NORSEMAN STRUCTURES
Fiercely Reliable

Fabric Covered Buildings

CRITICAL DESIGN FACTORS TO CONSIDER

White Paper

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Introduction

Not all steel framed, fabric covered buildings are created equal and not all manufacturers of steel framed, fabric covered buildings follow all requirements of building codes.

Most states use the International Building Code (IBC) and all provinces use the National Building Code of Canada (NBC) as reference documents to determine requirements for building permit applications. These building codes provide requirements for snow, wind and earthquake loads and establish criteria for the design of building structures.

The IBC references ASCE 7-05, "Minimum Design Loads for Buildings and Other Structures". It also requires steel structures be designed in accordance with AISC 360-05, "Specification for Structural Steel Buildings". The NBC provides design loads in their supplement.

This white paper outlines several issues that are often not addressed properly in steel framed, fabric covered building design. Its purpose is to help ensure you purchase a product that meets your requirements, is safe, minimizes liability and is insurable.

Snow and Wind Loads

Some manufacturers ignore the possibility of combined snow and wind loads, using the theory wind will blow snow off buildings. Wind will not blow snow off buildings under certain temperature and humidity conditions. The building fabric finish deteriorates over time, resulting in a rougher, less slippery finish, restricting sliding snow.

Norseman Structures considers all combinations of combined snow and wind loads, as required by the building codes.

Snow Shed

Some manufacturers use a "snow shed" design theory to reduce the design snow load on their buildings. Many of these manufacturers use a design snow load of 8 pounds per square foot, which is significantly less than the snow loads specified by the building codes, based on the theory snow will slide off the slippery fabric cover or be blown off by wind. This theory has been proven to be incorrect and is not referenced anywhere in the building codes.

Norseman Structures does not reduce the design snow loads any more than allowed by the building codes.

Thermal Factors

Some manufacturers use a thermal factor of 1.0, which is only appropriate for heated buildings, or even 0.9, which is only appropriate for heated greenhouses, to reduce the design snow load on buildings.

Norseman Structures uses the correct thermal factor of 1.2 for the design of unheated fabric buildings.

Some manufacturers ignore the possibility of combined snow and wind loads, using the theory wind will blow snow off buildings. Norseman Structures considers all combinations of combined snow and wind loads, as required by the building codes.

Importance Categories

Some manufacturers use a low hazard importance factor for all buildings. Norseman Structures only uses low hazard for low occupancy buildings, such as cold storage facilities and agricultural storage buildings, as specified by the building codes. The standard importance factor provides 25 percent more structural capacity than low hazard importance.

Importance Category	Use and Occupancy	Factor
Low Hazard (Category I USA)	Buildings that represent a low hazard to human life in the event of failure, including: • Low human-occupancy buildings where it can be shown that collapse is not likely to cause injury or other serious consequences • Minor storage buildings	**0.8**
Standard (Category II USA)	All buildings except those listed in importance categories Low, High, and Post-disaster	**1.0**
High Hazard (Category III USA)	Buildings that are likely to be used as post-disaster shelters, including buildings whose primary use is: • As an elementary, middle or secondary school • As a community center Manufacturing and storage facilities containing toxic, explosive or other hazardous substances in sufficient quantities to be dangerous to the public if released.	**1.15**

Some manufacturers use a low hazard importance factor for all buildings. Norseman Structures only uses low hazard for low occupancy buildings as specified by the building codes.

Enclosure Categories

A building with significant openings in the fabric, such as air vents, fabric doors or overhead doors not designed to resist the design wind loads is subject to significant wind pressures or suctions. This means any overhead doors or man doors must be rated to the design wind speed. Failure of a door or window could result in wind forces as much as 50 percent higher than the design wind forces.

Norseman Structures design all door frames and components to resist the design wind speeds. In buildings with large openings or fabric doors, Norseman Structures designs the building structure to resist the additional wind pressures caused by the openings in accordance with building codes.

Exposure Factors

Many manufacturers consider buildings to be sheltered from wind by adjacent buildings or trees, in order to reduce the design wind pressures. They will also consider buildings to be exposed to winds for the purposes of reducing the design snow loads. In reality, many buildings will be exposed to winds on two or three sides, but could also collect more snow from adjacent structures or trees on a fourth side.

Norseman Structures only uses wind and snow load reductions for sheltered or exposed conditions in strict accordance with building codes.

Rough Terrain

(Exposure C – Canada, Exposure B – USA)

Suburban, urban, wooded areas, center of large town. Although this generally depicts 'rough' terrain, there are areas of 'open' terrain. For this reason, 'open' terrain should be selected if there is any question about the type of terrain.

Norseman Structures only uses wind and snow load reductions for sheltered or exposed conditions in strict accordance with building codes.

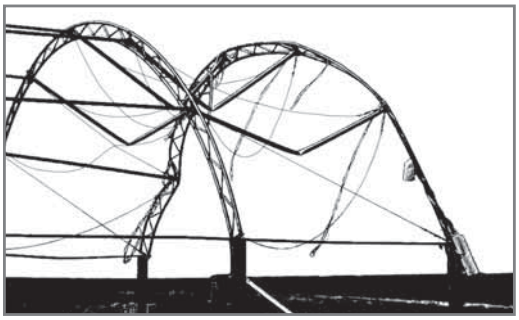
Open Terrain

(Exposure A – Canada, Exposure C – USA)

Few trees, scattered trees, open water. Buildings classified as 'open' require as much as 30 percent more capacity and strength than those classified as 'rough'.

End Truss Strength

Some manufacturers do not consider all loads on end trusses when checking the effects of fabric tension on end trusses. Wind pressure on building end walls causes significant loads pulling downward and inward on end trusses. These loads need to be considered, as well as any snow or wind loads acting vertically on end trusses.



Norseman Structures considers both vertical and horizontal fabric tension in combination with design snow and wind loads on end trusses.

Wind pressure on building end walls causes significant loads pulling downward on end trusses. These loads need to be considered, as well as any snow or wind loads acting vertically on end trusses.

Web Punching

Many manufacturers do not check for the possibility of truss webs punching through the thin walls of the truss chords. Thin gauge truss chords will buckle at relatively low web forces if the webs are small in diameter compared to truss chords.

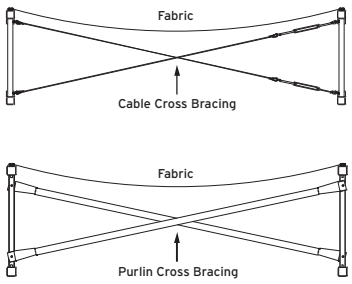
Norseman Structures have increased truss chord thickness and use larger web diameters to prevent web punching. All truss connections are checked and designed to eliminate the possibility of web punching.

Bracing

Many manufacturers use slender roof purlins and light steel cables to provide bracing to roof trusses. These are often undersized because they also need to resist fabric tension forces.

Norseman Structures utilizes large diameter roof purlins and heavy cables to resist the fabric tension loads, as well as to provide stability bracing for roof trusses.

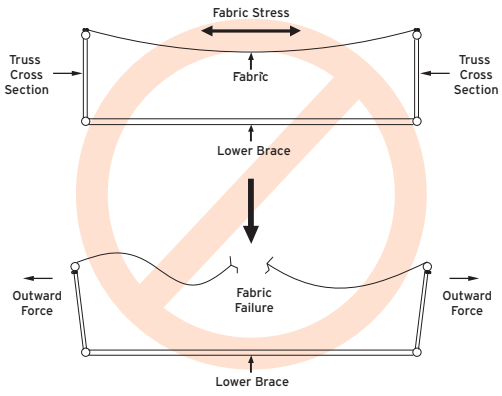
Norseman Structures Bracing



Fabric as Bracing

Some manufacturers rely on fabric to brace the outer chords of the trusses. This does not work if the fabric is damaged or if snow loads are uneven, which is often the case. Buildings with one piece fabric covers do not have any connection between the fabric and the interior trusses, so fabric cannot be relied upon to brace the trusses.

Fabric as Bracing



Norseman Structures does not rely on fabric to brace truss chords.

Norseman Structures utilizes large diameter roof purlins and heavy cables to resist the fabric tension loads, as well as to provide stability bracing for roof trusses.

Steel Strength

An effective way to compare building structures is by weight of the structural steel in the building. It may be possible, although unlikely, that a very efficient design could use 10 percent less steel in a building than a less efficient design.

Any building using 10 percent less steel than a building supplied by Norseman Structures, likely does not meet all building code requirements.

Steel Specifications

Many manufacturers use steel strengths advertised by their steel supplier, instead of steel strengths stated in the building codes and steel specifications. Use of steel strengths higher than those specified by the ASTM specification should not be used, due to lack of consistency of strength and reduced elongation requirements. Light gauge steel generally is not as ductile as heavier gauge material, so the design yield strengths of steel must be reduced to prevent brittle failure. Using advertised steel strengths instead of the ASTM specified yield strengths could result in structures with as much as 30 percent less capacity in some cases.

Norseman Structures uses the ASTM specified yield strengths as stated in the building codes.

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Norseman Structures uses the ASTM specified yield strengths as stated in the building codes.

Liability

Consumers may be of the opinion it is unnecessary to meet the requirements of the building codes if their building is for personal use. They should consider the matter of liability if somebody is killed or seriously injured while working or visiting the structure. Consideration should also be given to insurance for the building and contents. Many insurance companies will not offer insurance for buildings that do not meet requirements of the building codes. Some insurance companies may offer insurance and collect premiums for building insurance, but deny insurance claims after building failure if the buildings are found to be non-compliant with the building codes. Both the building itself and contents inside the building may effectively have no insurance coverage. It may also be difficult to get any value for an uninsurable building when it comes to the sale of a property.

Conclusion

While it is a fact that the design and manufacturing of steel framed, fabric covered buildings should follow the requirements of building codes — in reality, some manufacturers do not.

Norseman Structures is committed to designing, manufacturing and constructing steel framed, fabric covered buildings that are safe, efficient and economical. Our Commercial line of buildings are engineered and designed to meet the requirements of building codes and we will not compromise safety to provide a 'less expensive' product.

About Norseman Structures

Norseman Structures is a division of Norseman Inc., which has been in the fabric structure business since 1921 when it started as a manufacturer of outfitter and exploration tents. Norseman Inc. is the parent company of a group of companies including Norseman Structures and Norseman, which is one of Canada's largest suppliers of industrial fabric and foam products to the construction and bulk packaging industries.

Norseman has been manufacturing and selling building enclosure systems since the 1960s and is a major supplier of fabric buildings and drilling rig enclosures systems to the Oil and Gas and commercial markets.

Norseman Structures operates over 200,000 square feet of quality controlled manufacturing space for unmatched production capacity. Norseman Structures has the manpower and inventory in place to meet customer project timelines.

This, combined with an extensive network of dealers and corporate offices, has Norseman Structures positioned to be a world leader in the manufacturing and distribution of steel framed, fabric covered buildings.

Norseman Structures Manufacturing Facility

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NORSEMAN STRUCTURES
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Compare Before You Buy

All buildings are engineered, but are they equal?

	NORSEMAN STRUCTURES	Competitor 1	Competitor 2
Building Model			
Building Size (width x length)			
Chord Gauge - What gauge of steel is being used in the chords?			
Chord Diameter - What is the diameter of the chord steel?			
Web Gauge - What is the gauge of steel being used in the web?			
Web Dimension - What are the dimensions of the web steel?			
Truss Depth - What is the truss depth?			
Purlin Diameter - What is the diameter of the roof purlins?			
Wind Bracing - How many bays are wind braced?			
Cable Size - What size are the cables being used?			
Snow & Wind Loads – Does the building design take the effects of 'combined' wind and snow load into account? *See Page 2*	YES		
Snow Shedding – Does the building design assume that snow will be shed from the roof of your building? *See Page 2*	NO		
Use & Occupancy – Does your building design assume the appropriate occupancy rating? Remember, if your building is to be occupied, it needs to have an occupancy factor of at least 1.0. *See Page 3*			
Exposure Factors – Does the building design take the proper exposure factor into account? Remember, Open terrain should be used when building exposure is in question. *See Page 4*			
Use of fabric in the design – Does the building design use the fabric to give the building trusses lateral strength? *See Page 6*	NO		
End Truss Strength – Does your building design consider both vertical and horizontal fabric tension in combination with snow and wind loads on the end trusses? *See Page 5*	YES		
Steel Strength – Does your building design account for web punching or chord plastification? You may require larger web material. *See Page 5*	YES		
Bracing – Does your building design use adequate bracing? Compare purlin and cable sizes. *See Page 6*	YES		
Steel Specifications – Is the steel strength used in the design specified by the manufacturer or a regulatory organization ie. CSA or ASTM? *See Page 7*	YES		
Enclosure Category – Does your building design include doors and/or windows? Have these additional wind pressures been accounted for in accordance with the building code? *See Page 3*	YES		
Thermal Factor – Is your building unheated? If so, is it using a thermal factor of 1.2? *See Page 2*			