Design of Details: Theory and Biaxial Testing of commonly used Details in Membrane Architecture

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Abstract

The mechanical properties of commonly used materials are known, the definition of the elastic properties is principally understood, but the way to measure these properties needs to be discussed. Principally all tools to analyze elastic problems are available. Thus one can enter the most important problems into the mechanical analysis of the stress distribution in load introducing details of membranes. These most important details are

- Introduction of a single load in the field
- Introduction of a single load on a cable edge
- Stress distribution in a seam
- Design of a corner plate for cable edges
- Tear propagation

For these details the solutions typically used nowadays are presented, the mechanical system of these details are shown. Then the stress distribution of these details based on an anisotropic material theory is presented and compared to the classical solutions.

The effect of stress channeling is discussed in a wide manner. It can be shown that this effect of stress channeling is widely governing the properties of details in membrane design.

To show the importance of these theoretical considerations some of the details are experimentally analyzed using the biaxial test facilities of DEKRA Laboratory for Technical Textiles and Films, the former Labor Blum. Here an optical method of measuring the deformation field in a flat sample is used; the results are compared with the theoretical solutions.

From these experiments, one can also get a good impression on the homogeneity of the deformation field in a biaxial testing machine and is able to discuss whether some results are real material properties or properties of the sample design.

Keywords: Conventional detail design, detail analysis based on anisotropic material properties, design of new details, experiments to test the properties of the new developed details, effect of stress channeling, homogeneity of deformation field

References


