CHICAGO SOLAREXPRESS

PHOTOVOLTAIC PANEL PERMITTING

GUIDELINES

CITY OF CHICAGO

DEPARTMENT OF BUILDINGS

OCTOBER 21, 2013

INTRODUCTION

This document defines procedures intended to facilitate the installation of Photovoltaic Panels (PV panels) in the City of Chicago through its Housing and Economic Development and Building Departments (DHED & DOB). The procedures listed herein are intended to specifically define the process for obtaining a permit for the installation of PV panels on roofs of buildings. For a range of installations defined in Section A, the time required to obtain a permit will be minimal.

The specific requirements for Zoning, Electrical and Structural are defined. The applicant must initially define the specific configuration of the PV panel installation (i.e. dimensions and location), and ensure that it meets the Zoning requirements. The applicant must then define all of the components of the system and ensure that they meet the Electrical requirements. Finally, the applicant must determine if the existing roof structure can carry the additional dead, wind and possibly snow loads due to the new PV panels.

The procedures listed herein are for existing roof structures consisting of concrete, steel or wood. For steel and concrete roof structures an architect or structural engineer, licensed in the State of Illinois, is required to evaluate the adequacy of the existing structure and list their findings on the appropriate forms included herein. Their analysis must be made using accepted engineering practice, standards of the industry and the requirements of the Chicago Building Code. Their calculations must also be provided.

For wood construction, the information included in this document can be used for the evaluation of the existing wood roof framing. Tables are provided, in the Appendix, to assist in determining the maximum span of joists or rafters given certain loading conditions. For conditions that are beyond the applicability of the span tables provided, analyses must be performed that conform to the requirements of the Chicago Building Code, referenced standards (such as the National Design Specification), and accepted structural engineering practice. The information listed in the span tables is provided for convenience only. It is the responsibility of the owner, contractor, architect and/or structural engineer to ensure that all members and connections are adequate for their intended purpose and meet the requirements of the Chicago Building Code.

For new construction, major building remodeling or building additions, the installation of PV panels is a part of that construction. Similarly, the building permit for PV panel installation is a part of that required for the overall construction project. The forms/tables included herein must be completed and submitted with the other documents, drawings and calculations required for the permit application for the project as a whole.

For projects that include only the installation of PV panels and where the PV panels will be hung or mounted onto building walls, mounted as bris-de-solei awnings above windows, mounted on auxiliary building such as garage roofs or storage shed roofs, or mounted on ground structures such as poles, pylons and pedestals, these Guidelines do not apply. These projects will be evaluated, during the permit review, using the Standard Plan Review process for compliance with zoning, electrical and structural requirements.

CONDITIONS

The information, procedures and provisions listed herein are based upon the applicable sections of the Chicago Municipal Code and consideration of the of the life-safety conditions unique to Photovoltaic Panel installations. As additional information becomes available or the specific requirements of DHED or DOB change, the information, procedures and provisions listed herein may be revised. The DHED & DOB reserve the right to modify or change any portion of this document at any time. To ensure that the most current provisions are being addressed, the user is advised to check the City of Chicago Website for the latest edition of this document.

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The PV panel design, permitting and construction should include the following process.

1	2	3	4	5
SELECT AN INSTALLER & DETERMINE SIZE OF SYSTEM	SELECT A DESIGN PROFESSIONAL (IF APPLICABLE)	APPLY FOR A PERMIT	INSTALL SYSTEM	REQUEST INSPECTIONS & PROJECT CLOSEOUT

STEP 1: SELECT INSTALLER AND SYSTEM

SYSTEM

Select a licensed contractor/installer that is qualified to assist you in determining the optimum PV panel system for your needs. Obtain information regarding other similar projects that they have done. In addition, obtain references that can be contacted to confirm the adequacy of their other installations. In addition, if possible, view these projects.

Determine the size and manufacturer(s) of the PV system to be installed. Determine whether the proposed system complies with the Zoning requirements. Also determine how the PV system is to be attached and supported on your building.

STEP 2: SELECT A DESIGN PROFESSIONAL

BUILDING STRUCTURE

Depending upon the type of roof structure and PV panel installation, a review of the existing structure by an architect or structural engineer may be required. If so, obtain the services of an architect or structural engineer licensed in the State of Illinois to examine and determine if the structure is adequate to support the additional gravity and wind loads due to the new PV panel system. They should prepare calculations and drawings as necessary to show adequacy of the existing roof structure or how it must be modified.

To find a suitable design professional, one of the following professional associations can be contacted for recommendations. In addition, the Internet or the telephone directory can be used.

- Association of Licensed Architects (ALA) (847) 382-0630 (www.ALAtoday.org)
- American Institute of Architects Chicago (AIA Chicago) (312) 670-7770 (www.aiachicago.org)
- Structural Engineers Association of Illinois (SEAOI) (312) 372-4198 (www.seaoi.org)

After finding several likely candidates, interview the design professionals. During the interviews with potential design professionals, obtain information regarding other similar projects that they have done. In addition, obtain references that can be contacted to confirm the adequacy of the services provided on these other projects. In addition, if possible, view these projects.

STEP 3: OBTAIN A BUILDING PERMIT

PERMIT PROCESS

Two Department of Building processes are available for the permitting of PV panel installations on existing buildings. They are the Easy Permit Process (EPP) and Standard Plan Review (SPR). PV panel installation projects that qualify for the Easy Permit Process must comply with the requirements listed on page 4 of this document. For installations that do not comply with the requirements of the Easy Permit Process, including those with an output of greater than 13.44 KW, the Standard Plan Review process must be used.

For PV panels installed as a part of new construction, major building remodeling or building additions, the permit must be obtained as a part of (or in conjunction with) that construction process.

Where the PV panels will be hung or mounted on to building walls, mounted as bris-de-solei awnings above windows, mounted on auxiliary building such as garage roofs or storage shed roofs, or mounted on ground structures such as poles, pylons and pedestals, the projects will be evaluated using the Standard Plan Review process for compliance with zoning, electrical and structural requirements. These Guidelines do not apply to these types of PV panel installations.

For further information regarding the permit processes the following individuals may be contacted:

- Easy Permit Process – debra.vallone@cityofchicago.org
- Standard Plan Review – ed.doherty@cityofchicago.org
- Green Permit Program / Developer Services – sophie.martinez@cityofchicago.org

STEP 3: CONT'D

EXISTING BUILDINGS

EASY PERMIT PROCESS (EPP)

For PV panel projects that meet the EPP requirements, the items listed below should be followed to obtain a building permit:

1) Complete the General, Zoning and Electrical tables/forms included herein.
2) Complete the Structural tables/forms included herein.
3) Provide drawings and calculations completed and stamped by a licensed architect or licensed structural engineer to show the adequacy of the existing structure to support the PV panels. (If the PV panels are to be installed on limited types of wood frame structures, as defined herein, drawings and calculations are not required.)
4) Provide photographs of the exterior of the building and the roof structure. (If necessary create inspection openings to document the roof structure.)
5) Provide PV panel manufacturer's technical information (cut sheets).
6) Provide a completed Easy Permit Application.
7) Provide a completed Electrical Permit Application.
8) Provide an Aldermanic Letter of Support to waive the 10 day waiting period.
9) The completed package is to be submitted at City Hall, 121 N. LaSalle Street, 9th Floor, EPP desk (312-744-8678) by a licensed general/installation contractor, only. The contractor must be in good standing with the City of Chicago.
10) The submittal package will be reviewed for completeness and accuracy using an abbreviated process. A separate Zoning review will not be made. The DOB review typically will not include Electrical and Structural disciplines. The DOB will rely on the applicant to ensure that the design and installation of the system complies with all Zoning and Chicago Building Code requirements.
11) After the permit fee of $275 is paid, a building permit will be issued.
12) Projects may be audited.

STANDARD PLAN REVIEW (SPR)

For PV panel projects that are to be submitted using the SPR process, the items listed below should be followed to obtain a building permit:

1) The General, Zoning and Electrical tables/forms included herein must be completed by the licensed architect or licensed structural engineer of record for the project.
2) The Structural tables/forms included herein must be completed by the licensed architect or licensed structural engineer of record for the project.
3) Provide drawings and calculations prepared and stamped by the licensed architect or licensed structural engineer of record for the project to show the adequacy of the existing structure to support the PV panels.
4) Provide photographs of the exterior of the building and the roof structure. (If necessary create inspection openings to document the roof structure.)
5) Provide PV panel manufacturer's technical information (cut sheets).
6) The PV Panel or Solar Contractor must be listed as the General Contractor for the project.
7) The licensed architect or licensed structural engineer of record for the project must submit the completed Photovoltaic Panel Permitting Guidelines, Permit application and Electrical Permit application using the SPR process of the Department of Buildings through the DOB E-Plan / ProjectDox Electronic Plan submission system.
8) The submittal package will be reviewed for completeness, accuracy and compliance with the Standard Plan Review process. The administrative and structural reviews will be performed on an accelerated basis by specifically designated DOB staff.
9) After the permit fee is paid, a building permit will be issued.
10) The permit fee for the SPR process can be determined using the Permit Fee Calculator at www.cityofchicago.org and is a minimum of $375.

STEP 4: INSTALLATION

INSTALL

The installation must be performed by a licensed contractor that is experienced in PV panel installations. The contractor must be or use a licensed electrician for all electrical work.

Wherever the existing roofing or roof membrane is penetrated, it must be sealed to prevent water infiltration. For sloped roofs, manufacturers make special devices with flashing to fit into or under the shingles. For flat roofs, a roofing contractor will be required to flash penetrations through the membrane.

STEP 5: REQUEST INSPECTION

SYSTEM INSPECTION

After the installation is completed, contact the DOB for inspections, including an electrical inspection. An owner or a contractor can request that an inspection be scheduled. The request for a Final Inspection should be made online at www.cityofchicago.org/buildings. An electrical inspection is required to be connected to Commonwealth Edison's electrical grid. The electrical contractor is required to send the DOB electrical inspector's form to Commonwealth Edison.

NEW CONSTRUCTION, MAJOR BUILDING REMODELING OR BUILDING ADDITIONS

For projects where PV panels will be installed on a building rooftop as one component of new construction, major building remodeling or a building addition, the five step process described above generally does not apply. In addition to design, contracting and permitting for projects of this sort, the items listed below should be considered or followed as appropriate.

1) The use of these Guidelines for PV panel design and installation will provide a consistent understanding of the required information, procedures and structural loads.
2) The General, Zoning and Electrical tables/forms included herein must be completed by the licensed architect or structural engineer of record for the project.
3) The Structural tables/forms included herein must be completed by the licensed architect or structural engineer of record for the project.
4) Provide drawings and calculations prepared and stamped by the licensed architect or structural engineer to show the adequacy of the new structure to support the PV panels. These drawings and calculations will likely be a part of the documents created and submitted for the project as a whole.
5) The permit for the work, including the PV panels, will be reviewed by Zoning/Planning and will be reviewed by all disciplines (Architectural, Fire, Plumbing, Electrical, etc.) as a part of the process for the Standard Plan Review (SPR) or Developer Services (DS).
6) The installer will likely not be a separate entity but a subcontractor to the overall project.
7) The electrical contractor will be a subcontractor to the overall project.

SOLAR PANELS NOT INSTALLED ON BUILDING ROOFTOPS / NOT INSTALLED ON THE PRIMARY BUILDING

For projects that include only the installation of PV solar panels and where the solar panels will be hung or mounted on to building walls, mounted as bris-de-solei awnings above windows, mounted on auxiliary building such as garage roofs or storage shed roofs, or mounted on ground structures such as poles, pylons and pedestals the five step process described above does not apply. In addition to design, contracting and permitting for projects of this sort, the items listed below should be followed.

1) The Solar Contractor must be listed as a General Contractor for the project.
2) The Licensed Design professional must submit plans, structural calculations, product literature and the permit application and electrical permit for the solar panel installation electronically to the Department of Buildings Standard Plan Review process using the DOB E Plan / Project DOX Electronic Plan Submission System.
3) The project cannot use these Guidelines as they are only intended to be used for the installation of photovoltaic panels on a building rooftop.
4) The project will receive a full administrative, zoning and structural plan review.

The following are the requirements for the Easy Permit Process and Standard Plan Review for PV panel permit applications.

DEPARTMENT / DICIPLINE	CATEGORY	REQUIREMENTS		PERMIT PROCESS EPP	PERMIT PROCESS SPR
Department of Housing & Economic Development and Department of Buildings (DHED & DOB)	Landmark	System is located on property that is NOT zoned as a designated Landmark or located in a Landmark District		X	
	Panel Location	System is installed on a defined, permitted rooftop. If in the residential sector, the System must be located on the property's principal structure.		X	X
	Panel Height	If the system is being installed on a flat rooftop, no part of the system may exceed 9 feet in overall height, or extend 5 feet above the building parapet, whichever is less.		X	X
		If being installed on an inclined roof, System must be attached, mounted parallel with the roof, and the top surface of the collector shall not extend any further than 12 inches from the roof surface at any point. No portion of the solar collectors shall extend beyond the ridgeline of the roof at any point. (Also see Fire below.)		X	X
	Policy Compliance	System must adhere to all of the guidelines of the City of Chicago's Solar Zoning Policy and will not require a formal Zoning review.		X	
		System must adhere to all of the guidelines of the City of Chicago's Solar Zoning Policy.			X
	Allowed Occupancies	All buildings, subject to Zoning review			X
		All building except those listed below		X	
		Exceptions	Buildings classified under Class C, "Assembly Units" (per CBC 13-56-080 classification of occupancy definition).	X	
			Institutional Facilities (e.g. nursing home or hospital)	X	
			Occupied or habitable roofs (i.e. roofs with penthouses or decks)	X	
FIRE	Roof Surface Edge Distance	PV panels shall be installed a minimum of 3 feet from the boundaries or edges of flat roofs (i.e. roofs with a maximum slope of 1.5:12). PV panels shall be installed a minimum of 3 feet from the ridges of gable and hip roofs and a minimum of 3 feet from the ends of gable roofs. Where installed on hip roofs, the PV panel layout shall include a 3 foot wide clear path from the eave to the ridge. PV panels shall be installed a minimum of 18 inches from hips or valleys where panels are installed on both sides of the hips or valleys; otherwise, where PV panels are installed on only one side of a hip or valley they may be installed to the edge of the hip or valley.		X	X
DOB - ELECTRICAL	Size	System's inverter output is 13.44 kW or less (maximum size for 70-amp breaker) per roof		X	
	Electrical Components	System's electrical components comply with the Chicago Electric Code (18-27, Article 690), and application has been certified by a Licensed Electrician in good standing with the City of Chicago		X	X
		Primary electrical equipment (panels and inverters) is listed and labeled from a Nationally Recognized Testing Laboratory (18-27-110.2) and installed per manufacturer's instructions		X	X
DOB - STRUCTURAL	Mounting Structure	System's mounting structure is an engineered product designed to mount PV modules to rooftops, and is adequate to support all gravity and wind loads.		X	X
	PV Panel Dead Load	System's distributed system weight (PV equipment and framing) is less than or equal to 5 lb/ft^2 (psf). Ballasted systems do not qualify for the Easy Permit Process.		X	

DOB - STRUCTURAL	Existing Roof Structure	Provide the existing building roof structure components, as listed in the Structural Tables. Provide photographs of rafters/joists (with tape measure) that uniquely indentify that the framing is for that building.	X	X
	Building Height	Maximum building height is less than or equal to 55 feet	X	
		Maximum building height is less than or equal to that indicated in the applicable figures of ASCE 7-05 and SEAOC PV2-2012		X
	Wind Pressure Requirements	The determination of the design wind pressure that impinges on the PV panels must be based upon the requirements of the Chicago Building Code, ASCE 7-05, Minimum Design Loads for Buildings and other Structures of the American Society of Civil Engineers and SEAOC PV2-2012, Wind Design For Low-Profile Solar Photovoltaic Arrays on Flat Roofs of the Structural Engineers Association of California. The applicable provisions of the CBC and the applicable standards depend upon the dimensions of the building, roof slope, PV panel angle, PV panel location on the roof, etc. For certain configurations of PV panels, neither the CBC nor ASCE 7-05 provide the appropriate (or applicable) wind load provisions. For those configurations, the DOB is accepting the use of SEAOC PV2-2012, Wind Design For Low-Profile Solar Photovoltaic Arrays on Flat Roofs of the Structural Engineers Association of California, for the determination of wind loads.	X	X

***** REQUIRED SUBMITTAL INFORMATION *****

The following general information and certification is required for all PV Panel installations.

BUILDING INFORMATION:		
BUILDING ADDRESS		
BUILDING HEIGHT		**Not to exceed 55 feet to be considered within the Easy Permit Process.**
BUILDING MAXIMUM LENGTH		**The maximum plan dimension of the building.**
BUILDING WIDTH		**The minimum plan dimension of the building.**
ROOF SLOPE		**The slope must be 1.5:12 (7 degrees) or less to be considered flat. (0 degrees = flat.)**

We, as the Property Owner and General Contractor, certify that the information provided herein and the statements made are true, and understand that the Department of Buildings has the right to revocation and penalties (as listed in the Easy Permit Application certification statements) in the event that the statements made regarding this criteria information have been falsified or is determined to be inaccurate.

_____	_____	_____
Property Owner's Name	Property Owner's Signature	Date
_____	_____	_____
General Contractor's Name	General Contractor Signature	Date

***** REQUIRED SUBMITTAL INFORMATION *****

Provide the following zoning information for all PV Panel permit applications. The PV panel installation must comply with all of the zoning requirements to be accepted under the Easy Permit Process.

ZONING INFORMATION:			
CATEGORY	**DATA**		**ZONING REQUIRMENTS**
LANDMARK	☐ Yes ☐ No		Is the building that the PV panel system to be mounted on a national or state landmark? (If yes, then the expedited process cannot be used.)
	☐ Yes ☐ No		Is the building that the PV panel system to be mounted on a city designated landmark? (If yes, then the expedited process cannot be used.)
	☐ Yes ☐ No		Is the building that the PV panel system to be mounted on located in a code orange or red landmark district? (If yes, then the expedited process cannot be used.)
LOCATION ON BUILDING			Define specifically, where on the building the PV panels are to be located. (PV panels must be installed on a defined, permitted rooftop. If in the residential zoning district, the PV panels must be located on the property's principal structure.)
TOP PANEL SURFACE ABOVE FLAT ROOF DECK	**Upper or Top Edge**		State the dimensions that the upper and lower edges of the sloped PV panel extend above the roof surface. (If installed on a flat rooftop, no part of the PV panel system may exceed 9 feet in overall height, or extend 5 feet above the building parapet, whichever is less.)
	Lower or Bottom Edge		
TOP PANEL SURFACE ABOVE SLOPED ROOF DECK			State the dimension between the top of the roof surface and the top of the PV panel. (If installed on an inclined or sloped roof, the PV panels must be attached to and mounted parallel with the roof. The top surface of the PV panels shall not be more than 12 inches from the roof deck at any point. No portion of the PV panels shall extend above the ridgeline of the roof at any point.)
POLICY COMPLIANCE	☐ Yes ☐ No		Does the PV panel system adhere to all of the guidelines of the City of Chicago's Solar Zoning Policy?

*** REQUIRED SUBMITTAL INFORMATION ***

Provide drawings below, or on a separate sheet, to clearly show the location of the PV panels. (See example.)

BUILDING ADDRESS:			
OWNER:			
DRAWN BY:		**DATE:**	

Required Information:

- Roof Plane with Overall Dimensions
- Location of Roof Plane on Building
- PV Panels (Show Individual Panels and Rows)
- Edge Distance Between PV Panels and Roof Edge
- End Distance Between PV Panels and Roof Edge
- Distance Between Rows of PV Panels
- Distance Between Adjacent PV Panels
- Side or End Elevation of Building Showing Roof Slope and PV Panel Locations
- Show North arrow

***** REQUIRED SUBMITTAL INFORMATION *****

Applications for all PV panel permits must include the following information and meet the listed electrical requirements.

ELECTRICAL INFORMATION:		
REQUIRED INFORMATION	**DATA**	**REQUIREMENTS**
INVERTER TYPE		**Manufacturer and model number**
INVERTER OUTPUT		**System's inverter output is 13.44 kW or less (maximum size for 70-amp breaker) for Easy Permit Process**
PV PANEL TYPE		**Manufacturer and model number**
PV PANEL OUTPUT		**Maximum watt output per panel**
NUMBER OF PANELS		**Total number of panels in installation**
TOTAL PV PANEL OUTPUT		**Multiply the number of panels times the output per panel**
ELECTRICAL CONTRACTOR		**Must be a licensed electrician in good standing with the City of Chicago and has certified PV panel system installation.**
COMPONENT COMPLIANCE	☐ **Yes** ☐ **No**	**Do all electrical components comply with the Chicago Electrical Code (18-27, Article 690)? Yes/No.**
	☐ **Yes** ☐ **No**	**Are all electrical components (or equipment), including panels and inverters, listed and labeled by a Nationally Recognized Testing Laboratory (as per 18-27-110.2) and have all components been installed as per the manufacturer's instructions? Yes/No.**

Provide below, or on a separate sheet, a one line electrical diagram of PV panel electrical system.

Address:		Permit No.:

The structural portion of these guidelines provides a process for determining whether the existing structure can support the additional loads due to the photovoltaic (PV) panels. The additional loads include the weight of the panels and their support structure, wind loads and possible snow loads.

The following list describes the Structural Process and requirements for obtaining a permit. All of the listed items must be addressed to use the Easy Permit Process for obtaining a building permit. For all other permit processes, all of the listed items, except No. 1 must be addressed or complied with.

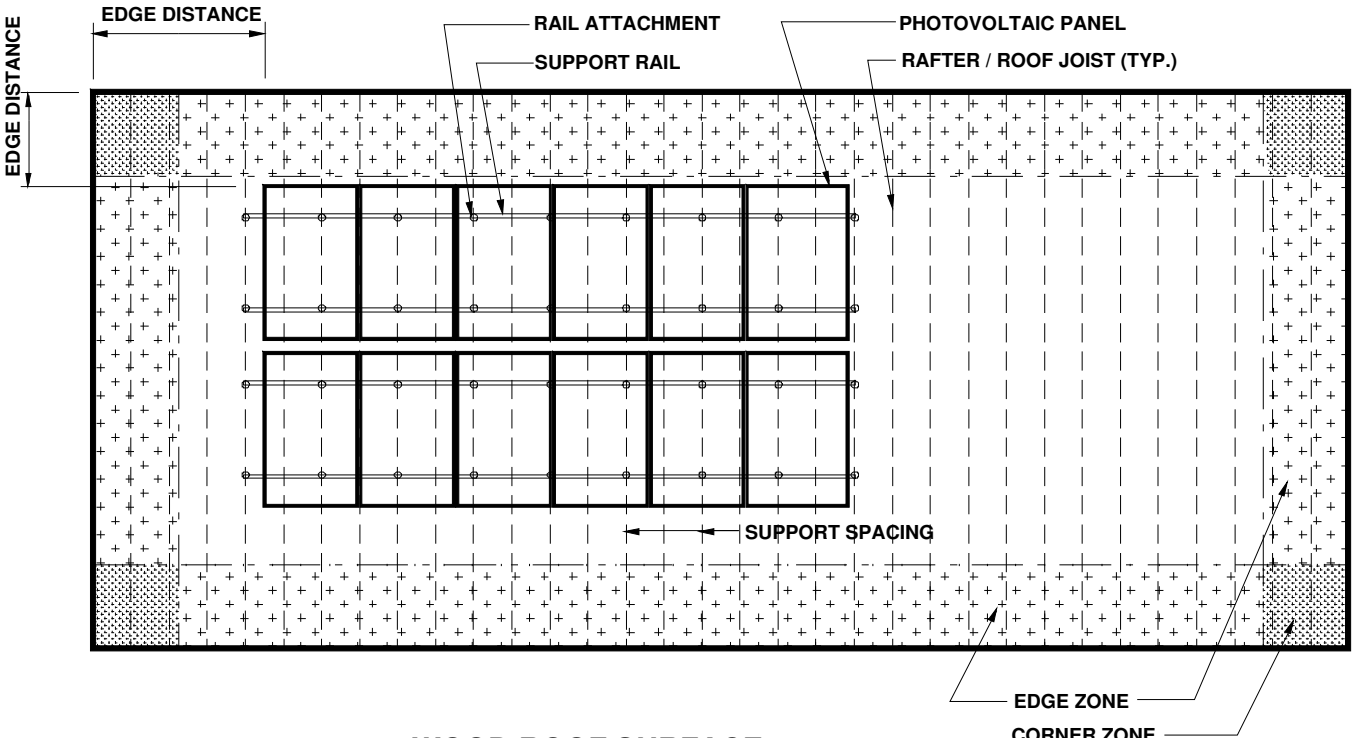
PV PANEL – STRUCTURAL PROCESS:
1) The building that the PV panels are to be mounted on must be an allowed occupancy. (See pp. 4, 5 & 7)
2) Establish the desired PV panel generating capacity and needed equipment. (See pp. 9 & 14)
3) Determine the location and layout of the PV panel installation on the roof. Roof panels must not be located within the corner zone of the roof. (See p. 12) Edge distances and access must also be maintained as required by the Fire Department. (See p. 4)
4) Provide building information. (See p. 6)
5) Determine required wind load on PV panels and support framing. (See pp. 11 - 13) Complete the wind load table/form. (See pp. 15 - 17)
6) Determine if mounting hardware can withstand PV panel gravity and wind loads. Revise hardware as necessary. (See p. 18)
7) Obtain and provide roof structure information. (Include photographs of the roof framing.) (See pp. 2 & 19 – 23)
8) Determine and provide roof dead load based upon structure information. (See pp. 19 – 23)
9) Establish whether the PV panel system is to be mechanically attached or ballasted. The PV panel system can only be ballasted on a flat roof with adequate structural load capacity. (See pp. 19 – 23)
10) For a mechanically attached PV panel system, determine if roof structure can support the additional PV panel system dead load. For concrete or steel construction, a licensed architect or structural engineer must determine the adequacy of the existing roof structure. For conventional wood framing, the Span Tables included herein may be used, if applicable. (See Appendix 1)
11) If ballasted, determine if the roof structure can support the additional ballast weight. An architect or structural engineer, licensed in the State of Illinois, will be required to determine the adequacy of the existing roof structure to support the additional dead load. The adequacy of the existing roof structure to support the additional loads will be determined by calculation using accepted engineering practice, standards of the industry and the requirements of the Chicago Building Code. Stamped and signed calculations shall be submitted with the completed application. Permit applications for ballasted PV Panel installations cannot use the Easy Permit Process.
12) Where the services of an architect or structural engineer are required, they must complete the Certification Statement at the end of this section and submit it with the completed application.
13) Submit completed application.

The additional gravity loads due to the PV panels are determined by the actual weight of the panels and the support frames. If the panels are to be ballasted to resist wind loads, then the additional gravity load is increased by the panels, support frames and ballast. Where the PV panels are to be installed on an existing roof, it must be determined if the existing roof structure is adequate to support those loads. Whether the PV panels are to be installed on existing or new construction, the provisions listed in the following table must be considered in the determination of the wind loads.

REQUIRED WIND LOAD:	
The required wind load for structures constructed in the City of Chicago is defined in the Chicago Building Code Section 16(13-52-310)	
For building or other structure configurations not listed in the CBC, a resource document is referenced for the determination of wind loads. That resource document is ANSI A58.1. It has been updated and the subsequent edition known as ASCE 7-05 is recognized by the DOB.	
For certain configurations of PV panels, neither the CBC nor ASCE 7-05 provide the appropriate (or applicable) wind load provisions. For those configurations, the DOB is accepting the use of SEAOC PV2-2012, Wind Design For Low-Profile Solar Photovoltaic Arrays on Flat Roofs of the Structural Engineers Association of California, for the determination of wind loads. www.seaoc.org/bookstore/	
The primary determinants of the appropriate Building Code wind load provisions for PV panels are the slope of the roof that the panels are mounted on and the angle of the panels to the roof surface. The overall configuration of the building also affects the determination of the appropriate wind loads.	
Of greatest concern regarding the wind loads on PV panels is uplift or the ability of wind to lift or pull the panels off of the roof. In general however, the underlying roof structure is considered to be adequate to resist the uplift pressure providing that 1.5 x Wind Pressure does not exceed the dead load of the roof, framing, ceiling and the PV panel system.	
SLOPED ROOF	The PV panels are necessarily mechanically attached to the sloped roof surface. The panels are parallel to the existing roof surface and are mounted a few inches (or a maximum of 4 inches) off of the roof. (clear distance)
	The wind pressure on the panels is determined from CBC Section 13-52-310(b) or ASCE 7 for Components and Cladding. (See discussion at the top of p. 15)
	The necessary panel anchorage is determined by the design wind pressure (or load) and capacity of manufacturer's mounting devices.
	The adequacy of the existing roof structure to support the weight of the panels must be determined from a structural evaluation. For simple span wood joists and rafters, the Span Tables included in Appendix 1 may be used.
FLAT ROOF	The PV panels can be either weighted down (ballasted) or mechanically attached to the building structure to resist wind loads. If the PV panels are to be ballasted, a licensed architect or licensed structural engineer must determine if the existing structure can support the additional dead load. If the PV panels are to be mechanically attached, the structure must also be checked to determine if it can support the additional, but much lower, dead load. For simple span wood joists and rafters, the Span Tables included in Appendix 1 may be used, if applicable.
	For mechanically attached PV panels that are parallel to the roof surface, the wind pressure is determined from the CBC Section 13-52-310(b) or ASCE 7 for Components and Cladding. (See discussion at the top of p. 15)
	For ballasted or mechanically attached PV panels that are not parallel to the (horizontal) roof surface but are less than or equal to 35 degrees from the roof surface, the wind pressures are to be determined from ASCE 7 and SEAOC PV2-2012. For buildings with a plan dimension of less than $2a_{pv}$ as defined in SEAOC PV2-2012, the wind pressures are to be determined for an edge zone and a maximum normalized wind area of 20 sq. ft. regardless of the calculated area. The wind velocity pressure on the panels is determined from the ASCE 7-05. The pressure coefficients are determined from SEAOC PV2-2012.
	For ballasted or mechanically attached PV panels that are not parallel to the (horizontal) roof surface and exceed the stated limitations of SEAOC PV2-2012, wind tunnel testing unique to the project will be required to determine the appropriate wind loads.

	For sloped PV panels that are ballasted or mechanically attached and where the highest edges of the panels are less than or equal to 1.5 feet above the roof surface, snow drifting due to the panels need not be considered. Snow loads and drifting need only be considered as if the panels did not exist on the roof except that the snow load in the field of the roof cannot be less than 25 psf. Wind loads must be considered as described above.
	For sloped PV panels that are ballasted or mechanically attached and where the highest edges of the panels exceed 1.5 feet above the roof surface, the wind uplift and lateral pressure must be considered with the snow drifting that can be caused by the panels. A licensed architect or licensed structural engineer must determine the dead, wind and snow loads due to the PV panels. A licensed architect or licensed structural engineer must also determine if the existing structure can support those loads.

The determination of the wind pressure is related to the location of the panels on the roof. The wind pressures are known to be more significant at the edges of a roof and still more significant at the corners of a roof surface. This drawing illustrates a PV panel layout on a wood framed roof surface. The layout illustrates the edge and end distances as well the support rails and attachment locations. The roof surface could be a flat roof or one side of a gable roof. The edge and corner zones relating to wind pressures are also shown. (This drawing is not to be used to illustrate the location of the panels as required in the Zoning portion of these Guidelines.)



WOOD ROOF SURFACE
NO SCALE - FOR REFERENCE ONLY

For a mechanically attached PV panel, the wind load is resisted by bolts, clips, frames and the building structure to which it is attached. Each component of the anchorage system is designed to resist the design loads. The capacity of each component is determined by design to be in conformance with applicable standards and they are designed to have an ultimate capacity that is in excess of the loads that they are to carry in use on the building. The ratio of the ultimate capacity to the in-place load is known as the factor of safety. The ultimate capacity of any component is not necessarily its in-place load capacity and the factor of safety is incorporated into the design to accommodate reductions in strength due to material imperfections, dimensional inaccuracies, overloads during construction and overloads after construction. Factors of safety are routinely incorporated into the design of buildings and their components to ensure reliable structural performance.

As with a mechanically attached PV panel, wind load on a Ballasted PV panel is resisted by bolts clips and frames, but is not attached to the supporting structure. It is simply set upon a flat roof and held in place with weights or ballast. The amount of ballast must be sufficient to resist the uplift, sliding and overturning forces created by the wind. In a fashion similar to the bolts and clips of a mechanically attached system, the amount of ballast must be designed to include a factor of safety. The required factor of safety is provided in the CBC and ASCE 7-05 as listed below. For Strength Design in ASCE 7, the load factor is provided, not the factor of safety, but effectively creates the same result. The quantity of ballast is equivalent to that required to resist the factored wind load, but does not need to be in excess of that amount.

FACTOR OF SAFETY:

BUILDING CODE SECTION	FACTOR OF SAFETY / LOAD COMBINATION	DESCRIPTION
CBC Section 13-52-300	1.5	Overturning. The overturning moment due to the wind load shall not exceed two-thirds of the moment of stability of the building or other structure due to the dead load only, unless the building or other structure is anchored so as to resist the excess overturning moment without exceeding the allowable stresses for materials used. Sliding. When the total resisting force due to friction is insufficient to prevent sliding, the building or other structure shall be anchored to withstand the excess sliding force without exceeding the allowable stresses for the materials used. Anchors provided to resist overturning moment may also be considered as providing resistance to sliding.
ASCE 7-05 Section 1.3.5		Counteracting Structural Actions. All structural members and systems, and all components and cladding in a building or other structure, shall be designed to resist forces due to earthquake and wind, with consideration of overturning, sliding, and uplift, and continuous load paths shall be provided for transmitting these forces to the foundation. Where sliding is used to isolate the elements, the effects of friction between sliding elements shall be included as a force. Where all or a portion of the resistance to these forces is provided by dead load, the dead load shall be taken as the minimum dead load likely to be in place during the event causing the considered forces.
ASCE 7-05 Section 2.3.2	1.2D + 1.6W + L + 0.5S 0.9D + 1.6W	Basic load combinations for Strength Design, where D = dead load, W = wind load, L = live load and S = snow load

***** REQUIRED SUBMITTAL INFORMATION *****

The Tables/Forms included on pages 14 through 24 of this Section must be completed for all PV panel permit application processes. The general information regarding the proposed PV panel installation is to be provided on this first Table/Form.

PV PANEL & SUPPORT FRAME:				
PV PANEL	**DATA**			**REMARKS**
MANUFACTURER				Manufacturer and product number
PANEL WATTAGE				Maximum watt output per panel
NUMBER OF PANELS	Number of Rows	Number per Row		Number of panels per group or roof surface
PANEL DIMENSIONS	Length	Width	Area	Length & width (in.) and area (sq. ft.)
PANEL WEIGHT				Weight of individual panel (lbs)
PANEL SPACING	Sides	Top	Bottom	The side spacing is the space between adjacent panels in a row. The top and bottom spacing is the distance between rows of panels. If there is no row above or below, state not applicable (N/A).
TYPE OF SUPPORT RAILS				Manufacturer and part or model number
ANCHOR BOLTS OR FASTENERS				Type and size and/or manufacturer's part number
SUPPORT RAIL OR PV PANEL ATTACHMENT SPACING				Equal to multiple of joist, rafter or truss spacing
ANGLE OF PANEL TO ROOF SURFACE				Provide angle in degrees from the roof surface.
BALLAST TYPE & WEIGHT				If PV panels & frames are to be ballasted, then provide total load per panel. If mechanically attached state 0 lbs.
PANEL AND RAIL UNIFORM LOAD				Uniform dead load of panel and panel support system, as determined by dividing the weight of the panel and support rails by the panel area, in pounds per square foot (psf)

***** REQUIRED SUBMITTAL INFORMATION *****

This second Table/Form is to be used to determine the required wind pressure on the PV panels. The dimensions of the building are those stated in the General Section of these Guidelines.

WIND LOADS:

BUILDING CODE SECTION	CODE PROVISION			WIND PRESSURE	
For PV panels mounted flat to the roof surface, the provisions of CBC Section 13-52-310(b) may be used for the determination of the wind load on the panels even though reference is made to "roof framing." The wind load provisions of ASCE 7 for Components and Cladding provide more appropriate loads for PV panels mounted flat to the roof surface and should be used.					For PV panels mounted parallel to a flat or sloped roof.
CBC Table 13-52-310	Table 13-52-310 Column A: For buildings of 200 feet or less the design wind pressure is 20 psf				
CBC Section 13-52-310(b)	(b) Roof Structures Over Enclosed Building Or Other Structures. All main roof framing structures shall be designed and constructed for the following pressures:	1. Flat roofs: an outward pressure acting normal to the surface equal to 75 percent of those established in Table 13-52-310, Column (A) for the corresponding mean height of the roof and applied to the entire roof area.			
		2. Sloped roof, slope equal to or less than 30 degrees: an outward pressure acting normal to the surface equal to 100 percent on the windward side and 75 percent on the leeward side of those established in Table 13-52-310, Column (A) for the corresponding mean height of the roof.			
		3. Sloped roofs, slope greater than 30 degrees: an inward pressure acting normal to the surface equal to 100 percent on the windward side and an outward pressure acting normal to the surface equal to 75 percent on the leeward side of those established in Table 13-52-310, Column (A) for the corresponding mean height of the roof.			
		5. Roofing sheathing and membranes: an outward pressure acting normal to the surface equal to the pressures set forth in Section 13-52-310b.1, b.2 and b.3 except within an area at the edge of the roof equal to ten percent of the width of the structure parallel to the wind direction being considered, outward pressure equal to 200 percent of those established in Table 13-52-310, Column (A) as set out in this section, for the corresponding mean height of the roof.			
ASCE 7-05 Section Figure 6-11B	Roof edge zone is 10% of the least horizontal dimension or 0.4h, whichever is smaller but not less than either 4% of least horizontal dimension or 3 ft. where h is the mean height of the building				
ASCE 7-05 Section 6.5.6	Wind Exposure B for majority of the City except Exposure D within 600 feet (or 20 times the building height) of Lake Michigan				
ASCE 7-05 Section 6.5.10	The wind velocity pressure is based upon the expression $q_h = 0.00256K_zK_{zt}K_dV^2I$, where:				
	Basic Wind Speed:	From Figure 6-1, V =	90 mph		
	Structure Classification:	From Table 1-1, the structure is classified as Category:	II		
	Importance Factor:	From Table 6-1, I =	1.0		

	Wind Directionality Factor:	From Table 6-4, K_d =		0.85		For PV panels mounted parallel to a flat or sloped roof.
	Exposure Category:	From Section 6.5.6, the exposure category is:				
	Topographical Effect:	From Section 6.5.7, K_{zt} =		1.0		
	Velocity Pressure Coefficient:	From Section 6.5.6.4 and Table 6-3 for a height of ____ ft. and exposure __, K_z =				
	Wind Velocity Pressure	$q_h = 0.00256K_zK_{zt}K_dV^2I$ =				
ASCE 7-05 Section 6.5.12.4	The design wind pressure on components and cladding is based upon the expression $p = q_h [(GC_p) - (GC_{pi})]$, where:					
	Internal Pressure Coefficient:	From Figure 6-5 GC_{pi} =		+/-0.18		
	Gust Effect Factor:	The gust effect factor for components and cladding GC_p is determined from Figures 6-11B through 6-17 for the applicable roof type and slope (where θ is the angle of the roof from the horizontal.)				
	For a Gable Roof	From Figure 6-11B for a building less than 60 ft. high	For PV panels located away from the edge of a gable roof surface where θ < 7° and a tributary area of ____ ft², GC_p =			
			For PV panels located within the edge of a gable roof surface where θ < 7° and a tributary area of ____ ft², GC_p =			
		From Figure 6-11C for a building less than 60 ft. high	For PV panels located away from the edge of a gable roof surface where 7° < θ < 27° and a tributary area of ____ ft², GC_p =			
			For PV panels located within the edge of a gable roof surface where 7° < θ < 27° and a tributary area of ____ ft², GC_p =			
		From Figure 6-11D for a building less than 60 ft. high	For PV panels located away from the edge of a gable roof surface where 27° < θ < 45° and a tributary area of ____ ft², GC_p =			
			For PV panels located within the edge of a gable roof surface where 27° < θ < 45° and a tributary area of ____ ft², GC_p =			
	For Other Roof Configuration	From Figure _____	For PV panels located away from the edge of roof surface and a tributary area of ____ ft², GC_p =			
			For PV panels located within the edge of roof surface and a tributary area of ____ ft², GC_p =			

For PV panels mounted at an angle to a flat roof, the Wind Velocity Pressure must be determined from Section 6.5.10 of ASCE 7 and the appropriate factors and coefficients must be obtained from SEAOC PV2-2012, as listed below, to obtain the Design Wind Pressure.

SEAOC PV2-2012	The width of the edge zone is defined as $2a_{pv.}$ a_{pv} is defined as $0.5(hW_L)^{0.5}$ but need not exceed h. Where, h = the mean roof height of the building and W_L = longest plan dimension of the building.			For PV panels mounted at an angle to a flat roof.
	From Figure 29.9-1, the net pressure normal to the surface of the PV panel is based upon the expression $p = q_h(\gamma_p\gamma_c(GC_m)_{nom})E$, where:			
	Velocity Pressure:	From ASCE 7-05 Section 6-5-10, q_h =		
	Angle of Panel to Roof Surface	As illustrated in Figure 29.9-1, the angle of the panel to the roof surface is:		
	Parapet Height Factor:	From Figure 29.9-1 for a parapet height of ____, γ_p =		
	Panel Chord Length Factor:	From Figure 29.9-1 for a panel angle of ____, γ_c =		
	Characteristic Height	From Figure 29.9-1 $h_c = \min(h_1, 1ft) + l_p\sin(\omega)$ =		
	Ratio of Edge Distance to Characteristic Height	Controlling ratio of panel - roof edge distance to panel characteristic height, d_x/h_c =		
	Location of Panel Being Considered	Row of the array that the panel is located (i.e. North, South, or Interior)		
		Location of panel within row (i.e. East end, West end, or Interior)		
	Array Edge Factor	From Figure 29.9-1, for the location of the panel within the array, E =		
	Roof Zone:	From Figure 29.9-1, the roof zone for the panels is:		
	Building Coefficient	From Figure 29.9-1, a_{pv} =		
	Effective Wind Area:	From Figure 29.9-1, the effective wind area for the structural element _____ being designed is:		
	Normalized Wind Area:	From Figure 29.9-1, the normalized wind area A_n =		
	Nominal Pressure Coefficient:	From Figure 29.9-1, the nominal net pressure coefficient $(GC_m)_{nom}$ =		
	Design Wind Pressure:	$p = q_h(\gamma_p\gamma_c(GC_m)_{nom})E$ =		

Notes:

1) For the calculation of q_h, some of the factors are listed. These factors should apply to most building in the Chicago area, but may need to be changed for specific structures.
2) From SEAOC PV2-2012 Figure 29.9.1, Note 2: "There shall be a minimum air gap around the perimeter of each solar module of 0.5 inches or between rows of panels of 1 inch to allow pressure equalization above and below panels."
3) From SEAOC PV2-2012 Figure 29.9.1 Note 4: "Array should not be closer than $2(h_2 - h_{pt})$ or 4 feet, whichever is greater from roof edge. Where h_2 is the distance from the roof to the raised edge of the panel and h_{pt} is the mean parapet height above the adjacent roof surface.

***** REQUIRED SUBMITTAL INFORMATION *****

The third and fourth Tales/Forms are to be used to determine/check the required bolt attachment or amount of ballast.

The following table applies only to mechanically attached panels and support frames. Using this table, the adequacy of the mechanical attachment of the PV panel rails to the roof is determined.

PV PANEL ATTACHMENT:		
REQUIRED INFORMATION	**DATA**	**REMARKS**
TRIBUTARY AREA PER ATTACHMENT BOLT (ft^2/bolt)		**Number of panels in a row x panel area / number of bolts**
UPLIFT FORCE PER BOLT (lbs)		**Tributary area per bolt x wind uplift pressure**
BOLT PULLOUT CAPACITY (lbs)		**Pullout strength for wood construction is based upon the National Design Specification, manufacturer's literature and species of wood joist, rafter or truss top chord. For concrete or steel construction, the attachment of the frame must comply with the applicable standards for those materials. (An increase in allowable stress or capacity of 1.33 for transient wind loads is not allowed. Anchorage capacity must include a factor of safety of 1.5 as discussed above.)**
BOLT PULLOUT CAPACITY GREATER THAN WIND UPLIFT	☐ Yes ☐ No	**Yes or no. If no, revise bolt size and or spacing.**

The following table only applies to ballasted PV panels and frames. Using this table, the amount of ballast is determined or listed.

PV PANEL BALLAST:		
REQUIRED INFORMATION	**DATA**	**REMARKS**
TRIBUTARY AREA PER PANEL		**Surface area of panel that is subject to wind load (sq. ft.)**
UPLIFT WIND PRESSURE		**Obtained from Wind Load Table (psf)**
TOTAL BALLAST LOAD PER PANEL		**Panel surface area times the wind load less the panel dead load times a factor of safety of 1.5 required to resist uplift, overturning and sliding (lbs) (See Factor of Safety discussion above.)**
UNIFORM PROJECTION OF BALLAST LOAD ON ROOF		**Ballast load divided by horizontal projection of ballast support frame or area covered by ballast. (psf)**

***** REQUIRED SUBMITTAL INFORMATION *****

Roof framing information is required to determine whether the existing structure is adequate to resist or carry the additional gravity load of the new PV panels. For concrete and structural steel roof structures, evaluation of the structural capacity must be performed by a licensed architect or licensed structural engineer. For wood framed roof structures, the Span Tables included in Appendix 1 may be used if the parameters are correct. Where the wood roof structure includes the use of trusses, the adequacy of the structure must be evaluated by a licensed architect or licensed structural engineer.

Complete the following tables/forms for concrete, structural steel or wood construction, as appropriate, and submit the information with the permit application. At least one of these tables must be completed for all of the permit processes.

EXISTING CONCRETE ROOF CONSTRUCTION:				
ROOF FRAMING TYPE				Flat slab, slab and beam or joists
SLAB THICKNESS OR JOIST DEPTH				
JOIST/BEAM WIDTH				
JOIST/BEAM SPACING (in.)				
SPAN (ft.)				For two-way slab, list span in both directions
		WEIGHT (psf)		
STRUCTURE				Concrete structure dead load
ROOFING	TYPE			Total roofing load
	NUMBER OF LAYERS			
CEILING				
INSULATION				
OTHER				Mechanical and electrical equipment
BALLAST				Ballast to resist wind loads on PV panel system, if used
	DEAD LOAD SUBTOTAL			
SNOW				Minimum snow load of 25 psf required by the CBC, plus drifting as defined in ASCE 7-05. (See Note 1.)
	TOTAL			Total dead and live load to be supported by existing structure
EXISTING STRUCTURAL LOAD CAPACITY (psf)				Dead and live load capacity of the concrete structural slab or joist system must be determined by a qualified licensed architect or licensed structural engineer
IS THE EXISTING CONCRETE STRUCTURE ADEQUATE TO SUPPORT THE ADDITIONAL LOAD DUE TO THE NEW PV PANEL SYSTEM?	☐Yes ☐No			If the structure is not adequate to support the additional load, then provide drawings and calculations to show how the structure is to be reinforced

***** REQUIRED SUBMITTAL INFORMATION *****

The evaluation of the roof framing in this table is based upon the PV panel support rails being oriented perpendicular to the joists, rafters or trusses. For other configurations, separate calculations must be submitted.

EXISTING STRUCTURAL STEEL ROOF CONSTRUCTION:				
ROOF FLAT OR SLOPED				Provide roof slope (in./12 in.) and degrees or 0 if none or flat α = atan(rise/run) and is the angle of the roof plane from the horizontal
FRAMING TYPE				Joists, trusses or beams
DECK TYPE				Concrete and/or metal deck
JOIST, TRUSS OR BEAM SPACING (in.)				
SPAN (ft.)				Joist, rafter or truss span. (Horizontal projection)
		WEIGHT (psf)		
STRUCTURAL STEEL				Steel framing dead load
METAL DECK				
CONCRETE				If a concrete deck or fill is not used, list 0 or none
ROOFING	TYPE			Total roofing load
	NUMBER OF LAYERS			
CEILING				
INSULATION				
OTHER				Mechanical and electrical equipment
PV PANEL				
BALLAST				Ballast to resist win loads on PV panel system, if used.
	DEAD LOAD SUBTOTAL			
SNOW				Minimum snow load of 25 psf required by the CBC, plus drifting as defined in ASCE 7-05. (See Note 1.)
	TOTAL			Total dead and live load to be supported by existing structure
LIVE LOAD TIMES MEMBER SPACING			Live or snow load per lineal foot of member (plf)	
HORIZONTAL PROJECTION OF DEAD LOAD TIMES MEMBER SPACING				

HORIZONTAL PROJECTION OF PV PANEL DEAD LOAD TIMES SUPPORT SPACING			**Uniform load of PV panel times support spacing and divided by the cosine of the roof angle (The PV panel load is assumed over full length of member.) (plf)**
TOTAL PROJECTED DEAD, PV PANEL & LIVE LOAD SUPPORTED BY MEMBER			**Sum of dead, PV panel and live loads (plf)**
STRUCTURAL LOAD CAPACITY			**Dead and live load capacity of the structural steel system must be determined by a qualified licensed architect or licensed structural engineer.**
IS THE EXISTING STEEL STRUCTURE ADEQUATE TO SUPPORT THE ADDITIONAL LOAD DUE TO THE NEW PV PANEL SYSTEM?	☐ **Yes** ☐ **No**		**If the structure is not adequate to support the additional load, then provide drawings and calculations to show how the structure is to be reinforced.**

1. For roofs with slopes in excess of 30 degrees from the horizontal, snow loads may be reduced in accordance with CBC Section 13-52-280(b). However, all roof snow loads must be determined with consideration of drifting that can occur due to parapets, roof top equipment, penthouses and adjacent higher buildings.

***** REQUIRED SUBMITTAL INFORMATION *****

The evaluation of the roof framing in this table is based upon the PV panel support rails being oriented perpendicular to the joists, rafters or trusses. For other configurations, separate calculations must be submitted.

EXISTING WOOD ROOF CONSTRUCTION:				
ROOF FLAT OR SLOPED				Provide roof slope (in./12 in.) and degrees or 0 if none or flat α = atan(rise/run) and is the angle of the roof plane from the horizontal
FRAMING TYPE				Joists/rafters or trusses
WOOD SPECIES AND GRADE				If unknown, use SPF No. 2
JOIST/RAFTER OR TRUSS SPACING				Units = inches (in.)
SPAN (ft.)				Joist, rafter or truss span. (Horizontal projection)
			WEIGHT (psf)	
JOIST/RAFTER OR TOP CHORD SIZE.				Size of lumber
SHEATHING TYPE				Plywood or lumber
ROOFING	TYPE			Total roofing load
	NUMBER OF LAYERS			
CEILING				
INSULATION				
OTHER				Other materials including mechanical and electrical equipment
BALLAST				Ballast to resist wind loads on PV panel system, if used
	DEAD LOAD SUBTOTAL			Dead load per square foot of roof surface
SNOW				Minimum snow load of 25 psf required by the CBC, plus drifting as defined in ASCE 7-05. (See Noe 1.)
	TOTAL DEAD & LIVE LOAD			Total dead and live load to be supported by existing structure along length of member
LIVE LOAD TIMES MEMBER SPACING				Live or snow load per lineal foot of member (plf)
HORIZONTAL PROJECTION OF DEAD LOAD TIMES MEMBER SPACING				Uniform dead load times support spacing and divided by the cosine of the roof angle
HORIZONTAL PROJECTION OF PV PANEL DEAD LOAD TIMES SUPPORT SPACING				Uniform load of PV panel times support spacing and divided by the cosine of the roof angle (The PV panel load is assumed over full length of member.) (plf)
TOTAL PROJECTED DEAD AND PV PANEL LOAD AND LIVE LOAD SUPPORTED BY MEMBER				Sum of dead, PV panel and live loads (plf)

STRUCTURAL LOAD CAPACITY			**Maximum load capacity of the wood roof rafters, joists or trusses calculated separately (plf)**
ALTERNATE – USE TABLES TO DETERMINE MAXIMUM SPAN	☐ Yes ☐ No		**State whether tables are being used and provide the maximum span listed in tables. (ft.)**
IS THE EXISTING WOOD STRUCTURE ADEQUATE TO SUPPORT THE ADDITIONAL LOAD DUE TO THE NEW PV PANEL SYSTEM?	☐ Yes ☐ No		**If the structure is not adequate to support the additional load, then provide drawings and calculations to show how the structure is to be reinforced.**

1. For roofs with slopes in excess of 30 degrees from the horizontal, snow loads may be reduced in accordance with CBC Section 13-52-280(b). However, all roof snow loads must be determined with consideration of drifting that can occur due to parapets, roof top equipment, penthouses and adjacent higher buildings.

*** REQUIRED SUBMITTAL INFORMATION ***

PV Panel Easy Permit Process
Professional of Record Certification Statement

Application Number: _____

Project Address: _____

I hereby certify that: (1) information and assertions made on this Permit Application are true and correct, (2) the attached Application, calculations and each page of the plans that I have stamped were personally prepared by me and submitted herewith are complete and in accordance with all applicable provisions of the Municipal Code of Chicago and any applicable state or federal laws, as of this date. I further state that I have exercised a professional standard of care in the preparation, completion and submission of these documents and am aware that the Commissioner of the Department of Buildings (DOB) will rely upon the truth and accuracy of this statement as the basis for issuance of a building permit. If it is determined by DOB that the submitted plans do not conform to all such laws, I agree to immediately take all remedial measures within my control, to meet the DOB's requirements. I also agree that if I become aware of any false or inaccurate statements made in any document provided to DOB, (whether such misrepresentations are made by agents, my employees or by me) I will immediately take all necessary measures to correct such statements. I realize that failure to take any such corrective action may result in termination of my participation in the DOB PV Panel Easy Permit Process and notification to the Illinois Department of Professional Regulation.

ARCHITECT:

Signature: _____

Printed Name: _____

Address: _____

Dated: _____

AFFIX SEAL HERE

STRUCTURAL ENGINEER:

Signature: _____

Printed Name: _____

Address: _____

Dated: _____

AFFIX SEAL HERE

The following Wood Joist/Rafter Maximum Span Tables can be used to determine the adequacy of an existing wood framed roof structure to support the additional dead load created by PV panel installation. The tables include three wood species. The actual wood species used for roof framing may be determined by checking the grade stamps on the wood members. If the grade stamps cannot be found, then the species of the lumber should be assumed to be Spruce-Pine-Fir, No. 2.

The span tables are based upon a snow live load of 25 psf on a flat roof and the horizontal projection on sloped roofs listed and a variable snow load as per CBC Section 13-52-280(b) for slopes of 8:12 to 14:12. These tables do not include consideration of snow drifting that may occur with various roof configurations and adjacent taller buildings.

The span tables apply to joists or rafters supporting uniform loads and one or two rows of PV panels set at the midspan of the member. For joists or rafters on roofs with a slope of 2 inches per foot or less, the maximum span is based upon the members acting as simple span elements. Simple span members are those that are supported vertically at either end to carry the gravity load. (See Illustration No. 1) For rafters with a slope of 4 inches per foot or greater, the maximum span is based upon the condition where the rafters bear against one another at the ridge but are not supported by a beam at the ridge. In essence, the rafters form a simple truss or triangle where the rafters have both axial and bending stresses. In addition, the rafters are tied to the ceiling (or attic floor joists), at their ends, to transmit the horizontal tensile force through the ceiling or attic floor joists. The rafters and joists are parallel to one another and the connections between the two are sufficient to transfer the axial tensile force from one side of the roof (or attic) to the other. (See Illustration No. 2) All dimensions are in decimal feet.

Tables 1 through 4 are based upon the support rails being perpendicular to the joists or rafters and the PV panels being attached to the members at 32 inches on center and therefore the dead load is carried by every other joist or rafter. Tables 5 through 8 are based upon the PV panels being attached to the members at 48 inches on center and the panel dead load is carried by every third joist or rafter. All of the tables are based on the long dimension of the panels oriented vertically (or parallel to the joists or rafters). For the tables based upon double rows of panels, the overall dimension of the two rows is 11'-1". As the PV panels can also be installed horizontally, the tables for double rows can also be used for three rows of panels oriented horizontally provided that the sum of the width of the 3 panels and spaces does not exceed 11'-1".

The tables for double rows of PV panels are also based upon both rows being attached to the same joists or rafters. That is, the attachment of the rows of PV panels is not staggered. If however, the attachment of the rows of PV panels is to be staggered such that no joist or rafter carries more than one row, the span tables for one row may be used.

Where joists or rafters have span or load conditions that differ from that listed in the tables, a separate analysis and design must be made of those members using accepted engineering practice and the provisions of the National Design Specification for Wood Construction of the American Forest and Paper Association, as well as the requirements of the Chicago Building Code.

TABLE 1: WOOD JOIST/RAFTER MAXIMUM SPANS (for 16" o.c. spacing) WITH SINGLE ROW OF PV PANELS AT MIDSPAN (ft.) AND PANEL SUPPORT AT 32" o.c. — **DEAD LOAD: 14 PSF**

	LIVE LOAD		25 PSF								VARIES WITH SLOPE			
Joist/Rafter Size	Species	Grade	Roof Slope (inches vertical per horizontal ft.)											
			0	2	4	6	8	10	12	14	8	10	12	14
2x6	Southern Pine	No. 1	12.8	12.7	11.3	11.3	11.3	11.2	10.9	10.7	11.6	11.9	12.1	12.1
		No. 2	11	11	10.1	10.1	10	9.9	9.7	9.5	10.3	10.6	10.7	10.8
	Spruce Pine Fir	No. 1	10.5	10.5	9.4	9.4	9.4	9.3	9.1	8.9	9.7	9.9	10.1	10.1
		No. 2	9.9	9.8	8.9	8.9	8.9	8.8	8.6	8.4	9.1	9.4	9.5	9.6
	Douglas Fir Larch	No. 1	11.3	11.2	10.2	10.2	10.2	10	9.8	9.6	10.4	10.7	10.8	10.9
		No. 2	10.7	10.6	9.7	9.7	9.7	9.5	9.3	9.1	9.9	10.1	10.3	10.3
2x8	Southern Pine	No. 1	16.2	16.1	14.5	14.5	14.5	14.3	14	13.7	14.9	15.3	15.5	15.6
		No. 2	14.4	14.4	13.2	13.2	13.1	12.9	12.7	12.4	13.5	13.8	14.1	14.1
	Spruce Pine Fir	No. 1	13.4	13.3	12.2	12.2	12.1	12	11.7	11.5	12.5	12.8	13	13.1
		No. 2	12.6	12.5	11.5	11.5	11.5	11.3	11.1	10.8	11.8	12.1	12.3	12.3
	Douglas Fir Larch	No. 1	14.4	14.4	13.1	13.1	13.1	12.9	12.6	12.3	13.4	13.8	14	14.1
		No. 2	13.6	13.6	12.5	12.5	12.4	12.2	12	11.7	12.7	13.1	13.3	13.4
2X10	Southern Pine	No. 1	19.3	19.2	17.6	17.6	17.5	17.3	16.9	16.5	18	18.5	18.8	18.9
		No. 2	17.3	17.2	16	16	15.9	15.7	15.4	15	16.3	16.8	17.1	17.2
	Spruce Pine Fir	No. 1	16.5	16.4	15.1	15.1	15.1	14.8	14.5	14.2	15.4	15.9	16.1	16.2
		No. 2	15.5	15.4	14.3	14.3	14.2	14	13.7	13.4	14.6	15	15.2	15.3
	Douglas Fir Larch	No. 1	17.7	17.7	16.3	16.3	16.2	16	15.6	15.3	16.6	17.1	17.4	17.5
		No. 2	16.8	16.7	15.5	15.5	15.4	15.1	14.8	14.5	15.8	16.2	16.5	16.6
2x12	Southern Pine	No.1	23.1	23.1	21.2	21.2	21.1	20.8	20.3	19.9	21.6	22.3	22.6	22.8
		No. 2	20.4	20.3	19	19	18.9	18.6	18.2	17.8	19.4	19.9	20.3	20.4
	Spruce Pine Fir	No.1	19.1	19.1	17.7	17.7	17.6	17.3	17	16.6	18.1	18.6	18.9	19.1
		No. 2	18	18	16.8	16.8	16.7	16.4	16.1	15.7	17.1	17.6	17.9	18
	Douglas Fir Larch	No.1	20.6	20.6	19.1	19.1	19	18.7	18.3	17.9	19.5	20.1	20.4	20.6
		No. 2	19.5	19.5	18.2	18.2	18	17.8	17.4	17	18.5	19	19.4	19.5

TABLE 2:	WOOD JOIST/RAFTER MAXIMUM SPANS (for 16" o.c. spacing) WITH DOUBLE ROW OF PV PANELS AT MIDSPAN (ft.) AND PANEL SUPPORT AT 32" o.c.	DEAD LOAD: 14 PSF

	LIVE LOAD		25 PSF							VARIES WITH SLOPE			
Joist/Rafter Size	Species	Grade	Roof Slope (inches vertical per horizontal ft.)										
			0	2	4	6	8	10	12	14	8	10	12	14
2x6	Southern Pine	No. 1	12.4	12.4	11	11	11	10.8	10.6	10.3	11.3	11.5	11.6	11.6
		No. 2	***	***	***	9.9	9.8	9.6	9.4	9.2	10	10.2	10.3	10.3
	Spruce Pine Fir	No. 1	***	***	***	***	9.2	9	8.8	8.6	9.4	9.6	9.7	9.7
		No. 2	***	***	***	***	***	8.6	8.4	8.2	8.9	9.1	9.2	9.2
	Douglas Fir Larch	No. 1	11	11	***	10	9.9	9.2	9.5	9.3	10.1	10.3	10.4	10.4
		No. 2	***	***	***	***	9.4	9.7	9	8.8	9.6	9.8	9.9	9.9
2x8	Southern Pine	No. 1	15.7	15.7	14.1	14.1	14.1	13.9	13.6	13.2	14.4	14.8	14.9	15
		No. 2	14	14	12.8	12.8	12.8	12.5	12.3	12	13.1	13.4	13.5	13.6
	Spruce Pine Fir	No. 1	13	13	11.9	11.9	11.8	11.6	11.4	11.1	12.1	12.4	12.5	12.5
		No. 2	12.3	12.2	11.2	11.2	11.2	11	10.7	10.5	11.4	11.7	11.8	11.8
	Douglas Fir Larch	No. 1	14	14	12.8	12.8	12.7	12.5	12.2	11.9	13	13.3	13.5	13.5
		No. 2	13.3	13.2	12.2	12.2	12.1	11.9	11.6	11.3	12.4	12.6	12.8	12.8
2X10	Southern Pine	No. 1	18.8	18.7	17.1	17.1	17.1	16.8	16.4	16.1	17.5	17.9	18.2	18.3
		No. 2	16.8	16.8	15.6	15.6	15.5	15.2	14.9	14.6	15.9	16.2	16.5	16.6
	Spruce Pine Fir	No. 1	16	16	14.7	14.7	14.6	14.4	14.1	13.8	15	15.3	15.5	15.6
		No. 2	15.1	15	13.9	13.9	13.8	13.6	13.3	13	14.1	14.5	14.7	14.7
	Douglas Fir Larch	No. 1	17.2	17.2	15.9	15.9	15.7	15.5	15.2	14.8	16.1	16.5	16.8	16.9
		No. 2	16.3	16.3	15.1	15.1	14.9	14.7	14.4	14.1	15.3	15.7	15.9	16
2x12	Southern Pine	No.1	22.5	22.5	20.6	20.6	20.6	20.2	19.8	19.4	21.8	21.6	21.9	22.1
		No. 2	19.8	19.8	18.5	18.5	18.3	18	17.7	17.3	18.8	19.3	19.6	19.7
	Spruce Pine Fir	No.1	18.6	18.6	17.3	17.3	17.1	16.9	16.5	16.2	17.6	18	18.3	18.4
		No. 2	17.5	17.5	16.3	16.3	16.2	15.9	15.6	15.3	16.6	17	17.3	17.4
	Douglas Fir Larch	No.1	20.1	20	18.6	18.6	18.5	18.2	17.8	17.4	19	19.4	19.7	19.9
		No. 2	19	18.9	17.7	17.7	17.5	17.2	16.9	16.5	18	18.4	18.7	18.8

*** Member is not long enough to accommodate two rows of PV panels. (Member length = span/cos(α) where α is the angle of the roof slope.) (The PV panel length used is 5'-6" with a 1" space between the rows.)

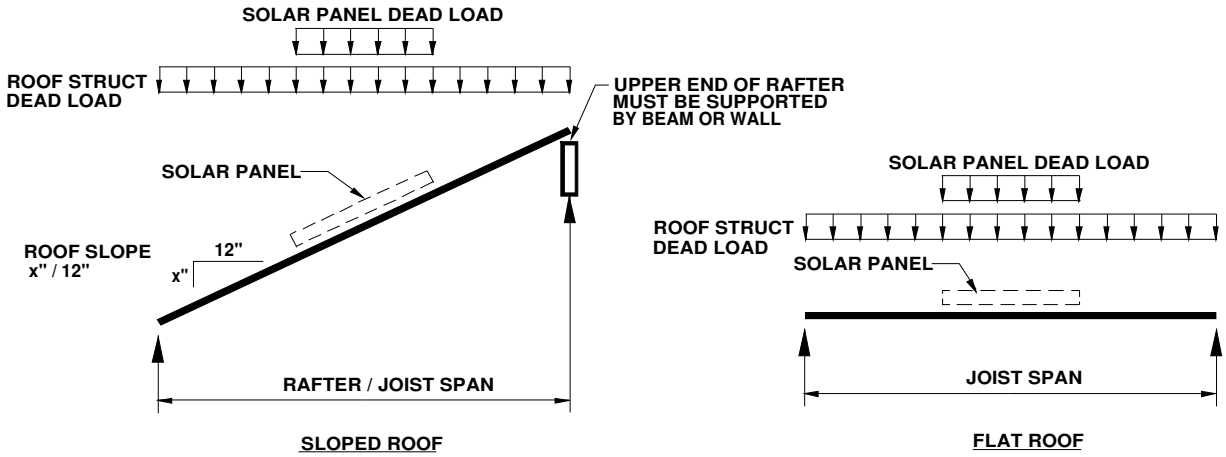


ILLUSTRATION No. 1 – SIMPLE SPAN JOISTS OR RAFTERS

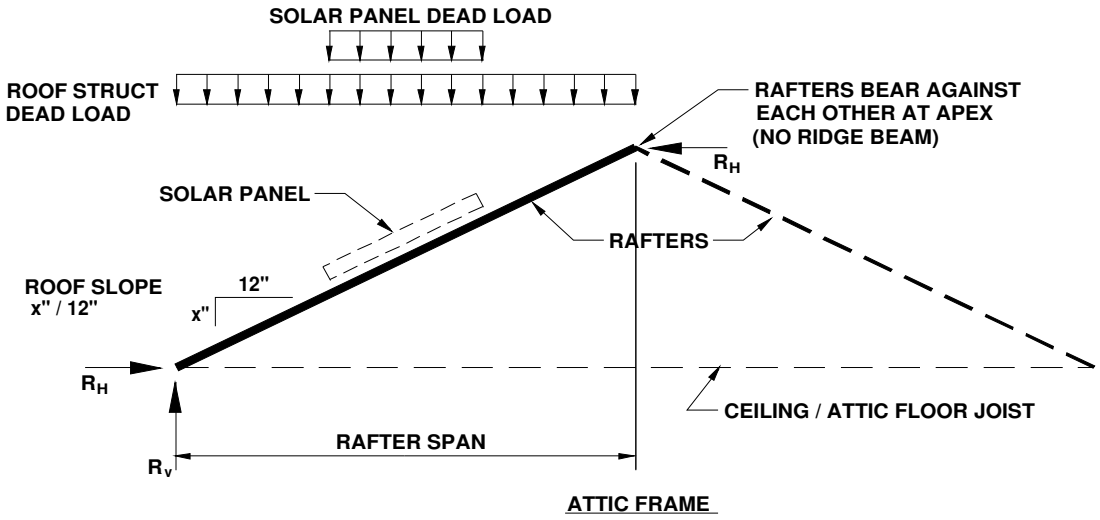


ILLUSTRATION No. 2 – ATTIC FRAME

Tables 3 & 4 are similar to Tables 1 & 2, respectively, except that the dead load of the existing roof structure is reduced to include only the roofing, roof sheathing and joists or rafters.

TABLE 3: WOOD JOIST/RAFTER MAXIMUM SPANS (for 16" o.c. spacing) WITH SINGLE ROW OF PV PANELS AT MIDSPAN (ft.) AND PANEL SUPPORT AT 32" o.c. — **DEAD LOAD: 8 PSF**

Joist/Rafter Size	Species	Grade	LIVE LOAD: 25 PSF — Roof Slope (inches vertical per horizontal ft.) 0	2	4	6	8	10	12	14	VARIES WITH SLOPE — Roof Slope (inches vertical per horizontal ft.) 8	10	12	14
2x6	Southern Pine	No. 1	13.8	13.8	12.1	12.1	12.1	12.2	11.9	11.4	12.7	13.2	13.5	13.8
		No. 2	11.9	11.9	10.9	10.9	10.9	10.8	10.6	10.2	11.2	11.7	12	12.3
	Spruce Pine Fir	No. 1	11.3	11.3	10.2	10.2	10.2	10.1	10	9.6	10.5	11	11.3	11.5
		No. 2	10.6	10.6	9.6	9.6	9.6	9.6	9.4	9.1	10	10.4	10.7	10.9
	Douglas Fir Larch	No. 1	12.2	12.1	11	11	11	10.9	10.7	10.3	11.4	11.8	12.2	12.4
		No. 2	11.5	11.5	10.4	10.4	10.4	10.4	10.2	9.8	10.8	11.2	11.6	11.8
2x8	Southern Pine	No. 1	17.5	17.4	15.6	15.6	15.6	15.6	15.3	14.7	16.2	16.9	17.4	17.8
		No. 2	15.6	15.5	14.2	14.2	14.2	14.1	13.9	13.4	14.7	15.3	15.8	16.2
	Spruce Pine Fir	No. 1	14.5	14.4	13.1	13.1	13.1	13.1	12.9	12.4	13.6	14.2	14.6	14.9
		No. 2	13.6	13.6	12.4	12.4	12.4	12.3	12.1	11.7	12.9	13.4	13.8	14.1
	Douglas Fir Larch	No. 1	15.6	15.5	14.1	14.1	14.1	14.1	13.8	13.3	14.7	15.3	15.8	16.1
		No. 2	14.7	14.7	13.4	13.4	13.4	13.3	13.1	12.7	13.9	14.5	15	15.3
2X10	Southern Pine	No. 1	20.9	20.9	19	19	19	18.9	18.6	17.9	19.7	20.6	21.2	21.7
		No. 2	18.7	18.7	17.3	17.3	17.3	17.2	16.9	16.3	17.9	18.7	19.3	19.8
	Spruce Pine Fir	No. 1	17.8	17.8	16.3	16.3	16.3	16.2	15.9	15.4	16.9	17.6	18.2	18.6
		No. 2	16.7	16.7	15.4	15.4	15.4	15.3	15.1	14.5	16	16.6	17.2	17.6
	Douglas Fir Larch	No. 1	19.2	19.1	17.6	17.6	17.6	17.5	17.2	16.6	18.2	19	19.6	20.1
		No. 2	18.1	18.1	16.7	16.7	16.7	16.6	16.3	15.7	17.3	18	18.6	19.1
2x12	Southern Pine	No.1	25	25	22.9	22.9	22.9	22.7	22.4	21.5	23.7	24.8	25.6	26.2
		No. 2	22.1	22	20.6	20.6	20.6	20.3	20	19.3	21.2	22.2	22.9	23.5
	Spruce Pine Fir	No.1	20.7	20.7	19.2	19.2	19.2	19	18.7	18	19.8	20.7	21.4	21.9
		No. 2	19.5	19.5	18.1	18.1	18.1	17.9	17.7	17.1	18.7	19.6	20.2	20.7
	Douglas Fir Larch	No.1	22.3	22.3	20.7	20.7	20.7	20.5	20.2	19.5	21.4	22.3	23.1	23.6
		No. 2	21.1	21.1	19.7	19.7	19.7	19.4	19.2	18.5	20.3	21.2	21.9	22.4

TABLE 4:	WOOD JOIST/RAFTER MAXIMUM SPANS (for 16" o.c. spacing) WITH DOUBLE ROW OF PV PANELS AT MIDSPAN (ft.) AND PANEL SUPPORT AT 32" o.c.												DEAD LOAD: 8 PSF
	LIVE LOAD		25 PSF								VARIES WITH SLOPE			
Joist/Rafter Size	Species	Grade	Roof Slope (inches vertical per horizontal ft.)											
			0	2	4	6	8	10	12	14	8	10	12	14
2x6	Southern Pine	No. 1	13.4	13.3	11.8	11.8	11.8	11.7	11.5	11.3	12.2	12.6	12.9	13.1
		No. 2	11.6	11.6	10.6	10.6	10.5	10.4	10.2	10	10.8	11.2	11.5	11.6
	Spruce Pine Fir	No. 1	11	11	9.9	9.9	9.9	9.8	9.6	9.4	10.2	10.5	10.7	10.9
		No. 2	***	***	***	***	9.4	9.3	9.1	8.9	9.6	9.9	10.2	10.3
	Douglas Fir Larch	No. 1	11.8	11.8	10.7	10.7	10.7	10.5	10.3	10.1	11	11.3	11.6	11.8
		No. 2	11.2	11.2	10.1	10.1	10.1	10	9.8	9.6	10.4	10.8	11	11.1
2x8	Southern Pine	No. 1	16.9	16.9	15.1	15.1	15.1	15	14.8	14.5	15.7	16.3	16.7	17
		No. 2	15.1	15	13.8	13.8	13.8	13.6	13.4	13.1	14.2	14.7	15.1	15.4
	Spruce Pine Fir	No. 1	14	14	12.7	12.7	12.7	12.6	12.4	12.1	13.1	13.6	13.9	14.2
		No. 2	13.2	13.2	12.1	12.1	12.1	11.9	11.7	11.5	12.4	12.8	13.1	13.4
	Douglas Fir Larch	No. 1	15.1	15	13.7	13.7	13.7	13.6	13.3	13.1	14.1	14.7	15	15.3
		No. 2	14.3	14.2	13	13	13	12.9	12.7	12.4	13.4	13.9	14.3	14.5
2X10	Southern Pine	No. 1	20.2	20.2	18.4	18.4	18.4	18.3	18	17.6	19	19.8	20.4	20.8
		No. 2	18.1	18.1	16.8	16.8	16.8	16.6	16.3	16	17.3	17.9	18.5	18.9
	Spruce Pine Fir	No. 1	17.2	17.2	15.8	15.8	15.8	15.6	15.4	15.1	16.3	16.9	17.4	17.7
		No. 2	16.2	16.2	14.9	14.9	14.9	14.8	14.5	14.2	15.4	16	16.4	16.7
	Douglas Fir Larch	No. 1	18.5	18.5	17	17	17	16.9	16.6	16.3	17.6	18.3	18.8	19.2
		No. 2	17.6	17.5	16.2	16.2	16.2	16	15.7	15.5	16.7	17.3	17.8	18.2
2x12	Southern Pine	No.1	24.3	24.3	22.2	22.2	22.2	22	21.7	21.3	23	23.9	24.7	25.2
		No. 2	21.4	21.3	19.9	19.9	19.9	19.7	19.4	19	20.5	21.3	22	22.5
	Spruce Pine Fir	No.1	20.1	20	18.6	18.6	18.6	18.4	18.1	17.8	19.1	19.9	20.5	21
		No. 2	18.9	18.8	17.6	17.6	17.6	17.3	17.1	16.8	18.1	18.8	19.4	19.8
	Douglas Fir Larch	No.1	21.6	21.6	20.1	20.1	20.1	19.8	19.5	19.2	20.7	21.5	22.2	22.7
		No. 2	20.5	20.4	19.1	19.1	19	18.8	18.5	18.2	19.6	20.4	21	21.5

*** Member is not long enough to accommodate two rows of PV panels. (Member length = span/cos(α) where α is the angle of the roof slope.) (The PV panel length used is 5'-6" with a 1" space between the rows.)

TABLE 5: WOOD JOIST/RAFTER MAXIMUM SPANS (for 16" o.c. spacing) WITH SINGLE ROW OF PV PANELS AT MIDSPAN (ft.) AND PANEL SUPPORT AT 48" o.c. — **DEAD LOAD: 14 PSF**

	LIVE LOAD		25 PSF								VARIES WITH SLOPE			
Joist/Rafter Size	Species	Grade	Roof Slope (inches vertical per horizontal ft.)											
			0	2	4	6	8	10	12	14	8	10	12	14
2x6	Southern Pine	No. 1	12.4	12.4	11	11	11	10.9	10.6	10.4	11.3	11.6	11.7	11.7
		No. 2	10.7	10.7	9.8	9.8	9.8	9.6	9.4	9.2	10	10.2	10.4	10.4
	Spruce Pine Fir	No. 1	10.2	10.1	9.2	9.2	9.2	9	8.8	8.6	9.4	9.6	9.7	9.8
		No. 2	9.5	9.5	8.7	8.7	8.7	8.5	8.3	8.1	8.9	9.1	9.2	9.2
	Douglas Fir Larch	No. 1	10.9	10.9	9.9	9.9	9.9	9.7	9.5	9.3	10.1	10.4	10.5	10.5
		No. 2	10.3	10.3	9.4	9.4	9.4	9.2	9	8.8	9.6	9.8	9.9	10
2x8	Southern Pine	No. 1	15.8	15.7	14.2	14.2	14.2	14	13.7	13.4	14.5	14.9	15.1	15.2
		No. 2	14	14	12.9	12.9	12.8	12.6	12.4	12.1	13.1	13.5	13.7	13.8
	Spruce Pine Fir	No. 1	13	13	11.9	11.9	11.8	11.7	11.4	11.2	12.1	12.4	12.6	12.7
		No. 2	12.2	12.2	11.2	11.2	11.2	11	10.8	10.5	11.4	11.7	11.9	12
	Douglas Fir Larch	No. 1	14	14	12.8	12.8	12.8	12.6	12.3	12	13.1	13.4	13.6	13.7
		No. 2	13.3	13.2	12.2	12.2	12.1	11.9	11.7	11.4	12.4	12.7	12.9	13
2X10	Southern Pine	No. 1	18.9	18.9	17.3	17.3	17.2	16.9	16.6	16.2	17.6	18.1	18.4	18.5
		No. 2	16.9	16.9	15.7	15.7	15.6	15.4	15.1	14.7	16	16.4	16.7	16.8
	Spruce Pine Fir	No. 1	16.1	16	14.8	14.8	14.7	14.5	14.2	13.9	15.1	15.5	15.7	15.8
		No. 2	15.1	15.1	14	14	13.9	13.7	13.4	13.1	14.2	14.6	14.8	14.9
	Douglas Fir Larch	No. 1	17.3	17.3	16	16	15.9	15.6	15.3	15	16.3	16.7	17	17.1
		No. 2	16.4	16.3	15.1	15.1	15.1	14.8	14.5	14.2	15.4	15.8	16.1	16.2
2x12	Southern Pine	No.1	22.7	22.6	20.8	20.8	20.7	20.4	20	19.6	21.3	21.9	22.2	22.4
		No. 2	20	19.9	18.7	18.7	18.5	18.2	17.9	17.5	19	19.5	19.8	20
	Spruce Pine Fir	No.1	18.7	18.7	17.4	17.4	17.3	17	16.7	16.3	17.7	18.2	18.5	18.7
		No. 2	17.6	17.6	16.4	16.4	16.3	16.1	15.8	15.4	16.7	17.2	17.5	17.6
	Douglas Fir Larch	No.1	20.2	20.2	18.8	18.8	18.7	18.4	18	17.6	19.1	19.7	20	20.2
		No. 2	19.1	19.1	17.8	17.8	17.7	17.4	17.1	16.7	18.1	18.6	19	19.1

TABLE 6:	WOOD JOIST/RAFTER MAXIMUM SPANS (for 16" o.c. spacing) WITH DOUBLE ROW OF PV PANELS AT MIDSPAN (ft.) AND PANEL SUPPORT AT 48" o.c.	DEAD LOAD: 14 PSF

	LIVE LOAD		25 PSF							VARIES WITH SLOPE			
Joist/Rafter Size	Species	Grade	Roof Slope (inches vertical per horizontal ft.)										
			0	2	4	6	8	10	12	14	8	10	12	14
2x6	Southern Pine	No. 1	12	12	10.6	10.6	10.6	10.4	10.2	9.9	10.8	11	11.1	11.1
		No. 2	***	***	***	***	9.4	9.2	9	8.8	9.6	9.8	9.8	9.8
	Spruce Pine Fir	No. 1	***	***	***	***	***	8.7	8.5	8.3	***	9.2	9.2	9.2
		No. 2	***	***	***	***	***	***	8	7.8	***	8.7	8.7	8.7
	Douglas Fir Larch	No. 1	***	***	***	***	9.5	9.3	9.1	8.9	9.7	9.9	9.9	9.9
		No. 2	***	***	***	***	***	8.9	8.7	8.4	9.3	9.4	9.4	9.4
2x8	Southern Pine	No. 1	15.2	15.1	13.6	13.6	13.6	13.4	13.1	12.8	13.9	14.2	14.3	14.3
		No. 2	13.5	13.5	12.4	12.4	12.3	12.1	11.8	11.5	12.6	12.8	12.9	13
	Spruce Pine Fir	No. 1	12.6	12.5	11.4	11.4	11.4	11.2	10.9	10.7	11.6	11.8	11.9	11.9
		No. 2	11.8	11.8	10.8	10.8	10.7	10.5	10.3	10	11	11.2	11.3	11.3
	Douglas Fir Larch	No. 1	13.5	13.5	12.3	12.3	12.3	12	11.8	11.5	12.5	12.8	12.9	12.9
		No. 2	12.8	12.8	11.7	11.7	11.6	11.4	11.2	10.9	11.9	12.1	12.2	12.2
2X10	Southern Pine	No. 1	18.2	18.1	16.6	16.6	16.5	16.2	15.9	15.5	16.9	17.3	17.5	17.6
		No. 2	16.2	16.2	15.1	15.1	14.9	14.7	14.4	14.1	15.3	15.6	15.8	15.9
	Spruce Pine Fir	No. 1	15.4	15.4	14.2	14.2	14.1	13.9	13.6	13.3	14.4	14.7	14.9	15
		No. 2	14.5	14.5	13.4	13.4	13.3	13.1	12.8	12.5	13.6	13.9	14	14.1
	Douglas Fir Larch	No. 1	16.6	16.6	15.3	15.3	15.2	15	14.7	14.3	15.6	15.9	16.1	16.2
		No. 2	15.7	15.7	14.6	14.6	14.4	14.2	13.9	13.6	14.8	15.1	15.3	15.3
2x12	Southern Pine	No.1	21.8	21.8	20.1	20.1	20	19.6	19.2	18.8	20.4	20.9	21.2	21.3
		No. 2	19.2	19.1	17.9	17.9	17.8	17.5	17.1	16.8	18.2	18.6	18.9	19
	Spruce Pine Fir	No.1	18	18	16.7	16.7	16.6	16.3	16	15.6	17	17.4	17.6	17.7
		No. 2	16.9	16.9	15.8	15.8	15.6	15.4	15.1	14.7	16	16.4	16.6	16.7
	Douglas Fir Larch	No.1	19.4	19.4	18.1	18.1	17.9	17.6	17.3	16.9	18.3	18.8	19	19.1
		No. 2	18.4	18.3	17.1	17.1	17	16.7	16.4	16	17.4	17.8	18	18.1

*** Member is not long enough to accommodate two rows of PV panels. (Member length = span/cos(α) where α is the angle of the roof slope.) (The PV panel length used is 5'-6" with a 1" space between the rows.)

Tables 7 & 8 are similar to Tables 5 & 6, respectively, except that the dead load of the existing roof structure is reduced to include only the roofing, roof sheathing and joists or rafters.

TABLE 7: WOOD JOIST/RAFTER MAXIMUM SPANS (for 16" o.c. spacing) WITH SINGLE ROW OF PV PANELS AT MIDSPAN (ft.) AND PANEL SUPPORT AT 48" o.c. — **DEAD LOAD: 8 PSF**

	LIVE LOAD		25 PSF								VARIES WITH SLOPE			
Joist/Rafter Size	Species	Grade	Roof Slope (inches vertical per horizontal ft.)											
			0	2	4	6	8	10	12	14	8	10	12	14
2x6	Southern Pine	No. 1	13.4	13.3	11.8	11.8	11.8	11.8	11.6	11.4	12.3	12.7	13.1	13.3
		No. 2	11.5	11.5	10.5	10.5	10.5	10.4	10.3	10.1	10.9	11.3	11.6	11.8
	Spruce Pine Fir	No. 1	10.9	10.9	9.8	9.8	9.8	9.8	9.6	9.4	10.2	10.6	10.8	11
		No. 2	10.3	10.2	9.3	9.3	9.3	9.2	9.1	8.9	9.6	10	10.2	10.4
	Douglas Fir Larch	No. 1	11.8	11.7	10.6	10.6	10.6	10.6	10.4	10.2	11	11.4	11.7	11.9
		No. 2	11.1	11.1	10.1	10.1	10.1	10	9.9	9.7	10.4	10.8	11.1	11.3
2x8	Southern Pine	No. 1	17	17	15.2	15.2	15.2	15.2	15	14.7	15.8	16.5	16.9	17.3
		No. 2	15.1	15.1	13.8	13.8	13.8	13.7	13.5	13.3	14.3	14.9	15.3	15.7
	Spruce Pine Fir	No. 1	14	14	12.8	12.8	12.8	12.7	12.5	12.3	13.2	13.7	14.1	14.4
		No. 2	13.2	13.1	12.1	12.1	12.1	12	11.8	11.6	12.5	12.9	13.3	13.6
	Douglas Fir Larch	No. 1	15.1	15.1	13.8	13.8	13.8	13.7	13.5	13.2	14.3	14.8	15.3	15.6
		No. 2	14.3	14.3	13.1	13.1	13.1	13	12.8	12.5	13.5	14.1	14.5	14.8
2X10	Southern Pine	No. 1	20.4	20.4	18.6	18.6	18.6	18.5	18.2	17.9	19.3	20.1	20.7	21.1
		No. 2	18.2	18.2	16.9	16.9	16.9	16.8	16.5	16.2	17.5	18.2	18.8	19.2
	Spruce Pine Fir	No. 1	17.3	17.3	15.9	15.9	15.9	15.8	15.6	15.3	16.5	17.1	17.7	18.1
		No. 2	16.3	16.3	15	15	15	14.9	14.7	14.4	15.5	16.2	16.7	17
	Douglas Fir Larch	No. 1	18.7	18.7	17.2	17.2	17.2	17	16.8	16.5	17.8	18.5	19.1	19.5
		No. 2	17.7	17.6	16.3	16.3	16.3	16.2	15.9	15.6	16.8	17.5	18.1	18.5
2x12	Southern Pine	No.1	24.5	24.5	22.5	22.5	22.5	22.3	22	21.6	23.3	24.3	25	25.6
		No. 2	21.6	21.5	20.1	20.1	20.1	19.9	19.6	19.3	20.8	21.6	22.4	22.9
	Spruce Pine Fir	No.1	20.2	20.2	18.8	18.8	18.8	18.6	18.3	18	19.4	20.2	20.9	21.3
		No. 2	19	19	17.7	17.7	17.7	17.5	17.3	17	18.3	19.1	19.7	20.2
	Douglas Fir Larch	No.1	21.8	21.8	20.3	20.3	20.3	20.1	19.8	19.4	20.9	21.8	22.5	23.1
		No. 2	20.7	20.6	19.2	19.2	19.2	19	18.7	18.4	19.8	20.7	21.4	21.9

TYPICAL UNIFORM LOAD OF ROOFING MATERIALS	
ROOF MEMBRANE	**UNIFORM LOAD OR WEIGHT**
Asphalt Shingles	3 psf / layer
Modified Bitumen	2 psf / layer
Built-Up Roof	6 psf / layer
EPDM, PVC or TPO	1 psf / layer
SLATE	10 psf
Clay tile	9 – 14 psf
Standing Seam Metal	1 psf

TABLE 8:	WOOD JOIST/RAFTER MAXIMUM SPANS (for 16" o.c. spacing) WITH DOUBLE ROW OF PV PANELS AT MIDSPAN (ft.) AND PANEL SUPPORT AT 48" o.c.												DEAD LOAD: 8 PSF
	LIVE LOAD		25 PSF								VARIES WITH SLOPE			
Joist/Rafter Size	Species	Grade	Roof Slope (inches vertical per horizontal ft.)											
			0	2	4	6	8	10	12	14	8	10	12	14
2x6	Southern Pine	No. 1	12.8	12.8	11.3	11.3	11.3	11.2	11	10.7	11.7	12	12.2	12.3
		No. 2	11.1	11.1	***	10.2	10.1	9.9	9.7	9.5	10.3	10.6	10.8	10.9
	Spruce Pine Fir	No. 1	***	***	***	***	9.5	9.3	9.1	8.9	9.7	10	10.1	10.2
		No. 2	***	***	***	***	***	8.8	8.6	8.4	***	9.4	9.6	9.6
	Douglas Fir Larch	No. 1	11.4	11.3	***	10.3	10.2	10.1	9.9	9.6	10.5	10.8	10.9	11
		No. 2	***	***	***	***	9.7	9.5	9.4	9.1	9.9	10.2	10.4	10.5
2x8	Southern Pine	No. 1	16.3	16.2	14.6	14.6	14.6	14.5	14.2	13.9	15	15.5	15.9	16.1
		No. 2	14.5	14.4	13.2	13.2	13.2	13	12.8	12.6	13.6	14	14.3	14.5
	Spruce Pine Fir	No. 1	13.4	13.4	12.2	12.2	12.2	12	11.8	11.6	12.5	12.9	13.2	13.4
		No. 2	12.6	12.6	11.6	11.6	11.5	11.4	11.2	10.9	11.8	12.2	12.4	12.6
	Douglas Fir Larch	No. 1	14.5	14.4	13.2	13.2	13.2	13	12.8	12.5	13.5	14	14.3	14.5
		No. 2	13.7	13.7	12.5	12.5	12.5	12.3	12.1	11.9	12.8	13.2	13.5	13.7
2X10	Southern Pine	No. 1	19.5	19.5	17.8	17.8	17.8	17.6	17.3	17	18.3	19	19.5	19.8
		No. 2	17.4	17.4	16.2	16.2	16.1	15.9	15.7	15.4	16.6	17.2	17.6	17.9
	Spruce Pine Fir	No. 1	16.6	16.5	15.2	15.2	15.2	15	14.8	14.5	15.6	16.2	16.6	16.8
		No. 2	15.6	15.5	14.4	14.4	14.3	14.1	13.9	13.7	14.7	15.2	15.6	15.9
	Douglas Fir Larch	No. 1	17.8	17.8	16.4	16.4	16.4	16.2	16	15.7	16.9	17.5	17.9	18.2
		No. 2	16.9	16.8	15.6	15.6	15.6	15.4	15.1	14.8	16	16.5	17	17.3
2x12	Southern Pine	No.1	23.5	23.5	21.5	21.5	21.5	21.3	21	20.6	22.2	23.1	23.7	24.2
		No. 2	20.6	20.6	19.3	19.3	19.2	19	18.7	18.4	19.8	20.5	21.1	21.5
	Spruce Pine Fir	No.1	19.3	19.3	17.9	17.9	17.9	17.7	17.4	17.1	18.4	19.1	19.6	20
		No. 2	18.2	18.1	16.9	16.9	16.9	16.7	16.4	16.1	17.4	18	18.5	18.8
	Douglas Fir Larch	No.1	20.9	20.8	19.4	19.4	19.4	19.1	18.8	18.5	19.9	20.7	21.3	21.7
		No. 2	19.7	19.7	18.4	18.4	18.3	18.1	17.8	17.5	18.9	19.6	20.1	20.5

*** Member is not long enough to accommodate two rows of PV panels. (Member length = span/cos(α) where α is the angle of the roof slope.) (The PV panel length used is 5'-6" with a 1" space between the rows.)

TYPICAL UNIFORM LOAD OF BUILDING MATERIALS	
MATERIAL	**UNIFORM LOAD OR WEIGHT**
2x6 @ 16" o.c.	**2 psf**
2x8 @ 16" o.c.	**2.5 psf**
2x10 @ 16" o.c.	**3 psf**
2x12 @ 16" o.c.	**3.5 psf**
¾" Plywood	**2.5 psf**
Batt Insulation	**1 psf**
5/8" Gypsum Board	**2.5 psf**

In these examples, two sample PV panel installations are shown; the first includes a sloped roof and the second a flat roof.

For this first example, each of the tables/forms is completed for a sloped roof with a mechanically attached system.

BUILDING INFORMATION:		
BUILDING ADDRESS	**Anywhere Chicago but not within 600 feet of the Lake**	
BUILDING HEIGHT	**35 ft.**	**Not to exceed 55 feet to be considered within the expedited permit process.**
BUILDING MAXIMUM LENGTH	**44 ft.**	**The maximum plan dimension of the building.**
BUILDING WIDTH	**20 ft.**	**The minimum plan dimension of the building.**
ROOF SLOPE	**12:12**	**The slope must be 1.5:12 (7 degrees) or less to be considered flat. (0 degrees = flat.)**

We, as the Property Owner and General Contractor, certify that the information provided herein and the statements made are true, and understand that the Department of Buildings has the right to revocation and penalties (as listed in the Easy Permit Application certification statements) in the event that the statements made regarding this criteria information have been falsified or is determined to be inaccurate.

Single Family Residence Owner

_____	_____	_____
Property Owner's Name	Property Owner's Signature	Date

PV Installer Construction

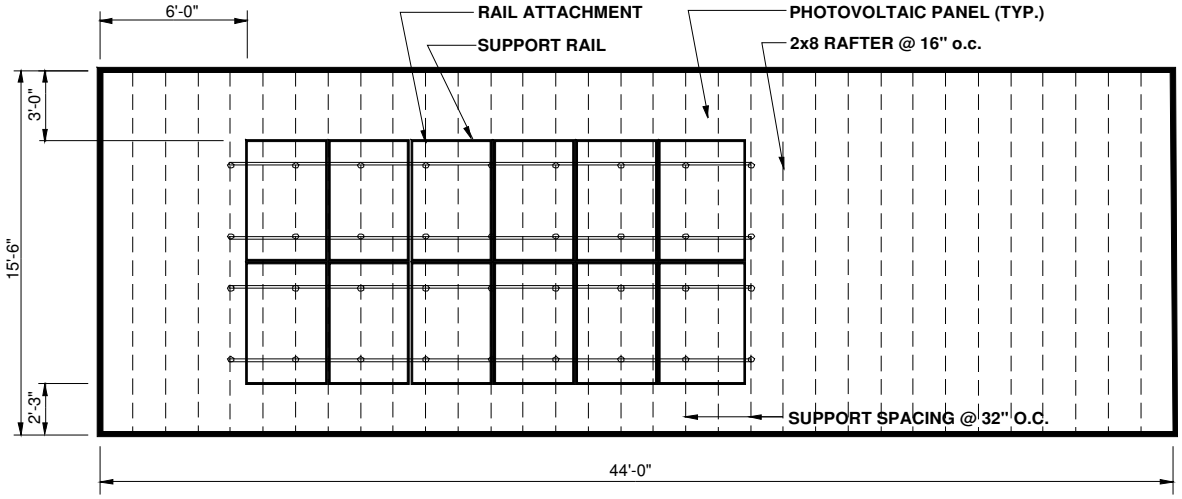
_____	_____	_____
General Contractor's Name	General Contractor Signature	Date

ZONING INFORMATION:			
CATEGORY	**DATA**		**ZONING REQUIRMENTS**
LANDMARK	☐ Yes ☒ No		Is the building that the PV panel system to be mounted on a national or state landmark? (If yes, then the expedited process cannot be used.)
	☐ Yes ☒ No		Is the building that the PV panel system to be mounted on a city designated landmark? (If yes, then the expedited process cannot be used.)
	☐ Yes ☒ No		Is the building that the PV panel system to be mounted on located in a code orange or red landmark district? (If yes, then the expedited process cannot be used.)
LOCATION ON BUILDING	**South facing surface of gable roof.**		Define specifically, where on the building the PV panels are to be located. (PV panels must be installed on a defined, permitted rooftop. If in the residential zoning district, the PV panels must be located on the property's principal structure.)
TOP SLOPED PANEL SURFACE ABOVE FLAT ROOF DECK	**Top or Upper Panel Edge**	**N/A**	State the dimension that the upper and lower edges of the sloped PV panel extend above the roof surface. (If installed on a flat rooftop, no part of the PV panel system may exceed 9 feet in overall height, or extend 5 feet above the building parapet, whichever is less.)
	Bottom or Lower Panel Edge	**N/A**	
TOP PANEL SURFACE ABOVE SLOPED ROOF DECK	**8" to top surface of panel**		State the dimension between the top of the roof surface and the top of the PV panel. (If installed on an inclined or sloped roof, the PV panels must be attached to and mounted parallel with the roof. The top surface of the PV panels shall not be more than 12 inches from the roof deck at any point. No portion of the PV panels shall extend above the ridgeline of the roof at any point.)
POLICY COMPLIANCE	☒ Yes ☐ No		Does the PV panel system adhere to all of the guidelines of the City of Chicago's Solar Zoning Policy?

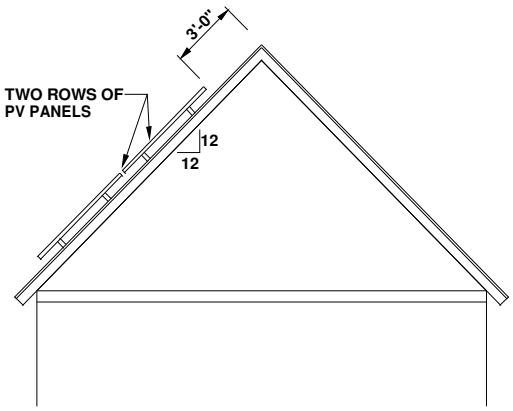
BUILDING ADDRESS:			
OWNER:	DOB Example		
DRAWN BY:		**DATE:**	

Required Information:

- Roof Plane with Overall Dimensions
- Location of Roof Plane on Building
- PV Panels (Show Individual Panels and Rows)
- Edge Distance Between PV Panels and Roof Edge
- End Distance Between PV Panels and Roof Edge
- Distance Between Rows of PV Panels
- Distance Between Adjacent PV Panels
- Side or End Elevation of Building Showing Roof Slope and PV Panel Locations
- North Arrow



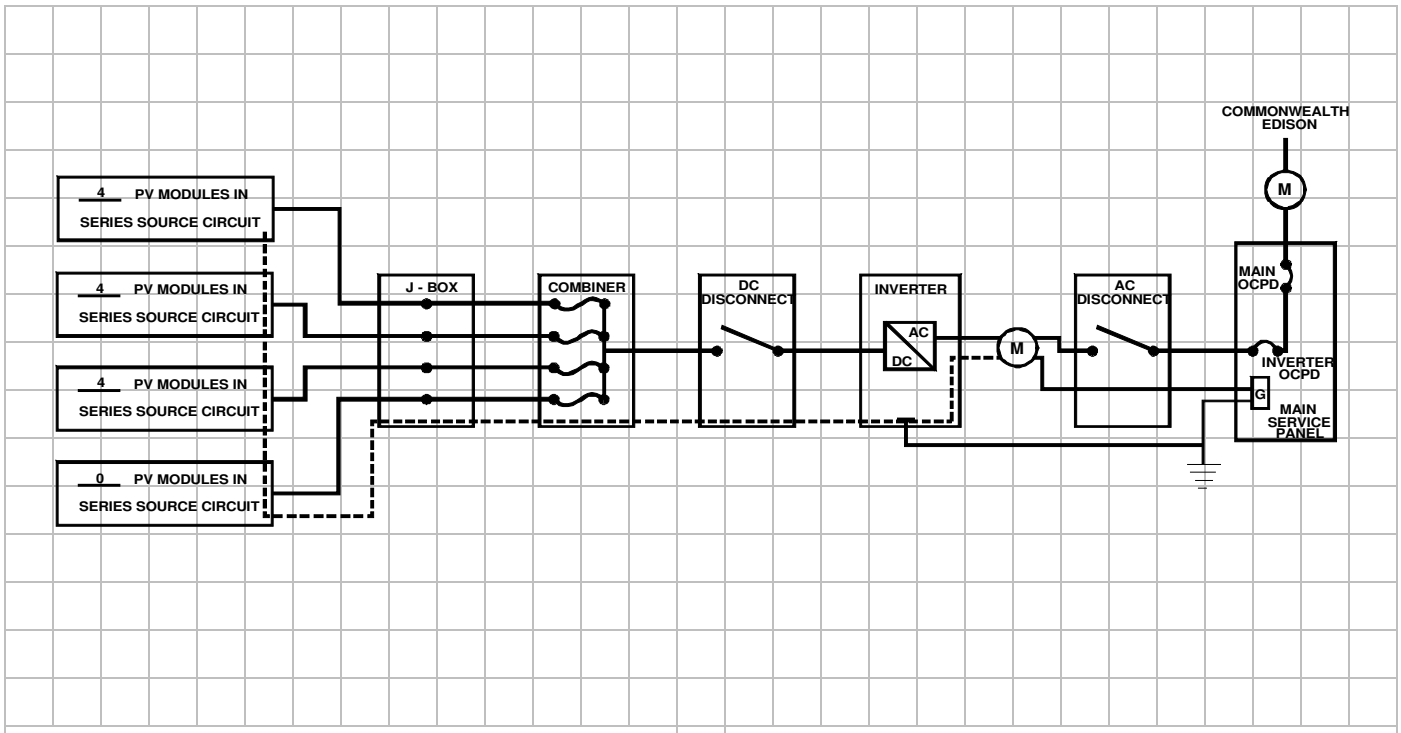
SOUTH FACING ROOF SURFACE



PARTIAL ELEVATION

ELECTRICAL INFORMATION:		
REQUIRED INFORMATION	**DATA**	**REQUIREMENTS**
INVERTER TYPE	**Fronius IG 4000W Grid Tied Inverter IG 4000**	**Manufacturer and model number**
INVERTER OUTPUT	**4 kW**	**System's inverter output is 13.44 kW or less (maximum size for 70-amp breaker)**
PV PANEL TYPE	**SunPower SPR-327NE-WHT-D**	**Manufacturer and model number**
PV PANEL OUTPUT	**327 W**	**Maximum watt output per panel**
NUMBER OF PANELS	**12**	**Total number of panels in installation**
TOTAL PV PANEL OUTPUT	**(327 W)(12) = 3924 W**	**Multiply the number of panels times the output per panel**
ELECTRICAL CONTRACTOR	***PV Installer Electrical Contractor***	**Must be a licensed electrician in good standing with the City of Chicago and has certified PV panel system installation.**
COMPONENT COMPLIANCE	**☑ Yes ☐ No**	**Do all electrical components comply with the Chicago Electrical Code (18-27, Article 690)? Yes/No.**
	☑ Yes ☐ No	**Are all electrical components (or equipment), including panels and inverters, listed and labeled by a Nationally Recognized Testing Laboratory (as per 18-27-110.2) and have all components been installed as per the manufacturer's instructions? Yes/No.**

Provide below, or on a separate sheet, a one line electrical diagram of PV panel electrical system.



Address: Anywhere Chicago…

Permit No.: From EPP Desk

PV PANEL & SUPPORT FRAME:				
PV PANEL	**DATA**			**REMARKS**
MANUFACTURER	SunPower SPR-327NE-WHT-D			Manufacturer and product number
PANEL WATTAGE	327 W			Maximum watt output per panel
NUMBER OF PANELS	Number of Rows	Number per Row		Number of panels per group or roof surface
	2	6		
PANEL DIMENSIONS	Length	Width	Area	Length & width (in.) and area (sq. ft.)
	61.4 in.	41.2 in.	17.6 sq. ft.	
PANEL WEIGHT	41 lbs.			Weight of individual panel (lbs)
PANEL SPACING	Sides	Top	Bottom	The side spacing is the space between adjacent panels in a row. The top and bottom spacing is the distance between rows of panels. If there is no row above or below, state not applicable (N/A).
	0.5 in.	12 in.	0 in.	
TYPE OF SUPPORT RAILS	SolarMount Beam, Clamps & Clips			Manufacturer and part or model number
ANCHOR BOLTS OR FASTENERS	3/8 in. x 4 in Lag Screw			Size and/or manufacturer's part number
SUPPORT RAIL ATTACHMENT SPACING	32 in. on center			Equal to multiple of joist, rafter or truss spacing
ANGLE OF PANEL TO ROOF SURFACE	0 deg.			Provide angle in degrees from the roof surface.
BALLAST TYPE & WEIGHT	0 lbs.			If PV panels & frames are to be ballasted, then provide total load per panel. If mechanically attached state 0 lbs.
PANEL AND RAIL UNIFORM LOAD	3.5 psf			Uniform dead load of panel and panel support system, as determined by dividing the weight of the panel and support rails by the panel area, in pounds per square foot (psf)

WIND LOADS:

BUILDING CODE SECTION	CODE PROVISION		WIND PRESSURE	
For PV panels mounted flat to the roof surface, the provisions of CBC Section 13-52-310(b) may be used for the determination of the wind load on the panels even though reference is made to "roof framing." The wind load provisions of ASCE 7 for Components and Cladding provide more appropriate loads for PV panels mounted flat to the roof surface and should be used.				For PV panels mounted parallel to a flat or sloped roof.
CBC Table 13-52-310	Table 13-52-310 Column A: For buildings of 200 feet or less the design wind pressure is 20 psf			
CBC Section 13-52-310(b)	(b) Roof Structures Over Enclosed Building Or Other Structures. All main roof framing structures shall be designed and constructed for the following pressures:	1. Flat roofs: an outward pressure acting normal to the surface equal to 75 percent of those established in Table 13-52-310, Column (A) for the corresponding mean height of the roof and applied to the entire roof area.		
		2. Sloped roof, slope equal to or less than 30 degrees: an outward pressure acting normal to the surface equal to 100 percent on the windward side and 75 percent on the leeward side of those established in Table 13-52-310, Column (A) for the corresponding mean height of the roof.		
		3. Sloped roofs, slope greater than 30 degrees: an inward pressure acting normal to the surface equal to 100 percent on the windward side and an outward pressure acting normal to the surface equal to 75 percent on the leeward side of those established in Table 13-52-310, Column (A) for the corresponding mean height of the roof.	+20 psf windward -15 psf leeward	
		5. Roofing sheathing and membranes: an outward pressure acting normal to the surface equal to the pressures set forth in Section 13-52-310b.1, b.2 and b.3 except within an area at the edge of the roof equal to ten percent of the width of the structure parallel to the wind direction being considered, outward pressure equal to 200 percent of those established in Table 13-52-310, Column (A) as set out in this section, for the corresponding mean height of the roof.		
ASCE 7-05 Section Figure 6-11B	Roof edge zone is 10% of the least horizontal dimension or 0.4h, whichever is smaller but not less than either 4% of least horizontal dimension or 3 ft. where h is the mean height of the building		3 ft.	
ASCE 7-05 Section 6.5.6	Wind Exposure B for majority of the City except Exposure D within 600 feet (or 20 times the building height) of Lake Michigan			
ASCE 7-05 Section 6.5.10	The wind velocity pressure is based upon the expression $q_h = 0.00256K_zK_{zt}K_dV^2I$, where:			
	Basic Wind Speed:	From Figure 6-1, V =	90 mph	
	Structure Classification:	From Table 1-1, the structure is classified as Category:	II	
	Importance Factor:	From Table 6-1, I =	1.0	
	Wind Directionality Factor:	From Table 6-4, K_d =	0.85	
	Exposure Category:	From Section 6.5.6, the exposure category is:	B	

	Topographical Effect:	From Section 6.5.7, K_{zt} =			1.0	
	Velocity Pressure Coefficient:	From Section 6.5.6.4 and Table 6-3 for a height of 35 ft. and exposure B, K_z =			0.73	
	Wind Velocity Pressure	$q_h = 0.00256K_zK_{zt}K_dV^2I$ =			12.87 psf	
ASCE 7-05 Section 6.5.12.4	The design wind pressure on components and cladding is based upon the expression $p = q_h [(GC_p) - (GC_{pi})]$, where:					For PV panels mounted parallel to a flat or sloped roof.
	Internal Pressure Coefficient:	From Figure 6-5 GC_{pi} =			+/-0.18	
	Gust Effect Factor:	The gust effect factor for components and cladding GC_p is determined from Figures 6-11B through 6-17 for the applicable roof type and slope (where θ is the angle of the roof from the horizontal.)				
	For a Gable Roof	From Figure 6-11B for a building less than 60 ft. high	For PV panels located away from the edge of a gable roof surface where $\theta < 7^o$ and a tributary area of ____ ft^2, GC_p =			
			For PV panels located within the edge of a gable roof surface where $\theta < 7^o$ and a tributary area of ____ ft^2, GC_p =			
		From Figure 6-11C for a building less than 60 ft. high	For PV panels located away from the edge of a gable roof surface where $7^o < \theta < 27^o$ and a tributary area of ____ ft^2, GC_p =			
			For PV panels located within the edge of a gable roof surface where $7^o < \theta < 27^o$ and a tributary area of ____ ft^2, GC_p =			
		From Figure 6-11D for a building less than 60 ft. high	For PV panels located away from the edge of a gable roof surface where $27^o < \theta < 45^o$ and a tributary area of 20 ft^2, GC_p =		-0.9	-13.9 psf at center
			For PV panels located within the edge of a gable roof surface where $27^o < \theta < 45^o$ and a tributary area of 20 ft^2, GC_p =		-1.1	-16.47 psf at edge but not corner
	For Other Roof Configuration	From Figure _____	For PV panels located away from the edge of roof surface and a tributary area of ____ ft^2, GC_p =			
			For PV panels located within the edge of roof surface and a tributary area of ____ ft^2, GC_p =			

For PV panels mounted at an angle to a flat roof, the Wind Velocity Pressure must be determined from Section 6.5.10 of ASCE 7 and the appropriate factors and coefficients must be obtained from SEAOC PV2-2012, as listed below, to obtain the Design Wind Pressure.

SEAOC PV2-2012	The width of the edge zone is defined as $2a_{pv.}$ a_{pv} is defined as $0.5(hW_L)^{0.5}$ but need not exceed h. Where, h = the mean roof height of the building and W_L = longest plan dimension of the building.				For PV panels mounted at an angle to a flat roof.
	From Figure 29.9-1, the net pressure normal to the surface of the PV panel is based upon the expression $p = q_h(\gamma_p\gamma_c(GC_m)_{nom})E$, where:				
	Velocity Pressure:	From ASCE 7-05 Section 6-5-10, q_h =			
	Angle of Panel to Roof Surface	As illustrated in Figure 29.9-1, the angle of the panel to the roof surface is:			
	Parapet Height Factor:	From Figure 29.9-1 for a parapet height of _____, γ_p =			
	Panel Chord Length Factor:	From Figure 29.9-1 for a panel angle of _____, γ_c =			
	Characteristic Height	From Figure 29.9-1 $h_c = \min(h_1, 1ft) + l_p\sin(\omega)$ =			
	Ratio of Edge Distance to Characteristic Height	Controlling ratio of panel - roof edge distance to panel characteristic height, d_x/h_c =			
	Location of Panel Being Considered	Row of the array that the panel is located (i.e. North, South, or Interior)			
		Location of panel within row (i.e. East end, West end, or Interior)			
	Array Edge Factor	From Figure 29.9-1, for the location of the panel within the array, E =			
	Roof Zone:	From Figure 29.9-1, the roof zone for the panels is:			
	Building Coefficient	From Figure 29.9-1, a_{pv} =			
	Effective Wind Area:	From Figure 29.9-1, the effective wind area for the structural element _____ being designed is:			
	Normalized Wind Area:	From Figure 29.9-1, the normalized wind area A_n =			
	Nominal Pressure Coefficient:	From Figure 29.9-1, the nominal net pressure coefficient $(GC_m)_{nom}$ =			
	Design Wind Pressure:	$p = q_h(\gamma_p\gamma_c(GC_m)_{nom})E$ =			

PV PANEL ATTACHMENT:		
REQUIRED INFORMATION	**DATA**	**REMARKS**
TRIBUTARY AREA PER ATTACHMENT BOLT (ft^2/bolt)	(6)(17.6 sq. ft.)/18 = 5.9 sq. ft.	Number of panels in a row x panel area / number of bolts
UPLIFT FORCE PER BOLT (lbs)	(5.9 sq. ft.)(16.47 psf) = 96.6 lb.	Tributary area per bolt x wind uplift pressure
BOLT PULLOUT CAPACITY (lbs)	>200 lbs	Pullout strength is based upon the National Design Specification manufacturer's literature and species of wood joist, rafter or truss top chord. (An increase in allowable stress or capacity of 1.33 for transient wind loads is not allowed.) Anchorage capacity must include a factor of safety of 1.5 as discussed below.
BOLT PULLOUT CAPACITY GREATER THAN WIND UPLIFT	☒ Yes ☐ No	Yes or no. If no, revise bolt size and or spacing.

EXISTING CONCRETE ROOF CONSTRUCTION:			
ROOF FRAMING TYPE	N/A		Flat slab, slab and beam or joists
SLAB THICKNESS OR JOIST DEPTH			
JOIST/BEAM WIDTH			
JOIST/BEAM SPACING (in.)			
SPAN (ft.)			For two-way slab, list span in both directions

EXISTING STRUCTURAL STEEL ROOF CONSTRUCTION:			
ROOF FLAT OR SLOPED	N/A		Provide roof slope (in./12 in.) and degrees or 0 if none or flat α = tan(rise/run) and is the angle of the roof plane from the horizontal
FRAMING TYPE			Joists, trusses or beams
DECK TYPE			Concrete and/or metal deck
JOIST, TRUSS OR BEAM SPACING (in.)			
SPAN (ft.)			Joist, rafter or truss span. (Horizontal projection)

EXISTING WOOD ROOF CONSTRUCTION:				
ROOF FLAT OR SLOPED		12:12 α = 45 degrees		Provide roof slope (in./12 in.) and degrees or 0 if none or flat α = atan(rise/run) and is the angle of the roof plane from the horizontal
FRAMING TYPE		Rafter		Joists/rafters or trusses
WOOD SPECIES AND GRADE		Douglas Fir Larch No. 1		If unknown, use SPF No. 2
JOIST/RAFTER OR TRUSS SPACING		16 in. o.c.		Units = inches (in.)
SPAN (ft.)		10 ft.		Joist, rafter or truss span. (Horizontal projection)
			WEIGHT (psf)	
JOIST/RAFTER OR TOP CHORD SIZE.		2x8	2	Size of lumber
SHEATHING TYPE		Spaced sheathing	2.5	Plywood or lumber
ROOFING	TYPE	Asphalt shingles	3	Total roofing load
	NUMBER OF LAYERS	1		
CEILING		Gypsum board	2.5	
INSULATION		Fiberglass batt	1	
OTHER		Wood furring & electrical	3	Other materials including mechanical and electrical equipment
BALLAST			0	Ballast to resist wind loads on PV panel system, if used
		DEAD LOAD SUBTOTAL	14	Dead load per square foot of roof surface
SNOW			25	Minimum snow load of 25 psf required by the CBC, plus drifting as defined in ASCE 7-05 (See Note 1.)
		TOTAL DEAD & LIVE LOAD	39	Total dead and live load to be supported by existing structure along length of member

LIVE LOAD TIMES MEMBER SPACING	25 psf x 1.33 ft.	33.33	Live or snow load per lineal foot of member (plf)
HORIZONTAL PROJECTION OF DEAD LOAD TIMES MEMBER SPACING	14 psf x 1.33 ft / cos(α)	26.4	
HORIZONTAL PROJECTION OF PV PANEL DEAD LOAD TIMES SUPPORT SPACING	3.5 psf x 1.33 x 2 / cos(α)	13.2	Uniform load of PV panel times support spacing and divided by the cosine of the roof angle (The PV panel load is assumed over full length of member.) (plf)
TOTAL PROJECTED DEAD, PV PANEL & LIVE LOAD SUPPORTED BY MEMBER		73	Sum of dead, PV panel and live loads (plf)
STRUCTURAL LOAD CAPACITY		N/A	Maximum load capacity of the wood roof rafters, joists or trusses calculated separately (plf)

ALTERNATE – USE TABLES TO DETERMINE MAXIMUM SPAN	☒ Yes ☐ No	**12.2 ft.**	**State whether tables are being used and provide the maximum span listed in tables. (ft.)**
IS THE EXISTING WOOD STRUCTURE ADEQUATE TO SUPPORT THE ADDITIONAL LOAD DUE TO THE NEW PV PANEL SYSTEM?	☒ Yes ☐ No		**If the structure is not adequate to support the additional load, then provide drawings and calculations to show how the structure is to be reinforced.**

1. A reduction in snow load, as per CBC Section 13-52-280(b), was not considered for this example with a sloped roof.

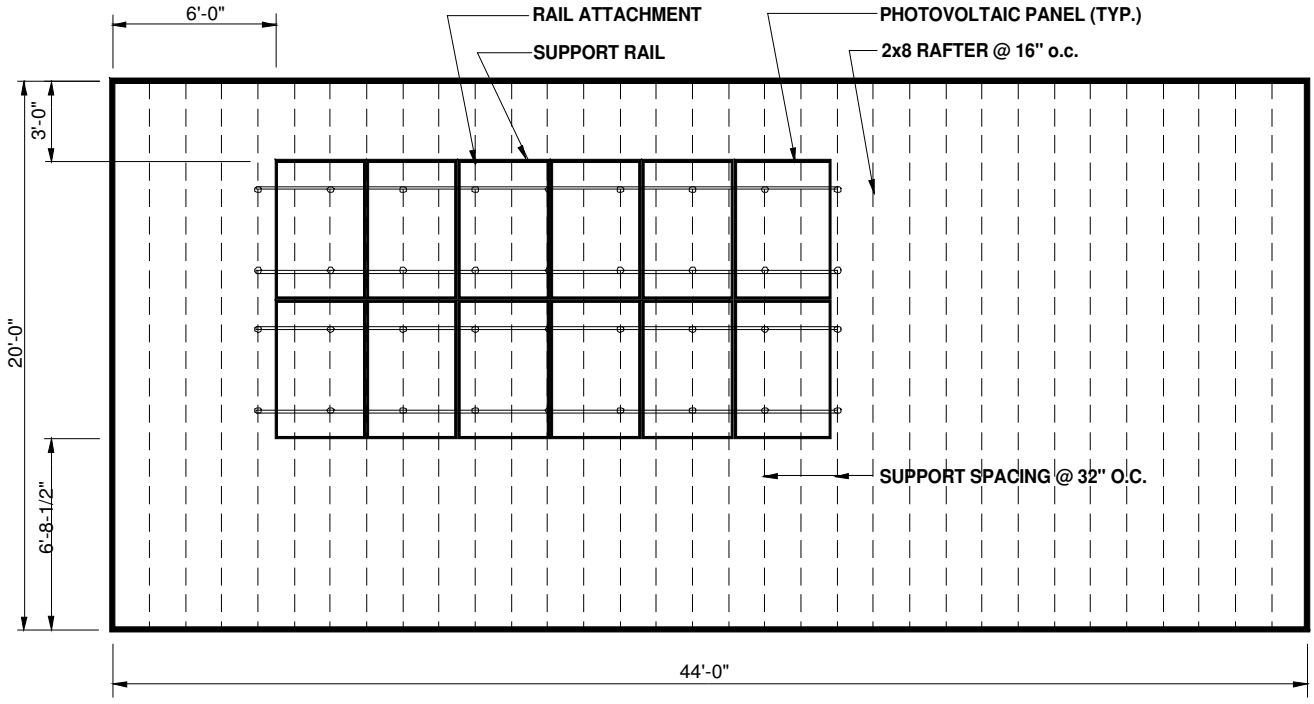
The following is the second example and is provided to illustrate the differences in calculating the wind load on a bolt, given a flat roof. The General, Zoning, and Electrical information are the same as that listed above except that the roof slope is 0:12 and the PV panels are mounted at an angle of 5 degrees from the roof surface.

ZONING INFORMATION:

CATEGORY	DATA		ZONING REQUIRMENTS
LANDMARK	☐ Yes ☒ No		Is the building that the PV panel system to be mounted on a national or state landmark? (If yes, then the expedited process cannot be used.)
	☐ Yes ☒ No		Is the building that the PV panel system to be mounted on a city designated landmark? (If yes, then the expedited process cannot be used.)
	☐ Yes ☒ No		Is the building that the PV panel system to be mounted on located in a code orange or red landmark district? (If yes, then the expedited process cannot be used.)
LOCATION ON BUILDING	Maim flat roof		Define specifically, where on the building the PV panels are to be located. (PV panels must be installed on a defined, permitted rooftop. If in the residential zoning district, the PV panels must be located on the property's principal structure.)
TOP SLOPED PANEL SURFACE ABOVE FLAT ROOF DECK	Top or Upper Panel Edge	13.4 in.	State the dimension that the upper and lower edges of the sloped PV panel extend above the roof surface. (If installed on a flat rooftop, no part of the PV panel system may exceed 9 feet in overall height, or extend 5 feet above the building parapet, whichever is less.)
	Bottom or Lower Panel Edge	8 in.	
TOP PANEL SURFACE ABOVE SLOPED ROOF DECK	N/A		State the dimension between the top of the roof surface and the top of the PV panel. (If installed on an inclined or sloped roof, the PV panels must be attached to and mounted parallel with the roof. The top surface of the PV panels shall not be more than 12 inches from the roof deck at any point. No portion of the PV panels shall extend above the ridgeline of the roof at any point.)
POLICY COMPLIANCE	☒ Yes ☐ No		Does the PV panel system adhere to all of the guidelines of the City of Chicago's Solar Zoning Policy?

BUILDING ADDRESS:			
OWNER:	DOB Example		
DRAWN BY:		**DATE:**	

Required Information:
- Roof Plane with Overall Dimensions
- Location of Roof Plane on Building
- PV Panels (Show Individual Panels and Rows)
- Edge Distance Between PV Panels and Roof Edge
- End Distance Between PV Panels and Roof Edge
- Distance Between Rows of PV Panels
- Distance Between Adjacent PV Panels
- Side or End Elevation of Building Showing Roof Slope and PV Panel Locations
- North Arrow



ROOF PLAN

N

PV PANEL & SUPPORT FRAME:				
PV PANEL	**DATA**			**REMARKS**
MANUFACTURER	SunPower SPR-327NE-WHT-D			Manufacturer and product number
PANEL WATTAGE	327 W			Maximum watt output per panel
NUMBER OF PANELS	Number of Rows	Number per Row		Number of panels per group or roof surface
	2	6		
PANEL DIMENSIONS	Length	Width	Area	Length & width (in.) and area (sq. ft.)
	61.4 in.	41.2 in.	17.6 sq. ft.	
PANEL WEIGHT	41 lbs.			Weight of individual panel (lbs)
PANEL SPACING	Sides	Top	Bottom	The side spacing is the space between adjacent panels in a row. The top and bottom spacing is the distance between rows of panels. If there is no row above or below, state not applicable (N/A).
	0.5 in.	12 in.	0 in.	
TYPE OF SUPPORT RAILS	SolarMount Beam, Clamps & Clips			Manufacturer and part or model number
ANCHOR BOLTS OR FASTENERS	3/8 in. x 4 in Lag Screw			Size and/or manufacturer's part number
SUPPORT RAIL ATTACHMENT SPACING	32 in. on center			Equal to multiple of joist, rafter or truss spacing
ANGLE OF PANEL TO ROOF SURFACE	5 deg.			Provide angle in degrees from the roof surface.
BALLAST TYPE & WEIGHT	0 lbs.			If PV panels & frames are to be ballasted, then provide total load per panel. If mechanically attached state 0 lbs.
PANEL AND RAIL UNIFORM LOAD	3.5 psf			Uniform dead load of panel and panel support system, as determined by dividing the weight of the panel and support rails by the panel area, in pounds per square foot (psf)

WIND LOADS:

BUILDING CODE SECTION	CODE PROVISION		WIND PRESSURE	
For PV panels mounted flat to the roof surface, the provisions of CBC Section 13-52-310(b) may be used for the determination of the wind load on the panels even though reference is made to "roof framing." The wind load provisions of ASCE 7 for Components and Cladding provide more appropriate loads for PV panels mounted flat to the roof surface and should be used.				For PV panels mounted parallel to a flat or sloped roof.
CBC Table 13-52-310	Table 13-52-310 Column A: For buildings of 200 feet or less the design wind pressure is 20 psf			
CBC Section 13-52-310(b)	(b) Roof Structures Over Enclosed Building Or Other Structures. All main roof framing structures shall be designed and constructed for the following pressures:	1. Flat roofs: an outward pressure acting normal to the surface equal to 75 percent of those established in Table 13-52-310, Column (A) for the corresponding mean height of the roof and applied to the entire roof area.		
		2. Sloped roof, slope equal to or less than 30 degrees: an outward pressure acting normal to the surface equal to 100 percent on the windward side and 75 percent on the leeward side of those established in Table 13-52-310, Column (A) for the corresponding mean height of the roof.		
		3. Sloped roofs, slope greater than 30 degrees: an inward pressure acting normal to the surface equal to 100 percent on the windward side and an outward pressure acting normal to the surface equal to 75 percent on the leeward side of those established in Table 13-52-310, Column (A) for the corresponding mean height of the roof.		
		5. Roofing sheathing and membranes: an outward pressure acting normal to the surface equal to the pressures set forth in Section 13-52-310b.1, b.2 and b.3 except within an area at the edge of the roof equal to ten percent of the width of the structure parallel to the wind direction being considered, outward pressure equal to 200 percent of those established in Table 13-52-310, Column (A) as set out in this section, for the corresponding mean height of the roof.		
ASCE 7-05 Section Figure 6-11B	Roof edge zone is 10% of the least horizontal dimension or 0.4h, whichever is smaller but not less than either 4% of least horizontal dimension or 3 ft. where h is the mean height of the building		3 ft.	
ASCE 7-05 Section 6.5.6	Wind Exposure B for majority of the City except Exposure D within 600 feet (or 20 times the building height) of Lake Michigan			
ASCE 7-05 Section 6.5.10	The wind velocity pressure is based upon the expression $q_h = 0.00256K_zK_{zt}K_dV^2I$, where:			
	Basic Wind Speed:	From Figure 6-1, V =	90 mph	
	Structure Classification:	From Table 1-1, the structure is classified as Category:	II	
	Importance Factor:	From Table 6-1, I =	1.0	
	Wind Directionality Factor:	From Table 6-4, K_d =	0.85	
	Exposure Category:	From Section 6.5.6, the exposure category is:	B	

	Topographical Effect:	From Section 6.5.7, K_{zt} =			1.0	
	Velocity Pressure Coefficient:	From Section 6.5.6.4 and Table 6-3 for a height of 35 ft. and exposure B, K_z =			0.73	
	Wind Velocity Pressure	$q_h = 0.00256K_zK_{zt}K_dV^2I$ =			12.87 psf	
ASCE 7-05 Section 6.5.12.4	The design wind pressure on components and cladding is based upon the expression $p = q_h [(GC_p) - (GC_{pi})]$, where:					For PV panels mounted parallel to a flat or sloped roof.
	Internal Pressure Coefficient:	From Figure 6-5 GC_{pi} =			+/-0.18	
	Gust Effect Factor:	The gust effect factor for components and cladding GC_p is determined from Figures 6-11B through 6-17 for the applicable roof type and slope (where θ is the angle of the roof from the horizontal.)				
	For a Gable Roof	From Figure 6-11B for a building less than 60 ft. high	For PV panels located away from the edge of a gable roof surface where $\theta < 7^o$ and a tributary area of ____ ft^2, GC_p =			
			For PV panels located within the edge of a gable roof surface where $\theta < 7^o$ and a tributary area of ____ ft^2, GC_p =			
		From Figure 6-11C for a building less than 60 ft. high	For PV panels located away from the edge of a gable roof surface where $7^o < \theta < 27^o$ and a tributary area of ____ ft^2, GC_p =			
			For PV panels located within the edge of a gable roof surface where $7^o < \theta < 27^o$ and a tributary area of ____ ft^2, GC_p =			
		From Figure 6-11D for a building less than 60 ft. high	For PV panels located away from the edge of a gable roof surface where $27^o < \theta < 45^o$ and a tributary area of 20 ft^2, GC_p =			
			For PV panels located within the edge of a gable roof surface where $27^o < \theta < 45^o$ and a tributary area of 20 ft^2, GC_p =			
	For Other Roof Configuration	From Figure _____	For PV panels located away from the edge of roof surface and a tributary area of ____ ft^2, GC_p =			
			For PV panels located within the edge of roof surface and a tributary area of ____ ft^2, GC_p =			

For PV panels mounted at an angle to a flat roof, the Wind Velocity Pressure must be determined from Section 6.5.10 of ASCE 7 and the appropriate factors and coefficients must be obtained from SEAOC PV2-2012, as listed below, to obtain the Design Wind Pressure.

SEAOC PV2-2012	The width of the edge zone is defined as $2a_{pv}$. a_{pv} is defined as $0.5(hW_L)^{0.5}$ but need not exceed h. Where, h = the mean roof height of the building and W_L = longest plan dimension of the building.		39.2 ft.		For PV panels mounted at an angle to a flat roof.
	From Figure 29.9-1, the net pressure normal to the surface of the PV panel is based upon the expression $p = q_h(\gamma_p\gamma_c(GC_m)_{nom})E$, where:				
	Velocity Pressure:	From ASCE 7-05 Section 6-5-10, q_h =	12.87 psf		
	Angle of Panel to Roof Surface	As illustrated in Figure 29.9-1, the angle of the panel to the roof surface is:	5°		
	Parapet Height Factor:	From Figure 29.9-1 for a parapet height of 2 ft. , γ_p =	1.0		
	Panel Chord Length Factor:	From Figure 29.9-1 for a panel angle of 5 deg. , γ_c =	1.0		
	Characteristic Height	From Figure 29.9-1 $h_c = \min(h_1, 1ft) + l_p\sin(\omega)$ =	1.11 ft.		
	Ratio of Edge Distance to Characteristic Height	Controlling ratio of panel - roof edge distance to panel characteristic height, d_x/h_c =	6.0		
	Location of Panel Being Considered	Row of the array that the panel is located (i.e. North, South, or Interior)	S		
		Location of panel within row (i.e. East end, West end, or Interior)	I		
	Array Edge Factor	From Figure 29.9-1, for the location of the panel within the array, E =	1.3		
	Roof Zone:	From Figure 29.9-1, the roof zone for the panels is:	2		
	Building Coefficient	From Figure 29.9-1, a_{pv} =	19.6 ft		
	Effective Wind Area:	From Figure 29.9-1, the effective wind area for the structural element bolt being designed is:	5.9 ft.^{2}		
	Normalized Wind Area:	From Figure 29.9-1, the normalized wind area A_n =	19.1 ft.^{2}		
	Nominal Pressure Coefficient:	From Figure 29.9-1, the nominal net pressure coefficient $(GC_m)_{nom}$ =	1.32		
	Design Wind Pressure:	$p = q_h(\gamma_p\gamma_c(GC_m)_{nom})E$ =	22.1 psf		
				22.1 psf	

Note: The edge factor "E" varies for panels at various locations on the roof and within the array. The above value is for panels within the southernmost row, but not at the edges of that row. A complete evaluation of the wind loads on the PV panels requires an analysis of each unique panel location. (See the discussion in SEAOC PV2-2012 Appendix A.)

PV PANEL ATTACHMENT:		
REQUIRED INFORMATION	**DATA**	**REMARKS**
TRIBUTARY AREA PER ATTACHMENT BOLT (ft^2/bolt)	(6)(17.6 sq. ft.)/18 = 5.9 sq. ft.	Number of panels in a row x panel area / number of bolts
UPLIFT FORCE PER BOLT (lbs)	(5.9 sq. ft.)(22.1 psf) = 130.4 lb.	Tributary area per bolt x wind uplift pressure
BOLT PULLOUT CAPACITY (lbs)	>200 lbs	Pullout strength based upon manufacturer's literature and species of wood joist, rafter or truss top chord
BOLT PULLOUT CAPACITY GREATER THAN WIND UPLIFT	☒ Yes ☐ No	Yes or no. If no, revise bolt size and or spacing.

EXISTING WOOD ROOF CONSTRUCTION:					
ROOF FLAT OR SLOPED		0:12 α = 0 degrees			Provide roof slope (in./12 in.) and degrees or 0 if none or flat α = atan(rise/run) and is the angle of the roof plane from the horizontal
FRAMING TYPE		Joist			Joists/rafters or trusses
WOOD SPECIES AND GRADE		Douglas Fir Larch No. 1			If unknown, use SPF No. 2
JOIST/RAFTER OR TRUSS SPACING		16 in. o.c.			Units = inches (in.)
SPAN (ft.)		20 ft.			Joist, rafter or truss span. (Horizontal projection)
				WEIGHT (psf)	
JOIST/RAFTER OR TOP CHORD SIZE.		2x12		3.5	Size of lumber
SHEATHING TYPE		Spaced sheathing		2.5	Plywood or lumber
ROOFING	TYPE	Single Ply Membrane		1	Total roofing load
	NUMBER OF LAYERS	1			
CEILING		Gypsum board		2.5	
INSULATION		Rigid Polyisocyanurate		1	
OTHER		Wood furring, mechanical & electrical		3.5	Other materials including mechanical and electrical equipment
BALLAST				0	Ballast to resist wind loads on PV panel system, if used
		DEAD LOAD SUBTOTAL		14	Dead load per square foot of roof surface
SNOW				25	Minimum snow load of 25 psf required by the CBC, plus drifting as defined in ASCE 7-05
		TOTAL DEAD & LIVE LOAD		39	Total dead and live load to be supported by existing structure along length of member
LIVE LOAD TIMES MEMBER SPACING		25 psf x 1.33 ft.	33.33	Live or snow load per lineal foot of member (plf)	
HORIZONTAL PROJECTION OF DEAD LOAD TIMES MEMBER SPACING		14 psf x 1.33 ft / cos(α)	18.62		
HORIZONTAL PROJECTION OF PV PANEL DEAD LOAD TIMES SUPPORT SPACING		3.5 psf x 1.33 x 2 / cos(α)	9.31	Uniform load of PV panel times support spacing and divided by the cosine of the roof angle (The PV panel load is assumed over full length of member.) (plf)	
TOTAL PROJECTED DEAD, PV PANEL & LIVE LOAD SUPPORTED BY MEMBER			61	Sum of dead, PV panel and live loads (plf)	
STRUCTURAL LOAD CAPACITY			N/A	Maximum load capacity of the wood roof rafters, joists or trusses calculated separately (plf)	

ALTERNATE – USE TABLES TO DETERMINE MAXIMUM SPAN	☒ Yes ☐ No	20.1 ft.	State whether tables are being used and provide the maximum span listed in tables. (ft.)
IS THE EXISTING WOOD STRUCTURE ADEQUATE TO SUPPORT THE ADDITIONAL LOAD DUE TO THE NEW PV PANEL SYSTEM?	☒ Yes ☐ No		If the structure is not adequate to support the additional load, then provide drawings and calculations to show how the structure is to be reinforced.