

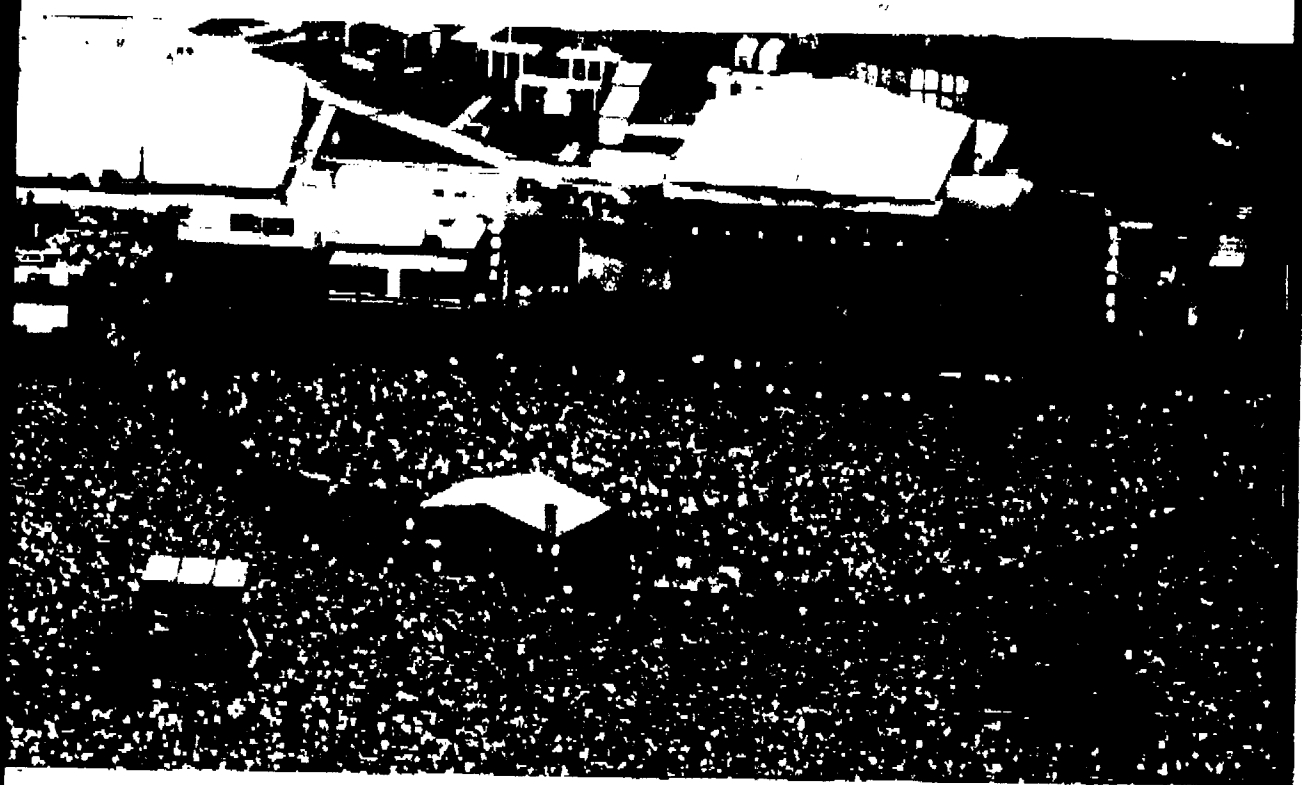
The Institution of Structural Engineers

MARCH 1999

# Temporary demountable structures

Guidance on design, procurement and use

SECOND EDITION



Published for the Institution of Structural Engineers

Complexes involving many large structures in close proximity may need specialist advice regarding the siting of any measuring devices.

All wind speeds measured are referenced at 10m above ground level and Table 6 gives the appropriate speeds to be used if measurements are taken at different heights. Intermediate values for heights above 5m may be interpolated.

Where wind speeds have been recorded as a result of a Level 1 action, a hard copy of the wind speed record should be kept for inspection if required.

An audible and/or visual alarm system should be provided to warn of exceedance of wind speed Levels 1 and 2.

### 8.3 Wind loading on tents and marquees

Design, erection and operation of tents and marquees are discussed in Section 12.

#### 8.3.1 Basis

The safety of tents and marquees in wind is assured through a two stage process:

- (1) Selection of a suitable marquee for the site.
- (2) Active management of risk in service

This process uses monitoring of the maximum service gust speed at 10m above ground,  $V_{10}$ , which is appropriate for the site where the marquee is to be erected.  $V_{10}$  should be determined for the erection site from BS 6399: Part 2: 1997<sup>(8.1)</sup>, which gives  $V_{10}$  as:

$$V_{10} = V_b \times S_a \times S_b \times S_d \times S_e \times S_p \quad (1)$$

The basic wind speed  $V_b$  depends on the geographic location of the site. The values of altitude factor,  $S_a$ , and terrain and building factor,  $S_b$ , depend on the exposure of the site, while the values of direction factor,  $S_d$ , seasonal factor,  $S_e$ , and probability factor,  $S_p$  depend on the use of the structure.

By standardising the expected range of sites for tents and marquees in the UK, equation (1) simplifies to:

$$V_{10} = V_b \times S_{\text{marquee}} \quad (2)$$

where  $V_b$  is taken from the wind map in Figure 6 in BS 6399: Part 2 (Fig 10 in this Guide) and  $S_{\text{marquee}}$  is taken from Table 7.

#### 8.3.2 Large marquees

Large marquees are pole marquees with a span greater than 12m (40ft) or framed marquees with a span greater than 9m. Large marquees should be designed to remain stable for the design wind loads specified by CP3: Chapter V: Part 2: 1972<sup>(8.2)</sup> for marquees designed prior to August 1995 or BS 6399: Part 2: 1995 or 1997<sup>(8.1)</sup> for marquees designed from June 1997. In the period August 1995 to July 1997 either Code may have been used. Compliance with the Code requirements may be determined by:

- structural calculations, or
- load testing.

Long-term experience gained in previous use of a design may be taken as equivalent to load testing when new marquees are constructed to the same design. Previous structural calculations will apply to all new marquees constructed to the same design.

For any large marquee, compliance should be defined in terms of the rated maximum service gust speed at a height of 10m above ground,  $V_{10}$  for the marquee. It may be practical to rate the canopy and the guying system separately, in which case the lower rated value applies. The rated value of  $V_{10}$  for double-guying may be taken as 1.4 times the rated value for single-guying.

A series of 9m span bays, valley guttered, where one bay is capable of standalone erection, should not be considered a large framed tent or marquee.

Smaller marquees those framed 9m span or less and pole marquees 40 ft span or less do not necessarily require formal stability calculations. If they do not, their wind load rating is assumed to be in accordance with the Beaufort scale range 5 and range 7 for tents which are double staked and additionally guyed or otherwise strengthened.

This in effect means that smaller tents are rated at 35 mph or 16m/s and double staked at 52 mph or 23 m/s. This approach will probably err on the side of caution.

Exceptional sites – where the basic wind speed exceeds the rating of the marquee. This does not mean that the marquee cannot be used, rather that the contractor actively manages the marquee(s) while in use.

Active management means frequent reference to local weather forecasts – having available on site or within reasonable call out. A maintenance crew of appropriate size, that should wind speed on site approach 90% of the maximum in service rating of the marquee (refer to calculations or use Beaufort Scale) they are able to:

- a) maintain and or strengthen the marquee(s) so it remains a safe condition

or

- b) ensure the marquee and its immediate area is cleared of the public, then remove covers from a frame tent or lower a pole tent. In both cases the site foreman or manager must ensure that it can be done without endangering the crew.

### **Section 9 – Entirely Low Ceiling Grandstands**

*'Design of temporary grandstands and seating should be the responsibility of a competent person. Before assembly, the design should be independently checked by a chartered engineer of appropriate skill and experience.'*

*'Demountable structures should be designed to form a robust and stable three-dimensional structural arrangement which will support the design loadings for the required period with an adequate margin of safety.'*

*'Demountable structures should possess sufficient transverse and longitudinal stiffness to resist wind loads and dynamic loads induced by spectator movement.'*

*'Dynamic loads will only be significant when any crowd movement is synchronised and periodic. If the synchronised movement excites a natural frequency of the structure, resonance will occur which can greatly amplify its response.'*

### **Section 10 – Entirely concerns Stages and Barriers**

*'Temporary stages should be assembled in accordance with plans and specifications drawn up by a competent person. The calculations involved in drawing up the plans and specifications should be independently checked by a chartered engineer.'*

*'Design of any temporary staging system is essentially a consideration of the balance between weight, strength, fabrication, cost and deployment cost of the individual components. In such a consideration, safety must not be compromised.'*

*'Lack of handrails and poor stairs are the biggest causes of stage-related accidents indoors.'*

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TEMPORARY DEMOUNTABLE STRUCTURES - SYNOPSIS

Synopsis  
Temporary Demountable Structures  
Guidance on Procurement Design and Use

This summary of the guide is meant to highlight the main points which are of interest or concern to members. MUTA accepts no responsibility for errors or omission. It is highly recommended that members obtain and read in full the document when published in March 1999.

**Section 1 – Introduction and Scope**

Primarily, the client/venue owner has the responsibility for public safety but everybody involved including the contractor has a duty of care to ensure the safety of those involved in erection and use of temporary demountable structures.

Temporary demountable structures included in this guide comprise – grandstands, stages, marquees and canopies etc.

Temporary demountable structures are generally erected for 28 days or less

Status – The document is a guide – however departures from its recommendations should be agreed and recorded.

**Section 2 - Responsibilities**

**Client**  
Responsible for safety of users of the temporary demountable structure.  
See Section 3

**Local authority**  
Responsible for statutory public safety controls in some circumstances.  
See Section 4

**Contractor**  
Responsible for design, erection and dismantling of temporary demountable structure.  
Responsible also for arranging independent design check.

*Primary responsibility for the safety of persons attending an event and of the users of temporary demountable structures lies with the client. The client cannot pass on the responsibility for safety to any third party.*

*The client should ensure that competent persons are employed to design, supply and erect the temporary demountable structures.*

*An independent erection check on the structure once it has been erected should be carried out by a competent person, who may be an employee of the supplier of the structure or a person nominated to carry out such checking by the contractor. Where a member of the erection team carries out the erection check, evidence of that person's competence should be made available.*

*'The area immediately in front of a stage presents particular hazards for a standing audience.'*

**Section 11 – Concerns ancillary special structures e.g. video screens, camera platforms, score boards, lighting equipment etc**

*'Some of these structures differ from other structures discussed in the Guide in that during an event they are located in the middle of a venue and are surrounded by the audience.'*

*'As with other temporary structures, an independent design check by a chartered engineer of appropriate skill and experience should be carried out.'*

*'It is paramount that the design of the structure is appropriate for the situation and that the structure is built strictly in accordance with the design.'*

**Section 12 – Tents and Marquees**

There are two broad categories, unframed and framed.

**Design**

Tents and marquees should be capable of withstanding all forces which they may reasonably be expected to encounter. Of these, wind is the most important from a design point of view, see Section 8.

The design of new large marquees should be carried out by a competent person and subject to an independent check by a chartered engineer of appropriate skill and experience.

**Anchors**

Anchors are a critical aspect of marquee structures. The force that an anchor can withstand depends on:

- Type of soil
- Inclination of anchor
- Depth of anchor

The type of soil on which the marquee is erected has a large influence on the pull-out force that a stake can withstand. Stiff to very stiff cohesive soils provide the best resistance to pull-out. For most soil types, steel or wooden stakes are appropriate. Loose, non-cohesive soils such as sand provide the least resistance and helical or screw anchors may be required.

**Flame retardancy of fabric and materials**

All fabric should be inherently or durably flame-retardant and should be certified as conforming to test 2 of BS 5438 [12.2] or Annex A of BS 7157 [12.3] and BS 7837.

**See Text from Primrose Guide and MUTA Code of Practice**

**Procurement and Use**

*Site Plan*

For larger events, it is recommended that an outline plan of all the structures on the site should be prepared by the client showing the position of all entrances and exits, generator equipment, vehicles etc.

*Fire Safety*

Guidance is given in *Guide to Fire Precautions in Existing places of Entertainment and Like Premises* [12.7], in subsequent advice issued by the Home Office [12.8] and by the Home Office Fire Research Development Group [12.8a].

*Loads*

Nothing should be attached to or suspended from the tent without reference to and approval of the contractor.

Very few tented structures have snow-load capacity and if snow is a possibility the structure should be heated in order to maintain a minimum temperature of 12°C to prevent build-up of snow on the roof.

*Underground and overhead cables*

The client should notify the contractor of the position of underground services or overhead cables which may present hazards during the erection or use of the tent.

**Safety considerations – contractor**

*Access and egress*

Tents intended to hold more than 50 persons should have at least two suitable exits.

The maximum distance of travel from any part of a tent to a final exit should not normally be more than 24m.

All doors on an exit route should open outwards and, where exit doors have to be secured against intruders, they should be fitted with panic bolts or latches to comply with BS 5725: Part 1 [12.11]. Where there are no doors, flap exits of quick release design should be provided.

*Stakes and Ropes*

Stakes and ropes near exits should be clearly marked or roped off to prevent members of the public from walking into or tripping over them.

*Services*

Electrical installations should be installed, tested and maintained in accordance with the provisions of normative standards or national guidelines such as the IEE Regulations for Electrical Installations [12.13]. Work on electrical installations and appliances should only be carried out by competent persons.

All means of heating other than electrical heating should be placed externally and ducted in by means of flame-retardant hosing.

Marquee contractors should have access to a reliable local weather forecasting service to determine the level of maintenance necessary during an event.

Marquee contractors should provide an out of office hours emergency telephone number and response service.

### 12.4.1 – Erection

Tents and marquees should be erected and dismantled by competent persons. The manufacturer or supplier should provide a method statement for erection and dismantling.

#### Inspection

After erection and before use, a tent or marquee should be thoroughly inspected by the client and/or the supplier. The inspection should be based on a checklist and should include the points that are recommended in the MUTA Code of Practice. [12.1].

#### VERIFICATION

The Made-Up Textiles Association (MUTA), the trade organisation representing marquee contractors, operates a self-regulatory scheme which imposes on its members compliance with a Code of Practice [12.1] which the Association enforces through an Inspectorate. MUTA's self-regulatory status is recognised by the Home Office Fire Safety Unit.

Design stability calculations should be available for all large marquees, clearly stating the rated maximum service gust wind speed and certified by a chartered engineer of appropriate skill and experience. The MUTA Code of Practice Certificate may be accepted as evidence of satisfactory supplier performance.

Those tents designed empirically and used successfully by generations of marquee contractors, i.e. traditional marquees of 12m span or less and frame-supported of 9m span or less, can continue to be used without the necessity of to produce stability calculations. These types of tentage can readily be strengthened for use during abnormal weather conditions (See MUTA Recommendation for Marquees and Frame Tents used during winter months [12.10]).

A self-check sign-off form should be available which is signed and dated by the site supervisor. Supervisors should have at least two years' field experience. A level 3 National Vocational Qualification for senior staff involved in the erection, dismantling and signing-off of tented structures is being prepared at the time of writing.