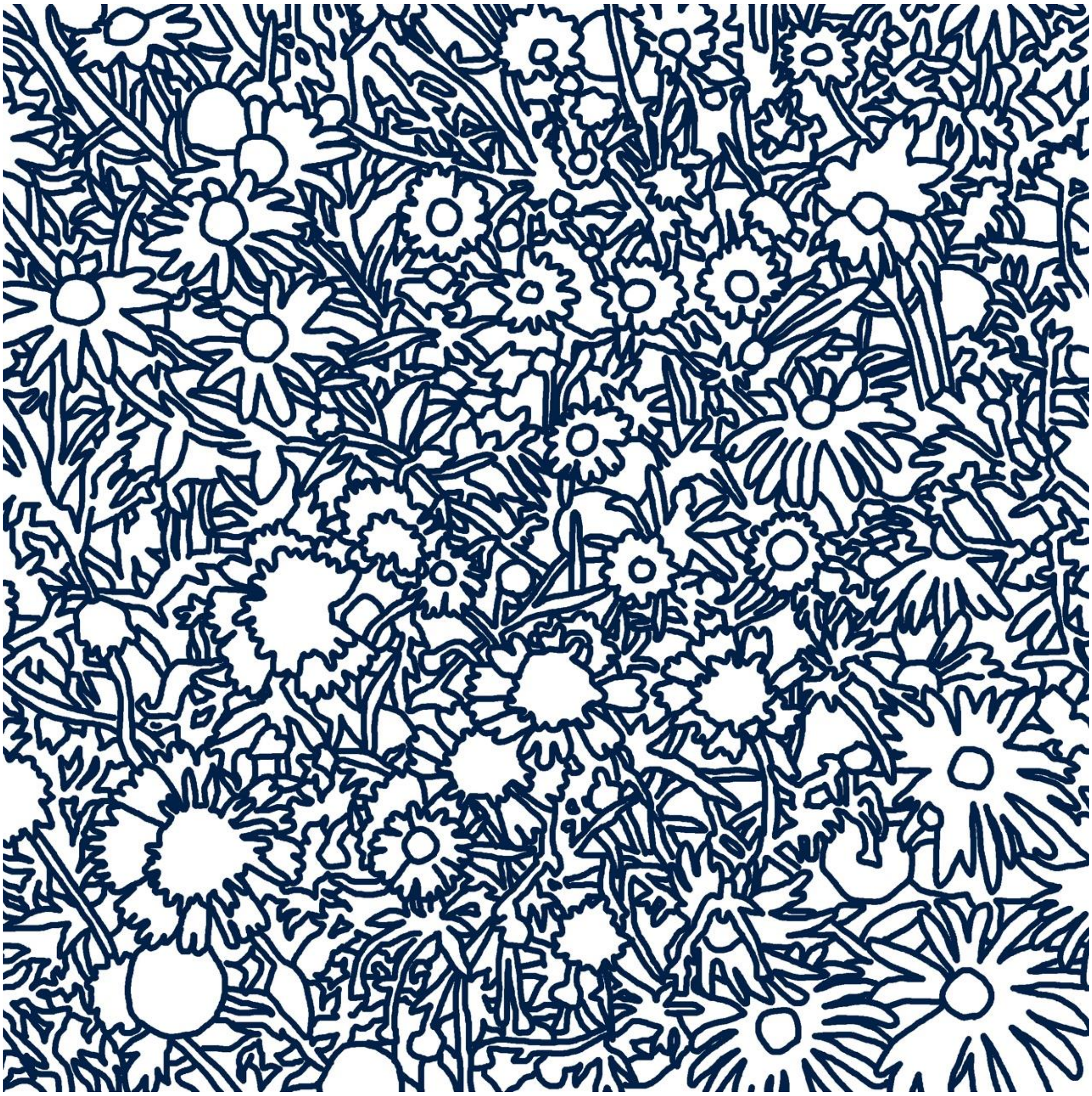
Estates Services

Sustainability Design Guide



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Contents

1. Introduction and background

The principle target audience for this guide is project Design Teams and Project Managers. It provides a framework to minimise the operational energy consumption of buildings and to deliver wider sustainability benefits, mirroring University policy requirements and the Estates Standing Orders. Its focus on operational energy consumption (and CO_2 emissions) places a clear emphasis on outcomes rather than compliance (i.e. Part L Building Regulations). The proposals a Design Team make to a Project's Sponsor Group (PSG) could make a difference of thousands of tonnes of CO_2 over the building's lifetime and will have a significant impact on the occupying department's energy and maintenance costs.

Since 2008 the University has produced internal guidance on the sustainability of capital projects. In 2009 this was supplemented by a requirement that all capital projects with a construction value over £1m would achieve the Building Research Establishment Environmental Assessment Methodology (BREEAM) Excellent standard. Guidance was fundamentally overhauled in 2011 and subsequently updated to focus the BREEAM process on University needs.

In February 2017 the University elected to move from its BREEAM Excellent requirement to using the Passivhaus methodology to guide its projects. The design guidance in this document supports the delivery of that policy change and summarises expectations in other areas of sustainability.

The approved policy is as follows:

All capital projects with a construction value over £1m are required to be designed using the Passivhaus methodology. The expectation is that a project will obtain Passivhaus Certification but with the understanding that PSG's may exercise disgression over the feasibility of full certification.

The mechanism for informing this evaluation is set out in section 2.1 of this document.

2. Key principles and objectives

The overall objective of this guide is to enable the delivery of sustainable buildings that compliment and support the University's education and research objectives and:

- Increase energy efficiency and reduce carbon emissions.
- Enhance occupant comfort, experience and productivity.
- Drive reduced complexity and increase occupant ownership of the energy consumed by buildings.
- Drive design for long life, low environmental impact, low maintenance, flexibility and end of life recycling.
- Reduce water consumption.
- Increase biodiversity.
- Promote and support sustainable travel modes.

The document is divided into key issues or compliance areas; each of these is accompanied by a summary of its rationale, the expected responsibility for delivery and any evidence requirements. The guidance should be consulted throughout the project and an updated Compliance Checklist (included at the end of this document and as a separate MS Word file) must be submitted to the Environmental Sustainability team with each stage report. Significant changes should also be reported as they occur during each stage to enable adequate time for review.

2.1. Passivhaus

Issue

Passivhaus

Responsibility

Architect / M&E Designer / Passivhaus Consultant/Designer

Rationale

Good performance against compliance metrics such as Part L, BREEAM and EPC's (which utilise a series of significant assumptions) may be characteristics of a high performing building but designing to them does not guaranteed performance during operation. University capital projects have frequently performed poorly against their design emissions expectations.

The Passivhaus methodology has demonstrated far greater surety in delivering minimal (and predictable) operational energy consumption combined with greater occupant comfort. These attributes support core University aspirations and are the principle drivers in adopting the methodology.

Achieving Passivhaus requirements is challenging and minimising any uplift in costs requires the early establishment of a delivery strategy with the support of an experienced Passivhaus Designer/Consultant. This design support is also critical for heritage buildings and partial refurbishments where a more bespoke approach may be appropriate.

Requirements

- Passivhaus design advice should be sought from Pre-feasibility.
- A Passivhaus Designer/Consultant should be appointed from Stage 1 and retained client-side for the duration of the project to guide the PSG on the feasibility of full certification and monitor compliance against agreed standards.
- The responsibility for achieving Passivhaus or EnerPHit certification (or critical elements thereof) should be clearly allocated at contract stage.

Key RIBA Stages

0 – 7

Evidence

- Passivhaus evaluation in project reports.
- Clear requirements in the project brief.
- Passivhaus Planning Package (PHPP) reports.
- Passivhaus certification.

2.2. Energy Benchmarking

Issue	Energy Benchmarking
Responsibility	M&E Designer / Passivhaus Consultant
Rationale	Ensuring design decisions are targeted on minimising operational energy consumption supports the long term interests of both the University and occupying departments. This requires the setting of clear benchmarks to enable PSG's to make informed choices. As the carbon intensity of the University's energy supply fluctuates based on the UK energy mix, energy consumption in kWh/m^2/yr is a more consistent measure of performance. For many projects this will be delivered by the Passivhaus certification process but, where attaining this is deemed not feasible, a relaxed energy consumption per m^2 requirement should be set (that can be audited in the PHPP tool) to support design development. The appropriate benchmark will depend on the type of project but should be agreed immediately following the decision not to certify to ensure that design decisions support achieving that target. For more complex projects (deemed those over £5m construction cost) a more granular assessment of energy consumption than PHPP and the Part L compliance model is required. CIBSE TM54 has been demonstrated by University projects, and by the wider industry, to provide an accurate prediction of energy consumption and also a sound basis for seasonal commissioning analysis. TM54 models are only as good as their inputs so, to ensure departments are well informed on their energy budget and the energy impacts of operational/design decisions, time must be invested in agreeing reasonable operational diversity scenario/s.
Requirements	• Consumption benchmarks (both environmental conditioning and primary energy) must be agreed immediately following a decision not to certify. • All projects over £5m should complete a CIBSE TM54 analysis. • The TM54 analysis should be updated for each design stage review. • Changes during contractor/sub-contractor design should be clearly communicated and their impact recorded. • Completed projects must be audited against the revised energy benchmark.
Key RIBA Stages	2 – 7
Evidence	• PSG records of benchmark agreement. • PHPP reports. • TM54 reports. • Records of contractor/sub-contractor change agreements including assessment of energy consumption impact.

2.3. Fabric performance (partial refurbishments)

Issue

Fabric Performance (partial refurbishments)

Responsibility

Architect / Passivhaus Consultant/Designer

Rationale

Where achieving the Passivhaus standard is deemed not feasible, an energy performance benchmark (section 2.2) will determine fabric performance requirements. For partial refurbishments, where it is deemed that the performance of the refurbished space is too dependent on the performance of areas outside of the project scope to be modelled in PHPP, clear fabric performance requirements will need to be set.

Refurbishments are an inimitable opportunity to lock-in energy savings for 20-50 years while optimising the comfort and productivity of working environments. The expectation is that all projects will strive for best practice, minimising U-values, but that requirements should be reviewed in proportion to their potential benefit, costs and any constraints of the existing fabric.

Significant investment in fabric improvement and a nominally excellent U-value can be undermined by detailing that fails to consider risks such as thermal bridging and thermal bypass. It is critical that the University's investment in enhancements are rigorously checked at both design and construction phase.

Requirements

- Potential options for improving the performance of individual fabric elements (over-cladding, roof/floor insulation, internal insulation, window replacement, secondary glazing etc.) should be appraised for their deliverability at feasibility stage in consultation with the Conservation and Buildings team.
- Appraisals should consider benefits in terms of economics (ROI), comfort (surface temperatures) and health (condensation and mould) with window and fabric performance U-values independently appraised.
- Façade adaptation, solar shading and glazing films to reduce gains should be considered holistically with thermal improvements.
- The potential to design out thermal bridges at material junctions should be considered for all existing and proposed details.
- Air-tightness (section 2.4) should be considered holistically with fabric.
- Care should be taken to ensure that non certified projects do not suffer from over-heating (section 2.6).

Key RIBA Stages

2 – 4

Evidence

- Site evaluation with an Environmental Sustainability team representative.
- Fabric options appraisal report/matrix.
- Evidence of independently reviewed U-value calculations.
- Drawings of key details and site implementation photographs.
- Workshops with contractors to ensure design intent is communicated clearly.

2.4. Air-tightness (non-certified projects)

Issue

Air-tightness (non-certified projects)

Responsibility

Architect / M&E Designer / Passivhaus Consultant/Designer

Rationale

Unmanaged air infiltration and leakage can account for up to 50% of a buildings heating load, drafts are a significant factor in occupant discomfort and air leakage in a building's fabric can result in condensation and structural damage. Air-tightness is therefore a key consideration in providing productive, cost-effective and robust University workspaces.

Complexity and buildability are significant risks to delivering an air-tight envelope that is robust for the long term. To mitigate these, and the risk of cost premium, air-tightness should be an early consideration in the design process and be subject to early contractor review. It should not be retrospectively applied to a developed concept, and should be appropriately tested during the construction period. Suitable products, warranted for the purpose and required lifespan, should be used for key details, junctions and penetrations.

Tests at positive and negative pressures are required to ensure that tapes and seals are robustly installed and will perform in all scenarios. Construction areas must be appropriately sealed-off to ensure realistic testing of partial-refurbs.

Requirements

- An air-tightness target should be agreed at Stage 1 ($\leq$ 3m3/hr/m^2 at 50Pa).
- For refurbished buildings, a managed supply of any required make-up air should be considered where air-tightness is significantly improved.
- The air-tightness delivery strategy should be clearly detailed in stage reports, including planning sectional testing for refurbishments.
- A clear contractual requirement for attainment and testing should be agreed.
- Air tightness products with an appropriate life expectancy should be specified.
- Testing should be completed in line with BS EN 13829 by operatives qualified to test to TS3. Average positive and negative pressure tests between 10 and 100 Pa should be taken.
- Air-tightness risks should be clearly communicated in O&M's to ensure it is protected from penetrations.

Key RIBA Stages

1 – 4

Evidence

- Air-tightness target referenced in the project brief.
- Air-tightness line clearly drawn on plans and junction details.
- Agreed specifications for tapes, membranes and gaskets.
- Photographic record of junction details during construction.
- Signed ATTMA test certificate.

2.5. Passive design

Issue	Passive Design
Responsibility	Architect / Passivhaus Consultant/Designer
Rationale	Simplifying architectural forms and early consideration of passive opportunities to design out risks can have a significant impact on the deliverability of stable and comfortable internal environments. This approach can also be a driver for reducing capital costs. Stable environments minimise the need for heating and cooling, reduce the requirement for, size and cost of services, delivering comfort for the lowest energy input. Issues such as solar gain, which can be costly to mitigate actively (cooling) or passively (external solar shading/blinds), can be designed out with careful attention to orientation and glazing ratio's. This has significant benefit both to the capital and operational building costs and prevents locking in comfort problems for University staff and students for the lifetime of the building.
Requirements	• East and West facing facades (and particularly glazed areas on them) should be minimised. • Glazed areas should be optimised for daylighting (ideally >800mm from FF). • Shading from solar gain should be considered within the façade design. • External solar shading should be included as a last resort, designed for low maintenance and to eliminate the risk of creating pigeon roosts. • Spaces with high occupancy or equipment gain should be located and designed to minimise solar gain and to maximise the potential for natural ventilation (where appropriate to their use). • Thermal mass must be paired with a realistic ventilation strategy (section 2.7). • Segregating areas (both physically and in terms of services) likely to require extended or 24 hour operation should be considered.
Key RIBA Stages	1 – 4
Evidence	• Clear focus in design development from project inception. • Specific reference in project reports from pre-feasibility onwards.

2.6. Thermal comfort

Issue	Thermal Comfort
Responsibility	Architect / M&E Designer / Passivhaus Consultant/Designer
Rationale	Comfort is subjective, complex and dependent on a wide-range of factors including clothing, radiant temperature, relative air velocity and relative humidity. Passive design will reduce the impact of many of these factors but detailed modelling is essential to ensure risks to providing an appropriate environment for staff and students are understood. CIBSE and Passivhaus compliant comfort can be provided without the need for comfort cooling in most circumstances. University experience of the impact of density of occupation, ventilation, and thermal mass and industry best practice should all play a part in ensuring this is delivered.
Requirements	• CIBSE TM52/TM59 (or current best practice) analysis should be completed for all projects >£1m. • Assumptions and diversity of occupant numbers, heat generating equipment and operational hours must be realistic, clearly agreed with occupants and documented. • Designers should use current weather files – provision for cooling connection and plant space allocation is acceptable for future scenarios but should not influence day 1 plant unless significant change is expected within 10 years. • Where Passivhaus is not targeted, triple-glazing should be retained for all elevations enclosing spaces where sedentary work will be undertaken. • Exposed thermal mass should be maximised in heavy weight structures and thermal mass enhancements considered for lightweight structures. • Unless there is demonstrable research need, cooling set-points should be 24°C +/- 2°C.
Key RIBA Stages	2 – 4
Evidence	• PHPP comfort outputs for simple buildings. • IES dynamic thermal model reports and TM52 analysis for complex projects.

2.7. Ventilation and Cooling

Issue

Ventilation and Cooling

Responsibility

Architect / M&E Designer / Passivhaus Consultant/Designer

Rationale

Adequate and controllable ventilation is fundamental to providing comfortable and productive University work spaces. Research clearly demonstrates a connection between air-quality and productivity and well-designed ventilation is critical to delivering year-round comfort (section 2.6).

A lack of consideration for ventilation early in design and/or poorly designed ventilation and cooling systems can lead to a costly requirement for cooling being designed in or to be required as a retrofit early in occupation. Active cooling is also a significant ongoing cost in terms of maintenance, departmental energy bills and University carbon emissions as well as creating compliance requirements.

In order to be effective and to deliver energy reductions for the long-term, ventilation designs should be simple and engage users in their effective operation.

Requirements

- Spaces should be designed to maximise the potential of natural ventilation to deliver cooling in peak conditions; <7m deep or cross ventilated.
- High density office spaces should ideally provide for cross ventilation.
- Natural ventilation controls must be accessible, consider the location of furniture, lockable in a number of positions and consider potential conflicts with security concerns early in stage 2.
- Ventilation designs should consider conflict with the operation of glare blinds.
- Any night purge strategy should be simple, minimise BMS control requirements, clearly address security risks and its requirements of occupants must be agreed with the occupying department to ensure viability in operation.
- Cooling should be localised and controlled to deliver parity with naturally ventilated space.
- Localised cooling must be disabled by opened windows in the same space.
- Plant for large meeting spaces must consider efficiency at low occupancy.

Key RIBA Stages

2 – 4

Evidence

- Design development workshops.
- Stage reports outlining strategy and design details.
- Specifications.

2.8. Controls

Issue	Controls
Responsibility	Architect / M&E Designer / Passivhaus Consultant/Designer
Rationale	Poorly designed or over-complex controls will disengage building occupants and are likely to lead to performance issues and dissatisfaction. University projects have demonstrated that giving occupants influence over their environment through simple, well explained, easy to understand and accessible controls has proven most successful. Complex controls have resulted in buildings being challenging to commission, incurring a long-term maintenance burden and costs, and in some cases requiring replacement. The design of controls should foster a shared responsibility for delivering on the buildings design intent. Third party controls systems have resulted in a legacy of costs for the University, delays for modifications and are frequently a barrier to the effective control, optimisation and continuous commissioning of buildings.
Requirements	• Controls should be simple, intuitive, appropriate to the technical knowledge of occupants and reviewed with users prior to being confirmed. • Automated controls must be TREND not 3rd party packages.
Key RIBA Stages	1 – 4
Evidence	• Design development workshops. • Stage reports outlining strategy and design details. • User group feedback. • Specifications.

2.9. Daylighting and View-out

Issue	Daylighting and View-out
Responsibility	Architect / M&E Designer / Passivhaus Consultant/Designer
Rationale	Access to daylight and views are significant factors in the wellbeing and productivity of occupants. Maximising these in University buildings is critical to delivering space that is fit for purpose and brings co-benefits in reducing the energy consumption and cost of artificial lighting. Over-glazing spaces can however lead to negative effects such as solar gain, glare (requiring continuous use of blinds that negate views), additional costs in provisioning shading and cooling, additional maintenance and occupant discomfort for the lifetime of the building. Very careful attention should therefore be given to glazing ratios and design.
Requirements	• 80% of workspaces (excluding spaces with specific daylight restrictions) should be within 7.5m of a view window or have a direct view of sky. • Glazing below 800mm should be minimised. • The building form should design out glare risk. • Glare blinds should be included to all risk elevations. Controls should be accessible, consider the location of furniture and should not conflict with ventilation.
Key RIBA Stages	1 – 4
Evidence	• Design development workshops. • Stage reports outlining strategy and design details. • Marked-up drawings. • Specifications.

2.10. Entrance Design

Issue

Entrance Design

Responsibility

Architect

Rationale

Balancing requirements for accessibility, traffic volumes, security, comfort and energy conservation has been challenging for University buildings. Entrance design will be a key architectural element of any project and considering these often conflicting priorities at an early project stage is essential to ensure that requirements are adequately incorporated and that the experience of all users of the completed building is optimised.

Small changes to design including orientation, façade treatments and landscaping can have a significant impact on the effect of wind on heat loss as well as on the function of automatic door mechanisms.

Requirements

- Major entrance orientation should be between NE-SE or W-N where possible.
- Wind breaks/landscaping to prevailing wind directions must be considered.
- The need for over-door air heaters/curtains should be designed out.
- Adequately sized draft lobby's should be included where possible to reduce heat loss and reception occupant discomfort.

Key RIBA Stages

1 – 4

Evidence

- Design development workshops.
- Stage reports outlining strategy and design details.

2.11. Metering

Issue	Metering
Responsibility	M&E Designer / Contractor
Rationale	Metering of utilities and heat should ensure that the consumption and performance of major plant, systems and loads can be monitored effectively. Designs should anticipate the needs of both continuous commissioning and the potential future sub-division of space between different occupiers to ensuring that sufficient granularity of data can be extracted. Key meters should be connected to the University's remote monitoring system (this will require separate meters in-line with revenue meters) to enable the significant cost savings that this affords in the long term. Previous projects have demonstrated the importance of completing, properly commissioning and verifying this work prior to occupation. Construction site supplies should be separately metered and the basis of billing and settlement agreed with the contractor prior to site set-up.
Requirements	• The metering strategy should be agreed before the end of stage 3. • Renewable systems metering must comply with the requirements of Ofgem. • Construction site metering should be installed and the contractual arrangement for bill settlement agreed with the Energy Team pre-start. • Meters should be accessible and readable without the need for access equipment or manual handling. • External locations should be used wherever possible to facilitate AMR. • All meters should be connected, commissioned and verified pre-occupation.
Key RIBA Stages	2 – 5
Evidence	• Inclusion of requirements in brief. • Metering workshops with Sustainability and Building Services in stage 2/3. • Provision of construction site metering information to Energy Team pre-start. • Verification records of meter operation (including reconciliation of hear meters) supplied pre-occupation.

2.12. LZC's and Renewables

Issue

LZC's and Renewables

Responsibility

Architect / M&E Designer / Contractor

Rationale

The functions of University research buildings often require complex services. Adding renewables to deliver heating or cooling has led to buildings that are difficult to commission, complex to control and costly to maintain. The case for technologies of this type must therefore be compelling and interconnections with conventional systems very carefully designed.

The majority of the University's carbon emissions are from consumed electricity. This means that solar PV is a good fit and it has also proven to be the least problematic renewable technology. Systems have been most successful where the building form and orientation is optimised for PV and to eliminate shading (including that from edge protection) to the installed system.

Requirements

- Designs and controls should be a simple as possible and target consistent operation rather than introduce complexity by chasing efficiency.
- Briefs must require that buildings are optimised for PV and to eliminate shading.
- PV systems should only be installed on roof finishes with a design life >20 years and not in contravention of warranty conditions.
- Condition of existing roofs must be reviewed with the Conservation and Building team.
- Simple controls and operation strategy agreed during stage 3.
- Risk of DC interference to research equipment reviewed with department.

Key RIBA Stages

1 – 5

Evidence

- Inclusion in brief.
- Design team workshops with Building Services and Sustainability teams.
- Written confirmation that DC poses no risk to research equipment operation.

2.13. Water

Issue

Water

Responsibility

Architect / M&E Designer / Contractor

Rationale

The University's Environmental Sustainability Policy and Water Management Strategy both set out targets for reducing the University's water consumption. Water is a significant cost to departments and projects should go as far as possible towards minimising water use.

University projects have encountered significant issues and costs derived from the specification of rainwater harvesting systems and from systems providing boiling and chilled potable water. Careful attention to the design and specification of these systems is therefore required.

Requirements

- Water should be sub metered and connected to the University's remote monitoring system as close as possible to the revenue meter.
- Water pressure should be tested and fittings should be specified to the following max flow rates up to 5 bar with pressure reducing valves installed for pressures in excess of this:

WC (dual flush)	6/4 litre
Showers	< 6 litres/min
Urinals (inc. control devices or waterless)	< 1 litres/hour
Kitchen/ette Taps (should be aerating)	< 4 litres/min
Basin Taps (should be aerating and with minimised percussion timing)	< 4 litres/min

- Flow rates should be verified at commissioning.
- Boiling water taps should be avoided and, where specified, should have simple user interfaces allowing control to hours of operation and should not require specialist maintenance contracts.
- Rainwater harvesting systems should be limited to gravity fed designs providing for landscaping maintenance.

Key RIBA Stages

1 – 4

Evidence

- Specifications.
- Commissioning reports.

2.14. Materials & Equipment

Issue	Materials & Equipment
Responsibility	Architect / Contractor
Rationale	The University's Environmental Sustainability Policy requires lifecycle impacts to be considered in all purchasing decisions. Construction projects require significant volume of materials with a plethora of potential impacts including deforestation, mineral extraction, manufacturing, transport and end-of-life disposal. The embodied carbon and embedded lifetime environmental footprint of University projects will also be heavily influenced by specification decisions. The specification of plug-in equipment in projects can have a significant impact on operational costs.
Requirements	• All timber must be from chain of custody certified sources (FSC, PEFC or GIB) or reclaimed. • All non-timber floor finishes/coverings should have an A/A+ rating in the BRE's Green Guide or an ISO 14025 compliant environmental product declaration. • At least 80% of insulation by volume should have an A/A+ rating in the BRE's Green Guide or an ISO 14025 compliant environmental product declaration. • Multi-foil insulation products should not be specified. • All paints, coatings, polishes and varnishes should have the EU Ecolabel or an ISO 14025 compliant environmental product declaration. • At least 80% of hard landscaping materials by volume should have an A/A+ rating in the BRE's Green Guide. • White goods and plug-in equipment should be specified in accordance with Energy Saving Trust recommendations – http://www.toptenuk.org/
Key RIBA Stages	1 – 5
Evidence	• Inclusion in brief. • Clear requirements within the specification. • Evidence that installed products comply with the specification. • Chain of custody delivery notes for all specified timber and for any used on site. • Delivery notes or invoices.

2.15. Waste

Issue

Waste

Responsibility

Architect / Contractor

Rationale

Waste disposal is a substantial cost to the University, a key external reporting metric and one of its greatest environmental impacts. Construction projects present a significant opportunity for waste minimisation, reuse and recycling if managed correctly. There are a number of opportunities to re-use fixtures, fittings and furniture if suitably audited before a refurbishment commences. Reuse within the University saves approximately £100,000 each year.

Project design should adequately account for operational waste. Workspace waste and recycling provision should be developed to be consistent with the requirement of the central waste contract and bin stores should be adequately sized for standard bins to enable easy and cost effective integration.

Requirements

- Projects should ensure that waste provision of the completed building will be adequate to integrate with the central non-hazardous waste contract.
- A Resource Management Plan should be completed for all projects. This must comprise a pre-refurbishment and/or pre demolition audit detailing all waste streams, quantified by estimated weight and identifying disposal routes.
- Items that could be re-used should be listed on Warp-it for a minimum of a month and high value equipment reviewed with the Uni Green Scheme.
- Contractors must produce a construction Resource Management Plan and record waste quantities by stream and tonnage.
- Diversion from landfill of non-hazardous waste should be evidenced by waste transfer notes and a summary monthly report:

PAS 402 certified waste contractor	85%
Non-PAS 402 certified waste contractor	95%

Key RIBA Stages

1 – 6

Evidence

- Plans demonstrating adequate waste provision for completed project.
- Resource Management Plans.
- Waste transfer notes and summary report.

2.16. Pollution

Issue

Pollution

Responsibility

Architect / M&E Designer / Contractor

Rationale

The University's Environmental Sustainability Policy requires that appropriate controls are put in place to prevent pollution. A building's materials, systems, positioning, layout and features (including the installation of equipment to reduce or detect pollution) should be considered from Stage 1 to support the University in meeting its compliance obligations and to prevent pollution during normal, abnormal and emergency scenarios. Consideration should be given to preventing or managing connections between pollution sources (eg back-up generators, chemical stores, kitchens and carparks), pathways (drains, land, extraction) and receptors (air, land, water).

Careful specification of insulation and of systems containing refrigerants can help limit ozone layer damage. Attention to the design of these systems can also deliver lower maintenance operation and lower energy costs.

Oil traps, sump-pumps (including appropriate detection alarms and isolation) and the location and design of spaces containing chemical stores, waste management and back-up generators should all be considered in relation to potential pathways and receptors. Basement groundwater sump-pump systems also introduce a problematic maintenance burden, discharge costs and compliance risk to the University and should be avoided in the design stage.

Requirements

- All specified insulation (thermal, pipe, fire, acoustic) must have a GWP of <5.
- For systems using refrigerants, the Direct Effect Life Cycle (DELC) CO_2 per kW cooling should be calculated to BS EN 378-1 and must be ≤ 1 T CO_2e/kW. Refrigerant specification must be approved in advance.
- Where refrigerant systems have a charge over 3kg and/or refrigerant with a GWP ≥ 5 leak prevention to BS EN378-1: 2008A2:2012 must be provided alongside an appropriate leak detection system.
- A pollution risk assessment must be undertaken for the design of generators, chemical stores, kitchens and carparks at Stage 3.
- The requirement for groundwater sump-pumps should be designed out.
- Grease traps (BS EN 1825-1:2004/1825-2:2002) should be designed in to all food preparation areas to comply with Part H of the Building Regulations.

Key RIBA Stages

1 – 6

Evidence

- Inclusion in the brief.
- Insulation specification, manufacturers' data sheets and delivery notes.
- DELC calculation substantiated by manufacturers' literature.
- Leak prevention/detection clause in specification and clear verification at PC.
- Kitchen/food preparation area specifications.

2.17. Travel & Transport

Issue

Travel & Transport

Responsibility

Architect / Transport Consultant

Rationale

The University is responsible for 20% of employment in Oxford, 10,000 daily commuter trips from outside of the ring road and 12,000 interwork journeys across the city each day. Adequate support for connectivity, and in particular measures that support sustainable transport and removing car trips from the road network, is therefore a key priority for all projects.

Cycling is the key sustainable transport mode for staff and students accounting for 31% of all staff commutes across the city and for over 40% of commutes to the Science Area. Sufficient facilities for cyclists should be included in all projects and their careful design is paramount; pressure on space has sometimes led to compromises causing costly facilities to become under-used or redundant.

Projects should support the objectives of the University's Transport Strategy.

Requirements

- Cycle parking should be provided at the ratio of one space per 2.8 occupants.
- Sheffield stands should be at ≥1m spacing's.
- Covered cycle parking is preferable to uncovered in all cases.
- Staff cycle parking should be secure, covered and accessed either at grade or via a shallow ramp with gradient ≤1:8.
- One shower should be provided per 10 cycle spaces (minimum 1) or 35 staff.
- Adequate clothing drying space should be provided in all projects.
- Charging points for operational electric vehicles should be considered.

Key RIBA Stages

1 – 4

Evidence

- Plans approved by Sustainable Transport Manager at Stage 2, 4 and 5.

2.18. Biodiversity and Landscaping

Issue	Biodiversity and Landscaping
Responsibility	Architect / Ecologist / Contractor
Rationale	Enhancing habitats on University land is a key deliverable of the Environmental Sustainability policy and Biodiversity Strategy. As well as supporting increases in biodiversity, effective planting can reduce heat gain through shading and evapotranspiration, supporting both energy and comfort objectives. It can also assist with surface water management, improve occupant experience of a building, promote sustainable behaviours and reduce CO_2 and pollutants. Failure to consider biodiversity pre-demolition and during construction can be a statutory risk. Failure to re-survey following project pauses has also led to significant impacts on University project cost and programme. Conflicts with building use, maintenance and lighting reviewed to ensure the maximum benefit is delivered.
Requirements	• Enhancing biodiversity should be clearly identified in the project brief. • Where a project potentially affects existing habitats, an extended phase one habitat survey should be carried out before <u>any</u> demolition or in Stage 2. • Habitats should be re-surveyed following a project pause exceeding 1 year. • A planting/habitat strategy and management plan should be developed with Parks and the appointed Ecologist to deliver a net biodiversity increase that supports the habitat survey findings, pollinating insects and other relevant UK BAP species. It should list interventions, rationale and proposed management. • Planting should be drought resistant (excluding green wall watering systems) and tree species must be selected to limit disease risk. • The impact of lighting on bats & birds should be reviewed with an Ecologist. • Behavioural and experiential planting e.g. green walls should be considered. • Green roofs should include fire breaks at 40m intervals and designs should be reviewed with the University's insurers at Stage 3. • Natural SUDS schemes should be shallow sided, more than 0.6m deep and contain submergent, emergent and marginal planting of native species. • Natural SUDS schemes must have a specific management plan. • Consideration should be given to the origin of hard landscape materials eg European rather than Chinese granite.
Key RIBA Stages	0 – 5
Evidence	• Inclusion in brief. • Design development workshops. • Stage reports outlining strategy and designs. • Specifications. • Plans approved by Superintendent of the University Parks and the Head of Environmental Sustainability at stage 4.

2.19. IT Spaces

Issue	IT Spaces
Responsibility	Architect / M&E Designer / Passivhaus Consultant/Designer
Rationale	The provision of IT and data support for research facilities can account for a significant proportion of a buildings energy consumption while driving energy intensive cooling requirements. University projects have also suffered from the challenge of anticipating the growth of IT requirements leading to the installation of over-sized, inefficient and costly plant. Cloud-based and off-site options are inherently more energy efficient and can deliver operational savings for departments, free up costly space within buildings, reduce stress on the provision of electrical power and facilitate reductions in the University's carbon emissions.
Requirements	• A needs and constraints assessment should be undertaken considering the feasibility of cloud-based and off-site (ideally as part of the off-site capacity procured via IT Services) opportunities. • Cooling plant should be designed to ensure efficient operation at a variety of potential load scenarios.
Key RIBA Stages	1 – 4
Evidence	• IT needs assessment. • Plant efficiency sensitivity analysis.

2.20. Lifecycle Cost and Value Engineering

Issue	Lifecycle Cost and Value Engineering
Responsibility	Architect / M&E Designer / Passivhaus Consultant/Designer
Rationale	University projects are often typified by a tension between capital and operational cost considerations. While capital savings will be attractive to a cost challenged project, their long term cost to the University in terms of maintenance, energy and potentially rectification can be onerous and should be well understood at the point such a decision is taken. This analysis is also of value when applied to decisions to invest in plant that may require a long-term specialist maintenance contract. Robust whole life cost analysis should be undertaken for all decisions and for fabric considerations, the Passivhaus methodology has the advantage that reliable operational energy implications can be modelled easily for small projects upwards to enable this.
Requirements	• Value engineering options with energy implications should be evaluated using the BSi/BICS PD 15685-5:2008 lifecycle cost tool using PHPP energy data. • Market tested specialist maintenance contract costs should form part of the evaluation for investments in plant such as heat pumps and CHP.
Key RIBA Stages	3 – 5
Evidence	• VE options reports in an appropriate format. • Sample maintenance contracts.

2.21. Commissioning and Seasonal Commissioning

Issue	Commissioning and Seasonal Commissioning
Responsibility	Architect / M&E Designer / Contractor
Rationale	Commissioning and hand-over can cement or undermine design and construction work, defining user experience and successful operation for the long-term. Seasonal commissioning is essential to ensure that this process is repeated for the various modes in which the building will operate. Both have been demonstrated to be critical to the success of University projects. Staff can become disenfranchised quickly and should be actively engaged in the process of verifying a building is meeting its design criteria.
Requirements	• An independent Commissioning Engineer or non-novation of the M&E designer must be included for all complex projects. • Training should be provided only when systems are operational and only training on essential systems should be provided pre-PC. • Seasonal commissioning should be well defined and started 6 months post PC. • A clear communication plan for any post occupation commissioning and seasonal commissioning should be defined and agreed with the occupants during construction as part of the Soft Landings Strategy. • BMS data recording services should be considered for seasonal commissioning but only where their review can be adequately resourced.
Key RIBA Stages	1 – 7
Evidence	• Commissioning strategy workshops and reports.

2.22. Building User Guide

Issue	Building User Guide
Responsibility	Architect / M&E Designer / Passivhaus Consultant/Designer
Rationale	User understanding of a building's function is critical to occupants experience of it and to its long term energy performance but full understanding of the buildings design intent is likely to be held by a relatively small number of people by occupation. Where University projects have invested time and resources in communicating this to all occupants it has delivered significant performance improvements and levels of satisfaction. There is no best-practice pro-forma as appropriate formats will vary significantly based on a buildings function and complexity. Brief, visual instructions that can be left/mounted near controls in workspaces or web-based guidance and videos have proven most successful in engaging users and remaining accessible for new occupants.
Requirements	• User guides should consider the range of staff knowledge and staff turnover. • Detailed user guides should be produced by the main contractor for all occupant facing systems and controls. • User guides should signpost the key University sustainability initiatives for operational buildings. • Web based user guides should be considered where thermal comfort strategies require a variety of occupant interventions dependent on conditions.
Key RIBA Stages	1 – 4
Evidence	• Cost allowance from stage 1. • Building User Guide workshop at stage 3. • Building User Guide.

2.23. Historic Buildings

Issue

Historic Buildings

Responsibility

Architect / Passivhaus Consultant/Designer

Rationale

The University has 56 listed buildings, 12 of which are at Grade 1 and many more affected by conservation areas around the City. Although these designations do not freeze a building in time, interventions that affect their special interest must be balanced against function, condition and viability. Pragmatism and creativity are therefore needed to balance requirements in this document with their constraints.

There are also significant risks of bending historic structures to new purposes. Thermal comfort and low energy consumption can for example be challenging to deliver for conversions of roof spaces where adequate ventilation and insulation are unlikely to be feasible without significant changes to external appearance. Condensation and fabric damage can also be triggered by fabric improvements.

Requirements

- Any project in a listed building must engage with the Head of Conservation and Buildings at stage 0.
- Feasibility studies for the conversion of roof spaces must include thermal comfort modelling (section 2.6) regardless of value and submit proposed insulation details for review.
- Thermal modelling must be completed for significant increase in occupant density.
- Ventilation must be considered in detail early in stage 2. This is particularly critical for lecture/seminar spaces where purge between sessions may be required if mechanical ventilation is not feasible.
- Secondary glazing, air-tightness and thermal bridge free junction detailing should be considered.
- Natural insulation materials such as wood fibre and aerogel plaster should be considered to afford fabric improvements without risk of condensation.

Key RIBA Stages

1 – 4

Evidence

- Modelling reports to TM52/59.
- Ventilation workshop at Stage 2.
- Fabric options appraisal as per section 2.3.

2.24. Laboratories

Issue

Laboratories

Responsibility

Architect / M&E Designer / Passivhaus Consultant/Designer

Rationale

Laboratories are energy intensive by nature; they account for over 70% of the University's carbon emissions but only 15% of floor area. 40% of energy may be consumed by plugged in equipment and 30-50% by ventilation equipment (all of which also represent a major capital cost). For these reasons their energy efficient design and operation is a key target in the University's Carbon Management Strategy.

Impacts on safety should always be considered for any potential energy savings.

Requirements

- Air change rates should be scrutinised for their measurable safety benefits to ensure appropriate safe and correctly sized design.
- Plant should be designed to ensure efficient operation at normal, as well as peak loads and close environmental control limited to areas needing this.
- Appropriate automated control should be considered for equipment at risk of being left on.
- Designs should engage users in saving energy, enable and normalise energy efficient behaviour such as fume hood closure and equipment sharing.
- ULT freezers should be co-located in rooms positioned to enable free cooling.
- Ventilated storage should be provided separate to fume hoods where required.
- Slabs and Labs21 Environmental Performance Criteria should be consulted.

Key RIBA Stages

0 – 4

Evidence

- Inclusion in brief
- Design development workshops.
- Stage reports outlining strategy and designs.
- Specifications.

Sustainability Design Guide – Compliance Checklist

Project Name	
RIBA Stage	

Issue	Requirements	Evidence	Compliance comments
2.1 Passivhaus	• Passivhaus design advice should be sought for Pre-feasibility and Feasibility. • A Passivhaus Designer/ Consultant should be appointed from Stage 1 and retained client-side for the duration of the project to guide the PSG on the feasibility of full certification and monitor compliance against agreed standards. • The responsibility for achieving Passivhaus or EnerPHit certification (or critical elements thereof) should be clearly allocated at contract stage.	• Passivhaus evaluation in project reports. • Clear requirements in the project brief. • PHPP reports. • Passivhaus certification.	0 – 7
2.2 Energy Benchmarking	• Consumption benchmarks (both environmental conditioning and primary energy) must be agreed immediately following a decision not to certify. • All projects over £5m should	• PSG records of benchmark agreement. • PHPP reports. • TM54 reports.	2 – 7

	complete a CIBSE TM54 analysis. • The TM54 analysis should be updated for each design stage review. • Changes during contractor/sub-contractor design should be clearly communicated and their impact recorded. • Completed projects must be audited against the revised energy benchmark.	• Records of contractor/sub-contractor change agreements including assessment of energy consumption impact.	
2.3 Fabric Performance	• Potential options for improving the performance of individual fabric elements (over-cladding, roof/floor insulation, internal insulation, window replacement, secondary glazing etc.) should be appraised for their deliverability at feasibility stage in consultation with the Conservation and Buildings team. • Appraisals should consider benefits in terms of economics (ROI), comfort (surface temperatures) and health (condensation and mould) with window and fabric performance U-values independently appraised. • Façade adaptation, solar shading and glazing films to reduce gains should be considered holistically with thermal improvements. • The potential to design out thermal bridges at material	• Site evaluation with an Environmental Sustainability team representative. • Fabric options appraisal report/matrix. • Evidence of independently reviewed U-value calculations. • Drawings of key details and site implementation photographs. • Workshops with contractors to ensure design intent is communicated clearly.	2 – 4

	junctions should be considered for all existing and proposed details. • Air-tightness (section 2.4) should be considered holistically with fabric. • Care should be taken to ensure that non certified projects do not suffer from over-heating (section 2.6).		
2.4 Air-Tightness	• An air-tightness target should be agreed at Stage 1 (≤ 3m3/hr/m^2 at 50Pa). • For refurbished buildings, a managed supply of any required make-up air should be considered where air-tightness is significantly improved. • The air-tightness delivery strategy should be clearly detailed in stage reports, including planning sectional testing for refurbishments. • A clear contractual requirement for attainment and testing should be agreed. • Air tightness products with an appropriate life expectancy should be specified. • Testing should be completed in line with BS EN 13829 by operatives qualified to test to TS3. Average positive and negative pressure tests between 10 and 100 Pa should be taken. • Air-tightness risks should be clearly communicated in O&M's to prevent barrier penetrations.	• Air-tightness target referenced in the project brief. • Air-tightness line clearly drawn on plans and junction details. • Agreed specifications for tapes, membranes and gaskets. • Photographic record of junction details during construction. • Signed ATTMA test certificate.	1 – 4

2.5 Passive Design	• East and West facing facades (and particularly glazed areas on them) should be minimised. • Glazed areas should be optimised for daylighting (ideally >800mm from FF). • Shading from solar gain should be considered within the façade design. • External solar shading should be included as a last resort, designed for low maintenance and to eliminate the risk of creating pigeon roosts. • Spaces with high occupancy or equipment gain should be located and designed to minimise solar gain and to maximise the potential for natural ventilation (where appropriate to their use). • Thermal mass must be paired with a realistic ventilation strategy (section 2.7). • Segregating areas (both physically and in terms of services) likely to require extended or 24 hour operation should be considered.	• Clear focus in design development from project inception. • Specific reference in project reports from pre-feasibility onwards.	1 – 4
2.6 Thermal Comfort	• CIBSE TM52/TM59 (or current best practice) analysis should be completed for all projects >£1m. • Assumptions and diversity of occupant numbers, heat generating equipment and operational hours must be realistic, clearly agreed with occupants and documented.	• PHPP comfort outputs for simple buildings. • IES dynamic thermal model reports and TM52 analysis for complex projects.	2 – 4

	• Designers should use current weather files – provision for cooling connection and plant space allocation is acceptable for future scenarios but should not influence day 1 plant unless significant change is expected within 10 years. • Where Passivhaus is not targeted, triple-glazing should be retained for all elevations enclosing spaces where sedentary work will be undertaken. • Exposed thermal mass should be maximised in heavy weight structures and thermal mass enhancements considered for lightweight structures. • Unless there is demonstrable research need, cooling set-points should be 24°C +/- 2°C.		
2.7 Ventilation and Cooling	• Spaces should be designed to maximise the potential of natural ventilation to deliver cooling in peak conditions; <7m deep or cross ventilated. • High density office spaces should ideally provide for cross ventilation. • Natural ventilation controls must be accessible, consider the location of furniture, lockable in a number of positions and consider potential conflicts with security concerns early in stage 2. • Ventilation designs should consider conflict with the	• Design development workshops. • Stage reports outlining strategy and design details. • Specifications.	2 – 4

	operation of glare blinds. • Any night purge strategy should be simple, minimise BMS control requirements, clearly address security risks and its requirements of occupants must be agreed with the occupying department to ensure viability in operation. • Cooling should be localised and controlled to deliver parity with naturally ventilated space. • Localised cooling must be disabled by opened windows in the same space. • Plant for large meeting spaces must consider efficiency at low occupancy.		
2.8 Controls	• Controls should be simple, intuitive, appropriate to the technical knowledge of occupants and reviewed with users prior to being confirmed. • Automated controls must be TREND not 3rd party packages.	• Design development workshops. • Stage reports outlining strategy and design details. • User group feedback. • Specifications.	1 – 4
2.9 Daylighting and View-out	• 80% of workspaces (excluding spaces with specific daylight restrictions) should be within 7.5m of a view window or have a direct view of sky. • Glazing below 800mm should be minimised. • The building form should design out glare risk. • Glare blinds should be included to all risk elevations. Controls	• Design development workshops. • Stage reports outlining strategy and design details. • Marked-up drawings. • Specifications.	1 – 4

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	should be accessible, consider the location of furniture and should not conflict with ventilation.		
2.10 Entrance Design	• Major entrance orientation should be between NE-SE or W-N where possible. • Wind breaks/landscaping to prevailing wind directions must be considered. • The need for over-door air heaters/curtains should be designed out. • Adequately sized draft lobby's should be included where possible to reduce heat loss and reception occupant discomfort.	• Design development workshops. • Stage reports outlining strategy and design details.	1 – 4
2.11 Metering	• The metering strategy should be agreed before the end of stage 3. • Renewable systems metering must comply with the requirements of Ofgem. • Construction site metering should be installed and the contractual arrangement for bill settlement agreed with the Energy Team pre-start. • Meters should be accessible and readable without the need for access equipment or manual handling. • External locations should be used wherever possible to facilitate AMR. • All meters should be connected, commissioned and verified pre-occupation.	• Inclusion of requirements in brief. • Metering workshops with Sustainability and Building Services in stage 2/3. • Provision of construction site metering information to Energy Team pre-start. • Verification records of meter operation (including reconciliation of hear meters) supplied pre-occupation.	2 – 5

<table>
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<td>2.12 LZC's and Renewables</td>
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Designs and controls should be a simple as possible and target consistent operation rather than introduce complexity by chasing efficiency.
Briefs must require that buildings are optimised for PV and to eliminate shading.
PV systems should only be installed on roof finishes with a design life >20 years and not in contravention of warranty conditions.
Condition of existing roofs must be reviewed with the Conservation and Building team.
Simple controls and operation strategy agreed during stage 3.
Risk of DC interference to research equipment reviewed with department.

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Inclusion in brief.
Design team workshops with Building Services and Sustainability teams.
Written confirmation that DC poses no risk to research equipment operation.

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<td>2.13 Water</td>
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Water should be sub metered and connected to the University's remote monitoring system as close as possible to the revenue meter.
Water pressure should be tested and fittings should be specified to the following max flow rates up to 5 bar with pressure reducing valves installed for pressures in excess of this:

<table>
<tr><td>WC (dual flush)</td><td>6/4 litre</td></tr>
<tr><td>Showers</td><td>< 6 litres/min</td></tr>
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Specifications.
Commissioning reports.

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<td>1 – 4</td>
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<tr><td>Urinals (inc. control devices or waterless)</td><td>< 1 litres/hour</td></tr>
<tr><td>Kitchen/ette Taps (should be aerating)</td><td>< 4 litres/min</td></tr>
<tr><td>Basin Taps (should be aerating and with minimised percussion timing)</td><td>< 4 litres/min</td></tr>
</table>

Flow rates should be verified at commissioning.
Boiling water taps should be avoided and, where specified, should have simple user interfaces allowing control to hours of operation and should not require specialist maintenance contracts.
Rainwater harvesting systems should be limited to gravity fed designs providing for landscaping maintenance.

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<td>2.14 Materials</td>
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All timber must be from chain of custody certified sources (FSC, PEFC or GIB) or reclaimed.
All non-timber floor finishes/coverings should have an A/A+ rating in the BRE's Green Guide or an ISO 14025 compliant environmental product declaration.
At least 80% of insulation by volume should have an A/A+

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Inclusion in brief.
Clear requirements within the specification.
Evidence that installed products comply with the specification.
Chain of custody delivery notes for all specified timber and for any used on

</td>
<td>1 – 5</td>
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	rating in the BRE's Green Guide or an ISO 14025 compliant environmental product declaration. • Multi-foil insulation products should not be specified. • All paints, coatings, polishes and varnishes should have the EU Ecolabel or an ISO 14025 compliant environmental product declaration. • At least 80% of hard landscaping materials by volume should have an A/A+ rating in the BRE's Green Guide. • White goods and plug-in equipment should be specified in accordance with Energy Saving Trust recommendations – http://www.toptenuk.org/	site. • Delivery notes or invoices.	
2.15 Waste	• Projects should ensure that waste provision of the completed building will be adequate to integrate with the central non-hazardous waste contract. • A Resource Management Plan should be completed for all projects. This must comprise a pre-refurbishment and/or pre demolition audit detailing all waste streams, quantified by estimated weight and identifying disposal routes. • Items that could be re-used should be listed on Warp-it for a minimum of a month and high value equipment reviewed with the Uni Green Scheme.	• Plans demonstrating adequate waste provision for completed project. • Resource Management Plans. • Waste transfer notes and summary report.	1 – 6

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<td>• Contractors must produce a construction Resource Management Plan and record waste quantities by stream and tonnage.
• Diversion from landfill of non-hazardous waste should be evidenced by waste transfer notes and a summary monthly report:
<table><tr><td>PAS 402 certified waste contractor</td><td>85%</td></tr><tr><td>Non-PAS 402 certified waste contractor</td><td>95%</td></tr></table></td>
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<td>2.16 Pollution</td>
<td>• All specified insulation (thermal, pipe, fire, acoustic) must have a GWP of <5.
• For systems using refrigerants, the Direct Effect Life Cycle (DELC) CO_2 per kW cooling should be calculated to BS EN 378-1 and must be ≤ 1 T CO_2e/kW. Refrigerant specification must be approved in advance.
• Where refrigerant systems have a charge over 3kg and/or refrigerant with a GWP ≥ 5 leak prevention to BS EN378-1: 2008A2:2012 must be provided alongside an appropriate leak detection system.
• A pollution risk assessment must be undertaken for the design of generators, chemical</td>
<td>• Inclusion in the brief.

• Insulation specification, manufacturers' data sheets and delivery notes.

• DELC calculation substantiated by manufacturers' literature.

• Leak prevention/detection clause in specification and clear verification at PC.

• Kitchen/food preparation area specifications.</td>
<td>1 – 6</td>
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	stores, kitchens and carparks at Stage 3. • The requirement for groundwater sump-pumps should be designed out. • Grease traps (BS EN 1825-1:2004/1825-2:2002) should be designed in to all food preparation areas to comply with Part H of the Building Regulations.		
2.17 Travel and Transport	• Cycle parking should be provided at the ratio of one space per 2.8 occupants. • Sheffield stands should be at ≥1m spacing's. • Covered cycle parking is preferable to uncovered in all cases. • Staff cycle parking should be secure, covered and accessed either at grade or via a shallow ramp with gradient ≤1:8. • One shower should be provided per 10 cycle spaces (minimum 1) or 35 staff. • Adequate clothing drying space should be provided in all projects. • Charging points for operational electric vehicles should be considered.	• Plans approved by Sustainable Transport Manager at Stage 2, 4 and 5.	1 – 4

2.18 Biodiversity and Landscaping	• Enhancing biodiversity should be clearly identified in the project brief. • Where a project potentially affects existing habitats, an extended phase one habitat survey should be carried out early in Stage 2 or, before any demolition. • Habitats should be re-surveyed following a project pause exceeding 1 year. • A planting/habitat strategy and management plan should be developed with Parks and the appointed Ecologist to deliver a net biodiversity increase that supports the habitat survey findings, pollinating insects and other relevant UK BAP species. It should list interventions, rationale and proposed management. • Planting should be drought resistant (excluding green wall watering systems) and tree species must be selected to limit disease risk. • The impact of lighting on bats & birds should be reviewed with an Ecologist. • Behavioural and experiential planting e.g. green walls should be considered. • Green roofs should include fire breaks at 40m intervals and designs should be reviewed with the University's insurers at Stage 3.	• Inclusion in brief. • Design development workshops. • Stage reports outlining strategy and designs. • Specifications. • Plans approved by Superintendent of the University Parks and the Head of Environmental Sustainability at stage 4.	0 – 5

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	• Natural SUDS schemes should be shallow sided, more than 0.6m deep and contain submergent, emergent and marginal planting of native species. • Natural SUDS schemes must have a specific management plan. • Consideration should be given to the origin of hard landscape materials eg European rather than Chinese granite.		
2.19 IT Spaces	• A needs and constraints assessment should be undertaken considering the feasibility of cloud-based and off-site (ideally as part of the off-site capacity procured via IT Services) opportunities. • Cooling plant should be designed to ensure efficient operation at a variety of potential load scenarios.	• IT needs assessment. • Plant efficiency sensitivity analysis.	1 – 4
2.20 Lifecycle Cost and VE	• Value engineering options with energy implications should be evaluated using the BSi/BICS PD 15685-5:2008 lifecycle cost tool using PHPP energy data. • Market tested specialist maintenance contract costs should form part of the evaluation for investments in plant such as heat pumps and CHP.	• VE options reports in an appropriate format. • Sample maintenance contracts.	3 – 5

2.21 Commissioning	• An independent Commissioning Engineer or non-novation of the M&E designer must be included for all complex projects. • Training should be provided only when systems are operational and only training on essential systems should be provided pre-PC. • Seasonal commissioning should be well defined and started 6 months post PC. • A clear communication plan for any post occupation commissioning and seasonal commissioning should be defined and agreed with the occupants during construction as part of the Soft Landings Strategy. • BMS data recording services should be considered for seasonal commissioning but only where their review can be adequately resourced.	• Commissioning strategy workshops and reports.	1 – 7
2.22 Building User Guide	• User guides should consider the range of staff knowledge and staff turnover. • Detailed user guides should be produced by the main contractor for all occupant facing systems and controls. • User guides should signpost the key University sustainability initiatives for operational buildings. • Web based user guides should be considered where thermal	• Cost allowance from stage 1. • Building User Guide workshop at stage 3. • Building User Guide.	1 – 4

	comfort strategies require a variety of occupant interventions dependent on conditions.		
2.23 Historic Buildings	• Any project in a listed building must engage with the Head of Conservation and Buildings at stage 0. • Feasibility studies for the conversion of roof spaces must include thermal comfort modelling (section 2.6) regardless of value and submit proposed insulation details for review. • Thermal modelling must be completed for significant increase in occupant density. • Ventilation must be considered in detail early in stage 2. This is particularly critical for lecture/seminar spaces where purge between sessions may be required if mechanical ventilation is not feasible. • Secondary glazing, air-tightness and thermal bridge free junction detailing should be considered. • Natural insulation materials such as wood fibre and aerogel plaster should be considered to afford fabric improvements without risk of condensation.	• Modelling reports to TM52/59. • Ventilation workshop at Stage 2. • Fabric options appraisal as per section 2.3.	1 – 4

2.24 Laboratories	• Air change rates should be scrutinised for their measurable safety benefits to ensure appropriate safe and correctly sized design. • Plant should be designed to ensure efficient operation at normal, as well as peak loads and close environmental control limited to areas needing this. • Appropriate automated control should be considered for equipment at risk of being left on. • Designs should engage users in saving energy, enable and normalise energy efficient behaviour such as fume hood closure and equipment sharing. • ULT freezers should be co-located in rooms positioned to enable free cooling. • Ventilated storage should be provided separate to fume hoods where required. • Slabs and Labs21 Environmental Performance Criteria should be consulted.	• Inclusion in brief • Design development workshops. • Stage reports outlining strategy and designs. • Specifications.	0 – 4

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Owner:	Tom Heel, Deputy Head of Environmental Sustainability