

FLEXIBILITY FOR DISPLACEMENTS

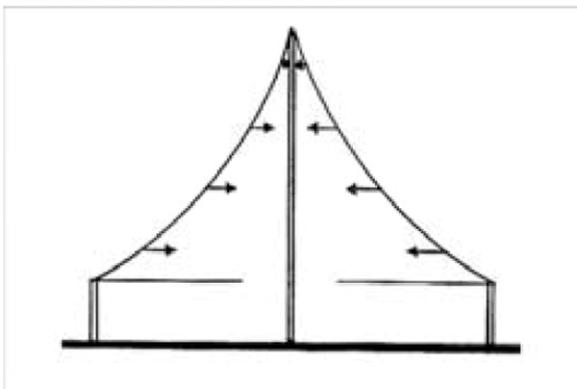
The displacements of tensioned membrane structures produced by external loads are relatively large compared with those of more conventional building systems. This characteristic has to be considered. Details should allow for displacement and rotation, the magnitudes of which are calculated during the design process, as well as their precise position, direction and angular orientation (European Design Guide, 2004).



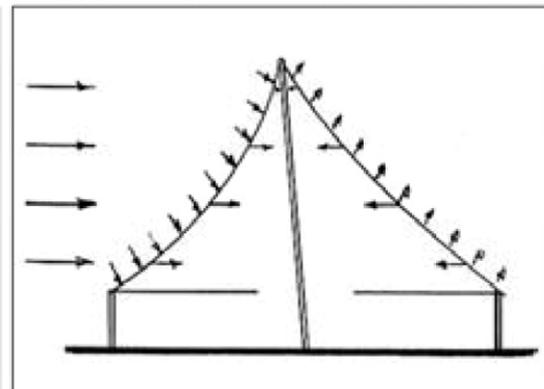
Skiiing = avoiding difficulties



Boxing = facing difficulties



Only prestress: the mast is vertical



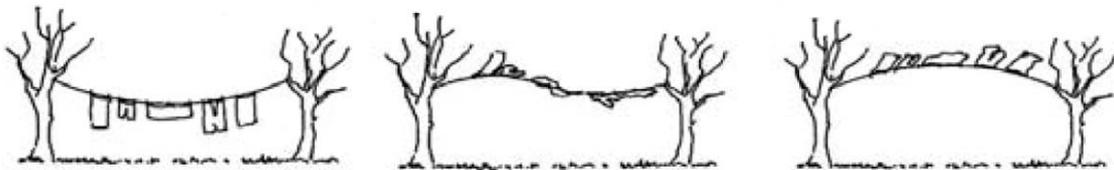
Under lateral wind load the mast should move

A radial tent is subjected to the wind moving from left to right. The wind causes inward pressure on the wind side and outward suction on the lee side. The radial force on the wind side will increase while that on the lee side will decrease. This change will result in an unbalanced force at the top of the mast pulling it towards the left. If the mast tilts in that direction, the windward side will increase its sag and hence will decrease its tension. On the contrary, the leeward side will decrease its sag and increase its tension. The mast will tilt until a new equilibrium of forces is reached at its top. If the mast was not tilted because it was too rigid or fixed, it should resist the bending caused by the imbalance and the force change in the membrane would be large. "Letting go" is an important rule in the design of tensile structures (H.Berger, 1996)

Examples of flexibility for displacements are the deformability of leaves and plants and the movements of the hanging clothes and flags. Leaves and plants move under the wind so that the amount of exposed surface decreases. "A clothesline will change its shape drastically when the load changes in magnitude, direction or distribution. It takes on a smooth downward bow in response to its own weight and the weight of the pieces of laundry which hang from it. We call this funicular shape of a cable a catenary. As long as there are no other forces acting on the system, it retains this shape.

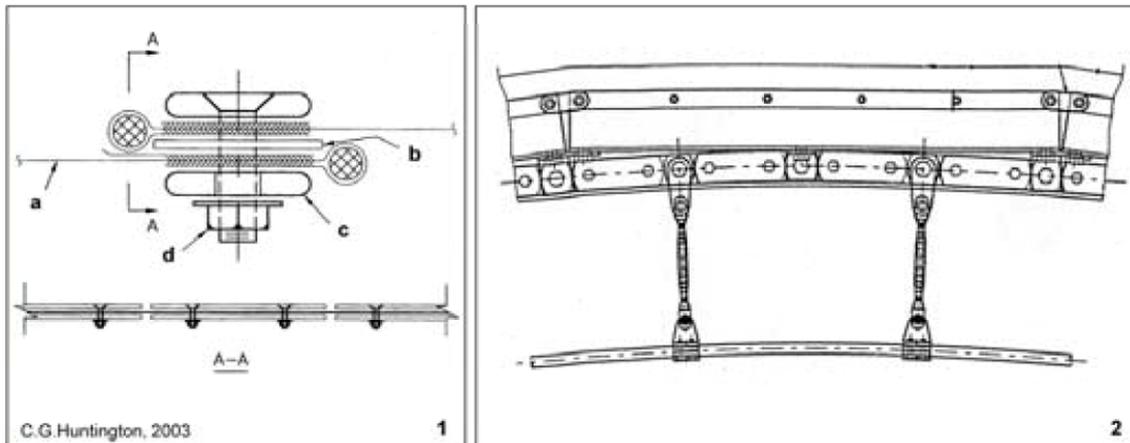


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If there is wind, the clothesline moves dramatically. Under gusty conditions it will lose its initial shape flapping.

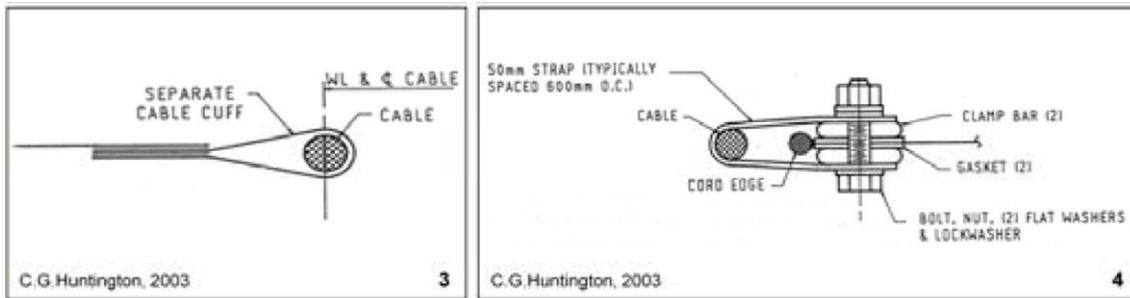
If there is wind, the situation changes dramatically. Under gust conditions, the clothesline will lose its initial shape, flapping up and down. Steady upward wind may even reverse its curvature for a time” (H.Berger, 2005)



Differences in the deformability of different materials require clearance or releases to allow for relative displacements that are compatible with the transfer of load. There are multiple ways of detailing by use of displacements and rotations.

1 Fabric field joints can be made by sandwiching two fabric roped edges between aluminium clamp bars. The ends of upper and lower clamp bars are aligned, as shown in Section A-A, so that continuously linked clamping bars do not acquire stiffness similar to the cables, attracting forces for which they were not designed. Nevertheless, different elongations between the cables and the fabric are not permitted. **a)** Fabric panel. **b)** 3 mm neoprene gasket. **c)** Aluminium clamp bar 10 x 50 x 395 mm. **d)** Flat hex head socket steel cap screw \varnothing 12 mm.

2 The edge cable is outside the membrane and connected intermittently. Allowance is made for different elongations.



3 The edge cable is integrated into a pocket formed by an extra strip of material. Different elongations are not permitted.

4 The edge cable is outside connected intermittently by straps spaced 600 mm. Allowance is made for different elongations.