Custom Covers Technical Guide (II)

How to Stop your Marquee Blowing Away!

- ***Make sure it is held down properly***

When assembling any marquee or temporary structure, it is essential that it is adequately held down. If it is not held down properly in high winds the consequences can be catastrophic with damage to buildings, vehicles and most importantly the risk of serious injury to anyone in the vicinity. There are 3 main ways of holding the tent down:

1. Stakes or other ground anchors
2. Weights
3. Bolts

1. Stakes or other ground anchors

When using stakes, we recommend for our 48mm x 94mm profile tents (3, 6, 9m) that a minimum of one stake per leg is used. For our 114mm x 80mm profile tents (12, 15m) we recommend a minimum of two stakes per leg. This is based on a 36 inch stake in good firm soil, but each job will have to be assessed on its own merits. Soil with high clay content will give a very good holding down force, whereas sandy or rocky soil will not have as much cohesive friction with the side of the stake. I would refer you to the IFAI study on soil types and equivalent holding down forces required. Every job will have to have an assessment of the soil carried out to ensure the correct number of stakes is used. Additional stakes and guy roping of the structure, and inserting stakes at an angle are all good methods of increasing the holding down force on a tent. Screw down anchors can be used as an alternative to stakes in sandy soil, and it is essential the manufacturer's recommendations are followed when using these.

2. Weights

If the marquee is weighted, there must be sufficient weight on each leg to ensure the stability of the structure (**see attached table 1**) For the structural tent legs, ideally the weight should be positioned over the base plate to stop any shear movement as well as opposing the lifting forces. If this is not possible the structure must be guyed to the weight using a heavy duty ratchet strap or similar. Rubberised pads underneath base plates would also help to reduce shear movement. Marquees with weighted floors that have no external weights must be assembled according to the manufacturer's instructions to ensure even distribution of loads. Gable end legs do not need as much weight as the structural legs, so the loads can be reduced accordingly (see table attached)

3. Bolts

Where the structure is assembled on a hard surface i.e. on concrete, and it is allowable, the tent can be bolted to the ground either mechanically or by use of a chemical resin fixing. Checks must be made that there are no pipes or cables where the holes are going to be drilled. It has been calculated that one M12 mechanical rawl bolt per leg gives sufficient holding

down force for the tents maximum wind loading. This would also apply to a chemical fixing into good concrete, provided the holes are drilled not less than 400mm from the edge of the concrete. Large washers fully covering the holes in the base plates are also essential.

- ***Make sure it has been built properly and is properly sealed against the weather***

  Marquees should always be constructed according to the manufacturer's instructions. The design wind speeds are based on a correctly assembled and braced tent with no openings. In high winds it is essential that all opening into the tent are closed, and where access is required it is preferable not open any panels on the windward side of the structure. If high winds are forecast it is possible to increase the holding down force of the tent with additional guy ropes. These can be attached to stakes, vehicles or any other heavy load present so long as there is no risk of pulling up. If extreme weather is forecast the preference is to strike the structure if there is time to do so safely. Alternatively simply removing the PVC covers will mean the loads on the structure will be dramatically reduced, and in emergencies covers can be cut out with a knife instead of being removed as normal. Once this has happened the entire site would have to be roped off and kept clear as there will still be the danger of purlins blowing out.

- ***The design wind speeds of our structures are as follows:***

  9m Tent – 28m/s or 63mph
  12m Tent – 36m/s or 80mph
  15m Tent – 28m/s or 63mph

- ***How can it let go?***

  Wind damage can occur in a number of ways. Tears in the fabric could appear which will allow the wind to get inside the structure and create uplift, which will increase the risk of the anchorages failing. The structure could be blown sideways and then trip over itself, or simply be lifted from one side and peeled open. There is also the possibility of the ridge knuckles or roof beam buckling, but this is mostly when there are other forces acting on the tent than wind alone such as build up of ice or snow. Further guidance is available from organisations such as MUTA, IFAI, and the Temporary Demountable structures publication from the Institute of Structural Engineers

- ***Risk assessments and monitoring of conditions***

  It is essential that for every site a full risk assessment is carried out to ensure the safety of structures in high winds. This should include inspection of soil/floor conditions and the exposure of the site to prevailing winds and any forecast change in direction. Forecasts should be monitored and plans should be in place to deal with extreme conditions. The customer must be made fully aware of their responsibilities to keep the tent sealed and not leave doors

open in high winds, and stand by crews need to add more guy ropes or stakes which should be available if the forecast dictates.

Simply put, making sure the tent is correctly assembled and held down on every job means it is extremely unlikely you will lose one!

- ***Wind Management***

This wind management advice is based on an extract from Temporary Demountable Structures published by the Institute of Structural Engineers (4th Edition).

The operational maximum gust speed should be taken as a three second gust measured 10m above ground level

Two levels of warning are suggested;

Level 1; When wind monitoring registers a gust wind speed in excess of 75% operational maximum gust speed in conjunction with an increasing general trend of recorded wind speed. Staff to be put on alert that action may be required. If erection in progress consideration to be taken whether to delay erection.

Level 2; When wind monitoring registers a gust wind speed in excess of 90% of operation maximum gust speed in conjunction with an increasing trends in wind speed the operational management plan should be implemented and the site secured against access by the public.

If an isolate gust exceeds either limit against a background of a decreasing trend in wind speed then further monitoring may be appropriate

CC structures	Design wind speed (mph)	Level 1 75% alert level (mph)	Level 2 90% action level (mph)
Standard 3,6, 9m frame Standard 15m frame Curved 3,6,9 & 12m frame	62	46.5	55.8
Standard 12m frame (114 x 80)	81	60	72.9

When Level 1 is reached the structures should be checked to ensure that all stakes and ballast are firmly in place and that all openings are securely closed. Consideration should be given to providing additional forms of protection by adding additional guying where possible

When level 2 is reached evacuation is necessary for all but safety critical staff

- ***What to do If wind speeds exceed design speed of structure***

  If forecasts are predicting that wind speeds will be above those that the tent is designed for, and there is sufficient time, then the structure should be taken down and stowed safely as it normally would.
  If the conditions occur whilst the structure is in use, the priority is to evacuate everybody to a safe distance upwind of the tent.
  If the conditions allow, the PVC roofs and gables should be removed first to stop the aerofoil effect of the PVC skin. Walls can be removed afterwards to stop the side force applied. If the roofs are missing in high winds it is possible for the purlins to be blown out of their brackets so it is essential that the structure is cordoned off and only trained staff with the necessary PPE can enter the area until it can be made safe.
  If conditions are so extreme that it is not possible to remove the PVC covers as normal, then they can be cut out with a sharp bladed knife around the keder. This may release sheets of PVC to be blown downwind, but is preferable to allowing the framework to fail as this can do considerably more damage.

Table 1

Custom Covers hold down forces in kg per upright (weight per leg) for marquee frames under varying wind speeds

Wind Speed (m/s)	13	20	28	36
Wind Speed MPH	30	45	63	81
Beaufort Force	6	9	10	12
Span (m) on 2.3m Eave				
3	200kg	400kg	800kg	-
6	150kg	500kg	795kg	-
9	100kg	600kg	1010kg	-
12	100kg	700kg	1200kg	1550kg
15	100kg	800kg	1300kg	-

Span (m) on 3m Eave				
3	200kg	400kg	800kg	-
6	150kg	500kg	800kg	-
9	100kg	600kg	1010kg	-
12	100kg	700kg	1315kg	1550kg
15	100kg	800kg	1400kg	-