



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS C 8955 : 2011

(JEMA)

**Design guide on structures for photo-
voltaic array**

ICS 27.160;91.140.50

Reference number : JIS C 8955 : 2011 (E)

PROTECTED BY COPYRIGHT

C 8955 : 2011

Date of Establishment: 2004-08-20

Date of Revision: 2011-02-21

Date of Public Notice in Official Gazette: 2011-02-21

Investigated by: Japanese Industrial Standards Committee

Standards Board

Technical Committee on Electricity Technology

JIS C 8955 : 2011, First English edition published in 2012-08

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

© JSA 2012

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Printed in Japan

PROTECTED BY COPYRIGHT

Contents

	Page
Introduction	1
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Assumed load	2
4.1 Classification of assumed loads	2
4.2 Combination of loading condition and load	3
5 Wind pressure load	3
5.1 Wind pressure load for design	3
5.2 Velocity pressure for design	3
5.3 Coefficient of wind force	13
6 Snow load	17
7 Seismic load for design	24
8 Material and its allowable unit stress	24
8.1 Selection of material	24
8.2 Allowable unit stress	25
9 Joining of members	26
10 Corrosion protection	27

Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by the Japan Electrical Manufacturers' Association (JEMA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS C 8955** : 2004 is replaced with this Standard.

This **JIS** document is protected by the Copyright Law.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public or utility model right. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public or the utility model right.

Design guide on structures for photovoltaic array

Introduction

This Japanese Industrial Standard was established in 2004, and has been revised at this time in order to correspond to the installation mode which is in conformance with the latest status of the related laws, regulations and standards.

No International Standard corresponding to this Standard has been established at this point.

1 Scope

This Standard specifies the design guide on the structures with the height from the lower end to the upper end of 4 m or less which constitute a photovoltaic array (hereafter referred to as “array”).

The following arrays are not covered by this Standard.

- a) Arrays having the function as building materials such as roofing and window materials.
- b) Arrays to be used at an altitude exceeding 1 000 m.
- c) Arrays to be installed at a ground height exceeding 60 m.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS C 8960 *Glossary of terms for photovoltaic power generation*

JIS G 3101 *Rolled steels for general structure*

JIS G 3106 *Rolled steels for welded structure*

JIS G 3114 *Hot-rolled atmospheric corrosion resisting steels for welded structure*

JIS G 3302 *Hot-dip zinc-coated steel sheet and strip*

JIS G 3350 *Light gauge steel sections for general structure*

JIS G 3444 *Carbon steel tubes for general structure*

JIS G 3466 *Carbon steel square and rectangular tubes for general structure*

JIS H 4100 *Aluminium and aluminium alloy extruded shape*

JIS H 8641 *Hot dip galvanized coatings*

3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in **JIS C 8960** and the following apply.

3.1 structures

a generic term for work pieces intended for supporting a photovoltaic module (hereafter referred to as “module”), such as single poles, support structures, etc.

3.2 fixed load

load permanently acting, which includes the mass of modules, structures, etc.

3.3 wind pressure load

load due to wind pressure force which acts on modules, structures, etc.

3.4 snow load

load due to accumulation of snow, which acts on the surface of modules

3.5 seismic load

the horizontal seismic force which acts on structures

3.6 application coefficient

a coefficient to be considered for calculation of the wind pressure load or seismic load, determined by the application of the photovoltaic power generating system

3.7 recurrence interval

period (number of years) until natural phenomena with a certain strength (a typhoon, heavy rain, heavy snowfall, earthquake, etc.) occur again

3.8 environmental coefficient

a coefficient to be considered for calculation of the wind pressure load, determined by the height of the installation site, geographical conditions and natural features, etc. around the construction spot

4 Assumed load

4.1 Classification of assumed loads

For the load exerted on structure, the following four types are assumed.

- a) **Fixed load (G)** The load obtained by summing up the mass of modules (G_M) and mass of structures (G_K).
- b) **Wind pressure load (W)** The summation (vector sum) of the wind pressure force (W_M) on the modules and the wind pressure force (W_K) the on structures.
- c) **Snow load (S)** The vertical snow load on a module plane.
- d) **Seismic load (K)** The horizontal seismic force exerted on structures.

4.2 Combination of loading condition and load

The combination of loading condition and load shall be as given in table 1.

Table 1 Combination of loading condition and load

Loading condition		Classification	
		General district	District of heavy snowfall
Long term	Stationary	G	G
	Snow		$G + 0.7S$
Short term	Snow	$G + S$	$G + S$
	Storm	$G + W$	$G + W$
			$G + 0.35S + W$
	Earthquake	$G + K$	$G + 0.35S + K$

In addition, the district of heavy snowfall shall fall under either of the following :

- a district with a vertical snow accumulation specified in 6 c) of 1 m or more;
- a district where the average of the number of days between the first day of snow cover and the last day of snow cover (i.e. the number of days in the period during which the ratio of the snow cover to the district concerned is over 1/2) is 30 days or more.

5 Wind pressure load

5.1 Wind pressure load for design

The wind pressure load on an array shall be calculated according to formula (1).

$$W_p = C_w \times q_p \times A_w \dots\dots\dots (1)$$

where, W_p : wind pressure load for design (N)
 C_w : coefficient of wind force
 q_p : velocity pressure for design ($\text{N} \cdot \text{m}^{-2}$)
 A_w : wind receiving area (m^2) (Total area of all the modules that constitute an array. See table 6.)

5.2 Velocity pressure for design

The velocity pressure for design shall be calculated according to formula (2). The reference wind speed for design, environmental coefficient and application coefficient to be used for this calculation shall be as described in a), b) and c), respectively.

$$q_p = 0.6 \times V_0^2 \times E \times I \dots\dots\dots (2)$$

where, q_p : velocity pressure for design ($\text{N} \cdot \text{m}^{-2}$)
 V_0 : reference wind speed for design ($\text{m} \cdot \text{s}^{-1}$)
 E : environmental coefficient
 I : application coefficient

- a) **Reference wind speed for design** The reference wind speed given in table 2 which is determined in the range of $30 \text{ m} \cdot \text{s}^{-1}$ to $46 \text{ m} \cdot \text{s}^{-1}$ by the degree of wind hazard

and nature of other wind based on the past record of typhoons in the district of construction spot shall be used.

Table 2 Reference wind speed for design

Number	Applicable district	Reference wind speed $\text{m} \cdot \text{s}^{-1}$
(1)	Districts other than those described in (2) to (9)	30
(2)	In Hokkaido Sapporo-shi, Otaru-shi, Abashiri-shi, Rumoi-shi, Wakkanai-shi, Ebetsu-shi, Mombetsu-shi, Nayoro-shi, Chitose-shi, Eniwa-shi, Kitahiroshima-shi, Ishikari-shi, Ishikari-gun, Atsuta-gun, Hamamasu-gun, Namporo-cho in Sorachi-gun, Yuni-cho and Naganuma-cho in Yubari-gun, Furen-cho and Shimokawa-cho in Kamikawa-gun, Bifuka-cho, Otoineppu-mura and Nakagawa-cho in Nakagawa-gun, Mashike-gun, Rumoi-gun, Tomamae-gun, Teshio-gun, Soya-gun, Esashi-gun, Rebun-gun, Rishiri-gun, Higashimokoto-mura, Memambetsu-cho and Bihoro-cho in Abashiri-gun, Kiyosato-cho and Koshimizu-cho in Shari-gun, Tanno-cho, Saroma-cho and Tokoro-cho in Tokoro-gun, Kami-Yubetsu-cho, Yubetsu-cho, Okoppe-cho, Nishi-Okoppe-mura and Omu-cho in Mombetsu-gun, Oiwake-cho and Hobetsu-cho in Yufutsu-gun, Biratori-cho in Saru-gun, Niikappu-gun, Shizunai-gun, Mitsuishi-gun, Urakawa-gun, Samani-gun, Horoizumi-gun, Akkeshi-cho in Akkeshi-gun, Kawakami-gun. In Iwate-ken Kuji-shi, Kuzumaki-machi in Iwate-gun, Tanohata-mura and Fudai-mura in Shimo-Hei-gun, Noda-mura and Yamagata-mura in Kunohe-gun, Ninohe-gun. In Akita-ken Akita-shi, Odate-shi, Honjo-shi, Kazuno-shi, Kazuno-gun, Takanosu-machi, Hinai-machi, Aikawa-machi and Kami-Koani-mura in Kita-Akita-gun, Gojome-machi, Showa-machi, Hachirogata-machi, Itagawa-machi, Tenno-machi and Ikawa-machi in Minami-Akita-gun, Nikaho-machi, Kanaura-machi, Kisakata-machi, Iwaki-machi and Nishime-machi in Yuri-gun. In Yamagata-ken Tsuruoka-shi, Sakata-shi, Nishi-Tagawa-gun, Yuza-machi in Akumi-gun. In Ibaraki-ken Mito-shi, Shimotsuma-shi, Hitachinaka-shi, Uchihara-cho in Higashi-Ibaraki-gun, Tomobe-machi and Iwama-machi in Nishi-Ibaraki-gun, Yasato-machi in Nihari-gun, Akeno-machi and Makabe-machi in Makabe-gun, Yuki-gun, Goka-machi, Sashima-machi and Sakai-machi in Sashima-gun. In Saitama-ken Kawagoe-shi, Omiya-shi, Tokorozawa-shi, Sayama-shi, Ageo-shi, Yono-shi, Iruma-shi, Okegawa-shi, Kuki-shi, Fujimi-shi, Kami-Fukuoka-shi, Hasudashi, Satte-shi, Ina-machi in Kita-Adachi-gun, Oi-machi and Miyoshi-machi in Iruma-gun, Minami-Saitama-gun, Kurihashi-machi, Washimiya-machi and Sugito-machi in Kita-Katsushika-gun. In Tokyo-to Hachioji-shi, Tachikawa-shi, Akishima-shi, Hino-shi, Higashi-Murayama-shi, Fussa-shi, Higashi-Yamato-shi, Musashi-Murayama-shi, Hamura-shi, Akiruno-shi, Mizuho-machi in Nishi-Tama-gun.	32

Table 2 (continued)

Number	Applicable district	Reference wid speed m·s ⁻¹
(2)	In Kanagawa-ken Yamakita-machi in Ashigara-Kami-gun, Tsukui-machi, Sagamiko-machi and Fujino-machi in Tsukui-gun. In Niigata-ken Ryotsu-shi, Sado-gun, Sanpoku-machi and Awashimaura-mura in Iwafune-gun. In Fukui-ken Tsuruga-shi, Obama-shi, Mikata-gun, Onyu-gun, Oi-gun. In Yamanashi-ken Fujiyoshida-shi. Nambu-cho and Tomizawa-cho in Minami-Koma-gun, Akiyama-mura, Dosi-mura, Oshino-mura, Yamanakako-mura and Narusawa-mura in Minami-Tsuru-gun. In Gifu-ken Tajimi-shi, Seki-shi, Mino-shi, Minokamo-shi, Kakamigahara-shi, Kani-shi, Fujihasi-mura and Sakauchi-mura in Ibi-gun, Neo-mura in Motosu-gun, Yamagata-gun, Horado-mura and Mugegawa-cho in Mugi-gun, Sakahogi-cho and Tomika-cho in Kamo-gun. In Shizuoka-ken Shizuoka-shi, Hamamatsu-shi, Shimizu-shi, Fujinomiya-shi Shimada-shi, Iwata-shi, Yaizu-shi, Kakegawa-shi, Fujieda-shi, Fukuroi-shi, Kosai-shi, Fuji-gun, Ihara-gun, Shida-gun, Omaezaki-cho, Sagara-cho, Haibara-cho, Yoshida-cho and Kanaya-cho in Haibara-gun, Ogasa-gun, Asaba-cho, Fukuda-cho, Ryuyo-cho and Toyoda-cho in Iwata-gun, Hamana-gun, Hosoe-cho and Mikkabi-cho in Inasa-gun. In Aichi-ken Toyohashi-shi, Seto-shi, Kasugai-shi, Toyokawa-shi, Toyota-shi, Komaki-shi, Inuyama-shi, Owariasahi-shi, Nisshin-shi, Aichi-gun, Niwa-gun, Nukata-cho in Nukata-gun, Hoi-gun, Miyoshi-cho in Nishi-Kamo-gun. In Shiga-ken Otsu-shi, Kusatsu-shi, Moriyama-shi, Shiga-gun, Kurita-gun, Ika-gun, Takashima-gun. Kyoto-fu In Osaka-fu Takatsuki-shi, Hirakata-shi, Yao-shi, Neyagawa-shi, Daito-shi, Kashiwara-shi, Higashi-Osaka-shi, Shijonawate-shi, Katano-shi, Mishima-gun, Taishi-cho, Kanan-cho and Chihayaakasaka-mura in Minami-Kawachi-gun. In Hyogo-ken Himeji-shi, Aioi-shi, Toyooka-shi, Tatsuno-shi, Ako-shi, Nishiwaki-shi, Kasai-shi, Sasayama-shi, Taka-gun, Shikama-gun, Kanzaki-gun, Ibo-gun, Ako-gun, Shisou-gun, Kinosaki-gun, Izushi-gun, Mikata-gun, Yabu-gun, Asago-gun, Hikami-gun. In Nara-ken Nara-shi, Yamato-Takada-shi, Yamato-Koriyama-shi, Tenri-shi, Kashihara-shi, Sakurai-shi, Gose-shi, Ikoma-shi, Kashiba-shi, Soekami-gun, Yamabe-gun, Ikoma-gun, Shiki-gun, Ouda-cho, Utano-cho, Haibara-cho and Murou-mura in Uda-gun, Takaichi-gun, Kita-Katsuragi-gun.	32

Table 2 (continued)

Number	Applicable district	Reference wid speed m·s ⁻¹
(2)	In Tottori-ken Tottori-shi, Iwami-gun, Koge-cho, Funaoka-cho, Hatto-cho and Wakasa-cho in Yazu-gun. In Shimane-ken Masuda-shi, Hikimi-cho in Mino-gun, Nichihara-cho in Kanoashi-gun, Oki-gun. In Okayama-ken Okayama-shi, Kurashiki-shi, Tamano-shi, Kasaoka-shi, Bizen-shi, Hinase-cho in Wake-gun, Oku-gun, Kojima-gun, Tsukubo-gun, Asakuchi-gun. In Hiroshima-ken Hiroshima-shi, Takehara-shi, Mihara-shi, Onomichi-shi, Fukuyama-shi, Higashi-Hiroshima-shi, Fuchu-cho in Aki-gun, Yuki-cho and Yoshiwa-mura in Saeki-gun, Tsutsuga-son in Yamagata-gun, Kochi-cho in Kamo-gun, Hongo-cho in Toyota-gun, Mukaishima-cho in Mitsugi-gun, Numakuma-gun. In Fukuoka-ken Yamada-shi, Amagi-shi, Yame-shi, Buzen-shi, Ogori-shi, Keisen-machi, Inatsuki-machi, Usui-cho, Kaho-machi in Kaho-gun, Asakura-gun, Ukiha-gun, Mii-gun, Yame-gun, Soeda-machi, Kawasaki-machi, Oto-machi and Akamura in Tagawa-gun, Saigawa-machi in Miyako-gun, Chikujo-gun. In Kumamoto-ken Yamaga-shi, Kikuchi-shi, Kikusui-machi, Mikawa-machi and Nankan-machi in Tamana-gun, Kamoto-gun, Kikuchi-gun, Ichinomiya-machi, Aso-machi, Ubuyama-mura, Namino-son, Soyo-machi, Takamori-machi, Hakusui-mura, Kugino-mura, Choyo-mura and Nishihara-mura in Aso-gun. In Oita-ken Oita-shi, Beppu-shi, Nakatsu-shi, Hita-shi, Saiki-shi, Usuki-shi, Tsukumi-shi, Taketa-shi, Bungotakada-shi, Kitsuki-shi, Usa-shi. Nishi-Kunisaki-gun, Higashi-Kunisaki-gun, Hayami-gun, Notsuharu-machi, Hasama-machi and Shonai-cho in Oita-gun, Kita-Amabe-gun, Minami-Amabe-gun, Ono-gun, Naori-gun, Shimoge-gun, Usa-gun. In Miyazaki-ken Takachiho-cho and Hinokage-cho in Nishi-Usuki-gun, Kitagawa-cho in Higashi-Usuki-gun.	32
(3)	In Hokkaido Hakodate-shi, Muroran-shi, Tomakomai-shi, Nemuro-shi, Noboribetsu-shi, Date-shi, Matsumae-gun, Kamiiso-gun, Kameda-gun, Kayabe-gun, Shari-cho in Shari-gun, Abuta-gun, Kyowa-cho in Iwanai-gun, Shakotan-gun, Furubira-gun, Yoichi-gun, Usu-gun, Shiraoi-gun, Hayakita-cho, Atsuma-cho and Mukawa-cho in Yufutsu-gun, Mombetsu-cho in Saru-gun, Hamanaka-cho in Akkeshi-gun, Notsuke-gun, Shibetsu-gun, Menashi-gun. Aomori-ken In Iwate-ken Ninohe-shi, Karumai-machi, Taneichi-machi, Ono-mura and Kunohe-mura in Kunohe-gun.	34