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The development of the RSSB tent

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Abstract

This paper describes the design principles of the two hectare RSSB tent. The latest of several very large demountable tents designed by Buro Happold. The PVC/polyester tent is 120m wide by 150m long with a very shallow slope. It is reinforced with cables at 15m spacing running across the 120m width supported bby masts at 12/16m spacing. It is designed to be raised by pushpoling.

1. Introduction

Shows and exhibitions, for example the Chelsea Flower Show, can be accommodated within multiple marquee type structures supplied through the rental tent industry. Larger structures to provide shelter for large audiences attending theatre or music events, or large meetings when there is a need for sight lines to be maintained and for a single volume space have to be specially designed.

Demountable tent structures are invariably designed around the method of assembly and lifting. One has the option of installing the masts first which are equipped with sheaves and hoisting ropes or laying the masts out on the ground and pushing them up. Generally the second method results in lower installation costs but there is a limit on the size of the masts. During lifting, the fabric is moved from a safe and stable position on the ground to its final fully tensioned condition when it acts as designed. In between the fabric is loose and the designed boundary connections may not be fully made or temporary attachments are used. In this condition problems can arise if the wind gets up but this can generally be avoided by paying attention to the weather forecasts. However big the tent is it has to be possible to get it lifted and partially tensioned within 12 hours so that it can be safely left overnight.

2. Cable Hoisted Tents

Examples of tents in which the masts are installed first with overhead guy cables and built in lifting equipment are listed below. The lifting equipment consists of "Tirfor" manually operated cable winches with built in cables and sheaves. With the last three the lifting cable was replaced by a direct connection of the main ridge cables to the mast top when the fabric had reached its correct height. (fig 1)

CFAN	12,000 m2
Princes St. Gardens, Edinburgh	3,000 m2
Boston Harbour Lights	5,000 m2
Darien Lake, Buffalo	5,000 m2

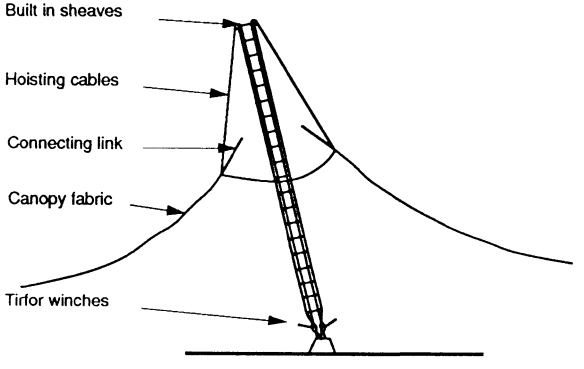

Fig 1 lifting fabric using built in winches

3. Push Pole Tents

Push poling is sometimes used for lifting marquee sized tents, more frequently in America that in the. UK A previous example of a tent in which the fabric was pushed up by the poles is the Theatre tent for the Welsh National Eisteddford. For this tent the main masts were about 9m high. It was found that the edge masts could be installed by lifting by hand. Once these were raised the internal masts were raised by pushing at the base with a fork lift truck. The trick is that fabric or cables sloping down from the already raised masts pulls the new mast up (fig 2). This process was extremely successful and the erection crew never had any problems with lifting this tent.

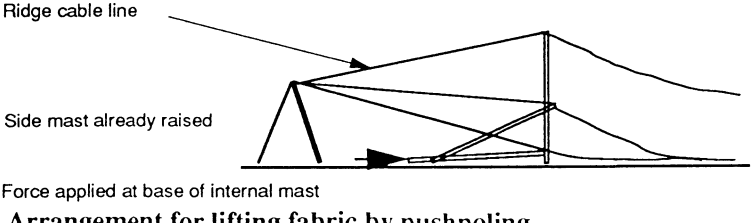

Fig 2 Arrangement for lifting fabric by pushpoling

4. Design of the RSSB Tent

The RSSB community required the tent for their annual meeting when their master comes to address them. It was to be erected in the grounds of the house which was their centre in the UK. It was required for a period of three days in each year. They wished to be able to install the tent themselves. Their members have a tradition of giving service to their community and hence they have available a large number of able bodied helpers. A number of them had experience with construction and engineering and were well able to learn the procedures involved.

They wanted to have a large tent capable of seating 25,000 people but expandable in case their community grew. Ideally this would be one volume with no, or a minimum of masts. For growth it would have to be modular. We suggested a tent with two very high (30m) external masts which supported the roof with cables. It was clear that the installation would require large cranes and would take probably 2 weeks to complete. Whilst they have a large number of volunteers they all have jobs and cannot make themselves available for too long.

The alternative was to have a number of internal masts but keep them slim so that viewing is not obstructed. If these could be kept as short as possible they would be slender and light in weight so that they could be pushed up. To get the area the tent should be wide with a minimum slope. Extra bays could be added to increase the length but it was not practicable to increase the width.

The developed structure had cables at 15m spacing running 120m across the building. They sloped from 3.5m height at the sides to 11m at the centre a slope of 1 in 10. The columns were spaced at 16m along these cables except for the end bays where the span was reduced to 12m. The cables were heavily pretensioned so that the cables were essentially straight. The fabric was basically stretched flat between the cables. Wind uplift was resisted by the internal masts and not just at the ends of the cables. The central mast was replaced by short flying masts with hanging cables back to the adjacent columns to gve an unobstructed view down the centre of the hall. At the edges there were masts between the cables 2.5m high. This induced some curvature at the edges to stabilise the fabric where the wind effects would be greatest. The gable ends were supported by masts and tie backs at 8m spacing.

5. Construction

The tent was made in type 2 PVC coated polyester fabric, belts were introduced on the column lines running across the panels i.e. down the length of the building. These were to add security to the columns particularly during lifting of . Obvi

ously the biggest problem was avoiding ponding. The fabric was carefully patterned to ensure that the surface would drain. The belts on the column lines were a pontential source of trouble. If they were too tight then they would cause a ridge in the fabric panel which could cause ponding. It was necessary to compensate carefully the stretch in the belts relative to the stretch in the fabric so that the belts did not pick up too much tension when the fabric was stressed.

The internal columns were designed to resist uplift and were anchored to concrete bases. The perimeter tie backs were all anchored to Chance screw anchors whic were preinstalled on site.
The first installation was a learning process for the crew. They had a lot of problems with the Loadall fork trucks and with tensioning equipment. The second installation went pretty smoothly and the tent was laid out and lifted in 5 days.

Fig 3 External view of RSSB tent

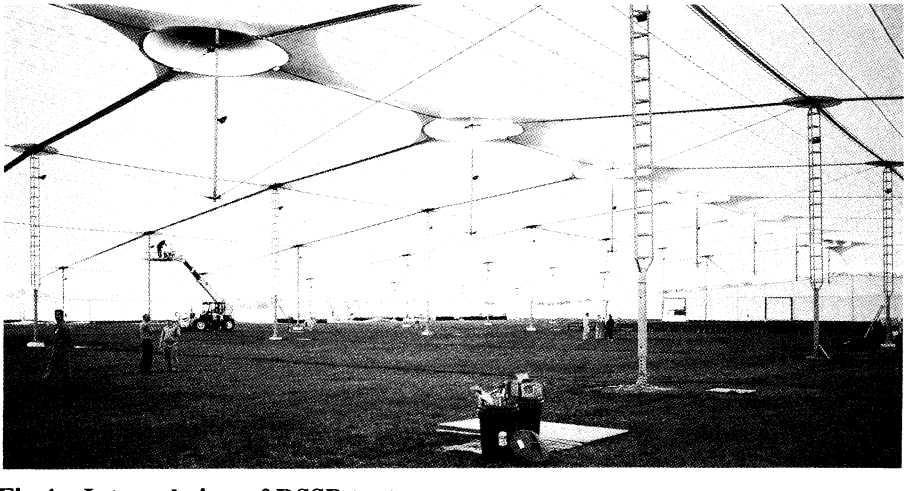

Fig 4 Internal view of RSSB tent