

project **Totem Pole Tent**  
onderwerp **Technical Information**  
opdrachtgever **Tribal Field Events**  
rapportnummer **091903\_RA02\_V1**  
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project Totem Pole Tent

opdrachtgever Tribal Fields Events  
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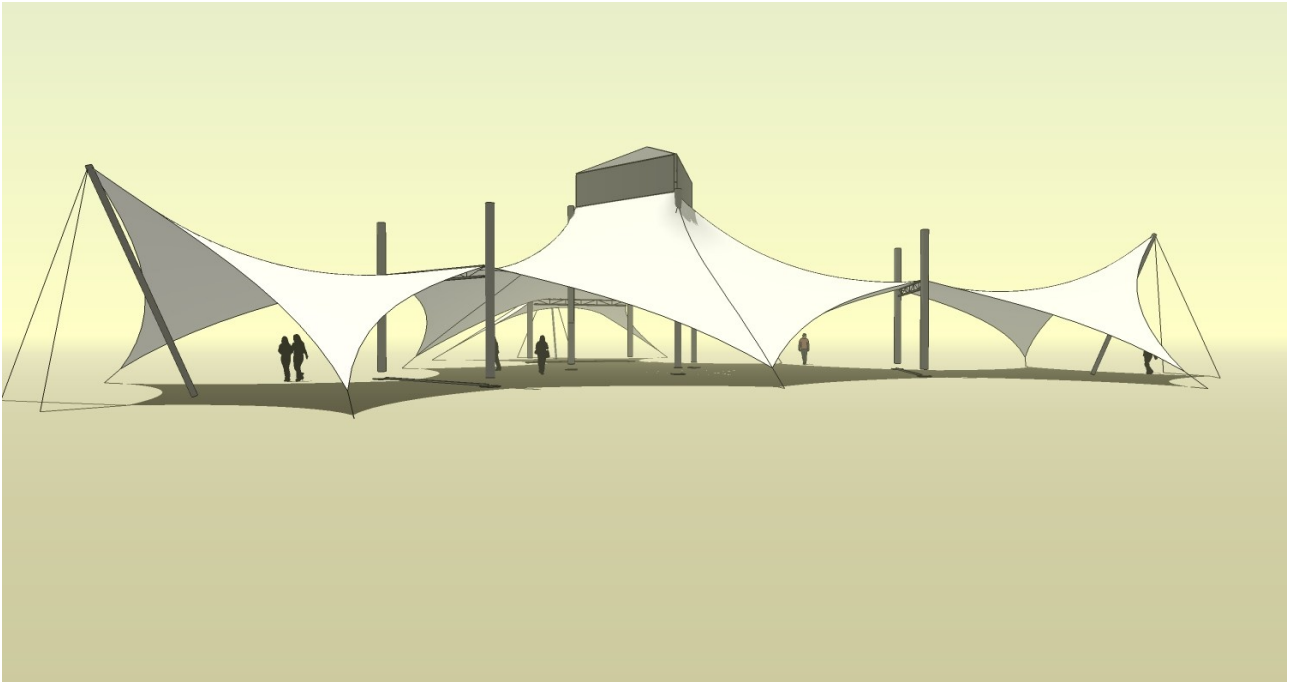
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## Introduction

Tribal Fields Events has designed a Totem Pole tent. The structure is based upon a triangular base frame in the middle of the structure. Towards each side of the triangle, a portal frame is placed that creates an opening in the structures. In between the long sides that are formed by the portal frames, an extra pull down point is situated to create more curvature in the fabric.

It is possible to place additional canopies to the portal frames to enlarge the structure.

The supporting structure is made of square totem poles of Batu Meranti.



Figuur 1 visualisation of Totem Pole Tent

Utrecht, 22. 04. 2009

Rogier Houtman

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## 1. Assumptions and Codes

### 1.1. Codes

Following codes are used:

EN 1990 Eurocode	Grondslag van het constructief ontwerp (Basis of structural design)
EN 1991 Eurocode 1	Ontwerpgrondslagen en belastingen op constructies (Actions on structures)
NEN-EN-1991-1-4	Belastingen op constructies- windbelastingen
NEN-EN-13782	Temporary structures –tents - safety
DIN 4112	Temporary structures
DIN 1052	Wood

## 1.2. Partial Safety factors

Safety factor fundamental combinations (NEN-EN 13782 6.6.2)

$\gamma_g = 1,35$	Partial safety factor for unfavourable permanent actions
$\gamma_g = 1,00$	Partial safety factor for favourable permanent actions
$\gamma_f = 1,50$	Partial safety factor for only one variable action
$\gamma_f = 1,35$	Partial safety factor for more variable actions
$G_k$	Characteristic value of permanent action
$Q_{k,i}$	Characteristic value of one of the variable actions

Safety factor against overturning, sliding and lifting (NEN-EN 13782 table 2)

$\gamma_g = 1,00$	Partial safety factor for favourable permanent actions
$\gamma_f = 1,2$	Partial safety factor for unfavourable wind loads

## 1.3. Design Actions

- Dead load of structure (permanent action) of the structure is taken into account.
- Wind load (variable action) is taken into account according to NEN EN 13782 / DIN 4112
- Snow load (variable action) is taken into account according to NEN EN 13782
- User load (variable action) depending on spare capacity of structure.

## 1.4. Load cases

### LG 1 Dead load & pretension:

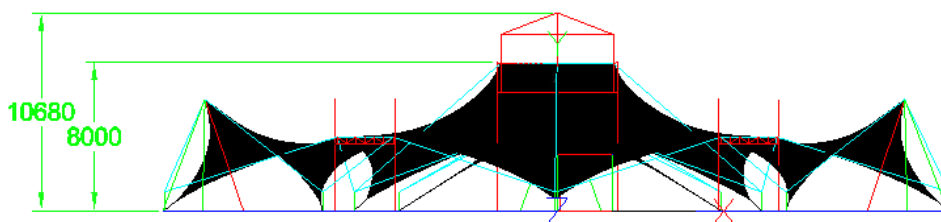
Dead load of wooden structure and dead load of fabric are determined by the software package. Pretension of the fabric is set to 1 kN/m'.

### LG Wind load:

According to EN 13782 following wind load shall be applied: for any other location where  $v_{ref} > 28\text{m/s}$ , calculations shall be provided with the local conditions. For  $v_{ref} < 28\text{ m/s}$ , the wind load may be evaluated applying the following minimum values given in NAD-NVN-ENV 1991-2-4 with:

$C_{TEM}$	= 0.8
$T_r$	= 10 years
$C_d$	= 1
$C_{alt}$	= 1

Max height of structure is 10.7m (see Appendix A, geometry).



Figuur 2 height of structure

$q_{ref} = 0.6 \text{ kN/m}^2$  according to Table 1 of EN 13782.

As the structure also should be able to be placed in Germany, the windload according to the DIN 4112 is determined:

Till a height of 8m :  $q_{ref} = 0.5 \text{ kN/m}^2$   
Above a height of 8m:  $q_{ref} = 0.8 \text{ kN/m}^2$

It is decided to use  $q_{ref} = 0.6 \text{ kN/m}^2$  up till 8m height and to use  $q_{ref} = 0.8 \text{ kN/m}^2$  above 8m height (this is the covering of the triangular base)

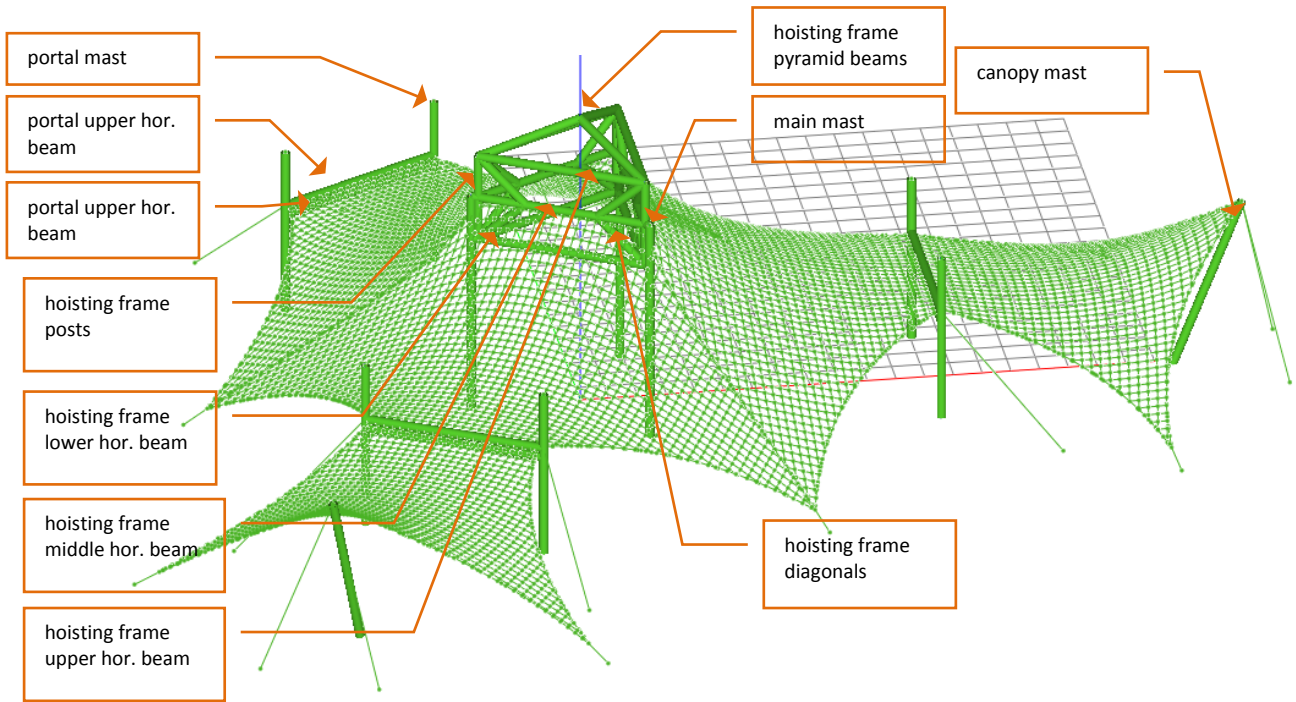
## 2. Approach

The structure is modelled in the FEM software EASY FSC of Technet GmbH, Berlin, Germany. This is a package that is developed especially for membrane structures and is capable of handling large deformations, that occur with membrane structures.

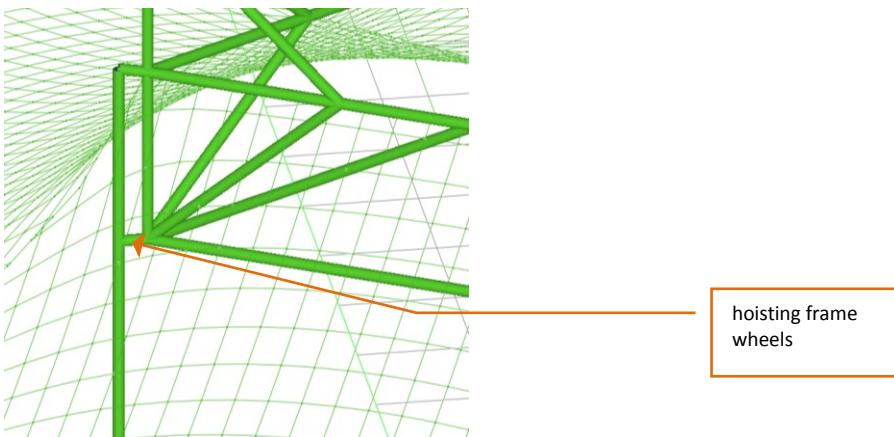
Those large deformations in the fabric cause a change in load bearing behavior in the structure. Therefore it is not a safe approach to put load factors on the design loads. These values are added afterwards and will be compared with the allowable stresses.



### 3. Overview of structure



Figuur 3 Structural elements (overview)



Figuur 4 Detail of hoisting frame.