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DIFFERENT DETERMINATION PROCEDURES FOR STIFFNESS PARAMETERS OF WOVEN FABRICS AND THEIR IMPACT IN THE MEMBRANE STRUCTURE ANALYSIS

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The design of membrane structures in Europe is characterised by different codes in different countries. For this reason, currently the development of a Eurocode for membrane structures is under way. One important specific part of the design process for membrane structures is the determination of stiffness parameters for predominantly used woven fabrics, because they show a highly nonlinear and anisotropic stress-strain-behaviour under biaxial tensile loads. However, in the structural analysis this behaviour is commonly simplified as a linear-elastic plane stress material, using the elastic constants "tensile stiffness" and "Poisson's ratio" as more or less "fictitious" stiffness parameters. The determination of these elastic constants from biaxial test results is found to be very complex and a rather rough approximation at the same time. The situation can become confusing for designers as several different biaxial test methods and determination procedures for elastic constants exist worldwide. The Japanese standard MSAJ/M-02-1995 "Testing Method for Elastic Constants of Membrane Materials", commonly used in Europe, provides different determination procedures to calculate the stiffness parameters in the two main directions of a fabric from the results of plane biaxial tensile tests. Further procedures are established in the "European Design Guide for Tensile Surface Structures" published by the TensiNet Association and in the US-code ASCE-SEI 55-10 "Tensile Membrane Structures".
The aim of the presented paper is to analyse the different methods, demonstrate similarities and differences and show how far structural analysis results vary due to differently determined stiffness parameters for same materials. Furthermore, the paper will show design professionals and code developers rules which allow to assess the quality of the determined sets of elastic constants in order to enhance the accuracy of the structural design of membrane structures.