

Sustainable architectural design studio

Lecturers

Ahmed Zaib KHAN MAHSUD (Coordinator) and Hera Van Sande

Course mnemonic

ARCH-H4002

ECTS credits

8 credits

Language(s) of instruction

English

Course period

Second term

Campus

Other campus

Course content

The content of this course / studio comprises the development of an integrated **Sustainable Architectural Project (SAP)**, (individual design work). Students choose one building or a cluster for this purpose that is sufficiently complex from the SUDF / Master plans (developed during 1st semester, ARCH-H400, SUDS). They develop the detailed SAP through **integrated design** (i.e. integration of architectural, structural, technical, and sustainability aspects) demonstrating low to net **ZEBs standards and ambitious levels of carbon neutrality**.

The content of the studio over 12 weeks starts with the analysis of the context and typological exploration (including building form / 3D volumetric study with bioclimatic and solar analysis, density, program, case studies focusing on net ZEBs / carbon neutrality, etc.) for **project definition and concept formulation** spatially and programmatically (1st 3 weeks), building system analysis (building envelope study, and exploring materials, energy, structural / construction system options for achieving ZEBs / carbon neutrality) for **concept, design, and program articulation** (2nd 3 Weeks), systems integration and detailed **design development** (3rd 3 Weeks), and **synthesis** (last 3 weeks).

With a focus on **sustainable design and construction principles and systems** to achieve low to net **ZEBs and carbon neutrality**, the SAP will demonstrate an innovative **sustainable architectural expression** through detailed design drawings (plans, sections, elevations, model, 3D views / renders, etc.) illustrating the following:

- **Building envelope**
- **Program and spatial distribution of functions**
- **Micro-climate & interior spatial quality**
- **Energy & Water systems**
- **Materials choices & Construction / structural system**

Objectives (and/or specific learning outcomes)

The over-arching objective is to develop **design skills and capabilities** of students to **comprehend, analyze and address sustainability issues at multiple scale levels** (spatial and temporal) in an integrated way: from the **scale of the building materials and systems** to that of the spatial articulations at the urban and regional scales. This is achieved through the development of a SAP - for one building or a cluster that the student choose from the SUDF / Master plans (developed during 1st semester, ARCH-H400, SUDS) - with **integrated design** (i.e. integration of architectural, structural, technical, and sustainability aspects) to achieve low to net **ZEBs standards and ambitious levels of carbon neutrality**.

Underpinning the studio objectives is our premise that sustainability is not a static notion, a fixed ideal, or a set of principles/attributes that can be simply added onto a conventional design process, such as a building, district or a city. Sustainability ought to be an intrinsic value in design as a dynamic integrative framework with evolving concepts that must be redefined and reassessed with each new design process/project as an opportunity to do so. In pedagogical terms, therefore, we aim at exposing / sensitizing students to a higher level of complexity through exploring sustainable design: i) at different **scale levels and contextual specificities**; ii) as a process of **reflection and reformulation**; and iii) as an **integrated way** of using issues of sustainability, ecology and energy as catalyst for **creatively rethinking** conventional notions of **enclosure, tectonics, and program**.

The **specific learning outcomes** include that students learn *to comprehend and analyze the sustainability potential of a site, form a concept, devise a program, spatially and temporally articulate and architecturally substantiate (SAP) a specific sustainability position*.

- Question and take a critical attitude towards the elements at stake of a program and a site within the general context of Sustainable Development.
- Explore and analyze the sustainability potential of a site at different scale levels.
- Develop conceptual capabilities to comprehend the composition of an architectural form in the context of complex urban organism, and
- Implement different materials, technologies, building methods in order to integrate, prioritize & achieve sustainability goals and ambitions (energy efficiency, low-to-net ZEBs, carbon neutrality, etc.)

The studio contributes to the following **program 'specific learning outcomes'** (MSc in Architectural Engineering program), whereby, the student

- can conceive and implement design concepts by creatively integrating architectural and engineering sciences with attention to the structural, material and energy performance of buildings and structures, and their architectural value and constructability

- › can develop an architectural or urban design project based on an analysis and synthesis of the context, program, structure, material and concept with particular attention to sustainability
- › can design innovative buildings and structures based on cutting-edge (digital) modelling and analysis methods, and a good understanding of material and structural behaviour
- › can communicate design concepts and projects effectively using state-of-the-art physical and digital representation techniques (drawings, images, renderings, and three-dimensional models)
- › can expand the scale of the design problem not only in space, but also in time – a crucial dimension of sustainable design – and to comprehend the multi-scalar effects of design interventions.
- › has an integrative attitude towards using issues of sustainability, ecology and energy as catalyst for creatively rethinking conventional notions of enclosure, tectonics, and programme
- › has design skills and research capabilities to address spatial and temporal complexity in the development of architectural and urban projects that ensures sustainable functioning of the built environment

Pre-requisites and co-requisites

Required knowledge and skills

Prerequisites: **Courses requiring this course**

[[table]]

Teaching method and learning activities

Studio based design methods and learning activities that are organized in 4 stages (**problem definition, conceptualization, design development, and synthesis**) supported by 5 process tracks: **Analysis; Theoretical component / guest lectures; Interactive discussions / coaching; Pecha-Kucha sessions; and Design Reviews / Critics.**

Analysis is the foundation upon which design frameworks and proposals are developed.

- › This track runs throughout the semester structured by a series of design based research exercises / assignments exploring different aspects of the context / site, building form and typologies, case studies, solar analysis, building systems (energy, materials, structure / construction, etc.), etc.
- › Each of these exercises will allow exploring new aspect of the problem, adding new layers of complexity to the evolving sustainable design process.

Theoretical component (TC) / guest lectures are closely coordinated with the content of the studio with insights provided by specialists / actors / stakeholders in the form of guest lectures.

Interactive discussions / coaching – individual & group: Students' design process is guided interactively through daily feed-back sessions tailored to specific stage of the design, including problem (re)formulation, suggesting reference material / cases, reflections on the mode of analysis, alternative conceptualizations, highlighting missing aspects, critical appraisals, etc.

Pecha-Kucha Sessions: are organized as short presentations by 3-4 students followed by comments / questions from the

lecturers (and students) at the start of alternative studio days. These sessions (45 minutes max.) are required to be attended by all students and lecturers. Each student presents their state of the art in a short (5- 10 minute) presentation (sketches, schemes, drawings, etc.) – a schedule is made at the beginning of the semester. These sessions allow other students to see the work of their peers, to improve their presentation and expression skills, to have a generalized feed-back and suggestions on the stage they are, and what is expected from them at that stage.

Design Reviews / Critics: Two main types of reviews are organized – a mid term (with internal jury) and a final review (internal and external jury) in each semester.

Contribution to the teaching profile

This teaching unit contributes to the following (**program specific learning outcomes** and competences:

- › conceive and implement design concepts by creatively integrating architectural and engineering sciences with attention to the structural, material and energy performance of buildings and structures, and their architectural value and constructability
- › develop an architectural or urban design project based on an analysis and synthesis of the context, program, structure, material and concept with particular attention to sustainability
- › design innovative buildings and structures based on cutting-edge (digital) modelling and analysis methods, and a good understanding of material and structural behaviour
- › communicate design concepts and projects effectively using state-of-the-art physical and digital representation techniques (drawings, images, renderings, and three-dimensional models)
- › expand the scale of the design problem not only in space, but also in time – a crucial dimension of sustainable design – and to comprehend the multi-scalar effects of design interventions.
- › has an integrative attitude towards using issues of sustainability, ecology and energy as catalyst for creatively rethinking conventional notions of enclosure, tectonics, and programme
- › design skills and research capabilities to address spatial and temporal complexity in the development of architectural and urban projects that ensures sustainable functioning of the built environment

The studio contributes to the following (**general Bruface**) **learning outcomes** and competences:

- › present and defend results in a scientifically sound way, using contemporary communication tools, for a national as well as for an international professional or lay audience
- › collaborate in a (multidisciplinary) team
- › a creative, problem-solving, result-driven and evidence-based attitude, aiming at innovation and applicability in industry and society
- › critical attitude towards one's own results and those of others
- › consciousness of the ethical, social, environmental and economic context of his/her work and strives for sustainable solutions
- › flexibility and adaptability to work in an international and/or intercultural context

References, bibliography and recommended reading

Williams, D. E. (2007). *Sustainable Design* (New Jersey: Wiley).



Contal, M. & Revedin, J. (2009). *Sustainable Design* (Basel: Birkhauser).

Brophy, V. & Lewis, J. O. (2011). *A Green Vitruvius* (London: Earthscan).

Kristinsson, J., Dobbeltstein, A. V. D., (2012). *Integrated Sustainable Design* (Delft: Dleft U. Press).

Appleby, P., (2010). *Integrated Sustainable Design of Buildings* (London: Routledge).

Keeler, M., & Burke, B., (2009). *Fundamentals of Integrated Design for Sustainable Building* (New Jersey: Wiley).

Lechner, N., (2008). *Heating, Cooling, and Lighting: Design Methods for Architects*, 3rd edition (New York: Wiley).

Szokolay, S. (2004). *Introduction to Architectural Science: The basis of Sustainable Design* (Oxford: Architectural Press / Elsevier).

Oliver Heckmann et al. (2017). *Floor Plan Manual Housing* (Birkhauser).

Marilyne Andersen, Emmanuel Rey. (2019). *THINKINGVisions for Architectural Design. Towards 2050* (Park Books).

Aurora Fernández Per, et al. (2014). *THIS IS HYBRID: An analysis of mixed-use buildings* (a+t).

A+t research group (2013). *10 Stories of Collective Housing* (a+t).

Ghyoot, et al. (2018). *Déconstruction et Réemploi* (Brussels: Rotor).

Ahmed Z. Khan and Karen Allacker. (2015). *Architecture and Sustainability: Critical perspectives for integrated design* (Leuven: ACCO).

Course notes

Université virtuelle

Other information

Place(s) of teaching

Other campus

Contact(s)

Titular & Coordinator:

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Evaluation method(s)

Other, Oral presentation, Project, Portfolio and Personal work

Evaluation method(s) (additional information)

Two design reviews (a mid and a final review) are organized for project presentations in which oral and graphic examination of the design project (individual design work) is carried out using an

evaluation matrix based on general and specific design criteria by the jury (internal during mid-review, and the final-reviews include also external jury members).

The **general criteria** for assessment include:

- Maturity of global dealing with the project; Coherence; Ability to communicate concept, methods, strategies in a clear graphical way; Completeness of handed in documents.
- Demonstrate an awareness of responsibilities towards: the environment and sustainable development; social, economic and cultural issues; urban fabric; architectural and spatial quality
- Active participation in group assignments; attendance in studio (every Tuesday), discussions and guest lectures; presentations in pecha-kucha sessions.

Detailed criteria and evaluation matrix:

For each review, the specific criteria is delineated along three categories: **content (60%), graphics (25%) and presentation (15%)**.

The assessors include studio coordinator and teaching staff, and in the case of final reviews, also the members of invited external jury.

Second Session Exam (Aug./Sep.): For unjustified absence from studio (every Tuesday) during the semester and reviews (mid and final), there is no opportunity offered for the 2nd exam in August/September of the same year (Article 61, 28, 29 & 30 of the ULB exams and juries regulation). However, if valid, legitimate and convincing reason(s) are presented in writing (with proofs) a 2nd sit can be arranged for the student, at the coordinator's discretion.

Such students, and those who fail in the first session, will have to do the 2nd session exam individually. They will have to make an appointment with the coordinator as soon as possible (during June, latest by the 1st week of July) to define a project and deadline for submission, and a date for final exam – project presentation to the jury (Review).

Determination of the mark (including the weighting of partial marks)

Marks attributed in the following two reviews determine the final mark:

- **Mid-Review-1** (with internal jury): Concept, Preliminary Design & Program - 30%
- **Final-Review-1** (with internal + external jury): Sustainable Architectural Design Project - 70%

Active participation in the studio learning activities, guest lectures, discussions, pecha-kucha sessions, and minimum 75% attendance in the studio (every Tuesday) is required for being eligible for the exam (both mid and final reviews). Participation in these learning activities is evaluated as 'process' (15% marks) in all the reviews by the jury. Moreover, unjustified absence from these learning activities can also lead to ineligibility for the 2nd session exam.

Main language(s) of evaluation

English

Programmes

Programmes proposing this course at the
Brussels School of Engineering

MA-IRAR | Master of science in Architecture and
Engineering | finalité Professional/unit 1

