Optimal Prestressing of Membrane Structures

M.Sc. Project Presentation W. Kragting

Monday 17th of May at 16:00 in Room F



Traditionally, the form of a tent structure is computed as a soap film with a uniform stress distribution. Recently, however, innovative architects propose forms that do not have this property of isotropic tension. Consequently, a structural engineer needs to make an advanced computer model to determine whether such a design is structurally feasible. If the form is not feasible it needs to be adapted by the architect. Often, many design cycles are needed to find a suitable form.

The challenge of this project is to develop a computational method for determining stresses in tent structures. When implemented it could be used by architects to quickly check an initial design.

Figure 1: The Marsyas structure in Tate Modern Gallery in London

To this end, three small computer programs have been build, 1) a mesh generator that is added to the design program MAYA, 2) the program Stressfin that computes the optimal stress distribution and 3) a postprocessor developed in AutoCAD.

Stressfin computes the stress distribution and optimal prestressing of a membrane based on equilibrium only. It finds a suitable set of redundants and minimises the largest tensile stress using the downhill simplex procedure. The method does not change the proposed shape of the structure. The programs have been applied to - amongst others - the tension structure Marsyas in the Tate Modern Gallery in London.

Student: W. Kragting Professor:



Figure 2: Optimal principal stresses in a part of the Marsyas structure computed by Stressfin

prof. ir. A.C.W.M. Vrouwenvelder (TU Delft) Supervisors: dr. ir. P.C.J. Hoogenboom (TU Delft) ir. A. Borgart (TU Delft, Architecture) ir. A.P.H.W. Habraken (Arup Amsterdam) ir. P.A. de Vries (TU Delft, Tentech Delft)