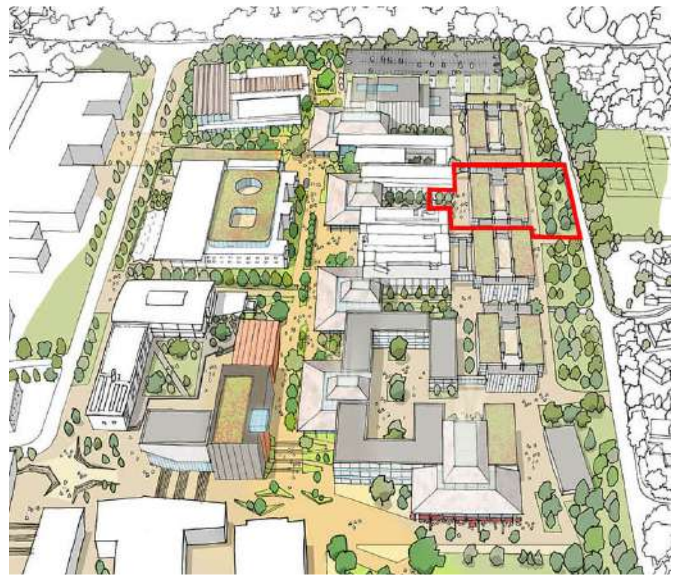
CIVIL ENGINEERING BUILDING

New Engineering Campus at West Cambridge ↓



New civil engineering building site overview

Key Sustainability Facts

PROJECT SITE
Existing Site Expansion

TRANSEC / CLIMATIC ZONES
Sub-Urban / Temperate Zone

OPERATIONAL ENERGY [REGULATED + UNREGULATED]
> EUI: 105 to 148 kWh/m²/yr [Predicted mid to high range]
> EUI: 85 kWh/m²/yr [In-use] *
> Energy/Fuel type: 100% electric building
> On-site renewables: 10.8 kW photovoltaic [PV] array with a potential to generate 5,242 kWh/yr

** Annual consumption reported for 2021 – Building occupied from October 2019*

EMBODIED ENERGY/CARBON
While the embodied energy for key building elements were measured as part of the ECM analysis, the building's total embodied carbon has not been measured during design or construction phases. As part of their campus wide carbon off-setting strategy, the University's Estates Department plans to measure the building's upfront embodied carbon from as-built drawings information and supply-chain documentation.

WATER USE AND DRAINAGE
The design employs low-flow appliances to minimise on-site water use and incorporates a sustainable drainage strategy with on-site swales and a blue/green roof to attenuate water run-off from the site.

CERTIFICATION
BREEAM Excellent [Design + Construction]

Alignment with UN Sustainable Development Goals

SDG 3 GOOD HEALTH AND WELL-BEING
This goal was central to the University's brief with occupant comfort, access to daylight, natural ventilation, external spaces and dedicated cycling facilities (inc. showers) prioritised in the design.

SDG 7 AFFORDABLE AND CLEAN ENERGY
The brief sought to minimise operational energy demands, maximise on-site renewables and banned the combustion of fossil fuels from the project.

SDG 9 INDUSTRY, INNOVATION, INFRASTRUCTURE
SDG 11 SUSTAINABLE CITIES & COMMUNITIES
The research undertaken in the building is part-funded by the UK Collaboratorium for Research on Infrastructure and Cities (UKCRIC) with a mission to underpin the renewal, sustainment and improvement of infrastructure and cities in the UK and elsewhere.

SDG 12 RESPONSIBLE CONSUMPTION & PRODUCTION
The design team's focus on material and carbon reduction, from lightweight structures to the innovative ECM assessment tool, supports responsible consumption and production.

SDG 13 CLIMATE ACTION
Minimising the building's whole-life energy, and carbon, was a central tenet of the Department of Engineering efforts to address climate change.

SDG 15 LIFE ON LAND
The project sort to create a net-positive contribution to biodiversity with the incorporation of a green roof and the restoration of the adjacent woodland belt to the buildings eastern perimeter.

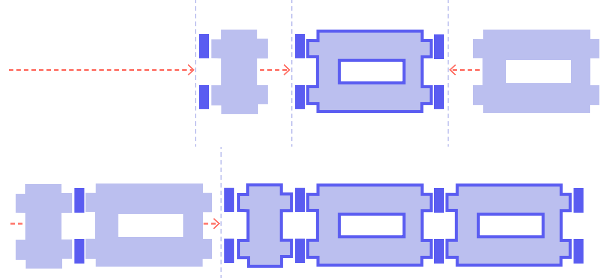
Location:	West Cambridge, UK
Client:	University of Cambridge
Construction cost:	~ £20m
Area [GIA]:	4380m²
Completion:	2019 [April]
Occupation:	2019 [October]

Grimshaw project leads:	Neven Sidor, Partner; Peter Swallow, Associate
Main Contractor:	SDC

Project Team:

Grimshaw	Lead consultant / Architect
Max Fordham	MEP Services / Environmental
Smith & Wallwork	Structures / Civil engineering
Turkington Martin	Landscape design
Montressor [LLP]	Facade engineering

Flexible/adaptable arrangement ↑
A modular approach to the building's planning grid and services distribution maximises the potential for future flexibility and adaptation, ensuring a long service life.



Optimised layout for future expansion ↑
Service cores are located to the perimeter to minimise disruption during future phases and clad with demountable cassette panels that can be reused as the building grows.

The new civil engineering building is a world-class research space, and home to the Engineering Department's civil engineering division and the newly established National Research Facility for Infrastructure. Here researchers are exploring sustainable infrastructure and cities in collaboration with engineers from across the Department of Engineering. The building marks the completion of the first phase of the Department of Engineering's new campus at West Cambridge, also designed by Grimshaw. Due for completion in 2026, the new campus will reintegrate the entire Department of Engineering into a single site, providing 100,000 sq m of research, teaching and collaboration space.

The brief — Sustainability was a core driver, with the Department of Engineering setting ambitious targets for the design and construction of all building's at their new campus. Our brief required the design to minimise whole-life energy/carbon, while simultaneously providing a pleasant environment for occupants — promoting natural ventilation where possible, avoiding 'green bling', ensuring future flexibility and making sure the building's performance met predicted design performance targets.

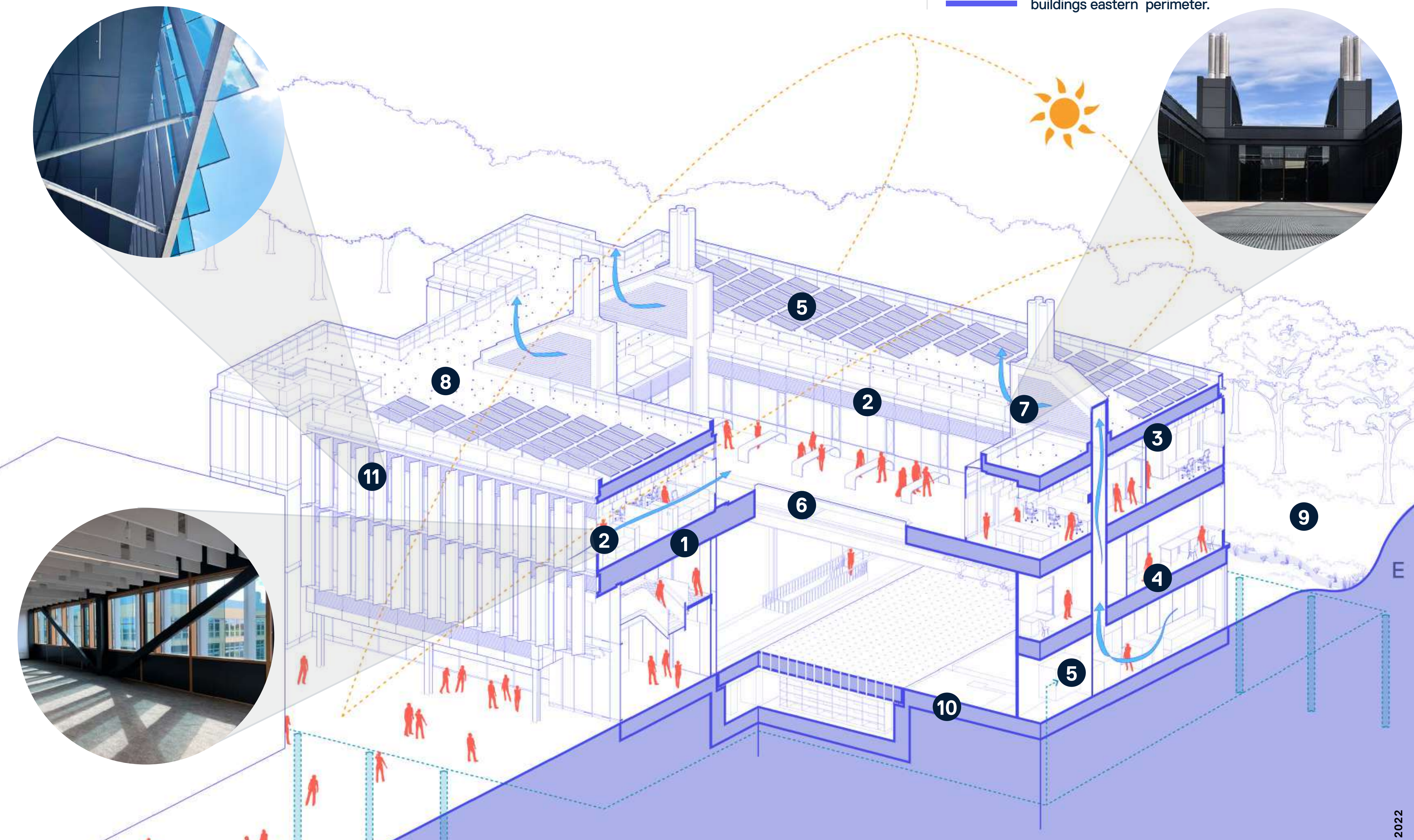
Design considerations — The building's form, massing and location were informed by the local planning requirements, the wider engineering campus masterplan and the technical requirements of the end users. The building's location was chosen to enhance the existing urban realm, achieved through alignment with the existing buildings and lawn to the west, creating a new courtyard at the approach to the building main entrance. The building's massing and height provide continuity with the existing building to its west, whilst minimise the visual impact to its residential neighbours to the east. Its form and internal layout were driven by the needs of the research to be undertaken in the laboratories, with heavy labs located on the ground floor, lighter labs located on the middle floor and offices arranged around a central courtyard on the upper floor to promote cross ventilation to the open plan offices and provide daylight to the labs below. The building also provides visual connectivity between the labs and public realm to give campus visitors an insight into the research being undertaken.

More enquiry, less assumption — The Grimshaw led design team were privileged to collaborate the late Sir David MacKay, a world-leading authority in sustainable energy at the University. MacKay wanted to address the proliferation of 'green bling' in architecture and the emerging gap between predicted and actual performance of modern buildings. Using the building as a test-bed, Grimshaw's team worked with MacKay, and other leading academics at the University, to develop the Energy Cost Metric (ECM). By combining whole-life energy and costing assessments into a single analytical tool, the ECM provided a new way to objectively evaluate and whole-life energy savings and associated cost for different design strategies in a single equation to establish which provided the best value to the University. Its use during the design phase directly influenced the decision to specify a ground source heat pump with heat recovery over gas boilers: The University's Estates Department has subsequently incorporated the ECM into their guidance for new buildings. The Department of Engineering has recently published a paper, outlining the ECM's development and application during the projects design phase, to support the construction industry's efforts to minimise whole-life energy and carbon within a cost-conscious framework.

More adaptive reuse, less rubble — The masterplan for the new engineering campus is conceived as 'loose-fit' framework to maximise the possible growth scenarios available. This approach was essential to accommodate the intermittent nature of funding streams available to finance the Department's move to West Cambridge and to maximise the potential to re-use as much of the existing building stock on site as possible. The building itself adopted a flexible spatial framework employing a regular planning module, zoning of heavy and light engineering activities to avoid operational disruption. The building adopted the principles of circularity by ensuring as many of the primary structural and facade components were designed for quality and longevity and with deconstruction and re-use in mind. An estimated 80% of the structural steel and façade components are recoverable. As a consequence of this approach the buildings whole-life embodied carbon profile was further reduced.

More numbers, less rhetoric — The project follows the UK Governments soft-landing's framework to ensure commissioning and handover goes smoothly, with post-occupancy analysis undertaken over an extended two-year period. This will enable the project team to establish if the predicted performance targets are being met. This approach, combined with data captured from integrated environmental sensors, will enable the design team to draw lessons that can be applied to future phases of the engineering campus.

Main entrance lobby ↑



Axonometric sectional diagram ↑

LOW ENERGY/CARBON STRATEGIES

1. **Thermal mass –** Exposed concrete floor slabs reduce internal annual temperature swings by storing heat in the summer months, preventing overheating, and releasing heat during the winter months to provide passive heating.
2. **Natural ventilation & cooling –** High level actuated louvres provide background ventilation year-round. In the summer they are supplemented by manual windows to maximise air flow and provide secure night-time cooling/purge ventilation.
3. **Active ventilation & cooling –** All laboratories are temperature controlled with fan coil units [FCU] with fresh air supplied and exhausted locally from the external facade with heat recovery.
4. **Zoned underfloor heating –** Office and light laboratory accommodation is heated via a low temperature underfloor heating system which can be zoned to maximise flexibility to subdivide and combine rooms at a later date.
5. **Ground source heat pump [GSHP] –** Fan coil units and underfloor heating systems are connected to a GSHP which stores excess heat from the laboratories to provide cooling and heating to the building throughout the year. Combined with the on-site PV array, the system provides an all electric, low energy/carbon solution.

USER COMFORT, HEALTH & WELLBEING

6. **Daylighting –** A central courtyard, 40:60 window to wall ratio, external solar shading and glazing with a high visible light transmission above 55%, all help to maximise daylight within the buildings, while keeping excess glare and solar heat gains to a minimum.
7. **Well-measured –** Sensors integrated throughout the building measure environmental performance, including energy consumption.

NET-POSITIVE BIODIVERSITY

8. **Green roof –** The entire roof is covered with sedum, providing amenity for wildlife and a net gain in soft planting on site.
9. **Woodland belt –** The existing woodland belt to the east of the site has been cut back and replanted. These interventions, along with a commissioning of a detailed woodland management plan, will promote a net increase in quality vegetation, which over time should lead to a net gain in biodiversity.

INNOVATIONS

10. **Self-healing concrete –** In collaboration with the Department of Engineering, self-healing concrete was installed in a section of the ground floor slab. This technology uses a graphene additive that acts as a binder when cracks form, to maintain the concrete's integrity.
11. **Dynamic solar shading –** A thermochromic film, incorporated into glass shading fins on the western facade, changes opacity in response to increases in ambient temperature and direct solar heat gain. On hot sunny days the film becomes opaque helping to omit excess heat gains from the building, while maintaining unobstructed views out. On colder days the fins become fully transparent, maximising access to daylight and passive solar heat gains.