



DESIGN OF SHELL STRUCTURES

Enrollment year	2020/2021
Academic year	2021/2022
Regulations	DM270
Academic discipline	ICAR/09 (CONSTRUCTION TECHNIQUES)
Department	DEPARTMENT OF CIVIL ENGINEERING AND ARCHITECTURE
Course	CIVIL ENGINEERING
Curriculum	Strutturistico
Year of study	2°
Period	1st semester (27/09/2021 - 21/01/2022)
ECTS	6
Lesson hours	45 lesson hours
Language	Italian
Activity type	WRITTEN AND ORAL TEST
Teacher	NASCIMBENE ROBERTO - 6 ECTS
Prerequisites	Basics in reinforced concrete and steel structures design.
Learning outcomes	<p>Aim of the course is to better understand the behaviour of two and three dimensional shell structures. Mainly to: - analyse, modelling and verify plate structures such as rectangular, square and circular plates. Reinforcement design and crack verification; elastic and elasto-plastic buckling analysis will be done; - calculate cylindrical shells (tanks, pipes and silos) using membrane and bending formulation; - evaluate the ring stiffeners used to connect the wall with the roof; - analyse spherical cup (dome). Ordinary reinforced and precast concrete and steel structures will be considered.</p>
Course contents	<p>The may goal in studying a shell course is to reach the ability to analyse and design a shell from the bottom plate to the wall and at the end the roof with the ring stiffeners. Here are the schedule of the course:</p>

plate

Design of reinforced concrete plate moving from the classical Lagrange-Sophie Germain equation; analytical solution; evaluation of thickness and reinforcement details;

tanks

Analysis and design of cylindrical shells such as tank, pipes and silos. Membrane and bending solutions. Design reinforcement, crack verification. Elastic and elastoplastic verification for steel tank;

Ring

Analysis and design of horizontal and vertical ring stiffeners. Reinforced concrete and steel ring. Analytical solution for prestressed or posttensioned reinforced concrete ring.

Dome

Analysis and design of spherical dome.

Seismic analysis of tanks

Some introduction in earthquake analysis of tanks. Equivalent mechanical models, Impulsive and convective components of the motion. Shear and overturning moment.

Teaching methods

Lessons (hour/year in classroom): 45

Recommended or required readings

G.M. Calvi, R. Nascimbene. Progettare i Gusci. IUSSPRESS (ISBN: 978-88-6198-061-7).
<http://www.iusspress.it/pc/viewPrd.asp?idcategory=7&idproduct=138>.

Assessment methods

Written and oral examination at the end of the course.

Further information

Sustainable development goals - Agenda 2030

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