जामिया मिल्लिया इस्लामिया
(संसदीय अधिनियमानुसार केन्द्रीय विश्वविद्यालय)
मौलाना मोहम्मद अली जौहर मार्ग, नई दिल्ली–110025
JAMIA MILLIA ISLAMIA
NAAC Accredited 'A' Grade
(A Central University by an Act of Parliament)
Maulana Mohammad Ali Jauhar Marg, New Delhi-110025

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Website : www.jmi.ac.in

सिविल इंजीनियरिंग विभाग
इंजीनियरिंग और प्रौद्योगिकी संकाय
Department of Civil Engineering
Faculty of Engineering & Technology

NO: 2021/3851 **Dated: 01.01.2021**

TO WHOMSOEVER IT MAY CONCERN

To,

Sai Babuji Projects Pvt. Ltd.
Plot No.-16, IDA, Balanagar,
Hyderabad, Telengana-500037

Subject: - Solar PV Module Mounting Structural Design Analysis and Certification

Document Reference specification: Structure design provided in MNRE's Technical Specification of Solar Water Pumping System- July 2019.

Dear Sir/Madam,

Following designs of Solar Module Mounting Structure submitted by **M/S Sai Babuji Projects Pvt. Ltd**.

S. No.	Structure Table Size	Drawing No.
01	9 Modules Mounting Structure	SMP-SM-1216
02	10 Modules Mounting Structure	SMP-SM-1216

have been checked & evaluated using STAAD Pro report for various parameters as per IS 875 : 2015, IS 800 : 2007 for a wind speed of 150 *kmph* and hence it is approved.

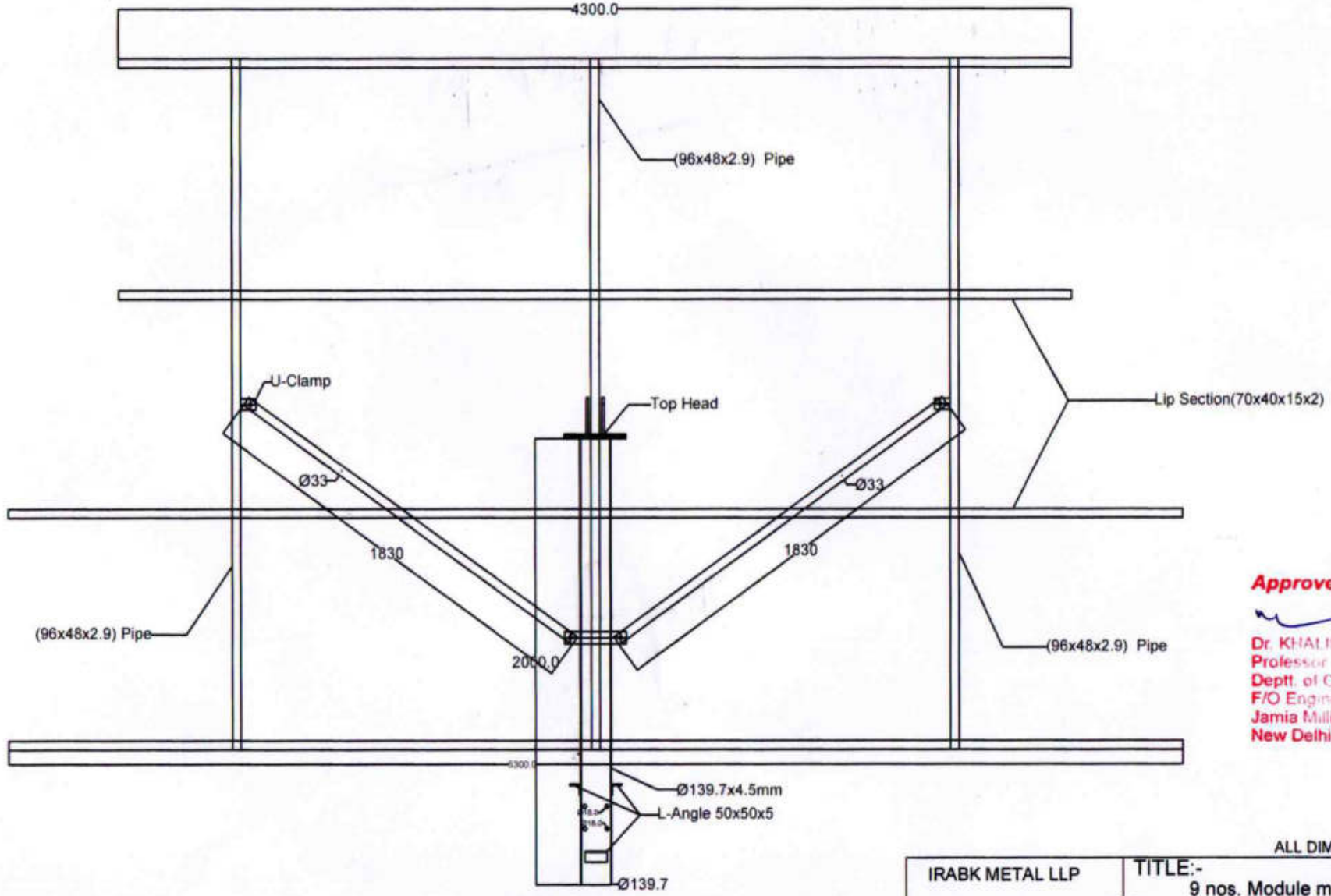
The above designs have been compared with "Indicative MNRE Design of July 2019 and had been found to be improved alternative over "Indicative MNRE Design" as shown below:

S.No.	Feature	Improvement in ALTERNATE Design	Advantage of Improvement
01	Wind Speed withstanding capacity	Design can withstand a wind speed of 150kmph.	
02	All parts per BIS standards	All the members used in ALTERNATE Design are as per IS 1161 where as several members of MNRE Design are not conforming IS 1161.	100% conformity to BIS would result in better quality
03	Suitability of Foundation for different soil types.	As per MNRE Annexure – A of the tender document, foundation is with base plate and direct pilling design is used. The "ALTERNATE Design" has piling foundation and such type of foundation is better suited for all types of soils including soils having low bearing capacity.	- The proposed foundation is more suitable for sandy soils - Pile cap of 200mm will ensure that there is no damage to MMS due to water logging.

Certified By:

Prof. Khalid Moin
(Structural Engineer)
Professor

Dr. KHALID MOIN
Professor
Deptt. of Civil Engineering
F/O Engineering & Technology
Jamia Millia Islamia
New Delhi-110025



Approved :-

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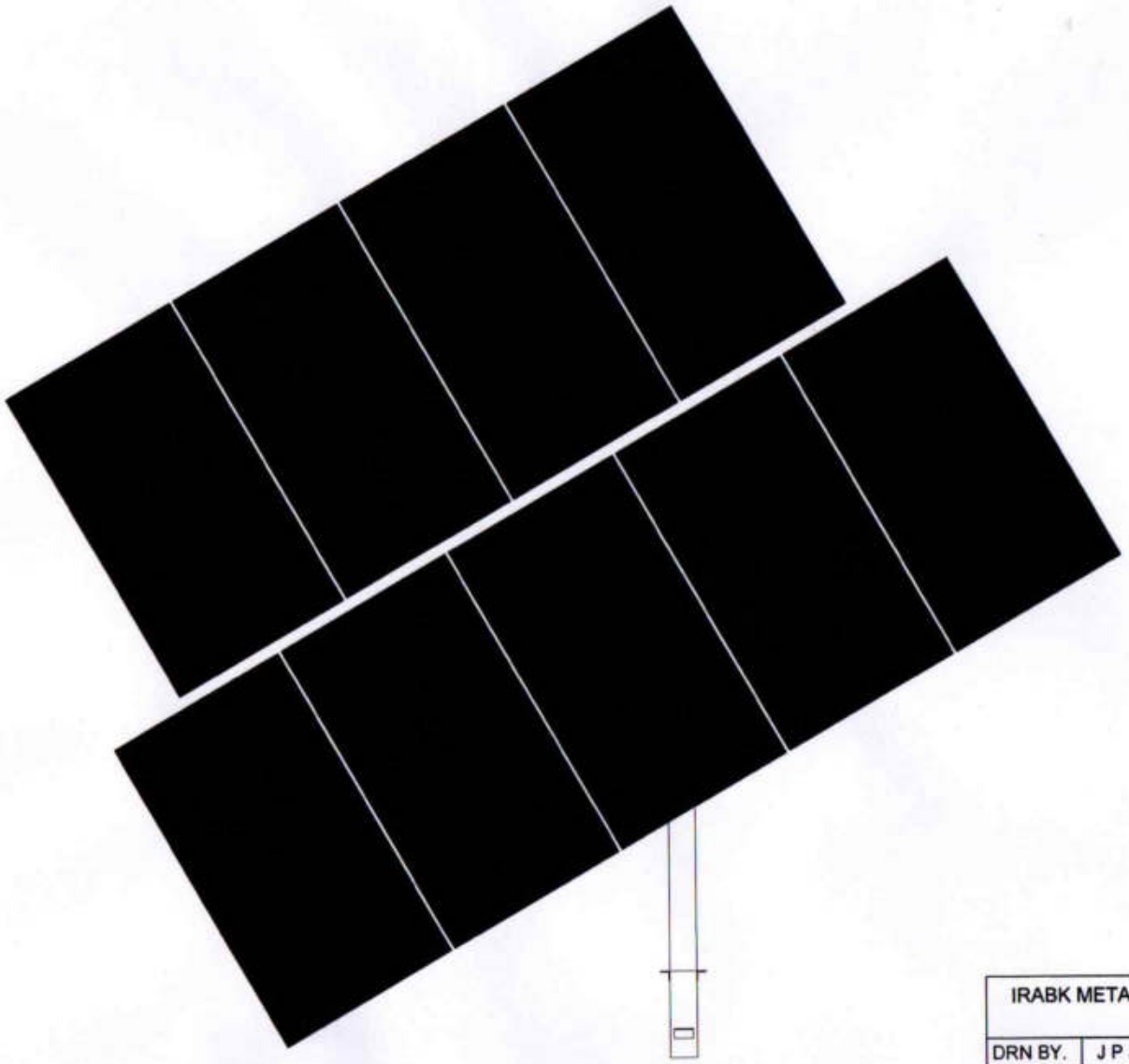
ALL DIMESIONS ARE IN MM

IRABK METAL LLP		TITLE:- 9 nos. Module moutnting structure		
DRN BY.	J P Jangid		SCALE 1:1	DRG. NO. SMP-SM-1216 (Sheet 1)
CHD BY	Anil Upadhyay	-		
CHD BY		PO.No.	105	
SUPERSEDES		NO		

FORMAT ISO A4



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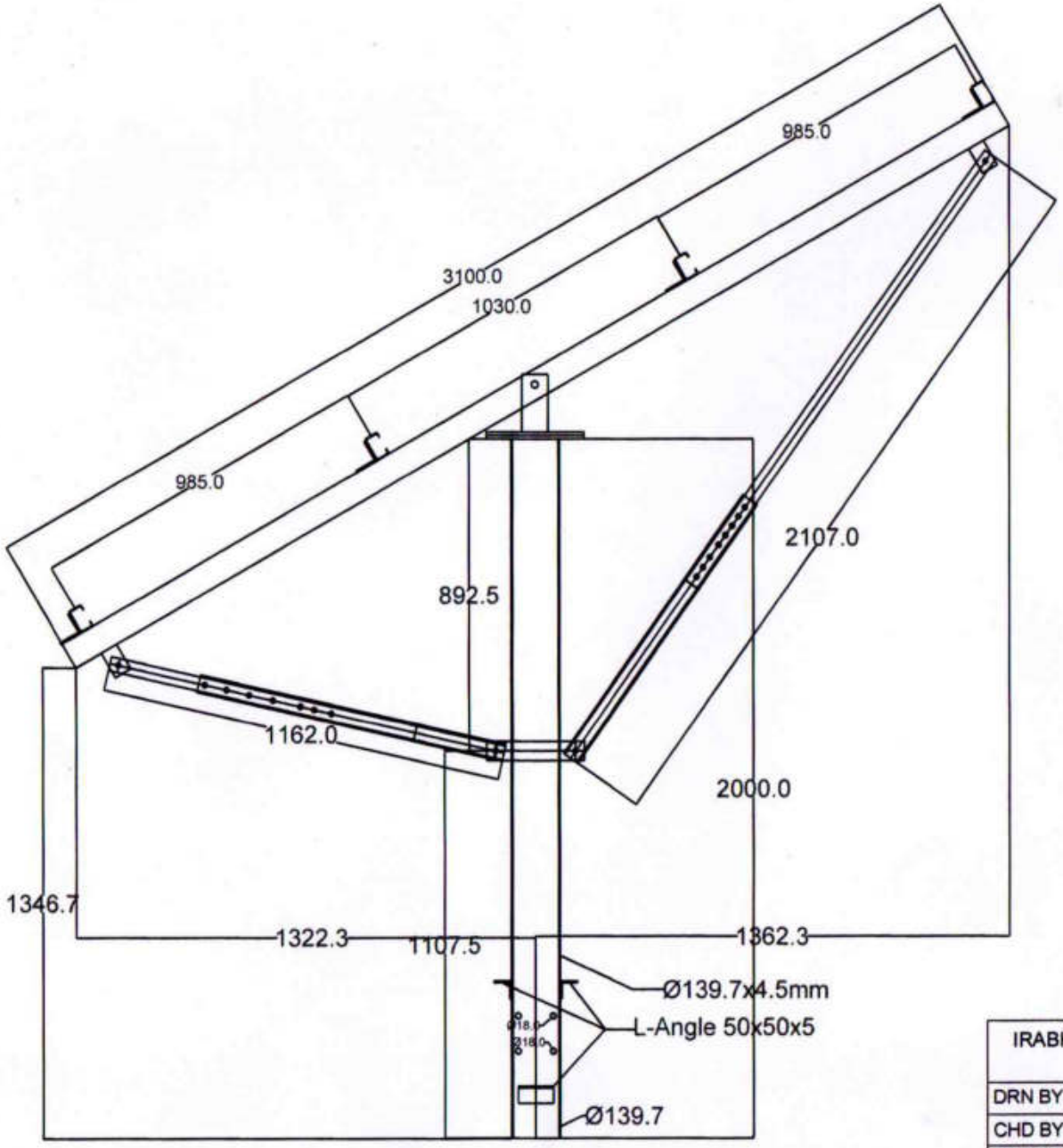
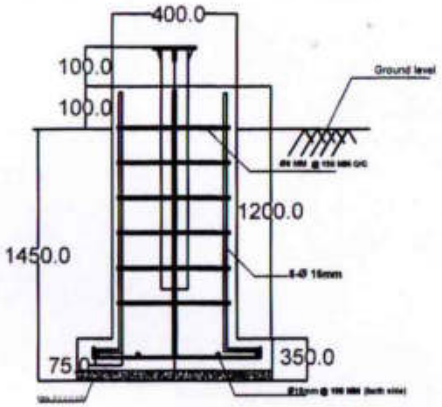
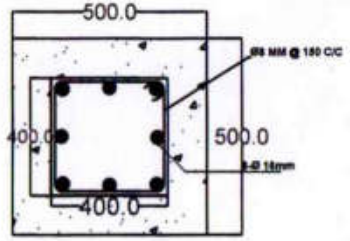
IRABK METAL LLP		TITLE:- 9 nos. Module moutnting structure	
DRN BY.	J P Jangid	SCALE	DRG. NO. SMP-SM-1216 (Sheet 3)
CHD BY	Anil Upadhyay	- 1:1	
CHD BY		PO.No. 105	
SUPERSEDES NO			FORMAT ISO A4







Foundation Detail

Approved :-

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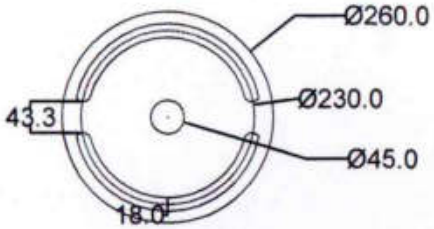
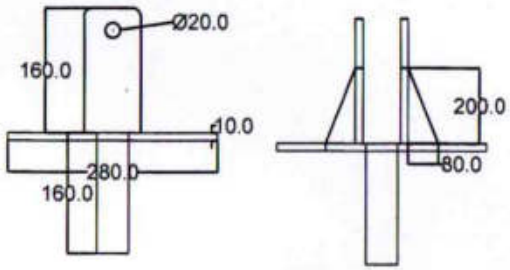
IRABK METAL LLP		TITLE:- 9 nos. Module moutnting structure	
DRN BY.	J P Jangid		DRG. NO. SMP-SM-1216 (Sheet 2)
CHD BY	Anil Upadhyay		
CHD BY		PO.No. 105	

SUPERSEDES NO

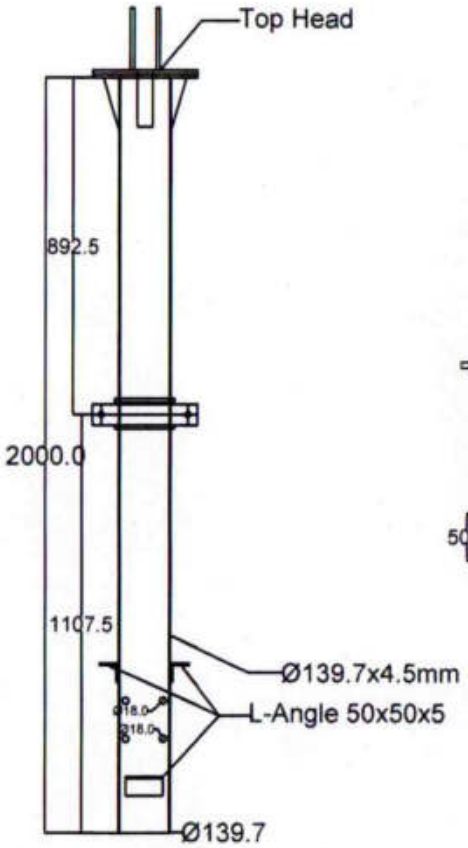
FORMAT ISO A4



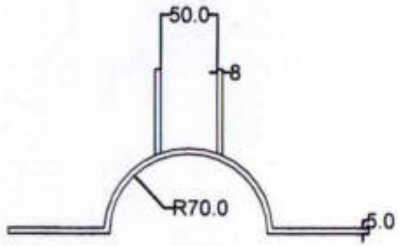
Profile Plate

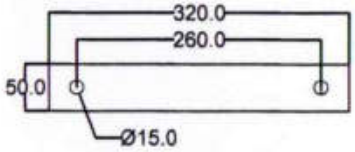


Top Head

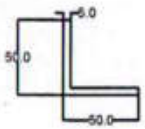


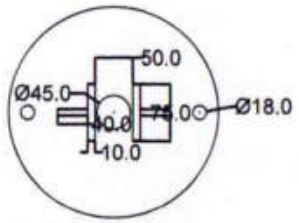
MAIN POLE





MAIN PIPE CLAMP





Head Plate

Approved :-

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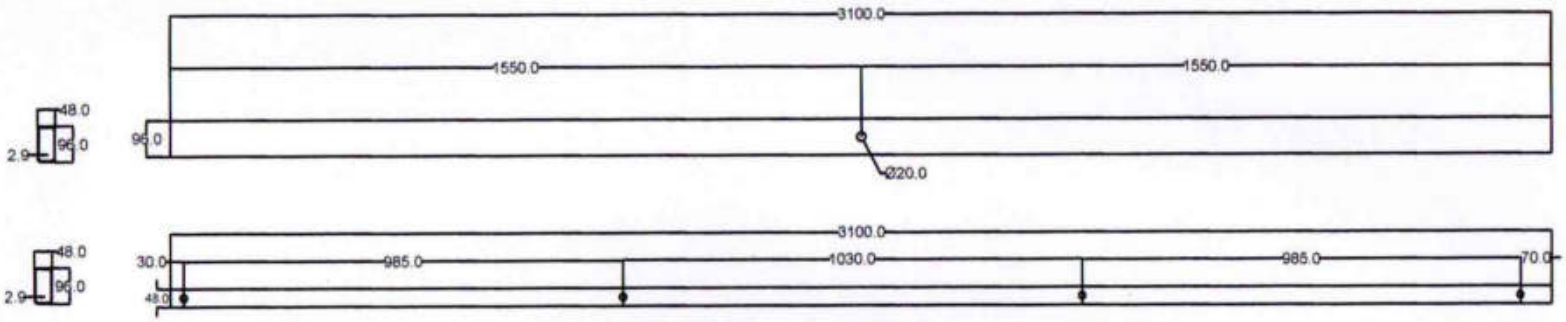
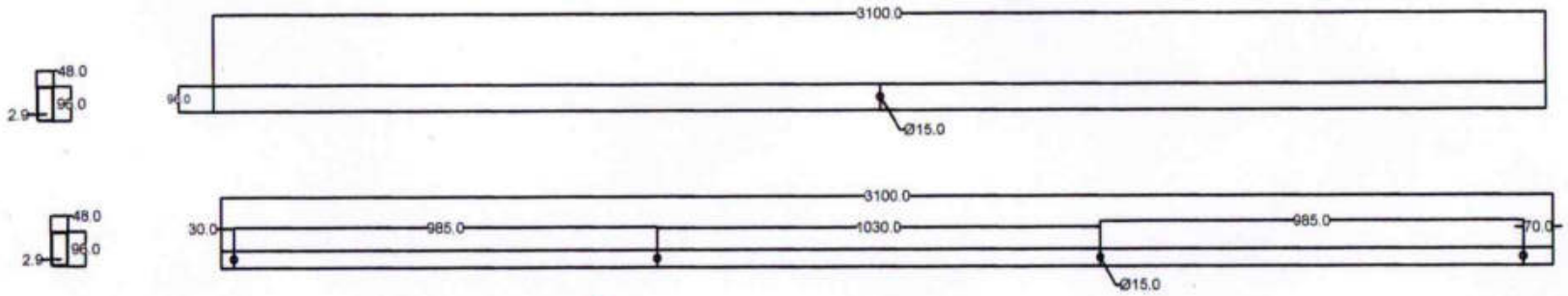
IRABK METAL LLP		TITLE:- 10 nos. Module moutnting structure	
DRN BY.	J P Jangid		DRG. NO. SMP-SM-1216 (Sheet 4)
CHD BY	Anil Upadhyay		
CHD BY		PO.No. 105	
SUPERSEDES		NO	FORMAT ISO A4

Main Rafter



Side Rafter



Approved :-

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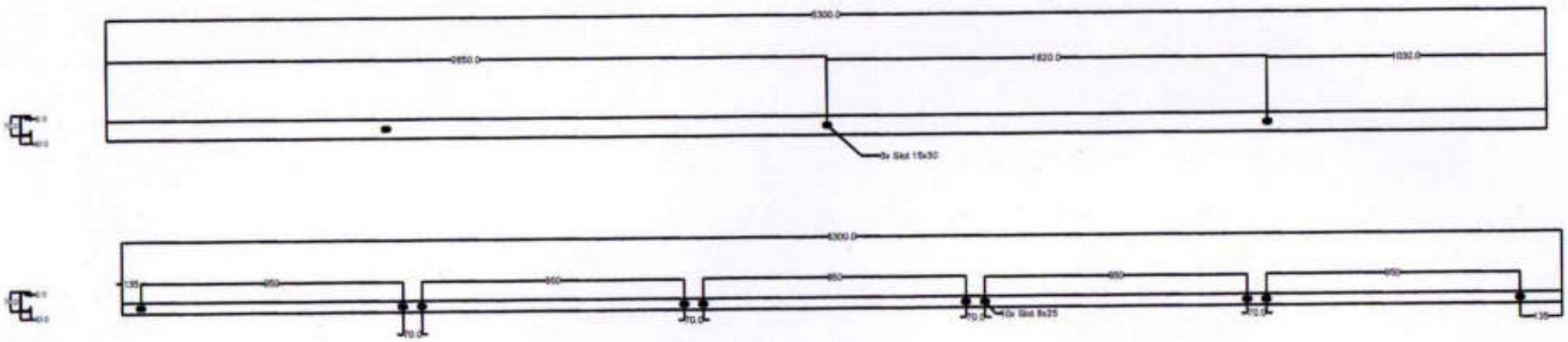
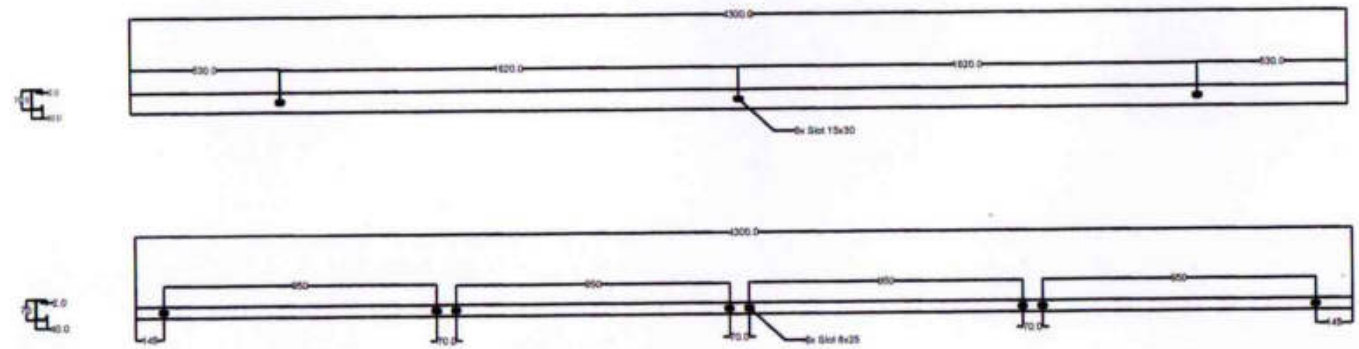
IRABK METAL LLP		TITLE:- RAFTER PART DRAWING	
DRN BY.	J P Jangid		DRG. NO. SMP-SM-1216 (Sheet 5)
CHD BY	Anil Upadhyay	-	
CHD BY		PO.No. 105	
SUPERSEDES		NO	FORMAT ISO A4

Purlin-Front



Purlin-Rear



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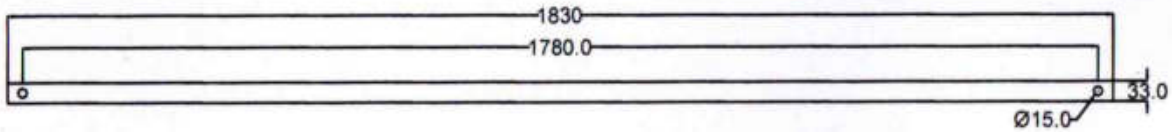
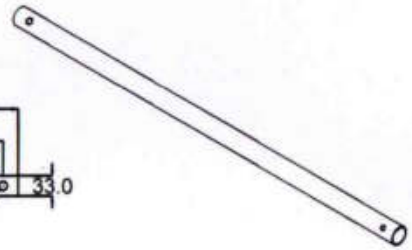
New Delhi-110025

IRABK METAL LLP		TITLE:- 9 nos. Module moutnting structure	
DRN BY.	J P Jangid	SCALE 1:1	DRG. NO. SMP-SM-1216 (Sheet 5)
CHD BY	Anil Upadhyay		
CHD BY		PO.No. 105	
		SUPERSEDES	NO

FORMAT ISO A4

E-W Support





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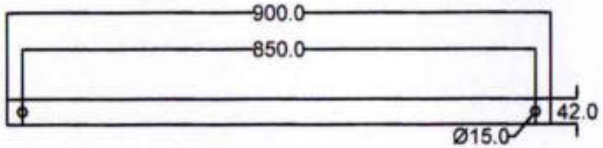

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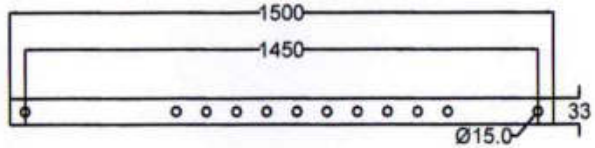

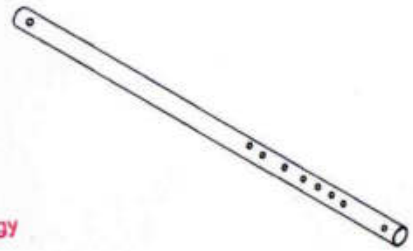

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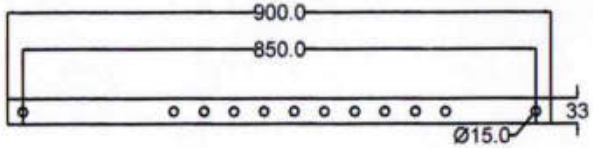

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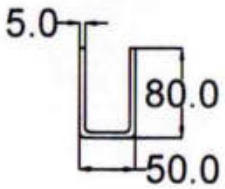
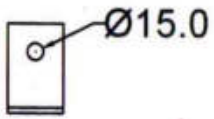
IRABK METAL LLP		TITLE:- SUPPORT SYSTEM PART DRAWING		
DRN BY.	J P Jangid		SCALE 1:1	DRG. NO. SMP-SM-1216 (Sheet 7)
CHD BY	Anil Upadhyay	-		
CHD BY		PO.No.	105	
		SUPERSEDES	NO	

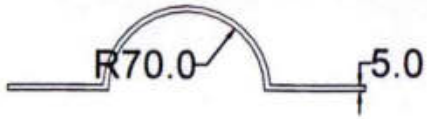
FORMAT ISO A4

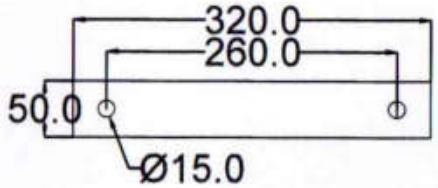
U-Clump

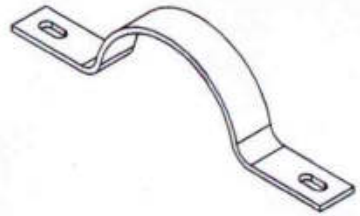




Controller Clamp

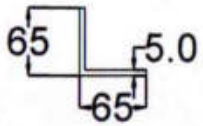


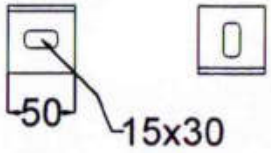


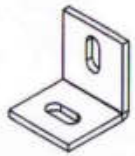


Main Pipe clamp

Purlin-Clit







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IRABK METAL LLP		TITLE:- ACCESORIES PART DRAWING	
DRN BY.	J P Jangid	SCALE 1:1	DRG. NO. SMP-SM-1216 (Sheet 8)
CHD BY	Anil Upadhyay	-	
CHD BY		PO.No. 105	
		SUPERSEDES NO	FORMAT ISO A4

DESIGN BASIS REPORT

FOR

9 MODULE SOLAR

WATER PUMP

GROUND MOUNT SOLAR

MODULE MOUNTING

STEELSTRUCTURETABLE

Approved :-

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TABLE OF CONTENTS

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1. GENERAL:

SCOPE

This document covers the Analysis & Design of Fixed type Solar PV Module mounting structure at an angle of tilt 20 degree.

UNITS OF MEASUREMENTS

Units of measurements used in analysis shall be of SI Units.

CODES AND REFERENCE

Following have been referred for analysis and design of the MMS

Project Reference Drawings/Documents		
1	----------	Geo-Technical Investigation
2	----------	Plot Plan
3	----------	Module GA
Indian Standard Codes		
4	IS 456 - 2000	Plain and Reinforced Concrete - Code of Practice
5	IS 875: Part 1 & 2	Code of practice for the design loads for building andstructures
6	IS875:Part3-2015	Code of practice for the design loads for building and structures - Wind Loads
7	IS 800: 2007 (LSD)	Code of practice for general construction in steel of hot rolled
8	IS 801: 1975	Code of practice for cold formed steel
9	IS 4923: 2017	Specifications for Hollow Steel Sections for Structural Use
10	IS 2062:2011	Hot rolled medium and high tensile structural steel-Specification
11	IS 4759:1996	Hot Dip Zinc Coating on Structural Steel and Alied Products -Specification

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MATERIAL PROPERTIES:

Material	Property	Value	Units
Concrete - M20	Density	23	kN/m³
	Characteristic Strength	20	N/mm²
	Modulus of Elasticity	25000	N/mm²
High Strength Reinforcing Steel	Density	78.5	kN/m³
	Characteristic Strength	500	N/mm²
	Modulus of Elasticity	200000	N/mm²
Structural Steel	Density	78.5	kN/m³
	Characteristic Strength	210 &250	N/mm²
	Modulus of Elasticity	200000	N/mm²

Section Properties

Prop	Section	Area (cm^2)	I_{yy} (cm^4)	I_{zz} (cm^4)	J (cm^4)	Material
1	PIP1397L	19.100	437.000	437.000	874.407	STEEL
3	70CS40X2	3.303	7.532	25.341	0.000	STEEL
4	TUB96482.9	8.016	31.980	95.810	73.990	STEEL
5	PIP424L	3.250	6.460	6.460	12.929	STEEL
6	PIP337L	2.540	3.090	3.090	6.185	STEEL

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PLANT INFORMATION:

PlantLocation: Rajasthan/Haryana/Madhya Pradesh. India Wind Speed: 41.6m/s(150kmph)

SOFTWARE USED:

Below listed software are used for the structural analysis and design;

S. No.	Software Name	Developed By	Usages
1	STAAD Pro	Research Engineers Inc., Berkely, USA	Structural Analysis And Design
2	In-house developed MS -Excel Programs		Load Calculations

2. LOADS:

Load Calculation:

Dead Load

Dead Load Calculations			
Module =	-	335	-
Module Dimensions =	Length (mm)	Width (mm)	Nos.
	1998	1010	8+1=9
Module Orientation =	Portrait		
Tabel Configuration =	Horizontal Row	x	Vertical Column
	4	x	2
Module to Module Gap =	20	mm	
Module Tilt =	30	degree with horizontal	
Weight per module =	24	s	
Weight of 10 Modules =	240	kg	
Length of Purlin =	5300	mm	
Nos. of Purlins =	4		
Member load per unit length =	11.32	kg/m	
	0.1132	kN/m	
All dead load of module have been applied as member load by considering the modules are in constant touch with the purlin upper face.			

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Wind Load:

Wind Pressure Calculations			
Basic Wind Speed =		150	kmph
Basic Wind Speed =		41.6	m/s
Design Period =		25	years
Type of Module Mounting Structure =		Gound mount	
Terrain Category =		2	
Minimum Module Clearance From NGL =		1.0	m
Height of Terrain/Building =		10	m
Risk Coefficient Factor (k1) =		0.90	Table-1, IS-875, part-3-2015
Terrian Factor (k2) =		1.00	Table-2, IS-875, part-3-2015
Topography factor (k3) =		1.00	Clause-6.3.3.1 of IS: 875, part 3-2015
Importance factor (k4) =		1.00	Clause-6.3.4 of IS-875, part-3-2015
Design Wind Speed, Vz=Vb*k1*k2*k3*k4=		37.44	m/s
Design Wind pressure, Pz =0.6*(Vz)^2=		841.0	N/sqm
As per Latest code IS : 875 (Part-3-2015), the design wind pressure Pd can be obtained as as per clause 7.2; Pd = Kd. Ka. Kc .Pz			
Where,	Kd = Wind directionality factor	0.9	Clause-7.2.1 of IS-875, part-3-2015
	Ka = Area averaging factor	1	Table-4 of IS: 875 part 3- 2015
	Kc = Combination factor	0.9	Clause-7.3.3.13 of IS: 875 part 3-2015
Hence, Design pressure = Pd = Kd.Ka.Kc.Pz=		**681.21**	N/sqm

Approved :-

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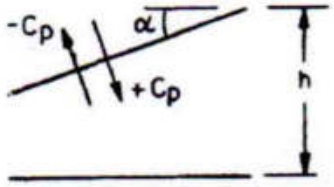
Calculating pressure coefficient for mono-slope roof;



SIGN CONVENTION

+ TOWARDSTHESTRUCTURE(SUCTION),-AWAYFROMTHESTRUCTURE(UPLIFT)

For calculating the force on the panels from the pressure calculated above, we need pressure coefficient. The current structure falls under mono-slope free roofs. Pressure coefficient for mono-slope roof is found out referring section 7.3.3.2, Table 8, IS: 875, Part3 - 2015. The pressure coefficients for a mono-slope free roof of 20° tilt angle and solidity ratio of 0.

WINDLOAD UPWARD/DOWNWARD (+/-Y DIRECTION)		
Upward/Downward Wind Force, F = Cp*A*Pd		
Pressure Coefficient for Upward wind,-Cp	-1.3	(As per IS875 Part-3, Table-7)
Pressure coefficient for Downward wind,+Cp	0.8	(As per IS875 Part-3, Table-7)
Design wind pressure,Pd	681.21	N/sqm
Design wind pressure(Upward Direction) = Cp*Pd	-885.57	N/sqm
Design wind pressure(Downward Direction) = Cp*Pd	544.97	N/sqm
Surface Area of Structural element, A =(1998*1010*9)/(10^6)	18.17	sqm
Upward Wind force,Fu=Cp*A*Pd=	-16.09	kN
Downward Wind force,Fd = Cp*A*Pd =	9.9	kN
Here, we are considering aplied wind force of Solar panels shall be bear by Purlin		
Upward Wind force per unit purlin length,F=Fu/(4*5.3)	-0.76	kN/m
Downward Wind force per unit purlin length,F=Fd/(4*5.3)	0.47	kN/m
Note:- Negative sign shows Upward direction of Wind		

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WINDLOAD SIDEWAYS (X & Z DIRECTION), X-being along the slope

MMS ELEMENT S	SECTION DETAILS			
	Lentgh (mm)	Width (mm)	Lip (mm)	Thickness (mm)
COLUMN	139.7(DIA)	0	0	4.5
RAFTER	96	48	0	2.9
PURLIN	70	40	15	2

As per table-29, IS-875,part-3 value of co-efficient & Reduction factor shall be refered

SECTION S	ANGLE OF WIND	Cft	Wind Facing Width (D) in mm (X-direction)	Length of member mm (l)	D*Vz (in m2/s)-X-dir	l/D (X-Dir)	Reduction Factor (K)
COLUMN	90 degree	2.0	139.7	2000	5.2	14.0	0.70

SECTION S	ANGLE OF WIND	Cfn	Wind Facing Width (D) in mm (Z-direction)	Length of member mm (l)	D*Vz (in m2/s)-X-dir	l/D (X-Dir)	Reduction Factor (K)
COLUMN	0 degree	2.0	139.7	2000	5.2	14.0	0.70
RAFTER	0 degree	2.0	96	3100	3.5	32	0.78

SECTION S	WIND FORCE (Pd*width*Cf* K)	UNITS	DIRECTION
COLUMN	0.066	kN/m	X-Direction
COLUMN	0.066	kN/m	Z-Direction
RAFTER	0.10	KN/M	Z-Direction

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LOAD COMBINATION

LOAD TYPE	L/C	LOAD NAME
Primary	1	Dead Load + Module Weight (DL+MW)
Primary	2	WIND UP
Primary	3	WIND DOWN
Primary	4	WIND X
Primary	5	WIND Z
Combination	6	1.5 (DL+MW)
Combination	7	1.5 (DL+MW+WIND DOWN)
Combination	8	1.5 (DL+MW+WINDX)
Combination	9	1.5 (DL+MW+WINDZ)
Combination	10	1.2 (DL+MW+WIND UP)
Combination	11	1.2 (DL+MW+WIND DOWN)
Combination	12	1.2 (DL+MW+WIND X)
Combination	13	1.2 (DL+MW+WIND Z)
Combination	14	0.9 (DL+MW)+1.5WIND UP
Combination	15	0.9(DL+MW)+1.5 WINDDOWN
Combination	16	0.9 (DL+MW)+ 1.5 WIND X
Combination	17	0.9 (DL+MW)+1.5 WIND Z
Combination	18	1.5 (DL+MW)+ WIND UP

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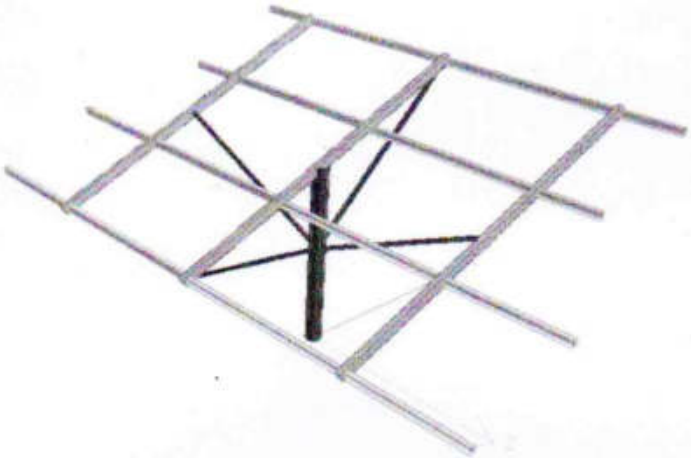
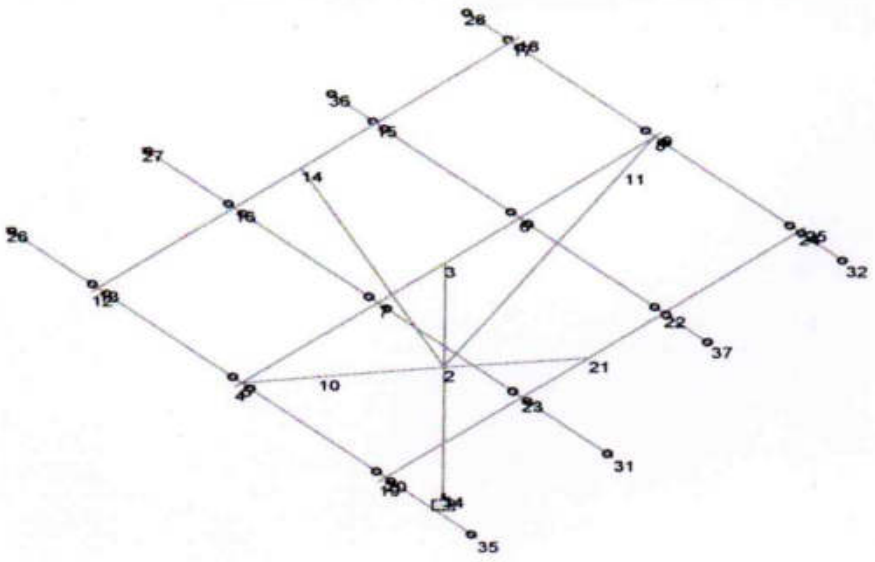
3. STAAD MODEL:



3D RENDERED VIEW



NODE NUMBER

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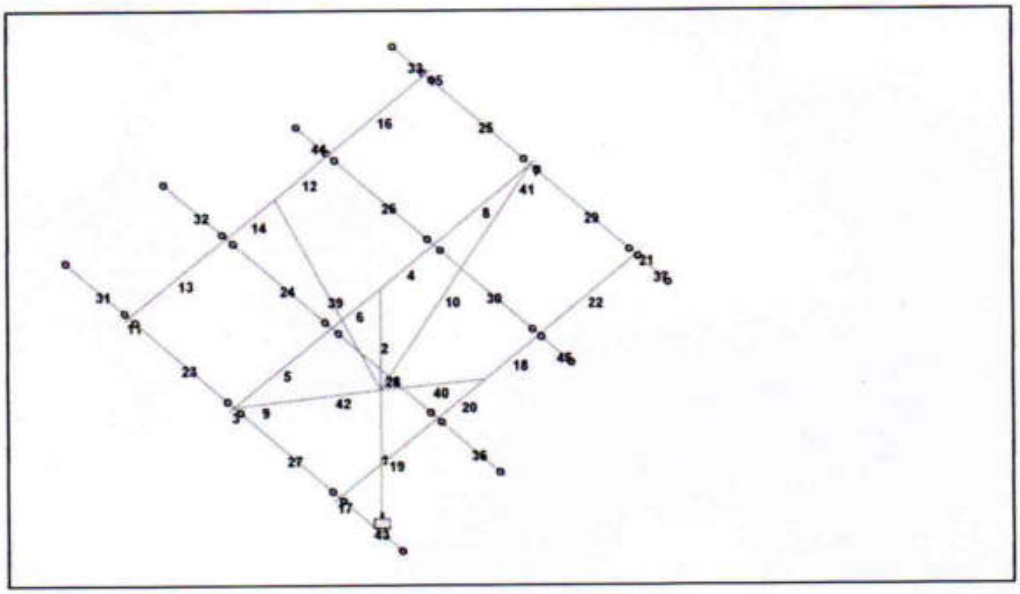

BEAM NUMBER

4. DEFLECTION CHECK:

As per IS 800:2007, following table can be referred for deflection check.

Table 6 Deflection Limits

Type of Building	Deflection	Design Load	Member	Supporting	Maximum Deflection
(1)	(2)	(3)	(4)	(5)	(6)
Industrial Buildings	Vertical	Live load/ Wind load	Purlins and Girts	Elastic cladding	Span/150
				Brittle cladding	Span/180
		Live load	Simple span	Elastic cladding	Span/240
				Brittle cladding	Span/300
		Live load	Cantilever span	Elastic cladding	Span/120
				Brittle cladding	Span/150
		Live load/ Wind load	Rafter supporting	Profiled Metal Sheeting	Span/180
				Plastered Sheeting	Span/240
		Crane load (Manual operation)	Gantry	Crane	Span/500
		Crane load (Electric operation up to 50 t)	Gantry	Crane	Span/750
		Crane load (Electric operation over 50 t)	Gantry	Crane	Span/1 000
	Lateral	No cranes	Column	Elastic cladding	Height/150
				Masonry/Brittle cladding	Height/240
		Crane + wind	Gantry (lateral)	Crane (absolute)	Span/400
				Relative displacement between rails supporting crane	10 mm
		Crane+ wind	Column/frame	Gantry (Elastic cladding; pendent operated)	Height/200
				Gantry (Brittle cladding; cab operated)	Height/400
Other Buildings	Vertical	Live load	Floor and Roof	Elements not susceptible to cracking	Span/300
				Elements susceptible to cracking	Span/360
		Live load	Cantilever	Elements not susceptible to cracking	Span/150
				Elements susceptible to cracking	Span/180
	Lateral	Wind	Building	Elastic cladding	Height/300
				Brittle cladding	Height/500
		Wind	Inter storey drift	—	Storey height/[illegible]

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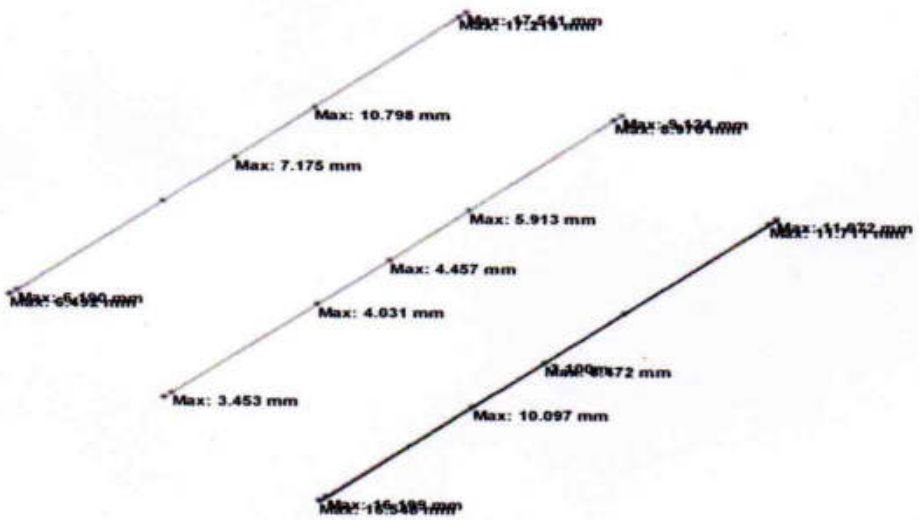
Column deflection check:

Maximum deflection in Column =4.457 mm

Permissible limit for deflection in Column =2000 / 240 = 8.33 mm > 4.457, **Hence OK**

Rafter deflection check:



Maximum deflection in Rafter = 17.219 mm

Permissible limit for deflection in Rafter =3100 / 180 = 17.22mm > 17.219, **Hence OK**

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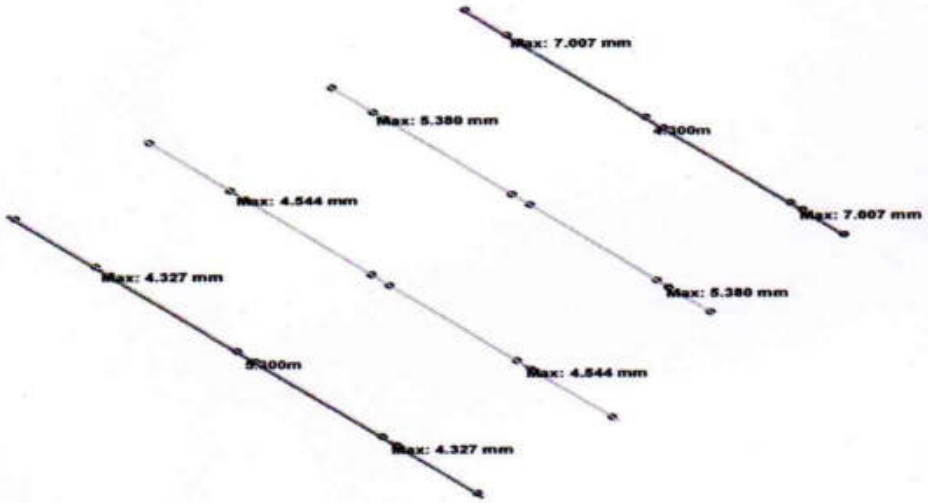
Purlin deflection check:



Maximum deflection in Purlin = 7.007 mm

PermissiblelimitfordeflectioninPurlin=5300/150=35.33mm>07.007,**Hence OK**

5. RAECTION SUMMARY:

	Node	L/C	Horizontal FX (kN)	Vertical FY (kN)	Horizontal FZ (kN)	Moment MX (kNm)	MY (kNm)	MZ (kNm)
Max FX	1	9:1.5(DL+MW+	**0.198**	4.902	0.000	0.000	-0.000	-0.268
Min FX	1	6:1.5(DL+MW+	**-0.000**	17.445	0.000	0.000	-0.000	-0.490
Max FY	1	6:1.5(DL+MW+	-0.000	**17.445**	0.000	0.000	-0.000	-0.490
Min FY	1	14:0.9(DL+MW	-0.000	**-17.344**	-0.000	-0.000	0.000	0.637
Max FZ	1	6:1.5(DL+MW+	-0.000	17.445	**0.000**	0.000	-0.000	-0.490
Min FZ	1	8:15(DL+MW+	-0.000	4.902	**-1.593**	-3.015	0.032	-0.070
Max MX	1	6:1.5(DL+MW+	-0.000	17.445	0.000	**0.000**	-0.000	-0.490
Min MX	1	8:15(DL+MW+	-0.000	4.902	-1.593	**-3.015**	0.032	-0.070
Max MY	1	8:15(DL+MW+	-0.000	4.902	-1.593	-3.015	**0.032**	-0.070
Min MY	1	6:1.5(DL+MW+	-0.000	17.445	0.000	0.000	**-0.000**	-0.490
Max MZ	1	14:0.9(DL+MW	-0.000	-17.344	-0.000	-0.000	0.000	**0.637**
Min MZ	1	6:1.5(DL+MW+	-0.000	17.445	0.000	0.000	-0.000	**-0.490**

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6. UTILITY RATIO:

Beam	Analysis Property	Design Property	Actual Ratio	Allowable Ratio	Ratio (Act./Allow.)	Clause	L/C	Ax (cm^2)	Iz (cm^4)	Iy (cm^4)	Ix (cm^4)
1	PIP1397L	PIP1397L	0.192	1.000	0.192	Sec. 8.2.1.2	8	19.100	437.000	437.000	874.000
2	PIP1397L	PIP1397L	0.080	1.000	0.080	Sec. 8.2.1.2	8	19.100	437.000	437.000	874.000
3	TUB96482.9	TUB96482.9	0.000	1.000	0.000	Sec. 8.4	8	8.016	95.810	31.980	80.100
4	TUB96482.9	TUB96482.9	0.093	1.000	0.093	Sec. 8.2.1.2	8	8.016	95.810	31.980	80.100
5	TUB96482.9	TUB96482.9	0.046	1.000	0.046	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
6	TUB96482.9	TUB96482.9	0.091	1.000	0.091	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
7	TUB96482.9	TUB96482.9	0.000	1.000	0.000	Sec. 8.4	8	8.016	95.810	31.980	80.100
8	TUB96482.9	TUB96482.9	0.049	1.000	0.049	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
9	PIP337L	PIP337L	0.064	1.000	0.064	Sec. 9.3.2.2	7	2.540	3.090	3.090	6.180
10	PIP424L	PIP424L	0.163	1.000	0.163	Sec. 9.3.2.2	7	3.250	6.460	6.460	12.920
11	TUB96482.9	TUB96482.9	0.000	1.000	0.000	Sec. 8.4	8	8.016	95.810	31.980	80.100
12	TUB96482.9	TUB96482.9	0.516	1.000	0.516	Sec. 9.3.2.2	7	8.016	95.810	31.980	80.100
13	TUB96482.9	TUB96482.9	0.279	1.000	0.279	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
14	TUB96482.9	TUB96482.9	0.581	1.000	0.581	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
15	TUB96482.9	TUB96482.9	0.000	1.000	0.000	Sec. 8.4	8	8.016	95.810	31.980	80.100
16	TUB96482.9	TUB96482.9	0.233	1.000	0.233	Sec. 9.3.2.2	7	8.016	95.810	31.980	80.100
17	TUB96482.9	TUB96482.9	0.000	1.000	0.000	Sec. 8.4	8	8.016	95.810	31.980	80.100
18	TUB96482.9	TUB96482.9	0.516	1.000	0.516	Sec. 9.3.2.2	7	8.016	95.810	31.980	80.100
19	TUB96482.9	TUB96482.9	0.279	1.000	0.279	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
20	TUB96482.9	TUB96482.9	0.581	1.000	0.581	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
21	TUB96482.9	TUB96482.9	0.000	1.000	0.000	Sec. 8.4	8	8.016	95.810	31.980	80.100
22	TUB96482.9	TUB96482.9	0.233	1.000	0.233	Sec. 9.3.2.2	7	8.016	95.810	31.980	80.100
23	70CS40X2	70CS40X2	0.315	1.000	0.315	Bending Z	14	3.303	25.341	7.532	0.044
24	70CS40X2	70CS40X2	0.471	1.000	0.471	Bend + Comp	14	3.303	25.341	7.532	0.044
25	70CS40X2	70CS40X2	0.315	1.000	0.315	Bending Z	14	3.303	25.341	7.532	0.044
26	70CS40X2	70CS40X2	0.450	1.000	0.450	Bend + Comp	14	3.303	25.341	7.532	0.044

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Beam	Analysis Property	Design Property	Actual Ratio	Allowable Ratio	Ratio (Act./Allow.)	Clause	L/C	Ax (cm^2)	Iz (cm^4)	Iy (cm^4)	Ix (cm^4)
27	70CS40X2	70CS40X2	0.315	1.000	0.315	Bending Z	14	3.303	25.341	7.532	0.044
28	70CS40X2	70CS40X2	0.471	1.000	0.471	Bend + Comp	14	3.303	25.341	7.532	0.044
29	70CS40X2	70CS40X2	0.315	1.000	0.315	Bending Z	14	3.303	25.341	7.532	0.044
30	70CS40X2	70CS40X2	0.450	1.000	0.450	Bend + Comp	14	3.303	25.341	7.532	0.044
31	70CS40X2	70CS40X2	0.124	1.000	0.124	Bending Z	14	3.303	25.341	7.532	0.044
32	70CS40X2	70CS40X2	0.124	1.000	0.124	Bending Z	14	3.303	25.341	7.532	0.044
33	70CS40X2	70CS40X2	0.033	1.000	0.033	Bending Z	14	3.303	25.341	7.532	0.044
36	70CS40X2	70CS40X2	0.124	1.000	0.124	Bending Z	14	3.303	25.341	7.532	0.044
37	70CS40X2	70CS40X2	0.033	1.000	0.033	Bending Z	14	3.303	25.341	7.532	0.044
39	PIP424L	PIP424L	0.597	1.000	0.597	Sec. 9.3.2.2	7	3.250	6.460	6.460	12.920
40	PIP424L	PIP424L	0.597	1.000	0.597	Sec. 9.3.2.2	7	3.250	6.460	6.460	12.920
41	PIP337L	PIP337L	0.091	1.000	0.091	Sec. 9.3.2.2	7	2.540	3.090	3.090	6.180
42	PIP424L	PIP424L	0.058	1.000	0.058	Sec. 9.3.2.2	7	3.250	6.460	6.460	12.920
43	70CS40X2	70CS40X2	0.124	1.000	0.124	Bending Z	14	3.303	25.341	7.532	0.044
44	70CS40X2	70CS40X2	0.033	1.000	0.033	Bending Z	14	3.303	25.341	7.532	0.044
45	70CS40X2	70CS40X2	0.033	1.000	0.033	Bending Z	14	3.303	25.341	7.532	0.044

CONCLUSION:

The structure is found to be safe and the maximum utility ratio observed is 0.597. The IS Code referred during analysis is IS800-2007 & IS 801- Code of practice for use of cold- formed light gauge steel structural members in general building construction,IS875-Part3:WindLoads andIS875-Part1:DeadLoads.

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7. STAAD INPUT DATA:

```
STAAD SPACE
START JOB INFORMATION
ENGINEER DATE 03-Nov-20
END JOB INFORMATION
INPUT WIDTH 79
UNIT METER KN
JOINT COORDINATES
1 0 0 0; 2 0 1.1 0; 3 0 2 0; 4 -1.35 1.3 0; 5 -1.30561 1.32302 0;
6 0.478755 2.25832 0; 7 -0.431174 1.77643 0; 8 1.34562 2.72605 0;
9 1.39 2.75 0; 10 -0.812749 1.23883 0; 11 1.14758 2.48674 0;
12 -1.35 1.3 -1.62; 13 -1.30561 1.32302 -1.62; 14 0 2 -1.62;
15 0.478755 2.25832 -1.62; 16 -0.431174 1.77643 -1.62;
17 1.34562 2.72605 -1.62; 18 1.39 2.75 -1.62; 19 -1.35 1.3 1.62;
20 -1.30561 1.32302 1.62; 21 0 2 1.62; 22 0.478755 2.25832 1.62;
23 -0.431174 1.77643 1.62; 24 1.34562 2.72605 1.62; 25 1.39 2.75 1.62;
26 -1.30561 1.32302 -2.65; 27 -0.431174 1.77643 -2.65;
28 1.34562 2.72605 -2.15; 31 -0.431174 1.77643 2.65; 32 1.34562 2.72605 2.15;
34 0 0 0; 35 -1.30561 1.32302 2.65; 36 0.478755 2.25832 -2.15;
37 0.478755 2.25832 2.15;
MEMBER INCIDENCES
1 1 2; 2 2 3; 3 4 5; 4 3 6; 5 5 7; 6 7 3; 7 8 9; 8 6 8; 9 5 10; 10 2 11;
11 12 13; 12 14 15; 13 13 16; 14 16 14; 15 17 18; 16 15 17; 17 19 20; 18 21 22;
19 20 23; 20 23 21; 21 24 25; 22 22 24; 23 5 13; 24 7 16; 25 8 17; 26 6 15;
27 5 20; 28 7 23; 29 8 24; 30 6 22; 31 13 26; 32 16 27; 33 17 28; 36 23 31;
37 24 32; 39 14 2; 40 2 21; 41 11 8; 42 10 2; 43 20 35; 44 15 36; 45 22 37;
DEFINE MATERIAL START
ISOTROPIC STEEL
E 2.05e+008
POISSON 0.3
DENSITY 76.8195
ALPHA 1.2e-005
DAMP 0.03
TYPE STEEL
STRENGTH FY 253200 FU 407800 RY 1.5 RT 1.2
END DEFINE MATERIAL
CONSTANTS
MATERIAL STEEL ALL
MEMBER PROPERTY INDIAN
1 2 TABLE ST PIP139ZL
10 39 40 42 TABLE ST PIP424L
9 41 TABLE ST PIP337L
3 TO 8 11 TO 22 TABLE ST TUB96482.9
MEMBER PROPERTY COLDFORMED INDIAN
23 TO 33 36 37 43 TO 45 TABLE ST 70CS40X2
SUPPORTS
1 FIXED
MEMBER RELEASE
23 TO 33 36 37 43 TO 45 START MX MY MZ
23 TO 33 36 37 43 TO 45 END MX MY MZ
LOAD 1 LOADTYPE Dead  TITLE DL+MW
```

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```
SELFWEIGHT Y -1
MEMBER LOAD
23 TO 33 36 37 43 TO 45 UNI GY -0.1132
LOAD 2 LOADTYPE Live REDUCIBLE TITLE WIND UP
MEMBER LOAD
23 TO 33 36 37 43 TO 45 UNI GY 0.76
LOAD 3 LOADTYPE Live REDUCIBLE TITLE WIND DOWN
MEMBER LOAD
23 TO 33 36 37 43 TO 45 UNI GY -0.47
LOAD 4 LOADTYPE Live REDUCIBLE TITLE WIND Z
MEMBER LOAD
1 2 UNI GZ 0.066
3 TO 8 11 TO 22 UNI GZ 0.1
LOAD 7 LOADTYPE Live REDUCIBLE TITLE WIND X
MEMBER LOAD
1 2 UNI GX -0.066
LOAD COMB 5 1.5(DL+MW)
1 1.5
LOAD COMB 6 1.5(DL+MW+ WIND DOWN)
1 1.5 3 1.5
LOAD COMB 8 15(DL+MW+ WIND Z)
1 1.5 4 1.5
LOAD COMB 9 1.5(DL+MW+WIND X)
1 1.5 7 1.5
LOAD COMB 10 1.2(DL+MW+WIND UP)
1 1.2 2 1.2
LOAD COMB 11 1.2(DL+MW+WIND DOWN)
1 1.2 3 1.2
LOAD COMB 12 1.2(DL+MW+WIND Z)
1 1.2 4 1.2
LOAD COMB 13 1.2(DL+MW+WIND X)
1 1.2 7 1.2
LOAD COMB 14 0.9(DL+MW)+1.5 WIND UP
1 0.9 2 1.5
LOAD COMB 15 0.9(DL+MW)+1.5 WIND DOWN
1 0.9 3 1.5
LOAD COMB 16 0.9(DL+MW)+1.5 WIND Z
1 0.9 4 1.5
LOAD COMB 17 0.9(DL+MW)+1.5 WIND X
1 0.9 7 1.5
LOAD COMB 18 1.5(DL+MW)+WIND UP
1 1.5 2 1.0
PERFORM ANALYSIS
PARAMETER 1
CODE IS800 LSD
FYLD 210000 MEMB 1 TO 22 39 TO 42
CHECK CODE MEMB 1 TO 22 39 TO 42
PARAMETER 2
CODE IS801
FYLD 250000 MEMB 23 TO 33 36 37 43 TO 45
CHECK CODE MEMB 23 TO 33 36 37 43 TO 45
FINISH
```

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8. STAAD OUTPUT:

```
|--------------------------------------------------------------------------------|
| MemberNumber: 1                                                                |
| MemberSection:ST PIP1397L          (INDIANSECTIONS)                            |
|Status:PASSRatio:      0.161CriticalLoadCase:      8Location:      0.00         |
| CriticalCondition:Sec.8.2.1.2                                                  |

|--------------------------------------------------------------------------------|
| MemberNumber: 2                                                                |
| MemberSection:ST PIP1397L          (INDIANSECTIONS)                            |
|Status:PASSRatio:      0.068CriticalLoadCase:      8Location:      0.00         |
| CriticalCondition:Sec.8.2.1.2                                                  |

|--------------------------------------------------------------------------------|
| MemberNumber: 3                                                                |
| MemberSection: ST TUB96482.9 (INDIANSECTIONS)                                  |
|Status:PASSRatio:      0.000CriticalLoadCase:      8Location:      0.05         |
| CriticalCondition:Sec.8.4                                                      |

|--------------------------------------------------------------------------------|
| MemberNumber: 4                                                                |
| MemberSection: ST TUB96482.9 (INDIANSECTIONS)                                  |
|Status:PASSRatio:      0.087 CriticalLoadCase: 14Location:      0.00            |
| CriticalCondition:Sec.9.3.2.2
STAAD.PROCODECHECKING-IS-800-2007-LSD(V2.0)
**********

|--------------------------------------------------------------------------------|
| MemberNumber: 5                                                                |
| MemberSection: ST TUB96482.9 (INDIANSECTIONS)                                  |
|Status:PASSRatio:      0.044 CriticalLoadCase: 14Location:      0.98            |
| CriticalCondition:Sec.9.3.2.2                                                  |

|--------------------------------------------------------------------------------|
| MemberNumber: 6                                                                |
| MemberSection: ST TUB96482.9 (INDIANSECTIONS)                                  |
|Status:PASSRatio:      0.086 CriticalLoadCase: 14Location:      0.49            |
| CriticalCondition:Sec.9.3.2.2                                                  |

|--------------------------------------------------------------------------------|
| MemberNumber: 7                                                                |
| MemberSection: ST TUB96482.9 (INDIANSECTIONS)                                  |
|Status:PASSRatio:      0.000CriticalLoadCase:      8Location:      0.00         |
| CriticalCondition:Sec.8.4                                                      |

|--------------------------------------------------------------------------------|
| MemberNumber: 8                                                                |
| MemberSection: ST TUB96482.9 (INDIANSECTIONS)                                  |
|Status:PASSRatio:      0.046 CriticalLoadCase: 14Location:      0.00            |
| CriticalCondition:Sec.9.3.2.2                                                  |
```

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****

MemberNumber: 9					
MemberSection:ST PIP337L		(INDIANSECTIONS)			
Status:PASS	Ratio:	0.058	CriticalLoadCase:	7	Location: 0.42
CriticalCondition:Sec.9.3.2.2					

MemberNumber: 10					
MemberSection:ST PIP424L		(INDIANSECTIONS)			
Status:PASS	Ratio:	0.166	CriticalLoadCase:	7	Location: 0.00
CriticalCondition:Sec.9.3.2.2					

MemberNumber: 11					
MemberSection: ST TUB96482.9 (INDIANSECTIONS)					
Status:PASS	Ratio:	0.000	CriticalLoadCase:	8	Location: 0.05
CriticalCondition:Sec.8.4					

MemberNumber: 12					
MemberSection: ST TUB96482.9 (INDIANSECTIONS)					
Status:PASS	Ratio:	0.467	CriticalLoadCase:	7	Location: 0.00
CriticalCondition:Sec.9.3.2.2					

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****

MemberNumber: 13					
MemberSection: ST TUB96482.9 (INDIANSECTIONS)					
Status:PASS	Ratio:	0.263	CriticalLoadCase:	14	Location: 0.98
CriticalCondition:Sec.9.3.2.2					

MemberNumber: 14					
MemberSection: ST TUB96482.9 (INDIANSECTIONS)					
Status:PASS	Ratio:	0.549	CriticalLoadCase:	14	Location: 0.49
CriticalCondition:Sec.9.3.2.2					

MemberNumber: 15					
MemberSection: ST TUB96482.9 (INDIANSECTIONS)					
Status:PASS	Ratio:	0.000	CriticalLoadCase:	8	Location: 0.00
CriticalCondition:Sec.8.4					

MemberNumber: 16					
MemberSection: ST TUB96482.9 (INDIANSECTIONS)					
Status:PASS	Ratio:	0.211	CriticalLoadCase:	7	Location: 0.00

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| CriticalCondition:Sec.9.3.2.2 |

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****

|---|
MemberNumber: 17
| MemberSection: ST TUB96482.9 (INDIANSECTIONS)
|Status:PASSRatio: 0.000CriticalLoadCase: 8Location: 0.05 |
| CriticalCondition:Sec.8.4

|---|
| MemberNumber: 18
| MemberSection: ST TUB96482.9 (INDIANSECTIONS)
|Status:PASSRatio: 0.467CriticalLoadCase: 7Location: 0.00 |
| CriticalCondition:Sec.9.3.2.2

|---|
| MemberNumber: 19
| MemberSection: ST TUB96482.9 (INDIANSECTIONS)
|Status:PASSRatio: 0.263 CriticalLoadCase: 14Location: 0.98 |
| CriticalCondition:Sec.9.3.2.2

|---|
| MemberNumber: 20
| MemberSection: ST TUB96482.9 (INDIANSECTIONS)
|Status:PASSRatio: 0.549 CriticalLoadCase: 14Location: 0.49 |
| CriticalCondition:Sec.9.3.2.2

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****

|---|
| MemberNumber: 21
| MemberSection: ST TUB96482.9 (INDIANSECTIONS)
|Status:PASSRatio: 0.000CriticalLoadCase: 8Location: 0.00 |
| CriticalCondition:Sec.8.4

|---|
| MemberNumber: 22
| MemberSection: ST TUB96482.9 (INDIANSECTIONS)
|Status:PASSRatio: 0.211CriticalLoadCase: 7Location: 0.00 |
| CriticalCondition:Sec.9.3.2.2

|---|
| MemberNumber: 39
| MemberSection:ST PIP424L (INDIANSECTIONS)
|Status:PASSRatio: 0.590CriticalLoadCase: 7Location: 1.85 |
| CriticalCondition:Sec.9.3.2.2

|---|
| MemberNumber: 40

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| MemberSection:ST PIP424L (INDIANSECTIONS) |
|Status:PASSRatio: 0.590CriticalLoadCase: 7Location: 0.00 |
| CriticalCondition:Sec.9.3.2.2 |

STAAD.PROCODECHECKING-IS-800-2007-LSD(V2.0)
****

|MemberNumber:41 |
| MemberSection:ST PIP337L (INDIANSECTIONS) |
|Status:PASSRatio: 0.083CriticalLoadCase: 7Location: 0.00 |
| CriticalCondition:Sec.9.3.2.2 |

| MemberNumber: 42 |
| MemberSection: ST PIP424L (INDIANSECTIONS) |
| Status:PASS Ratio: 0.053 CriticalLoadCase: 7 Location: 0.82 |
| CriticalCondition:Sec.9.3.2.2 |

STAAD.ProCODECHECKING-(I801)
****

|UNITS:MM,KN,KNM,MPA |
| |
|MEMBER#23 SECTION:70CS40X2 LEN:
1620.00 GOV.LOC:810.00|
|STATUS:PASSRATIO= 0.267 GOV.MODE:BendingZGOV.LOAD:14 |

|UNITS:MM,KN,KNM,MPA |
| |
|MEMBER#24 SECTION:70CS40X2 LEN:
1620.00 GOV.LOC:810.00|
|STATUS: PASS RATIO= 0.398
GOV.MODE :Bend +Compress GOV.LOAD:14 |
|UNITS:MM,KN,KNM,MPA |
| |
|MEMBER#25 SECTION:70CS40X2 LEN:
1620.00 GOV.LOC:810.00|
|STATUS:PASSRATIO= 0.267 GOV.MODE:BendingZGOV.LOAD:14 |

|UNITS:MM,KN,KNM,MPA |

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Prof. [illegible]
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|                                                                    |
|MEMBER#26 SECTION:70CS40X2          LEN:
1620.00 GOV.LOC:810.00|
|STATUS:PASSRATIO= 0.379
GOV.MODE:Bend+CompressGOV.LOAD:14 |
|-------------------------------------------------------------
|UNITS:MM,KN,KNM,MPA                                                 |
|                                                                    |
|MEMBER#27 SECTION:70CS40X2          LEN:
1620.00GOV.LOC:                    810.00|
|STATUS:PASSRATIO= 0.267
GOV.MODE:BendingZGOV.LOAD:14 |
|-------------------------------------------------------------------------
|UNITS:MM,KN,KNM,MPA                                                 |
|                                                                    |
|MEMBER#28 SECTION:70CS40X2          LEN:
1620.00 GOV.LOC:810.00|
|STATUS:PAS RATIO= 0.398
GOV.MODE:Bend+CompressGOV.LOAD:14 |
|-------------------------------------------------------------
                  ----------|

|UNITS:MM,KN,KNM,MPA                                                 |
|                                                                    |
|MEMBER#29 SECTION:70CS40X2          LEN:
1620.00 GOV.LOC:810.00 |
|STATUS:PASSRATIO= 0.267
GOV.MODE:BendingZGOV.LOAD:14 |
|-------------------------------------------------------------
                  ----------|

|UNITS:MM,KN,KNM,MPA                                                 |
|                                                                    |
|MEMBER#30 SECTION:70CS40X2          LEN:
1620.00 GOV.LOC:810.00 |
|STATUS:PASSRATIO= 0.379
GOV.MODE:Bend+CompressGOV.LOAD:14 |
|-------------------------------------------------------------
                  ----------|

|UNITS:MM,KN,KNM,MPA                                                 |
|                                                                    |
|MEMBER#31 SECTION:70CS40X2          LEN:
1030.00 GOV.LOC:515.00 |
|STATUS:PASSRATIO= 0.099
GOV.MODE:BendingZGOV.LOAD:14 |
|-------------------------------------------------------------
```

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----------|

|UNITS:MM,KN,KNM,MPA |
|
|MEMBER#32 SECTION:70CS40X2 LEN:
1030.00 GOV.LOC:515.00 |
|STATUS:PASS RATIO= 0.099
GOV.MODE:BendingZGOV.LOAD:14 |
|----------
----------|

|UNITS:MM,KN,KNM,MPA |
|
|MEMBER#33 SECTION:70CS40X2
LEN:530.00 GOV.LOC:265.00 |
|STATUS:PASS RATIO= 0.026
GOV.MODE:BendingZGOV.LOAD:14 |
|----------|
|UNITS:MM,KN,KNM,MPA |
|
|MEMBER#36 SECTION:70CS40X2 LEN:
1030.00GOV.LOC: 515.00 |
|STATUS:PASS RATIO= 0.099
GOV.MODE:BendingZGOV.LOAD:14 |
|----------
----------|

|UNITS:MM,KN,KNM,MPA |

|
|MEMBER#37 SECTION:70CS40X2 LEN:
530.00GOV.LOC: 265.00 |
|STATUS:PASSRATIO= 0.026
GOV.MODE:BendingZGOV.LOAD:14 |
|----------
----------|

|UNITS:MM,KN,KNM,MPA |
|
|MEMBER#43 SECTION:70CS40X2 LEN:
1030.00 GOV.LOC:515.00 |
|STATUS:PASS RATIO= 0.099
GOV.MODE:BendingZGOV.LOAD:14 |
|----------
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|UNITS:MM,KN,KNM,MPA |
|
|MEMBER#44 SECTION:70CS40X2 LEN:

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530.00 GOV.LOC:265.00 |
|STATUS:PASSRATIO= 0.026
GOV.MODE:BendingZGOV.LOAD:14 |
|----------

|UNITS:MM,KN,KNM,MPA |
|
|MEMBER#45 SECTION:70CS40X2 LEN: 530.00GOV.LOC: 265.00 |
|STATUS:PASSRATIO= 0.026
GOV.MODE:BendingZGOV.LOAD:14 |
|----------|

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8. FOUNDATION

Breadth of Pedestal	B	=	0.40	m	
Length of the Pedestal	L	=	0.40	m	
Unit weight of water	Yw	=	10.00	kN/m3	
Unit weight of soil	Ys	=	20.00	kN/m3	
Factor of Safety	FOS	=	1.5		
Unit Weight of Pedestal Material	Yp	=	23.00	kN/m3	
Grade of Concrete		=	20 .00	N/mm2	
Grade of Steel	Fy	=	500	N/mm2	
Soil Bearing Capacity		=	80.00	kN/m2	
Bearing Capacity factor, Ny	Ny	=	0.60		
Bearing Capacity factor, Nq	Nq	=	1.75		IS:6403:1981 Table:1 Bearing Capacity Factors
Bearing Capacity factor, Nc	Nc	=	6.86		
Downward force from superstructure(P)	Qv(+)	=	17.34	kN	
Uplift from superstructure	Qv(-)	=	17.45	kN	
Lateral force from superstructure	QH	=	5.60	kN	From STAAD Result
Moment from Superstructure	M	=	3.02	kN-m	
Unsupported length of the Pedestal above ground	e	=	0.10	m	

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DESIGN
VERTICAL CAPACITY OF FOOTING

AREA OF FOOTING:

Assume self weight of footing	w	=	0.1x17.34	KN	w=0.1P
Total Weight	W	=	1.734+17.34	kN	W=0.1P+P
	W	=	19.074	kN	
Area of Footing	A	=	19.074/80	kN	A= W/SBC

Size of Footing, = $\sqrt{0.238}$ m

=0.487 m

Therefore

Provide 0.5 m x 0.5 m Square Footing,

So

Total area Required	=0. 25	m2
Length of Footing	=0. 25	m
Beadth of Footing	=0. 25	m

PRESSURE ACTS ON FOOTING:

Pressure	P	=Pu/A	KN/m2
	P	= 1.5x19.074/0.25	KN/m2
Pressure	P	= 114.42	KN/m2

FACTORED BENDING MOMENT per 'm':

Factored Bending Moment	Mu	=PxLX((B-D)/2)^2/2	KN-m
	Mu	=114.42x0.5X((0.5-0.4)/2)^2/2	KN-m
	Mu	=0.0715	KN-m

Where
B= Length of Footing
D= Length of Pedestal
P= Pressure on Footing
L= B

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Prof. [illegible]
Dean [illegible]
FIO E[illegible]ngineering
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EFFECTIVE DEPTH:

$d_{required} = \sqrt{Mu}/0.133 f_{ck} x b$ mm

$d_{required} = \sqrt{0.0715 x 10^6}/0.133 x 20 x 500$ mm

$d_{required} = 8.0$ mm

we provide $d_{required} = 150.0$ mm

For considerations,increase depth 1.75 to 2 times more than the calculated value

$d_{required} = 150.0 \times 2$

Efective depth $d_{required} = 300$ mm

Overall depth $D = 350$ mm

Footing cover $= 50$ mm

Where
Mu= Factored Moment
f_{ck}= Characteristic Compressive strength
b= Breadth of Footing

AREA OF TENSION REINFORCEMENT:

Moment of Resistance $Mu = 0.87 Fy Ast d(1-Ast Fy/bd Fck)$ mm^2

$0.0715 = 0.87x500 Astx 300(1-Astx500/500x500x500x 20)$ mm^2

$0.0715 = 0.87x500 Astx 300(1-Astx500/500x500x500x 20)$ mm^2

$Ast = 671$ mm^2

Where
Mu= Factored Moment
f_{ck}= Characteristic Compressive strength
b= effective depth
d= Breadth of Footing

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AREA OF STEEL per m:

=Ast/span
=671/0.5
=1342 mm^2

AREA OF ONE BAR:

ast $=\pi d^2/4$

Assume 16 mm dia bar, $= 3.14x12^2/4$

$= 200.96$ mm^2

SPACING OF REINFORCEMENT:

=(Area of one bar/area/m)x1000
= (ast/Ast) x 1000
= (200.96/1342)x1000 mm
= 149.746

mm

Provide 16 mm dia bars at 150 mm c/c spacing.

NUMBER OF BARS:

= (Ast/ast)
= (1342/200.96)
= 7 nos of bar

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CHECK FOR ONE WAY SHEAR:
(a) SHEAR FORCE PER 'm':

Vu = P X B X ((L-D)/2-d
= 114.42x1x(((0.5-0.4)/2-0.5)
= 51.49 KN

(b) NOMINALSHEAR STRESS:

Tv =Vu/bd

= 51.49x10^3/1000x300

= .0.172 N/mm2

(c) percentage of steel:

=100xAst/bd

= 100x671/500x300

= 0.447

Now, Refer Table No.19 Page No. 73 of IS456:2000

Tc = 0.46 N/mm2

Therefore,

Tv < Tc

0.172 N/mm2 < 0.46 N/mm2

HENCE, Design is safe against one way shear.

Approved :-

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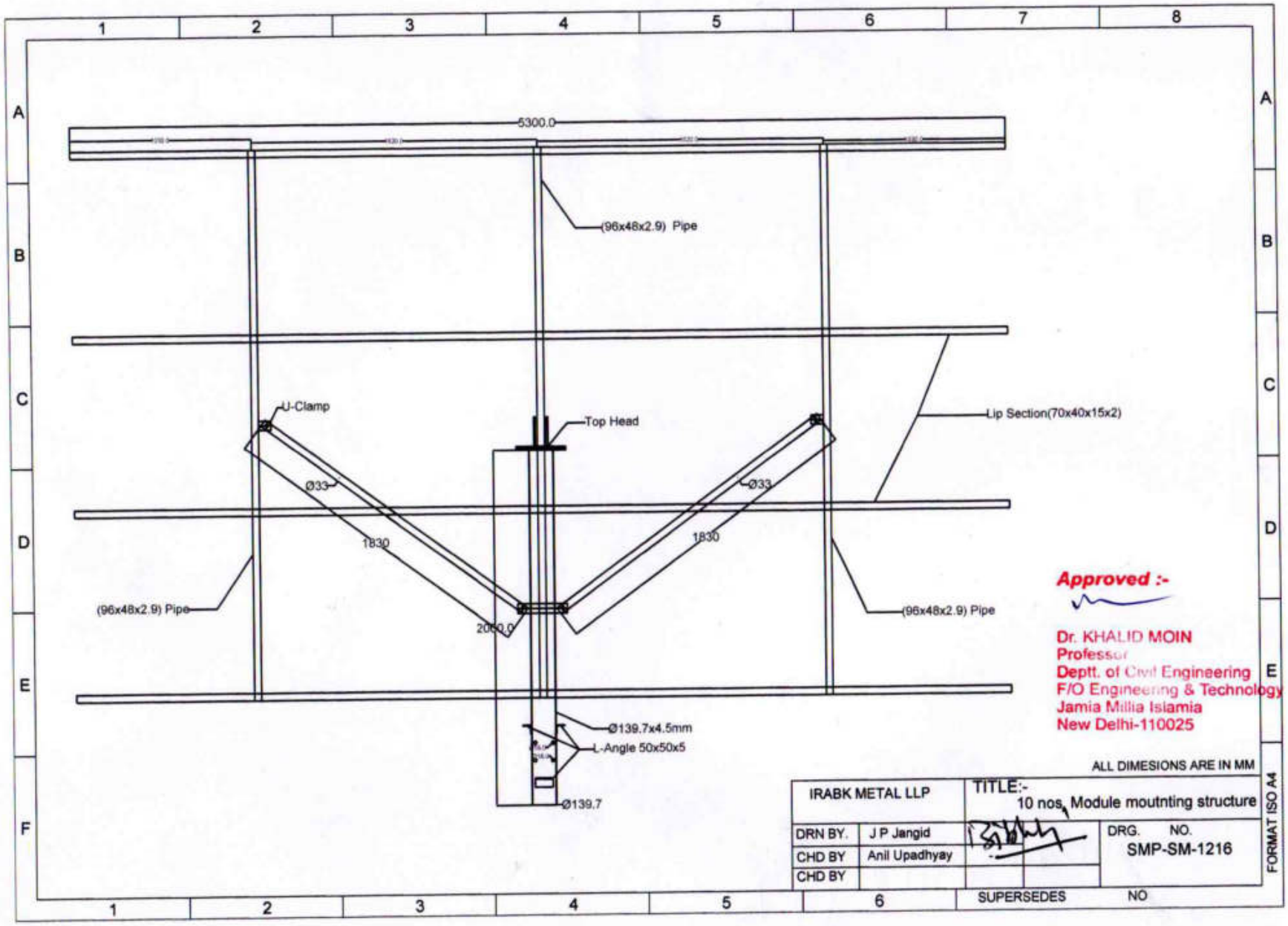

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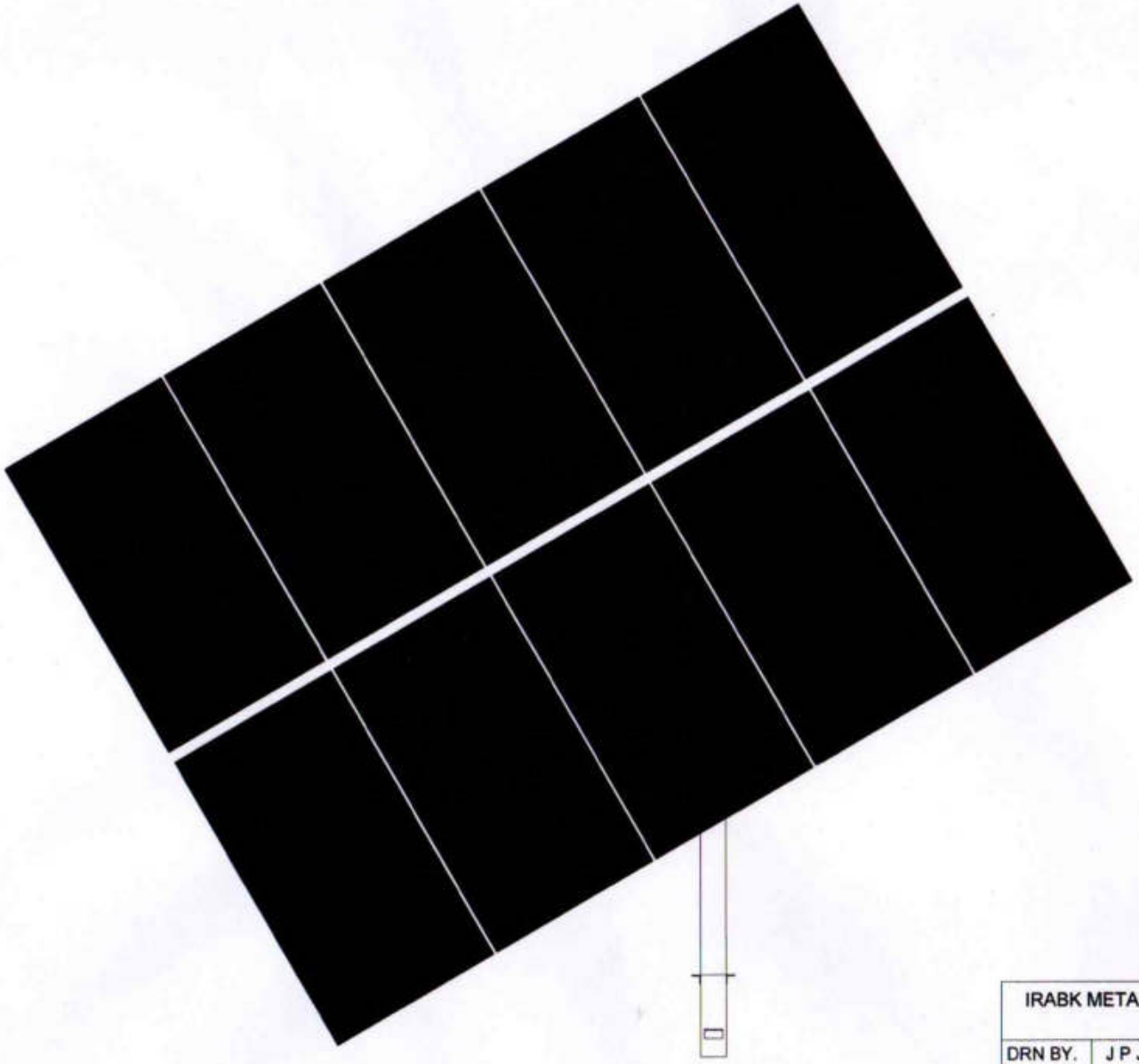
ALL DIMESIONS ARE IN MM

IRABK METAL LLP		TITLE:- 10 nos. Module moutnting structure	
DRN BY.	J P Jangid		DRG. NO. SMP-SM-1216
CHD BY	Anil Upadhyay		
CHD BY			
		SUPERSEDES	NO

FORMAT ISO A4



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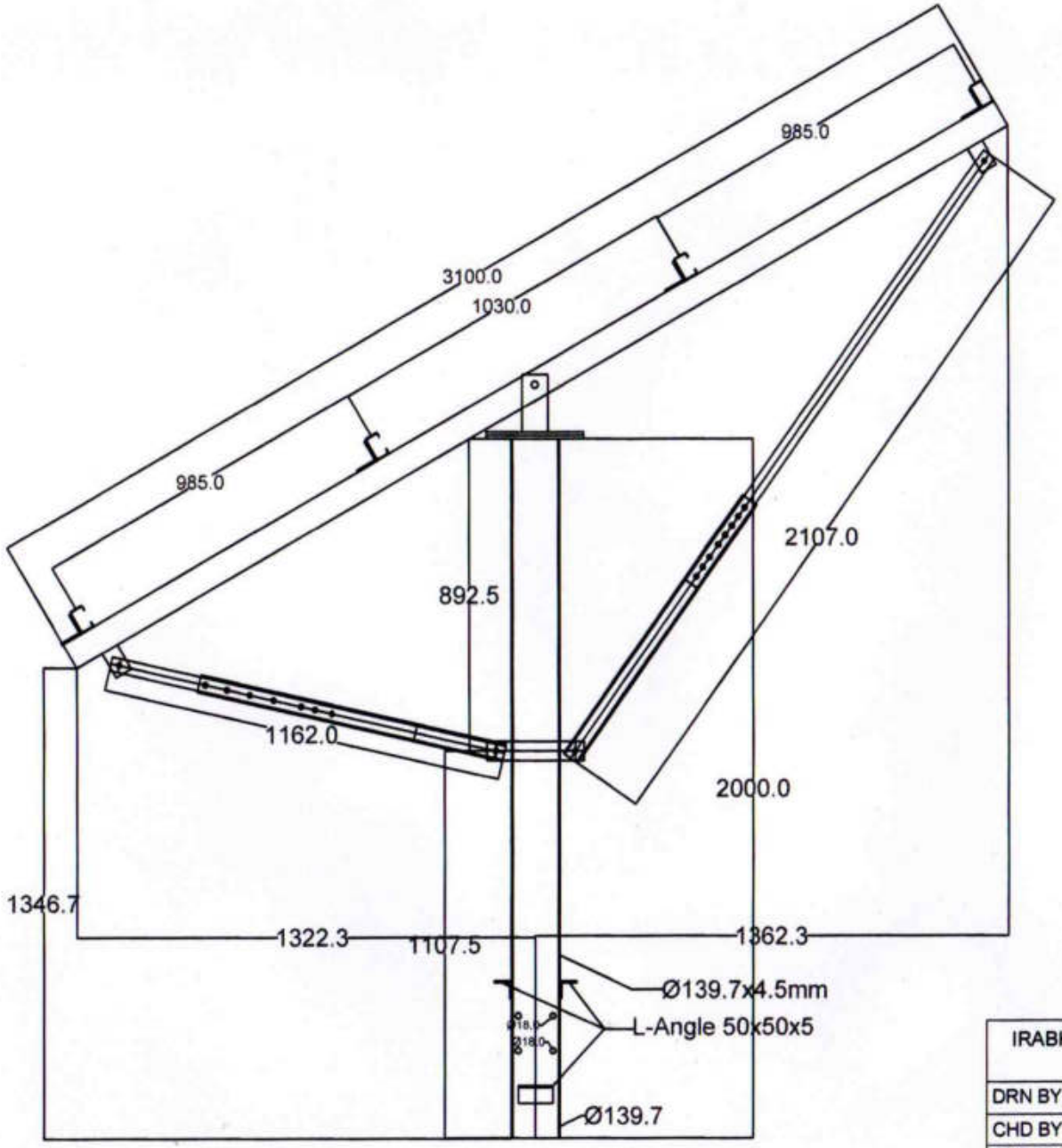
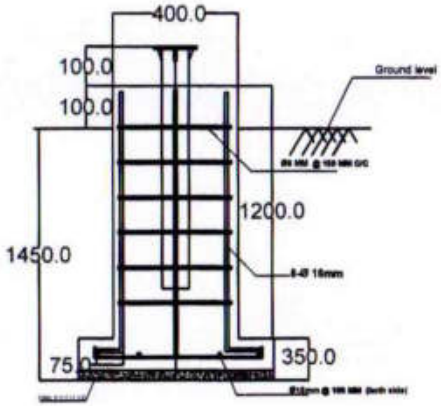
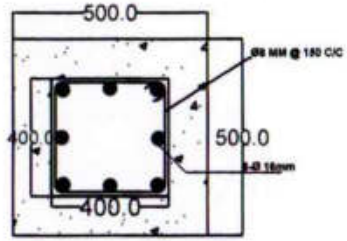
IRABK METAL LLP		TITLE:- 10 nos. Module moutnting structure	
DRN BY.	J P Jangid	SCALE	DRG. NO. SMP-SM-1216 (Sheet 3)
CHD BY	Anil Upadhyay	1:1	
CHD BY		PO.No. 105	
SUPERSEDES	NO		

FORMAT ISO A4







Foundation Detail

Approved :-

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New Delhi-110025

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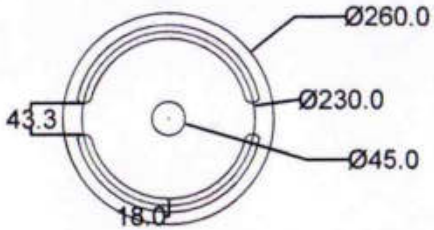
DRN BY.	J P Jangid			DRG. NO. SMP-SM-1216 (Sheet 2)
CHD BY	Anil Upadhyay	-		
CHD BY		PO.No.	105	

SUPERSEDES NO

FORMAT ISO A4



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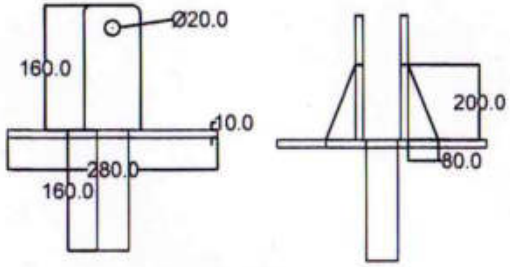
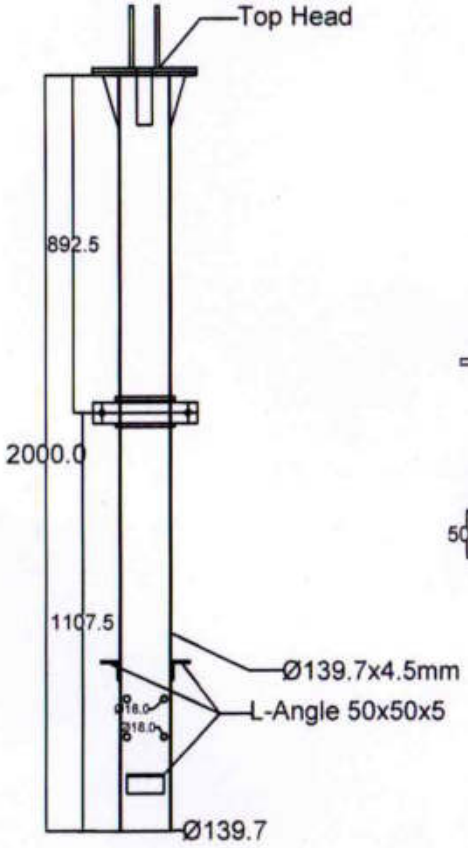
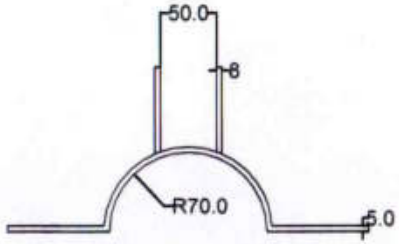
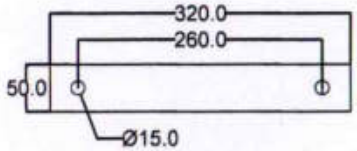


Top Head

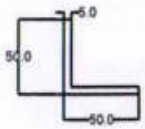


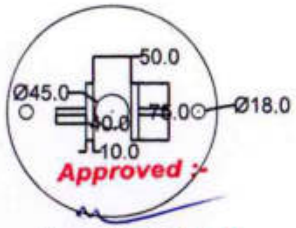
MAIN POLE





MAIN PIPE CLAMP





Approved :-

Head Plate

Professor
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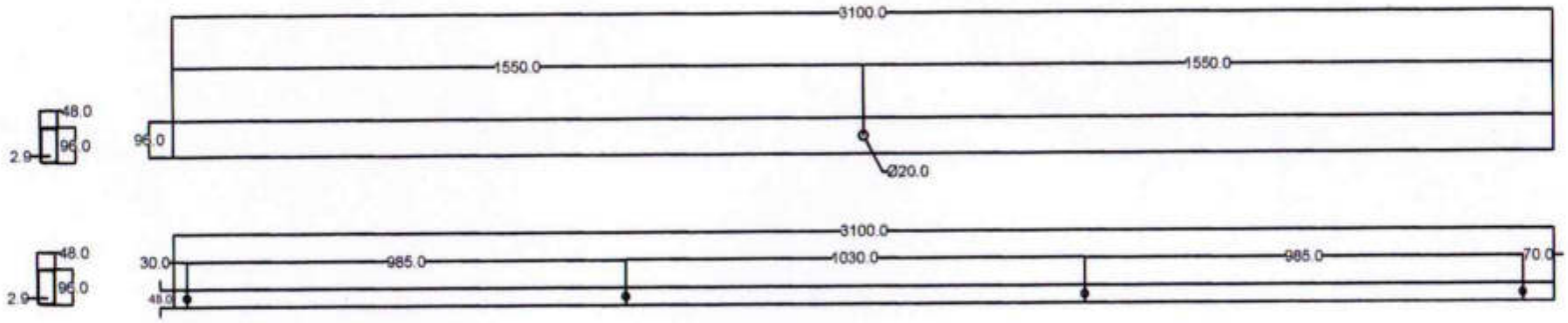
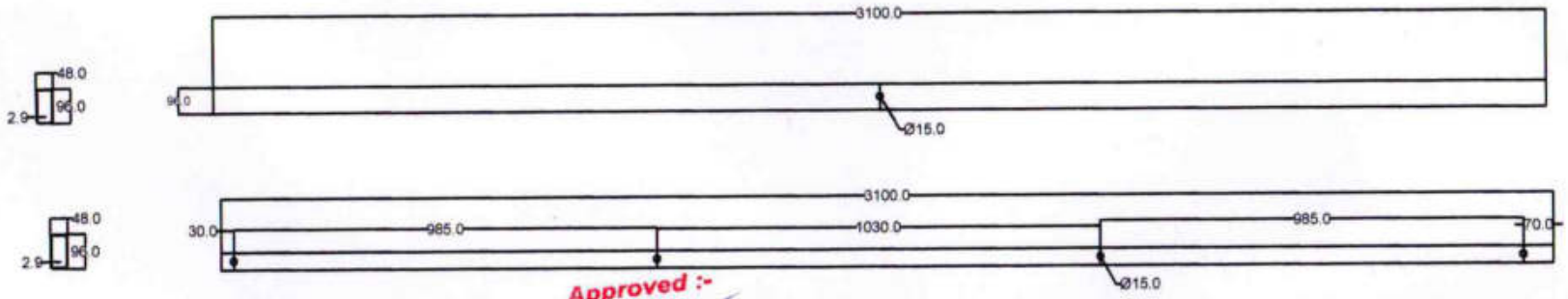
DRN BY.	J P Jangid		DRG. NO. SMP-SM-1216 (Sheet 4)
CHD BY	Anil Upadhyay		
CHD BY		PO.No. 105	
SUPERSEDES	NO		FORMAT ISO A4

Main Rafter



Side Rafter



Approved :-

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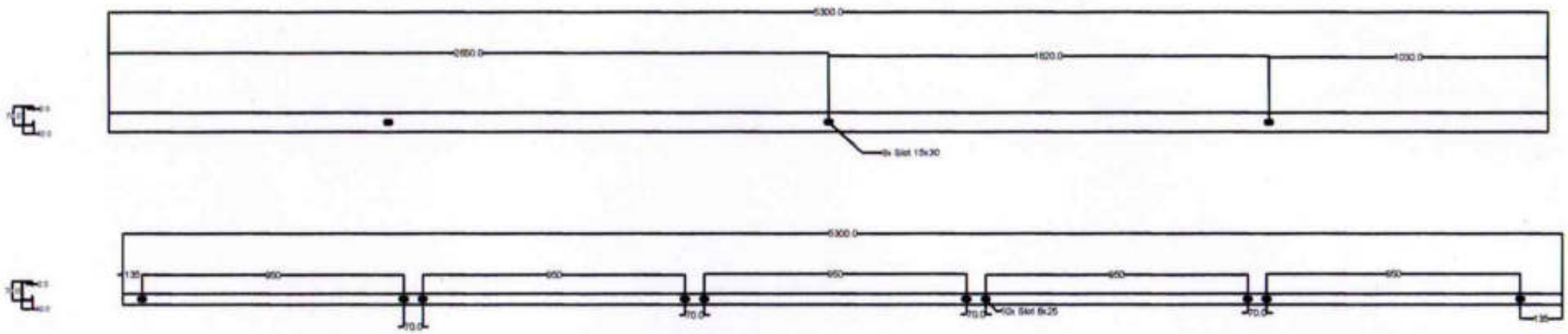
IRABK METAL LLP		TITLE:- RAFTER PART DRAWING	
DRN BY.	J P Jangid		DRG. NO. SMP-SM-1216 (Sheet 5)
CHD BY	Anil Upadhyay		
CHD BY		PO.No. 105	
SUPERSEDES			NO

FORMAT ISO A4



Purlin

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DRN BY.	J P Jangid		SCALE 1:1	DRG. NO. SMP-SM-1216 (Sheet 6)
CHD BY	Anil Upadhyay	-		
CHD BY		PO.No.	105	
SUPERSEDES		NO		

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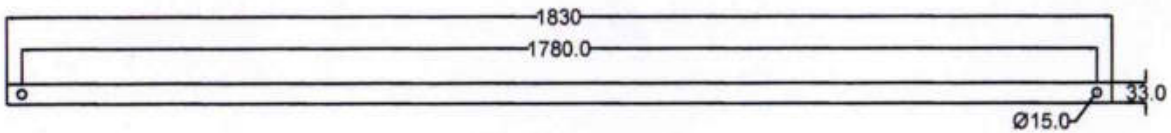
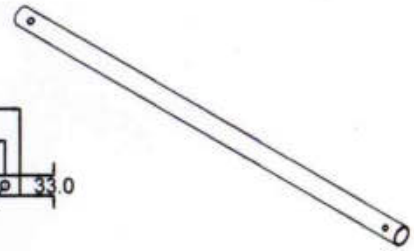
E-W Support





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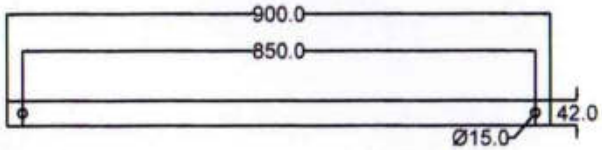

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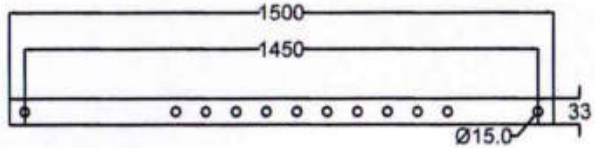

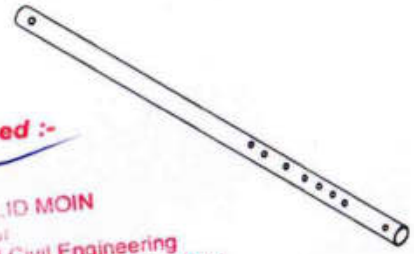

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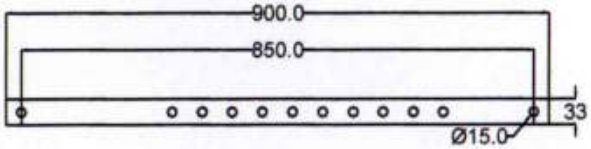

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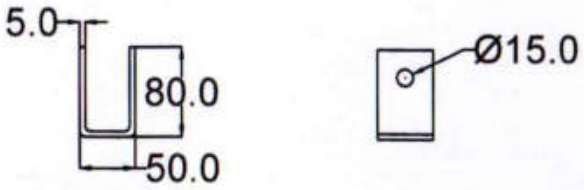
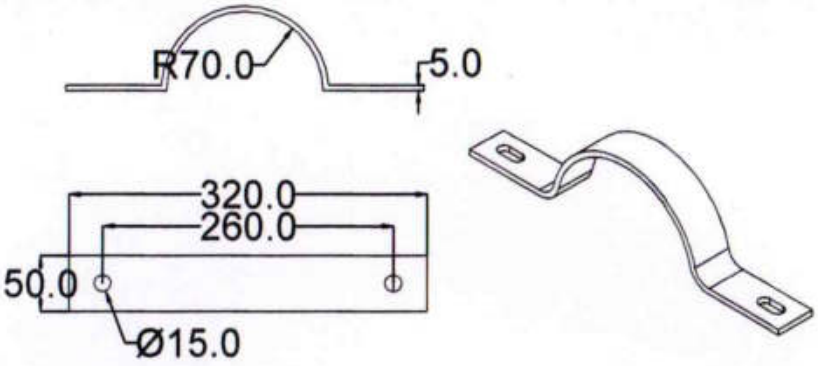
IRABK METAL LLP		TITLE:- SUPPORT SYSTEM PART DRAWING		
DRN BY.	J P Jangid		SCALE 1:1	DRG. NO. SMP-SM-1216 (Sheet 7)
CHD BY	Anil Upadhyay	-		
CHD BY		PO.No.	105	
		SUPERSEDES	NO	

FORMAT ISO A4

U-Clump

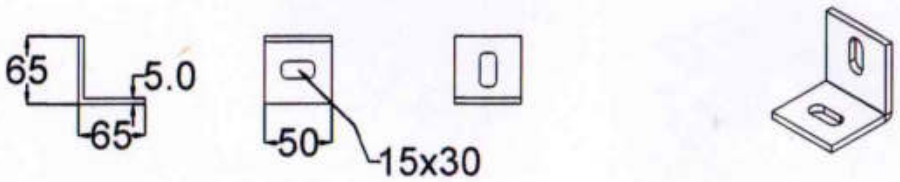


Controller Clamp



Main Pipe clamp

Purlin-Clit



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IRABK METAL LLP		TITLE:- ACCESORIES PART DRAWING	
DRN BY.	J P Jangid	SCALE 1:1	DRG. NO. SMP-SM-1216 (Sheet 8)
CHD BY	Anil Upadhyay	-	
CHD BY		PO.No. 105	
SUPERSEDES NO			FORMAT ISO A4

Wind Load:

Wind Pressure Calculations			
Basic Wind Speed =		150	kmph
Basic Wind Speed =		41.6	m/s
Design Period =		25	years
Type of Module Mounting Structure =		RoofTop	
Terrain Category =		2	
Minimum Module Clearance From NGL =		1.0	m
Height of Terrain/Building =		10	m
Risk Coefficient Factor (k1) =		0.90	Table-1, IS-875, part-3-2015
Terrian Factor (k2) =		1.00	Table-2, IS-875, part-3-2015
Topography factor (k3) =		1.00	Clause-6.3.3.1 of IS: 875, part3-2015
Importance factor (k4) =		1.00	Clause-6.3.4 of IS-875, part-3-2015
Design Wind Speed, Vz=Vb*k1*k2*k3*k4=		37.44	m/s
Design Wind pressure, Pz =0.6*(Vz)^2=		841.0	N/sqm
As per Latest code IS : 875 (Part-3-2015), the design wind pressure Pd can be obtained as as per clause 7.2; Pd = Kd. Ka. Kc .Pz			
Where,	Kd = Wind directionality factor	0.9	Clause-7.2.1 of IS-875, part-3-2015
	Ka = Area averaging factor	1	Table-4 of IS: 875 part 3- 2015
	Kc = Combination factor	0.9	Clause-7.3.3.13 of IS: 875 part3-2015
Hence, Design pressure = Pd = Kd.Ka.Kc.Pz=		**681.21**	N/sqm

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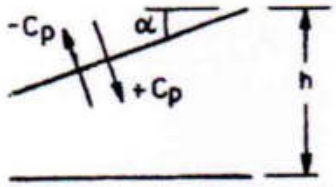
Calculating pressure coefficient for mono-slope roof;



SIGN CONVENTION

\+ TOWARDSTHESTRUCTURE(SUCTION),-AWAYFROMTHESTRUCTURE(UPLIFT)

For calculating the force on the panels from the pressure calculated above, we need pressure coefficient. The current structure falls under mono-slope free roofs. Pressure coefficient for mono-slope roof is found out referring section 7.3.3.2, Table 8, IS: 875, Part3 - 2015. The pressurecoefficientsforamono-slope freeroof of 20° tilt angle and solidity ratio of 0.

WINDLOAD UPWARD/DOWNWARD (+/-Y DIRECTION)		
Upward/Downward Wind Force, F = Cp*A*Pd		
Pressure Coefficient for Upward wind,-Cp	-1.3	(As per IS875 Part-3, Table-7)
Pressure coefficient for Downward wind,+Cp	0.8	(As per IS875 Part-3, Table-7)
Design wind pressure,Pd	681.21	N/sqm
Design wind pressure(Upward Direction) = Cp*Pd	-885.57	N/sqm
Design wind pressure(Downward Direction) = Cp*Pd	544.97	N/sqm
Surface Area of Structural element, A =(1998*1010*10)/(10^6)	20.18	sqm
Upward Wind force,Fu = Cp*A*Pd =	-17.87	kN
Downward Wind force,Fd = Cp*A*Pd =	10.99	kN
Here, we are considering aplied wind force of Solar panels shall be bear by Purlin		
Upward Wind force per unit purlin length,F=Fu/(4*5.3)	-0.84	kN/m
Downward Wind force per unit purlin length,F=Fd/(4*5.3)	0.52	kN/m
Note:- Negative sign shows Upward direction of Wind		

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WINDLOAD SIDEWAYS (X & Z DIRECTION), X-being along the slope

MMS ELEMENTS	SECTION DETAILS			
	Lentgh (mm)	Width (mm)	Lip (mm)	Thickness (mm)
COLUMN	139.7(DIA)	0	0	4.5
RAFTER	96	48	0	2.9
PURLIN	70	40	15	2

As per table-29, IS-875,part-3 value of co-efficient & Reduction factor shall be refered

SECTIONS	ANGLE OF WIND	Cft	Wind Facing Width (D) in mm (X-direction)	Length of member mm (l)	D*Vz (in m2/s)-X-dir	l/D (X-Dir)	Reduction Factor (K)
COLUMN	90 degree	2.0	139.7	2000	5.2	14.0	0.70

SECTIONS	ANGLE OF WIND	Cfn	Wind Facing Width (D) in mm (Z-direction)	Length of member mm (l)	D*Vz (in m2/s)-X-dir	l/D (X-Dir)	Reduction Factor (K)
COLUMN	0 degree	2.0	139.7	2000	5.2	14.0	0.70
RAFTER	0 degree	2.0	96	3100	3.5	32	0.78

SECTIONS	WIND FORCE (Pd*width*Cf*K)	UNITS	DIRECTION
COLUMN	0.066	kN/m	X-Direction
COLUMN	0.066	kN/m	Z-Direction
RAFTER	0.10	KN/M	Z-Direction

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LOAD COMBINATION

LOAD TYPE	L/C	LOAD NAME
Primary	1	Dead Load + Module Weight (DL+MW)
Primary	2	WIND UP
Primary	3	WIND DOWN
Primary	4	WIND X
Primary	5	WIND Z
Combination	6	1.5 (DL+MW)
Combination	7	1.5 (DL+MW+WINDDOWN)
Combination	8	1.5 (DL+MW+WINDX)
Combination	9	1.5 (DL+MW+WINDZ)
Combination	10	1.2 (DL+MW+WIND UP)
Combination	11	1.2 (DL+MW+WINDDOWN)
Combination	12	1.2 (DL+MW+WINDX)
Combination	13	1.2 (DL+MW+WINDZ)
Combination	14	0.9 (DL+MW)+1.5WIND UP
Combination	15	0.9(DL+MW)+1.5 WINDDOWN
Combination	16	0.9 (DL+MW)+ 1.5 WIND X
Combination	17	0.9 (DL+MW)+1.5 WIND Z
Combination	18	1.5 (DL+MW)+ WIND UP

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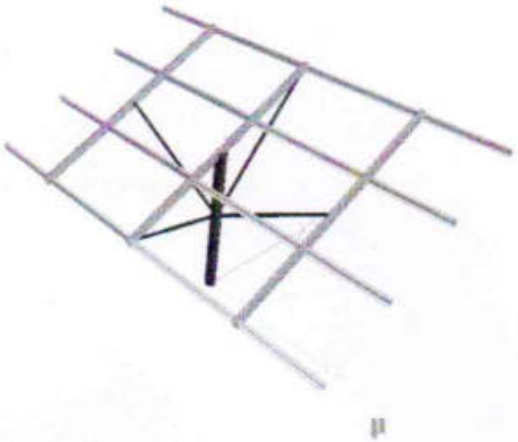
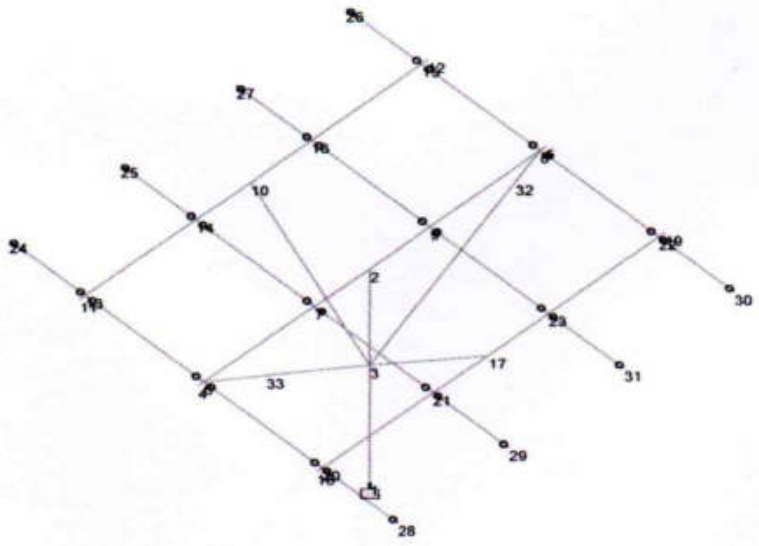
3. STAAD MODEL:



3D RENDERED VIEW



NODE NUMBER

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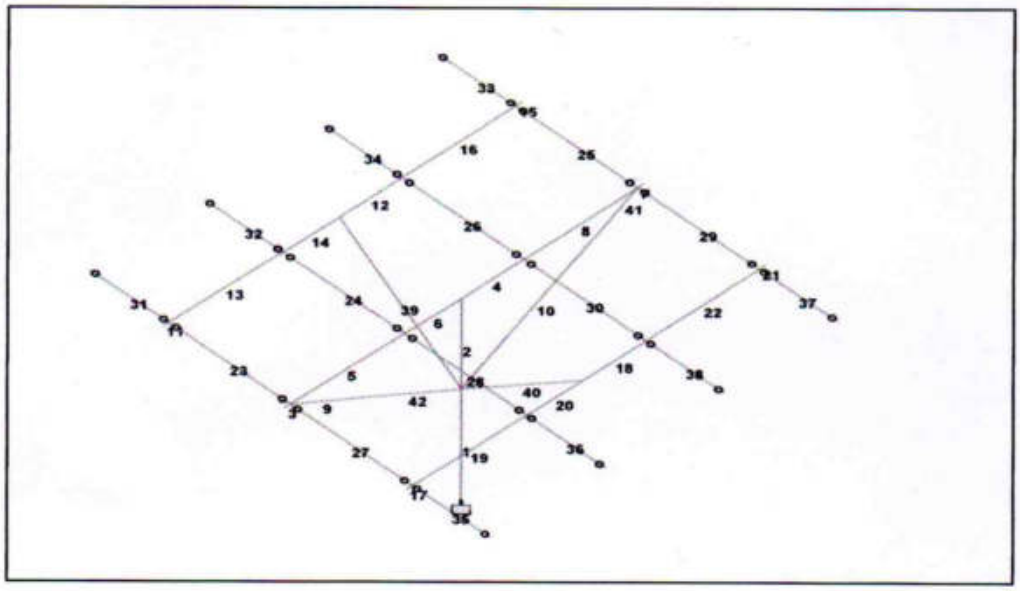

BEAM NUMBER

4. DEFLECTION CHECK:

As per IS 800:2007, following table can be referred for deflection check.

Table 6 Deflection Limits

Type of Building	Deflection	Design Load	Member	Supporting	Maximum Deflection
(1)	(2)	(3)	(4)	(5)	(6)
Industrial Buildings	Vertical	Live load/ Wind load	Purlins and Girts	Elastic cladding	Span/150
				Brittle cladding	Span/180
		Live load	Simple span	Elastic cladding	Span/240
				Brittle cladding	Span/300
		Live load	Cantilever span	Elastic cladding	Span/120
				Brittle cladding	Span/150
		Live load/ Wind load	Rafter supporting	Profiled Metal Sheeting	Span/180
				Plastered Sheeting	Span/240
		Crane load (Manual operation)	Gantry	Crane	Span/500
		Crane load (Electric operation up to 50 t)	Gantry	Crane	Span/750
		Crane load (Electric operation over 50 t)	Gantry	Crane	Span/1 000
	Lateral	No cranes	Column	Elastic cladding	Height/150
				Masonry/Brittle cladding	Height/240
		Crane + wind	Gantry (lateral)	Crane (absolute)	Span/400
				Relative displacement between rails supporting crane	10 mm
		Crane+ wind	Column/frame	Gantry (Elastic cladding, pendent operated)	Height/200
				Gantry (Brittle cladding, cab operated)	Height/400
Other Buildings	Vertical	Live load	Floor and Roof	Elements not susceptible to cracking	Span/300
				Elements susceptible to cracking	Span/360
		Live load	Cantilever	Elements not susceptible to cracking	Span/150
				Elements susceptible to cracking	Span/180
	Lateral	Wind	Building	Elastic cladding	Height/300
				Brittle cladding	Height/500
		Wind	Inter storey drift	—	Storey height/300

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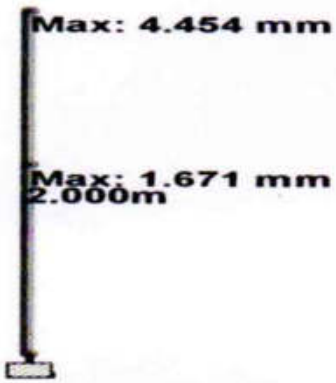
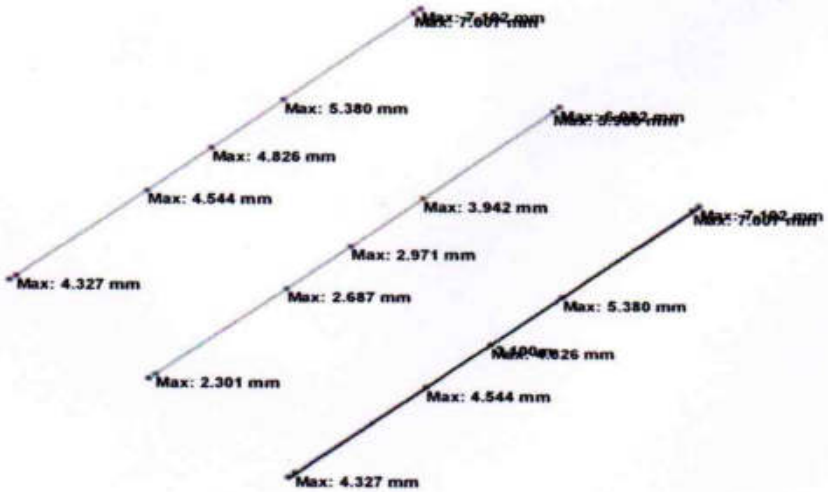
Column deflection check:



Maximum deflection in Column =4.454 mm

Permissible limit for deflection in Column =2000/ 240 = 8.33 mm > 4.454, **Hence OK**

Rafter deflection check:



Maximum deflection in Rafter = 7.607 mm

Permissible limit for deflection in Rafter =3100 / 180 = 17.22mm > 7.607, **Hence OK**

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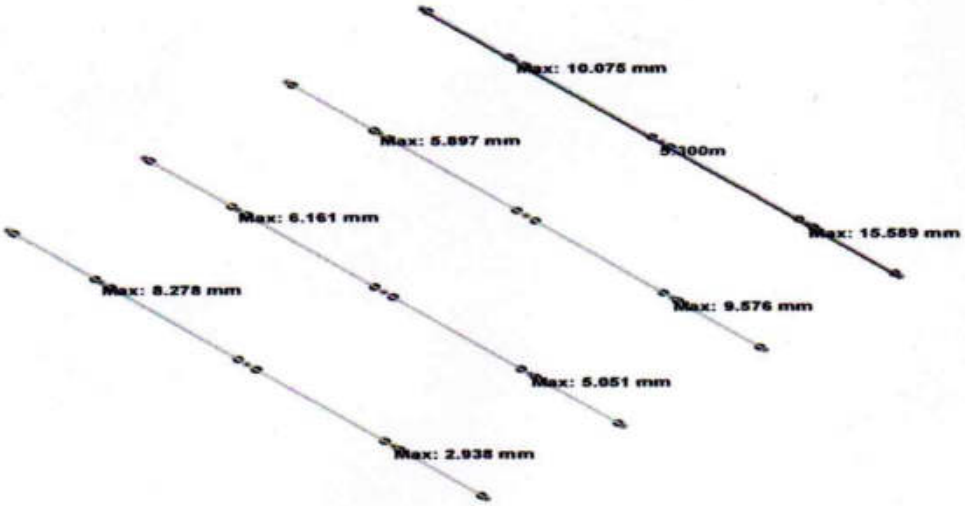
Purlin deflection check:



Maximum deflection in Purlin = 15.589 mm

PermissiblelimitfordeflectioninPurlin=5300/150=35.33mm>15.589,**HenceOK**

5. RAECTION SUMMARY:

	Node	L/C	Horizontal FX (kN)	Vertical FY (kN)	Horizontal FZ (kN)	Moment MX (kNm)	MY (kNm)	MZ (kNm)
Max FX	1	9:1.5(DL+MW+	**0.198**	5.070	0.000	0.000	0.000	-0.077
Min FX	1	6:1.5(DL+MW+	**-0.000**	18.393	0.000	0.000	0.000	0.412
Max FY	1	6:1.5(DL+MW+	-0.000	**18.393**	0.000	0.000	0.000	0.412
Min FY	1	14:0.9(DL+MW	-0.000	**-18.504**	-0.000	-0.000	-0.000	-0.399
Max FZ	1	9:1.5(DL+MW+	0.198	5.070	**0.000**	0.000	0.000	-0.077
Min FZ	1	8:15(DL+MW+	-0.000	5.070	**-1.593**	-3.015	0.032	0.121
Max MX	1	6:1.5(DL+MW+	-0.000	18.393	0.000	**0.000**	0.000	0.412
Min MX	1	8:15(DL+MW+	-0.000	5.070	-1.593	**-3.015**	0.032	0.121
Max MY	1	8:15(DL+MW+	-0.000	5.070	-1.593	-3.015	**0.032**	0.121
Min MY	1	14:0.9(DL+MW	-0.000	-18.504	-0.000	-0.000	**-0.000**	-0.399
Max MZ	1	6:1.5(DL+MW+	-0.000	18.393	0.000	0.000	0.000	**0.412**
Min MZ	1	14:0.9(DL+MW	-0.000	-18.504	-0.000	-0.000	-0.000	**-0.399**

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6. UTILITY RATIO:

Beam	Analysis Property	Design Property	Actual Ratio	Allowable Ratio	Ratio (Act./Allow.)	Clause	L/C	Ax (cm^2)	Iz (cm^4)	Iy (cm^4)	Ix (cm^4)
1	PIP1397L	PIP1397L	0.192	1.000	0.192	Sec. 8.2.1.2	8	19.100	437.000	437.000	874.000
2	PIP1397L	PIP1397L	0.080	1.000	0.080	Sec. 8.2.1.2	8	19.100	437.000	437.000	874.000
3	TUB96482.9	TUB96482.9	0.000	1.000	0.000	Sec. 8.4	8	8.016	95.810	31.980	80.100
4	TUB96482.9	TUB96482.9	0.104	1.000	0.104	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
5	TUB96482.9	TUB96482.9	0.052	1.000	0.052	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
6	TUB96482.9	TUB96482.9	0.102	1.000	0.102	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
7	TUB96482.9	TUB96482.9	0.000	1.000	0.000	Sec. 8.4	8	8.016	95.810	31.980	80.100
8	TUB96482.9	TUB96482.9	0.055	1.000	0.055	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
9	PIP337L	PIP337L	0.069	1.000	0.069	Sec. 9.3.2.2	7	2.540	3.090	3.090	6.180
10	PIP424L	PIP424L	0.174	1.000	0.174	Sec. 9.3.2.2	7	3.250	6.460	6.460	12.920
11	TUB96482.9	TUB96482.9	0.000	1.000	0.000	Sec. 8.4	8	8.016	95.810	31.980	80.100
12	TUB96482.9	TUB96482.9	0.654	1.000	0.654	Sec. 9.3.2.2	7	8.016	95.810	31.980	80.100
13	TUB96482.9	TUB96482.9	0.323	1.000	0.323	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
14	TUB96482.9	TUB96482.9	0.673	1.000	0.673	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
15	TUB96482.9	TUB96482.9	0.000	1.000	0.000	Sec. 8.4	8	8.016	95.810	31.980	80.100
16	TUB96482.9	TUB96482.9	0.295	1.000	0.295	Sec. 9.3.2.2	7	8.016	95.810	31.980	80.100
17	TUB96482.9	TUB96482.9	0.000	1.000	0.000	Sec. 8.4	8	8.016	95.810	31.980	80.100
18	TUB96482.9	TUB96482.9	0.654	1.000	0.654	Sec. 9.3.2.2	7	8.016	95.810	31.980	80.100
19	TUB96482.9	TUB96482.9	0.323	1.000	0.323	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
20	TUB96482.9	TUB96482.9	0.673	1.000	0.673	Sec. 9.3.2.2	14	8.016	95.810	31.980	80.100
21	TUB96482.9	TUB96482.9	0.000	1.000	0.000	Sec. 8.4	8	8.016	95.810	31.980	80.100
22	TUB96482.9	TUB96482.9	0.295	1.000	0.295	Sec. 9.3.2.2	7	8.016	95.810	31.980	80.100
23	70CS40X2	70CS40X2	0.353	1.000	0.353	Bending Z	14	3.303	25.341	7.532	0.044
24	70CS40X2	70CS40X2	0.544	1.000	0.544	Bend + Comp	14	3.303	25.341	7.532	0.044
25	70CS40X2	70CS40X2	0.353	1.000	0.353	Bending Z	14	3.303	25.341	7.532	0.044
26	70CS40X2	70CS40X2	0.524	1.000	0.524	Bend + Comp	14	3.303	25.341	7.532	0.044

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Beam	Analysis Property	Design Property	Actual Ratio	Allowable Ratio	Ratio (Act./Allow.)	Clause	L/C	Ax (cm^2)	Iz (cm^4)	Iy (cm^4)	Ix (cm^4)
27	70CS40X2	70CS40X2	0.353	1.000	0.353	Bending Z	14	3.303	25.341	7.532	0.044
28	70CS40X2	70CS40X2	0.544	1.000	0.544	Bend + Comp	14	3.303	25.341	7.532	0.044
29	70CS40X2	70CS40X2	0.353	1.000	0.353	Bending Z	14	3.303	25.341	7.532	0.044
30	70CS40X2	70CS40X2	0.524	1.000	0.524	Bend + Comp	14	3.303	25.341	7.532	0.044
31	70CS40X2	70CS40X2	0.139	1.000	0.139	Bending Z	14	3.303	25.341	7.532	0.044
32	70CS40X2	70CS40X2	0.139	1.000	0.139	Bending Z	14	3.303	25.341	7.532	0.044
33	70CS40X2	70CS40X2	0.139	1.000	0.139	Bending Z	14	3.303	25.341	7.532	0.044
34	70CS40X2	70CS40X2	0.139	1.000	0.139	Bending Z	14	3.303	25.341	7.532	0.044
35	70CS40X2	70CS40X2	0.139	1.000	0.139	Bending Z	14	3.303	25.341	7.532	0.044
36	70CS40X2	70CS40X2	0.139	1.000	0.139	Bending Z	14	3.303	25.341	7.532	0.044
37	70CS40X2	70CS40X2	0.139	1.000	0.139	Bending Z	14	3.303	25.341	7.532	0.044
38	70CS40X2	70CS40X2	0.139	1.000	0.139	Bending Z	14	3.303	25.341	7.532	0.044
39	PIP424L	PIP424L	0.615	1.000	0.615	Sec. 9.3.2.2	7	3.250	6.460	6.460	12.920
40	PIP424L	PIP424L	0.615	1.000	0.615	Sec. 9.3.2.2	7	3.250	6.460	6.460	12.920
41	PIP337L	PIP337L	0.098	1.000	0.098	Sec. 6.2	14	2.540	3.090	3.090	6.180
42	PIP424L	PIP424L	0.056	1.000	0.056	Sec. 9.3.2.2	7	3.250	6.460	6.460	12.920

CONCLUSION:

The structure is found to be safe and the maximum utility ratio observed is 0.673. The IS Code referred during analysis is IS800-2007 & IS 801- Code of practice for use of cold- formed light gauge steel structural members in general building construction, IS 875- Part 3: Wind Loads and IS 875-Part 1: Dead Loads.

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7. STAAD INPUT DATA:

```
STAAD SPACE
START JOB INFORMATION
ENGINEER DATE 03-Nov-20
END JOB INFORMATION
INPUT WIDTH 79
UNIT METER KN
JOINT COORDINATES
1 0 0 0; 2 0 2 0; 3 0 1.1 0; 4 -1.35 1.3 0; 5 1.39 2.75 0;
6 -1.30561 1.32302 0; 7 -0.431174 1.77643 0; 8 1.34562 2.72605 0;
9 0.478755 2.25832 0; 10 0 2 -1.62; 11 -1.35 1.3 -1.62; 12 1.39 2.75 -1.62;
13 -1.30561 1.32302 -1.62; 14 -0.431174 1.77643 -1.62;
15 1.34562 2.72605 -1.62; 16 0.478755 2.25832 -1.62; 17 0 2 1.62;
18 -1.35 1.3 1.62; 19 1.39 2.75 1.62; 20 -1.30561 1.32302 1.62;
21 -0.431174 1.77643 1.62; 22 1.34562 2.72605 1.62; 23 0.478755 2.25832 1.62;
24 -1.30561 1.32302 -2.65; 25 -0.431174 1.77643 -2.65;
26 1.34562 2.72605 -2.65; 27 0.478755 2.25832 -2.65; 28 -1.30561 1.32302 2.65;
29 -0.431174 1.77643 2.65; 30 1.34562 2.72605 2.65; 31 0.478755 2.25832 2.65;
32 1.14758 2.48674 0; 33 -0.812749 1.23883 0;
MEMBER INCIDENCES
1 1 3; 2 3 2; 3 4 6; 4 2 9; 5 6 7; 6 7 2; 7 8 5; 8 9 8; 9 6 33; 10 3 32;
11 11 13; 12 10 16; 13 13 14; 14 14 10; 15 15 12; 16 16 15; 17 18 20; 18 17 23;
19 20 21; 20 21 17; 21 22 19; 22 23 22; 23 6 13; 24 7 14; 25 8 15; 26 9 16;
27 6 20; 28 7 21; 29 8 22; 30 9 23; 31 13 24; 32 14 25; 33 15 26; 34 16 27;
35 20 28; 36 21 29; 37 22 30; 38 23 31; 39 10 3; 40 3 17; 41 32 8; 42 33 3;
DEFINE MATERIAL START
ISOTROPIC STEEL
E 2.05e+008
POISSON 0.3
DENSITY 76.8195
ALPHA 1.2e-005
DAMP 0.03
TYPE STEEL
STRENGTH FY 253200 FU 407800 RY 1.5 RT 1.2
END DEFINE MATERIAL
MEMBER PROPERTY INDIAN
1 2 TABLE ST PIP1397L
MEMBER PROPERTY COLDFORMED INDIAN
23 TO 38 TABLE ST 70CS40X2
MEMBER PROPERTY INDIAN
3 TO 8 11 TO 22 TABLE ST TUB96482.9
10 39 40 42 TABLE ST PIP424L
9 41 TABLE ST PIP337L
CONSTANTS
MATERIAL STEEL ALL
SUPPORTS
1 FIXED
MEMBER RELEASE
23 TO 38 START MX MY MZ
23 TO 38 END MX MY MZ
LOAD 1 LOADTYPE Dead  TITLE DL+MW
```

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```
SELFWEIGHT Y -1 LIST 1 TO 40
MEMBER LOAD
23 TO 38 UNI GY -0.1132
LOAD 2 LOADTYPE Live REDUCIBLE TITLE WIND UP
MEMBER LOAD
23 TO 38 UNI GY 0.841
LOAD 3 LOADTYPE Live REDUCIBLE TITLE WIND DOWN
MEMBER LOAD
23 TO 38 UNI GY -0.52
LOAD 4 LOADTYPE Live REDUCIBLE TITLE WIND Z
MEMBER LOAD
1 2 UNI GZ 0.066
3 TO 8 11 TO 22 UNI GZ 0.1
LOAD 7 LOADTYPE Live REDUCIBLE TITLE WIND X
MEMBER LOAD
1 2 UNI GX -0.066
LOAD COMB 5 1.5(DL+MW)
1 1.5
LOAD COMB 6 1.5(DL+MW+ WIND DOWN)
1 1.5 3 1.5
LOAD COMB 8 15(DL+MW+ WIND Z)
1 1.5 4 1.5
LOAD COMB 9 1.5(DL+MW+WIND X)
1 1.5 7 1.5
LOAD COMB 10 1.2(DL+MW+WIND UP)
1 1.2 2 1.2
LOAD COMB 11 1.2(DL+MW+WIND DOWN)
1 1.2 3 1.2
LOAD COMB 12 1.2(DL+MW+WIND Z)
1 1.2 4 1.2
LOAD COMB 13 1.2(DL+MW+WIND X)
1 1.2 7 1.2
LOAD COMB 14 0.9(DL+MW)+1.5 WIND UP
1 0.9 2 1.5
LOAD COMB 15 0.9(DL+MW)+1.5 WIND DOWN
1 0.9 3 1.5
LOAD COMB 16 0.9(DL+MW)+1.5 WIND Z
1 0.9 4 1.5
LOAD COMB 17 0.9(DL+MW)+1.5 WIND X
1 0.9 7 1.5
LOAD COMB 18 1.5(DL+MW)+WIND UP
1 1.5 2 1.0
PERFORM ANALYSIS
PARAMETER 1
CODE IS800 LSD
FYLD 210000 MEMB 1 TO 22 39 TO 42
CHECK CODE MEMB 1 TO 22 39 TO 42
PARAMETER 2
CODE IS801
FYLD 250000 MEMB 23 TO 38
CHECK CODE MEMB 23 TO 38
FINISH
```

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8. STAAD OUTPUT:

STAAD.PROCODECHECKING-IS-800-2007- LSD(V2.0)
****
***

|----------|
|MemberNumber:1 |
|MemberSection:STPIP1397L(INDIANSECTIONS) |
Status:PASS Ratio:0.161 CriticalLoadCase:8 Location:0.00 |
CriticalCondition:Sec.8.2.1.2 |

|----------|
| MemberNumber:2 |
|MemberSection:STPIP1397L(INDIANSECTIONS) |
|Status:PASSRatio:0.068CriticalLoadCase:8Location:0.00 |
| CriticalCondition:Sec.8.2.1.2 |

|----------|
| MemberNumber:3 |
|MemberSection:STTUB96482.9(INDIANSECTIONS) |
|Status:PASSRatio:0.000CriticalLoadCase:8Location:0.05 |
|CriticalCondition:Sec.8.4 |

|----------|
| MemberNumber:4 |
|MemberSection:STTUB96482.9(INDIANSECTIONS) |
|Status:PASSRatio:0.087CriticalLoadCase:14Location:0.00 |
| CriticalCondition:Sec.9.3.2.2
|----------|
|MemberNumber: 5 |
|MemberSection:ST TUB96482.9 (INDIANSECTIONS) |
|Status:PASSRatio: 0.044 CriticalLoadCase: 14 Location: 0.98 |
| CriticalCondition:Sec.9.3.2.2 |

|----------|
|MemberNumber: 6 |
|MemberSection:ST TUB96482.9 (INDIANSECTIONS) |
|Status:PASSRatio: 0.086 CriticalLoadCase: 14 Location: 0.49 |
| CriticalCondition:Sec.9.3.2.2 |

|----------|
|MemberNumber: 7 |
|MemberSection:ST TUB96482.9 (INDIANSECTIONS) |
|Status:PASSRatio: 0.000CriticalLoadCase: 8Location: 0.00 |
| CriticalCondition:Sec.8.4

|----------|
|MemberNumber: 8 |

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MemberSection:ST TUB96482.9 (INDIANSECTIONS)
Status:PASS Ratio: 0.046 CriticalLoadCase: 14 Location: 0.00
CriticalCondition:Sec.9.3.2.2

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MemberNumber: 9
MemberSection:ST PIP337L (INDIANSECTIONS)
Status:PASS Ratio: 0.058 CriticalLoadCase: 7 Location: 0.17
CriticalCondition:Sec.9.3.2.2

MemberNumber:10
MemberSection:ST PIP424L (INDIANSECTIONS)
Status:PASS Ratio: 0.166 CriticalLoadCase: 7 Location: 0.00
CriticalCondition:Sec.9.3.2.2

MemberNumber:11
MemberSection:ST TUB96482.9 (INDIANSECTIONS)
Status:PASS Ratio: 0.000 CriticalLoadCase: 8 Location: 0.05
CriticalCondition:Sec.8.4

MemberNumber:12
MemberSection: ST TUB96482.9 (INDIANSECTIONS)
Status:PASS Ratio: 0.550 CriticalLoadCase: 7 Location: 0.00
CriticalCondition:Sec.9.3.2.2

MemberNumber:13
MemberSection: ST TUB96482.9 (INDIANSECTIONS)
Status:PASS Ratio: 0.272 CriticalLoadCase: 14 Location: 0.98
CriticalCondition:Sec.9.3.2.2

MemberNumber:14
MemberSection:ST TUB96482.9 (INDIANSECTIONS)
Status:PASS Ratio: 0.565 CriticalLoadCase: 14 Location: 0.49
CriticalCondition:Sec.9.3.2.2

MemberNumber:15
MemberSection:ST TUB96482.9 (INDIANSECTIONS)
Status:PASS Ratio: 0.000 CriticalLoadCase: 8 Location: 0.00
CriticalCondition:Sec.8.4

MemberNumber:16
MemberSection:ST TUB96482.9 (INDIANSECTIONS)
Status:PASS Ratio: 0.248 CriticalLoadCase: 7 Location: 0.00
CriticalCondition:Sec.9.3.2

STAAD.PROCODECHECKING-IS-800-2007-LSD(V2.0)

****

MemberNumber:17

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|MemberSection:ST TUB96482.9 (INDIANSECTIONS) |
|Status:PASS Ratio: 0.000 CriticalLoadCase: 8 Location: 0.05 |
|CriticalCondition:Sec.8.4 |

|----------|
|MemberNumber:18 |
|MemberSection:ST TUB96482.9 (INDIANSECTIONS) |

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|Status:PASS Ratio: 0.550 CriticalLoadCase: 7 Location: 0.00 |
| CriticalCondition:Sec.9.3.2.2 |

|---|
| MemberNumber:19 |
| MemberSection: ST TUB96482.9 (INDIANSECTIONS) |
|Status:PASS Ratio: 0.272 CriticalLoadCase: 14 Location: 0.98 |
| CriticalCondition:Sec.9.3.2.2 |

|---|
| MemberNumber:20 |
| MemberSection: ST TUB96482.9 (INDIANSECTIONS) |
|Status:PASS Ratio: 0.565 CriticalLoadCase: 14 Location: 0.49 |
| CriticalCondition:Sec.9.3.2.2 |

STAAD.PROCODECHECKING-IS-800-2007-LSD(V2.0)
****

|---|
|MemberNumber:21 |
|MemberSection:ST TUB96482.9 (INDIANSECTIONS) |
|Status:PASS Ratio: 0.000 CriticalLoadCase: 8 Location: 0.00 |
|CriticalCondition:Sec.8.4 |

|---|
|MemberNumber:22 |
|MemberSection:ST TUB96482.9 (INDIANSECTIONS) |
|Status:PASS Ratio: 0.248 CriticalLoadCase: 7 Location: 0.00 |
| CriticalCondition:Sec.9.3.2.2 |

|---|
|MemberNumber:39 |
|MemberSection:ST PIP424L (INDIANSECTIONS) |
|Status:PASS Ratio: 0.567 CriticalLoadCase: 7 Location: 1.85 |
| CriticalCondition:Sec.9.3.2.2 |

|---|
|MemberNumber:40 |
|MemberSection:ST PIP424L (INDIANSECTIONS) |
|Status:PASS Ratio: 0.567 CriticalLoadCase: 7 Location: 0.00 |
| CriticalCondition:Sec.9.3.2.2

STAAD.PROCODECHECKING-IS-800-2007-LSD(V2.0)
****

|---|
|MemberNumber:41 |
|MemberSection:ST PIP337L (INDIANSECTIONS) |
|Status:PASS Ratio: 0.083 CriticalLoadCase: 14 Location: 0.00 |
|CriticalCondition:Sec.6.2 |

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```
|-------------------------------------------------------------------------------|
|  MemberNumber:       42                                                       |
|  MemberSection: ST      PIP424L          (INDIANSECTIONS)                     |
|  Status:PASS Ratio:      0.048 CriticalLoadCase:         7  Location:        0.82  |
|  CriticalCondition:Sec.9.3.2.2                                                |
```

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STAAD.ProCODECHECKING-(I801)
****

```
 |-------------------------------------------------------
                  ----------|
|UNITS:MM,KN,KNM,MPA                                     |
|                                                        |
|MEMBER#23 SECTION:70CS40X2              LEN:
1620.00 GOV.LOC:810.00 |
|STATUS:PASSRATIO= 0.267 GOV.MODE:BendingZGOV.LOAD:14 |
|-------------------------------------------------------
                  ----------|


|-------------------------------------------------------
                  ----------|
|UNITS:MM,KN,KNM,MPA                                     |
|                                                        |
|MEMBER#24 SECTION:70CS40X2 LEN:
        1620.00GOV.LOC:810.00|
|STATUS:PASSRATIO= 0.411
GOV.MODE:Bend+CompressGOV.LOAD:14 |
|-------------------------------------------------------
                  ----------|


|-------------------------------------------------------
                  ----------|
|UNITS:MM,KN,KNM,MPA                                     |
|                                                        |
|MEMBER#25 SECTION:70CS40X2              LEN:
1620.00 GOV.LOC:810.00 |
|STATUS:PASSRATIO= 0.267 GOV.MODE:BendingZGOV.LOAD:14 |
|-------------------------------------------------------
                  ----------|


|-------------------------------------------------------
                  ----------|
|UNITS:MM,KN,KNM,MPA                                     |
|                                                        |
|MEMBER#26 SECTION:70CS40X2LEN:
1620.00 GOV.LOC:810.00 |
|STATUS:PASSRATIO= 0.395
GOV.MODE:Bend+CompressGOV.LOAD:                  14|
|-------------------------------------------------------

 |-------------------------------------------------------
|UNITS:MM,KN,KNM,MPA                                     |
|                                                        |
```

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|MEMBER#27 SECTION:70CS40X2 LEN:
1620.00GOV.LOC810.00|
|STATUS:PASSRATIO= 0.267 GOV.MODE:BendingZGOV.LOAD:14 |

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```
|UNITS:MM,KN,KNM,MPA                                                    |
|                                                                       |
|MEMBER#28 SECTION:70CS40X2              LEN:
1620.00 GOV.LOC:810.00 |
|STATUS:PASSRATIO= 0.411
GOV.MODE:Bend+CompressGOV.LOAD:14 |
|-------------------------------------------------------

|-------------------------------------------------------
|UNITS:MM,KN,KNM,MPA                                                    |
|                                                                       |
|MEMBER#29 SECTION:70CS40X2              LEN:
1620.00 GOV.LOC:810.00 |
|STATUS:PASSRATIO= 0.267 GOV.MODE:BendingZGOV.LOAD:14 |
|-----------------------------------------------------------------------------|
|-------------------------------------------------------
                    ----------|
|UNITS:MM,KN,KNM,MPA                                                    |
|                                                                       |
|MEMBER#30 SECTION:70CS40X2LEN:
1620.00 GOV.LOC:810.00 |
|STATUS:PASSRATIO= 0.395
GOV.MODE:Bend+CompressGOV.LOAD:14 |
|-------------------------------------------------------
                    ----------|

|-------------------------------------------------------
                    ----------|
|UNITS:MM,KN,KNM,MPA                                                    |
|                                                                       |
|MEMBER#31 SECTION:70CS40X2              LEN:
1030.00 GOV.LOC:515.00 |
|STATUS:PASSRATIO= 0.099 GOV.MODE:BendingZGOV.LOAD:14 |
|-------------------------------------------------------
                    ----------|

|-------------------------------------------------------
                    ----------|
|UNITS:MM,KN,KNM,MPA                                                    |
|                                                                       |
|MEMBER#32 SECTION:70CS40X2              LEN:
1030.00 GOV.LOC:515.00 |
|STATUS:PASSRATIO= 0.099 GOV.MODE:BendingZGOV.LOAD:14 |
|-------------------------------------------------------
```

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UNITS:MM,KN,KNM,MPA
|MEMBER#33 SECTION:70CS40X LEN: 1030.00
GOV.LOC:515.00	

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|STATUS:PASSRATIO= 0.099
GOV.MODE:BendingZGOV.LOAD:14 |
|----------

|UNITS:MM,KN,KNM,MPA |
|
|MEMBER#34 SECTION:70CS40X2 LEN:
1030.00GOV.LOC:515.00 |
|STATUS:PASSRATIO= 0.099 GOV.MODE:BendingZGOV.LOAD:14 |
|----------

|----------
|UNITS:MM,KN,KNM,MPA |
|
|MEMBER#35 SECTION:70CS40X2 LEN:
1030.00GOV.LOC:515.00 |
|STATUS:PASSRATIO= 0.099 GOV.MODE:BendingZGOV.LOAD:14 |
|----------

|----------
|UNITS:MM,KN,KNM,MPA |
|
|MEMBER#36 SECTION:70CS40X2 LEN:
1030.00GOV.LOC:515.00 |
|STATUS:PASSRATIO= 0.099 GOV.MODE:BendingZGOV.LOAD:14 |
|----------

|----------
|UNITS:MM,KN,KNM,MPA |
|
|MEMBER#37 SECTION:70CS40X2 LEN: 1030.00
GOV.LOC:515.00 |
|STATUS:PASSRATIO= 0.099 GOV.MODE:BendingZGOV.LOAD:14 |
|----------

|----------
|UNITS:MM,KN,KNM,MPA |
|
|MEMBER#38 SECTION:70CS40X2 LEN:
1030.00 GOV.LOC:515.00 |
STATUS:PASSRATIO= 0.099 GOV.MODE:BendingZGOV.LOAD:14

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9. FOUNDATION

Breadth of Pedestal	B = 0.4	m	
Length of Pedestal	L = 0.4	m	
Density of Waterl	Yw = 10	KN/m^3	
Density of Soil	Ys = 20.0	KN/m^3	
Factor of safetyl	FOS = 1.5		
Unit of Pedestal material	Yp = 23.0	Kn/m^3	
Grade of Concrete I	= 23.0	N/mm^2	
Grade of Steel	Fy = 500	N/mm^2	
Soil Bearing Capacity	SBC = 80.0	Kn/m^2	
Bearing capacity Factor,Ny	Ny =0.6		IS 6403:1981 Table-1' Bearing Capacity factor
Bearing capacity Factor,Nq	Nq =1.75		
Bearing capacity Factor,Nc	Nc =6.86		
Downward Pressure from Super structure(P)	Qv(+) = 18.39	KN	
Uplift from Super structure	Qv(-) = 18.50	KN	From STAAD Result
Lateral force from Super structure	QH = 1.593	KN	
Moment from Super structure(P)	M = 3.015	KN-m	
Unsupported length of pedestal Above ground	e = 0.1	m	

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DESIGN
VERTICAL CAPACITY OF FOOTING

AREA OF FOOTING:

Assume Selfweight of footing	w = 1.839	KN	w=0.1P
Total Weight	W = 1.839+18.39	KN	W=0.1P+P
	=20.229	KN	
Area of Footing	A = 20.229/ 80	KN	A= W / SBC
	A =0.253	m^2	
Size of footing	L=B= √0.253	m	
	=0.5029	m	

Therefore
Provide 0.5 m x 0.5 m Square Footing,
So

Total area Required	=0. 25	m2
Length of Footing	=0. 50	m
Breadth of Footing	=0. 50	m

PRESSURE ACTS ON FOOTING:

Pressure	P =Pu/A	KN/m2
	P = 1.5x20.229/0.25	KN/m2
Pressure	P = 121.37	KN/m2

FACTORED BENDING MOMENT per 'm':

Factored Bending Moment	Mu =PxLX((B-D)/2)^2/2	KN-m
	Mu =121.37x0.5X((0.5-0.4)/2)^2/2	KN-m
	Mu =0.0758	KN-m

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Where
B= Length of Footing
D= Length of Pedestal
P= Pressure on Footing
L= B

EFFECTIVE DEPTH:

$d_{required} = \sqrt{Mu}/0.133 x f_{ck} x b$ mm

$d_{required} = \sqrt{0.0758 x 10^6}/0.133 x 20 x 500$ mm

$d_{required} = 56.99$ mm

we provide $d = 150.0$ mm

For considerations,increase depth 1.75 to 2 times more than the calculated value

$d = 150.0 \times 2$

Efective depth	$d = 300$	mm
Overall depth	$D = 350$	mm
Footing cover	$= 50$	mm

Where
Mu= Factored Moment
f_{ck}= Characteristic Compressive strength
b= Breadth of Footing

AREA OF TENSION REINFORCEMENT:

Moment of Resistance $Mu = 0.87 Fy Ast d(1-Ast Fy/bd Fck)$ mm^2

$0.0758 x10^6 = 0.87x500 Ast x 300(1-Astx500/500x500x 20)$ mm^2

$0.0758 x10^6 = 0.87x500 Astx 300(1-Astx500/500x500x 20)$ mm^2

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$Ast = 721$ mm^2

Where
Mu= Factored Moment
f_{ck}= Characteristic Compressive strength
b= effective depth
d= Breadth of Footing

AREA OF STEEL per m:

=Ast/span
=721/0.5
=1442 mm^2

AREA OF ONE BAR:

ast $=\pi d^2/4$

Assume 16 mm dia bar, $= 3.14 \times 12^2/4$

$= 200.96$ mm^2

SPACING OF REINFORCEMENT:

=(Area of one bar/area/m)x1000
= (ast/Ast) x 1000
= (200.96/1442)x1000 mm
= 139.36 mm

Provide 16 mm dia bars at 150 mm c/c spacing.

NUMBER OF BARS:

= (Ast/ast)
= (1442/200.96)
= 8 nos of bar

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CHECK FOR ONE WAY SHEAR:

(a) SHEAR FORCE PER 'm':

Vu = P X B X ((L-D)/2-d
= 121.37x1x((0.5-0.4)/2-0.5)
= 54.62 KN

(b) NOMINALSHEAR STRESS:

Tv =Vu/bd
= $54.62x10^3$/1000x300
= .0.182 N/mm2

(c) percentage of steel:

=100xAst/bd
= 100x721/500x300
= 0.48

Now, Refer Table No.19 Page No. 73 of IS456:2000

Tc = 0.47 N/mm2

Therefore,

Tv < Tc

0.172 N/mm2 < 0.47 N/mm2

HENCE, Design is safe against one way shear.

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