THE BASIS OF STRUCTURAL ANALYSIS FOR MEMBRANE STRUCTURES

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Abstract

Why undertake an analysis?

Tensile structures are complicated 3 dimensional structural systems. These are very difficult to simplify into 2 dimensional problems to be solved by simple hand or numerical tools.

These structures suffer large deflections which are outside normal building deflection limits. The complex shapes frequently require detailed load distributions to be considered which might be derived from wind tunnel test or CFD analysis.

Tensile structures are elegant lightweight forms which requires the accurate determination of loads within those structures to ensure they remain lightweight and elegant.

Analysis requirements?

These structures transfer surface load via tensile loads to the supporting structure. In this process the structure suffers large geometry deflections and also may suffer a reduction of prestress when supporting these loads.

The analysis tools must therefore be able to accommodate large scale geometry changes and also handle the on/off characteristics of membranes.

The analysis tools must be able to apply a wide variety of surface loadings and must deal with the detailed review of possible wáter ponding.

Use of software packages

The suitability of software packages needs to be carefully considered. The functionality available is not constant between different packages with some offering only basic modelling tools.

The critical starting point is the creation of an equilibrium form found state. Without this the subsequent analyses will be invalid and could lead the user to assume the structure has been successfully designed.

Impact of the forthcoming Eurocode

The partial factor framework of the Eurocodes must ensure that aceptable levels of safety are provided for membrane structures.

This would require careful consideration of the use of a partial factor for the numerical modelling tools applied to the design of membrane structures.

Previous experience has shown that the results to a given problem can vary by a significant amount depending upon the software tool being used.

Historically the generous factors of safety used could incorpórate such variations but when a more detailed partial factor approach is implemented this may not be the case..

Rigorous reliability analyses could be required in order to define these partial factors.