ADVANCED ARCHITECTURAL GRAPHICS

Bachelor in Architectural Studies BAS SEP-2023 AAG-AS.4.M.A

Area Architecture and Design

Number of sessions: 30

Academic year: 23-24

Degree course: FOURTH

Number of credits: 6.0

Semester: 2º

Category: COMPULSORY

Language: English

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ROBERTO MOLINOS ESPARZA

Roberto Molinos is an architect and holds a Master of Advanced Studies in Structural Design from Madrid Tech - Madrid (ES). He has developed undergraduate research with Rafael Escolá Foundation and POLE Europe program, completing essays on applied use of information technologies in multidisciplinary projects.

Currently, he combines part time teaching at IE University with his work at Modelical, a model-based consultancy for better architecture and engineering projects. Roberto is also promoter of Algomad http://www.algomad.org/, a workshop that seeks to spread the use of computational tools in architectural design.

Office Hours

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SUBJECT DESCRIPTION

Advanced Architectural Geometry is an introduction to the practical and rigorous use of Computational and Building Information Modelling techniques for complex projects through the collaboratively development of an architectural competition.

The course focuses on the integration and management of several design variables into a thoughtful and consistent project design workflow by means of parametric 3D modelling, scripting or algorithmic thinking, where the design performance is the main objective.

Building Information Modelling is impacting the way architects approach project delivery: as studios and offices adopt BIM and complex modelling as their core methodology and principal tools they realize that concept and detail design, cost control, programme control and other areas of common practice need to be addressed differently.

BIM and computational modelling enables a more comprehensive and integrated design, where plans, sections, 3D, quantities, structural behavior and business model alignment can be weighed and assessed almost in real time, changes can be solved rapidly, coordination between trades is more transparent and output can be measured closer to the design decisions.

On the promise of fewer errors and a budget under control, delivering projects in a digital environment is becoming mandatory in many countries around the world. Governments, public institutions and leading private companies require this methodology while practices of all sizes struggle to adapt and find the right staff for challenging, global projects.

With the framework of the competition for the design of an Arena, the course will provide students with the skills and mindset necessary to approach a project digitally, under real-world conditions:

- The program brief will be solved comprehensively, with clear output indicators.
- Work will be developed in teams. Competition among teams will be fostered.
- Multidisciplinarity will be a constant requirement.
- Tools like Revit, Dynamo, Rhinoceros, Grasshopper will be used to provide students with resources to solve the complexities of their projects.

LEARNING OBJECTIVES

Advance Architectural Geometry aims to equip students with the following competences:

- To acquire knowledge of Advanced Geometry, CAD and BIM practices, including planning, modelling and information management, as a response to the strong requirement expressed by authorities and companies that are enforcing this methodology around the world.
- To understand the ways project information and geometry can be integrated in a design process, not to constraint it but to make it more sound, performance oriented.
- To be able to address a complex project brief, with economic, functional and output requirements entwined with design intentions with the help of digital tools.
- To be able to integrate cost, coordination, comfort and sustainability indicators in their design workflow.
- To learn the basics on how to plan and coordinate the production of an Advanced Geometry project, including execution planning, clash detection, standards curation and automation.
- To learn professional-grade modelling skills with tools like Revit and Rhinoceros and to evaluate multi-variable project decisions with the help of data visualization and and parametric modelling techniques.

Additionally, Per the Decree EDU/2075/2010, 29 of July

Basic Competencies:

CB1: Students have demonstrated knowledge and an understanding of a given area of study, building upon the foundation of secondary education, supported by advanced texts, and including aspects that engage the latest advances in their area of study.
CB2: Students know how to apply their knowledge professionally to their work or vocation and possess the competencies that are often demonstrated through elaboration and defense of arguments and the resolution of problems within their area of study.
CB3: Students can gather and interpret relevant facts (usually within their area of study) in order to make judgments that include reflection on relevant social, scientific, and ethical topics.
CB4: Students can transmit information, ideas, problems, and solutions to both specialized and non-specialized audiences.
CB5: Students have developed the necessary learning skills to continue their studies with a high degree of autonomy.

General Competencies:

CG1: Knowledge of the history and theories of architecture, as well as that of the arts, technologies and human sciences related to the field.

Specific Competencies:

CE48: Adequate knowledge of the general theories of form, composition, and architectural typologies.
CE54: Adequate knowledge of aesthetics, and the history and theory of fine and applied arts.

Crossed Competencies:

CT1: Ability to identify the main characteristics of cultural identities that characterize the contemporary world through the knowledge of central ideological currents.
CT2: Ability to exercise professional behavior in accordance with constitutional principles and ethical values of the respective profession.
CT3: Manage unforeseen situations with the capacity to respond to changes within organizations.
CT4: Use disciplinary knowledge to analyze and evaluate current situations.
CT5,
CT5: Integrate oneself into interdisciplinary and multicultural teams to achieve common goals in a context of diversity
CT6: Work actively at in an international context.

TEACHING METHODOLOGY

Being part of the Studio / Proyectos Module, the course is planned as a competition for the design and delivery of an Arena, a multi-purpose venue with clear economic, iconic, operational and construction constraints. Students will have to propose and solve their design in teams, approaching the project in a layered sequence, solving and fixing variables such as the location, the programme, the expected return on investment, the capacity, the spectator experience and comfort, the structural safety and constructability, all in an integrated manner.

Output parameters will be established and then measured for construction costs, operational costs and operational returns. The course is not a design studio per se, but architectural design quality will also be a key performance parameter.

Teams will then compete with each other to reach the best possible solution, one that balances all the variables at stake and will end with the presentation of their design in a final review with guest jury made of professionals of the field.

The choice of an Arena as the core topic is not by chance. This type of buildings allow their evaluation in very clear terms, as capacity and sightline quality, number of VIP boxes, possible pitch sizes and structural feasibility can be expressed mathematically and allow for checks and optimization.

The competition will be used as workbench for discussing building information modelling techniques that include:

- Execution Planning. Model subdivision and overseas collaboration. Project set-up in Revit.
- Seat-bowl design and sightline analysis using Dynamo and Grasshopper.
- Interoperability between applications using open formats like IFC and data exchange using simple workflows and Excel.
- System design and modelling using Rhinoceros wireframes and Revit families.
- Systems coordination using Navisworks and BIMcollab.
- Key indicators scheduling and processing using Revit, Dynamo, Excel and PowerBI.
- Interactive presentation using Revit rendering and others

Course as Workshop

The spirit of the course is to tackle the competition in a fast-track manner, within a short span of time. Thus, the course can be seen as an extended workshop where lectures and software tutorials will be combined with in-class and out-of-class individual and team work.

The workshop will happen along a compressed schedule of days with several sessions, where each day will be used to cover one topic and follow the same briefing - training - discussion - debriefing structure.

The briefing will consist in the presentation of a topic in the form of lectures that introduce the state-of-the-art or a specific problem.

Training will include practical, guided sessions on software and algorithms.

Discussion will be fostered among team members in order to make them advance in the resolution of the competition while in class, sharing with the rest of the class their findings at the end of each day.

Additional home-work will need to be conducted in order to advance with the design, using the tools and methods covered in class.

Learning Activity	Weighting	Estimated time a student should dedicate to prepare for and participate in
Lectures	10.0 %	15.0 hours
Discussions	10.0 %	15.0 hours
Exercises in class, Asynchronous sessions, Field Work	20.0 %	30.0 hours
Group work	40.0 %	60.0 hours
Individual studying	20.0 %	30.0 hours
TOTAL	100.0 %	150.0 hours

PROGRAM

SESSIONS 1 - 3 (LIVE IN-PERSON)

Project Kick-off

Briefing

Course presentation.
Competition briefing. Locations, business models, markets.

Training

Arena design. Flexibility and operation.
Project information management best practices.

Discussion

Location selection. Budget and ROI statement.

Debriefing and homework

- Requirements research
- Arena Business Plan

SESSIONS 4 - 6 (LIVE IN-PERSON)

PERFORMANCE IN DESIGN

Briefing

Performance in architecture. Key metrics in structure, comfort, safety and energy.

Training

Resolution of performance problems through parametric modelling. Case studies in Grasshopper and Dynamo.

Massing in Rhinoceros and Grasshopper

Discussion

Exercises. Grandstand profile creator. Truss modelling.

Debriefing and homework

- Arena Business Plan 90%
- Massing Model 30%

SESSIONS 7 - 9 (LIVE IN-PERSON)

Conceptual Modelling

Training

Resolution of performance problems through parametric modelling. Case studies in Grasshopper and Dynamo.

Massing in Rhinoceros and Grasshopper

Facade Modelling in Rhinoceros and Grasshopper

Debriefing and homework

- Business Plan 90%
- Massing Model 60%
- Facade Model 30%

SESSIONS 10 - 12 (LIVE IN-PERSON)

BIM SETUP & INTEROPERABILITY

Briefing

Data vs. Document exchange. Open standards and the use of Excel and Dynamo as bridge applications. BIM project execution planning. Project subdivision. Reference system. Common data environment.

Training

- Revit Setup
- Structure Modelling
- Grandstands Modelling. Driving Revit elements from Rhinoceros wireframes. Bi-directional connection.

Discussion - Work in class

- Structure Modelling
- Arena layout setup.
- Roof modelling.

Debriefing and Homework

- Business Plan 90%
- Massing Model 90%
- Facade Model 30%
- Structure model 30%

SESSIONS 13 - 15 (LIVE IN-PERSON)

PROJECT COORDINATION

Briefing

Use of Links and Basic Collaborative Workflows. Clash detection workflows.

Training

Modelling Architectural Elements

Element classification and costing.

Discussion

Roof structure review.
Arena layout refinement.

Coordination review. Preliminary costing

Debriefing and homework

- Business Plan 90%
- Massing Model 90%
- Facade Model 60%
- Structure Model 60%
- Architecture Model 30%

SESSIONS 16 - 18 (LIVE IN-PERSON)

TEAM WORK

Debriefing and homework

- Business Plan 90%
- Massing Model 90%

- Facade Model 90%
- Structure Model 90%
- Architecture Model 60%

SESSIONS 19 - 21 (LIVE IN-PERSON)

PROJECT DOCUMENTATION

Briefing

Documentation best practices in Revit.
Data extraction and scheduling.

Training

Arena documentation. Line drawings, views and key indicators.

Discussion

Arena documentation.

Debriefing and homework

Complete arena documentation. Dossier preparation.

- Business Plan 90%
- Massing Model 90%
- Facade Model 90%
- Structure Model 90%
- Architecture Model 90%
- Documentation 30%

SESSIONS 22 - 24 (LIVE IN-PERSON)

TEAM WORK

Debriefing and Homework

- Business Plan 100%
- Massing Model 100%
- Facade Model 100%
- Structure Model 100%
- Architecture Model 100%
- Documentation 60%

SESSIONS 25 - 27 (LIVE IN-PERSON)

PROJECT PRESENTATION

Briefing

Advanced techniques for presentation
Interactive experiences

Training

Project presentation with Revit and Enscape

Discussion

Arena presentation.

Debriefing and homework

Complete arena presentation. Dossier preparation.

- Documentation 90%

SESSIONS 28 - 30 (LIVE IN-PERSON)

FINAL REVIEW

Discussion
Each group to present their final design.
Ranking and trophy ceremony.

EVALUATION CRITERIA

Evaluation will be heavily based on the performance indicators achieved by each group in their respective designs, with additional appreciations on architectural quality of the solution, as esteemed by an independent jury, and the faculty continuous assessment of each team involvement.

As deliverables subject to evaluation, teams will be required to submit:

- A set of BIM models as primary source for all additional design data.
- A set of drawings, views, documents, representing the design in a narrative way.
- A dossier describing each of the design decisions and the performance achieved.

1. Students have access to a total of four enrolments , in two consecutive academic years

2. Students must attend at least 80% of all class sessions. Students who do not meet this minimum percentage automatically fail both first and second enrolments , and pass directly to the third enrolment.

3. Grading of students in the extraordinary enrolments will follow the following guidelines: Students that have fail the subject in first enrolment pass to the second enrolment, except those who do not meet the minimum attendance percentage, and that therefore pass directly to the third enrolment.

4.The maximum grade that a student may achieve in second enrolment is an 8.

The form of assessment for the 3rd and 4th enrolment will be as an exercise consisting of a development of a smaller Arena that collects all the knowledge acquired during the program and a written report that includes design and development process and result.

criteria	percentage	Learning Objectives	Comments
Design performance	70 %		
Jury evaluation	10 %		
Professor Appraisal	20 %		

RE-SIT / RE-TAKE POLICY

BEHAVIOR RULES

Please, check the University's Code of Conduct here. The Program Director may provide further indications.

ATTENDANCE POLICY

Please, check the University's Attendance Policy here. The Program Director may provide further indications.

ETHICAL POLICY

Please, check the University's Ethics Code here. The Program Director may provide further indications.