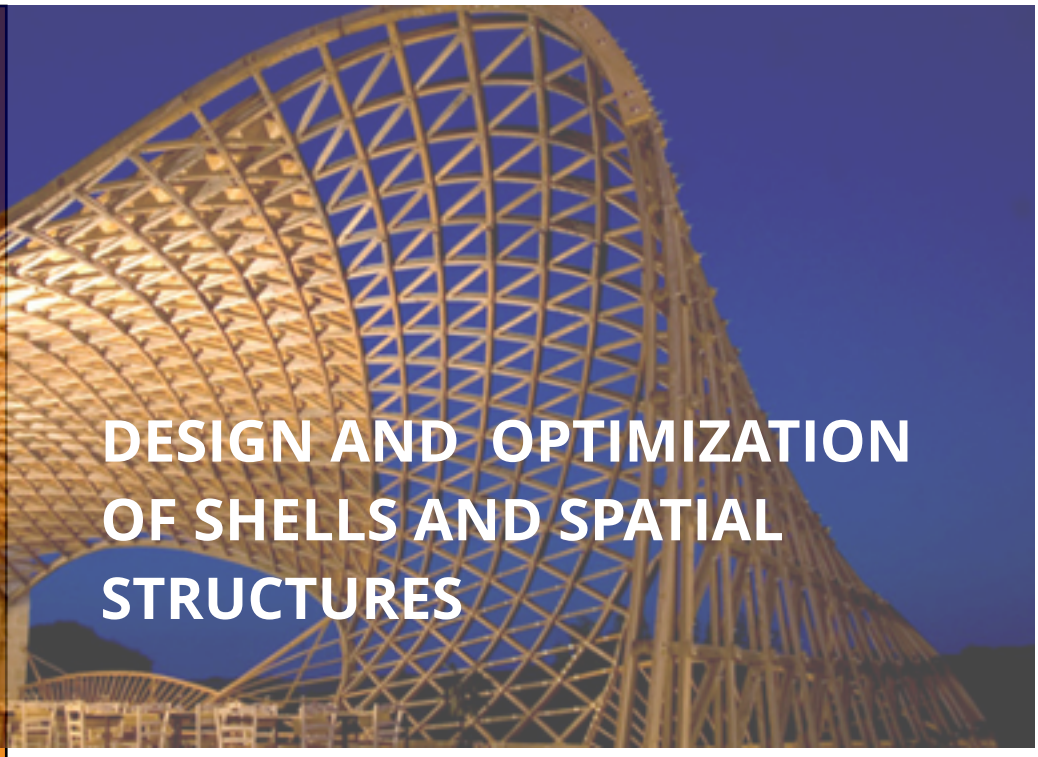
PhD Course



DESIGN AND OPTIMIZATION OF SHELLS AND SPATIAL STRUCTURES

May 14th - June 25th 2021
10-13 am | Politecnico di Torino

***Under loads, beyond light**: Structural Shaping and Optimization.*

Short Programme: **Shell and spatial structures:** Light-weight structures: origins and developments. Iconic and emblematic cases in the European and American schools.
Form finding approaches: dynamic relaxation method (DRM), particle spring model (PSM), thrust network analysis (TNA), multibody rope approach (MRA), R-funicularity. Theory and applications.
Tensile and tension-compression lightweight structures: Tent structures, tensegrity and origami. **Theory and fundamental features**;
Local and Non-local stability analysis. Snap-through instability and collapse of shell structures, instability for tensegrities.
Structural optimization of shell and spatial structures: traditional and innovative approaches.
Monitoring of shell and spatial structures: main technologies and applications.

Coordinator:

Prof. Amedeo Manuello Bertetto - Politecnico di Torino

Invited Lecturers:

Prof. Giuseppe Marano - Politecnico di Torino
Prof. Francesco Marmo - Napoli Federico II
Prof. Stefano Gabriele - Universita' Roma Tre
Prof. Andrea Micheletti - Roma Tor Vergata

in collaboration with IWSS

visit: IWSS2020
IWSS2020 (google.com)

Info: **Prof. Amedeo Manuello Bertetto**
Aggregate Professor - DISEG Department - PoliTo
+39 011 090 4873 amedeo.manuellobertetto

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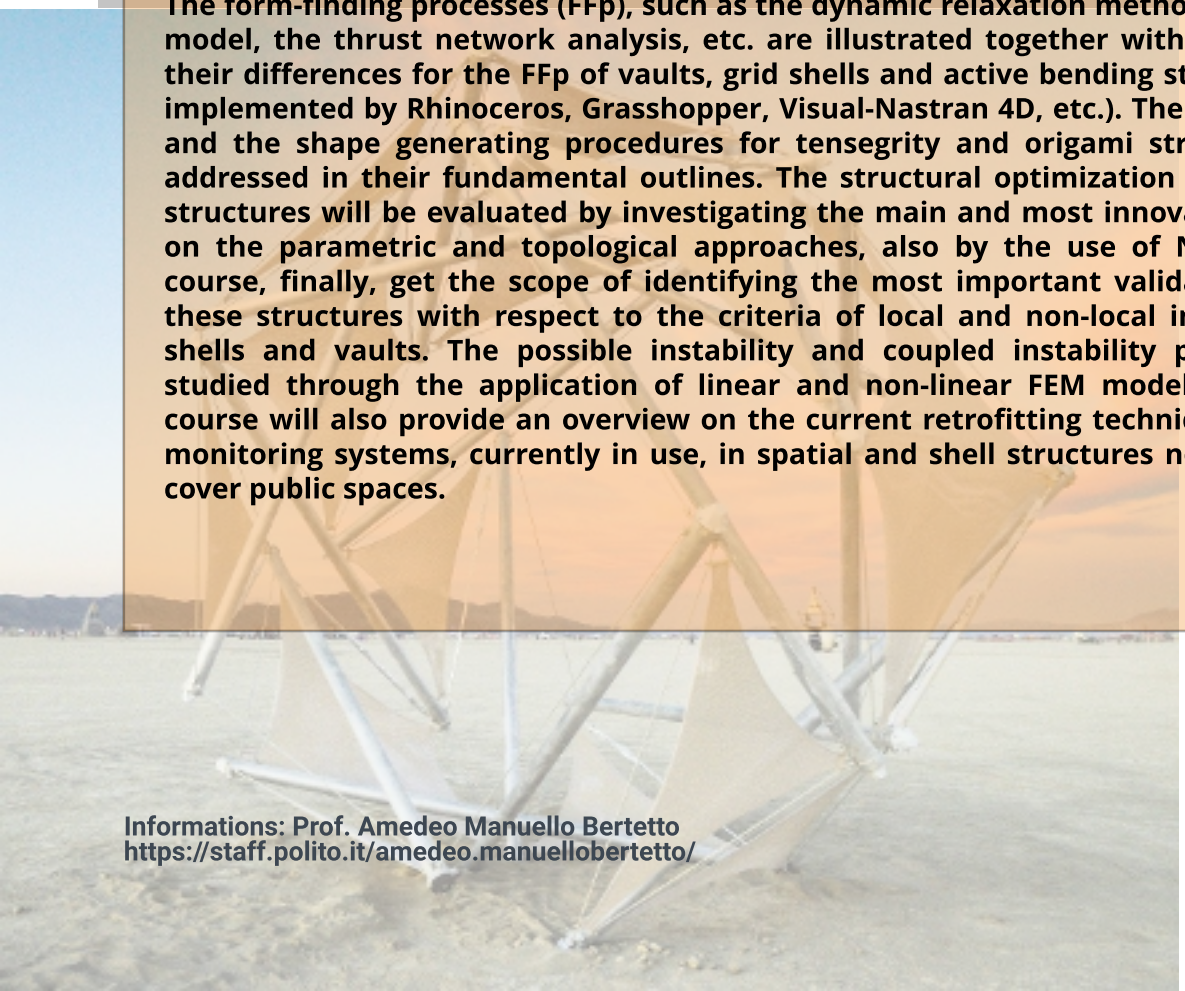
DESIGN AND OPTIMIZATION OF SHELLS AND SPATIAL STRUCTURES

Course Description

The course aims to offer an analysis of the most important realizations, in the field of space structures, large span roofs and shells, regarding, at the same time, the buildings of the 50-70s, and the most important realizations with respect to nowadays architectures in Italy and all over the World. Through a detailed analysis of the modeling and verification methods, the course purposes to explain, the different approaches, progressively proposed, for the calculation of shell and spatial structures. With this motivation, the form-finding and the successive validation phase, for structures of this type, are presented. The course aims to provide a critical point of view of the different methods introduced for the design of lightweight structures, firstly, considering the models employed for the realizations using traditional materials and successively evaluating atypical and innovative prototypes. In these last cases, the use of sustainable and eco-friendly materials and the design of transportable structures for aerospace applications will be explored.

The form-finding processes (FFp), such as the dynamic relaxation method, the particle spring model, the thrust network analysis, etc. are illustrated together with their principles and their differences for the FFp of vaults, grid shells and active bending structures (FFp will be implemented by Rhinoceros, Grasshopper, Visual-Nastran 4D, etc.). The calculation methods and the shape generating procedures for tensegrity and origami structures will be also addressed in their fundamental outlines. The structural optimization of shells and spatial structures will be evaluated by investigating the main and most innovative methods based on the parametric and topological approaches, also by the use of NURBS surfaces. The course, finally, get the scope of identifying the most important validation procedures for these structures with respect to the criteria of local and non-local instability analysis of shells and vaults. The possible instability and coupled instability phenomenon will be studied through the application of linear and non-linear FEM models. In particular, the course will also provide an overview on the current retrofitting techniques and permanent monitoring systems, currently in use, in spatial and shell structures normally employed to cover public spaces.



Informations: Prof. Amedeo Manuello Bertetto
https://staff.polito.it/amedeo.manuellobertetto/