



Code: ICAR/04

Credits: 9

Matter: Construction of roads, railways and airports

Main language of instruction: Italian

Other language of instruction: English

Teaching Staff

Head instructor

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Introduction - Objective of the course

The course allows to students to learn rudiments of the infrastructure design by means of the study of conformity assessment of the geometric and functional design parameters of road infrastructure, according to current Italian legislation, as well as the introducing of design concepts and the study of:

- a. dynamics of vehicle motion and their characteristics;
- b. design and verification processes of an infrastructure;
- c. safety criteria in the design and construction of the works;
- d. differences between the different types of infrastructure.

Course Structure

The course is organized in nine modules. The first module is focused on the study of interaction between **Vehicle and road**. The second module is devoted to a brief recall of fundamentals of **Road traffic** and **vehicular flows**. The third module provides the concept of the **Italian road standard**. The fourth module is focused on the **Road Geometric Elements**. The fifth module presents the fundamental concepts of the **Road safety** and the **design of a road infrastructure**. The sixth module is focused on the **Urban and suburban road intersections** typologies. The seventh module is devoted to **Railway infrastructures**, instead the eighth module provides the concept of the **Airport infrastructures**. Finally, the ninth module introduces the concept of the **roadway and over structures**.

The knowledge acquired in theory lessons will be applied in the "virtual classroom" forum through five activities, consisting in the solution of design problems (E-tivity).

Competencies

Knowledge and understanding

At the end of the course, the student will have demonstrated his knowledge of the topics of infrastructure design and verification in relation to both user safety and comfort and to Italian standard and literature indications. In addition, the student

will acquire knowledge of the principles on which the current design criteria have been developed. Finally, the student will acquire methods for infrastructure security analysis.

Application of knowledge

The student will be able to use the knowledge of the safety criteria and dynamics of motion to design the geometry of an infrastructure, with particular reference to the technical solutions in accordance with the standard requirements.

Ability to draw conclusions

The student will be able to identify critical issues and anomalies in existing infrastructure contexts, localizing phenomena of lower Level Of Service of the infrastructure or design anomalies, intervening to mitigate or remove the critical issues identified.

Communication skills

The student will be able to describe and hold conversations on infrastructure design and sizing problems, correctly identifying the parameters that contribute to determining a quality design.

Ability to learn

At the end of the course, the student will have knowledge of the fundamental notions necessary for infrastructure analysis.

Syllabus - Course structure

Module 1 - Vehicle and road: *Modeling of road vehicles. Traction equation and resistance to motion of road vehicles. Adherence. Stages of various motion: Starting and braking phases. Kinematic and dynamic models of vehicular motion. Dynamic balance of the vehicle when cornering. Quadrangle of Janteau. Dispersion of the trajectories.*

Module 2 - Road traffic: *vehicular flow models. Ideal conditions. Capacity of an infrastructure. Highway Capacity manual. Level Of Service.*

Module 3 - The Italian road standard: *standards framework. Road classification. Definition of the design documents.*

Module 4 - Road geometry: *Horizontal design of road axis (Straights, Circular curves, curves with variable curvature. Clothoids and generalized spirals. Criteria for planimetric, constrained and unconstrained design. Vertical design of the axis (grade lines. Vertical junctions. Vertical design criteria: solution cases. Horizontal and vertical design coordination). Transversal definition of the infrastructure (Composition of the road section. Transversal slopes and curves. Enlargement of the roadway and internal margins. Cross section in tunnel and viaduct).*

Module 5 - Road safety and design of a road infrastructure: *in which the following topics are addressed: Speed diagram. Clear viewing distance and visibility distances (stopping, overtaking and changing lanes). Visibility verification methods. Safety*



barriers (outline). Insertion of a road layout in a design context. Evaluation of the design configurations in the choice of the route. Optimization criteria.

Module 6 - Urban and suburban road intersections: *Typological classification of intersections. Common design solutions, on one and more levels. Geometric characteristics and operating principles. Points of conflict. Maneuvering trunks. Exchange trunks. Waiting trunks. Specialized lanes. Roundabouts. Visibility checks. Eyelash curves.*

Module 7 - Railway infrastructures: *Fundamental characteristics of the railway system. Characteristic components. Resistance to motion of railway vehicles. Adherence in the railway system. Traction equation. The rail and the track gauge. Wheel-rail interaction. Dynamic balance of railway vehicles.*

Module 8 - Airport infrastructure: *Composition of an airport infrastructure. The obstacle surfaces. Limitation of obstacles. The runways. Runway length. Width of a runway. Longitudinal slopes. Vertical junctions. Security strips.*

Module 9 - The roadway and over structures: *Embankments, trenches, bridges (outline), viaducts (outline) and tunnels (outline). Works to protect and stabilize the roadway. Basic geotechnical parameters of the soils. Soil classification. Road construction materials. Mechanical and physical-chemical characteristics and main characterization tests (outline). Stone aggregates, organic binders, hydraulic binders (outline) Functions of the floors. Types of flooring (materials used). Design of a pavement. Breaking criteria. Sizing and calculation methods. Italian catalog of road pavements. The railway over structure. The airport pavement*

Evaluation system and criteria

The exam consists of a written exercise, 10 multiple choice questions and 1 open-ended theoretical question. The exercise is evaluated for a maximum score of 15/30, the 10 multiple choice questions are assigned a maximum overall score of 5/30, the theoretical question is assigned a maximum score of 5/30, while the etivity, possibly carried out in itinere, contribute to the overall exam mark up to 5/30 points.

Bibliography and resources

Materials to consult

The educational materials (lecture notes, slides and video lessons) are available on the Unicusano platform.

Recommended bibliography

- *Fondamenti di Ingegneria delle Infrastrutture Viarie – Ranzo – Ed. CompoMat.*
- *La geometria stradale – Esposito, Mauro – Benevento, Hevelius.*
- *Strade, ferrovie e Aeroporti – Agostinacchio – Ed. EPC.*
- *Ferrari Giannini – Costruzioni stradali – ISEDI*