ROUND ROBIN EXERCISE 3: COLLATING WIND TUNNEL DATA FOR THE BASIC SHAPES OF TENSIONED SURFACE STRUCTURES

The first Round Robin Exercise, launched by the TensiNet Working Group Materials & Analysis, was a comparative study of analysis methods and results for a set of well-defined membrane structures. The results were published in 'Engineering Structures' and the full paper is available at http://eprint.ncl.ac.uk/pub_details2.aspx?pub_id=184881.
The second Round Robin Exercise, just launched by the TensiNet Working Group Materials & Analysis and WG4 of the COST Action TU1303 Novel Structural skins, follows a similar format. A comparative exercise will be carried out by practitioners and Universities worldwide on the interpretation of biaxial and shear test data, i.e. the assessment of the stiffness of architectural fabrics and how these properties are represented in the analysis of a structure.
The third Round Robin Exercise is launched by the TensiNet Working Group Specifications and WG5 of the COST Action TU1303 Novel Structural skins and aims at collating wind tunnel data for the basic shapes of tensioned surface structures.

Membrane structures are typically applied in outdoor applications as sheltering or facade element. Therefore, they are subject to the natural elements and must be designed to resist these external loads. Especially in the field of wind analysis accurate wind load determination on these pre-tensioned lightweight structures has to be investigated, as stipulated in the European Design Guide for Tensile Surface Structures (Forster et al., 2004). The need for accurate wind-load Standards on these structures has also been stressed in several international publications (Gorlin 2009), stating the lack of the current Standards (ASCE) in governing the wind-resisting strength for these structures and the need for an industry-wide set of Standards.

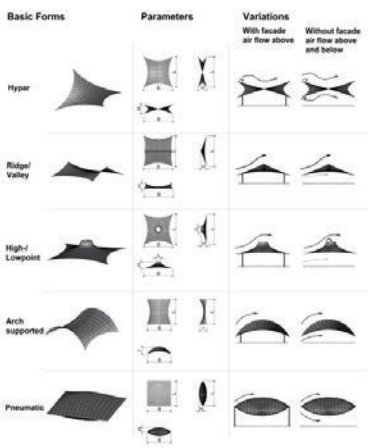
In general, conventional Codes on wind design give upper bound values for the majority of structures (conventional building typologies), but the level of uncertainties increases as the building configuration deviates from the codified Norms. The structural analysis of membrane structures can only benefit from improved and more accurate wind load estimations and analysis methods. Currently, wind loading on tensioned surface structures is often based on rough approximations referring to flat or spherical shapes of EN 1991-1-4, while the special nature of the textile covers are not taken into account (EN 1991-1-4 and EN 13782, which refers to EN 1991-1-4 for wind loading, is insufficient for tensile surface structures, dynamics actions, flexible deformations etc.). Extrapolation from the Standard may be acceptable for static structures, but for flexible membrane structures, with a non-uniform curvature, additional wind investigation has to be performed. Appropriate wind pressure data is essential to provide confidence in the analysis and design process, and to ensure the development of the Eurocode that will facilitate the safe and efficient design of membrane structures.

Therefore in a first stage, research institutes, universities, specialized laboratories and engineering offices are asked to provide the available experimental data for basic forms in a uniform way to allow comparing and interpolating the information. Further, where crucial data is missing new experimental campaigns should be launched. In a second stage, engineers and research institutes experienced in performing wind tunnel tests are invited to perform standardized **wind tunnel test** on the **basic membrane forms**. The standardized results could be used for a prospective Eurocode on wind loading for tensile surface and shell structures.

The Round Robin exercise is proposed as a non-commercial activity. It is intended to serve the purpose of advancing the scientific and engineering practice in the analysis and design of membrane structures. Participation in the Round Robin exercise is voluntary and undertaken without fee. Contributors to the exercise will be acknowledged in all disseminations (journal papers, reports etc.), while the ownership of the data will remain with the participants.

Timeline

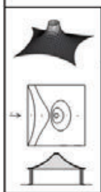
January 2015	**Round Robin Exercise 3 is launched.** Research institutes, universities, specialized laboratories and engineering offices are invited to volunteer to provide available experimental or analytical data for wind analysis of basic membrane shapes. Participants are asked to register their interest in the exercise by emailing Eng.-Arch. Jimmy Colliers at jimmy.colliers@vub.ac.be.
June 2015	Full details of Round Robin Exercise 3 are circulated to participants.
September 2015	Deadline for return of results by emailing to jimmy.colliers@vub.ac.be.
Oct 2015 - Jan 2016	Analysis and dissemination of results.



Hypar

Shape parameter $\frac{\sqrt{B^2+L^2}}{H}$	F $C_{pe,10}$	F $C_{pe,1}$	G $C_{pe,10}$	G $C_{pe,1}$	H $C_{pe,10}$	H $C_{pe,1}$	I $C_{pe,10}$	I $C_{pe,1}$	J $C_{pe,10}$	J $C_{pe,1}$
	Zone for wind direction 45° (high corner under attack)									
1,0										
2,5										
5,0										
7,5										
10,0										
12,5										
15,0										
...										

Cone



Shape parameter $\frac{B+L}{4H}$	F $C_{pe,10}$	F $C_{pe,1}$	G $C_{pe,10}$	G $C_{pe,1}$	H $C_{pe,10}$	H $C_{pe,1}$	I $C_{pe,10}$	I $C_{pe,1}$	J $C_{pe,10}$	J $C_{pe,1}$
	Zone for all wind directions with high internal point									
1,0										
2,5										
5,0										
7,5										
10,0										
12,5										
15,0										
...										

Figure 1.
Left: Overview of basic shapes, established by Alex Michalski
Right: Example of a simplified data template (hypar, cone)

cost EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

NOVEL STRUCTURAL SKINS COST ACTION TU1303

Specifications Working Group TensiNet