

Textile Roofs 2006

May 25th - 27th 2006

Prof. Dr.-Ing. Lothar Gründig
Technical University of Berlin (TUB)
Berlin, Germany

Report

Prof.Dr.-Architect Josep Llorens
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Introduction

Textile Roofs 2006, the Eleventh International Workshop on the Design and Practical Realisation of Architectural Membranes, took place from 25 to 27 May at the Technische Universität Berlin and was chaired by Prof. Dr.- Ing. Lothar Gründig.



It attracted 62 participants from 18 countries and three continents who celebrated its 11th anniversary, once again demonstrating the success of the event, which has become firmly consolidated since it was first held in 1995.

Tensi  **et**

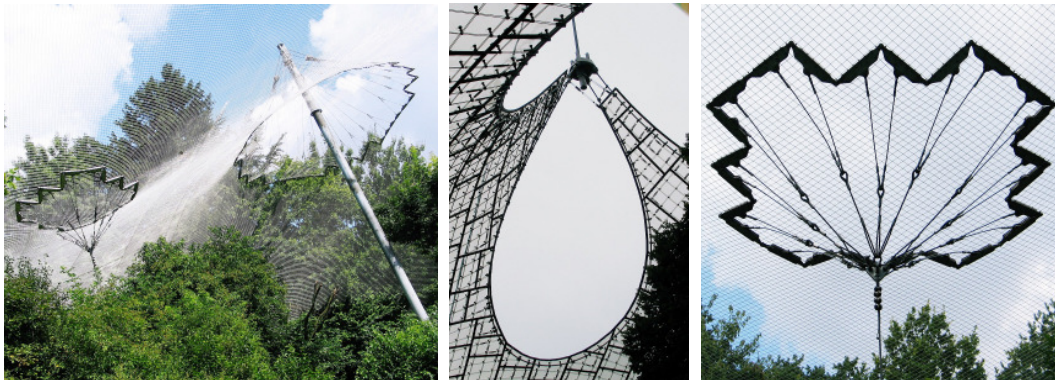
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Student seminar

The workshop was preceded by the International Student Seminar “De-light and air”, which was organised by Dr. Lothar Gründig (Berlin), Joachim Bahndorf (Bielefeld/Minden), Dr. Rosemarie Wagner (Munich) and P. Michael Schultes (Vienna). The main emphasis of the International Students Seminar is put in developing and manufacturing building models for tensioned and inflated structures, including all experience during the process of development and manufacturing up to the final and real model.



Main lectures

1. “About Lightness in Form and Structure” by Jürgen W. Hennische, Institut für Leichtbau, Entwerfen und Konstruktion, Universität Stuttgart

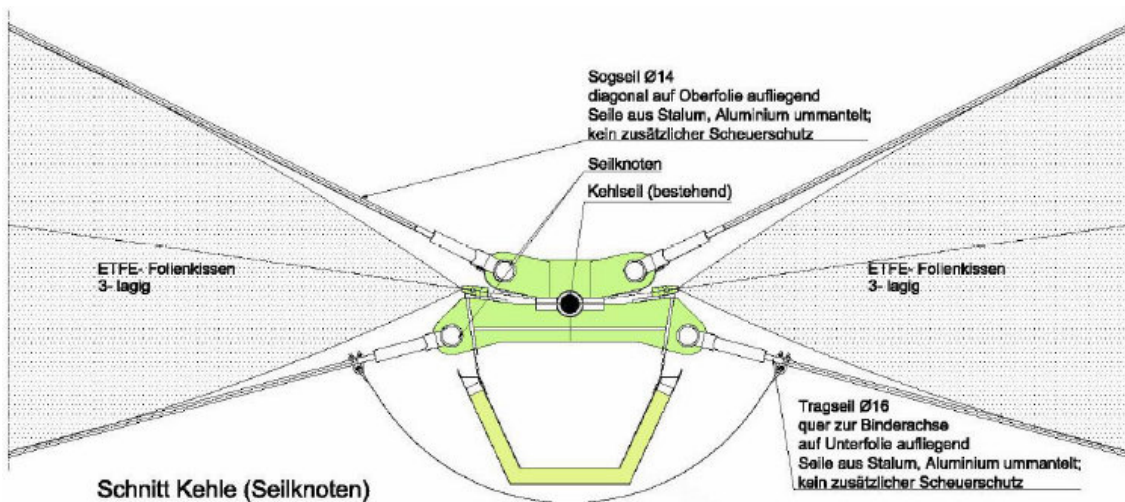
“Lightness is not only lightweight or low weight. It is an architectural approach” summarizes Jürgen Hennische’s lecture. He illustrated the concept with a wealth of examples taken from his long journey of research at the IL Institute of Stuttgart. Tents, nets, radiolarian membranes, suspended bridges, pneumatic structures, beams evolving to trusses, supports evolving to trees, grids shells, aviaries and convertible roofs were shown among many others, together with experimental methods of design based on bubbles, flexible nets, ropes and membranes aimed to find the form that better fits the transmission of loads and, hence, saves material.



2. “Textile Materials for Membrane Structures” by Ms. Françoise Fournier, Ferrari S.A. La Tour-du-Pin, France

Benefits from textile roofing and enclosing were presented on the basis of Ferrari’s experience: natural light, day and night performance, difficult access locations, unique shapes, flexible skin, coloured and graphic customization, quick on site installation, large clear spans, resistance to corrosive environments, antic sites restoration, easy combination with different materials, wide spectrum of climatic conditions, resistant to tough social environments, longevity and fire safety,

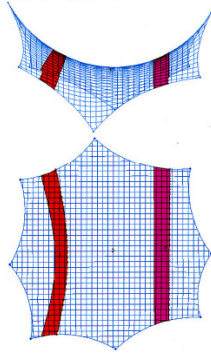
The list of works was endless: courtyards, castles, town halls, markets, sport halls, shopping centres, train and monorail stations, lake pontoons, tennis courts, anniversary parties, high rise building top floor shading, balconies, hotel canopies, car parks, school yards, parks, stages, swimming pools, stadiums, gymnasiums, congress halls, sculptures and many more.



3. “Recent ETFE-foil Projects with large format Cushions” by Dipl.-Ing. Bernd Stimpfle, form TL Radolfzell, Germany

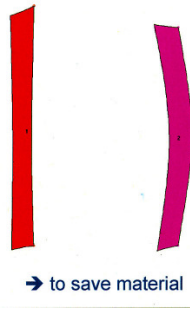
Large cushions for transparent roofs compete well with glass enclosures. Their technology has been developed as illustrated by edge clamps, pressurizing devices, structural behaviour or mobile frames capability introduced in recent works such as Fachmarktzentrum in Baden Baden, Rheinwelle in Bingen-Ingelheim and Tropical Islands in Brand, South of Berlin

Seams = geodesic lines

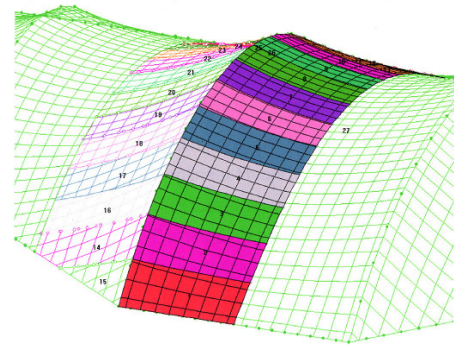


red strip:
geodesic line
'curved' in 3D
'straight' in 2D

violet strip:
vertical cut
'straight' in 3D
'curved' in 2D



Optimal and fast layout with minimal waste by Batchjobs



4. "Computational Modelling Concepts", by Dr.-Ing. Dieter Ströbel, Technet GmbH, Stuttgart, Germany

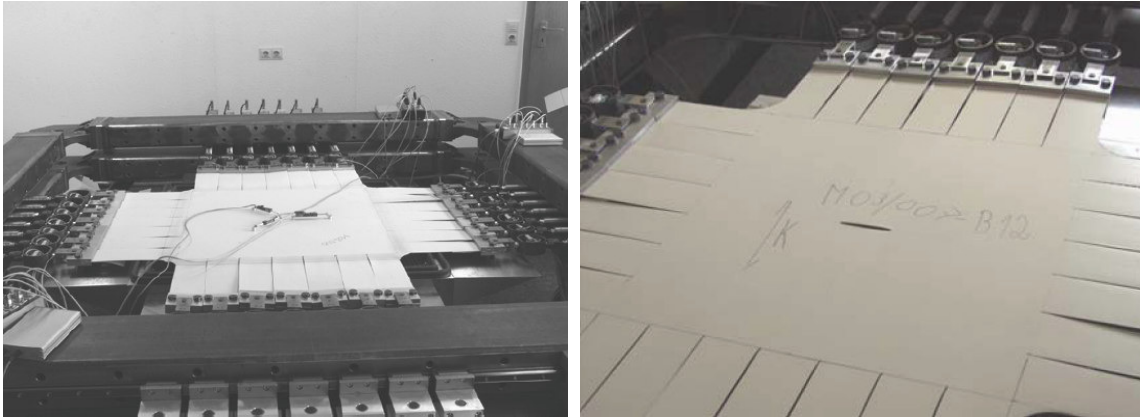
The full range of Easy modules of software was presented together with examples of application. Main principles were mentioned:

- form finding is the procedure of determining the shape of the surface taking into account that geometry and internal forces are not independent.
- with the force density method harmonically stressed surfaces are created without starting values.
- it is followed by the nonlinear statical analysis and sizing of steel members.
- special procedures are needed for pressurized volumes.
- additional tools allow for force finding and examination of flexibility ellipsoids and element redundancy
- cutting patterns are developed following geodesic lines completed by compensation. seam allowance. additional marks and points.



5. "Kinematics in tensile structures", by Prof.-Ing. Rossemarie Wagner, Fachhochschule München, Munich, Germany.

Movement in tensioned structures can be found on three different layers. On the microscopic layer the sliding of molecular chains in polymer fibres or the sliding in the crystalline grid in steel wires is used get material with high strength. On the second layer tensioned structural elements such as cables, belts and fabric made of high strength wires and yarns are showing several movements under tension influencing the stress and strain behaviour, the long term behaviour and the possibility of folding and bending with less strain. On the third layer the behaviour of tensioned structures is described by movement and strain less deformations depending on the curvature, pretension and installation process.



6. “Material Properties of Fabrics and Films: Theory and Measurement”. by Frau Dr.-Ing.Heidrun Bögner-Balz

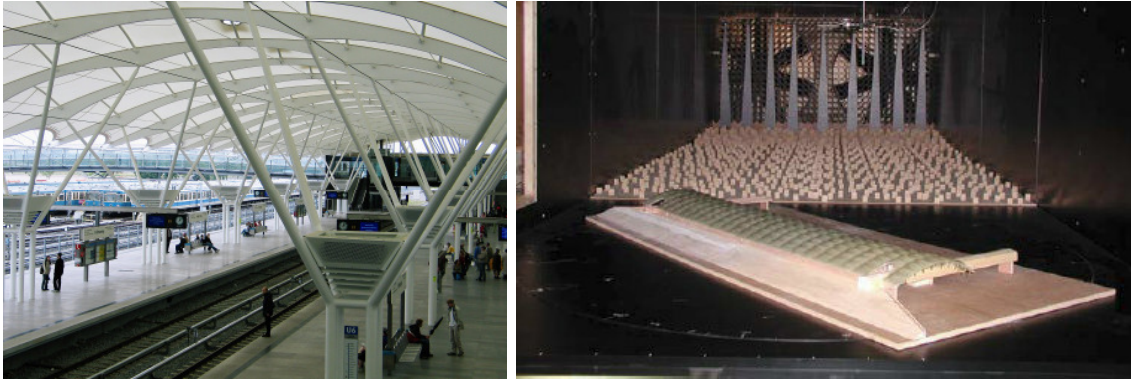
The design of membrane buildings and roofs compared to common structures needs a much closer team work between architect and structural engineer already from the early design stage. Because of the fact that membrane surfaces are statically determined the shape can not be seen independently from the stresses. On the other hand the behaviour of membrane materials, especially fabrics, coated or not, needs to be known exactly for design.



7. “Detailing” by Josep I.Llorens, University of Catalonia, Barcelona, Spain.

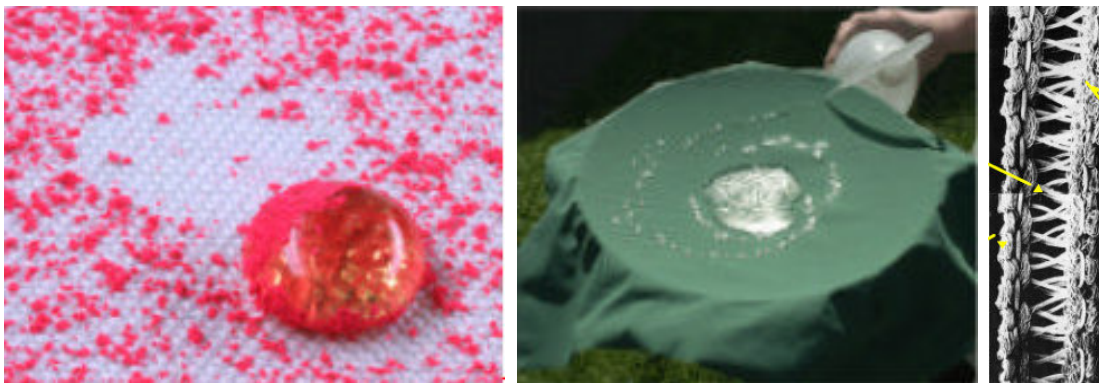
Detailing for fabric membrane architecture is not yet a well-established, thoroughly documented or widespread practice. Nevertheless, choosing, designing and evaluating connections and joints is critical to the overall concept and the resulting structure. The process of detailing fabric architecture is subject to the principles and requirements listed in this presentation. They are grouped by concept and presented consecutively. Their significance varies according to the particularities of each case.

By examining case studies, one can achieve a better understanding of the relation between details and structure as a whole. During the design process, details are subject to overall structural requirements, such as structural behaviour, geometry, installation process, durability, maintenance or visual expression. The reverse is also true.



8. “Wind and Snow Loads on Membrane Roofs” by Dipl.-Ing. Jürgen Wacker, Wacker Ingenieure, Birkenfeld, Germany

It was the objective of this paper to give a short overview with regard to wind effects on membrane roofs. The state of the art of wind tunnel methodology was summarised. Fundamentals of wind loads and snow drift and accumulation were described shortly. In case studies the investigation of wind load and snow drift and accumulation aspects was demonstrated. The benefit of wind tunnel tests was shown especially if the wind engineer is involved at an early planning stage.



9. “Fibre based Material developments for Textile Construction” by Dr.-Ing. Thomas Stegmaier, ITV Denkendorf, Germany.

9.1.- Surface developments: self cleaning surfaces by superhydrophoby, textiles with lotus effect, dynamic wetting, fluocarbon finishing, sign of approval for self cleaning, air holding surfaces, ceramic and metal coatings, thermal spraying. Potential applications: flame retardance, protection clothing against flames, heat, hot particles, stab and bullet protection, semipermeable membranes, electrical conductivity, shielding against electromagnetic waves, integration of polymers and metals, flexible antenna, biomedical applications.

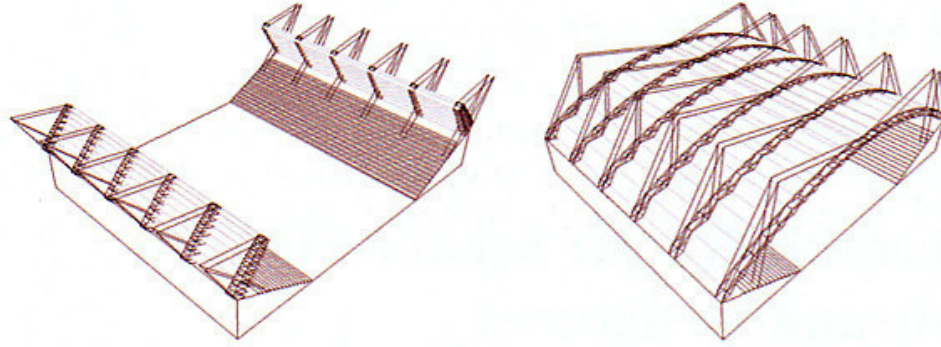
9.2.- Three dimensional materials: nonwovens, warp knitting, knittings. Advantages: up to 50 – 80 mm (2000g/m²), strength and elongation adjustable due to fibre orientation and fixation, laminating several layers / coating possible, breathable or nonbreathable, noise absorbent, heat isolation, recyclable.

9.3.- Solar energy materials: solar thermal, photovoltaic.

9.4.- Materials in combination with electronic.

9.5.- Lightweight products

9.6.- Simulation with FEM and material reliability



10. “Adaptable Membrane Structures. Non Static Applications” by Mr.IR arch.Tom Van Mele, Vrije Universiteit, Brussels, Belgium

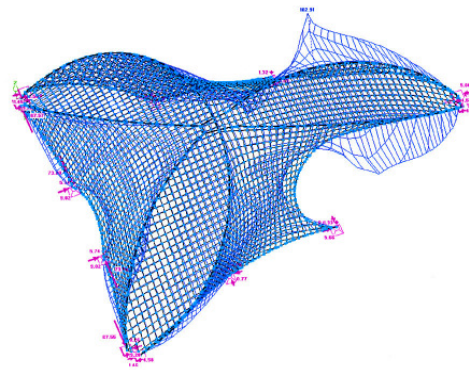
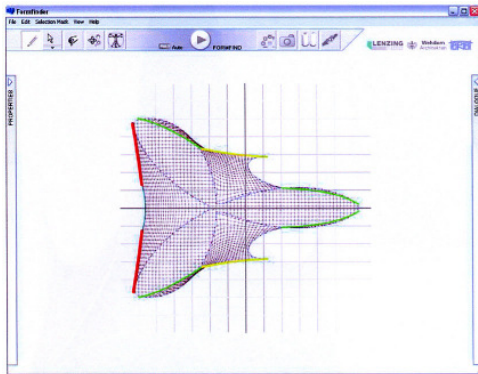
A concept for retractable membrane roofs with scissor-like elements as a retractable load bearing structure was presented. This specific combination should allow the roof to be used in multiple configurations.

The general theory (linear) behind scissor structures with straight bars and stress free foldability was explained and implemented in a number of interactive tools.

A small sports arena was considered as a case study. A model with identical polar units was refined based on architectural and structural considerations. The consequences of using a membrane covering in a multiple configuration roof were discussed.



11.- “The Actual State of Design of Pneus. Considering as Example the Allianz Arena” by Dipl.-Ing.Lutz Schöne, Covertex GMBH, Obing, Germany.

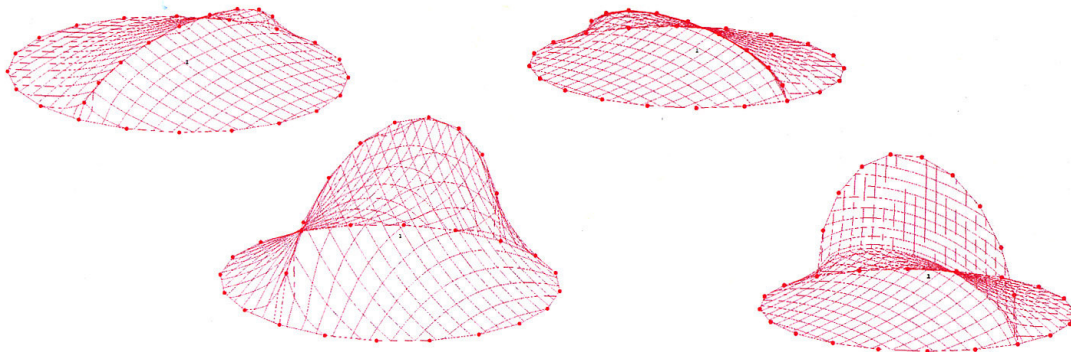


Afternoon sessions

12. "Introducing Form-finder" by Dr.Techn.Robert Wehdorn-Roithmayr, Wien.

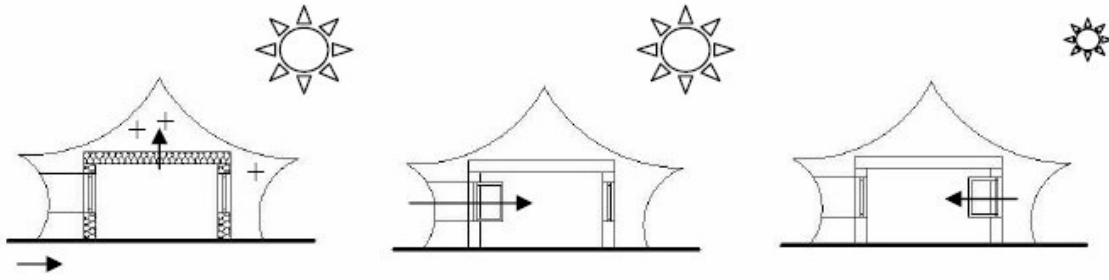
Form-finder is a design software that is as easy to operate as a sheet of paper and a pencil. The aim is to assist architects and project planners in the design, planning and cost effectiveness assessment for the implementation of form active structures. Form active structures are made of flexible non-rigid materials ranging from a simple awning to textile façades and the roofing over sport stadiums.

A sketch is drawn by hand of a spatial model that is examined in terms of its physical, geometrical and architectural characteristics. This examination is necessary for every design, since form active structures cannot be described in terms of shape and geometry easily in drawings. The reason for this is in the direct influence that the material characteristics have on the desired geometry and shape



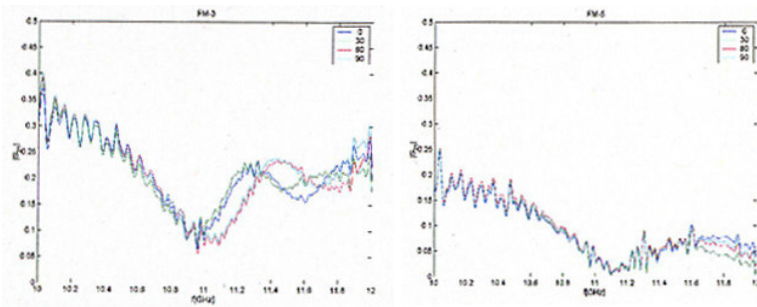
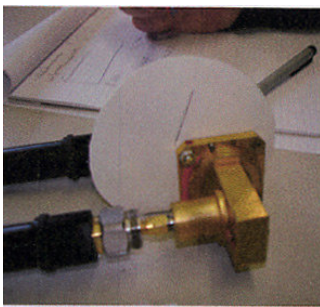
13. "Netzfolien: netfoils", by Michael Karwath, Munich and Dipl.-Ing.(FH) M.Sc. Britta Their, Bielefeld.

Design of lucent structure shells produced from a combination of transparent foils and thin wires, fibre glass or high performance synthetic yarns was exposed with references to computer simulations for form finding and static calculation. Several aspects of both were discussed such as the different approaches, the degeneration of minimal surfaces, the influence of the shear stiffness or the verification of the results. A saddle roof was used as an example for verification



14. "Enveloped Membrane Structures" by Dipl.-Ing.Gregor Grunwald, Berlin

A short introduction to the application for a membrane architecture devised as a system was given aimed to expel the membrane from its present architectural conundrum. In understanding the boundaries in which we are working, the first exercise is to envelop a conventional building with a second skin of membrane covering the building and forming an outer surface as both facade and roof. Significantly then, the membrane structure forms a single element - an interface between inside and outside. It protects the building and offers an informal communication with the surrounding environment.



15. "Structural Characterization of Fibre-matrix Systems Using Spectroscopic techniques", by Dr.-Ing.Michael Kröger, HH, Frank Deschner, Kiel.

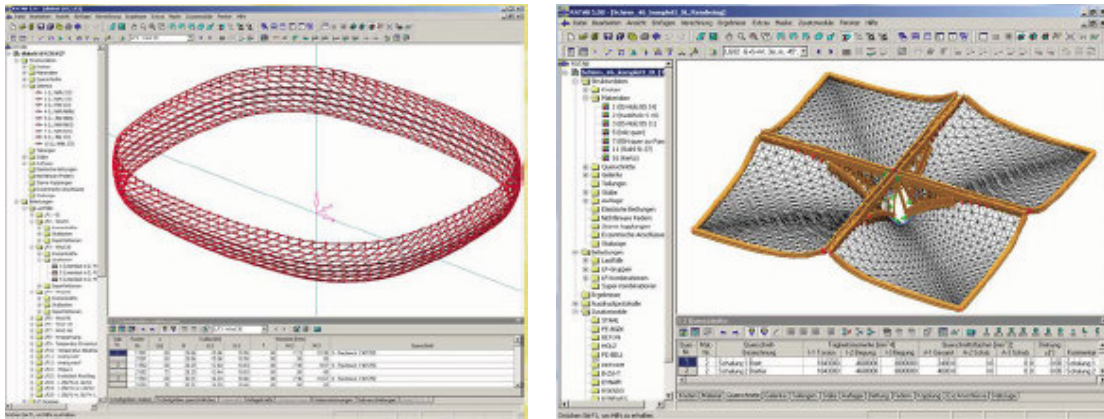
A summary of the main characteristics and advantages of the spectroscopic techniques was presented:

Spectroscopic techniques are useful tools for the investigation of surface material characteristics of textile systems.

Spectroscopic techniques for linear polarized microwaves are useful tools for the investigation of the anisotropy of textile systems. Only the reflection has significance for practical use.

Data from spectroscopic characteristics are combined to a feature vector. The designed spectroscopy system gives information about local material properties (150 x 150 mm).

Characterization of local material properties on real objects (textile roofs) needs small scale stress strain experiments.



16. “RSTAB: Calculation of Planar and Spatial Structures”, by Dipl.-Ing.Walter Rustler, Ing.-Software Dlubal GmbH, Germany

Dlubal Engineering Software provides the RSTAB framework program and the RFEM program, which are able to carry out stress analysis, stability analysis, connection design, dynamic design, CAD interfaces, and the design of concrete, timber and composite beams. The RSTAB takes the geometry, deformation and internal forces computed by the Easy system and develops the steel framework, connections and the design of the foundations, and makes it possible to view the results.



17. “Winterbadeschiff Berlin”, by Dipl.-Ing.Nadine Kannegießer and Dipl.Arch.Gil Wilk TU Berlin, Freier Architekt, Berlin, Germany.

This original project “bathing ship” was born in 2004 in the context of the “Stadtkunstprojekte” and in cooperation with “AMP architects” of Tenerife, Spain, the Berlin artist Susanne Lorenz and the architect Gil Wilk. The idea was to make the river Spree accessible again, just as it was in the lost tradition of the Berlin river swimming-pools. A drop of clean water in the river Spree, a swimming pool and as a result the possibility for all the inhabitants of Berlin to experience their river again while swimming and enjoying the view of the Eastern harbour, the Oberbaum-bridge and the television tower.

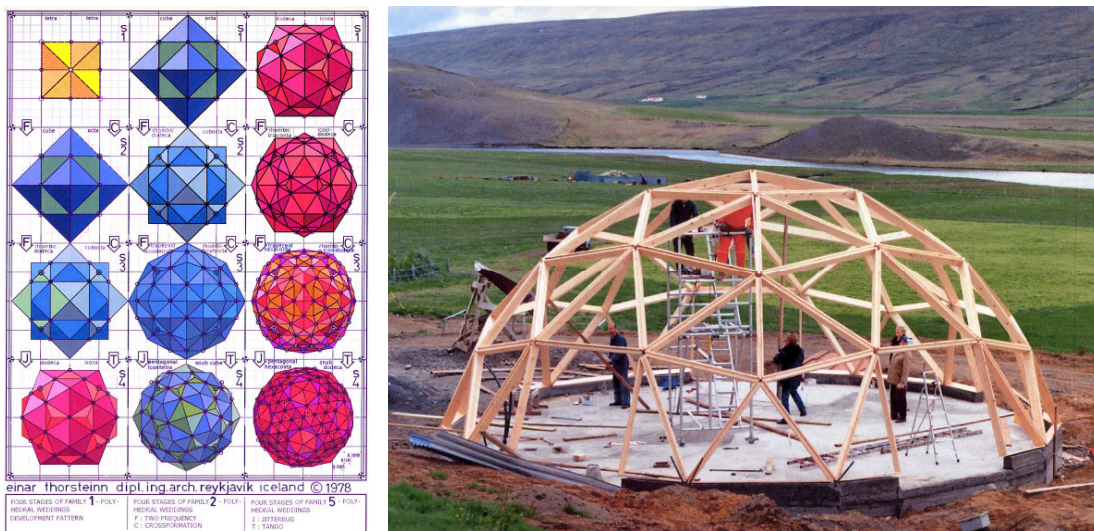


18. “Archimedia”, by Mr. Ivo Vrouwe, TU Eindhoven, The Netherlands.

The project ARCHIMEDIA is based on the search to find new forms of communication through the medium architecture. ARCHIMEDIA consists of projects and products to make architecture possible as a medium and embodiment symbol of uniqueness, identity and personality of the user or inhabitant instead of architecture as an excuse to create an ecstasy of visual, technical and esthetical abilities.

19. “Algorithmic approaches”, by Prof. Joachim Bahndorf, Minden.

Some formulas were explained starting from an understandable explanation of the initial steps, such as minimizing the sum of lengths in a net



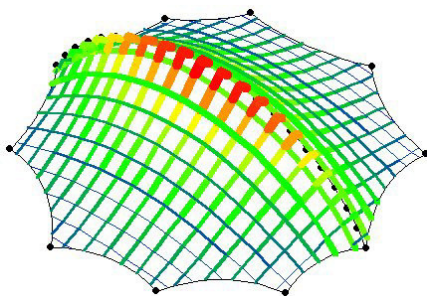
Special Guest Lecture

20. “The Alchemy of Constructions”, by Dipl.-Ing.Arch.Einar Thorsteinn, Reykjavik, Island; Brieselang, Germany.

A powerful presentation of ideas, sculptures, models, constructions and designs invited the audience to open their minds. “If you swim against the stream and you keep swimming, you success” was the spirit.



2006 City Sightseeing Cruise. Participants enjoyed Berlin architecture and Calatrava bridges



Textile Roofs 2007

June 7th - 9th 2007

Prof. Dr.-Ing. Lothar Gründig
Technical University of Berlin (TUB)
Berlin, Germany

The Twelfth International Workshop on the Design and Practical Realisation of Architectural Membrane Structures will take place from 7 to 9 June, 2007. Its format will be similar to that of TR 2006 with seminar-style lectures and hands-on activities. It will also be preceded by the student seminar. It will be sponsored by TU, TensiNet, Ferrari and Technet.