powdered, and filtered to remove unwanted/unburnt stones or particles. The resultant powder like lime is mixed with sand at a ratio of one part lime and three parts filtered sand, grinded and mixed in a rotating grinding stone driven by a motor and gear system at a controlled speed and stored for 10 to 15 days. Later they are regrinded and mixed with aloe vera – cactus - stem soaked water and vilva [Aegel Marmelos] fruits and will be taken up for construction work. Lime mortar will be prepared in the traditional way for which the construction of necessary structures are in progress as shown in page no. 22.

WATER

The Cauvery river water will be used for lime mortar preparation and other related construction activities.

BRICKS

Bricks are specially manufactured in Coimbatore at predetermined dimensions - length, width and breath – for use. Unlike the present day bricks, the bricks manufactured as above with smaller dimensions have better mechanical properties and higher compressive strength as is evident from the enclosed brick testing report in page no. 106. Strength testing will be done for randomly selected bricks in each lot. A picture of the bricks showing various dimensions is shown in page no. 22

ENGINEERING CONSULTANT

Dr. Arun Menon, a doctorate from the University of Pavia, is at present Assistant Professor of Structural Engineering at the Civil Engineering Department, Indian Institute of Technology - IIT - Madras. Known for his wonderful work in restoration of heritage structures notionally and internationally, Dr. Arun Menon is coordinating the efforts of National Center for Safety of Heritage Structures - NCSHS - IIT - Madras. He is a member of International Council On Monuments and Sites – ICOMOS – and an UNESCO consultant. His biodata is enclosed in the enclosure (Page No. 109)

STHAPATHI

Shri. Kumaragurubaran, a well known and TN HRCE department approved sthapathi, hails from a traditional family of well informed sthapathies in the last few generations. His deep involvement in the given job, his knowledge of the silpa sashtras, high skills level in lime mortar work, his nearly 50 dedicated team members knowledgeable in gopuram construction especially with lime mortar have made us chose him as our sthapathi and we have formed an agreement with him. A copy of the agreement and a copy of his biodata are enclosed in the enclosure (Page Nos. 110 and 114 respectively)

QUALITY MAINTENANCE SERVICES

At pre-determined intervals as per the IIT - Madras guidelines, quality check will be done on the raw materials and reports will be sent to IIT - Madras for their scrutiny and guidance.

LIGHTNING ARRESTER

We plan to install a state of the art lightning arrester which is capable of recording even a mild apparently unharmful lightning strike. It also has the capacity to record lightning strikes of varying intensities.

ENCLOSURES

6.1 IIT - MADRAS FINAL REPORT

National Centre for Safety of Heritage Structures
Department of Civil Engineering, IIT Madras, Chennai – 600 036

TITLE:	**Summary of Findings** **Structural Feasibility of Adding of Additional Floors in Raja Gopuram**
PROJECT:	**Restoration of Raja Gopuram** **Sri Pundarikatcha Perumal Thirukovil, Thiruvellarai**
PREPARED FOR:	(1) Sri Pundarikatcha Perumal Rajagopura Thiruppani Committee (2) Commissioner, Department of HR&CE, Government of TN
REFERENCE:	(1) TN No.: 1719/1414 T5 dated 15.12.2015 (2) Letter received from Joint Commissioner, Srirangam Department of HR&CE, Government of TN (3) MoU between IIT Madras and SPPRTC dated 31 May 2016
SITE VISITS ON:	01 May 2014, 11-12 September 2015, and 31 October 2015
VISITED & REPORT BY:	Arun Menon, Satyadhrik Sharma, Hareesh Haridasan Shibu Samson, Elesh Lakhani, Namitha Chacko

I. PREFACE:

Mr. V.S. Jayabal and his family members, representing the Sri Pundarikatcha Perumal Rajagopura Thiruppani Committee (SPPRTC), intend to complete the hitherto incomplete Rajagopuram with two tiers in Sri Pundarikatcha Perumal Temple in Thiruvellarai to a seven-tiered Rajagopuram. In this connection, SPPRTC had approached IIT Madras on 20th February, 2014 for guidance them in the construction of the Rajagopuram using traditional technology, assisted by modern tools for structural diagnosis and material testing. In the last two years, IIT Madras has been conducting basic investigations such as condition mapping and assessment, including core cutting and strength evaluation, geotechnical studies including soil testing at different depths, etc. to ascertain foundation stability and structural stability of the existing two tiers. The Department for Tourism, Culture and Religious Endowments, Tamil Nadu in their order no.: 266 dated 19.11.2015 has given the conditional approval to construct the Rajagopuram subject to the IIT Madras clearance.

The current document provides a summary of the technical investigations that have been carried out by IIT Madras, through the agency of NCSHS The significant findings of the study on the feasibility of construction of the new floors are reported here. The document also provides an overview of the technical recommendations for the project.

II. METHODOLOGY OF STUDY

The current section provides an overview of the methodology followed for the structural and geotechnical investigations aimed at assessing the feasibility of additional floors in the Rajagopuram.

(1) **Topographical Survey:**
A total station survey of the site, and specifically the area where the structure is situated to develop a topographical survey map at 1:400 scale. This component of the work was a feeder to the current study, and was executed by an external agency. The total station survey also provided the coordinates of the existing structure. This information was used to verify the existing drawings of the structure.

(2) **Condition Mapping:**
The existing condition of the incomplete Rajagopuram was documented with the aim of recording the existing structural distress and material deterioration, and past additions or interventions. For details, refer to *Plates* in *Appendix-1: P1-P3, E1-E3 and PP1.* The structure does not show any signs of severe structural distress, except in the stone beams inside the

structure, on either side of the walkway, and at the two levels within the *kalkaram*. The damaged stone beams have been supported by brick walls introduced later. The damaged stone beams require replacement.

(3) Ground Penetrating Radar Survey and Foundation Trial Pits:

The details of the soil bearing capacity and standard characteristics of the soil were available through previous investigations conducted by the SPPRTC through the agency of NIT, Tiruchirappalli. In the study by IIT Madras, with the information from the contour mapping from the topographical survey, trial pits executed on the northern and southern sides of the structure, and Ground Penetrating Radar (GPR) surveys executed at the site, it became evident that the structure was completely founded on the bedrock. The deduced cross-sectional profile of the structure is reported in *Plate E3* in *Appendex-1*. The GPR sections are also reported here, which were calibrated with the information from the two trial pits.

(4) Radar Survey on Stone Masonry and Brick Masonry:

Radar surveys were conducted on the stone masonry load-bearing walls of the *kalkaram* and the brick masonry load-bearing walls of the upper levels. These load-bearing walls are typically three-leaf constructions with weaker core material. The radar survey was used to estimate the thickness of the outer leaf of the walls before carrying out any extraction of material from the walls for laboratory testing.

(5) Wall Morphology Reconstruction:

A essential constituent of the structural studies is the morphology of the load-bearing walls of the structure, both in terms of configuration and residual strength. Cores were extracted from the load-bearing walls in both the stone masonry level and the brick masonry levels. These cores provided an indication of the thickness of the outer leaves of the three-leaf masonry and also provided an opportunity to examine the quality of the masonry across the load-bearing cross section. Details of the five (5) cores through the stone masonry walls and the three (3) cores through the brick masonry walls are reported in *Plates* in *Appendix-2*.

(6) Compressive Strength Tests on Extracted Materials:

Compressive strength tests were conducted on the granite cores extracted from the stone masonry walls and on the four (4) brick masonry wallettes extracted from the upper brick masonry levels. A summary of the test results are reported here. This information formed a critical input to the structural analysis of the Rajagopuram.

Table 1: Direct compression test results under dry condition

S. No.	Designation	h/d ratio	Failure Load (kN)	*h* (mm)	*d* (mm)	Mass (grams)	f_c (MPa)	Corrected f_c as per IS 1121 p.1 - 1974 (MPa)
1	D1	1	12.6	25	24.5	31	26.73	26.73
2	D2		5.7	25	24.5	29	12.09	12.09
3	D3		18.1	25	24.5	30	38.39	38.39
4	D4	2	13.9	50	24.5	58	29.48	33.25
5	D5		24.1	50	24.5	59	51.12	57.65
6	D6		16.9	50	24.5	56	35.85	40.42
Average Ultimate Compressive Stress *excluding D2* **(MPa)**								**39.28**
Standard Deviation *excluding D2* **(MPa)**								**11.55**

Table 2: Compression test results on brick masonry wallettes

S. No.	Ultimate compressive stress, F_m (MPa)	H/t ratio	Correction factor as per IS 1905 - 1987 (MPa)	Corrected F_m (MPa)
1	2.62	2.8125	0.8375	2.19
2	1.6	2.5000	0.8000	1.28
3	3.46	3.6360	0.9208	3.19
Average Ultimate Compressive Stress (MPa)				**2.22**
Standard Deviation (MPa)				**0.95**

(7) Characterisation of Lime Mortar:

In a parallel study at IIT Madras, the original lime mortar from the structure has been characterised to determine the constituents, and provide prescriptions for the new mortar to be used in the restoration works. The test results on the lime mortar are beyond the scope of the current document.

(8) Structural Analysis and Assessment

A structural model of the Rajagopuram was developed to study the behaviour of the existing structure and the expected response with the addition of the proposed floors to complete the structure. A non-linear finite element 3D model of the structure was developed, as shown in the figure below, with parametric study including the range of material strengths, presence and strength of core material (or infill) in the three-leaf masonry walls, thickness of the outer leaves of the three-leaf masonry and presence of a rigid floor diaphragm. The model was studied under gravity forces and lateral forces induced by wind and earthquake. Details of the different configurations considered and results of the analyses are reported in *Appendix-3*.

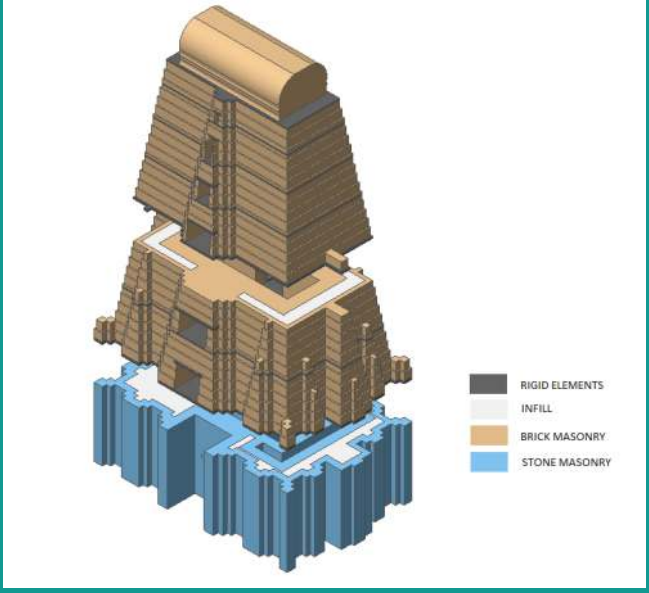


Figure 1: A 3D view of the structural model developed to perform structural analysis

III. SIGNIFICANT CONCLUSIONS:

(1) Satisfactory structural response *under gravity loading* has been observed under the following structural conditions in the proposed structure with the additional floors:

a. The original stone masonry level, i.e. *kalkaram*, is retained;
b. The original first and second brick masonry levels are retained;
c. All portions above the second brick masonry level are dismantled;
d. The four additional levels are added as per the architectural design proposed by the stapathi;
e. The brick masonry in the newly added portions are considered to be solid clay brickwork in lime mortar;
f. The core of the stone masonry level is consolidated; and
g. Rigid diaphragm action is established at all the floor diaphragms with the introduction of structurally designed reinforced concrete (RC) floor slabs and bond beams in the masonry.

(2) For the aforementioned configuration, satisfactory performance has been observed under the *combined action of gravity load and earthquake load*, corresponding to the Maximum Considered Earthquake (MCE) as per IS: 1893 p.1 (2002), for seismic zone 2, importance factor 1.5 (monumental structure) and response reduction factor of 1.0.

(3) Hence, the addition of the four levels in order to complete the Raja Gopuram *appears to be feasible*, provided the recommendations in the following section are adhered to.

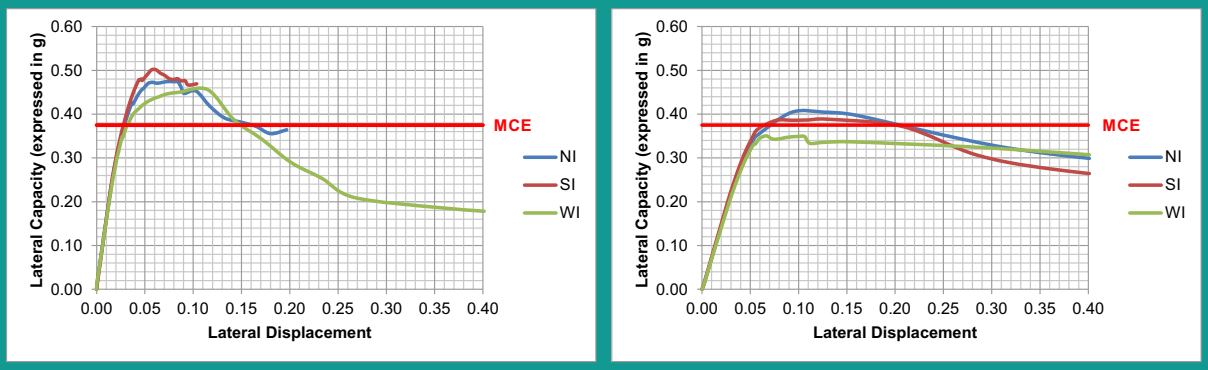


Figure 2: Capacity of structure under combination of gravity load and lateral force in the (L) stronger (East-West) and (R) weaker (N-S) directions of the structure
(MCE: Earthquake demand; NI – normal infill, SI – stronger infill, WI – weaker infill)

IV. SIGNIFICANT RECOMMENDATIONS:

(1) Grouting of Core of Stone Masonry Level:

The core of the three-leaf stone masonry level, i.e. *kalkaram*, has to be grouted in order to consolidate the core. A combination of lime and pozzolanic cements (e.g. PPC or slag cement) should be used with the aim of reducing Portland cement content in the grout. The structural study has shown how the integrity of the core masonry is crucial to satisfactory performance of the structure under gravity and lateral forces. In addition, the existing brick masonry levels can be grouted with pre-approved grout mixes that are compatible with historical masonry, available in the market.

(2) Tying Masonry Walls and Provision of Rigid Diaphragm:

Structural analysis has shown that the role of a diaphragm is crucial in ensuring stability against lateral forces. It is therefore prescribed that all the floor slabs of the new construction, and the slabs for the existing brick masonry levels should structurally designed and executed in reinforced concrete. Continuous RC bond beams will also be required at the floor level to tie all the brick masonry walls together to the RC slabs. All reinforced concrete elements should be structurally designed and executed with stainless steel reinforcement bars, with strict quality control and assurance protocol for concreting.

(3) Structural Health Monitoring:

The entire execution work must be carried out only after installation of a structural health monitoring system (SHM). Structural movements causing settlements, deflections and inclinations can be measured and monitored with the help of Ground Settlement Markers (GSM), Building Settlement Markers (BSM), tiltmeters and deflection gauges. An external agency must be hired to install and periodically record and report on these parameters. SHM will ensure safety of the technical personnel and labour during investigations and execution, and will provide necessary indication of unacceptable levels of structural movement. Crack width gauges must also be installed in locations of the structure where pre-existing cracks have been noticed.

(4) Quality Control on Material Samples:

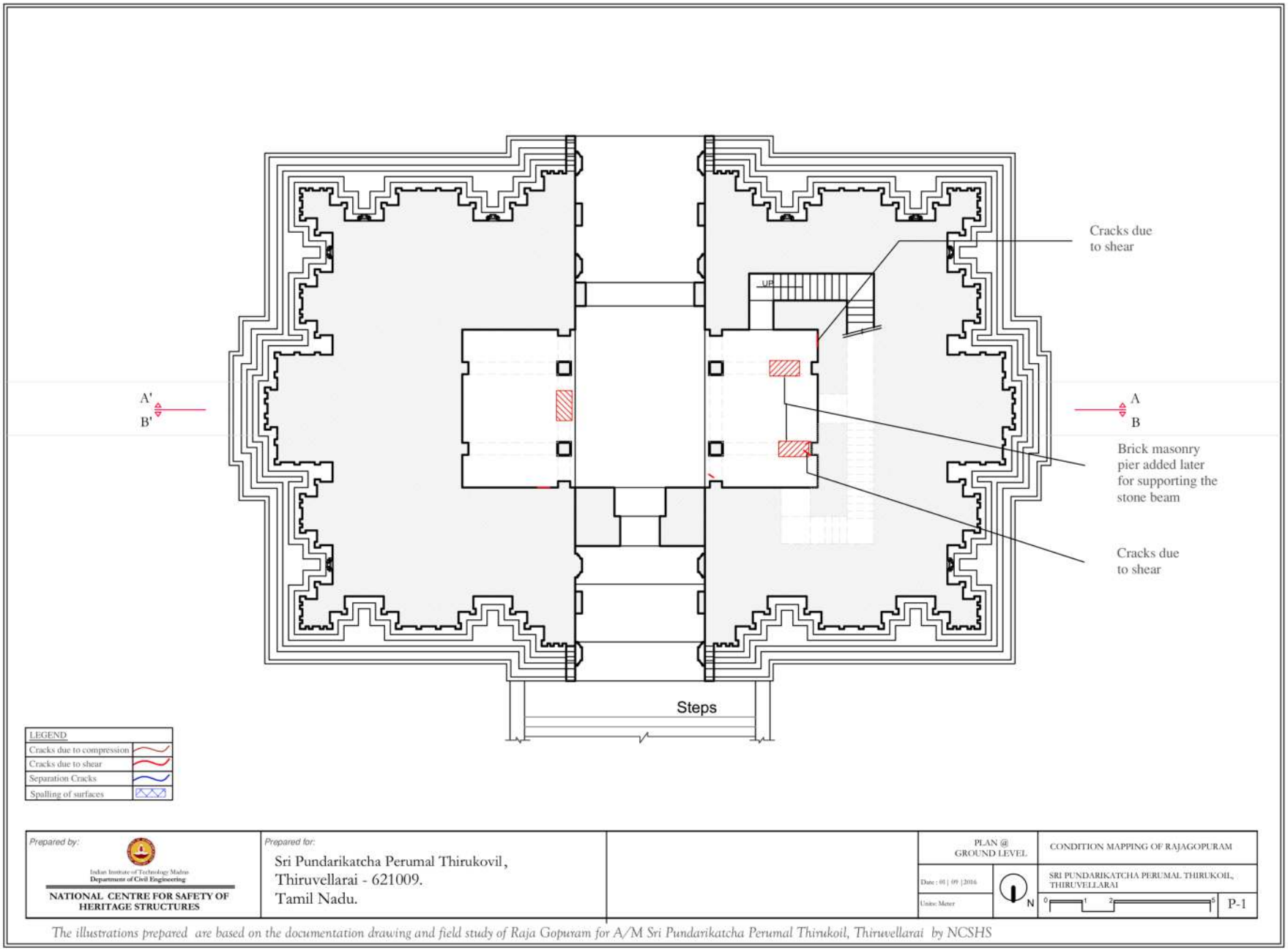
The structural materials to be used in the restoration work, namely clay brick units, lime mortar, concrete and stainless steel should be periodically tested with a strict quality control (QC) and quality assurance (QA) protocol. Test reports submitted to IIT Madras in order to ensure that subs-standard or inadequate material are not being used.

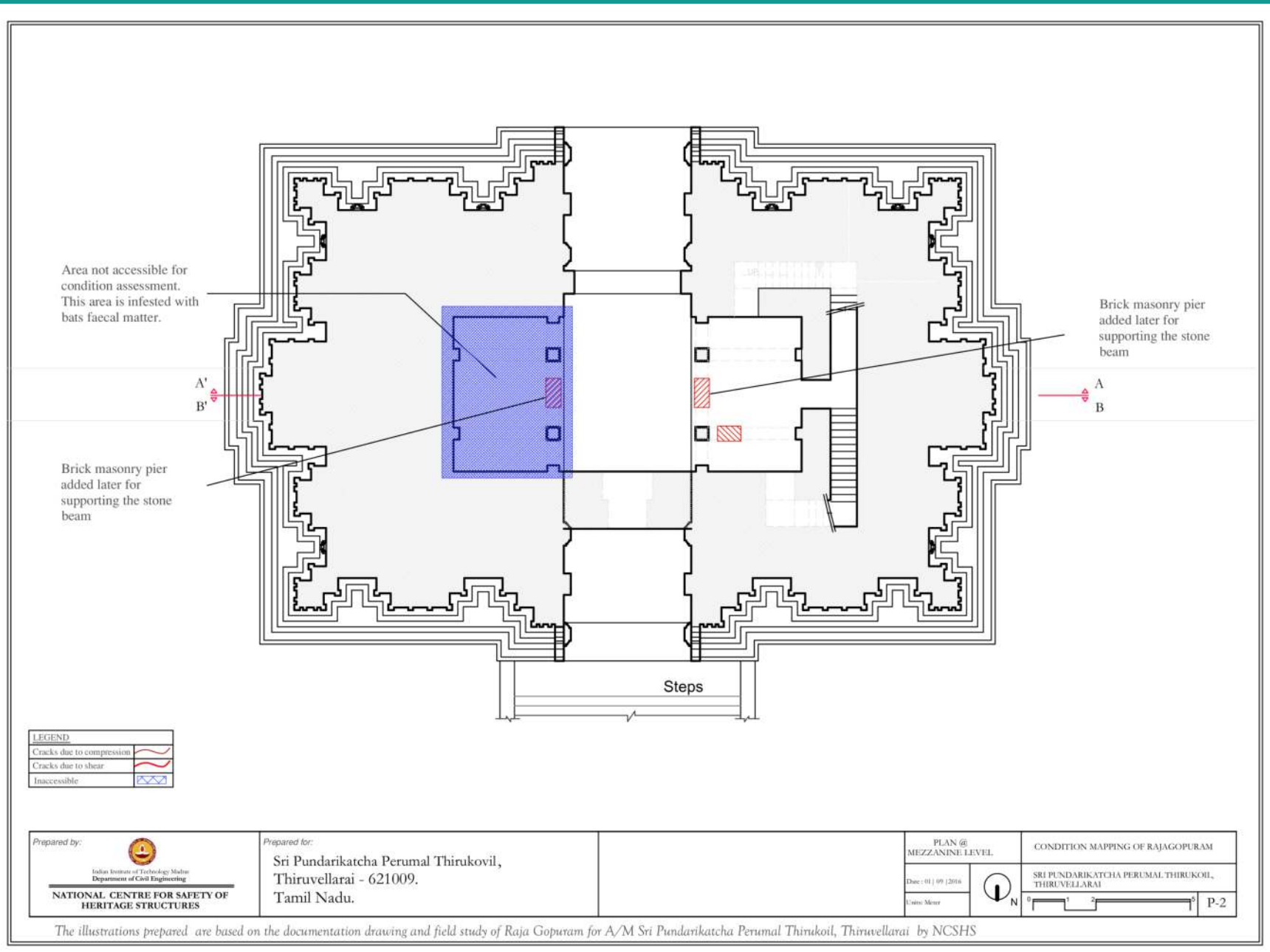
Dated: 02 September 2016

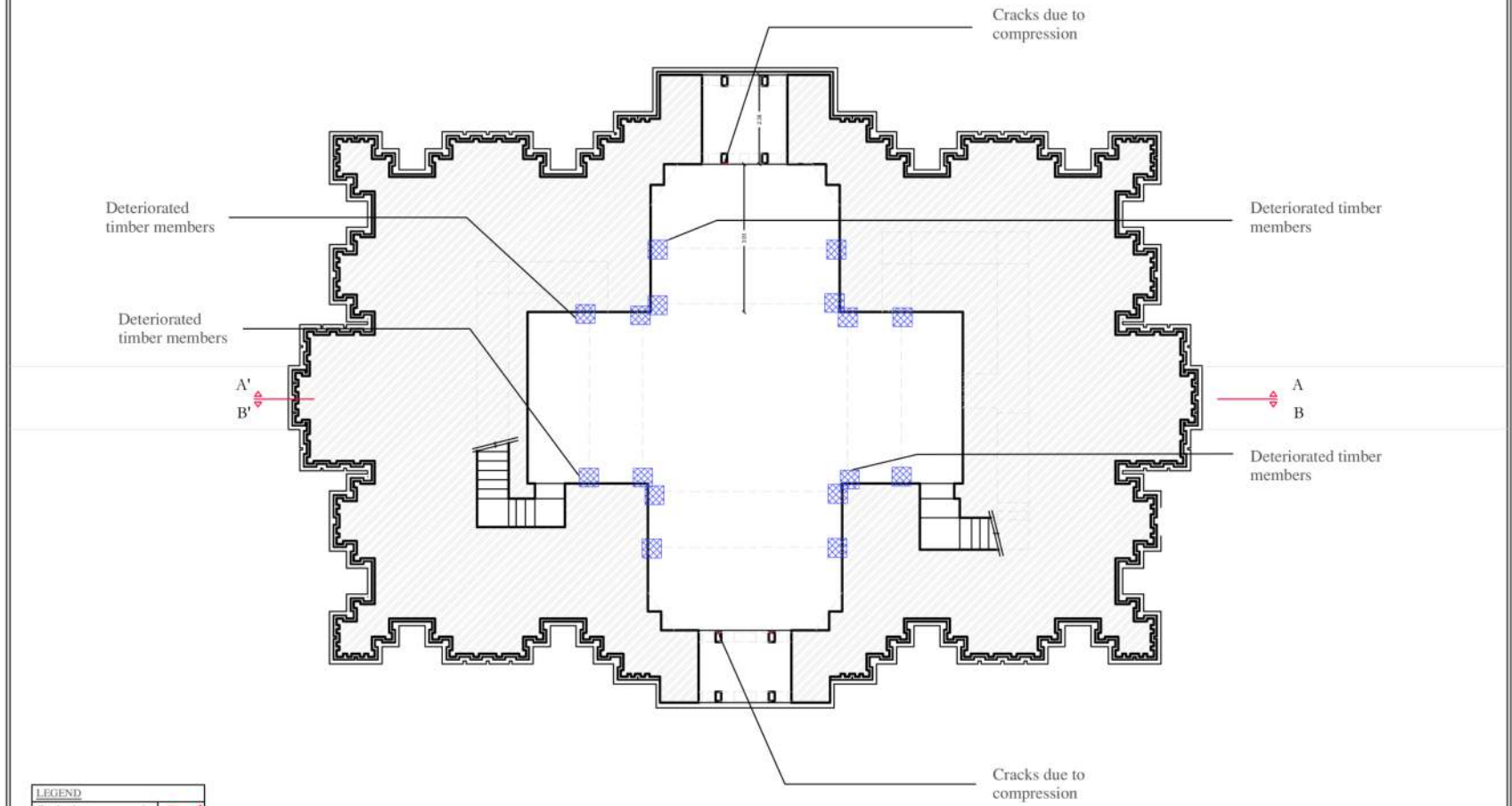
Arun Menon
Assistant Professor
Structural Engineering Laboratory, STR-202

Convener, National Advisory Board
National Centre for Safety of Heritage Structures (NCSHS)

Department of Civil Engineering, IIT Madras, Chennai - 600 036, TN
E-mail: arunmenon@iitm.ac.in; Phone: (O) 044-2257 4299; (M) 99629 34559


Cracks due to shear
A'
B'
A
B
Brick masonry pier added later for supporting the stone beam
Cracks due to shear
Steps
LEGEND
Cracks due to compression
Cracks due to shear
Separation Cracks
Spalling of surfaces
Prepared by:
Indian Institute of Technology Madras
Department of Civil Engineering
NATIONAL CENTRE FOR SAFETY OF HERITAGE STRUCTURES
Prepared for:
Sri Pundarikatcha Perumal Thirukovil,
Thiruvellarai - 621009.
Tamil Nadu.
PLAN @ GROUND LEVEL
CONDITION MAPPING OF RAJAGOPURAM
Date : 01 | 09 |2016
Units: Meter
N
SRI PUNDARIKATCHA PERUMAL THIRUKOIL, THIRUVELLARAI
0 1 2 5
P-1
The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Sri Pundarikatcha Perumal Thirukoil, Thiruvellarai by NCSHS


Area not accessible for condition assessment. This area is infested with bats faecal matter.
Brick masonry pier added later for supporting the stone beam
Brick masonry pier added later for supporting the stone beam
A'
B'
A
B
Steps
LEGEND
Cracks due to compression
Cracks due to shear
Inaccessible
Prepared by:
Indian Institute of Technology Madras
Department of Civil Engineering
NATIONAL CENTRE FOR SAFETY OF HERITAGE STRUCTURES
Prepared for:
Sri Pundarikatcha Perumal Thirukovil,
Thiruvellarai - 621009.
Tamil Nadu.
PLAN @ MEZZANINE LEVEL
Date : 01 | 09 |2016
Units: Meter
N
CONDITION MAPPING OF RAJAGOPURAM
SRI PUNDARIKATCHA PERUMAL THIRUKOIL, THIRUVELLARAI
0 1 2 5
P-2
The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Sri Pundarikatcha Perumal Thirukoil, Thiruvellarai by NCSHS



Prepared by:

Indian Institute of Technology Madras
Department of Civil Engineering

NATIONAL CENTRE FOR SAFETY OF HERITAGE STRUCTURES

Prepared for:

Sri Pundarikatcha Perumal Thirukovil,
Thiruvellarai - 621009.
Tamil Nadu.

PLAN @ FIRST LEVEL

Date : 01 | 09 | 2016

Units: Meter

N

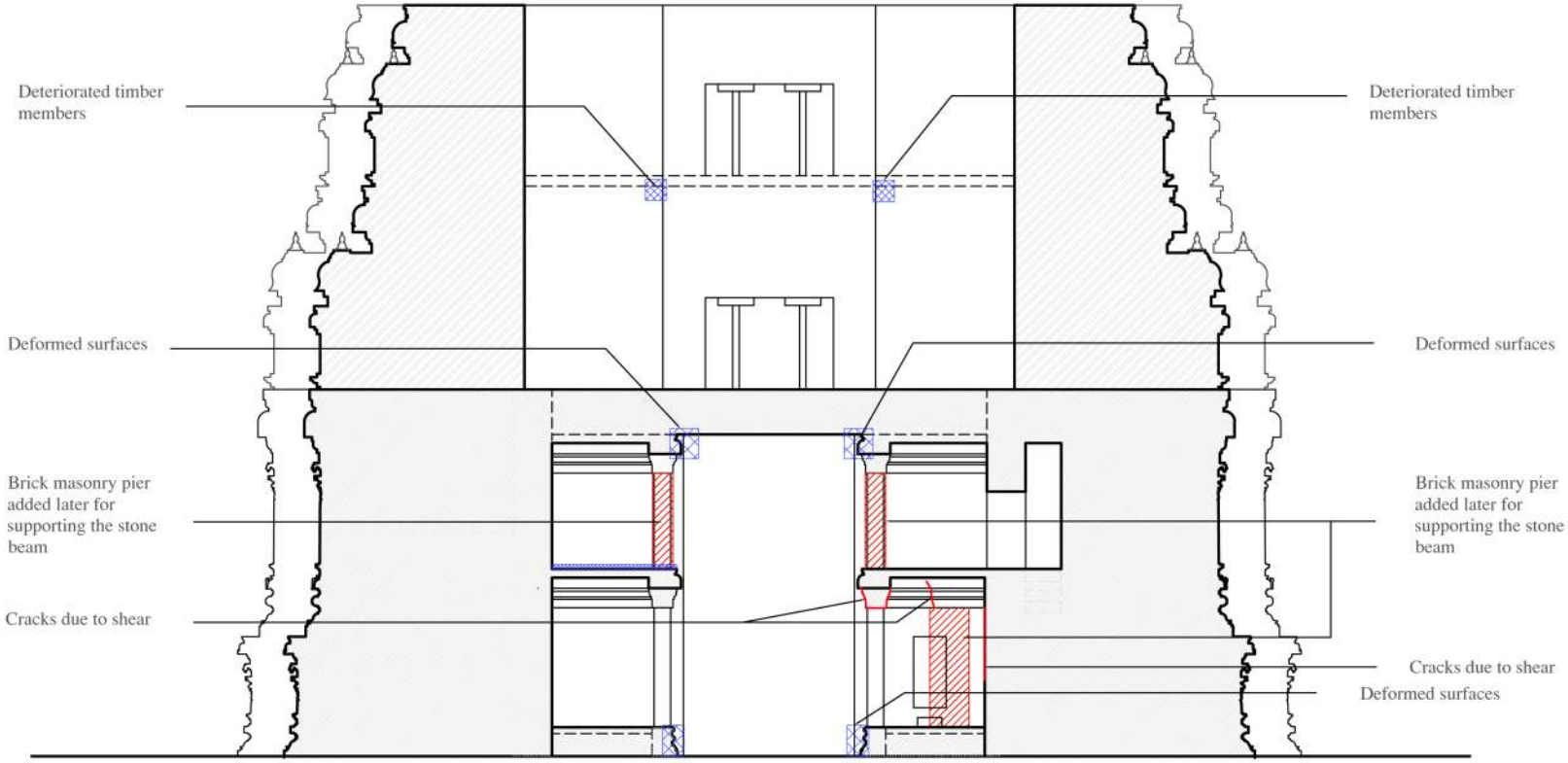
CONDITION MAPPING OF RAJAGOPURAM

SRI PUNDARIKATCHA PERUMAL THIRUKOIL, THIRUVELLARAI

0 1 2 5

P-3

The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Sri Pundarikatcha Perumal Thirukoil, Thiruvellarai by NCSHS



LEGEND	
Cracks due to compression	
Cracks due to shear	
Separation Cracks	
Spalling of surfaces	

Prepared by:

Indian Institute of Technology Madras
Department of Civil Engineering

NATIONAL CENTRE FOR SAFETY OF HERITAGE STRUCTURES

Prepared for:

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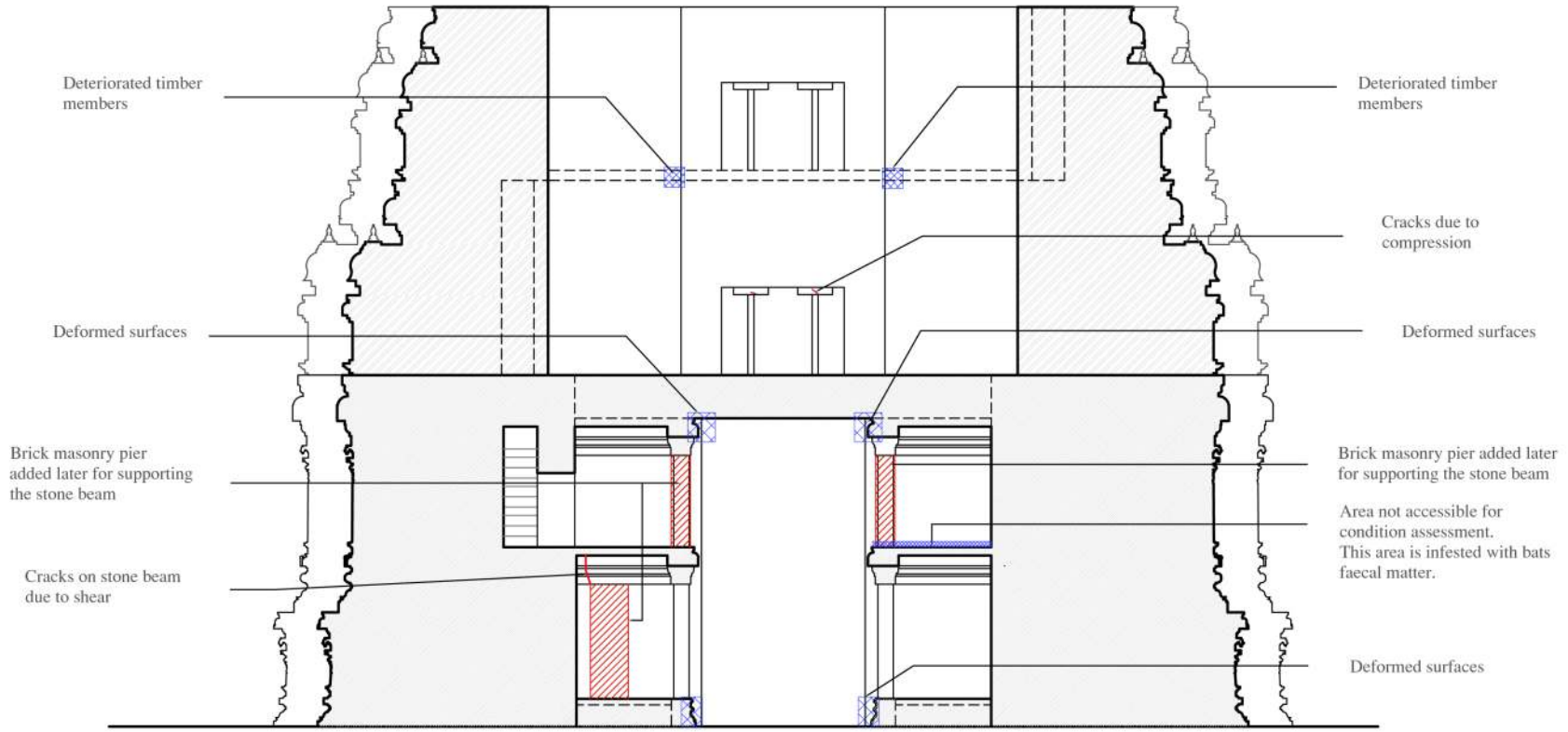
Thiruvellarai - 621009.
Tamil Nadu.

SECTION AA'	CONDITION MAPPING OF RAJAGOPURAM
Date : 01 | 09 | 2016	SRI PUNDARIKATCHA PERUMAL THIRUKOIL, THIRUVELLARAI
Units: Meter	0 1 2 5 E-1

The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Sri Pundarikatcha Perumal Thirukoil, Thiruvellarai by NCSHS



LEGEND	
Cracks due to compression	
Cracks due to shear	
Separation Cracks	
Spalling of surfaces	

Prepared by:

Indian Institute of Technology Madras
Department of Civil Engineering

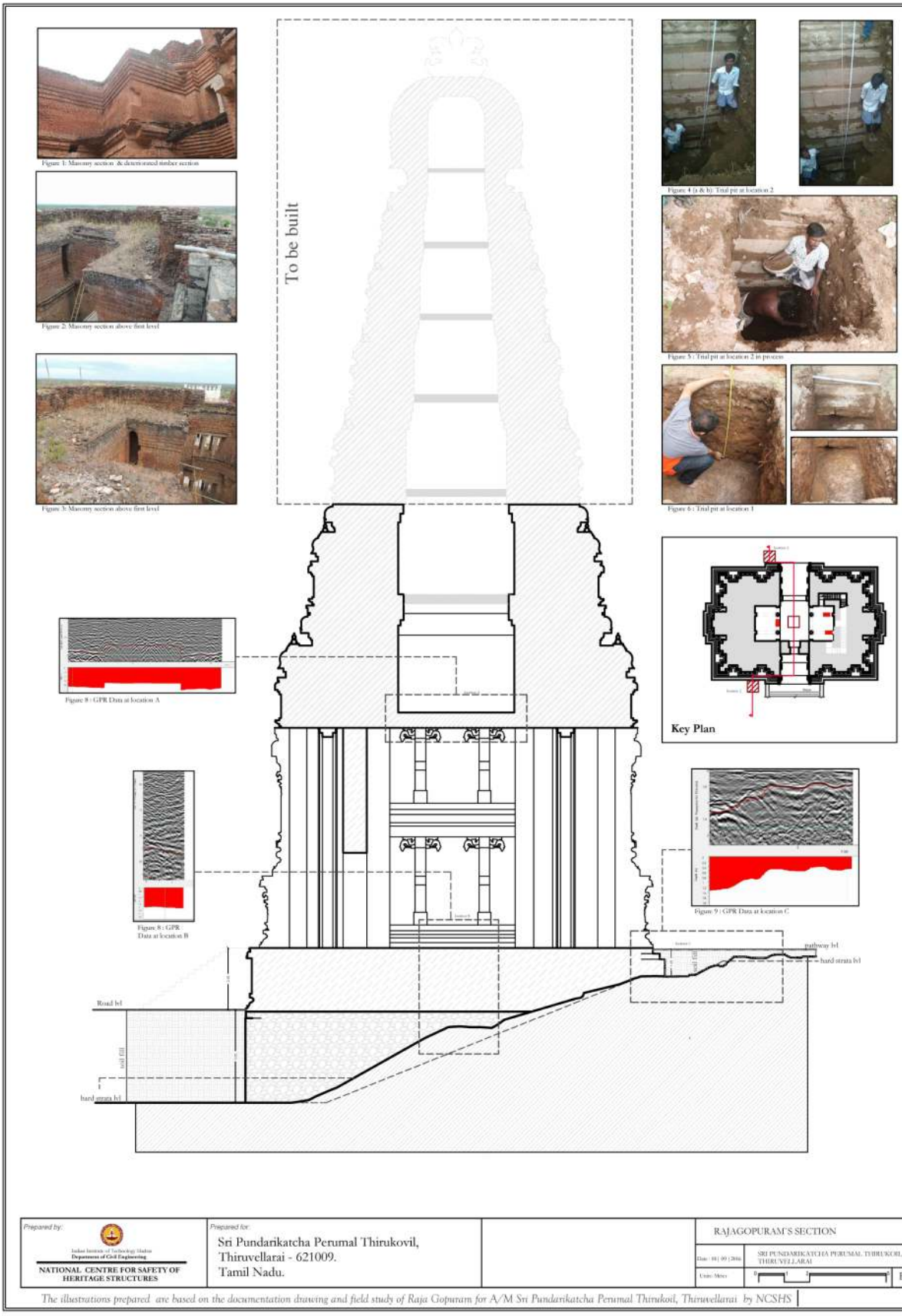
NATIONAL CENTRE FOR SAFETY OF HERITAGE STRUCTURES

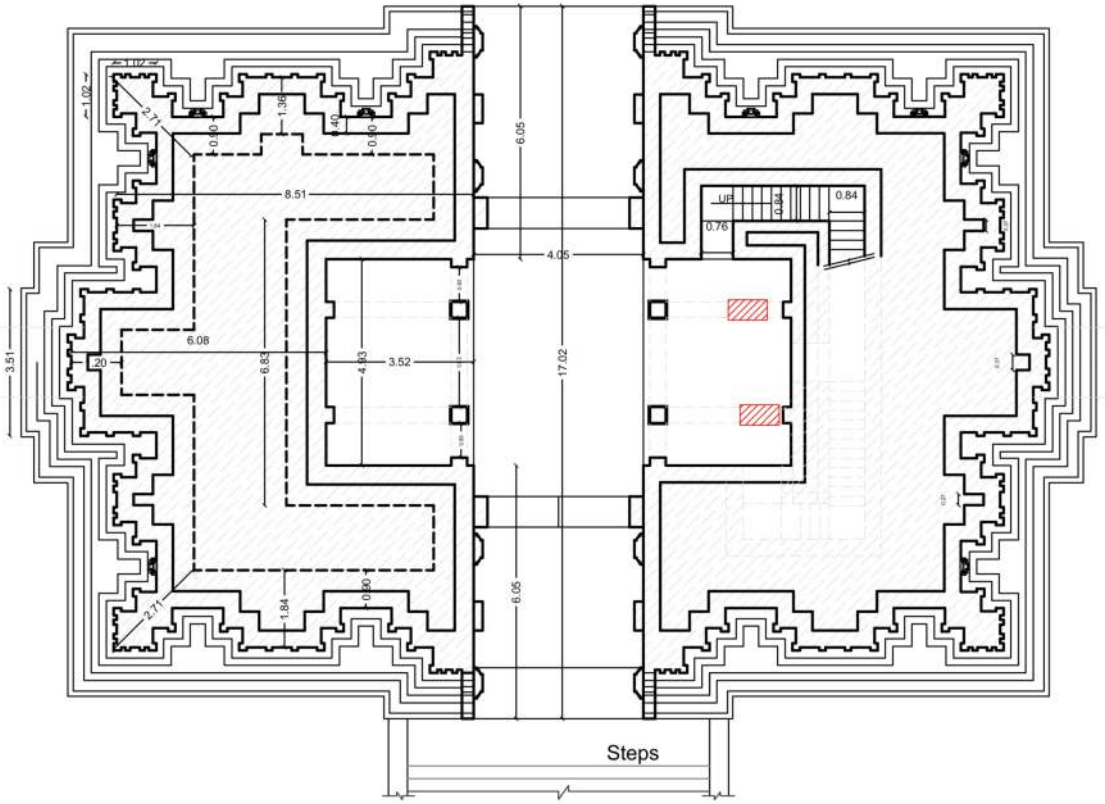
Prepared for:

Sri Pundarikatcha Perumal Thirukovil,
Thiruvellarai - 621009.
Tamil Nadu.

SECTION BB'	CONDITION MAPPING OF RAJAGOPURAM
Date : 01| 09 |2016	SRI PUNDARIKATCHA PERUMAL THIRUKOIL, THIRUVELLARAI
Units: Meter	0 1 2 5 E-2

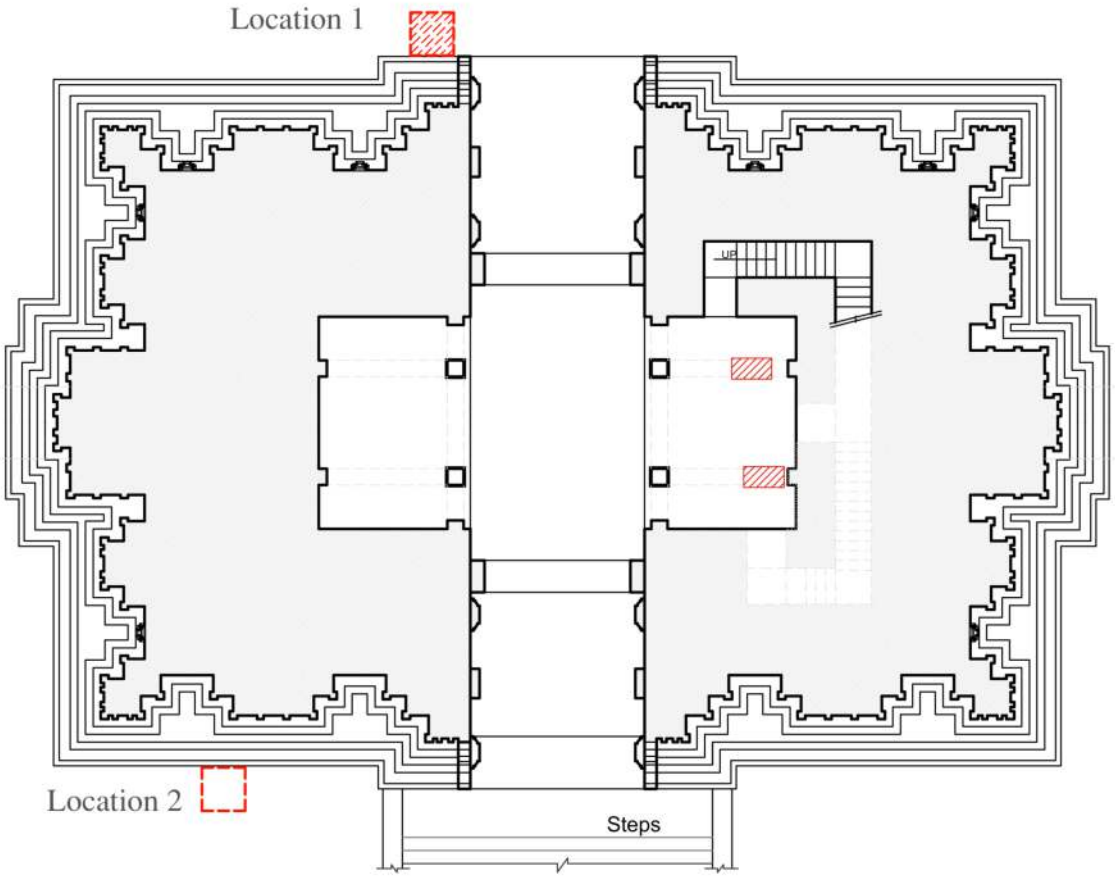
The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Sri Pundarikatcha Perumal Thirukoil, Thiruvellarai by NCSHS


To be built
Key Plan
pathway lvl
hard strata lvl
Road lvl
soil fill
hard strata lvl
Prepared by:
Indian Institute of Technology Madras
Department of Civil Engineering
NATIONAL CENTRE FOR SAFETY OF HERITAGE STRUCTURES
Prepared for:
Sri Pundarikatcha Perumal Thirukovil,
Thiruvellarai - 621009.
Tamil Nadu.
RAJAGOPURAM'S SECTION
SRI PUNDARIKATCHA PERUMAL THIRUKOIL, THIRUVELLARAI
E-3
The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Sri Pundarikatcha Perumal Thirukoil, Thiruvellarai by NCSHS



Prepared by: Indian Institute of Technology Madras, Department of Civil Engineering. NATIONAL CENTRE FOR SAFETY OF HERITAGE STRUCTURES	Prepared for: Sri Pundarikatcha Perumal Thirukovil, Thiruvellarai - 621009. Tamil Nadu.		PLAN Date : 01	MASONRY DETAIL SRI PUNDARIKATCHA PERUMAL THIRUKOIL, THIRUVELLARAI
			Units: Meter	N 0 1 2 5 L-1

The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Sri Pundarikatcha Perumal Thirukoil, Thiruvellarai by NCSHS



LEGEND

Location of trial pits 1m x 1m.

Prepared by:

Indian Institute of Technology Madras
Department of Civil Engineering

NATIONAL CENTRE FOR SAFETY OF HERITAGE STRUCTURES

Prepared for:

Sri Pundarikatcha Perumal Thirukovil,
Thiruvellarai - 621009.
Tamil Nadu.

PLAN @ GROUND LEVEL

LOCATION OF TRIAL PITS

Date : 01.09.2016.

Units: Meter

N

SRI PUNDARIKATCHA PERUMAL THIRUKOIL, THIRUVELLARAI

0 1 2 5

L-2

The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Sri Pundarikatcha Perumal Thirukoil, Thiruvellarai by NCSHS

Figure 1:Deterioration in brick masonry ; the second floor

Figure 2:Condition of masonry in upper floors

Figure 3: Deteriorated timber members

Figure 4: Deteriorated timber members

Figure 5: Deteriorated upper floor.

Figure 6: Deteriorated and delaminated masonry in upper floor.

Figure 7: Masonry section infested with bats

Figure 8: Masonry section infested with bats

Figure 8: Cracks on granite beams

Figure 9: Cracks on granite beam and temporary support system

Figure 10: Cracks on masonry wall

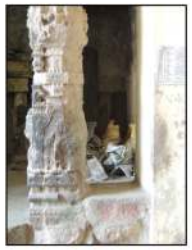


Figure 11: Deterioration in stone column

Figure 12: Masonry pier as temporary support

Figure 13: Masonry pier as temporary support

Figure 14: Masonry pier as temporary support at upper level

Figure 15: Masonry at east side of kalkaram

Figure 16: Masonry at west side of kalkaram

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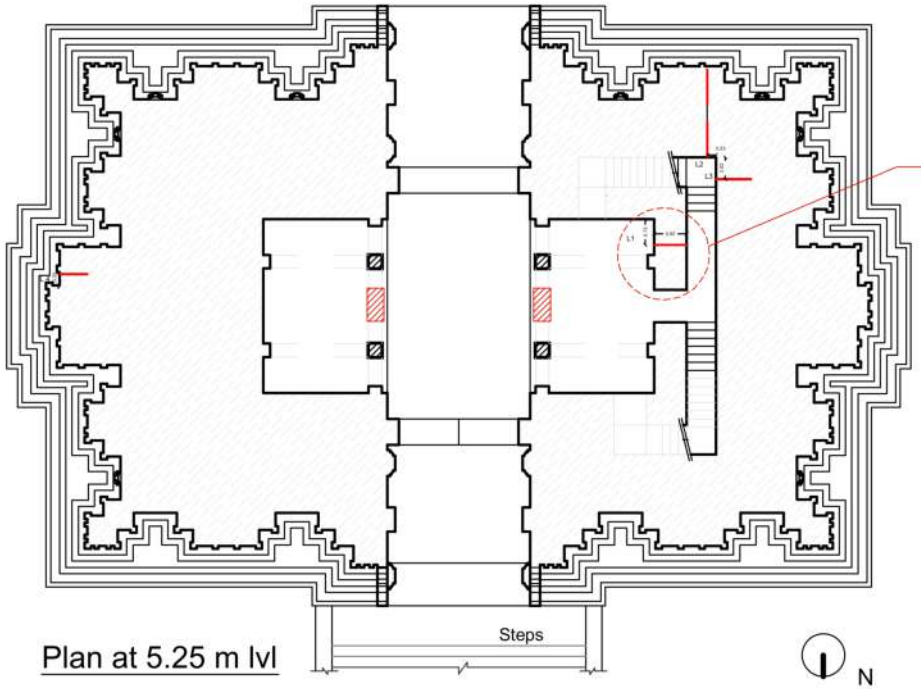
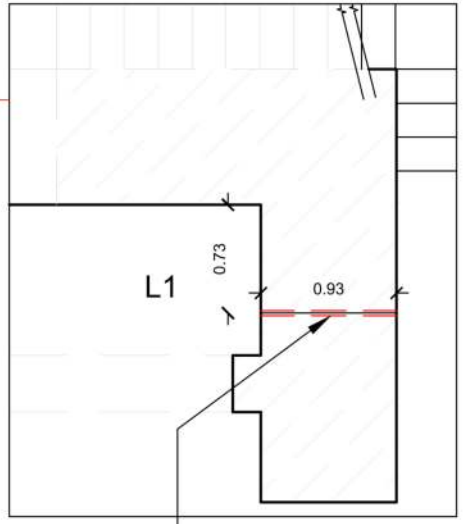
			Date : 01 | 09 |2016	SRI PUNDARIKATCHA PERUMAL THIRUKOIL, THIRUVELLARAI
				PP-1

The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Sri Pundarikatcha Perumal Thirukoil, Thiruvellarai by NCSHS



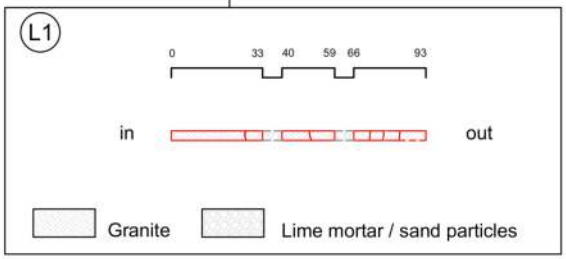
Plan at 5.25 m lvl

Detail of L1



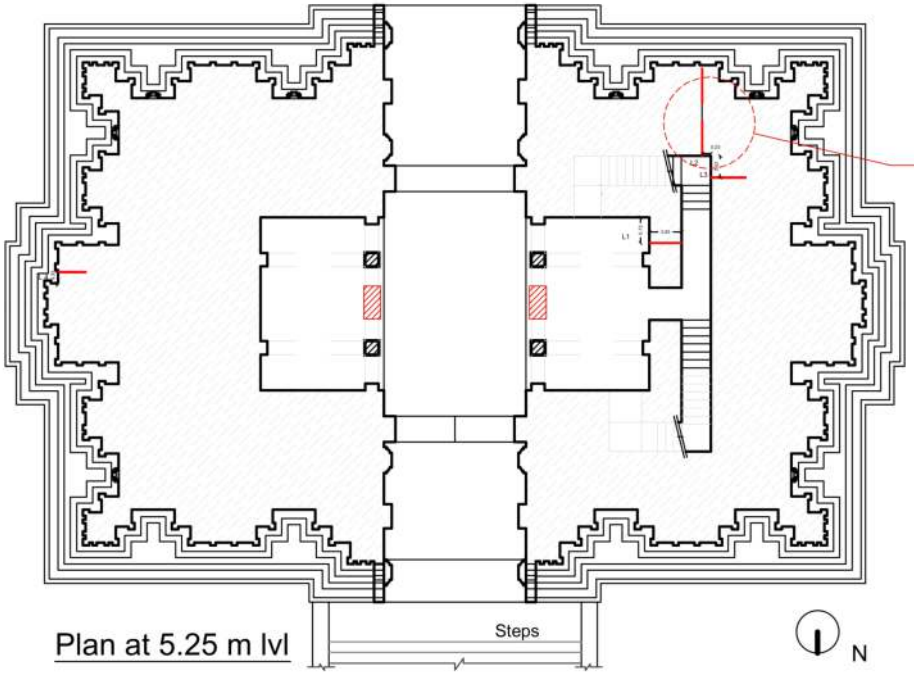
dimension in "m"

Wet core drilling 35 mm Ø executed on 12th September 2015.
The core at L1 is drilled at height of 1 m from finished floor level.



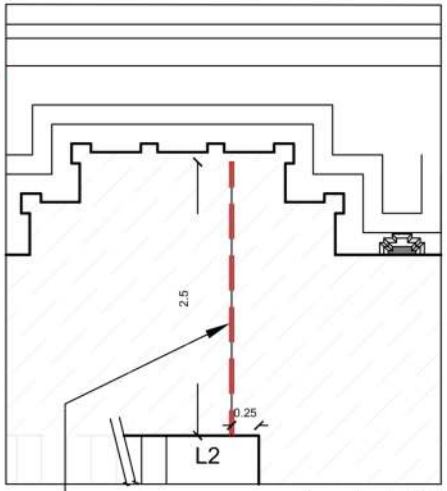
dimension in "cm"

The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Pundhakaksha Perumal Thirukoil, Thiruvellarai by NCSHS



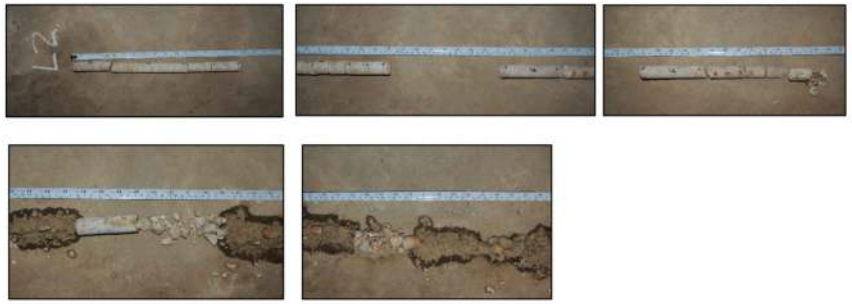
Plan at 5.25 m lvl

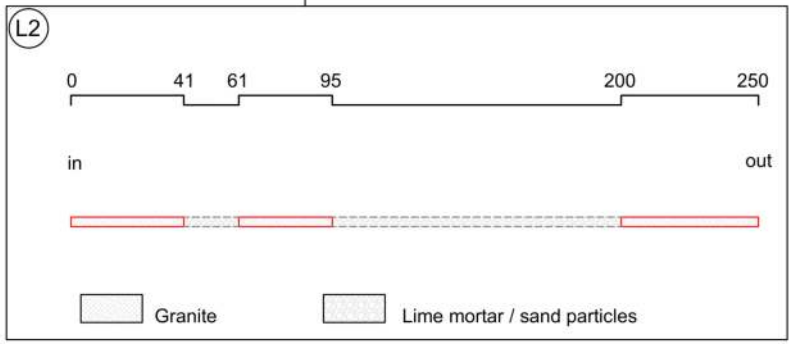
Detail of L 2



dimension in "m"

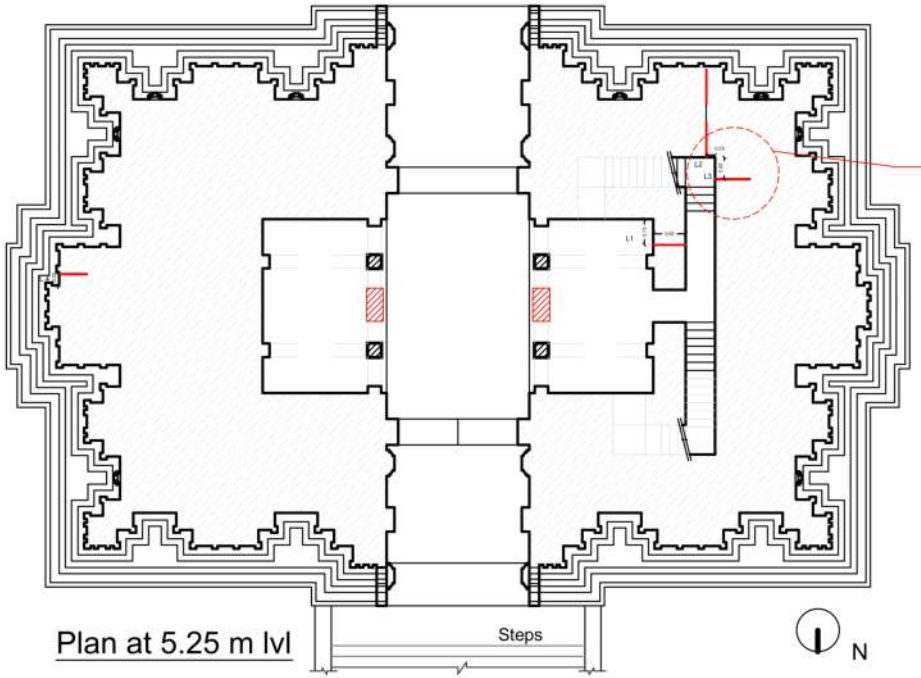
Wet core drilling 35 mm Ø executed on 12th September 2015.
The core at L2 is drilled at height of 1.28 m from finished floor level (landing).

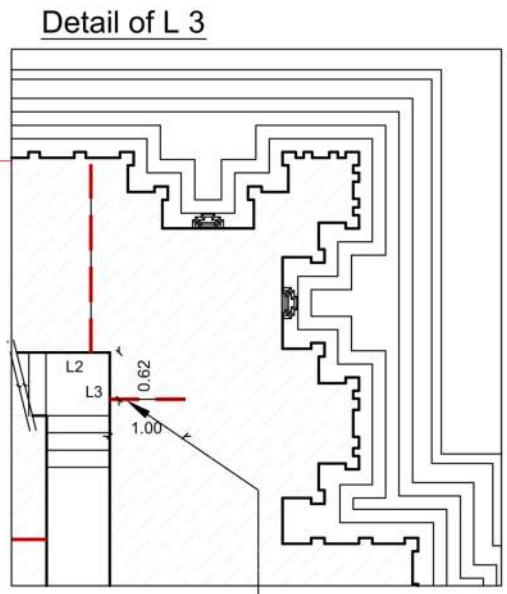




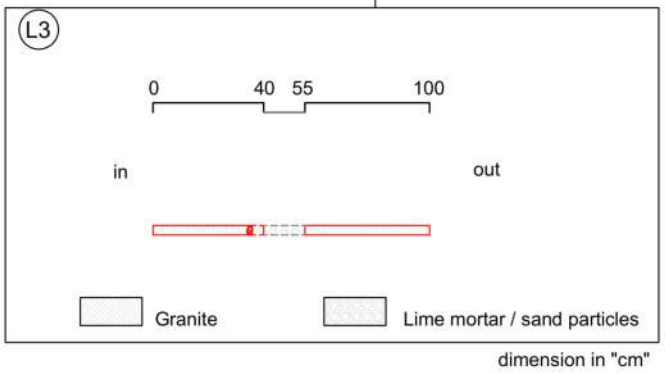
dimension in "cm"

The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Pundhakaksha Perumal Thirukoil, Thiruvellarai by NCSHS

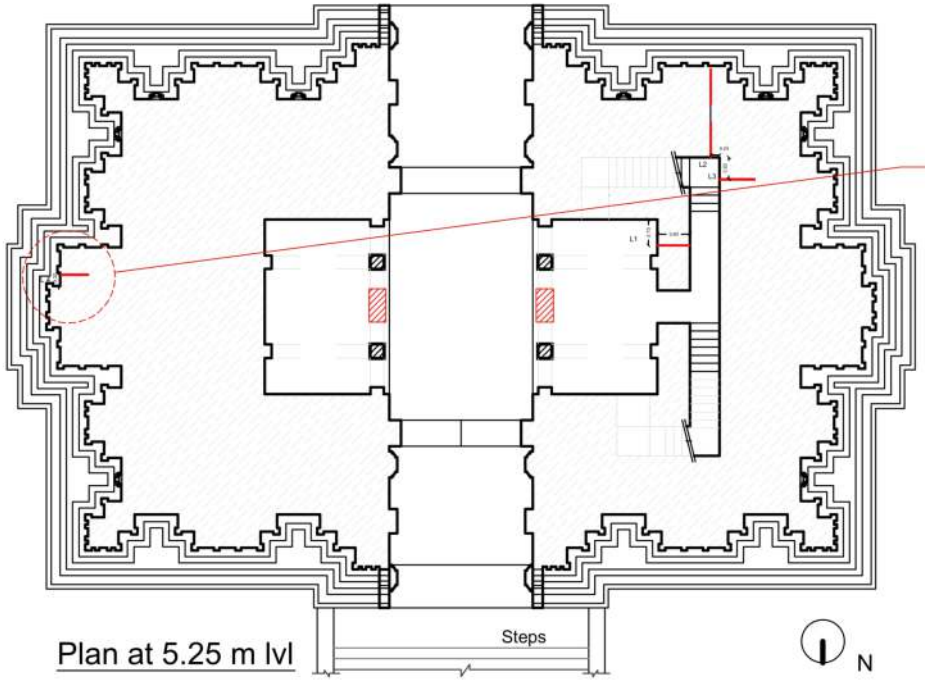




Wet core drilling 35 mm Ø executed on 12th September 2015.
The core at L3 is drilled at height of 1.3 m from finished floor level (landing).

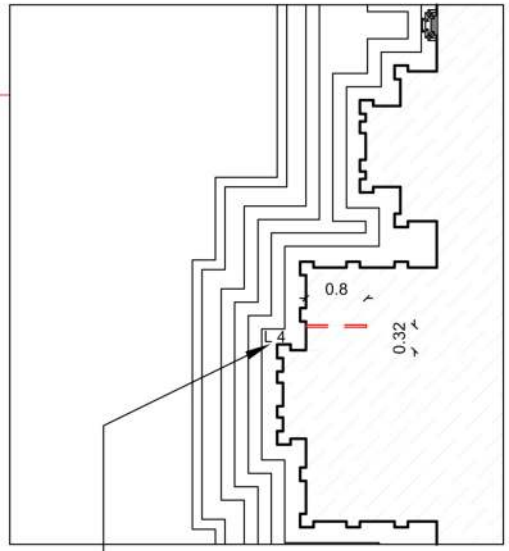


The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Pundhakaksha Perumal Thirukoil, Thiruvellarai by NCSHS

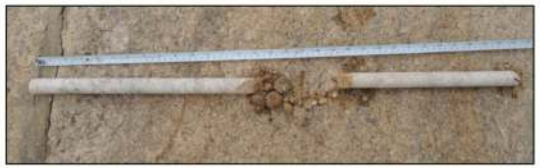


Plan at 5.25 m lvl

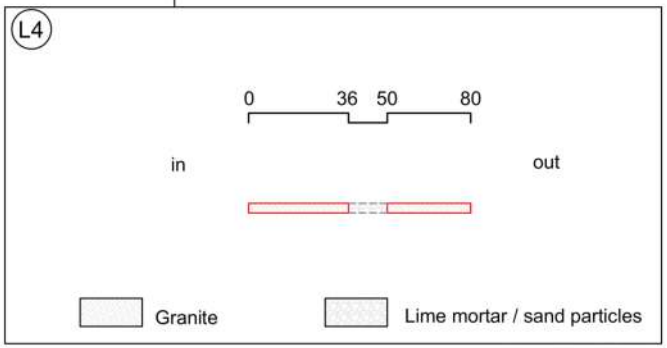
Detail of L 4



dimension in "m"

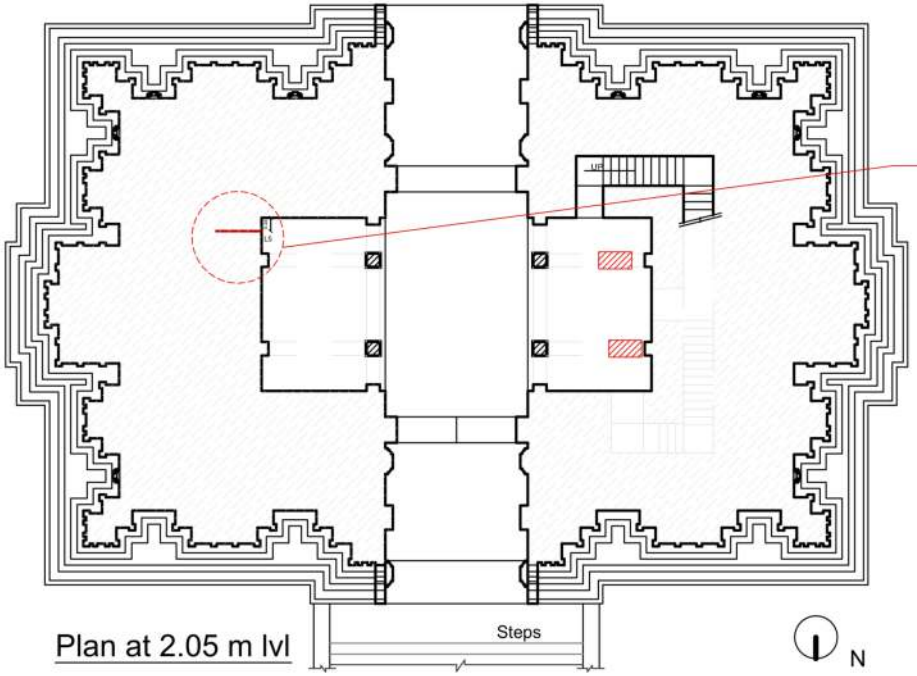


Wet core drilling 35 mm Ø executed on 12th September 2015. The core at L4 is drilled at height of 0.5 m from top level of the fortification wall. Total height from the ground level is 5.56 m



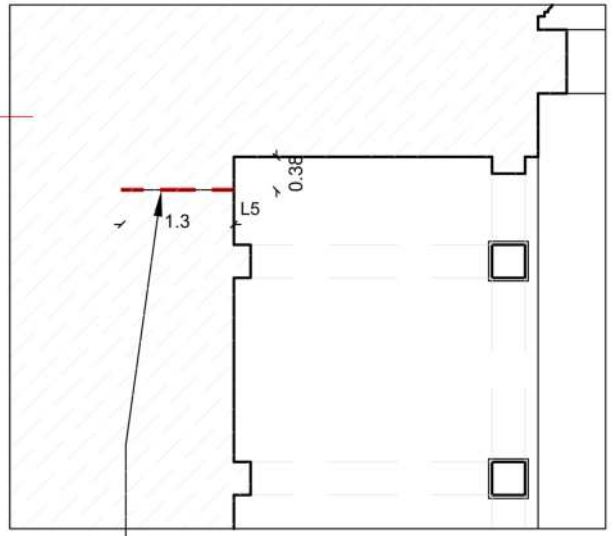
dimension in "cm"

The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Pundhakaksha Perumal Thirukoil, Thiruvellarai by NCSHS



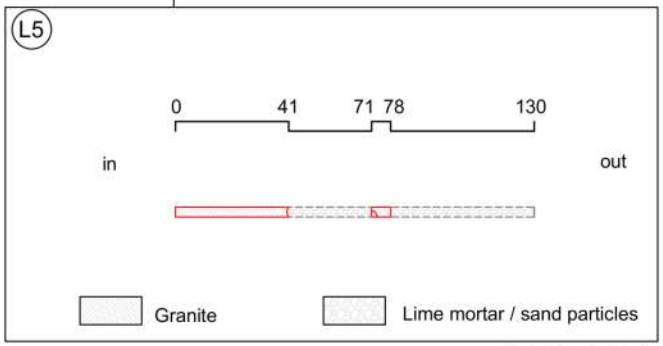
Plan at 2.05 m lvl

Detail of L 5



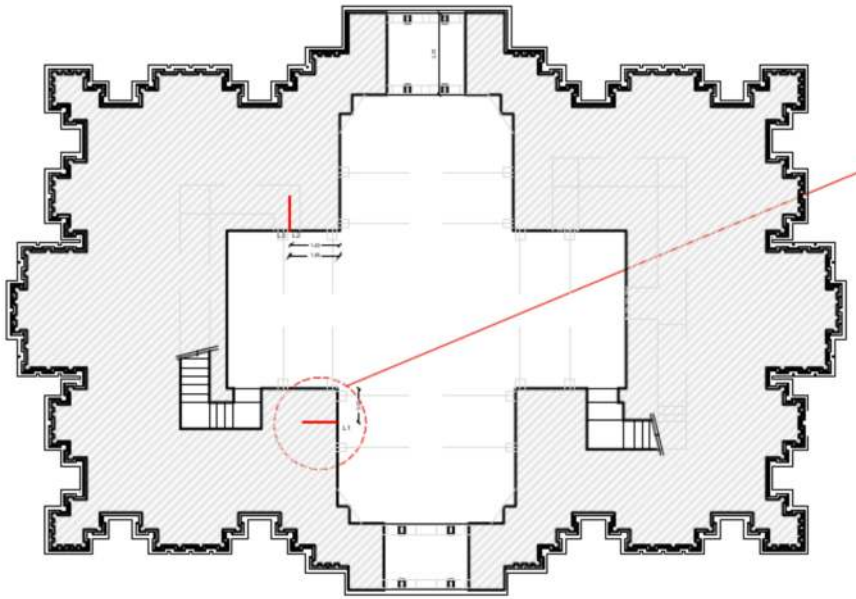
dimension in "m"

Wet core drilling 35 mm Ø executed on 12th September 2015.
The core at L5 is drilled at height of 0.99 m from finished floor level.



dimension in "cm"

The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Pundhakaksha Perumal Thirukoil, Thiruvellarai by NCSHS

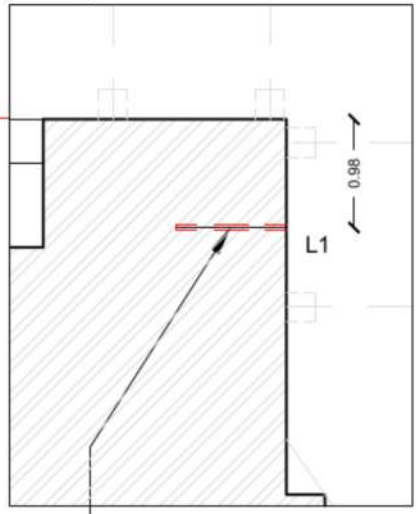


Plan at 8.65 m lvl

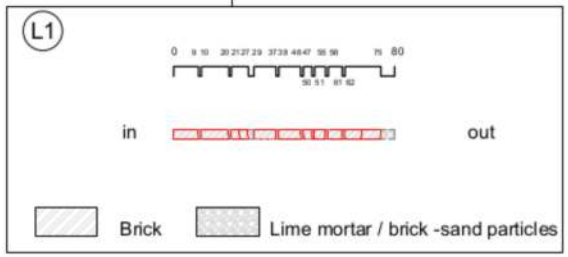
N

A combinaiton of Dry and Wet core drilling 35 mm Ø executed on 31st October 2015. The core at L1 is drilled at height of 1 m from finished floor level. The Dry Coring was done till a depth of 30 cms.

Detail of L1

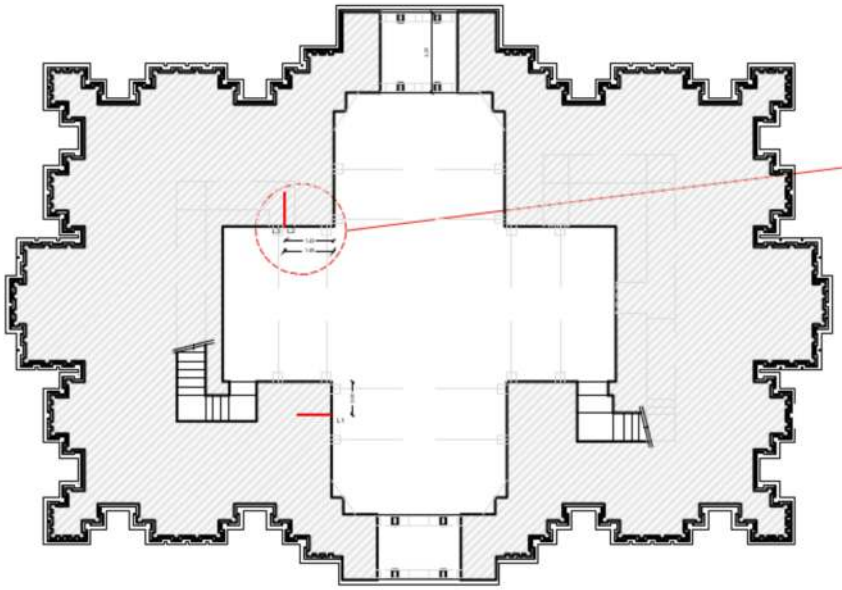


dimension in "m"



dimension in "cm"

The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Pundhakaksha Perumal Thirukoil, Thiruvellarai by NCSHS

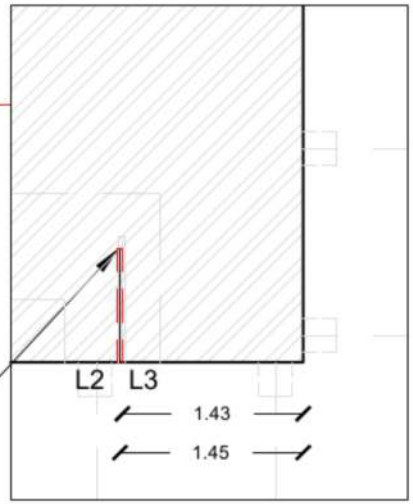


Plan at 8.65 m lvl

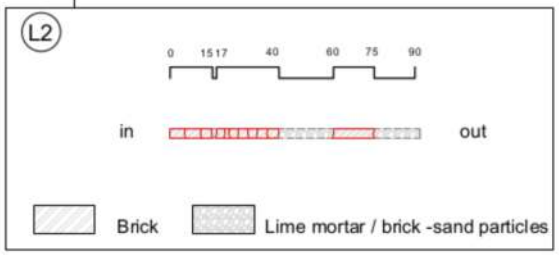
N

A Wet core drilling 35 mm Ø executed on 31st October 2015.
The core at L2 is drilled at height of 1 m from finished floor level.

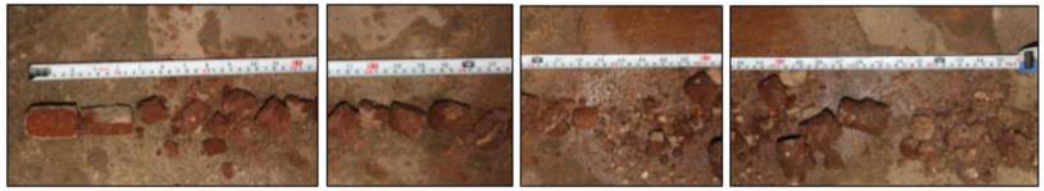
Detail of L2



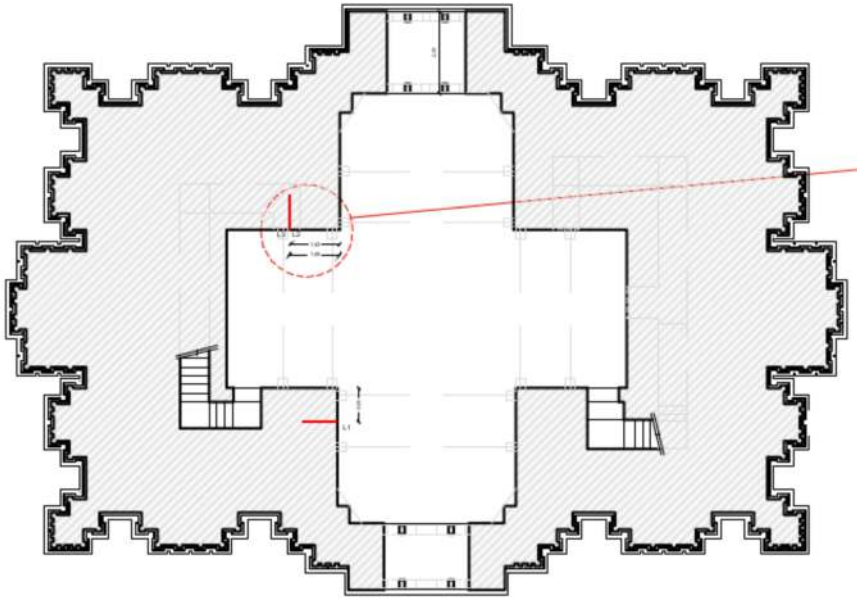
dimension in "m"



dimension in "cm"



The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Pundhakaksha Perumal Thirukoil, Thiruvellarai by NCSHS

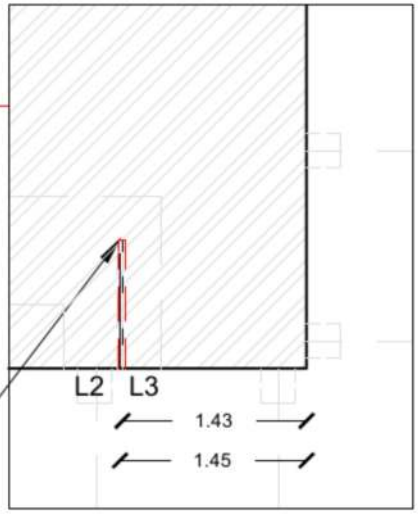


Plan at 8.65 m lvl

N

A Wet core drilling 35 mm Ø executed on 31st October 2015.
The core at L3 is drilled at height of 0.45 m from finished floor level.

Detail of L3



dimension in "m"

dimension in "cm"

The illustrations prepared are based on the documentation drawing and field study of Raja Gopuram for A/M Pundhakaksha Perumal Thirukoil, Thiruvellarai by NCSHS

MATERIAL PROPERTIES

	BRICK	BRICK INFILL	GRANITE	GRANITE INFILL	RCC*	FLOORS*	LINTELS*
Compressive Strength (MPa)	2.62	0.2	4	0.4	-	-	-
Modulus of Elasticity (MPa)	800	200	2200	550	22360	50000	50000
Poisson's Ratio	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Tensile Strength (Mpa)	0.2	0.1	0.2	0.1	-	-	-
Fracture Energy Mode I (Compression) (N/mm)	4.2	0.4	6.4	0.64	-	-	-
Fracture Energy Mode I (Tension)(N/mm)	0.012	0.012	0.012	0.012	-	-	-
Specific Weight (kN/m3)	19	15	24	19	24	21	24

Table 1: Material Properties adopted in the numerical models

*Assumed as linear elastic materials in this numerical model

CONFIGURATIONS

In accordance to results obtained by performing coring on the granite walls of the temple at various locations, two possible thickness are assumed for the solid granite walls of the structure. On the basis of these assumed thickness , two configurations are defined as:

- **CONFIGURATION 1** assuming 90 cm thick granite walls.
- **CONFIGURATION 2** assuming 45 cm thick granite walls.

These configurations are again organized into sub configurations on the basis of the assumption if the infill that exists between the solid leafs of both the brick as well as the granite is considered a structural material. Alternately, the infill is also considered in one sub configuration as just contributing to the load acting only. The resulting sub configurations are:

- **SUB CONFIGURATION A**
- **SUB CONFIGURATION B**

CONFIGURATION A considers the infill material of both the stone and brick masonry to have some contribution towards carrying the loads of the structure. They are considered as materials having material properties summarised in **Table 1.** Thus in this configuration, the infill has contribution to both the load acting as well as the strength.

CONFIGURATION B considers only the weight of the infill of masonry. This is done by distributing the load of the infill material to the floors bearing their load in the form of point mass elements. Thus the infill in this configuration has a contribution to the loads acting but no contribution to the strength of the structure **(Figure 1).**

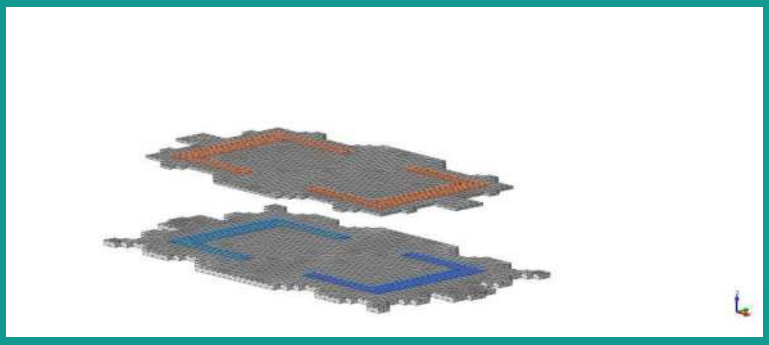


Figure 1: Point mass elements simulating the weight of the infill material

The different numerical models corresponding to various configurations of the structure which are addressed in this report are tabulated in **Table 2.**

Table 2: Summary of configurations corresponding to each numerical model.

	GRANITE THICKNESS	NATURE OF INFILL
CONFIGURATION 1A	90 cm	STRUCTURAL
CONFIGURATION 1B	90 cm	ONLY LOAD
CONFIGURATION 2A	45 cm	STRUCTURAL
CONFIGURATION 2B	45 cm	ONLY LOAD

For ease of understanding in this note, the different existing levels of the temple are numbered as illustrated in **Figure 2.**

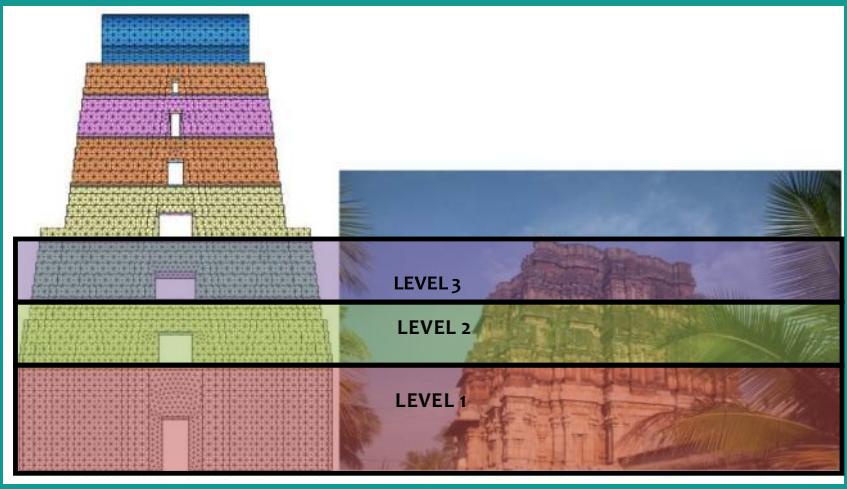
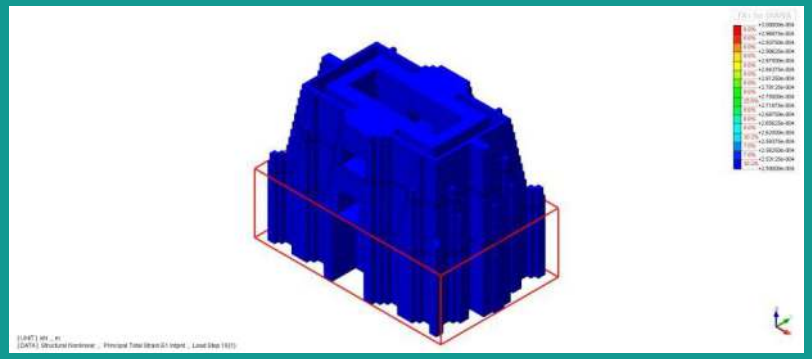
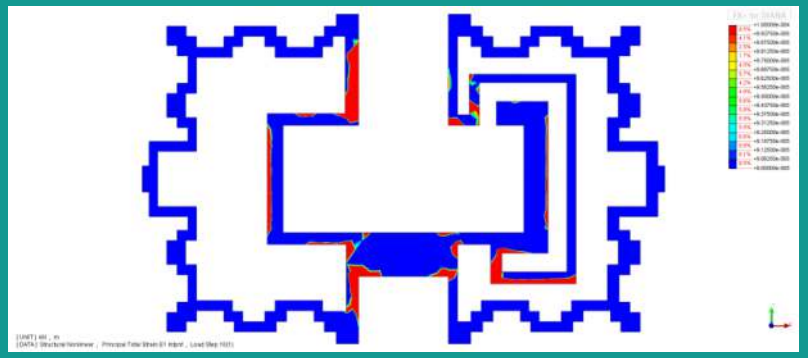
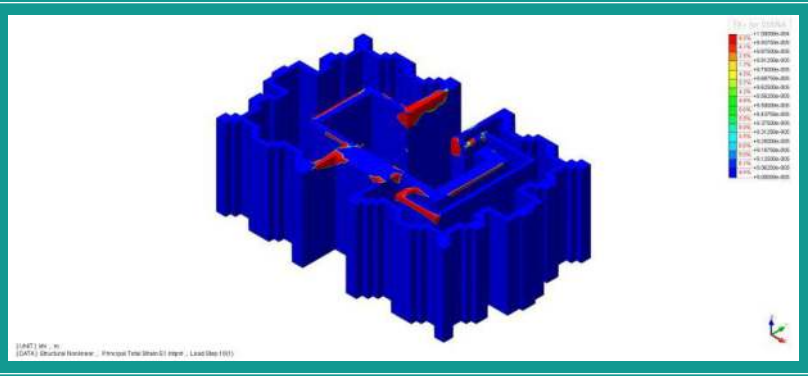


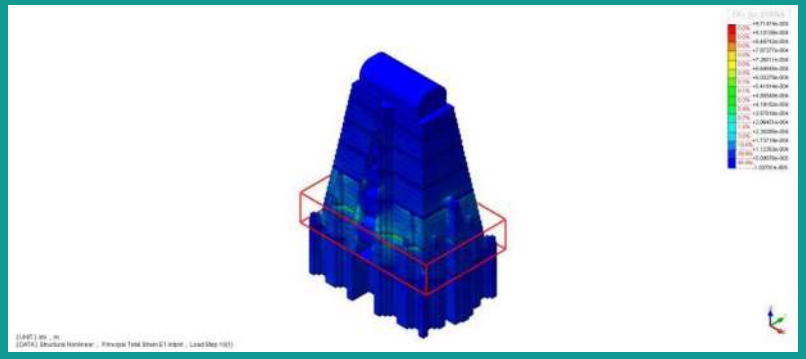
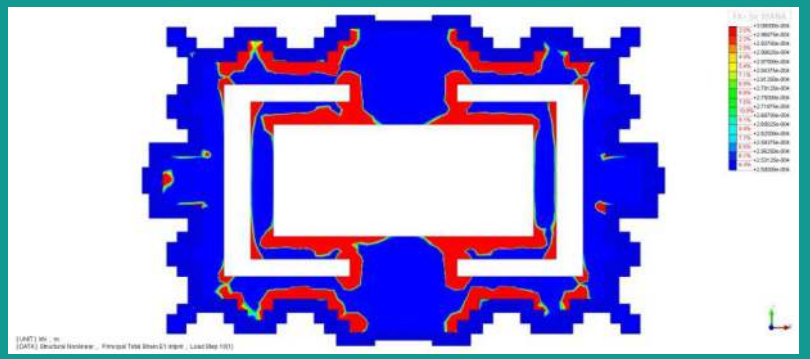
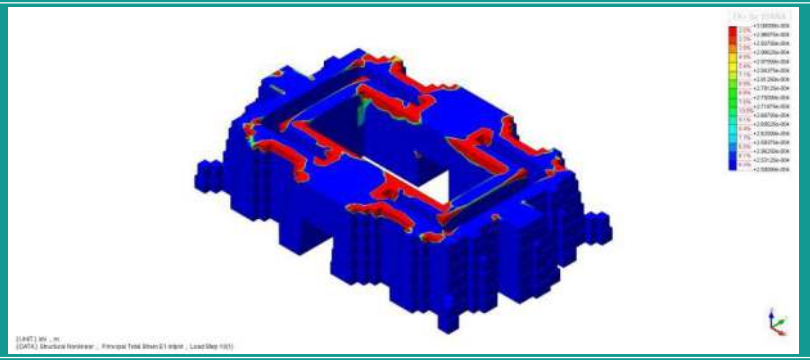
Figure 2: Numbering of existing floors of the temples as different levels.

CONFGURATION 1A

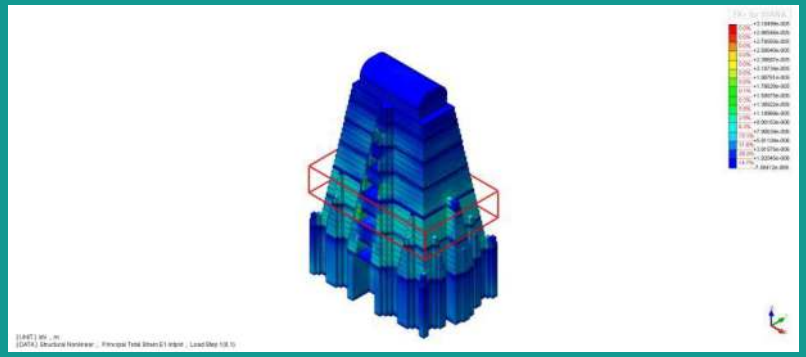
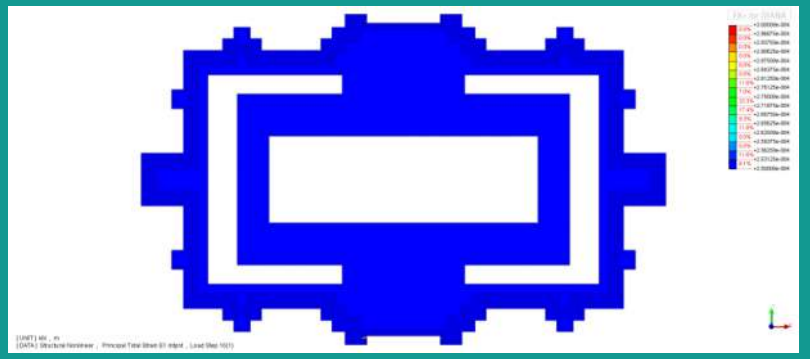
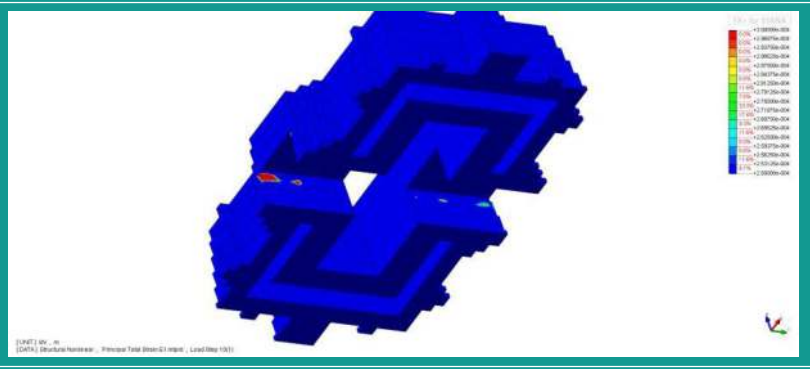
PRESENT and PROPOSED

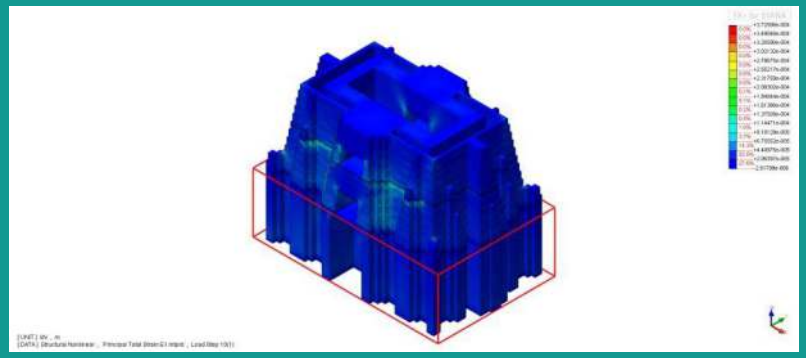
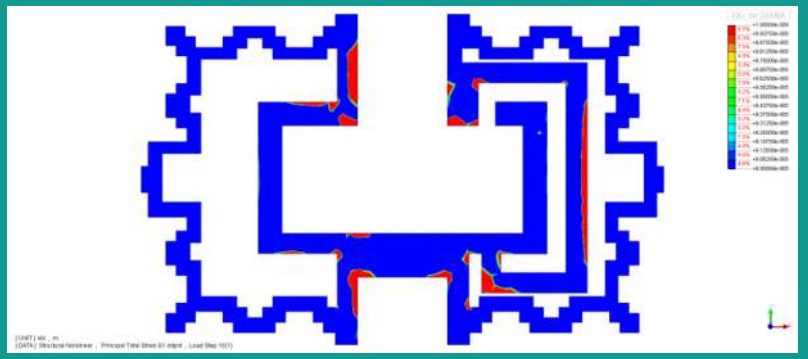
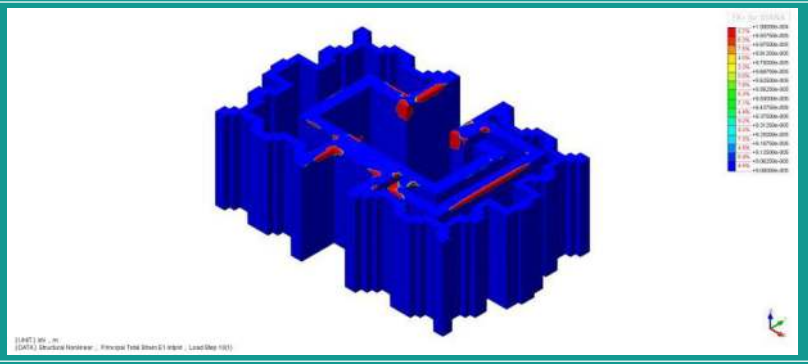
No significant tensile damages and hence critically weak sections of the structure cannot be identified in these configurations.

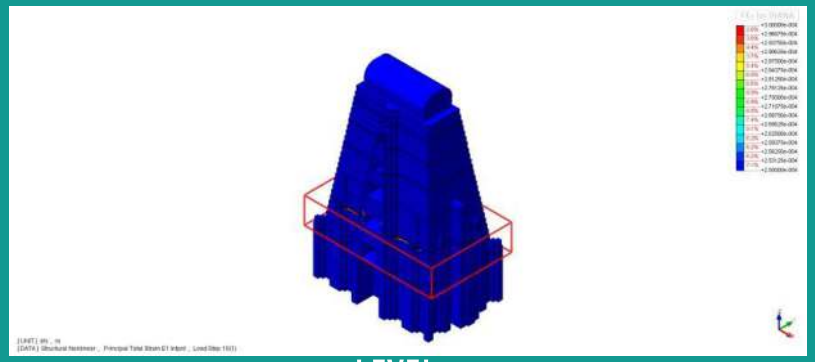
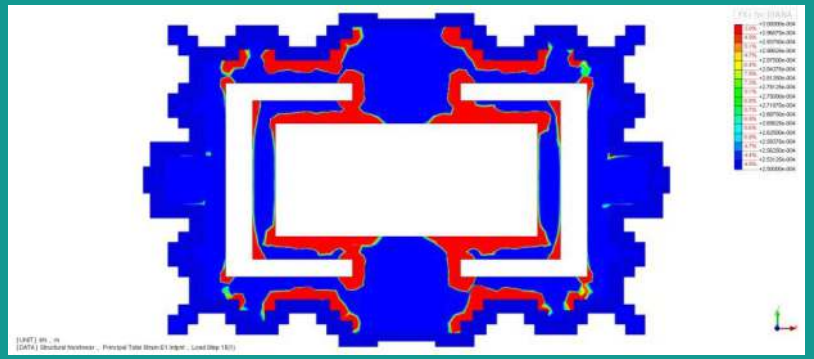
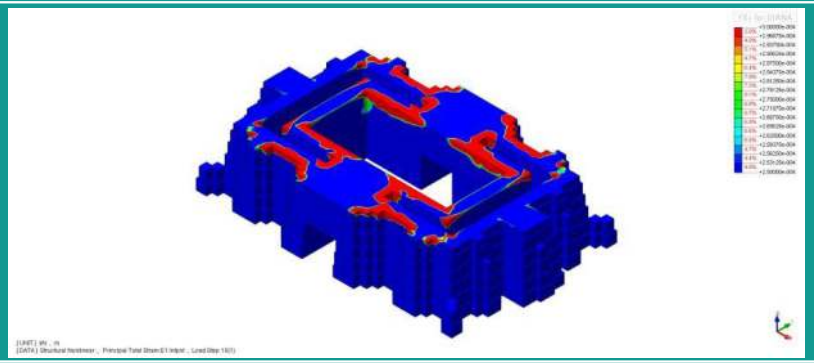
CONFIGURATION 1B PRESENT STATE	
CRITICAL SECTION LOCATION (CS)	TENSILE STRAINS IN CS
 LEVEL 1	 

CONFIGURATION 1B PROPOSED STATE	
CRITICAL SECTION LOCATION (CS)	TENSILE STRAINS IN CS
 LEVEL 2	 

No significant damage are seen in **CONFIGURATION 2A PRESENT STATE**

CONFIGURATION 2A PROPOSED STATE	
CRITICAL SECTION LOCATION (CS)	TENSILE STRAINS IN CS
 LEVEL 3	 

CONFIGURATION 2B PRESENT STATE	
CRITICAL SECTION LOCATION (CS)	TENSILE STRAINS IN CS
 LEVEL 1	 

CONFIGURATION 2B PROPOSED STATE	
CRITICAL SECTION LOCATION (CS)	TENSILE STRAINS IN CS
 LEVEL 2	 
Damages similar to CONFIGURATION 2A PROPOSED STATE are also observed in a similar location (Level 3).	

ADDITIONAL OBSERVATIONS

- No damages due to compressive stresses can be observed in any of the configurations.
- Damages are reported in terms of damages due to tensile stresses. The same is represented in terms of contours showing the distribution of principal strain S1. The range of contours in each figure shown in this note remains the same corresponding to each material i.e. the same range for brick masonry and the same range for stone masonry.
- **All configurations not considering the infill as a structural material show significant tensile damage in the present state of the structure which is not observed in-situ.**

SPECIMEN NO.	ULTIMATE COMPRESSIVE STRESS F_M(MPA)	H/T RATIO	CORRECTION FACTOR	CORRECTED F_M (MPA)
1	2.62	2.8125	0.8375	2.19
2	1.6	2.5000	0.8000	1.28
3	3.46	3.6360	0.9208	3.19

	GRANITE THICKNESS
C1	90 cm
C2	45 cm

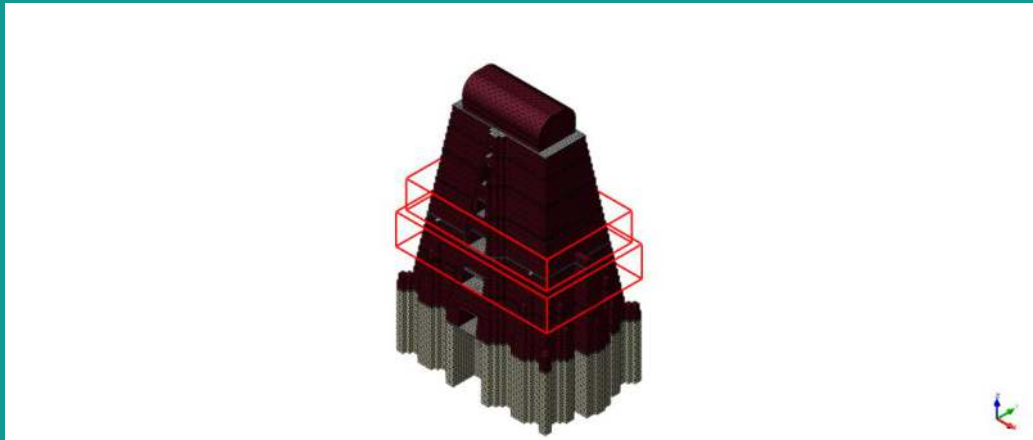
	BRICK1	BRICK2	BRICK3	GRANITE	BRICK INFILL	GRANITE INFILL
COMPRESSIVE STRENGTH (MPA)	1.28	2.19	3.46	4	0.2	0.4
MODULUS OF ELASTICITY (MPA)	400	700	1000	2200	200	550
POISSON'S RATIO	0.2	0.2	0.2	0.2	0.2	0.2
TENSILE STRENGTH (MPA)	0.2	0.2	0.2	0.2	0.1	0.1
FRACTURE ENERGY MODE I (COMPRESSION) (N/MM)	2.1	3.5	5.5	6.4	0.4	0.64
FRACTURE ENERGY MODE I (TENSION)(N/MM)	0.012	0.012	0.012	0.012	0.012	0.012
SPECIFIC WEIGHT (KN/M3)	19	19	19	24	15	19
FAILURE STRAIN IN TENSION	5.00E-04	2.86E-04	2.00E-04	9.00E-05	5.00E-04	1.81E-04
FAILURE STRAIN IN COMPRESSION	3.20E-03	3.13E-03	3.46E-03	1.80E-03	1.00E-03	7.27E-04

MODEL			BRICK		GRANITE		BRICK INFILL		STONE INFILL	
			T	C	T	C	T	C	T	C
BRI1.28	C1	PRESENT								
		PROPOSED	1					2		
	C2	PRESENT								
		PROPOSED	3					4		
BRI2.19	C1	PRESENT								
		PROPOSED	5							
	C2	PRESENT								
		PROPOSED	6							
BRI3.46	C1	PRESENT								
		PROPOSED	7							
	C2	PRESENT								
		PROPOSED	8							

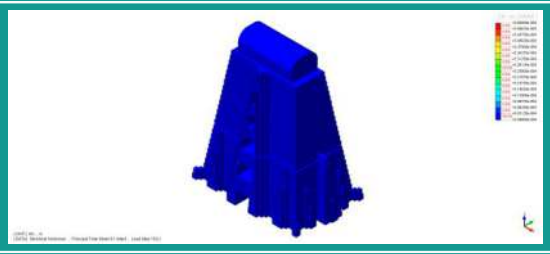
		LOCATION
1	LE NL INTERACTION FAILURE ?	LEVEL 3&4
2	BRICK INFILL COMPRESSIVE FAILURE	LEVEL 2
3	TENSILE AND LE NL INTERACTION FAILURE	LEVEL 3
4	BRICK INFILL COMPRESSIVE FAILURE	LEVEL 2
5	LE NL INTERACTION FAILURE ?	LEVEL3&4
6	TENSILE AND LE NLINTERACTION FAILURE	LEVEL3
7	LE NL INTERACTION FAILURE?	LEVEL3&4
8	TENSILE AND LE NL INTERACTION FAILURE	LEVEL 3

1,5 &7

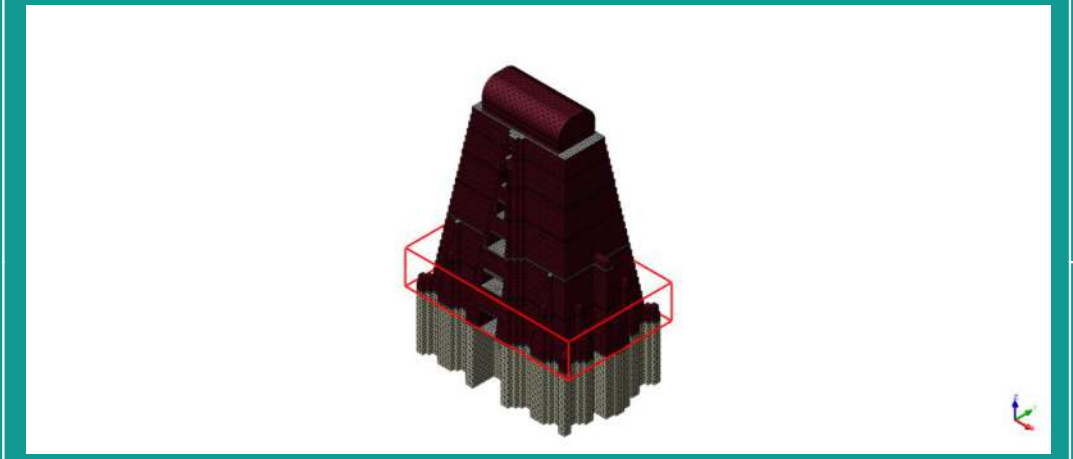
LE NL INTERACTION FAILURE ?	BRICK 1.28,2.19,3.46 C1 PROPOSED STATES
LOCATION	PRINCIPAL STRAINS S1



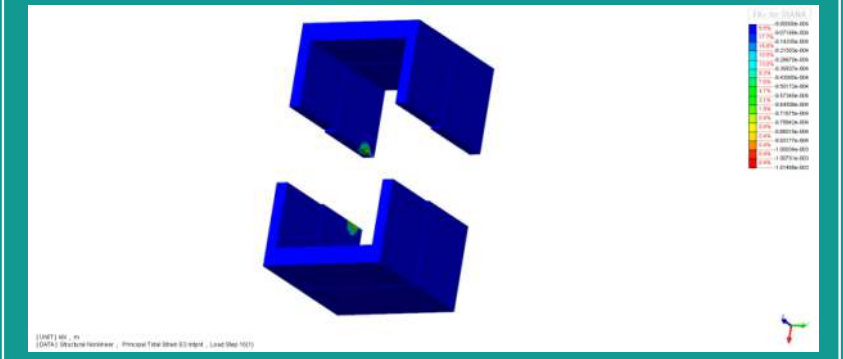
LEVEL 3&4

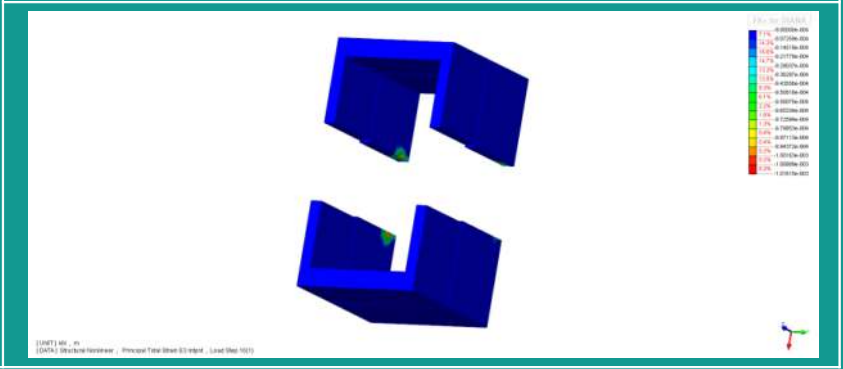


2 &4	
BRICK INFILL COMPRESSIVE FAILURE	BRICK 1.28 C1 & C2 PROPOSED STATES
LOCATION	PRINCIPAL STRAINS S3

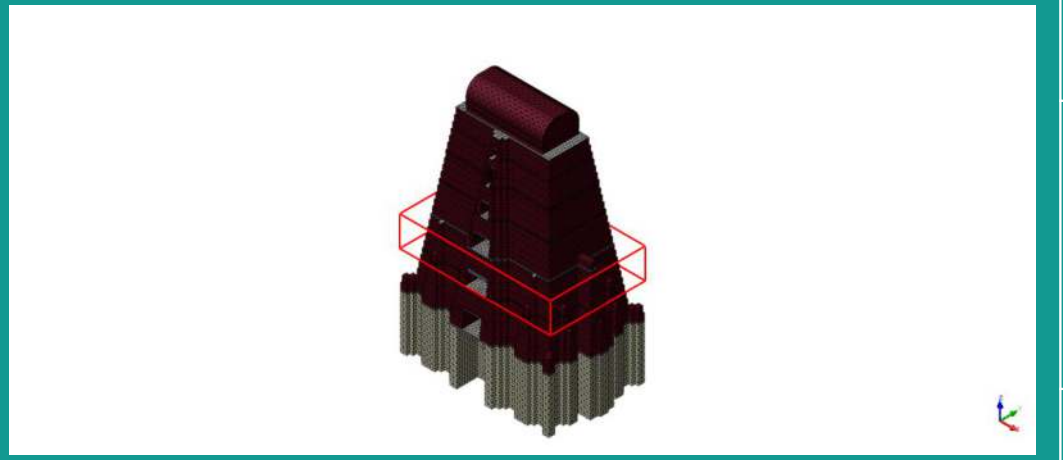
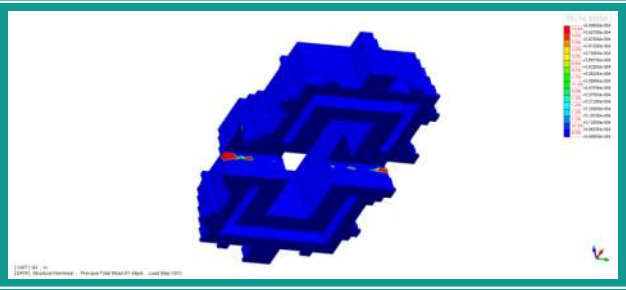
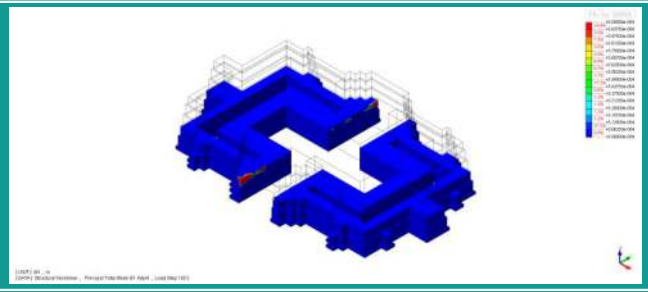
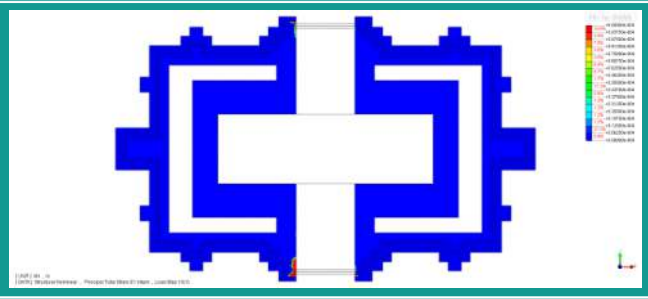


LEVEL 2

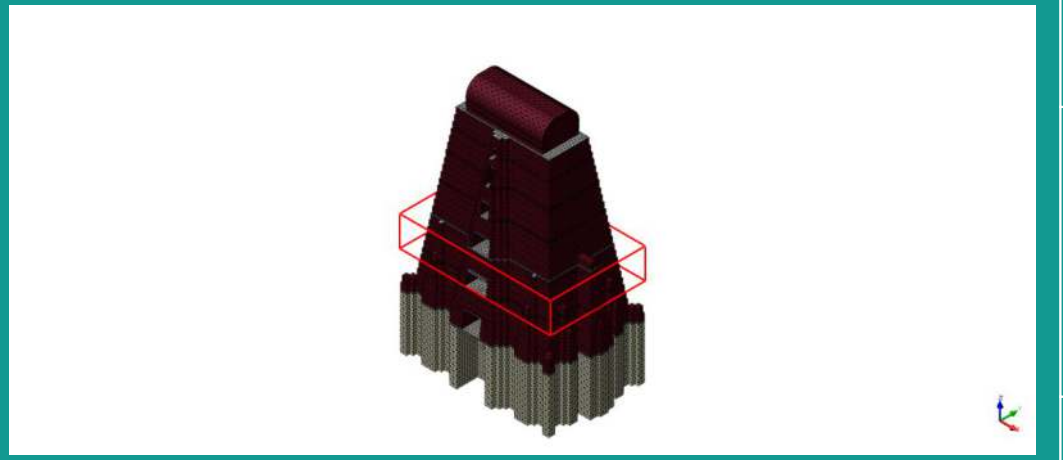
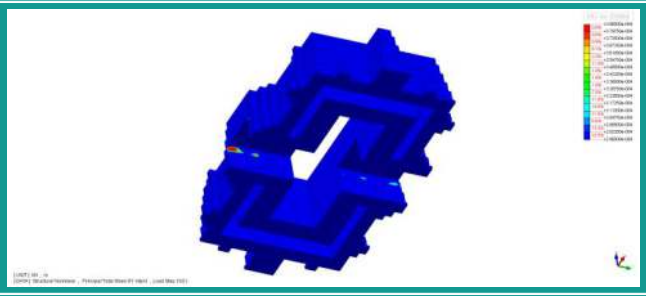
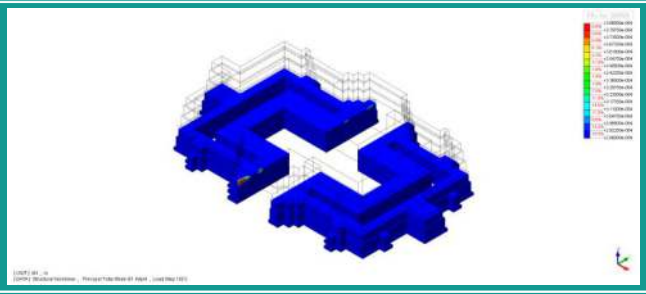
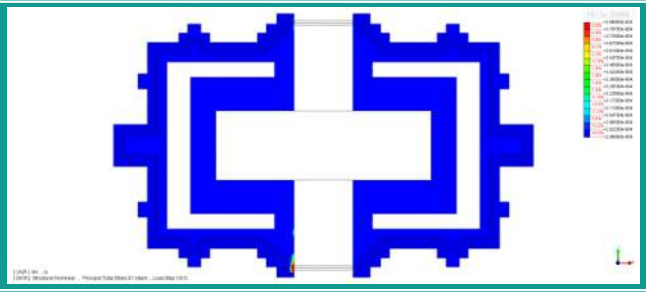




3

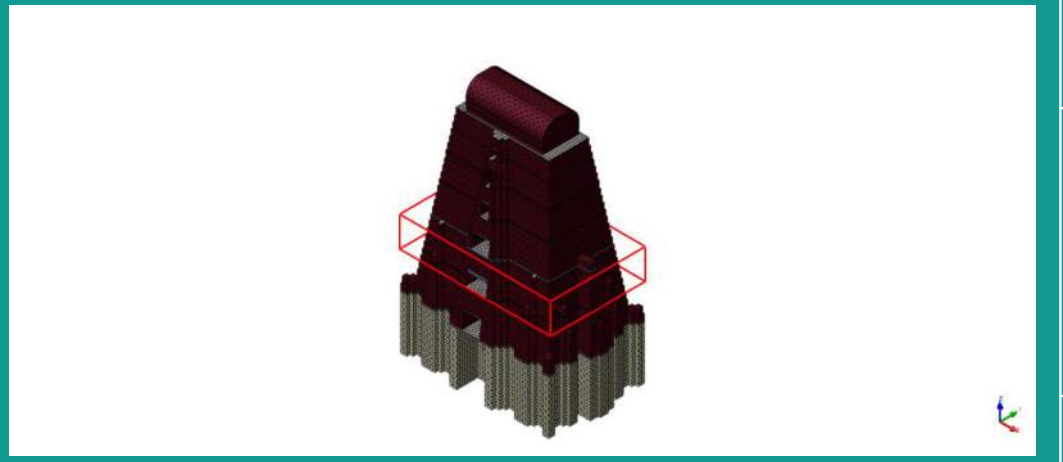
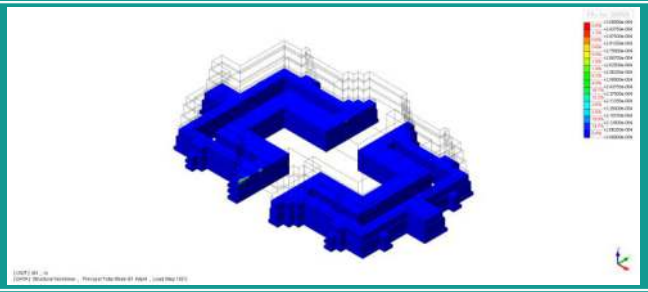
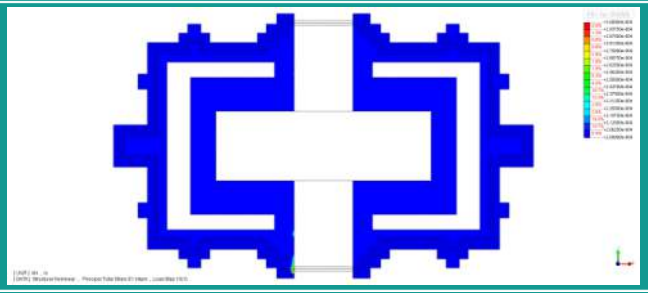
TENSILE AND LE NL INTERACTION FAILURE	BRICK 1.28 C2 PROPOSED STATES
LOCATION	PRINCIPAL STRAINS S1
	
LEVEL3	
	

6

TENSILE AND LE NL INTERACTION FAILURE	BRICK 2.19C2 PROPOSED STATES
LOCATION	PRINCIPAL STRAINS S1
	
	
	

LEVEL3

8

TENSILE AND LE NL INTERACTION FAILURE	BRICK 3.46C2 PROPOSED STATES
LOCATION	PRINCIPAL STRAINS S1
	
	
	

LEVEL3

OBSERVATIONS

- C1 shows no significant damage at all.
- Damages 3,6 & 8 are of primary interest and they occur only in C2. Additionally they decrease with increasing brick strength: almost negligible when the strength of brick masonry is assumed to be 3.46.
- A part of the damage is due to interaction of L and NL elements. Could this damage be aggravated by the concentration of stresses being caused by that ?
- How important is 2 &4 ??
- To see how much these results are influenced by the properties of the infill, the properties of the infill are varied and studied now.

UPDATED MATERIAL PROPERTIES

Note that only properties of granite Infill are increased to simulate grouting. Properties of brick infill are increased as grouting would be practically difficult in that region.

Also properties of both infill are lowered to consider " most" conservative cases for structural analyses.

	BRICK1	BRICK2	Brick3	GRANITE	BRICK INFILL	GRANITE INFILL	STRONGER GRANITE INFILL	WEAKER BRICK INFILL	WEAKER GRANITE INFILL
Compressive Strength (MPa)	1.28	2.19	3.46	4	0.2	0.4	0.8	0.2	0.2
Modulus of Elasticity (MPa)	400	700	1000	2200	200	550	1100	200	550
Poisson's Ratio	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Tensile Strength (Mpa)	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.05
Fracture Energy Mode I (Compression) (N/mm)	2.1	3.5	5.5	6.4	0.4	0.64	1.28	0.4	0.32
Fracture Energy Mode I (Tension)(N/mm)	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.006
Specific Weight (kN/m3)	19	19	19	24	15	19	20	15	19
Failure Strain in Tension	5.00E-04	2.86E-04	2.00E-04	9.00E-05	5.00E-04	1.81E-04	9.10E-05	5.00E-04	9.00E-05
Failure Strain in Compression	3.20E-03	3.13E-03	3.46E-03	1.80E-03	1.00E-03	7.27E-04	7.27E-04	1.00E-03	3.6E-04

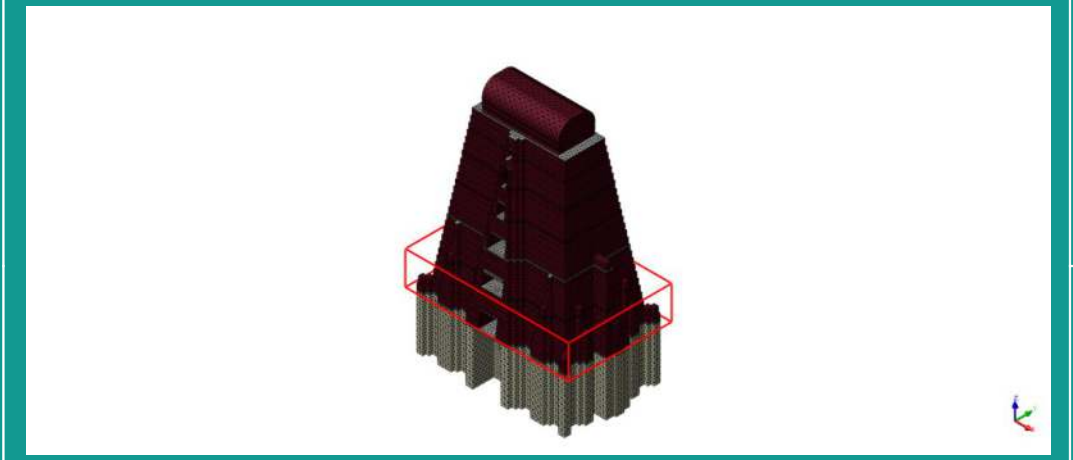
WEAKER INFILL

WEAKER INFILL

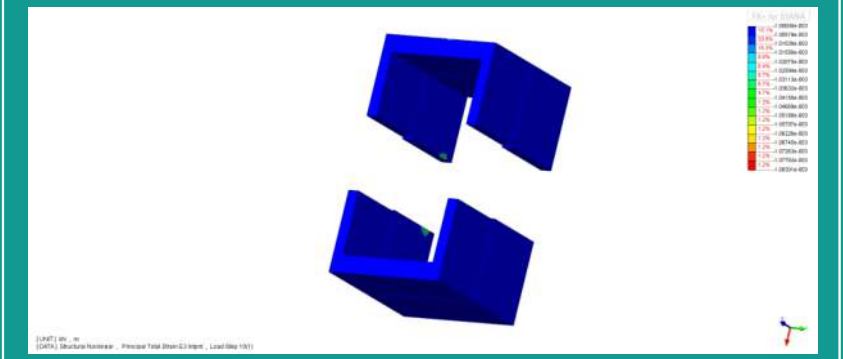
MODEL			BRICK		GRANITE		BRICK INFILL		STONE INFILL	
			T	C	T	C	T	C	T	C
BRI1.28	C1	PRESENT								
		PROPOSED	1					2		
	C2	PRESENT								
		PROPOSED	3					4		
BRI3.46	C1	PRESENT								
		PROPOSED	5							
	C2	PRESENT								
		PROPOSED	6							

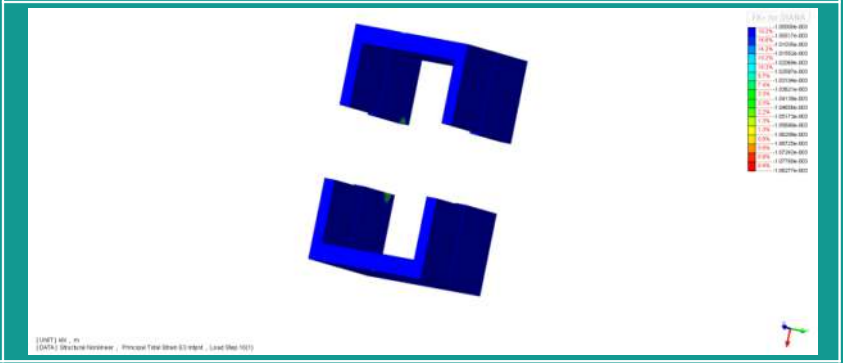
		LOCATION
1	LE NL interaction failure	LEVEL 3&4
2	Brick INFILL Compressive Failure	LEVEL 2
3	Failure and LE NL interaction failure	LEVEL 3
4	Brick INFILL Compressive Failure	LEVEL 2
5	LE NL interaction failure	LEVEL3&4
6	Failure and LE NL interaction failure	LEVEL 3

2 &4	
BRICK INFILL COMPRESSIVE FAILURE	BRICK 1.28 C1 & C2 PROPOSED STATES
LOCATION	PRINCIPAL STRAINS S3

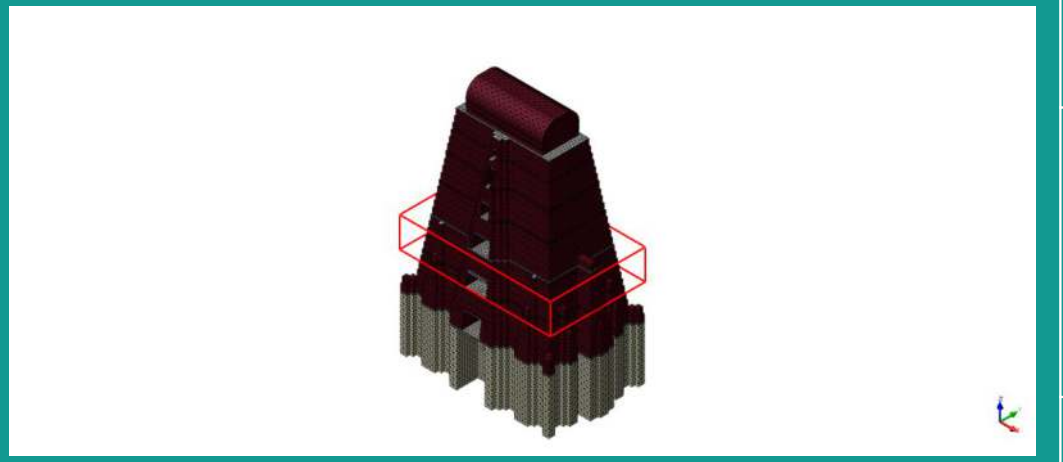
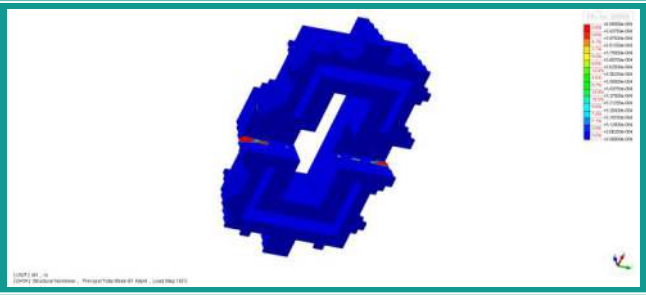
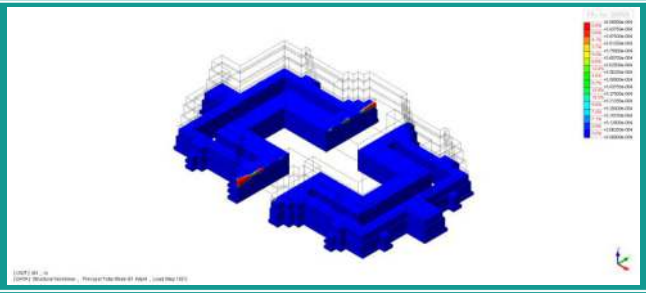
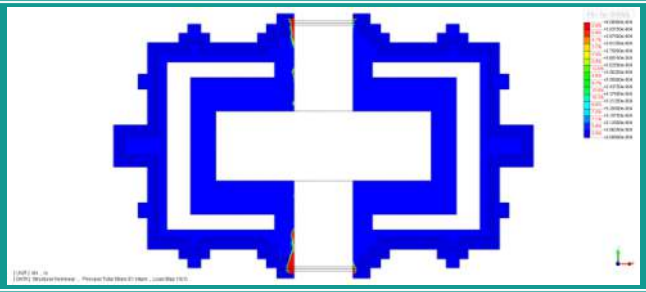


LEVEL 2



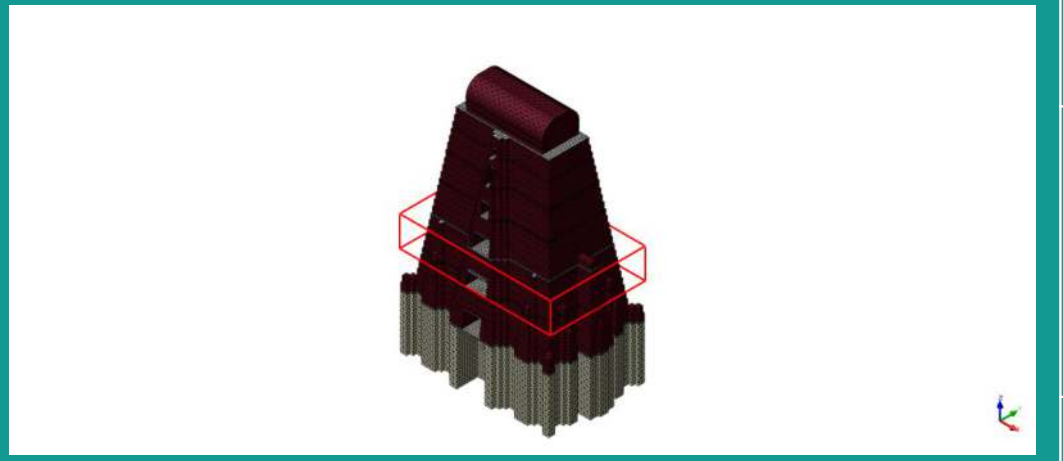
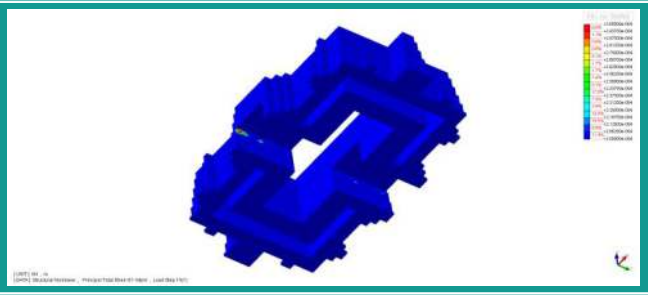
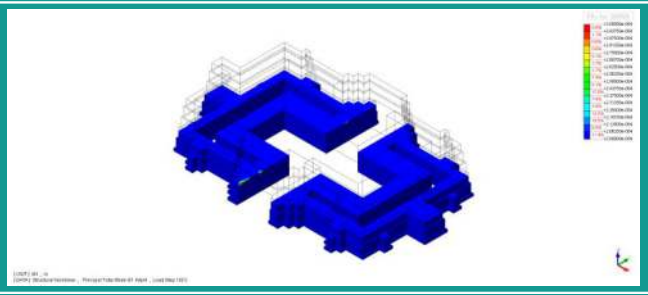
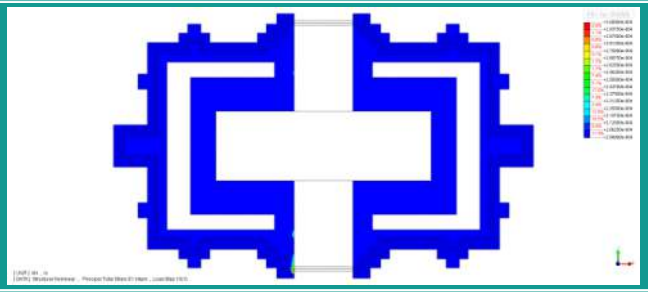


3

TENSILE AND LE NL INTERACTION FAILURE	BRICK 1.28 C2 PROPOSED STATES
LOCATION	PRINCIPAL STRAINS S1
	
	
	

LEVEL3

6

TENSILE AND LE NL INTERACTION FAILURE	BRICK 3.46C2 PROPOSED STATES
LOCATION	PRINCIPAL STRAINS S1
	
	
	

LEVEL3

OBSERVATIONS

- C1 shows no significant damage again.
- Damages 3, & 8 (6 here) are recurring again. Additionally they have increased with decreasing brick infill strength. Additionally they are significant even when the strength of brick masonry is assumed to be 3.46
- How important is 2 &4 ?? They are recurring again.

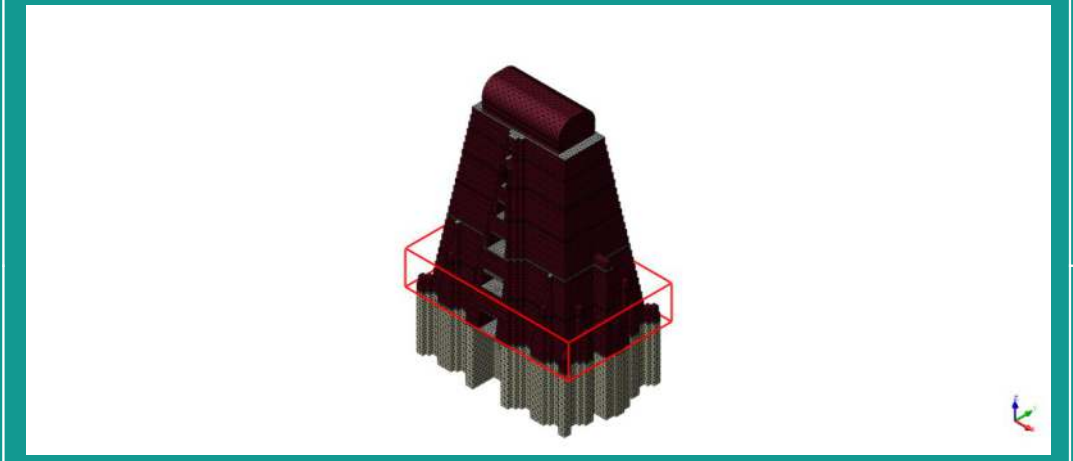
STRONGER INFILL

STRONGER INFILL

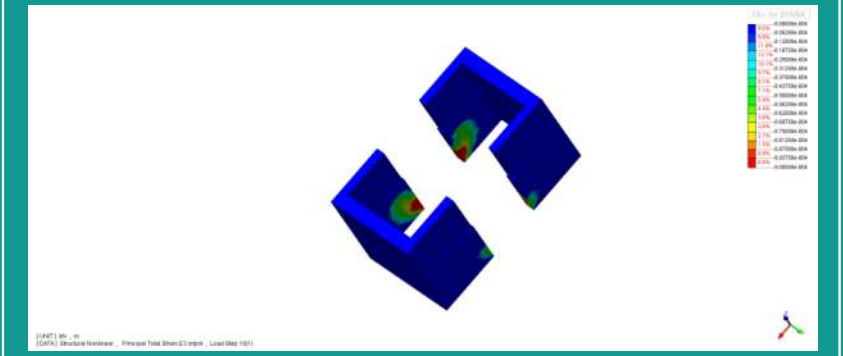
MODEL			BRICK		GRANITE		BRICK INFILL		STONE INFILL	
			T	C	T	C	T	C	T	C
BRI1.28	C1	PRESENT								
		PROPOSED	1					2		
	C2	PRESENT								
		PROPOSED	3					4		
BRI3.46	C1	PRESENT								
		PROPOSED	5							
	C2	PRESENT								
		PROPOSED	6							

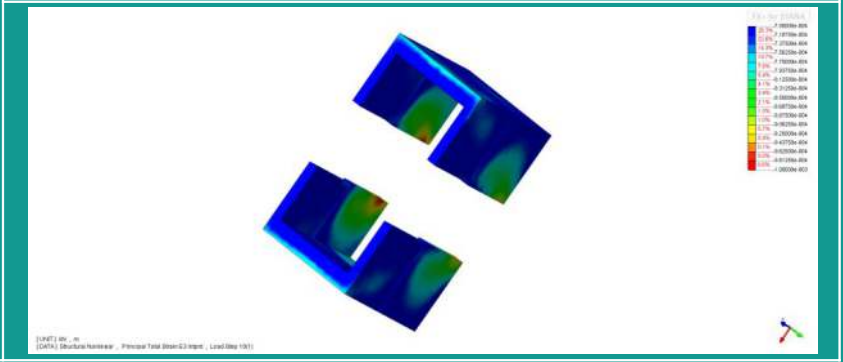
		LOCATION
1	LE NL interaction failure	LEVEL 3&4
2	Brick INFILL Compressive Failure	LEVEL 2
3	Failure and LE NL interaction failure	LEVEL 3
4	Brick INFILL Compressive Failure	LEVEL 2
5	LE NL interaction failure	LEVEL3&4
6	Failure and LE NL interaction failure	LEVEL 3

2 &4	
BRICK INFILL COMPRESSIVE FAILURE	BRICK 1.28 C1 & C2 PROPOSED STATES
LOCATION	PRINCIPAL STRAINS S3



LEVEL 2





OBSERVATIONS

- C1 shows no significant damage again.
- Damages 3, & 8 (6 here) are recurring again. However making stone infill stronger have not bought much changes in these damages.
- 2 & 4 occur and these damages have increased.

MAKING ENTIRE BRICK REGION SOLID (Demolishing and reconstructing)

MAKING ENTIRE BRICK REGION SOLID (Demolishing and reconstructing)

- No damages seen in this case. Analysis performed assuming that new brick i.e. all the brick masonry in the model will have strength of at least 3.46 MPa.
- **This is safe completely even when weaker stone infill is assumed.**

DEMOLISHING LEVEL 3 BUT KEEPING LEVEL 2

DEMOLISHING LEVEL 3 BUT KEEPING LEVEL 2

This implies that LEVEL 3 is solid brick masonry(having a strength of 3.46 MPa here)and LEVEL 2 has solid brick masonry plus infill as well. Depending on the assumed strength of brick masonry in LEVEL 2, we have the following cases:

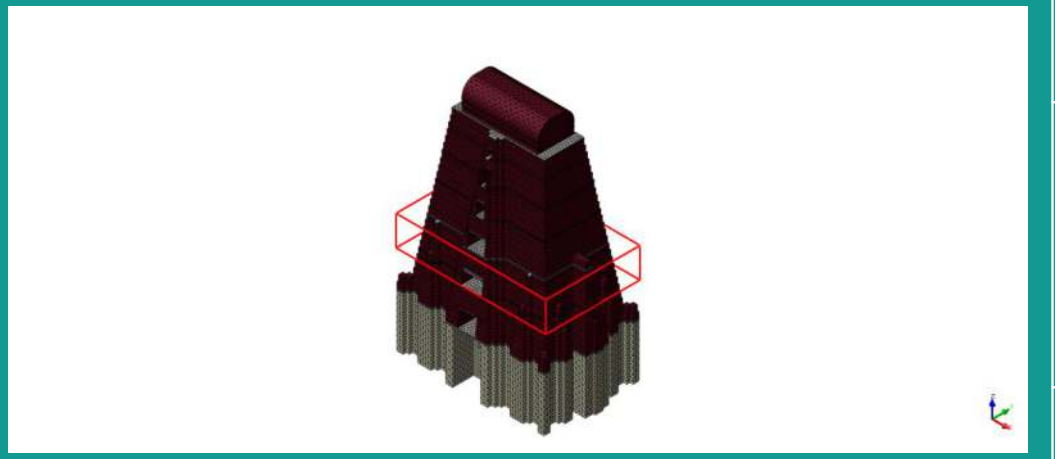
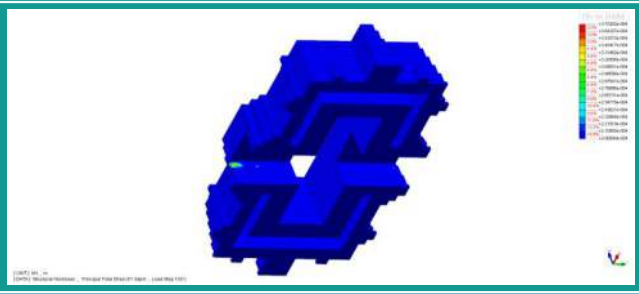
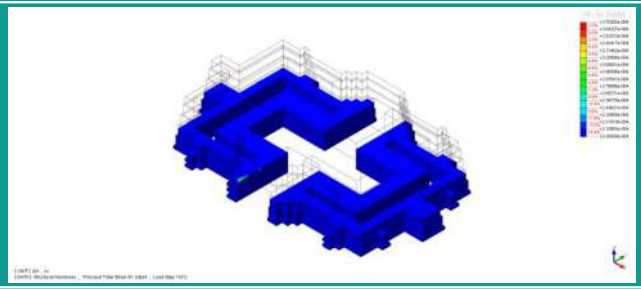
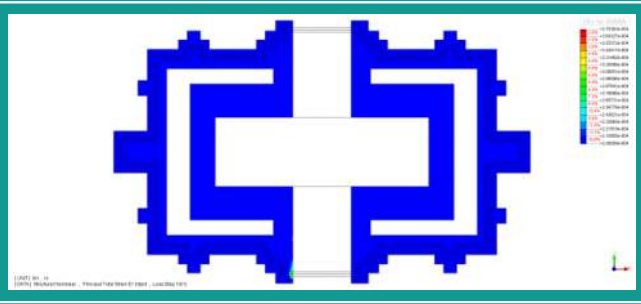
	STRENGHT OF BRICK MASONRY IN LEVEL 2
A	1.28
B	2.19
C	3.46

Only C2 has been considered since C1 is not showing any failure even without these measures to strengthen the structure. Properties of infill correspond to the values originally assumed.

MODEL			BRICK		GRANITE		BRICK INFILL		STONE INFILL	
			T	C	T	C	T	C	T	C
A	C2	PRESENT								
		PROPOSED	1							
B	C2	PRESENT								
		PROPOSED	2							
C	C2	PRESENT								
		PROPOSED	3							

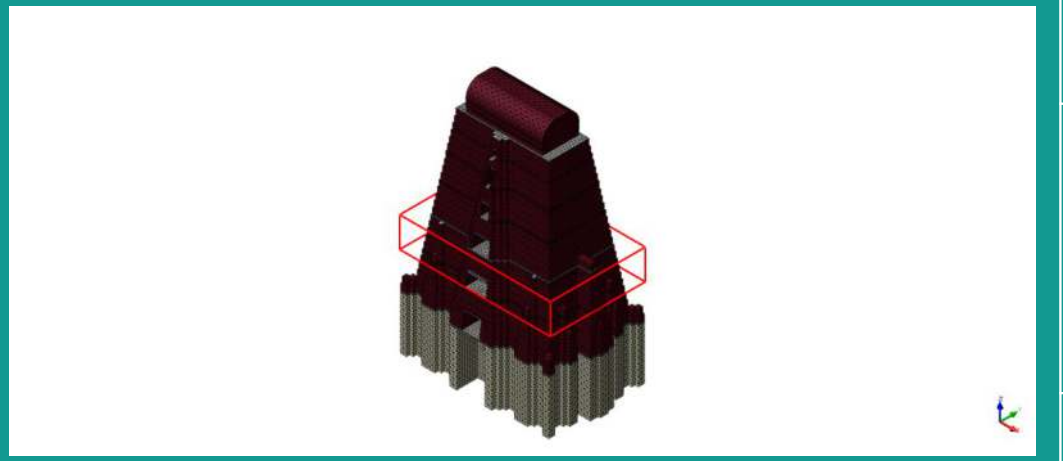
		LOCATION
1	Minor Failure and LE NL interaction failure	LEVEL 3
2	Minor Failure and LE NLinteraction failure	LEVEL 3
3	Minor Failure and LE NL interaction failure	LEVEL 3

1

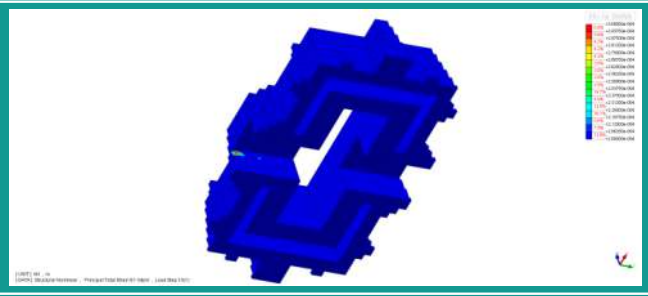
TENSILE AND LE NL INTERACTION FAILURE	A
LOCATION	PRINCIPAL STRAINS S1
 LEVEL3	  

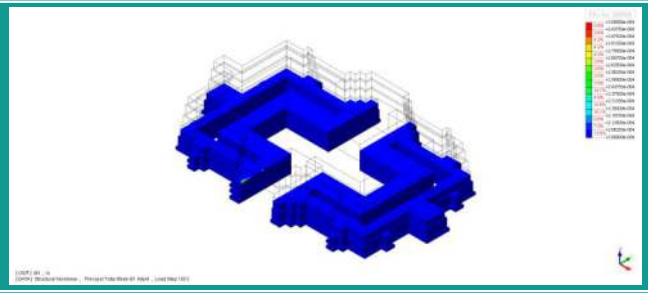
2

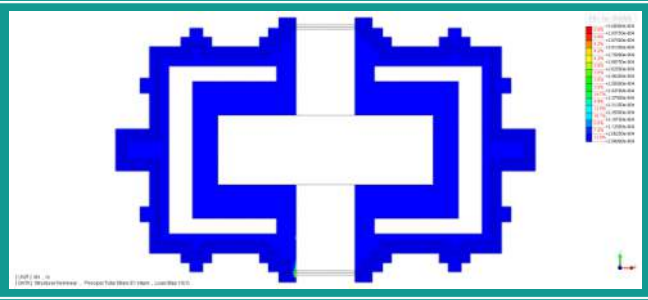
TENSILE AND LE NL INTERACTION FAILURE	B
LOCATION	PRINCIPALSTRAINS S1



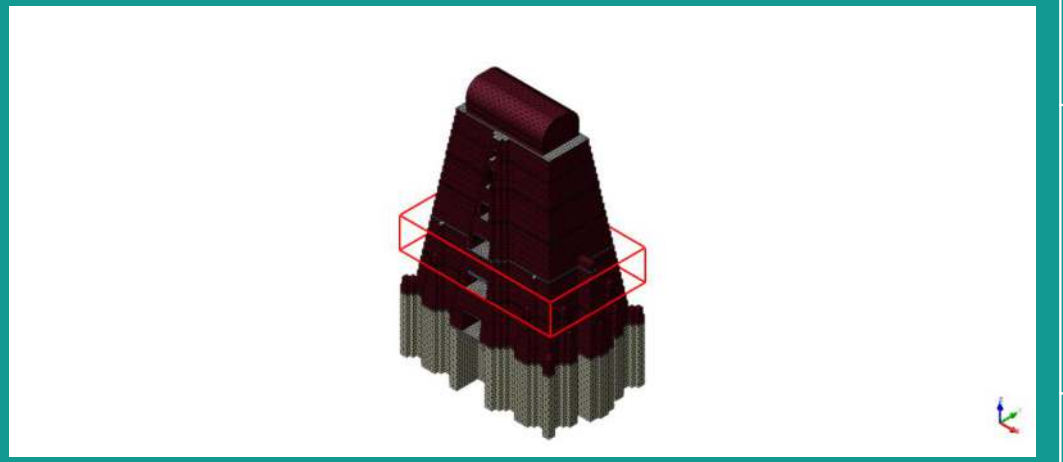
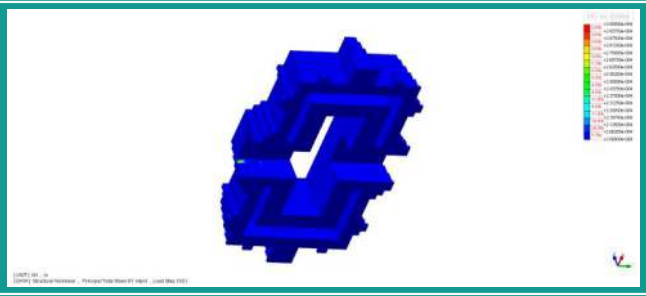
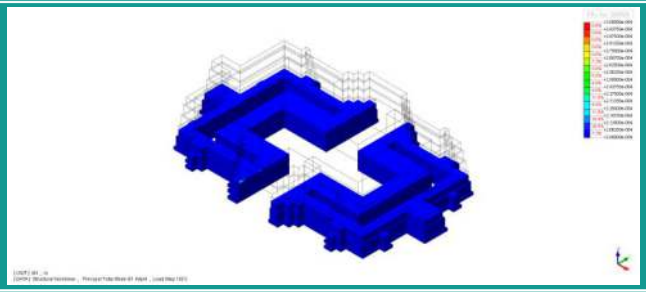
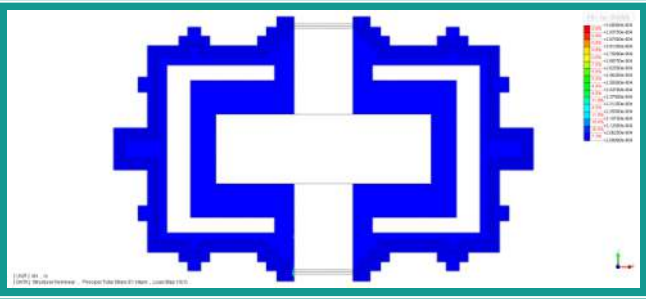
LEVEL3







3

TENSILE AND LE NL INTERACTION FAILURE	C
LOCATION	PRINCIPAL STRAINS S1
	
	
	

LEVEL3

6.2 NIT - TRICHY REPORT

Feasibility Study on Construction of
RAJAGOPURAM OVER THE EXISTING KALHARAM AT SHRI PUNDARIKATCHA PERUMAL TEMPLE THIRUVALLARAI

Client

The Joint Commissioner
Arulmigu AranganathaSwamy Thirukovil
Srirangam Tiruchirappalli
(Letter No.1719/1414/D5/Dated 19.02.2014)

Report-2
13th August 2014

Department of Civil Engineering
National Institute of Technology
Tiruchirappalli – 620 015

FEASIBILITY STUDY ON CONSTRUCTION OF RAJAGOPURAM OVER THE EXISTING KALHARAM AT SHRI PUNDARIKATCHA PERUMAL TEMPLE, THIRUVALLARAI

1. INTRODUCTION

The authorities of Arulmigu aranganathaswamy Temple Srirangam have decided to construct seven tier Rajagopuram over the existing kalharam at the entrance of the Sri Pundarikathcha Perumal Kovil at Thiruvellarai.

The Joint Commissioner, Arulmigu Ranganathar Temple, Srirangam Trichy, vide letter No.1719/1414/D5 dated 19.02.2014 has requested for the technical expertise report, about the feasibility of the construction of new seven tier Rajagopuram over the existing structure(Kalharam) in the entrance of Sri Pundarikatchaperumal Kovil , Thiruvellarai, from the National Institute of Technology Tiruchirappalli – 620 015.

The scope of work is not limited to and include inspection of the incomplete Raja Gopuram at Shri Pundarikatcha Perumal Temple, Thiruvallarai, Trichy District and to provide a feasibility/technical scheme to complete/rehabilitate the construction of Raja Gopuram. This report presents the details of the inspection and recommendations.

2. INSPECTION TEAM MEMBERS

The following are the members of the team which conducted the few rounds of site visit to the incomplete Raja Gopuram at Shri Pundarikatcha Perumal Temple, Thiruvallarai on various days.

1. Dr. G. Swaminathan, Professor, Dept. of Civil Engg., NITT.
2. Dr. K. Baskar, Associate Professor, Dept. of Civil Engg., NITT.
3. Dr. K. Muthukkumaran, Associate Professor, Dept. of Civil Engg., NITT.
4. Er. S. Kannan, Assistant Executive Engineer, HR&CE, Srirangam
5. Er. V. Nandakumar, Oversear, HR&CE, Srirangam
6. Shri. Srinivasa Rengarao, Superindent, Thiruvallarai Temple
7. Shri. C. Ramachandran, Auditor, 97 North Chithirai Street, Srirangam

3. DETAILS OF THE BUILDING INSPECTED

i. Name : Raja Gopuram
ii. Location : Thiruvallarai Temple.
iii. Year of Construction : Date Back to Mythological period (Said to be older than Srirangam Temple)
iv. Status quo of the structure on the date of inspection

a. Superstructure: At present, an incomplete part of Raja Gopuram exists in the main entrance of the temple, facing North direction and provided in the main entrance to the temple. The main and first deck of the Raja Gopuram is constructed with typical RR stone masonry. Above the first deck, there exists an incomplete brick masonry deck.

b. Foundation: Two open pits were made adjacent to the outer side of the Rajagopuram to inspect the type of foundation and the resting status. It is revealed that a stone masonry stepped shallow foundation is employed and is resting at a depth of around 3.0m from the existing ground level. The foundation is laid over a medium weathered rock with a sand cushion of 600mm.

c. Soil Investigation: Two Boreholes were made at the Rajagopuram site. Standard Penetration Tests were conducted at every 1m interval and soil samples were collected and tested in the laboratories. Boreholes (BH-01 & 02) were terminated at a depth of 10.0m and 6.0m respectively below EGL. Ground water table was not encountered within the investigation depth. Rock core samples were recovered for rock quality estimation. From the field investigation, it is observed that the encountered soil in borehole one (BH-01/ drilled inside the temple) up to 1.0m depth is made-up soil (filling soil) and followed by medium to dense soil up to 3.0m below EGL. From 3.20m onwards a layer of partially weathered rock/unweathered with RQD values 20 to 60 was encountered up to end of borehole i.e. 6.5m below EGL. In borehole two (BH-02/ drilled outside the temple) up to 3m depth is made-up (filling soil) soil with medium compactness and followed by soft disintegrated rock (SDR) up to 7.0m and then partially weathered rock/unweathered with RQD 20 to 50%.

4. OBSERVATIONS MADE DURING INSPECTION

a. Some kind of distress is observed in the RR stone masonry first deck. It was informed by the trust board members that the distress was noted earlier and was strengthened using in-situ reinforced concrete sections at appropriate places.
b. It was informed that the RR stone masonry would be a peripheral one and the inside may be filled with filler materials.
c. Settlement cracks were observed near southeast corner of the Raja Gopuram structure.

5. CONCLUSION AND RECOMMENDATION

i. NITT team studied the construction drawings of the Rajagopuram which are prepared by S. Natarajan Sthapathy and approved by the temple committee.
ii. Gravity loads and lateral loads were arrived and checked for the stability of the Rajagopuram and is found to be safe at all the seven tiers. The detailed design calculation is as attached in Annexure-1
iii. From the analysis, it is noted that the maximum reaction from structure to the foundation strata below rajagopuram is 48 ton/m^2.
iv. Based on the geotechnical investigation, the proposed type of foundation is Raft with foundation depth of 4.0m from EGL.

The hereditary image of the Raj Gopuram has to be brought out and the team is of the opinion that restoration/construction can be carried out to bring the Raja Gopuram to its desired form.

Dr. K. Muthukkumaran	**Dr. K. Baskar**	**Dr. G. Swaminathan**
Associate Professor	Associate Professor	Professor

Annexure -I Thiruvallarai Rajagopuram - Seismic Analysis

Zone factor, Z =		0.16		Temple project									
Imp. Factor, I =		1.5		Seismic zone assumed as III									
Resp Red Fac, R =		1.5		Natual period assume as 2.96 sec									
Natl prd assumd,		0.5		the yellow cells may be modified and corresponding									
Sa/g		0.54		results may be seen.									
Ah		0.0432							Inputs				
Vb		4762.152			hl.forces, in kN								
8	33.45	3813	4266375	4762.152	656.73	F8 at storey 8				3.6	1.8		
7	29.85	3482	3102540	4762.152	477.58	F7 at storey 7				2.23	1.115		
6	27.62	5392	4113365	4762.152	633.17	F6 at Storey 6				2.74	1.37		
5	24.88	8089	5007207	4762.152	770.76	F5 at Storey 5				3.28	1.64		
4	21.6	10090	4707590	4762.152	724.64	F4 at Storey 4				3.77	1.885		
3	17.83	13403	4260933	4762.152	655.89	F3 at Storey 3				4.3	2.15		
2	13.53	22286	4079695	4762.152	627.99	F2 at storey-2				7.87	3.935		
1	5.66	43680	1399315	4762.152	215.40	F1 at storey-1				5.66	2.83		
		110235	30937022										
							P/A+M/z	P/A-M/z		e' lim	e' actual		
	P, kN	M, kN-m	Area, m^2	I, m^4	P/A N/mm^2	M/Z, Mpa	Mpa	Mpa	Z, m^3	Z/A	M/P		
8	3813	1182.106	35	239	0.11	0.02	0.13	0.09	68.85	1.97	0.31	Safe	
7	7295	3179.1	74	641	0.10	0.02	0.12	0.08	145.7	1.97	0.44	Safe	
6	12687	7154.531	94.8	906	0.13	0.04	0.17	0.10	193.5	2.04	0.56	Safe	
5	20776	14215.89	122.6	1422	0.17	0.05	0.22	0.12	269.59	2.20	0.68	Safe	
4	30866	25150.99	129.6	1914.8	0.24	0.08	0.32	0.16	323	2.49	0.81	Safe	
3	44269	40591.52	151.2	2843	0.29	0.10	0.39	0.20	421.23	2.79	0.92	Safe	
2	66555	73903.34	230.68	5881.6	0.29	0.10	0.39	0.19	743	3.22	1.11	Safe	
1	110235	100247.5	300	7767.6	0.37	0.10	0.47	0.26	971	3.24	0.91	Safe	
						Max	0.47	0.26					
						Min	0.12	0.08					
	Maximum reaction under earthquake load =					48.00	t/m^2						

NATIONAL INSTITUTE OF TECHNOLOGY, TRICHY BORING LOG

PROJECT NAME: GI for the Proposed Reconstruction of Rajagopuram at Shripundarikatcha Perumal Temple, Thiruvallarai

LOCATION: Shripundarikatcha Perumal Temple, Thiruvallarai (inside temple)

COORDINATES:	NORTH: --	TYPE OF BORING: Rotary Drilling	BORING NO: **BH - 01**
	EAST: ---	DIA. OF BORING: 150mm.	
GROUND ELEVATION:		DIA. OF UNDISTURBED SAMPLE: --	DATE COMMENCED: 14.05.2014
DEPTH OF GROUNDWATER TABLE: -- Nil		CASING HAMMER WT. & DROP: N. A	DATE COMPLETED: 16.05.2014
		HAMMER WT. & DROP: 63.5 kg / 760mm	

Depth (m)	Sample Type & Number	Sample Blows per 30cm	Moisture Content %	Passing 75 mm	Soil Symbol	Classification	DESCRIPTION
1							Sand with silt (filling soil)
2	SPT-1	22		0		SP	Medium dense, poorly graded sand
3	SPT-2	26		2		SP	Medium dense, poorly graded sand
4	SPT-3	38		0		SP	Medium dense, poorly graded sand
5	R-1					PWR	Partially weathered rock: REC=50% & RQD=20%
6	R-2					ROCK	Unweathered rock: REC=60% & RQD=40%
6.5	R-3					ROCK	Unweathered rock: REC=90% & RQD=60%

Borehole terminated at 6.5m depth

LEGEND:

SPT - 1 : STANDARD PENETRATION TEST & NUMBER
UDS : UNDISTRUBED SAMPLE
H - 1 : HAND SAMPLE & NUMBER
R - 1 : ROCK CORE RUN & NUMBER
RQD : ROCK QUALITY DESIGNATION

▼ : WATER TABLE

REC : ROCK CORE RECOVERY
SDR : SOFT DISINTEGRATED ROCK
HWR : HIGHLY WEATHERED ROCK
PWR : PARTIALLY WEATHERED ROCK
ROCK : UNWEATHERED ROCK

Fig. 1

NATIONAL INSTITUTE OF TECHNOLOGY, TRICHY BORING LOG

PROJECT NAME: GI for the Proposed Reconstruction of Rajagopuram at Shripundarikatcha Perumal Temple, Thiruvallarai

LOCATION: Shripundarikatcha Perumal Temple, Thiruvallarai (inside temple)

COORDINATES:	NORTH: --	TYPE OF BORING: Rotary Drilling	BORING NO: **BH - 02**
	EAST: ---	DIA. OF BORING: 150mm.	
GROUND ELEVATION:		DIA. OF UNDISTURBED SAMPLE: --	DATE COMMENCED: 17.05.2014
DEPTH OF GROUNDWATER TABLE: -- Nil		CASING HAMMER WT. & DROP: N. A	DATE COMPLETED: 19.05.2014
		HAMMER WT. & DROP: 63.5 kg / 760mm	

Depth (m)	Sample Type & Number	Sample Blows per 30cm	Moisture Content %	Passing 75 mm	Soil Symbol	Classification	DESCRIPTION
1							Sand with silt (filling soil)
2	SPT-1	17		2		SP	Medium dense, poorly graded sand with gravel
3	SPT-2	12		1		SP	Medium dense, poorly graded sand
4	SPT-3	15		1		SP	Medium dense, poorly graded sand with gravel
5	SPT-4	68		1		SP	Very dense, poorly graded sand
6	SPT-5	63		1		SP	Very dense, poorly graded sand with gravel
7	SPT-6	53		20		SM	Very dense, poorly graded sand with gravel
8	SPT-7	68				SDR	Soft disintegrated rock, REC=0 & RQD=0
9	R-1						Unweathered rock: REC=30% & RQD=20%
10	R-2						Unweathered rock: REC=60% & RQD=40%
	R-3						Unweathered rock: REC=90% & RQD=50%

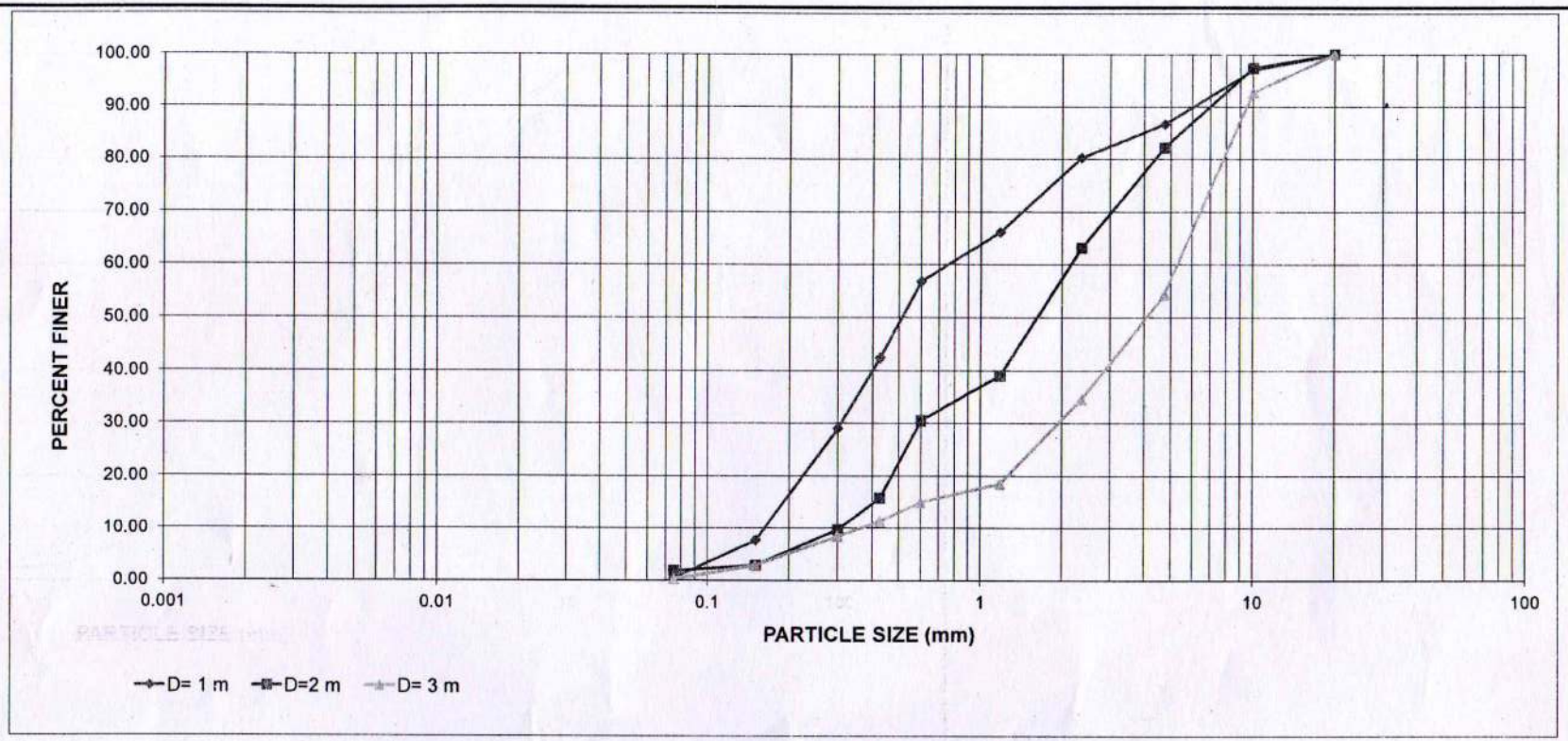
Borehole terminated at 10m depth

LEGEND:

SPT - 1 : STANDARD PENETRATION TEST & NUMBER
UDS : UNDISTRUBED SAMPLE
H - 1 : HAND SAMPLE & NUMBER
R - 1 : ROCK CORE RUN & NUMBER
RQD : ROCK QUALITY DESIGNATION
▼ : WATER TABLE

REC : ROCK CORE RECOVERY
SDR : SOFT DISINTEGRATED ROCK
HWR : HIGHLY WEATHERED ROCK
PWR : PARTIALLY WEATHERED ROCK
ROCK : UNWEATHERED ROCK

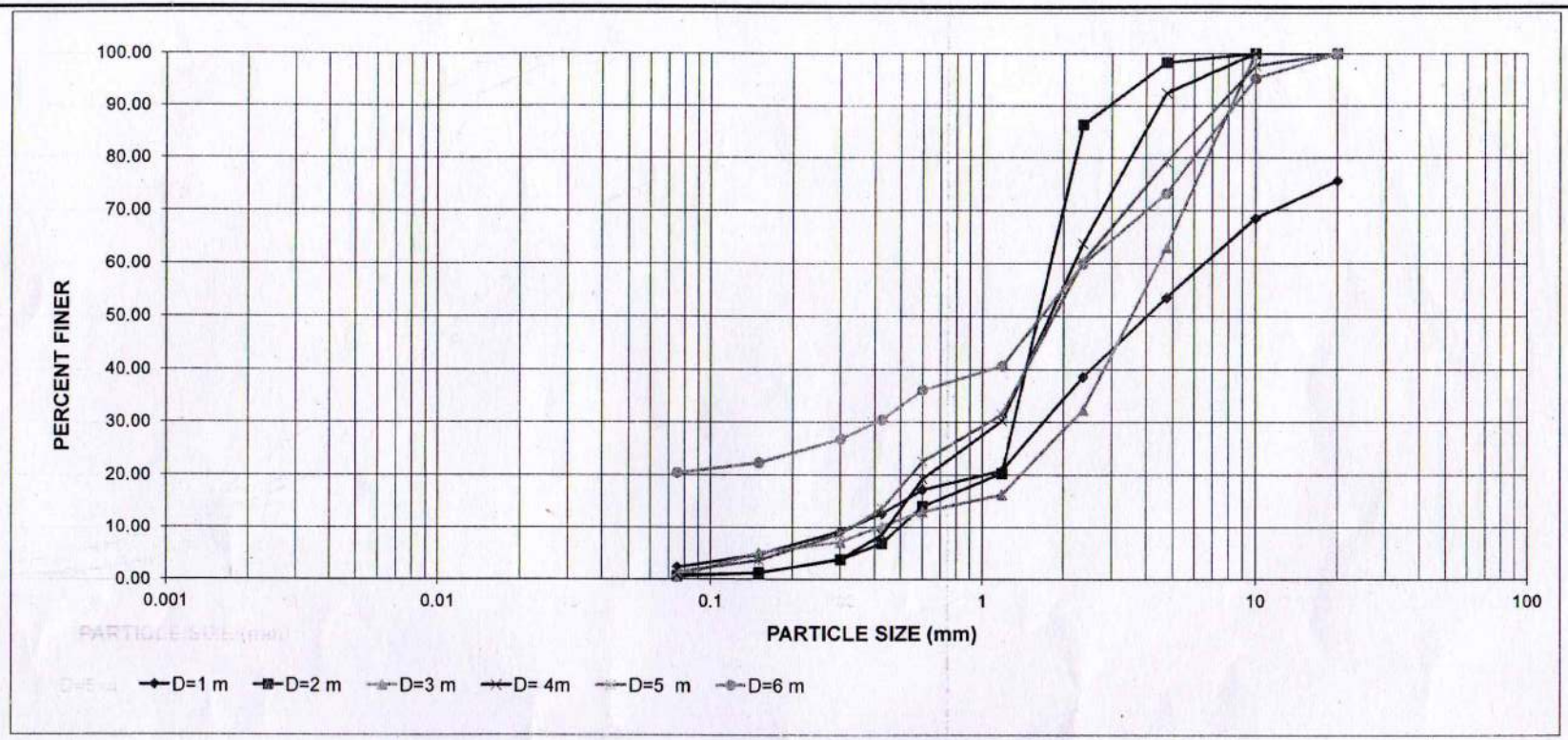
Fig. 2



BH No.	Depth (m)	% Passing			Atterberg Limits		U.S.C Group
		# 4	# 40	# 200	LL%	PI%	
BH-01	1	87	42	0			SP
BH-01	2	82	16	2			SP
BH-01	3	54	11	0			SP

NOTE:
Particle size analysis of soils was done in accordance with IS2720 (Part-4) /ASTM D-422. Soils were classified following IS 1498/ASTM D-2487

Fig. 3



BH No.	Depth (m)	% Passing			Atterberg Limits		U.S.C Group
		# 4	# 40	# 200	LL%	PI%	
BH-02	1	53	13	2			SP
BH-02	2	98	7	1			SP
BH-02	3	63	10	1			SP
BH-02	4	92	8	1			SP
BH-02	5	79	14	1			SP
BH-02	6	73	30	20			SM

NOTE:
Particle size analysis of soils was done in accordance with IS2720 (Part-4) /ASTM D-422. Soils were classified following IS 1498/ASTM D-2487

Fig. 4

D= 1 m	20	0	0.00	0.00	100.00
	10	7.5	7.50	3.00	97.00
	4.75	26.1	33.60	13.44	86.56
	2.36	15.9	49.50	19.80	80.20
	1.18	35.3	84.80	33.92	66.08
	0.6	23.3	108.10	43.24	56.76
	0.425	35.9	144.00	57.60	42.40
	0.3	33.5	177.50	71.00	29.00
	0.15	53.4	230.90	92.36	7.64
	0.075	18	248.90	99.56	0.44
250		1.1			
D=2 m	20	0	0.00	0.00	100.00
	10	5.2	5.20	2.60	97.40
	4.75	30.6	35.80	17.90	82.10
	2.36	38	73.80	36.90	63.10
	1.18	48.2	122.00	61.00	39.00
	0.6	17.1	139.10	69.55	30.45
	0.425	29.4	168.50	84.25	15.75
	0.3	12.2	180.70	90.35	9.65
	0.15	13.7	194.40	97.20	2.80
	0.075	2	196.40	98.20	1.80
200		3.6			
D= 3 m	20	0	0.00	0.00	100.00
	10	18.2	18.20	7.28	92.72
	4.75	96	114.20	45.68	54.32
	2.36	49.5	163.70	65.48	34.52
	1.18	40.2	203.90	81.56	18.44
	0.6	8.7	212.60	85.04	14.96
	0.425	9.3	221.90	88.76	11.24
	0.3	7.2	229.10	91.64	8.36
	0.15	13.9	243.00	97.20	2.80
	0.075	6.5	249.50	99.80	0.20
250		0.5			

D10	D30	D60	Cu	Cc
0.17	0.21	0.79	4.65	1.56
0.30	0.60	2.20	7.33	0.91
0.38	1.30	5.10	13.42	0.67

	D=1 m	20	61	61.00	24.40	75.60	D=6 m	20	0	0.00	0.00	100.00
		10	17.8	78.80	31.52	68.48		10	12	12.00	4.80	95.20
		4.75	37.5	116.30	46.52	53.48		4.75	55	67.00	26.80	73.20
		2.36	37.3	153.60	61.44	38.56		2.36	33.4	100.40	40.16	59.84
		1.18	44.5	198.10	79.24	20.76		1.18	48	148.40	59.36	40.64
		0.6	9	207.10	82.84	17.16		0.6	11.4	159.80	63.92	36.08
		0.425	11.5	218.60	87.44	12.56		0.425	14.2	174.00	69.60	30.40
		0.3	8.4	227.00	90.80	9.20		0.3	9.1	183.10	73.24	26.76
		0.15	11.2	238.20	95.28	4.72		0.15	11.3	194.40	77.76	22.24
		0.075	6.1	244.30	97.72	2.28		0.075	4.8	199.20	79.68	20.32
250			5.7				200		0.8			
	D=2 m	20	0	0.00	0.00	100.00						
		10	0	0.00	0.00	100.00						
		4.75	3.5	3.50	1.75	98.25						
		2.36	23.9	27.40	13.70	86.30						
		1.18	132.1	159.50	79.75	20.25						
		0.6	12.6	172.10	86.05	13.95						
		0.425	14.2	186.30	93.15	6.85						
		0.3	6.2	192.50	96.25	3.75						
		0.15	5	197.50	98.75	1.25						
		0.075	1.4	198.90	99.45	0.55						
200			1.1									
	D=3 m	20	0	0.00	0.00	100.00						
		10	0	0.00	0.00	100.00						
		4.75	92.6	92.60	37.04	62.96						
		2.36	76.7	169.30	67.72	32.28						
		1.18	40.2	209.50	83.80	16.20						
		0.6	8.2	217.70	87.08	12.92						
		0.425	6.7	224.40	89.76	10.24						
		0.3	7.9	232.30	92.92	7.08						
		0.15	5.1	237.40	94.96	5.04						
		0.075	11.3	248.70	99.48	0.52						
250			1.3									
	D= 4m	20	0	0.00	0.00	100.00						
		10	0	0.00	0.00	100.00						
		4.75	19	19.00	7.60	92.40						
		2.36	71.7	90.70	36.28	63.72						
		1.18	83.8	174.50	69.80	30.20						
		0.6	27.5	202.00	80.80	19.20						
		0.425	26.8	228.80	91.52	8.48						
		0.3	11.6	240.40	96.16	3.84						
		0.15	6.6	247.00	98.80	1.20						
		0.075	1.1	248.10	99.24	0.76						
250			1.9									
	D=5 m	20	0	0.00	0.00	100.00						
		10	4.7	4.70	2.35	97.65						
		4.75	37	41.70	20.85	79.15						
		2.36	37.6	79.30	39.65	60.35						
		1.18	57.8	137.10	68.55	31.45						
		0.6	17.9	155.00	77.50	22.50						
		0.425	17.8	172.80	86.40	13.60						
		0.3	9.9	182.70	91.35	8.65						
		0.15	10	192.70	96.35	3.65						
		0.075	4.6	197.30	98.65	1.35						
200			2.7									

POINT LOAD INDEX TEST

BH. No.	Depth	Div	Penetration (mm)	Pmax (kn)	D*D (mm2)	Is (N/mm2)	Is (kN/m^2)
1	4a	5.00	3.00	2.50	2401.00	1.04	1041.233
1	4b	9.00	4.00	4.50	2401.00	1.87	1874.219
1	5a	8.00	4.00	4.00	2304.00	1.74	1736.111
1	5b	7.50	5.00	3.75	2304.00	1.63	1627.604
1	6.50	6.00	5.00	3.00	2304.00	1.30	1302.083
2	9	17.50	2.00	8.75	2500.00	3.50	3500
2	10	20.00	5.00	10.00	2401.00	4.16	4164.931

NITT

SUMMARY OF LABORATORY TEST RESULTS

GI for the Proposed Reconstruction of Rajagopuram at Shripundarikatcha Perumal Temple, Thiruvallarai

FIG. NO. 5

BH	Sample Depth	NATURAL		PHYSICAL PROPERTIES									GEOTECHNICAL PROPERTIES			Remarks
		Moisture Content	Dry Unit Weight	Specific Gravity	Sieve Analysis % Passing			Atterberg Limit			FSI	I.S. Group	Shear Test		UCC	
								LL	PI	SL			c	φ		
	(m)	%	kN/m^3		# 4	# 40	# 200	%	%	%	%		kN/m^2	Deg.	kN/m^2	
BH-02	1				53	13	2					SP				
	2				98	7	1					SP				
	3				63	10	1					SP				
	4				92	8	1					SP				
	5				79	14	1					SP				
	6				73	30	20					SM				
BH-01	1				87	42	0					SP				
	2				82	16	2					SP				
	3				54	11	0					SP				

6.3 ARCHAELOGIST'S REPORT

Joint Inspection on Shri Pundareekaksha Perumal Temple, Tiruvellarai, Taluk & District Tiruchirapalli, By Dr.R.Kannan, I.A.S., Additional Chief Secretary to the Government of Tamil Nadu cum Archaeologist and K.T.Narasimhan, Superintending Archaeologist (Retd) and Consultant Archaeologist /Conservationist to the Government of Tamil Nadu.

A joint inspection was conducted on Shri Pundareekaksha Perumal temple,Tiruvellarai on 21-05-2015. The aim and main purpose of this joint inspection is to have a critical study of the unfinished ancient exposed brick Raja-gopura and to give appropriate technical advice to complete this in all respect.

During our joint inspection the following HR&CE officials and a representative of the donors were present.

1. Shri.P.Jayaraman, Joint Commissioner/ Executive officer of this temple.
2. Shri.N.Siva kumar, Assistant Executive Engineer O/o the J.C.Srirangam.
3. Shri. V.Nanda kumar, Overseer, O/o the J.C.,Srirangam.
4. Shri. C.Ramachandran, Representative of Shri. S.Jayapal and Dr.S.Velumani (donors).

Before inspecting the Raja-Gopura, we have inspected the temple complex. Earlier we have jointly inspected this temple and the famous **Swasthik Tank** on 30-04-2013 and all items of conservation works were given in our inspection report. In addition to that the following item of conservation works is recommended here under.

1. There is a flight of steps made with granite stone for **Uttarayana** and **Dakshinayana** entrances. In between these entrances the pada (wall) portion has got beautiful life size stucco bas-relief sculptures. They were retouched in the past with cement liquid to strengthen the skin and to fill up the hair cracks. Cement should not be used over the lime finish. With the result, facial beauty of the great **Pallava** sculpture is totally lost. In other words the "**Lavanya**" (charm of the face) which can be seen over the cheek of those stucco figures is totally lost. Crowning this some odd colouring is done all over those sculptures. Now removal of cement skin is an herculean task because, they may develop numerous hair cracks due to rubbing. Therefore, with sharp blade with utmost care the existing stronger material has to be scraped. Once the original lime skin is exposed, the surface should

be given a thin coat with pure lime paste, so that the original sculptural charm can be obtained. This has to be done by an expert, who is well versed with stucco figures conservation.

2. The existing cement flooring in ardha-mandapa and maha-mandapa should be removed and such portion may be provided granite flooring to enhance the aesthetic value of this temple.

3. For providing a hand railing to **Uttarayana** and **Dakshinayana** entrances flight of steps, the ancient pada (wall) portion is drilled at regular interval in the past and iron hooks are fitted to hold the stainless steel pipe (hand railing). Due to constant pulling of the railing the ancient core (wall) has developed visible cracks around each whole. This facility can be provided by inserting wooden plugs into the hole in which metal rings can be fixed to hold the railing pipe. Such re-arrangement will safe guard the core and improve the ancient environ.

4. All iron sheet doors may be replaced with temple type wooden doors.

5. To control the bats nuisance, a herbal medicine is made by Smt.Jayanthi of Srivilliputtur. She may be approached to do the needful.

Raja-Gopura:-

This temple has got an ancient and gigantic **"Misra"** type of unfinished Raja-gopura in exposed brick architecture right at the main entrance, on the top of the flight of stone steps. Even after several centuries, it is physically in good condition, despite no conservation or preservation having been done till date. As usual, it is built with good quality of dressed granite stones up to prastara (kalkaram) level. Above which the super structure (tiers) is made of well burnt different size bricks. Unfortunately, it is unfinished and only first two talas (tiers) were built. It with stood all sort of ravages till date and is fit for further addition.

The HR&CE department is very keen to construct the remaining talas (tiers) of this unique ancient Raja-gopura. Shri.S.Jayapal and Dr.S.Velumani of Coimbatore have come forward to finance for this noble work. How to proceed further on this has to be decided by the competent authorities based on these following technical expert recommendations.

1. The existing ancient stone structure's physical strength and its load bearing capacity has to be ascertained by using modern equipment and technique, before deciding the number of talas (tiers) that has to be added over this old base.

2. The existing stone adhishtana total width in east-west is 23.20 Mts, out of which the main entrance open space is 13.60 Mts. In the first tala span in east-west is 10.55 M and tala (tier) koshta is 4 Mts. The difference between Ist and IInd tala reduction in dimension is 1.20 Mts. In other words, width reduction is 35%. This calculation is based on the karnakoshta's width. In all ancient gopura construction, this formula is being adopted by the sthapathys. This is done in a very simple way by making the inner veneer of the lower tala (tier) which becomes outer veneer for the upper tala. However, the space and reduction percentage may vary on upward talas. The number of talas is calculated following this arithmetic calculation in the ancient days. The total number of talas may be decided on this principle, so that there will not be any extra head load over the ancient stone base.

3. The existing ancient structure (granite/brick) should be thoroughly cleaned and given preservative coat. Shri.Venkatesan, who did similar treatment in Shri Parthasarathy temple, Triplicane, Chennai with herbal materials may be approached for this work.

4. As on date some vegetation is grown over the brick talas (tiers). It should be cleaned, before commencing work.

5. The proper approach to reach up to second tala (tier) is originally made at the time of construction. Similar facility should be made up to **Brahmarandra** in the new construction.

6. Seasoned teak-wood should be used for construction of tala roof.

7. Different size of bricks were used for construction for making the existing talas (tiers). Similar size bricks should be used in the new construction, so that there will not be any deviation in space and strength.

8. It is up to the competent authority's discretionary power to decide the number of talas (tiers).

9. Since the original brick talas (tiers) are made of exposed brick architecture, the addition also should follow the same principle.

10. The combination mortar should be used for new construction.

The above mentioned recommendations are illustrative and not an exhaustive one.

24/06/2015

(K.T.Narasimhan) 24/6/15
Consultant Archaeologist/Conservationist

(Dr.R.Kannan, I.A.S.)
Addl Chief Secy cum Archaeologist.

Archaelogist's Report

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The above-mentioned recommendations are illustrative and not an exhaustive one.

(K.T. Narasimhan)
Consultant Archaeologist / Conservationist

(Dr. R.Kannan I.A.S.)
Addl Chief Secy cum Archeologist.

6.4 HR&CE SECRETARY REPORT

61129

சுருக்கம்

இந்து சமய அறநிலையத்துறை – மாண்புமிகு முதலமைச்சர் அவர்களால் 2015–2016– ஆம் ஆண்டின் வரவு–செலவு கூட்டத்தொடரின் போது விதி 110–ன்கீழ் அறிவிக்கப்பட்ட அறிவிப்பு – ஸ்ரீரங்கம், அருள்மிகு அரங்கநாதசுவாமி திருக்கோயிலின் உபகோயில் – திருவெள்ளறை அருள்மிகு புண்டரிகாட்சப் பெருமாள் திருக்கோயில் இராஜகோபுரக் கட்டுமானம் ரூபாய் 5 கோடி செலவில் புனரமைக்கும் பணி – நிர்வாக மற்றும் தொழில்நுட்ப அங்கீகாரம் வழங்கி – ஆணை வெளியிடப்படுகிறது.

சுற்றுலா, பண்பாடு மற்றும் அறநிலையங்கள்(அநி 4–2) துறை

அரசாணை(நிலை) எண்.266

நாள்: 19.11.2015
மன்மத வருடம், கார்த்திகை – 3,
திருவள்ளுவர் ஆண்டு – 2046.

படிக்க:-

இந்து சமய அறநிலையத்துறை ஆணையர் அவர்களின் கடித ந.க.எண்.8246/2014/ஒய்1, நாள் 30.10.2015 மற்றும் 02.11.2015.

ஆணை:-

2015–16 –ஆம் ஆண்டின் வரவு செலவு கூட்டத்தொடரின்போது 23.09.2015 அன்று மாண்புமிகு முதலமைச்சர் அவர்களால் தமிழக சட்டமன்றப் பேரவையில் விதி 110–ன் கீழ் பின்வரும் அறிவிப்பு வெளியிடப்பட்டது:-

"ஸ்ரீரங்கம், அருள்மிகு அரங்கநாதசுவாமி திருக்கோயிலின் உபகோயிலான திருவெள்ளறை அருள்மிகு புண்டரிகாட்சப் பெருமாள் திருக்கோயிலில் 13–ஆம் நூற்றாண்டில் ஹோய்சாலா மன்னன் வீர பல்லாளாவால் கட்டப்பட்டு, முழுமை பெறாமல், இரண்டு நிலைகள் வெளியில் தெரியும் செங்கல் கட்டுமானத்தோடு உள்ளது. இந்த இராஜகோபுரக் கட்டுமானம் தொன்மை மாறாது தொல்லியல் முறையில் 5 கோடி ரூபாய் செலவில் புனரமைக்கப்படும்."

2. மேலே படிக்கப்பட்ட கடிதங்களில் ஆணையர் திருச்சி, ஸ்ரீரங்கம், , அருள்மிகு அரங்கநாதசுவாமி திருக்கோயிலின் உபகோயிலான திருச்சி, திருவெள்ளறை, அருள்மிகு புண்டரிகாட்சப்பெருமாள் திருக்கோயில் வெண்மையான பாறைகளாலானபடியாலே வெள்ளறை என்ற பெயர் பெற்ற ஸ்தலம், தமிழில் திரு என்ற உயர்வைக் குறிக்கும் பதத்துடன் சேர்த்து திருவெள்ளறை என்றும், வடமொழியில் ஸ்வேதகிரி (ஸ்வேத–வெண்மை, கிரி–மலை) திருவரங்கத்திற்கும் முந்தையானதால் ஆதிவெள்ளறை என்றும் போற்றப்படுகிறது என்றும் தெரிவித்துள்ளார். மேலும் கீதையின் 18 அத்தியாயங்களைக் குறிக்கும் வகையில் அமைந்துள்ள 18 படிகள், கோபுர வாசலில் நான்கு வேதங்களைக் குறிக்கும் வகையில் அமைந்துள்ள 4 படிகள், பலிபீடத்திற்குப் பிறகு பஞ்ச பூதங்களைக் குறிக்கும் வகையில் அமைந்துள்ள 5 படிகள், இத்திருக்கோயிலின் சிறப்பம்சங்களாகும். மேலும் இத்திருக்கோயில் பெரியாழ்வார் மற்றும்

திருமங்கையாழ்வரால் மங்களாசாசனம் செய்யப்பட்ட சிறப்புடையதாகும் என்றும் ஸ்ரீ ராமபிரானுக்கு ஏழு தலைமுறைக்கு முந்தைய சிபி சக்கரவர்த்தியால் வைணவத் திருத்தலங்களில் ஒன்றான "ஸ்வேதகிரி" என்ற இத்தலம் திருச்சி–துறையூர் மார்க்கத்தில் திருச்சியிலிருந்து சுமார்18 கி.மீ. தொலைவில் அமைந்துள்ளது என்றும், இத்திருக்கோயிலைச் சுற்றி நான்கு மதில் சுவர்களும், ஐந்து பிரகாரங்களையும் உள்ளடக்கியதாகும் எனத் தெரிவித்துள்ளார். இத்தலத்தில் உய்யக்கொண்டார் மற்றும் எங்களாழ்வார் அவதாரம் செய்துள்ளனர் எனவும், இத்திருக்கோயிலில் சூரியன் ஸஞ்சரிக்கும் சூரியநாடியின் வழியாக மலைக்குச் செல்லும்படி தக்ஷிணாயன வாயில் மற்றும் உத்தராயண வாயில் ஆகிய இரண்டு வாயில்கள் அமையப்பெற்றுள்ளது என்றும், ஆடி முதல் மார்கழி வரையில் தக்ஷிணாயன வாயில் வழியாகவும், தை முதல் ஆனி வரையில் உத்தராயண வாயில் வழியாகவும் மூலஸ்தானம் சென்றடையலாம் என்றும், இந்த இரு வாயில்களில் 24 படிக்கட்டுகள் அமையப்பெற்றுள்ளது என்றும், பிரதான நுழைவுவாயிலில் 18 படிக்கட்டுகள் மற்றும் முடிவு பெறாமல் கோபுரம் அமையப்பெற்றுள்ளது என்றும், மேலும் இத்திருக்கோயிலின் இராஜகோபுரத்திருப்பணியை ரூ.5.00 கோடிக்கு உபயமாக செய்ய கோயம்புத்தூரைச் சேர்ந்த திரு. வி.எஸ். ஜெயபால் மற்றும் டாக்டர் எஸ். வேலுமணி ஆகியோர்கள் சம்மதம் தெரிவித்துள்ளனர் என்றும் தெரிவித்துள்ளார்.

3. மேலும், ஆணையர் ஸ்ரீரங்கம், அருள்மிகு அரங்கநாதசுவாமி திருக்கோயிலின் உபகோயிலான திருவெள்ளறை அருள்மிகு புண்டரிகாட்சப் பெருமாள் திருக்கோயிலின் இராஜகோபுரக் கட்டுமானத்தை ரூபாய் 5 கோடி செலவில் புனரமைக்கும் பணியினை செயல்படுத்தும் வண்ணம் ரூபாய் 5 கோடிக்கு 2015–2016–ம் ஆண்டின் செந்தர விலைப்பட்டியலின் அடிப்படையில் மதிப்பீடு தயார் செய்யப்பட்டது என்றும், மேற்படி மதிப்பீடு 28.10.2015 அன்று மதிப்பீடு ஒப்புதல் குழுவின் முன் வைக்கப்பட்டது என்றும், மதிப்பீடு ஒப்புதல் வழங்கும் குழுவால் பின்வருமாறு தீர்மானிக்கப்பட்டுள்ளது என்றும் தெரிவித்துள்ளார்:–

> "The Estimate Sanction Committee accorded Technical approval to carry out the above construction at the total estimate cost of Rs.5.00 Crore and recommended the same to the Government for according Administrative sanction and Technical sanction, subject to the condition that the foundation stability and structural stability should be obtained from IIT Madras before commencement of work and the work should be carried out as per the recommendation of IIT, Madras and based on the suggestions given by Archaeological Consultants."

4. எனவே, ஸ்ரீரங்கம், அருள்மிகு அரங்கநாதசுவாமி திருக்கோயிலின் உபகோயிலான திருவெள்ளறை, அருள்மிகு புண்டரிகாட்சப் பெருமாள் திருக்கோயிலில் முழுமை பெறாமல் உள்ள ஏழுநிலை இராஜகோபுரம் கட்டுமானம் தொன்மை மாறாமல் தொல்லியல் முறையில் ரூபாய் 5 கோடி செலவில் புனரமைக்கும் பணிக்கு நிர்வாக மற்றும் தொழில்நுட்ப அங்கீகாரம் வழங்குமாறு ஆணையர் கேட்டுக் கொண்டுள்ளார்.

5. இந்து சமய அறநிலையத்துறை ஆணையரின் கருத்துருவினை அரசு கவனமுடன் பரிசீலனை செய்தது. பரிசீலனைக்குப் பின்னர் அதனை ஏற்று "ஸ்ரீரங்கம், அருள்மிகு அரங்கநாதசுவாமி திருக்கோயிலின் உபகோயிலான திருவெள்ளறை அருள்மிகு புண்டரிகாட்சப் பெருமாள் திருக்கோயில் இராஜகோபுரக் கட்டுமானப் பணியினை தொன்மை மாறாது தொல்லியல் முறையில் 5 கோடி ரூபாய் செலவில் உபயதாரர்கள் நிதியின் மூலம் கீழ்க்காணும் நிபந்தனைகளுக்குட்பட்டு புனரமைக்க நிர்வாக மற்றும் தொழில்நுட்ப அனுமதி வழங்கி அரசு ஆணை வெளியிடுகிறது:-

(i) அஸ்திவாரத்தின் ஸ்திரத்தன்மை (Foundation Stability) மற்றும் கட்டிடத்தின் உறுதிதன்மை (Structural Stability) குறித்து பணிகள் தொடங்குவதற்கு முன்பு,

Shri. Rajaraman - HR&CE Secretary, Shri. V S Jayabal,
Shri. Pon Jayaraman - Joint Commissioner, Srirangam, Dr S Velumani
Shree Pundarikatcha Perumal Temple, Thiruvellarai
Sarva Veda Parayanam NOV 2015

சென்னை, இந்திய தொழில்நுட்ப கழகத்தின் (சென்னை IIT) அறிக்கை பெறப்பட வேண்டும்.

(ii) சென்னை, இந்திய தொழில்நுட்ப கழகத்தின் (சென்னை IIT) பரிந்துரையின் அடிப்படையிலும், தொல்லியல் வல்லுநர்களின் ஆலோசனைகளின்படியும் பணிகள் மேற்கொள்ளப்பட வேண்டும்.

(ஆளுநரின் ஆணைப்படி)

க. ராஜாராமன்
அரசு முதன்மைச் செயலாளர்

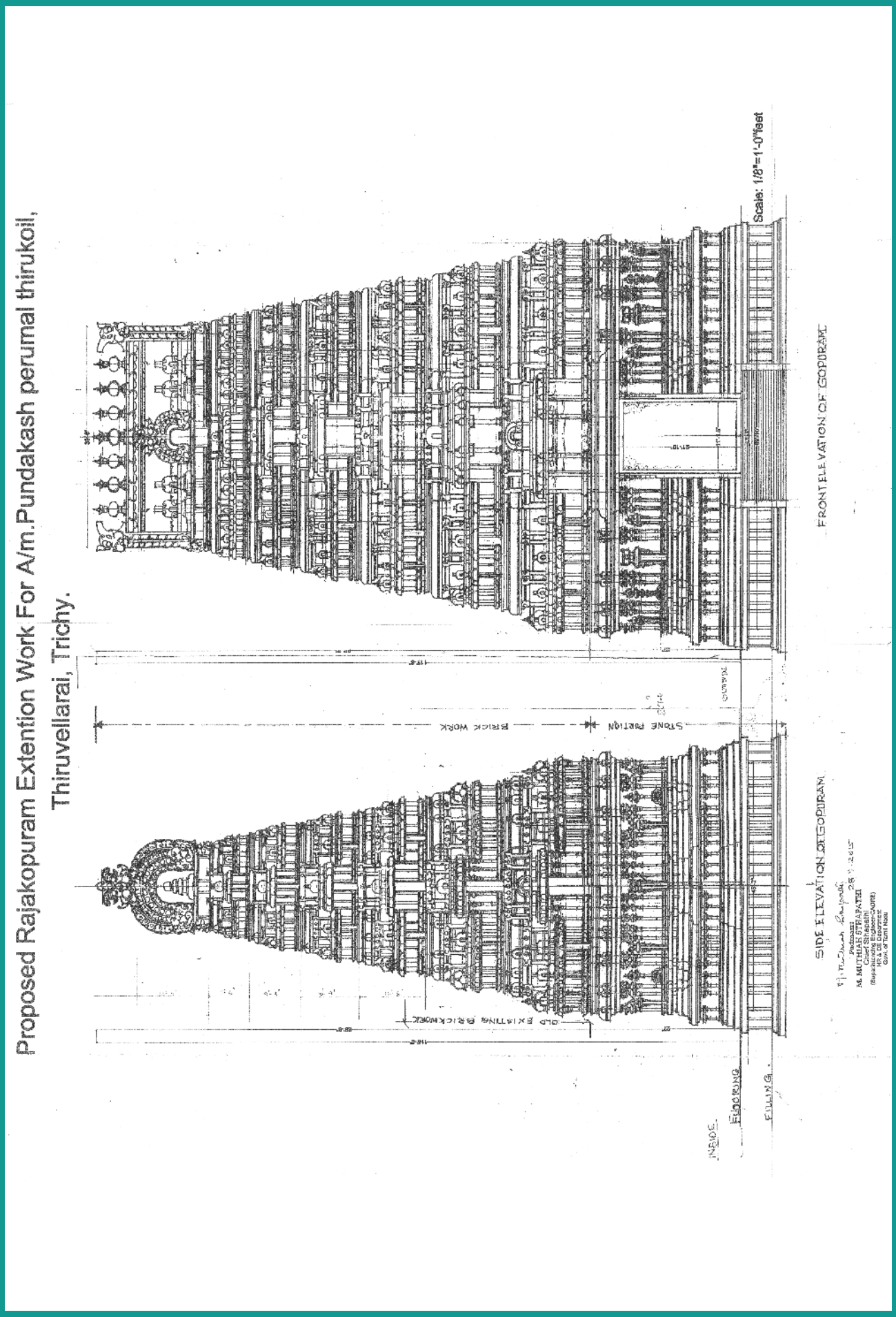
பெறுநர்
ஆணையர், இந்து சமய அறநிலையத்துறை, சென்னை–34.
நகல்
மாண்புமிகு முதலமைச்சர் அவர்களின் அலுவலகம், சென்னை–9.
மாண்புமிகு உணவு, இந்து சமயம் மற்றும் அறநிலையங்கள் துறை அமைச்சர் அலுவலகம், சென்னை–9.
அரசு முதன்மைச் செயலாளரின் தனிச்செயலர், சுற்றுலா, பண்பாடு மற்றும் அறநிலையங்கள் துறை, சென்னை–9.
சுற்றுலா, பண்பாடு மற்றும் அறநிலையங்கள்(பொது–2) துறை, சென்னை – 9.
இருப்புக் கோப்பு/உதிரி.

/ஆணைப்படி அனுப்பப்படுகிறது/

பிரிவு அலுவலர் 19/11/15

19/11/15

6.5 COPY OF RAJAGOPURAM DESIGN SIGNED BY CHIEF STHAPATHI



6.6 COPY OF HRCE APPROVAL ORDER

Page 1 of 2

அருள்மிகு அரங்கநாதசுவாமி திருக்கோயில், ஸ்ரீரங்கம்

அனுப்புநர்

பொ. ஜெயராமன், பி.எஸ்.சி. பி.எல்.,
இணை ஆணையர் / செயல் அலுவலர்,
அருள்மிகு அரங்கநாதசுவாமி திருக்கோயில்,
ஸ்ரீரங்கம், திருச்சிராப்பள்ளி – 6.

பெறுநர்

திரு. V.S. ஜெயபால்,
டாக்டர் S. வேலமணி
136, அப்புசாமி நாயுடு வீதி,
ரெட்பீல்ட்ஸ், கோயம்புத்தூர் 641 045.

ந.க. எண் 1719 / 1414 / டி5 / நாள் 15.12.2015

ஐயா,

பொருள் : திருப்பணி – உபயப்பணி – ஸ்ரீரங்கம் அருள்மிகு அரங்கநாதசுவாமி திருக்கோயிலின் உபகோயிலான திருவெள்ளறை அருள்மிகு புண்டரீகாட்சப் பெருமாள் திருக்கோயில் இராஜகோபுர திருப்பணி ₹.5.00 கோடி மதிப்பீட்டில் புனரமைக்கும் பணிக்கு பணி ஆணை வழங்குதல் – அருள்மிகு அரங்கநாதசுவாமி திருக்கோயில், ஸ்ரீரங்கம் – தொடர்பாக.

பார்வை : 1. அரசாணை (நிலை) எண் 266 / சுற்றுலா பண்பாடு மற்றும் அறநிலையங்கள் (அநி. 4-2)துறை நாள் 19.11.2015.
2. ஆணையர், இந்துசமய அறநிலையத்துறை ந.க.எண் 8246 / 2014 / ஓய் 1 / நாள் 01.12.2015.

திருச்சிராப்பள்ளி மாவட்டம், ஸ்ரீரங்கம் வட்டம், ஸ்ரீரங்கம் அருள்மிகு அரங்கநாதசுவாமி திருக்கோயிலின் உபகோயிலான திருவெள்ளறை அருள்மிகு புண்டரீகாட்சப் பெருமாள் திருக்கோயிலில் இராஜகோபுரம் கட்டுமானம் புனரமைக்கும் பணிக்கு பார்வை 1ல் காணும் அரசாணையில் ₹.5.00 கோடிக்கு உபயதாரர் மூலம் நிர்வாக அனுமதி மற்றும் தொழில்நுட்ப அனுமதி வரப்பெற்றுள்ளது. ₹.5.00 கோடி மதிப்பீட்டில் சீரமைத்துத் தருவதற்கு பார்வை 2ல் காணும் ஆணையர் கடிதத்தில் அரசாணையின்படி செயல்பட தெரிவிக்கப்பட்டுள்ளது. அரசாணையில் தெரிவித்துள்ளவாறு அதிலுள்ள நிபந்தனைகளின்படி மேற்கொள்ள வேண்டுமென தெரிவித்து பணி துவங்க பணி ஆணை வழங்கப்படுகிறது.

நிபந்தனைகள்

1. அஸ்திவாரத்தின் ஸ்திரத்தன்மை (Foundation Stability) மற்றும் கட்டிடத்தின் உறுதித்தன்மை (Structural Stability) குறித்து பணிகள் தொடங்குவதற்கு முன்பு சென்னை இந்திய தொழில்நுட்ப கழகத்தின் சென்னை IIT அறிக்கை பெறப்பட வேண்டும்.
2. சென்னை இந்திய தொழில்நுட்ப கழகத்தின் சென்னை IIT பரிந்துரையின் அடிப்படையிலும், தொல்லியல் வல்லுநர்களின் ஆலோசனைகளின்படியும் பணிகள் மேற்கொள்ளப்பட வேண்டும்.

3. திருக்கோயிலின் கோபுர கல்காரத்தில் எந்த சிறு துளையும் போடக்கூடாது. பணி நடைபெறும் இடம் தொன்மையான இடம் என்பதை நினைவில் கொண்டு மிக மிக கவனத்துடன் பணி மேற்கொள்ள வேண்டும். மதிற்சுவர், கட்டிடம் எந்தவொரு தொன்மையான அமைப்பிற்கும் சிறு இடையூறும் நேரக்கூடாது. தொன்மை மாறாமல் இத்துறை அரசு செயலர், ஆணையர் வழிகாட்டுதலின்படியான பொருட்களை மட்டும் பயன்படுத்த வேண்டும். திருச்சி மண்டல செயற்பொறியாளர், இத்திருக்கோயில் உதவி செயற்பொறியாளர் அறிவுரை பெற்று பணி மேற்கொள்ள வேண்டும் என தெரிவிக்கப்படுகிறது.
4. பொதுமக்கள் பயன்பாட்டிற்கு எந்தவித இடையூறும் இல்லாதவாறும் புகார்கள் ஏதும் வராத வகையில் பணி நடைபெற வேண்டும்.
5. பணி நடைபெறும்போது திருக்கோயில் ஒவர்சீயர், ஆலய உதவி செயற்பொறியாளர் முன்னிலையில் பணி நடைபெற வேண்டும்.
6. மேற்படி உபயப்பணி தொடர்பாக திருக்கோயிலில் எந்தவித முன்னுரிமையும் கோரக்கூடாது.
7. பொருட்கள் நல்ல தரமுள்ளவையாகவும், ISI தர சான்றுடனும் இருக்க வேண்டும்.
8. தேவையற்ற பொருட்களை உடன் அப்புறப்படுத்த வேண்டும்.
9. பணியாளர்களுக்கான விபத்து காப்பீடு தங்கள் சொந்தப் பொறுப்பில் எடுத்துக் கொள்ள வேண்டும் எனவும் தெரிவிக்கப்படுகிறது.

(ஒம்) பொ. ஜெயராமன்,
இணை ஆணையர் / செயல் அலுவலர்,

உத்தரவுப்படி / அனுப்பப்படுகிறது

15/12/15

மேலாளர்.

நகல் பணிந்தனுப்பப்படுகிறது

1. ஆணையர்,
   இந்துசமய அறநிலையத்துறை,
   சென்னை-34.

நகல்

1. கண்காணிப்பு பொறியாளர், இந்துசமய அறநிலையத்துறை, சென்னை-34.
2. மண்டல செயற்பொறியாளர், இந்துசமய அறநிலையத்துறை, உத்தமர்கோயில், திருச்சிராப்பள்ளி.
3. உதவி செயற்பொறியாளர்
4. ஒவர்சீயர்
5. உதவி கண்காணிப்பாளர் (திருவெள்ளறை ஆலயம்)
6. மிகை

6.7 COPY OF MOU WITH NCSHS and IIT - MADRAS

Memorandum of Understanding

between

SRI PUNDARIKATCHA PERUMAL RAJAGOPURA THIRUPPANI COMMITTEE
Represented by
Shri V.S. Jayabal
Foundry Engineer
Residing at
35 Lalbahadur Colony, Peelamedu, Coimbatore-641004

And

National Center for Safety of Heritage Structures (NCSHS)
Indian Institute of Technology Madras
Chennai, India

*This Memorandum of Understanding is entered into between Sri Pundarikatcha Perumal Rajagopura Thiruppani Committee, represented by Shri V.S. Jayabal, Foundry Engineer, residing at 35 Lalbahadur colony, Peelamedu, Coimbatore-64100 (hereinafter referred to as "**SPPRT Committee**") and the President of India, acting through the National Centre for Safety of Heritage Structures, Indian Institute of Technology Madras, an autonomous institute under the Ministry of Human Resources Development, Government of India (hereinafter referred to as "**IITM**") of the other part;*

The expression "SPPRT Committee" and "IITM" may hereinafter individually be referred to as "Party" and collectively as "Parties";

Whereas

1. –Shri V.S. Jayabal and his family members decided to complete the hitherto incomplete Rajagopuram with two tiers in Sri Pundarikatcha Perumal Temple in Thiruvellarai to a seven-tiered Rajagopuram. They further decided to construct the remaining tiers with the ancient construction technology namely using lime mortar without the cement etc. and also to construct the remaining tiers with the same architectural pattern as is present in the existing two tiers, constructed approximately 700 to 800 years ago.

2. Shri V.S. Jayabal has approached Dr Arun Menon in IIT Madras, learning about his knowledge, skills and interest in conservation of heritage structures, to help and guide them in the construction of the Rajagopuram on 20th February, 2014.

3. Since then Dr Arun Menon in the last two years has been conducting basic investigations such as condition mapping and assessment, including core cutting and strength evaluation, geotechnical studies including soil testing at different depths, etc. to ascertain foundation stability and structural stability of the existing two tiers with his team members. Site surveying and soil testing were outsourced.

4. The Department for Tourism, Culture and Religious Endowments, Tamil Nadu in their order no.: 266 dated 19.11.2015 has given the conditional approval to construct the rajagopuram subject to the IIT Madras clearance. The Hindu Religious and Charitable Endowments (HRCE) Department's letter no. 1719/1414/D5 dated 15.12.2015 is provided as an annexure to the Memorandum of Understanding.

5. Shri V.S. Jayabal has understood the magnitude of the project in its various dimensions and would like to go ahead with the construction as per the religious rules, Tamil Nadu Government's Hindu Religious and Charitable Endowments (HRCE) Department regulations, repeating the same architectural pattern of the existing two tiers and use this project as an educational tool to the present day archaeology and civil engineering students as and when needed.

6. In the above scenario Shri V.S. Jayabal has requested NCSHS to participate in an advisory capacity in the restoration of the 7-storied ~800-year old Rajagopuram at Sri Pundarikatcha Perumal Temple at Thiruvellarai near Tiruchirappali (the "**Project**").

7. The restoration of the Rajagopuram will be carried by out by the *"SPPRT committee"* by the family funds of Shrimathy G. Ranganayaki, Shri S. Narayanaswamy, Shri V.S. Jayabal and Dr S. Velumani and from donations if any.

8. IITM through the agency of NCSHS is agreeable for the same to undertake the Project on a *pro bono* basis (except expenses related to travel and living allowances) under the terms and conditions contained herein.

NOWTHEREFORE for good and valuable consideration the Parties hereto agree as follows:

1. Scope

IITM will provide technical assistance for the Project in the

(1) The selection of construction materials;

(2) Quality control for lime mortar and bricks to be used in the construction: Only limited testing will be conducted at laboratories in IITM and all routine tests will have to be outsourced and their costs borne directly by SPPRT Committee;

(3) Residual strength estimation and structural assessment for existing portions of the masonry and proposed portions of the Rajagopuram: These tests and structural analysis will be conducted at laboratories in IITM or with field equipment from IITM;

(4) Liaising with the structural engineering for the project on structural analysis, strengthening design and new construction design for the Rajagopuram; and

(5) Such other matters as may be agreed between the parties in writing from time to time.

2. Responsibilities

(a) The SPPRT Committee shall
  (i) Provide access to all places in the temple that is required for inspection and review of the work provided that due care is taken during inspection; and
  (ii) Provide all inputs together with all available material, drawings, etc.;

(b) SPPRT Committee will bear all costs of travel, boarding and lodging expenses of IITM team members relating to IITM's work.

(c) IITM may make any publication in relation to the work executed and the Project.

(d) SPPRT Committee may make any publication/leaflet/presentation in print or electronic media about the nature of the construction to sensitise the public about the religious value, architectural / heritage significance and the ancient Indian construction methodology.

3. Equipment

Equipment and material will be provided by the SPPRT Committee.

4. Intellectual Property

Any know-how, discovery or patentable invention generated as a result of this project will be the joint property of IITM and SPPRT Committee. If such discovery is patentable, the patents will be jointly filed by IITM and SPPRT Committee. Terms and conditions regarding licensing of these rights for commercialization shall be governed by a separate agreement.

5. Confidentiality Obligation

Each Party shall keep confidential and not use, for any purpose not contemplated hereunder, all proprietary information disclosed by the other Party, directly or indirectly. Any discoveries, inventions or know-how resulting from the project shall be kept confidentially for a period of three (3) years from the date of termination of this Memorandum of Understanding, except as authorized in writing by other Party or provided herein.

6. Financial Aspects

(a) Travel, boarding and lodging expenses of IITM team members related to IITM's work will be borne by SPPRT Committee.

7. Validity

This *Memorandum of Understanding* will be *valid till the completion of the Rajagopuram and Samprokshanam* from the date of signing of this MOU which will be 36 months.

8. Termination of the project

This agreement may be terminated if both Parties agree at any time and the Project Accounts settled as on the date of termination. No penalty clause is tied up to the project execution.

9. Force Majeure

IIT Madras shall not be held liable for any loss, damage, delay or failure of performance, resulting directly or indirectly from any cause, which is beyond its reasonable control (Force Majeure). In the case of circumstances falling beyond the control of IIT Madras and causing hindrance in the completion of the undertaking, the Investigators shall promptly notify SPPRT with a written report in twenty (20) days after the date of the force majeure and the lawful authority should certify this status. Following certification, the contract shall be suspended for the duration of the force majeure.

DISCLAIMER:

Notwithstanding anything to the contrary contained in this Agreement, the Consultant or the Institute does not provide any guarantee, warranty or indemnity in connection with the Results/Reports/Analysis/Designs or specifications provided under this Agreement which are based on the inputs received by the Consultant or client. Further neither the Consultant nor the Institute shall be in any manner liable for the use of the Results, any performance, negligence or the failure to perform on the part of the Architect, Client, builder, engineer, sub-contractors, employees or workmen, any third party or its group companies or any employee or workmen of these parties or any other third party involved in the design, construction or restoration project. The obligations contained in this paragraph shall survive expiration or termination of the Agreement.

11. Settlement of Disputes

In the event of any question, dispute or differences arising out of this Memorandum of Understanding between the parties with regard to the interpretation of this agreement or the rights, liabilities or duties arising out of it or otherwise in connection with this agreement, shall be resolved by mutual consultation of the Parties. In such mutual consultations fail, the matter shall be referred to the sole Arbitrator to be appointed by the Director of IIT Madras, in accordance with the provisions of the Indian Arbitration & Conciliation Act, 1996, as amended from time to time. The Parties agree that the decision of the Arbitrator so appointed shall be final and binding upon the parties. If the work under the agreement has not been completed when a dispute is referred to arbitration, the work shall continue during the arbitration proceedings, and no payment due to either Party within the provisions of the agreement shall be withheld on account of pendency of the arbitration proceedings unless authorised or required by the Arbitrator.

In the witness whereof, the undersigned (duly authorised thereto) have signed this *Memorandum of Understanding*, in two originals at **Chennai** on the 31...day of the month of May in the year 2016.

Indian Institute of Technology, Madras

Prof. KRISHNAN BALASUBRAMANIAN
CHAIRPERSON

Sri Pundarikatcha Perumal Rajagopura Thirupani Committee

Shri V. S. Jayabal

Witnesses

1. Dr. MANU SANTHANAM
PROFESSOR
DEPARTMENT OF CIVIL ENGINEERING
IIT MADRAS, CHENNAI - 600 036

2. Dr ARUN MENON
Assistant Professor
Department of Civil Engineering
Indian Institute of Technology Madras
Chennai - 600 036, INDIA
Tel : +91-44-2257 4299, Fax : +91-44-2257 5286
Email: arunmenon@iitm.ac.in

6.8 BRICK TESTING REPORT

CIVIL TECHNO LAB PRIVATE LIMITED

An ISO 9001:2008 Certified Lab

No.12 / 26, Thanthai Periyar Nagar, 2nd Street, M K Palayam Road,
Sowripalayam, Coimbatore - 641 028. Mobile : 98422 34561, 93825 74564
Email: civiltechnolab@gmail.com, Website : www.civiltechnolab.com

Ref: CTL-CBE/Brick/16 Date: 21.09.2016
Test order: 281 dated: 19.09.2016

M/S KSK Builders
183, Co- operative Colony
Kavundampalayam
Coimbatore

3" Thick MECHANICAL PROPERTIES

TEST REPORT ON RED BRICKS

Source of sample	:	Sample supplied by the customer
Customer's reference*	:	Letter No: Nil, dated 19.09.2016
Project*	:	**Arulmigu Perumal kovil Raja Gopuram works at Trichy**
Brand*	:	**YBC**
Technical Reference	:	IS: 3495 (Part 1, 2, 3) -1992 (Reaffirmed 2002) & IS: 1077-1992 (Reaffirmed 2002)

I. COMPRESSIVE STRENGTH:

Sl. No.	Measured Size (mm)	Weight (Kg)	Compressive Strength (N/sq.mm)	Average (N/sq.mm)	Requirements As Per IS 1077-1992- Clause 4.1, Table1Classes-of common Burnt Clay Bricks	
					Class Designation	Average (N/sq.mm)
1	230 x 100 x 75	3.420	10.13	9.66	3.5	3.5
2	230 x 100 x 75	3.422	10.96		5.0	5.0
					7.50	7.50
3	230 x 100 x 75	3.244	7.61		10.0	10.0
					12.5	12.5
4	230 x 100 x 75	3.350	9.04		15.0	15.0
5	230 x 100 x 75	3.240	8.48		17.5	17.5
6	230 x 100 x 75	3.505	10.43		20.0	20.0
					25.0	25.0
7	230 x 100 x 75	3.270	11.52		30.0	30.0
8	230 x 100 x 75	3.290	9.13		35.0	35.0

* As furnished by the customer

Note: 1. The results relate only to the items tested.
2. Report shall not be reproduced except in full, without the written approval of the laboratory.
3. Any corrections invalidate this report.

for **CIVIL TECHNO LAB P Ltd**
S. Chandrasekar
S. CHANDRASEKAR, M.E., (STRU)
CHIEF STRUCTURAL CONSULTANT

CIVIL TECHNO LAB PVT LTD. Coimbatore

CIVIL TECHNO LAB PRIVATE LIMITED

An ISO 9001:2008 Certified Lab

No.12 / 26, Thanthai Periyar Nagar, 2nd Street, M K Palayam Road,
Sowripalayam, Coimbatore - 641 028. Mobile : 98422 34561, 93825 74564
E-mail : civiltechnolab@gmail.com, Website : www.civiltechnolab.com

Ref: CTL-CBE/Bri/16
Test order: 153 dated: 06.09.2016

Date: 08.09.2016

2nd Thk

M/S KSK Builders
183, Co- operative Colony
Kavundampalayam
Coimbatore

ME CHAMUNDI PROPERTIES

TEST REPORT ON RED BRICKS

YBC, Cbe.

Source of sample	:	Sample supplied by the customer
Customer's reference*	:	Letter No: Nil, dated 06.09.2016
Project*	:	**Arulmigu Perumal kovil Raja Gopuram works at Trichy**
Technical Reference	:	IS: 3495 (Part 1, 2, 3) -1992 (Reaffirmed 2002) & IS: 1077-1992 (Reaffirmed 2002)

I. COMPRESSIVE STRENGTH:

Sl. No.	Measured Size (mm)	Weight (Kg)	Compressive Strength (N/sq.mm)	Average (N/sq.mm)	Requirements As Per IS 1077-1992- Clause 4.1, Table1Classes-of common Burnt Clay Bricks	
					Class Designation	Average (N/sq.mm)
1	230 x 105 x 50	2.268	14.12	**14.57**	3.5	3.5
2	230 x 105 x 50	2.486	15.28		5.0	5.0
3	230 x 105 x 50	2.462	15.11		7.50	7.50
4	230 x 105 x 50	2.410	15.57		10.0	10.0
5	230 x 105 x 50	2.366	13.17		12.5	12.5
6	230 x 105 x 50	2.454	14.58		15.0	15.0
7	230 x 105 x 50	2.396	13.46		17.5	17.5
8	230 x 105 x 50	2.412	15.24		20.0	20.0
					25.0	25.0
					30.0	30.0
					35.0	35.0

* As furnished by the customer

Note: 1. The results relate only to the items tested.
2. Report shall not be reproduced except in full, without the written approval of the laboratory.
3. Any corrections invalidate this report.

for **CIVIL TECHNO LAB P Ltd**

S. CHANDRASEKAR, M.E., (STRU)
CHIEF STRUCTURAL CONSULTANT

CIVIL TECHNO LAB PVT. LTD. Coimbatore

3+0+7 = 14.12
24150

CIVIL TECHNO LAB PRIVATE LIMITED

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No.12 / 26, Thanthai Periyar Nagar, 2nd Street, M K Palayam Road,
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Ref: CTL-CBE/Bri/16
Test order: 153 dated: 06.09.2016

Date: 08.09.2016

M/S KSK Builders
183, Co- operative Colony
Kavundampalayam
Coimbatore

2 'THICK
WATER ABSORPTION TEST

TEST REPORT ON RED BRICKS

Source of sample	:	Sample supplied by the customer
Customer's reference*	:	Letter No: Nil, dated 06.09.2016
Project*	:	**Arulmigu Perumal kovil Raja Gopuram works at Trichy**
Technical Reference	:	IS: 3495 (Part 1, 2, 3) -1992 (Reaffirmed 2002) & IS: 1077-1992 (Reaffirmed 2002)

I. WATER ABSORPTION:

Sl. No.	Measured Size (mm)	Water Absorption (% by wt)	Average (% by wt)	Requirements as per IS:1077-1992
1	230 x 105 x 50	5.60	**5.44**	The average water absorption (5 Samples) shall not be more than 20% by weight up to class 12.5 and 15% by weight for higher classes
2	230 x 105 x 50	6.50		
3	230 x 105 x 50	4.90		
4	230 x 105 x 50	6.00		
5	230 x 105 x 50	4.20		

* As furnished by the customer

Note: 1. The results relate only to the items tested.
2. Report shall not be reproduced except in full, without the written approval of the laboratory.
3. Any corrections invalidate this report.

for **CIVIL TECHNO LAB P Ltd**

S. Chandrasekar

S. CHANDRASEKAR, M.E., (STRU)
CHIEF STRUCTURAL CONSULTANT

CIVIL TECHNO LAB PVT. LTD. Coimbatore

6.9 BIODATA OF ENGINEERING CONSULTANT

Arun Menon is Assistant Professor of Structural Engineering at the Civil Engineering Department of IIT Madras. He received his PhD in Earthquake Engineering from University of Pavia, Italy.

He has 15 years of exposure to the field of seismic engineering and his research interests include seismic behaviour of masonry structures, restoration of heritage structures and seismic risk assessment. He is currently coordinating the efforts of National Centre for Safety of Heritage Structures (NCSHS), IIT Madras. He is member of Bureau of Indian Standards Panel for Masonry, CED 46:P7and Convener, Working Group for Draft Code: "Seismic Retrofit of Structures: Masonry Buildings" in CED 39:Earthquake Engineering Sectional Committee.

6.10 AGREEMENT WITH STHAPATHI

Memorandum Of Understanding

Between

SRI PUNDARIKATCHA PERUMAL RAJAGOPURA THIRUPPANI COMMITTEE
[SPPRT Committee]

represented by

Shri V S JAYABAL, Foundry Engineer

Residing at

35 Lalbahadur colony, Peelamedu, Coimbatore 641004

And

Shri KUMARAGURUBARAN, Sthapathi

Residing at

25,A/2 cuddalore road

Panruti – 607106

Cuddalore District.

This Memorandum Of Understanding is entered into between

SRI PUNDARIKATCHA.PERUMAL RAJAGOPURA THIRUPPANI COMMITTEE represented by Shri V S JAYABAL, Foundry Engineer, residing at 35 Lalbahadur colony, Peelamedu, Coimbatore 641004 [herein referred to as SPPRT Committee] and

Shri Kumaragurubaran, Sthapathi, residing at 25 A/2 cuddalore road, panruti - 607106, Cuddalore Disrtrict. herein referred to as sthapathi

The expression 'SPPRT Committee' and 'Sthapathi' may herein after individually be referred to as 'Party' and collectively as 'Parties'

Whereas

Shri V S Jayabal and his family members decided to complete the hitherto incomplete Rajagopuram in Sri Pundarikatcha Perumal Temple in Thiruvellarai to a seven tired Rajagopuram. They further decided to construct the remaining tiers with the ancient construction technology namely using lime mortar without cement and also to construct the remaining tiers with the same architectural pattern as is present in the existing two tiers constructed approximately 700 to 800 years ago.

Shri V S Jayabal has applied to the Tamil Nadu Hindu Religious and Charitable Endowment Department - TN HRCE Dept – and obtained the necessary clearance to go ahead with the construction.

Shri V S Jayabal has also approached the Indian Institute of Technology, Madras – IIT Madras – and the National Center for Safety of Heritage Structures – NCSHS – seeking their technical expertise and requested them to participate in an advisory capacity in the restoration of the hitherto planned seven tier rajagopuram at Sri Pundarikatcha Perumal Temple, at Thiruvellarai for which they have agreed. To this effect a Memorandum of understanding has been signed

between

SRI PUNDARIKATCHA PERUMAL RAJAGOPURA THIRUPPANI COMMITTE Represented by Shri V S JAYABAL, Foundry Engineer, Residing at, 35 Lalbahadur colony, Peelamedu, Coimbatore 641004

And

National Center for Conservation of Heritage Structures – NCSHS – and

Indian Institute of Technology, Madras – IIT Madras.

In the above scenario, on the advice of Mr P JAYARAMAN, Joint Commissioner, HRCE Dept Srirangam, the SPPRT Committee has requested Shri Kumaraguru , sthapathi, residing at 25 A/2 cuddalore road, Panruti – 607106, Cuddalore District.

To undertake the construction work of the Rajagopuram for which Shri Kumaraguru readily agreed.

NOW TEHREFORE for good and valuable consideration the parties hereto agree as follows

RESPONSIBILITIES

The SPPRT committee shall provide all drawings and construction materials to the sthapathi and his team.

The committee shall also provide the necessary equipment to prepare the lime mortar and undertake to carry out any repair work in the said equipment as and when needed. The committee shall help to the sthapathi to provide the head caps to the gopuram workers and to have them covered for accident insurance by giving the money as and when agreed upon and needed. The committee reserves the right to make any publication/presentation in print/electronic media to sensitise the public about the religious value, architectural/heritage significance and the construction methodology for which the sthapathi will give full cooperation.

The Sthapathi shall organise to provide the shelter and food to the gopuram workers during the construction period. He shall take care to ensure the safety of the gopuram workers by providing them with the necessary head gears, accident insurance cover, the required scaffolding infra structure etc.

He shall help the SPPRT Committee to acquire the raw materials. He shall further liaison with the SPPRT Committee to coordinate with the IIT Madras and NCSHS during their Quality Audit inspection/discussions. He shall maintain a good rapport with the HRCE officials during their inspection/discussions. He shall undertake the construction work without any disturbances to the temple battars, pandarikal, sthalathars and general public. He further undertakes to construct the gopuram with the same architectural pattern as is present in the existing tiers.

The sthapathi shall respect and honour all the clauses in the memorandum of understanding entered into and signed between the SPPRT Committee and NCSHS & IIT Madras.

The sthapathi also shall respect and honour all the clauses in the sanction order of the TNHRCE dept and also further clauses as and when imposed by the HRCE dept.

The payments will be made subject to the muster rolls / original receipts of the materials purchased weekly or monthly.

The Memorandum of Understanding will be valid till the completion of the rajagopuram and Samprokshanam from the date of signing of this MOU which will be 36 months.

This agreement may be terminated if both parties agree at any time and the project accounts settled as on the date of termination. No penalty clause is tied up to the project execution.

In the event of any question, dispute or differences arise out of this Memorandum Of Understanding between the parties with regard to the interpretation of this agreement or the rights, liabilities or duties arising out of it or otherwise in connection with this agreement, shall be resolved by mutual consultation of the parties. If such mutual consultation fails, the dispute will be settled subjected to the jurisdiction of the Coimbatore courts.

In the witness whereof, the undersigned have signed this Memorandum of Understanding, in two originals at Thiruvellarai on the ---- day of the month of September in the year 2016

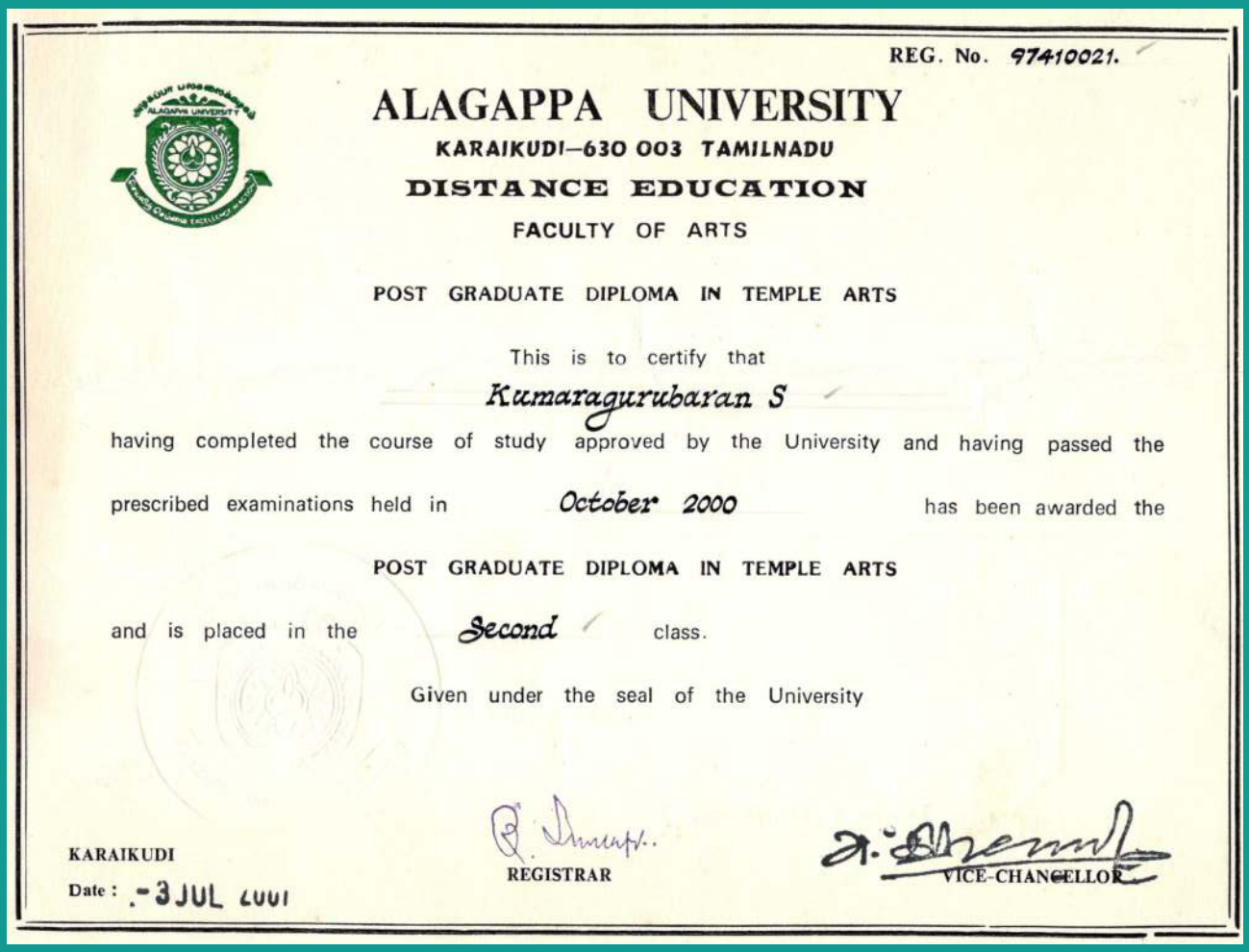
Shri V. S.Jayabal

Shri Kumaragurubaran

Witness

6.11 BIODATA OF STHAPATHI

A post graduate diploma in temple arts holder from Alagappa University, Karaikudi, Shri. Kumaragurubaran is a HRCE Department approved Sthapathi for which documentary supports are provided herewith. In addition, a partial list of his renovation works has also been enclosed herewith.



REG. No. 97410021.

ALAGAPPA UNIVERSITY

KARAIKUDI–630 003 TAMILNADU

DISTANCE EDUCATION

FACULTY OF ARTS

POST GRADUATE DIPLOMA IN TEMPLE ARTS

This is to certify that

Kumaragurubaran S

having completed the course of study approved by the University and having passed the prescribed examinations held in October 2000 has been awarded the

POST GRADUATE DIPLOMA IN TEMPLE ARTS

and is placed in the Second class.

Given under the seal of the University

KARAIKUDI

Date : 3 JUL 2001

REGISTRAR

VICE-CHANCELLOR

Biodata of Shri. Kumaragurubaran, Sthapathi

- Approval from HRCE Department

இந்துசமய அறநிலையத்துறை ஆணையர் அவர்களின் செயல்முறை நடவடிக்கைகள்

முன்னிலை: முனைவர் மா. வீர சண்முகமணி,
ஆணையர்.

செ.மு.நக.எண்.12353/2016/ஓய்.2 நாள் 08.07.2016

பொருள்: இந்துசமய அறநிலையத்துறை – ஸ்தபதிகள் வகைப்படுத்துதல் சிற்பி மற்றும் ஸ்தபதி மர வேலை வண்ண ஓவியர்– அங்கீகாரம் நீட்டிப்பு செய்து ஆணை வெளியிடுதல் – தொடர்பாக.

பார்வை:
1. அரசாணை நிலை எண்.172, தமிழ்வளர்ச்சி, பண்பாடு மற்றும் அறநிலையத்துறை, நாள் 4.8.2006.
2. அரசாணை நிலை எண்.444, தமிழ்வளர்ச்சி, அறநிலையங்கள் மற்றும் செய்தித்(அ.நி.3.2)துறை, நாள் 26.12.2012
3. இவ்வலுவலக ந.க.எண்.3975/1998–2 / ஓய்2 நாள் 02.01.2009.
4. இவ்வலுவலக ந.க.எண். 67895/2010 ஓய்2 நாள் 22.02.2011.
5. இவ்வலுவலக ந.க.எண். 20960/2015 /ஓய்.2, நாள் 17.05.2015.
6. இவ்வலுவலக ந.க.எண். 20961/2015 /ஓய்.2, நாள் 17.05.2015.
7. இவ்வலுவலக ந.க.எண். 20962/2015 /ஓய்.2, நாள் 17.05.2015.

பார்வைக் குறிப்பு 3, 4, 5, 6 மற்றும் 7ல் காணும் உத்தரவுகளில் வழங்கப்பட்ட அங்கீகாரம்/ அங்கீகார நீட்டிப்பு முடிவடைந்ததையடுத்து, அங்கீகாரம் நீட்டிப்பு வேண்டி விண்ணப்பதாரர்களால் அனுப்பப்பட்ட விவரங்களை பரிசீலித்து பின்வரும் தகுதியுடைய நபர்களுக்கு இவ்வுத்தரவு நாளிலிருந்து ஓராண்டு காலத்திற்கு கீழ்கண்ட நிபந்தனைகளுக்கு உட்பட்டு அங்கீகாரம் நீட்டிப்பு செய்து இதன் மூலம் உத்தரவிடப்படுகிறது.

இவ்வங்கீகாரம் சென்னை உயர் நீதி மன்றத்தில் நிலுவையில் உள்ள நீதிப்பேராணை மனு எண்.11979/07ல் பிறப்பிக்கப்படும் இறுதி உத்திரவிற்கு உட்பட்டதாகும்.

இந்த அங்கீகாரம் திருக்கோயில்களில் பணி அமர்த்தப்படுவதற்கான பணி நியமன ஆணை அல்ல. திருக்கோயில்களில் திருப்பணிகள் மற்றும் கட்டுமானப் பணிகள் செய்வதற்கு திருக்கோயில் நிர்வாகங்களால் கோரப்படும் ஒளிவுமறைவற்ற ஒப்பந்தப்புள்ளிகளில் கலந்து அவரவருக்கு தகுதியான பணியில் கலந்து கொள்வதற்கான அங்கீகாரம் மட்டுமே ஆகும்.

நிபந்தனைகள்

1. திருக்கோயில்களில் இவ்வங்கீகாரம் பெற்ற நபர்களால் மேற்கொள்ளப்படும் பணிகள் இந்துசமய அறநிலையத்துறையில் பணியாற்றும் பொறியாளர்கள் மற்றும் அலுவலர்களால் கண்காணிக்கப்படும்.

2. பணிகளின் தரம் குறைவாக இருந்தாலோ, பணிகளை உரிய காலத்திற்குள் சரியான காரணங்கள் இல்லாமல் முடிக்கத் தவறினாலோ இந்த ஆணையில் வழங்கப்பட்டுள்ள அங்கீகாரம் இரத்து செய்யப்பட்டு, இப்பட்டியலில் இருந்து பெயர் நீக்கம் செய்யப்படும்.

3. பணிகள் மேலே குறிப்பிட்டபடி ஒப்பந்தப்புள்ளி நடைமுறைப்படி தேர்வு செய்யப்பட்ட நபர்களிடம் ஒப்படைப்பதற்கு முன்னர், இது தொடர்பாக ஒப்பந்தம் செய்து கொண்ட பின்னரே பணி செய்ய அனுமதிக்கப்படும்.

4. இவ்வங்கீகாரம் உத்தரவு வெளியிடப்படும் நாளிலிருந்து ஓராண்டிற்கு மட்டுமே ஆகும்.

5. இவ்வங்கீகாரம் வழங்கப்பட்ட நாளிலிருந்து இத்துறை கட்டுப்பாட்டிலுள்ள திருக்கோயில்களின் திருப்பணிகள் செய்வதற்கான ஒப்பந்தப்புள்ளியில் கலந்துக்கொண்டு பணிகளை செய்திட திருக்கோயில்களிடம் ஒப்பந்தம் செய்து பணிகளை துவக்கியும், பணி முன்னேற்றத்தின் அவ்வப்போதான நிலைகள் குறித்த புகைப்படம் எடுத்தும் ஓராண்டிற்குள் துறை கட்டுப்பாட்டிலுள்ள எத்தனை திருக்கோயில்களுக்கு திருப்பணி செய்யப்பட்டுள்ளன என்ற விவரங்களுக்கு ஆதாரமாக பணி ஆணை நகல்களை திருக்கோயில் செயல் அலுவலர்களிமிருந்து பெற்று மண்டல இணை ஆணையர்கள் அல்லது சரக உதவி ஆணையர்கள் ஒப்புதல் பெற்று சமர்ப்பித்தால் மட்டுமே அங்கீகாரம் நீட்டிப்பது குறித்து பின்வரும் காலங்களில் பரிசீலிக்கப்படும்.

6. இவ்வங்கீகாரம் வழங்கப்பட்ட நாளிலிருந்து ஓராண்டிற்குள் இத்துறை கட்டுப்பாட்டிலுள்ள திருக்கோயில்களில் நடைபெறும் திருப்பணிகளின் ஒப்பந்தப்புள்ளியில் கலந்து கொள்ளாத நபருக்கு இந்த ஆணையினை தொடர்ந்து அங்கீகாரம் நீட்டிப்பு வழங்கப்படமாட்டாது.

வ. எண்	பெயர் மற்றும் முகவரி	அங்கீகாரிக்கப்பட்ட விபரம்	வகைபாடு
1.	திரு.ச.கலியமூர்த்தி, த/பெ. கே.சடகோபன், 18, பெருமாள் நகரம் திருவேற்காடு சென்னை 77	செ.மு.நக.எண். 67895/2010 /ஓய்.2, நாள் 22.02.2011	சிற்பி
2.	திரு.ம. தியாகராஜன், எண்.11/9 கீழ்கரை, பெரியார் நகர், சிதம்பரம், கடலூர் மாவட்டம்	செ.மு.நக.எண். 20961/2015 /ஓய்.2, நாள் 17.05.2015	சிற்பி
3.	திரு.சி. பாலசுப்பிரமணியன் நெ. 69, காந்திநகர், தம்மம்பட்டி பேரூராட்சி, தம்மம்பட்டி அஞ்சல், கெங்கவள்ளி வட்டம், சேலம் மாவட்டம் – 636113.	செ.மு.நக.எண். 20962/2015 /ஓய்.2, நாள் 17.05.2015	சிற்பி (மரவேலை)
4.	திரு.கே.நாராயணசாமி, எண்.5/525 சாயி இல்லம், கே.என்.ஜி.நகர், பேரூர், செட்டிபாளையம், கோயம்புத்தூர்.641010.	செ.மு.நக.எண். 20961/2015 /ஓய்.2, நாள் 17.05.2015	சிற்பி
5.	திரு.என்.சி.ரமேஷ், 1, சாரங்கபாணிகோயில் கீழ் மடவிளாகம், கும்பகோணம்.612001 தஞ்சாவூர் மாவட்டம்.	செ.மு.நக.எண். 20960/2015 /ஓய்.2, நாள் 17.05.2015	வண்ண ஓவியர்
6.	திரு.எம்.சுந்தரமூர்த்தி, த/பெ. மருத பத்தர், நெ.3E 71 ஏரிக்கரை தெரு, கார்குடல், விருத்தாசலம் வட்டம், கடலூர் மாவட்டம்.	செ.மு.நக.எண். 67895/2010 /ஓய்.2, நாள் 22.02.2011	சிற்பி
7.	திரு.A.ராஜூ த/பெ. ஆருமுக பத்தர், 1/28, திரௌபதியம்மன் கோயில் தெரு, புள்ளிசைப்பள்ளம் அஞ்சல், வானூர் வட்டம், விழுப்புரம் மாவட்டம் 605109	செ.மு.நக.எண். 3975/1998–2 /ஓய்.2, நாள் 02.01.2009	சிற்பி

8.	திரு.B.T.பிரஜாபதி, த/பெ.திருமாலயப்பெருமாள் 140 அசாரியார் வடக்கு தெரு, நாகராஜா கோவில் சமீபம், நாகர்கோயில் கன்னியாகுமரி மாவட்டம் 629001	செ.மு.நக.எண். 67895/2010 /ஒய்.2, நாள் 22.02.2011	சிற்பி
9.	திரு.ச.குமரகுருபரன், 25–ஏ, கடலூர் ரோடு, திருவதிகை, பண்ருட்டி– 607106, கடலூர் மாவட்டம்.	செ.மு.நக.எண். 20961/2015 /ஒய்.2, நாள் 17.05.2015	சிற்பி
10.	திரு.இரா. முருகேசன், எண்.17, பெரிய பட்டறை தெரு, அண்ணா நகர், கள்ளக்குறிச்சி, விழுப்புரம் மாவட்டம். 606 202	செ.மு.நக.எண். 20961/2015 /ஒய்.2, நாள் 17.05.2015	ஸ்தபதி – மர வேலை
11.	திரு.T. பாபு, த/பெ. எஸ். தங்க ராசு, 1/12, தெற்கு வீதி, திருநாகேஸ்வரம். கும்பகோணம் வட்டம், தஞ்சாவூர் மாவட்டம்.	செ.மு.நக.எண். 20962/2015 /ஒய்.2, நாள் 17.05.2015	வண்ண ஓவியர்
12.	திரு.எம்.பழனிவேலு, மூங்கில் பாடி ரோடு, சக்தி பதர் மில் பின்புறம், சின்னச்சேலம், கள்ளக்குறிச்சி வட்டம், விழுப்புரம் மாவட்டம் 606202 .	செ.மு.நக.எண். 20960/2015 /ஒய்.2, நாள் 17.05.2015	ஸ்தபதி – மரவேலை
13.	திரு.டி.பக்கிரிசாமி, 2, 76–ஏ, சிவன் வடக்கு வீதி, கீழையூர் அஞ்சல் கீவளூர் வட்டம், நாகப்பட்டிணம் மாவட்டம். 611103	செ.மு.நக.எண். 20962/2015 /ஒய்.2, நாள் 17.05.2015	சிற்பி
14.	திரு.வி. கே. கேட்டு, பிள்ளையார் கோயில் வீதி, வாழியூர் கிராமம், போளூர் வட்டம், திருவண்ணாமலை மாவட்டம்.	செ.மு.நக.எண். 20962/2015 /ஒய்.2, நாள் 17.05.2015	சிற்பி
15.	திரு.எஸ்.கணேசன், எண். 4/315, சிற்பகலைஞர்கள் தெரு, பாரதிபுரம், தழுதாழை, அரும்பாவூர் போஸ்ட், வேப்பந்தட்டை வட்டம், பெரம்பலூர் மாவட்டம். 621 103.	செ.மு.நக.எண். 20961/2015 /ஒய்.2, நாள் 17.05.2015	ஸ்தபதி – மர வேலை
16.	திரு.எஸ்.சுரேஷ், த/பெ.என்.செல்வம் 5, சாரங்கபாணி கீழ மட விளாகம், கும்பகோணம் 612001. தஞ்சாவூர் மாவட்டம்.	செ.மு.நக.எண். 20960/2015 /ஒய்.2, நாள் 17.05.2015	வண்ண ஓவியர்
17.	திரு.ஜெ. வீராசாமி, அப்புராஜபுரம்புத்தூர், ஆக்கூர் அஞ்சல், தரங்கை தாலுகா, நாகை மாவட்டம். 609 301.	செ.மு.நக.எண். 20961/2015 /ஒய்.2, நாள் 17.05.2015	சிற்பி
18.	திரு.வ.அன்புக்கரசு, த/பெ. ந. வரதராஜன், ஞானமுருகன் பூண்டி, அனக்காவூர் அஞ்சல்,செய்யார் வட்டம், திருவண்ணாமலை மாவட்டம். 604401.	செ.மு.நக.எண். 20960/2015 /ஒய்.2, நாள் 17.05.2015	சிற்பி

பெறல்
1 – 18 நபர்கள்

ஒப்பம்/மா. கவிதா,
கூடுதல் ஆணையர் (திருப்பணி)
ஆணையருக்காக

/உண்மை நகல்/உத்தரவுப்படி/

கண்காணிப்பாளர்

11/7/16

8/7/16

வ.எண்	ஆண்டு	திருக்கோயில் பெயர் மற்றும் முகவரி	மதிப்பீடு	பணி ஆணை வழங்கப்பட்ட நாள்	ஒப்பந்தப்படி பணி செய்து முடிக்கவேண்டிய நாள்	பணியினை செய்து முடித்த நாள்
1.	2010	அருள்மிகு பாடலீஸ்வரர் திருக்கோயில் திருப்பாதிரிபுலியூ ர் கடலூர். இராஜகோபுர மராமத்து மற்றும் பஞ்சவர்ண திருப்பணி.	ரூ. 7,93,355.00	22-11-2010	6 மாதம்	பணி நிறைவுப்பெற்றது.
2	2011	அருள்மிகு இராமானுஜர் பஜனை மடம். தோட்டப்பட்டு கடலூர் மாவட்டம்.	ரூ. 4,65,082.00	25-02-2011	6 மாதம்	பணி நிறைவுப்பெற்றது
3.	2011	அருள்மிகு மீனாட்சி சுந்தரேஸ்வரர் திருக்கோயில், மதுரை. அருள்மிகு மாரியம்மன் திருக்கோயில் தெப்பக்குளம் மையமண்டபம் மராமத்து பணி.	ரூ. 42,29,074.22	06-11-2011	6 மாதம்	பணி நிறைவுப்பெற்றது
4	2011	மேற்படி திருக்கோயில் வடக்கு, மேற்கு ஆடி வீதி கல்யாண மண்டபம் மேம்பாட்டு பணி.	ரூ. 15,52,642.00	06-11-2011	6 மாதம்	பணி நிறைவுப்பெற்றது
.5.	2012	மேற்படி திருக்கோயில் பொற்றாமரைக்குளம் பத்தி மண்டபம் தெற்குப்பக்கம் கிழக்கு பகுதி கல்விரிசல் அகற்றி புதிய தூண்கள், உத்திரம், பாவுகற்கல் மாற்றும் பணி -1 (13வது நிதி ஆணைய பணி-1)	ரூ. 46,35,942.00	10-03-2012	6 மாதம்	பணி நிறைவுப்பெற்றது
6.	2012	மேற்படி திருக்கோயில் வடக்கு, மேற்கு ஆடி வீதி கல்யாண மண்டபம் மேம்பாட்டு பணி. இரண்டாம் பகுதி.	ரூ. 13,57,268.00	09-06-2012	1 மாதம்	பணி நிறைவுப்பெற்றது

வ.எண்	ஆண்டு	திருக்கோயில் பெயர் மற்றும் முகவரி	மதிப்பீடு	பணி ஆணை வழங்கப்பட்ட நாள்	ஒப்பந்தப்படி பணி செய்து முடிக்கவேண்டிய நாள்	பணியினை செய்து முடித்த நாள்
7.	2012	மேற்படி திருக்கோயில் பொற்றாமரைக்குளம் பத்தி மண்டபம் தெற்குப்பக்கம் கிழக்கு பகுதி கல்விரிசல் அகற்றி புதிய தூண்கள், உத்திரம், பாவுகற்கல் மாற்றும் பணி-2 (13வது நிதி ஆணைய பணி-2)	ரூ. 42,77,014.00	22-09-2012	6 மாதம்	பணி நிறைவுப்பெற்றது
8.	2012	மேற்படி திருக்கோயில் பொற்றாமரைக்குளம் பத்தி மண்டபம் தெற்குப்பக்கம் மேற்கு பகுதி கல்விரிசல் அகற்றி புதிய தூண்கள், உத்திரம், பாவுகற்கல் மாற்றும் பணி	ரூ. 89,60,496.00	18-09-2012	9 மாதம்	பணி நிறைவுப்பெற்றது
9.	2012	மேற்படி திருக்கோயில் பொற்றாமரைக்குளம் பத்தி மண்டபம் கிழக்குப்பக்கம் வடக்கு பகுதி கல்விரிசல் அகற்றி புதிய தூண்கள், உத்திரம், பாவுகற்கல் மாற்றும் பணி	ரூ. 94,16,759.00	18-09-2012	9 மாதம்	பணி நடைபெற்றுக்-கொண்டிருக்கிறது
10.	2012	மேற்படி திருக்கோயில் பொற்றாமரைக்குளம் பத்தி மண்டபம் கிழக்குப்பக்கம் தெற்கு பகுதி கல்விரிசல் அகற்றி புதிய தூண்கள், உத்திரம், பாவுகற்கல் மாற்றும் பணி.	ரூ. 90,38,001.00	22-09-2012	9 மாதம்	பணி நடைபெற்றுக்-கொண்டிருக்கிறது
11.	2012	அருள்மிகு அகத்தீஸ்வரர் திருக்கோயில், ஆவு ர். அருள்மிகு விநாயகர் சந்நிதி, சுவாமி சந்நிதி, அம்மன், சண்டிகேஸ்வரர், நவகிரக சந்நிதி, அலங்கார மண்டபம், மடப்பள்ளி, அம்மன் மண்டபம் திரும்பகட்டுதல் திருப்பணி. (13வது நிதி ஆணைய பணி)	ரூ. 74,25,347.00	02-11-2012	9 மாதம்	பணி நிறைவுப்பெற்றது

வ.எண்	ஆண்டு	திருக்கோயில் பெயர் மற்றும் முகவரி	மதிப்பீடு	பணி ஆணை வழங்கப்பட்ட நாள்	ஒப்பந்தப்படி பணி செய்து முடிக்கவேண்டிய நாள்	பணியினை செய்து முடித்த நாள்
12.	2013	அருள்மிகு ஜெனகைமாரியம்மன் திருக்கோயில், சோழவந்தான். வாடிப்பட்டி வட்டம் மதுரை மாவட்டம் திருத்தேர் திருப்பணி.	ரூ. 17,04,651.00	07-05-2013	9 மாதம்	பணி நிறைவுப்பெற்றது.
13.	2014	அருள்மிகு மீனாட்சி சுந்தரேஸ்வரர் திருக்கோயில், மதுரை. மகாநாசி செப்பனிட சாரம் கட்டும் பணி.	ரூ. 2,00,748.00	03-03-2015	1 மாதம்	பணி நிறைவுப்பெற்றது.
14.	2014	அருள்மிகு மீனாட்சி சுந்தரேஸ்வரர் திருக்கோயில், மதுரை. சேதமடைந்த மகாநாசி அகற்றி புதிய மகாநாசி கட்டும் பணி.	ரூ. 4,97,911.60	03-03-2015	1 மாதம்	பணி நிறைவுப்பெற்றது.
15.	2014	அருள்மிகு அய்யம்பொழில்ஈஸ்வரர் திருக்கோயில், ஆமூர். சுவாமி சந்நிதி, அம்மன், மகா மண்டபம் திரும்பகட்டுதல் திருப்பணி.	ரூ. 50,78,247.00	05-03-2014	9 மாதம்	பணி நடைபெற்றுக்-கொண்டிருக்கிறது.
16.	2015	அருள்மிகு மீனாட்சி சுந்தரேஸ்வரர் திருக்கோயில், மதுரை. அம்மன் சந்நிதி புதிய தேக்குமரக்கதவு பொருத்தும் பணி.	ரூ. 4,54,956.00	24-01-2015	6 மாதம்	பணி நிறைவுப்பெற்றது.
17.	2015	அருள்மிகு மீனாட்சி சுந்தரேஸ்வரர் திருக்கோயில், மதுரை. அருள்மிகு மாரியம்மன் திருக்கோயில் தெப்பக்குளம் படித்துறை சுவர் புதிய கல் நந்தி அமைக்கும் பணி.	ரூ. 1,42,330.00	16-12-2015	2 மாதம்	பணி நிறைவுப்பெற்றது.
18.	2016	மேற்படி திருக்கோயில் வடக்கு, மேற்கு ஆடி வீதி கல்யாண மண்டபம் முன் கருங்கல் தளம் அமைக்கும் பணி.	ரூ. 6,30,900.00	10.2.2016	6 மாதம்	பணி நடைபெற்றுக்-கொண்டிருக்கிறது.

உபயதாரர்கள் மூலம் செய்துள்ள திருக்கோயில்கள் விபரம்

1. அருள்மிகு ஆபத்துகாத்த விநாயகர் திருக்கோயில்
திருச்செங்கோடு. புதிய கருங்கல் திருப்பணி.

2 அருள்மிகு கைலாசநாதர் திருக்கோயில் திருச்செங்கோடு.
மராமத்து மற்றும் பஞ்சவர்ண வேலைகள்.

3. அருள்மிகு கரியமாணிக்கப்பெருமாள் திருக்கோயில்
புரிசை கிராமம் காஞ்சிபுரம் மாவட்டம்.
திருக்கோயில் பிரித்தெடுத்து புதிய கட்டுமானம்.

4 அருள்மிகு அர்த்தநாரிஸ்வரர் திருக்கோயில் திருச்செங்கோடு.
புதிய கொடிமரம் திருப்பணி.

.5. அருள்மிகு பூ மிநாத சுவாமி திருக்கோயில் திருச்சுழி.
மராமத்து மற்றும் பஞ்சவர்ண வேலைகள்.

6. அருள்மிகு தாயுமானசுவாமி திருக்கோயில் மலைக்கோட்டை
திருச்சிராப்பள்ளி.
மராமத்து மற்றும் பஞ்சவர்ண வேலைகள்.

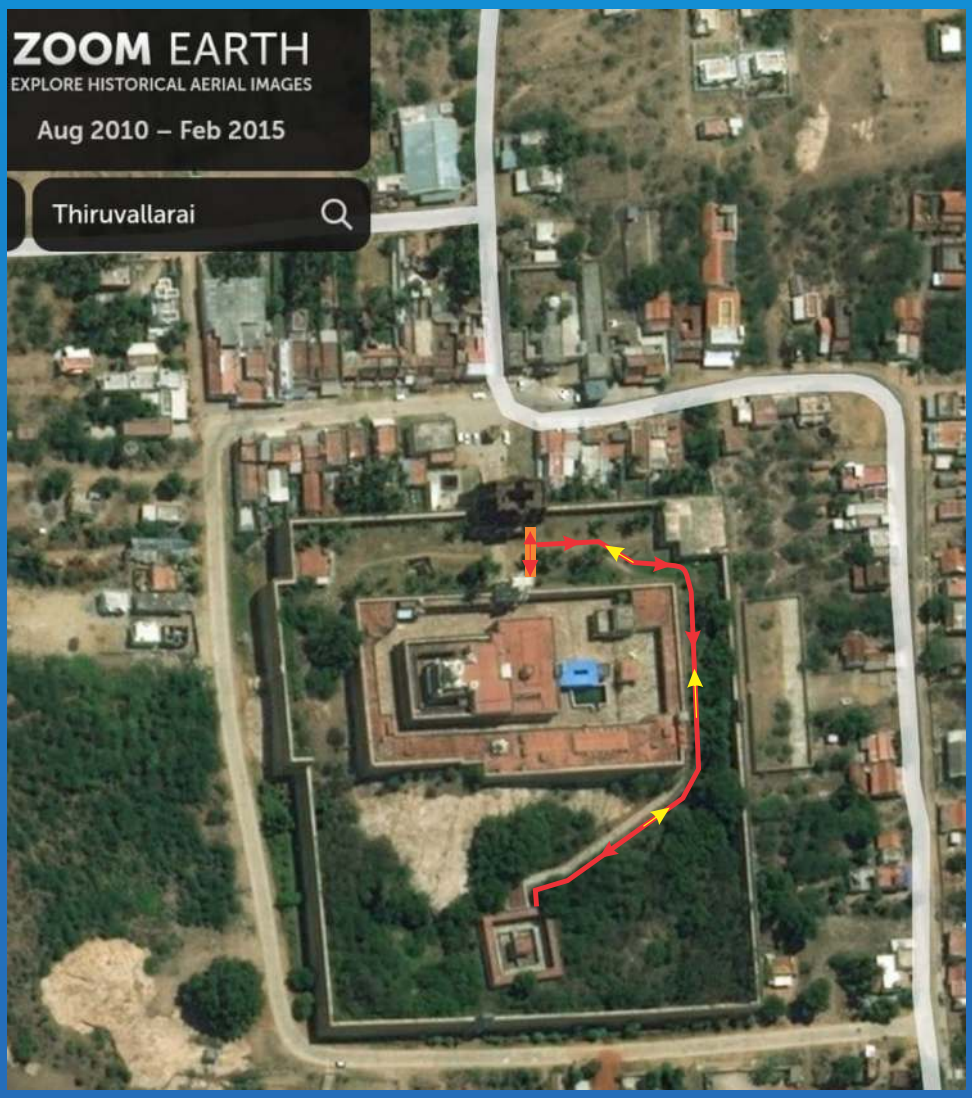
7. அருள்மிகு இராமநாதசுவாமி திருக்கோயில் இராமேஸ்வரம்.
புதிய திருக்கல்யாண மண்டபம் அலங்கார வேலைகள்.

8. அருள்மிகு அருணாச்சலேஸ்வரர் திருக்கோயில்
திருவண்ணாமலை.
வல்லால மகாராஜ இராஜகோபுரம் மராமத்து மற்றும் ஏகவர்ணம்
செய்யும் திருப்பணி.

9. அருள்மிகு இராஜகோபாலசுவாமி திருக்கோயில் புதுப்பாளையம்
கடலூர்.
புதிய ஐந்துநிலை இராஜகோபுரம் கட்டுமானம்.

10. அருள்மிகு அரங்கநாதர் சுவாமி திருக்கோயில் ஸ்ரீரங்கம்.
கருவறை விமானம் மராமத்து மற்றும் பஞ்சவர்ண வேலைகள்.
தேக்கு மரக்கதவு செய்து பொருத்தும் பணிகள்.

11 அருள்மிகு வரதராஜப்பெருமாள் திருக்கோயில்
அழுந்தலைப்பூ ர் கிராமம் பெரம்பலூர் மாவட்டம்.
திருக்கோயில் பிரித்தெடுத்து புதிய கட்டுமானம்.



4th Prakaram

Before renovation, the red line shows the existing pilgrimage path in an incomplete circle. Only upto Vasantha mandapam & back not enabling the Vasantha mandapam Perumal purapaadu (normally in May) to come in a full circle.

The renovation works started in **August 2014 and completed in May 2015,** enabling Vasantha mandapam Perumal purapaadu to come in a full circle.

The renovation works further continued until 2019 to pave the 16 feet Granite pilgrimage path to about 1600 feet.

The arrow mark in red color shows the clockwise direction and the yellow color shows the anti-clockwise direction.