

## Course guides

# 250453 - ORDURBINSU - Urban Planning and Urban Service Infrastructure

Last modified: 06/10/2020

**Unit in charge:** Barcelona School of Civil Engineering  
**Teaching unit:** 751 - DECA - Department of Civil and Environmental Engineering.

**Degree:** MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Optional subject).  
MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Optional subject).

**Academic year:** 2020    **ECTS Credits:** 5.0    **Languages:** Catalan, Spanish

### LECTURER

---

**Coordinating lecturer:** JOAN MIRO FARRERONS

**Others:** JOSEP MERCADÉ ALOY, JOAN MIRO FARRERONS

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

---

**Specific:**

8208. The ability to analyse and interpret the regulation and impact of infrastructure and their repercussions for sustainable development, taking into account economic, environmental, social and cultural factors.

**Transversal:**

8559. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding the mechanisms on which scientific research is based, as well as the mechanisms and instruments for transferring results among socio-economic agents involved in research, development and innovation processes.

8560. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

8561. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

### TEACHING METHODOLOGY

---

The course consists of 1,8 hours per week of classroom activity (large size group) and 0,8 hours weekly with half the students (medium size group).

The 1,8 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

We spend 0.9 hours (medium group), the resolution of the five course work, with greater interaction with students, to consolidate the general and specific learning objectives.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

## LEARNING OBJECTIVES OF THE SUBJECT

---

Specialization subject in which knowledge on specific competences is intensified.

Knowledge and skills at specialization level that permit the development and application of techniques and methodologies at advanced level.

Contents of specialization at master level related to research or innovation in the field of engineering.

The basic objective of the course, is the study of the technical infrastructure of various urban services that characterize the development of the modern city, from an urban vision, ie to serve the city and its physical elements (public spaces, land and buildings), which integrates and reproduces the functional aspects, calculation, sizing and layout of each service together in a public urban space.

This requires that the student previously read and understand the urban plans, through the differentiation of different forms of urban growth and structure of the road network (complementary objective of the course).

The course seeks technological effort of synthesis of concepts from other subjects of the race's transmetrel from this new joint service vision of building the city and its elements, conformation and good use of the urban space.

## STUDY LOAD

---

Type	Hours	Percentage
Guided activities	6,0	4.80
Self study	80,0	63.95
Theory classes	19,5	15.59
Practical classes	9,8	7.83
Laboratory classes	9,8	7.83

**Total learning time:** 125.1 h

## CONTENTS

### THEME I: Building the modern city and urban services.

#### Description:

- 1.1. - The urbanistic concept of situation. Potential sites and vocations. Application to the territory Catalan: general physical structure of the territory, the maze Catalan ranges and depressions and gaps Besòs-Congost-Ter, and Llobregat - Cardener. The situation of sites throughout recent human history: Catalonia refuge and corridor. The privileged location of Barcelona and the capital mission. The formation of transport networks and Catalan 8.
- 1.2. - The urbanistic concept of site . Description of the site through the relief of the landscape, land use and human activity. The sizes of the site. Application to the case of Barcelona in the Eixample projects (of Cerdà) and Sanitation (of Peter Garcia Fària)
- 1.3. - The different forms of urban growth explained by the combination of temporal elements, the importance of the element and the type of agent that embodied the physical elements of the urban construction: Forest land (Plot setup P), construction infrastructure (Urbanization U), and building E. The Gothic or Old City, the suburban growth, the Eixample, Garden City, the housing estate, and the Marginal Urbanisation
- 1.4. - Characteristics of urban extensions. The Eixample Cerdà and the General Theory of Urbanization.
- 1.5. - Morphological Features of expansion plans. The case of extensions under the Barcelona region.
- 1.6. - The role of urban development the construction of urban services. The construction of the Eixample Barcelona; threshold notion of urban growth by exhaustion of the capacity of the service; characteristics of urban services and urban planning requirements.
- 1.7. - Reform of Paris (Haussmann 1853). Arguments, urban structure and system of city building.
- 1.8. - The construction of the city center in Europe and England. Camillo Sitte, Garden City (Howard and Unwin), the Linear City of A. Soria, and Industrial City of T. Garnier.
- 1.9. - The development marginal. The neighborhoods of self without urban services. The development in the marginal area of Barcelona.
- 1.10. - Evolution of the garden city model of urban housing developments to Rationalism.
- 1.11. - The rationalism of CIAM and the housing estate. The city functional and diffuse. Housing developments in the Barcelona area
- Exercise 1: Analysis and design of the plane of the parts of the different characteristics of each urban fabric of a city average, for the articulated skeleton of the road network and proposed arrangement for mobility and parking to create an "Pedestrians area" in the historic center of the city.
- . - Particularised care to the student by the teacher to clarify doubts and corrections work 5.

#### Specific objectives:

- 1.1, 1.2, 1.3. - To facilitate the student's understanding of geomorphological conditions, historical, landscape, geographic... determining: 1) the provision of urban systems and infrastructure networks applied to the case of Catalonia and described through maps (situation), 2) the site description and location through maps, and 3) morphology of urban forms (urban areas) through the urban development model of forms of urban growth.
- 1.4. - Frames the project in the Eixample Cerdà site conditions and the situation of Barcelona.
- 1.5. - Check the layout of infrastructure such as railways, highways, channeling streams, bridges, have conditioned or determined the orientation of new patterns of urban growth of minor extensions.
- 1.6. - Understanding of the role of jerarquitzador and urban growth have been the construction of the various networks of urban services, applied to the case of construction of the Eixample district of Barcelona.
- 1.7. - Oppose expansion and reform in the two cases in Barcelona and Paris.
- 1.8 to 1.11. - Describe the main models and formalistic construction of city schools in Europe in the twentieth century and their evolution into the actions of the current monofuncionals and scattered urban sprawl.
- Exercise 1:
- . - Expressing a travers drawing the map the different urban areas of the city for the articulated skeleton laxarxa road to diagnosis necessary to intervene in planning proposals such as this one.
- . - Understand the design of urban form is the main diagnostic element of any intervention in the urban city.
- . - Check the correct fit and the results of calculations street lighting and electrical design of the installation of lighting.

**Full-or-part-time:** 16h 48m

Theory classes: 5h

Laboratory classes: 2h

Self study : 9h 48m

## THEME II: The construction of public space. Streets, squares and parks.

### Description:

2.1.- Basic functions of the street side access to the space plots enable and buildings infrastructure passing through; public space of social relations. Character of the street according to the organization, development, functions and uses, and the container side. Types of streets for their demarcation of plots or urban areas (rounds, boulevards, walls, roads link), by their penetration in urban areas (streets, boulevards, avenues, through roads, streets esbutzament) or their belongings in a given road network (passages, streets, street patterns, ...).

2.2. - The concept of mobility. Explanatory variables and effects in shaping urban growth. Participation and development of different forms of mobility in metropolitan areas.

2.3. - In adapting the city to adapt the car to drive to the city. The report "Traffic in the cities" of C. Buchanan, and concepts of environmental capacity and Environmental Department. Increased capacity for urban renewal and environmental restrictions and traffic calming. The traffic calming in the street be: streets and pedestrian areas, residential streets, or coexistence of inverted priority (S-28 and woonerf Netherlands); streets of area 30. Elements of moderate speed.

. - The urban mobility plans (PMU). Prioritization of traffic for each network and hierarchical forms of mobility. Areas of pacification traffic. Reference to the law of mobility Catalan 2003.

Work 1: - Completing the skeleton and organization of road traffic and parking access to the central pedestrian area.

2.4. - The project of road space I: Planning of streets. Criteria and mechanisms for organizing the different areas of the street requirements and measures of each form of mobility in the design of the cross section, determining the urban layout plan and longitudinal profile of the street.

2.5. - The project of road space II: Elements of urban streets and squares: paving urban boundaries of urbanization, vegetation, trees and street furniture ..

. - Troubleshooting urban road layout:

Lace longitudinal profiles of vertical agreements, and representation of the topography in plant modified for various cross sections.

. - Delivery of coursework 1.

. - Statement of Work Course 2: Managing plant in the different streets of a residential sector of lace and longitudinal profiles of the streets will be screened on the section of sewer.

. - Personal attention by the teacher to the student to answer questions i corrections to the exercise of course 2.

### Specific objectives:

2.1. - The analysis takes site, but now seen from a road to understanding the role played by each of the streets of the plot, to allow proper intervention project in the organization of urban mobility, the planning and development of the road.

2.1. - Understanding the urban form of the city from the shape of the skeleton of the road network, and the role played by different types of streets laid out in class

2.2. - The urban road project is not a problem of rigid closed and sectorally imposed by any authoritative determination of the functions or uses for which will be used, but otherwise an open problem that has to satisfy a variety of integrated demands and requirements of a proper context for environmental quality and good use of urban intervention.

2.3. - To facilitate different forms of mobility in the city creating networks for each of them, from the hierarchy of the road and creating traffic calming areas.

2.3. - Understanding urban road project as a result of the resolution of conflicts between different users and functions of the solicitations of the street

. - Understanding the synthesis of the diagnosis of supply and demand for mobility of a PMU and the proposed organization of the various networks and mobility services for those favoring more sustainable modes

Work 1:

. - Understand the design of urban forms and the skeleton of the road network, the main element constitueixent diagnosis of any urban intervention in the city, and in particular the organization of access and parking in the area pedestrian

. - To assess the possible organization of mobility solutions from the view of the map as the road network.

. - Understanding urban road project as a result of the resolution of conflicts between different users and functions of the solicitations of the street.

. - Mastering the analytical fit and shape in profile vertical agreements and the resulting modified plant topography combined with the profile cross section.

. - Catàlecs-Provide constructive solutions with different materials of urban pavements, adapted to different users and solicitations.  
. - Concern for the student to facilitate the fitting on the disposal of various items of furniture, plants and trees, logs and other facilities or elements of services in urban road project, to ensure smooth use

. - Mastering the fit of the vertical agreement conditioned to the demands of urban and planimetric representation of the topography and the profile given by the modified transverse section of the street.

. - Work in progress 2: Apply in a specific case and sort criteria in plant layout, profile and cross section of streets that will act on the sewer project.

. - Apply the knowledge and engagement of the management and road layout to Iso conditions and demands of the urban



reserve.

**Full-or-part-time:** 19h 12m

Theory classes: 2h

Practical classes: 2h

Laboratory classes: 4h

Self study : 11h 12m

### THEME III: The system of urban sanitation.

#### Description:

3.1. System - sanitation and phases: Collection and Transport (drainage and type), treatment or purification, and discharges to the environment.

3.2. - The sewage system: Dimensioning of pipes.

Concepts of urban hydrology and runoff flow calculation by using the formulation of rational and Témez: calculating runoff coefficients in urban areas; aggregation of watershed runoff through the analysis of the plots ; time of runoff and the addition of travel time by calculating the time of concentration and determination of the intensity of precipitation. Demand for waste discharges to urban uses and ratios for different tip.

Hydraulic calculations for free under a sheet of Manning's formula, applied to the case of circular ducts. Earnings and optimum speeds.

Dimensioning of mechanical circular ducts: optimum depths, section and longitudinal profile of the ditch and pipe materials and joints.

3.3. - Elements of network functions, layout and construction of the different work units.

Wastewater collection and storm: building connections and valves antiretorn, scupper, cross fences and mailboxes (absorptive capacity); sorrera header.

Well log and hydraulic ridge. Sobrexidor jump back, height and length of the lip. Siphons. Gates.

3.4. - Alternative systems of urban drainage planning based on the retention, storage and infiltration of rain water: theoretical basis, the calculation of retention and techniques used. Filter ditches, reservoirs, ponds and porous paving.

. - Troubleshooting drainage capacity of sections of streets and clavagueres, sobreixidors calculation, using the rational method of formation of runoff flows, laminar and storage for the tip of the hydrograph.

. - Delivery of coursework 2.

. - Presentation of 3 led by the classroom teacher: Draft a section of sewer in an urban area of new development.

3.5. - Physical, chemical and bacteriological waste water. Measurement parameters.

3.6. - Independent or extensive systems: Design, dimensioning of the elements and urban areas of application. Elements of Pre-treatment: the septic tank and decanter tank digester. Treatment by filtration: trenches and filter beds with natural terrain, sand filters contribution of vertical or horizontal, mounds of earth contribution. The lagooning.

3.7. - Conventional or Intensive Systems: The activated sludge treatment plant. Elements and sizing. Reference to the Wastewater Treatment Plan of Catalonia.

. - Care particularised to the student by the teacher to clarify doubts and corrections work 3.

#### Specific objectives:

. - Synthesize knowledge of hydrology and hydraulics technology to reproduce them from an urban perspective, that is to service the construction of the city and its elements: the urban street layout, deployment and functional elements of the network sewer, construction details, building connections.

. - Applying the method of forming rational flow of rain water and the sizing of the various elements of the sewer.

. - To properly measure and the functional elements of the conventional network as well as those new elements designed to store and infiltrate into the groundwater in origin or elements of high-capacity peak flows before reaching the transport network of smaller sewer discharges .

. - Applying the method of forming rational flow of rain water and the sizing of the various elements of the sewer.

. - To familiarize students with techniques and tools of the construction project, especially in the realization of plans at different scales and in establishing the correct correspondence between design, calculation, construction process, materials, work units, measurements and budget.

. - To introduce the student constructive concern from the moment of signing the project, defining carefully the different work units and how to proceed in preparing the budget and measurements.

. - Apply techniques of self-cleaning "naturalized" in urban areas of low population density.

. - Predimensionar necessary to locate the area of wastewater treatment plants.

. - To familiarize students with techniques and tools of the construction project, especially in the realization of plans at different scales and in establishing the correct correspondence between design, calculation, construction process, materials, work units, measurements and budget.

**Full-or-part-time:** 14h 23m

Theory classes: 3h

Practical classes: 1h

Laboratory classes: 2h

Self study : 8h 23m



#### THEME IV: The distribution network of drinking water.

##### Description:

- 4.1. - Demand of potable water daily, evolution and consumption point for each urban uses: residential, tertiary, industrial equipment, services and watering gardens.
- 4.2. - Items prior to the distribution network: Collection, transportation, treatment and regulation tanks. And brief description of each type.
- 4.3. - Determining the hydraulic operation of the network: optimal regime of pressures and speeds. The phenomenon of water hammer and pipe timbratge. Choice of pumps. Hydraulic calculations of the flow distribution in mesh networks: the method of Hardy Cross and the theorem Bernuilli. Check pressures and speeds. Checking the conditions of fire.
- 4.4. - Functional elements of the network: Description, features and available in the network. Pipes: materials and types together. Civil trench, disposal on public roads, easements for crossings and parallels with other services. Valves, antiretorn, suckers or traps, pressure reducing, the drainage, fire hydrants, mouths watering, pericons, anchors, connections, sources, special pieces. Special case of the irrigation network: sprinklers, diffusers and degoters.
- . - Troubleshooting design of mesh networks, prior estimation of flow passage, according to the iterative method of Hardy Cross.
- . - Care particularised to the student by the teacher to clarify doubts and corrections work 3.
  
- .- Design and dimensioning of a network of water distribution in an urban area of new development.
- .- Care particularised to the student by the teacher to clarify doubts and corrections work 4.

##### Specific objectives:

- . - To facilitate the process of establishing adequate potable water demand in the various urban uses, and the transformation instantaneous flows.
- . - Location and reserve space for the regulation tanks in the city to establish the appropriate regime of pressures in the network.
- . - Design, measure and verify the correct operation of a hydraulic network of water supply.
- . - To facilitate the process of requesting and define the parameters of the design grid mesh, and verify that the calculation is a tool to check the goodness of the design with the expected results.
- . - To understand the functions and provide adequately the various elements of the distribution network of drinking water.
- . - Designing successful distribution network of drinking water, incorporating the concerns of construction, materials used and costs.
- . - Understand the hydraulic calculation of mesh networks as a tool to check a sizing and design must proceed prior to the student.
- . - To familiarize students with techniques and tools of the construction project, especially in the realization of plans at different scales and in establishing the correct correspondence between design, calculation, construction process, materials, work units, measurements and budget.
- . - Application requesting the parameters and design of a network of water distribution in a real case of a particular sector of new development, and verification of results with the application of the iterative method of Hardy Cross.
- . - Applying for a real demand parameters, network design and check calculations of the expected results.
- . - To establish the hierarchy of the pipe network to mesh application of calculus.

**Full-or-part-time:** 16h 48m

Theory classes: 2h

Practical classes: 1h

Laboratory classes: 4h

Self study : 9h 48m

## THEME V: The urban street lighting.

### Description:

5.1. - Functions of urban lighting. Brief description of the lighting as a public service center: the torches to discharge lamps. The safe use of urban nightlife and the creation of urban nightlife. Projectual requirements, mechanisms and techniques. Guiding principles of a lighting project: orientation and character of the road site, morphological integration of the environment, maintenance and operation.

5.2. - Parameters and units luminotècniques: flux  $\Phi$ , E light, luminous efficiency  $lm / w$ , and intensity, brightness or luminance  $L$ ,  $U$  uniform medium and minimum. Needs and levels of lighting of streets and other public spaces. The spectrum of sunlight.

5.3. - Elements of the installation:

Photometric characteristics of the different lamps outdoor lighting: VMCC, HPSV, VSBP, Fluorescent, halogen, LED. The auxiliary power team: starters, capacitor, reactance. The half-lit room with ballast.

Lights: Elements. Classification by concentration or dispersion of the flow rate and IP protection. Representation of the photometric characteristics: polar diagram, use factors, isolux curves, curves isocandela. Luminotècnics calculations. Comfort glare index (G and TI).

5.4. - Design of the installation. \* Levels and uniform illumination and to different types and intensity of use of streets and public spaces. Relations across the street, provision of lighting, height, and flow separation points of light.

5.5. - Calculations of electric lines for heating criteria ( $I_{max}$ ) and maximum voltage drop ( $\Delta U = 3\% U$ ).

5.6. - Elements of civil works. The trench and the pipe, the laying on the floor, boxes and staffs of foundations

. - Resolu of problemes of Calculs luminotècnics i electric Línies d'Alimentació of them.

Course work 5: Design and lighting calculations and electrical installation of lighting the streets of an area of new development.

### Specific objectives:

- . - Inculcate in students the importance of lighting in the creation of urban nightlife, and as such largely condition the use to be made in this area at night.
- . - Breaking concerns only quantity that we are accustomed to use as guidelines and manuals that make lighting a problem for the traffic, the scaled only by the maximum intensity at night time and the speed of movement, with the sole concern of ensuring traffic safety.
- . - Understanding urban public space for the use made of the different users, the way it has, by routes and urban elements to emphasize the relationship with the built space, the project requires a lighting concern more open and more rich than that to which we referred deterministic.
- . - It requires an effort to understand the place of operation and ensure a good quality, composition and night use.
- . - Learn the techniques and materials typical of these facilities to accommodate the values and the proper use of urban space.
- . - To provide the student with the characteristics of the diverse range of materials commonly used in outdoor lighting and lighting calculation methods to verify the expected results of the preliminary design.
- . - To encourage the student to the application domain of the lighting calculations for different representations photometric.
- . - Determine ways to have fixed and variable design of lighting in the streets and the need for coordination with trees and buildings.
- . - Impregnate the student's concern as constructive elements of civil pipe, boxes and staffs of foundations.
- . - To understand the development and distribution power lines to feed diferens lights.
- . - To apply the curves by factors of predimensionament use of outdoor lighting and checking the results through methods of 9 or 12 points isolux curves.
- . - Presentation of the lighting calculations for computer.
- . - Resolution of practical cases of calculations for sizing of the electrical sections of lines of outdoor lighting.
- . - To encourage the student to the application domain of the lighting calculations for different photometric performances.
- . - Projecting the correct street lighting.
- . - Design, test fit the urban and the results of the calculation of a street lighting project.

**Full-or-part-time:** 9h 36m

Theory classes: 2h

Practical classes: 1h

Laboratory classes: 1h

Self study : 5h 36m

**THEME VI: Other networks of urban technical services and coordination in the implementation.**

**Description:**

6.1. - Structure of the generation, transport and transformation of the voltage: Power generation, types and participation in electricity production. The airline transport networks in high voltage and very high. Easements. Substations. The medium voltage distribution network of centers and transformers. Types of MT network (linear and ring) and BT.

The power demand of different urban uses and the reduction simultanit.

Calculations of low and medium voltage electrical criteria for maximum intensity and maximum voltage drop ( $\Delta U = 5\% U$ ).

Provisions and civil works elements of the distribution network in BT: Air, attached in front, buried in trench, pipe, junction boxes and urban distribution, collection boxes.

6.2. - Type of gas and heat power. Transport networks in high pressure, the pressure chambers and cabinets to reduce pressure.

The distribution medium and low pressure. Urban demands and simultanit coefficients. Dimensioning of the network: flow calculations, quadratic load losses and maximum speeds. Materials and pipe together. Elements of the installation and civil works.

6.3. - The network for cable.

Types of services: voice, data, image. Types of cables and transmission capabilities and attenuation: pair cables of copper (Cu) and DSL technology, network and hybrid fiber coax (HFC), fiber optic (FO) to the subscriber.

Structure of the deployment of conventional network cable pairs for Cu. Type plants and interconnections, network power, record and first quarters of urban distribution, interconnection cabinets, distribution network and the types of boxes, connection cabinets and dispersion, and the rush of pairs cables to the subscribers. Type of piping and civil works.

The HFC network hybrid. Structure of deployment: the HUB, the nodes of power (NP), opto-electrical nodes (or NOE IS) with fiber optic network, the network backbone with coaxial cable, radio frequency amplifiers, distribution network and referral to subscribers. Civil works and pipe boxes.

6.4. - Provision of easements and networks of urban services.

Conventional available for each type of network services: air and / or buried by sidewalk or driveway, easements parallels and cross networks buried. The buried section: minimum requirements for sidewalk space. The shortage of road space available in galleries and services: types of galleries, the cost and financing of civil works.

**Specific objectives:**

- . - To convey to students the skills essential to understand the basic requirements of the project these other networks of urban services operated by private companies, not to be self-sufficient in the drafting of projects, but for that the time to discuss with the technicians responsible for the company's size and suitability of the implementation and provision of networks, for a proper coordination with the provision of other services.
- . - Reference to the more global structure and deployment of the grid, from the various central generating service to the subscriber: the generation, transport in high and substations; assessment demand service for various urban uses; to dwell mainly in the sizing, calculation, and deployed in the provision of urban public space network in medium and low voltage distribution to the subscriber.
- . - Open the path to technological openness to other technicians not linked to the respective utility companies increasingly need to act referees decisions to implement these services on public roads or coordinators in unit of development projects.
- . - To properly track and the arrangement of lines and elements of medium and low voltage in coordination with the division, building and public space.
- . - To understand the scope of urban power supply of conventional sections of the lines in medium and low voltage transformer centers.
- . - Understand the need to establish an order of the spatial arrangement of services, because ultimately be an economic order in the construction of the city.
- . - To provide the future civil engineer of minimal technological expertise that enable dialogue with those responsible for technical services companies to achieve optimal coordination in the implementation and provision of these networks in urban public space.
- . - Open the way for technological transparency of other experts not connected with the respective utility companies increasingly need to act referees decisions to implement these services on public roads or coordinators unit of development projects.
- . - Arbitrary planning and coordination of the decisions of public companies, the coordination in the implementation of services in the highway area.
- . - Claiming the need to move towards the solution of future service galleries in those cases in which the density of services and the opportunity for new initiatives in the construction of urban space so require.

**Full-or-part-time:** 7h 11m

Theory classes: 3h

Self study : 4h 11m



## THEME VII: The cost of primary urbanization.

### Description:

- 7.1. - Explanatory variables in the cost of urbanization levels and minimum service standards for each service. The efficiency of the sorting surface, linear and parcel distribution. Economies of scale for the size of the performance: cost assessment method for MSV (INCASOL) and others. The density of use and the unit cost of production floor and roof built.
- 7.2. - Participation of different services in the production cost of conventional residential streets. The additional cost of implementing the network and service galleries of pneumatic municipal solid waste.
- 7.3. - Theory of urban growth according to economic thresholds Malisz. Type of thresholds; planning applications; indivisibility of public works supply of services.
- 7.4. - Cost of maintenance services to the development. Influence of urban parameters of efficiency linear and surface, and density.

### Specific objectives:

- To facilitate the provision of urban services in time, as it consolidates the performance and the income level of residents.
- . - Search systems more flexible and elastic elements of the consolidation of development with the possibility of supplementing the time.
- . - Relate variables regulating urban development with the cost of development.
- . - To bring the strongest impact on unit cost and net Land referred to the plot that has taken physical arrangement, efficiency and linear road surface on the ground of total performance.
- . - Assess the cost of development according to the size of the activity measured in road surface, in recognition of economies of scale in the production of road built, or a combination of variables and length of the road surface developed.
- . - To highlight the influence of low density residential use, or if you want the building sector in the gross variation of the unit cost of production of the developed land.
- .

**Full-or-part-time:** 9h 36m

Theory classes: 1h

Laboratory classes: 3h

Self study : 5h 36m

## GRADING SYSTEM

The rating of the course is obtained from the average grades of continuous assessment and the related course work.

The continuous assessment is to do different activities, both individual and group training and of additive, made during the course (in the classroom and outside it).

The rating of the degree course work, is the average of such work.

The assessment tests consist of a part with issues associated with the concepts of the course learning objectives with regard to knowledge or understanding, and a set of application exercises.

## EXAMINATION RULES.

If not done any of the coursework or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.



## BIBLIOGRAPHY

---

### Basic:

- Solà-Morales, Manuel de. Les formes de creixement urbà. Barcelona: Edicions UPC, 1993. ISBN 8476533497.
- Panerai, P.R.; Castex, J.; Depaule, J.-C. Formas urbanas: de la manzana al bloque. Barcelona: Gustavo Gili, 1986. ISBN 842521291X.
- Herce, H.; Magrinyà, F. La ingeniería en la evolución de la urbanística [on line]. Barcelona: Edicions UPC, 2002 [Consultation: 01/04/2020]. Available on: <http://hdl.handle.net/2099.3/36703>. ISBN 848301632X.
- Herce, M.; Miró, J. El soporte infraestructural de la ciudad [on line]. 2a ed. Barcelona: Edicions UPC, 2006 [Consultation: 29/04/2020]. Available on: <http://hdl.handle.net/2099.3/36757>. ISBN 8483018586.

### Complementary:

- McCluskey, J. Diseño de vías urbanas. Barcelona: Gustavo Gili, 1984. ISBN 8425212006.
- Vilar, P. Catalunya dins l'Espanya moderna: recerques sobre els fonaments econòmics de les estructures nacionals: Tom 1: Introducció, el medi natural. Barcelona: Edicions 62, 1964.