Engineers

MULTI-TENANT INDUSTRIAL BUILDING

SOLAR PANEL STRUCTURAL FEASIBILITY STUDY

8000 Avenue Blaise-Pascal, Montreal

Prepared for:

Dream Unlimited
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1.0 INTRODUCTION

Further to your request, Read Jones Christoffersen Ltd. (RJC Engineers) completed a preliminary structural review on the roof structure for the building located at the above noted site, per our proposal dated September 12, 2025. The purpose of this review is to determine whether the as-built structure has sufficient reserve capacity to support the installation of new solar panel systems.

RJC personnel were onsite on November 4th, 2025, to perform a preliminary review of the as-built structure, and roof systems. Specifically, RJC's scope of work included the following:

1. Request for, and review of any structural building record drawings to assist with our evaluation, however at this site, no record drawings were available for our review.
2. On-site review of the subject building to confirm the general as-built structural framing systems, both from the ground level and via scissor lift.
3. Visual review of the roof surface to determine likely roofing system assemblies.
4. Preliminary loading analysis to determine whether there is reserve structural capacity to support density solar panel system on the roof surface.

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2.0 BUILDING DESCRIPTION

2.1 GENERAL DESCRIPTION OF THE BUILDING AND ROOF STRUCTURE

The site located at 8000 Avenue Blaise-Pascal is adjacent to Highway 25 in Montreal, Quebec. The building is divided into two different parts. The first includes the original building, the construction year of which is 1993, while the second is a recent expansion carried out in 2023. Based on the information we received from Dream, a budget is planned for replacing part of the roof in 2026-2028. No structural building drawings were made available to RJC related to the original building, but we received IFC drawings for both architectural and structural for the expansion.

Based on this, the overall locations reviewed include the roof exterior and the warehouse. Following a general visit of the building, the survey was conducted at a location that seemed the most representative as shown in figure 1. A typical bay was surveyed, and the building structure consists of typical open web steel joists (OWSJ) spanning approximately 39'-4" and supported on Gerber girder beams spanning approximately 39'-4" (figure 2). A typical OWSJ consists of 2' spans between panel points and a height of 26 1/8". The top and bottom chords consist of steel omega-shaped sections, while the web members consist of circular rods. The OWSJ supporting system consists of a 8 1/2" wide by 20 7/8" high Gerber girder and a 7 5/8" wide by 18 1/8" high link beam connected at the cantilever point of the girder. The cantilever span is 79 1/4".

Based on our observations as well as a 2024 roof inspection report, according to figure 3, basins 1 to 10 are Built-Up-Roof (BUR) systems with an approximately 3/4" thick gravel overlay (figure 4) and basin 11 is an EPDM system with ballast. Basin 12 is the 2023 expansion and is composed of a TPO system according to the original architectural drawings.

3.0 TYPES OF SOLAR PANELS

Roof mounted PV Solar Panels are typically supported by racking systems which come in two basic forms. The first is a mechanically fastened system and the second, the more common of the two, is a ballast restrained system. The mechanically fastened system penetrates through the roofing membrane and can be used in pitched roofs and flat roofs. A complete mechanically fastened PV system, including the panels and the racking, weighs between 0.10 kPa to 0.24 kPa. The more common systems are restrained on the roof by ballast weights and have no roof penetrations. These systems are typically low profile and are installed on flat roofs. They can be easily installed on the roof surface and are usually more economical. The average weight of a ballast system can range from 0.17 kPa to 0.34 kPa which includes the racking, the panels, and the average weight of the ballasts over the surface area of the PV system. The distribution of the ballasts on a roof is typically not uniform and usually has more weight concentrated along the edges and corners of a building, where wind loads are higher. In high seismic zones and post-disaster buildings, special consideration may also be required to prevent sliding of the PV system.

Due to the variability of panel weights, a design load of 0.5 kPa would typically be considered. However, for the purpose of the project and since they are existing structures, it's crucial to choose the lightest possible system and avoid any additional snow accumulation. Additionally, if the work needs to comply with NBCC 2020 (as of October 2026 in Quebec), new articles specify more critical loads for snow and wind effects. The supplier can however carry out wind tunnel tests to ensure compliance with the tolerances allowed for PV panels.

4.0 STRUCTURAL ASSESSMENT

For the original building, as mentioned in the previous section, without any structural building record drawings available to assist our analysis, RJC completed a visual review of the roofing and structural systems, alongside taking a limited sampling of typical structural member sizes and layouts to perform a preliminary analysis to determine if the existing building structure can facilitate the addition of photovoltaic system onto the roof.

RJC completed this analysis based on the observed general structural layout of the building, in reference to the 2015 NBCC and structural commentary L – "*Application of NBC Part 4 of Division B for the Structural Evaluation and Upgrading of Existing Buildings*". According to table L-1 (figure 5), when evaluating an existing structure with no change of occupancy load, we can use reduced load factors at ultimate limit states as prescribed in Commentary L, as well as the original snow loads. However, in the case of a "*Design of upgrade*" involving an increase in load due to solar panels, current code loads are required, and current load factors are also recommended.

For this type of industrial structure, the maximum load that can be applied to the roof typically depends on the capacity of the steel joists. As this product is optimized for design loads, we can expect utilizations approaching 95% to 100%. The method proposed in this report is to validate the original utilizations of the joists according to an estimate of existing loads. Based on these conclusions, it will be possible to assess whether a surplus capacity is available. The surveyed joist was selected to ensure it was not near a mechanical unit likely to cause snow accumulation, to confirm the basic design loads. Existing loading values are determined by visual review of roof composition on site and by common practice used loads for this type of building as shown on table 1.

Table 1 – Summary of roof loading values (Built-Up-Roof) – Original building

Existing dead load	Unfactored Area Load (kPa)
Built-up-roof + ¾" ballast overlay	0.72
Steel deck (38mm)	0.10
Mechanical & electrical	0.15
Existing Total dead load	0.97
2015 NBCC snow load	2.78
1990 NBCC snow load	1.84

For the 2023 expansion, we have design loads from the original structural drawings, see table 2.

Table 2 – Summary of roof loading values (TPO) – 2023 expansion

Existing dead load	Unfactored Area Load (kPa)
Existing Total dead load	1.00
2015 NBCC snow load	2.78

For basin 11, which is composed of an EPDM membrane, no survey and analysis have been carried out on this part as it does not represent a significant percentage of the surface area. We do not have any indication if recent renovations have taken place and if the original system was the same as the BUR system of basins 1 to 10.

To be noted that in Quebec, the code in effect for calculating loads on buildings is the "*Quebec Construction Code, Chapter 1 – Building*", and the National Building Code of Canada 2015 (amended). When a building undergoes a transformation, its ability to withstand seismic loads must comply with the requirements of clause 10.4.1.3 per Part 10 of Chapter 1. According to this clause, the transformation must undergo seismic upgrading to resist a minimum of 60% of the seismic loads calculated in accordance with Part 4 of the National Building Code (NBC) 2015 if the transformation results in an increase in the permanent load of more than 5% of the building. For this type of single-story industrial steel structure, the mass of the building is essentially defined by the mass of the roof. For example, adding 0.25 kPa to a 1.00 kPa roof represents approximately 15-25% increase in permanent load, and consequently, an approximately equivalent increase in seismic demand must be taken up by the original bracing system and foundations.

SAP2000 from Computers and Structures, Inc. (CSI) has been used to perform a typical joist analysis of the structure. Figure 6 shows the general geometry model, and a yield stress value of 300 MPa has been used for all steel members.

5.0 RECOMMENDATIONS

According to our analysis results, the existing steel joists are designed to support a maximum dead load equivalent to the one detailed in table 1, considering the reduced load factors from Commentary L and the 1990 NBCC snow load. Based on this analysis and our experience with OWSJ design practices and historical performance, we are of the opinion that the OWSJ systems installed on site are not suitable to withstand the addition of photovoltaic systems if installed onto the existing roofing assemblies. Reinforcing would therefore be required to support additional weight especially since this is considered a "*Design of upgrade*" application according to NBCC commentary L, requiring an update with the current structural design standards as well as the current NBCC loads.

The most viable option for the original building structure at 8000 Blaise-Pascal, avoiding a "*Design of upgrade*", is to relieve the structure from its original dead loads and to not exceed them. Removing the 3/4" ballast would free up to 0.36 kPa, which would be sufficient to accommodate light to medium density PV panels. However, due to the BUR nature of the roof, it must retain a minimum of ballast for durability. The roof should therefore be changed to a light TPO or conventional roof system. The total surplus capacity freed up would be 0.60 kPa for PV panels (table 3).

Table 3 – Summary of roof loading values (TPO) – Original building – With PV panels

Existing dead load	Unfactored Area Load (kPa)
TPO system no ballast	0.10
Steel deck (38mm)	0.10
Mechanical & electrical	0.15
PV panels	0.60
Existing Total dead load	0.95
2015 NBCC snow load	2.78
1990 NBCC snow load	1.87

For basin 11, although we do not have an in-depth study, it would be possible to conclude the same thing as basins 1 to 10, that is, switching to TPO or conventional roof without ballast. Would free up the same order of magnitude of surplus capacity.

Note that our analysis is based on only one bay, allowing us to mention that the design loads seem to be close to 15 PSF (0.72 kPa) historically considered for a BUR system. These loads include a maximum of 3/4" to 1" of ballast. If the thickness exceeds this value in certain areas, it should not be concluded that it is possible to remove only the ballast necessary to compensate for the weight of the PV panels, as the loads may possibly exceed the existing capacity. We recommend monitoring ballast thickness to the minimum required without exceeding capacity.

For the 2023 expansion, the design loads for the joists are rather conservative, which is 1 kPa for a light TPO roof system. By making a more realistic estimate of the loads, it is possible to free up a surplus capacity of 0.40 kPa, which should be sufficient to accommodate light to medium density PV panels (table 4).

Table 4 – Summary of roof loading values (TPO) – 2023 expansion with PV panels

Dead load	Unfactored Area Load (kPa)
TPO system no ballast	0.10
Steel deck (38mm)	0.10
Mechanical & electrical	0.25
Steel joists	0.15
PV panels	0.40
Total dead load	1.00
2015 NBCC snow load	2.78

6.0 CLOSING REMARKS

Thank you for selecting Read Jones Christoffersen Ltd. for this project. RJC would be pleased to assist you with the implementation of our recommendations. Should you have any questions or concerns, please do not hesitate to contact this office.

This report prepared by:

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APPENDIX A: PHOTOGRAPHS

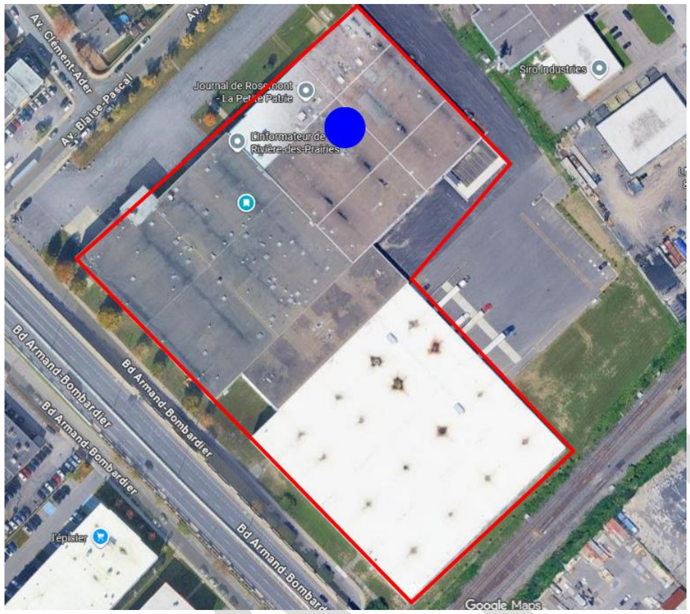

Figure 1 – Approximate location of survey represented by the blue dot

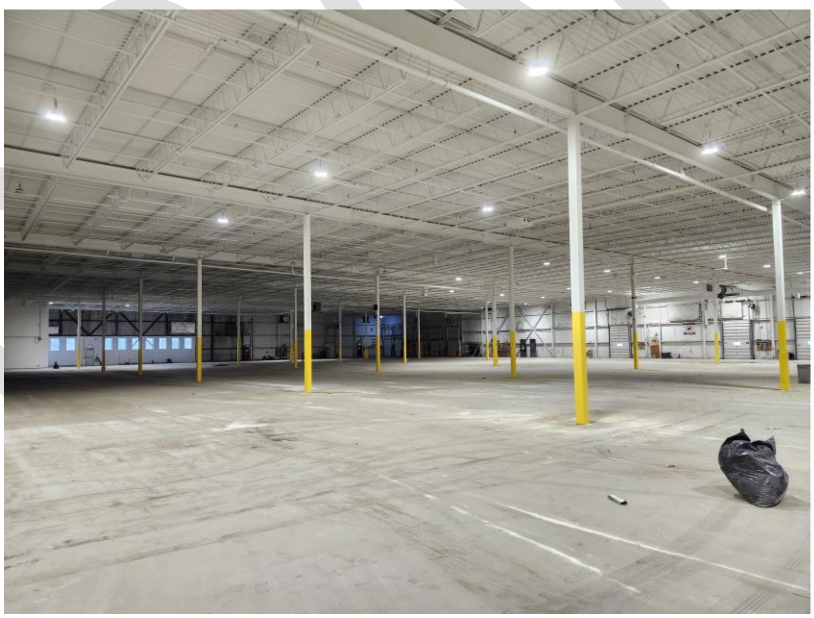

Figure 2 – Overall roof structure of the warehouse

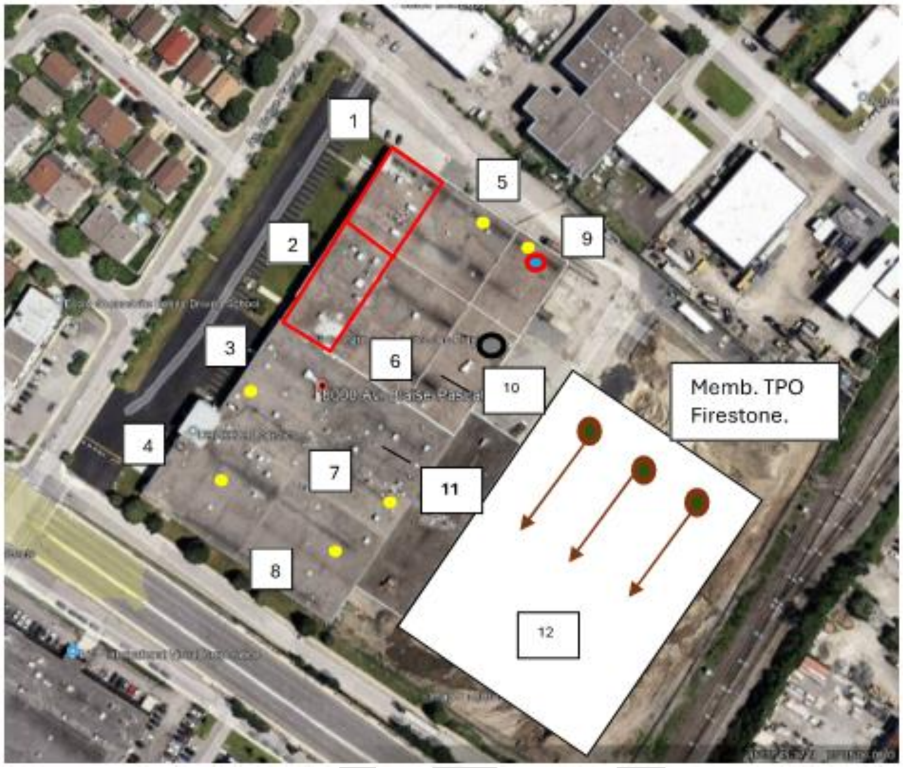

Figure 3 – Representation of the basins, LA POINTE DU CONSEIL, 2024

Figure 4 – Ballasted roof with approximately 3/4" thick gravel overlay

Table L-1
Recommended Loads, Load Factors and Structural Design Standards[1]

Application	Current Code/Standards			Current Commentary L	Code/Standards when Built	
	Loads	Load Factors	Structural Design Standards	Load Factors	Loads	Structural Design Standards
Evaluation						
no change in use or occupancy loads	✓	✓	✓	✓	✓ (2)	✓ (2)(3)
change in use or occupancy loads	✓	✓	✓	✓	X	✓ (2)(3)
Design of upgrade	✓	✓ (4)	✓	✓ (4)	X	X

Figure 5 – Extract from NBCC 2015 Commentary L regarding load factors that may be used for analysis

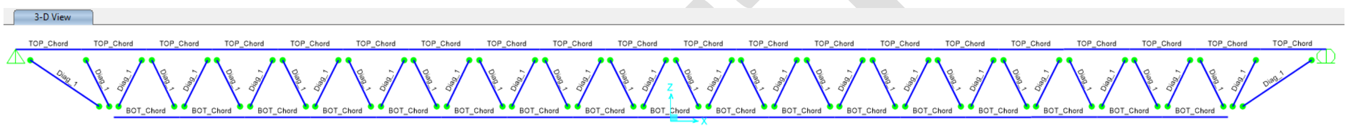

Figure 6 – SAP2000 typical joist geometry model