

4th YEAR
OPTION B2.1 – LIGHTWEIGHT CONSTRUCTIONS

Paulo Mendonça

PROGRAMME

The lightweight membrane constructions, with a reduced proper weight and great flexibility characteristics allow easy adaptation to different uses and forms, low cost of construction and transportation, assembly / disassembly and reuse. They also exhibit specific thermal properties and allow luminous architectural solutions that enhance fully functional advantages and different approaches than those associated with heavyweight conventional solutions.

Lectures, theoretical and practical exercises will be developed throughout the semester with the following topics: Analysis of the concept of lightweight construction; Evolution of membrane structures from the early prehistoric shelters to the present day; Presentation of traditional lightweight constructions that remain to the present day; Classification of the form and structural solutions in membrane, such as saddle, tubular, punctual and arch deformation, etc... Presentation of different methods of formfinding, such as models or CAAD; Special cares with the project of membrane constructions (3d modeling, 3d to 2d geometries conversion for the definition of cutting patterns, accessories, fittings, prestressing) cares after completion of work (maintenance); Specificity of the membrane materials used in construction - fibers, fabrics, coatings, simple membranes, double membranes, panels; Non-structural and structural properties of different types of membranes.

The practical collective exercise to perform at the end of the semester should apply to the concepts explored throughout the year in small individual exercises consisting in the design / construction of a temporary solution, easy to assemble, transport and store. Laboratories will be available at the School of Architecture, also with the support of company(ies) specialized in lightweight membrane constructions or other types of lightweight structures, where study visits and workshops will be held throughout the semester, exploring different materials and construction techniques for the construction of a small prototype which could reach full scale.

TEACHING OBJECTIVES

This course aims to introduce some concepts regarding non-conventional building solutions such as Membrane constructions, which are characterized by low specific weight and specific structural and non-structural properties that allow diverse applications in the field of architecture.

LEARNING RESULTS

Report specificity of lightweight constructions;
Explain the historical development of lightweight constructions;
Specify the types of lightweight constructions and its common applications;
Specify the advantages and disadvantages of lightweight constructions;
Design and produce a prototype of a lightweight membrane construction.

BIBLIOGRAPHY

Architectural Design Profile; N°117; "Tensile Structures"; Academy Editions; London, 1995.
Berger, H.; "Light Structures, Structures of Light"; The Art and Engineering of Tensile Architecture; Birkhäuser Verlag; Basel, Boston, Berlin, 1996.
Davies, J. M.; "Lightweight sandwich construction"; Blackwell Science Ltd; Oxford, 2001.
Detail, Zeitschrift für Architektur+Baudetail n° 8 Serie 1996; "Temporäre Bauten"; Institut für internationale Architektur-Dokumentation GmbH, München, 1996.
Doriez, M.; Blin, P.; "Architecture Textile"; A. Tempera Éditions, Paris 1990.
Glaeser, L.; "The work of Frei Otto and his teams 1955-1976"; Institut für Leiche Flächentragwerke (IL), University Stuttgart;1977.
Horden, R.; "Light Tech, Towards a light Architecture"; Birkhäuser; Basel, Boston, Berlin, 1995.
Knippers, J., Cremers, J., Glaber, M. & Lienhard, J.; "Construction Manual for Polymers and membranes – Materials, semi-finished products, form finding, design"; Alemanha: Edições Detail e Birkäuser, 2010.
Kronenburg, R.; "Houses in Motion, the Genesis, history and development of the Portable Building"; Academy Editions; London,1995.
Krüger, S.; "Textile Architecture"; Jovis Verlag, Berlin, 2009.
Otto, F.; Rash, B.; "Finding Form"; Edition Axel Henges, 1995.
Robbin, Tony; "Engineering A New Architecture"; Yale University Press; New Haven and London, 1996.
Shaeffer, R. E; "Tensioned Fabric Structures, a Practical Introduction"; Task Committee on Tensioned Fabric Structures; American Society of Civil Engineers; New York, 1996.

Vandenberg, Maritz; "Soft Canopies, Detail in Building"; Academy Editions; London, 1996.

TEACHING METHODS

Theoretical and practical. Classes will be taught in blocks of 3 hours per week, including lecture exposures, punctuated with moments of discussion and short exercises. The topics covered will be coordinated with the exercises of practical classes, supporting and encouraging the work developed there. The practical collective exercise to perform at the end of the semester should apply to the concepts explored throughout the year in small individual exercises and reports, consisting in the design / construction of a lightweight membrane solution prototype, which can approach real scale.

EVALUATION METHODS

Continuous, throughout the semester the student will perform various exercises that will become part of an individual report with an experimental component in the end. The final grade is the weighted average of the ratings of these elements of assessment, accounting for 70% the note for the individual report and 20% for the collective component. It would also be considered for the assessment, 10% for the attendance and participation (behaviors and attitudes), and the frequency of at least 2/3 of the classes are mandatory condition for approval.