Design Guide Part 1: Principles and overview

RIBA Stages 1 – 7

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1.0 Introduction

1.0.1 Purpose of UEA's Design Guide

The UEA Design Guide is written for any person involved in the design and specification of projects for new and existing buildings for the University of East Anglia (UEA) or UEA Estates Services Ltd. It is written for employees of UEA as well as external architects, consultants and contractors.

The purpose of the Design Guide is to set out the design principles, philosophies and general requirements for projects, providing a means of controlling quality in the production of designs, specifications and the subsequent performance of buildings.

The Design Guide aims to discuss strategic matters and does not provide an exhaustive treatment of statutory or best practice design and compliance requirements; its primary purpose is to establish a starting point for design *briefs*. It is the responsibility of readers/duty holders to ensure subsequent designs are complete, compliant and able to meet the final approved brief when measured in use.

It is important to note that although external consultants and architects might be engaged by the Estates and Facilities Division (EFD) of UEA, the EFD is in turn engaged with the UEA who is The Client. It is the duty of the EFD to ensure designs and the subsequent buildings and systems meet the diverse and often specialist needs of UEA.

1.0.2 Purpose of this Part of the Design Guide

This Part of the Design Guide (Part 1), outlines and explains the design principles as a first step to understanding the needs for all projects at UEA. It is an *introduction* intended for use at RIBA stages 1-7[1]. It is part of a wider suite of documents that comprise the full Design Guide. Other documents in the Design Guide include technology or system specific design guides (e.g. lighting, vertical transport, BMS, etc.,), accompanied by their relevant standards and specifications. A full list of Design Guide Parts can be found in Part 0 – *Information for users*.

If a specific Part isn't available for a particular technology or system please contact the Head of Sustainability, Utilities and Engineering (hereafter 'Head of S.U.E') who will arrange its production or agree an interim set of principles and specifications.

1.0.3 Interpretation

This Part of the Design Guide may be referenced in project contractual documentation in order to control quality. The following interpretations apply:

Enforced requirements; the use of the word(s) 'shall', 'are required', 'is required' 'must' or 'will be' denotes a requirement that is non-negotiable and shall be used as the basis for designs, technical submissions and/or activities. If such a statement conflicts with a statutory obligation then a report to the Head of S.U.E shall be produced highlighting the conflict, for his or her final decision regarding compliance.

[1] http://www.ribaplanofwork.com

Requirements needing confirmation; the use of the word 'may' denotes a negotiable requirement or indication of a solution, where innovation and further calculation, design and discussion may be required to arrive at an optimised solution.

Quality; the Design Guide aims to arrive at UEA's highest design aspirations and standards. It may be that, at UEA's sole discretion, solutions are value engineered during subsequent design iterations. Designers are encouraged to consider where value engineering may result in an improved financial performance should funding constraints occur.

Currency of third party documents; where superseded standards and regulatory documents are referred to in the text, the reader shall apply current versions and disregard superseded versions.

Proof; where the word 'proof' is used e.g. 'proof is required', a written report or installation certificate must be produced for approval depending on context. Installation certificates shall comply with industry standards and expectations such as those set out in relevant CIBSE[2] and/or BSRIA[3] codes.

Approval and proof; all designs shall be approved by UEA. Approval shall be interpreted as meaning written approval from either UEA's appointed approving authority or by the Head of S.U.E where no other approving authority is appointed. Approvals shall be sought prior to design decision points or installation activities (depending on context) and shall be made in writing. Where approvals are sought, a written technical submission shall accompany the request setting out, with proof (e.g. calculations, drawings), the case for the approval. The purpose of the approval process is to ensure designs meet the strategic requirements of UEA.

1.0.4 Version control and updates

Any new or amended content is highlighted in yellow so readers can easily identify changes from previous versions. Where no yellow highlights exist the document either remains unchanged or it is the first version to be published.

1.0.5 Context for this Part of the Design Guide

The comfort of UEA staff and students is of primary importance and environmental comfort conditions must be at the forefront of the design. UEA has challenging carbon reduction targets to achieve and therefore projects must meet, in an affordable way, the environmental performance standards set out in subsequent parts of this Guide. New technologies and approaches must be carefully considered in terms of their whole life cost and technical risk.

UEA is both the developer and user of its buildings and so seeks buildings and systems that maximise whole life benefit while minimising negative environmental impact over the long term. At the outset of the design process for a significant project a BREEAM target will be set either by UEA or its funding providers and this target must be achieved or exceeded; UEA seeks genuine best practice and value for money as measured on a performance in use basis.

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[2] Chartered Institute of Building Services Engineers
[3] www.bsria.co.uk

1.1 Design Principles

1.1.1 Statement of principles

Below is a list of statements that convey UEA's design principles that shall be applied to all UEA designs. The order of the principles doesn't represent a hierarchy of importance.

- Designs shall meet the brief following detailed discussion and agreement regarding criteria, constraints, risks and process, as well as being:
- Designs must deliver a workable strategy for operating under future and current climatic conditions and for 40 years from the date of commissioning in consideration of projected future weather data;
- Conceived as part of a multidisciplinary approach;
- Accessible to all
- Safe to build, maintain, operate and decommission;
- Compliant;
- Resource efficient considering all resources consumed in construction, operation and at end of life;
- Reliable and avoiding complex building syndrome;
- Innovative following comprehensive risk analysis;
- Resulting from analysis of site specific data;
- Minimising negative environmental impact and promoting positive environmental impact;
- Giving value for money on a whole life cost basis;
- Flexible and adaptable in consideration of the likelihood of future growth and change;
- Resilient
- Able to be maintained, controlled, optimised, commissioned and re-commissioned effectively;
- Able to be monitored effectively with data logging functionality

The sections below explore each principle in greater detail including giving practical examples to demonstrate how the principles can be adhered to. Although the examples given are of an electrical and mechanical nature, the principles are applicable to all disciplines.

1.1.2 Designs shall meet the brief following a detailed discussion regarding requirements, constraints, risks and process

The requirements of buildings and projects developed at UEA are often specialist and therefore demanding of designers. Numerous specialist systems and conditions exist that present unusual design challenges and risks. The purpose of the Design Guide is to present an initial brief to designers and to facilitate a detailed and well informed discussion regarding solutions. UEA not only welcomes but insists that designers fully engage in such discussions at the brief development stage and ask any question required to ensure design briefs and processes are fully understood.

The university is promoting the move away from compliance checks to checks of Performance in Use (PIU) and so designers must ensure actual performance can be delivered. Key performance indicators and the scope of post occupancy evaluation exercises must be determined as part of the development of the brief and subsequent designs and specifications.

1.1.3 Designs must deliver a workable strategy operating for 40 years in consideration projected future weather data

Designs must produce a workable strategy for operating under current climatic conditions and for 40 years from the date of commissioning in consideration of the UKCIP02 climate change scenarios. CIBSE's *Future TRY/DSY Hourly Weather Data Set - Norwich*[4] shall be used in dynamic simulation applications to determine future weather related risk - the 2050's (text omitted) high scenario shall be used[5].

The purpose of this exercise is to understand how buildings or systems will behave in the future; to understand the level of risk that comfort criteria may not be met. It is not necessary to ensure future comfort criteria can be met on the day of commissioning but a workable strategy for the future must be included in the design.

For example, for a building requiring a cooling capacity of 250 kW when it's commissioned, it is not necessary to install the cooling capacity that might be required in 2050, as this would offer poor value for money. However, a workable strategy for operating in 2050 must be included in the design. Such a workable strategy might describe (for example) how additional shading can be used to reduce load, or it might detail the location of additional cooling plant required in the future. Where chilled water pipes run through inaccessible risers (staying with the same example) it would be a requirement of the design to size the pipes for the 2050 capacity requirement so that expensive fabric modifications can be avoided.

1.1.4 Multidisciplinary approach

Successful buildings and systems result from a joined-up approach between all stakeholders and contributors throughout the development programme. For example, the design of a cooling system for a building begins at the earliest stages of the building's design – RIBA Plan of Work stage 1[6]. The design may, for example, include a high degree of natural ventilation using civil engineering structures included in the building's fabric. In this case a

[4] Future CIBSE *TRY/DSY Hourly Weather Data Set Norwich* – Product Code WD16NOR
[5] As discussed as 'Future Weather Years' in 'TM48 2009 *Use of climate change scenarios for building simulation'* published by the Chartered Institute of Building Services Engineers
[6] http://www.ribaplanofwork.com

mechanical cooling system might be employed for 'peak lopping' only and so it would be important for the engineer designing the system to be aware of the whole cooling strategy.

This simplistic example illustrates how a multidisciplinary approach can save capital cost (it resulted in a system with less capacity) as well as operational cost (the wrongly sized larger system might have cycled more frequently using more power and requiring more maintenance and increased carbon emissions).

CIBSE[7]'s *TM57:2015 Integrated School Design* gives an overview of the integrated approach to design promoted by UEA as well as current thinking on how to achieve best practice educational environments.

1.1.5 Accessible to all

UEA requires a campus of equal opportunity that is accessible to all. In order to achieve this principle, UEA employs the concept of Universal Design. Ensuring equitable access ensures a high quality user experience for people with diverse abilities.

1.1.6 Safe to build, maintain, operate and decommission

All mechanical and electrical designs must be risk assessed using the 'UEA Design Risk Assessment Template'. Individual risk assessments must be signed off by the Head of S.U.E. Designers are reminded of their responsibilities as 'duty holders' under the CDM Regulations 2015 and are required to eliminate, reduce or control foreseeable risks that may arise during construction, maintenance, use and decommissioning of the project. Duty holders also have a responsibility to provide information to other members of the project team to help them fulfil their duties.

Duty holders are advised to seek guidance such as the HSE's '*Policy and guidance on reducing risks as low as reasonably practicable in Design*' or from similar publications.

1.1.7 Compliant

Compliance with national, regional and local regulation must be ensured as well as compliance with best practice guides published by chartering and other recognised industry bodies. However, sometimes regulation holds back appropriate innovation and in such cases UEA will consider challenging regulation. Designers meeting regulatory barriers to innovation should present their case to the Head of S.U.E.

1.1.8 Resource efficient considering all resources consumed in construction, operation and at end of life

UEA has a long history of developing award winning buildings. In 1998 the Elizabeth Fry building was proclaimed to be the Best Building ever by CIBSE and in 2005 the ZICER building won the Carbon Trust's Low Energy Building of the Year.

Resource efficiency is closely assessed by methodologies such as BREEAM[8] and is a key umbrella concept for developing buildings that have a low embodied and operational

[7] Chartered Institute of Building Services Engineers
[8] Building Research Establishment's Environmental Assessment Methodology

environmental footprint. UEA welcomes innovation with regards resource efficiency, especially where it accompanies cost savings.

1.1.9 Reliable and avoiding complex building syndrome

Reliability and innovation (which is the topic of the next section) might be considered to be mutually exclusive. Reliability *can* be borne out of innovation by careful analysis of risk, by the application of careful design and by studying existing similar and relevant cases.

Reliability often results from simplicity, using components that are tried and tested and supplied with robust warranties from companies able, in commercial terms, to honour their warranties. UEA's procurement framework aims to ensure reliable components are purchased from reliable companies.

Complex building syndrome can result from the integration of multiple M&E systems. This problem sometimes occurs due to poor fabric design or a multidisciplinary approach not being pursued at early stages of a project. M&E designers find themselves having to 'control' their way out of problems placing an over-reliance on complex controls integration, programming and maintenance. These design principles aim to ensure that projects avoid this problem by the application of good practice & process.

1.1.10 Innovative following comprehensive risk analysis

In order to meet challenging carbon targets and to develop exemplar buildings, UEA must innovate. Innovation can occur in a number of forms such as in administrative process development, in data analysis and the use of unusual materials or components or the way that more common components and materials are configured and used.

When proposing an innovative solution, a comprehensive risk analysis process must be agreed by and when completed presented to, the Head of S.U.E. Risks relating to health and environmental safety, commercial and reputational loss and technical failure shall be considered. Where the level of risk is considerable a feasibility study will be required to scope the nature and level of risk and to determine how risk can be effectively controlled.

1.1.11 Resulting from analysis of site specific data

Efficient solutions result from the comprehensive collection or projection of data and its analysis to determine accurate design parameters. For example, when sizing a heating system for a building, the use of standard heat loss tables (W/m^2) often results in systems being oversized. Oversizing, as discussed briefly above, may result in increased capital and operating costs and an unnecessarily high negative impact on the environment.

UEA seeks solutions based on advanced modelling/simulation techniques using inputs agreed at the start of the design stage. Inputs may be, for example, the pattern of varying occupancy of a building, the limits of comfort conditions on the hottest design day and such like. UEA can often provide hourly data (such as typical weather data) to support modelling processes and will give clear instruction regarding the outputs it seeks to assess suitability of design and whether value for money will be achieved.

Following the initial concept design and modelling process, a set of energy targets will be agreed between UEA and the designer. Actual performance of the new system will be measured as part of a 'Soft Landings[9]' approach so that lessons can be learned for future projects and retentions adjusted accordingly.

1.1.12 Minimising negative environmental impact and promoting positive environmental impact

In recent years measures to minimise environmental impact have become embedded in Building Regulations as well as some local authority planning application processes. As an innovator, UEA may require impact mitigation exceeding that imposed by existing regulatory frameworks.

Generally speaking UEA seeks buildings that are capable of achieving DEC ratings of A for new-build projects and B for refurbishment projects. Detailed energy and carbon performance in use specifications will be developed by the project team. UEA requires that all new build projects meet the requirements of the Passivhaus Classic Standard and refurbishments meet the EnerPHit standard, on the basis that capital costs for Passivhaus buildings are now comparable to buildings constructed using conventional methods.

The impact of constructing, operating and decommissioning buildings will be assessed using BREEAM or a similar methodology. As will be discussed below, a 'fabric first' approach is the preferred strategy to reducing operational impacts, combined with the use of low embodied energy construction materials.

In the 'fabric first' scenario reliance on mechanical HVAC systems can be reduced but a detailed understanding of their operating conditions becomes more critical. A further challenge is the integration of renewable energy technologies which often require high annual loads to be commercially feasible and reliable. This challenge is partly overcome by the centralisation of energy supply at UEA in the form of district heating and cooling systems and the onsite generation of low carbon electricity.

Connection to these systems is required of all new buildings and refurbishments. However, this should not dissuade designers from finding innovative ways to integrate renewable technologies that configure well with centralised energy systems. Solutions should be presented so a comprehensive risk analysis can be undertaken.

Designers shall consider the risks and opportunities relating to biodiversity for all projects. Designers must protect important wildlife habitats that exist at UEA and find innovative ways to promote biodiversity through changes to the built environment.

UEA enforces a policy that requires no net loss of biodiversity and reminds consultants and contractors of shared obligations under the EU Habitats Directive[10] and EU Birds Directive[11]. No net loss shall be interpreted as meaning loss in one location can be mitigated by gain in another location.

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9. See, for example, BSRIA BG54/14 Soft Landings Framework NEW EDITION 2014 (BG54/2014)

10 Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora

11 Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds

There shall be no loss of, or significant reduction in, the populations of protected species on UEA grounds. Biodiversity shall be maintained and enhanced by adhering to the management plan for each red and amber zone on the UEA grounds.

1.1.13 Value for money on a whole life cost basis

UEA disperses public funds and must be fully accountable for its expenditure. It applies a business centred methodology to all capital expenditure. UEA defines value for money on a whole life cost basis as often, the lowest capital cost approach results in higher operating costs over the long term. When costs are considered over the life of a *well-designed* asset, higher capital cost often results in reduced costs when measured over the whole life of the asset.

As part of the modelling processes discussed in Section 1.1.10 above, a cost model shall be developed to determine solutions that are optimised for minimum life cycle cost. The fabric first approach discussed in 1.1.11 above is an example of a strategy that returns a reduced life cycle cost. Another example is the rewinding of larger motors such as circulating pump motors. Rewinding has a lower cost than purchasing but if the motor is not manufactured to meet the requirements of the EuP[12] Directive, it will consume considerable more power than a new pump and so the new motor will have better value for money on a lifecycle cost basis.

1.1.14 Adaptable in consideration of the likelihood of future growth and change

It is anticipated that UEA will be in growth to 2030 and during this time it is likely that new buildings will be developed and existing buildings modified. Designs should consider the need for future flexibility. For example, it is a common trend for open plan spaces to be reconfigured into smaller rooms and so structural design should consider this potential for change. In this case various systems have to be expanded or modified upon such as fire alarms, the switching of individual luminaires, etc. Designs should consider the use of modular and expandable systems that can be adapted at minimum cost.

1.1.15 Resilient

Building systems shall be resilient by design and able to maintain critical service provision during planned maintenance procedures.

1.1.16 Able to be maintained, controlled, optimised, commissioning and recommissioned effectively

Designs shall inherently minimise the need for maintenance and then carefully consider how implemented systems and buildings will be serviced and maintained. It is not acceptable for example, to place a valve that needs annual maintenance behind a panel that prevents easy access.

Designs shall provide for sufficient measurement and control points to allow systems to be set-up to accurately meet their design requirements. For example, where a plate heat exchanger is used to integrate a building with the district heating network, sufficient sensors should be included to allow flow, temperature and pressure on both sides of the plate to be measured. In this example flow must be able to be fully regulated, e.g. by means of regulating valves or by modulating pumps. This approach allows systems to be set-up

[12] Energy Using Products Directive.

correctly and then optimised for changing conditions over time. All systems shall be open protocol i.e. if password protection is a requirement of the design then UEA shall be privy to the password or access code.

UEA uses Trend BMS exclusively.

1.1.17 Able to be monitored effectively with data logging functionality

Monitoring has a number of functions including:

- Ensuring systems are optimised for efficient operation
- For post occupancy evaluation
- Enabling energy billing of consumers
- Enabling government incentives for low carbon systems to be claimed

It is important that systems can be monitored effectively according to the needs of the project. For example, comparing lighting energy consumption in a building with industry benchmarks can only be achieved if lighting circuits are separated from other types of consumption; if circuits have mixed loads on them then lighting energy consumption cannot be accurately determined. For energy billing it is important that meters of sufficient accuracy are used that can also communicate via the correct buss protocol for centralised functionality.

Most monitoring and data logging will be achieved by means of the Trend BMS system. It is important to establish the monitoring and data logging needs of a project as part of the design brief at an early stage.

1.2 Design Principles - Summary

Buildings and systems designed in the 21st century must address the urgent need to mitigate environmental deterioration as well as ever increasing resource constraints, in an affordable way with controlled risk. UEA seeks designs that meet all current and proposed best practice standards as a minimum and promotes the development of exemplar buildings and systems.