



**LEGACY**  
BUILDING SOLUTIONS

**WHITE  
PAPER**



FABRIC STRUCTURES:  
**A JOURNEY  
TO A SOLUTION**



If you need a new building and are considering a fabric structure, you came to the right place. This is an overview of what's out there, but there's a level of detail in this document that will help you feel confident in your ability to explain to others the pros and cons of fabric structure technology.

First let's look at what's out there. These are the categories of fabric structures currently available, with a little about each of them. We hope this will help you make decisions about what you need in a building as you proceed in your investigations.

## »» KNOW YOUR OPTIONS

Getting an overview of the kinds of fabric structures is not as easy as it seems. Call a structure company and they are more than likely to just tell you about their own structure, not about the whole universe of buildings, including the fabric building industry. In order to get a feel for the landscape of the industry, here's what we think is a comprehensive list.



### FABRIC-CLAD RIGID FRAME STRUCTURES

This category includes the tension fabric structures from Legacy. The rigid frame is self-supporting; the fabric does not provide any structural support (nor can it according to building codes). The structural frames are typically designed with tried and tested Metal Building Rigid frame design software, used by hundreds of metal building manufacturers around the world. The exterior fabric cladding creates the walls and roof. The buildings can be entirely customized, and the frames can be designed to carry significant loads.

### OPEN-WEB TRUSS STRUCTURES

This is the most common type of fabric building, and the support comes from a truss made up of a top chord, a bottom cord, and a zig-zag of support pieces between them. The web trusses can have a shape other than a hoop, but most of the ones you have seen have that half-hoop shape. Some have individual bays (Keder panels). Some open web truss structures can be used in applications requiring permitting or an engineer's stamp. They can be customized but typically have preset widths and frame profiles.



Original structure: Coverall Titan Series 3



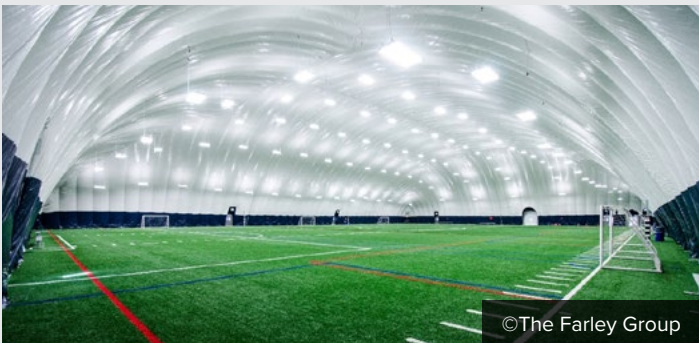


## **SINGLE TUBE STRUCTURES**

Using single tubes to create the arch, this structure is typically a series of half-hoop supports with a single moncover stretched over it. They are popular as temporary structures and typically do not span more than 40' wide. Most are not an "engineered" structure and can often only be built in locations where permits are not required.

## **TENSILE FABRIC STRUCTURES**

These are generally a combination of poles and cables and fabric working together, from an engineering perspective. They are generally seen as architectural covers or canopies over public monuments, playgrounds, airport terminals, etc. The roof of the Denver airport is one of the more visible examples.



## **AIR-SUPPORTED DOME STRUCTURES**

These enclosures are fabric structures supported by internal air pressure, without other sources of support. They are typically inexpensive and set up quickly. They are also vulnerable to weather and generally have high operating costs to keep the air-supported dome inflated and heated or cooled.

## EVENT TENTS

Typically, what you find at rental companies, they are common for weddings, graduations, festivals and other events.



## RAPID-DEPLOYMENT TENTS

Though they are not completely different from the “tents” above, these are primarily designed for the military. They are at the higher end of the quality spectrum (designed for more extended use), and they require minimal effort to assemble and disassemble in terms of manpower and equipment.

## SMALL-FRAME BUILDINGS

Designed for residential backyards, they are typically sold at big box home improvement stores and the fabric is loosely attached to the frames instead of tensioned.



It's clear there's a wide range of options out there, from the very permanent to the very temporary, from the prefab to the customized, from the out-of-the-box tent to the engineered solution. Some of these structures have been around, and virtually unchanged, for centuries. Some others, however, are advancing and evolving the physics and the chemistry of how buildings can be built, should be built and will undoubtedly be built in the future.



# »» TENSION FABRIC STRUCTURES: A NEW APPROACH



That's a quick run-down of the fabric structures that make up the industry. Now let's take a look at the tension fabric structure, an innovative new way to build with fabric that is rewriting the playbook for designing, manufacturing and constructing buildings.

The definition of the tension fabric structure is a building with fabric cladding stretched over a rigid frame. If you read the Wikipedia entry on tension fabric buildings, it will tell you that the fabric is stretched over the frame and the tension provides structural support for the building. That information is true, but it is a bit dated. The new generation of tension fabric structures includes a rigid frame, as stated, but by building

code the fabric cladding is not included in the calculation to provide support.

What does the fabric do then, you may ask? Good question. It makes up the wall and the roof cladding that keeps the weather out, in much the same way traditional walls and roofs do. It's pretty simple.

If you are wondering if fabric walls are strong enough, remember that this is industrial fabric that has been used on buildings in climates and seismic areas all over the world. Most cladding for fabric buildings is either polyethylene (PE) or polyvinyl chloride (PVC).



In some cases, the fabric in a tension fabric structure is one piece stretched over the frame. These applications leave the building fabric vulnerable because it acts like a very large sail attached at each end of the building.

Other applications, like our patented attachment system, use individual fabric panels stretched between the support beams. We tested the strength of our ExxoTec™ Elite fabric panels and our patented fabric attachment system by driving a 10,000-lb skid steer loader on a suspended panel and it performed exceptionally well with no damage. With individual panels, if damage occurs, the panel is more easily replaced at a fraction of the cost of replacing the entire fabric cladding.

This is an exciting time for the tension fabric structure industry. More and more industries are finding that these structures meet their building needs including:

- **BULK STORAGE**
- **ENTERTAINMENT VENUES**
- **AVIATION**
- **MILITARY**
- **EQUESTRIAN**
- **AGRICULTURE**
- **SPORTS COMPLEXES**
- **MINING**
- **OIL, GAS & ENERGY ALTERNATIVES**
- **SALT SHEDS**





Some of these applications are open-air, roof-only buildings, but others are completely enclosed with insulation, heating and cooling, and all the features you would expect from a traditional building. You might be asking: why choose a tension fabric structure in the first place? Tension fabric structures tend to be much easier to maintain than a steel building. They can also be constructed much more quickly.

The advances made in tension fabric structures continue to extend the reach of this construction alternative. Applications of this technology are

only limited by the imagination. Eventually people will understand that many of the things that you can do with a traditional building, you can also do with a tension fabric structure.

To this point, we have examined the range of buildings out there. We have also demonstrated the potential, the possibilities, emerging in the industry. We hope we have you thinking in a new direction. Fabric structures have a huge range of possible applications. Where might they fit into your future plans?



## »» GETTING READY FOR A QUOTE OR RFP

If you think a fabric structure could be on your horizon, there are some questions you should ask yourself as you go forward. These are the bigger pieces of the puzzle, not the small decisions that always arise in a construction project. Let's call them design elements. With these elements in mind, you can expect a very productive dialogue with the companies who sell fabric structures.

Here are seven things to consider as you are making a decision.

### STEP 1: HOW BIG?

Do you know how much square footage you need? Often it's clear. For example, the hangars we build for the military have strict specifications about the width and height of the building based on the wingspan and height of the aircraft being stored. In other cases, there's a lot of back and forth between our clients and designers before a final square footage is established. One thing to think about is not just how much room you need for your storage or equipment, but also how much "workaround" room do you need. Just packing everything into the smallest possible footprint might saddle you with an unworkable space.

What you can afford is certainly another consideration. Your ideal structure in terms of size might exceed your budget, so be willing to be flexible.

### STEP 2: HOW WARM/HOW COOL?

If you need to control the climate inside your structure, we provide completely insulated buildings for the hottest and coldest climates and everything in-between. If you don't need the structure to be insulated, you can get the benefits of the [natural light](#) that comes through the fabric roof and walls.





### STEP 3: PERMANENT OR TEMPORARY?

Because we build with fabric, clients sometimes assume our structures are temporary. To be clear, a lot of fabric structures are not temporary. Our tension fabric structures are built to last. We have warranties on our fabric, our steel, and on our construction that deliver and ensure permanence. That said, some clients have moved our structures from one place to another.

One warning: some building owners want to label their structure temporary to avoid real estate taxes. That can create future challenges if you don't check with your local building regulators first.

### STEP 4: ARE YOU LOOKING FOR THE BUILDING TO SUPPORT ANY HANGING LOADS?

Many fabric buildings have a steel or aluminum support structure that is only designed to support the walls and roof and little else. Legacy's steel structure, on the other hand, [can be designed to support a wide array of equipment](#), from cranes and conveyors to scoreboards and stage lights. For a lot of our clients, the ability to support equipment from the roof beams is a plus. They say things like "I didn't know you could do that with a fabric building."

Something to consider is fire suppression and, can the structure you are planning support it. More and more structures are being required to have fire suppression systems, and that sometimes catches building owners off guard.





## STEP 5: WHAT KIND OF FABRIC?

There are primarily two kinds of fabric in the fabric structures industry: Polyethylene (PE) and Polyvinyl Chloride (PVC). PE is used widely. PVC fabric is tougher and stands up to UV rays better. Legacy's [proprietary fabric, ExxoTec™](#), is a PVC fabric.

There is also coated fiberglass fabric, but that tends to be costly and used by very high-end building owners, e.g. roofs of football stadiums.

## STEP 6: WHAT DO YOU NEED TO KNOW ABOUT THE FOUNDATION?

One thing we encounter often is that clients put in foundations without doing due diligence about what's under them. Many projects are delayed by bad soil under the foundation, so spend the time and effort to do the borings and soil reports. This is not the time to skip a step. If your foundation engineer doesn't require soil testing before designing the foundation, ask some pointed questions.

## STEP 7: TALKING TO BUILDING OFFICIALS?

Do this early and often. We can't emphasize this enough. Don't get blindsided by requirements from local building regulators late in the game. These local officials can help you think about the project and may get you thinking about it in new ways that can make the project more successful. Communicate with them throughout the process.

If there's a rule, it's overcommunicate. Remember, these officials will need to sign off on the designs, and they have final approval authority.

One final thing to consider: the total cost of your building. Many clients come to us thinking that the cost of our tension fabric structure is the cost of the project. It rarely is. A building project has a lot of incidentals that add up fast. The cost of digging, laying the foundation (plus soil reporting), windows, doors, HVAC, fire suppression, electrical, plumbing, etc. can make up the majority of a project's cost. The fabric structure itself can be a fraction of the total, sometimes as low as one-third of the costs incurred.

When it comes to big decisions, we all get nervous. Buying a new building is one of the more imposing decisions you and your team can make. In this guide, we've called out the options and examined what's possible in the world of fabric structures. Then we dove into the latest in fabric and framing technology, opening up the field of what is possible and what is imaginable. The point is: you need to think about buildings in new ways. If a fabric structure wasn't on your radar before, this tour of the technology should put it there. Finally, the seven steps are a great way to begin a discussion with a fabric building company.

Thank you for your time and attention. [We are here when you are ready to take the next step in this journey.](#)