Report: Textile Roofs 2003

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The Textile Roofs 2003 Eighth International Workshop on the Design and Practical Realisation of Architectural Membrane Structures took place on 19-21 June at the Technische Universität Berlin and was chaired by Dr. Lothar Gründig (http://www.survey.tu-berlin.de).

It attracted 80 participants from 22 countries, whose presence demonstrated the continuing success of the original 1995 initiative to promote the design of architectural membrane roof structures. The main lectures, presentations by specialists and participants and hands-on physical, computational modelling and fabrication workshops were held over three days and ranged from general overviews to specialists' points of view: all yielded valuable data and advice.

HANDS-ON FABRICATION OF TEXTILE STRUCTURES

The main attraction this year was the fabrication and installation of a tensile roof designed specifically for the event. Led by Ingo Lishke, the participants monitored the entire process and dealt with practicalities that are rarely discussed in lectures and presentations.

Manufacturing


Anchoring

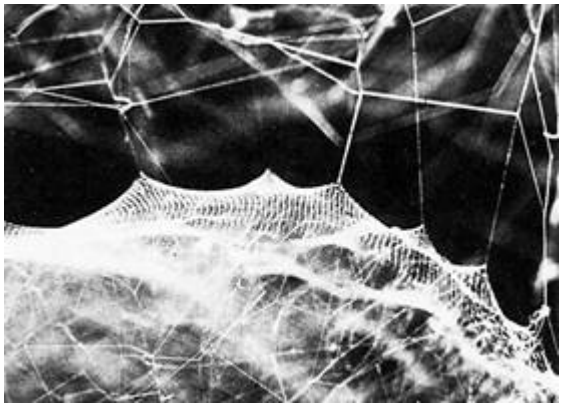

Installing


Installing

Main lectures:

1. "The lightweight architecture approach", by Jürgen W. Hennicke (http://www.uni-stuttgart.de/ilek).

This extensive survey on naturally-occurring and man-made lightweight structures focussed on their variety and usefulness in saving resources and energy. Tents, pre-stressed membranes, soap films, convertible roofs, umbrellas, nets, pneumatic structures, plastic tubes, trees, shells and grid shells, among many others, "could contribute to the creation of a human architecture which will certainly better meet our requirements as living beings, and which will be helpful in the end to ensure our survival as a species".



Cyrtophora's web

Boulevard Carnot Swimming Pool, Paris

2. "Workshop overview and the design process", by Erik Moncrieff (http://www.technet.gmbh.com)

After focussing on the difference between conceptual and production design, mention was made of the main players in the process: client, architect and structural engineer and the fundamental relationships between them were summarised.

Form-finding, geometrically non-linear load analysis and cutting pattern generation were considered the most critical tasks in tensile design, while non-computational, non-specialised software and specialised software were cited as the most important design methodologies.

Three recommendations were formulated for architects and engineers:

1. Change geometry rather than pre-stress
2. Avoid unnecessarily sensitive configurations
3. Share experiences

The adverse effects of secrecy were also highlighted.

Axel Schultes and Eduardo Chillida dialogue in front of the German Federal Chancellery, Berlin

3. "Case study: The new ICE-Station at Leipzig", by Klaus Gipperich (http://www.ceno-tec.de)

The platforms of the ICE-Station at Leipzig Airport are covered with PTFE-coated glass fibre canopies.

The following aspects motivated their selection:

- Contrast with other structures
- Visual effect
- Translucency for indirect illumination at night
- Feeling of safety
- Self-cleaning
- Fire prevention
- Colour of the material and surface quality
- Durability

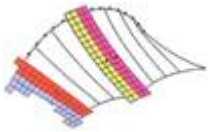
4. "Computational modelling concepts", by Dr. Dieter Ströbel (http://www.technet-gmbh.com).

Form-finding is necessary in order to determine appropriate forms for stressed membrane surfaces. The author first described primitive form-finding techniques, followed by the general concepts common to all equilibrium modelling systems. The force density method was explained and extended to geometrically non-linear elastic analysis.

Analogously, several approaches have been used for cutting pattern generation, which include physical paper strip modelling, geodesic string relaxation and flattening. The combined flat and planar sub-surface regeneration strategy used in the "Easy" design system was described and illustrated.


Easy Form


Easy San


Easy Cut

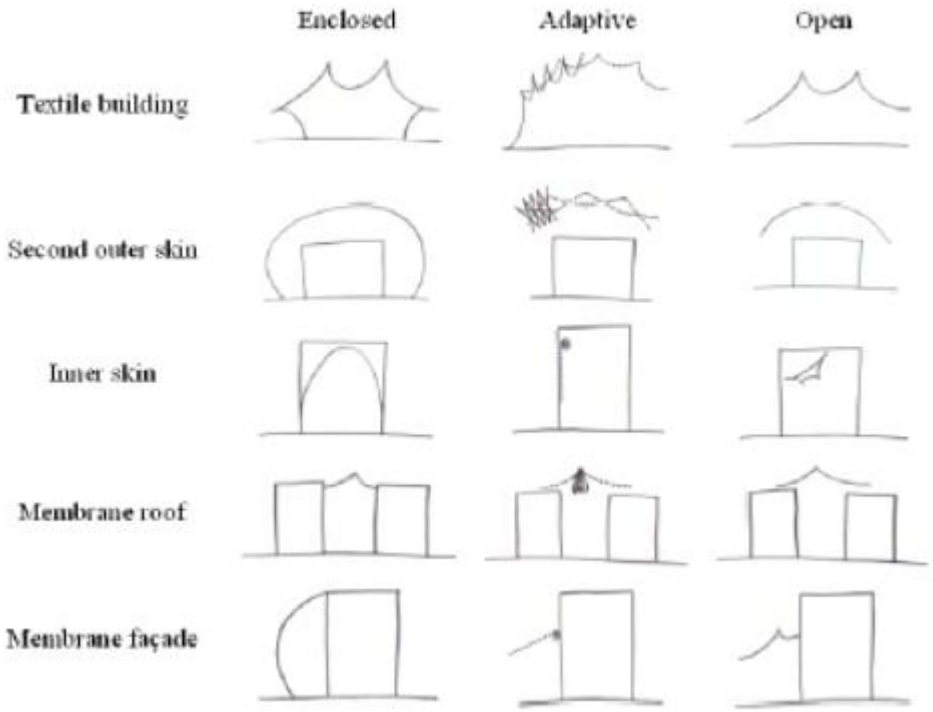

Easy Beam


Easy Vol

The complete EASY lightweight structure Design System suite.

5. "A classification for the application of technical textiles and lightweight structures", by Marijke Mollaert (http://dtwws1.vub.ac.be/arch/team/mm/pers.htm)

This presentation described the entire range of pre-tensioned membrane structures, which were arranged by function.

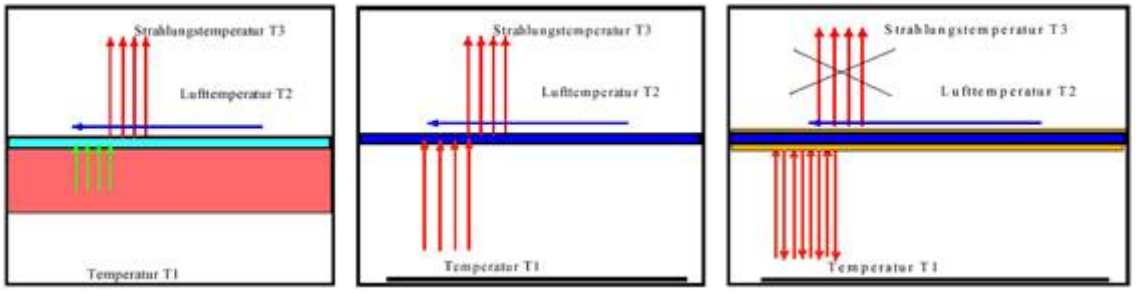


6. "Detail and connection design", by Ingo Lishke (http://www.textilbau.de)

Advice stemming from experience with PVC-coated polyester details was presented with a further focus on cutting guidelines, seam and hem preparation, welding, setting up and cut backs, reinforcements, edge rope pockets, water guards and corner plates. Most of this issues had been addressed during the hands-on fabrication workshop.

7. "Materials for textile structures", by Dr. Rainer Blum (www.labor-blum.de)

Several materials were introduced, along with commentary on elastic moduli, tear propagation and thermal and acoustic behaviour. A textile structure that has one single layer has poor acoustic and thermal insulation properties, but reasonable solutions may be found by using double or multilayer systems.



Heat transfer in a clear night in winter: classical wall (left), one single layer (middle), two layers (right).

8. "Fluotop T2. Composite membranes and environment", by Françoise Fournier (http://www.ferrari-textiles.com)

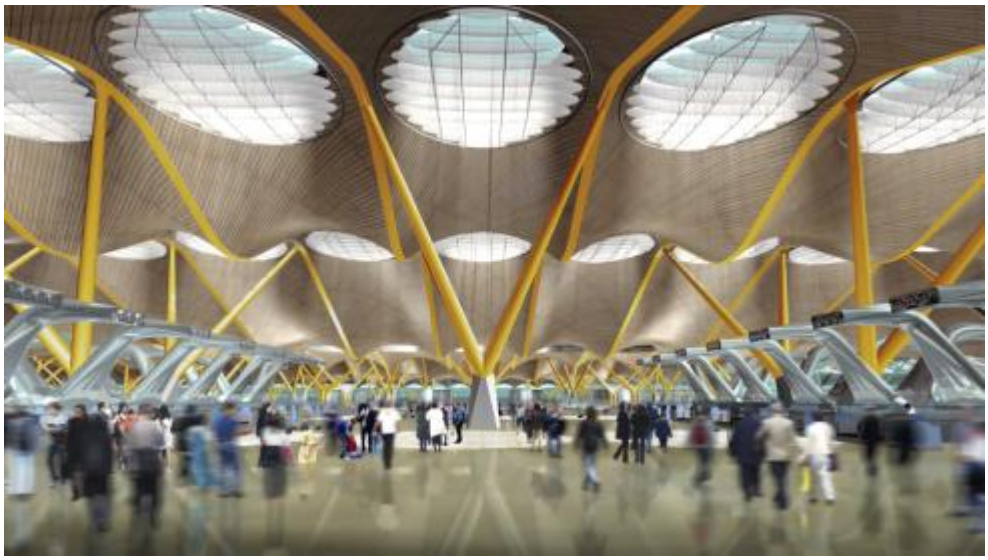
8.1 The longevity of this material was considered insofar as it increases as a result of the "précontraint" procedure, because the homogeneity of the membrane and thickness of coating are improved.

8.2 As regards safety, a fire test revealed that fire burns the fabric but it extinguishes itself and not propagates. Moreover, big holes are formed for smoke and people to escape.

8.3 The environment was also a matter of concern when the Texyloop recycling technology for PVC-coated polyester was introduced.

8.4 Two products were presented: Fluotop T2, a surface treatment to enhance a textile membrane's aesthetic aspect over the years, and Sky 300, a silicon glass fabric for interior applications, which qualified as MO for flame retardancy.

8.5 Finally, the Qatar Foundation building and a cruise terminal, which both made use of several kinds of fabric, were described as "global textile solutions".



Barajas Airport, R. Rogers, Madrid

9. "Textile structure design principles", by Dr. Architect Josep Llorens (http://www.upc.es/ca1/cat/recerca/tensilestruc/portada.html).

The author outlined ten well-known principles of textile structure design and illustrated them with a diverse collection of examples taken from the author's own experience, other structures, conventional buildings and daily life.

9.1 Basics: tension, curvature and pre-stress.
9.2 Structural requirements: resistance, stability, redundancy, stiffness and flexibility for displacements.
9.3 Geometry: form, following direct load paths, convergence and balance, need for space, scale effect and coordination.
9.4 Material.
9.5 Visual expression: overall appearance, lightness, load paths, balance, translucency, boundaries, framing the views, common vocabulary, smoothness and style.
9.6 Relation to the surroundings: isolated structures, related to the urban space, to nature, to existing buildings and the connection to vertical enclosures.
9.7 Environment.
9.8 Installation process.
9.9 Economy.
9.10 The design process.

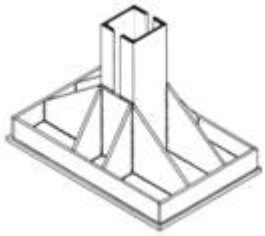
Avoiding difficulties

Facing difficulties

Classical proportion

Exhibitionism

Hinged base prevents the transmission of bending



Totally restrained base

Simplicity looks light

Complexity looks over-structured

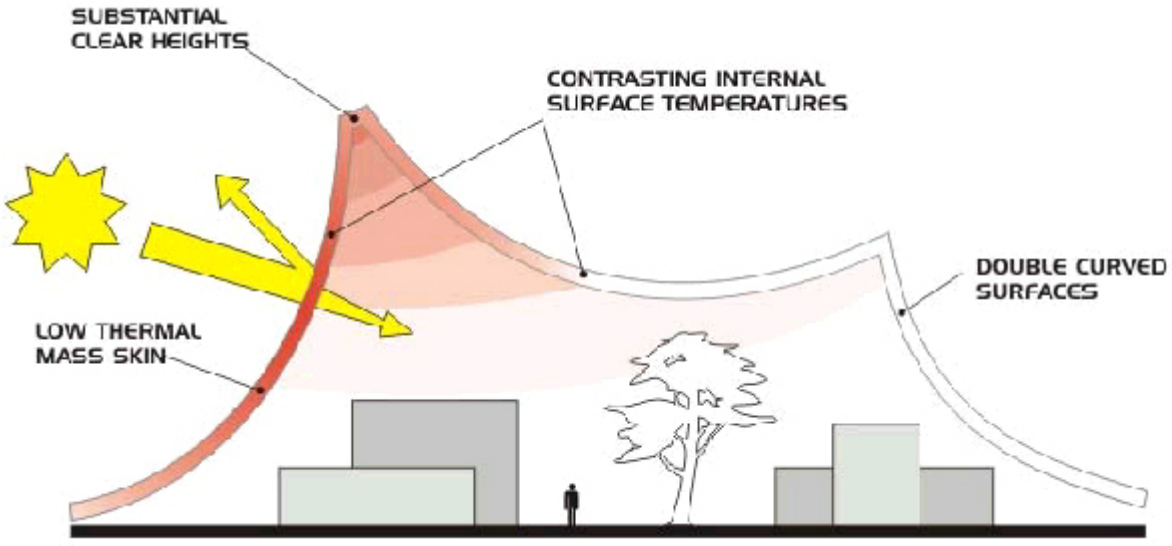
10. "Environmental aspects", by Dr. John Chilton (http://www.nottingham.ac.uk/sbe/acrg).

The environmental conditions of membrane enclosures are different from those encountered in conventional buildings because A MEMBRANE IS MORE OF A FILTER THAN A BARRIER. Its properties include:

- Fast response to radiative gains and losses
- Translucency
- Non-uniform internal conditions
- Innappropriate U, as thermal behaviour is mainly driven by radiation heat transfer.

The internal environment is governed by sky conditions, air temperature, wind speed, membrane topology, skin properties, internal gains and enclosure type. These lead to thermal stratification that is positive during the day and negative at night, when condensation occurs due to the low membrane temperature.

The thermal monitoring and a light description of the Inland Revenue Amenity Building in Nottingham (M. Hopkins, Architect) were used to illustrate most of the aforementioned properties.



11. "Tensile and pneumatic systems. Applications and research", by Dr. Rosemarie Wagner (http://www.lrz-muenchen.de/architektur).

A variety of cable nets were analysed under uniform load, processes of pre-tensioning and high points. Similarly, observations were made on inflated structures with reference to stress distribution and buoyancy.

It was demonstrated that the shape of equilibrium does not provide enough information for the structural analysis.

The cutting pattern, direction of the fabric, material behaviour and distribution of loads influence deformation and stresses.

High point of a net with hexagonal (left), square mesh (middle) and square mesh with opening (right)

12. "Price finding", by Werner Fröhlich (www.skyspan.com).

Range of prices for a 1000 m^2 textile roof including material, manufacturing, cables, fittings, engineering and installation		
MATERIAL	Membrane €/m^2	Membrane + steel €/m^2
PVC-coated polyester	80 - 200	200 - 900
PTFE-coated glass fibre	200 - 700	300 - 1200
ETFE (including air supply)	250 - 400	400 - 1200

Remarks:

1. IF YOU WANT AN ACCURATE PRICE, SPECIFY WHAT YOU WANT. The price depends on the details. The table shows a wide range of values because does not provide details.

2. The client should be aware know that, though textile roofs are eye-catching, they have low U values and bad acoustics.

13. Special guest lecture: "Spirit of Air", by P. Michael Schultes (http://info.tuwien.ac.at/histu/pers/15536.html).

An astonishing collection of designs based on membranes, from raincoats to inflatable lights, boats, water gadgets, games, exhibitions, bandages, hoods, pressure sleeves, inflatable hairstyling, clothes, shoes, pavilions, roofs, soft bags, cubes, sculptures, tents, student projects and much more.

Raincoat, 1952

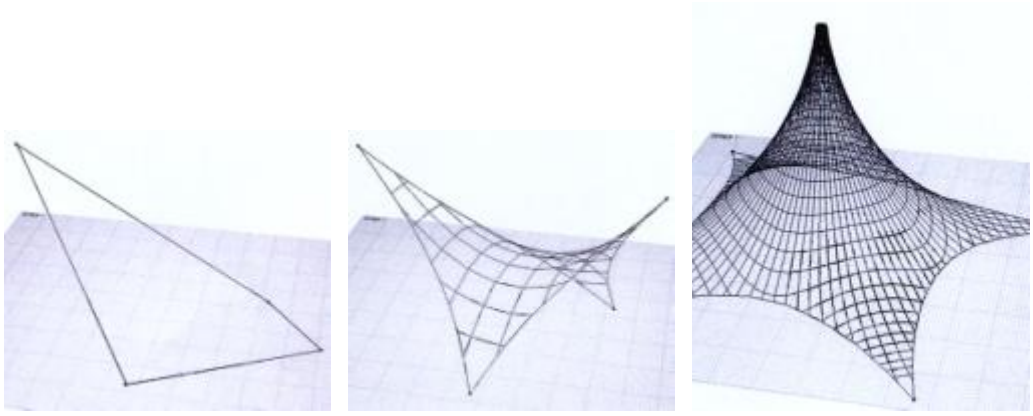
Stage Orf, 2003

Mega, 2002

Afternoon presentations:

14. "Form finder", by Robert Wehdorn-Roithmayr.

"Form finder" was presented as a tool to assist architects in the preliminary design of form-active systems. This tool will allow designers to lay-out form-active system in an uncomplicated way and have easy access to the information they need, as the quality of form-active systems lies in the preliminary design.



15. "Blob architecture", by Rogier Houtman (http://www.tentech.nl).

Irregular forms, smoothness and a double curved skin are the characteristics of Blob Architecture.

A specific production method for Blob Architecture is B. B. S. (Blobs Blowing Structure) which employs balloons and nylon stockings to make a model and the application of layers of composites to stiffen the form. The translation of the physical model into a real-size structure poses several problems because it is affected by the change in scale. Further analysis and modifications are needed.

Nouvelle DestiNation Expo 02, Piet Eckert

16. "Textile structures pathology", by Dr. Josep Llorens (http:// www.upc.es/ca1/cat/recerca/tensilestruc/portada.html).

The author's presentation dealt with some of the most vexing failures associated with tensile structures, which can be due to their materials, design, installation, use and maintenance.

Material failures are usually due to an inadequate resolution of requirements and properties. The design is responsible, for flatness, lack of pre-stress or an inadequate shape, resistance or detailing.

The installation process involves stability issues and provisional situations. Final use does not always correspond to the design specifications and maintenance is necessary to keep the structure clean and to preserve the effects of pre-tensioning.

A building's success depends on its owner, designer, manufacturer, builder and users.

Meca fire

Deconstructed deconstructivism
Hosca Sport Pavilion, 1993

Spandome Sport Pavilion. Pozuelo de Alarcon

Poor maintenance. Jaén, 2002

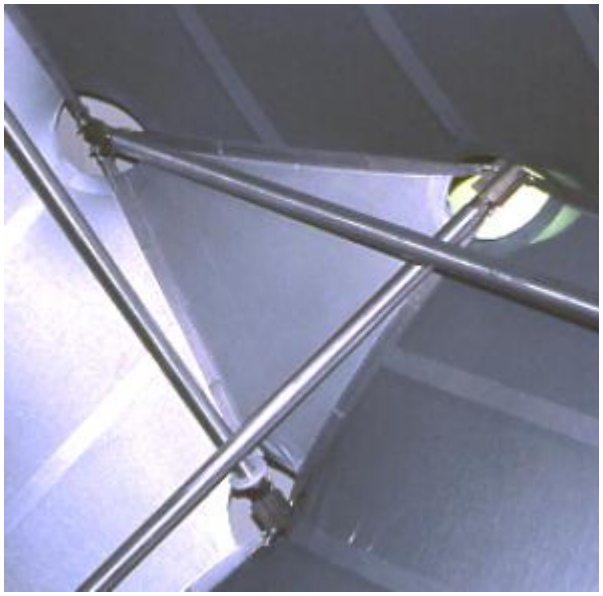
17. "Tensegrity. Textiles and tensegrity", by Laars Meess-Olsohn (http://www.leichtbaukunst.de).

Attracted by the formal appearance of textile architecture and fascinated by tensegrity structures, the author thought to combine them both to create "textegrities".

To make practical use of tensegrity, there must be space-enveloping elements such as membranes.

By replacing external tension members with membranes, the principles of tensegrity are maintained and the space is enclosed.

Two experiments were described: "Textegrity" and "Textraede". A third one: "Textegrity - Dome" was re-built for TR 2003.



18. "Tensinet. Latest developments", by Jürgen Haase (http://www.tensinet.com)

Tensinet continues to offer and accept new and up-to-date information on tensile structures. Its latest developments are the database and the 2003 International Symposium.

The membrane structures database contains information on project data, companies, organisations and pertinent literature. The description of each contains a general and environmental description, pictures, drawings, a list of the companies involved, its material properties, dimensions and the duration of use. The 2003 International Symposium "Designing Tensile Architecture" was held in Brussels on 19 and 20 September.

19. "Human cocoon", by Samuel Fournier

The human cocoon is an aerial tent built solely from soft material. The definition of its shape is a result of the process of tensioning a sphere at different points.

The cocoon could be used in the forest as a tree house, in scenography for different types of productions, as a climbing game for kids or wherever such a symbolic shape might be installed.

Sketch

Model

Prototype

20. Exhibition of work by students

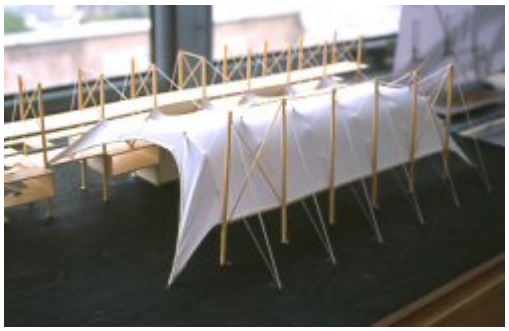
The workshop was also taken as an opportunity to exhibit student' projects:

"Schwimmbad in Aubervilliers bei Paris", by B. Dorfmeister.

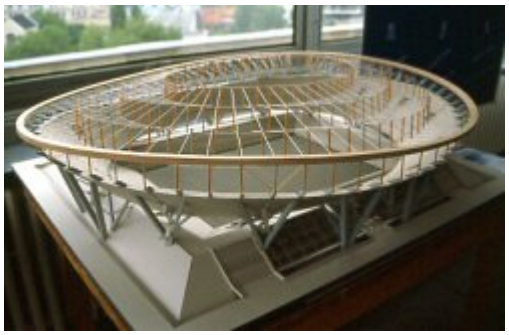
"Luftschiffhalle in Braud", by S. Lorentz, V. Oldiges and J. Schmidt–Thomsen.

"Mobiler veranstaltungpavillon: Pophouse", by T. Schierwater.

"Stadionentwurf für das Sportgelände, Berlin – Köpenick", by J. Schmidt – Thomsen.



Luftschiffhalle in Brand



Stadionentwurf in Berlin

Textile Roofs 2004

The ninth edition of the Workshop, "Textile Roof 2004" (http://www.textile-roofs.de) will take place on 10-12 June, and the successful rate of attendance, high level of participation and renewed and enlarged content of its lectures, presentations and workshops, will continue. Participants will have access to up-to-date information, inside views, expert

lectures and practical training and will benefit from the expertise of successful engineers and architects and the enthusiasm of new corners and returning participants.

(TR 2003 was organised by the “Technische Universität”, Berlin. The sponsors were Tensinet, Serge Ferrari SA and Technet GmbH)

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