Techniques and Solutions to Installation of Tensile Membrane Fabrics

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I would like to talk to you all about a number of issues relating to the installation of large membrane structures and the techniques and solutions to overcoming some of the issues that can be encountered. I will be dealing directly with the techniques of handling deploying and tensioning various large fabrics and some solutions for dealing with difficult issues on site in the installation of these projects.

Briefly as most if not all of you know there are so many different products and variations of product on the market these days. Each of all of these products require different consideration with regard to:

- Stretch criteria and compensations –creep
- Fabric compositions and versatility and stretch compensations – PVC, Mesh
- Application requirement/suitability – Fire Retardancy
- Ease of manufacture and freight i.e. Fibreglass fabrics require padding between folds
- Handling and installation requirements/issues traffic ability

For example the basic types of fabrics, PTFE (Fibreglass fabric), PVC (Vinyl) and Shade mesh are similar in effecting various shade solutions. Although require different handling, deploying methods, hoisting and tensioning during the installation process.

At this point one thing I must stress is that from an installation perspective each member of a project from planning and design to construction personnel and engineers has a part to play in enabling the erection crew to complete their installation quickly and efficiently.

Depending on what particular type of fabric structure or tensioned membrane you are building there is always at least one if not a number of issues that can offer a challenge. These include:

- Logistical issues

  Height restriction including proximity of steel to fabric beneath and above the structure.

  Elevated heights, working and trafficking steel and fabric.

  Elevated work platforms: usable/unusable.

  Deployment of fabric at height: no crane/no boom lifts.

  Accessing all points at heights: no boom lifts. Using rope access or scaffold.

- Structural/Design issues

  Rigidity of steel frame structure: Need for temp

  Tensioning into blind corners.

  Practicality of steel design for installation

  Complexity of steel componentry and connections

Environmental Issues

Wind, rain, heat/cold

The important thing to remember is where there's a will there's a way. And once again to reiterate the basic resolve to all these issues is a little pre–planning and discussion on the criteria of each job to eliminate any and all fore seeable hazards and construction hiccups that might occur.

Obviously to cover every issue that relates to construction process and the solutions to overcome these issues would take some time – more time than I have right now, and definitely more material than I have with me. So I have just picked out a few of Ozrig's recently installed projects and I would like to just briefly show these to you and provide a bit of a visual on how we get some things done.

Firstly when deploying fabric onto steel frame it's not always possible to have a flat area adjacent to the structure to lay out a fabric or lift a fabric from, even the use of cranes is not an option. In many cases fabric in its loose state is vulnerable to the elements. Particularly wind and rain and so the use of webbing is employed. This picture shows deploying fabrics from roof level between steel frames on top of a webbing platform Ozrig installed. Webbing The use of a webbing type platform facilitates deployment and control of an entire structure or panel of a structure.

In some cases webbing can be setup to sandwich the fabric the entire time it is being deployed top and bottom and sliding the panel through. In either case securing ropes or webbing should be deployed with the fabric simultaneously and secured as soon as possible once the fabric has been deployed and before tensioning.

Another type of platform can double as a lifting rig Steel framed platforms are often fixed to steel elements on a structure for the purpose of deploying fabrics. These platforms have to be engineered and certified for traffic ability, load rating capacity and so on. Theses platforms are re usable and allow fabrics to be deployed at heights with precise placement and control of the fabric. Obviously the actual pulling out of the fabric is done by hand or with cable Tirfors or chain motors.

Platforms – Purpose built deployment platforms

Fabric is positioned and rigged up on the platform ready for deployment once in situ.

Then lifted to steel super structure

And bolted off and secured

Scaffolding built into a platform is a last resort option for deploying fabric ¿
are very effective and functional, however they are extremely costly. As I mentioned pulling out fabric is usually done by hand with ropes, tirfors or chain motors. Another means of spreading the fabric is through the use of:

Spreader Bars

- Purpose built or bolt together steel trusses of various lengths
- We recently used a spreader bar in Melbourne that we bolted together on site. Its length was 39 metres this allowed us to position the fabric on a webbing net on top of a steel frame which was then deployed with Tirfors.
- The only downside being the size of crane that you need to use for such a spreader in this case it was a 160 tonne crane. This then leads to the question of access to the structures at heights.

Access

There are several methods of accessing difficult areas

1. EWPS and Boom lifts Any mans preferred option as a means of access allowing close working proximity to the task with a safe and stable platform to heights in excess of 30 metres.

   MSAC PHOTO

2. Scaffolding

Here is a purpose built scaffold used to access this difficult area and to close the field joint and tension the mast and fabric

3. Dog box

You can see in these photos purpose built scaffold to access all edges for tensioning and deploying purposes.

4. Twin ropes Accessing some locations will demand a bit of old fashioned hard yakka via twin ropes access or trafficking the fabric.

Accessing Bale rings

Closure flaps being welded on a PTFE cone.

This photo shows a crew welding closure flaps over a field joint between two fabrics.

This photo shows a crew almost a panel replacement on a PTFE structure.

The circumstances of the task will always dictate what method of access is required in any situation. It is important to remember that life lines should be employed when working at heights from steel super structures or roofs and gutter sections.

Once you have access to work areas and have deployed the fabric then you will need to tension the fabric, cables and associated hardware. Some of the most common and useful manual aids are:

Aids to the installation process:

- Rope edge clamps Sheave blocks
- Split sail track Corkscrew clamps
- Chain pullers Double sided rope edged track

- Wire rope pullers Hydraulic jacking rams
- Tirfor blocks Nylon slings and high stretch ropes
- Tensioning (Clamps – Chain blocks)

A combination of soft slings shackles and clamps and pullers can be used singly or in gangs to tension individual points or entire lengths of a structure. As in the picture a fibreglass fabric is being tensioned to make connections.

This picture shows tensioning a field joint with threaded rod and fitting fabric under tension to membrane plate.

This shot also shows fabric joint tensioning and next two pictures

Hydraulics Another type of tensioner is the hydraulic pump and ram. These are used to tension masts with attached bale rings which are controlled with guy cables. Design tension is reached through hydraulic jacking.

Tensioning with Wire rope pullers

If ever there is a case to pull flexible steel wire rope or cable then the use of wire rope pullers are a very inventive but practical tool designed to be able to latch onto steel or stainless cables to pull wire cable to make connections.

This is not recommended for tensioning to achieving design loads. ¿ connections.

And so in closing, in attempt to try to take up as little of your time as possible and without giving away too many secrets. I leave you with a few images of a structure Ozrig recently disassembled. which will answer your questions as to how this should be done also.