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Teaching Membrane Architecture

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Abstract

In the year 2010 the postgraduate Master's Program for "Tensile Membrane Structures" was initiated in Vienna Austria. Since then positive improvements have been made to provide a pleasant and efficient learning environment.

In 2018 it was possible to enrich the existing curriculum with a collaborative researching and learning method. The basis of this method is a massive amount of content which was provided by experts in the field like Dr. Rainer Blum, Architect Horst Dürr or Prof. Vinzenz Sedlak. The content of these authors is pending for publication but already integrated in a semantic database. Although the amount of information is growing constantly it was possible to keep the access simple and effective. The process to structure and classify relevant information is to make "clever" annotations to each bit of information. So the annotation helps the researcher gain a better view on the available data. It should be possible to share learning's and valuable findings with colleagues and the scientific community. One major goal of this system is to connect experts and researchers with a constantly improved research environment which is pleasant to use an inspiring. As the method is about the visualization and communication of expertise we structured the work in several fields of interest. To mention one pivot point we focus on case studies of existing building projects. The collection of several hundred case studies was used to create a semantic database. Case studies are individually presented including a full digital 3D model that can be addressed online. Each 3D model was described throughout automated object recognition in respect to the geometric properties. Therefore a kind of 3D fingerprint is generated to compare eg. performance parameters. Throughout annotations by researchers the 3D models get more and more information. This process helps to recognize several aspects of a building project. The system is also open to bind other useful information to performance parameters. As we developed with the Danube University Krems a full climate membrane building envelope it is possible

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to share this information with other researchers when the performance power of one specific project is higher than others. It is a kind of alert system which keeps researchers updated when new knowledge or findings are made.

Based on the semantic database we intend to establish a future "ontology" of membrane architecture. The term ontology describes that it needs a common sense in the scientific world to define and describe parameters. The goal of this system is to provide access to relevant knowledge and to bind together a team of experts and researchers to make membrane architecture better.

Keywords: softening, lightweight structures, structural membrane, sustainability, performance, conceptual design, form finding, formfinder, optimization, manufacturing, climate building envelope, textile facade

Drawing Tools



Image: Drawing interface with integrated "object" recognition to access the online database.

Membrane.Online

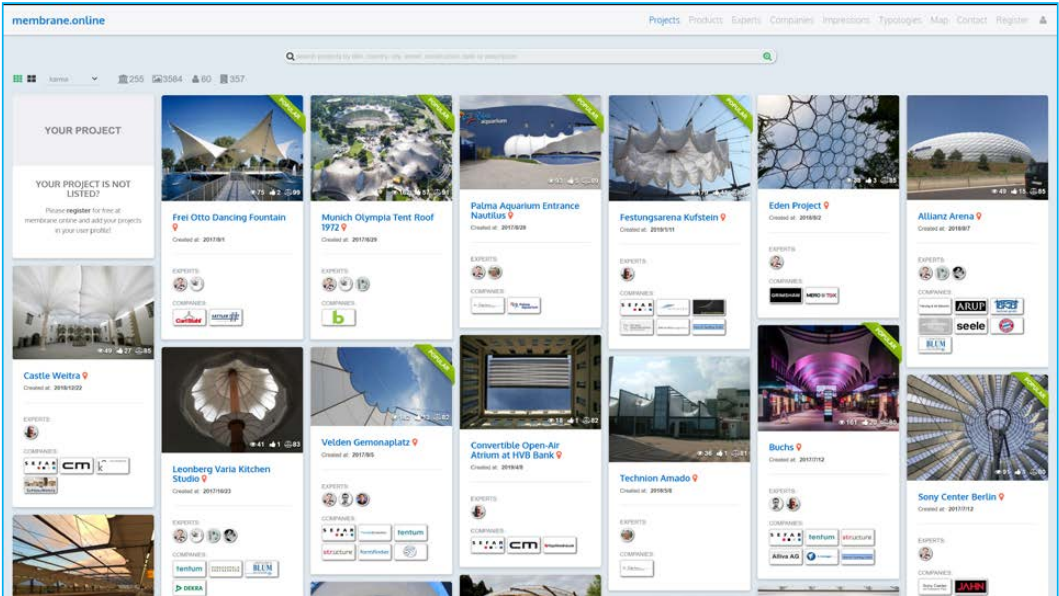


Image: Membrane.Online Platform

membrane.online/project/21

Project Description

A wonderful stage cover designed by FF Group with Horst Dürr, constructed in 2011. A tensioned membrane roof protects the outdoor area of Senftenberg stage in Germany from rain and sun mainly throughout the summer season. The main supporting structure is supported by six ridge cables depart from the 23 meter high central A frame mast, ending in six ringed columns, which are forming the outer edge of the grandstand. The structure is significant due to its colorful lighting. The structure is located in Germany by Senftenberger See in Schwarzwald and is designed to withstand sun, rain, snow and wind.

SENFTENBERG STAGE COVER

Architecture Requirement ■■■■■

Goal of Design was to create a significant lightweight membrane large scale structure of general size 50x50m with main use for cultural purpose with 600 places to sit. The Membrant is intended to have a fast and cost effective permanent cover. The design of this project was a super fast idea to production process by architect Horst Dürr who is an expert since 40 years in the field of lightweight membrane structures. The engineering office of Horst Dürr (FF Group) has developed many structures and send a list of details that they already used over years.

Functional Aspect of the project is a multi-purpose stage cover, used mainly for cultural events (music concerts, cabarets, theatre, shows).

Materials used for the membrane: PVS/PVC, Supporting Structure: Steel, Membrane Edges: Steel Cable, Membrane Corners: Steel plates.

Engineering Requirement ■■■■■

Structural Geometry of Symmetrical structure is designed as a central A-frame mast, membrane cover is supported by six ridge cables, each leading from the A frame to one of the six straight perimeter columns. The entry area is covered by a six point sail, which is in three points connected to the main membrane surface.

Membrane Connection to Primary Structure solved using steel cables and steel plates. Steel cables are used as tensioned elements for the masts and foring, for the purpose of attaching the membrane to the masts as edge cables and as ridge cables for high points.

Movement in anchors it is generally possible to say that almost every membrane structure is subjected to movement depending on the effect of the external load. Reaction for ces depends on design criteria, Position and Orientation Vector of corner plates depends on resulting reaction forces. Building Codes according to EN 1991-3:2003.

Installation /Production ■■■■■

Installation requirement is to build the structure in the easiest way, although lightweight structures are complex structures which need in double curvature. The Senftenberg stage cover is a large-scale structure with big span, the whole building procedure took about three months.

Future Requirement ■■■■■

Since the structure was build, the membrane has been replaced once due to its age-related damage. Client Preferences in the future is weather protection, fully functionality and eye catching lighting.

Provided	■	Perfect
Unbalanced	■	Weightless
non Replicable	■	Homogenous
Unclear	■	Replicable
Confusing	■	Clear
Unfinished	■	Cohesive
Temporary	■	Lasting
Preventative	■	Natural
Foreign	■	Familiar
Imprecise	■	Functional
Asymmetrical	■	Symmetrical
Duplicated	■	Useless
Clear	■	Elegant
Unmanaged	■	Imaginative

Total Score: 4300

Architecture	800
Engineering	1000
Installation	800
Future	600
Risk	1100

Image: ForFlex Research Project with Forsstrom

Membrane.Online

formfinder Membrane Master

GLOSSARY #TAG

CLICK HERE FOR BASIC INFORMATION ON GLOSSARY

FILTER

#TAG #cable #air #rigid #membrane #tensar #rigid #basics #component reset

Find Title Language Reset Search

Filter by **A** **B** **C** **D** **E** **F** **G** **H** **I** **J** **K** **L** **M** **N** **O** **P** **Q** **R** **S** **T** **U** **V** **W** **X** **Y** **Z** all

Adaptable Structure

Class of structure which may be reconfigured, either at installation, or

Cable

A flexible tensile component usually made from stranded rope. The rope is

Airbeam Tensairity

High pressure pneumatic structural component capable of resisting

formfinder Membrane Master

TYPOLOGY

CLICK HERE FOR BASIC INFORMATION ON TYPOLOGY

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#TAG #flat #cable #air #rigid #membrane #tensar #rigid #basics #component reset

Find Title Reset Search

FOUR POINT SAIL

Four edge points are attached. Two end "legs" to create the most common form. The load is distributed across "legs".

DOWNLOAD

#TAG Download

HIGH POINT IN SURFACE

One of the most common shapes, similar structure often called as "one ridge".

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#TAG Download

LOW POINT IN SURFACE

One of the most common shapes, similar structure often called as "one ridge".

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ARCH IN SURFACE EDGES

The introduction of an arch in the surface is usually integral. Only the flat edge defines the flexibility and the arching is not a separate element.

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formfinder Membrane Master

MEMBRANE

CLICK HERE FOR BASIC INFORMATION ON MEMBRANE MATERIAL

FILTER

#TAG #ppc #fiberglass #glass #pvc #hdpe #pvc #hdpe #fiberglass #fiberglass #tensar reset

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MATERIAL SAMPLE I

Product: Membrane Company. Material: suitable for use in a high light transmission and large range of colors. (quantified light effects).

DOWNLOAD

#TAG Download

MATERIAL SAMPLE II

Product: Membrane Company. Material: suitable for use in a high light transmission and large range of colors. (quantified light effects).

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MATERIAL SAMPLE III

Product: Membrane Company. Material: suitable for use in a high light transmission and large range of colors. (quantified light effects).

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MATERIAL SAMPLE IV

Product: Membrane Company. Material: suitable for use in a high light transmission and large range of colors. (quantified light effects).

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LITERATURE

CLICK HERE FOR BASIC INFORMATION ON LITERATURE

FILTER

#TAG #designing #change #detail #info #introduction reset

Author or Title Reset Search

PROSPECT FOR EUROPEAN GUIDANCE FOR THE STRUCTURAL DESIGN OF TENSILE MEMBRANE STRUCTURES

Author: Gert Stalls, Germany

Copyright: www.membran.com

FABRIC STRUCTURES IN ARCHITECTURE

Author: Jochen Lipinski

TENNET

Author: Gert Stalls, Germany

Copyright: www.membran.com

formfinder Membrane Master

PHYSICAL MODEL

CLICK HERE FOR BASIC INFORMATION ON PHYSICAL MODEL BY HUMAN HANDS

FILTER

#TAG #loop #cable #mast #ring #rosette reset

Find Title Reset Search

LOOP MODEL

This Model is an advanced model. Time needed: 10 minutes. Items Required: Paper, Glue, Stick, Thread, Scissors.

Click here for shipping list report. Click here to view video.

download

#TAG Download

CABLE LENGTH DEFINITION

To achieve real cable length all used dimensions in the measurement.

Time needed: 5 Minutes. Items Required: Paper, Glue, Stick, Thread, Scissors, Paper

download

#TAG Download

MAST RING

This Model is an advanced model. Time needed: 10 minutes. Items Required: Paper, Glue, Stick, Thread, Scissors.

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#TAG Download

MAST ROSETTE

This Model is an advanced model. Time needed: 10 minutes. Items Required: Paper, Glue, Stick, Thread, Scissors.

Click here for shipping list report. Click here to view video.

download

#TAG Download

ARCH

This Model is relatively simple to build. Time needed: 10 minutes. Items Required: Paper, Glue, Stick, Thread, Scissors, Cable

download

#TAG Download

Image: Formfinder Database

Augmented Tools

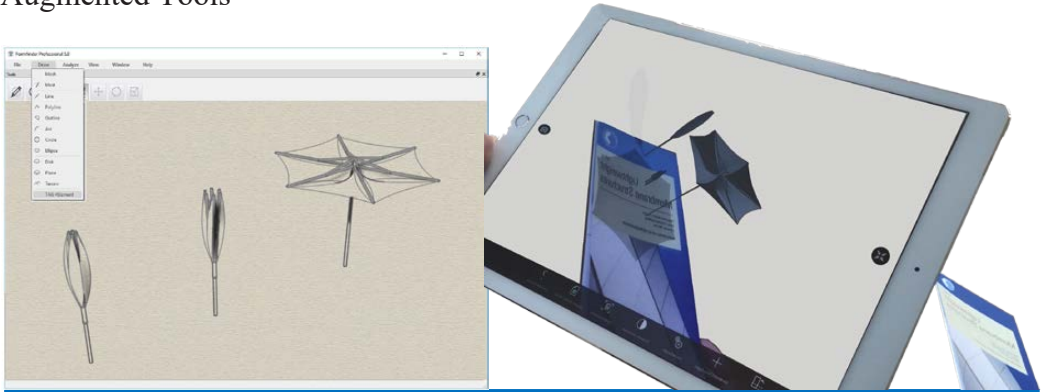


Image: Augmented Reality Tools

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