UNIVERSIDADE DA CORUÑA

| Teaching Guide | | | | |
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| Identifying Data | | | | 2020/21 |
| Subject (*) | Structures 4 | | Code | 630G02034 |
| Study programme | Grao en Estudos de Arquitectura | | | |
| Descriptors | | | | |
| Cycle | Period | Year | Type | Credits |
| Graduate | 1st four-month period | Fourth | Obligatory | 6 |
| Language | Spanish | | | |
| Teaching method | Face-to-face | | | |
| Prerequisites | | | | |
| Department | Construcións e Estruturas Arquitectónicas, Civís e AeronáuticasEnxeñaría Civil | | | |
| Coordinador | Perez Valcarcel, Juan Bautista | | E-mail | juan.pvalcarcel@udc.es |
| Lecturers | Barreiro Roca, José Carlos | | E-mail | jose.barreiro@udc.es |
| | Dominguez Diez, Eloy Rafael | | | eloy.dominguez@udc.es |
| | López César, Isaac | | | isaac.lopez@udc.es |
| | Martín Gutiérrez, Emilio | | | emilio.martin@udc.es |
| | Perez Valcarcel, Juan Bautista | | | juan.pvalcarcel@udc.es |
| Web | moodle.udc.es | | | |
| General description | Structures 4 is a core subject that is taught in the 4th Course. The objective is to introduce the student to the design and calculation of reinforced concrete structures at a professional level. For this, emphasis will be placed both on the basic concepts of behavior of reinforced concrete, as well as its practical concretion and its adaptation to current regulations. It is about developing the students' abilities to give a concrete and buildable answer to the structural problems that will present themselves in architectural practice and to be able to apply responsibly, but also critically, the calculation regulations and to be able to assume their variations in the future. | | | |

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| Contingency plan | Two contingency plans have been designed.<br><br>SCENARIO 1<br>A first scenario is proposed in which, due to the capacity of the classrooms or other types of reasons, it is not feasible to do face-to-face teaching in expository classes (master sessions), while interactive and workshop teaching, as they are smaller groups of students can continue to be taught in person.<br>In this situation, the only change foreseen affects the teaching methodology used in the master sessions that will be held in online format with the help of the Teams platform included in Office365.<br>There are no changes in the content of the subject, nor in the mechanisms of personalized attention to the student, nor in the evaluation criteria.<br><br>SCENARIO 2<br>A second scenario is proposed in which, in the event of possible confinement, any type of classroom teaching is not feasible. In such case, the planned changes are as follows:<br><br>1. Modifications to us<br>No changes are made<br><br>2. Methodologies<br>* Teaching methodologies that are maintained<br>None<br>* Teaching methodologies that are modified<br>Master session, problem solving, workshop, diagrams, mixed test.<br>The impossibility of continuing to use both methodologies in face-to-face format requires the adoption of alternative strategies that facilitate learning regardless of possible contingencies related to the equipment and connection of the student body. Therefore, it is chosen to provide the necessary documentation through the Moodle platform to continue advancing in the training program, and the rest of the tasks are carried out with the help of the Teams platform included in Office365.<br><br>3. Mechanisms of personalized attention to or students<br>Moodle, virtual forum.<br>The forum remains open throughout the school period, with teachers responding to possible queries both during virtual sessions and during official tutoring hours.<br>Teams, virtual meetings and channels.<br>Communication channels (general and by groups) are kept open so that the student can make inquiries.<br><br>4. Modifications under evaluation<br>Mixed tests. Rating weight 70%<br>To be developed online through Forms or some other institutional tool that facilitates the electronic contribution of answers, images or other types of documents that allow assessing the level of competence acquired by the student in the subject.<br>Practices and / or Workshop. Weight in the 30% rating. The general practice that will take place in the workshop and the practices carried out during the course are included in this section..<br><br>* Observations of assessment:<br>The indicated evaluation criteria are maintained.<br>Students who, for justified reasons related to computer equipment or connection, duly accredited, could not take the exams corresponding to the mixed tests online, will have the right to carry out these mixed tests orally, an essential requirement being to request it by email the same day of the exam, after which they will be opportunely summoned for its realization.<br><br>5. Modifications of the bibliography or webgraphy |

No changes are made

| Study programme competences | |
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| Code | Study programme competences |
| A12 | Ability to conceive, calculate, design, integrate in buildings and urban units and execute building structures (T) |
| A17 | Ability to apply technical and construction standards and regulations |
| A18 | Ability to maintain building structures, foundations and civil works |
| A44 | Ability to develop civil work projects (T) |
| A63 | Development, presentation and public review before a university jury of an original academic work individually elaborated and linked to any of the subjects previously studied |
| B1 | Students have demonstrated knowledge and understanding in a field of study that is based on the general secondary education, and is usually at a level which, although it is supported by advanced textbooks, includes some aspects that imply knowledge of the forefront of their field of study |
| B2 | Students can apply their knowledge to their work or vocation in a professional way and have competences that can be displayed by means of elaborating and sustaining arguments and solving problems in their field of study |
| B3 | Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgements that include reflection on relevant social, scientific or ethical issues |
| B4 | Students can communicate information, ideas, problems and solutions to both specialist and non-specialist public |
| B5 | Students have developed those learning skills necessary to undertake further studies with a high level of autonomy |
| B6 | Knowing the history and theories of architecture and the arts, technologies and human sciences related to architecture |
| B9 | Understanding the problems of the structural design, construction and engineering associated with building design and technical solutions |
| B11 | "Knowing the industries, organizations, regulations and procedures involved in translating design concepts into buildings and integrating plans into planning " |
| C1 | Adequate oral and written expression in the official languages. |
| C3 | Using ICT in working contexts and lifelong learning. |
| C4 | Exercising an open, educated, critical, committed, democratic and caring citizenship, being able to analyse facts, diagnose problems, formulate and implement solutions based on knowledge and solutions for the common good |
| C5 | Understanding the importance of entrepreneurial culture and the useful means for enterprising people. |
| C6 | Critically evaluate the knowledge, technology and information available to solve the problems they must face |
| C7 | Assuming as professionals and citizens the importance of learning throughout life |
| C8 | Valuing the importance of research, innovation and technological development for the socioeconomic and cultural progress of society. |

| Learning outcomes | | | |
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| Learning outcomes | Study programme competences | | |
| Representar convenientemente diferentes tipoloxías de estruturas de formigón armado, no ámbito da edificación e a nivel de proxecto de execución | A12<br>A17<br>A18<br>A63 | B1<br>B2<br>B3<br>B4<br>B6<br>B9<br>B11 | C1<br>C3<br>C4<br>C5<br>C6<br>C7<br>C8 |
| Adquirir os coñecementos básicos relativos ás características físicas e mecánicas do formigón armado | A17 | B1<br>B2<br>B3<br>B4<br>B5<br>B6<br>B9<br>B11 | |

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| Coñecer e saber aplicar os métodos de cálculo de estruturas de formigón armado | A12<br>A17<br>A18<br>A44<br>A63 | | C3<br>C4<br>C5<br>C6<br>C7<br>C8 |
| Deseñar e calcular diferentes elementos e sistemas estruturais en formigón armado, no ámbito da edificación | A12<br>A17<br>A18<br>A44<br>A63 | B1<br>B2<br>B3<br>B4<br>B5<br>B6<br>B9 | C6<br>C7<br>C8 |
| Familiarizarse coa consulta, interpretación e aplicación da normativa vixente no ámbito das estruturas de edificación de formigón armado | A12<br>A17<br>A18 | | |
| Iniciarse na utilización de aplicacións informáticas de análise estrutural, e de ferramentas básicas ligadas á implantación das tecnoloxías da información e das comunicacións | A12<br>A44 | | C3<br>C6<br>C7 |
| Fomentar o desenrolo de capacidades e actitudes de carácter autónomo (tendencia á aprendizaxe continua, habilidade para resolver problemas de forma efectiva, capacidades de análise e síntese, organización e planificación persoal, xestión produtiva da información) ou cooperativa (comunicación efectiva, comportamento fundamentado en responsabilidades compartidas) | | B1<br>B2<br>B3<br>B4<br>B5<br>B6<br>B9<br>B11 | C1<br>C3<br>C4<br>C5<br>C6<br>C7<br>C8 |

| Contents | |
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| **Topic** | **Sub-topic** |
| TIPOLOXÍA E REPRESENTACIÓN | Tipoloxías estruturais en formigón armado<br>Representación de proxectos de estruturas |
| TIPIFICACIÓN DE FORMIGÓNS | Materiais constitutivos<br>Características mecánicas<br>Durabilidade<br>Especificación de formigóns |
| BASES DE CÁLCULO | Estados límite<br>Rexións B e D<br>Dominios de deformación |
| FLEXIÓN SIMPLE | Disposicións relativas ás armaduras<br>Diagramas parábola-rectángulo e rectangular<br>Limitación de ductilidade<br>Métodos aproximados<br>Gráficos de dimensionado<br>Formigóns de alta resistencia<br>Seccións transversais en T |

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| SECCIÓNS CON AXIL E MOMENTO: FLEXIÓN COMPOSTA | Tracción simple<br>Compresión simple<br>Tracción composta<br>Armaduras asimétricas<br>Armaduras simétricas |
| FLEXIÓN ESVIADA | Ábacos adimensionais en roseta<br>Método simplificado por redución a flexión recta |
| ESFORZOS CORTANTE E RASANTE | Mecanismo resistente<br>Tratamento na Instrución<br>Resistencia a rasante en xuntas entre formigóns. |
| TORSIÓN | Torsións principais e secundarias<br>Mecanismo resistente<br>Determinación de armaduras<br>Interacción entre torsión e outros esforzos |
| ANCORAXE E EMPALME DE ARMADURAS | Ancoraxe de barras corrugadas<br>Ancoraxe de grupos de barras<br>Empalme de armaduras pasivas |
| ORGANIZACIÓN DE ARMADURAS | Armado de vigas<br>Armado de soportes<br>Solucións construtivas |
| ESTADOS LÍMITE DE SERVIZO | Fisuras<br>Deformación<br>Limitación por canto<br>Métodos de estimación de frecha |
| PÓRTICOS | Criterios de deseño<br>Modelaxe<br>Métodos de análise<br>Redondeo parabólico<br>Efecto de muros e tabiques<br>Inestabilidade |
| FORXADOS UNIDIRECCIONAIS | Funcións<br>Tipoloxías<br>Consideracións de deseño<br>Estados límite últimos<br>Estados límite de servizo<br>Aspectos construtivos |
| FORXADOS BIDIRECCIONAIS. | Tipoloxías e elementos constitutivos<br>Consideracións de deseño<br>Método directo<br>Método de asimilación a engrellado<br>Aspectos construtivos<br>Cortante e punzonamento<br>Estimación de deformacións |
| PLACAS, LOUSAS PREFABRICADAS E SOLUCIÓNS MIXTAS | Teoría xeral de sistemas bidimensionais<br>Métodos de análise de placas<br>Prelousas e lousas alveolares<br>Forxados de chapa colaborante |

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| REXIÓNS D | Método de bielas e tirantes<br>Comprobación de tirantes e nodos<br>Vigas parede<br>Ménsulas cortas |
| EDIFICIOS EN ALTURA | Condicións funcionais e estruturais<br>Consideracións específicas de deseño<br>Sistemas de estabilización lateral |
| PATOLOXÍA | Accións agresivas<br>Corrosión de armaduras<br>Lume<br>Fisuras<br>Coqueras, disgregacións e desagregacións<br>Lesións por asentos<br>Lesións por deformacións excesivas |

| Planning | | | | |
|---|---|---|---|---|
| Methodologies / tests | Competencies | Ordinary class hours | Student?s personal work hours | Total hours |
| Guest lecture / keynote speech | A12 A17 A18 A44 A63 B1 B2 B3 B4 B5 B6 B9 B11 | 30 | 25 | 55 |
| Problem solving | A12 A17 A18 A44 A63 B1 B2 B3 B4 B5 B6 B9 B11 C1 C3 C4 C5 C6 C7 C8 | 13 | 48 | 61 |
| Workshop | A12 A17 A18 A44 A63 B2 B3 B4 B5 B6 B9 B11 C1 C3 C4 C5 C6 C7 C8 | 12 | 15 | 27 |
| Diagramming | A12 A17 A18 | 0 | 2 | 2 |
| Mixed objective/subjective test | A17 A18 A44 A63 B1 B2 B3 B4 B5 B6 B9 B11 C1 C3 C4 C5 C6 C7 C8 | 4 | 0 | 4 |
| Personalized attention | | 1 | 0 | 1 |
| (*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. | | | | |

| Methodologies | |
|---|---|
| Methodologies | Description |
| Guest lecture / keynote speech | A relevant fraction of the face-to-face activity uses the expository method, whose responsibility rests fundamentally on the teaching staff, either orally or with the complement of audiovisual media. However, and independently of the foregoing, during these sessions a certain participation rate is sought by the students, enhancing their involvement, encouraging the feedback of the process (and therefore the bidirectional character of the communication), and energizing the learning mechanisms through interaction techniques. |

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| Problem solving | Practical tests will be carried out, designed from previously worked contents, and that must be solved in a limited time. The progressive nature of such tests obeys to the criteria of continuous evaluation, so that the conclusions of each phase can serve to redirect the teaching and learning processes conveniently, adapting them to the particularities of the group in order to reach the purported competences.<br>These tests are organized in the development of an architectural project and will progressively incorporate the different topics that are developed in theory. To this end the student must design a concrete framed building in the first week of the course and progressively draw the type of structure, resizing its elements, calculating a representative frame of it, assembling the indicated sections and completely solving the assembly of frames and slabs that are indicated in each case. From this work, partial deliveries of each of these aspects will be made. The complete work will be delivered in a final portfolio that will develop the whole structure of the building. |
| Workshop | The subject participates in Workshop 5, where Projects 6, Construction 5 and Urban Planning 4 are also integrated. The workshop is conceived as a work and exchange space conceived to facilitate the confluence of the contents of the different subjects around the architectural project, and therefore it is based on multidisciplinary integration on the resolution of practical cases. |
| Diagramming | It is intended that the student develops during the course the capabilities of analysis and synthesis through the preparation of synoptic documents. The aim is to reinforce meaningful learning through the structured synthesis of the main contents worked on. The elaboration is understood progressive, ordering of continued form concepts and expressions, schematizing processes of analysis |
| Mixed objective/subjective test | Written tests are proposed as a tool for diagnostic, formative and additive evaluation. The design is adjusted in each statement to the profile of knowledge and skills that is intended to assess, focusing on the understanding of the theoretical content and the skills associated with the analysis and resolution of practical cases. |

| Personalized attention | |
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| **Methodologies** | **Description** |
| Workshop<br>Problem solving | Unha metodoloxía orientada cara á aprendizaxe require a consideración das singularidades que distancian a uns alumnos doutros dentro dun mesmo grupo, en termos de formación previa, posibles carencias, actitudes e aptitudes, expectativas e motivacións. Por elo enténdese necesaria unha dedicación adicional estruturada basicamente mediante titorías presenciais ou virtuais, cuxo froito depende en gran medida do nivel de implicación do discente. Co obxecto de facilitar o seguimento da súa evolución ao longo do curso, ao principio do mesmo débese cumprimentar correctamente a correspondente ficha de alumno.<br>Do mesmo modo, e dado o carácter progresivo da materia, é aconsellable resolver todas as posibles dúbidas a medida en que van xurdindo, á maior brevidade e facendo uso das correspondentes titorías.<br>Esta cuestión intensifícase, si cabe, no desenvolvemento dos proxectos propostos a nivel de taller, cuxa metodoloxía só adquire sentido se se produce un contacto regular e periódico co profesorado a fin de optimizar e, no seu caso, reconducir as actividades en curso.<br>As probas propostas poderán ser revisadas tras a súa cualificación, dentro dos prazos establecidos, a efectos de constatar os posibles erros cometidos e servir, en consecuencia, a unha mellor función formativa dos procesos de avaliación continua. |

| Assessment | | | |
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| **Methodologies** | **Competencies** | **Description** | **Qualification** |
| Mixed objective/subjective test | A17 A18 A44 A63 B1 B2 B3 B4 B5 B6 B9 B11 C1 C3 C4 C5 C6 C7 C8 | Dichas pruebas contemplarán la resolución de ejercicios teóricos-prácticos y el desarrollo de determinados aspectos vinculados al proyecto de estructuras de edificación. La configuración de las mismas, así como los oportunos criterios de calificación, serán definidos expresamente en cada enunciado. | 80 |

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| Workshop | A12 A17 A18 A44 A63 B2 B3 B4 B5 B6 B9 B11 C1 C3 C4 C5 C6 C7 C8 | Se valorarán los resultados obtenidos en el taller teniendo en cuenta la complejidad de la solución y su adecuación a la propuesta arquitectónica, así como su desarrollo tanto a nivel de cálculo como gráfico. | 20 |

| Assessment comments |
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| The evaluation, as a system for collecting information aimed at the issuance of value judgments (and, where appropriate, merit) on the learning process, requires continuous development with constant involvement of the student. With this premise, attendance and participation are fundamental, so that an unjustified and repetitive absence has an unfavorable impact on the grade obtained by the course, in a similar proportion to a lack of participation or a negative attitude. The correction criteria include not only the accuracy of the results, but also the clarity of the presentation, the structure of the analysis carried out, the use of units, the correct application of the normative criteria, and the terminology used.A preferential itinerary is established through continuous evaluation, which is configured through mixed tests, practical activities and the development of the workshop project. To be able to participate in the mixed tests, it is necessary to have submitted the student file within the established period and to comply with an attendance of not less than 70%, including all the regulated activities of the subject. The attendance status will not be required of students with part-time enrollment. The mixed tests represent 80% of the final grade, while the remaining 20% ??comes from the practical activities and workshop development. In order to pass the subject per course, in addition to the aforementioned requirements, a global grade of no less than 5 (out of 10) must be achieved, including in the practical and workshop part a minimum grade of 2 (out of 10). Students who do not pass the subject per course may examine the pending parts in each of the two official opportunities of the same course. In both the note of practices and workshop obtained will be kept. |

| Sources of information | |
|---|---|
| Basic | - Pérez Valcárcel, J. (2012). 1. Introducción a las estructuras de hormigón armado. A Coruña. Reprografía del Noroeste<br>- (2009). DB Se Seguridad Estructural. Bases de cálculo. Madrid. Ministerio de Vivienda, Boletín Oficial del Estado<br>- Pérez Valcárcel, J. (2011). 2. Armado de secciones de hormigón. A Coruña. Reprografía del Noroeste<br>- Pérez Valcárcel, J. (2010). 5. Pórticos de hormigón armado. A Coruña. Reprografía del Noroeste<br>- Pérez Valcárcel, J.; Aragón Fitera, J. (2010). 6. Forjados de hormigón. A Coruña. Reprografía del Noroeste<br>- Pérez Valcárcel, J. (2011). 7. Placas y forjados reticulares. A Coruña. Reprografía del Noroeste<br>- Jiménez Montoya, P.; García Meseguer, A.; Morán Cabré, F.; Arroyo Portero, J.C. (2010). Hormigón armado. Barcelona. Gustavo Gili<br>- Calavera, J. (2008). Proyecto y cálculo de estructuras de hormigón : en masa, armado y pretensado. Madrid. Intemac<br>- (2008). EHE-08 Instrucción de Hormigón Estructural. Madrid. Ministerio de Fomento, Centro de Publicaciones<br>- Pérez Valcárcel, J.; Martín Gutiérrez, E. (2017). Diseño de estructuras de hormigón armado. A Coruña. Reprografía del Noroeste |

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| **Complementary** | - López R. Muñiz, M. (1999). Construcción y cálculo en hormigón armado. Madrid. Colegio Oficial de Aparejadores y Arquitectos Técnicos<br>- (2002). Guía de aplicación de la Instrucción de Hormigón Estructural. Edificación. Madrid. Ministerio de Fomento<br>- Fernández Cánovas, M. (2013). Hormigón. Adaptado a la Intrucción de Recepción de Cementos RC-08 y a la Instrucción de Hormigón Estructural EHE-08. Madrid. Garceta Grupo Editorial<br>- Calavera, J. (2002). Cálculo, construcción, patología y rehabilitación de forjados de edificación unidireccionales y sin vigas-hormigón metálicos y mixtos. Madrid. Intemac<br>- Murcia Vela, J.; Aguado de Cea, A.; Marí Bernat, A.R. (1993). Hormigón armado y pretensado. Barcelona. Universidad Politécnica de Cataluña<br>- Regalado Tesoro, F. (1996). Biblioteca de detalles constructivos prácticos de hormigón armado en estructuras de edificación. Madrid. Cype Ingenieros<br>- Fernández Cánovas, M. (1994). Patología y terapéutica del hormigón armado. Madrid. Colegio de Ingenieros de Caminos, Canales y Puertos<br>- Leonhardt, F. (1986). Estructuras de hormigón armado. Buenos Aires. El Ateneo<br>- Regalado Tesoro, F. (1999). Cortante y punzonamiento. Teoría y práctica: propuestas alternativas a la EHE. Madrid. Cype Ingenieros<br>- Regalado Tesoro, F. (1999). Los forjados de los edificios: pasado, presente y futuro. Madrid. Cype Ingenieros<br>- Regalado Tesoro, F. (1999). Los pilares: criterios para su proyecto, cálculo y reparación. Madrid. Cype Ingenieros<br>- Regalado Tesoro, F. (2003). Los forjados reticulares diseño, análisis, construcción y patología. Madrid. Cype Ingenieros |

| **Recommendations** |
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| **Subjects that it is recommended to have taken before** |
| Structures 1/630G01019<br>Structures 2/630G01023<br>Structures 3/630G01028 |
| **Subjects that are recommended to be taken simultaneously** |
| Projects 6/630G01026<br>Urban Planning 4/630G01032<br>Construction 5/630G01033 |
| **Subjects that continue the syllabus** |
| Structures 5/630G01038 |
| **Other comments** |
| <p>Las materias que se recomienda cursar de forma simultánea integran, conjuntamente con Estructuras 4, el Taller 7. </p> |

**(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.**