FABRIC COVERED STRUCTURES – *for Composting Facilities*

The inherent advantages of natural diffused lighting; wide-span column-free interior space; speed of erection; light-weight/low-cost foundation systems; material durability and overall cost effectiveness— from both a capital cost, and maintenance perspective— make a fabric-covered steel arch-truss MegaDome®, a preferred choice for composting facilities and general industrial uses, and an environmentally friendly solution for a wide range of other applications.

Design and Engineering

Fully Engineered Building System & Building Code Compliance…

MegaDomes® are engineered and manufactured in compliance with the National Building Code of Canada, and the various provincial building codes. Typically, professional engineers signed and sealed construction drawings are supplied for a project, together with Letters of Assurance of Professional Design and Commitment for Field Review (Schedules B1 & B2). The major Material Quality Standards, such as CSA, ASTM, ULC, AWPA, NFPA, and NBCC are complied with. MegaDome® is Canadian Welding Bureau (CWB) certified.

Resistance to wind and snow …

As required for any other approved building system, MegaDomes are designed to for the snow, rain, and wind condition—in accordance with Appendix C (Climatic Design Data) of the National Building Code of Canada— for a project's specific location.

Benefits of Arch-Truss Designs…

The arch-truss MegaDome superstructure combines the optimum design advantage of the arch and of the triangle shapes, achieving maximum strength with low dead-loads, and without compromising the ability to withstand heavy live-loads such as wind and snow.

Low Foundation Costs and Design Options…

The resultant reactions of the light-weight arch-truss at the foundations are low, requiring relatively light-weight footings. This offers the flexibility of choosing between a variety of foundation systems, such as: cast-in-place concrete strip footings and foundation walls, drilled concrete piers, concrete grade beams, preserved-wood foundations, and interlocking modular concrete 'Lock-Blocks'.

Traditional pre-engineered steel building, however— designed as a rigid-frame, with massive welded plate steel frames, and with wide centre to centre spacing— imposes heavy point-loads on the foundations requiring costly spread-footings, and/or pilings, to support the superimposed loads.

Fire performance…

The fire performance of the membrane structures is unique when compared with conventional types of construction.

The steel arch-trusses and accessories used in the framing of a membrane structure are non-combustible. The fabric covering is FR-rated in conformance to the requirements of CAN/ULC S-109 and NFPA 701 standards. These membranes will not ignite and spread fire across the membrane. In case of a fire, the membrane will melt, reducing the energy feedback to the fire, and acting as a smoke vent. This improves the safety and safe exiting of the building's occupants; ready access for fire-fighters; and reduction of fire or smoke damage.

By comparison, standard steel clad, insulated, pre-engineered buildings tend to trap the occupants; will contain the heat within the building –thereby contributing to the progression of the fire, and resulting in an increased risk to the building's occupants

Sprinkler systems may be installed in fabric covered structures if required, and the structure designed to accommodate the additional loads.

Emergency exiting requirements are the same for all building types, and can be easily accommodated in a MegaDome building.

Building Accessories and Features

Building accessories…

Fabric structures, such as a MegaDome® can be fitted with virtually any accessory system found in other types of construction. Lights, sprinkler systems, man-doors, overhead doors, air ducts, etc., are all readily accommodated.

Rain-water collection …

A 'green' storm water management plan will aim to distribute the rain falling on a building into the ground at, or near, the point of collection, rather than amassing it and directing it into a central storm sewer, which in turn requires expensive storm detention ponds or other systems. Rain-water collection from membrane structures, if required, can be achieved either by collection in a swale, or by an attached gutter system, as in traditional building types. In the case of heavy snowfall the prior is the recommended method.

Security / Vandalism…

Where security and protection against unwanted access is required, this may be accomplished with fabric covered structures in several ways. Firstly, the site may be secured with perimeter fencing – which will then protect the yard / outside storage areas all at one time. The selection and design of the foundation/wall system can also be used to advantage for security. For example composting facilities often are constructed with integrated footings-walls, 6', 8' or more in height, to protect the building walls from the operation of loaders or compost turners or to function as push-walls for loading equipment. Such concrete walls will simultaneously reduce the potential for vandalism or theft. Metal clad lower walls are another option to achieve the same end.

Construction and Cost Advantages

Planning and Design

Membrane structures offer a 'pre-engineered' approach to design and construction. After establishing a client's specific needs and the project's design parameters, an engineered construction drawing, including foundations, can be supplied within just a few days; cost estimates rendered typically within 48 hours.

Speed of erection

The erection time for membrane structures such as the MegaDome® is measured in days, rather than weeks as is typical with traditional pre-engineered steel buildings; or the months that is common to concrete or other building systems. This makes a fabric clad structure a preferred building system when timely completion is important.

Low Construction Cost

The inherent light-weight of a fabric covered structure results in low supply and building erection costs. The tonnage of erection cranes required for constructing a MegaDome® is much lower than that required for other building types. Crane time is measured in hours, not days. Mobilization cost and equipment costs are low. Fabric structures are typically erected by framing crews, rather than by high-priced steel workers. Ready availability of erection crews for membrane covered structures is especially a significant advantage for projects in remote locations

A study by the Ontario Milk Producer, Jan. 2002 found soft covered barns to cost approx. 50% of a wood post-frame type farm building. The difference with steel or concrete structures is even more significant.

Operational Advantages

Natural lighting

The light transmission through the membrane covering provides a pleasant interior working environment; and the diffused, no-shadow sunlight reduces the need for artificial lighting, and lowers energy costs. Harmful UV rays are blocked by the membrane; and the typical white exterior reduces the heat-gain during summer months.

Clear interior space; wide building spans

The choice of building width, or span, is generally a function of several factors: operational requirements (compost channels; equipment; access, etc) and cost. Generally mid-range building widths (50 to 80 ft) are most cost-effective, while membrane structures as narrow as 10 ft., and as wide as 200 ft., have been constructed by the membrane building industry.

While wide spans with traditional pre-engineered steel structures may be achieved by the introduction of mid-span, or multiple rows, of columns, those tend to interfere with efficient operations of the compost facility.

Fabric Buildings Meets the Unique Challenges for Composting Environments

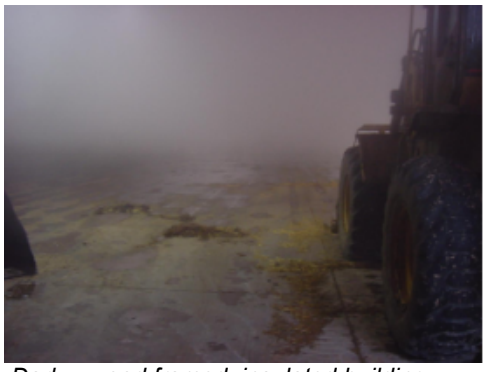
Composting environments offer a unique set of design challenges for any building type considered. High humidity and ammonia will impair the expected service life of most structures and reduce the quality and safety of the work environment. Close attention is required to the effectiveness of air/moisture containment and exhaust systems.

Separate containment… the better approach

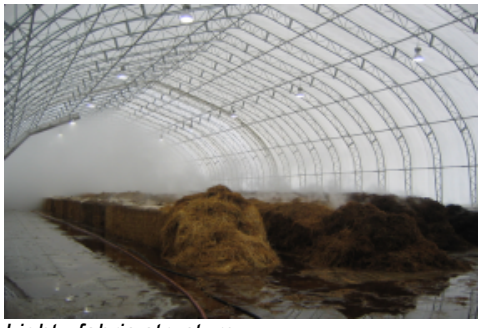
Innovative composting technology, such as is applied by BuildWorks Construction Inc., in conjunction with Transform Compost Systems Ltd. of Abbotsford, BC. Canada, separates the compost process-air from the general building space – for more effective air/moisture containment, protection of the building envelope, and to provide a 'clean-air' environment for workers and for sensitive electrical, lighting, control, and other systems.

Reduction of fog / improved visibility…

A fabric structure has the distinct advantage—over other traditional systems— in that the heat-gain and direct sunlight penetrating the membrane helps to alleviate the fog which develops inside a composting facility. The naturally diffused daylight maintains a level of visibility which cannot be found in traditional 'dark' structures. Condensation that tends to form on the inside of a MegaDome® mostly runs along the inside of the membrane where it combines with surface liquids, or it may be channelled into a leachate collection system.



Dark – wood framed, insulated building



Light –fabric structure

Building Service Life in Corrosive Environments

There are two distinctly different approaches to achieving protection of the building structure and its envelope from the corrosive effects of composting air and moisture—

Failure of moisture/air seal in standard frame building

Traditional buildings, such as pre-engineered steel or wood-frame buildings attempt to achieve protection by a complex system of structural components, insulation and moisture seals. A near-perfect seal may initially be achieved, after intensive efforts and high costs, but sooner or later the effectiveness of the seal is lost, thus exposing the (often concealed) components to the effects of corrosion. Traditional building structures have collapsed in less than two years from the time of construction, and others are endangering lives with continued operation of severely corroded structures. Further complicating these 'built'-up' systems are the need for surface protection (especially on the interior of walls) from damage to the sealed building envelope caused by the operation of composting equipment.

Building collapse due to corrosion

Fabric covered structures, on the other hand, are typically constructed with single skin coverings that do not trap moisture. The tough and resilient polyethylene or vinyl membranes are impervious to moisture, totally rust free, and are not susceptible to building rot, as is the case with wood structures or unprotected steel.

Various methods of corrosion protection are available with membrane structures, including: galvanizing (hot-dipped or pre-galvanized); epoxy coatings, or vinyl/paint coatings. The use of low temperature **silicone-bronze welding in conjunction with pre-galvanized steel** is offered by Harnois Industries, in the manufacturing of the MegaDomes®, is a very effective, low-cost and solution for general corrosion protection. **Hot-dip galvanization**, after fabrication and welding, with a 4 mils thick zinc coating, offers a life expectancy of 50 years in general use; and 25 years in industrial use. Further protection for use in corrosive environments can be achieved with epoxy or vinyl coatings.

Hot-dip galvanized steel frames (left), and pre-galvanized steel with silicon-bronze welding are options available on the MegaDome® system.

A Total System Approach

For a successful development of composting facilities, a broad experience in design, construction, and selection of materials and of the integrated systems specific to such facilities is highly desirable. The selection of an appropriate building system and building envelope design will determine the overall and long-term performance of the facility. Fabric covered buildings have proven to be a very suitable choice as a building method.

Dirk M. Kerkhoff,
President, BuildWorks Construction Inc.
dirk@buildworks.com