GENERAL DESIGN REQUIREMENTS & SPECIFICATIONS

1.2.1 Scope

a. This specification covers the design, manufacture, shipping, handling and erection of a prefabricated membrane covered structure.

b. The membrane shall be tensioned over the framework. The structure shall be rectangular in shape with vertical gable end walls. The interior of the structure below the main trusses shall be clear span free of any structural support members and shall provide unobstructed floor space. No exterior purlins, guy ropes or cables shall be used for anchoring the structure.

1.2.2 Design Requirements - Structural Frame

a. Roof and Wall Surfaces: To provide for maximum compatibility with standard door, window, ventilation and other accessory and cladding systems and the structure shall be designed such that roof and gable side wall surfaces form flat planes.

b. Purlin Spacing: To provide for structural stability and to provide for installation of accessory items, the main structural trusses shall be laterally braced by tubular purlins at intervals required by the truss design.

c. Connecting Joints: Connections between structural elements shall be designed so as to transfer the compressive and tensile forces present in a given joint. A minimum of two 5/8” diameter Grade 5 bolts shall be used at each truss chord joint. Primary axial steel, secondary purlins, and end wall frame connections shall be made with 5/8” diameter Grade 5 bolts.

d. Mechanical Equipment Interface: The main structural roof trusses shall allow for installation of electrical and mechanical equipment. Likewise, the structure shall accept penetrations through the membrane for access doors and mechanical services with minimal modification.

e. Shipping: The main structural trusses shall be two-dimensional; planar trusses which nest tightly together in order to minimize shipping and storage volume.

f. Ancillary Systems: The structure shall be designed such that it can be readily retrofitted with insulation systems and other ancillary systems such as lighting, sprinklers, HVAC, etc.

1.2.3 Design Requirements - Membrane Cladding System

a. Continuous, Weather Tight Membrane: In order to provide for a good finished appearance and to insure weather tightness, the membrane shall be assembled and tensioned, in a manner to minimize wrinkles in hot and cold temperatures. The structure membrane shall be constructed in way so that each bay is equipped with its own individual membrane which will be attached to the upper cord of the steel truss system utilizing an extruded aluminum channel and a beaded Keder system.

b. Base Tensioning System: The membrane cladding will be provided with a mechanical tensioning system that allows the membrane to be fully tensioned around the structure perimeter. The system will be designed such that the membrane can be tightly and neatly secured over the structural frame and such that the system has remaining range of adjustment.

c. Membrane Seal at Openings and Base: The structure supplier will provide all materials and methods necessary to fully tension and seal the membrane material around all doors, ventilation and other openings as well as around the structure perimeter below the main tensioning system. This seal shall provide a neat and finished appearance and eliminate any loose membrane cladding that could otherwise be damaged by flapping or abrasion. When a membrane base skirt is required, this shall be supplied and attached at the base perimeter to allow a reasonable seal against air and water intrusion.

d. The structure membrane shall not be designed to function as a structural member such that, should any damage to or penetrations of the membrane occur, the integrity of the structural framework shall not be affected.

1.2.4 The Contractor shall provide drawings and calculations acceptable to the Architect, meeting the provisions of the State Building Code. The Contractor shall bear all costs for production of drawings and associated structural calculations. Contractor shall make all revisions and corrections to those documents required for approval and shall resubmit as required to obtain approvals.

1.2.5 Successful bidders shall make all required changes or corrections and will deliver to the Owner's Stamped Architect all approved drawings and calculations.

ENGINEERED DESIGN CRITERIA

The structure shall be designed in accordance with appropriate building code standards using methodology from the _____Building Code. Primary and secondary framing shall comply with current issues of AISC, AISI, NEMA and ASTM specifications, as applicable. Structural members shall be designed using Allowable Stress Design (ASD) or Load Resistance Factored Design (LRFD) for the design loads given below. Appropriate safety factors to yield and ultimate shall be maintained. Wind load factors and coefficients used in design of structural members must be in accordance with _____ building Code guidelines.

1.4.1 Snow Loads: The structure shall be designed based upon a minimum ground snow load as required by each individual town or jurisdiction.

1.4.2 If structure is required to be designed per IBC 2003, the structure system shall be designed for a minimum roof live load of 20psf.

1.4.3 Wind Loads: The structure shall be capable of withstanding wind loads as required by each individual town, jurisdiction, or applicable code.

1.4.4 Rainfall: The structure shall be capable of withstanding the effects of rainfall up to 4 inches per hour for at least 2 hours.

1.4.5 Design Loads: The design shall be based as a minimum on the following load cases:

D	D= Dead Load + Collateral Load
D + S	S= Symmetrical Snow or Live Load
D + (Ws or E)	(Balanced or Unbalanced)
D + (Wp or E)	Ws = Wind with internal suction
D + Ws + S (Ws or E)	Wp = Wind with internal pressure
D + Wp + S (Wp or E)	E = Earthquake

1.4.6 Design each member to withstand stresses resulting from combinations of loads that produce maximum percentage of actual to allowable stress in that member.

1.5 OPERATION AND USE

1.5.1 The structure shall be designed to provide a minimum 20-year operational use period with appropriate inspection and maintenance.

1.5.2 The structure shall be capable of being assembled operated and dismantled in all ambient temperatures between -20°F and 120°F.

1.5.3 The structure shall be capable of being erected on concrete, asphalt, or compacted earth and of accepting differential settlement of up to 2-1/2% between truss positions.

1.6 MATERIALS

All materials used in the structure shall be new, without defects and free of repairs. The quality of the materials used shall be such that the structure is in conformance with the performance requirements as specified herein.

1.6.1 Cladding Membrane: The structure shall be clad with a 28oz (+/- 1) polyester coated PVC with an acrylic/PVDF Top coat) Specifications listed with **FABRIC SPECIFICATIONS section of proposal**

Flame Resistance

Flame resistance has been evaluated using the following flame retardant test standards.

- NFPA 701 – 1996 Edition Test Method 1
- NFPA 702 – 1996 Edition Test Method 2
- NFPA 701 – 1989 Edition Small Scale Test
- NFPA 701 – 1989 Edition Large Scale Test
- CAN/ULC – S109 – M87 Small Flame Test
- CAN/ULC – S109 – M87 Large Flame Test
- CPAI – 84 Section 6 (Horizontal Test) and Section 7 (Vertical Test)
- California Fire Marshall Small Scale Test (Paragraph 1237.1), California Fire Marshall Spec. (Section 13115)
- European Standards – CL 2, Din 4102/B1, M2 SIS 65 00 82, BS 5867 Part 2 1980

The average melting point of all coated fabrics using the Fisher-Johns Melting Point apparatus is:

- 160 C (320 F)

Fungal & Microbial Resistance

Fungal and microbial resistance has been evaluated using the following test standards.

- Fungal Chamber Test: U.S. MIL STD-810E Method 508.4 (1989)
- A.A.T.C.C. Test Method 147-1993 – Staphylococcus Aureus (ATCC # 6538)
- A.A.T.C.C. Test Method 30-1993 – Aspergillus Niger (ATCC # 6275)

Acceptable membrane suppliers include: Naizil Coated Fabrics and Ferrari Textiles. Other membrane materials maybe considered, however the membrane manufacturer must demonstrate a minimum of (5) five years successful field experience.

1.6.3 Corrosion Protection: All steel tube components, trusses, purlins, fastening tubes shall be hot dipped galvanized post fabrication to the standards ASTM A123.

1.6.4 Painting: Painting of steel components shall only be utilized if necessary for field repairs and shall not be employed as a factory finish. Should field repair be necessary, a zinc-rich field coat shall be used

1.6.5 Hardware:

a. Bolts: Bolts subject to extreme stress and wear shall be structural bolts of Grade 5 and plated / galvanized or upgraded with Sun Seal corrosion resistant. All bolts shall be installed and securely torqued so as to prevent change in tightness. Those subject to removal or adjustment shall not be swaged, peened, staked or otherwise installed.

b. Anchor bolts: shall conform to ASTM A 354, A 307 or A 687 and CAN 3-S16.1 anchor bolt projections based on no grout are as follows:
Min. 2.5” Max 3.5”

c. Membrane Tensioning Hardware: The fabric membrane shall be tensioned with load rated hardware which is plated/hot dip galvanized so as to prevent corrosion. Hardware shall allow full and fee rotation at the foundation connection to avoid fatigue failure of threaded assemblies.

i. Membrane Tensioning Webbing: The membrane shall be tensioned with load-tested tie-downs.

ii. Cable Assemblies: Main and wind bracing cable assemblies shall be manufactured to the required length and press swaged with metal sleeves. The cables are manufactured using preformed galvanized “aircraft” cables, sized with appropriate safety factors.

3/16” dia	=	4,200 lbs.
1/4" dia.	=	7,000 lbs.
5/16” dia.	=	9,800 lbs.
3/8” dia.	=	14,400 lbs.
1/2" dia.	=	22,800 lbs

iii. Other Fasteners: Non-structural fasteners such as wood screws, tek screws, etc., shall be of standard commercial quality.

iv. Exterior Trim: Aluminum extrusion shall be a natural mill finish, unpainted and non-anodized to prevent scratching and chipping. The aluminum alloy used in the structure shall meet or exceed 6063-T5 and shall carry a minimum pro-rated warranty of 10 years.

1.6.6 Welding: Welding shall be employed only when specified in the original design

1.6.7 Manufacturer: The structure fabricator shall be a reputable manufacturer:; shall operate according to a comprehensive quality system and shall provide documentary evidence as follows:

a. Provide three positive references from the fabricator of projects that required a structure of a similar size and use that have been in place for at least one year.

b. Provide references of company experience, engineering and installation

capability, which meet the above experience requirements.

1.6.8 Material Delivery: The building system materials shall be delivered to the project site during normal working hours on weekdays. Installation contractor will provide adequate workmen and equipment to promptly unload, inspect and accept material delivery.

1.6.9 Handling: The installation contractor shall be responsible for unloading, field storage, protection and transfer to the work area of all materials and equipment required to perform the work. At no time shall materials be dropped, thrown or dragged over the transport equipment or the ground. Damage to any piece under its own or superimposed weight shall be cause for repair or replacement.

1.6.10 Short, Damaged or Excess Materials: Installation contractor shall inspect, count and verify quantities based on the shipping documents.

REFERENCES AND STANDARDS

The following publications are for the standards listed below but referred to thereafter by basic letter designation only. They form a part of this specification to the extent referenced thereto:

American Institute of Steel Construction (AISC):

M016-89	Manual of Steel Construction, Ninth Edition
S326-78	Design, Fabrication and Erection of Structural Steel Buildings
S329-85	Structural Joints Using ASTMA325 or A490 Bolts

American Iron and Steel Institute (AISI)

SG 503-76	Design of Fabrication of Cold-Formed Steel Structures

American Society for Testing and Materials (ASTM):

A36-89	Structural Steel
A 123 A-89	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
A 307-89	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
A 325-89	High-Strength Bolts for Structural Steel Joints
A 500 A-90	Standard Specification for Cold Formed Welded & Seamless Carbon Steel Structural Tubing in Rounds and Shapes
A 563 Rev A-89	Carbon and Alloy Steel Nuts
A 687-89	High-Strength Non-Headed Steel Bolts and Studs

American Society of Civil Engineers (ASCE) - Minimum Design Loads for Building and Other Structures

American Welding Society (AWS)

D1.1-92	Structural Welding Code-Steel

National Fire Protection Association

(NFPA) 701-89.1 Standard methods for Flame Resistant Textiles and Films

Canadian Standards Association

CAN/CSA-S16.1	Limit States Design of Steel Structures

WARRANTIES

Membrane – The membrane shall carry a 15 year warranty. The first 8 years shall be full coverage on all material replacement, equipment and labor costs. The remaining 7 years shall be pro-rated at a rate of 1/84th/ month for all associated costs of replacement.

Steel Corrosion – The main structural steel framework shall carry a non-prorated 15 year corrosion warranty.

See included warranty document

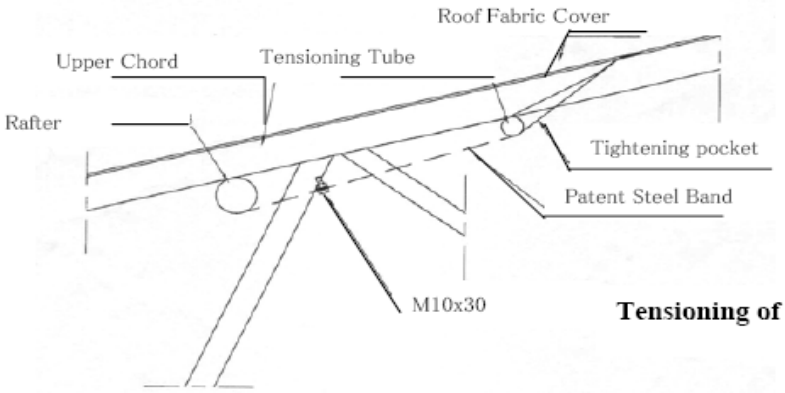
ADDITIONAL SPECIFIC STRUCTURAL INFORMATION

A) STEEL SYSTEM REQUIREMENT – BOX TRUSS

- Engineer the system in conformance with applicable building regulations, BOCA, UBC, and ANSI standards.
- All bolts, anchors, and washers used shall have a minimum Grade 5 specification and shall be zinc plated or Hot-dip galvanized.
- Main structural components shall be steel with bolts, splices, anchors, and washers being the only exceptions considered. Include all parts needed for complete and operational system.
- All major structural steel shall have the following structural properties**:**
  - Minimum yield stress: 46 KSI
  - Minimum tensile stress: 58 KSI
- All truss members shall be fabricated from high-strength structural steel, ASTM A500 grade B.
- Frame design will include flat gable end walls with support columns.
- All truss members shall be rectangular and box girder steel trusses, 4”x 4” chords minimum. Tubular steel truss members shall not be accepted.
- Truss spacing to be on 10’-15’ (+/-) centers. Loading requirements will determine actual spacing.
- Steel truss frame shall be designed with horizontal tensioning to ensure compression seal.
- All welding to be done in a metal shop on clean, shot-blasted steel, before galvanizing or painting, with complete weld around joint.
- All Steel framework and welds to be coated after fabrication.
- All welds shall be full, not crimped, for maximum truss strength
- All cross bracing between arches shall be accomplished with the use of threaded steel bars. Cable cross-bracing shall not be accepted.
- No plastic deformation of structural steel channels as production process is allowable.

B - PVC Cladding Attachment Specification

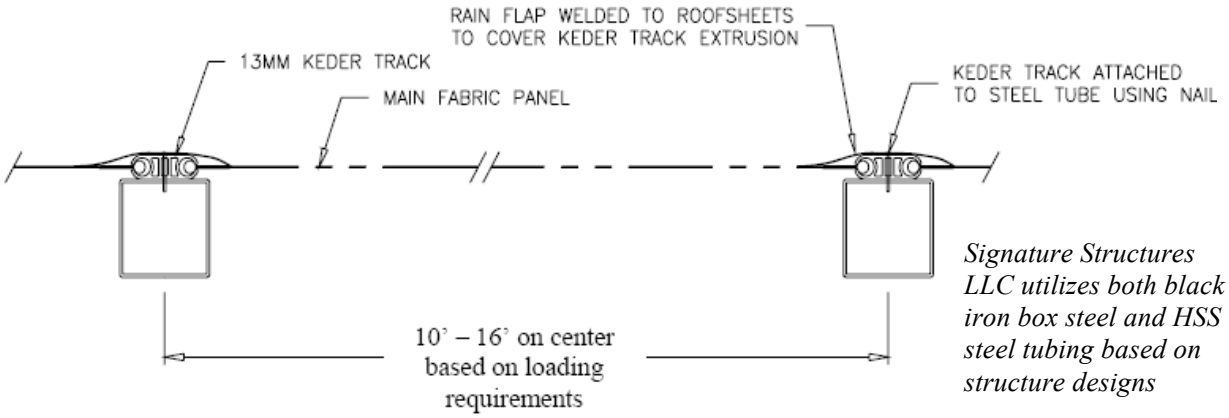
- All PVC membranes utilized have a polyester scrim as a base and have PVC impregnated overtop to create a strong durable coated fabric.
- All cladding to be flame retardant with self-extinguishing properties.
- RF (radio frequency) Welding of panels in manufacturing process is required to maintain strength characteristics.
- All Fabric to be between 18 and 32 oz based on loading requirements and application
- TENSIONING & CONNECTIONS: Fabric Connection will be done one of two ways. The overriding engineering principal common to both methods is **maintaining both vertical and horizontal tension** throughout the membrane. This ensures aesthetics, longevity and structural integrity of the membrane.
    - Large fabric sections running the length of the building. An overlapping panel will create a watertight cap and weatherproof seal at the joint of each section. Tensioning is maintained through threaded rod at perimeter and through piping that is integrated into



Tensioning of roof cover

connected to the frame.

- Keeder Connection using fabric panels on bay spacing centers. Tensioning accomplished at the perimeter with threaded rod and between frame members using telescoping horizontal purlins

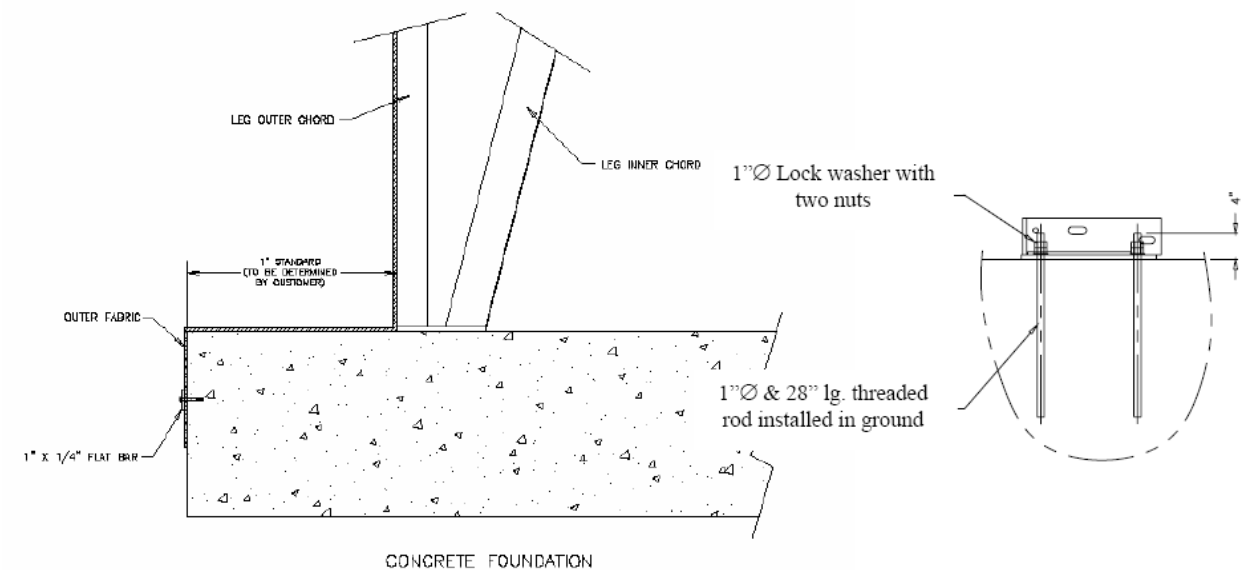


Signature Structures LLC utilizes both black iron box steel and HSS steel tubing based on structure designs

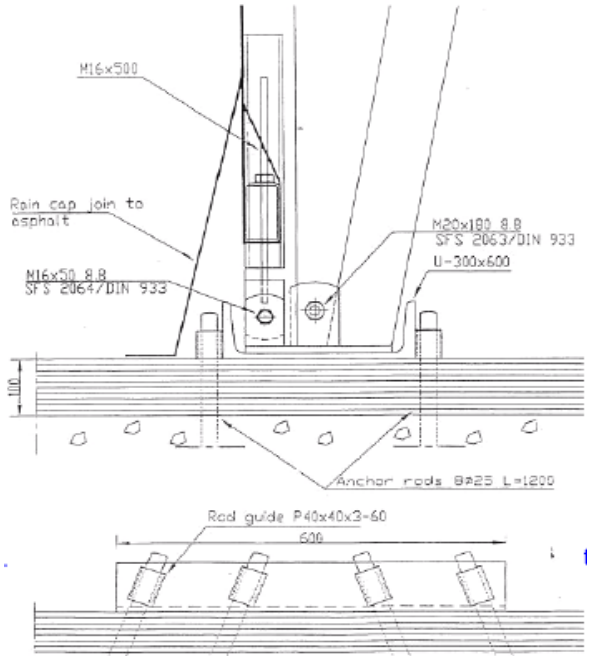
C) Anchorage Requirements

- Foundation requirements and anchorage to be based on existing site conditions and loading requirements. It will be considered standard anchorage for surfaces of concrete and/or asphalt in loading conditions where snow is less than or equal to 25psf and wind speeds do not exceed 90mph, exposure C. conditions.

  - **Anchorage to concrete:**



  - **Anchorage to asphalt**



- Site preparation and installation of foundation is the responsibility of the customer unless otherwise specified.

- Signature specializes in special building solutions including movable structures on wheel and rail systems, crane liftable structures, and ballast weighted structures. The anchorage for these types of buildings requires engineering review before method of anchorage is determined.

- Special building sizes may require additional engineered anchoring.

- Temporary and rented structures may be able to be anchored to earth after engineering review.