LARO EXPERTS
Ingénieur en Bâtiment/Structure
Conseillers en Construction
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INFLATABLE TENTS – HANGAR 15X30

CALCULATIONS OF SUPPORTING ANCHORS

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INFORMATION ON THE CONTRACT

PROJECT

Determinations of the number of anchors and their required strengths in order to support wind and snow loads. Self-supporting inflatable tent with 15 meters wide by 30 meters long rectangular base.

2020-08-21

Revision : 1

CLIENT

INFLATABLE TENT INC- M2B INFLATABLE.

SUMMARY

The mandate given to LARO EXPERTS-CONSEIL aims to establish the number of anchors required to withstand wind and snow loads. The tent will be installed in various public places in Canada. To achieve this goal, the inflatable structure was modeled with several simplifications and was evaluated under wind and snow loads. The mandate is thus to ascertain the number of anchors required to withstand wind forces, in addition to the resistance necessary to avoid their pullout.

This document is written based on the technical data provided by INFLATABLE TENT INC- M2B INFLATABLE.

The tent discussed in this report is a self-supporting inflatable structure. Its base is rectangular shaped, and the roof is dome-like. Its approximate dimensions are 15x30 meters at its base and a total of 9,98 meters in height.

Based on the data received, our analysis was constructed with wind and snow constraints.

DESCRIPTION OF THE STRUCTURE

INFLATABLE TENT INC- M2B INFLATABLE provided all technical data.

The tent discussed here has a rectangular base whose dimensions are 15x30 meters and its roof forms a dome with a square base, bringing the structure to its highest level, 9,98 meters. The structure is a self-supporting inflatable type, and its walls are composed of pressurized air between two flexible membranes.

The wind loads considered in this report are established at gusts of 50 km/h, 70 km/h and 120 km/h.

(75 mph).

Comply with CAN ULC S109 and NFPA 701 requirements.

With an internal pressure of 0.48kPa, the inflatable structure will resist to a 150 mm height of snow load without any important or unsafe deflexion.

As the tent is a temporary installation, the idea here is not to comply with the National Building Code of Canada (NBC) but to determine if the installation can be used while ensuring the safety of users.

WIND LOADS

In this structural analysis, we modeled one case. The wind load was simulated on the X+, X+Y+ and Y + (Figure 1, Figure 2, Figure 3, respectively).

As an example, this is a wind load of 90 km/h is here modeled by the wind tunnel simulation. The same process was done with 50 km/h and 70 km/h gusts.

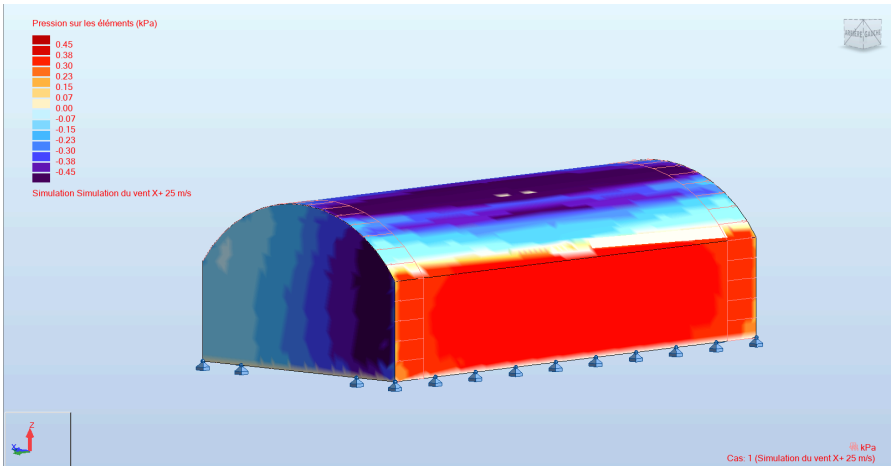


FIGURE 1 : DISTRIBUTION OF THE WIND LOAD ON THE X+ AXIS. AT 50 KM/H WIND GUST

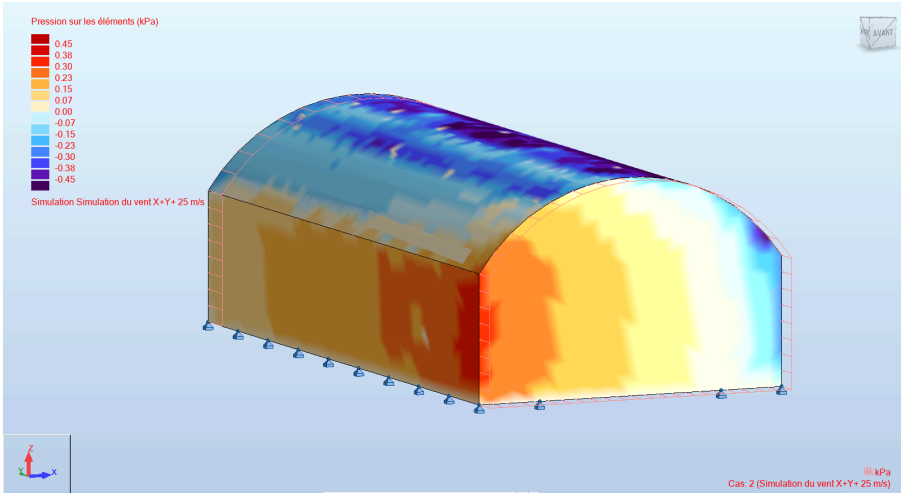


FIGURE 2 : DISTRIBUTION OF THE WIND LOAD ON THE X+Y+ AXIS AT 90KM/H WIND GUST

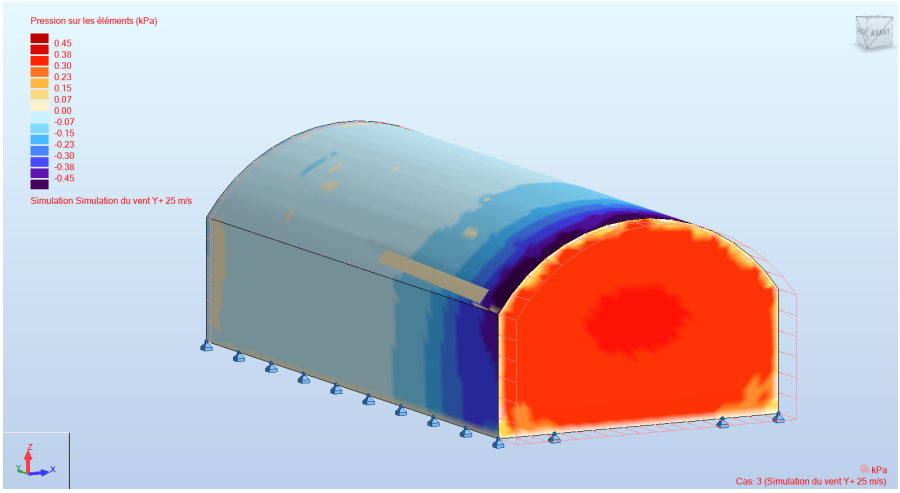


FIGURE 3 : DISTRIBUTION OF THE WIND LOAD ON THE Y+ AXIS AT 90KM/H WIND GUST

STANDARD AND SAFETY FACTOR

Since the wind load is considered as the service load, a weighting factor of 1.0 is applied for the risk coefficient, taken from 2015 NBC's combined load equations.

MODELIZATION- SIMPLIFIED MODEL

In order to simplify the analysis, only a simplification of the tent reproducing the physical characteristics was used for the modeling. This simplification has a weakening impact on the structure as the weight of the structure itself opposes the critical wind load. By doing so, the reaction values at the supports of the structure are slightly higher than the actual values. This means that the wind resistance is ensured by using ground anchoring and bracing, and not only with the weight of the structure itself.

ANALYSIS

In this analysis, 3 different wind gust speed were evaluated. These speeds affect the number of anchors and/or the pullout resistance required by each anchor as shown in *Table 1 – wind velocity and anchors required.*

There is no maximum number of anchors to stabilize the structure as long as the minimum total pullout resistance is respected.

Wind speed (km/h)	Minimum total pullout resistance (lbs)	Minimum number of anchors
50	850	24
70	1500	24
120 (75 mph)	2900	24

900X (sand bag 66 pds)

TABLE 1 – WIND VELOCITY AND ANCHORS REQUIRED.

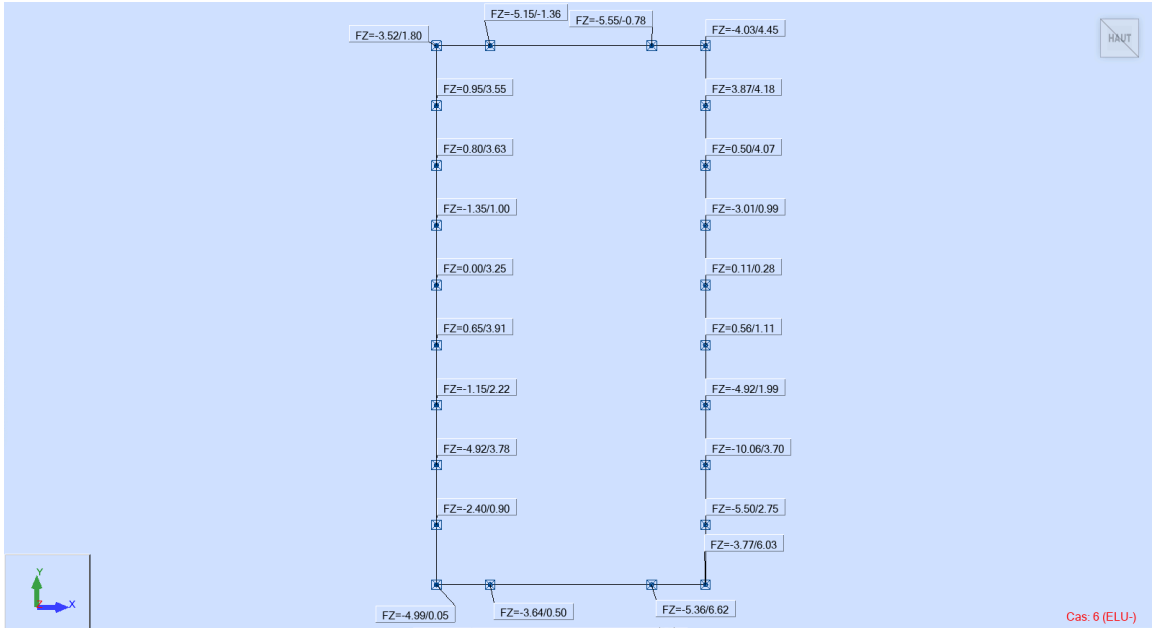


FIGURE 4 : ANCHORS REACTIONS IN VERTICAL AXIS AT 90KM/H

CONCLUSION

The results obtained from the analysis of the simplified model of the structure, using the measurements provided by INFLATABLE TENT INC- M2B INFLATABLE, allow a conclusion stating that each anchorage must comply with *Table 1 – wind velocity and anchors required.*

Louis Larouche, ing.

NOTES OF CALCULATIONS

Project: AR20-EV008
Inflatable tents
Self supportant inflatable tent - Hangar 15m x 30m
Basic wind speed: 50 km/h

Prepared by: Alexandre Létourneau
Verified by: Louis Larouche ing.

charges

	Cas	Type de charge	Liste	Valeurs de la charge
	1	(EF) surfacique uniforme	16	PZ=-0.00[kN/m2] local
	1	(EF) surfacique uniforme	13	PZ=-0.05[kN/m2] local
	1	(EF) surfacique uniforme	15	PZ=0.05[kN/m2] local
	2	(EF) surfacique uniforme	16	PZ=-0.00[kN/m2] local
	2	(EF) surfacique uniforme	13	PZ=0.02[kN/m2] local
	2	(EF) surfacique uniforme	15	PZ=0.02[kN/m2] local
	3	(EF) surfacique uniforme	16	PZ=0.01[kN/m2] local
	3	(EF) surfacique uniforme	13	PZ=0.06[kN/m2] local
	3	(EF) surfacique uniforme	15	PZ=0.02[kN/m2] local

Réactions: Extrêmes globaux

Repère global - Cas: 1A3 5 6 8 9

	FX [kN]	FY [kN]	FZ [kN]	MX [kNm]	MY [kNm]	MZ [kNm]
MAX	0.66	1.82	2.35	0.00	0.00	0.00
Noeud	178	178	178	190	161	215
Cas	ELU/3	ELU/1	ELU/3	ELU/3	ELU/3	ELU/1
MIN	-0.87	-2.33	-3.70	-0.00	-0.00	-0.00
Noeud	152	178	154	214	215	178
Cas	ELU/3	ELU/3	ELU/3	ELU/3	ELU/3	ELU/2

NOTES OF CALCULATIONS

Project: AR20-EV008
Inflatable tents
Self supportant inflatable tent - Hangar 15m x 30m
Basic wind speed: 70 km/h

Prepared by: Alexandre Létourneau
Verified by: Louis Larouche ing.

charges

	Cas	Type de charge	Liste	Valeurs de la charge
	1	(EF) surfacique uniforme	16	PZ=-0.00[kN/m2] local
	1	(EF) surfacique uniforme	13	PZ=-0.08[kN/m2] local
	1	(EF) surfacique uniforme	15	PZ=0.08[kN/m2] local
	2	(EF) surfacique uniforme	16	PZ=-0.00[kN/m2] local
	2	(EF) surfacique uniforme	13	PZ=0.04[kN/m2] local
	2	(EF) surfacique uniforme	15	PZ=0.04[kN/m2] local
	3	(EF) surfacique uniforme	16	PZ=0.01[kN/m2] local
	3	(EF) surfacique uniforme	13	PZ=0.10[kN/m2] local
	3	(EF) surfacique uniforme	15	PZ=0.04[kN/m2] local

Réactions: Extrêmes globaux

Repère global - Cas: 1A3 5 6 8 9

	FX [kN]	FY [kN]	FZ [kN]	MX [kNm]	MY [kNm]	MZ [kNm]
MAX	1.16	3.27	4.17	0.00	0.00	0.00
Noeud	178	178	178	157	178	178
Cas	ELU/3	ELU/1	ELU/3	ELU/3	ELU/2	ELU/3
MIN	-1.55	-4.12	-6.58	-0.00	-0.00	-0.00
Noeud	152	178	154	158	215	182
Cas	ELU/3	ELU/3	ELU/3	ELU/3	ELU/1	ELU/1

NOTES OF CALCULATIONS

Project: AR20-EV008
Inflatable tents
Self supportant inflatable tent - Hangar 15m x 30m
Basic wind speed: 90 km/h

Prepared by: Alexandre Létourneau
Verified by: Louis Larouche ing.

Chargements - Cas

Cas	Préfixe	Nom du cas	Nature	Type d'analyse
1	VENT7	Simulation du vent X+ 25 m/s	vent	Statique linéaire
2	VENT8	Simulation du vent X+Y+ 25 m/s	vent	Statique linéaire
3	VENT9	Simulation du vent Y+ 25 m/s	vent	Statique linéaire
4		ELU		Statique linéaire
5		ELU+		Statique linéaire
6		ELU-		Statique linéaire
7		ELS		Statique linéaire
8		ELS+		Statique linéaire
9		ELS-		Statique linéaire

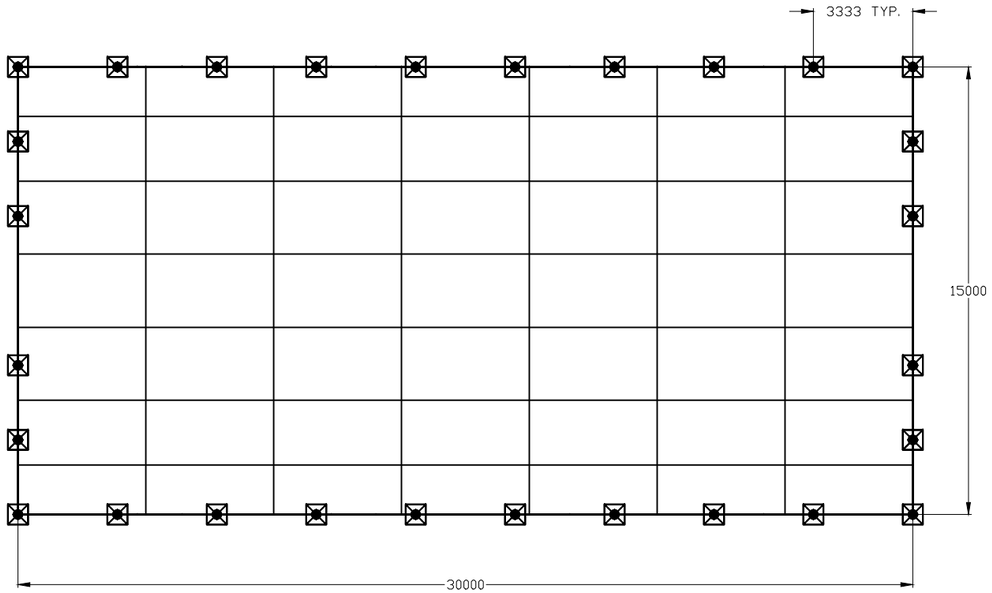
Chargements - Valeurs

	Cas	Type de charge	Liste	Valeurs de la charge
	1	(EF) surfacique uniforme	16	PZ=0.00[kN/m2] local
	1	(EF) surfacique uniforme	13	PZ=-0.13[kN/m2] local
	1	(EF) surfacique uniforme	15	PZ=0.13[kN/m2] local
	2	(EF) surfacique uniforme	16	PZ=0.00[kN/m2] local
	2	(EF) surfacique uniforme	13	PZ=0.05[kN/m2] local
	2	(EF) surfacique uniforme	15	PZ=0.07[kN/m2] local
	3	(EF) surfacique uniforme	16	PZ=0.02[kN/m2] local
	3	(EF) surfacique uniforme	13	PZ=0.16[kN/m2] local
	3	(EF) surfacique uniforme	15	PZ=0.04[kN/m2] local

Réactions: Extrêmes globaux

Repère global - Cas: 1A3 5 6 8 9

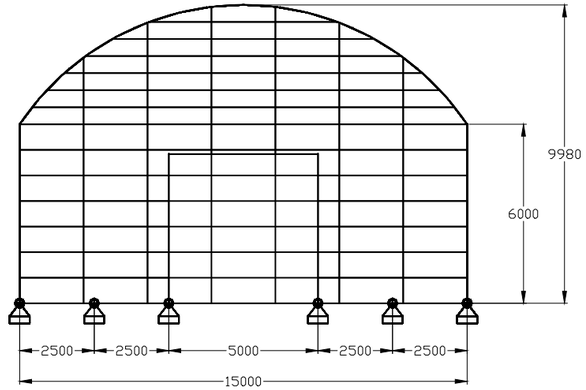
	FX [kN]	FY [kN]	FZ [kN]	MX [kNm]	MY [kNm]	MZ [kNm]
MAX	1.86	5.13	6.62	0.00	0.00	0.00
Noeud	178	178	178	157	178	215
Cas	ELU/3	ELU/1	ELU/3	ELU/3	ELU/2	ELU/1
MIN	-2.42	-6.54	-10.06	-0.00	-0.00	-0.00
Noeud	152	178	154	214	215	153
Cas	ELU/3	ELU/3	ELU/3	ELU/3	ELU/2	ELU/3



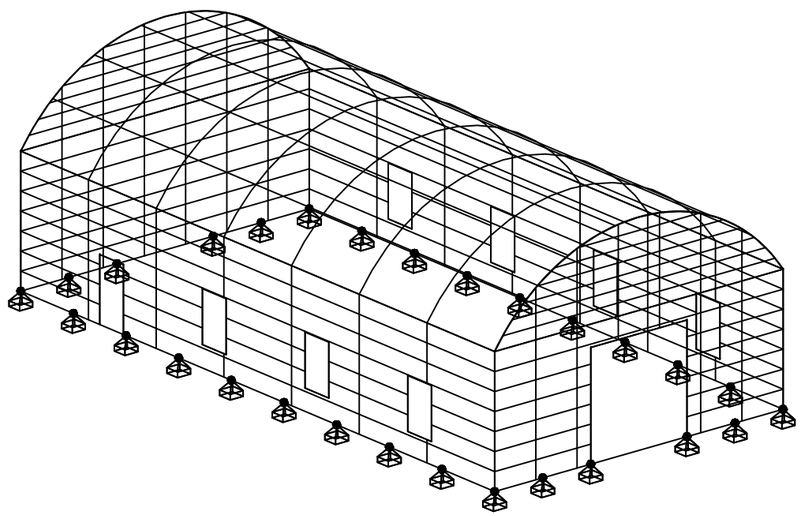
PLAN VIEW
1:200

GENERAL NOTES

- ANCHORS PULLOUT RESISTANCE MUST COMPLY WITH THIS ANNEXED REPORT.



ELEVATION VIEW
1:200



ISOMETRIC VIEW

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No	Description	Date
1	Anchors localisation	21/08/2020

Client
TENTES GONFLABLES

Project
HANGAR 15X30

Drawing title
Anchors localisation

Project number AR20-EV008

Date 21/08/2020

Drawn by Alexandre Létourneau

Verified by Louis Larouche

S-01

Scale Indicated