



Structural - Solar Panels

Johnson Engineering Consultants Inc.

Stratford Office

368 Huron Street, Stratford, Ontario, N5A 5T5
Phone: (519) 271-9923 (1-800-468-1476) Fax: (519) 271-5353
jecstrat@jecinc.on.ca

Structural Considerations for Roof Top Solar Panels in Ontario, Canada

Today, everyone is working towards living in a "greener" environment. One option that has been getting some serious attention lately, is the growing interest in installing solar panels, both photovoltaic and water heating systems, on roof tops in Ontario, especially since the Feed-in-tariff (FIT) program was announced by the Ontario Power Authority in September 2009.

New buildings that are being proposed for construction can easily and inexpensively have their structural system designed to accommodate the weight (dead load) of these solar energy systems, but at the same time, it is rarely true for existing buildings.

Existing buildings should be evaluated for the extra loading that the solar panels apply to the roof assembly. Solar panels may not only add dead weight to the structure, but may also cause snow accumulation to be increased compared to the original roof design. Additionally, how the snow load is transferred through the solar panel support system may cause a relocation of WHERE the load is applied to the roof which also may be a problem in itself.

Another potential problem to consider is that the design snow loads for many areas in Ontario were increased slightly in the 2006 revision of the Ontario Building Code.

All of these items mean that it is unlikely that the existing building was designed to handle additional capacity and even if it were analyzed today, it would likely not meet today's loading requirements, let alone support the additional weight of solar panels.

Wood or Steel Truss Roofs

Many small buildings use wood truss roof systems while many medium and large buildings use steel truss roof systems (also called open web steel joists or OWSJs). This type of roofing system has proven to be an economical structural system that has been tested through decades of use. The main reason why a truss roof system is economical also becomes the problem when you attempt to add loads to accommodate solar panels. Trusses are typically designed to meet the minimum design loads as specified in the Ontario Building Code for the specific building they are to be installed in, so unless someone has specified that the trusses be designed for extra loading, they will not have additional capacity.

Analyzing an existing truss can be a time consuming process, particularly if plans for the existing trusses are not available. Not only do the design loads need to be determined for the building, all of the existing members need to be measured before any structural calculation can be performed. The truss manufacturer's goal is geared toward selling roof systems as economically as possible, in as large a volume as possible. Analyzing an existing truss is not a service normally offered by truss manufacturers.

It is also important to note that many wood trusses have proprietary connection plates (connections are a weak point in wood structures) and information about these connections must be obtained to properly assess the structural loading capacity.

Structural systems used to support these roof systems are discussed briefly later in this brochure.



Illustration 1.: Wood Trusses



Illustration 2.: Open Web Steel Joists

Rigid Frame Steel Building Systems

Often called 'pre-engineered buildings', the exterior columns of this style of structural system changes in size and shape from the foundation to the roof. Because of the changing cross-sectional shape of the members, this type of structure is very time consuming to analyze. It is also highly unlikely that additional capacity was built into these systems.

Standard Sized Rafters, Roof Joists, and Beams

This type of system is easier to analyze and usually the system is also relatively easy to strengthen members (by sistering a joist beside the first joist). Also in smaller buildings, these systems are often designed from tables and "rounded up" to the next standard size so there is some hope of finding that the existing joists/rafters may have additional capacity.

Structural systems used to support these roof systems are discussed briefly later in this brochure.



Illustration 3.: Rigid Frame Steel Structure



Illustration 4.: Wood Joists and Steel Beam

Structures With Roof Systems Supported by Columns

Columns and the concrete piers and footings upon which they rest, are typically custom designed to support the loads they need to carry. It is highly unlikely that additional capacity was considered and therefore not built into these systems.

Column footings for small buildings originally designed under Part 9 of the Ontario Building Code may have extra capacity since the OBC assumes weak soil bearing in order to apply to the majority of areas in Ontario. A Professional Engineer has the authority to decide that the soil bearing capacity of your site is greater than required by the original design (meaning that it can accept larger loads) but exposure of the footing and adjacent soil should be expected in order to complete an investigation which may nullify any cost benefits from this approach.

Structures With Roof Systems Supported by Loadbearing Walls, Foundations, and Strip Footings

This type of structural support system often has some amount of additional capacity, however, a review would have to be carried out to determine the amount of additional capacity that is available.

Practical solutions if your structure is not strong enough

- Strengthen the existing system. This is usually disruptive to operations in the building. Cost-wise it is likely comparable to building an addition.
- Support new loads with new members. This might include separating new loads from the existing system by adding new columns under the roof and/or adding new roof joists above or below the existing roof. This might be the least expensive way to accommodate extra loads, but it should be expected that it will result in having additional columns.
- Consider a building addition that is designed to carry the additional loads without affecting the original structure. If you are considering a building addition anyway, this would be the least expensive way to accommodate extra roof loading.
- Build a separate external structure. Although you could construct an elevated support framework, ground mount is likely the least expensive option in this scenario

Taking the easy way out

Some building owners may be tempted to install a system without proper review. While this may sound like an attractive option, you should consider how it might affect your insurance coverage if any problems occur in the future. Also, it is unknown what problems this option may cause during a resale of the property with an astute buyer's lawyer (many are now asking for building department clearance of even small building additions).

Are solar panels part of your future construction project or building upgrade?

Please consider choosing Johnson Engineering Consultants Inc. to handle all of your engineering requirements. With over 40 years of engineering expertise providing practical, hands-on advice, such as providing you with the information in this brochure, let us put our team to work for you.

In addition to structural engineering services, Johnson Engineering Consultants Inc. also provides engineering services for site design and site servicing, subdivisions, stormwater management, agricultural structures, Ontario Building Code reviews, electrical and mechanical design, and industrial safety review.

Please visit our web site at <http://jecinc.on.ca> or contact us for your engineering needs.