



STRUCTURAL CONSIDERATIONS – ROOF TOP SOLAR PANELS: FOR NEW OR EXISTING BUILDINGS

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SUMMARY

Criteria to be considered for the installation of roof top solar panels: system additional self weight, snow drift load, wind pressure, and original and future design loads.

STRUCTURAL CONSIDERATIONS: ROOF TOP SOLAR PANELS

With the advent of the green technologies and environmental energy directives, solar panels are becoming more and more popular. Different jurisdictions, such as Ontario, had introduced incentive programs and green focused by-laws on new construction. The Canadian market, and more noticeably the Ontario market for solar photovoltaics (PV) have developed steadily over the past decades, and swiftly over the past years, with the financially lucrative FIT (Feed-in Tariff) and MicroFit programs.

The popular FIT and MicroFIT programs, administered by the Ontario Power Authority, pay property owners up to \$0.80 per kilowatt hour for solar generated electricity. With returns on investment up to 20%, depending on the type of system installed, these systems appear to be beneficial and profitable. Due to these incentive programs, there is a growing interest in installing solar panels on roof tops, either a water heating or photovoltaic system. The weights of these systems and their method of construction can vary and must be contemplated during the design phase.



Considerations for roof top solar panel installation

When installing solar panels on roof tops there are structural considerations to be investigated and analyzed. Solar panels can be placed on new or existing buildings. Solar panels can easily and inexpensively be incorporated at the time of design for new or future construction. The structural system can be designed to accommodate the additional loading from the system self weight (dead load), snow build-up, and wind uplift. Existing buildings must be investigated due to the additional loading caused by the solar panels. Since many agencies regulating the building codes have modified the base snow load, it must be validated in addition to considering the weight of the solar panels. All future loading must be considered and all structural elements must be analyzed from the roof deck to the foundation.

Characteristics of open web steel joists and steel deck

Many existing buildings being considered for midsize and large solar roof top systems are constructed with open web steel joists (OWSJ) and steel deck. Generally speaking, the joists are located at a spacing that allows for an efficient deck thickness. The deck may have limited additional capacity and therefore must be analyzed utilizing the manufacturer's drawings and field measurements. If the deck is deemed to have inadequate capacity, a cost effective remediable repair to increase the strength can be coordinated with your local Canam office.

OWSJ's are proprietary products engineered and manufactured by the joist manufacturer. Steel joists are commonly used in the construction industry due mainly their efficient design. Typically, each manufacturer such as Canam, designs their products to meet the design loads set forth by the building designer. Unless the building designer has allowed for additional load capacity, the steel roof joists will be designed as efficiently as possible to meet code requirements, leaving minimal additional strength capacity.

Analyzing existing OWSJ's without the manufacturer's design calculations is an onerous and tedious process. The manufacturer's design and fabrication processes allow for material changes within the chords and webs. Since steel thicknesses may differ by 0.5 mm, the field measurements must be surveyed accurately. For additional information on measuring existing joists, please refer to the InfoTech Express article Field measurement for existing joists requiring reinforcement.

Design requirements for fabrication

The OWSJ designer may change the joist design based on load considerations so the design cannot be determined only by a basic visual inspection. Two similar joists could have numerous differences in the welding, and web and chord thicknesses and therefore must be correctly measured for comparison purposes. It is recommended to validate the manufacturer's joist tag to ensure that they are indeed identical.

The grade of steel used in the original fabrication may be difficult to determine as well. Canam has published a steel grade table as a guide for our products: History of steel grades used in joist and joist girder fabrication. It is recommended to contact your local Canam office since steel grades could vary for specific projects or on the inventory available at the time of manufacture.

A standard roof system with a total unfactored load of 2.5 kPa (depending on the region) could be subjected to an additional solar panel load in the 0.4 kPa range. Since the OWSJ's will certainly not have 16% of additional capacity, remedial measures must be undertaken if the building design loading cannot be reduced. The joists can be strengthened by traditional welding methods, which can cause disturbances to the occupants of the building, or a non-welding solution can also be investigated.



It must be noted, that other structural elements must be reviewed in conjunction with the OWSJ's and the deck. Elements such as the joist girders, beams, columns, load bearing walls and foundations must also be investigated.

Conclusion

In conclusion, solar panels added to existing roofs must be analyzed thoroughly. By adding even a relatively small amount of additional weight, such as solar panels, all structural elements must be reviewed and analyzed completely. Since the National Building Code of Canada modified the base snow load from time to time, this factor should be considered in conjunction with the additional load applied to the structure. The exact placement of solar panels can cause additional snow build-up and uplift which affect the structural elements. With respect to Canam's products such as OWSJ's and steel deck, these additional loads can cause structural elements to be overstressed.

Canam has assisted in developing reinforcement solutions to both OWSJ's and deck to increase their existing capacity. These solutions are offered through both a welded and non-welded process. Please contact Canam for further information on these solutions or any of our other products and services.

Canam's trained professional employees are always available to provide assistance with engineering support and guidance.



Should you require additional information, wish to meet with one of our representatives or experts to learn more about our products and services or to organize a lunch and learn, please call: **1-866-466-8769**.

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