

Prof. (Dr.) Indrajit Patel
Principal



Birla Vishvakarma Mahavidyalaya
BVM Engineering College
An Autonomous Institution
(Managed by Charutar Vidya Mandal)

No: F/38/051



Date: 18th March 2020

TO WHOMSOEVER IT MAY CONCERN

We have been offered various configurations/designs of Solar Photovoltaic Module mounting structures (MMS) as per following drawings for evaluation as per IS 875-1964.

These designs were evaluated by using STAAD PRO REPORT for various parameters described in IS 875-1964 & IS 800 and found to be having a factor of safety of 2.0 or higher at wind load of 150 kms/hour.

Structure size	Drawing Number	Calculated Factor of Safety as per IS 875-1964
4 Module MMS	SMP-SM-1220	The elements have been designed using guideline as per IS 875-1964, the attached report shows that actual stresses in the elements are at least 2 time less than allowable stresses. Hence it has 2 FOS.
6 Module MMS	SMP-SM-1219	
9 Module MMS	SMP-SM-1216	
10 Module MMS	SMP-SM-1217	

We therefore certify that the Solar Photovoltaic Module mounting structures as per aforementioned design and drawings numbers fully comply with the requirements of IS 875-1964 as are suitable for withstanding a wind load of 150 kms/hour.


Certified by

Name

Post

Date

Location:


Prof. Vishalkumar B. Patel
Assistant Professor
Structural Engg. Department
B.V.M. Engineering College,
V. V. Nagar-388120

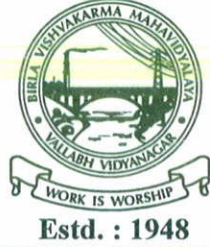

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Solex Energy Ltd
Plot no - 131/A, Phase -1,
H.M. Road, G.I.D.C.,
Vitthal Udyognagar - 388121
Aanand, Gujarat,



Subject: Evaluation of Module mounting structures

Dear Sir,

You have submitted following drawings for various types/designs of Solar Photovoltaic Module mounting structures for evaluation of their suitability for bearing a wind load of 150 Kms/hour

Structure size	Drawing Number
4 Module MMS	SMP-SM-1220
6 Module MMS	SMP-SM-1219
9 Module MMS	SMP-SM-1216
10 Module MMS	SMP-SM-1217

The same have been evaluated as per IS 875-1964 for bearing a wind load of 150 Kms/hour and we are herewith enclosing the following documents:

1. Certificate confirming that the drawings meet the requirements of IS 875-1964 for a wind load of 150 kms/hour.
2. Our Analysis of each of these structures.
3. Certified copy of each of the aforementioned drawings, including the drawing for the foundation.
4. Details of various structural design and certifications projects undertaken by the Structural engineering department of our college.
5. Background information of our college

Name

[Signature]

Post

Prof. Vishalkumar B. Patel
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Date

Location:

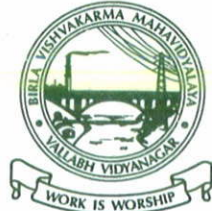
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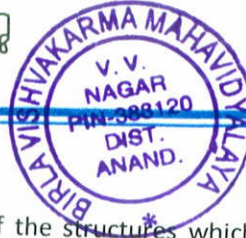
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No: F/38/053

Date : 20/05/2020


We have compared the designs of the structures which are provided in the tender No. NIT/Bid Document No. EESL / 06 / 2019-20/ KUSUM/ SWPS/ Phase-1/ Off Grid/ 192007012 dt 18-07-2019 (Section-4; Page-19 of 102 Clause 3.5.3) which we call as the 'Indicative MNRE design' with the structure and foundation designs as per following drawing numbers which we call the 'ALTERNATE design'


SR NO	Structure size	Drawing Number
1	4 Module MMS	SMP-SM-1220
2	6 Module MMS	SMP-SM-1219
3	9 Module MMS	SMP-SM-1216
4	10 Module MMS	SMP-SM-1217

These designs have been verified and duly certified by us vide our letter no. F/38/05/452 dated 18/03/2020 and that certificate should be read in conjunction with this certificate.

We hereby state the improved technical features and advantages of the ALTERNATE design over the Indicative MNRE design.

Sr. No	Feature	Improvement in Alternate design	Advantage/Benefit
1	Factor of safety	MNRE design specifies the structure should be suitable for wind load of 150 Kms/hour. The alternate design has a factor of 2.0 or higher of all the structural members considering a wind load of 150 Kms/hour on basis of 'Staad Pro' report for various parameters described in IS 875-1964 and IS-800	Higher factor of safety would result in better reliability and longer life of the structure.
2	Use of all parts as per BIS standards	MNRE design has several parts as per attached table which are not as per IS 1161 whereas all the members used in ALTERNATE design are as per IS 1161. Refer annexure to this certificate	100% conformity of all parts to national standards resulting in better quality.


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3	Shear force withstanding capability	The central member of MNRE design has a shear force withstanding ability of 8.0 KN/m, whereas the ALTERNATE design has a shear force withstanding ability of 11.5 KN/m. for 10 MMS design and 11.0 KN/m for 9 MMS design.	35% higher shear force withstanding ability of the central member would ensure higher strength and reliability of the ALTERNATE design
4	Shadow free area occupied by the structures	As per MNRE design 2 structures are required in 3 HP covering an area of 34 sq m with 02 foundations and in ALTERNATE design, a single structure is required requiring and areas of 20 sq m with 01 foundation.	30% higher land use efficiency for 3 HP pumps.
5	Foundation suitability for sandy soils	<p>As per MNRE, Annexure-I of Circular No. F. No. 41/3/2018-SPV Division dated 17.7.2019 specifications of MMS – Specification of main parts point 1. Centre shaft, suggest foundation with Base plate and direct piling foundation design.</p> <p>The ALTERNATE design employs piling foundation type and such type of foundation is better suited for soft and sandy soils having density lower than 1.7g/cm³</p>	<p>Use in multiple locations including soft and sandy soils having density lower than 1.73 g/cm³.</p> <p>Direct Piling design is design is preferable for soft soil type like sandy soil or soil having low bearing capacity It is also provide high uplift resistance to Wind loads.</p> <p>The structure having piling foundation has better alignment than the structure having 4 nos J-BOLT foundation. Alternate structure top of foundation is 200 mm above ground level, so no water logging and longer life of structure.</p> <p>In J- Bolt foundation sturcture design the whole loads are on J-Bolts which are 750 mm below ground level where in piling foundatin the main pole is 850 mm below gorund level which gives more stability to structure.</p> <p>Piling design prevents</p>

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			the users from installing the structures on their roof tops and other unsuitable sites.
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Thus we state that the 'ALTERNATE design' of structures have several improvements over the 'Indicative MNRE design' as stated above and hence the ALTERNATE design is an improved design.

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ANNEXURE to the certificate



Table of materials specified for the MNRE design

Bill of Quantity for main parts of MMS for Solar Water Pumping System

SR. NO.	PART NAME	CROSS SECTION DETAIL	LENGTH (MM)	QUANTITY PER SET
A Common for MMS for 4, 6 and 8 Modules				
1.	MAIN POLE	139 OD	1500	1
2.	TOP PLATE	300 OD	--	1
3.	CLAMP WITH BLADE	75X8	380	2
4.	SUPPORTING PIPES	41 OD & 33 OD	--	6
B Different for MMS for 4, 6 and 8 Modules				
5.	MAIN TUBE			
	4 and 6 Module	60X60X3.6	3300	1
	8 Modules	122X61X3.6	3300	1
6.	SIDE TUBE			
	4 and 6 Module	50X50X3.6	3300	2
	8 Modules	80X40X3.2	3300	2
7.	MOUNTING PURLIN			
	4 Module	80X50X15X2	2050	4
	6 Module	80X50X15X2	3100	4
	8 Modules	80X50X15X2	4150	4


The following components in the table above do not conform to IS Standards


- Main Pole - PIPE 139 OD and 4 mm thick –Non conforming to IS 1161
- Supporting Pipes - PIPE 41 OD and 33 OD –Non conforming to IS 1161
- Main Tube for 4 & 6 modules - TUBE 60X60X3.6, Not conforming to IS 4923

As may be seen in the drawings of ALTERNATE design, each main part of each MMS conforms to the relevant IS standard.

Refer drawing nos SMP-SM-1216 and 1217 for 9 and 10 MMS respectively:

- On page 5 of 17 of drawings, the pipe OD has been taken exactly as per IS 1161, which is specified as OD 139.7 and thickness 4.5mm and 5.4 mm respectively for 9 and 10 MMS. Whereas the 8 structure MNRE design has OD 139 and thickness 4mm (which in any case is non conforming to IS 1161).
- On page 13 of 17 of drawings, instead of round pipe, the square pipes of 50 x 50 and 40 x 40, exactly as per IS 1161, which is substantially thicker than the specified round pipe of OD 41 and OD 33 (which are in any case non conforming to IS 1161).


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