ROOF STRUCTURAL ASSESSMENT REPORT

Date of Report:	12-01-2014/Rev A	Job Name:	103-zep
Data Input by:	Tom Milner	Job Number:	103
Contact E-mail:	tom@solar-roof-check.com	Job Address:	123 Main Street
Contact Phone:	530-878-0755		Auburn, CA 95603

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Report Provided by Solar-Roof-Check
Background Calculations Platform
created by James A. Adams, S.E.

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OUTPUT SUMMARY

Date of Report:	**12-01-2014/Rev A**	**Job Name:**	**103-zep**
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CALCULATIONS	COMPLIANCY TEST RESULT
Loading Combination #1: (% of Code Compliancy=318.6 %) Wind Uplift on standoff- 0.6 DL Solar	**PASS**
Loading Combination #2: (% of Code Compliancy=1001.8 %) DL Rf + DL Solar + Roof Live Load	**PASS**
Loading Combination #3: (% of Code Compliancy=642.6 %) DL Rf + DL Solar + Wind Down	**PASS**
Loading Combination #4: (% of Code Compliancy=207.1 %) DL Rf + DL Solar + Snow	**PASS**
Loading Combination #5: (% of Code Compliancy=286.9 %) DL Rf + DL Solar + .75 Wind + .75 Snow:	**PASS**
Loading Combination #6: (% Increase of Seismic Load=6.1 %) Check Additional Seismic Load	**PASS**
Loading Combination #7: (% of Code Compliancy=1166.1 %) DL Rf + DL Solar + Wind Up	**PASS**

This Report is based on Code required Engineering Calculations using the data which has been input by the User. This Report indicates the Code compliance or Code non-compliance of the Solar Panels proposed for the Selected Roof Type. This Report has not been reviewed by a licensed Professional Engineer.

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ABSTRACT

This Report is based on Engineering calculations using the input data supplied by the User, listed above. The User's input has not been independently reviewed by a licensed Professional Engineer for appropriateness or accuracy.
This Report indicates Compliance/Non-Compliance with the reference Codes listed below. The following items have been checked for Code Compliance:

- **Load Combination#1**: Wind Uplift on the Standoff attachment to the Roof Framing members: Wind Uplift - 0.6DL Solar
- **Load Combination#2**: Supporting Rafter Strength with: DL Rf + DL Solar + Roof Live Load
- **Load Combination#3**: Supporting Rafter Strength with: DL Rf + DL Solar + Wind Down
- **Load Combination#4**: Supporting Rafter Strength with: DL Rf + DL Solar + Snow
- **Load Combination#5**: Supporting Rafter Strength with: DL Rf + DL Solar + .75Wind + .75Snow
- **Load Combination #6**: Check Additional Seismic Load
- **Load Combination #7**: Supporting Rafter Strength with: DL Rf + DL Solar + Wind Up

Job Information

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Job Address:	123 Main Street
City, State:	Auburn, CA 95603

Current Input Data

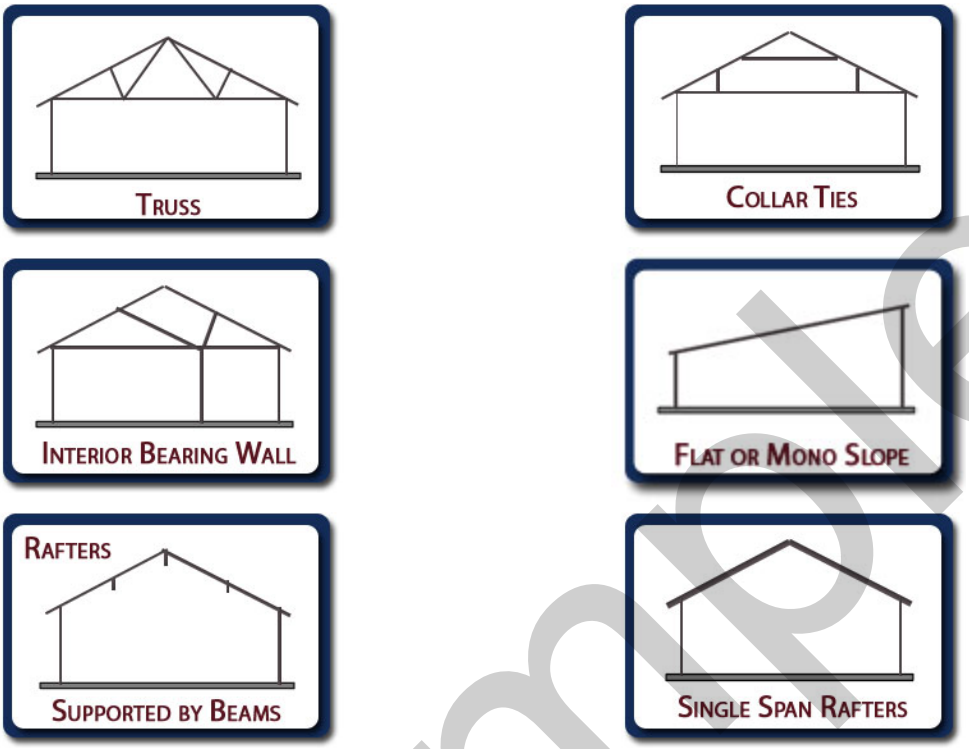
Payment Method	Invoice
Roof Type	Truss
Ceiling Type	None
Collar Tie Space	0
Coverage %	20
Frame Size	2x8@12
Ground Snow (psf)	30
Sloped Roof Snow Load (psf)	30
Lag Screw Diam. (in)	3/8
Lag Screw Embed. (in)	2
Overall Span (ft)	7
PV Weight (psf)	4
PV Width (ft)	4
Rafter Span (ft)	7
Roof Mean Height (ft)	20
Roof Slope (degrees)	20
Roofing Type	Asphalt Shingles
Sloped Ceiling	Yes
Standoff Spacing (ft)	4
Standoff Staggered	Yes
Wind Exposure	B
Wind Speed (mph)	110

Legend: DL=**Dead Load**
Rf=**Roof**

Reporting and Analysis Orgainization
Solar-Roof-Check www.solar-roof-check.com
Email: service@solar-roof-check.com

Reference Codes
International Building Code (IBC latest edition)
American Society of Civil Engineers (ASCE/SEI 7-05, 7-10) National Design Spec. for Wood Constr. (NDS latest edition) CBC and NJ Edition

Roof Types



Basis of the Structural Roof Assessment Report

- This report platform was created by James A. Adams, S.E., after years of reviewing hundreds of Solar Panel plans and performing structural engineering calculations for hundreds of Solar Panel installations across the United States.
- The number of Solar Panel installations throughout the USA is increasing every year. However, the process of obtaining building permits varies from one jurisdiction to another, and can be a maze of municipal red tape. Some jurisdictions require a Professional Engineer's review and seal be placed on the calculations and the permit set of plans. However, what happens to the 70 to 80 percent that do not have any oversight? Are those roofs adequate? Even though the Building Department may not require an engineer's stamp, this does not relieve us of the responsibility of doing a proper job.
- The intent of this reporting methodology is to reduce roof assessment liabilities, by standardizing the roof structural assessment process. The input methodology used in this report is easy, economical, quick, and an accurate way to measure the code compliance or non-compliance of roofs. Having a Structural Roof Assessment Report for every project will insure that proper due diligence has been completed as a necessary part of risk management.
- For companies that have multiple offices across the nation, setting standards for Code compliant installations is a must. Multiple personnel can now self-check the appropriateness of roof structures using the procedures of this Report.

LOAD COMBINATION#1:
WIND UPLIFT

The force created by strong winds will result in Wind Uplift on the Solar Panels. These panels will literally fly off the roof if not anchored securely. The Wind Uplift force is dependent upon the following:

1. **Wind velocity.** The Codes dictate the required minimum wind speed. This varies from one region to another. The wind force is a function of the square of the velocity. For example the uplift force in Florida as compared to California is divided can be 311% more force!!
2. **Topographic features**. Topographic features such as hills and bluffs can increase the wind force by a factor of 2. This Report assumes that the roof under consideration is not on the upper half of a hill or bluff.
3. **Roof height**. The average height of the roof above the surrounding ground. The higher the roof the stronger the Wind Load.
4. **Dead weight**. Dead weight of the roof structure, such as Roofing, plywood, framing, ceiling, insulation and Solar Panels. This all helps resist the Wind uplift force.
5. **Standoff spacing.** The spacing of the standoffs will affect the Wind Uplift force attributed to each standoff. The greater the standoff spacing, the greater the Uplift Wind force.
6. **Standoff connection**. The standoff connection of the Solar Panel rails to the roof framing members is critical. Both the lag screw diameter and the length of threaded embedment into the roof framing members will determine the standoff Uplift capacity.
7. **Proximity of panels**. The proximity of the individual Solar Panels, to the edges of the roof plane. The closer the Panels are to the edges of the roof plane, the higher the wind force.

LOAD COMBINATION#2:
ADDED WEIGHT OF THE SOLAR PANELS

Load Combination#2 reviews the strength of the rafters which support the Solar Panel system under Existing Roof Dead Load + Solar Panel added Dead Load + Roof Live Load.

The roof framing members supporting the Solar Panel standoffs are going to be asked to support additional loads. These loads include the added weight of the Panels.

The standoff spacing accumulates the area (tributary area) which is loaded, creating a concentrated load at each standoff. Prior to the installation of the Solar Panels, the normal superimposed loads such as Wind, and Snow, would be uniformly distributed over the roof. Now they will be concentrated at the standoff locations.

By decreasing the standoff spacing, you can decrease the downward concentrated load..

Load Combination#3:
Added Weight of the Solar Panels plus Wind Downward

Load Combination#3 reviews the strength of the rafters which support the Solar Panel system under existing Roof Dead Load + Solar Panel added Dead Load + Wind Force acting Downward.

The roof framing members that support the Solar Panels, must be able to carry the additional weight of the Panels, plus the additional accumulated Wind Load acting downward on the panels.

The standoff spacing will accumulate the area (tributary area) which is loaded, creating a concentrated load at each standoff. Prior to the installation of the Panels, these loads would be uniformly distributed over the roof, but now they will be concentrated at the standoff locations. Decreasing the standoff spacing will decrease the downward concentrated load.

Load Combination#4:
Added Weight of the Solar Panels plus Snow Loads

Load Combination#4 reviews the strength of the rafters which support the Solar Panel system under existing Roof Dead Load + Solar Panel added Dead Load + Snow Loads.

Certain roof framing members are going to be asked to support the additional weight of the Panels, plus the additional accumulated Snow Load acting downward on the panels. The standoff spacing will accumulate the area (tributary area) which is loaded, creating a concentrated load at each standoff. Prior to the installation of the Panels, these loads would be uniformly distributed over the roof, but now they will be concentrated at the standoff locations. Decreasing the standoff spacing, will decrease the downward concentrated load.

Load Combination#5:
Added Weight of the Solar Panels
75% Snow Load + 75% wind Downward

Load Combination#5 reviews the strength of the rafters which support the Solar Panel system under Existing Roof Dead Load + Solar Panel added Dead Load + 75% Snow Loads + 75% Wind Doward.

Certain roof framing members are going to be asked to support the additional weight of the Panels, plus the additional accumulated Snow Load acting downward on the panels. The standoff spacing will accumulate the area (tributary area) which is loaded, creating a concentrated load at each standoff. Prior to the installation of the Panels, these loads would be uniformly distributed over the roof, but now they will be concentrated at the standoff locations. Decreasing the standoff spacing, will decrease the concentrated load.

Load Combination#6:
Seismic Review

Often overlooked, a review of the Seismic Forces is very important. Installing Solar Panels on the roof of an old garage, for example, may not be appropriate without further investigation. Is the garage capable of withstanding an earthquake even without the added weight of the Panels? Does it contain any visible shear resisting elements? (Cross bracing, shear walls?)

Adding too much coverage of Solar Panels on the roof, could trigger the requirement to analyze the entire structure under current Code established Seismic Loading, This could be very challenging, even if the existing house plans are available, and may require strengthening of the seismic resisting elements. If Load Combination#6 reveals Seismic to be non-code compliant, decreasing the percentage of coverage of the roof by the Solar Panels should be considered. Otherwise, strengthening the existing structure is always a possibility.

LOAD COMBINATION#7:
ADDED WEIGHT OF THE SOLAR PANELS
PLUS WIND UPWARD

Load Combination#7 reviews the strength of the rafters which support the Solar Panel system under existing Roof Dead Load + Solar Panel added Dead Load + Wind Force acting Upward.

The roof framing members that support the Solar Panels, must be able to carry the additional weight of the Panels, plus the additional accumulated Wind Load acting upward on the panels.

The standoff spacing will accumulate the area (tributary area) which is loaded, creating a concentrated load at each standoff. Prior to the installation of the Panels, these loads would be uniformly distributed over the roof, but now they will be concentrated at the standoff locations. Decreasing the standoff spacing will decrease the upward concentrated load.

REFERENCES

Codes

- **International Building Code (IBC latest edition)**
- **American Society of Civil Engineers ASCEI 7-05 and ASCE 7-10**
- **National Design Spec. for Wood Constr.(latest edition including 2012 NDS Changes)**
- **California Building Code**
- **New Jersey Editions**