Fabric ARCHITECTURE

The cost of building fabric structures

Experienced professionals comment on how much it costs to build fabric structures

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By Samuel J. Armijos

The hardest part of designing and building a fabric structure is determining its cost. There are three major components to a fabric structure—steel, fabric and cables—and every decision made about the design and its installation affects the cost. In general, the more complex and the more steel there is on a project, the more it will cost to design, fabricate and install. Also critical is what you see and don't see. The fabric and hardware chosen are just as important as the paint finish and the foundations. Location, site access and labor rates also play a major role. Finally, there are different ways to proceed: design/build or plans and specifications. Confused? Want advice? Ask people with experience in tensioned fabric structures.

DESIGN AND ENGINEERING

Fabric structures are mostly used as a cost-effective solution for providing shade and shelter. The added bonus is that fabric structures are festive in nature and can be used for temporary or permanent applications. The beauty and cost of these structures is in the details. A designer's signature style is often expressed in the details of a project. Detailing fabric structures is no different. Architects, designers, consulting engineers and clients all have different ideas about how a fabric structure and its details should look, but may not know their subsequent cost. Consulting with a design professional can save thousands of dollars. Decisions can be made at the outset of the project to determine if it makes sense to do the project as a negotiated design/build or as a formal public bid. One way requires a set of construction documents to be prepared before a public bid while another can go out to specialized contractors as a performance specification or with schematic drawings.

According to Nic Goldsmith, senior principal at FTL Design Engineering Studio, New York City, the costs of design and engineering tensile structures have remained relatively flat over the past few years, even though construction costs have increased. What is seen, however, is a trend in the industry from a more traditional scope of professional services to a leaner "design engineering package" that can then be bid by specialized consultants as a design/build scope. This allows the owner to lock in construction numbers early and still create an even playing field for bidders.

STEEL

Steel plays a major role in cost. Selecting the method by which primary components are made can greatly influence the overall cost of a structure. A minimum number of elements is usually desirable. A mast-supported structure is more cost effective than a frame-supported structure. Less is more. Be aware that the cost of designing custom components, such as tapered masts and custom trusses, needs to be weighed against the use of standard products (i.e., tube, pipe, etc.). The price of steel has been volatile over the past few years, and the time frame involved from conception to build out can play havoc on a project's steel budget. The different material properties (strength, thickness, elasticity, weight, etc.) make material selection critical. For example, using high tensile materials with smaller cross sections most often implies higher material cost. However, using low strength materials with larger cross sections increases the weight and cost of the installation. A need for components to be highly abrasion-resistant, low maintenance and "vandal proof" also influences the choice of suitable materials. An important design factor often overlooked is the utilization of more common (commercially available) sizes and wall thicknesses. This is a large variable because it reduces drawings and fabrication costs, but sometimes affects the architects' aesthetic intention. According to Jim Land, president of Affiliated Metal Industries Inc. of Cleveland, Ohio, a custom steel fabricator of tension fabric structures, the price of a ton of fabricated steel had gone up 50–60% in the past 10 years. In 2000 it was $2,200 per ton, and by mid 2008 it was $3,500 per ton and rising until the current economic crash. Closing in on 2010, it is currently around $1,900 per ton, but some projects are going for $1,500 per ton and less. With the current economic crisis, material prices are going down rapidly and fabricators around the country appear to be "buying jobs" left and right just to fill capacity through the winter months. But the buyer had better beware. Just because XYZ fabricating company spits out a lowball price today does not mean it will not come back for huge change orders or, worse yet, be unable to fulfill the contract obligations once the economy picks up.

Beyond the price and type of the material, a number of other factors can affect the price to contractors. Project timing, completeness of design, finish coatings, project scope, market price and commonality of materials used all have a major impact on how a project gets quoted out.

"The best advice I can give is to get a fabricator involved early in the design process. We can study the project's design and constructability, suggest modifications and put real-world dollar figures into the costing at an early stage, allowing the project owner to change course earlier if needed," Land suggests.

FABRIC

Membranes have different costs as well. Some membranes have longer life spans than others and selecting a membrane should be based on application and lifespan. Membranes come with different top coats that provide different forms of protection. All membranes are not created equal.

"The cost of chemical feedstock used in the production of architectural fabrics has doubled this decade," says Brad Hochberger, western regional sales manager for Seaman Corp., Wooster, Ohio, a manufacturer of vinyl-coated polyester. "Some of these increases have made it to the owners, but not all. Overall, the demand for architectural fabric structures has been robust, with many owners tending to prefer the higher end materials."

Architectural fabric performance has improved with new long-lasting top finishes extending the life and cleanability of the membrane. Membranes are available with various options and costs to meet an assortment of needs and applications. It is worth researching the source and type of membrane and a fabric company's history and warranty. To assure proper performance and long life of these structures, quality performance criteria must be established and specified by the architect, engineer or procurement agency. Read the fine print and ask for samples. Some fabrics require additional prep work and cost in order to be joined, while others may be hard to handle in the field. For membranes, symmetry and optimization of cutting patterns is important. The fewer the number of cutting patterns, the more cost effective the production.

CABLES

Clients should be made aware of the difference not only of the quality but the price between custom parts such as cast and stainless steel fittings versus standard and galvanized parts (bolts, nuts, shackles, etc.).

According to Peter Katcha of Ronstan International, Portsmouth, Rhode Island, makers of architectural stainless steel fittings, "With the lengthening of product life cycle and durability of architectural fabrics, more of our clients are requesting stainless steel cable systems instead of galvanized. Stainless steel cable systems and hardware will equal and surpass the fabric's life span. Galvanized cables will typically not meet the fabric's life expectancy and can be the first material requiring replacement on the structure. Galvanized cables will lower the initial installation cost, but will increase the cost over time to maintain the structure." There is common practice in the industry to mix galvanized cables and stainless steel fittings but make note: pay now, pay later or have a plan. Galvanized cables are much cheaper than stainless but over the last two years, stainless has dropped 10% in price, making it a worthy investment.

INSTALL

Installation (which includes shipping and equipment) is the hardest part in cost estimating a fabric structure. Equipment rates and availability can change dramatically, access can play a big role in the install and shipping rates change as trucking costs and gas go up. As in real estate, tension structure installers play close attention to location, location, location. A project's location can have a dramatic effect on cost. Projects requiring union wages can increase the price. Working in major cities where crane access and street closure permits are required will definitely raise the price of a project. The ability to transport components to the job site must be considered as well. Many times, projects require "multiple mobilizations" because the membrane cannot be installed right after the steel has been placed. The best way to check the pricing is to make sure your contractor has a "Means and Method" statement in their proposal or a written procedure on how they intend to erect their structure. A construction schedule for all to see prior to proceeding is highly desirable.

ANATOMY OF A FABRIC STRUCTURE

The best way to understand the cost of a fabric structure is to request a Schedule of Value (SOV), or a breakdown of the major cost (design/engineering/project management; steel, fabric and hardware fabrication; installation and equipment and shipping.) The percentage of the overall cost can vary significantly depending on the complexity of the design, the material chosen, the location and access of the site, the cost of labor and equipment and the amount of material needed to be shipped. Keep in mind, fabric structures are normally priced by surface area because of their unique shapes.

Here is a basic rule of thumb:

Plan Area (Length x Width) X Shape Factor (H) = Surface Area

Shape Factor is a number that varies depending on the form chosen and is used to estimate the amount of fabric, including waste, used on a project. Mast-supported structures tend to have twice as much material as a hypar or a barrel vault design. Today's computer programs can also provide surface area easily.

Surface Area X Cost per SqFt = Budget

The budget does not include foundations but it will give some idea on how much the fabric structure is going to cost. There is a large variable in cost-per-square-foot because the more steel used on a structure (frame-supported vs mast-supported), the more expensive it will be. Also, there are many grades of PTFE, PVC and HDPE. The key to building a cost-effective fabric structure is to design the lightest structure possible. Remember, less is more; light is even better.

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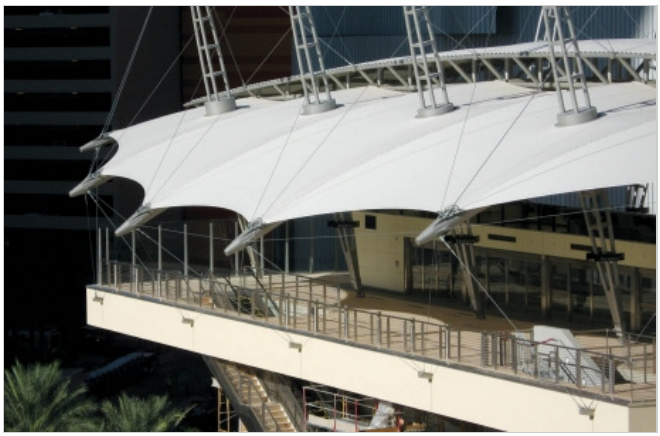

Design (5-15%)	Design Development to Construction Document. Percentage varies depending on Design/Build versus Plans and Specification approach.
Engineering (5-15%)	Awning to Dome Stadium. All projects require a structural analysis. It depends on how many load cases (DD, LL, etc.) are required.
Project Management (5-15%)	Varies depending on the scope of work. Some projects are membrane only while most are single source complete structures.
Steel and Fabrication (10-60%)	Large variable. Mast-supported structures versus frame-supported structures.
Membrane and Fabrication (10-60%)	Cost varies depending on the complexity of design.
Installation (10-30%)	Costs vary depending on labor rates and location.
Equipment (5-10%)	Cost can vary depending on access and site location.
Shipping	Membrane is fabricated around the world. Shipping cost

A custom cantilever canopy attached to a main structural system shades a drop-off area at the Magnolia Medical Plaza in Palestine, Texas. Architects: WHR Architects; Fabricator: FabriTec Structures.

Custom structures with high-end paint finished steel and vinyl-coated polyester hypars shade Valliance Bank's entry and carpark in Dallas, Texas. Architect: TAP Architects; Fabricator: FabriTec Structures.

Truss arches span two different types of building systems over a pedestrian walkway at Vornado's Rego Park Retail Center atrium

in Queens, New York. Architects: EEK Architects; Fabricator: FabriTec Structures.

COMMENTS

Comments are the opinion of individual posters and do not reflect the views of Fabric Architecture or Industrial Fabrics Association International.

Alan Johnson CWI
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Drawings Review

If the engineer is not familiar with a shop's fabrication abilliies, they may specify welding processes or procedures that the fabricator may not be able to perform in a timely or economical manner.

The fabricator should always review the submission and be ready to suggest to the engineer any changes that would meet the job requirements and and the fabricator's abilities.

Alan Johnson, Certified Welding Inspector