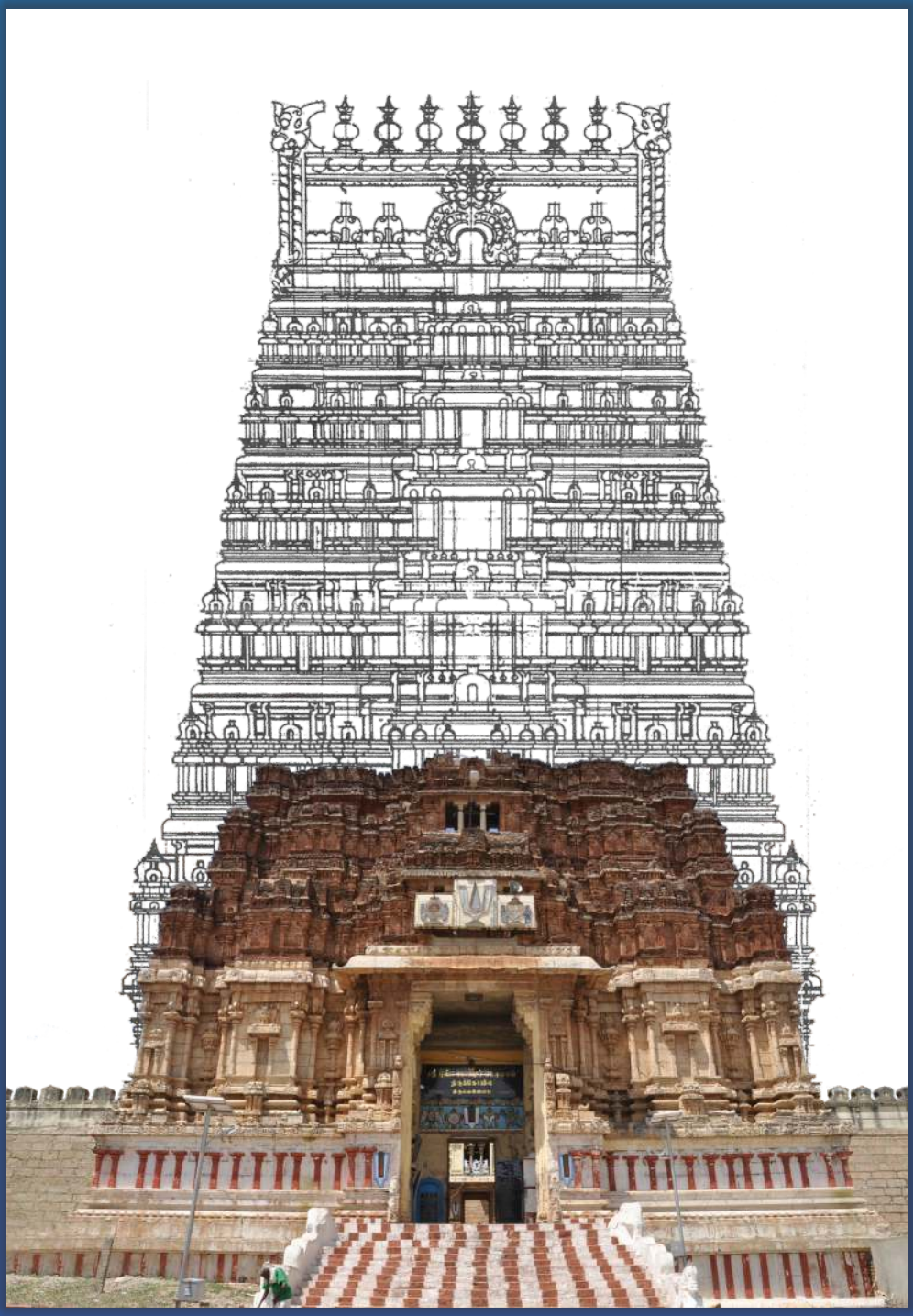
ARULMIGHU THIRU PUNDARIKATCHA PERUMAL THIRUKOIL
RAJAGOPURA THIRUPPANI

14 April 2017

REPORT - 2



THIRUPPANI DONORS

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

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

ARULMIGHU PUNDARIKATCHA PERUMAL THIRUKOIL
RAJAGOPURA THIRUPPANI

14th April 2017

REPORT - 2

Kalkaram grouting report
&
Replacement of the Cracked Beams and Pillars
Status Report

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 PUNDARIKATCHA PERUMAL THIRUKOIL

Rajagopuram Thiruppani

Contents

Balalayam

The Balalayam for the Rajagopuram was performed on 19th February 2016. The ceremonies were performed by archagars and pandaries, in the presense of Joint Commissioner, SriRangam Shri. P.Jayaraman, sthlathars, Sthabathi Shri. Kumaraguru, donors and the guests.

Lime - Mortar Grinding machine - Traditional

Lime - Mortar Development

In December 2014, we commenced the construction of our Shri Uyyakondar Ramanuja Koodam (Mutt), approximately 5500 Sq Ft., including ground & 1st floor, right opposite to the Raja Gopuram.

This has RCC skeleton and Porotherm hollow insulating clay bricks with cement. When we began plastering , the sudden thought came to our mind, why not to use the lime mortar, instead of the cement. Because in any case, it is mandatory for us to use the lime - mortar for the construction of the Raja Gopuram.

Therefore, it was imperative for us to build the machine suitable for grinding the lime - mortar, since ready machines were not available in the market. In this context, we conceived the concept of the machine and it took almost 5 months to completely fabricate the machine, from the drawing board to the prototype. Initial trials of grinding the lime - mortar and the quality were satisfactory.

So the plastering of the mutt and the other ornamental works were completed with the Lime - mortar and the house - warming ceremony was performed on 21 January 2016.

During the construction, IIT Madras team visited the temple for their regular work in reg to Raja Gopuram, and also spend some time inspecting the lime mortar grinding and plastering process and were satisfied.

This gave us confidence and encouraged us to go-ahead with the use of lime mortar for the construction of Raja Gopuram.

On a second thought, it flashed in our mind, why not to use the traditional grinding process for lime mortar, where the bulls will walk in circular path to facilitate the granite rollers to do the job, instead of the modern machine.

Nowadays, the problem is the space. Hence, we decided to use the electrical motors driven gear-box, located in the middle of the circular ring for the grinding. Now the problem is balancing : so we decided to use two granite rollers diagonally opposite.

In the end it turned out to be the perfect traditional machine to carry out the job.

The quality of the lime mortar obtained from the machine was highly satisfactory.

Lime Mortar Prescription

Lime Mortar Slurry Mix Details

The following prescription was recommended by Sthabathi Shri. Kumaraguru

1. Lime and sieved river sand were mixed in the ratio one part of the lime with three parts sand adding small quantity of water to the wet consistency and allowed to ferment for about a week.
2. Then this mixture was ground in the machine for about 30 minutes with the addition of water to get thick paste consistency. The twin granite rollers will take a minute for each revolution.
3. This paste was stored in a covered area, with the coconut thatched roof and sides for coolness, allowed to ferment for 7 - 10 days.
4. Subsequently, this paste is again ground for about 30 minutes, then utilized either for grouting or for brick mortar construction.

Grouting paste. Typical composition.

AA. Vilvam fruit solution. Typical composition.

100 grams (2 Nos.) of this pealed fruit is mixed with 4.0 liters of water and blend to a homogeneous solutions.

BB. Sotru kattalai - Aloe Vera solution.

The soft paste inside the Aloe Vera is scooped out (by slitting it) and mixed with water in the ratio of 500 cc with 20.0 litres of water, blended to get a homogeneous solution.

CC. Aloe Vera solution + Vilvam fruit Solution

200 cc of AA is mixed with the entire quantity of **BB**

Preparing the Grouting slurry. Typical composition.

8.0 liters (16.0 kg) of the Lime-Mortar paste is mixed with 2.5 liters of **CC.**

Now this homogeneous slurry is used for grouting.

The annexed picture will explain the slurry pouring techniques.

Kalkaram Grouting - Procedure

As per the discussion with Dr.Arun Menon, we have selected around 10-15 locations inside the temple 4th Pragharam, on the west, south and east, at two different levels, approximately 1.2 meters and 5.5 meters height from the ground level.

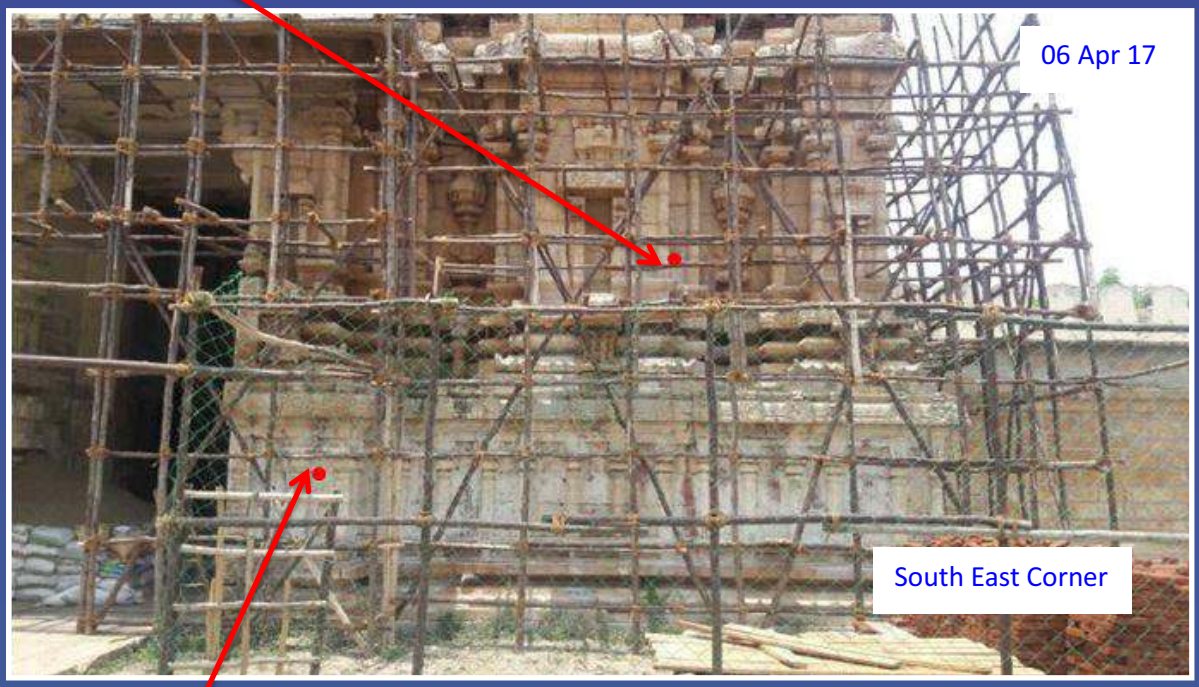
55mm diameter, 1000 mm deep holes have been drilled on these locations. The details are furnished in the following figures. Lime-Mortar slurry was poured in all these holes and frequently pushed inside with the 30mm diameter sticks enabling the slurry to reach the empty pockets, if any, around these holes. All these details have been monitored. The annexed pictures will give more information.

In this process, after analyzing all the Core-cut samples, probably we could understand that double-leaf construction techniques were used to built the Raja Gopuram of this size, seems a normal practice. The granite stones thickness being at least 300 - 400 mm on both the sides, inside filled with broken stones and Lime - Mortar Procedure.

Location Deails of the Grouting Points

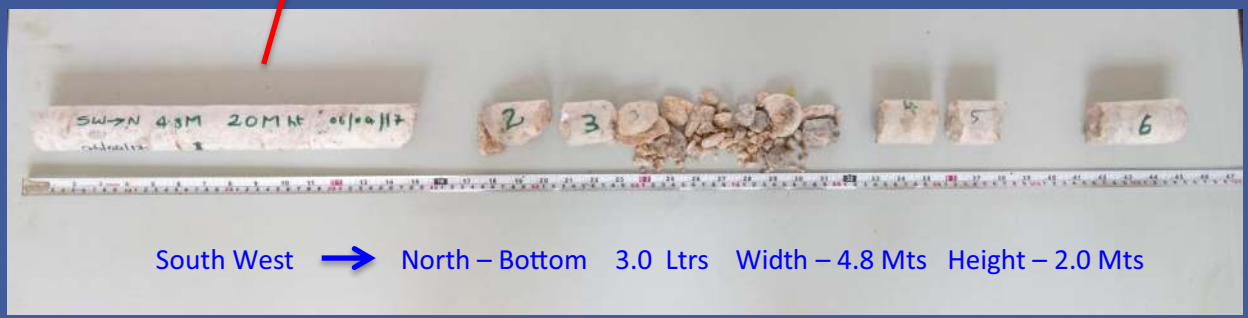
SNo	Location - Side	Qty Litre	Width Meter	Height Meter
1	South West -North – TOP	1.25	2.8	5.3
2	South West -North – TOP	3.5	4.2	5.3
3	South West -North – BOTTOM	3.0	4.8	2.0
4	South West -North – BOTTOM	5.5	1.1	2.0
5	South West -East – TOP	4.0	1.2	5.0
6	South West -East – TOP	5.5	4.0	5.0
7	South West -East – BOTTOM	5.5	1.0	1.7
8	South West -East – BOTTOM	9.5	4.0	2.2
9	South East-West – BOTTOM	5.0	8.5	1.7
10	South East -West – TOP	2.5	3.0	5.0
11	South East - North – TOP	3.0	1.2	5.4
12	South East - North – TOP	2.5	4.8	5.2

South East → West – Top 2.5 Ltrs Width – 3.0 Mts Height – 5.2 Mts

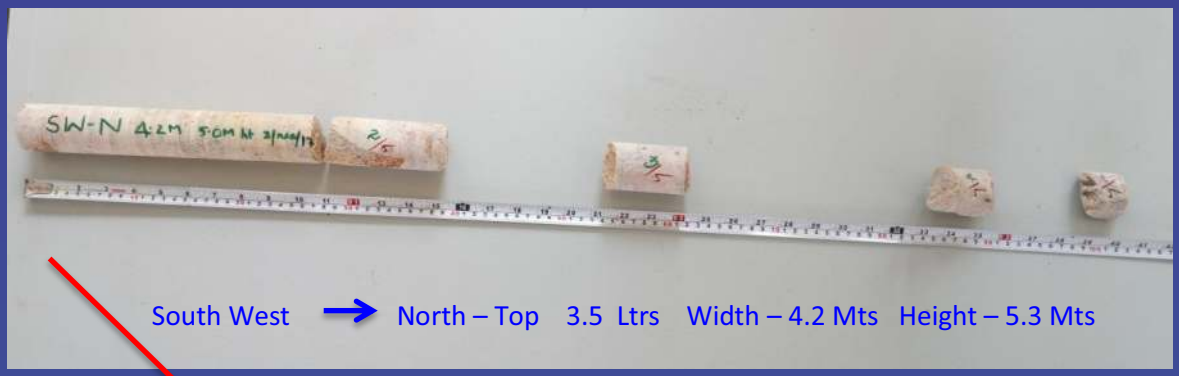


South East → West – Bottom 5.0 Ltrs Width – 8.5 Mts Height – 1.7 Mts

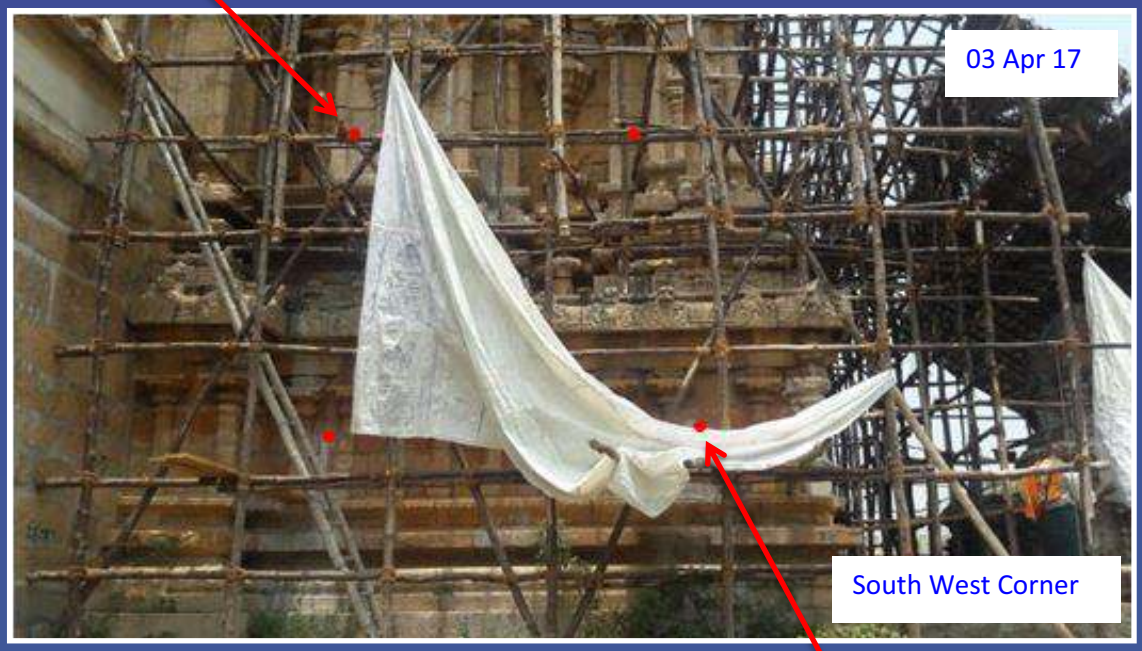
South West → North – Top 1.25 Ltrs Width – 2.8 Mts Height – 5.3 Mts



South West → North – Bottom 3.0 Ltrs Width – 4.8 Mts Height – 2.0 Mts



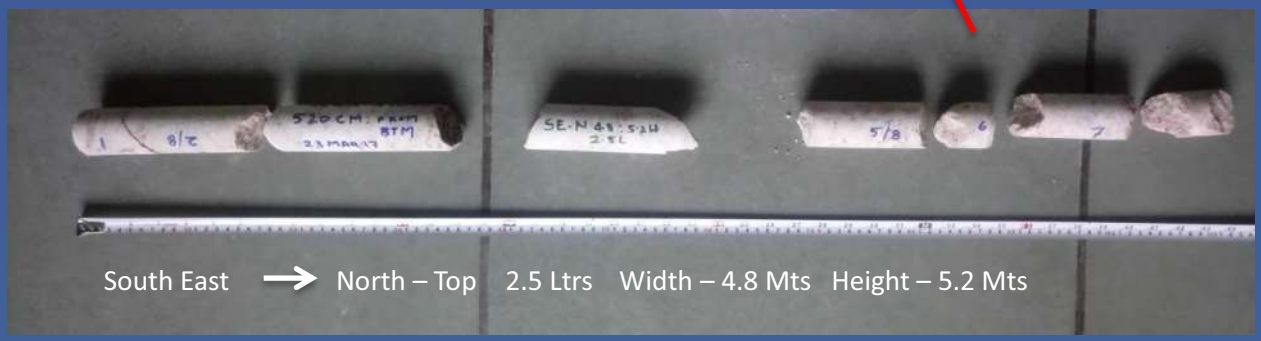
South West → North – Top 3.5 Ltrs Width – 4.2 Mts Height – 5.3 Mts



South West → North – Bottom 5.5 Ltrs Width – 1.1 Mts Height – 2.0 Mts


South East → North – Top 3.0 Ltrs Width – 1.2 Mts Height – 5.4 Mts


03 Apr 17
South East Corner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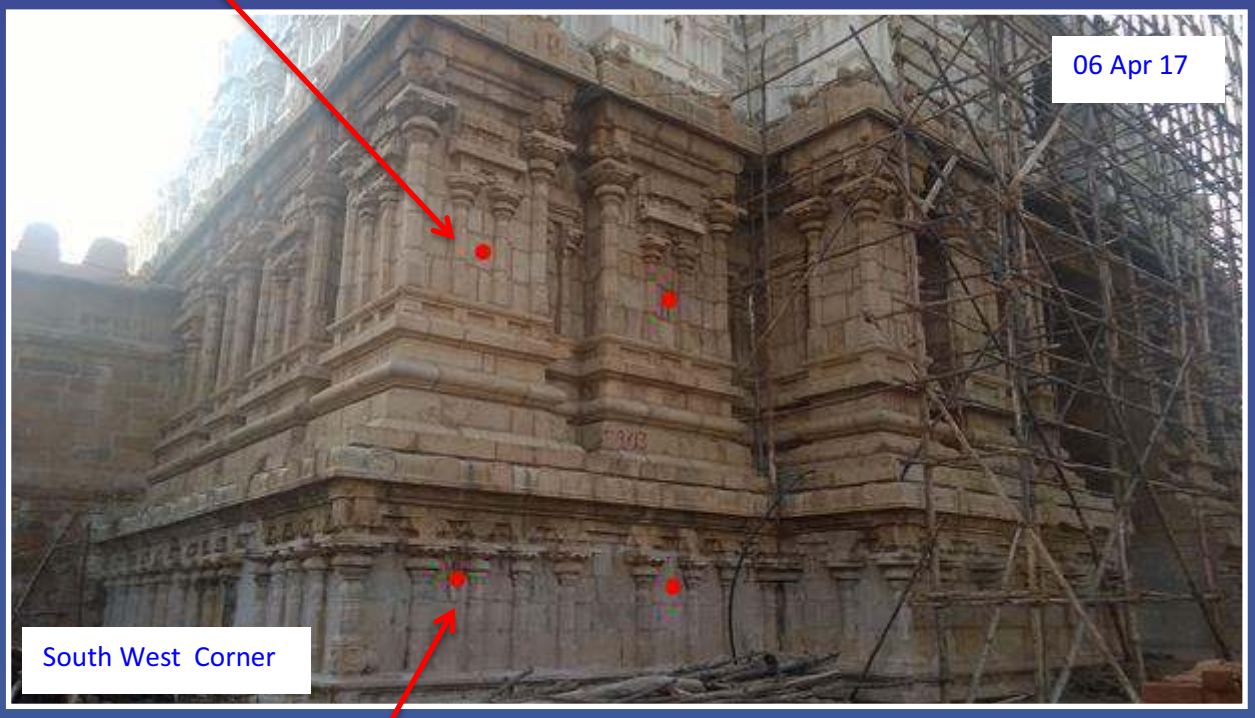
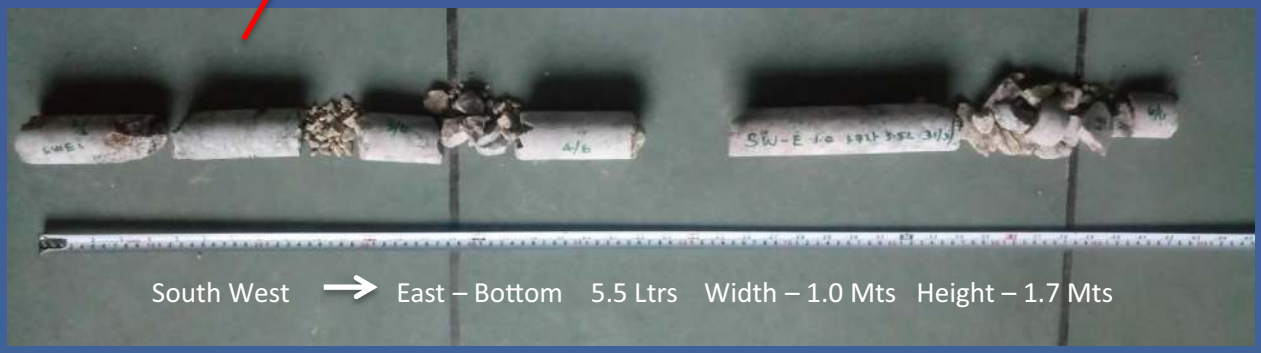
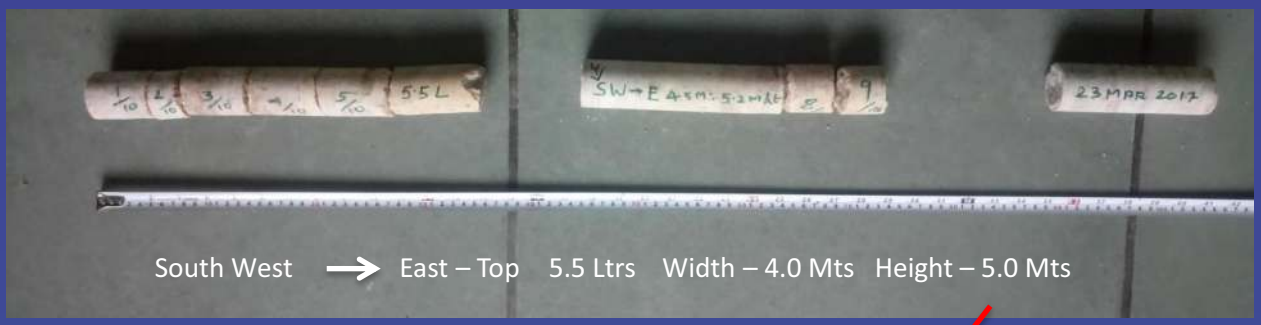
South West → East – Top 4.0 Ltrs Width – 1.2 Mts Height – 5.0 Mts

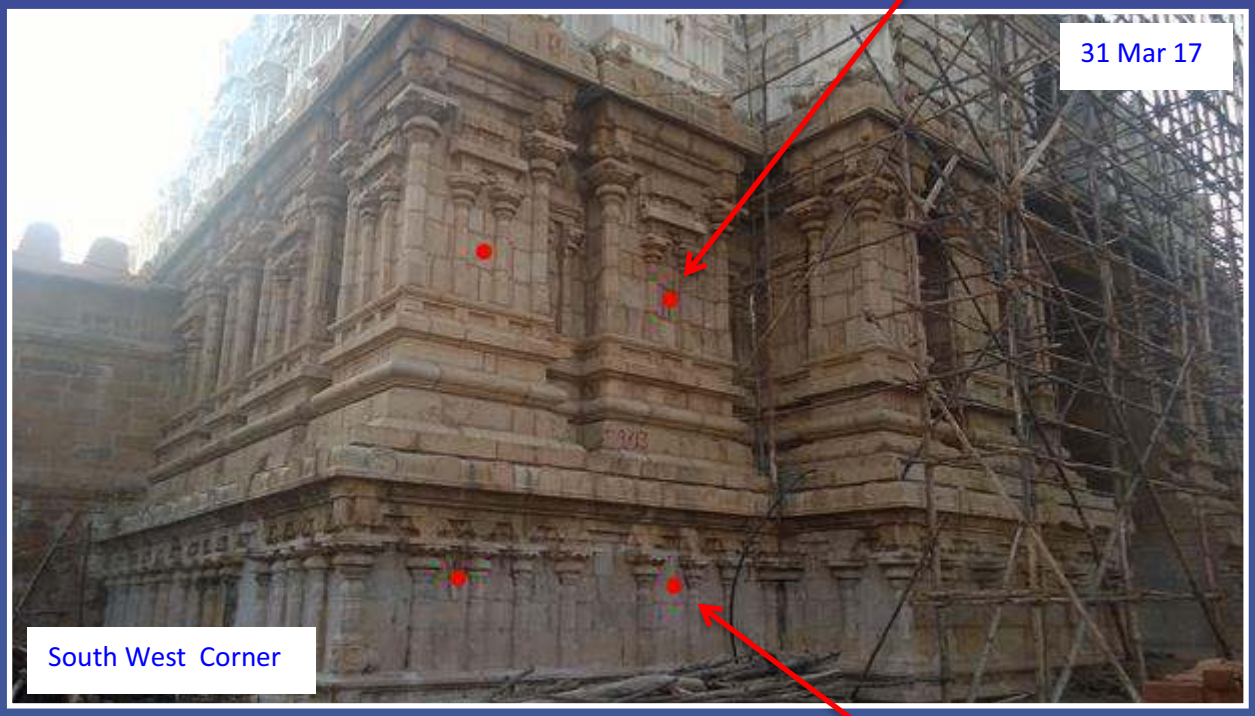


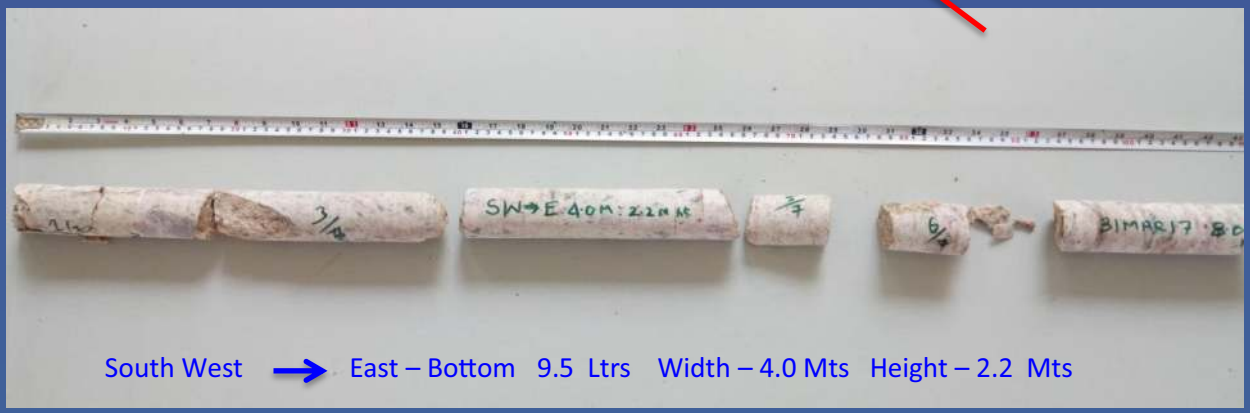


South West → East – Bottom 5.5 Ltrs Width – 1.0 Mts Height – 1.7 Mts



South West → East – Top 5.5 Ltrs Width – 4.0 Mts Height – 5.0 Mts





South West → East – Bottom 9.5 Ltrs Width – 4.0 Mts Height – 2.2 Mts

Model Gopuram

Karnakudu from the 3 Tiers of the RajaGopuram 1st, 2nd and 3rd, (the 4 corners of the Raja Gopuram) were built utilising the above detailed Lime - Mortar slurry in December 2016, to the height of around 3.0 meters, 1.5 Meter & 1 Meter.

After 2/3 months of setting, test specimens will be cut and checked for quality in the IIT Madras Laboratories.

After confirmation, the subsequent tiers will be constructed.
This is also done to understand the complexities in design/ shape and building the structures.

This will be retained for the future reference.

Granite Beams & Pillars

14 Nos. Granite Beams & Pillars, approximately 95 Metric Tonnes from the regions around Bangalore were brought in to replace the damaged Pillars & Beams. This also includes 3 Nos extra Beams in case if any of them breaks in the installation process

The team of sculptors are working on this beams Since, 4th of Apr 2017, We hope to complete this work by Mid of May 2017.
Immediately after that , the replacement work will commence.

Structural Health Monitoring

Based on the recommendations from IIT madras, installation of the health monitoring system is commenced. The materials are received in the temple , the copies of the invoices & packing list is annexed.

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Invoice for removal of excisable goods from factory or warehouse on payment of duty (Rule 11 of C.Ex Rules)

ORIGINAL INVOICE FOR BUYER

Commissionerate	LUCKNOW	Division	1-LUCKNOW	Range	TALKATORA	Tariff Heading No.
ECC/Regn. Number	[illegible]	Location code	[illegible]	Service tax no.	[illegible]	9033, 9031, 8544, 7682, 7204
CIN	[illegible]	PAN No.	[illegible]	D&B Rating	4A1	NSIC : [illegible]

WE ARE REGISTERED UNDER MSME ACT 2006 VIDE REGISTRATION NO. 09 02712 00221 DT. 16/01/2008

SALE INVOICE

Consignee **Kalpanajaybal Foundation** Vuyyakondar Ramanuja Koodam Agaraharam Street Thiruvellari,Trichy -621009 Mr. Manikkam : 09894474852 Pan No. : AACTK5805H	Invoice No. **16-17/315**	Dated **31-Mar-2017**
	Delivery Note	Mode/Terms of Payment **Direct**
	Supplier's Ref. **KJF-001/2016-17**	Other Reference(s) B1703479
Buyer (if other than consignee) **Kalpanajaybal Foundation** Vuyyakondar Ramanuja Koodam Agaraharam Street Thiruvellari, Trichy -621009 Pan No. -AACTK5805H	Buyer's Order No. **KJF-001/2016-17**	Dated **25-Mar-2017**
	Despatch Document No. 1633516[illegible]	Dated 07-4-17
	Despatched through **Gati**	Destination **Thiruvellari, Trichy -621009**
	Terms of Delivery **100% Advance Received**	

Sl No.	Marks & Nos./ Container No.	No. & Kind of Pkgs.	Description of Goods	Part No.	Quantity	Rate	per	Amount
1	2-3/7		**ESMP-10 Ground Settlement Point** *Tariff Code : 90318000*	3100096	**10 Nos**	560.00	Nos	**5,600.00**
2	4/7		**EBS-16 Building Settlement Point** *Tariff Code : 90318000*	7002019	**20 Nos**	315.00	Nos	**6,300.00**
3	4/7		**EDJ-40C Crack Meter. Range: 50 mm** *Tariff Code : 90318000*	7001678	**12 Nos**	405.00	Nos	**4,860.00**
4	5/7		**Tilt Plates** *For Tilt Meter Model EAN-70M* *Tariff Code : 90318000*	3101136	**20 Nos**	1,080.00	Nos	**21,600.00**
5	6/7		**EAN-70M-U Portable Tilt Meter** *Tariff Code : 90318000*	7001761	**1 Nos**	1,12,500.00	Nos	**1,12,500.00**
6	7/7		**EDI-53UTM Readout Unit** *Readout Unit for Tilt Meter* *Tariff Code : 90318000*	7001041	**1 Nos**	63,000.00	Nos	**63,000.00**
7	1/7	7 Boxes	**EPP-10/6 Water Level Sounder (Range 100m)** *Water Level Indicator* *Resolution: 1mm, Tariff Code: 90318000*	7001919	**1 Nos**	25,000.00	Nos	**25,000.00**
								2,38,860.00

continued ...

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Goods should be thoroughly examined immediately after receipt. Complaints, if any, should be made in writing within 3 days of receipt of goods. No complaints will be entertained, thereafter. No goods should be returned unless our prior approval has been obtained. All claims subject to Lucknow, U.P., India Jurisdiction only.

VAT: 09952200058S CST: 09952200058C BIN: AAACE5260BFT001 IEC No.: 0588009420 Exporters Code: KE000105

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Commissionerate	LUCKNOW	Division	I-LUCKNOW	Range	TALKATORA	Tariff Heading No.
ECC/Regn. Number	[illegible]	Location code	[illegible]	Service tax no.	[illegible]	[illegible]
CIN	[illegible]	PAN No.	[illegible]	D&B Rating	4A1	NSIC [illegible]

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SALE INVOICE(Page 2)

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	Delivery Note	Mode/Terms of Payment **Direct**
	Supplier's Ref. **KJF-001/2016-17**	Other Reference(s)
Buyer (if other than consignee) **Kalpanajaybal Foundation** Vuyyakondar Ramanuja Koodam Agaraharam Street Thiruvellari, Trichy -621009 Pan No. :AACTK5805H	Buyer's Order No. **KJF-001/2016-17**	Dated **25-Mar-2017**
	Despatch Document No.	Dated
	Despatched through **Gati**	Destination **Thiruvellari, Trichy -621009**
	Terms of Delivery **100% Advance Received**	

Sl No.	Marks & Nos./ Container No.	No. & Kind of Pkgs.	Description of Goods	Part No.	Quanity	Rate	per	Amount
			Excise Duty 12.5% Payable A/c			12.50	%	29,857.50
			Central Sales Tax 4%			4	%	10,748.70
			Additional Tax - 1% CST			1	%	2,687.18
			Freight Charges by Courier					4,777.20
			Amount Round Off					0.42
			Total		65 Nos			₹ 2,86,931.00

E. & O.E

Amount Chargeable (in words)
Indian Rupees Two Lakh Eighty Six Thousand Nine Hundred Thirty One Only

Company's VAT TIN : 09952200008C
Company's CST No. : 09952200008C
Company's PAN : AAACE5280B

Date & Time of Invoice : 31-Mar-2017 at 11:32
Date & Time of Removal : 31-Mar-2017 at 11:57 Hrs

Pre Authenticated by

Authorised Signatory
Name : Gulshan Wadhera
Designation : Manager Finance

for Encardio Rite Electronics Pvt. Ltd.
Issuing Signatory
Name : Gulshan Wadhera
Designation : Manager Finance

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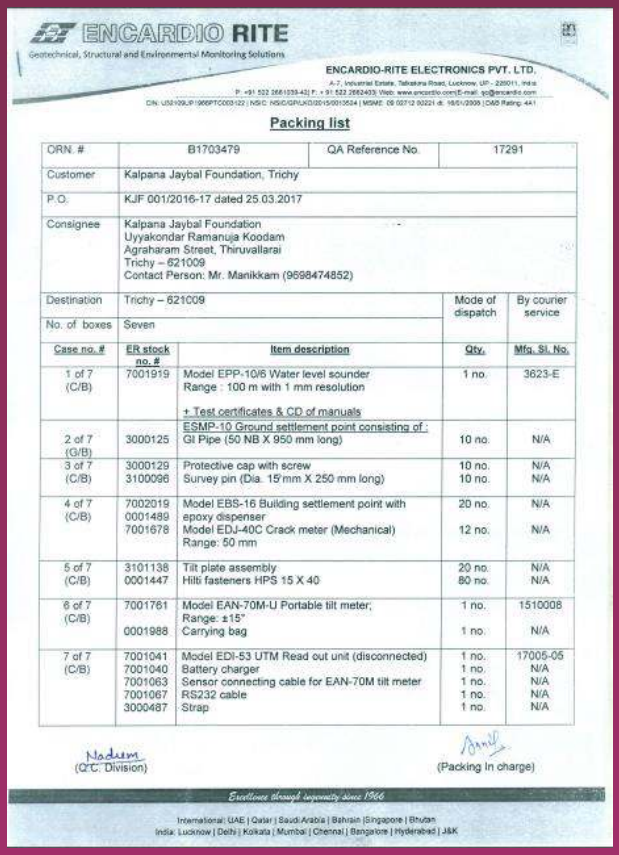
VAT: [illegible] CST: [illegible] BIN: AAACE5280BFT001 IEC No.: [illegible] Exporters Code: KE000105



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CIN: U32109UP1996PTC093122 | NSIC: NSIC/GP/UKO/2015/00013524 | MSME: 09 02712 00221 dt. 16/01/2008 | D&B Rating: 4A1

Packing list

ORN. #	B1703479	QA Reference No.	17291
Customer	Kalpana Jaybal Foundation, Trichy		
P.O.	KJF 001/2016-17 dated 25.03.2017		
Consignee	Kalpana Jaybal Foundation Uyyakondar Ramanuja Koodam Agraharam Street, Thiruvallarai Trichy – 621009 Contact Person: Mr. Manikkam (9698474852)		
Destination	Trichy – 621009	Mode of dispatch	By courier service
No. of boxes	Seven		

Case no. #	ER stock no. #	Item description	Qty.	Mfg. Sl. No.
1 of 7 (C/B)	7001919	Model EPP-10/6 Water level sounder Range : 100 m with 1 mm resolution + Test certificates & CD of manuals	1 no.	3623-E
2 of 7 (G/B)	3000125	ESMP-10 Ground settlement point consisting of : GI Pipe (50 NB X 950 mm long)	10 no.	N/A
3 of 7 (C/B)	3000129 3100096	Protective cap with screw Survey pin (Dia. 15'mm X 250 mm long)	10 no. 10 no.	N/A N/A
4 of 7 (C/B)	7002019 0001489 7001678	Model EBS-16 Building settlement point with epoxy dispenser Model EDJ-40C Crack meter (Mechanical) Range: 50 mm	20 no. 12 no.	N/A N/A
5 of 7 (C/B)	3101138 0001447	Tilt plate assembly Hilti fasteners HPS 15 X 40	20 no. 80 no.	N/A N/A
6 of 7 (C/B)	7001761 0001988	Model EAN-70M-U Portable tilt meter; Range: ±15° Carrying bag	1 no. 1 no.	1510008 N/A
7 of 7 (C/B)	7001041 7001040 7001063 7001067 3000487	Model EDI-53 UTM Read out unit (disconnected) Battery charger Sensor connecting cable for EAN-70M tilt meter RS232 cable Strap	1 no. 1 no. 1 no. 1 no. 1 no.	17005-05 N/A N/A N/A N/A

Nadium
(QTC Division)

(Packing In charge)

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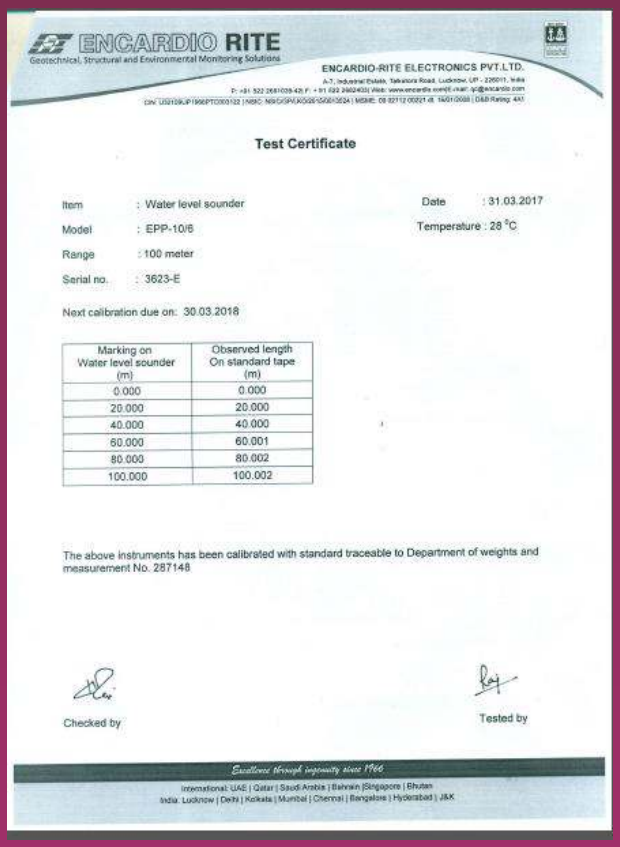
International: UAE | Qatar | Saudi Arabia | Bahrain |Singapore | Bhutan
India: Lucknow | Delhi | Kolkata | Mumbai | Chennai | Bangalore | Hyderabad | J&K



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Test Certificate

Item : Water level sounder
Model : EPP-10/6
Range : 100 meter
Serial no. : 3623-E

Date : 31.03.2017
Temperature : 28 °C

Next calibration due on: 30.03.2018

Marking on Water level sounder (m)	Observed length On standard tape (m)
0.000	0.000
20.000	20.000
40.000	40.000
60.000	60.001
80.000	80.002
100.000	100.002

The above instruments has been calibrated with standard traceable to Department of weights and measurement No. 287148

Checked by

Tested by

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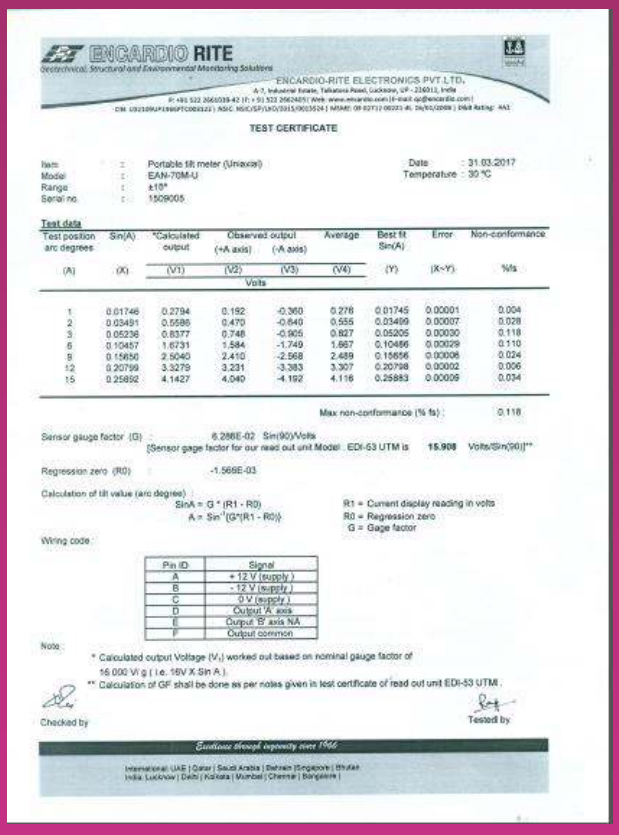
International: UAE | Qatar | Saudi Arabia | Bahrain |Singapore | Bhutan
India: Lucknow | Delhi | Kolkata | Mumbai | Chennai | Bangalore | Hyderabad | J&K



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CIN: U32109UP1996PTC093122 | NSIC: NSIC/GP/UKO/2015/00013524 | MSME: 09 02712 00221 dt. 16/01/2008 | D&B Rating: 4A1

TEST CERTIFICATE

Item : Portable tilt meter (Uniaxial)
Model : EAN-70M-U
Range : ±18°
Serial no. : 1509005

Date : 31.03.2017
Temperature : 30 °C

Test data

Test position arc degrees	Sin(A)	*Calculated output	Observed output (+A axis)	Observed output (-A axis)	Average	Best fit Sin(A)	Error	Non-conformance
(A)	(X)	(V1)	(V2)	(V3)	(V4)	(Y)	(X-Y)	%fs
		Volts						
1	0.01746	0.2794	0.192	-0.360	0.276	0.01745	0.00001	0.004
2	0.03491	0.5586	0.470	-0.640	0.555	0.03499	0.00007	0.028
3	0.05236	0.8377	0.748	-0.905	0.827	0.05205	0.00030	0.118
6	0.10457	1.6731	1.584	-1.749	1.667	0.10466	0.00029	0.110
9	0.15650	2.5040	2.410	-2.568	2.489	0.15656	0.00006	0.024
12	0.20799	3.3279	3.231	-3.383	3.307	0.20798	0.00002	0.006
15	0.25882	4.1427	4.040	-4.192	4.116	0.25883	0.00009	0.034

Max non-conformance (% fs) : 0.118

Sensor gauge factor (G) : 6.286E-02 Sin(90)/Volts
[Sensor gage factor for our read out unit Model : EDI-53 UTM is **15.908** Volts/Sin(90)]**

Regression zero (R0) : -1.569E-03

Calculation of tilt value (arc degree) :
SinA = G * (R1 - R0)
A = Sin⁻¹{G*(R1 - R0)}

R1 = Current display reading in volts
R0 = Regression zero
G = Gage factor

Wiring code :

Pin ID	Signal
A	+ 12 V (supply)
B	- 12 V (supply)
C	0 V (supply)
D	Output 'A' axis
E	Output 'B' axis NA
F	Output common

Note :
* Calculated output Voltage (V_o) worked out based on nominal gauge factor of 16.000 Vi g (i.e. 16V X Sin A).
** Calculation of GF shall be done as per notes given in test certificate of read out unit EDI-53 UTM .

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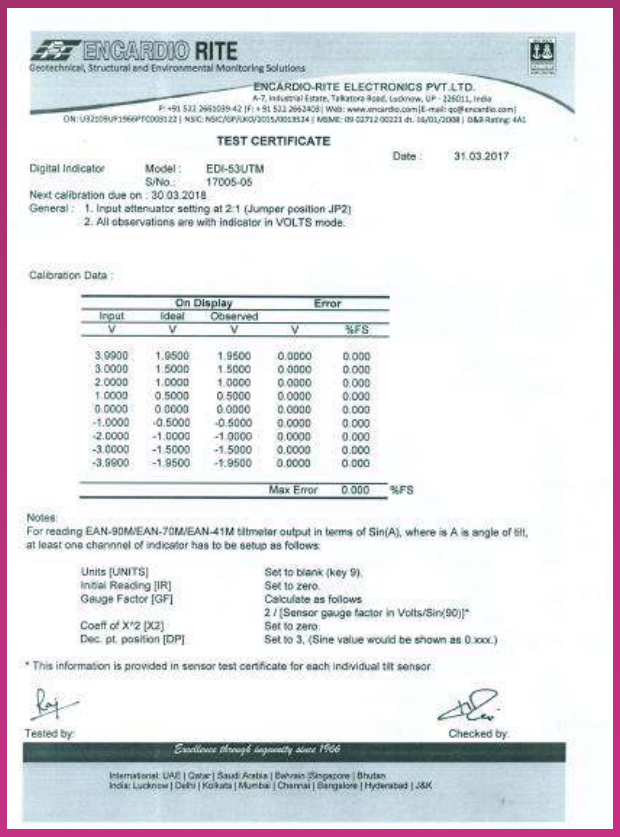
India: Lucknow | Delhi | Kolkata | Mumbai | Chennai | Bangalore |



ENCARDIO RITE

Geotechnical, Structural and Environmental Monitoring Solutions

ENCARDIO-RITE ELECTRONICS PVT.LTD.

A-7, Industrial Estate, Talkatora Road, Lucknow, UP - 226011, India

P: +91 522 2661039-42 | F: +91 522 2662403 | Web: www.encardio.com | E-mail: qc@encardio.com

CIN: U32109UP1996PTC093122 | NSIC: NSIC/GP/UKO/2015/00013524 | MSME: 09 02712 00221 dt. 16/01/2008 | D&B Rating: 4A1

TEST CERTIFICATE

Date : 31.03.2017

Digital Indicator Model : EDI-53/UTM
Sl/No : 17005-05

Next calibration due on : 30.03.2018
General : 1. Input attenuator setting at 2:1 (Jumper position JP2)
2. All observations are with indicator in VOLTS mode.

Calibration Data :

On Display Input	On Display Ideal	On Display Observed	Error V	Error %FS
V	V	V		
3.9900	1.9500	1.9500	0.0000	0.000
3.0000	1.5000	1.5000	0.0000	0.000
2.0000	1.0000	1.0000	0.0000	0.000
1.0000	0.5000	0.5000	0.0000	0.000
0.0000	0.0000	0.0000	0.0000	0.000
-1.0000	-0.5000	-0.5000	0.0000	0.000
-2.0000	-1.0000	-1.0000	0.0000	0.000
-3.0000	-1.5000	-1.5000	0.0000	0.000
-3.9900	-1.9500	-1.9500	0.0000	0.000
		Max Error	0.000	%FS

Notes:
For reading EAN-90M/EAN-70M/EAN-41M tiltmeter output in terms of Sin(A), where is A is angle of tilt, at least one channnel of indicator has to be setup as follows:

Units [UNITS]	Set to blank (key 9).
Initial Reading [IR]	Set to zero.
Gauge Factor [GF]	Calculate as follows 2 / [Sensor gauge factor in Volts/Sin(90)]*
Coeff of X^2 [X2]	Set to zero.
Dec. pt. position [DP]	Set to 3. (Sine value would be shown as 0.xxx.)

* This information is provided in sensor test certificate for each individual tilt sensor.

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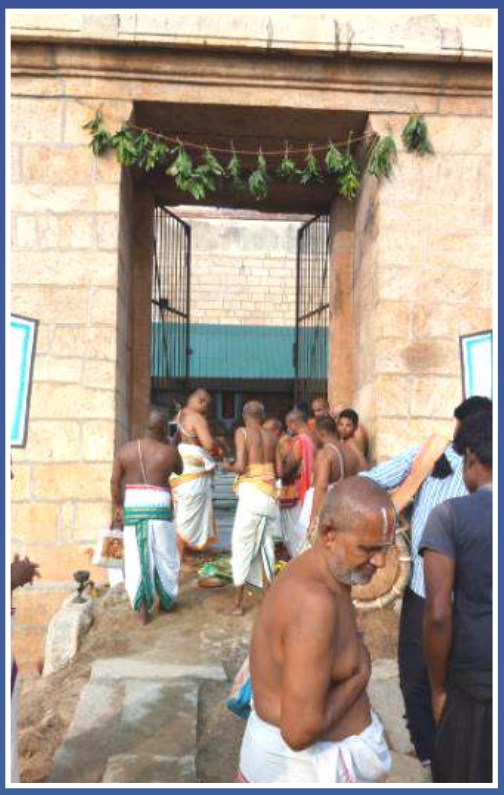
Eastern Gopuram

Eastern Gopuram - Entrance.

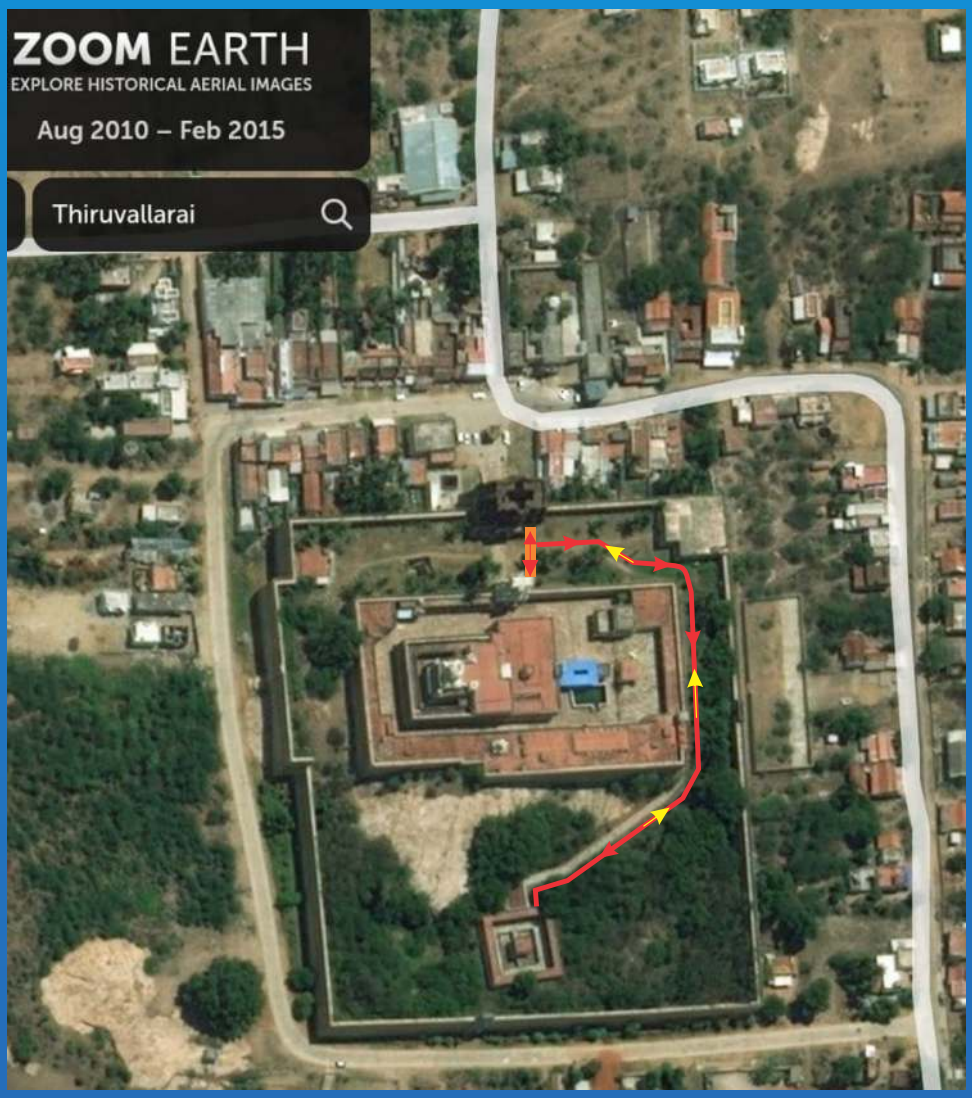
Consequent to all these developments, it became imperative to shift the Main entrance to the temple from the Northern side to the Eastern side.



Anticipating all this, the renovation work at the Eastern Gate was taken up sufficiently early and opened up by performing the relevant religious ceremonies on the 9th December 2016 by the temple Archagars and pandaries in the presence of the Superintending officer.

Conclusions

1. After Analysing , the quantum of intake of Lime – Mortar Slurry in all the 12 Holes & in consultation with IIT Madras, further Grouting of the Kalkaram will be taken up if needed.
2. The Test coupons from the model Gopuram will be furnished to IIT Madras Labarotories for their testing & feedback by end of April 2017.
3. The Grouting of the Brick masonry will also be discussed
4. The lime mortar Prescription given in this report will also be discussed in our next meeting with IIT Madras , to make any changes if necessary
5. It's our Request to IIT Madras & HRCE dept to make it convenient to be present in this noble inaugural function
6. The exact date & time will be communicated by end of April 2017.
7. Any suggestions from the stakeholders are welcome



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.