CITY OF SOMERVILLE, MASSACHUSETTS
OFFICE OF STRATEGIC PLANNING & COMMUNITY DEVELOPMENT
JOSEPH A. CURTATONE
MAYOR

HISTORIC PRESERVATION COMMISSION

ALTERATION TO A HISTORIC PROPERTY STAFF REPORT

Site:	57 Meacham Road	Jacob and Charles Skinner - Johnson, Frank House
Case:	HPC 2016.073 R1	Campbell Park/Meacham Road Historic District

Applicant Name: SunBug Solar. for Ben Livermore, Owner
Applicant Address: 411A Highland Avenue, Somerville, MA

Date of Application: September 22, 2016
Legal Notice: *Install solar panels on slate roof.*

Staff Recommendation: *Conditional* Certificate of Appropriateness
Date of Public Hearing: January 17, 2016

Historic and Architectural Significance
See attached survey form.

Existing Conditions
The wood-framed vinyl-sided building is in fair condition. The Owner would like to install solar panels which would involve the removal of selected shingles from the slate roof on one side of the building. See structural engineers report and photos.

Proposed Work and Recommendations
The Applicant originally applied to remove half the slate roof and replace it with architectural shingles. Staff met with representatives of Sun Bug Solar to discuss the Somerville Historic District Ordinance pursuant to MGL Chapter 40C and M.G.L. Chapter 184 §23C. While the Commission cannot "*forbid or **unreasonably restrict** the installation or use of a solar energy system"*, the Commission can require that important historic fabric be preserved and recommend other locations for the placement of solar panels. Slate roofs with care, can last over 200 years and are more sustainable than asphalt roof shingles.

After the HPC Meeting in November, the Applicants found alternatives to the complete removal of the slate roof on the side of the building where the panels would be installed. (See attached for plans and mounting specs from Sun Bug Solar and structural engineers report. Page 18 of the attachment has not been altered from the previous application)

In an e-mail from SunBug "The page 18 question. To give you some background information that will explain the confusion. When Sunbug needs a structural engineering analysis we prepare a packet that we give to the engineer with all the pertinent information that they need. The engineer then attaches that to

the bottom of their report. You can see the delineations between the engineers report which is pages 1-13 and then Sunbug's attached report which is pages 14 on. Sunbug's original report was done with the intent on removing the slate which was denied. After we found the subcontractor who could install the flashings I called up the engineer Greg and said we need to re run the engineering numbers based on the slate remaining on the roof. This was a lot easier than preparing an entire new report to him. He has the engineering template saved in his files and can the numbers quickly by substituting a few numbers in his equations for the weight of the slate and does not need an entire new report from Sunbug. The engineers actual stamped report, which is the legally governing document that is reviewed for the building permit, is based upon the slate staying. Also our latest proposal was written stating that we only want to remove minimal slate. If you thought I was trying to sneak something by you, I sincerely apologize. That was not the intent.

"The customer will be able to store the removed slate in his basement."

1. *Proposal of Alteration:*
    1. Add a solar array to the roof:
        i. Remove approximately 52 selected slate shingles to allow for installation of solar array and wiring;
        ii. Install solar array;
        iii. Seal the new attachment points
        iv. Store removed slate safely in the basement of the house.

See the final pages for details and photos.

II. FINDINGS

1. *Prior Certificates Issued/Proposed:*

C/A	2002.030	Caroline Normand & David Zraket	1. Remove pipe handrail and portion of chain link fence; 2. Install a wooden handrail to match existing porch railing on both sides of front stairs.
C/NA	2002.052	Caroline Normand & David Zraket	Repair and replace rotted stairs and porch skirt in-kind with rails and newels previously reviewed by the Commission.
C/NA	2006.068	Carrie Normand & David Zraket	1. Replace 18 vinyl windows with 1/1 and 2/1 Marvin Ultimate Insert double-hung vinyl windows.

1. *Precedence:*
    - *Are there similar properties / proposals?*
        - Add solar panels on top of lower roof and southern side of upper roof.

This is the first proposal for the installation of solar panels on a slate roof. In the past few years, the Commission has reviewed several requests for solar panels on asphalt shingle roofs. These have generally received Certificates of Appropriateness or Non-Applicability depending upon placement and visibility of the panels under guideline for roofs - #5 (see below). 148 Morrison Avenue (2016) and 8 Westwood Road (2016) are not visible from the public rights of way.46 Mount Vernon Street (2015), 23 Pleasant Avenue (2013) 22 Summer Street (2013) and 170 Summer Street (2016) have panels set well back from the road. A Certificate of Hardship was issued for 302 Lowell Street since the panels were located on the front of the house (2016).

2. *Considerations:*

    - *What is the visibility of the proposal?*

The portions of the roof where the array will be placed are visible from Meacham Road.

    - *What are the Existing Conditions of the building / parcel?*

The slate roof is in good condition.

- *Is the proposal more appropriate than the existing conditions?*

It is not appropriate to remove any of the original slate roof which can last hundreds of years and is a major historical architectural characteristic of buildings of this style and era. Removal of portions of the slate roof on one side of the building could seriously impact the historic value and character of the building unless the slates are conserved for re-installation at a later date.

- *Is the proposal more in-keeping with the age, purpose, style and construction of the building?*

This is not an alteration that would bring the building closer to its original style and intent. The proposed alteration will still involve the removal of historic fabric but will have less of an impact on the original fabric than the original proposal. The removed slate will be stored on site in the basement for later re-use.

- *Does the proposal coincide with the General Approach set forth in the Design Guidelines?*

GENERAL APPROACH

The primary purpose of Somerville's Preservation Ordinance is to encourage preservation and high design standards in Somerville's Historic Districts, in order to safeguard the City's architectural heritage. The following guidelines ensure that rehabilitation efforts, alterations, and new construction all respect the design fabric of the districts and do not adversely effect their present architectural integrity.

A. *The design approach to each property should begin with the premise that the features of historic and architectural significance described in the Study Committee report must be preserved. In general, this tends to minimize the exterior alterations that will be allowed.*

C. *Whenever possible, deteriorated material or architectural features should be repaired rather than replaced or removed.*

D. *When replacement of architectural features is necessary, it should be based on physical or documentary evidence of the original or later important features.*

E. *Whenever possible, new materials should match the material being replaced with respect to their physical properties, design, color, texture and other visual qualities. The use of imitation replacement materials is discouraged.*

F. *The Commission will give design review priority to those portions of the property which are visible from public ways or those portions which it can be reasonably inferred may be visible in the future.*

The roof is visible from the public right of way. The roof was not discussed in the Form B. Some historic material will be replaced or altered. The removed slates shall be retained.

Roofs

1. ***Preserve the integrity of the original or later important roof shape.***
2. ***Retain the original roof covering whenever possible**. **If the property has a slate roof, conserve the roof slates. Slate is a near-permanent roofing material, and deterioration is generally caused by rusted roofing nails.***
7. ***Utility equipment**, such as television antennae, air conditioners, solar collectors and other mechanical units **should be restricted to the rear of the property or on portions of the roof that are not visible from a public way**.*

The roof shape will not be altered. However, approximately 52 shingles would be removed for the solar installation. No other existing character-defining features will be altered. The array will consist of sixteen panels located on both sides of the dormer on the south side of the building. The proposed new roof on half the building would be GAF Timberline® with a white aluminum drip edge. The slate would be disposed of. This is definitely not in-keeping with the preservation of this important architectural characteristic of the district.

Based upon the Secretary of the Interior's Standards, the National Park Service Brief 3 Improving Energy Efficiency in Historic Buildings states:

"Active solar devices, such as solar heat collectors and photovoltaic systems, can be added to historic buildings to decrease reliance on grid-source fossil-fuel powered electricity. Incorporating active solar devices in existing buildings is becoming more common as solar collector technology advances. Adding this technology to historic buildings, however, **must be done in a manner that has a minimal impact on historic roofing materials and preserves their characte**r by placing them in locations with limited or no visibility, i.e., on flat roofs at a low angle or on a secondary roof slope." (Emphasis added.)

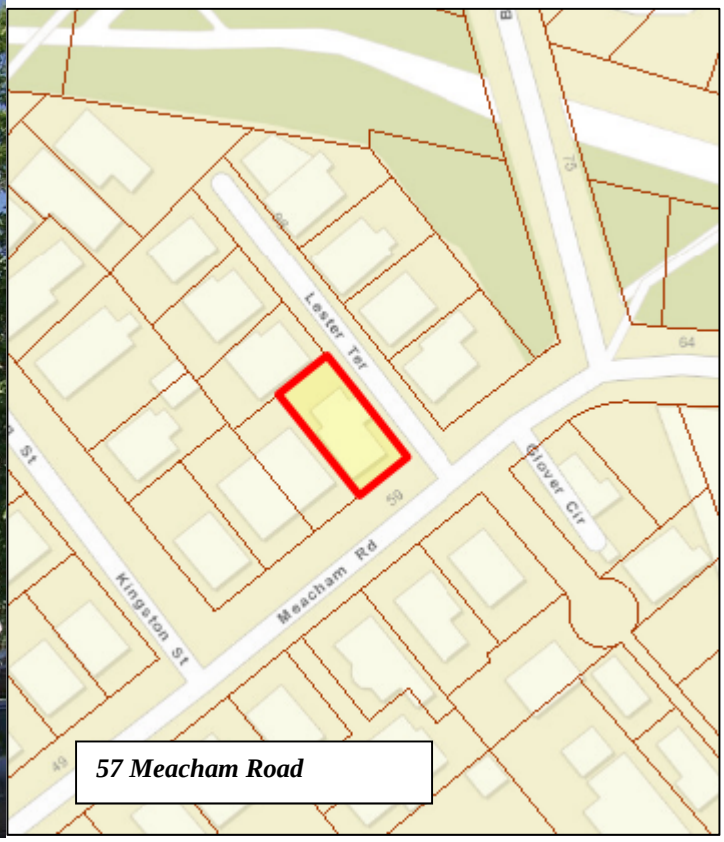
III. RECOMMENDATIONS

The Staff recommendation is based on a complete application and supporting materials, as submitted by the Applicant, and an analysis of the historic and architectural value and significance of the site, building or structure, the general design, arrangement, texture, material and color of the features involved, and the relation of such features of buildings and structures in the area, in accordance with the required findings that are considered by the Somerville Historic District Ordinance for a Historic District Certificate. This report may be revised or updated with new a recommendation or findings based upon additional information provided to Staff or through more in depth research conducted during the public hearing process.

Staff determines that the alteration for which an application for a Historic Certificate has been filed **is appropriate for and compatible** with the preservation and protection of the Campbell Park/Meacham Road Historic District; and **would not cause substantial detriment or derogation** to the District if the work is done with the following conditions, therefore **Staff recommends that the Historic Preservation Commission grant** a **Certificate of Appropriateness** for the installation of a solar array on 57 Meacham Road.

1. All appropriate building permits shall be obtained prior to the start of any work.
2. If changes are necessary to the proposed design for which this Certificate of Appropriateness was issued, new plans shall be submitted to Historic Staff prior to commencing the work.
3. A solar array of sixteen panels may be added to the roof with the following:
    a. A limited selection of 52 slates may be removed to allow for installation of solar array and wiring;
    b. The slates shall be stored in a documented secure location in the basement of 57 Meacham Road for re-installation when the solar array is removed.
    c. Install waterproofing as per plans.
4. Historic Staff shall issue a sign-off upon completion of the project that it was executed in accordance with this Certificate and approved plans.

Date: November 15, 2016
Case #: HPC 2016.084 R1
Site: 57 Meacham Road



Massachusetts Cultural Resource Information System

Scanned Record Cover Page

Inventory No:	SMV.193
Historic Name:	Glover, Henry R. House
Common Name:	Skinner, Jacob and Charles - Johnson, Frank House
Address:	57 Meacham Rd
City/Town:	Somerville
Village/Neighborhood:	Davis Square
Local No:	
Year Constructed:	1892
Architect(s):	
Architectural Style(s):	Colonial Revival
Use(s):	Multiple Family Dwelling House
Significance:	Architecture
Area(s):	SMV.N: Campbell Park - Meacham Road Historic District
Designation(s):	Local Historic District (10/31/1989)
Building Materials(s):	Wall: Vinyl Siding; Wood Foundation: Brick

The Massachusetts Historical Commission (MHC) has converted this paper record to digital format as part of ongoing projects to scan records of the Inventory of Historic Assets of the Commonwealth and National Register of Historic Places nominations for Massachusetts. Efforts are ongoing and not all inventory or National Register records related to this resource may be available in digital format at this time.

The MACRIS database and scanned files are highly dynamic; new information is added daily and both database records and related scanned files may be updated as new information is incorporated into MHC files. Users should note that there may be a considerable lag time between the receipt of new or updated records by MHC and the appearance of related information in MACRIS. Users should also note that not all source materials for the MACRIS database are made available as scanned images. Users may consult the records, files and maps available in MHC's public research area at its offices at the State Archives Building, 220 Morrissey Boulevard, Boston, open M-F, 9-5.

Users of this digital material acknowledge that they have read and understood the MACRIS Information and Disclaimer (http://mhc-macris.net/macrisdisclaimer.htm)

Commonwealth of Massachusetts
Massachusetts Historical Commission
220 Morrissey Boulevard, Boston, Massachusetts 02125
www.sec.state.ma.us/mhc

LHD - 10/31/89 (TC)
PI - DAVIS SQ
USGS BOST, N
SEC T A

FORM B - BUILDING

MASSACHUSETTS HISTORICAL COMMISSION
80 BOYLSTON STREET
BOSTON, MA 02116

AREA: N | FORM NO.: 193

Davis Square

SOMERVILLE

S 57 Meacham Road

ic Name Henry R. Glover

(developer)

Present residential

Original residential

TION

1892

deeds / directories

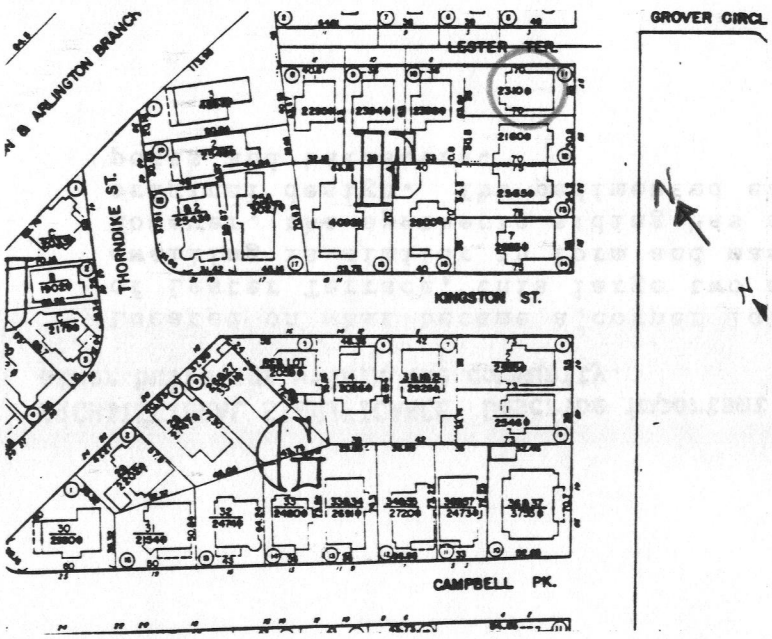
Italianate / vernacular

Architect

Exterior Wall Fabric synthetic siding

Outbuildings

Sketch Map: Draw map showing property's location in relation to nearest cross streets and/or geographical features. Indicate all buildings between inventoried property and nearest intersection(s).
Indicate north



Major Alterations (with dates)

mid-20th century synthetic siding

Condition fair

Moved Date

Acreage 2310 sq. ft.

Setting West side of well established residential street of late 19th century dwellings of varying architectural elaboration.

UTM REFERENCE

USGS QUADRANGLE

SCALE

Recorded by Gretchen G. Schuler

Organization Somerville Historic Preservation Commission

Date March, 1988

SMV.193

NATIONAL REGISTER CRITERIA STATEMENT (if applicable)

ARCHITECTURAL SIGNIFICANCE Describe important architectural features and evaluate in terms of other buildings within the community.

Located on what became a corner lot with the turn of the century laying out of Lester Terrace, this large two and one-half story, templar gable-end dwelling is similar in form and massing to other houses on Meacham Road. However, the synthetic siding has altered the overall effect of the original design. The pedimented entrance porch retains wood unadorned posts and balusters.

HISTORICAL SIGNIFICANCE Explain the role owners played in local or state history and how the building relates to the development of the community.

The property is one of many houses in the immediate area that was built in the 1890s when the subdivision was created. Although the subdivision was laid out in 1847 by George Meacham there was no development until the 1890s. Much of the land on Meacham Road was owned by Henry Glover and Charles H. Saunders of Cambridge in the 1870s and 1880s. Glover, a real estate investor from Cambridge built many of the houses, sold some, and retained others for rental income.

Much of the Davis Square area became home for railroad and streetcar commuters and is evidence of the suburban building boom of the late 19th century. Streetcar service along nearby Massachusetts Avenue to Porter Square and to Davis Square provided easy access to Boston and Cambridge for employment. This area was also home for many Somerville workers. By the 1870s Davis Square was evolving into a commercial center with several commercial blocks and good transportation with the Somverville Horse Railroad Company and the Boston and Maine Railroad.

City directories indicate that those who lived here, Jacob and Charles Skinner and Frank Johnson were salesmen. No other information is available about the nature of their business.

BIBLIOGRAPHY and/or REFERENCES

1. Atlas of Middlesex County, Somerville: 1895 ("Henry R. Glover").
2. City Directories, 1890s
3. Registry of Deeds, Middlesex County: Book , Page .

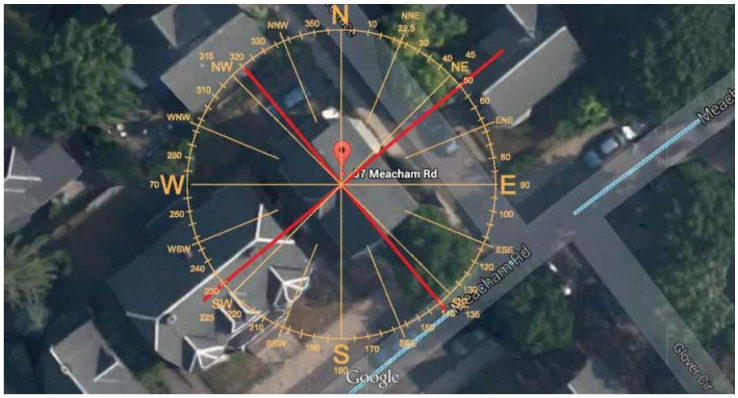
12/12/16

Sarah White
City of Somerville
93 Highland Avenue
Somerville, MA 02143

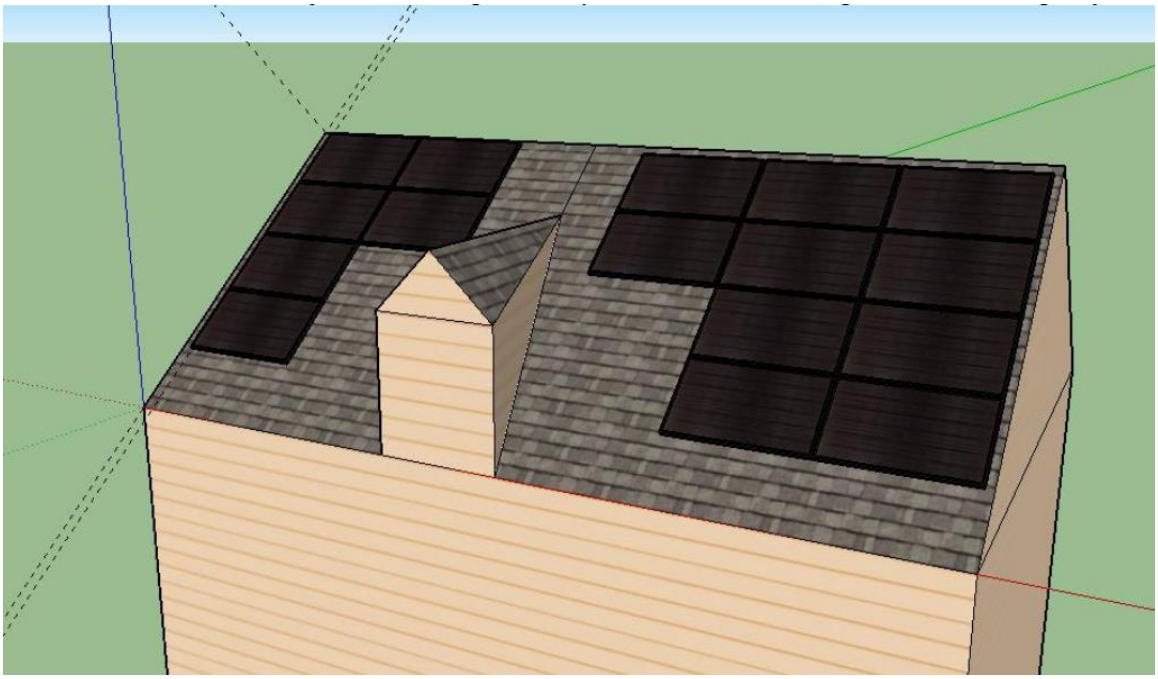
Dear Sarah,

Sunbug would like to reapply to be on the next historical meeting for 57 Meacham Road.

-Sunbug and the homeowner, Ben Livermore, are in talks with a subcontractor who has stated that they can remove the existing slates in only those areas needed to mount railing attachments. This will result in the removal of approximately 52 slates on the south west roof. The likely subcontractor, Roofing and Restoration Group, will build a scaffolding shell which will allow Sunbug to perform the installation without the need to disturb or damage non-essential slates.



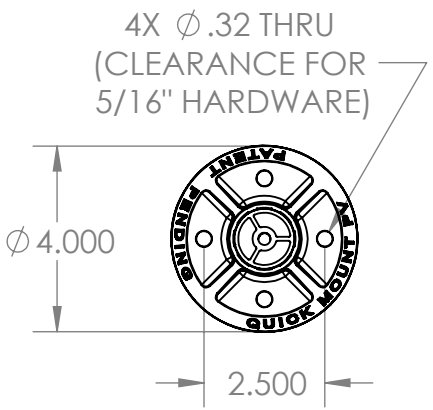
-Sunbug will install a solar array consisting of 16 panels resembling the following layout.

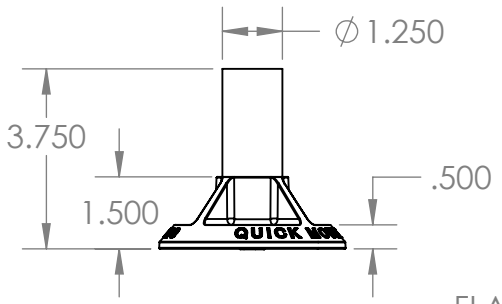


Sunbug has a signed structural affidavit from a license PE stating that the roof can support the weight of the slate and panels. The scaffolding structural to be built by the subcontractor will suffice for OSHA fall protection requirements.

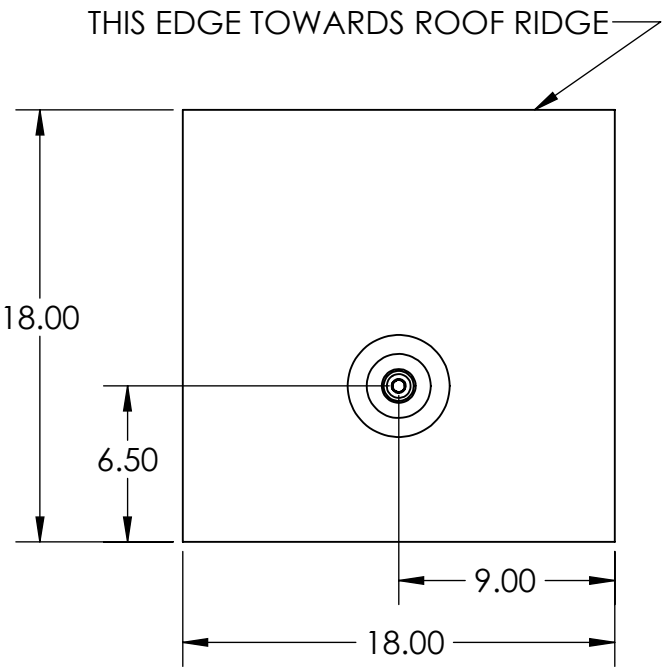
The appropriate spec sheets and structural reports can be seen in the following pages.

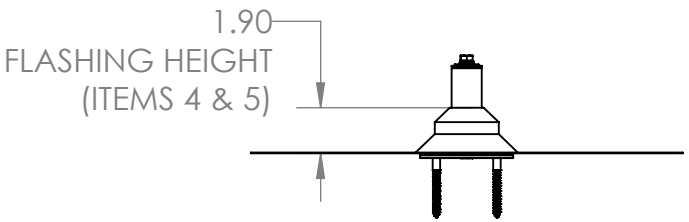
Regards,
Chris Miller
617 500 7015

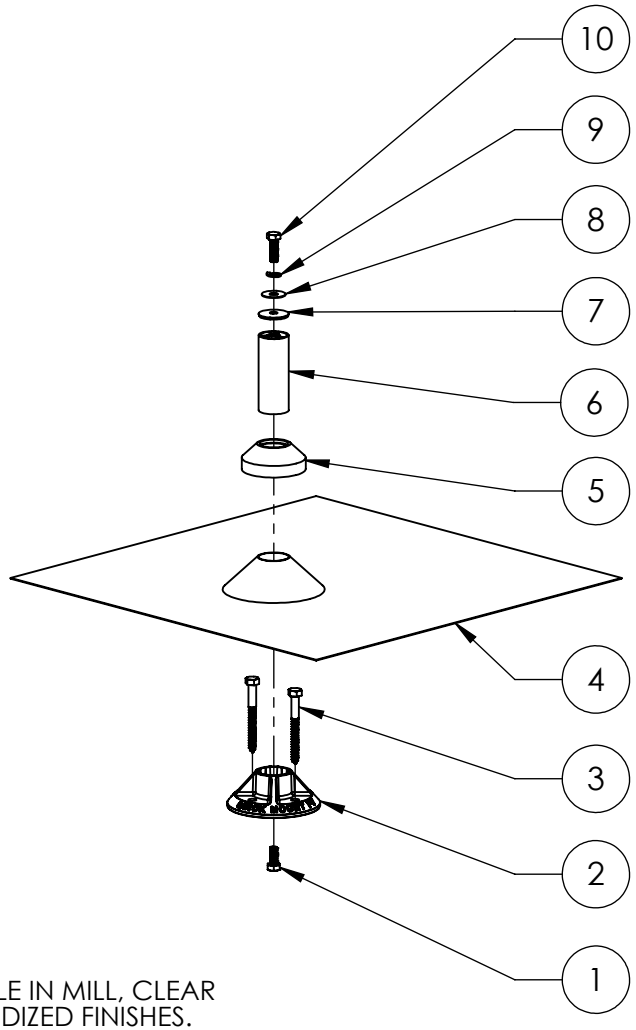




QBASE (ITEM 2) AND
POST (ITEM 6)







ITEM NO.	DESCRIPTION	QTY.
1	CAP SCREW, HEX HEAD, 5/16"-18 X 3/4" UNC-2A, GRADE 8	1
2	QBASE, 1-1/4" ID, FOR 5/16" HARDWARE, A360.1 CAST AL	1
3	LAG SCREW, HEX HEAD, 5/16" X 3", ZINC	2
4	FLASHING, SPUN CONE, 18"X18"X.032", 3003 AL, MILL	1
5	COLLAR, COUNTER FLASHING, 1-1/4" ID EPDM	1
6	POST, 1-1/4" OD X 3-1/4", 6063-T5, MILL	1
7	WASHER, SEALING, 5/16" ID X 1-1/4" OD, EPDM BONDED SS	1
8	WASHER, FENDER, 5/16" ID X 1" OD, 18-8 SS	1
9	WASHER, SPLIT-LOCK, 5/16" ID, 18-8 SS	1
10	CAP SCREW, HEX HEAD, 5/16"-18 X 1" UNC-2A, 18-8 SS	1

POST AND FLASHING AVAILABLE IN MILL, CLEAR ANODIZED, AND BRONZE ANODIZED FINISHES.

STAINLESS STEEL LAG SCREWS INCLUDED WITH ANODIZED FINISHES.

Quick Mount PV

TITLE:

QMNS: QBASE SHAKE AND SLATE MOUNT

UNLESS OTHERWISE SPECIFIED:	SIZE	DRAWN BY: RAD	REV
DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± 1/8 TWO PLACE DECIMAL ±.18 THREE PLACE DECIMAL ±.125	A	DATE: 1/15/2013	6
	SCALE: 1:8	WEIGHT: 1.93	SHEET 1 OF 1

DO NOT SCALE DRAWING

5 4 3 2 1

RILEY P.ENG. SERVICES

STRUCTURAL ENGINEERING CONSULTANT

785 TUCKER ROAD SUITE "G" PMB 552 TEHACHAPI CA 93561

#204 279 MIDPARK WAY SE CALGARY ALBERTA CANADA T2X1M2

TELE: 805.630.6619 E-MAIL: grileype@aol.com

WWW.STRUCTURALCONSULTING.COM

December 12, 2016

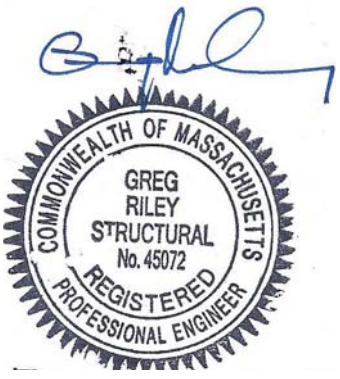
Job No.: 16-394.Livermore

Sun Bug Solar
411A Highland Avenue Suite 312
Somerville, Massachusetts 02144
Attention: Ms. Andrea Mitter-Burke
Director of Operations

Re: Existing Residential Building Roof Structural Certification
New Roof Mounted Solar Panels
57 Meacham Road
Somerville, Massachusetts 02144

At your request, the below-signed licensed professional engineer performed a structural engineering analysis of the existing roof structure at the referenced address. The purpose of this analysis was to determine if the existing roof structure is adequate to support the proposed roof mounted solar panels. This analysis is attached to this letter and it includes the slate tile roof and solar panel dead loads and the code prescribed live, balanced and unbalanced snow, and wind loads. Per this analysis, it is the professional opinion of the below-signed that the existing roof rafters are adequate to support the new solar panels.

Sincerely,



Greg Riley, MCE, S.E., P.Eng.
Massachusetts S.E. 45072
Expires 06.30.18

Verification of Existing Roof Rafters for New Solar Panels

Code: Massachusetts State Building Code 8th Edition with CMR 780

ASCE 7-10

Project Address: 57 Meacham Road, Somerville, MA 02144

Existing Condition (see attached from Sun Bug Solar):

40 degree pitch (10:12) 2" x 7" rough sawn roof rafters @ 22" o.c.

Effective horizontal span: 11'-6"

Residential Building ASCE 7-10 Risk Category II

(Sunbug and town building inspector to verify prior to construction)

Roof Dead Load

Roofing Framing and Slate Materials	*22 psf*
LG Solar Panels	*3 psf*
Total Roof Dead Load:	*25 psf*
Roof live load 10: 12 pitch (ASCE 7-10 Section 4.9.1)	*14 psf*

Roof live load, $L_r = (L_o)(R_1)(R_2)$

$R_1 = 1$ $R_2 = 1.2 – 0.05(F)$ where F = 10 (10:12 pitch)

$R_2 = 0.7 < 1$ (code maximum)

10:12 roof live load, $L_r = (20\ psf)(1.0)(0.7) = 14\ psf$

Roof Snow Loads per ASCE 7-10 Section 7.4

Ground Snow Load = 40 psf Somerville, MA per MA State Building Code

Do not consider as "Slippery and Unobstructed" at solar panels

"Normal" insulated attic → Use $C_t = 1.0$

$P_S = (C_S)(P_f)$ $P_f = (0.7)(C_e)(C_t)(I)(P_g) = (0.7)(1.0)(1.0)(1.0)(40\ psf) = 28\ psf$

$P_{S\ 40\ degree\ pitch} = (C_S)(P_f) = (0.75)(28\ psf) = 21\ psf$

ASCE 7-10 Section 7.3.4: Minimum snow loads do not apply (pitch > 15 degrees)

But check $P_{minimum} = (20)(I_{snow}) = (20)(1.0) = 20\ psf < 21\ psf$

Verification of Existing Roof Rafters for New Solar Panels (Continued)

Project Address: 57 Meacham Road, Somerville, MA 02144

ASCE 7-10 Section 7.6.1, unbalanced snow loads need not be considered for roof pitch greater than 30 degrees.

Use $P_{balanced\ roof\ snow}$ = 21 psf as roof snow load at 40 degree roof

Per Enercalc analysis, existing 2x7 roof rafters are ok

Wind Loads per ASCE 7-10 Chapter 30 and MA State Code 780 CMR 8th Edition

Components and Cladding

Basic Wind Speed at 3 second = 125 mph (ASCE 7-10 Figure 26.5-1)

Exposure "C" (per Google Earth) at 22 foot mean roof height

Per Enercalc ASCE 7-10 Wind Forces Chapter 30 Components and Cladding

ASCE 7-10 Figure 30.7-2 Roof Zone 1

40 Degree Roof: $P_{wind\ uplift}$ = -37 psf $P_{wind\ downward}$ = 34 psf

<u>ASCE 7-10 Load Combinations per Section 2.4.1 (Allowable Stress Design)</u>

1. D

2. D + L

3. D + (L_R or S)

4. D + 0.75L + 0.75(L_R or S)

5. D + 0.6W

6a. D + 0.75(0.6W) + 0.75L + 0.75(L_R or S)

7. 0.6D + 0.6W

<u>Deflection per 2012 I.B.C. Table 1604.3 (Roof Not Supporting Ceiling)</u>

Live and snow = L/180 D + S = L/120

Note: Per CMR 780 Section 303.3, "Existing structural elements carrying gravity loads", structural members are considered to be "ok" if increase does not exceed 5% of total load onto member.

Governing load case: ASCE 7-10 #3. D + S

Verification of Existing Roof Rafters for New Solar Panels (Continued)

Project Address: 57 Meacham Road, Somerville, MA 02144

Check dead plus snow for 10:12 pitch roof

Existing: 12 psf + 21 psf = 23 psf

Increase: (26 psf)/(23 psf) = 1.13 > 1.05 (5%) Roof rafters must be checked

Check Wind Uplift on Solar Panel

Area of Panel: 5.5 ft x 3.25 ft = 18 sq. ft. (Use 20 sq ft)

Maximum uplift = (20 sq ft)(37 psf) = 740#

Uplift per anchor = 740#/4 anchors = 185#/anchor

Per 2005 NDS specification Table 11.2A, ¼" diameter lag screw with 2" thread penetration in withdrawl = (225#/inch)(2") = 450# > 185# ok.

→ Use ¼" diameter (or equal per solar panel manufacturer) ***lag screw with a minimum 2" embed*** *into existing 2" x 7" rafters (or "Snap-N-Rack" system). Sunbug and town building inspector to verify extent, span, and condition of the existing 2" x 7" wood roof rafters supporting solar panels. Should the verified actual conditions differ from that analyzed in these calculations, the engineer must be contacted immediately before proceeding with construction.*

Check C and C Wind Uplift at Rafters

Per 2012 IBC Table 2304.9.1 "Fastening Schedule" Items 15 and 19

Ceiling Joists and Rafter to Top Plate: (3) 8d x 2 ½" x 0.131" dia

By roof sheathing rafters act as a group

Toe nail connection per 2005 NDS: W' = (W)(C_d)(C_{tn}) per NDS Table 10.3.1

"G" for SPF = 0.42 per NDS Table 11.3.2A

C_d = 1.6 (wind) C_{tn} = 0.67 (toenail) W = 21#/inch NDS Table 11.2C

8d nail embed length per NDS Table 11.1.5.4: (2/3)(2.5") = 1.7"

W' = (6 - 8d nails)(1.7")(21#/inch)(1.6)(0.67) = 230# at each rafter to wall

(3) 16d connection at CJ to rafter per IBC Table 2304.9.1 Item 18

Verification of Existing Roof Rafters for New Solar Panels (Continued)

Project Address: 57 Meacham Road, Somerville, MA 02144

Per NDS Table 11N: (3) 16d = (3 nails)(120#/nail)(1.6) = 576# > 230# ok

Panel uplift at end of each rafter per ASCE 7-10 Load Case #7: 7. 0.6D + 0.6W

Consider 22" wide section of roof for uplift (rafter spacing)

Use uplift for ASCE 7-10 Fig 30.7-2 Roof Zone 1

Consider only roof, do not use ceiling framing dead weight to resist uplift

(0.6)(37 psf – 15 psf)(1.83 ft)(13 ft) = 314#

314# < (2 rafter ends)(230#) = 460# ok against uplift

ASCE Live and Roof Live Load Reduction

Live Load Reduction Per ASCE 7-10, Section 4.7 & 4.8

Description	Load Type	Lo	A_T : Trib Area	K_{LL}	Roof Pitch	R1	R2	Reduced L -or- Lr
40 Degree Roof Pitch	Roof Live	20.0 psf	20.0 sq ft		10:12	1.0	0.70	14.0 psf

ASCE Snow Loads

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Description : GR Job 16-394 Sunbug Livermore, 57 Meacham Rd, Sommerville, MA Pg = 40 psf

Flat Roof Snow Loads

Description : Residential Roof **per ASCE 7-10**

Ground Snow Load, per Fig 7-1	40.00 psf	Roof Slope, Sec .7.3.4	40.00
Terrain Category	C (see ASCE 7-10 Section 26.7)	W : Horiz. Distance from eave to ridge	13.00 ft
Exposure of Roof	Partially Exposed	Roof Configuration	Hip and gable
Ce : Exposure Factor, Table 7-2	1.00		
Ct : Thermal Factor	1.0 : All not otherwise defined	pm, Minimum required	**0.00** psf
Risk Category, per Table 1.5-1	II	pf, Calculated Snow Load per Equation 7-1	**28.00** psf
Importance Factor, Is, Table 1.5-2	1.00	pf, Design Snow Load Max(pm min, pf calc)	**28.00** psf

Sloped Roof Snow Loads

Description : 40 Degree Pitch Main Roof **per ASCE 7-10**

pf : Snow Load	28.00 psf	Unobstructed & Slippery ?	No
Thermal Factor	1.00	Cs	0.75
Slope	40.00	ps, Calculated Sloped Roof Snow Load	21.00 psf

ASCE 7-10 Wind Forces Chpt 28, Pt2 & Chpt 30, Pt2

Description : GR Job 16-394 Livermore, 57 Meacham Rd, Sommerville, MA 02144 V = 125 mph

Analytical Values

Calculations per ASCE 7-10

V : Basic Wind Speed per Sect 26.5-1 A, B or C	**125.0** mph	
Roof Slope Angle	30 to 45 degrees	
Occupancy per Table 1.5-1	II	All Buildings and other structures except those listed as Category I, III, and IV
Exposure Category per 26.7	Exposure C	
MRH : Mean Roof Height	22.0 ft	*"Lambda" is interpolated between height tablular values.*
Lambda : per Figure 28.6-1, Page 305	**1.31**	
Effective Wind Area of Component & Cladding	10.0 ft^2	
Roof pitch for cladding pressure	>27 to 45 degrees	
User specified minimum design pressure	10.0 psf	
Topographic Factor Kzt per 26.8	**1.00**	
LHD : Least Horizontal Dimension	**24.0** ft	
a = max (0.04 * LHD, 3, min(0.10 * LHD, 0.4*MRH))	**3.00** ft	max (0.04 * LHD, 3, min(0.10 * LHD, 0.4*MRH))

Design Wind Pressures

Minimum Additional Load Case per 28.4.4 = 16 PSF on entire vertical plane

Horizontal Pressures . . .

Load Case # 1 . . .

Zone: A =	36.66 psf	Zone: C =	29.17 psf
Zone: B =	25.10 psf	Zone: D =	20.04 psf

Load Case # 2 . . .

Zone: A =	36.66 psf	Zone: C =	29.17 psf
Zone: B =	25.10 psf	Zone: D =	20.04 psf

Vertical Pressures . . .

Load Case # 1 . . .

Zone: E =	10.00 psf	Zone: G =	10.00 psf
Zone: F =	-22.27 psf	Zone: H =	-19.12 psf

Load Case # 2 . . .

Zone: E =	14.13 psf	Zone: G =	12.22 psf
Zone: F =	-10.97 psf	Zone: H =	-10.00 psf

Overhangs . . .

Load Case # 1 . . .

Zone: Eoh =	-12.88 psf	Zone: Goh =	-14.72 psf

Load Case # 2 . . .

Zone: Eoh =	-12.88 psf	Zone: Goh =	-14.72 psf

ASCE 7-10 Wind Forces Chpt 28, Pt2 & Chpt 30, Pt2

Description : GR Job 16-394 Livermore, 57 Meacham Rd, Sommerville, MA 02144 V = 125 mph

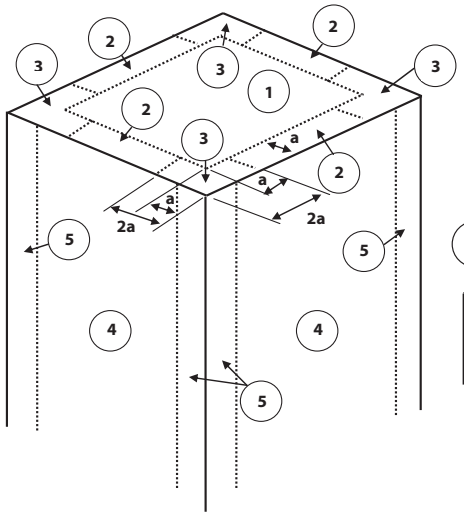
Component & Cladding Design Wind Pressures

*Design Wind Pressure = Lambda * Kzt * Ps30 per Eq 30.5-1*

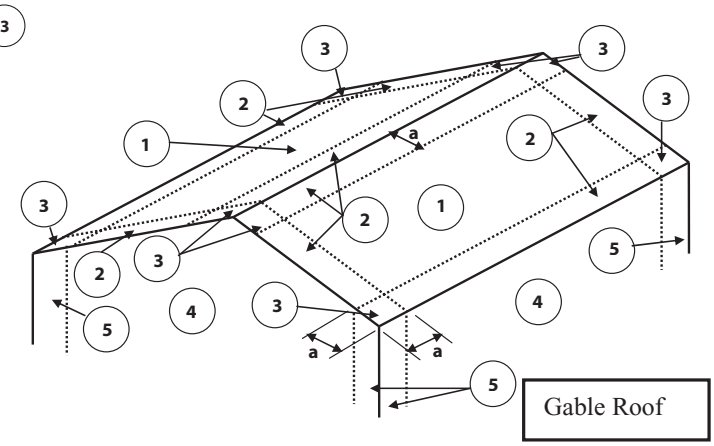
Roof Zone 1 :	Positive :	33.836 psf
	Negative :	-36.989 psf
Roof Zone 2 :	Positive :	33.836 psf
	Negative :	-43.296 psf
Roof Zone 3 :	Positive :	33.836 psf
	Negative :	-43.296 psf
Wall Zone 4 :	Positive :	36.989 psf
	Negative :	-40.143 psf
Wall Zone 5 :	Positive :	36.989 psf
	Negative :	-49.538 psf
Roof Overhang Zone 2:		-67.671 psf
Roof Overhang Zone 3:		-67.671 psf

Minimum Additional Load Case per 28.4.4 = 16 PSF
on entire vertical plane

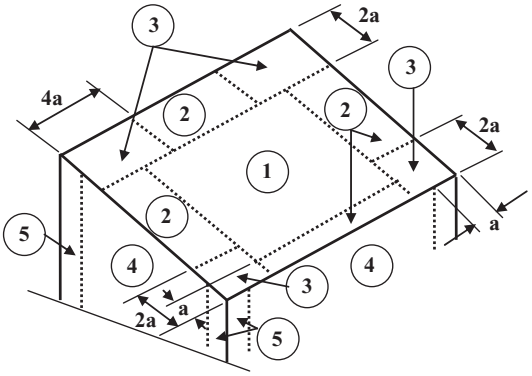
Components and Cladding – Part 4		h ≤ 160 ft.
Table 30.7-2	C & C Zones	C&C Wall and Roof Pressures
Enclosed Buildings		



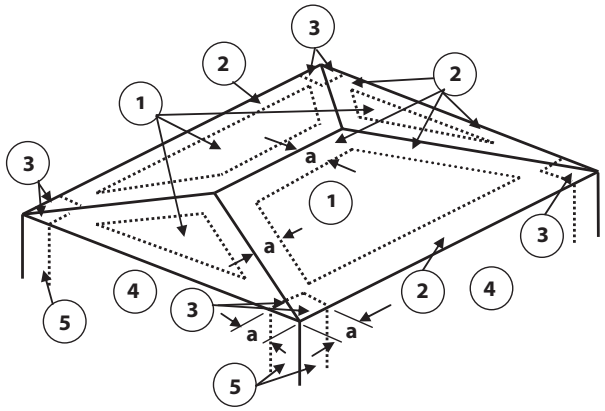
Flat Roof
θ < 10 deg



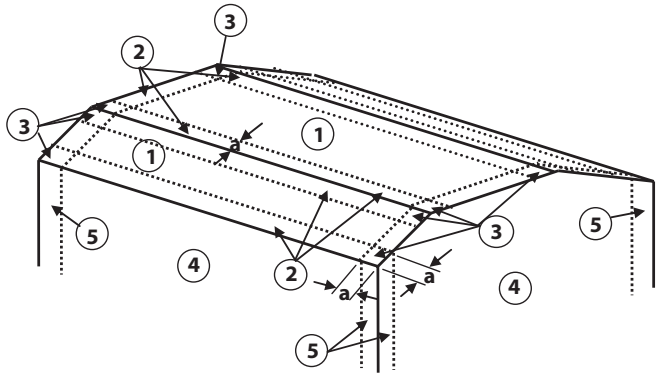
Gable Roof



Monoslope Roof



Hip Roof



Mansard Roof

51.00: continued

TABLE R301.2(4) MASSACHUSETTS BASIC WIND SPEEDS

<90 MPH	90 MPH		100 MPH		110 MPH
Adams	Acton	New Braintree	Abington	Middleton	Acushnet
Alford	Agawam	New Marlborough	Amesbury	Milford	Aquinnah
Ashfield	Amherst	New Salem	Andover	Millis	Barnstable
Becket	Ashburnham	North Brookfield	Arlington	Millville	Bourne
Bernardston	Ashby	Northampton	Ashland	Milton	Brewster
Buckland	Athol	Northborough	Attleboro	Nahant	Carver
Cheshire	Auburn	Northfield	Avon	Natick	Chatham
Clarksburg	Ayer	Oakham	Bedford	Needham	Chillmark
Colrain	Barre	Orange	Bellingham	Newbury	Dartmouth
Cummington	Belchertown	Otis	Belmont	Newburyport	Dennis
Dalton	Berlin	Palmer	Berkley	Newton	Duxbury
Egremont	Blandford	Paxton	Beverly	Norfolk	Eastham
Florida	Bolton	Pelham	Billerica	North Andover	Edgartown
Great Barrington	Boxborough	Pepperell	Blackstone	North Attleborough	Fairhaven
Greenfield	Boylston	Petersham	Boston	North Reading	Fall River
Hancock	Brimfield	Phillipston	Boxford	Northbridge	Falmouth
Hawley	Brookfield	Princeton	Braintree	Norton	Freetown
Heath	Carlisle	Rolyalston	Bridgewater	Norwell	Gay Head
Hinsdale	Charlton	Russell	Brockton	Norwood	Gosnold
Lanesborough	Chelmsford	Rutland	Brookline	Oxford	Halifax
Lee	Chester	Sandisfield	Burlington	Peabody	Harwich
Lenox	Chesterfield	Shirley	Cambridge	Plainville	Kingston
Leyden	Chicopee	Shrewsbury	Canton	Quincy	Lakeville
Middlefield	Clinton	Shutesbury	Chelsea	Randolph	Marion
Monroe	Conway	South Hadley	Cohasset	Raynham	Marshfield
Monterey	Deerfield	Southampton	Concord	Reading	Mashpee
Mount Washington	Dracut	Southbridge	Danvers	Rehoboth	Mattapoisett
New Ashford	Dunstable	Southwick	Dedham	Revere	Middleborough
North Adams	East Brookfield	Spencer	Dighton	Rockland	Nantucket
Peru	East Longmeadow	Springfield	Douglas	Rockport	New Bedford
Pittsfield	Easthampton	Sterling	Dover	Rowley	Oak Bluffs
Plainfield	Erving	Stow	Dudley	Salem	Orleans
Richmond	Fitchburg	Sturbridge	East Bridgewater	Salisbury	Pembroke
Rowe	Gardner	Sunderland	Easton	Saugus	Plymouth
Savoy	Gill	Templeton	Essex	Seekonk	Plympton
Sheffield	Goshen	Tolland	Everett	Sharon	Provincetown
Shelburne	Granby	Townsend	Foxborough	Sherborn	Rochester
Stockbridge	Granville	Tyngsborough	Framingham	Somerville	Sandwich
Tyringham	Groton	Wales	Franklin	Southborough	Scituate
Washington	Hadley	Ware	Georgetown	Stoneham	Somerset
West Stockbridge	Hampden	Warren	Gloucester	Stoughton	Swansea
Williamstown	Hardwick	Warwick	Grafton	Sudbury	Tisbury
Windsor	Harfield	Wendell	Groveland	Sutton	Truro
Worthington	Harvard	West Boylston	Hamilton	Swampscott	Wareham
	Holden	West Brookfield	Hanover	Taunton	Welfleet
	Holland	West Springfield	Hanson	Tewksbury	West Tisbury
	Holyoke	Westfield	Haverhill	Topsfield	Westport
	Hubbardston	Westford	Hingham	Upton	Yarmouth
	Hudson	Westhampton	Holbrook	Uxbridge	
	Huntington	Westminster	Holliston	Wakefield	
	Lancaster	Whately	mm	Walpole	
	Lawrence	Wilbraham	Hopkington	Waltham	
	Leicester	Williamsburg	Hull	Watertown	
	Leominster	Winchendon	Ipswich	Wayland	
	Leverett	Worcester	Lexington	Webster	
	Littleton		Lincoln	Wellesley	
	Longmeadow		Lynn	Wenham	
	Lowell		Lynnfield	West Bridgewater	
	Ludlow		Malden	West Newbury	
	Lunenburg		Manchester	Westborough	
	Maynard		Mansfield	Weston	
	Methuen		Marblehead	Westwood	
	Millbury		Marlborough	Weymouth	
	Monson		Medfield	Whitman	
	Montague		Medford	Willmington	
	Montgomery		Medway	Winchester	
			Melrose	Winthrop	
			Mendon	Woburn	
			Merrimac	Wrentham	

51.00: continued

FIGURE R301.2(5) Delete this Figure and replace with Table R301.2(5) for ground snow loads, P_g.

TABLE R301.2(5) MASSACHUSETTS GROUND SNOW LOADS, P_g

25 PSF	35 PSF	40 PSF	40 PSF	50 PSF		
Brewster	Abington	Alford	Nahant	Acton	Goshen	Paxton
Carver	Agawam	Arlington	Natick	Adams	Greenfield	Pepperell
Chatham	Amherst	Ashland	Needham	Amesbury	Groton	Peru
Eastham	Avon	Belmont	New Braintree	Andover	Groveland	Petersham
Harwich	Belchertown	Bellingham	New Marlborough	Ashburnham	Hamilton	Phillipston
Martha's Vineyard	Braintree	Beverly	New Salem	Ashby	Hancock	Pittsfield
Nantucket	Brockton	Blackstone	Newton	Ashfield	Harvard	Plainfield
Orleans	Chicopee	Blandford	Norfolk	Athol	Haverhill	Princeton
Plymouth	Cohasset	Boston	North Brookfield	Auburn	Hawley	Reading
Provincetown	East Longmeadow	Brimfield	Northampton	Ayer	Heath	Richmond
Truro	Easton	Brookfield	Northbridge	Barre	Hinsdale	Rockport
Wareham	Foxborough	Brookline	Norwood	Becket	Holden	Rolyalston
Wellfleet	Granby	Cambridge	Peabody	Bedford	Hubbardston	Rowe
	Hadley	Canton	Pelham	Berlin	Hudson	Rowley
	Hampden	Charlton	Quincy	Bernardston	Huntington	Rutland
	Hingham	Chelsea	Revere	Billerica	Ipswich	Salisbury
	Holbrook	Dedham	Russell	Bolton	Lancaster	Sandisfield
30 PSF	Holyoke	Douglas	Salem	Boxborough	Lanesborough	Savoy
Acushnet	Hull	Dover	Saugus	Boxford	Lawrence	Shelburne
Attleboro	Longmeadow	Dudley	Sheffield	Boylston	Lee	Shirley
Barnstable	Ludlow	East Brookfield	Sherborn	Buckland	Leicester	Shrewsbury
Berkley	Mansfield	Easthampton	Shutesbury	Burlington	Lenox	Spencer
Bourne	Monson	Egremont	Somerville	Carlisle	Leominster	Sterling
Bridgewater	North Attleborough	Everett	Southampton	Charlemont	Leyden	Stockbridge
Dartmouth	Norwell	Framingham	Southborough	Chelmsford	Littleton	Stow
Dennis	Palmer	Franklin	Southbridge	Cheshire	Lowell	Templeton
Dighton	Plainville	Grafton	Stoneham	Chester	Lunenburg	Tewksbury
Duxbury	Randolph	Granville	Sturbridge	Chesterfield	Maynard	Topsfield
East Bridgewater	Rockland	Great Barrington	Sudbury	Clarksburg	Merrimac	Townsend
Fairhaven	Scituate	Hardwick	Sunderland	Clinton	Methuen	Tyngsborough
Fall River	Sharon	Hatfield	Sutton	Colrain	Middlefield	Tyringham
Falmouth	South Hadley	Holland	Swampscott	Concord	Millbury	Warwick
Freetown	Southwick	Holliston	Tolland	Conway	Monroe	Washington
Gosnold	Springfield	Hopedale	Upton	Cummington	Montague	Wendell
Halifax	Stoughton	Hopkington	Uxbridge	Dalton	Monterey	Wenham
Hanover	West Springfield	Leverett	Wakefield	Danvers	New Ashford	West Boylston
Hanson	Westfield	Lexington	Wales	Deerfield	Newbury	West Newbury
Kingston	Weymouth	Lincoln	Walpole	Dracut	Newburyport	West Stockbridge
Lakeville	Wilbraham	Lynn	Waltham	Dunstable	North Adams	Westford
Marion		Lynnfield	Ware	Erving	North Andover	Westminster
Marshfield		Malden	Warren	Essex	North Reading	Williamsburg
Mashpee		Manchester	Washington	Fitchburg	Northborough	Williamstown
Mattapoisett		Marblehead	Watertown	Florida	Northfield	Willmington
Middleborough		Marlborough	Wayland	Gardner	Oakham	Winchendon
New Bedford		Medfield	Webster	Georgetown	Orange	Windsor
Norton		Medford	Wellesley	Gill	Otis	Worcester
Pembroke		Medway	West Brookfield	Gloucester	Oxford	Worthington
Plympton		Melrose	Westborough			
Raynham		Mendon	Westhampton			
Rehoboth		Middleton	Weston			
Rochester		Milford	Westwood			
Sandwich		Millis	Whately			
Seekonk		Millville	Winchester			
Somerset		Milton	Winthrop			
Swansea		Montgomery	Woburn			
Taunton		Mount Washington	Worcester			
West Bridgewater			Wrentham			
Westport						
Whitman						

Wood Beam

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Description : GR Job 16-394 Sunbug Livermore, 57 Meacham Road, Somerville, MA 02144 40 Degree Existing 2x7 Roof Rafter Slate Tile

CODE REFERENCES

Calculations per NDS 2012, IBC 2012, CBC 2013, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-10

Wood Species : Spruce - Pine - Fir
Wood Grade : No. 1/No. 2

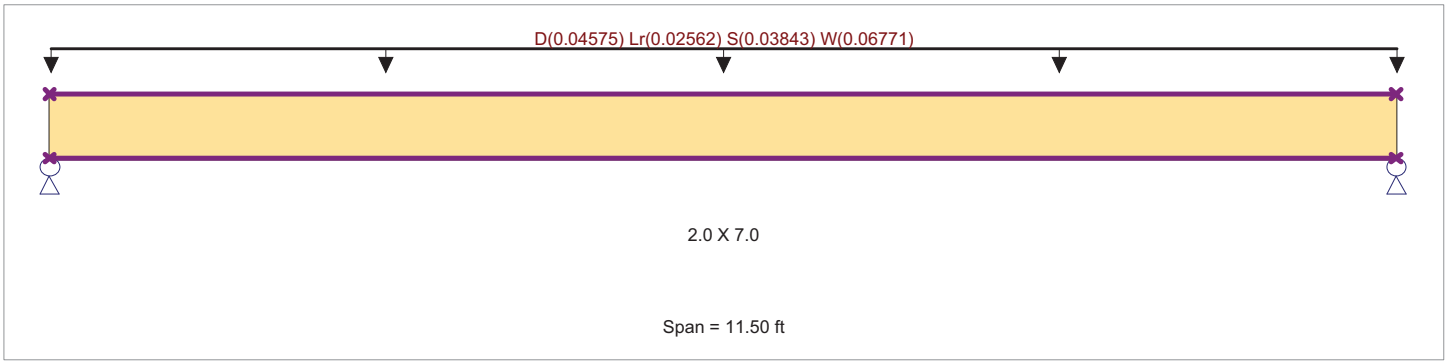
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb - Tension	875.0 psi
Fb - Compr	875.0 psi
Fc - Prll	1,150.0 psi
Fc - Perp	425.0 psi
Fv	135.0 psi
Ft	450.0 psi

E : Modulus of Elasticity

Ebend- xx	1,400.0 ksi
Eminbend - xx	510.0 ksi
Density	26.210 pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Uniform Load : D = 0.0250, Lr = 0.0140, S = 0.0210, W = 0.0370 ksf, Tributary Width = 1.830 ft, (Residential Roof Solar Panels)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.700 : 1	Maximum Shear Stress Ratio	=	0.312 : 1
Section used for this span		2.0 X 7.0	Section used for this span		2.0 X 7.0
fb : Actual	=	1,053.35 psi	fv : Actual	=	48.36 psi
FB : Allowable	=	1,504.34 psi	Fv : Allowable	=	155.25 psi
Load Combination		+D+S+H	Load Combination		+D+S+H
Location of maximum on span	=	5.750 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.335 in	Ratio =	412 >=180.
Max Upward Transient Deflection	0.000 in	Ratio =	0 <180.0
Max Downward Total Deflection	0.532 in	Ratio =	259 >=120.
Max Upward Total Deflection	0.000 in	Ratio =	0 <120.0

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	Moment Values M	Moment Values fb	Moment Values F'b	Shear Values V	Shear Values fv	Shear Values F'v
+D+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.498	0.222	0.90							0.80	586.60	1177.31	0.25	26.93	121.50
+D+L+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.448	0.199	1.00							0.80	586.60	1308.13	0.25	26.93	135.00
+D+Lr+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.549	0.244	1.25							1.22	897.77	1635.16	0.38	41.22	168.75
+D+S+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.700	0.312	1.15							1.43	1,053.35	1504.34	0.45	48.36	155.25
+D+0.750Lr+0.750L+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.501	0.223	1.25							1.12	819.98	1635.16	0.35	37.65	168.75
+D+0.750L+0.750S+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00

Wood Beam

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Lic. # : KW-06004325 **Licensee : STRUCTURAL ENGINEERING CONSULTANTS**

Description : GR Job 16-394 Sunbug Livermore, 57 Meacham Road, Somerville, MA 02144 40 Degree Existing 2x7 Roof Rafter Slate Tile

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
Length = 11.50 ft	1	0.623	0.277	1.15	1.300	1.00	1.15	1.00	1.00	1.00	1.27	936.66	1504.34	0.40	43.00	155.25
+D+0.60W+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.516	0.230	1.60	1.300	1.00	1.15	1.00	1.00	1.00	1.47	1,080.02	2093.00	0.46	49.59	216.00
+D-0.60W+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.045	0.020	1.60	1.300	1.00	1.15	1.00	1.00	1.00	0.13	93.18	2093.00	0.04	4.28	216.00
+1.042D+0.910E+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.292	0.130	1.60	1.300	1.00	1.15	1.00	1.00	1.00	0.83	611.24	2093.00	0.26	28.06	216.00
+1.042D-0.910E+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.292	0.130	1.60	1.300	1.00	1.15	1.00	1.00	1.00	0.83	611.24	2093.00	0.26	28.06	216.00
+D+0.750Lr+0.750L+0.450W+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.569	0.253	1.60	1.300	1.00	1.15	1.00	1.00	1.00	1.62	1,190.04	2093.00	0.51	54.64	216.00
+D+0.750Lr+0.750L-0.450W+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.215	0.096	1.60	1.300	1.00	1.15	1.00	1.00	1.00	0.61	449.91	2093.00	0.19	20.66	216.00
+D+0.750L+0.750S+0.450W+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.624	0.278	1.60	1.300	1.00	1.15	1.00	1.00	1.00	1.78	1,306.73	2093.00	0.56	59.99	216.00
+D+0.750L+0.750S-0.450W+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.271	0.120	1.60	1.300	1.00	1.15	1.00	1.00	1.00	0.77	566.60	2093.00	0.24	26.01	216.00
+1.032D+0.750L+0.750S+0.6825E+					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.456	0.203	1.60	1.300	1.00	1.15	1.00	1.00	1.00	1.30	955.14	2093.00	0.41	43.85	216.00
+1.032D+0.750L+0.750S-0.6825E+H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.456	0.203	1.60	1.300	1.00	1.15	1.00	1.00	1.00	1.30	955.14	2093.00	0.41	43.85	216.00
+0.60D+0.60W+0.60H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.404	0.180	1.60	1.300	1.00	1.15	1.00	1.00	1.00	1.15	845.38	2093.00	0.36	38.81	216.00
+0.60D-0.60W+0.60H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.068	0.030	1.60	1.300	1.00	1.15	1.00	1.00	1.00	0.19	141.46	2093.00	0.06	6.49	216.00
+0.5580D+0.910E+0.60H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.156	0.070	1.60	1.300	1.00	1.15	1.00	1.00	1.00	0.45	327.32	2093.00	0.14	15.03	216.00
+0.5580D-0.910E+0.60H					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.50 ft	1	0.156	0.070	1.60	1.300	1.00	1.15	1.00	1.00	1.00	0.45	327.32	2093.00	0.14	15.03	216.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S+0.450W+H	1	0.5321	5.792		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.619	0.619
Overall MINimum	0.147	0.147
+D+H	0.278	0.278
+D+L+H	0.278	0.278
+D+Lr+H	0.425	0.425
+D+S+H	0.499	0.499
+D+0.750Lr+0.750L+H	0.388	0.388
+D+0.750L+0.750S+H	0.443	0.443
+D+0.60W+H	0.511	0.511
+D+0.70E+H	0.278	0.278
+D+0.750Lr+0.750L+0.450W+H	0.563	0.563
+D+0.750L+0.750S+0.450W+H	0.619	0.619
+D+0.750L+0.750S+0.5250E+H	0.443	0.443
+0.60D+0.60W+0.60H	0.400	0.400
+0.60D+0.70E+0.60H	0.167	0.167
D Only	0.278	0.278
Lr Only	0.147	0.147
L Only		
S Only	0.221	0.221
W Only	0.389	0.389
E Only		
H Only		

SunBug Solar®

Structural information for: Livermore, Benjamin

57 Meacham Rd Somerville, MA 02144

Somerville Inspectional Services 1 Franey Road Somerville, MA 02145

Roof Information

Roof Pitch: 40
Roof Type: Asphalt shingle
Roof Height: 2 story

Dimensions of supporting members

Individual Rafters: 2x7 rough cut
Span of Rafters: see sketch
Spacing of Rafters: 20-22" oc
Timber: Rough Timber

Additional structural information

Additional Support: knee walls
Decking: 1" boards
Access to attic: knee wall access
Overhangs: 12"
Dimensions of ridge board: unknown
Dimensions of collar ties: n/a
Dimensions of ceiling rafters: 2x7 rough cut

Equipment

16 LG 300 BoB

16 Optimizer

1 SnapNRack Series 100 Racking

Engineering Note: Decking attachments are the preferred method of attachment if possible

Adders

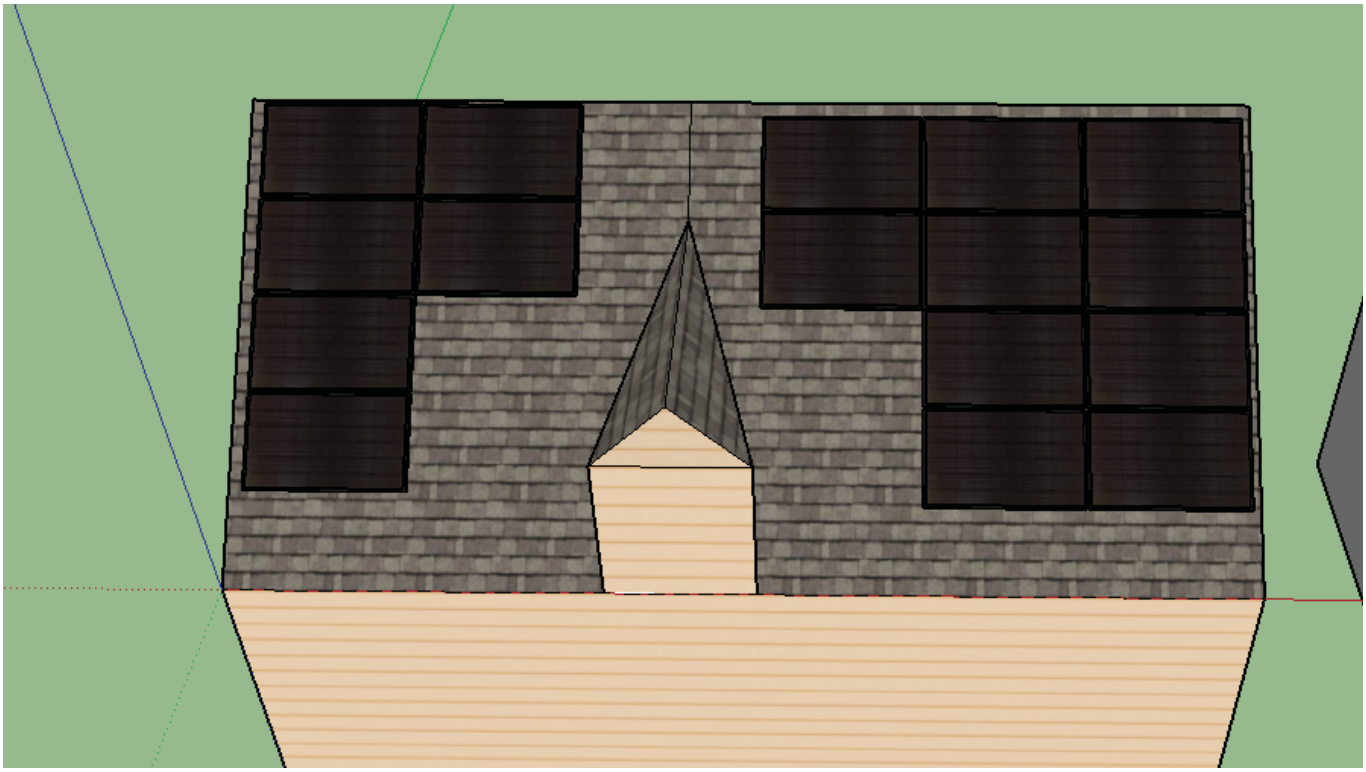
Other structural considerations

roof material is currently slate but the homeowner will be replacing with asphalt shingles before installation.

House from Street

Back roof for solar

system layout



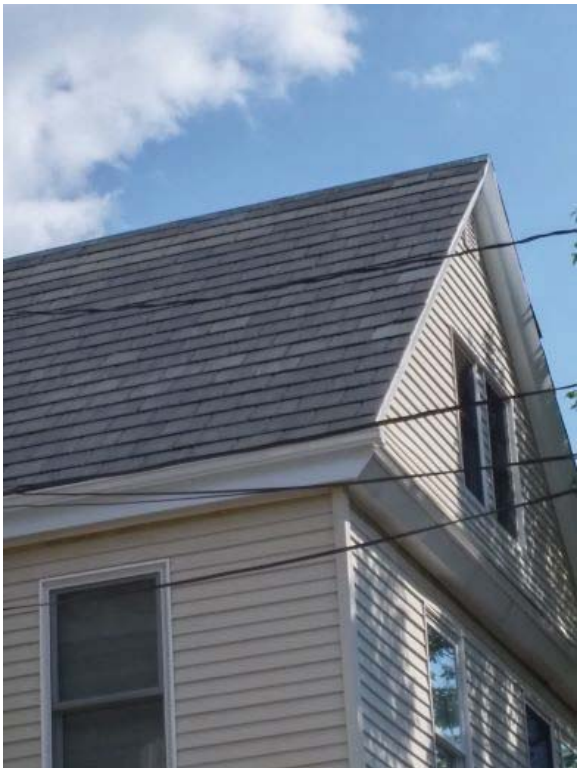
2x7 rough cut rafters

rafters 20-22" oc

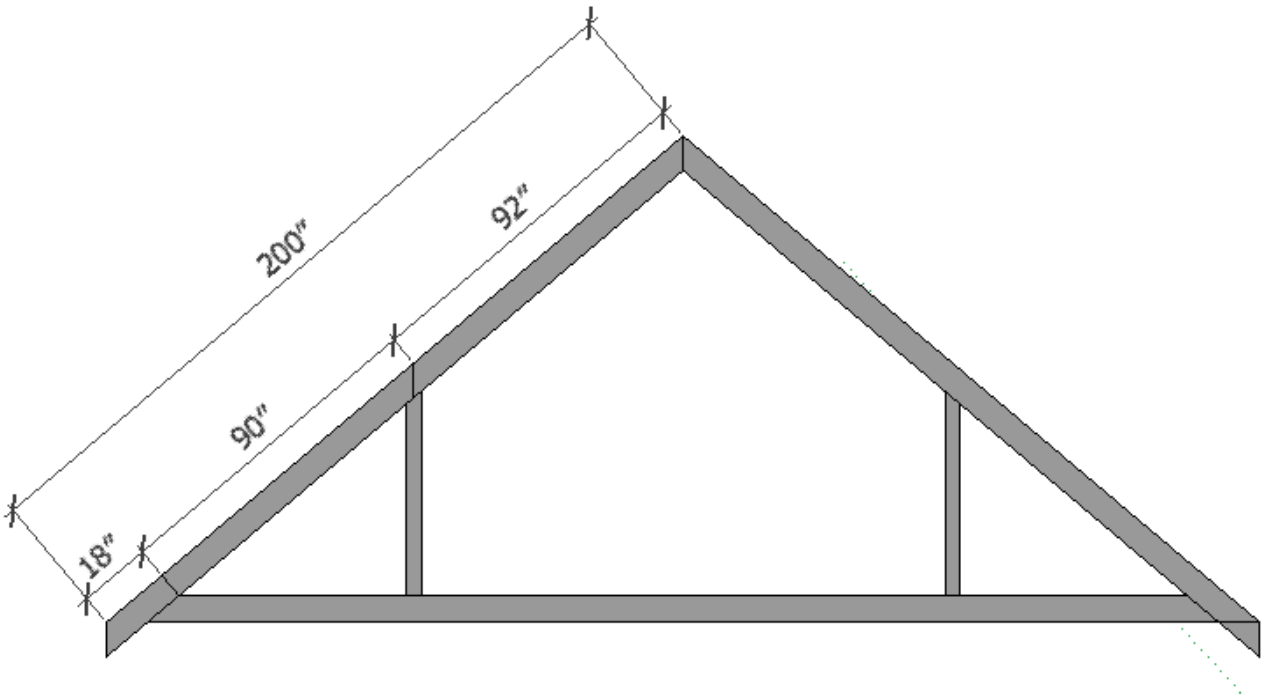
knee wall 56" high

knee wall access

roof material is currently slate but the homeowner will be replacing with asphalt



Sketch



LG
Life's Good

Innovation for a Better Life

LG NeON™ 2 Black LG300N1K-G4

60 cell

LG's new module, NeON™ 2 Black, adopts Cello technology. Cello technology replaces 3 busbars with 12 thin wires to enhance power output and reliability. NeON™ 2 Black demonstrates LG's efforts to increase customer's values beyond efficiency. It features enhanced warranty, durability, performance under real environment, and aesthetic design suitable for roofs.

APPROVED PRODUCT
KM 564573 BS EN 61215
Photovoltaic Modules

Enhanced Performance Warranty

LG NeON™ 2 has an enhanced performance warranty. The annual degradation has fallen from -0.7%/yr to -0.6%/yr. Even after 25 years, the cell guarantees 2.4%p more output than the previous NeON™ modules.

High Power Output

Compared with previous models, the LG NeON™ 2 has been designed to significantly enhance its output efficiency, thereby making it efficient even in limited space.

Aesthetic Roof

LG NeON™ 2 has been designed with aesthetics in mind; thinner wires that appear all black at a distance. The product may increase the value of a property with its modern design.

Outstanding Durability

With its newly reinforced frame design, LG has extended the warranty of the NeON™ 2 for an additional 2 years. Additionally, LG NeON™ 2 can endure a front load up to 6000 Pa, and a rear load up to 5400 Pa.

Better Performance on a Sunny Day

LG NeON™ 2 now performs better on sunny days thanks to its improved temperature coefficiency.

Double-Sided Cell Structure

The rear of the cell used in LG NeON™ 2 will contribute to generation, just like the front; the light beam reflected from the rear of the module is reabsorbed to generate a great amount of additional power.

About LG Electronics

LG Electronics is a global player who has been committed to expanding its capacity, based on solar energy business as its future growth engine. We embarked on a solar energy source research program in 1985, supported by LG Group's rich experience in semi-conductor, LCD, chemistry, and materials industry. We successfully released the first Mono X® series to the market in 2010, which were exported to 32 countries in the following 2 years, thereafter. In 2013, NeON™ (previously known as Mono X® NeON) won "Intersolar Award", which proved LG is the leader of innovation in the industry.

Mechanical Properties

Cells	6 x 10
Cell Vendor	LG
Cell Type	Monocrystalline / N-type
Cell Dimensions	156.75 x 156.75 mm / 6 x 6 inch
# of Busbar	12 (Multi Wire Busbar) NEW
Dimensions (L x W x H)	1640 x 1000 x 40 mm 64.57 x 39.37 x 1.57 inch
Front Load	6000 Pa / 125 psf NEW
Rear Load	5400 Pa / 113 psf NEW
Weight	17.0 ± 0.5 kg / 37.48 ± 1.1 lbs
Connector Type	MC4, MC4 Compatible, IP67
Junction Box	IP67 with 3 Bypass Diodes
Length of Cables	2 x 1000 mm / 2 x 39.37 inch
Glass	High Transmission Tempered Glass
Frame	Anodized Aluminum

Certifications and Warranty

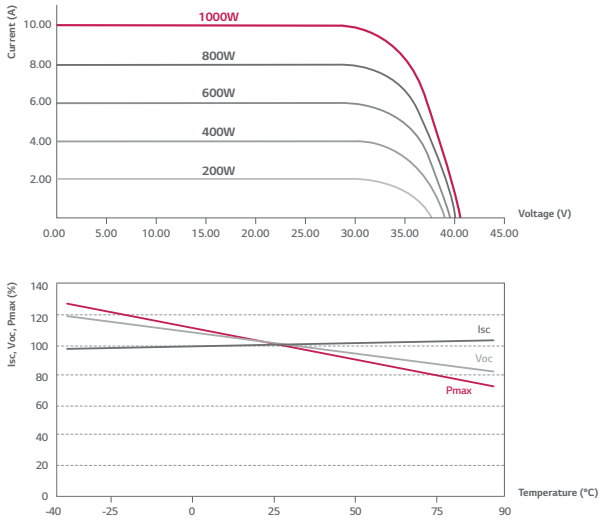
Certifications (In Progress)	IEC 61215, IEC 61730-1/-2, UL 1703, ISO 9001, IEC 62716 (Ammonia Test), IEC 61701(Salt Mist Corrosion Test)
Module Fire Performance	Type 2 (UL 1703)
Product Warranty	12 years NEW
Output warranty of Pmax (measurement Tolerance ± 3%)	Linear warranty* NEW

* 1) 1st year: 98%, 2) After 2nd year: 0.6%p annual degradation, 3) 83.6% for 25 years

Temperature Coefficients

NOCT	46 ± 3 °C
Pmpp	-0.38 %/°C NEW
Voc	-0.28 %/°C
Isc	0.02 %/°C

Characteristic Curves



Electrical Properties (STC *)

	300 W
MPP Voltage (Vmpp)	32.5
MPP Current (Impp)	9.26
Open Circuit Voltage (Voc)	39.7
Short Circuit Current (Isc)	9.70
Module Efficiency (%)	18.3
Operating Temperature (°C)	-40 ~ +90
Maximum System Voltage (V)	1000
Maximum Series Fuse Rating (A)	20
Power Tolerance (%)	0 ~ +3

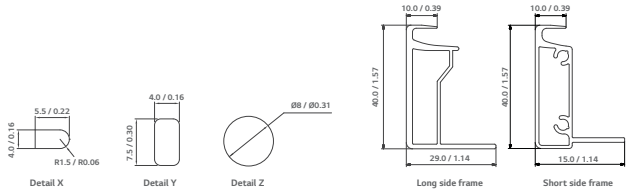
* STC (Standard Test Condition): Irradiance 1000 W/m², Module Temperature 25 °C, AM 1.5
* The nameplate power output is measured and determined by LG Electronics at its sole and absolute discretion.
* The typical change in module efficiency at 200 W/m² in relation to 1000 W/m² is -3.0%.

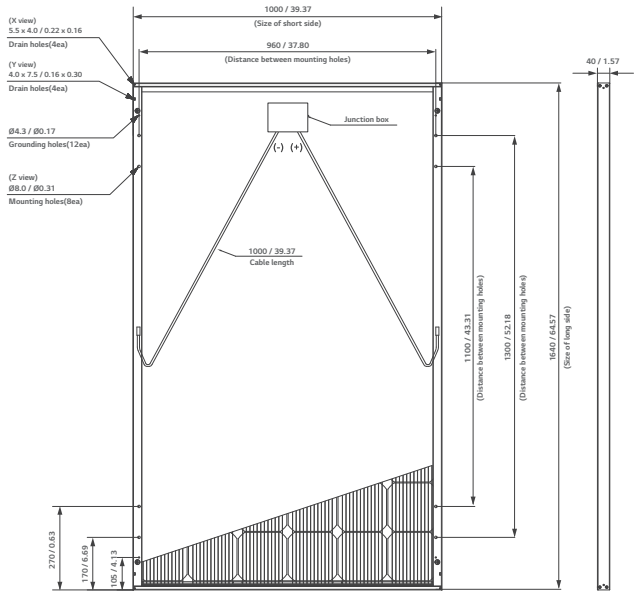
Electrical Properties (NOCT*)

	300 W
Maximum Power (Pmpp)	218
MPP Voltage (Vmpp)	29.5
MPP Current (Impp)	7.38
Open Circuit Voltage (Voc)	36.5
Short Circuit Current (Isc)	7.83

* NOCT (Nominal Operating Cell Temperature): Irradiance 800 W/m2, ambient temperature 20 °C, wind speed 1 m/s

Dimensions (mm/in)





* The distance between the center of the mounting/grounding holes.

LG Life's Good

North America Solar Business Team
LG Electronics U.S.A. Inc
1000 Sylvan Ave, Englewood Cliffs, NJ 07632

Contact: lg.solar@lge.com
www.lgsolarusa.com

Product specifications are subject to change without notice.
DS-N2-60-K-G-F-EN-50427

Innovation for a Better Life

LG SOLAR MODULE LIMITED WARRANTY

The limited warranties specified below **(**hereinafter **"Limited Warranty")** apply to LG Solar Module models listed under Section 11 below (hereinafter **"Module(s)")** sold by LG Electronics U.S.A., Inc. (hereinafter "**LG**") and installed by a licensed contractor under applicable local and state laws, and extend only to the original end use purchaser and subsequent owner(s) of the location on which the Module(s) is originally installed (all such persons hereinafter referred to as "**Customer**"). The warranty start date ("**Warranty Start Date**") shall be the date of purchase by the original end use purchaser. If the Customer is unable to provide adequate documentation of the original purchase, the Warranty Start Date shall be ninety (90) days after the Module(s) was manufactured.

1. 12 Years Limited Warranty for Module(s)

LG will, at its sole option, repair or replace the Module(s) if it proves to be defective in material or workmanship for a period ending 12 years from the Warranty Start Date under normal application, installation, use and service conditions. This "12 Years Limited Warranty for Module(s)" does not warrant a specific power output, which shall be exclusively covered under Section 2 hereinafter ("25 years Limited Warranty for Power Output")

2. 25 Years Limited Warranty for Power Output

LG warrants that for a period of one (1) year from Warranty Start Date the actual power output of the module will be no less than 98% of the labeled power output. From the second year, the warranty for power output will decline annually by 0.6% in each of the remaining 24 years, so that during 25th year, an actual output of at least 83.6% of the nameplate power output specified on the Module will be achieved. The power output values shall be those measured under LG's standard test conditions as follows: (a) light spectrum of AM 1.5; (b) an irradiation of 1000 W per *m*2 and; (c) a cell temperature of 25 degrees centigrade at right angle irradiation.

If the Module does not meet the warranted power output levels set out above when measured by LG or by an independent measuring institute agreed to prior to testing by LG under standard test conditions (IEC 61215) taking into account a ±3% measurement tolerance range, LG will, at its sole and absolute discretion, either (i) repair the Module(s); (ii) supplement such deficiency in power by either: (a) providing additional Module(s) to the Customer, or (b) replacing the Module(s); or (iii) Refund the difference between guaranteed minimal power output and actual power output (measured under LG's STC) multiplied by the then current market price of the Module(s) or a comparable model at the time of the Customer's claim.

3. How this Limited Warranty Applies

The remedies set forth in this Limited Warranty shall be the sole and exclusive remedies, and the original warranty period in this Limited Warranty shall not extend beyond the period set forth therein, nor will a new warranty period begin, upon repair, replacement or pro-rated refund due to power loss at LG's sole option provided under this Limited Warranty.

Repair or replacement will be made with new or re-manufactured Module(s) or parts and the replaced Module(s) or parts shall become the property of LG. In the event the Module(s) is no longer available, LG reserves the right, at its sole option, to deliver new or remanufactured Module(s) that may differ in size, color, shape, model number, and/or power level.

This Limited Warranty covers the transportation cost for reshipment of any repaired or replaced Module(s) to the Customer site, but does NOT cover the transportation cost and risk including shipping damage or loss for return of the Module(s) to LG or LG's

authorized agent and any other costs associated with installation, removal, or re-installation of the Module(s). If Module(s) returned to LG is found not to be defective or this Limited Warranty has expired, the Customer is responsible to pay for return shipping cost.

4. Limited Warranty Exclusions

4-1. This Limited Warranty does NOT apply to Module(s):

(a) Sold and/or installed outside the geographic territory of the United States and US territories;

(b) Sold AS IS or WITH ALL FAULTS or consumables; or

(c) That had a serial number or any part thereof altered, defaced or removed.

4-2. This Limited Warranty also does NOT apply to Module(s) which have been subjected to:

(a) Damage and/or failure caused by use on a mobile unit including, but not limited to, vehicles, vessels, etc.;

(b) Damage and/or failure caused by non-compliance with national and local electric codes;

(c) Damage and/or failure caused by installations not in conformance with the Module(s) specifications, installation manuals, operation manuals, or labels attached to the Module(s);

(d) Damage and/or failure caused by improper wiring, installation, or handling;

(e) Damage and/or failure caused by devices and/or parts other than the Module(s) or by mounting methods of such devices and/or parts;

(f) Damage and/or failure caused by improper or incorrectly performed maintenance, operation or modification;

(g) Damage and/or failure caused by removal from the original place of installment;

(h) Damage and/or failure caused by repairs not in accordance with LG's instructions;

(i) Damage and/or failure caused by inappropriate handling during storage, packaging or transportation;

(j) Damage and/or failure caused by external shock such as flying objects or external stress;

(k) Damage and/or failure caused by environmental pollution such as soot, salt damage, or acid rain;

(l) Damage and/or failure caused by natural forces (earthquakes, tornados, floods, lightning, hurricanes, heavy snow, etc.) and fire, power failures, power surges or other unforeseen circumstances that are beyond LG's control;

(m) Damage and/or failure caused by terrorist acts, riots, war or other man-made disasters;

(n) Damage and/or failure caused by external stains or scratches that do not affect output;

(o) Damage and/or failure caused by sound, vibration, rust, scratching, or discolorations that are the result of normal wear and tear, aging or continuous use; or

(p) Damage and/or failure caused by Module(s) installed in a location that exceeds operating conditions.

5. Limitation of Warranty Scope

EXCEPT TO THE EXTENT PROHIBITED BY APPLICABLE LAW, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ON THE MODULE(S) IS LIMITED IN DURATION OF THIS LIMITED WARRANTY. UNDER NO CIRCUMSTANCES SHALL LG BE LIABLE FOR ANY INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES INCLUDING, WITHOUT LIMITATION, LOST GOODWILL, LOST REVENUES OR PROFITS, WORK STOPPAGE, MODULE(S) FAILURE, IMPAIRMENT OF OTHER GOODS, COSTS OF REMOVAL AND REINSTALLATION OF THE MODULE(S), LOSS OF

USE, INJURY TO PERSONS OR PROPERTY ARISING OUT OR RELATED TO THE MODULE(S). LG'S TOTAL LIABILITY, IF ANY, DAMAGES OR OTHERWISE, SHALL NOT EXCEED THE INVOICE VALUE PAID BY THE CUSTOMER FOR THE MODULE(S) OR SERVICE(S) FURNISHED, WHICH IS THE SUBJECT OF A CLAIM OR DISPUTE.

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, OR ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU. THIS LIMITED WARRANTY GIVES THE CUSTOMER SPECIFIC LEGAL RIGHTS; CUSTOMERS MAY ALSO HAVE OTHER RIGHTS THAT VARY FROM STATE TO STATE.

6. Assertion of Claims

The assertion of claims under this Limited Warranty presupposes that the Customer has (i) informed the authorized reseller/distributor of our Module(s) in writing of the alleged claim, or that; (ii) this written notification has-been sent directly to the address stated in Section 7 below in the event that the authorized reseller/distributor no longer exists (e.g. due to discontinuance of business or bankruptcy). Any such assertion of claims must be accompanied by the original sales receipt as the proof of purchase and time of purchase of LG Module(s). The assertion of the claim must occur within thirty (30) days from the date that the claim is identified. The return of Module(s) may only occur after the written authorization of LG has been given.

7. Obtaining Warranty Performance

Customers who believe they have a justified claim covered by this Limited Warranty must immediately notify the authorized LG representative, or contact LG directly by writing to:

LG Electronics U.S.A. Inc

Solar Business Team

1000 Sylvan Ave. Englewood Cliffs, NJ 07632

Email : lg.solar@lge.com

Customer may also contact LG via its web-site at **www.lgsolarusa.com**.

8. Force Majeure

LG shall not be responsible or liable to Customer or any third party for any non-performance or delay in performance of any terms and conditions of sale, including this Limited Warranty, due to acts of God, war, strikes, riots, unavailability of suitable and sufficient labor, material, capacity, technical, yield failures or any other unforeseen event beyond LG's control, including, without limitations, any technological, physical event or condition which is not reasonably known or understood at the time of sale of the Module(s) or the claim.

9. Disputes

Except to the extent prohibited by applicable law, the Customer agrees she/he will not bring any action, regardless of form, arising out of or in any way connected with this Limited Warranty, more than one (1) year after the cause of action has occurred.

10. Severability

If a part, provision or section of this Limited Warranty, or its application to any person or circumstance is held invalid, void or

unenforceable, such holding shall not affect this Limited Warranty and all other parts, provisions, clauses or applications shall remain, and, to this end, such other parts, provisions, clauses or applications of the Limited Warranty shall be treated as severable.

11. Validity

This Limited Warranty is valid from June 1, 2015 and shall apply to below Modules sold to specific Customer(s) on or after this date.

“LGxxxSxx-G4” and “LGxxxNxx-G4”

LG holds the right to amend the provisions, clauses or applications of this Limited Warranty from time to time without notice, however such changes would not be retrospective.

solaredge

SolarEdge Power Optimizer

Module Add-On For North America

P300 / P320 / P400 / P405

PV power optimization at the module-level

- Up to 25% more energy
- Superior efficiency (99.5%)
- Mitigates all types of module mismatch losses, from manufacturing tolerance to partial shading
- Flexible system design for maximum space utilization
- Fast installation with a single bolt
- Next generation maintenance with module-level monitoring
- Module-level voltage shutdown for installer and firefighter safety

SolarEdge Power Optimizer

Module Add-On for North America

P300 / P320 / P400 / P405

	P300 (for 60-cell modules)	P320 (for high-power 60-cell modules)	P400 (for 72 & 96-cell modules)	P405 (for thin film modules)	
INPUT					
Rated Input DC Power[1]	300	320	400	405	W
Absolute Maximum Input Voltage (Voc at lowest temperature)	48		80	125	Vdc
MPPT Operating Range	8 - 48		8 - 80	12.5 - 105	Vdc
Maximum Short Circuit Current (Isc)	10	11	10		Adc
Maximum DC Input Current	12.5	13.75	12.5		Adc
Maximum Efficiency	99.5				%
Weighted Efficiency	98.8				%
Overvoltage Category	II				
OUTPUT DURING OPERATION (POWER OPTIMIZER CONNECTED TO OPERATING SOLAREDGE INVERTER)					
Maximum Output Current	15				Adc
Maximum Output Voltage	60			85	Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM SOLAREDGE INVERTER OR SOLAREDGE INVERTER OFF)					
Safety Output Voltage per Power Optimizer	1				Vdc
STANDARD COMPLIANCE					
EMC	FCC Part15 Class B, IEC61000-6-2, IEC61000-6-3				
Safety	IEC62109-1 (class II safety), UL1741				
RoHS	Yes				
INSTALLATION SPECIFICATIONS					
Maximum Allowed System Voltage	1000				Vdc
Compatible inverters	All SolarEdge Single Phase and Three Phase inverters				
Dimensions (W x L x H)	128 x 152 x 27.5 / 5 x 5.97 x 1.08		128 x 152 x 35 / 5 x 5.97 x 1.37	128 x 152 x 48 / 5 x 5.97 x 1.89	mm / in
Weight (including cables)	770 / 1.7		930 / 2.05	930 / 2.05	gr / lb
Input Connector	MC4 Compatible				
Output Wire Type / Connector	Double Insulated; MC4 Compatible				
Output Wire Length	0.95 / 3.0		1.2 / 3.9		m / ft
Operating Temperature Range	-40 - +85 / -40 - +185				˚C / ˚F
Protection Rating	IP68 / NEMA6P				
Relative Humidity	0 - 100				%

[1] Rated STC power of the module. Module of up to +5% power tolerance allowed.

PV SYSTEM DESIGN USING A SOLAREDGE INVERTER[2]	SINGLE PHASE	THREE PHASE 208V	THREE PHASE 480V	
Minimum String Length (Power Optimizers)	8	10	18	
Maximum String Length (Power Optimizers)	25	25	50	
Maximum Power per String	5250	6000	12750	W
Parallel Strings of Different Lengths or Orientations	Yes			

[2] It is not allowed to mix P405 with P300/P400/P600/P700 in one string.

LIMITED PRODUCT WARRANTY

This SolarEdge Technologies Ltd. Limited Warranty covers defects in workmanship and materials of the below-listed products for the applicable warranty period set out below:

- Power optimizers: 25 years commencing on the earlier of: (i) 4 months from the date the power optimizers are shipped from SolarEdge; and (ii) the installation of the power optimizers, *provided, however*, that for the module embedded power optimizers (CSI and OPJ models), the Warranty Period shall not exceed the warranty period provided by the applicable module manufacturer.
- Inverters: 12 years commencing on the earlier of: (i) 4 months from the date the Inverters are shipped from SolarEdge; and (ii) the installation of the Inverters.
- Smart Monitoring Combiner Box: 5 years commencing on the earlier of: (i) 4 months from the date the Combiner Boxes are shipped from SolarEdge; and (ii) the installation of the Combiner Boxes.
- Safety & Monitoring Interface (SMI): 12 years commencing on the earlier of: (i) 4 months from the date the SMIs are shipped from SolarEdge; and (ii) the installation of the SMIs.
- Home gateway, Control and communication gateway, Firefighter safety gateway, Wireless Communication Products: 5 years commencing on the earlier of: (i) 4 months from the date the product is shipped from SolarEdge; and (ii) the installation of the product.

The Limited Warranty does not apply to components which are separate from the Products, ancillary equipment and consumables, such as, for example, cables, fuses, fans, wires and connectors, whether supplied by SolarEdge or others. Some components may carry their own manufacturer warranty. See product datasheet for more details. In addition, for all power optimizers with a part number ending in C, the SolarEdge warranty does not apply to the input connector.

The Limited Warranty only applies to the buyer who has purchased the Products from an authorized seller of SolarEdge for use in accordance with their intended purpose. The Limited Warranty may be transferred from buyer to any assignee, and will remain in effect for the time period remaining under the foregoing warranties, *provided* that the Products are not moved outside its original country of installation and any reinstallation is done in accordance with the installation directions and use guidelines accompany the Products (collectively the "*Documentation*").

If, during the applicable Warranty Period, buyer discovers any defect in workmanship and materials and seeks to activate the Limited Warranty, then buyer shall, promptly after such discovery, report the defect to SolarEdge by sending an email to support@solaredge.com with the following information: (i) a short description of the defect, (ii) the Product's serial number, and (iii) a scanned copy of the purchase receipt or warranty certificate of the applicable Product.

Upon buyer's notification, SolarEdge shall determine whether the reported defect is eligible for coverage under the Limited Warranty. The Product's serial number must be legible and properly attached to the Product in order to be eligible for Warranty coverage. If SolarEdge determines that the reported defect is not eligible for coverage under the Limited Warranty, SolarEdge will notify buyer accordingly and will explain the reason why such coverage is not available. If SolarEdge determines that the reported defect is eligible for coverage under the Limited Warranty, SolarEdge will notify buyer accordingly, and SolarEdge may, in its sole discretion, take any of the following actions:

- repair the Product at SolarEdge's facilities or on-site; or
- issue a credit note for the defective Product in an amount up to its actual value at the time buyer notifies SolarEdge of the defect, as determined by SolarEdge, for use toward the purchase of a new Product; or
- provide Buyer with replacement units for the Product.

SolarEdge will determine whether the Product should be returned to SolarEdge and, if SolarEdge so determined, the Return Merchandise Authorization ("*RMA*") Procedure (set out below) will be invoked. Where replacement Products are sent, SolarEdge generally sends such products within 48 hours. SolarEdge may use new, used or refurbished parts that are at least functionally equivalent to the original part when making warranty repairs. The repaired Product or replacement parts or Product, as applicable, shall continue to be covered under the Limited Warranty for the remainder of the then-current Warranty Period for the Product.

Where the RMA Procedure is invoked by SolarEdge, SolarEdge will instruct buyer how to package and ship the Product or part(s) to the designated location. SolarEdge will bear the cost of such shipment, upon receipt of the Product or part(s), SolarEdge will, at its expense and sole discretion, either repair or replace the Product or part(s).

SolarEdge will deliver the repaired or replaced Product or part(s) to buyer at buyer's designated location in countries where SolarEdge has an office and/or a there is a significant PV market. For the specific list of countries to which such service is provided, please access http://www.solaredge.com/articles/shipping_cost_coverage_warranty. SolarEdge will bear the cost of such shipment, including shipping and customs (where applicable) and buyer shall bear any applicable value added tax. SolarEdge may elect to ship replacement Product and/or part(s) prior to receipt of the Product and/or part(s) to be returned to SolarEdge as per the above.

Where SolarEdge decides to repair the Product or part(s), warranty coverage includes labor and material costs necessarily incurred to correct the Product defect; and where SolarEdge decides to replace the Product or part(s) to which the Limited Warranty applies, warranty coverage includes the cost of the replacement of the Product or part(s). In addition, SolarEdge shall bear shipping costs in respect to the foregoing, as set out above. All other costs, including, without limitation, travel and boarding costs of SolarEdge service personnel that are incurred for repairs of Products on-site, as well as costs related to buyer's employees and contractors repair or replacement activities, are not covered by the Limited Warranty and, unless otherwise agreed in writing in advance by SolarEdge, shall be borne by the buyer.

Warranty Exclusions: This Limited Warranty will not apply if (a) buyer is in default under the General Terms and Conditions of other Agreement governing the purchase of the Product, or (b) the Product or any part thereof is:

- damaged as a result of misuse, abuse, accident, negligence or failure to maintain the Product;
- damaged as a result of modifications, alterations or attachments thereto which were not pre-authorized in writing by SolarEdge;
- damaged due to the failure to observe the applicable safety regulations governing the proper use of the Product;
- installed or operated not in strict conformance with the Documentation, including without limitation, not ensuring sufficient ventilation for the Product as described in SolarEdge installation guide;
- opened, modified or disassembled in any way without SolarEdge's prior written consent;
- used in combination with equipment, items or materials not permitted by the Documentation or in violation of local codes and standards;
- damaged or rendered non-functional as a result of power surges, lightning, fire, flood, pest damage, accident, action of third parties, or other events beyond SolarEdge's reasonable control or not arising from normal operating conditions; or
- damaged during or in connection with shipping or transport to or from buyer where buyer arranges such shipping or transport.

This Limited Warranty does not cover cosmetic or superficial defects, dents, marks or scratches, which do not influence the proper functioning of the Product.

THE LIMITED WARRANTIES SET OUT HEREIN ARE IN LIEU OF ANY OTHER WARRANTIES WITH RESPECT TO THE PRODUCTS PURCHASED BY BUYER FROM SOLAREDGE, WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL (INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), ALL OF WHICH ARE EXPRESSLY EXCLUDED TO THE FULLEST EXTENT PERMITTED BY APPLICABLE LAW.

Claims by buyer that go beyond the warranty terms set out herein, including claims for compensation or damages, are not covered by the Limited Warranty, insofar as SolarEdge is not subject to statutory liability. In such cases, please contact the company that sold you the Product. Eventual claims in accordance with the law on product liability remain unaffected.

Coverage under the Limited Warranty is subject to buyer complying with the foregoing notification requirements and cooperating with SolarEdge's directions. SolarEdge's sole obligation and buyer's exclusive remedy for any defect warranted hereunder is limited to those actions expressly stated above. Such actions are final and do not grant any further rights, in particular with respect to any claims for compensation.

Unless otherwise specified in an executed Agreement with SolarEdge, the Limited Warranty and related provisions set out herein are subject to SolarEdge's General Terms and Conditions, including, without limitation, the provisions thereof, which relate to disclaimer of warranties, limitation of liability and governing law and jurisdiction.

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SERIES 100 ROOF MOUNT SYSTEM

SnapNrack Residential PV Mounting Systems

The SnapNrack line of solar mounting systems is designed to reduce total installation costs. The system features technical innovations proven on more than 100MW of solar projects to simplify installation and reduce costs.

Pitched Roof Arrays Simplified

The SnapNrack Series 100 Roof Mount System is an efficient, visually appealing, photovoltaic (PV) module installation system. Series 100 was developed in the field by a team of veteran solar engineers and installers. Their goal was to ensure a quick, efficient installation. Series 100 has been tested on megawatts of real-world residential and commercial installations. Industry leading installation times are achieved with unique Snap-in fasteners and fully adjustable components that make installation of roof mounted solar arrays easy while achieving lower installation costs.

- Up to 3" of height adjustability at roof connection
- Waterproof full-metal flashing at each roof penetration
- Works on virtually all composition and tile roofs
- Single wrench size for all system hardware
- Configures easily as low profile or tilt (0-60 Degrees)
- Rail channels provide excellent wire management

Roof System in 4 Simple Steps:

1) Identify Site Conditions (Array Tilt, Building Height, Roof Type, Wind and Snow Loads)

2) Determine Footing Span from Engineering Tables (download at www.snapnrack.com)

3) Choose color (Clear or Black) and roof attachment type

4) Place Order with your distributor. Purchase material for a single project or order in bulk for additional savings
- Rail & Module Clamps
- Roof Attachments
- Array Accessories

Patent Pending

SnapNrack™
PV Mounting Systems

Simple

- Quick assembly and clean aesthetic finish
- One wrench fits every bolt in the system
- Low profile installation on any roof

Adaptable

- Compatible with virtually all 60 and 72 cell modules
- Unique “snap-in” channel nuts can be installed anywhere on the rail
- Rail channels provide improved wire management

Strong

- Excellent seismic, wind, and snow-loading protection
- Vertical and horizontal adjustments ensure superior fit
- Rain-tight metal flashing ensures waterproofing

Innovative Universal End Clamps

- One size fits any standard L frame module
- Clean look - nothing extends beyond module frames
- Less waste - rail lengths match most modules

SnapNrack Series 100 Technical Data Patent Pending	
Materials	• 6000 Series aluminum • Stainless steel • Galvanized steel
Material Finish	• Clear and black anodized aluminum
Installation	• Quick and efficient mounting • Adjustable hardware to ensure clean and level finish • Worry-free waterproof flashing
Calcs. & Certifications	• Wind speeds up to 150 MPH and snow loads to 120 PSF
Grounding	• Washer, Electrical Equipment Bond (WEEB) or lay-In lugs
Warranty	• 10 Year material and worksmanship (download full details at snapnrack.com)

SnapNrack™
PV Mounting Systems

(877) 732-2860 www.SnapNrack.com

Printed on recycled paper using soy based inks.

Manufacturers Limited Product Warranty

Limited Warranties: SnapNrack, Inc. (“Manufacturer”), the manufacturer of the SnapNrack photovoltaic solar mounting solutions (the “Product”), warrants to the end-user of the Product (“buyer”), that while installed as part of the original solar electric system (the “System”) at the original installation site, the Product shall be free from defects in materials and workmanship for a period of ten (10) years (the “Limited Product Warranty”), and any products with an anodized finish shall be free from visible peeling, cracking or chalking under normal atmospheric conditions for a period of five (5) years (the “Limited Finish Warranty”) (collectively, the “Limited Warranties”). The Limited Warranties shall commence on the date of completion of the installation of the Product as a part of the System.

Warranty Service: If, within the applicable warranty period, the product is determined by Manufacturer to be defective, based on reasonable evidence of a defect provided by you, Manufacturer will, at its sole option, (a) repaid the Product or replace it with an equivalent product, or (b) take back the Product and refund to you the purchase price paid to Manufacturer by the original purchaser of the Product. The buyer’s sole and exclusive remedy under the Limited Warranties shall be limited to the repair, replacement or refund specified herein.

Warranty Conditions: THE FOREGOING WARRANTIES ARE CONTINGENT ON THE PROPER USE OF THE PRODUCT IN ACCORANCE WITH THE INSTRUCTIONS AND SPECIFICATIONS PUBLISHED BY MANUFACTURER AND SHALL NOT APPLY TO ANY PRODUCT THAT HAS BEEN REPAIRED OR MODIFIED BY PERSONS OTHER THAN MANUFACTURERS.

Warranty Disclaimer: THE EXPRESS WARRANTIES SET FORTH IN HEREIN ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED. MANUFACTURER HEREBY SPECIFICALLY DISCLAIMS ANY OTHER REPRESENTATIONS OF WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF TITLE, NONINFRINGMENT, QUIET ENJOYMENT, MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE.

Damage Waiver: NOTWITHSTANDING ANY OTHER PROVISIONS HEREIN, IN NO EVENT WILL MANUFACTURER OR ITS SUPPLIERS BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTAL DAMAGES SUFFERED BY YOU, DISTRIBUTOR, OR ANY THIRD PARTY WHICH MAY ARISE UNDER OR IN CONNECTION WITH THE PRODUCT OR THESE LIMITED WARRANTIES.

Limitation of Liability: DISTRIBUTOR AND MANUFACTURER HAVE NEGOTIATED RISK ALLOCATION BETWEEN THEMSELVES AND AGREE THAT IN NO EVENT WILL MANUFACTURER’S LIABILITY FOR ANY CLAIM, WHETHER IN CONTRACT, TORT, OR UNDER ANY OTHER THEORY OF LIABILITY, EXCEED THE CUMULATIVE AMOUNTS ACTUALLY RECEIVED BY MANIFACTURER FROM DISTRIBUTOR FOR THE PRODUCTS SOLD TO DISTRIBUTOR DURING THE12 MONTH PERIOD IMMEDIATELY PRECEDING THE ACCRUAL OF THE CLAIM.

Warranty Transference: Buyer May transfer this Warranty to subsequent Site owners, or, if the original buyer is a contractor, to the Site. Proof of Purchase is required for any warranty claim

Warranty Claims: If Buyer has a claim for repair or replacement under this Limited Warranty, Owner must contact SnapNrack as soon as possible and under no circumstances later than 30 days after the end of the applicable Limited Warranty Period to initiate the Limited Warranty Claims Process. Address all Warranty claims to SnapNrack, Warranty Claim, 775 Fiero Lane, Suite 200, San Luis Obispo, CA 93401. Any claim under the above limited Warranty must include proof of the date the installation was completed or the date of the original product delivery, such as the copy of Owners receipt or invoice.