Module Specification

Zero Carbon Design and Innovation

Version: 2025-26, v2.0, Approved

Contents

Part 1: Information

Module title: Zero Carbon Design and Innovation

Module code: UBLL45-30-3

Level: Level 6

For implementation from: 2025-26

UWE credit rating: 30

ECTS credit rating: 15

College: College of Arts, Technology and Environment

School: CATE School of Architecture and Environment

Partner institutions: None

Field: Architecture and the Built Environment

Module type: Module

Pre-requisites: None

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: The Zero Carbon Design and Innovation module is a semester-long course that provides students with the technical and computational skills needed to understand the principles and techniques required to achieve zero carbon architecture. It operates alongside the Exploratory Design Studio to provide a technical foundation for students' design projects, focusing on climate, environment, and sustainability in architecture. This module emphasises the application of zero carbon frameworks and equips students to actively integrate and evaluate zero

carbon strategies in their work to achieve environmentally sustainable design. Through a combination of digital tools, modelling, lifecycle analysis, and digital fabrication, students gain a hands-on understanding of how to design and build responsibly, sustainably, and in alignment with evolving zero carbon standards.

Building on prior knowledge developed through undergraduate study this module equips students to specialise in sustainable technology, applying computational methods and digital innovations to reduce embodied carbon and optimise building performance. The module is closely aligned with ARB competencies in climate change, regenerative design, and digital systems, and it encourages a research-driven and reflective approach to professional development.

In addition to zero carbon and sustainability goals, this module equips students to address fire and life safety within their designs. Students learn to incorporate advanced structural, construction, environmental, and technological strategies that comply with relevant performance, fire, and safety standards. Emphasis is placed on resilience and long-term impact, ensuring that design solutions are not only sustainable but also safe and resilient for occupants throughout a building's lifecycle. The module includes training on assessing fire risks, selecting fire-resistant materials, and integrating fire-safe design principles alongside carbon reduction measures, preparing students to meet comprehensive safety and sustainability benchmarks.

Aligning with the RIBA's commitment to climate literacy and safe building design, this module emphasises carbon-neutral solutions, health, and life safety (E1). Students develop technical skills for sustainable construction and resource management (E3), preparing to meet standards for climate resilience and sustainable practice.

Features: Zero Carbon Frameworks: Comprehensive understanding of zero carbon standards and frameworks, empowering students to create designs that meet true zero carbon criteria.

Computational and Digital Tools for Zero Carbon: Use of advanced computational and digital techniques, such as parametric modelling, lifecycle assessment (LCA),

and digital fabrication, to inform and validate carbon reduction strategies.

Professional and Ethical Responsibility: Emphasis on ethical frameworks, regulatory standards, and responsible sourcing, guiding students to create socially and environmentally responsible designs.

Fire and Safety: Students will gain the skills to incorporate fire-resistant materials, plan for safe building evacuation routes, and apply fire and life safety regulations to ensure that their designs meet comprehensive performance and safety standards.

Educational aims: This module aims to provide students with the technical expertise and ethical grounding required to produce architectural designs that meet zero carbon standards. By the end of the module, students will:

Apply zero carbon frameworks and standards to inform environmentally responsible and socially valuable design decisions.

Incorporate fire and safety considerations into their work, aligning with regulatory requirements for occupant protection and resilience.

Use advanced digital tools to model, analyse, and validate architectural designs, ensuring reduced embodied carbon and enhanced environmental performance.

Explore digital fabrication processes that support zero carbon design, enabling resource-efficient construction and customisation.

Understand and apply best practice detailing principles in relation to zero carbon design and fire and life safety.

Reflect critically on their technical and professional development, adapting to evolving standards and innovations in sustainable design.

Outline syllabus: The syllabus integrates zero carbon design principles with advanced digital and computational methods, providing a robust technical foundation for sustainable architectural solutions.

The module begins by introducing zero carbon frameworks and principles. Students examine current zero carbon standards, regulations, and ethical frameworks relevant to architecture, exploring their applications within design and construction. Through case studies and practical examples, students learn to assess and incorporate zero carbon strategies in architectural projects, considering lifecycle impacts, regenerative design, and the ethical sourcing of materials.

In the computer lab, students engage with advanced computational tools and digital modelling techniques essential for zero carbon design. These lab sessions cover parametric modelling, energy simulation, and Life Cycle Assessment (LCA), enabling students to optimise their designs based on carbon metrics and sustainability goals. The emphasis is on practical applications of these tools, such as form-finding and optimisation to reduce embodied carbon, with students learning to evaluate and enhance the environmental performance of their designs.

The syllabus also includes an exploration of digital fabrication and customisation techniques. Students investigate digital fabrication processes that reduce material waste and support zero carbon goals, such as customised component fabrication and automated construction. Sessions include hands-on experiences with digital fabrication tools and processes, allowing students to explore how sustainable design can be implemented at scale while maintaining precision and resource efficiency.

In the final stage of the module, students synthesise their learning through a Technical and Carbon Performance Report based on their design projects in the Exploratory Design Studio. This report requires students to document the zero carbon strategies applied in their designs, including computational analyses and digital fabrication techniques used to minimise carbon footprint. This technical assessment aligns their design with zero carbon standards and validates the project’s environmental impact through evidence-based methods. It also includes a safety analysis, demonstrating compliance with fire and life safety standards and verifying that their designs meet essential regulatory requirements for occupant protection.

Alignment to ARB Competency Outcomes

The ARB Competency Outcomes listed below are assessed to a passing standard as required under ARB's Accreditation Standard 1.1.

CK5: The principles of building construction, services, structure, materials use, assembly and manufacture. (Knowledge)

CK6: The principles of building physics and environmental design. (Knowledge)

CK7: The principles required to ensure that buildings are safe to construct, inhabit, use and maintain, refurbish, re-use and deconstruct. (Knowledge)

D5: Propose strategies for structure, construction technology, materials, services, ventilation, thermal environment and lighting and acoustics that are appropriate to a project's brief and context. (Ability)

D10: Understand the implications and benefits of working with existing buildings including potential for re-use and retrofit, and the resulting environmental impact. (Understanding)

D12: Use appropriate digital systems for creating, modelling, processing, presenting, and sharing design, building and project information. (Understanding)

RE6: Understand how modelling and post occupancy evaluation inform design. (Understanding)

Part 3: Teaching and learning methods

Teaching and learning methods: The module combines lab-based skills training, research-led seminars, and guided self-study to support the theoretical and practical aspects of zero carbon design:

Lab-Based Skills Sessions: Practical lab sessions allow students to engage directly with computational tools, parametric modelling, and digital fabrication, building competency through hands-on applications.

Seminars and Lectures: These sessions introduce zero carbon principles and sustainable design methodologies, supported by case studies on the successful application of zero carbon frameworks.

Guided Self-Directed Study: Students are encouraged to independently explore computational and digital methods specific to their design interests, fostering specialisation and technical proficiency.

Research Tutorials: Supervised research tutorials provide tailored guidance on integrating zero carbon strategies into projects, with feedback on technical and ethical aspects.

Module Learning outcomes: On successful completion of this module students will achieve the following learning outcomes.

MO1 Apply principles of construction, structure, materials, and building services to propose integrated technical strategies responding to a project's brief and context. (Mapped ARB Outcomes: CK5, D5)

MO2 Apply principles of building physics, environmental design, modelling and post-occupancy evaluation to inform and refine design proposals (Mapped ARB Outcomes: CK6, RE6).

MO3 Understand how to ensure safety across the building lifecycle from construction to deconstruction and evaluate the environmental benefits and implications of reuse and retrofit in existing buildings (Mapped ARB Outcomes: CK7, D10).

MO4 Utilise appropriate digital systems to create, model, process, present, and share architectural and technical information effectively (Mapped ARB Outcomes: D12).

Hours to be allocated: 300

Contact hours:

Independent study/self-guided study = 228 hours

Face-to-face learning = 72 hours

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://rl.talis.com/3/uwe/lists/341BA9A0-F825-95D7-8F05-3D064DC12873.html

Part 4: Assessment

Assessment strategy: Assessment Type: Portfolio-based Technical Report (100%)

The assessment comprises a comprehensive technical report that evaluates the student's ability to apply zero carbon design principles, supported by digital analysis and lifecycle tools. Students are encouraged to align this report with their design work from the Exploratory Design Studio. However, where the studio project does not offer sufficient complexity or scale for full technical investigation, students may adapt or supplement their project using a hypothetical or extended scenario to demonstrate required technical depth.

The report includes two main components:

Zero Carbon Design Report: This component assesses students' ability to apply principles of building construction, materials, services, and environmental design (CK5, CK6). The report demonstrates how zero carbon standards are achieved through responsible design decisions, supported by lifecycle analysis, ethical material sourcing, and regenerative design strategies. Students must show knowledge of regulatory frameworks, performance benchmarks, and how environmental design principles shape architectural solutions.

Technical Analysis: This component includes modelling and simulation results that validate zero carbon objectives. This section demonstrates the application of building physics and performance modelling (CK6), digital systems for design and

communication (D12), and strategies for low-carbon construction, material use, and technical detailing (D5). A component of this analysis focuses on safety, where students address lifecycle safety and regulatory compliance from construction through to reuse and deconstruction (CK7, D10). Students must evidence how their proposals meet fire and life safety requirements while contributing to environmental performance.

This assessment also measures the student's capacity to understand how post-occupancy evaluation and modelling can inform iterative improvement in sustainable design (RE6).

This integrated portfolio thus assesses students across all mapped ARB Outcomes: CK5, CK6, CK7, D5, D10, D12, and RE6.

As per UWE Academic Regulations and Programme Specification, the pass mark for each assessment on the module is 40%. As per the ARB requirements compensation and/or condonement are not permitted for any module that will assess ARB's Outcomes to passing standard.

Formative Feedback: Ongoing feedback during sessions and tutorials provides students with opportunities to refine their technical report based on interim reviews and critiques.

Resit Assessment: If required, the resit assessment will follow the same brief and submission format as the main assessment, allowing students to develop and submit a revised report that meets the original assessment objectives.

Assessment tasks:

Portfolio (First Sit)
Description: Portfolio-based Technical Report (100%)

Students may use their Exploratory Design Studio project or an alternative/extended

scenario to demonstrate zero carbon strategy, technical analysis, and fire safety integration.
Weighting: 100 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4

Portfolio (Resit)
Description: Assessment Type: Portfolio-based Technical Report (100%)

Students may use their Exploratory Design Studio project or an alternative/extended scenario to demonstrate zero carbon strategy, technical analysis, and fire safety integration.
Weighting: 100 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Architecture [Frenchay] MArch 2025-26

Architecture [Frenchay] MArch 2025-26

Architecture {Apprenticeship-UWE}[Frenchay] MArch 2025-26

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