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DATE : 23-06-2020

SUB : TPSSL DESIGN IMPROVEMENT SUMMARY FOR EESL MNRE MMS STRUCTURE

The Tata Power Solar Systems Ltd drawing / document no. TPS-PUMP-EESL-9MMS-002 and TPS-PUMP-EESL-10MMS-002 was reviewed by us and compared along with the Module Mounting Structural designs provided in the NIT/Bid Doc. No. : EESL/06/2019-20/KUSUM/SWPS/Phase-1/10HP/Off Grid/192012030. The description of the TPSSL documents is as follows :

Sl. No.	Configuration / Size	Document No.	Contents
1	9 Module Mounting System (MMS)	TPS-PUMP-EESL-9MMS-002	<ul style="list-style-type: none"> Report for STAAD-Pro analysis as per IS standard. Wind Load Calculations as per IS 875 Pile Foundation Design as per IS standard. Structural drawings of the Module Mounting System.
2	10 Module Mounting System (MMS)	TPS-PUMP-EESL-10MMS-002	<ul style="list-style-type: none"> Report for STAAD-Pro analysis as per IS standard. Wind Load Calculations as per IS 875 Pile Foundation Design as per IS standard. Structural drawings of the Module Mounting System.

The above mentioned TPSSL documents have been duly certified by us vide certificates dated 23-06-2020 which form a part of this document and shall be read in conjunction with these certificates. The improvements and advantages of the TPSSL designed structure in comparison to MNRE-2019 design have been mentioned in the Table 1.0 of Annexure 1 of this document.

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ANNEXURE 2	ABOUT BANGALORE UNIVERSITY	PAGE 4 TO 6
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Thanking You

Yours Sincerely

Dr. Jayaramappa N (Bangalore University)



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ANNEXURE 1
TPSSL DESIGN IMPROVEMENT SUMMARY OVER MNRE STRUCTURES

Table 1.0

Sl. no.	Short Description	MNRE - 2019	Improved design																
1	Additional cross members provided.	No cross beam structural members provided in MNRE 2019 MMS designs. The purlins are carrying weight of the rafters.	Additional cross beam members have been provided to avoid excess deflection and stresses. This feature is absent in the MNRE design. The complete behaviour of the structure has been modelled and analysed on STAAD-Pro software.																
2	Top Plate Gussets.	4 nos. Gussets provided on top plate of the structure.	8 nos. Gussets provided on the top plate of the structure.																
3	Structural Material Strength	MNRE - 2019 guidelines for yield strength : <table border="1"> <thead> <tr> <th>Component</th> <th>MNRE Yield Strength</th> </tr> </thead> <tbody> <tr> <td>Purlins</td> <td>250 MPa</td> </tr> <tr> <td>Rafter</td> <td>250 MPa</td> </tr> <tr> <td>Base Column</td> <td>250 MPa</td> </tr> </tbody> </table>	Component	MNRE Yield Strength	Purlins	250 MPa	Rafter	250 MPa	Base Column	250 MPa	TPSSL design uses High Yield Strength materials for better safety margins : <table border="1"> <thead> <tr> <th>Component</th> <th>TPSSL Yield Strength</th> </tr> </thead> <tbody> <tr> <td>Purlins</td> <td>350 MPa</td> </tr> <tr> <td>Rafter</td> <td>310 MPa</td> </tr> <tr> <td>Base Column</td> <td>310 MPa</td> </tr> </tbody> </table> All materials grades used in the structure are as per IS standards.	Component	TPSSL Yield Strength	Purlins	350 MPa	Rafter	310 MPa	Base Column	310 MPa
Component	MNRE Yield Strength																		
Purlins	250 MPa																		
Rafter	250 MPa																		
Base Column	250 MPa																		
Component	TPSSL Yield Strength																		
Purlins	350 MPa																		
Rafter	310 MPa																		
Base Column	310 MPa																		
4	Dimensions of main structure members	Base pole and Supporting pipes are main load bearing member for the structure. MNRE 2019 guidelines : <table border="1"> <thead> <tr> <th>Component</th> <th>MNRE Diameter</th> </tr> </thead> <tbody> <tr> <td>Base Pole Diameter</td> <td>139 mm</td> </tr> <tr> <td>Supporting Pipe 1 dia.</td> <td>41 mm</td> </tr> <tr> <td>Supporting Pipe 2 dia.</td> <td>33 mm</td> </tr> </tbody> </table>	Component	MNRE Diameter	Base Pole Diameter	139 mm	Supporting Pipe 1 dia.	41 mm	Supporting Pipe 2 dia.	33 mm	TPSSL has used larger diameter base pole and Supporting Pipes for high strength and low deflections : TPSSL Design : <table border="1"> <thead> <tr> <th>Component</th> <th>TPSSL Diameter</th> </tr> </thead> <tbody> <tr> <td>Base Pole Diameter</td> <td>152 mm</td> </tr> <tr> <td>Supporting Pipe 1 dia.</td> <td>42.7 mm</td> </tr> <tr> <td>Supporting Pipe 2 dia.</td> <td>33.7 mm</td> </tr> </tbody> </table>	Component	TPSSL Diameter	Base Pole Diameter	152 mm	Supporting Pipe 1 dia.	42.7 mm	Supporting Pipe 2 dia.	33.7 mm
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Base Pole Diameter	139 mm																		
Supporting Pipe 1 dia.	41 mm																		
Supporting Pipe 2 dia.	33 mm																		
Component	TPSSL Diameter																		
Base Pole Diameter	152 mm																		
Supporting Pipe 1 dia.	42.7 mm																		
Supporting Pipe 2 dia.	33.7 mm																		

2/20/2014

Sl. no.	Short Description	MNRE - 2019	Improved design
5	Deflections and Stress	Structure to be designed as per IS 875 . MNRE does not mention anything on deflection limits of the structure.	Structure designed as per IS 875 for a wind velocity of 150kmph with maximum stress ratio 90.8 %(9MMS) and 93.7% (10MMS). No members are 100% loaded. Structure designed not only with minimum deflections but also with stress considerations which are complying with IS standards.
6	Pile design.	MNRE is silent on pile design guidelines.	Pile length designed as per IS 2911 with 300% safety margin considering utilization of the pile in clayey soil. Full 2m deep length steel structure column provided for sub-surface pile with surface anchors for adhesion to pile cap.
7	Theft proofing.	J-bolt type bolted foundation which can be easily dismantled with a spanner and thus prone to theft easily.	Central mounting column which is the heaviest component of the structure has been designed as a fully embedded structure. This cement embedded structure cannot be dismantled easily and thus discouraging theft.
8	Land Utilization.	MNRE has given guidelines for module mounting structures. The guidelines requires combination of 4MMS , 6MMS and 8MMS only. Combination of MMS and foundations required will be more in case of MNRE recommended structures since number of modules per structure is lesser.	Tata Power Solar Ltd has alternatively developed 9MMS and 10MMS structures. The number of modules per structure in TPSSL design are more compared to MNRE structure hence require lesser number of structural combinations and foundations. Thus leaving more productive land for agricultural utilization.



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ANNEXURE 2
ABOUT BANGALORE UNIVERSITY

Bangalore University is located in the Garden City of Bangalore aptly hailed as the "I.T. Capital of India", was established in July 1964 as an off shoot of the University of Mysore, primarily to include institutions of higher learning located in the metropolitan city of Bangalore and the districts of Bangalore, Kolar and Tumkur, which eventually became a separate university. Initially, the two premier colleges of the city, the Central College (CC) and the University Visvesvaraya College of Engineering (UVCE) formed the nucleus of Bangalore University.

Soon after the establishment of Bangalore University, as a first step in the re-organization of courses instructions, the University introduced Honours Courses in the year 1965-66. Three year Honour's courses in Botany, Chemistry, Economics, English, Geology, Kannada, Mathematics and Zoology which were offered only at the University Post Graduate Departments have attracted many brilliant students. Honours passed students were admitted to Post Graduate Courses on priority and B.A/B.Sc. graduates, who marginally missed admission to the Post Graduate Courses were given an opportunity to join the final year Honours course and seek admission to Post Graduate Courses, thereafter. Since 1964, Bangalore University has grown both in size and strength to include a large number of affiliated colleges, P.G. Centers with a rich diversity of programme options. In consonance with this expansion, in 1973, the University moved into a new campus named 'Jnana Bharathi' (JB) located on a sprawling 1100 acres of land and shifted many of its post graduate departments to this newly established campus. At present, the JB Campus houses the office of the Vice Chancellor, Registrar, Registrar (Evaluation), Finance Officer and a large number of post graduate departments, Directorates, Centres of higher learning, NSS Bhavan, Outdoor Stadium and other support services. The University Law College, started in 1948 and The College of Physical Education, started in 1959 are located in the JB Campus.

The University has also established Gandhi Bhavan, Dr. B.R. Ambedkar Study and Research Centre, and Centre for Study on Social Exclusion and Inclusive Policy. Bangalore University has completed Fifty-two years of fruitful existence and has come to be hailed as one of the largest universities of Asia. Though originally intended to be a federal university, it has eventually emerged as an affiliating University. The University was first accredited in 2002 by NAAC with Five Star Status, re-accredited in the years 2008 and Nov. 2016 in 2nd and 3rd Cycles with 'A' Grade.

According to QS University Ranking: BRICS-2016, an international agency ranked Bangalore University at 151st position amongst BRICS nations. As per Hansa Research Survey 2016 published in THE WEEK-May 29, 2016 issue, Bangalore University is ranked at No. 15 in the Top Multi-

disciplinary Universities at All India level, at No.9 in the Top State Multi-disciplinary Universities, No.5 in the South Zone and No.1 in the State of Karnataka.

Academically, the University is structured into six faculties- Arts, Science, Commerce & Management, Education, Law and Engineering. It has 48 Post Graduate Departments, One post graduate Centre at Kolar, (started during 1994-95), four University colleges, 684 affiliated colleges and several other Centres and Directorates of higher learning and research under its purview. At present, the University offers 50 Post Graduate Courses and Employment Oriented Diploma and Certificate Courses. The University has launched the Five years Integrated Courses in Biological Sciences.

The University is also reaching out to the society by organizing endowment and extension lectures apart from bringing out publications on issues of contemporary relevance through its Prasaranga division.

Bangalore University has achieved milestones by establishing MOUs with Universities and Institutions of national and international repute. To cater to a student population of over three lakhs, the University is striving to provide access, expansion and excellence in higher education. The vision of the University is to make distinctive and significant contributions to the cause of higher education in Humanities, Social Science, Law, Commerce, Science & Technology. The University is providing quality teaching and encouragement to research in frontier areas with social relevance that would reflect its mission and goals aptly symbolized by its emblem 'JNANAM VIGNANA SAHITHAM'.

Undergraduate Engineering Courses offered :

- I. Civil Engineering
 - a. High Way Engineering
 - b. Prestressed Concrete Engineering
 - c. Structural Engineering
 - d. Geo-Technical Engineering.
 - e. Water Resources Engineering.
 - f. Construction Technical Engineering.
 - g. Environmental Engineering.
- II. Mechanical Engineering
- III. Electrical and Electronics Engineering.
- IV. Electronics and Communication Engineering.
- V. Computer Science & Engineering.
- VI. Information Science & Engineering.
- VII. Bachelor of Architecture.



M. S. G.

Post-Graduate M-Tech / M-Arch Courses offered :

- I. Department of Civil Engineering
 - 1) Structural Engineering
 - 2) Geotechnical Engineering

- 3) Environmental Engineering
- 4) Highway Engineering
- 5) Prestressed Concrete
- 6) Construction Technology
- 7) Water Resources Engineering
- 8) Earthquake Engineering

II. Department of Mechanical Engineering

- 9) Machine Design
- 10) Manufacturing Science and Engineering
- 11) Thermal Science and Engineering
- 12) Advanced Materials Technology

III. Department of Electrical Engineering

- 13) Power Systems
- 14) Power Electronics
- 15) Control and Instrumentation

IV. Department of Electronics and Communication Engineering

- 16) Electronics and Communication.

V. Department of Computer Science and Engineering

- 17) Computer Science and Engineering
- 18) Information Technology
- 19) Computer Networking
- 20) Software Engineering
- 21) Bio Informatics
- 22) Web Technologies

VI. Department of Architecture

- 23) Landscape Architecture
- 24) Project and Construction Management



ANNEXURE 3

CREDENTIALS OF THE EVALUATOR

Dr. Jayaramappa N, Professor

Dept Of Civil Engg, UVCE,
Bangalore University, Bangalore

- 1 Qualifications: B.E.(Civil) ,GBDT, Davangere 1990
M.E.(Structures), SIT,Tumkur, BU ,2001
Ph.D - 2017, Bangalore University
CIC (IGNOU), GATE-1994 Qualified.
- 2 Date of Birth : 22-07-1965
- 3 Teaching Experience: From Aug 1991 to 31.10.2002,Lecturer and from 1.11.2002 to 31.3.2003 Senior Lecturer,SSIT,Tumkur.
From 3.4.2003 to 25th .October 2006, Lecture, BMS Evening, Bangalore
From 25th October 2006 to till date UVCE ,Bangalore
Professor From 25th July 2019 , UVCE ,Bangalore
- 4 Publication: 41 Journals
27 Papers , 16 International conferences, 10 National conferences
03 papers at Japan ,Presented
01 Paper at USA, Presented
01 Paper at South Koria, Presented
- 5 Membership: MISTE(Life member),
MICI (Life member)
IGASE
IGS(Life member)
- 6 Course Conducted: CAD Training Programme (from Auto disk) organized
for Civil Engg Faculty of UVCE ,Bangalore
NISA Training Programme (from Karnes Software)
Proposed for ME Students,
- 7 Committee: BE and ME Syllabus Revision ,for UVCE ME, SSC Question paper setting ,
BU,VTU, and other Universities , SSC questions papers and selection
committee and etc .
- 8 Expert Lecture: 1. PES University Bangalore.
2. Ph.D Advisory committee Member MSRIT (VTU).
3. Ph.D Doctoral Committee Member , Sri Siddhartha Academy of



- 9 Guidance : Guidance for 45 ME Students
- 10 Membership : Nirmithi Kendra Bangalore Rural
Governing Council Member Since 10 years
- 11 Reviewer : Reviewer for ICRITCSA – 2019 , International Conference MSRIT Bangalore, Scopus Indexed Journal.
- 12 Professional Consultancy Projects
- Feasibility Study of RBI Bangalore.
 - Feasibility Study of BHEL Bangalore.
 - Feasibility Study of KV schools Bangalore.
 - Design vetting to IITDM Karnolu,
 - Design vetting to CRPF Belgaum
 - Design vetting to USMANIA University
 - Design and vetting to Post office Building Bangalore, Devanahalli and T. Narasipur
 - DCF Office Devanahalli Bangalore
 - Design and vetting more than 25 Projects of Bangalore Nirmithi Kendra (Rural)
 - Design and vetting to BBMP Retaining wall and buildings
 - Design and vetting to CPWD and MES (Military Engineering Services buildings).
 - Design and vetting to KIRDL buildings.
 - Design and vetting to Railway Department.
 - Design and vetting to PEB structures MES
 - Design and vetting to BBMP solid waste disposal PEB.
 - NAIE Doddaballapura to Gouribedunur Serviceability of Bridges.
 - Nirmithi Kendra Bangalore Rural Governing Council Member Since 10 years. About 150 to 250 Crore projects Design, and Third Party Quality Assurance (TPQA) Works.
 - Similar works of state Government, Postal Department and MES Third Party Quality Assurance (TPQA) Works.



S. S. S. S. S.

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Date : 23-06-2020



TO WHOMSOEVER IT MAY CONCERN

Dwg / Doc. Ref : TPS-PUMP-EESL-9MMS-002

NIT/Bid Doc. No. : EESL/06/2019-20/KUSUM/SWPS/Phase-1/10HP/Off Grid/192012030

This is to certify that the design and analysis for 9 module mounting structure (TPS-PUMP-EESL-9MMS-002) being offered by M/s Tata Power Solar Systems Limited is reviewed. The design and analysis work submitted by M/s Tata Power Solar System Limited is validated to work upto 150km/hr wind speed and is complying to the EESL NIT/Bid document number mentioned above.

Thanking You

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Dwg / Doc. Ref : TPS-PUMP-EESL-10MMS-002

NIT/Bid Doc. No. : EESL/06/2019-20/KUSUM/SWPS/Phase-1/10HP/Off Grid/192012030

This is to certify that the design and analysis for 10 module mounting structure (TPS-PUMP-EESL-10MMS-002) being offered by M/s Tata Power Solar Systems Limited is reviewed. The design and analysis work submitted by M/s Tata Power Solar Systems Limited is validated to work upto 150km/hr wind speed and is complying to the EESL NIT/Bid document number mentioned above.

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TPS-EESL-10MMS-N- TP-PVPT-F-001	TATA POWER SOLAR SYSTEMS LIMITED	SECTION 1 (Cover sheet)
	10 MODULE MOUNTING STRUCTURE	SHEET 1 of 16

TATA POWER SOLAR SYSTEMS

10 MODULE MOUNTING STRUCTURE (MMS)

Document No.: TPS-EESL-10MMS-N-TP-PVPT-F-001



TATA POWER SOLAR SYSTEMS LIMITED

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PPD BY	Harisha								
CHO BY	Sunil								
APD BY	Nilesh								
DATE	01.08.2020								



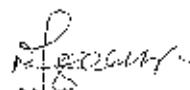
N. Jayaramappa 19/8/2020
Dr. N. Jayaramappa

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INTRODUCTION

This document covers structural design and analysis of 10 Module Mounting Structure (MMS) for mounting of solar panels of Solar Water Pumping System meant for Agricultural, Drinking Water and other purposes. The analysis has been carried out using STAAD software simulation of the structure. The structure has been designed to withstand a wind velocity of 150kmph.

1 SCOPE

The scope of the report is limited to providing structural design of module mounting structure as described in section 5.1. The solar yield analysis shadow effects, construction procedure are outside the purview of the report.

2 REFERENCE DOC/CODES

IS 875 : Part -1	Design load for Building and Structures – Code of practice for Dead Load
IS 876 : Part -3	Design load for Building and Structures – code of practice for wind load
IS 800 : 2007	General Construction In Steel - Code of Practice
IS 1079-2009	Hot Rolled Carbon Steel Sheet And Strip- Specification
IS 4759-1996	HDZ- Coating on Structural Steel products
IS 2062 - 2011	Hot Rolled Medium and High Tensile Structural Steel-Specification
IS 811 -1987	Specification For Cold Formed Light Gauge Steel Structural Member

3 DESIGN BASIS

BASIC DATA ASSUMED FOR STRUCTURAL DESIGN

A MATERIAL CONSTANTS

Characteristic strength of

- 1 concrete (for foundation) : 25 N/sq.mm
- 2 Unit wt. of concrete : 2400 kg/Cu.m
- 3 Unit wt. of steel : 7850 kg/Cu.m
- 4 Steel grade : IS 2062 E250A /E250B/ E350A / IS 4923 Yst 310 / IS 1161 Yst 310.
- 5 Bolt Grade : 8.8

B DEAD LOADS

- 1 PV module weight : 24 kg per module



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C WIND LOAD

1 Basic Wind Speed	:	42 m/s	IS 875 2015 - Part 3
2 Terrain Category	:	Category 3	IS 875 2015 - Part 3
4 Topography factor	:	1.0	IS 875 2015 - Part 3
5 Importance Factor (k_i)	:	1.0	IS 875 2015 - Part 3

E DESIGN CODES

1 Steel Structure	:	IS 800 :2007/ IS 801 :1975
2 Wind load Calculation	:	IS 875 : 2015 Part -3

F SOFTWARE

1 Structural Analysis	:	STAAD Pro
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4 INPUT DATA

The input data refer module data sheet and tender document (i.e. Structural configuration, Tilt angle, Members used, Module data, etc.) is as per tender document.

4.1 STRUCTURAL DESCRIPTION.

The MMS (Module Mounting Structure) supports 10 modules suitable for TPSSL Modules of dimensions 1.984m x 1.004 m and 1.956m x 0.992m and PV Power Tech Module of dimension 1.960 x 0.989m. The modules are arranged in 2x5 Portrait arrangement. The angle of inclination for seasonal tilt provided is 15 to 20 degree to the horizontal so that inclination can be adjusted at the specified tilt angle. Manual tracking with 3 times tracking per day has also been provided to maximise the water output and enhance the SPV water pumping systems. The structure has a single leg arrangement. Reactions were obtained from the analysis and are used for the pile foundation design. The members were designed by STAAD Software.

5 STRUCTURAL PRE-REQUISITES

The following are the pre-requisites for the module supporting structure to qualify for structure and foundation sufficiency study,

- The module supporting structure is deemed to have been designed using relevant IS codes to satisfy both strength and serviceability criteria.
- Execution quality compliance on material quality, safety in construction and proper construction practices are deemed taken care.

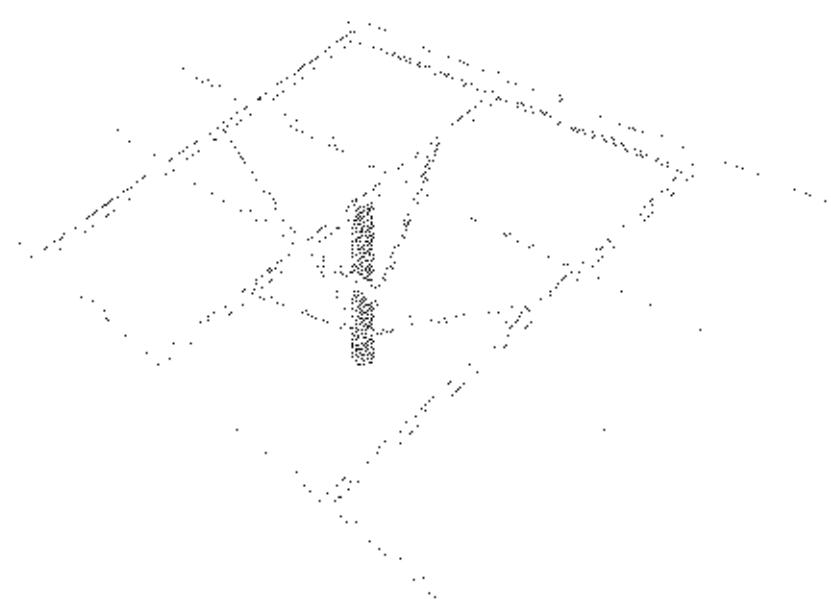


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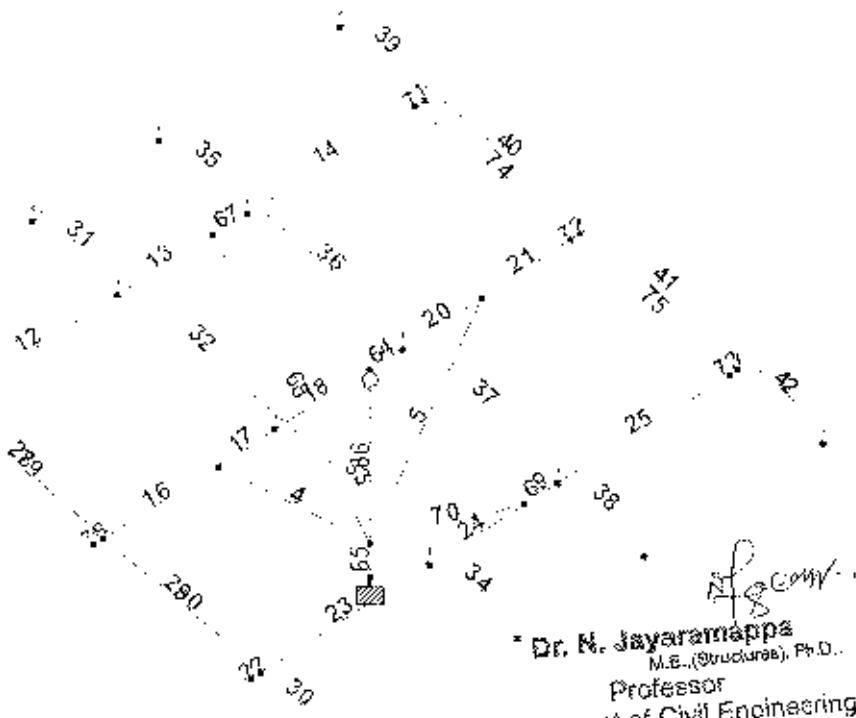
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6 STAAD MODELING

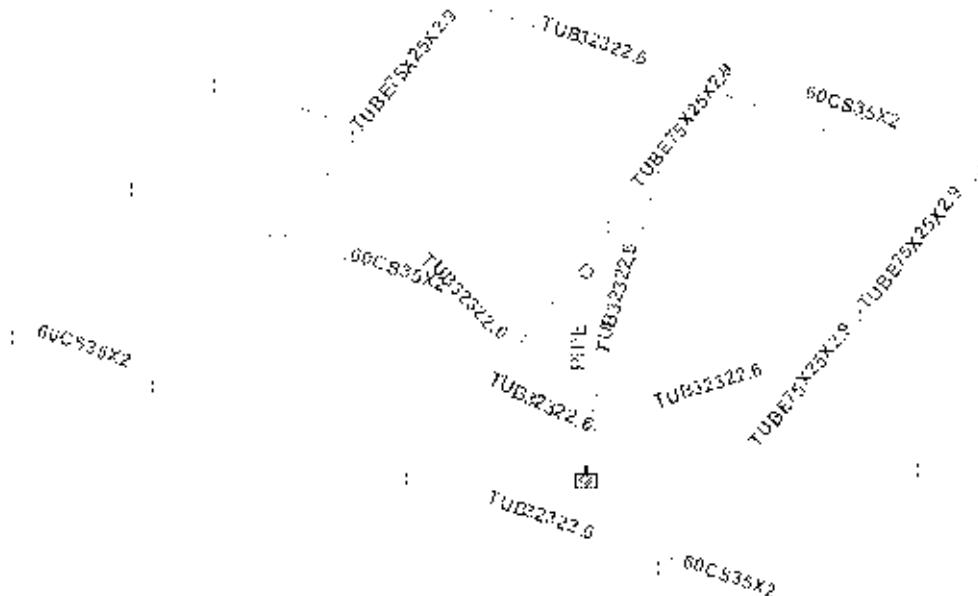
6.1 STAAD MODEL



6.2 STAAD MEMBER NUMBER



6.3 STAAD MEMBER PROPERTIES



part	Section	Dimensions	Area(cm ²)	Iyy(cm ⁴)	Izz(cm ⁴)	I(xy)(cm ⁴)	material
1	P-FF	Q152 mm x 8 mm thick	15.316	450.54	439.32	203.679	STEEL
2	TUBE 32X23	Tube 32x23(2.6 mm)	2.85	4.07	2.72	0.607	STEEL
3	TUBE 50X25X2.6	Tube 50x25x2.6 mm	5.464	5.612	34.07	27.652	STEEL
4	60CS35X2	60x35x25x12x2mm thick	3.93	4.14	15.625	—	STEEL

7 LOAD CALCULATION

The module mounting structure is subjected to the following loads :

- Module dead load
- Wind Load

7.1 DEAD LOAD

Module dead load -



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- Weight of Module = 24 kg (from Module Data Sheet)
- Panel Dimensions = 1.984m x 1.004 m and 1.956m x 0.992m (from TPSSL Module data sheets) & 1.960 x 0.989m (from PV Power Tech Module sheet)
- Load due to module = (Weight of the module/Area of module) x (length of the module/2)

$$\approx (0.24/1.984 \times 1.004) \times (1.984/2) = 0.12 \text{ kN/m}$$
- Self-weight of module supporting structure.

TPS-EESI -10MMS-NTP-PVPT-F-001	TATA POWER SOLAR SYSTEMS LIMITED 10 MMS PUMP STRUCTURE	SECTION: Calculation SHEET 7 of 16
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7.2 WIND LOAD**WIND LOAD CALCULATION: (AS PER IS:875 Part-3 2015)**

Basic Wind Speed =	42 m/s	150 kmph	Fig : 1
Design Life N =	25	(for 25 year design life)	
Tilt angle =	20		From GA DWG
Risk Co-efficient, α_1 =	0.91		Table 1
Terrain =	3		Clause 6.3.2.1
Building height =	10		From GA DWG
Terrain, Height and Structure size factor, α_2 =	0.91		Table 2
Topography Factor, α_3 =	1	(Upwind Slope = 0)	Clause 6.3.3
Importance Factor, α_4 =	1		
Design Wind Speed V_2 =	34.61 m/s		Clause 6.3 $V_2 = k_1 \times k_2 \times k_3 \times k_4$
Wind pressure at height z P_z =	0.659 kN/m ²		Clause 7.2 $P_z = 0.6 V_2^2$
Directionality factor K_d =	0.9		Clause 7.2.1
Avg Area of module =	20		From Layout DWG
Area averaging factor K_a =	0.93		Table 4
Combination factor K_c =	1.00		Clause 7.3.3.13
Design Wind Pressure P_d =	0.653 kN/m ²		Clause 7.2 $P_d = K_a K_d k_0$
Considering 20 % reduction	0.4 kN/m ²		From GA DWG

Wind Load calculation along X direction

Tilt Angle 20 degrees

Condition	C_p	Wind Pressure	Contributory width	Total Uplift / Downward in kNm
Uplift	1.30	0.4	0.98	0.36
Downward	0.8	0.4	0.98	0.36
Condition	C_p	Wind Pressure	Contributory width	Total Uplift / Downward
column	1	0.40	0.16	0.06
Raft	2	0.40	0.06	0.06
Bracing	1	0.40	0.03	0.01
secondary raft	2	0.40	0.08	0.06

Table 8

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 Professor
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7.3 PRIMARY LOADS AND COMBINATION

Primary Load Cases

Number	Name	Type
1	DEAD LOAD	Dead
2	WIND LOAD-X	Wind
3	WIND LOAD-Y	Wind
4	WIND LOAD-Z	Wind
5	WIND LOAD-X-Z	Wind

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Combination Load Cases

Case	Composed LC Name	Primary	Primary LC Name	Factor
10	D.L. + X	1	DEAD LOAD	1.0
11		2	WIND LOAD-X	1.0
12	D.L. + Y	1	DEAD LOAD	1.0
13		2	WIND LOAD-Y	1.0
14	D.L. + Z	1	DEAD LOAD	1.0
15		2	WIND LOAD-Z	1.0
16	D.L. + X-Z	1	DEAD LOAD	1.0
17		2	WIND LOAD-X-Z	1.0
18	D.L. + Y-Z	1	DEAD LOAD	1.0
19		2	WIND LOAD-Y-Z	1.0
20	D.L. + X+Y	1	DEAD LOAD	1.0
21		2	WIND LOAD-X+Y	1.0
22	D.L. + X+Z	1	DEAD LOAD	1.0
23		2	WIND LOAD-X+Z	1.0
24	D.L. + Y+Z	1	DEAD LOAD	1.0
25		2	WIND LOAD-Y+Z	1.0
26	D.L. + X+Y+Z	1	DEAD LOAD	1.0
27		2	WIND LOAD-X+Y+Z	1.0
28	D.P. + X	1	DEAD LOAD	1.0
29		2	WIND LOAD-X	1.0
30	D.P. + Y	1	DEAD LOAD	1.0
31		2	WIND LOAD-Y	1.0
32	D.P. + Z	1	DEAD LOAD	1.0
33		2	WIND LOAD-Z	1.0
34	D.P. + X+Y	1	DEAD LOAD	1.0
35		2	WIND LOAD-X+Y	1.0
36	D.P. + X+Z	1	DEAD LOAD	1.0
37		2	WIND LOAD-X+Z	1.0
38	D.P. + Y+Z	1	DEAD LOAD	1.0
39		2	WIND LOAD-Y+Z	1.0
40	D.P. + X+Y+Z	1	DEAD LOAD	1.0
41		2	WIND LOAD-X+Y+Z	1.0



TPS-EESL-10MMS-
MTP-PVPT-F-001

TATA POWER SOLAR SYSTEMS LIMITED
10 MMS PUMP STRUCTURE

SECTION: Calculation
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7.4 STAAD INPUT

STAAD SPACE

START JOB INFORMATION

ENGINEER DATE 15-03-19

END JOB INFORMATION

INPUT WIDTH 79

UNIT METER KN

JOINT COORDINATES

4 -1.51029 0.991035 -1.675; 6 -0.392049 1.39804 -1.675;
7 0.397295 1.68532 -1.675; 9 1.51554 2.09233 -1.675; 10 -1.51029 0.991035 0;
11 -0.392049 1.39804 0; 12 0.397295 1.68532 0; 13 1.51554 2.09233 0;
14 -1.51029 0.991035 1.675; 16 -0.392049 1.39804 1.675;
17 0.397295 1.68532 1.675; 19 1.51554 2.09233 1.675; 20 -1.51029 0.991035 -2.6;
21 -0.392049 1.39804 -2.6; 22 0.397295 1.68532 -2.6; 23 1.51554 2.09233 -2.6;
24 -1.51029 0.991035 2.6; 25 -0.392049 1.39804 2.6; 26 0.397295 1.68532 2.6;
27 1.51554 2.09233 2.6; 36 0.191 0.526001 0; 45 0.190563 1.61008 0;
46 0.191 0.310001 0; 48 0.190562 1.61008 -1.675; 49 0.190562 1.61008 1.675;
50 1.45682 2.07096 -1.675; 51 1.45682 2.07096 0; 52 1.45682 2.07096 1.675;
53 -1.45156 1.01241 -1.675; 54 -1.45156 1.01241 1.675; 55 -1.45156 1.01241 0;
56 0.895333 1.86659 0; 58 -0.749132 1.26808 0;

MEMBER INCLINES

4 36 58; 5 36 56; 11 4 53; 12 6 53; 13 6 48; 14 7 50; 16 55 58; 17 11 58;
18 11 45; 20 12 56; 21 51 56; 22 14 54; 23 16 54; 24 16 49; 25 17 52; 27 4 20;
28 10 4; 29 14 10; 30 24 14; 31 21 6; 32 6 11; 33 11 16; 34 16 25; 35 7 22;
36 12 7; 37 17 12; 38 26 17; 39 23 9; 40 9 13; 41 13 19; 42 19 27; 61 45 12;
65 46 36; 66 36 45; 67 48 7; 68 36 48; 69 49 17; 70 36 49; 71 56 9; 72 51 13;
73 52 19; 74 50 51; 75 51 52; 78 55 10; 79 53 55; 80 55 54;

START USER TABLE

TABLE 1

UNIT MMS NEWTON

TUBE

DIA 75X25X2.0

546.36 75 25 2.0 348708 56840.4 156326 435 145

END

CND METER KN

NUMBER OF SET

27 TO 42 START 0.0 1.0

27 TO 42 END 0.0 1.0

DEFIN MATERIAL START

ISOTROPIC STEEL

1 2.05e-08

Poisson 0.3

DENSITY 76.8195

ALPHA 1.2e-05

DAMP 0.03

LYTE STEEL

STRENGTH FY 253200 Pu 407800 RY 1.5 RT 1.2

END DEFIN MATERIAL

MEMBER PROPERTY INHAK



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TPS-EESL-10MMS-
N-TP-PVPT-F-001**TATA POWER SOLAR SYSTEMS LIMITED**

SECTION: Calculation

10 MMS PUMP STRUCTURE

SHEET 10 of 16

65 66 TABLE ST PHL CH 0.152 H 0.1448
 MEMBER PROPERTY INDIAN
 74 75 79 80 TABLE ST TUB 2322.6
 UNIT MM8 NEWTON
 MEMBER PROPERTY INDIAN
 11 TO 14 16 19 18 20 30 25 64 67 69 71 TO 73 78 LPIABER TUBE 75X25X2.0
 MEMBER PROPERTY COULFORMED INDIAN
 27 TO 42 TABLE ST GCS 552
 MEMBER PROPERTY INDIAN
 4 5 68 70 TABLE ST R B322.6
 UNIT METER KN
 CONSTANTS
 BETA 20 MEMB 31 30 34 39 70 42
 BETA 340 MEMB 27 30 30 35 70 38
 MATERIAL ST 17 ALI
 MEMBER TRUSS
 4 5 68 70
 SUPPORTS
 46 FIXED
 UNIT MM8 NEWTON
 MEMBER RELEASE
 66 END MY MZ
 UNIT METER KN
 LOAD 1 LOAD TYPE Dead (THE DEAD LOAD)
 SLT WEIGHTY -1.1 LIST ALL
 MEMBER LOAD
 27 77 42 UNI GY 0.12
 LOAD 2 LOAD TYPE Wind (THE WIND LOAD X)
 MEMBER LOAD
 65 66 UNI GZ 0.07
 4 5 68 70 UNI GZ 0.02
 27 10 42 UNI Y -0.35
 LOAD 3 LOAD TYPE Wind (THE WIND LOAD X)
 MEMBER LOAD
 65 66 UNI GZ -0.07
 4 5 68 70 UNI GZ -0.02
 27 TO 42 UNI Y 0.55
 LOAD 4 LOAD TYPE Wind (THE WIND LOAD Z)
 MEMBER LOAD
 65 66 UNI GZ 0.07
 4 5 68 70 UNI GZ 0.02
 11 22 67 69 71 73 UNI GZ 0.08
 64 72 78 UNI GZ 0.08
 LOAD 5 LOAD TYPE Wind (THE WIND LOAD Z)
 MEMBER LOAD
 65 66 UNI GZ -0.07
 4 5 68 70 UNI GZ 0.03
 11 TO 14 16 TO 18 20 TO 25 64 67 69 71 TO 73 78 UNI GZ -0.08
 LOAD COMB 100 DE WL(X)
 LOAD COMB 100 DE WL(Y)

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TATA POWER SOLAR SYSTEMS LIMITED

SECTION: Calculation

10 MMS PUMP STRUCTURE

SHEET 1 of 16

1 1.0 2 1.0
LOAD COMB 101 (1.0 -W1,-X)
1 1.0 3 1.0
LOAD COMB 102 (1.0 -W1,-Z)
1 1.0 4 1.0
LOAD COMB 103 (1.0 -W1,-Z)
1 1.0 5 1.0
LOAD COMB 104 (1.0 -G,W1,-X)
1 1.0 2 0.8
LOAD COMB 105 (1.0 -0.8,W1,-X)
1 1.0 3 0.8
LOAD COMB 106 (1.0 -G,W1,-Z)
1 1.0 4 0.8
LOAD COMB 107 (1.0 -G,W1,-Z)
1 1.0 5 0.8
LOAD COMB 200 (1.5,W1,-W1,-X)
1 1.5 2 1.5
LOAD COMB 201 (1.5,W1,-W1,-X)
1 1.5 3 1.5
LOAD COMB 202 (1.5,W1,-W1,-Z)
1 1.5 4 1.5
LOAD COMB 203 (1.5,W1,-W1,-Z)
1 1.5 5 1.5
LOAD COMB 204 (0.9,W1,-1.5,W1,-X)
1 0.9 2 1.5
LOAD COMB 205 (0.9,W1,-1.5,W1,-X)
1 0.9 3 1.5
LOAD COMB 206 (0.9,W1,-1.5,W1,-Z)
1 0.9 4 1.5
LOAD COMB 207 (0.9,W1,-1.5,W1,-Z)
1 0.9 5 1.5
PERFORM ANALYSIS PRINT ALL
DEFINE ENVELOPE
100 TO 107 ENVELOPE TYPE ST SERVABILITY
END DEFINE ENVELOPE
LOAD LIST 200 TO 207
PARAMETER 1
CODE IS800 FSD
FL 420000 MEMB 4 5 11 22 64 TO 73 78
FYLD 250000 MEMB 4 5 11 0 14 16 19 18 20 10 25 64 TO 75 78 10 80
KX 0.85 MEMB 4 5 68 70
KZ 0.85 MEMB 4 5 68 70
MAIN 200 MEMB 4 5 11 TO 14 16 10 18 20 10 25 64 67 TO 75 78 10 80
CHECK CODE MEMB 4 5 11 TO 14 16 10 18 20 10 25 64 10 75 78 10 80
LOAD LIST 100 TO 107
PARAMETER 2
CODE IS800



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TATA POWER SOLAR SYSTEMS LIMITED

SECTION: Calculation

10 MMS PUMP STRUCTURE

SHEET 12 of 16

FY10 350000 MEMB 27 TO 42

LY 0.5 MEMB 27 TO 42

EXA 0 MMHB 27 TO 42

CHECK CODE: MMHB 27 TO 42

UNIT: MMS NEWTON

PRINT: MEMBER STRESSES IN FST 45 11 22 27 TO 42 64 10 73 78

FINISH



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8 STRUCTURAL DESIGN**8.1 MEMBER DESIGN (STAAD)**

Beam	Design Property	Actual Ratio	Allowable Ratio	Normalized Ratio (Actual/Allowable)	Clause	L.C
80	TUB32322.6	0.754	1	0.754	Sec. 9.3.2.2	200
79	TUB32322.6	0.754	1	0.754	Sec. 9.3.2.2	200
78	TUBE75X25X2.9	0.051	1	0.051	Sec. 8.2.1.2	205
75	TUB32322.6	0.396	1	0.396	Sec. 9.3.2.2	200
74	TUB32322.6	0.396	1	0.396	Sec. 9.3.2.2	200
73	TUBE75X25X2.9	0.275	1	0.275	Sec. 8.2.1.2	205
72	TUBE75X25X2.9	0.082	1	0.082	Sec. 8.2.1.2	205
71	TUBE75X25X2.9	0.275	1	0.275	Sec. 8.2.1.2	205
70	TUB32322.6	0.312	1	0.312	Sec. 7.1.2	200
69	TUBE75X25X2.9	0.781	1	0.781	Sec. 9.3.2.2	200
68	TUB32322.6	0.312	1	0.312	Sec. 7.1.2	200
67	TUBE75X25X2.9	0.781	1	0.781	Sec. 9.3.2.2	200
66	PIPE	0.261	1	0.261	Sec. 8.2.1.2	201
65	PIPE	0.335	1	0.335	Sec. 8.2.1.2	201
64	TUBE75X25X2.9	0.213	1	0.213	Sec. 9.3.2.2	205
42	60CS35X2	0.202	1	0.202	6.7.1(T)	100
41	60CS35X2	0.698	1	0.698	6.7.2(a)2	101
40	60CS35X2	0.698	1	0.698	6.7.2(a)2	101
39	60CS35X2	0.202	1	0.202	6.7.1(T)	100
38	60CS35X2	0.219	1	0.219	6.7.1(T)	100
37	60CS35X2	0.556	1	0.556	6.7.2(a)2	101
36	60CS35X2	0.556	1	0.556	6.7.2(a)2	101
35	60CS35X2	0.219	1	0.219	6.7.1(T)	100
34	60CS35X2	0.202	1	0.202	6.7.1(T)	100
33	60CS35X2	0.782	1	0.782	6.7.2(a)2	101
32	60CS35X2	0.782	1	0.782	6.7.2(a)2	101
31	60CS35X2	0.202	1	0.202	6.7.1(T)	100
30	60CS35X2	0.219	1	0.219	6.7.1(T)	100

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SECTION: Calculation

10 MMS PUMP STRUCTURE

SHEET 13 of 16

29	60CS35X2	0.92	1	0.92	6.7.2(a)1	101
28	60CS35X2	0.92	1	0.92	6.7.2(a)1	101
27	60CS35X2	0.219	1	0.219	6.7.1(1)	100
25	TUBE75X25X2.0	0.528	1	0.528	Sec. 9.3.2.2	200
24	TUBE75X25X2.0	0.712	1	0.712	Sec. 9.3.1.1	200
33	TUBE75X25X2.0	0.216	1	0.216	Sec. 8.2.1.2	200
22	TUBE75X25X2.0	0.45	1	0.45	Sec. 8.4	300
21	TUBE75X25X2.0	0.549	1	0.549	Sec. 8.2.1.2	200
20	TUBE75X25X2.0	0.549	1	0.549	Sec. 8.2.1.2	200
18	TUBE75X25X2.0	0.256	1	0.256	Sec. 8.2.1.2	200
17	TUBE75X25X2.0	0.836	1	0.836	Sec. 8.2.1.2	200
16	TUBE75X25X2.0	0.836	1	0.836	Sec. 8.2.1.2	200
14	TUBE75X25X2.0	0.528	1	0.528	Sec. 9.3.2.2	200
13	TUBE75X25X2.0	0.712	1	0.712	Sec. 9.3.1.1	200
12	TUBE75X25X2.0	0.216	1	0.216	Sec. 8.2.1.2	200
11	TUBE75X25X2.0	0.45	1	0.45	Sec. 8.4	300
5	TUB32322.6	0.247	1	0.247	Sec. 7.1.2	200
4	TUB32322.6	0.184	1	0.184	Sec. 7.1.2	200




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8.2 DEFLECTION CHECK

Permissible Lateral Deflection for Column = $1300 / 180 = 7.2$ mm

Maximum deflection for columns = 2.3 mm (Node-45, LC-101)

Simply supported portion,

Geometric Properties of Sets, Calculating Definite Integrals Using Python / Chapter 03

[2000] 22(1)



Permissible Vertical Deflection for Purlins $\geq 1800 / 150 = 12 \text{ mm}$

Maximum Vertical Deflection of structure = $10.179 - 6.08 = 4.1$ (beam 40-1C-101)

9 SUPPORT REACTION

			Horizontal	Vertical	Horizontal		Moment	
	Norde	E/C	Fx kN	Fy kN	Fz kN	Mx kN.m	My kN.m	Mz kN.m
Max Fx	46	101 DL+WL	-4,138	-6,784	0,000	-9,000	9,000	-4,028
Min Fx	46	100 DL+WL	-2,715	10,807	0,000	1,000	-1,000	1,505
Max Fy	46	100 DL+WL	-2,715	10,807	0,000	1,000	-1,000	1,505
Min Fy	46	101 DL+WL	-4,138	-6,784	0,000	-1,000	0,000	-4,028
Max Fz	46	103 DL+WL	-0,000	3,956	1,065	1,163	0,146	-0,682
Min Fz	46	102 DL+WL	-0,000	3,956	-0,308	-0,268	0,101	-0,682
Max Mx	46	103 DL+WL	-0,000	3,956	1,065	1,163	0,146	-0,682
Min Mx	46	102 DL+WL	-0,000	3,956	-0,308	-0,268	-0,031	-0,682
Max My	46	103 DL+WL	-0,000	3,956	1,065	1,163	0,146	-0,682
Min My	46	102 DL+WL	-0,000	3,956	-0,308	-0,268	-0,001	-0,682
Max Mz	46	100 DL+WL	-2,715	10,807	0,000	0,000	-0,000	1,505
Min Mz	46	101 DL+WL	-4,138	-6,784	0,000	-9,000	9,000	-4,028



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ANNEXURE 1 – FOUNDATION DESIGN

FOUNDATION DESIGN FOR 10 MMS STRUCTURE						
Borehole no.		Minimum value				
Angle of internal friction (degrees)	20.00	10.00	ASSUMED			
Density, t/m^3	16.00	16.00	ASSUMED			
SPT 'n' values	Between 10 & 20 'n' values are assumed in 10-20 penetration length of soil available N= 10 for design, average value of 15 is considered for safety factor of 1.5 considering N= 10 is reduced by 50%					
AXIAL AND UPLIFT CAPACITY BY STATIC FORMULA OF IS-2911 Part 4 Sec-2, Annex B						
OUTER STRUCTURE						
Pile length below FSL	4	1.00	m			
Pile diameter	0	0.35	m			
Pile Cross sectional area	$A_p = \pi r^2 A$	0.0962	m^2			
Pile shaft diameter	$d_s = \pi D$	0.098	m^2			
Soil density		15.00	kNm^{-3}			
Angle at pile-soil contact = 0		20.00	degrees			
Stress at FSL		0.00	kN/m^2			
Stress at depth 'd'	$P_d = L$	34.00	kN/m^2			
Effective vertical stress (average)	L1	17.00	kN/m^2			
Coefficient 'K'	As per code	1.00	1.00×1.50			
Uplift factor along shaft	$= 1.20 \times K_m$	6.00	kN/m^2			
Safe Factor, G_s	1.00	15.00	kN			
End bearing factor, N_e	Figure 1, Annex B	10.00	Unitless as per clause 10.6			
End bearing, Q_e	$A_p F_p N_e$	39.44	kN			
Safe axial load, $(Q_e + Q_u)/2.5$	$Q_{safe} = 2.5$	15.91	kN			
Self weight of pile, SW	$A_p L_1$	4.83	$\text{kN} = 0.01 \times 483$			
SAFE UPLIFT LOAD excluding SW	Q_u	5.10	kN			
SAFE UPLIFT LOAD including SW	$Q_u + 0.4 \times SW$	10.39				
Design requirements (kN)						
Structure	Axial	Uplift	Lateral			
Required	10.00	3.00	4.00			
Geotechnical Capacity (kN)						
Computed	15.90	4.39	7.57			
Design summary						
Desired	Safe	Safe	Safe			



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See [Blossom formulae](#) for a related scheme.

See Ethics Toolkit for detailed information				
Defendant	Offense	Description	Penalty	Comments
Mr.	0.0000	No service requirement necessary		
Brown, Plaintiff	0.0000	Court review	W.E. 14, 15, 17, 18	
Mr.	0.0000			
Defendant ...	0.0000			
Plaintiff	0.0000			

read test to be performed at one to three months postoperation and least of once a year thereafter unless otherwise specified.

ESTADO DE MÉXICO. TELÉFONO 36004, CONEXIÓN 2323. TELÉFONO 36004, CONEXIÓN 2323.

File a self-learning activity to learn how to do it correctly.

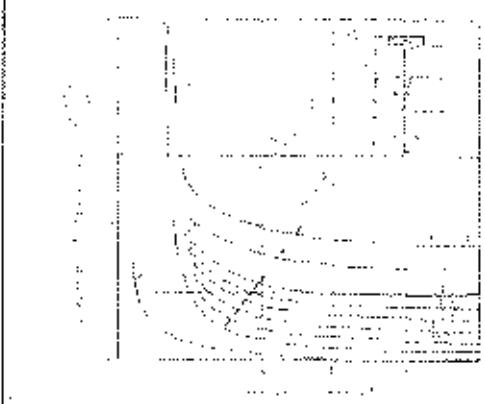


Table V. Models of heterotactic fractions for
Cylindrical SBRs, $\eta_0 = 1 \text{ dyne}^{-1}$

155

These are often called **passenger streams**.

IC 29111-Part 1: Dec-21 Level 1 test activity and is based on definition criteria, whereas Browning uses full threat & detection. Part 1 testing capability estimated to be 100% of IC 29111-Part 1.



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BILL OF MATERIAL FOR 10MMS SOLAR WATER PUMP STRUCTURE

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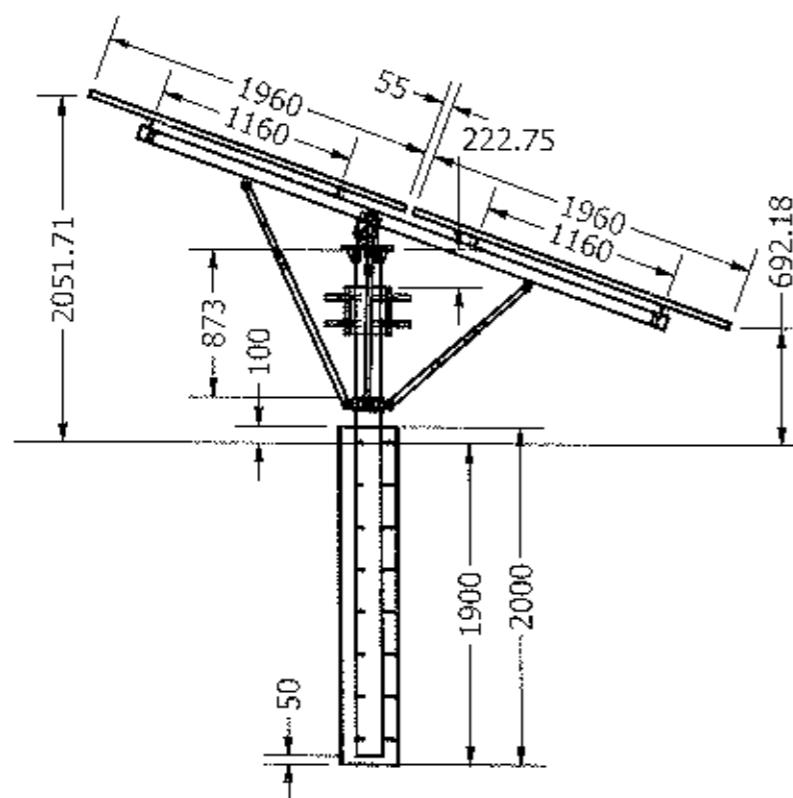
Dr. M. Jayaramappa

A circular stamp with the text "DEPARTMENT OF CIVIL ENGINEERING" around the top and "UNIVERSITY OF POONA" around the bottom. In the center, it says "MADE IN 1964".

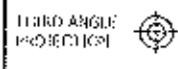
10MMS ASSEMBLY VIEW



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NOTE:
► REMOVE SURG & DENT
► REMOVE SHARP CORNERS & MAKE CHAMFER 1MM (UNLESS SPECIFIED)



DO NOT SCALE
THIS DRAWING
IF IN DOUBT
ASK

TATA POWER SOLAR SYSTEMS LIMITED
No.78, Electronics City,
Hosur Road,Bangalore - 560 100. INDIA

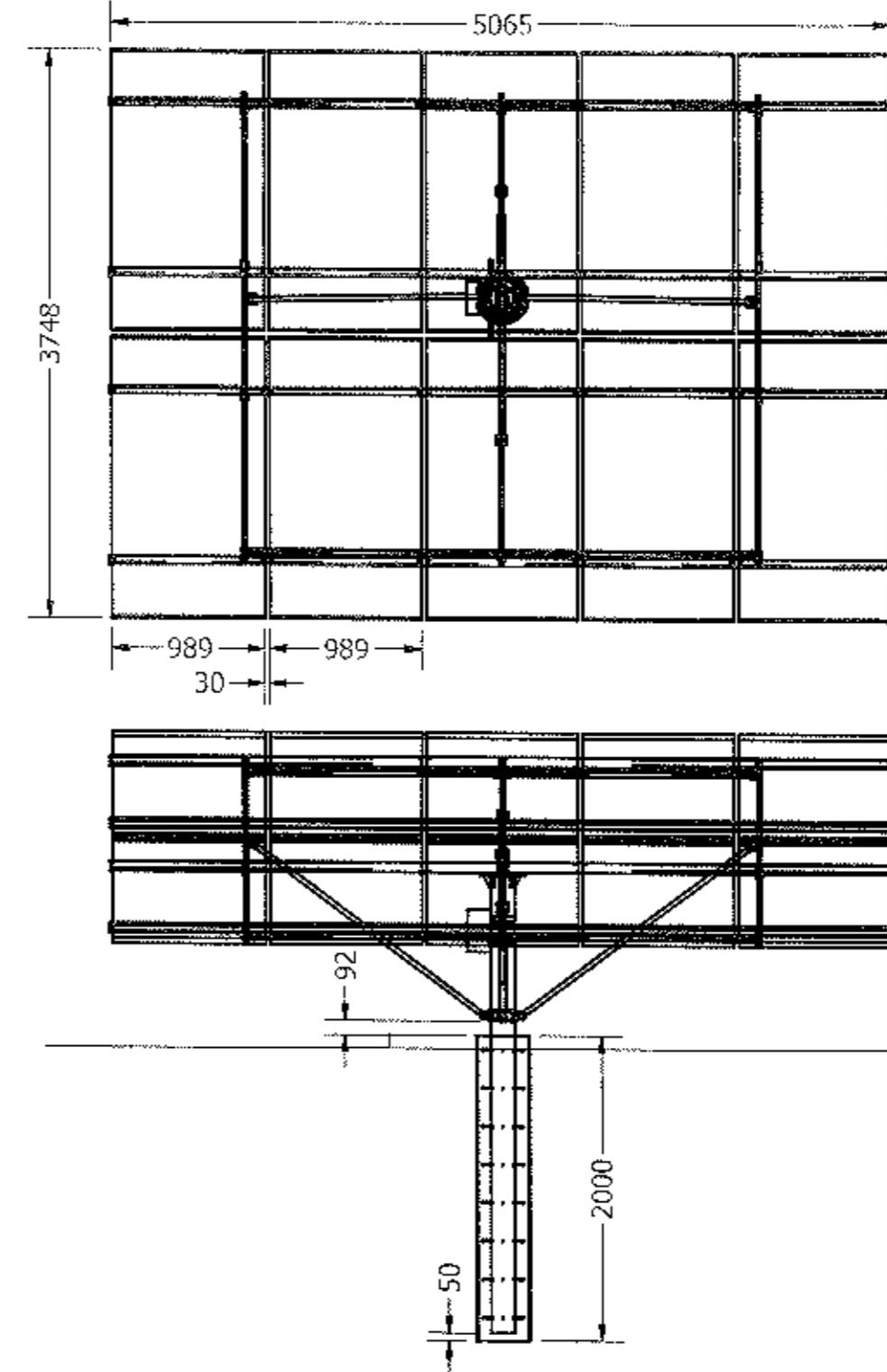
MATERIAL	BRUSH
REFER FROM	BLISTER GOM

10

PRODUCT INFO

10 MMS SOLAR WATER PUMP STRUCTURE

Learn Name: UCMMS AS-AK-18 X DRAW Pd.
Material Grade: 4030-B00
Gauge: 0.050 in
Tilt angle: 0.033333333 deg/in
No. of measures: 16



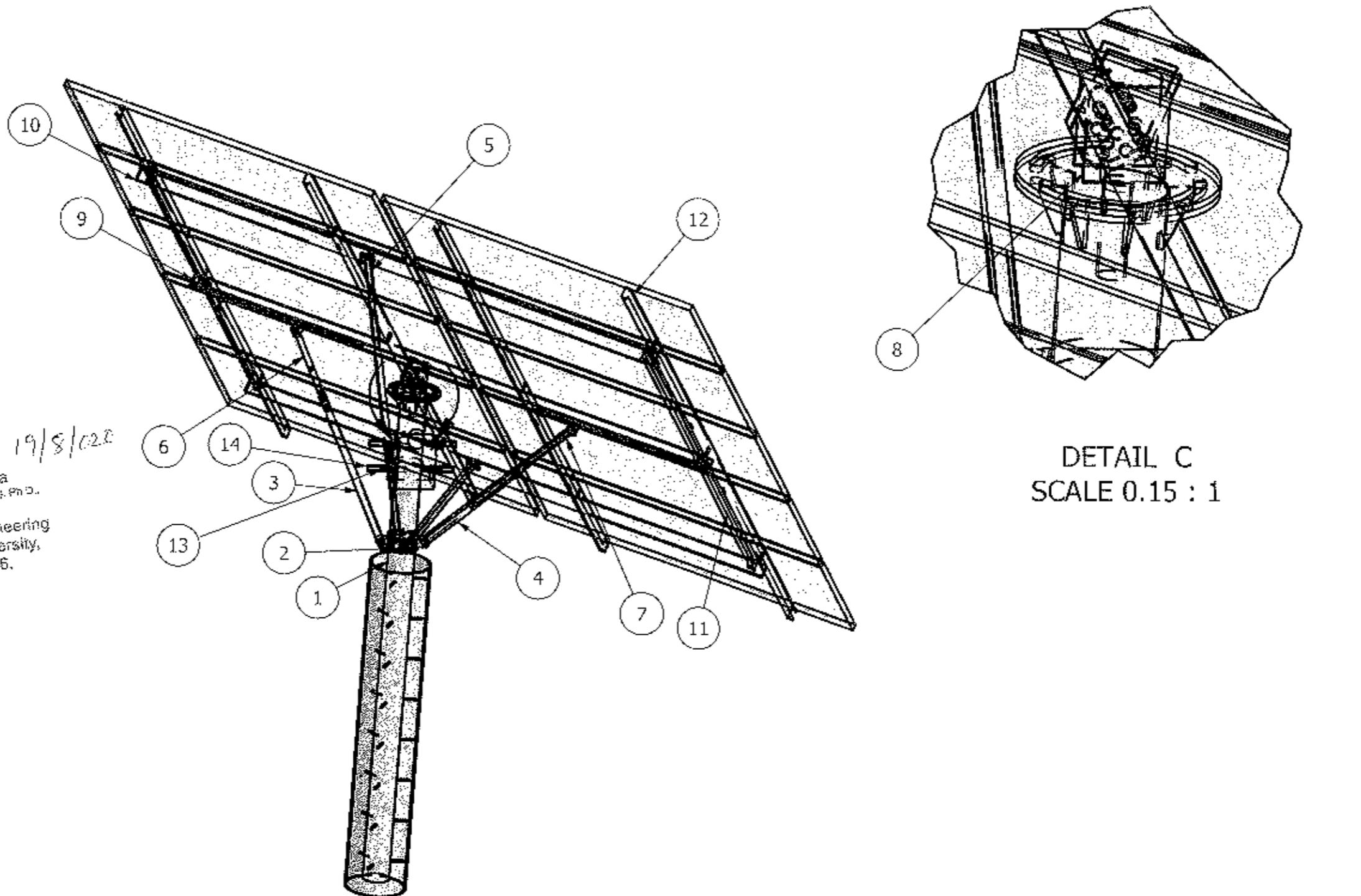
4	22-07-26-20	FOR 15 MMSL 10 MWSL 1-125 MWSL 1000 L/MIN. W/OUT PLS	SAC-HD-00000000000000000000000000000000	APR-10-A	BLDG.
3	22-07-27-20	CHANGES IN MATERIALS IN DRAWINGS IN BLDG. LIST	SAC-HD-00000000000000000000000000000000	APR-10-B	BLDG.
2	22-07-27-20	CHANGES IN SOME OF THE LINES IN BLDG. LIST	SAC-HD-00000000000000000000000000000000	ENRISH	BLDG.
1	22-07-27-20	FOR 15 MMSL 10 MWSL 1-125 MWSL 1000 L/MIN. W/OUT PLS	SAC-HD-00000000000000000000000000000000	APR-10-C	BLDG.
REV.	DATE	DESCR. IN JOBB	DRAWN BY	CHEKED	APPR.
PRODUCT TITLE:			SAC-HD-00000000000000000000000000000000	RESTD	APPR.
10 MMS SOLAR WATER PUMP STRUCTURE			WATER	0.000	
			DATE 22-07-2020	DATE 22-07-2020	DRAWN BY 4
PART/DWG NUMBER: TPS-EESL-10MMSL-11P-PVP1-F-001			SHEET 02		

Rev. Name: 10MMS ASSEMBLY DRAWING
 Material: Grade: Refer BOM
 Height: Refer BOM
 Fit angle: 0,15,30,45 degree
 No. of modules: 10

10MMS ISOMETRIC VIEW



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19/8/02
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DETAIL C
 SCALE 0.15 : 1

NOTE:
 * REMOVE BURR & DENT
 * REMOVE SHARP CORNER & MAKE CHAMFER (MM OR LESS SPECIFIED)

TRIMMED ANGLE
 PROJECTION



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MATERIAL
 REFER BOM

FINISH
 REFER BOM

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN MM.

SCALE

TO DRAWINGS

NO. D.P.
 ± 1

ONE D.P.
 ± 0.5

TWO D.P.
 ± 0.25

AND 15
 ± 10

PRODUCT TITLE:

10 MMS SOLAR WATER PUMP STRUCTURE

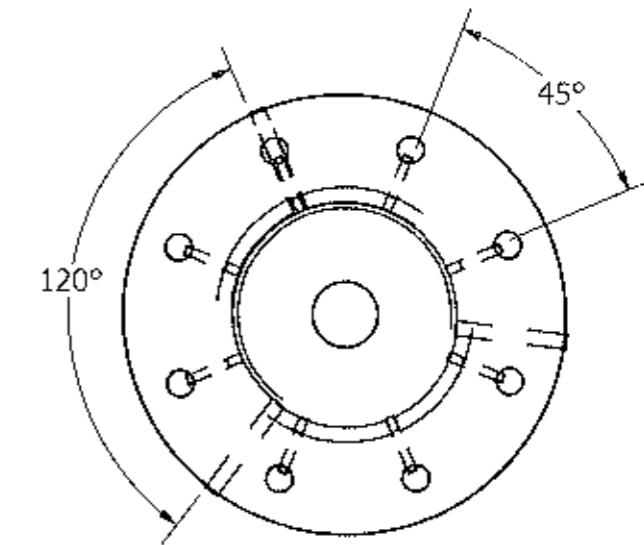
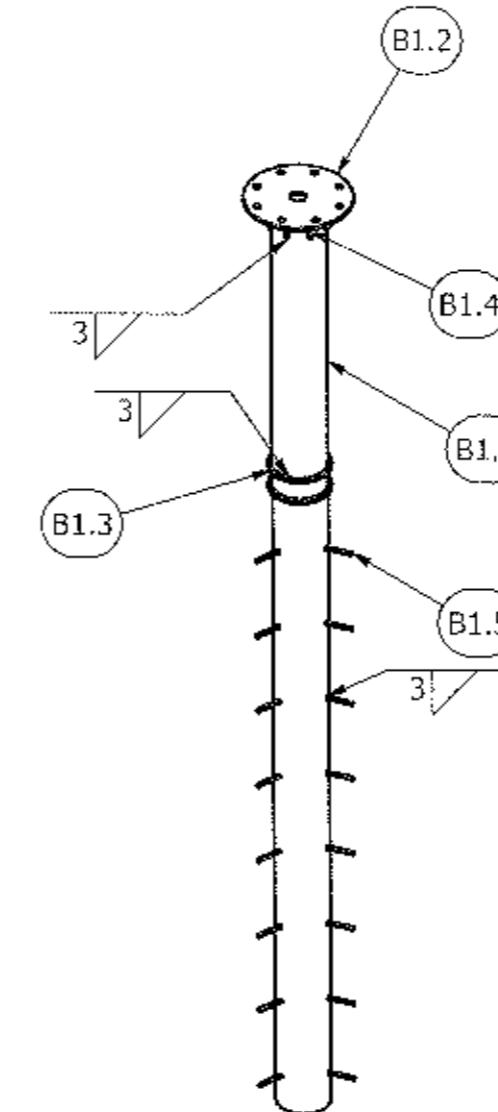
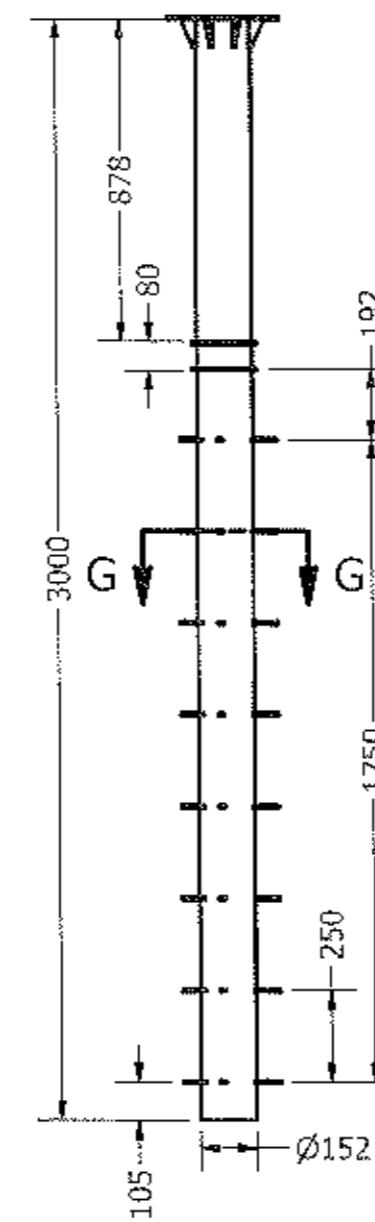
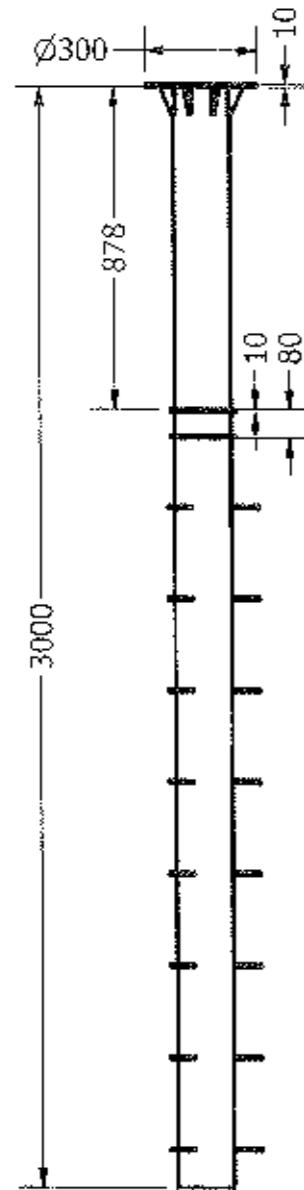
REV.	DATE	DESCRIPTION	DRAWN	CHKD	APPR.
			DRAWN BY IDHARAKUMAR S	CHKD V.NAGASHA	APPR. S.V.R.
0	22-07-2006	DATE 22-07-2006	DATE 22-07-2006	DATE 22-07-2006	REV. 0

PART/DWG NUMBER:	SHEET SIZE
TPS-EESL-10MMS-N-TP-PVPT-F-001	62

1. BASE PIPE ASSEMBLY

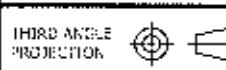


SECTION G-C
SCALE .05



Specimen
Dr. B. M. Ladd, Ph.D.
Desperately
University
of Michigan
Ann Arbor
Michigan
U.S.A.

NOTE:
- REMOVE BURR & DEBT
- REMOVE SHARP CORNER & MAKE CHAMFER 10MM (UNLESS SPECIFIED)



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卷之三

104

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11413:

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ED DIA.	MATERIAL		FINISH		
	REFER BOM		REF K BOM		
	UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MM				
TOLERANCES					
	NO D.P.	ONE D.P.	TWO D.P.	ANGLES	
	+ 1	+ 0.5	+ 0.25	+3	

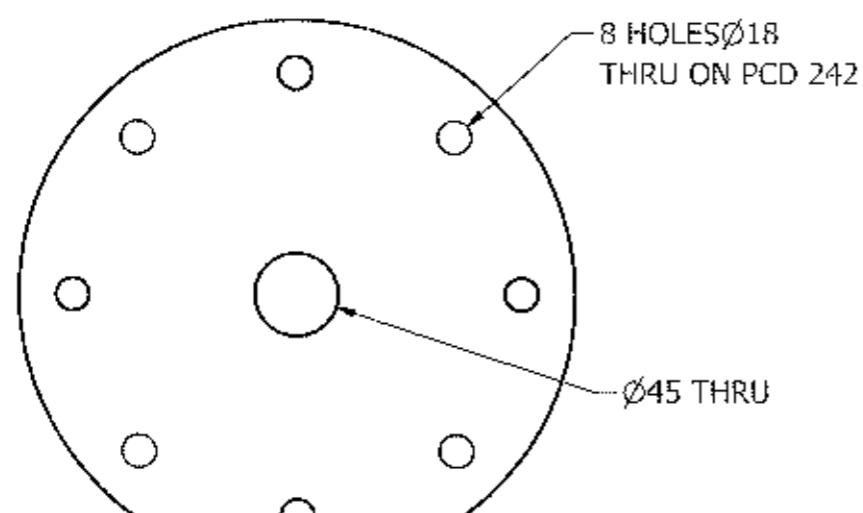
REV.	DATE	DESCRIPTION	DRAWN	CHECKED	APPR.
		PRODUCT TITLE:	DRAWN SAKTHI MECHANICAL	CHECKED RAJESHLA	APPR. SUWIL
E		10MMS SOLAR WATER PUMP STRUCTURE	DATE 2010-05-09	DATE 2010-05-09	REV 4
S		PART/DWG NUMBER: TPS-EESL-10MMS-N-TP-PVPT-F-001			54EFT SIZE: A3

John Kanner CIVIL ENGINEER DRAWING
Material Grade: Refer BOM
Pitch: 20° or 30°
Fl. angle: 0.15-25 degree
No. of modules: 10

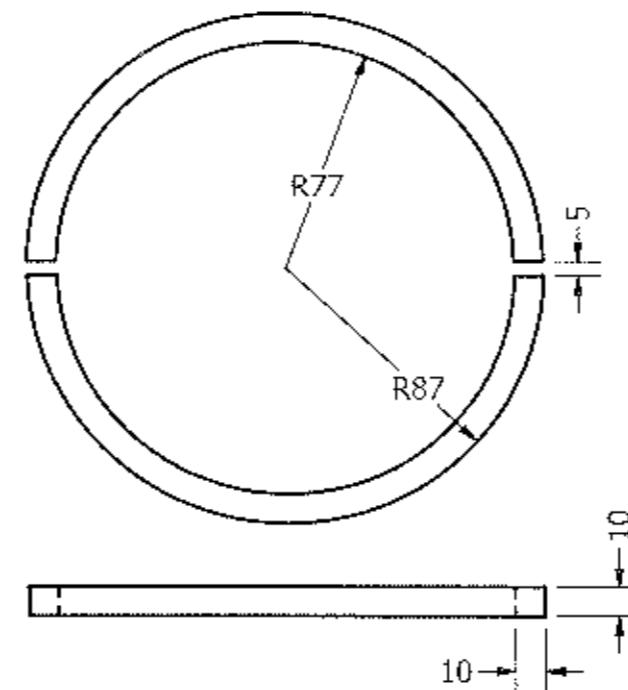
B1.1. BASE PIPE



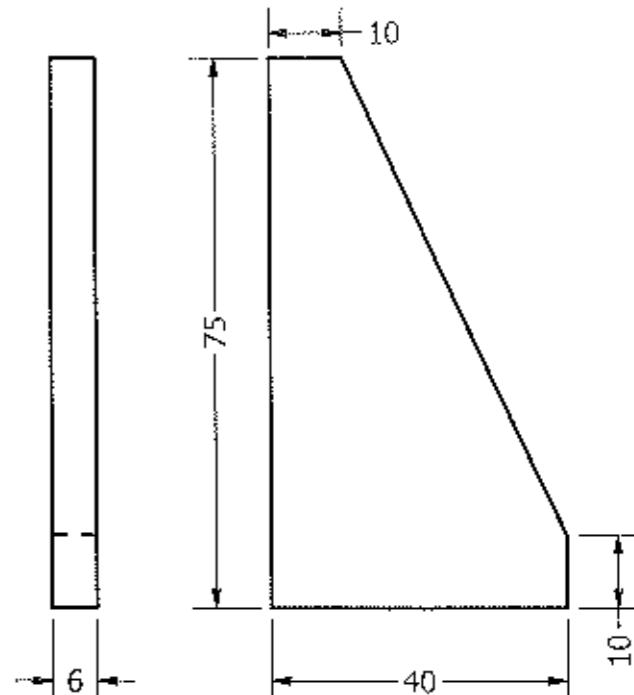
B1.2. FLANGE PLATE



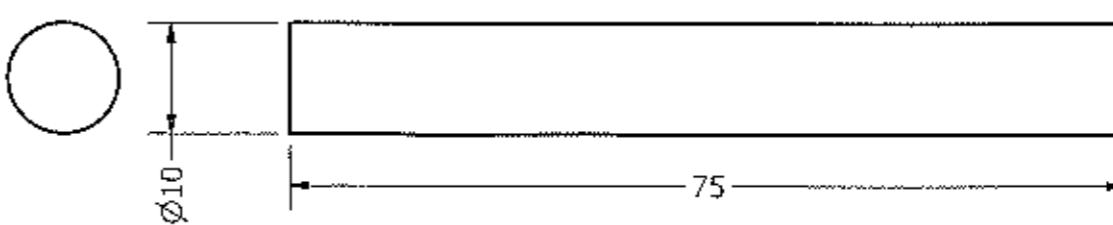
B1.3. RING



B1.4. TOP PLATE GUSSET



B1.5. LUGS

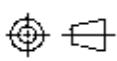


N. Jayaramappa
M.E., (Structural), Ph.D.
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Department of Civil Engineering
UVCE, Bangalore University,
Bengaluru - 560 056.

NOTE:
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• REMOVE SHAKEN COLOUR & PAKE CHAMFER 3MM (UNLESS SPECIFIED)



THIRD ANGLE PROJECTION



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MATERIAL
REFER BOM

FINISH
REFER BOM

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MM.

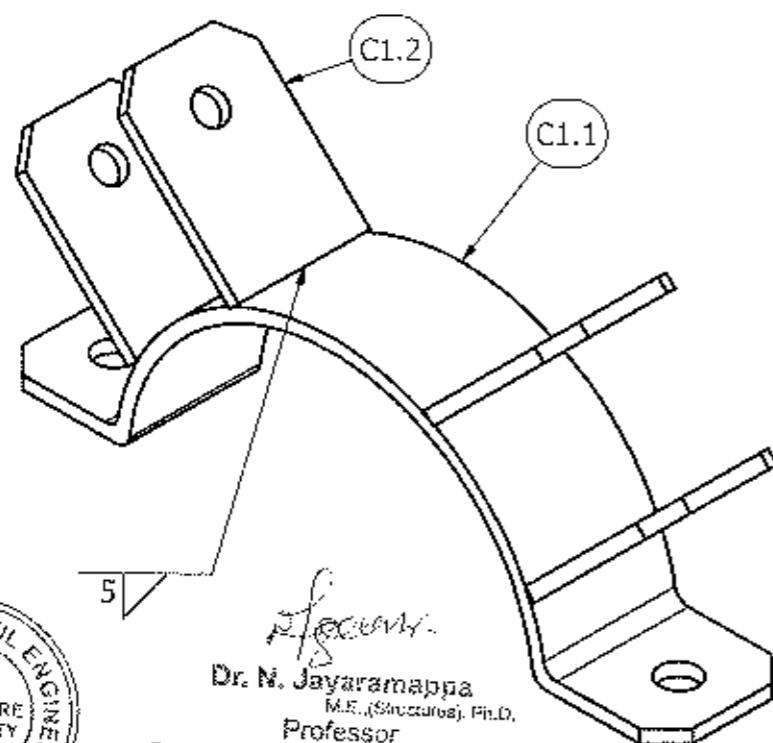
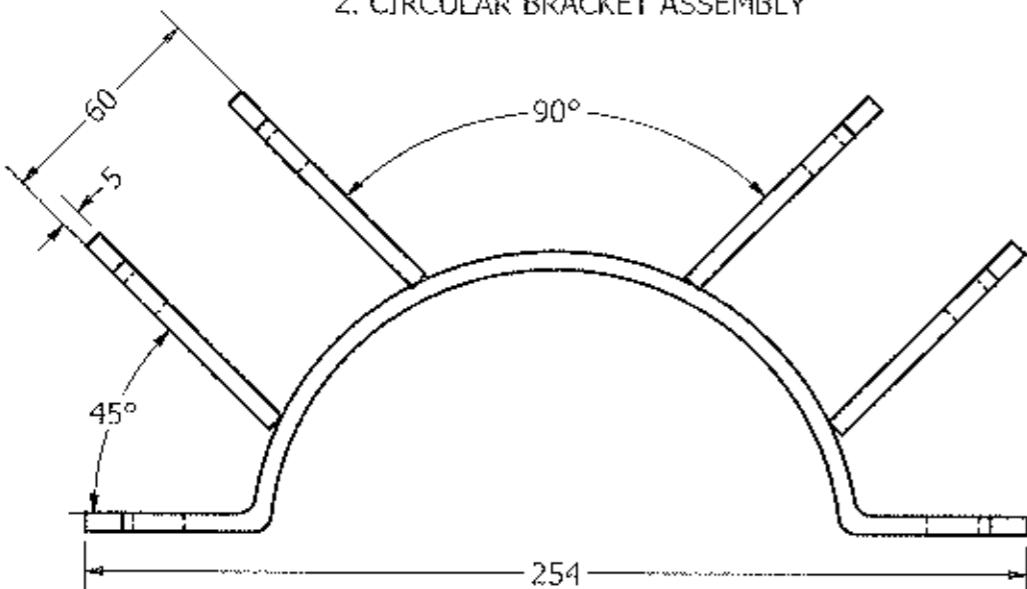
SCALE:

TOLERANCES

NO. D.P.	ONE D.P.	TWO D.P.	ANGLES	
± 1	± 0.5	± 0.25	± 10'	

REV.	DATE	DESCRIPTION	DRAWR.	CHKD.	APPR.
		PRODUCT TITLE: 10MMS SOLAR WATER PUMP STRUCTURE	DRAWN SACHIN HANAWADE	CHKD. JAGANNATH	APPR. SUDHIL
	DATE 24-09-2012		DATE 24-09-2012	DATE 24-09-2012	PIV. 4
		PART/DWG NUMBER: TPS-BESL-10MMS-N-TP-PVPT-F-001	SHEET SIZE A0		

2. CIRCULAR BRACKET ASSEMBLY



R. Jayaramappa
Dr. N. Jayaramappa
M.E.,(Structures), Ph.D.
Professor

Department of Civil Engineering
UVCE, Bangalore University,
Bengaluru - 560 056.



NOTE:
* REMOVE BURRS & DENT
* REMOVE SHARP CORNERS & MAKE CHAMFER 10MM (UNLESS SPECIFIED)

THIRD ANGLE PROJECTION

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MATERIAL
REFR. BOM

FINISH
REFER BOM

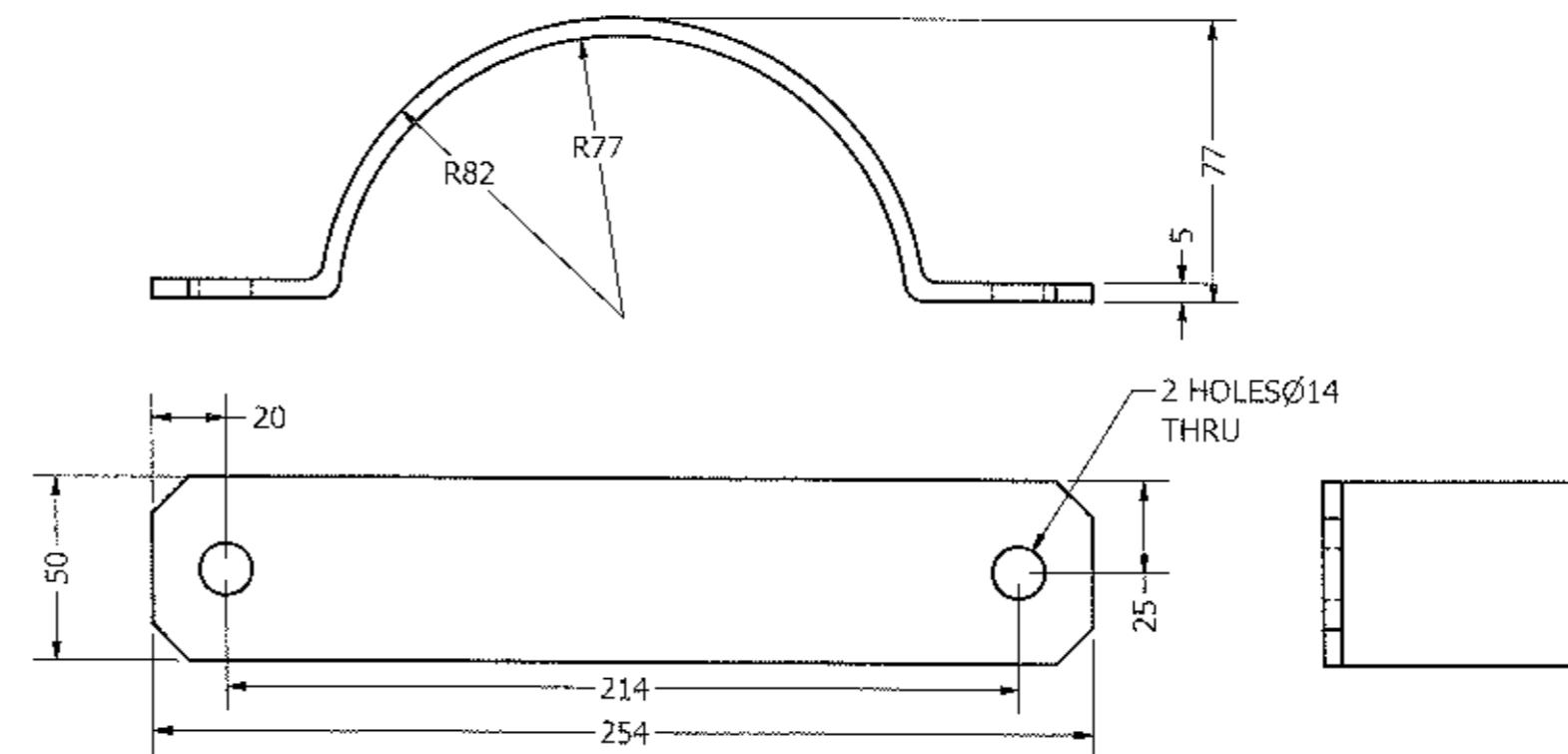
UNLESS OTHERWISE SPECIFIED, ALL DIMMINGS ARE IN MM.

TO: FRANCES

NO.O.P.	CNF.O.P.	TWO.O.P.	ANGLE	
+ 1	L 0.5	E 0.25	10	



C1.1. CIRCULAR PLATE

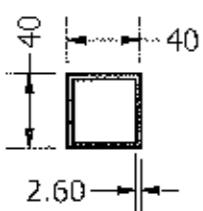


Part Name: C1.2BOM Drawing: C1.2BOM
Material: Steel Refer BOM
Axis: Refer BOM
All Conc: U15,25 degree
Ang. of Inclination: 10

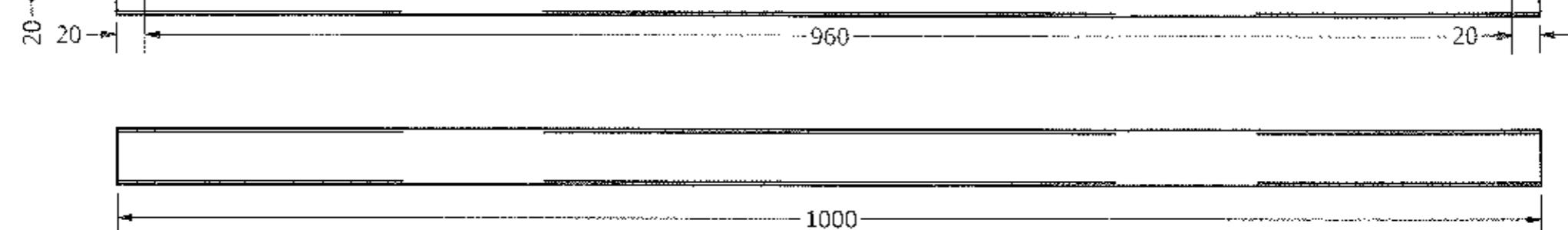
C1.2. TUBE MOUNTING PLATE

REF.	DATE	DESCRIPTION	DRAWN	CHKD.	APPR.
	22-07-2020	PRODUCT TITLE:	DRAWN ANNUAL DRAWN	CHKD. ANNUAL	APPR. SIL
		10 MMS SOLAR WATER PUMP STRUCTURE			
			DRAWN ANNUAL DRAWN	CHKD. ANNUAL	APPR. SIL
	22-07-2020		DATE 22-07-2020	DATE 22-07-2020	DATE 22-07-2020
			REV. A		
			PART/DWG NUMBER: TPS-GESL-10MMS-N-TP-PVPT-F-001	SHEET SIZE A1	

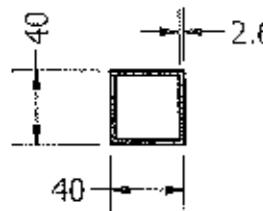
3. REAR SUPPORTING



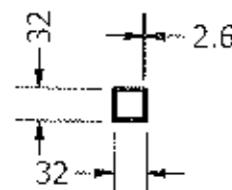
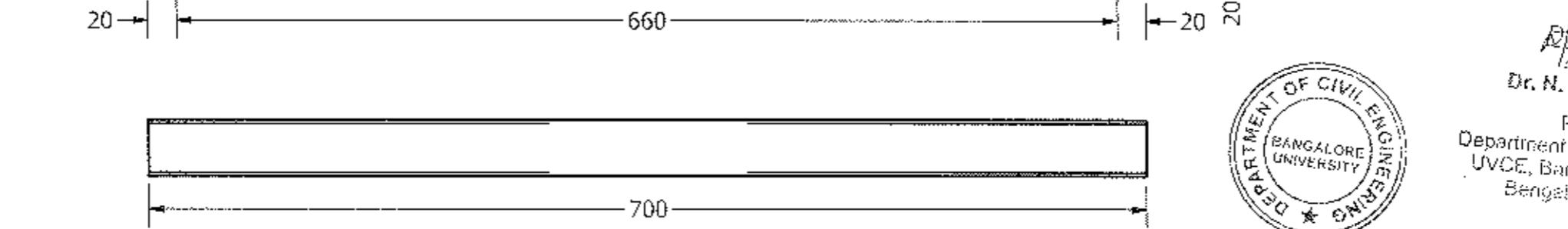
2 HOLES Ø12 THRU



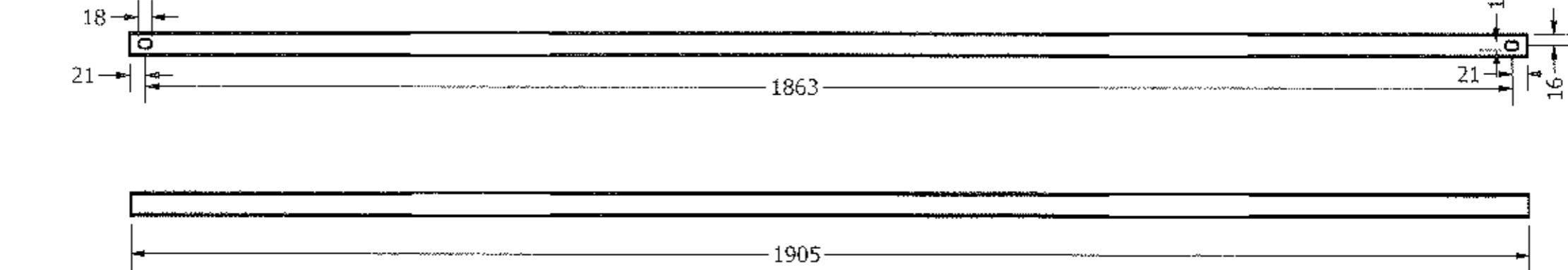
4. FRONT SUPPORTING



2 HOLES Ø12 THRU



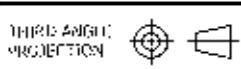
5. LH & RH SUPPORTING



R. Jayaramappa
Dr. N. Jayaramappa
M.E., M.Tech., Ph.D.
Professor
Department of Civil Engineering
UVCE, Bangalore University,
Bengaluru - 560 066.



NOTE:
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✓ REMOVE SHARP CORNER & MAKE CHAMFER (UNLESS SPECIFIED)



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MATERIAL
REFER BOM

FINISH
REFER RCM

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TOLERANCES

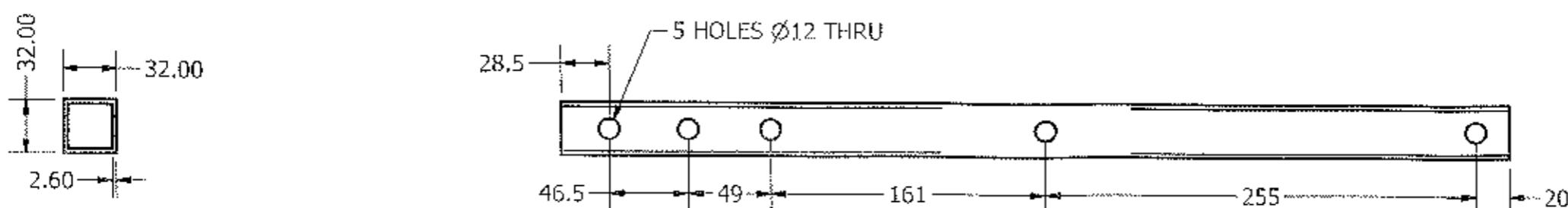
SCALE

NO D.P. ONE D.P. TWO D.P. ANGLES
± 1 ± 0.5 ± 0.25 ± 15

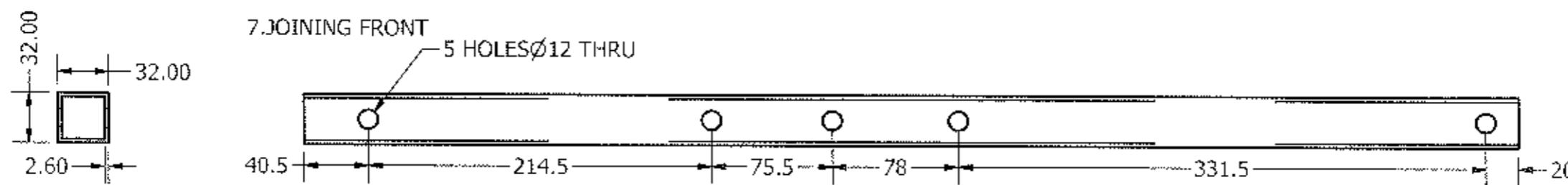
REV	DATE	DESCRIPTION	DRAWN BY	CPRD.	APPR.
		PRODUCT TITLE: 10MMS SOLAR WATER PUMP STRUCTURE	DRWNP S.G. DURGADEV	CHKD. HR-INR	APPR. S. JAI
			DATE 22-07-2016	DATE 22-07-2016	REV. 4
		PART/DWG NUMBER: TPS-EESL-10MMS-N-TP-PVPT-F-001	SCALE A1		Sheet Size A1

Item Agree: 100% Assemblies Drawing
 Material Grade: Refer Item
 Length: 1000 mm
 Weight: 0.150 kg
 No. of drawings: 1

6 JOINING REAR



7 JOINING FRONT



Dr. N. Jayaramappa
 M.E.(Structures), Ph.D.,
 Professor
 Department of Civil Engineering
 UVCE, Bangalore University,
 Bengaluru - 560 056.

NOTE:
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 * REMOVE SMOOTH CORNER & MAKE CHAMFER (MM) (UNLESS SPECIFIED)

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 REFER BOM
 REFER BOM

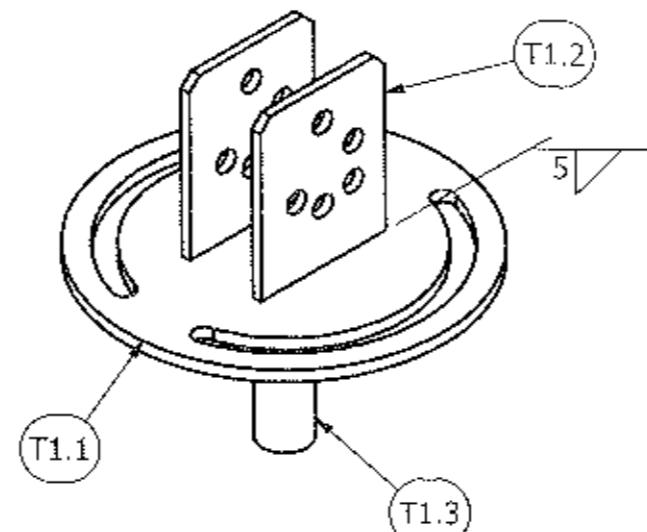
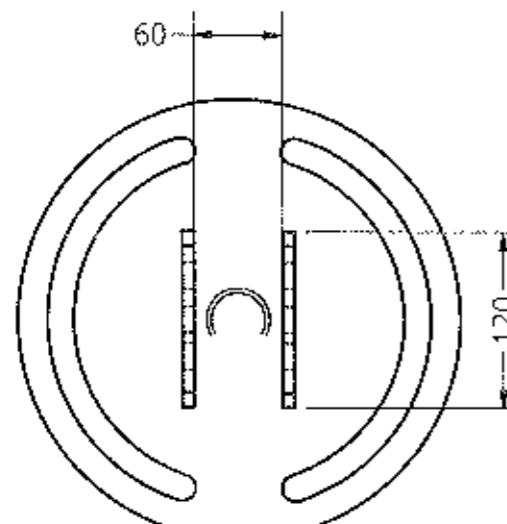
UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MM

TOLERANCES

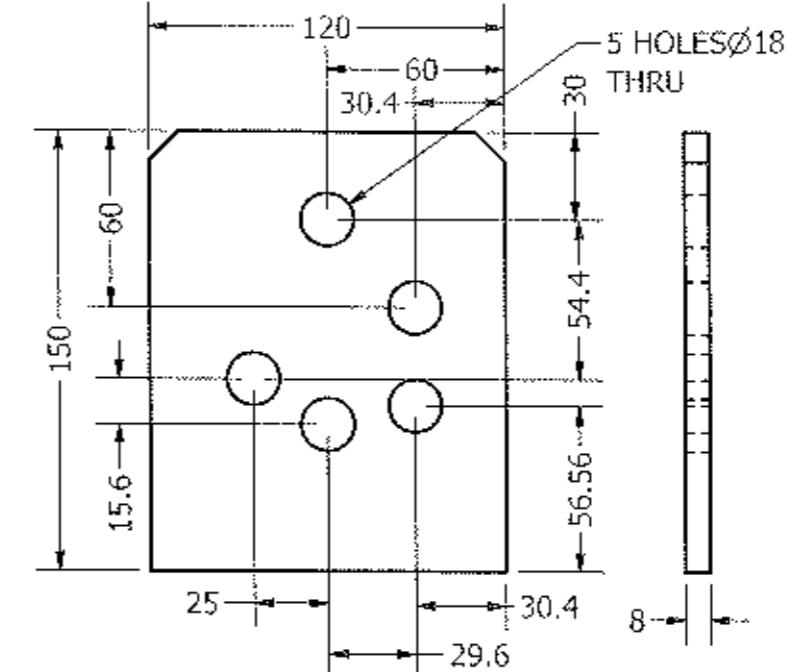
NO D.P.	ONE D.P.	TWO D.P.	ANGLES	
± 1	± 0.5	± 0.25	± 5	

REV.	DATE	DESCRIPTION			DRAWN BY	CHKD.	APPR.
		PRODUCT TITLE:			DRWNR SACHIN VAMKAR	CHKD. VAMKAR	APPR. S.G.B.
		10 MMS SOLAR WATER PUMP STRUCTURE					
PART/DWG NUMBER: TPS-CESL-10MMS-N-TP-PVPT-F-001						SHEET SIZE A3	

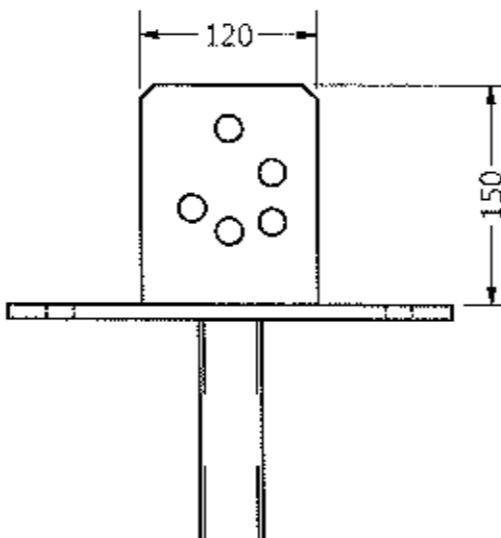
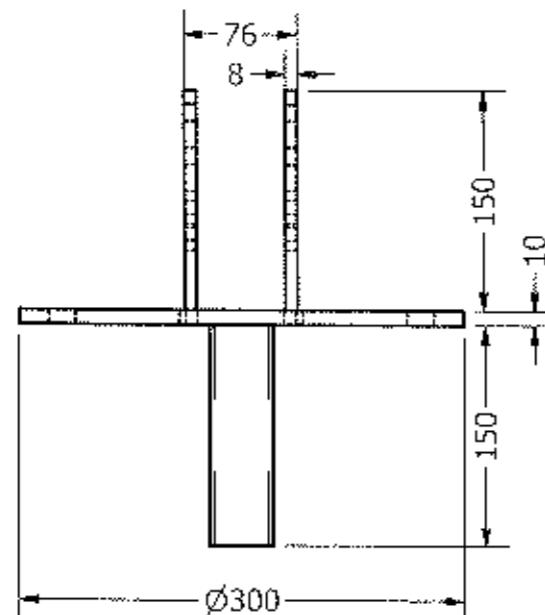
8. TOP PLATE ASSEMBLY



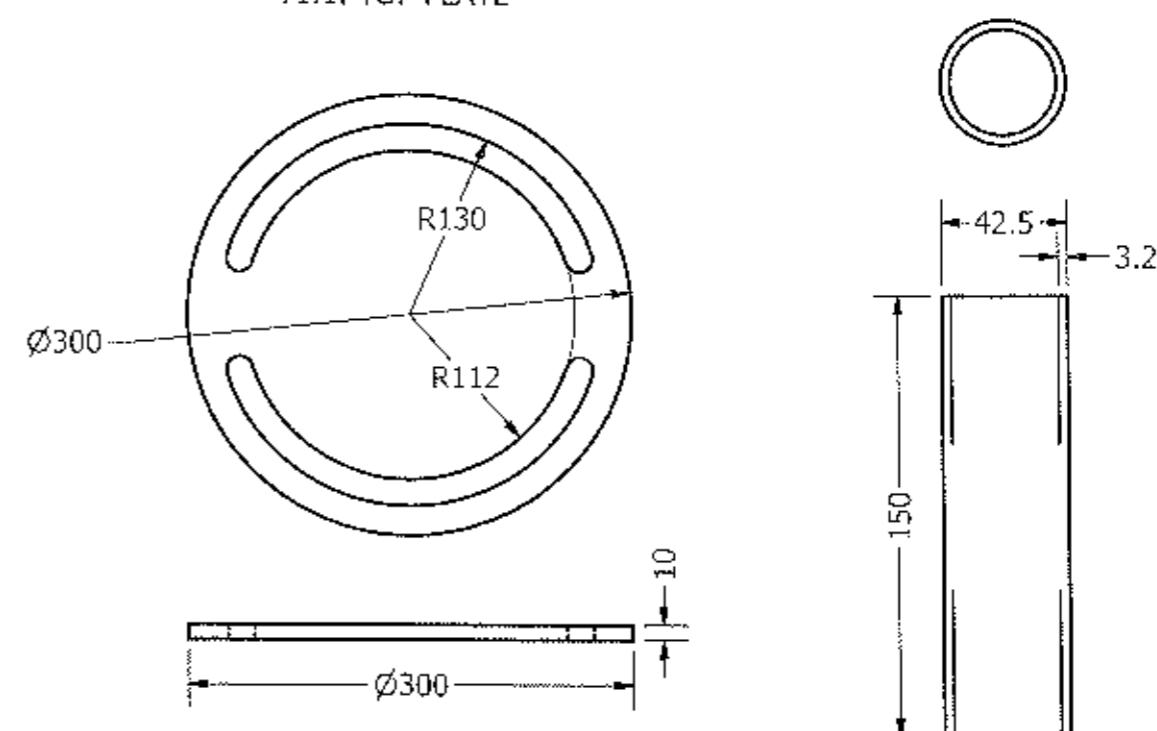
T1.2. MID PLATE



T1.1. TOP PLATE



T1.3. BASE PIPE



NOTE:
1. REMOVE BURR & DENT.
2. REMOVE SHARP CORNER & PAKE CHAMFER 10MM (UNLESS SPCT.HLD)



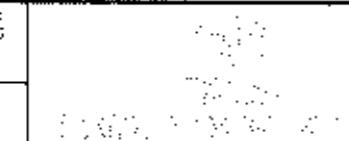
Dr. N. Jayaramappa
M.E. (Structures), Ph.D.,
Professor
Department of Civil Engineering
UVCE, Bangalore University,
Bangalore - 560 056.

THIRD ANGLE
PROJECTION



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MATERIAL

REFER PDS

PCMSL

REFER PDS

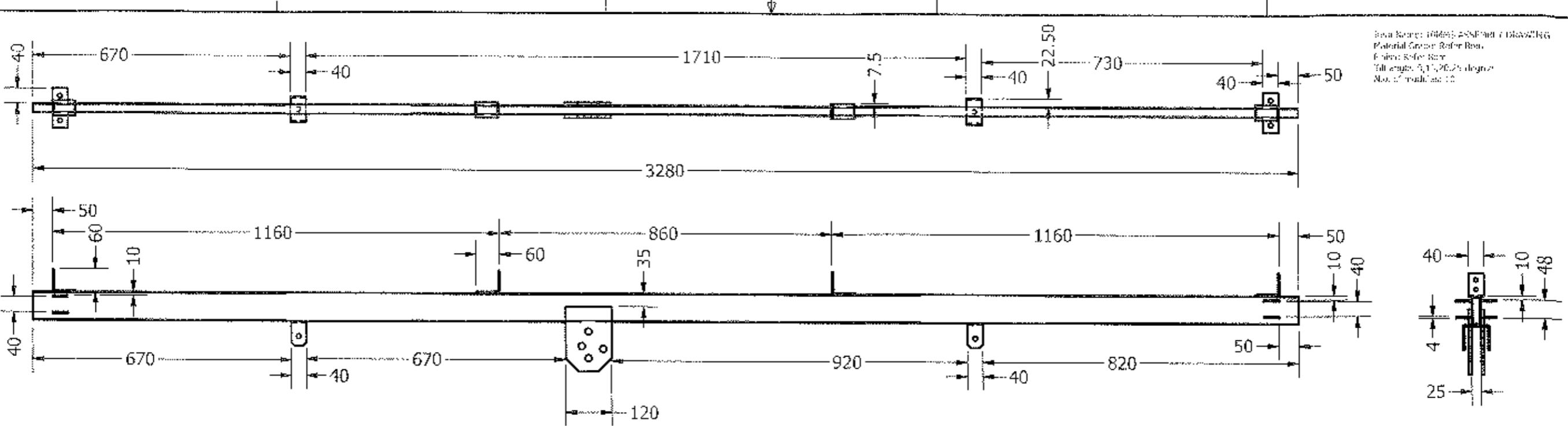
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN MM.

SCHE

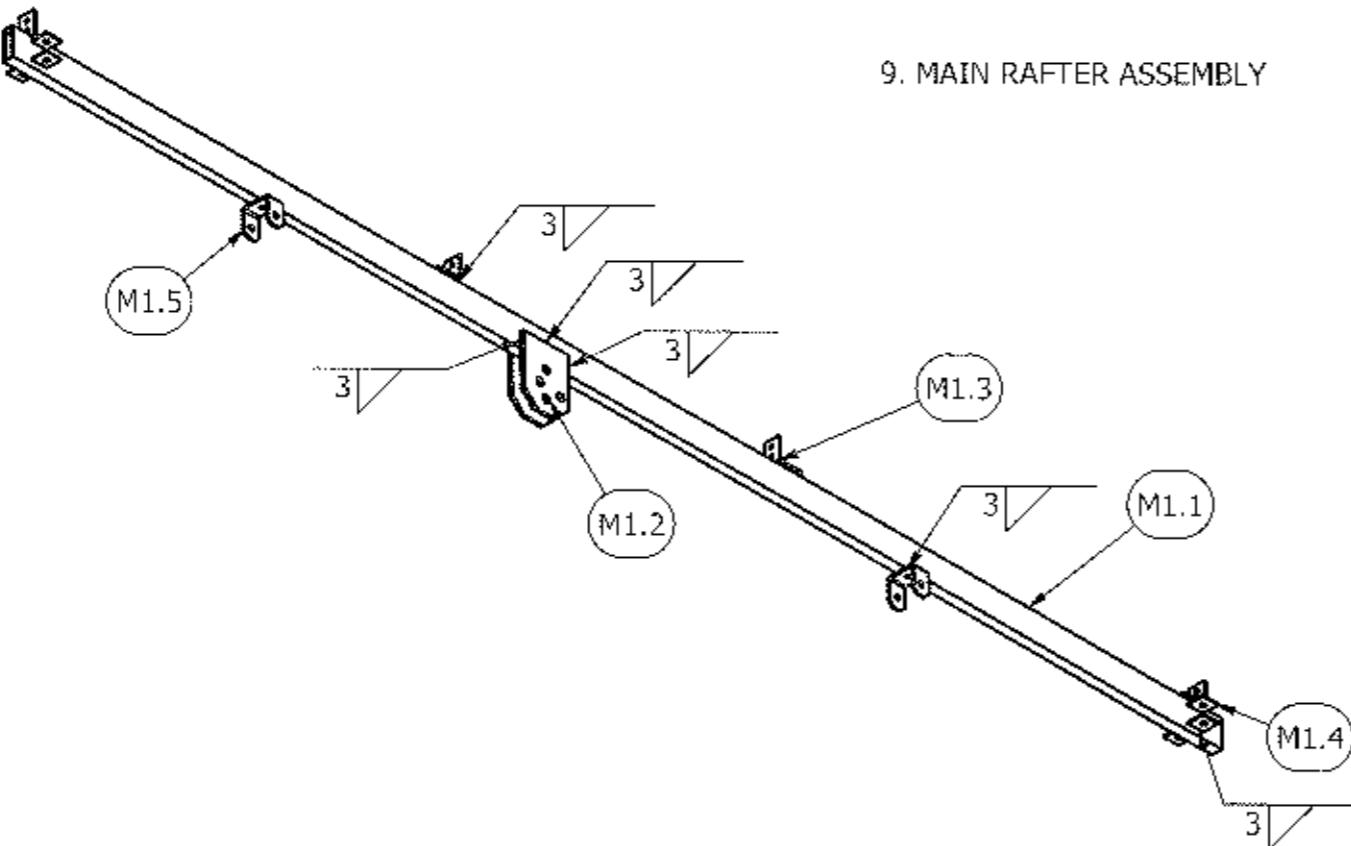
CLEARANCES

HGT.DP.	ONE.DP.	TWO.DP.	ANGLES	
± 1	± 0.5	± 0.25	± 10	

REV.	DATE	DESCRIPTION	DRAWN BY OR APPROVED	CHKD	APPR.
		PRODUCT TITLE:			
		10MMS SOLAR WATER PUMP STRUCTURE	DRAWN BY OR APPROVED	CHKD	APPR.
	2017-06-2		DATE 2017-06-2	DATE 2017-06-2	DATE 2017-06-2
		PART/DWG NUMBER: TPS-EESL-10MMS-N-TP-PVPT-F-001	SHEET SIZE		



9. MAIN RAFTER ASSEMBLY



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Dr. N. Jayaramappa
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Professor
Department of Civil Engineering
UVCE, Bangalore University,
Bengaluru - 560 056.

NOTE:
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• REMOVE SHARP CORNER & MAKE CHAMFER 10MM (UNLESS SPECIFIED)

THIRD ANGLE PROJECTION

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MATERIAL
REFER BOM

FINISH
REFER BOM

DRILLS OR HOLLOW SPOTS IF ALL DIMENSIONS ARE IN MM.

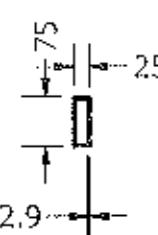
SCALE

TOLENCES

NO. O.P. ONE O.P. TWO O.P. ANGLES ± 10°

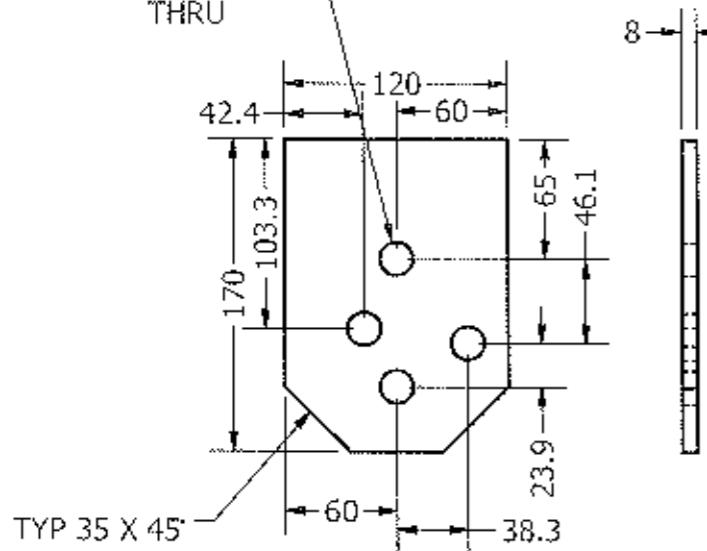
REV.	DATE	DESCRIPTION		DRAWN	CHkd	APPR.
PRODUCT TITLE:		10 MMS SOLAR WATER PUMP STRUCTURE		DRAWN BY: CIVIL ENGINEER	CHkd, HABIBA	APPR. SLTE.
DATE 22-07-2025		DATE 22-07-2026		DATE 22-07-2026	DATE 22-07-2026	REV. 4
PART/DWG NUMBER: TPS-EESL-10MMS-N-TP-PVPT-C-001				SHEET SIZE A1		

Part Name: 10 MM-ASSEMBLY DRAWING
 Material Grade: Refer BOM
 Fish: Rafter Beam
 Ilt angle: 1.5, 30, 25 degree
 No. of modules: 10

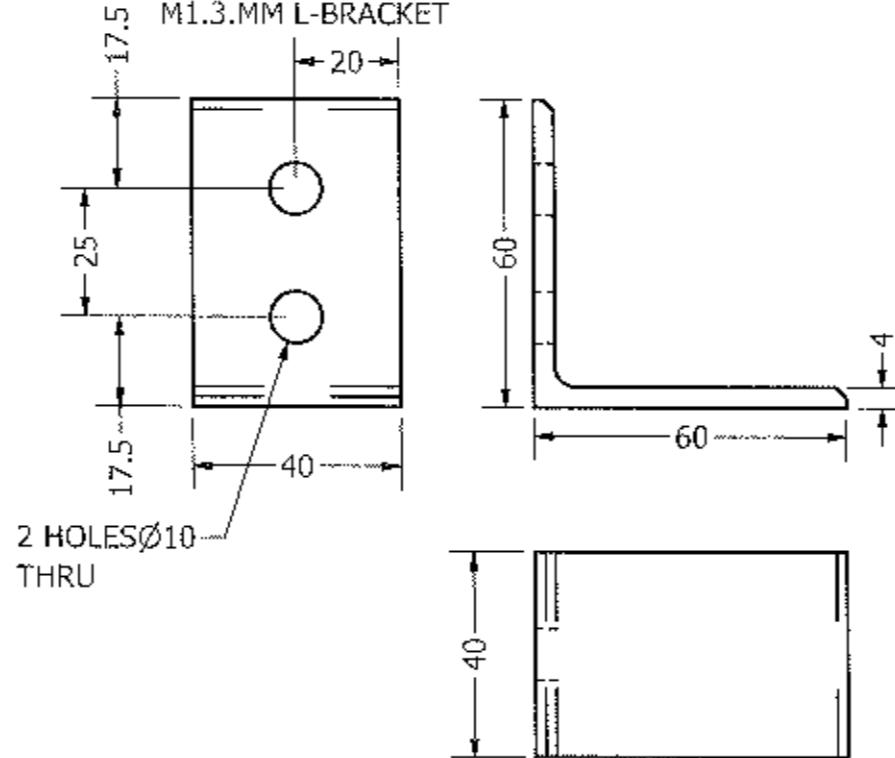


M1.1. MAIN RAFTER

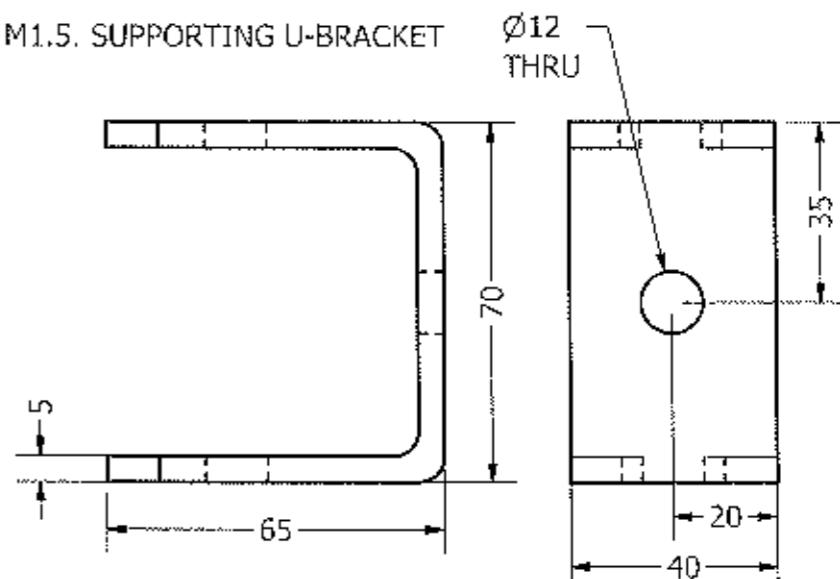
4 HOLES Ø18
THRU
M1.2. ANGLE PLATE



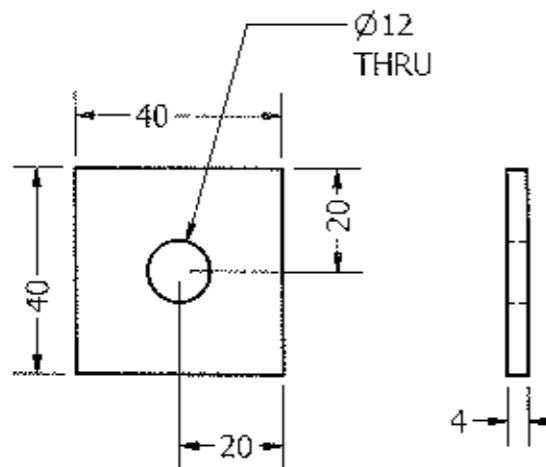
M1.3. MM L-BRACKET



M1.5. SUPPORTING U-BRACKET



M1.4. Rafter Connection Plate

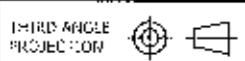


Dr. N. Jayaramappa

Dr. N. Jayaramappa
 M.Tech, Ph.D., P.G.
 Professor
 Department of Civil Engineering
 UVCE, Bangalore University,
 Bengaluru - 560 056.



NOTE
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 * REMOVE SHARP CORNER & MAKE CHAMFER 10MM (UNLESS SPECIFIED)



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MATERIAL
 REFER BOM

FINISH
 REFER BOM

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MM.

SCALE

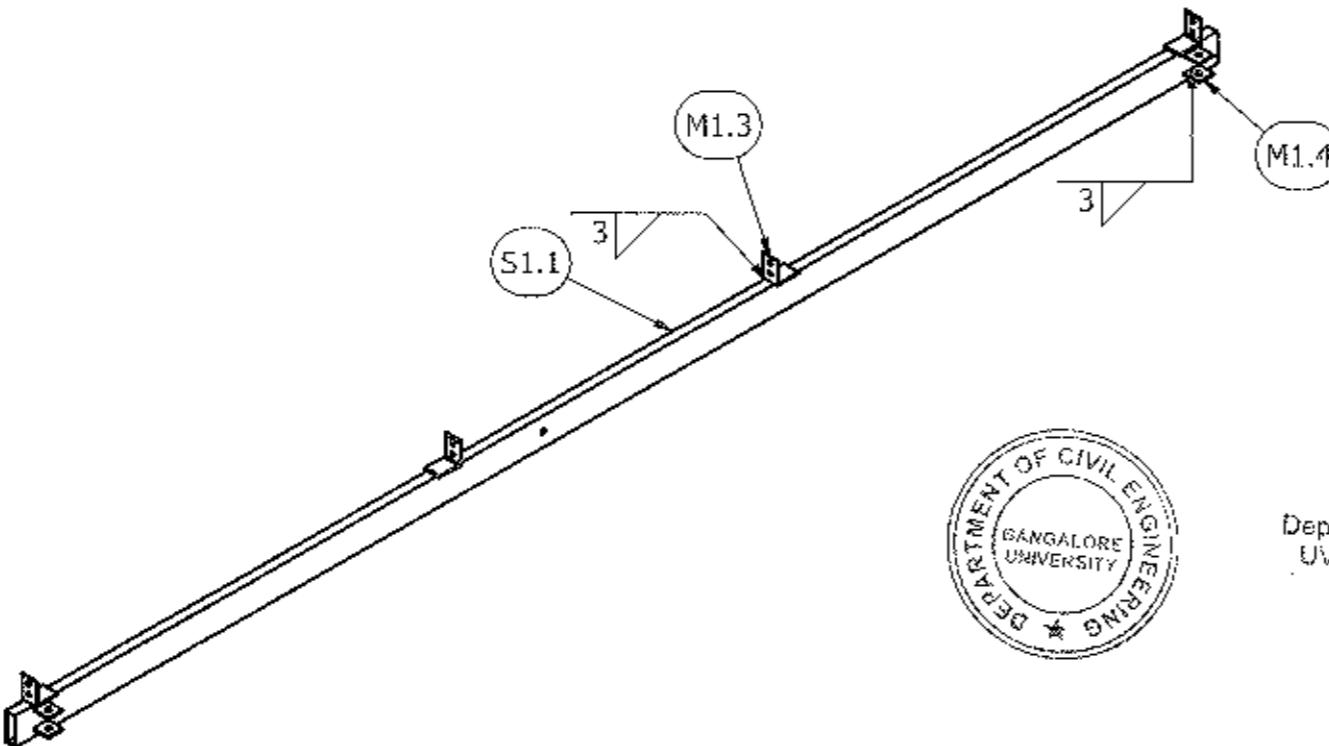
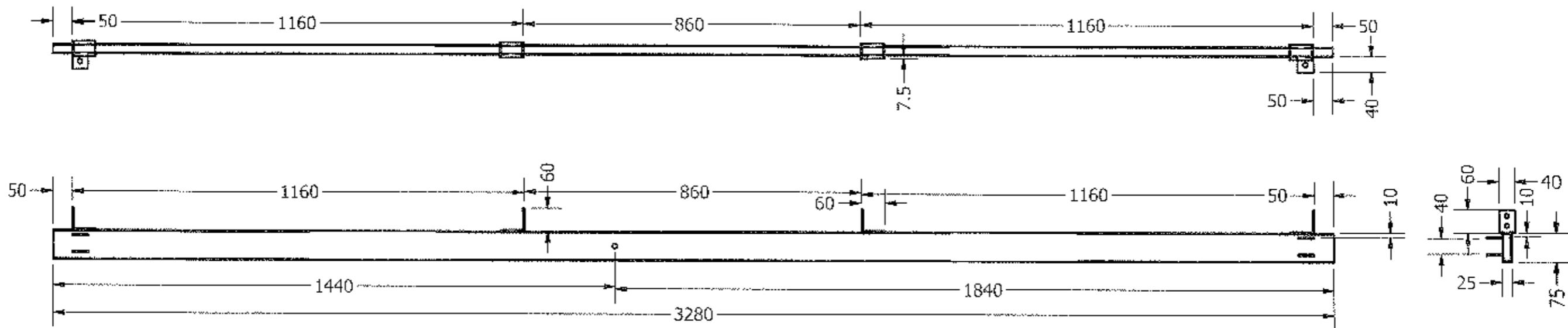
TOP FINISHES

NO. I.P. ± 1 ONE O.P. ± 0.5 TWO O.P. ± 0.25 ANGLES ± 5

REV.	DATE	DESCRIPTION	DRAWN	CHkd.	APPR.
		PRODUCT TITLE:	DRAWN 20-07-2020	CKD. 20-07-2020	APPR. 20-07-2020
		10 MMS SOLAR WATER PUMP STRUCTURE	DATE 20-07-2020	20-07-2020	REV. 4
		PART/DWG NUMBER: TPS-EESL-10MMS-N-TP-PVPT-F-001	SHEET SIZE A3		

Rev. Ver. 2. 10/06/07; ASSEMBLY DRAWING
Material Grade: Refer Rev.
Drawn Scale: 1:1
Drawing No.: TPS-EESL-10MMS-N-TP-PVPT-F-001
Date of Revision: 10

10. SECONDARY RAFTER ASSEMBLY



Specimen
Dr. N. Jayaramappa
M.E./Structures, Ph.D.,
Professor
Department of Civil Engineering
UVCE, Bangalore University,
Bangalore - 560 056.

NOTE:
• REMOVE BURR & DENT
• REMOVE SHARP CORNER & MAKE CHAMFER TURN (UNLESS SPECIFIED)

TRUE ANGLE
PROJECTION



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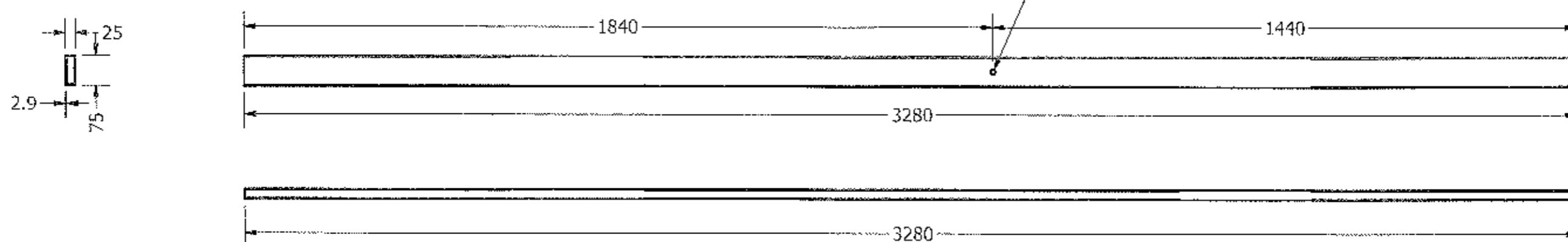
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+ 1	+ 0.5	+ 0.25	+ 0.2	

REV.	DATE	DESCRIPTION			DRAWN BY	CHEK.	APPR.
		PRODUCT TITLE:			DRWAK SCHIDAWAN, Date: 22-07-2007	CKD. HOBHADRA	APPB. SRIPL.
		10 MMS SOLAR WATER PUMP STRUCTURE			DATE 22-07-2007	REV. 22-07-2007	REV. 4
PART/DWG NUMBER: TPS-EESL-10MMS-N-TP-PVPT-F-001						SHEET SIZE A1	

Line Factor: 1.0000 Assumed Drawing
 Material Grade: Refer BOM
 Finish: Refer BOM
 Tilt angle: 0.0000 degrees
 No. of cambered: 0

S1.1.SECONDARY RAFTER



11.CROSS MEMBER



1650



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 M.E.(Structures), Ph.D.
 Professor
 Department of Civil Engineering
 UVCE, Bangalore University,
 Bangalore - 560 056.

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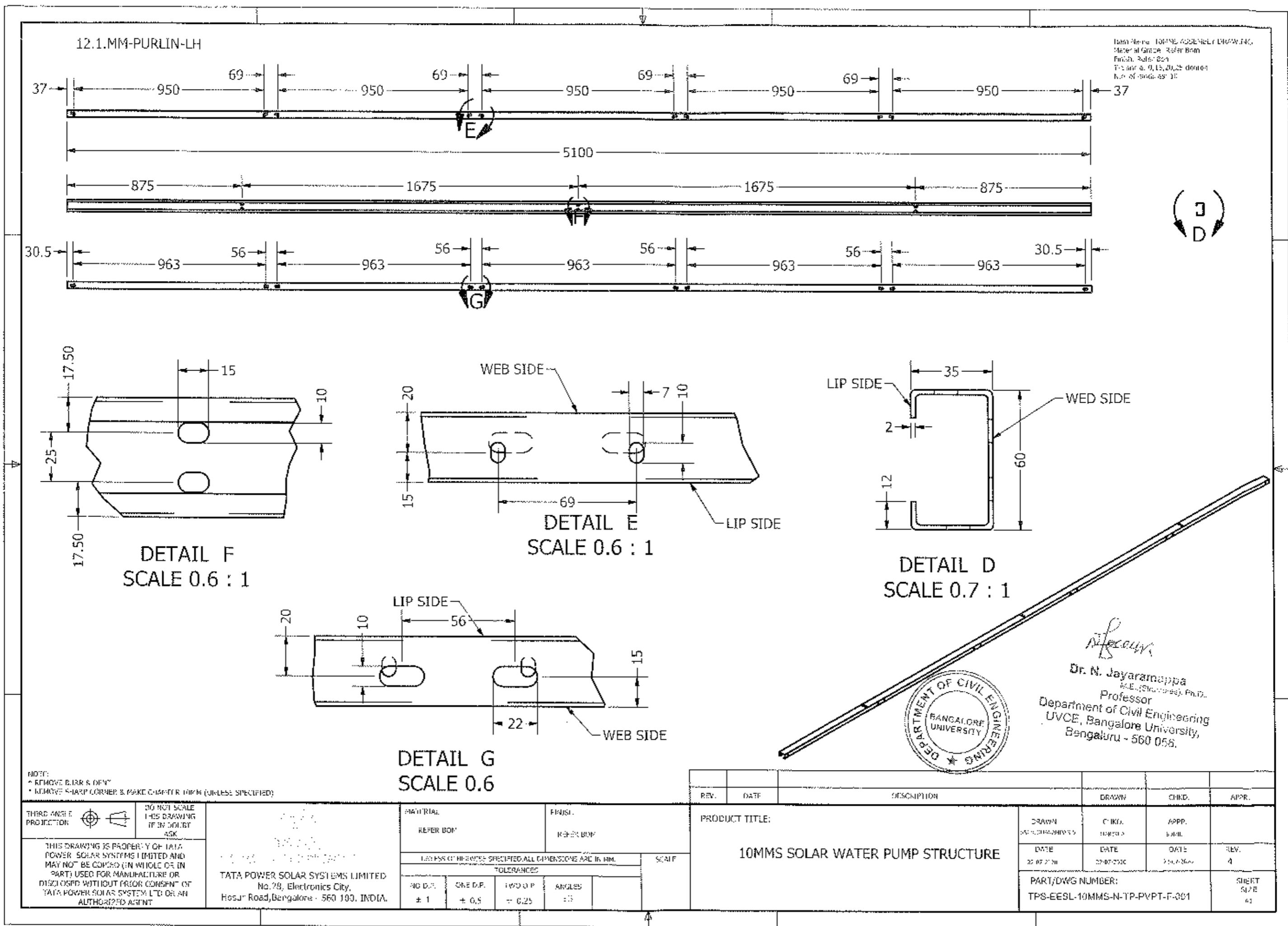
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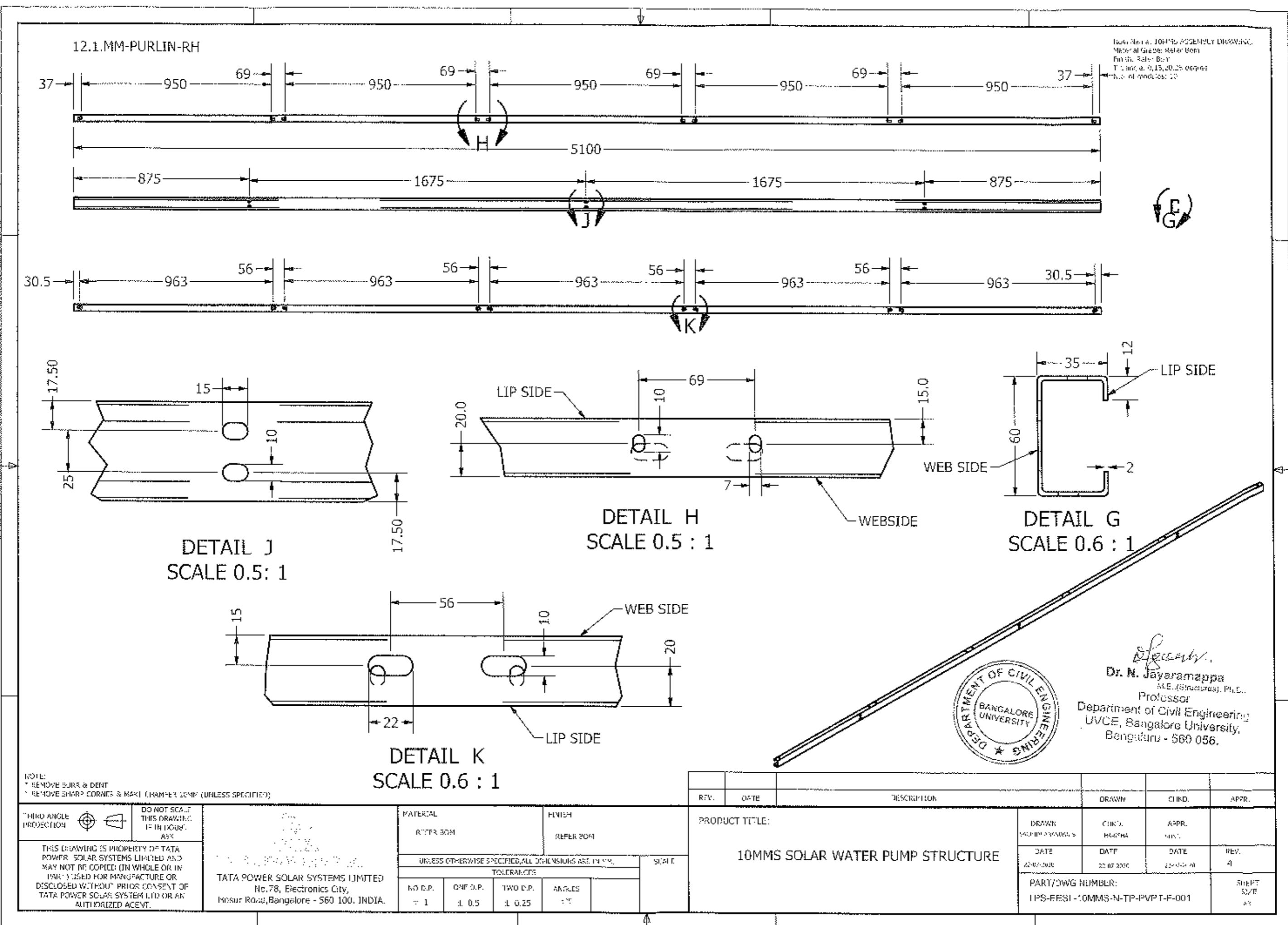
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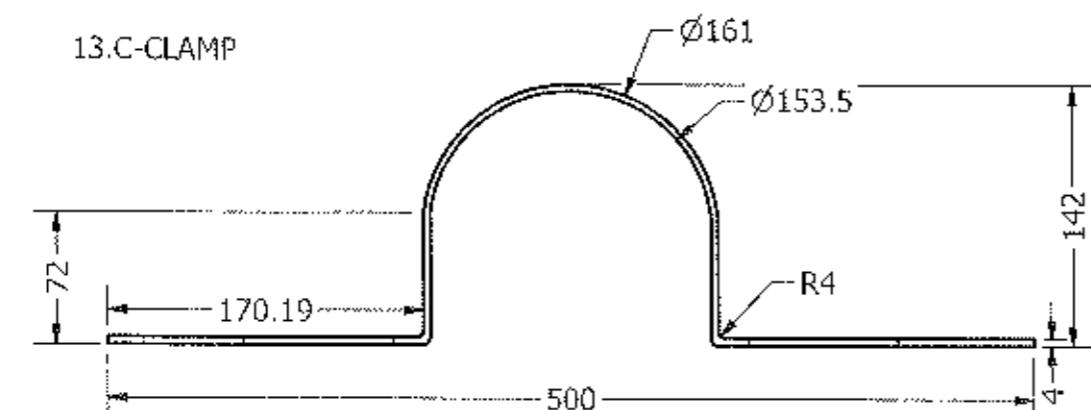
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PRODUCT TITLE:											
10MMS SOLAR WATER PUMP STRUCTURE							DRAWN	CHKD.			
TPS-EESL-10MMS-N-TP-PVPT-F-001							ISSUED	APPR.			
							DATE	DATE			
							22-07-2020	22-07-2020			
							P.T.	R.F.			
							PART/DWG NUMBER:	SHEET SIZE			
							TPS-EESL-10MMS-N-TP-PVPT-F-001	A3			



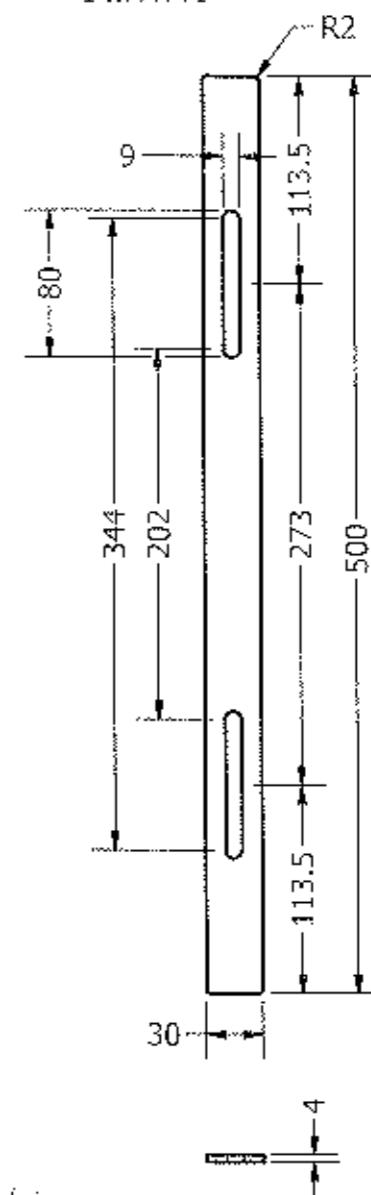


EESL CLAMP

13.C-CLAMP



14.PATTI

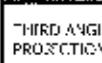


PARTS : IS*

PN#	DESCRIPTION	NAME P. #	FINISH	SIZE	QTY
1	CLAMP	IS 2032:2002 E5.5	HGS-80 M10X100	M10 X 100 A2	2
2	PATTI	IS 2032:2002 E5.5	HGS-80 M10X100	M10 X 100 A2	2
3	BOLT	MS	HGS-80 M10X100	M10 X 100 A2	4
4	NUT	MS	HGS-80 M10X100	M10 X 100 A2	4
5	WASHER	MS	HGS-80 M10X100	M10	2

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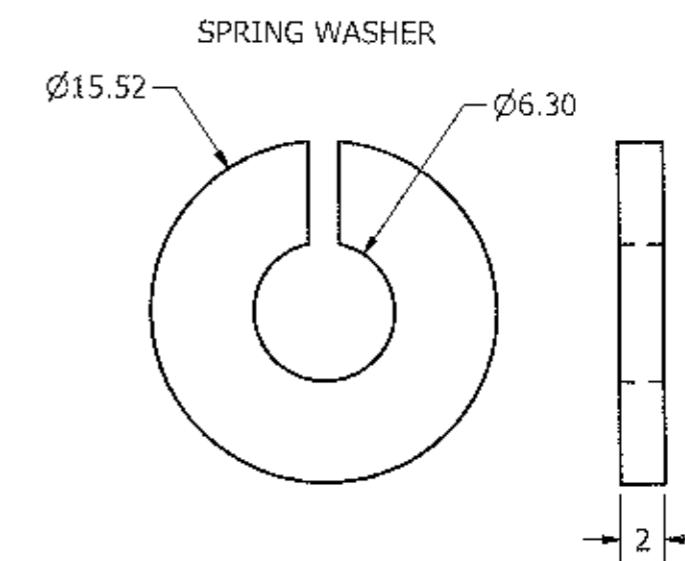
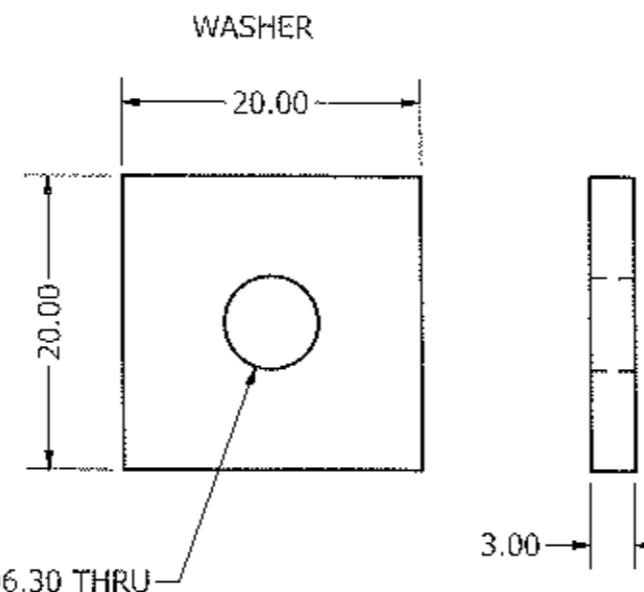
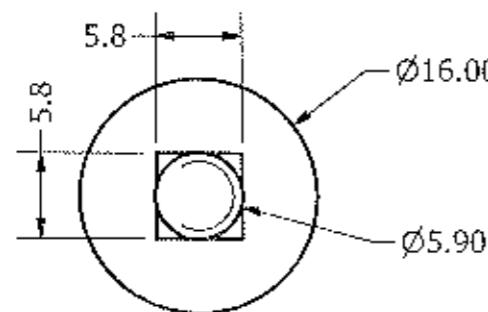
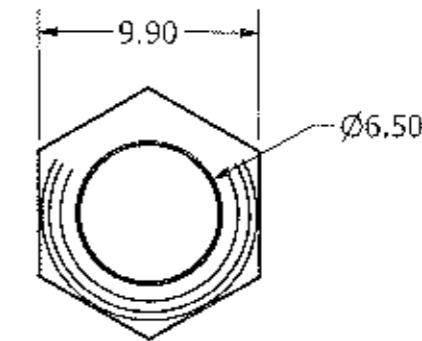
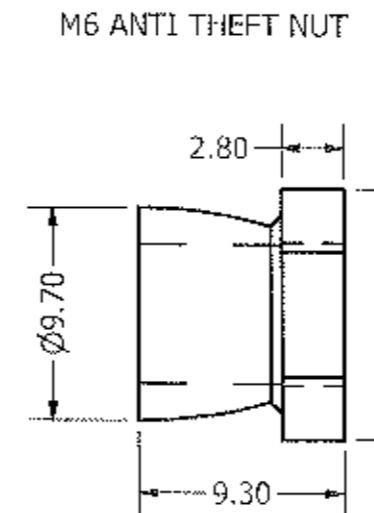
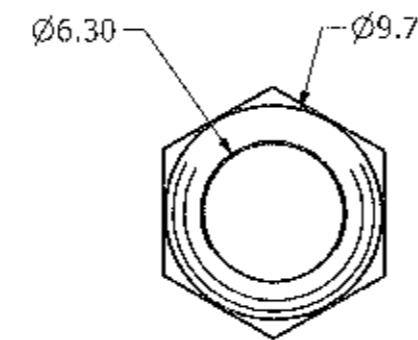
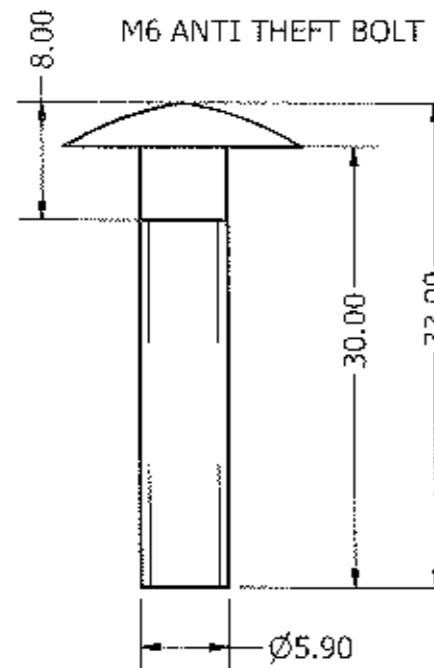
N/A



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Bengaluru - 560 056.

ID#	DATE	DESCRIPTION	DRAWN	C.I.D.	APPR.
PRODUCT TITLE:			DRAWN BY: PRABHAKAR S	CHK'D. SRIK.	APPR. E.N.H.
PUMP CONTROLLER MOUNTING CLAMP EESL	DATE 22-07-2008	DATE 22-07-2008	DATE 22-07-2008	REV. 4	
PART/DWG NUMBER: TPS-EESL-10MMS-N-TP-PVPT-F-001	SHEET SIZE A3				

M6 ANTI THEFT BOLT, NUT AND WASHER MINIMUM DIMENSIONS FOR
9MMS & 10MMS EESL STRUCTURES



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		PRODUCT TITLE:	DRAWN SOLIDWORKS	CHEK. SOL.	APPR. SOL.
		M6 ANTITHEFT BOLT FOR 9MMS & 10MMS EESL PROJECT	DATE 22-07-2014	DATE 22-07-2014	REV. A
		PART/OWG NUMBER: TPS-EESL-10MMS-N-TP-PVPT-F-001	SHEET SIZE A3		

TATA POWER SOLAR SYSTEMS

9 MODULE MOUNTING STRUCTURE (MMS)

Document No.: TPS-EESL-9MMS-N-TP-PVPT-F-001



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INDIA*Received 19/8/2020*Dr. N. Jayaramappa
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REV. NO.	R0								ISSUE
	INITIALS	SIGN	INITIALS	SIGN	INITIALS	SIGN	INITIALS	SIGN	
PPD BY	Harish	
CHD BY	sunil	
APD BY	Nilesh	
DATE	01.08.2020								R0

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9 MMS PUMP STRUCTURE

SHEET 3 of 17

INTRODUCTION

This document covers structural design and analysis of 9 Module Mounting Structure (MMS) for mounting of solar panels of Solar Water Pumping System meant for Agriculture, Drinking Water and other purposes. The analysis has been carried out using STAAD software simulation of the structure. The structure has been designed to withstand a wind velocity of 150kmph.

1 SCOPE

The scope of the report is limited to providing structural design of module mounting structure as described in section 5.1. The solar yield analysis shadow effects, construction procedure are outside the purview of the report.

2 REFERENCE DOC/CODES

: IS 875 : Part -1	Design load for Building and Structures ~ Code of practice for Dead Load
: IS 875 : Part -3	Design load for Building and Structures – code of practice for wind load
: IS 800 : 2007	General Construction In Steel - Code of Practice
: IS 1079-2009	Hot Rolled Carbon Steel Sheet And Strip- Specification
: IS 4759-1996	HDZ- Coating on Structural Steel products
: IS 2062 – 2011	Hot Rolled Medium and High Tensile Structural Steel-Specification
: IS 811 -1987	Specification For Cold Formed Light Gauge Steel Structural Member

3 DESIGN BASIS**BASIC DATA ASSUMED FOR STRUCTURAL DESIGN****A MATERIAL CONSTANTS**

- Characteristic strength of
 1 concrete (for foundation) : 25 N/sq.mm
 2 Unit wt. of concrete : 2400 kg/Cu.m
 3 Unit wt. of steel : 7850 kg/Cu.m
 4 Steel grade : IS 2062 E250A/ E350A / IS 4923 Yst 310 / IS 1161 Yst 310

B DEAD LOADS

- 1 PV module weight : 24 kg per module
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C WIND LOAD

1 Basic Wind Speed	:	42 m/s	IS 875 2015 - Part 3
2 Terrain Category	:	Category 3	IS 875 2015 - Part 3
4 Topography factor	:	1.0	IS 875 2015 - Part 3
5 Importance Factor (k_i)	:	1.0	IS 875 2015 - Part 3

E DESIGN CODES

1 Steel Structure	:	IS 800 :2007/ IS 801 :1975
2 Wind load Calculation	:	IS 875 :2015 Part -3

F SOFTWARE

1 Structural Analysis	:	STAAD Pro
-----------------------	---	-----------

4 INPUT DATA

The input data refer module data sheet and tender document (i.e. Structural configuration, Tilt angle, Members used, Module data, etc.)

4.1 STRUCTURAL DESCRIPTION.

The MMS (Module Mounting Structure) supports 9 modules suitable for TPSSL Modules of dimensions 1.984m x 1.034 m and 1.956m x 0.992m and PV Power Tech Moduie of dimension 1.960 x 0.989m. Modules are arranged in 5+4 portrait arrangement. The angle of inclination for seasonal tilt provided is 15 to 20 degree to the horizontal so that inclination can be adjusted at the specified tilt angle. Manual tracking with 3 times tracking per day has also been provided to maximise the water output and enhance the SPV water pumping systems. The structure has a single leg arrangement. Reactions were obtained from the analysis and are used for the pile foundation design. The members designed by STAAD Software.

5 STRUCTURAL PRE-REQUISITES

The following are the pre-requisites for the module supporting structure to qualify for structure and foundation sufficiency study.

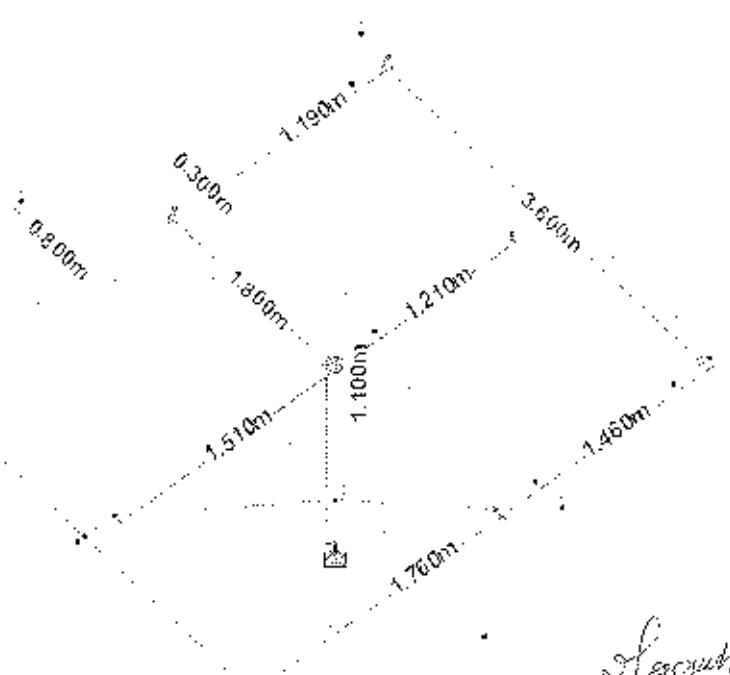
- The module supporting structure is deemed to have been designed using relevant IS codes to satisfy both strength and serviceability criteria.
- Execution quality compliance on material quality, safety in construction and proper construction practices are deemed taken care.



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6 STAAD MODELING

6.1 STAAD MODEL

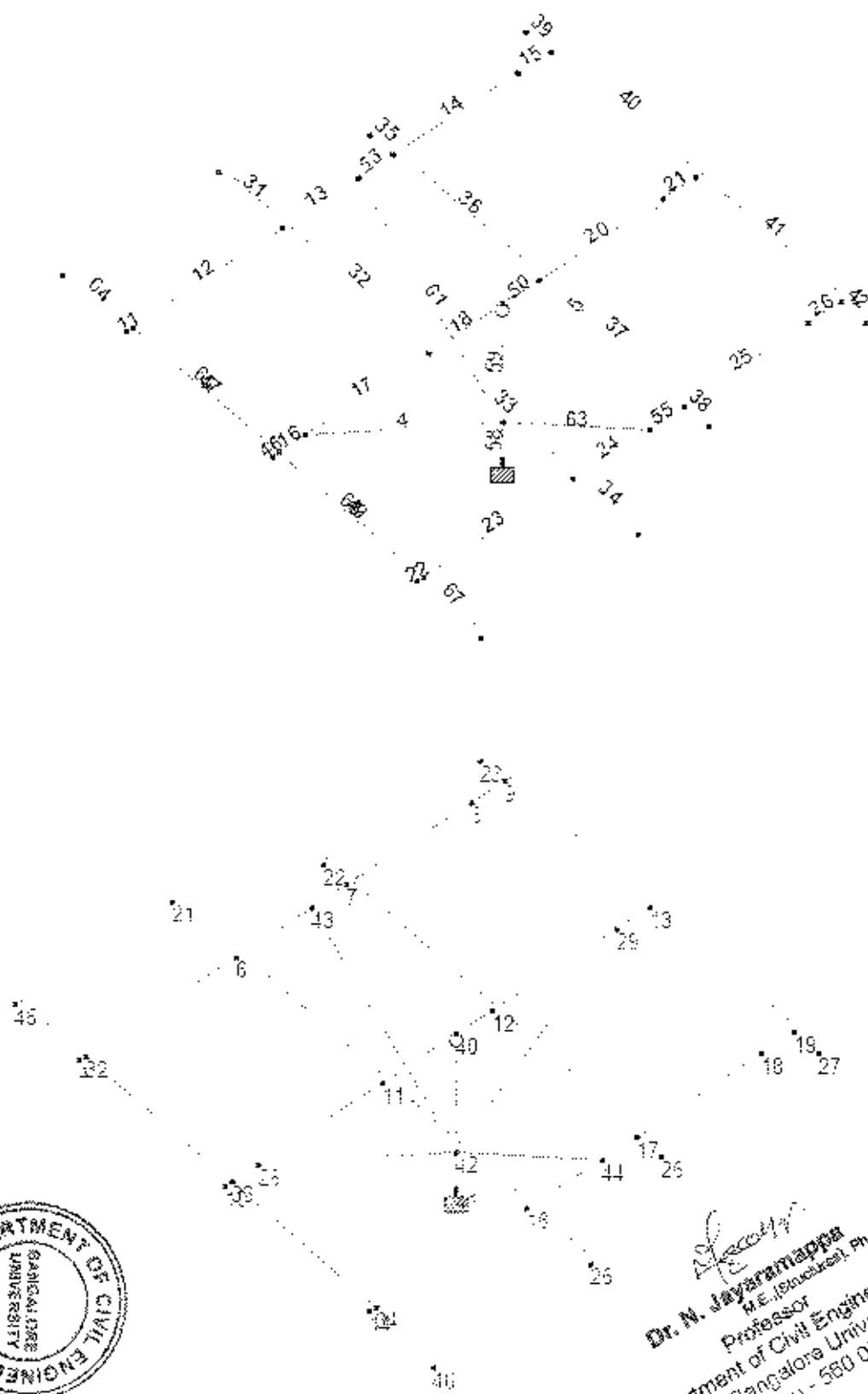


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9 MMS PUMP STRUCTURE

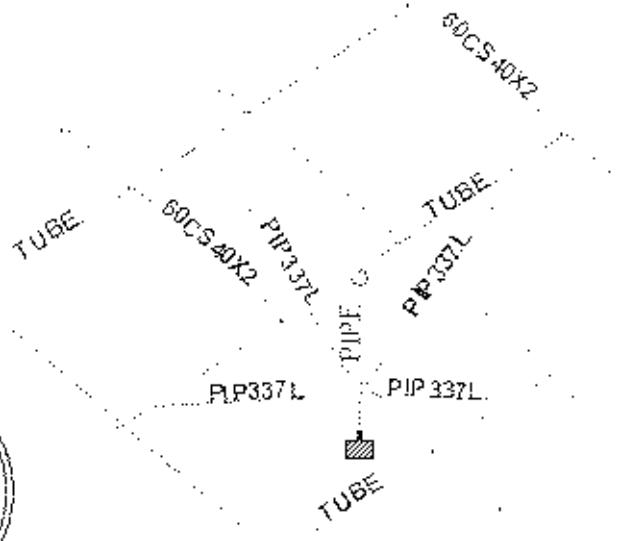
SHEET 6 of 17

6.2 STAAD MEMBER NUMBERS AND NODE NUMBERS



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6.3 STAAD MEMBER PROPERTIES



Prop	Description	Section	Dimensions	Area(cm ²)	Iy(cm ⁴)	Iz(cm ⁴)	J(cm ⁴)	Material
1	cross member	TUE2122.2	32x32x2.6mm I-beam	2.68	4.72	4.12	6.217	STEEL
2	corner	80CS40X2	0.8ip: 60x40x15x2	3.08	11	17.6	-	STEEL
3	columns	PF152	Pipe Ø152x3.6mm	16.734	41	462	824	STEEL
4	side rafter	TUB30262.9	70x23x2.9mm I-beam	5.49	5.634	24.87	15.8	STEEL
5	bracings	PIP337L	Pipe Ø33.7x2.6mm	2.64	3.03	3.09	6.2	STEEL
7	main rafter	US70252.9	70x25x2.9mm I-beam	5.46	5.634	24.87	15.8	STEEL

7 LOAD CALCULATION

The module mounting structure are subjected to following loads

- Module dead load
- Wind Load

7.1 DEAD LOAD

- Weight of Module = 24 kg (from Module Data Sheet)
- Panel Dimensions = 1.984m x 1.004 m and 1.956m x 0.992m (from TPSSL module data sheets) & 1.960 x 0.989m (from PV Power Tech module data sheet)
- Load due to module = $(24 \times 9.81) / (1.984 \times 1000) = 0.12\text{kN/m}$.
- Self-weight of module supporting structure.

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7.2 WIND LOADWIND LOAD CALCULATION (AS PER IS:875 Part-3, 2015)

Basic Wind Speed =	42 m/s	150 kmph	Fig : 1
Design Life N =	25	(for 25 year design life)	
Tilt angle =	20		From GA DWG
Risk Co-efficient, k1=	0.91		Table 1
Terrain =	3		Clause 6.3.2.1
Building height =	10		From GA DWG
Terrain, height and Structure size factor, k2=	0.91		Table 2
Topography Factor, k3=	1	(Upwind Slope = 0)	Clause 6.3.3
Importance Factor, k4=	1		
Design Wind Speed Vd=	34.81 m/s		Clause 6.3 $V_d = \sqrt{1 + 2 \times k_3 \times k_4}$
Wind pressure at height z Pz=	0.656 KN/m ²		Clause 7.2 $P_z = C_p \cdot V_d^2$
Orographic factor Kd=	0.9		Clause 7.2.1
Avg Area of module=	18		From Layout DWG
Area averaging factor Ka=	0.96		Table 4
Combination factor Kc=	1.00		Clause 7.3.3.13
Design Wind Pressure Pg=	0.56 KN/m ²		Clause 7.2 $P_d = K_a \cdot K_c \cdot K_d \cdot P_z$
Considering 20% reduction	0.4	KN/m ²	From GA DWG

Wind load calculation along X direction:

Tilt Angle 20 degrees

Table 3

Condition	C _p	Wind Pressure	Conditonary width	Total Uplift / Downward in kN/m
Spiral	0.89	0.4	0.92	0.36
Ground	0.8	0.4	0.96	0.34

Condition	C _p	Wind Pressure	Conditonary width	Total Uplift / Downward
column	1	0.4	0.95	0.08
rafter	2	0.4	0.98	0.06
bracing	1	0.4	0.93	0.04
ecc roller	2	0.4	0.96	0.08

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7.3 PRIMARY LOADS AND COMBINATION

Primary Load Cases

Number	Name	Type
1	DEAD LOAD	Dead
2	WIND LOAD (X)	Wind
3	WIND LOAD (-X)	Wind
4	WIND LOAD (Z)	Wind
5	WIND LOAD (-Z)	Wind

Combination Load Cases

CCN#	Combination LC Name	Primary	Primary LC Name	Factor
10	D+L+X	1	DEAD LOAD	1.0
		2	WIND LOAD X	1.0
11	D+L+Z	1	DEAD LOAD	1.0
		2	WIND LOAD Z	1.0
12	D+L+(-X)	1	DEAD LOAD	1.0
		2	WIND LOAD -X	1.0
13	D+L+(-Z)	1	DEAD LOAD	1.0
		2	WIND LOAD -Z	1.0
14	D+L+X+Z	1	DEAD LOAD	1.0
		2	WIND LOAD X	1.0
15	D+L+X+(-Z)	1	DEAD LOAD	1.0
		2	WIND LOAD X	1.0
16	D+L+(-X)+Z	1	DEAD LOAD	1.0
		2	WIND LOAD -X	1.0
17	D+L+(-X)+(-Z)	1	DEAD LOAD	1.0
		2	WIND LOAD -X	1.0
18	D+L+X+(-Z)+Z	1	DEAD LOAD	1.0
		2	WIND LOAD X	1.0
19	D+L+X+(-Z)+(-Z)	1	DEAD LOAD	1.0
		2	WIND LOAD -X	1.0
20	D+L+(-X)+Z+Z	1	DEAD LOAD	1.0
		2	WIND LOAD -X	1.0
21	D+L+(-X)+(-Z)+Z	1	DEAD LOAD	1.0
		2	WIND LOAD -X	1.0
22	D+L+(-X)+(-Z)+(-Z)	1	DEAD LOAD	1.0
		2	WIND LOAD -X	1.0



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7.4 STAAD INPUT

STAAD SPACE

START JOB INFORMATION

ENGINEER DATE 25.03.14

END JOB INFORMATION

INPUT WIDTH 79

UNIT MILLIMETER

JOINT COORDINATES

4 -1.47068 0.865401 -1.8; 8 -0.352437 1.2724 -1.8; 7 0.436907 1.55969 -1.8;
 8 1.32027 1.8812 -1.8; 9 1.55515 1.9667 -1.8; 10 -1.47068 0.865401 0;
 11 -0.352437 1.2724 0; 12 0.436907 1.55969 0; 13 1.55515 1.9667 0;
 14 -1.47068 0.865401 1.8; 16 -0.352437 1.2724 1.8; 17 0.436907 1.55969 1.8;
 18 1.32027 1.8812 1.8; 19 1.55515 1.9667 1.8; 21 -0.352437 1.2724 -2.6;
 22 0.436907 1.55969 -2.1; 23 1.55515 1.9667 -2.1; 25 -0.352437 1.2724 2.6;
 26 0.436907 1.55969 2.1; 27 1.55515 1.9667 2.1; 28 -1.23575 0.950902 0;
 29 1.32027 1.8812 0; 32 -1.42369 0.882501 -1.8; 33 -1.42369 0.882501 0;
 34 -1.42369 0.882501 1.8; 40 0.182964 1.46732 0; 41 0.182964 0.367275 0;
 42 0.182964 0.637275 0; 43 0.18319 1.46735 -1.8; 44 0.18319 1.46735 1.8;
 45 -1.47064 0.865401 -2.6; 46 -1.47064 0.865401 2.6;

MEMBER INCIDENCES

4 42 28; 5 42 29; 11 4 32; 12 6 32; 13 6 43; 14 7 8; 15 8 9; 16 28 33;
 17 11 28; 18 1 40; 20 12 29; 21 29 13; 22 14 34; 23 16 34; 24 16 44; 25 17 18;
 26 18 19; 31 21 6; 32 6 11; 33 11 16; 34 16 25; 35 7 22; 36 13 7; 37 17 12;
 38 26 17; 39 23 9; 40 9 13; 41 13 19; 42 19 27; 46 33 10; 47 32 33; 49 33 34;
 50 12 40; 53 7 43; 55 17 44; 58 41 12; 59 42 40; 61 42 43; 63 43 44; 64 45 4;
 65 4 0; 66 19 14; 67 14 46;

DEFINE MATERIAL

J1 PREDEFINER

START LIST TABLE

TABLE 1

UNIT NMS NEWTON

TUNE

T1 DEFSTANIS 1.9

546.36 75 25 2.9 348708 56840 4 156326 435 145

END

UNIT METRIC

MEMBER OFFSET

31 TO 42 64 TO 67 START 0 0.06 0

31 TO 42 64 TO 67 END 0 0.06 0

DEFINE MATERIAL START

ISO TROPIC MATERIAL

E 2.05e-08

POISSON 0.3

DENSITY 76.8195

ALPHA 1.2e-05

DAMP 0.03

TYPE STEEL

SYPNTHSY 253000 11 407800 2Y 1.5 PT 1.2

END DEFINITION MATERIAL



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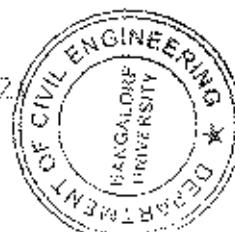
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9 MMS PUMP STRUCTURE

SHEET 11 of 17

MEMBER PROPERTY INDIAN
 47 49 TABLE ST TH 1A2322.0
 UNIT MMS NEWTON
 MEMBER PROPERTY COOPFORMED INDIAN
 31 TO 42 64 TO 67 TABLE ST 69CS40NC
 MEMBER PROPERTY INDIAN
 58 59 TABLE ST PIPE OD 152 ID 144.8
 16 TO 18 20 21 46 50 TABLE ST TUBE TH 2.9 WT 25 ID 75
 11 TO 15 22 TO 26 53 55 TABLE ST TUBE TH 2.9 WT 25 ID 75
 45 61 63 TABLE ST PIPE 107L
 UNIT MEMBER KN
 CONSTANTS
 RLT A 20 MEMBER 31 TO 34 39 TO 42 64 TO 67
 BETA 340 MEMBER 35 TO 38
 MATERIAL STEEL A31
 MEMBER TRUSS
 45 61 63
 SUPPORTS
 41 FIXED
 UNIT MEMBER NEWTON
 MEMBER 214 GANL
 59 END MEMBER
 UNIT MEMBER KN
 LOAD 1 LOADTYPE Dead TYPE DEAD LOAD
 SLEW WEIGHT Y-1 LIST ALL
 MEMBER LOAD
 31 TO 42 64 TO 67 UNI Y -0.12
 LOAD 2 LOADTYPE Wind TYPE WIND LOAD X,
 MEMBER LOAD
 58 59 UNI GZ 0.07
 45 61 63 UNI GZ 0.03
 31 TO 38 64 TO 67 UNI Y -0.35
 UNIT MEMBER NEWTON
 39 TO 42 UNI Y -0.35
 UNIT MEMBER KN
 LOAD 3 LOADTYPE Wind TYPE WIND LOAD (-X),
 MEMBER LOAD
 58 59 UNI GZ -0.07
 45 61 63 UNI GZ -0.03
 31 TO 42 64 TO 67 UNI Y 0.52
 LOAD 4 LOADTYPE Wind TYPE WIND LOAD (-Z),
 MEMBER LOAD
 58 59 UNI GZ 0.07
 45 61 63 UNI GZ 0.03
 11 TO 18 20 TO 26 46 50 53 55 UNI GZ 0.07
 LOAD 5 LOADTYPE Wind TYPE WIND LOAD (-Y),
 MEMBER LOAD
 58 59 UNI GZ -0.07
 45 61 63 UNI GZ -0.03
 11 TO 18 20 TO 26 46 50 53 55 UNI GZ -0.07

Plz check
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9 MMS PUMP STRUCTURE

SHEET 12 of 17

Serviceability Case
 LOAD COMB 100 DL+WL(N)
 1 1.0 2 1.0
 LOAD COMB 101 DL+WL(N)
 1 1.0 3 1.0
 LOAD COMB 102 DL+WL(Z)
 1 1.0 4 1.0
 LOAD COMB 103 DL+WL(Z)
 1 1.0 5 1.0

 LOAD COMB 104 1DL+0.8WL(Z)
 1 1.0 2 0.8
 LOAD COMB 105 DL+0.8WL(N)
 1 1.0 3 0.8
 LOAD COMB 106 DL+0.8WL(Z)
 1 1.0 4 0.8
 LOAD COMB 107 DL+0.8WL(Z)
 1 1.0 5 0.8

 Collapse Case
 LOAD COMB 200 1.5(DL+WL(N))
 1 1.5 2 1.5
 LOAD COMB 201 1.5(DL+WL(N))
 1 1.5 3 1.5
 LOAD COMB 202 1.5(DL+WL(Z))
 1 1.5 4 1.5
 LOAD COMB 203 1.5(DL+WL(Z))
 1 1.5 5 1.5

 LOAD COMB 204 0.9DL+1.5WL(X)
 1 0.9 2 1.5
 LOAD COMB 205 0.9DL+1.5WL(N)
 1 0.9 3 1.5
 LOAD COMB 206 0.9DL+1.5WL(Z)
 1 0.9 4 1.5
 LOAD COMB 207 0.9DL+1.5WL(-Z)
 1 0.9 5 1.5

PERFORM ANALYSIS PRINT ALL

DEFIN. ENVELOPE

100 TO 107 ENVELOPE 1 TYPE SERVICEABILITY

200 TO 207 ENVELOPE 2 TYPE STRENGTH

END DEFIN. ENVELOPE

LOAD LIST 200 TO 207

PARAMETER 1

CODE IS800 LSD

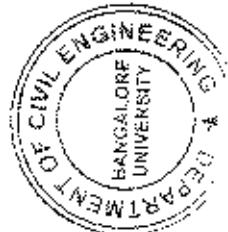
FYLD 310066 MEMB 4 5 11 TO 18 20 20 26 46 50 53 55 58 59 61 63

KX 0.85 XWMB 4 5 61 63

KZ 0.85 XWMB 4 5 61 63

MAIN 200 MEMB 4 5 61 63

CHECK CODE MEMS 4 5 11 TO 18 20 20 26 46 50 53 55 58 59 61 63

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9 MMS PUMP STRUCTURE

SHEET 13 of 17

LOAD LIST 100 TO 107

PARAMETER 2

CODE IS801

FY=1.0 350000 MEMBER 31 TO 42 64 TO 67

LV 0.5 MEMBER 31 TO 42 64 TO 67

TS 0.0 MEMBER 31 TO 42 64 TO 67

CHECK CYCLE MEMBER 31 TO 42 64 TO 67

PRIME MEMBER STRESSES LIST 4 5 11 14 15 17 20 T 22 25 26 31 TO 42 46 58 59 -

61 63 TO 67

FINISH

R.K. Srinivasan

Date : 14/01/2018, Pg No.:

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8 STRUCTURAL DESIGN

8.1 MEMBER DESIGN (STAAD)



Beam	Analysis Property	Design Property	Actual Ratio	Allowable Ratio	Normalized Ratio (Actual/Allow)	Clause	L-C	Ax cm ²
4	PIP337L	PIP337L	0.283	1	0.283	Sec. 7.1.2	200	2.5
5	PIP337L	PIP337L	0.253	1	0.253	Sec. 7.1.2	200	2.5
11	TUBE	TUBE	0.475	1	0.475	Sec. 8.4	200	5.5
12	TUBE	TUBE	0.114	1	0.114	Sec. 8.2.1.2	200	5.5
13	TUBE	TUBE	0.467	1	0.467	Sec. 8.2.1.2	200	5.5
14	TUBE	TUBE	0.289	1	0.289	Sec. 9.3.2.2	200	5.5
15	TUBE	TUBE	0.123	1	0.123	Sec. 8.2.1.2	201	5.5
16	TUBE	TUBE	0.238	1	0.238	Sec. 8.2.1.2	200	5.5
17	TUBE	TUBE	0.238	1	0.238	Sec. 8.2.1.2	200	5.5
18	TUBE	TUBE	0.142	1	0.142	Sec. 8.2.1.2	202	5.5
20	TUBE	TUBE	0.173	1	0.173	Sec. 9.3.2.2	205	5.5
21	TUBE	TUBE	0.155	1	0.155	Sec. 8.2.1.2	200	5.5
22	TUBE	TUBE	0.475	1	0.475	Sec. 8.4	200	5.5
23	TUBE	TUBE	0.114	1	0.114	Sec. 8.2.1.2	200	5.5
24	TUBE	TUBE	0.467	1	0.467	Sec. 8.2.1.2	200	5.5
25	TUBE	TUBE	0.289	1	0.289	Sec. 9.3.2.2	200	5.5
26	TUBE	TUBE	0.123	1	0.123	Sec. 8.2.1.2	201	5.5
31	60CS40X2	60CS40X2	0.147	1	0.147	6.7.1(T)	100	3.1
32	60CS40X2	60CS40X2	0.628	1	0.628	6.7.2(a)2	101	3.1
33	60CS40X2	60CS40X2	0.628	1	0.628	6.7.2(a)2	101	3.1
34	60CS40X2	60CS40X2	0.147	1	0.147	6.7.1(I)	100	3.1
35	60CS40X2	60CS40X2	0.023	1	0.022	6.7.1(T)	100	3.1
36	60CS40X2	60CS40X2	0.452	1	0.452	6.7.2(a)2	101	3.1
37	60CS40X2	60CS40X2	0.452	1	0.452	6.7.2(a)2	101	3.1
38	60CS40X2	60CS40X2	0.022	1	0.022	6.7.1(T)	100	3.1
39	60CS40X2	60CS40X2	0.021	1	0.021	6.7.1(T)	100	3.1
40	60CS40X2	60CS40X2	0.483	1	0.483	6.7.1(T)	101	3.1
41	60CS40X2	60CS40X2	0.483	1	0.483	6.7.1(T)	101	3.1
42	60CS40X2	60CS40X2	0.021	1	0.021	6.7.1(T)	100	3.1
46	TUBE	TUBE	0.045	1	0.045	Sec. 8.4	200	5.5

9 MMS PUMP STRUCTURE

SHEET 14 of 17

47	TUB32322.6	TUB32322.	0.929	1	0.929	Sec. 9.3.2.2	200	2.9
49	TUB32322.6	TUB32322.	0.929	1	0.929	Sec. 9.3.2.2	200	2.9
50	TUBE	TUBE	0.084	1	0.084	Sec. 9.3.2.2	205	5.5
53	TUBE	TUBE	0.528	1	0.528	Sec. 9.3.2.2	200	5.5
55	TUBE	TUBE	0.528	1	0.528	Sec. 9.3.2.2	200	5.5
58	PIPE	PIPE	0.23	1	0.23	Sec. 9.3.1.3	201	16.8
59	PIPE	PIPE	0.136	1	0.136	Sec. 9.3.1.3	202	16.8
61	PIP337L	PIP337L	0.361	1	0.361	Sec. 7.1.2	200	2.5
63	PIP337L	PIP337L	0.361	1	0.361	Sec. 7.1.2	206	2.5
64	60CS40X2	60CS40X2	0.147	1	0.147	6.7.1(T)	100	3.1
65	60CS40X2	60CS40X2	0.995	1	0.995	6.7.2(a)I	101	3.1
66	60CS40X2	60CS40X2	0.995	1	0.995	6.7.2(a)I	101	3.1
67	60CS40X2	60CS40X2	0.147	1	0.147	6.7.1(T)	100	3.1

8.2 DEFLECTION CHECK

Node	Loc	Horizontal	Vertical		Horizontal Resultant		Rotational		
			X mm	Z mm	X mm	Z mm	rX rad	rY rad	rZ rad
M-1-X	40	100 DL+AL	-0.126	-0.912	0.916	0.926	0.000	0.000	0.000
M-3-X	40	101 DL+AL	-0.323	0.908	-0.639	0.621	-0.000	-0.000	0.000
M-3-Y	40	101 DL+AL	-0.323	0.908	-0.639	0.623	-0.000	-0.000	0.001
M-7-Y	40	100 DL+AL	-0.126	-0.912	0.900	0.926	0.000	0.000	0.000
M-9-Z	25	102 DL+AL	-0.460	-0.395	0.379	0.596	0.001	0.000	0.000
M-2-Z	40	100 DL+AL	-0.460	-0.395	0.378	0.595	0.001	-0.000	0.000
M-9-Z	25	102 DL+AL	-0.460	-0.395	0.379	0.596	0.001	0.000	0.000
Driv-Y	25	101 DL+AL	-0.460	-0.395	0.379	0.596	-0.001	-0.000	0.000
Drv-0	25	102 DL+AL	-0.460	-0.395	0.376	0.596	0.000	0.000	0.000
M-1-Z	40	103 DL+AL	-0.265	-0.905	0.870	0.939	-0.000	-0.000	0.000
M-7-Z	40	101 DL+AL	-0.418	0.905	-0.600	0.724	-0.000	-0.000	0.001
M-1-Z	40	103 DL+AL	-0.265	-0.905	0.892	0.928	0.000	0.000	0.000
Max Rg	40	101 DL+AL	-0.923	0.905	0.000	0.923	-0.000	-0.000	0.001

Maximum deflection for columns = 0.93mm (Node-40, LC-101)

Allowable deflection is span/180=1300/180=7.22 mm

*✓
18/03/2018*

Dr. N. Jayaramappa

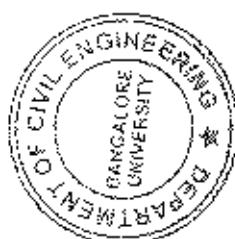
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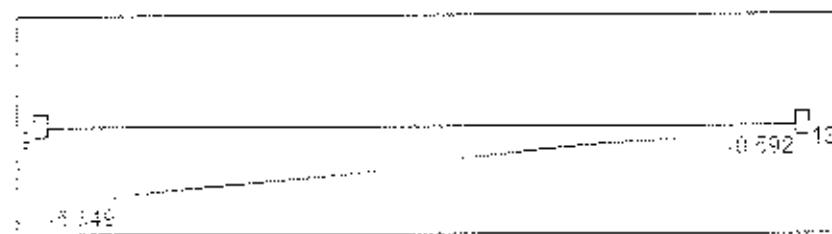


9 MMS PUMP STRUCTURE

SHEET 15 of 17

Geometry | Property | Loading | Shear Bending | Deflection | Design | Property | Steel Design

Beam No = 40



Order No.	Def.		Disp. mm
	Def.	Def.	
1	0.000	0.000	-5.349
2	0.000	0.000	-5.349
3	0.000	0.000	-5.349
4	0.000	0.000	-5.349
5	0.000	0.000	-5.349
6	0.000	0.000	-5.349
7	0.000	0.000	-5.349
8	0.000	0.000	-5.349
9	0.000	0.000	-5.349
10	0.000	0.000	-5.349
11	0.000	0.000	-5.349
12	0.000	0.000	-5.349
13	0.000	0.000	-5.349
14	0.000	0.000	-5.349
15	0.000	0.000	-5.349
16	0.000	0.000	-5.349
17	0.000	0.000	-5.349
18	0.000	0.000	-5.349
19	0.000	0.000	-5.349
20	0.000	0.000	-5.349
21	0.000	0.000	-5.349
22	0.000	0.000	-5.349
23	0.000	0.000	-5.349
24	0.000	0.000	-5.349
25	0.000	0.000	-5.349
26	0.000	0.000	-5.349
27	0.000	0.000	-5.349
28	0.000	0.000	-5.349
29	0.000	0.000	-5.349
30	0.000	0.000	-5.349
31	0.000	0.000	-5.349
32	0.000	0.000	-5.349
33	0.000	0.000	-5.349
34	0.000	0.000	-5.349
35	0.000	0.000	-5.349
36	0.000	0.000	-5.349
37	0.000	0.000	-5.349
38	0.000	0.000	-5.349
39	0.000	0.000	-5.349
40	0.000	0.000	-5.349
41	0.000	0.000	-5.349
42	0.000	0.000	-5.349
43	0.000	0.000	-5.349
44	0.000	0.000	-5.349
45	0.000	0.000	-5.349
46	0.000	0.000	-5.349
47	0.000	0.000	-5.349
48	0.000	0.000	-5.349
49	0.000	0.000	-5.349
50	0.000	0.000	-5.349
51	0.000	0.000	-5.349
52	0.000	0.000	-5.349
53	0.000	0.000	-5.349
54	0.000	0.000	-5.349
55	0.000	0.000	-5.349
56	0.000	0.000	-5.349
57	0.000	0.000	-5.349
58	0.000	0.000	-5.349
59	0.000	0.000	-5.349
60	0.000	0.000	-5.349
61	0.000	0.000	-5.349
62	0.000	0.000	-5.349
63	0.000	0.000	-5.349
64	0.000	0.000	-5.349
65	0.000	0.000	-5.349
66	0.000	0.000	-5.349
67	0.000	0.000	-5.349
68	0.000	0.000	-5.349
69	0.000	0.000	-5.349
70	0.000	0.000	-5.349
71	0.000	0.000	-5.349
72	0.000	0.000	-5.349
73	0.000	0.000	-5.349
74	0.000	0.000	-5.349
75	0.000	0.000	-5.349
76	0.000	0.000	-5.349
77	0.000	0.000	-5.349
78	0.000	0.000	-5.349
79	0.000	0.000	-5.349
80	0.000	0.000	-5.349
81	0.000	0.000	-5.349
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83	0.000	0.000	-5.349
84	0.000	0.000	-5.349
85	0.000	0.000	-5.349
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99	0.000	0.000	-5.349
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101	0.000	0.000	-5.349
102	0.000	0.000	-5.349
103	0.000	0.000	-5.349
104	0.000	0.000	-5.349
105	0.000	0.000	-5.349
106	0.000	0.000	-5.349
107	0.000	0.000	-5.349
108	0.000	0.000	-5.349
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111	0.000	0.000	-5.349
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120	0.000	0.000	-5.349
121	0.000	0.000	-5.349
122	0.000	0.000	-5.349
123	0.000	0.000	-5.349
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125	0.000	0.000	-5.349
126	0.000	0.000	-5.349
127	0.000	0.000	-5.349
128	0.000	0.000	-5.349
129	0.000	0.000	-5.349
130	0.000	0.000	-5.349
131	0.000	0.000	-5.349
132	0.000	0.000	-5.349
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137	0.000	0.000	-5.349
138	0.000	0.000	-5.349
139	0.000	0.000	-5.349
140	0.000	0.000	-5.349
141	0.000	0.000	-5.349
142	0.000	0.000	-5.349
143	0.000	0.000	-5.349
144	0.000	0.000	-5.349
145	0.000	0.000	-5.349
146	0.000	0.000	-5.349
147	0.000	0.000	-5.349
148	0.000	0.000	-5.349
149	0.000	0.000	-5.349
150	0.000	0.000	-5.349
151	0.000	0.000	-5.349
152	0.000	0.000	-5.349
153	0.000	0.000	-5.349
154	0.000	0.000	-5.349
155	0.000	0.000	-5.349
156	0.000	0.000	-5.349
157	0.000	0.000	-5.349
158	0.000	0.000	-5.349
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160	0.000	0.000	-5.349
161	0.000	0.000	-5.349
162	0.000	0.000	-5.349
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165	0.000	0.000	-5.349
166	0.000	0.000	-5.349
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169	0.000	0.000	-5.349
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171	0.000	0.000	-5.349
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174	0.000	0.000	-5.349
175	0.000	0.000	-5.349
176	0.000	0.000	-5.349
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178	0.000	0.000	-5.349
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202	0.000	0.000	-5.349
203	0.000	0.000	-5.349
204	0.000	0.000	-5.349
205	0.000	0.000	-5.349
206	0.000	0.000	-5.349
207	0.000	0.000	-5.349
208	0.000	0.000	-5.349
209	0.000	0.000	-5.349
210	0.000	0.000	-5.349
211	0.000	0.000	-5.349
212	0.000	0.000	-5.349
213	0.000	0.000	-5.349
214	0.000	0.000	-5.349
215	0.000	0.000	-5.349
216	0.000	0.000	-5.349
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218	0.000	0.000	-5.349
219	0.000	0.000	-5.349
220	0.000	0.000	-5.349
221	0.000	0.000	-5.349
222	0.000	0.000	-5.349
223	0.000	0.000	-5.349
224	0.000	0.000	-5.349
225	0.000	0.000	-5.349
226	0.000	0.000	-5.349
227	0.000	0.000	-5.349
228	0.000	0.000	-5.349
229	0.000	0.000	-5.349
230	0.000	0.000	-5.349
231	0.000	0.000	-5.349
232	0.000	0.000	-5.349
233	0.000	0.000	-5.349
234	0.000	0.000	-5.349
235	0.000	0.000	-5.349
236	0.000	0.000	-5.349
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238	0.000	0.000	-5.349
239	0.000	0.000	-5.349
240	0.000	0.000	-5.349
241	0.000	0.000	-5.349
242	0.000	0.000	-5.349
243	0.000	0.000	-5.349
244	0.000	0.000	-5.349
245	0.000	0.000	-5.349
246	0.000	0.000	-5.349
247	0.000	0.000	-5.349
248	0.000	0.000	-5.349
249	0.000	0.000	-5.349
250	0.000	0.000	-5.349
251	0.000	0.000	-5.349
252	0.000	0.000	-5.349
253	0.000	0.000	-5.349
254	0.000	0.000	-5.349
255	0.000	0.000	-5.349
256	0.000	0.000	-5.349
257	0.000</		

9 MMS PUMP STRUCTURE

SHEET 16 of 17

ANNEXURE I : FOUNDATION DESIGN**FOUNDATION DESIGN FOR 9 MMS STRUCTURE**

Parameter	Value	Minimum value	Notes
Angle of Inclination, degrees	20.00	20.00	ASSUMED
Density (kN/m ³)	16.00	16.00	ASSUMED
SPT N values	SPT N values along the foundation line are assumed as 10 for geotechnical investigation report. SPT N value for design average value of 10 is considered for safety factor of 1.0. Safe SWL SWL is assumed as 10000.		

AXIAL AND UPLIFT CAPACITY BY STATIC FORMULA OF IS-2011, Part I Sec-2, Annex B**OUTER STRUCTURE**

Pile length below G.L	4	1.00	m
Pile diameter	4	0.35	m
Pile Cross sectional area	$A_p = \pi D^2/4$	0.0442	m ²
Pile shaft resistance	$A_s = \pi D L$	2.128	m ²
Soil density		15.00	kNm ²
Angle at soil pile contact, α		10.00	degrees
Press at GCL		1.00	kNm ²
Shear stress at no SWL	$F_{s0} = C$	54.73	kNm ²
Effective vertical stress (average)	L1	17.00	kNm ²
Coefficient K	As per code	1.00	1.00 to 1.50
Unconfined shear strength	$c = 100 \text{ kN/m}^2$	8.00	kN/m ²
Unit Weight, γ	10.00	10.00	kN
End bearing factor, K_e	Figure 1 Annex B	10.00	Littered soil is very loose
End bearing, C_e	$A_p F_e \gamma$	30.44	kN
Safe axial load, $C_a = C_e K_e L$	$F_{s0} \times L$	15.91	kN
Self weight of pile, G	$\gamma A_p L$	4.81	kN/m = 100 kN/m^2
SAFE UPLIFT LOAD reducing SWL	0.1	6.40	kN
SAFE UPLIFT LOAD reducing SWL	$C_a - G$	10.39	

Note:

Pile capacities shall be confirmed by load tests.

SWL is governing the length.

Safe load computed is no less of self weight of pile.

The core advance is not included.

Proper preparation necessary, use of bentonite is not permitted.

Design requirement (kN)			
Parameter	Axial	Uplift	Lateral
Required	15.00	5.70	3.80
Geotechnical Capacity (kN)			
Computed	15.91	10.39	7.57
Design summary			
Surcharge	0.00	0.00	0.00



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(M.E., Structures), Ph.D.

Professor

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UVCE, Bangalore University,
6e

6e

9 MMS PUMP STRUCTURE

SHEET 17 OF 17

See Brooks (1994) for references.

Definition	Value	Description
alt	0.0000	Altitude judgement reference.
BrownCoatID	1.0000	Character
l	1.0000	
Redirection	0.0000	
YellowStar	1.00	

Load tests are performed in line to one & definition and layout of design and load test values to be taken during the project. At the completion, the temporary works load of permanent structures

Table 3. Mechanics of Side-grab Reaction for Granular Substrate in XYT

358

Capítulo 10: APOYO A DIFERENTES GRUPOS

10-2011-Prod 1 Gas-Block capacity and is based on defector criteria which is shown gives out shear force when
For 3000 N/m² calculated theoretically & verified by tests on 10

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M.A., M.Sc., Ph.D.

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UVM, State Farm University,
Syracuse, NY 13244



SL NO	PART NUMBER	DESCRIPTION	SPEC IN mm	MATERIAL GRADE & STD	DIMENSION STANDARD		FINISH	WEIGHT per m ² kg/m	QTY	TOTAL WEIGHT in kg
					BASE PIPE ASSY					
1	B1.1	BASE PIPE	Ø172x3000Hx5.67	ASTM-A-316L	IS 1161	IS 1161	H0G-80 Mtr/m	13.17	1	39.5
	B1.2	FLANGE PLATE	Ø172x5.1K	GT-F250A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	4.22	1	4.2
	B1.3	FLANGE,SKID WORL	Ø172x10x10 THK	GT-E250A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	0.21	4	0.9
	B1.4	TOP PLATE GUSSET	Ø172x46 THK	GT-E250A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	0.61	8	0.3
	B1.5	JOINTS	Ø172x5.1K	GT-E250A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	0.61	24	1.2
2	C1.1	CIRCULAR BRACKET ASSY	GT-E250A IS:2062	GT-E250A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	0.53	2	1.26
	C1.2	FLANGE VOUNTING PLATE	GT-F250A IS:2062	GT-F250A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	0.13	8	1.0
3		REAR SUPPORTING	GT-E250A IS:2062	GT-E250A IS:2062	IS 1161	IS 1161	H0G-80 Mtr/m	2.55	2.30	1
4		FRONT SUPPORTING	GT-E250A IS:2062	GT-E250A IS:2062	IS 1161	IS 1161	H0G-80 Mtr/m	2.55	2.74	1
5		LH & RH SUPPORTING	GT-E250A IS:2062	GT-E250A IS:2062	IS 1161	IS 1161	H0G-80 Mtr/m	1.99	3.98	1
6		JOINING NEAR	GT-E250A IS:2062	GT-E250A IS:2062	IS 1161	IS 1161	H0G-80 Mtr/m	1.99	1.14	1
7		JOINING FRONT	GT-E250A IS:2062	GT-E250A IS:2062	IS 1161	IS 1161	H0G-80 Mtr/m	1.99	1.43	1
8	T1.1	TOP PLATE	GT-E250A IS:2062	GT-E250A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	4.13	1	3.7
	T1.2	VAD PLATE	GT-F250A IS:2062	GT-F250A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	1.13	2	2.3
	T1.3	BOTTOM PLATE	GT-E250A IS:2062	GT-E250A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	0.47	1	0.5
9	M1.1	MAIN RAFTER	GT-E250A IS:2062	GT-E250A IS:2062	IS 1161	IS 1161	H0G-80 Mtr/m	4.19	13.51	1
	M1.2	ANGLE PLATE	GT-E250A IS:2062	GT-E250A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	2.55	2	2.4
	M1.3	MAIN-BRACKET	GT-E250A IS:2062	GT-E250A IS:2062	IS 80K	IS 80K	H0G-80 Mtr/m	3.70	3.3	4
	M1.4	SEAFER CONNECTION PLATE	GT-E250A IS:2062	GT-E250A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	0.98	4	0.3
	M1.5	SUPPORTING S.S.RK	GT-E250A IS:2062	GT-E250A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	0.31	2	0.63
	M1.6	H-CLIP	GT-E250A IS:2062	GT-E250A IS:2062	IS 80K	IS 80K	H0G-80 Mtr/m	0.15	2	0.3
10	M1.7	SECONDARY RAFTER	GT-E250A IS:2062	GT-E250A IS:2062	IS 1161	IS 1161	H0G-80 Mtr/m	6.12	13.51	2
	M1.8	MM4-L-BRACKETS	GT-F250A IS:2062	GT-F250A IS:2062	IS 80K	IS 80K	H0G-80 Mtr/m	3.70	0.15	8
	M1.9	RAFTER CONNECTION PLATE	GT-E250A IS:2062	GT-E250A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	0.08	4	0.3
	M1.10	SUPPORTING L-BRKT	GT-E250A IS:2062	GT-E250A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	0.35	2	0.63
11		CROSS MEMBER	GT-F250A IS:2062	GT-F250A IS:2062	IS 4873	IS 4873	H0G-80 Mtr/m	2.26	2.87	2
	12.1	MODULE MOUNTING PURIN LH	GT-S006436.1582.0785300	GT-S006436.1582.0785300	IS 811	IS 811	H0G-80 Mtr/m	2.49	12.24	1
12.2		MODULE MOUNTING PURIN RH	GT-S006436.1582.0785300	GT-S006436.1582.0785300	IS 811	IS 811	H0G-80 Mtr/m	2.49	12.24	1
12.3		MODULE MOUNTING PURIN LH-MINOR	GT-S006436.1582.0785300	GT-S006436.1582.0785300	IS 811	IS 811	H0G-80 Mtr/m	2.49	9.74	1
12.4		MODULE MOUNTING PURIN RH-MINOR	GT-S006436.1582.0785300	GT-S006436.1582.0785300	IS 811	IS 811	H0G-80 Mtr/m	2.49	9.74	1
13		L-CLAMP	GT-7750A IS:2062	GT-7750A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	0.73	1	0.7
14		L-CLAMP	GT-7750A IS:2062	GT-7750A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	0.074	2	0.09
15		Lightning arrester	GT-7750A IS:2062	GT-7750A IS:2062	IS 2062	IS 2062	H0G-80 Mtr/m	0.033	1	0.03

GRAND TOTAL FOR EACH STRUCTURE



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 CVCE, Bangalore University,
 Bengaluru - 560 056.



Sri Chaitanya
Dr. M. Jayaramappa
M.E., M.Sc., Ph.D.
Professor
Department of Civil Engineering
U.T.C.E., Bangalore University
Bengaluru - 560 056.

ASSEMBLY VIEW

The diagram illustrates a bridge structure with various dimensions labeled in millimeters:

- Total height from the base to the top of the pylon: 2190.59
- Width of the pylon: 2000
- Width of the central support structure: 92
- Width of the bridge deck at the supports: 100
- Width of the bridge deck at the center: 533.18
- Vertical distance from the base to the top of the pylon: 878
- Width of the bridge deck at the top: 50
- Length of the bridge deck segments: 1960 and 1150

The label "FGL" is located in the bottom right corner.

NOTE:
• REMOVE KIRK & DENT
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A circular symbol containing a circle with a diagonal line through it, indicating Third Angle Projection.

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第 1 页

Page 10 of 10

DRILL AS 43-11-FR9980-5-39

HOME DNE D3

Page 5

FINISH
RETER BOM

—

FRONT DIMENSIONS ARE IN MM

REFERENCES

± 0.25 11

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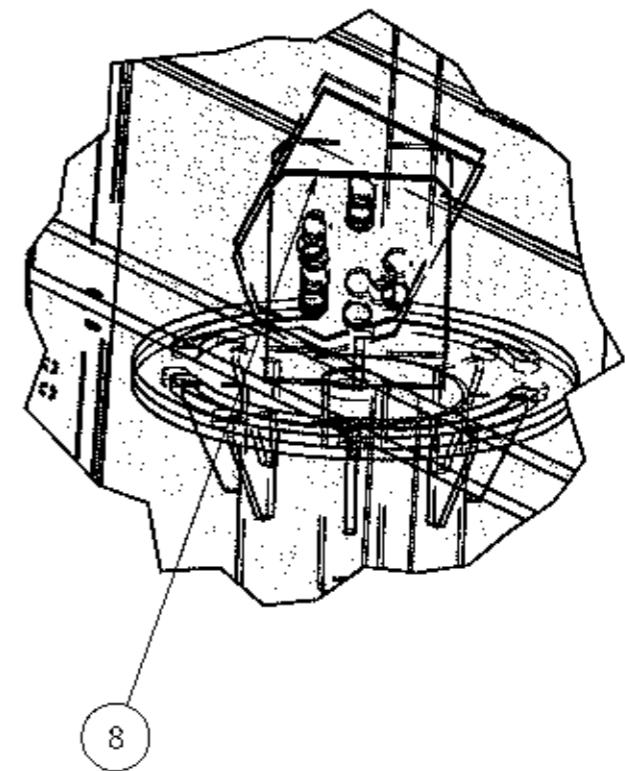
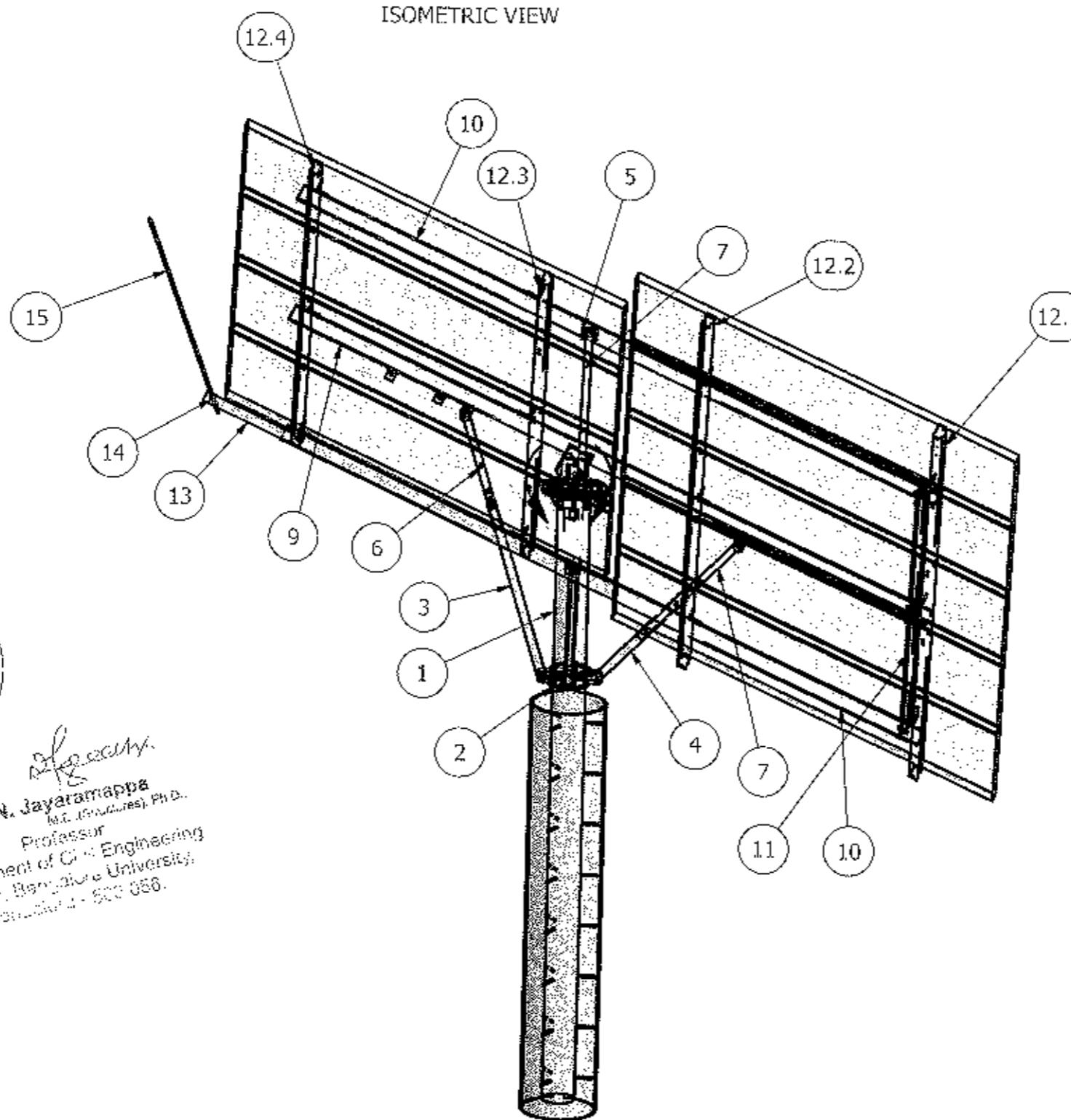
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2	13-05-2020	PORT-TO-DRILL PLATE ADDED
		PRODUCT TITLE:
		9MMS SOLAR WATER PUMP STRUCTURE

	PART/DWG NUMBER: TPS-BESI-9MMS-N-TP-PVPT-F-001	SHEET SIZE A3
	DATE 22-07-2020	DATE 22-07-2020
	DRAWN R.DAWAN RECHD/REVIEWED R.DAWAN	CHECKED APPR R.DAWAN
	DESIGNER R.DAWAN	APPROVED R.DAWAN

Page 18 of 36

Item No.: 9MMS ASSEMBLY DRAWINGS
 Material Grade: Befal 304
 Finish: Bright
 1 : 1 angle 6x6x0.25 degrees
 L.S. of number 9

ISOMETRIC VIEW



DETAIL F
 SCALE 0.2



R. Jayaramappa
Dr. N. Jayaramappa
 M.Tech, M.Phil, Ph.D.
 Professor
 Department of C.E. Engineering
 UVCE, Bangalore University,
 Bangalore - 560 066.

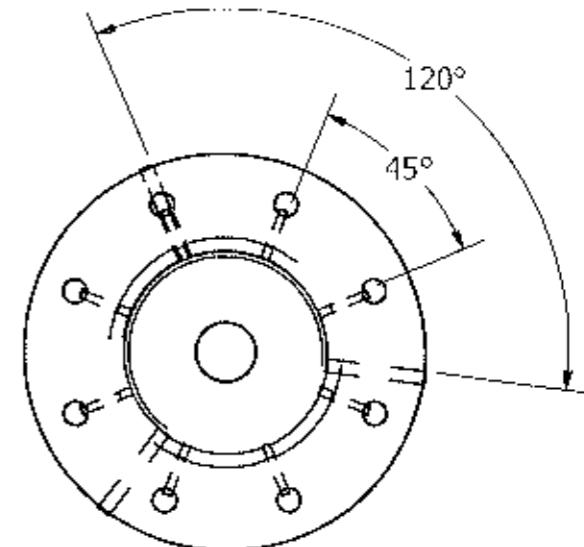
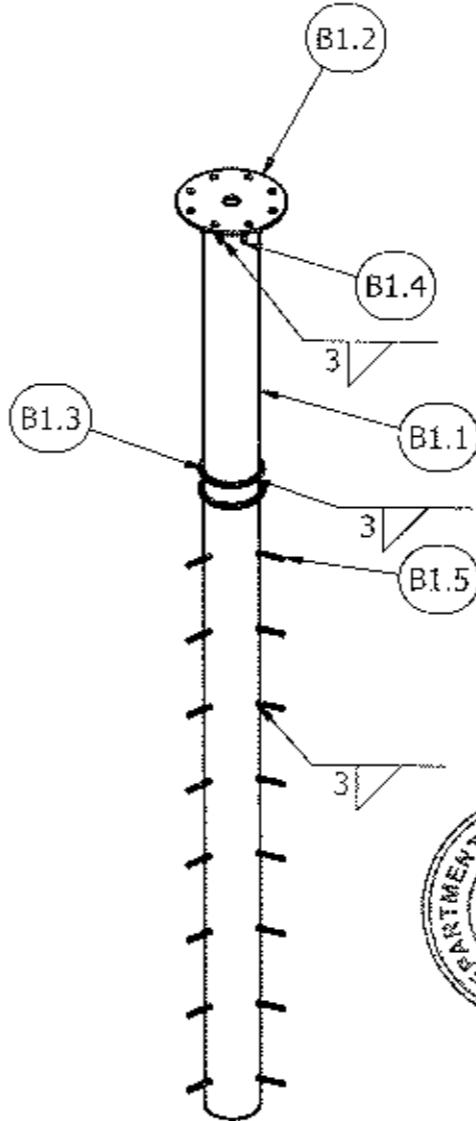
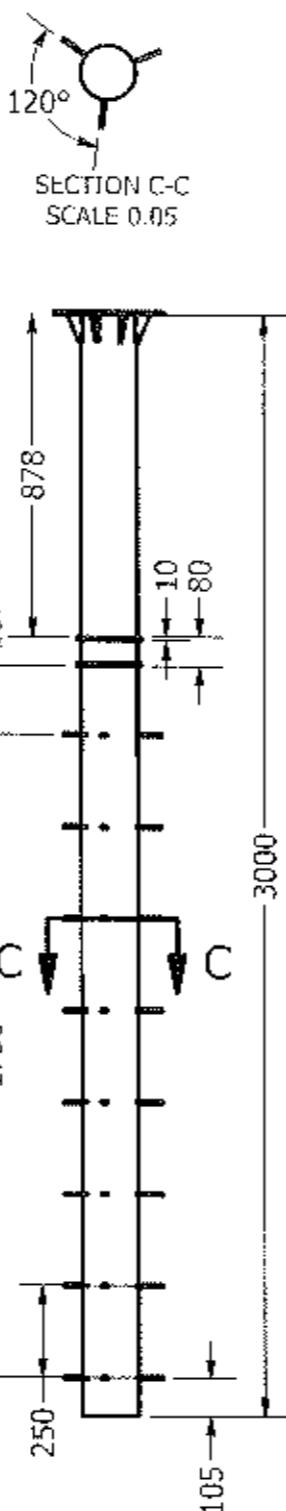
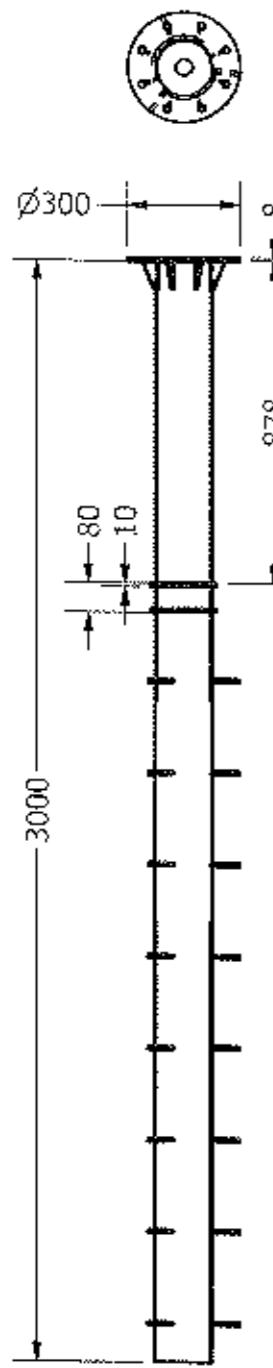
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NOTES:		UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MM.		TOLERANCES											
NO.D.P.	CNC D.P.	TWO D.P.	ANGLES		MATERIAL										
± 1	± 0.5	= 0.25	± 10		REF ID: N										
					REF ID: N										

1.BASE PIPE ASSEMBLY

Item Name: 9MMS ASSEMBLY DRAWING
Material Grade: S45C
Finish: Surface
Tilt angle: 0° to 30° degrees
No. of pages: 8



Plz accept
Dr. N. Jayaramappa
M.Tech., M.Phil., Ph.D.
Professor
Department of Civil Engineering
UVCE, Bangalore - 560 051
Bengaluru - 560 051

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MATERIAL
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FINISH
REFER 30M

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SCALE

TOLERANCES
NO.D.P. ONE D.P. TWO D.P. ANGLES
± 1 ± 0.5 ± 0.25 ± 3°

N.C.S.

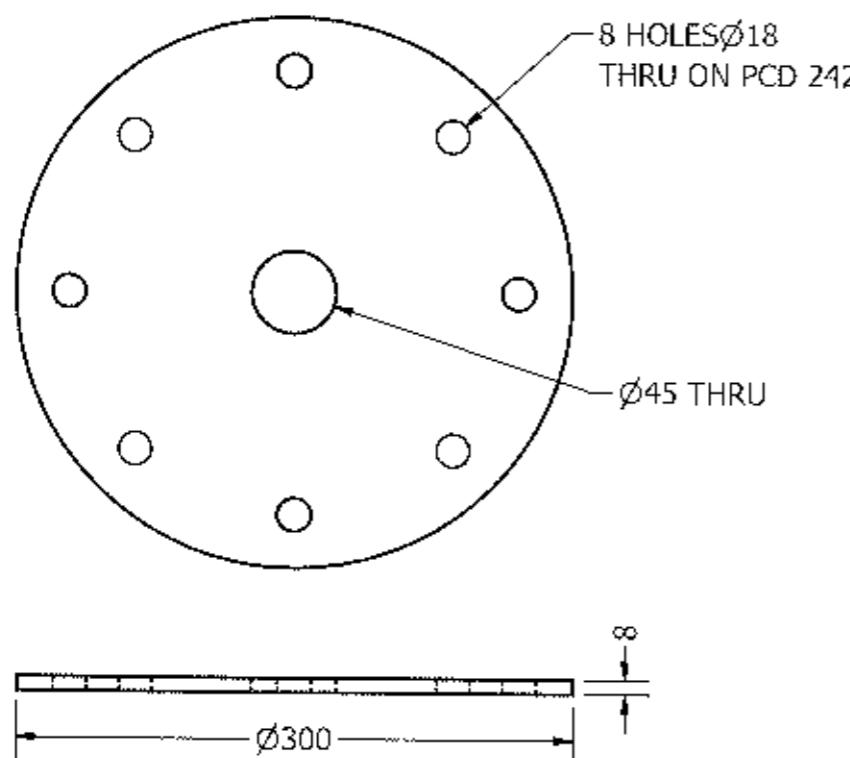
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		PRODUCT TITLE:	DRAWN SACHINRAO	CH-CD. HAKKI-A	APPR. SHIVIL
		9MMS SOLAR WATER PUMP STRUCTURE	DATE 24/7/2014	DATE 24/7/2014	REV. 4
		PART/DWG NUMBER: TPS-EESL-9MMS-N-IP-PVPT-F-001	SHEET SIZE A3		

B1.1. BASE PIPE



Item Name: 9MMS ASSEMBLY DRAWINGS
Material Grade: S45C Steel
Finish: Matte Gun
Date: 04-07-2025
Rev. of drawing: 5

B1.2. FLANGE PLATE



NOTE:
1. REMOVE BURRS & DENT
2. REMOVE SHARP CORNER & MAKE CHAMFER 10MM (UNLESS SPECIFIED)

THIRD ANGLE PROJECTION
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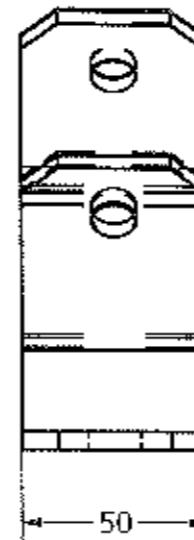
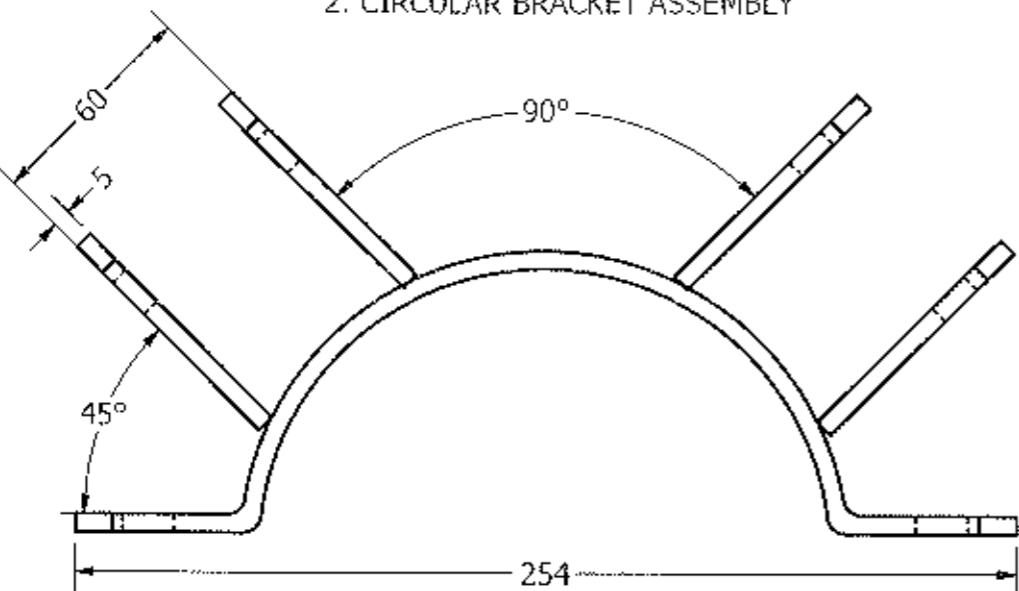
FINISH
REFER BOM

SCALE
TO FRANCES

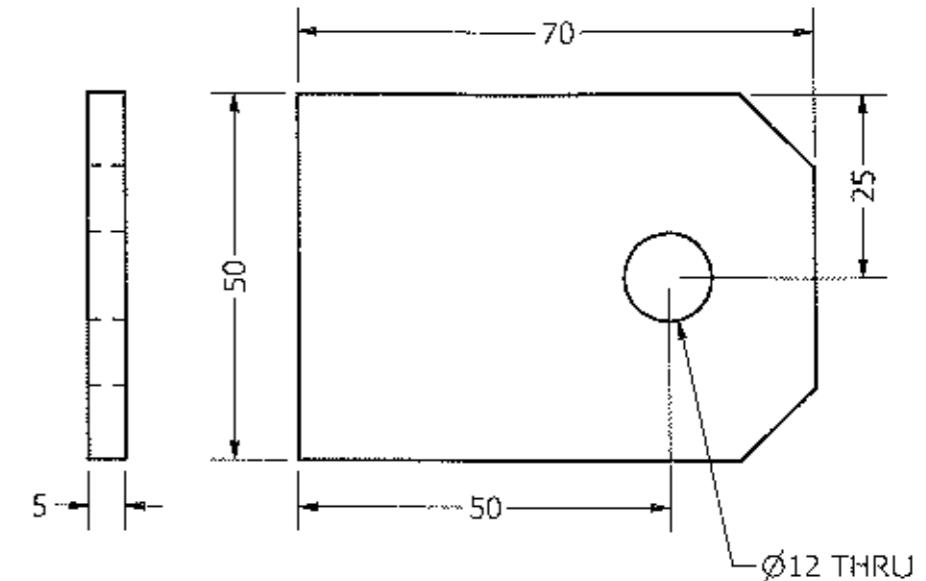
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REV.	DATE	DESCRIPTION	DRAWN BY/CHIEF ENGINEER	CHKD. PARTS-A4	APPR. SURF.
		PRODUCT TITLE: 9MMS SOLAR WATER PUMP STRUCTURE	DRAWN BY/CHIEF ENGINEER	CHKD. PARTS-A4	APPR. SURF.
DATE 04-07-2025	DATE 21-07-2025	REV. 4			
PART/DWG NUMBER: TPS-EESL-9MMS-N-TP-PVP1-F-001	SHFT SIZE A1				

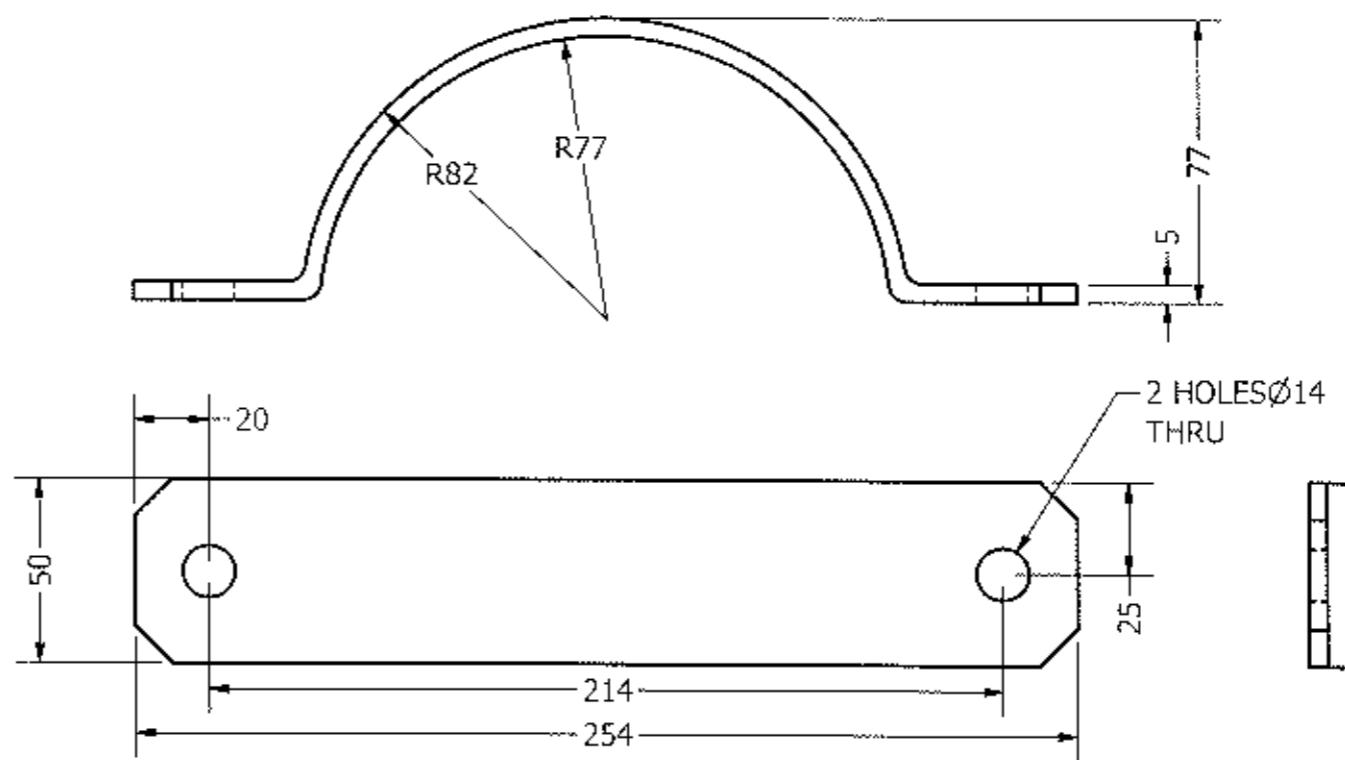
2. CIRCULAR BRACKET ASSEMBLY



C1.2. TUBE MOUNTING PLATE

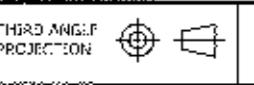


C1.1. CIRCULAR PLATE



*Dr. N. Jayaramappa
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Bengaluru - 560 056.*

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UNIPARTS C1.1-R91SF 250700 ALL DIMENSIONS ARE IN MM

SCALE

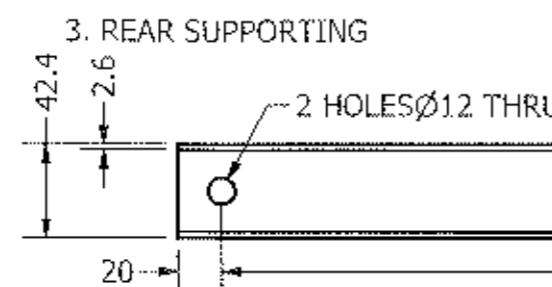
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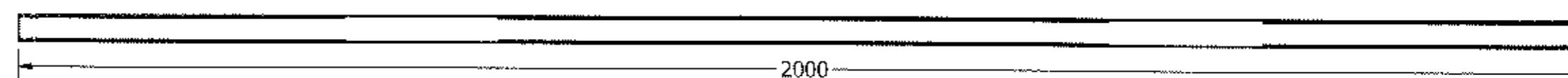
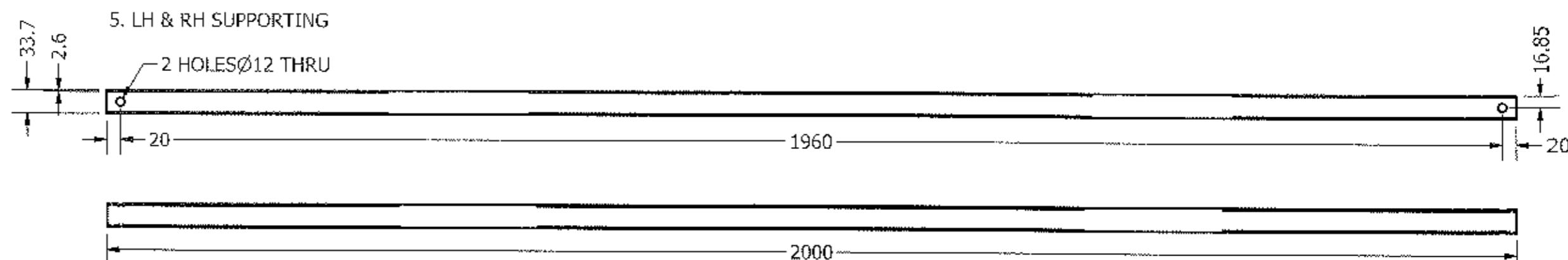
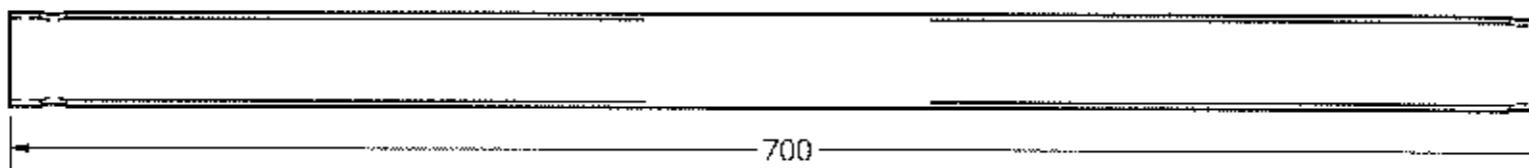
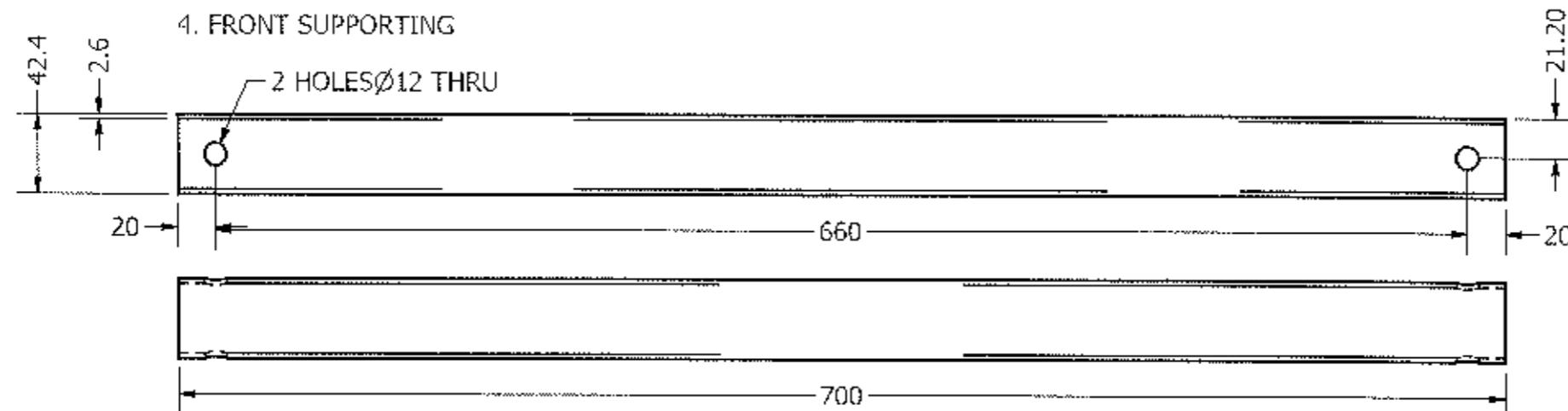
NO D.P. ± 1 ONE D.P. ± 0.5 TWO D.P. ± 0.25 ANGLES ± 10

REV.	DATE	DESCRIPTION	DRAWN	CHKD.	APPR.
		PRODUCT TITLE: 9MMS SOLAR WATER PUMP STRUCTURE	Drawn by: Sachin Aravamudan	Chkd. by: Prakash	Appr. by: Sumit
DATE 22-09-2020	DATE 22-09-2020		Rev. No.: 1	Date: 22-09-2020	RPV. 1
PART/DWG NUMBER: TPS-EESL-9MMS-N-TP-PVPT-F-001	SHEET SIZE A3				

Part Name: 9MMS ASSEMBLY DRAWING
 Material Grade: R400 BHN
 Finish Ref.: BOM
 T.B. angle: 2, 15, 20.0 degrees
 N.L. C. Modules: 9

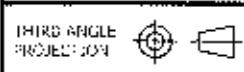


21.20



N. Jayaramappa
 Dr. N. Jayaramappa
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 Professor
 Department of Civil Engineering
 Bangalore University,
 Udupi - 574 114, India - 560 056.

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TOLERANCES

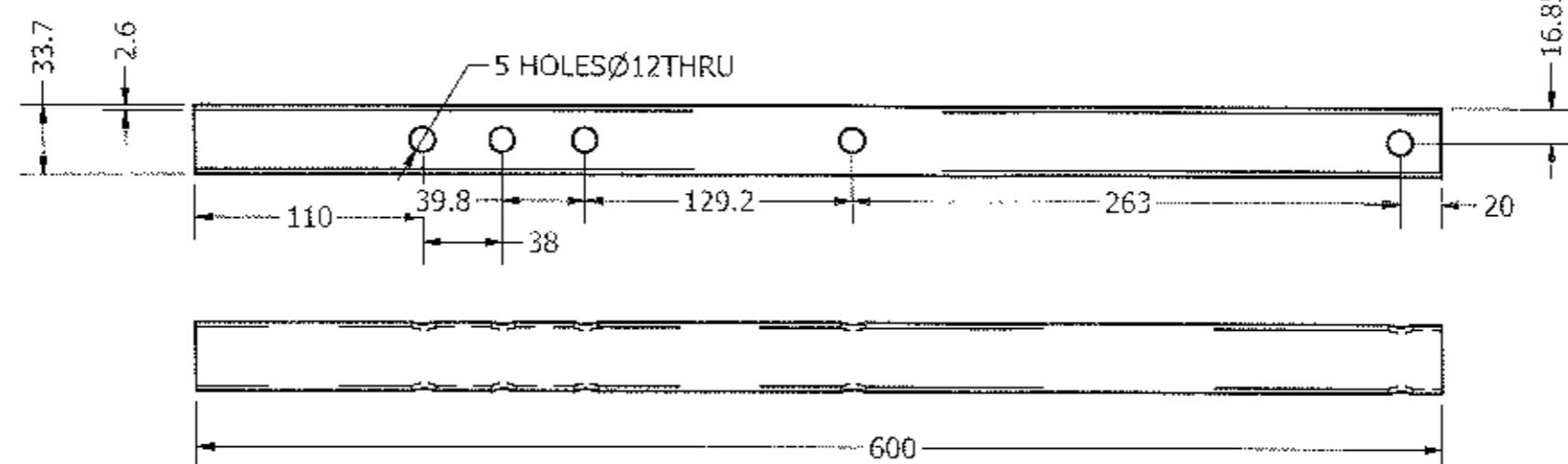
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NO C.P. C.V.C.P. I.W.C.D.P. ANGLES F.S.

± 1 ± 0.5 ± 0.25 13

REV.	DATE	DESCRIPTION			DRAWN	CHKD.	APPR.
PRODUCT TITLE:							
		9MMS SOLAR WATER PUMP STRUCTURE			DRAWN SAHIDHANANDA	CHKD. MEERA	APPR. SUJU
		DATE 22-01-2020	DATE 22-01-2020	DATE 22-01-2020	REV. 4		
PART/DWG NUMBER: TPS-EESL-9MMS-N-TP-PVPT-F-001						SheFT SLZC 43	

6.JOINING REAR



Item Name: 9MMS-Acc-Field Y DRAWING
Material: Carbon Steel Bar
Length: 600 mm
L-1 angle: 5.1 x 20.25 degree
No. of pieces: 9

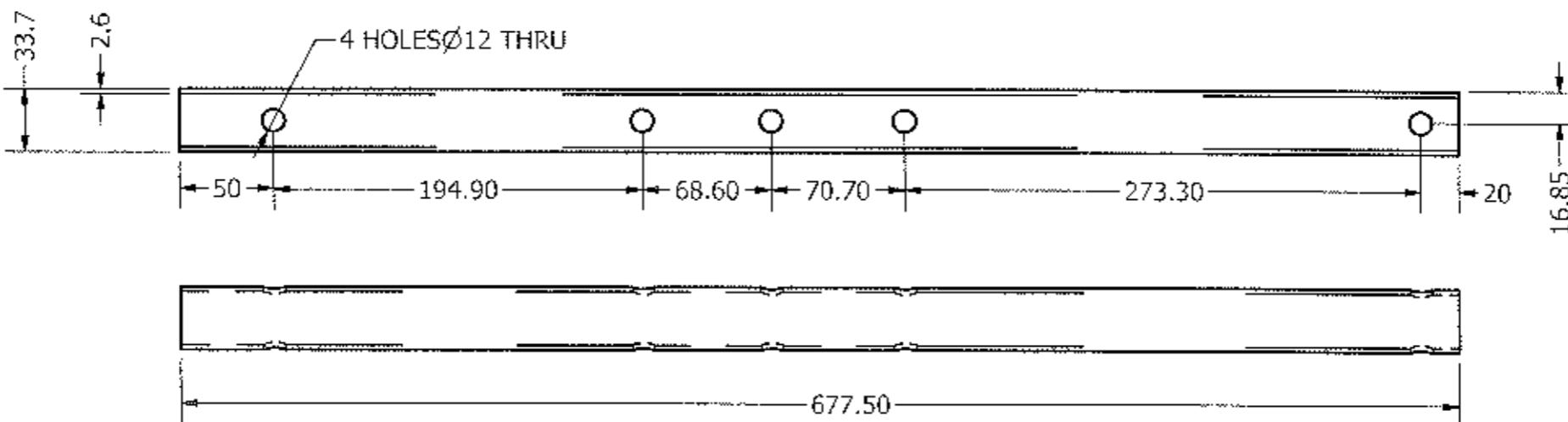


P. Jayaramappa

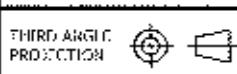
Dr. N. Jayaramappa
M.E., Structures, Ph.D.

Professor
Department of Civil Engineering
UVCE, Bangalore University,
Bengaluru - 560 056.

7. JOINING FRONT



NOTE:
• REMOVE BURRS & DENT.
• REMOVE SHARP CORNER & MAKE CHAMFER UPM (UNLESS SPECIFIED).



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MATERIAL
REBAR BOP

FINISH
RCFTR BOP

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SCALE

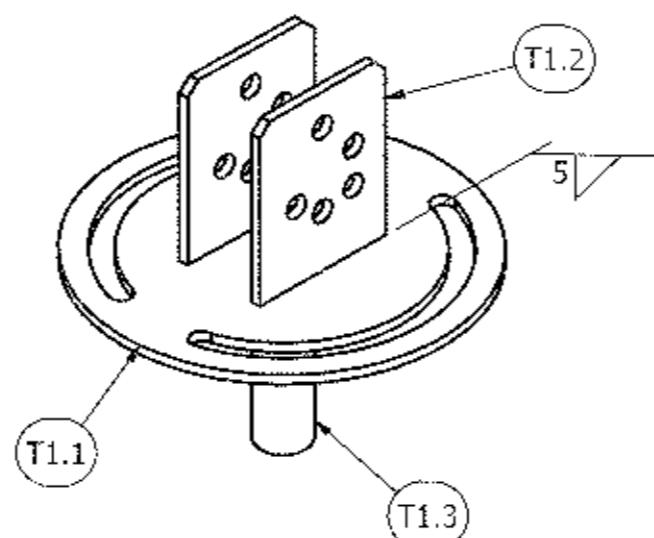
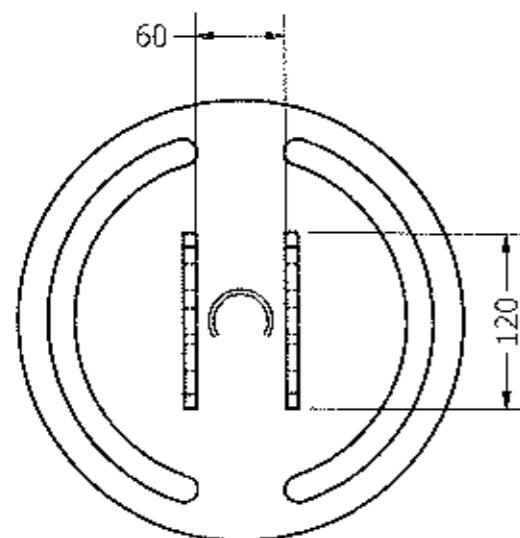
TOLERANCES

MM

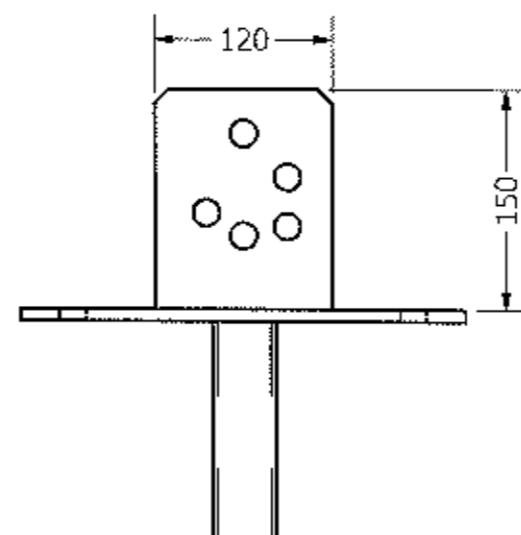
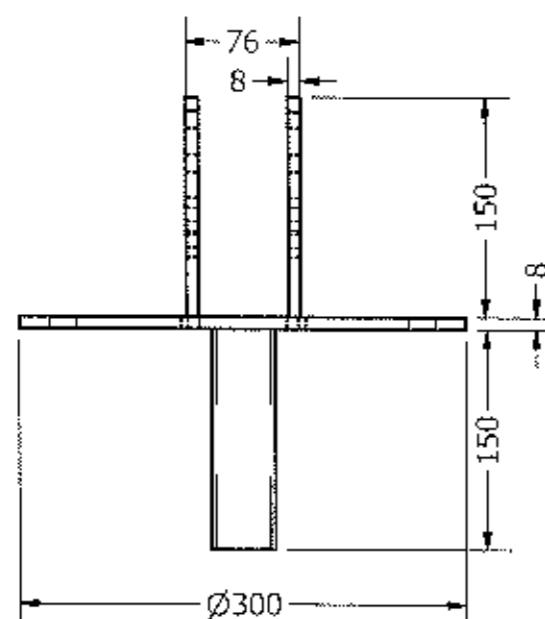
NO.O.P. ONE O.P. TWO O.P. ANGLES

± 1 ± 0.5 = 0.25 10

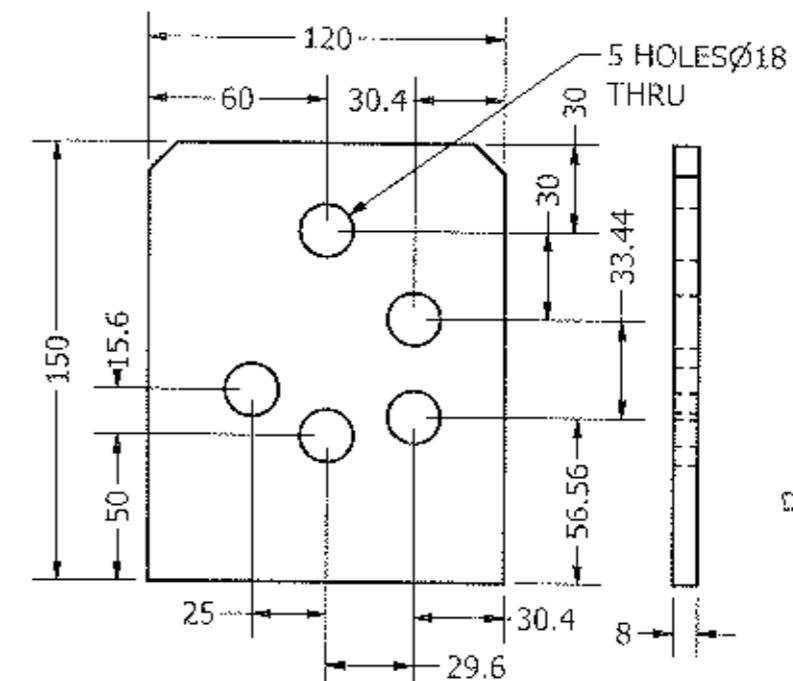
REV.	DATE	DESCRIPTION	DRAWN BY/CHIEF ENGINEER	CHKD.	APPR.
		PRODUCT TITLE:			
		9MMS SOLAR WATER PUMP STRUCTURE			
DRAWN BY/CHIEF ENGINEER					
DATE 20-07-2016	DATE 20-07-2016	DATE 20-07-2016	REV. 4		
PART/DWG NUMBER: TPS-EESL-9MMS-N-1P-PV21-F-001					SHEET SIZE A3



8. TOP PLATE ASSEMBLY



T1.2. MID PLATE

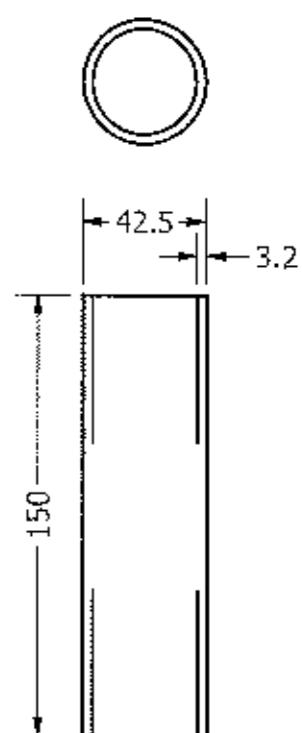


Part Name: 9MMS Assembly DRAWING
Material: Grade: R400
Size: 20x20 mm
Bolt angle: 3, 12, 20, 25 degrees
Size of modulus: 9

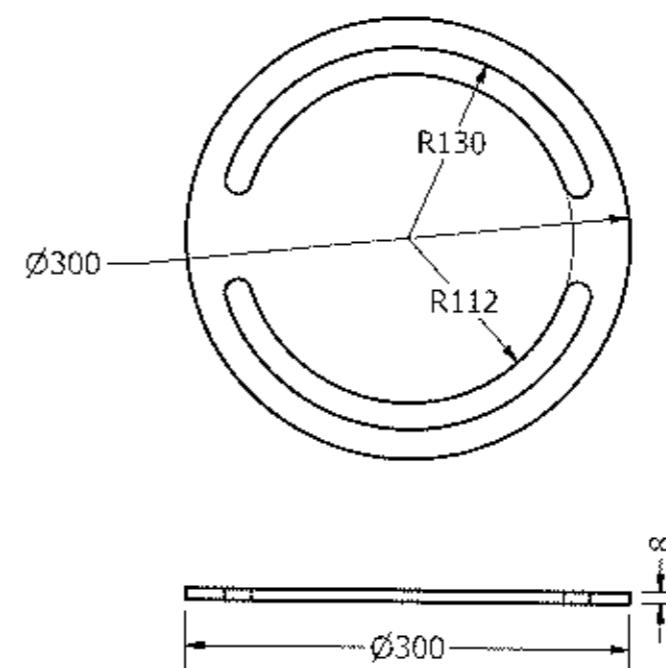


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T1.3. BASE PIPE



T1.1. TOP PLATE



NOTE:
1. REMOVE BURRS & DENT
2. APPROVE SHARP CORNER & MAKE CHAMFER 10MM (UNLESS SPECIFIED)

THIRD ANGLE PROJECTION

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ASK



MATERIAL
REFER BOM

FINISH
REFER BOM

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SCALE

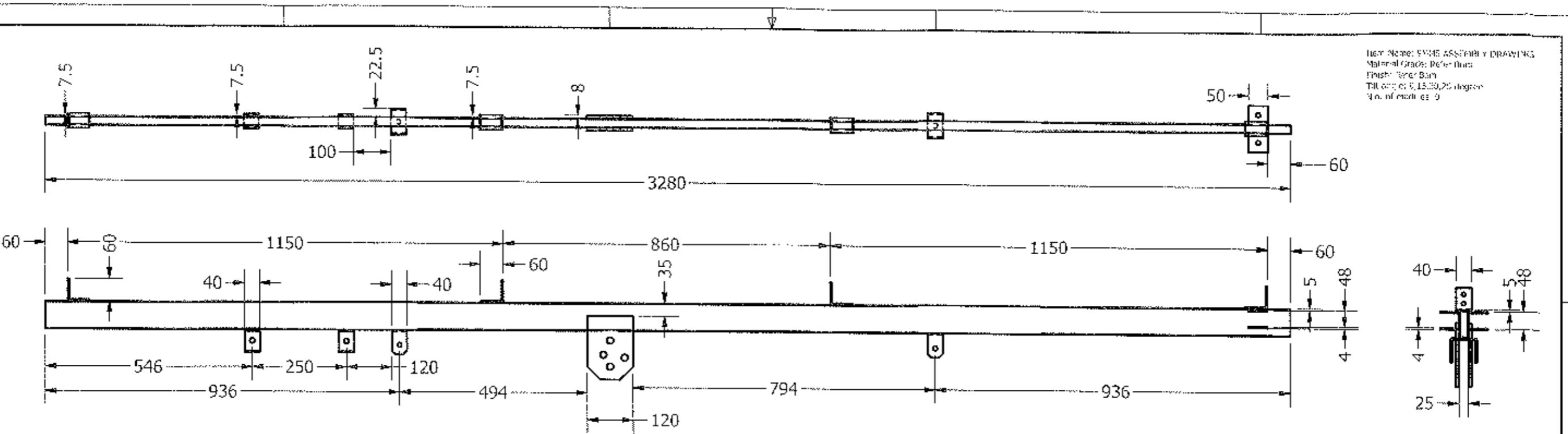
TOE FRAMES

NO D.R. ± 1

ONE D.R. ± 0.5

TWO D.R. ± 0.25

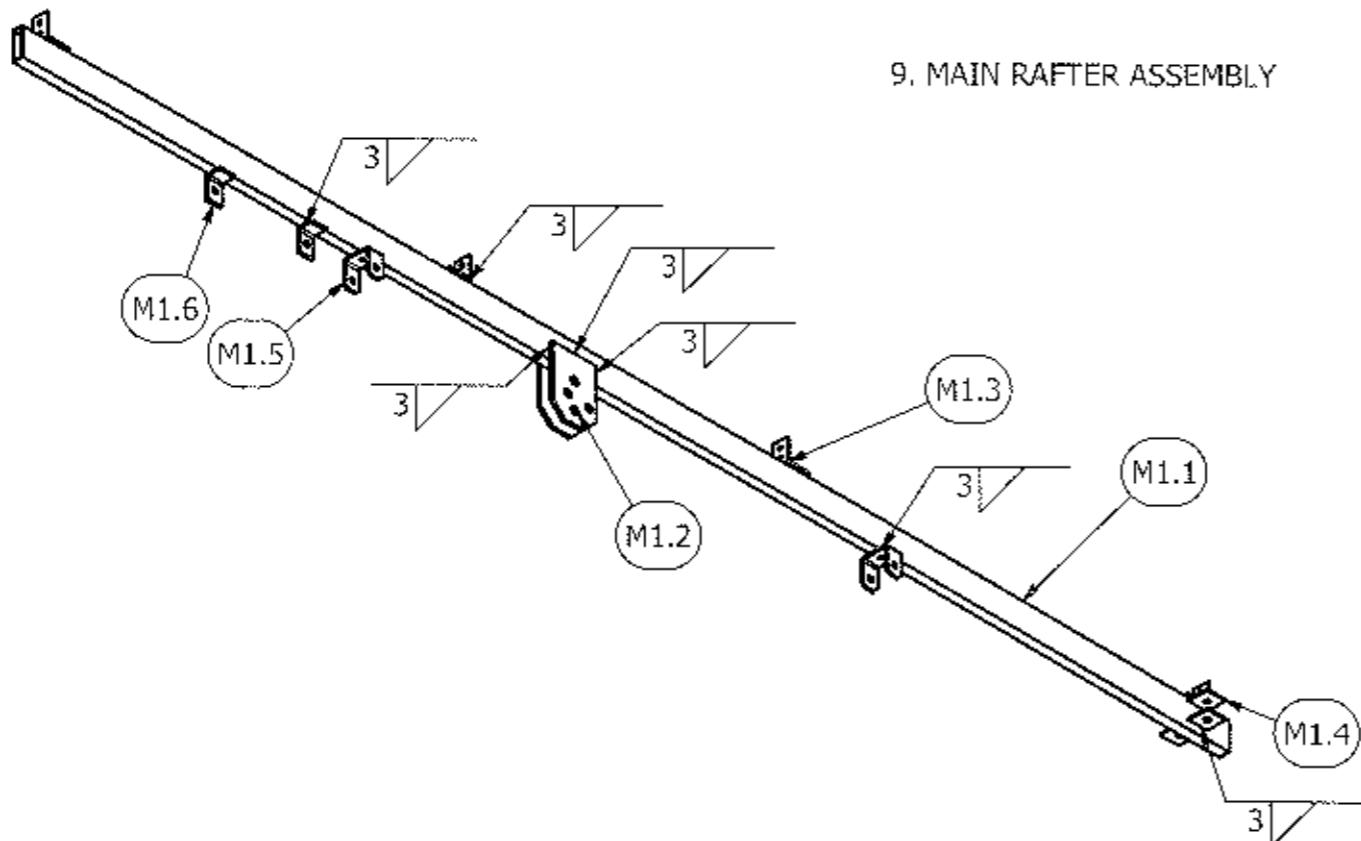
ANGLES ± 1°



9. MAIN RAFTER ASSEMBLY



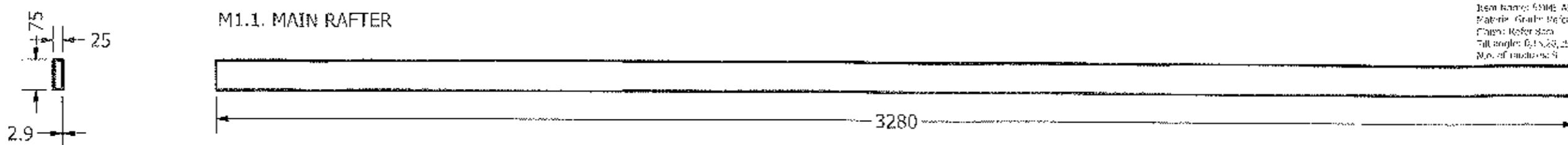
N. Jayaramappa
Dr. N. Jayaramappa
M.A./Sindhuvasi, Ph.D.,
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Department of Civil Engineering
UVCE, Bangalore University,
Bengaluru - 560 056.



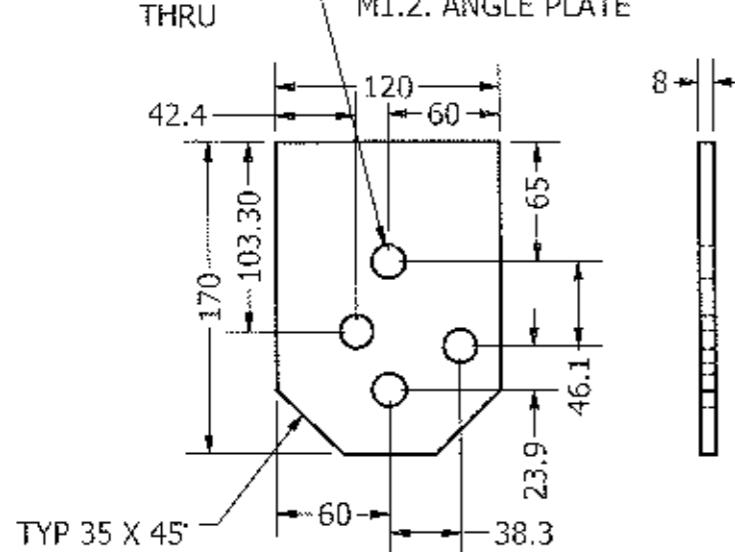
NOTE:
1 REMOVE BURR & DENT
2 REMOVE SHARP CORNER & MAKE CHAMFER (SIGHT UNLESS SPECIFIED)

Item Name: 9MMS ASSEMBLY DRAWING
 Material: Grade B450 BOM
 Chamfer: Refer BOM
 Tilt angle: 0, 15, 30, 45 degrees
 No. of radii: 3

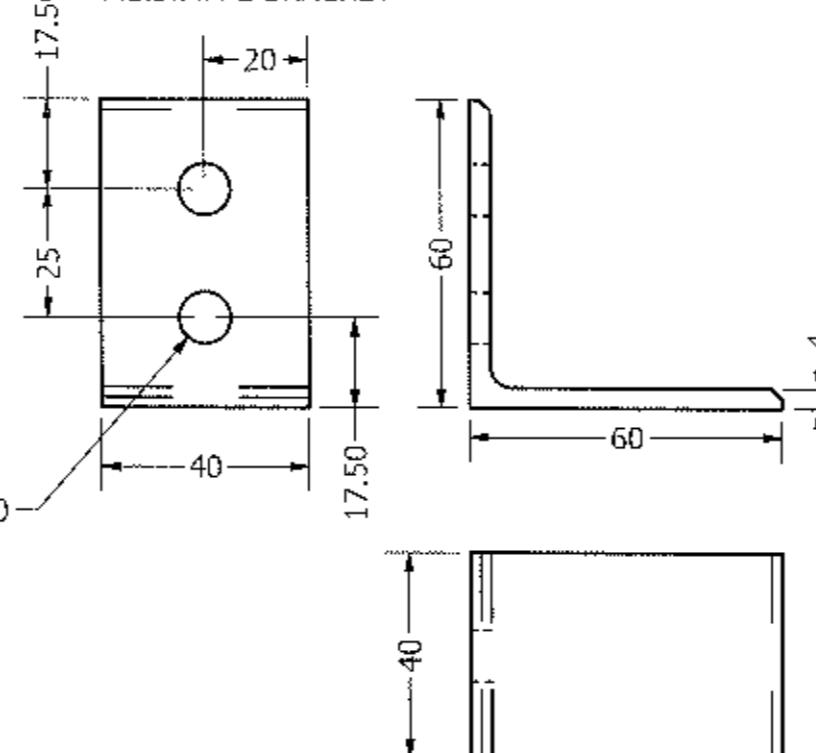
M1.1. MAIN RAFTER



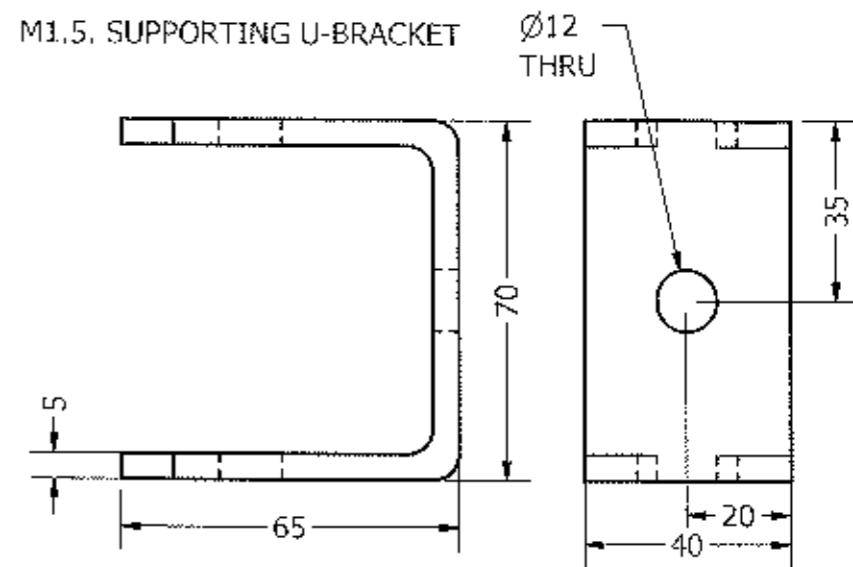
4 HOLES Ø18
THRU
M1.2. ANGLE PLATE



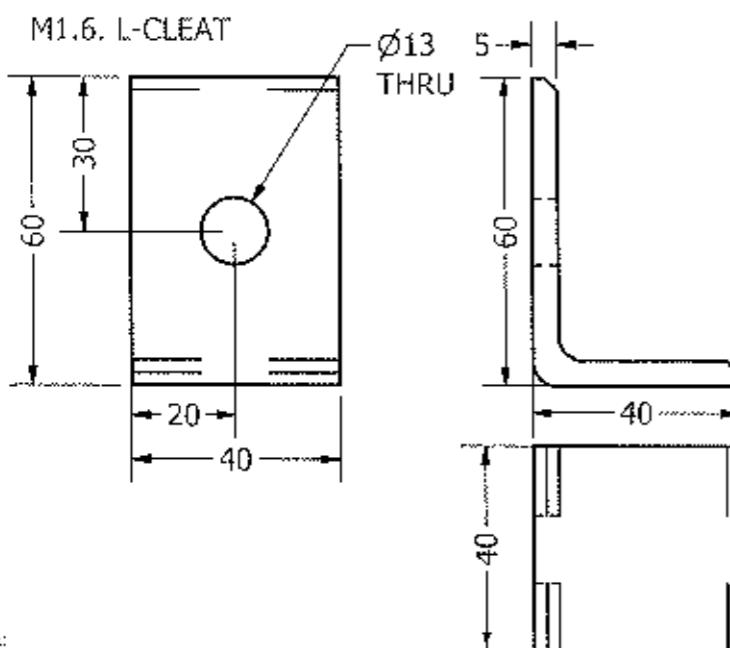
M1.3. MM L-BRACKET



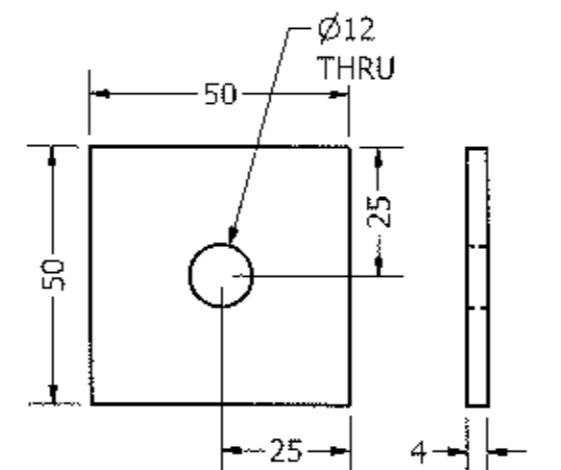
M1.5. SUPPORTING U-BRACKET



M1.6. L-CLEAT

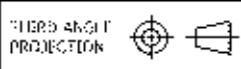


M1.4. RAFTER CONNECTION PLATE



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 UVCE, Bangalore University,
 Bengaluru - 560 056.

NOTE:
 * REMOVE KJRR & IRIN
 * REMOVE SHARP CORNER & MAKE CHAMFER 12MM (UNLESS SPECIFIED)



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MATERIAL
 REFER BOM

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MM

TOLENCES

NO D.P.	CNC D.P.	INWO D.P.	ANGLES	
± 1	± 0.5	1.025	± 5	

FINISH
 REFER BOM

SCALE

MM

PRODUCT TITLE:

9MMS SOLAR WATER PUMP STRUCTURE

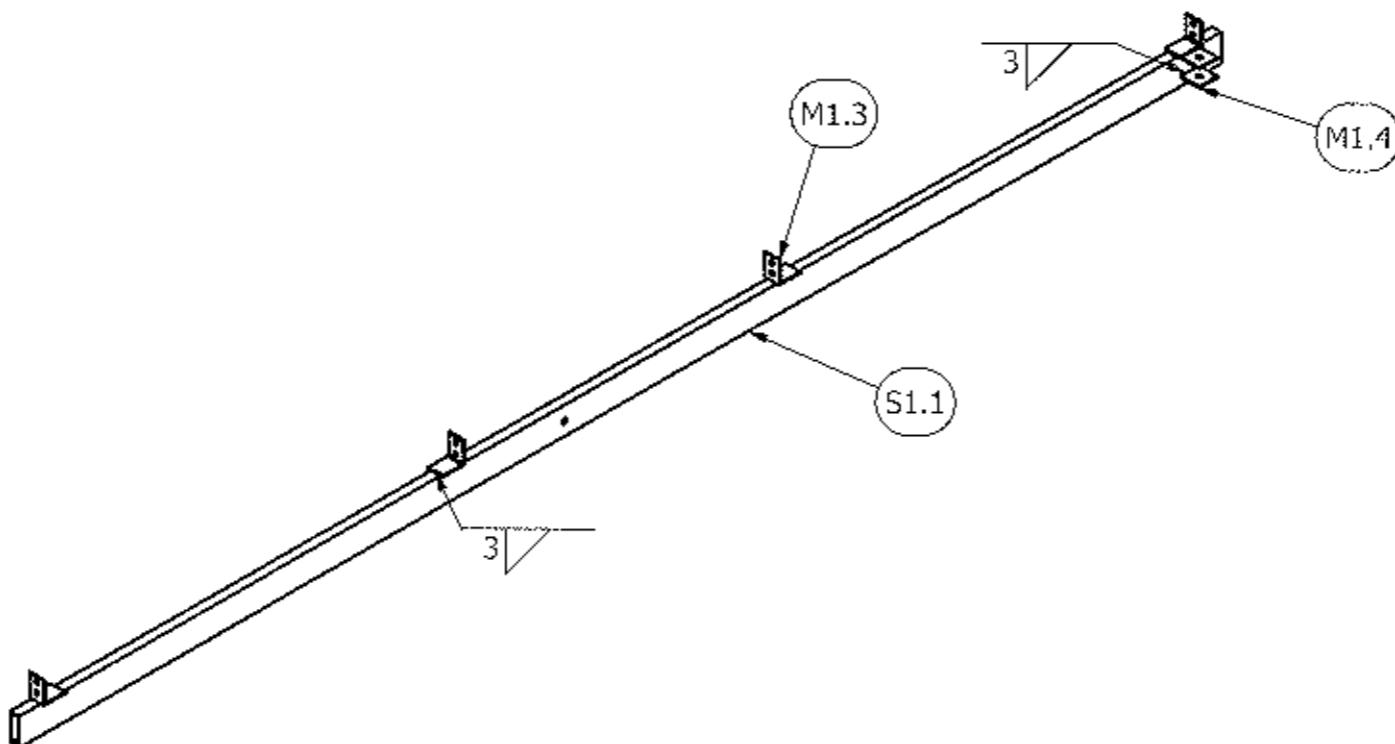
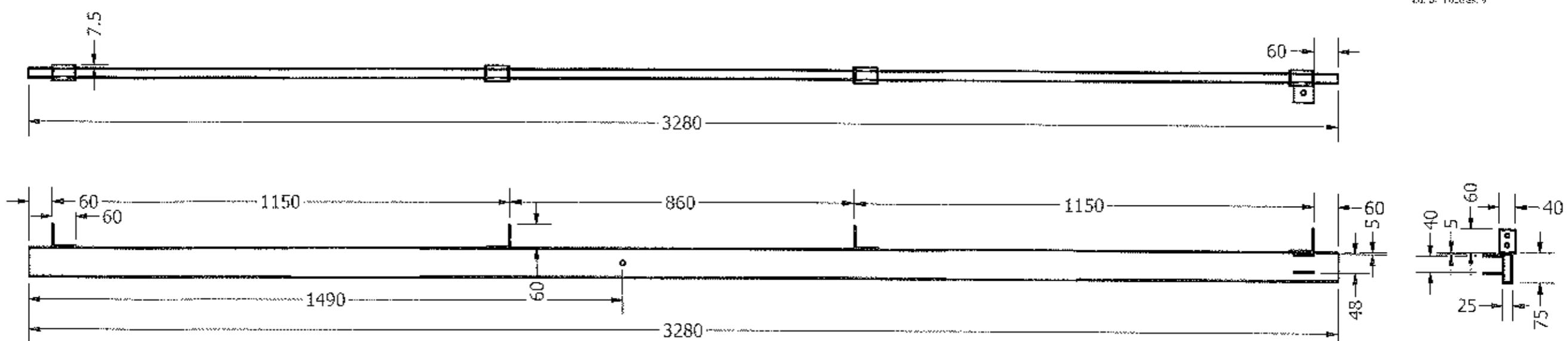
DRAWN SAKTHI KRISHNA	CHKD. IRINSHA	APPR. SHSS
-------------------------	------------------	---------------

DATE 21-09-2010	DATE 21-09-2010	DATE 21-09-2010
--------------------	--------------------	--------------------

PART/DWG NUMBER: TPS-EESL-9MMS-N-TP-PVPT-F-001	SHEET SIZE A3
---	---------------------

10. SECONDARY RAFTER ASSEMBLY

Item Name: 9MMS ASSEMBLY DRAWING
Material Grade: B30 - B30
Overall Rafter Length: 3280 mm
Pitch angle: 0.1570.21 degree
No. of Trusses: 9



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Bangalore - 560 056.

NOTE:
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* REMOVE SHARP CORNER & MAKE CHAMFER 10MM (UNLESS SPECIFIED)

THIRD ANGLE PROJECTION DO NOT SCALE THIS DRAWING IF IN COUNT ASA

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MATERIAL REFER BOM FINISH REFER BOM

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TOLERANCES

SCALE NTS

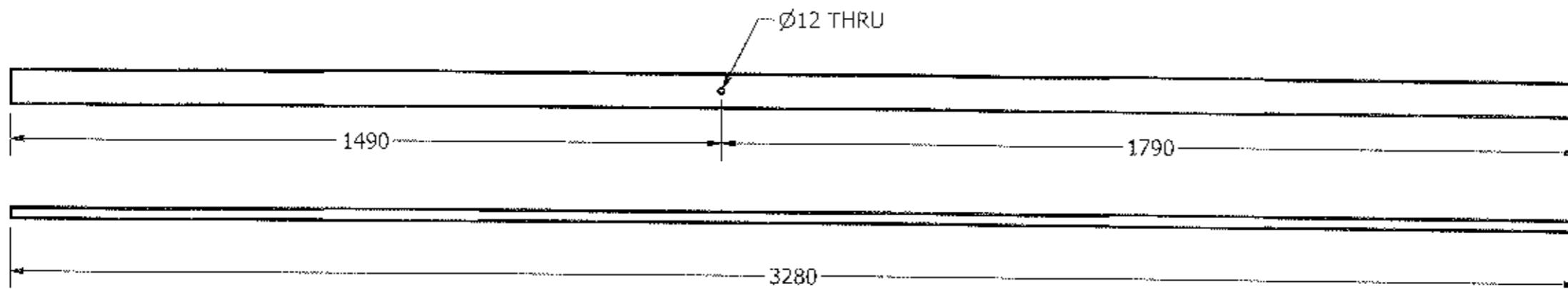
NO D.P. ONE D.P. TWO D.P. ANGLE

= 1 ± 0.5 ± 0.25 ± 10

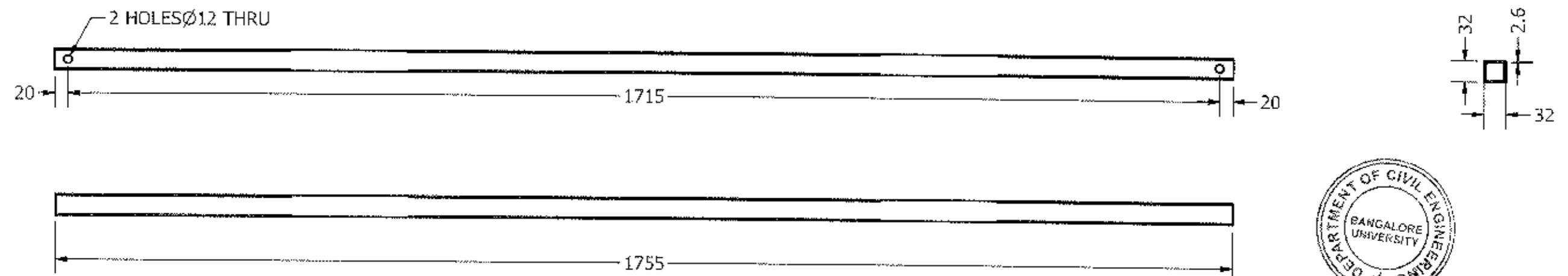
REV.	DATE	DESCRIPTION	DRAWN	CHKD.	APPR.
		PRODUCT TITLE: 9MMS SOLAR WATER PUMP STRUCTURE	DRAWN C. H. RAJENDRA PAUL	CHEKED. MAY 2016	APPR. L.S.L.
	24-05-2016	DATE 24-05-2016	DATE 24-05-2016	DATE 24-05-2016	REV. 4
		PART/DWG NUMBER: TPS-EESI-9MMS-N-TP-PVPT-F-001	SHRFT SIZE A3		

S1.1.SECONDARY RAFTER

Item Number: S1.1
 Material Grade: S235 Q235B
 Weight: 8.0 kg/m
 Tilt angles: 0, 15, 20, 25 degrees
 No. of members: 3



11.CROSS MEMBER



Dr. N. Jayaramappa
 M.E.,(Structures), Ph.D.
 Professor
 Department of Civil Engineering
 UVCE, Bangalore University,
 Bengaluru - 560 056,

NOTE:
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MATERIAL
 REFR. 9MMS
 FINISH
 REF. BOM

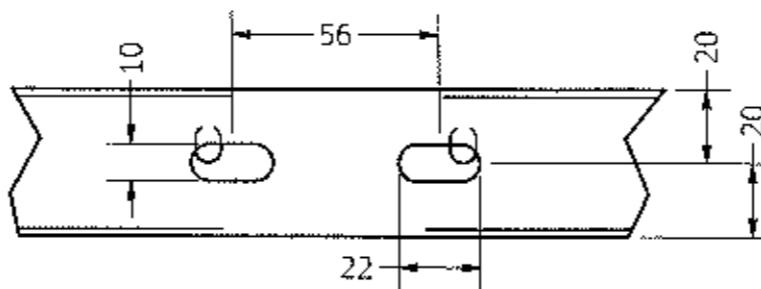
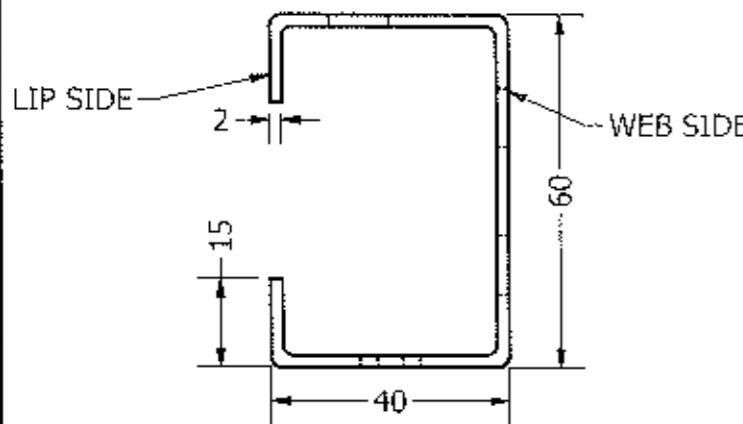
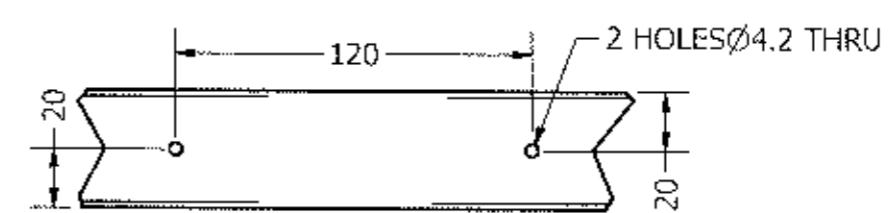
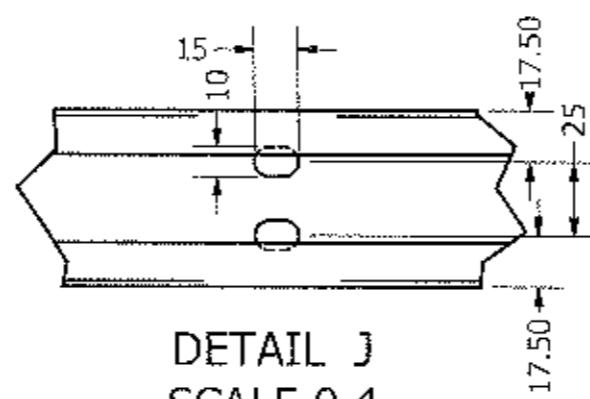
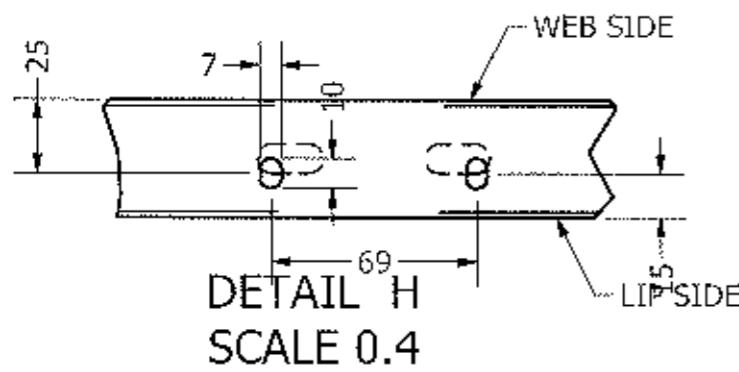
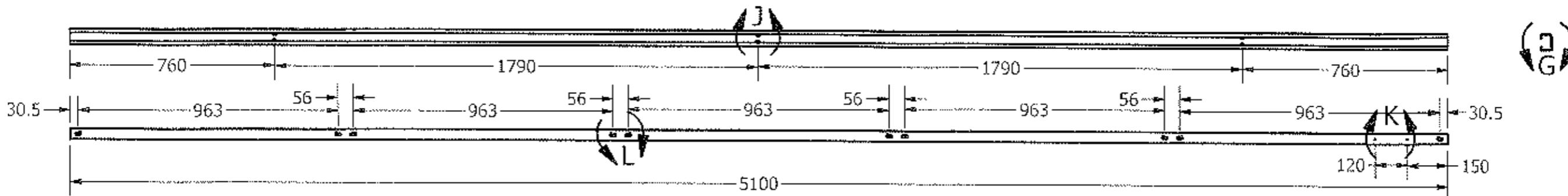
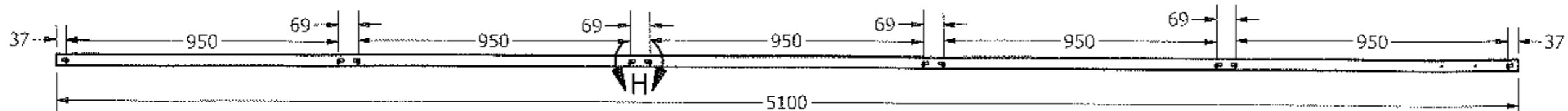
UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MM.
 TOLERANCES
 NO. C.P. OR: B.P. TOL: O.P. ANGLES
 ± 1 ± 0.5 ± 0.25 15°

SCALE
 KTS

REV.	DATE	DESCRIPTION			DRAWN	CHKD.	APPR.
		PRODUCT TITLE:			DRAWN ENGINERED BY	CHKD. TOKS-4	APPR. SCHL
		9MMS SOLAR WATER PUMP STRUCTURE			DATE 25-6-2010	DATE 25-6-2010	DATE 25-6-2010
					REV. 4		
PART/DWG NUMBER: TPS-EESL-9MMS-N-TP-PVPT-F-001						SIZE A3	

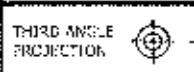
12.1. MM PURLIN-LH

Item Ref: 9MMS ASSEMBLY DRAWING
Material Grade: Roler Bar
Length: Total Bar
P. Angles: L, 15, 20, 25 degree
B.C. or modulus: 9



M. S. Devay
Dr. N. Jayaramappa
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Professor
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Bengaluru - 560 056.

NOTE:
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* REMOVE SHARP CORNER & MACHINER TURN (UNLESS SPECIFIED)



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ASK.

REF ID: 12.1
REV: 1
DATE: 10-07-2018

MATERIAL

REFER E04

FINISH

REFER E04

PRODUCT TITLE:

9MMS SOLAR WATER PUMP STRUCTURE

DRAWN
DRAFTSMAN

CKED
CHECKER

APPR.
SUPERVISOR

DATE
10-07-2018

DATE
10-07-2018

DATE
10-07-2018

PART/DWG NUMBER:
TPS-EESL-9MMS-N-TP-PVPT-F-001

SHEET
SIZE
A3

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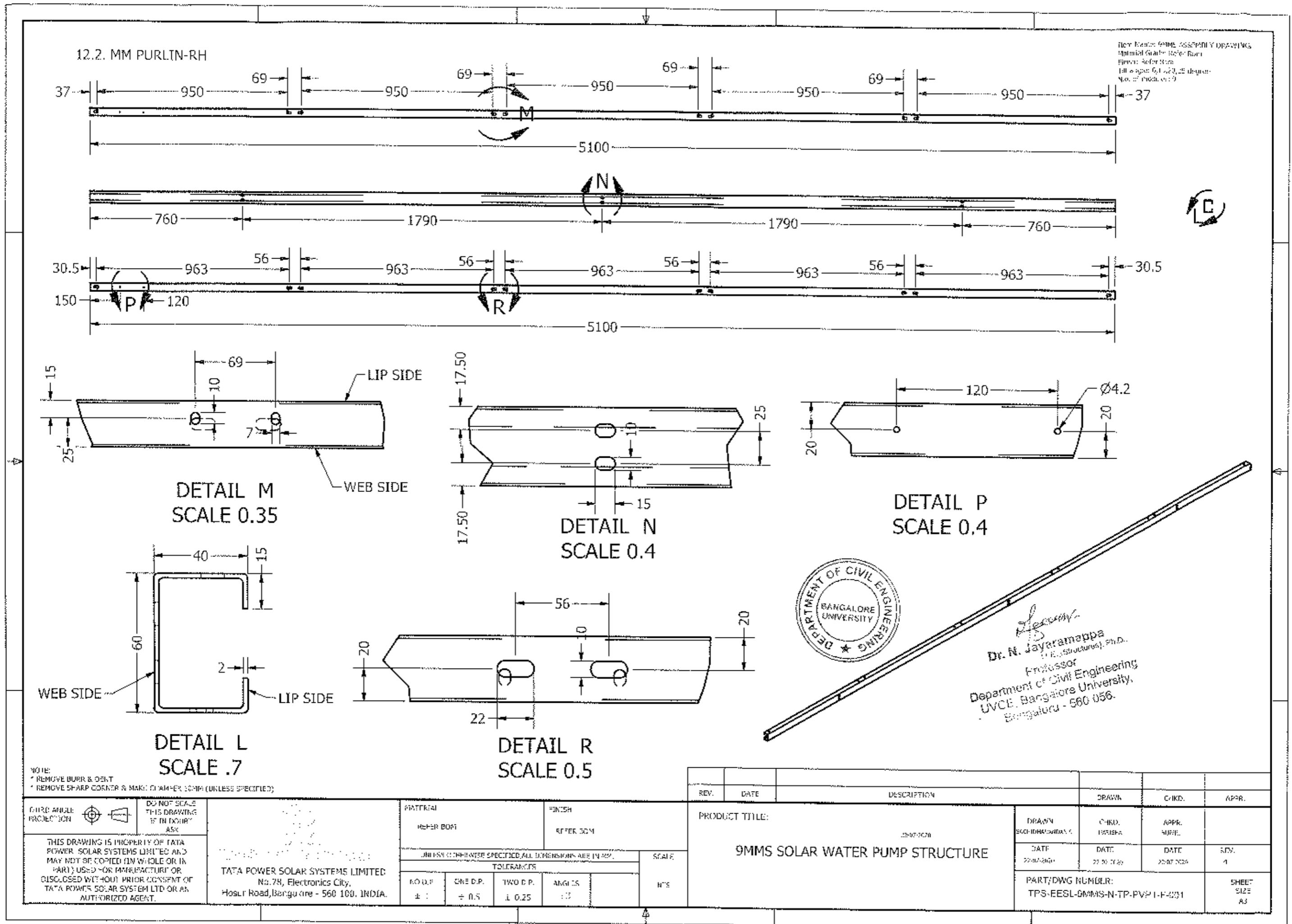
SLASH

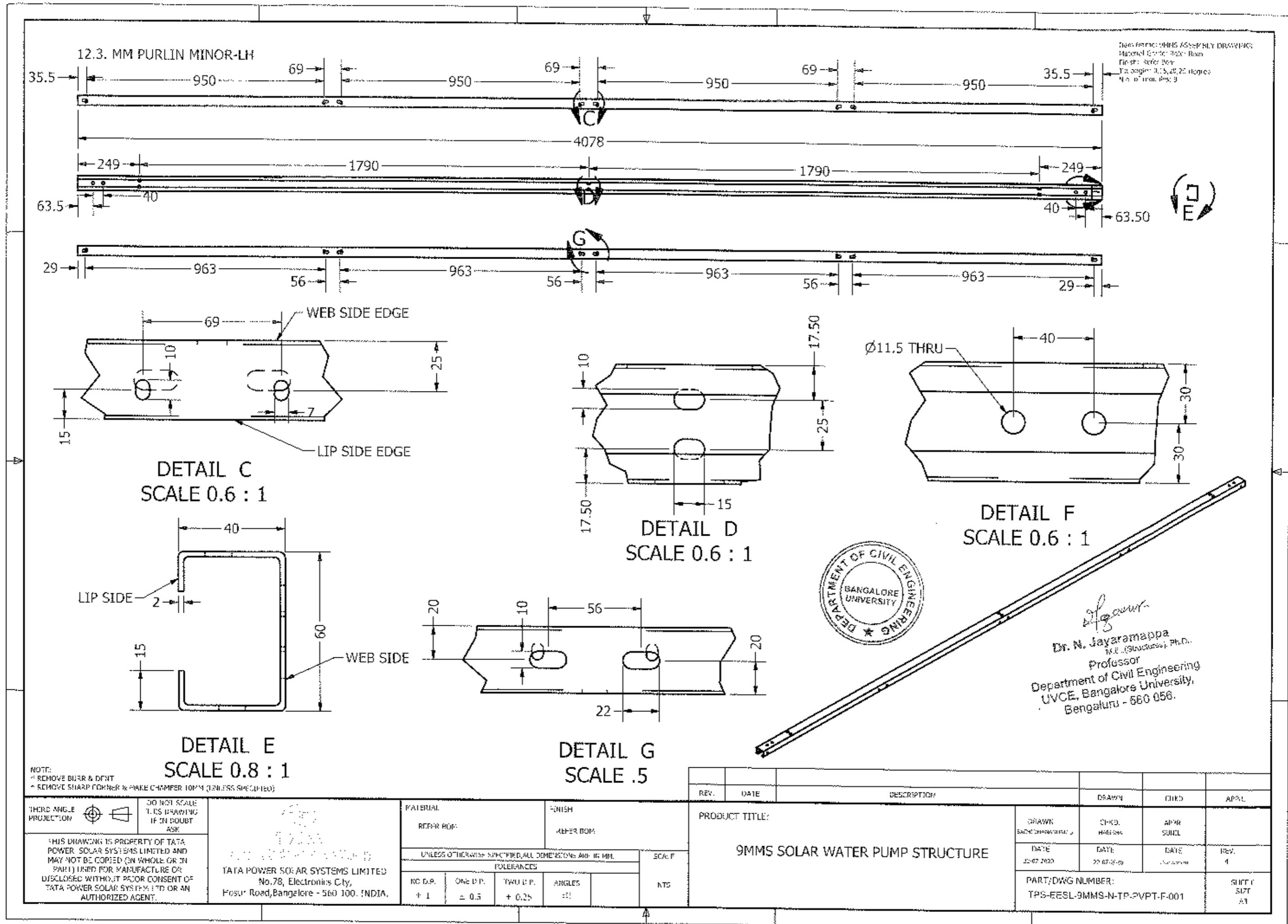
TOLERANCES

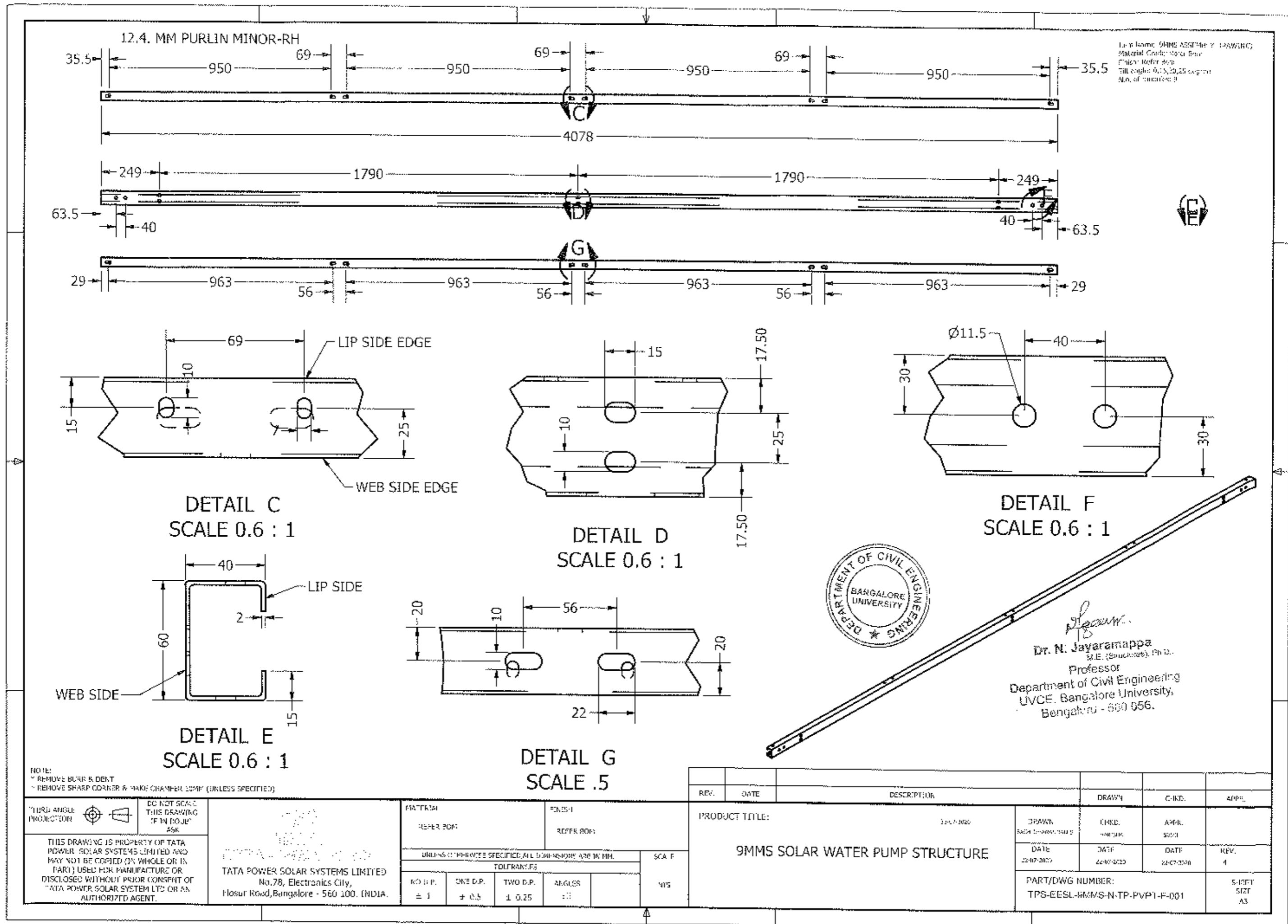
6.15

NO D.P. ONE D.P. TWO D.P. ANGLES

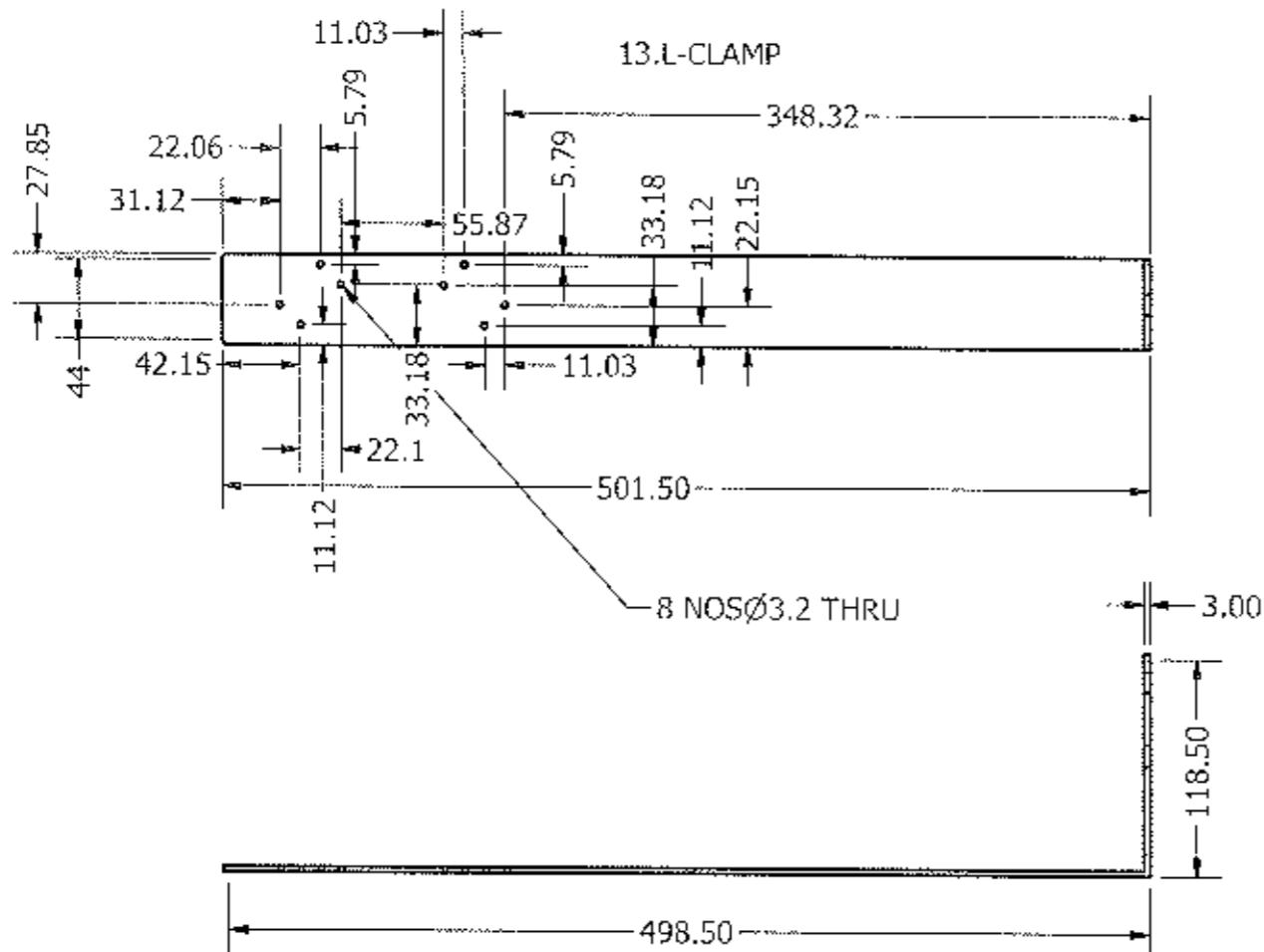
± 1 ± 0.5 ± 0.25 ± 10



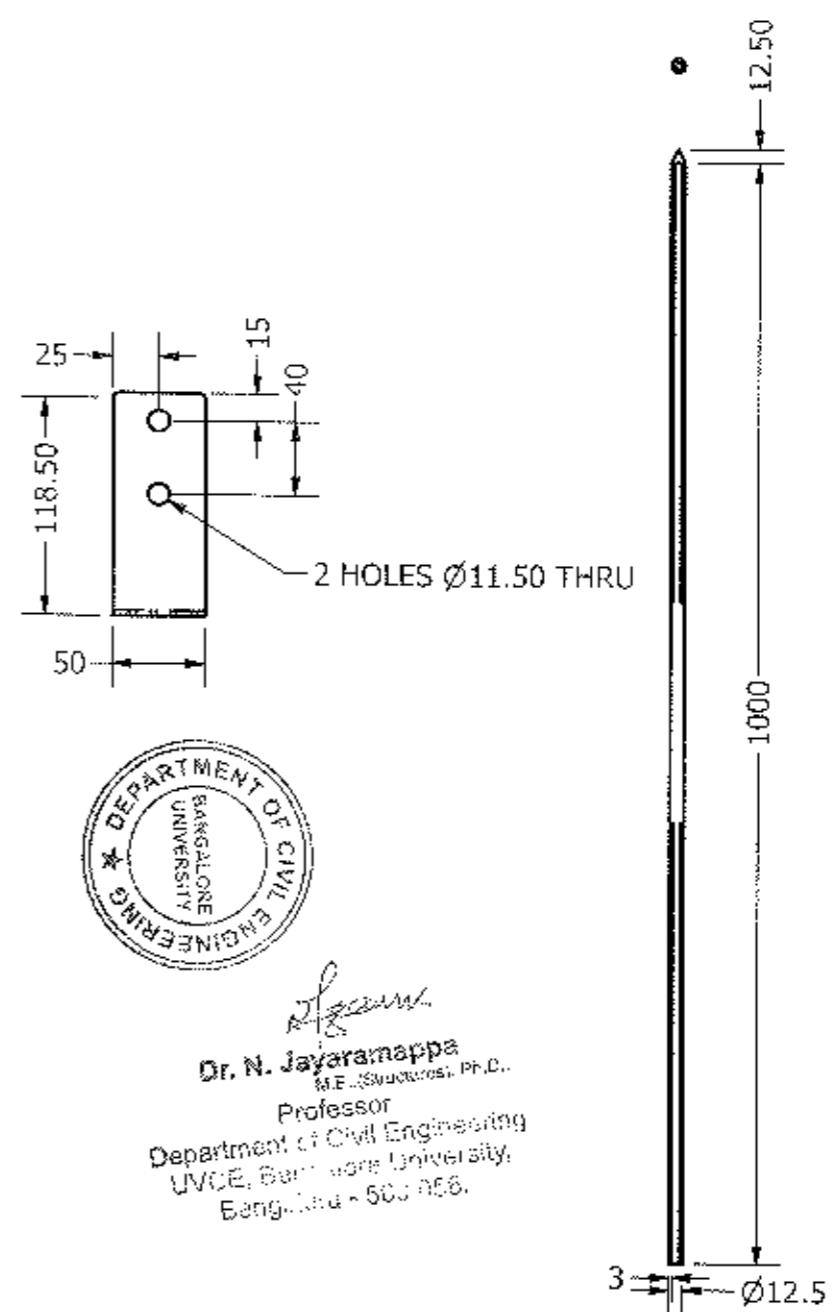




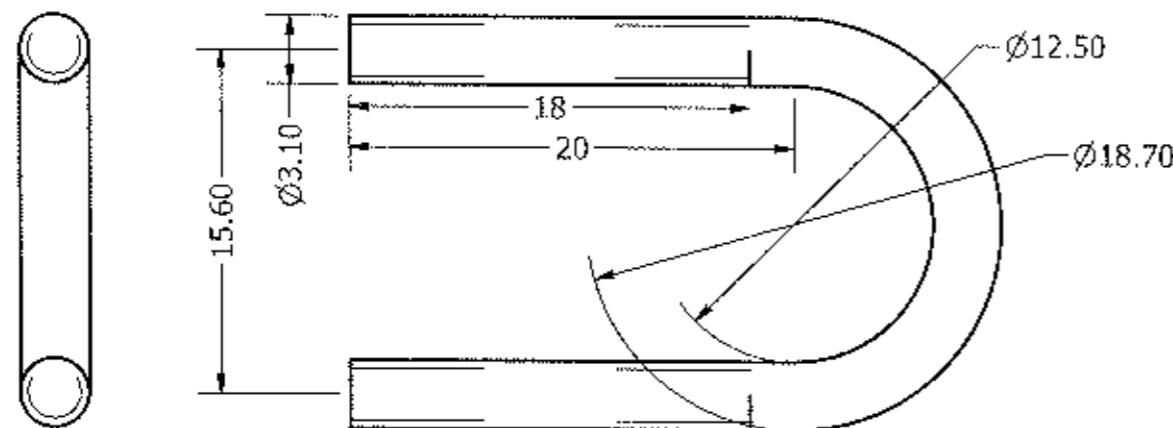
Part Name: 9MMS ASSEMBLY DRAWING
 Material Grade: S45C for 90%
 Finish: Refer 3D
 Flange angle: 6.15, 25 degree
 L.C. of thickness: 9



15.LIGHTNING ARRESTOR



14.U-BOLT



R. Jayaramappa
Dr. N. Jayaramappa
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 Professor
 Department of Civil Engineering
 UVCE, Bangalore University,
 Bengaluru - 560 056.

NOTE:
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 * REMOVE SHARP CORNER & MAKE CHAMFER (0.5MM UNLESS SPECIFIED)

HARD ANGLE PROJECTION
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 ASK

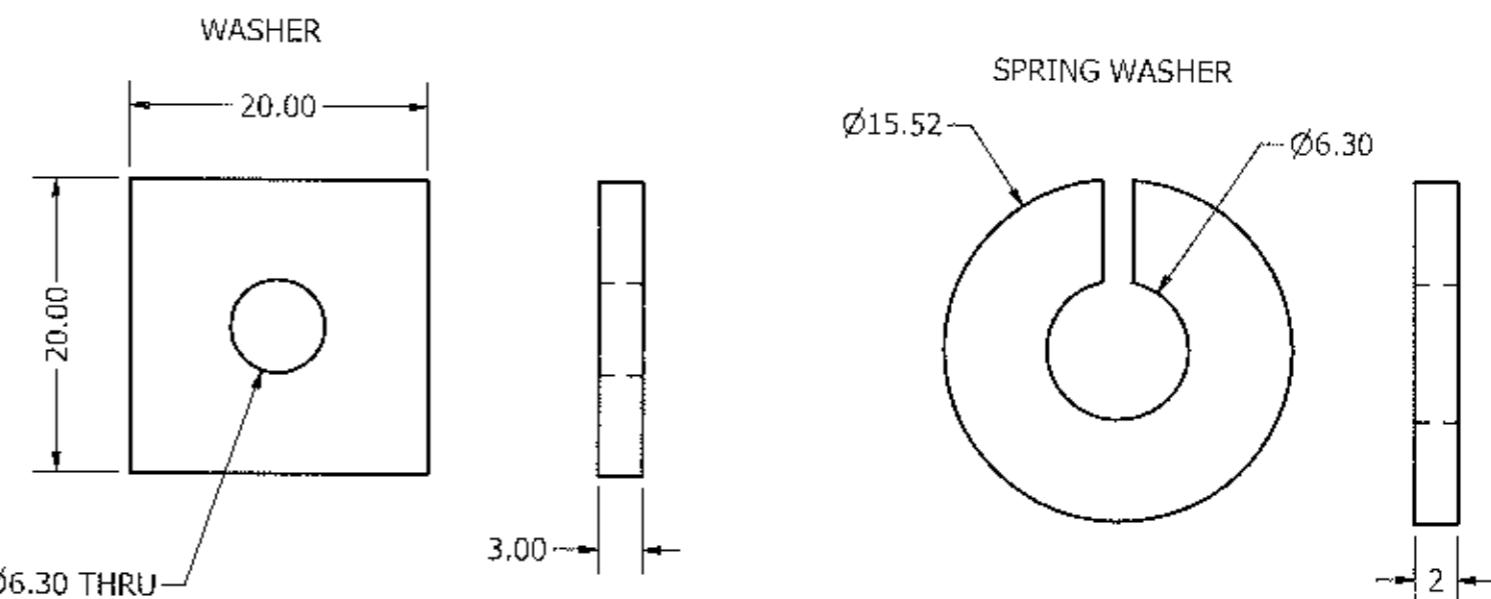
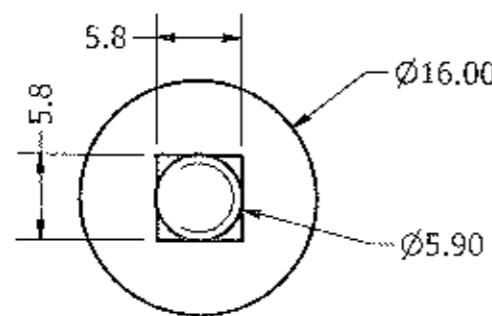
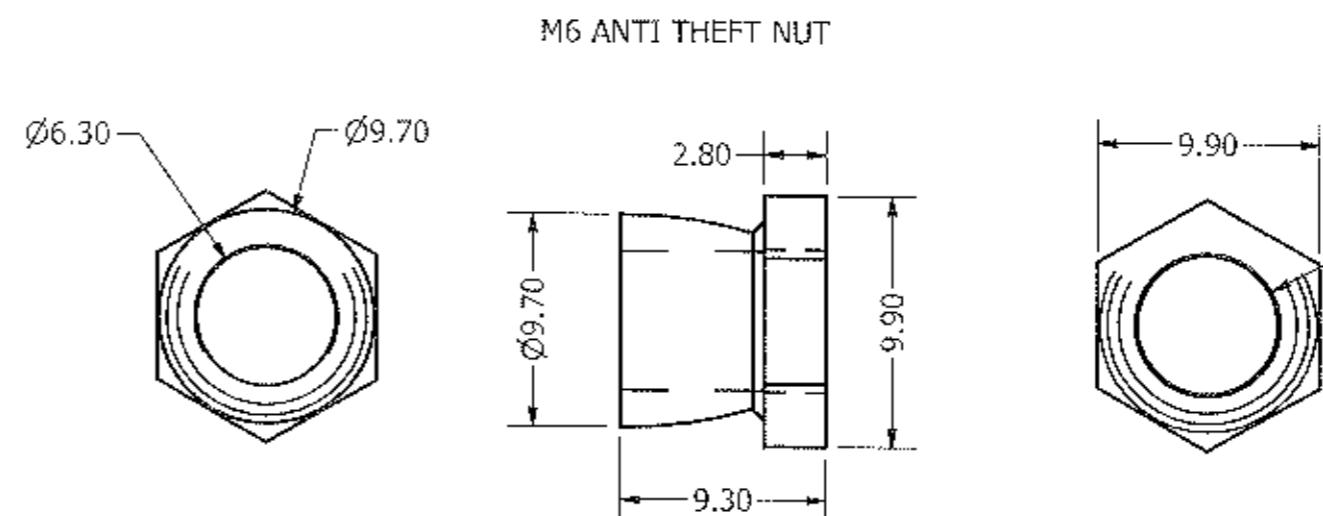
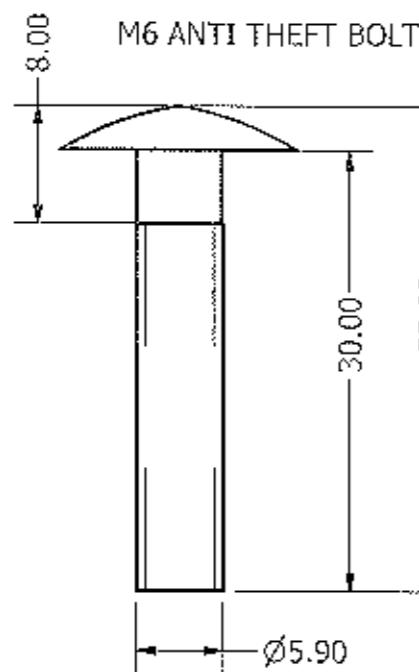
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MATERIAL
 REFER 9MMS
 FINISH
 REFER 3D

SCFT
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 TOLERANCES
 NTS

REV.	DATE	DESCRIPTION	DRAWN	CHKD.	APPR.
1	22-07-2020	9MMS SOLAR WATER PUMP STRUCTURE	DRWNSHIPS E	CHKD. 10-08-2020	APPR. 10-08-2020
	22-07-2020		DATE 22-07-2020	DATE 22-07-2020	REV. 4
		PART/DWG NUMBER: TPS-FEGL-9MMS-N-TP-PVPT-F-001	SHEET SIZE A3		

M6 ANTI THEFT BOLT, NUT AND WASHER MINIMUM DIMENSIONS FOR
9MMS & 10MMS EESL STRUCTURES



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NOTE:
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* REMOVE SHARP CORNER & MAKE CHAMFER 10MM (UNLESS SPECIFIED)

THIRD ANGLE
PROJECTION

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MATERIAL
REFER BOM

FINISH
REFER BOM

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SCALE

NO. D.P.	CNC D.P.	IND D.P.	ANGLES	
+ 1	± 0.5	± 0.25	± 10	6.15

REV.	DATE	DESCRIPTION		DRAWN BY	CH-CD	APPR.
		PRODUCT TITLE:		DRAWN BY-DR. N. JAYARAMAPPA	CH-CD SUVIL	APPR. SUVIL
		M6 ANTITHEFT BOLT FOR 9MMS & 10MMS EESL PROJECT		DATE 12/07/2020	DATE 24/07/2020	DATE 24/07/2020
		PART/DWG NUMBER: TPS-EESL-9MMS-N-1P-PVPT-F-001		SHEET SIZE A3		