

USAGE GUIDE FOR STRUCTURAL REVIEW WORKSHEET

This Structural Review Worksheet can be used to evaluate the integrity of a roof's framing for a proposed solar PV system. To use this Worksheet in an official capacity, you will need permission from the municipal building department. The Worksheet identifies structural conditions in a home's roof framing that may raise concerns with the installation of solar PV, including increased dead load and wind uplift.

This worksheet only applies to installations that meet the following basic criteria, as well as the more detailed criteria below and elsewhere in the Worksheet:

- Installation on one or two family home built after 1900
- Installation on home with regular, stick-built framing (not home with trusses)
- Installation on home with asphalt shingle or standing metal seam roof
- Solar PV panels are flush mounted (i.e., installed parallel to the roof)

User Qualifications for the Structural Review Worksheet

Users of this worksheet should have demonstrable knowledge of typical residential roof framing systems. A number of certification programs may be acceptable evidence of qualifications, if approved by the local jurisdiction, for example:

- Registered Design Professional (Professional Engineer or Architect)
- Licensed Home Inspector
- Engineer-in-Training (EIT)
- North American Board of Certified Energy Practitioners (NABCEP) PV Installation Professional certification
- Other approved certifications that require training in structural inspection of residential framing systems.

Visibility Requirements

Worksheet users must be able to view the roof framing to evaluate its strength. Enough of the framing must be exposed to be able to determine at a minimum:

- Rafter size and spacing
- Ridge board versus ridge beam
- Configuration of rafter cross-ties (e.g. attic floor, collar ties), including size and spacing

- Existence of framing irregularities (e.g. skylights, dormers) in the vicinity of the proposed PV panels
- Type of roof sheathing (e.g. plywood, oriented strand board (OSB), straight board sheathing)

If the framing is concealed by finishes, such as in spaces with cathedral ceilings, a Registered Design Professional should investigate the framing and review the proposed installation. Openings may be required in the finishes to observe the framing and document the construction details listed above.

Anchorage to Structure

Use of this worksheet is contingent upon fastening the PV system directly to the rafters. If the installer wishes to attach to the sheathing between the rafters, a registered design professional should evaluate the proposed design and confirm the available sheathing capacity. If the sheathing alone is not adequate to resist downward gravity and wind uplift forces, the addition of blocking between the rafters at the attachment locations may be a possible solution.

Structural Information

(To be used as a standalone supplemental form or in conjunction with the Structural Evaluation portion of this Worksheet on the following pages, 3-4)

Please fill in the following Roof Description Information

ROOF DESCRIPTION:

Wind Exposure Category (B / C / D):¹ _____

Roofing Type (e.g. asphalt shingle, slate, clay tile, cedar shake, metal seam, single-ply membrane, built-up): _____

Age of roof: _____ Number of Layers: _____

Roof Type (e.g. gable, hipped, flat): _____

Framing Type (e.g. stick-built, trusses): _____

If trusses, list manufacturer, if known: _____

Rafter Material (wood, steel, etc.; if wood, specify rafter species²): _____

Rafter Size (e.g. 2x6): _____ Rafter Spacing (e.g. 16"): _____

Maximum unsupported rafter span: _____ Feet _____ Inches

Ceiling joist or rafter tie size and spacing (e.g. 2x6@16"): _____

Ceiling joist or rafter tie orientation (relative to rafters): parallel perpendicular

Height of ceiling joist or rafter tie measured vertically above top of rafter support walls (enter "0" if ceiling joists are located at the top of the support walls): _____

Height of roof ridge measured vertically above top of rafter support walls: _____

Ridge type (beam or board): _____

Framing Irregularities in vicinity of proposed panel installation (e.g. modifications, skylights, dormers that interrupt rafter spans): _____

Heavy equipment or unusual loads suspended from rafters in the vicinity of proposed panel installation: _____

Other information/Comments: _____

¹ http://publiccodes.cyberregs.com/icod/irc/2009/icod_irc_2009_3_par010.htm

² Obtain species from grade stamps on the rafters. If no grade stamps, assume Spruce-Pine-Fir #2.

Please perform the following Roof Load Calculations

ROOF LOAD CALCULATIONS:

a. Total weight of PV modules, rails, mountings, hardware and wiring _____ Lbs

b. Total number of attachments (mountings) _____ Mountings

c. Weight per attachment point (mounting) a÷b _____ Lbs/Attachment

d. Maximum spacing between adjacent attachment (mounting) points _____ Feet-Inches

e. Total surface area of PV modules (square feet) _____ Ft²

f. Distributed weight of PV modules a÷e _____ Lbs/ft²

Structural Evaluation

Please answer the questions in the Maximum Rafter Span Table Qualifier

MAXIMUM RAFTER SPAN TABLE QUALIFIER:

1. Was the house built after 1900? Yes No
2. Does the roof have only one layer of asphalt roofing shingles or standing metal seam? Yes No
3. Does the roof have a slope of 4:12 or greater? Yes No
4. Is roof framing stick-built wood framing? Yes No
5. Are rafters continuously tied with ceiling framing from one supporting wall to the other at the eave level, noting that the ceiling framing must match the rafter spacing and direction? Yes No
6. Is the framing in the vicinity of the solar array free of irregularities (see Roof Description for examples)? Yes No
7. Is the framing in the vicinity of the solar array free of heavy equipment or unusual loads? Yes No
8. Is the roof framing free of visible indications of distress (e.g. ridge sagging, walls out of plumb, significant ceiling cracks, split rafters)? Yes No
9. Is the roof framing free of signs or knowledge of previous damage (e.g. water incursion, fire damage, impact from an object, termite damage, etc.)? Yes No
10. Is the new PV system flush mounted, with a maximum angle of 5 degrees relative to the roof line and a maximum gap of 6" between the roof surface and the solar panels? Yes No
11. Is the maximum weight of PV modules less than or equal to 4 lbs/ft² (see "Roof Load Calculations" p. 2)? Yes No
12. Is the "weight per attachment point" less than 45 lbs (see "Roof Load Calculations" p. 2)? Yes No

If all answers are "Yes," proceed to Rafter Span Verification. If any answer is "No," enter "NA" for your answer to Question 13 on the next page and employ a Registered Design Professional to evaluate the roof structure.

Structural Evaluation

RAFTER SPAN VERIFICATION

Refer to the Rafter Span Table below to determine whether the "Maximum Unsupported Span" (provided in the "Roof Description" on page 2) is less than the maximum allowed rafter span. (Consider wood species, rafter size, and rafter spacing in your assessment)

MAXIMUM RAFTER SPANS

Ground snow load = 30 psf

Maximum Dead Load Including PV Panels = 14 psf

Ceiling not attached to rafters (deflection ≤ L/180)

		Rafter Size				
		2x4	2x6	2x8	2x10	2x12
Rafter Spacing	Species and Grade	Maximum Rafter Spans (ft-in)				
12"	Spruce-Pine-Fir #2	8'-4"	12'-4"	15'-8"	19'-1"	22'-2"
	Douglas Fir-Larch #2	8'-10"	12'-11"	16'-5"	20'-0"	23'-3"
	Hem-Fir #2	8'-10"	12'-11"	16'-5"	20'-0"	23'-3"
16"	Spruce-Pine-Fir #2	7'-4"	10'-8"	13'-7"	16'-7"	19'-2"
	Douglas Fir-Larch #2	7'-8"	11'-2"	14'-2"	17'-4"	20'-1"
	Hem-Fir #2	7'-8"	11'-2"	14'-2"	17'-4"	20'-1"
19.2"	Spruce-Pine-Fir #2	6'-8"	9'-9"	12'-4"	15'-1"	17'-6"
	Douglas Fir-Larch #2	7'-0"	10'-3"	12'-11"	15'-10"	18'-4"
	Hem-Fir #2	7'-0"	10'-3"	12'-11"	15'-10"	18'-4"
24"	Spruce-Pine-Fir #2	6'-0"	8'-9"	11'-1"	13'-6"	15'-8"
	Douglas Fir-Larch #2	6'-3"	9'-2"	11'-7"	14'-2"	16'-5"
	Hem-Fir #2	6'-3"	9'-2"	11'-7"	14'-2"	16'-5"

13. According to the Rafter Span Table, is the observed "Maximum Unsupported Span" less than the "Maximum Rafter Span" listed in the table? Yes No NA

STRUCTURAL REVIEW WORKSHEET CONCLUSION:

If your answer to Question 13 is "Yes," you do not need to employ a Registered Design Professional to evaluate the roof structure unless required to do so by the local jurisdiction.

Disclaimer:

This worksheet should not be used to replace a Jurisdiction's requirement that a registered design professional perform a structural analysis for a roof-mounted solar PV installation, unless a municipal building department specifically authorizes its use for that purpose.