RISCAuthority

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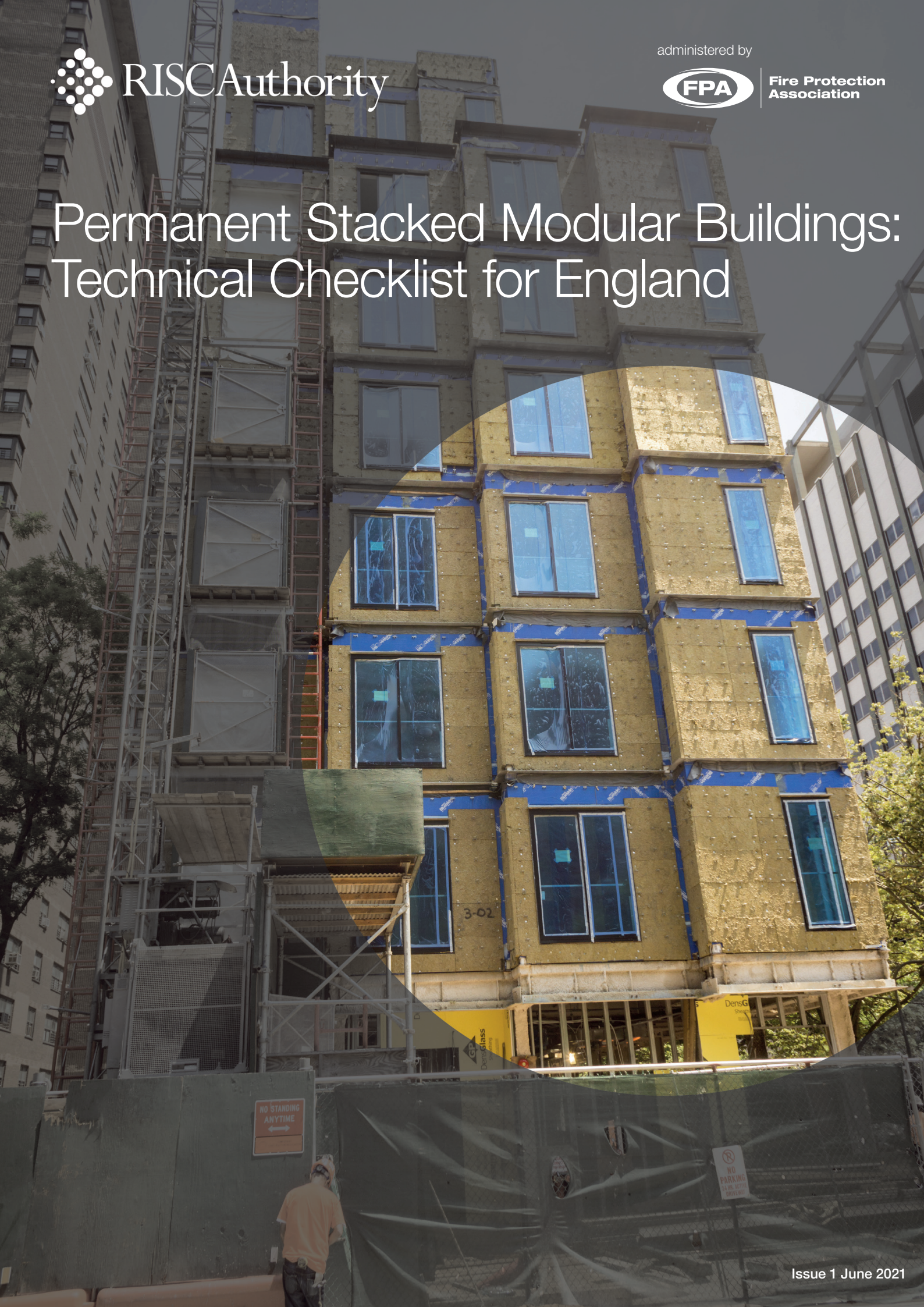
FPA Fire Protection Association

Permanent Stacked Modular Buildings: Technical Checklist for England



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Contents

The following verbal forms are used:
“shall” indicates a requirement
“should” indicates a recommendation
“may” indicates a permission
“can” indicates a possibility or a capability

Introduction – Compliance with the *2010 Building Regulations*

Modular Buildings involve far more than the manufacture, transportation and installation of room sized volumetric frames lined with plasterboard, decorated and fitted out. Modules are large and heavy components stacked into a building that is partly constructed on site. They must fit together, and in doing so the composition of the Permanent Stacked Modular Building must satisfy the *2010 Building Regulations*, including Schedule 1. Requirements.

The alphanumerical arrangement of Schedule 1. is the basis for this Technical Checklist, which corresponds to the higher level questions of Section 3 of the RISCAuthority publication *IQ8 Building system questionnaire: Permanent Stacked Modular Buildings – Version 1.0*.

The Parts of Schedule 1. Requirements are arranged as follows:

A Structure

B Fire Safety

C Site Preparation and Resistance to Contaminants and Moisture

D Toxic Substances

E Resistance to the Passage of Sound

F Ventilation

G Sanitation, Hot Water Safety and Water Efficiency

H Drainage and Waste Disposal

J Combustion Appliances and Fuel Storage Systems

K Protection from Falling, Collision and Impact

L Conservation of Fuel and Power

M Access to and Use of Buildings

N Glazing – Safety in Relation to Impact, Opening and Cleaning

P Electrical Safety

Letters "I" and "O" are not used to avoid confusion with Numbers "1" and "0".

The *2010 Building Regulations*, including Schedule 1. Requirements, shall be complied with. How compliance is achieved is a matter for the building owner, and the consultants and contractors they employ as a client.

These A to P Parts of Schedule 1. Requirements in the *2010 Building Regulations* are supported with a corresponding series of alphabetical Approved Documents in England, published as statutory guidance under the powers in Section 6 of the *1984 Building Act*. The Secretary of State publishes a series of Approved Documents that are updated over time to give practical guidance about how to meet the requirements of the *2010 Building Regulations*. In addition, there are Approved Documents for aspects of construction that are not included in Schedule 1. Requirements:

Q Security in Dwellings
R High Speed Electronic Communications Networks

Approved Document 7 – Material and Workmanship

Approved Document 7 refers to Regulation 7 of the *2010 Building Regulations*, which has been amended by the *2018 Building (Amendment) Regulations*. Regulation 7(1) for materials and workmanship applies to the whole building, across all aspects of the construction, while Regulations 7(2) and 7(3) are concerned with the Reaction to Fire of the external wall of "Relevant Buildings" defined in Regulation 7(4).

https://www.legislation.gov.uk/uksi/2018/1230/made

Approved Documents give statutory guidance on the *2010 Building Regulations* including Regulation 7. The building owner as the client, and their consultants and contractors, may choose to achieve compliance with the *2010 Building Regulations* in England by following the Approved Documents.

Although Approved Documents provide guidance for some common building situations, compliance with the statutory guidance does not provide a guarantee of compliance with the *2010 Building Regulations* because the Approved Documents cannot cater for all circumstances, variations and innovations.

Those with responsibility for meeting the *2010 Building Regulations* shall consider for themselves whether following the guidance in the Approved Documents is likely to meet the requirements in the particular circumstances of their case. Modular buildings may be regarded as uncommon, requiring special attention to the requirements of the *2010 Building Regulations* from first principles.

After specialist consideration it may be decided by persons carrying out partially Systemised works of Modular buildings that the Approved Documents provide sufficient statutory guidance for compliance with the *2010 Building Regulations*. That consideration in early Work Stages shall be recorded.

Some Approved Documents include provisions that must be followed exactly, as required by regulations or where methods of test or calculation have been prescribed by the Secretary of State.

There may be other ways to comply with the *2010 Building Regulations* than the methods described in an Approved Document. If the building owner as a client, or their consultants and contractors, prefer to meet a relevant requirement in some other way than that described in an Approved Document, they shall seek to agree this with the relevant Building Control Body at an early Work Stage. It is Section 7 of the 1984 Building Act that addresses compliance or non-compliance with the Approved Documents:

> *7(1) A failure on the part of a person to comply with an approved document does not of itself render him liable to any civil or criminal proceedings; but if, in any proceedings whether civil or criminal, it is alleged that a person has at any time contravened a provision of building regulations –*
>
> *(a) failure to comply with a document that at that time was approved for the purposes of that provision may be relied upon as tending to establish liability, and*
>
> *(b) proof of compliance with such a document may be relied on as tending to negative liability.*
>
> https://www.legislation.gov.uk/ukpga/1984/55/section/7

It is ultimately for the courts to determine whether the *2010 Building Regulations* have been met.

Where the statutory guidance in the Approved Document has been followed, a court may tend to find that there is no breach of the *2010 Building Regulations*. However, where the guidance in the Approved Document has not been followed, this may be relied upon as tending to establish breach of the regulations.

Whether the Approved Documents are followed or departed from, the persons carrying out building works should demonstrate that the requirements of the *2010 Building Regulations* have been complied with by acceptable means or methods. Building work must comply with all other applicable requirements of the *2010 Building Regulations* and all other applicable legislation.

Each Approved Document relates only to the particular requirements of the *2010 Building Regulations* that the document addresses. There are interrelationships between the Approved Documents for the building as a whole, and a Permanent Stacked Modular Building requires a holistic approach, being more than the Modules alone. The System of Modules includes the gaps between them, and their interfaces with construction built on site.

The Approved Documents specifically refer to British Standards within the text for alternative means of compliance. Notably Approved Document Part B approves Fire Safety Engineering:

> *0.18 Fire safety engineering might provide an alternative approach to fire safety. Fire safety engineering may be the only practical way to achieve a satisfactory standard of fire safety in some complex buildings and in buildings that contain different uses.*
>
> *Fire safety engineering may also be suitable for solving a specific problem with a design that otherwise follows the provisions in this document.*
>
> *0.19 BS 7974 and supporting published documents (PDs) provide a framework for and guidance on the application of fire safety engineering principles to the design of buildings.*

The uncommon character of complex Permanent Stacked Modular Buildings may suggest adoption of British Standards, and notably reliance upon *BS 7974: 2019 Application of fire safety engineering principles to the design of buildings. Code of practice* with the supporting Published Documents.

https://www.bsigroup.com/en-GB/our-services/product-certification/industry-sector-schemes/fire-testing-and-certification/bs-7974-fire-safety/

This document consequently includes the prior question about Fire Engineering to BS 7974.

B0.1 Has the discipline of Fire Engineering been adopted on the project?

For ease of reading this document the device of "0" sections have been added, which may be developed in future revisions, and added to. These are currently limited to:

B0 Fire engineering

E0 Acoustic engineering

Where a fire engineer or acoustician is instructed to the Permanent Stacked Modular Building project their earliest instruction in the RIBA Plan of Work Stages may be recommended to support other design consultants, including the architect and structural engineer. Modular buildings require particular attention to fire and acoustic performance in design and construction, and not all architects will profess sufficient expertise. The fire and acoustic engineers may not be sufficiently familiar with the proprietary Modular System being considered.

The appointment of a specialist Modular manufacturer under a Pre-Contract Services Agreement may be made prior to any application for Planning Approval. The Modular manufacturer may provide specialist consultancy to support the client's appointed consultants in consideration of the *2010 Building Regulations.*

The architect may additionally rely upon the advice of a façade engineer, sharing their concerns across several Schedule 1. Requirements. Like the architect the façade engineering profession is not focused on isolated Schedule 1. Requirements, as the professions of structural, fire and acoustic engineering may tend to be. All aspects of the *2010 Building Regulations* must be addressed.

The architect has a contractual responsibility as well as a general overview in their professional appointment with regard to the *2010 Building Regulations*. For that reason, the architect may be identified by the client as the "Lead Consultant", coordinating design specialists through Forms of Contract that variously overlap with the construction phase. Other designated roles of responsibility are established through legislation, and further advice is provided in the *RIBA Plan of Work 2020*:

https://www.architecture.com/knowledge-and-resources/resources-landing-page/riba-plan-of-work

Under the *2005 Regulatory Reform (Fire Safety) Order* the building owner or operator shall have appointed a Responsible Person who shall be satisfied with the Regulation 38 Information Exchange in the *2010 Building Regulations*. This may best be achieved by involvement of the Responsible Person earlier in the Work Stages. This document includes a section on aspects of Work Stages 6 and 7, which coincidentally are numbered, and as with additional sections "0" highlighted in BLUE:

B6 Handover of building under contract

B7 Occupation of building in use

Early in the design development a Movement and Tolerances Report is initiated and sophisticated, led by the client's structural engineer. The Movement and Tolerances Report is a good place to start to think about how the Part A Structure of the Schedule 1. Requirements are satisfied. It shall be informed by any fire engineering instructed with particular regard to Part B Fire Safety.

A1.1 Has a Movements and Tolerances Report been produced for the building?

Before starting with Question A1.1, it is useful to note the way questions and their answers can be arranged in increasing technical detail to follow the Parts in Schedule 1. Requirements.

Levels of Questions

The higher level questions summarised in Section 1 of this *Permanent Stacked Modular Buildings: Technical Checklist for England – Issue 01* correspond to Section 3 of the RISCAuthority publication *IQ8 Building System Questionnaire: Permanent Stacked Modular Buildings – Version 1.0*.

Checklist Section 1 – Summary of Higher Level Questions

This higher level of answers may initially be sufficient for the Insurer, but the answers may also lead to further questioning at a lower level of technical detail as aspects of the Building become apparent.

Checklist Section 2 – Summary of Lower Level Questions

This lower level of answers may be required by the Insurer to explore the technical detail of the Building as specific issues become apparent and serves as a contents list for the detail that follows.

Checklist Section 3 – Technical Exploration of Lower Level Questions

The lower level answers address a range of issues that may require contributions from several specialists involved in the design and construction of the Permanent Stacked Modular Building. The text of the Parts of Schedule 1. Requirements are included in each Part of Section 3 of *Permanent Stacked Modular Buildings: Technical Checklist for England – Issue 01*, and highlighted in **RED**, but reference shall be made to the arrangement of the published legislation online.

https://www.legislation.gov.uk/uksi/2010/2214/schedule/1

It is expected that over time this technical exploration will further develop into a useful guide to the issues involved in Permanent Stacked Modular Buildings as they affect the insurability of the property additional to the requirement for life safety in the *2010 Building Regulations*.

Feedback on these issues is very important to RISCAuthority. We welcome further questions and criticism of the purpose and content of this questionnaire and will endeavour to incorporate corrections and improvements in the development of subsequent Versions of the RISCAuthority publication *IQ8 Building System Questionnaire: Permanent Stacked Modular Buildings*.

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Checklist Section 1: Summary of Higher Level Questions to Schedule 1. Requirements

This higher level of answers may initially be sufficient for the Insurer, but the answers may also lead to further questioning at a lower level of technical detail as aspects of the Building become apparent.

Part A Structure

A1 Loading

A1.1 Has a Movements and Tolerances Report been produced for the building?

A1.2 What is the form of construction above the below Ground works?

A1.3 How has total Dead Load support been considered through the building?

A1.4 What is the Differential Vertical Movement due to Dead Load?

A1.5 How has Vertical Deflection as a result of imposed Live Loads been considered?

A1.6 What are the Wind Load assumptions based in Weather projections?

A1.7 How has Horizontal Sway in the Structure due to Wind Load been considered?

A1.8 How has the Façade Movement due to Wind Load been considered?

A2 Ground movement

A2.1 How have Ground Conditions been ascertained by the Structural Engineer?

A2.2 What is the relationship of Foundation design to Movement Joint requirements?

A3 Disproportionate collapse

A3.1 How has accidental Disproportionate Collapse been considered?

Part B Fire Safety

B0 Fire engineering

B0.1 Has the discipline of Fire Engineering been adopted on the project?

B1 Means of warning and escape

B1.1 How does the Detection and Alarm System relate to the Escape Provision?

B1.2 What is the Means of Escape in the fire situation?

B1.3 How is Smoke and Heat Exhaust Ventilation (SHEV) achieved in Escape Corridors?

B1.4 How has the construction of the Mechanical SHEV System been achieved?

B1.5 How has the construction of the Mechanical SHEV System been verified?

B1.6 How has the construction of the Natural SHEV System been achieved?

B1.7 How has the construction of the Natural SHEV System been verified?

B2 Internal fire spread (linings)

B2.1 What are the Internal Linings?

B3 Internal fire spread (structure)

B3.1 Has the Modular System been Fire Tested and Fire Engineering Assessed?

B3.2 How is Stability of the Primary Structure of the Module Stack maintained?

B3.3 How is the Interior of the Module constructed to be Fire Resistant?

B3.4 Where do Vertical Deflections in Risers and Shafts require Movement Joints?

B3.5 How have extensive Cavities within the Module Stack been constructed?

B4 External fire spread

B4.1 How is the Spread of Fire adequately resisted from one building to another?

B4.2 Where is the External Wall of the Module constructed to be Fire Resistant?

B4.3 How is the Spread of Fire adequately resisted over the External Walls?

B4.4 How is the Spread of Fire adequately resisted over the Roof?

B5 Access and facilities for the fire service

B5.1 What facilities assist fire fighters in the protection of life and property?

B5.2 What facilities are provided within the site of the building to enable fire appliances to be used near the building?

B6 Handover of building under contract

B6.1 How was Building Regulation 38 complied with?

B7 Occupation of building in use

B7.1 Which “purpose group” is the building within, or is it “mixed use”?

B7.2 What are the specific fire hazards and risks facing occupants?

Part C Site Preparation and Resistance to Contaminants and Moisture

C1 Preparation of site and resistance to contaminants

C2 Resistance to moisture

C2.1 How has the Façade been designed to provide Resistance to Moisture?

C2.2 How has the Façade with Attachments been coordinated with the Modules?

C2.3 Has the Façade construction been Hose tested for Weathertightness?

C2.4 What measures were taken to prevent Water Leakage from Sanitary Areas?

Part D Toxic Substances

D1 Cavity insulation

Part E Resistance to the Passage of Sound

E0 Acoustic engineering

E0.1 What are the Acoustic issues for the site to be addressed by the Façade?

E0.2 What Acoustic Engineering has informed both design and construction?

E1 Protection against sound from other parts of the building and adjoining buildings

E2 Protection against sound within a dwelling-house etc.

E3 Reverberation in common internal parts of buildings containing flats or rooms for residential purposes

E4 Acoustic conditions in schools

Part F Ventilation

F1 Means of ventilation

F1.1 How is Ventilation achieved through the Façade?

F1.2 How is any Mechanical Ventilation verified by Commissioning?

Part G Sanitation, Hot Water Safety and Water Efficiency

G1 Cold water supply

G2 Water efficiency

G3 Hot water supply and systems

G4 Sanitary conveniences and washing facilities

G5 Bathrooms

G6 Kitchens and food preparation areas

Part H Drainage and Waste Disposal

H1 Foul water drainage

H2 Wastewater treatment systems and cesspools

H3 Rainwater drainage

H3.1 How is Rainwater managed in the Façade from Roof, Terrace or Balcony areas?

H4 Building over sewers

H5 Separate systems of drainage

H6 Solid waste storage

Part J Combustion Appliances and Fuel Storage Systems

J1 Air supply

J2 Discharge of products of combustion

J3 Warning of release of carbon monoxide

J4 Protection of building

J4.1 Does the building incorporate separate Combustion Appliances with Flues?

J5 Provision of information

J6 Protection of liquid fuel storage systems

J7 Protection against pollution

Part K Protection from Falling, Collision and Impact

K1 Stairs, ladders and ramps

K2 Protection from falling

K2.1 How does the Façade provide Protection from Falling?

K3 Vehicle barriers and loading bays

K4 Protection from collision with open windows etc.

K5 Protection against impact from and trapping by doors

Part L Conservation of Fuel and Power

L1 Conservation of fuel and power

L1.1 How has Architectural Fenestration been designed to be Energy Efficient?

L1.2 Does the need for Daylighting satisfy other Requirements?

L1.3 How has Thermal Performance been achieved without Condensation Risk?

L1.4 Has the construction been monitored using Thermographic methods?

L1.5 Has the completed building been Air Tightness Tested?

L1.6 How were the Building Services Commissioned?

L1.7 How does the completed building relate to Energy and Emissions Regulations?

Part M Access to and Use of Buildings

M1 Access and use

M2 Access to extensions to buildings other than dwellings

M3 Sanitary conveniences in extensions to buildings other than dwellings

M4 Sanitary conveniences in dwellings

Part N Glazing – Safety in Relation to Impact, Opening and Cleaning

N1 Protection against impact

N1.1 How is Safety of Glazing ensured in the Façade?

N2 Manifestation of glazing

N2.1 What Glass Manifestation measures are provided?

N3 Safe opening and closing of windows etc.

N3.1 How is the building envelope fitted with openable and adjustable elements?

N4 Safe access for cleaning windows etc.

N4.1 How is façade access safely achieved?

Part P Electrical Safety

P1 Design and installation

P1.1 How has Earth Continuity been achieved?

P1.2 What is the Lightning Protection System required on the building?

Part Q Security in Dwellings

Q1 Secured by Design

Q1.1 How is Security achieved in the building if Residential?

Part R High Speed Electronic Communications Networks

Approved Document 7 – Material and Workmanship

AD7.1 Have the works been procured from Contractors operating a Quality Management System?

AD7.2 Where is the Register of Third Party verified As-Built record Drawings kept by the Facilities Manager?

AD7.3 Where are the Technical Submittals made during manufacturing, assembly and site built construction compiled in an Operations and Maintenance Manual maintained by the Facilities Manager?

AD7.4 How were the *2015 Construction (Design and Management) Regulations* complied with prior to handover to the Facilities Manager?

AD7.5 Where are the maintenance requirements fully defined?

AD7.6 Has a programme of Building User Training been provided to the Facilities Manager?

Checklist Section 2: Summary of Lower Level Questions to Schedule 1. Requirements

This lower level of answer may be required by the Insurer to explore the technical detail of the Building as specific issues become apparent and serves as a contents list for the detail that follows.

Part A Structure

A1 Loading

A1.1 Has a Movements and Tolerances Report been produced for the building?

A1.1.1 How are the manufacturing and installation tolerances resolved between site construction, such as the Foundations or the Core, and the manufacture of Modules to be stacked on site?

A1.1.2 How do those tolerances relate to movements in the construction supported by primary structure?

A1.2 What is the form of construction above the below Ground works?

A1.2.1 What is the primary structural slab supporting the Module stack?

A1.2.2 What is the form of the Stair and Lift Core which may contain a Fire Fighting Lift and Rising Main?

A1.2.3 What is the proprietary Modular System?

A1.2.4 Does the Modular System have an Insurance backed Structural Warranty?

A1.2.5 Who is the Warranty provider?

A1.2.6 What is the Structural Warranty period?

A1.2.7 What are the Terms and Conditions of the Warranty in relation to the site built primary structure?

A1.2.8 Is the Modular manufacturer a Member of Build Offsite as part of the Construction Industry Research and Information Association able to demonstrate a longevity of membership?

A1.2.9 Which CIRIA guidance has the Modular manufacturer complied with?

A1.2.10 Is the Modular System durability Certified by BOPAS for a 60 Year Design Life based on assessment by BLP Insurance, underwritten by Lloyds Register?

A1.3 How has total Dead Load support been considered through the building?

A1.3.1 How have the Dead Load limits in the Modules been calculated, including their fit-out?

A1.3.2 How much of the façade is to be completed on site?

A1.3.3 What are the characteristics of the different façade Systems, and which Product Standards apply?

A1.3.4 What is the allowance for the Dead Load of façade Systems built on site, which may include Balconies or other attachments,including the prospect of Rainwater Outlet blockage creating a head of water, and the weight of a depth of Snow?

A1.3.5 What is the allowance for the Dead Load of the built-up Roof or Terrace, which may be a Green or Blue Roof, including the prospect of Rainwater Outlet blockage creating a head of water, and the weight of a depth of Snow?

A1.3.6 What is the allowance for the Dead Load distribution of anticipated Building Services in the Roof Plant Area in addition to a Roof Plant Screen and External Support Frame?

A1.3.7 What is the allowance for a Building Maintenance Unit, which moves on a heavy Track system causing the Dead Load to travel over the primary structure?

A1.4 What is the Differential Vertical Movement due to Dead Load?

A1.4.1 What are the critical Vertical Movement joints on the project?

A1.4.2 How will the critical detail restraining the Module stack to the Core accommodate Differential Vertical Movement over time while being Fire Protected and achieving Compartmentation?

A1.4.3 Has agreement on Differential Vertical Movement due to Dead Load been achieved between the structural engineer for the site built Concrete Core and the specialist structural engineer for the manufacturer of the Modules, to be resolved in a consolidated Movement and Tolerances Report?

A1.4.4 Is there a dimensional range of possible shortening in the Concrete Core?

A1.4.5 How is the difference in floor levels at the threshold between the Module and the Core resolved as a Vertical Movement Joint detail without creating a trip hazard?

A1.4.6 Have all pairs of Module columns in stacks been engineered to shorten equally without introducing shear into horizontal bolted connections between them?

A1.4.7 Was shortening under Dead Load taken into account in the manufacture of Modules to design out the need for Shimming during installation?

A1.4.8 What was the method statement as a sequence of installation for the Module stack anticipating the temporary Weathering, ensuring that horizontal and vertical Cavities between Modules are correctly Fire Stopped, and achieving Services connections in the Risers?

A1.5 How has Vertical Deflection as a result of imposed Live Loads been considered?

A1.5.1 What are the Live Loads imposed on the partly Modular building?

A1.5.2 What are the Vertical Deflection limits for structural support of the External Backing Wall infill construction, Cladding, Glazing and Balconies or other attachments in a non-fire situation, either as Span/X or X mm, whichever is the lesser?

A1.5.3 How have the Vertical Deflection limits for structural support of the External Backing Wall infill construction, Cladding, Glazing and Balconies or other attachments in a fire situation been anticipated, tested, assessed and engineered?

A1.5.5 Where at the corners and on different elevations of the building does the structural support of the External Backing Wall infill construction, Cladding, Glazing and Balconies or other attachments also support the Internal Floor?

A1.5.6 What are the Vertical Deflection limits for the Internal Floor accumulative to the Vertical Deflection limits of the primary structure in a non-fire situation, either as Span/X or X mm, whichever is the lesser?

A1.5.7 How have the Vertical Deflection limits for the Internal Floor accumulative to the Vertical Deflection limits of the primary structure in a fire situation been anticipated, tested, assessed and engineered?

A1.5.8 How have the most onerous Vertical Deflection limits for the Internal Floor accumulative to the Vertical Deflection limits of the primary structure in a non-fire or fire situation informed the construction of the interior of External Backing Wall infill construction and Internal Walls?

A1.5.9 What are the Vertical Deflections due to imposed Live Load at the mid-span of the Floor?

A1.5.10 How will the gaps between Modules in a stack be Fire Stopped to prevent extensive horizontal and vertical Cavities when the Internal Floor deflects and the Soffit receives no imposed Live Load?

A1.6 What are the Wind Load assumptions based in Weather projections?

A1.6.1 What is the basis for the magnitude and direction of Wind Loads that are expected to be imposed on the partly Modular building over the Design Life, in the specific location?

A1.7 How has Horizontal Sway in the Structure due to Wind Load been considered?

A1.7.1 What are the Total absolute and accumulative Storey height Horizontal Displacement limits for the primary structure in a non-fire situation, either as Height/X or X mm, whichever is the lesser?

A1.7.2 Do the Modules provide any structural resistance to Horizontal Displacement by Wind Loads on the Façade of the Module stack,or does the single or multiple Core resist all Wind Loads?

A1.7.3 How have the Horizontal Displacement limits for fire protected primary structure been anticipated, tested, assessed and engineered in a fire situation, whether within stacked Modules or a Core or Cores?

A1.7.4 Has Wind Sway been taken account of during construction to prevent damage to restraint fixings using temporary bracing related to the sequence of stacking Modules around a single Core, or between Cores?

A1.8 How has the Façade Movement due to Wind Load been considered?

A1.8.1 How has the primary structure been designed in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering consultancy to assist the structural engineer?

A1.8.2 How are Wind Loads transferred through the façade System layers to the primary structure?

A1.8.3 What are the Storey height Horizontal Displacement limits for the various façade Systems in a non-fire situation, either as Height/X or X mm, whichever is the lesser?

A1.8.4 How is the façade system engineered to accommodate movement of the primary structure in a fire situation without mechanical failure at affected Storeys?

A1.8.5 What are the variations in the External Backing Wall infill construction to accommodate fenestration?

A2 Ground movement

A2.1 How have Ground Conditions been ascertained by the Structural Engineer?

A2.1.1 What geotechnical investigations have been undertaken?

A2.1.2 Is the Foundation structure including any Basement Storey engineered and constructed to achieve compliance with Requirement A2 Ground Movement of Schedule 1.?

A2.2 What is the relationship of Foundation design to Movement Joint requirements?

A2.2.1 Where do the Foundations introduce critical Vertical Movement joints or require details that prevent Differential Vertical Movement on the project?

A2.2.2 Where do the Foundations introduce critical Horizontal Movement joints on the project?

A2.2.3 Have Horizontal Movement joints in Foundations been maintained through primary structure, infill construction and the façade?

A3 Disproportionate collapse

A3.1 How has accidental Disproportionate Collapse been considered?

A3.1.1 What are the anticipated accidental hazards that may present a risk of disproportionate collapse?

A3.1.2 What provision against disproportionate collapse has been factored into the structural engineering design submitted to Building Control, with the consolidated Movement and Tolerances Report?

Part B Fire Safety

B0 Fire engineering

B0.1 Has the discipline of Fire Engineering been adopted on the project?

B0.1.1 Which standards are referred to in the design and construction of the Modular building when the statutory guidance in Approved Document Part B Volumes 1 and 2 (2019 to 2020) is considered insufficient for the design and construction to comply with Part B Fire Safety of Schedule 1.?

B1 Means of warning and escape

B1.1 How does the Detection and Alarm System relate to the Escape Provision?

B1.1.1 What are the assumptions made for the Evacuation of the building?

B1.1.2 How do the Fire and Rescue Service establish Fire Fighting Operations in the event of fire?

B1.2 What is the Means of Escape in the fire situation?

B1.2.1 How is Compartmentation maintained when the Escape Corridors are segmented in a series of Modules stacked adjacent to each other on a Storey?

B1.3 How is Smoke and Heat Exhaust Ventilation (SHEV) achieved in the Escape Corridors?

B1.3.1 What is the SHEV System to keep the Escape Corridor clear?

B1.4 How has the construction of the Mechanical SHEV System been achieved?

B1.4.1 How is the SHEV System contracted to avoid split responsibilities?

B1.4.2 What is the Mechanical SHEV System Equipment on the Roof?

B1.4.3 How is the Equipment protected from the weather at Roof level?

B1.4.4 What weathered Louvre arrangement is required to prevent water ingress?

B1.4.5 What were the access requirements of the specialist SHEV System contractors?

B1.4.6 What is the arrangement of Dampers and Doors in the Escape Corridor?

B1.4.7 Which Product Standard have the Dampers and Doors been specified and tested to?

B1.4.8 How does the Mechanical SHEV System relate to Alarm and Detection Systems and any Fire and Rescue Service control?

B1.5 How has the construction of the Mechanical SHEV System been verified?

B1.5.1 Was the segmentally stacked Smoke Shaft pressure tested for leakage either as a SHEV Shaft without Fire Resisting Ductwork or as a Riser Compartment containing Fire Resisting Ductwork?

B1.5.2 Has the operation of the Mechanical SHEV System been Third Party Certified?

B1.5.3 Has the same Third Party Certifier been instructed to verify any associated Natural SHEV Systems and report on their functional compatibility in design and construction?

B1.6 How has the construction of the Natural SHEV System been achieved?

B1.6.1 What is the arrangement of Natural Smoke Vents in the Escape Corridor?

B1.6.2 How are the Natural Smoke Vents electromechanically equipped and controlled to be Automated Opening Vents (AOV)?

B1.6.3 Which Product Standard have the Smoke AOVs been specified and tested to?

B1.6.4 How does the Natural Smoke AOV System relate to Alarm and Detection Systems and any Fire and Rescue Service control?

B1.7 How has the construction of the Natural SHEV System been verified?

B1.7.1 Has the operation of the Natural SHEV System been Third Party Certified?

B1.7.2 Has the same Third Party Certifier been instructed to verify any associated Mechanical SHEV Systems and report on their functional compatibility in design and construction?

B2 Internal fire spread (linings)

B2.1 What are the Internal Linings?

B2.1.1 Do the internal linings perform a fire resisting function in the Modular System?

B2.1.2 What is the Reaction to Fire of the internal linings in the different parts of the building?

B3 Internal fire spread (structure)

B3.1 Has the Modular System been Fire Tested and Fire Engineering Assessed?

B3.1.1 What Fire Testing has been undertaken on the Modular System?

B3.1.2 How have Fire Engineering Assessments been carried out based on Test evidence?

B3.1.3 How have the competency Levels of named Assessors undertaking Complex Fire Engineering Assessments been demonstrated?

B3.2 How is Stability of the Primary Structure of the Module Stack maintained?

B3.2.1 Has Stability been tested to National or European Standards?

B3.2.2 Is the fire resistance period of Stability expected of the primary structure in Requirement B3-(1) extended to allow time for compliance with Requirement B5 of Schedule 1., to provide a period of safe access and facilities for the Fire and Rescue Service to ensure the safety of occupants and fight the fire?

B3.2.3 What approach to Fire Protection is adopted to ensure that period of Stability in the Module stack?

B3.3 How is the Interior of the Module constructed to be Fire Resistant?

B3.3.1 Has Stability, Integrity and Insulation been tested to National or European Standards?

B3.3.2 What is the fire resistance of the single sided Internal Floor in terms of Stability, Integrity and Insulation to achieve Compartmentation as Requirement B3-(3)(a) of Schedule 1.?

B3.3.3 How is the fire resistance of the Internal Floor achieved to prevent fire burning down into the Cavity above the top of the Module below?

B3.3.4 How does the interface of the Floor with the Base of the Internal Wall maintain Compartmentation?

B3.3.5 What is the fire resistance of the single sided Internal Soffit in terms of Stability, Integrity and Insulation to achieve Compartmentation as Requirement B3-(3)(a) of Schedule 1.?

B3.3.6 How is the fire resistance of the Internal Soffit achieved above the non-fire resisting Ceiling to prevent fire burning up into the Cavity below the base of the Module above?

B3.3.7 How does the interface of the Soffit with the head of the Internal Wall maintain Compartmentation?

B3.3.8 What are the fire resistances of single sided Internal Walls between Modules in terms of Stability, Integrity and Insulation to achieve Compartmentation as Requirement B3-(3)(a) of Schedule 1.?

B3.3.9 How is the fire resistance of the pair of Internal Walls achieved to prevent fire burning into the Cavity between the Modules?

B3.3.10 How do the interfaces of the head of the single sided Internal Wall and the Soffit and the base of the single sided Internal Wall and the Floor maintain Compartmentation?

B3.3.11 What are the fire resistances of double sided Internal Walls between Module room accommodation and horizontal Corridors or vertical Service Risers in terms of Stability, Integrity and Insulation to achieve Compartmentation as Requirement B3-(3)(a) of Schedule 1.?

B3.3.12 How is the fire resistance of the Internal Walls forming Corridors and Service Risers achieved?

B3.3.13 How do the interfaces of the head of the double sided Internal Wall and the Soffit and the base of the double sided Internal Wall and the Floor maintain Compartmentation?

B3.4 Where do Vertical Deflections in Risers and Shafts require Movement Joints?

B3.4.1 How are segmented Service Risers constructed to maintain their fire resistance as Compartments over the full height of the Module stack when Vertical Deflections require Movement Joints?

B3.4.2 How will access to initially install, subsequently inspect, maintain and periodically replace Fire Stopping in Service Risers be achieved?

B3.4.3 What is the Service Life of the Fire Stopping at Service Riser Movement Joints?

B3.4.4 How are segmented Smoke and Heat Exhaust Ventilation (SHEV) Shafts constructed to maintain their fire resistance as Compartments over the full height of the Module stack when Vertical Deflections require Movement Joints?

B3.4.5 How will access to initially install, subsequently inspect, maintain and periodically replace Fire Stopping in the SHEV Shafts be achieved?

B3.4.6 What is the Service Life of the Fire Stopping at SHEV Shaft Movement Joints?

B3.5 How have extensive Cavities within the Module Stack been constructed?

B3.5.1 Have the concealed spaces of the horizontal and vertical Cavities between Modules, or between Modules and the Core, been constructed to comply with Requirement B3-(4) of Schedule 1. using non-combustible materials and Fire Stopping?

B3.5.2 Has Integrity and Insulation for Fire Stopping been tested to National or European Standards?

B3.5.3 Have the concealed spaces of the horizontal and vertical Cavities between Modules, or between Modules and the Core, been constructed with materials and products containing Fire Retardants to achieve better reaction to fire Classifications?

B3.5.4 Has the Fire Stopping for Cavities between Modules, or between Modules and the Core, been fire tested for the proprietary Modular System, or the project specific Modular stack?

B3.5.5 Were fire tests carried out on the range of compressions of the Fire Stopping due to Vertical Deflections expected in the primary structure engineered for compliance with Requirement A1-(1) of Schedule 1.?

B3.5.6 What is the Design Life of the building?

B3.5.7 Has the Service Life of Fire Stopping been proven equal to the Design Life of the building?

B3.5.8 If the Service Life of Fire Stopping is less than the Design Life, how will it be periodically replaced?

B3.5.9 What is the combustibility of Temporary Weathering Membrane protecting the individual Modules in storage, transportation, installation and while the Module stack is enclosed by any façade and the Roof built on site?

B3.5.10 Is there Third Party evidence of installation of all fire resistance tested fire stopping of otherwise extensive cavities within the compartmentation at the horizontal and vertical joints between Modules, or between Modules and the Core(s), during construction?

B3.5.11 When fire propagates to a hidden and potentially combustible void or cavity is there an understanding of how fire spread will be mitigated and ultimately extinguished?

B4 External fire spread

B4.1 How is the Spread of Fire adequately resisted from one building to another?

B4.1.1 What is the extent of fire resisting construction in the façade?

B4.2 Where is the External Wall of the Module constructed to be Fire Resistant?

B4.2.1 Has Stability, Integrity and Insulation been tested to National or European Standards?

B4.2.2 What are the fire resistances of double sided External Backing Wall as infill construction in terms of Stability, Integrity and Insulation to achieve Compartmentation as Requirement B3-(3)(a) of Schedule 1.?

B4.2.3 Does the specification of fire resistance address both sides of the External Backing Wall?

B4.2.4 Where required, how is the fire resistance of the External Backing Wall as infill construction achieved?

B4.2.5 How do the interfaces of the head of the External Wall and the Soffit and the base of the External Wall and the Floor maintain Compartmentation?

B4.3 How is the Spread of Fire adequately resisted over the External Walls?

B4.3.1 How has the façade been designed for Fire Safety in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering and Fire Engineering consultancy?

B4.3.2 Is the building a “Relevant Building” under Regulation 7(4) following the 2018 Building (Amendment) Regulations to the *2010 Building Regulations* which introduced the 2018 amendments to Approved Document 7 – Materials and Workmanship 2013 edition?

B4.3.3 How has the External Wall been designed and constructed to comply with Regulation 7(2) if the building is a “Relevant Building” under Regulation 7(4)?

B4.3.4 Which materials and products in the External Wall have been exempted under Regulation 7(3) if the building is a “Relevant Building” under Regulation 7(4)?

B4.3.5 How has the External Wall otherwise been designed and constructed to comply with Requirement B4-(1) of Schedule 1. where the building is not a Relevant Building” under Regulation 7(4)?

B4.3.6 Have Paragraphs 10.6 of Volume 1 or 12.6 of Volume 2 of Approved Document Part B (2019 to 2020) been relied upon for buildings with a Storey over 18m which are not a “Relevant Building” under Regulation 7(4)?

B4.3.7 Where are Cavity Barriers located in the façade?

B4.3.8 Has Stability, Integrity and Insulation been tested to National or European Standards?

B4.4 How is the Spread of Fire adequately resisted over the Roof?

B4.4.1 How does the Roof relate to the activation of the Smoke and Heat Exhaust Ventilation (SHEV) System in a fire situation to ensure the Roof is unaffected by smoke and heat?

B4.4.2 Is there a Lightening Protection system for the building from the Roof through the façade to Ground?

B5 Access and facilities for the fire service

B5.1 What facilities assist fire fighters in the protection of life and property?

B5.1.1 What advice from the Fire and Rescue Service was obtained in consultation early in the design development to determine the facilities required for life safety and further to protect the asset?

B5.1.2 Has an alternative approach been taken to providing the means of escape based on guidance other than the statutory guidance of the Approved Document?

B5.1.3 What enhanced internal fire facilities have been provided for firefighters to complete their tasks?

B5.1.4 What protected access into and within the building has been provided for firefighting personnel to search for and rescue people throughout the building?

B5.1.5 What protected access into and within the building has been provided for firefighting personnel to fight fire throughout the building?

B5.1.6 How have the activities of Fire and Rescue Service personnel in fighting fire and undertaking search and rescue been resolved with the evacuation of escaping occupants?

B5.1.7 What are the natural or mechanical smoke and heat exhaust ventilation systems provided throughout the building, which may include a basement?

B5.1.8 Is there a basement car park?

B5.1.9 Are electric car charging points installed within or around the building?

B5.1.10 How are gas and electric utilities to be turned off by the Fire and Rescue Service?

B5.1.11 What provision and location of firefighting shafts has been made?

B5.1.12 How are firefighting shafts designed and constructed?

B5.1.13 Is compartmentation provided by rolling shutters or fire and smoke curtains?

B5.1.14 What standard of rising fire mains have been designed and constructed?

B5.1.15 How are fire mains regularly serviced?

B5.1.16 Are private hydrants at ground level provided to a standard?

B5.1.17 Is there an alternative supply of water?

B5.2 What facilities are provided within the site for fire appliances near the building?

B5.2.1 How have the external access routes and hardstandings been arranged if the building is not fitted with fire mains?

B5.2.2 How have the external access routes and hardstandings been arranged where the building is fitted with fire mains?

B5.2.3 How have external access routes and hardstandings enabled fire appliances to be used near the building without obstruction of Fire and Rescue Service personnel in fighting fire and undertaking search and rescue during the evacuation of escaping occupants?

B5.2.4 What is the arrangement and construction of outlet ducts or shafts from basements anticipating deployment of fire appliances and emergency services vehicles around the building?

B6 Handover of building under contract

B6.1 How was Building Regulation 38 complied with?

B6.1.1 Who is the Responsible Person appointed under the 2005 Regulatory Reform (Fire Safety) Order?

B6.1.2 Was a complete Regulation 38 Information Exchange made to the Responsible Person at handover containing the Fire Safety information for the building as listed in Approved Document Part B?

B7 Occupation of building in use

B7.1 Which "purpose group" is the building within, or is it "mixed use"?

B7.2 What are the specific fire hazards and risks facing occupants?

Part C Site Preparation and Resistance to Contaminants and Moisture

C1 Preparation of site and resistance to contaminants

C2 Resistance to moisture

C2.1 How has the Façade been designed to provide Resistance to Moisture?

C2.1.1 How is the façade contracted to clearly resolve the split responsibilities in design and construction between the Modular manufacturer and installer, and the contractors for site built façade works?

C2.1.2 Has the Modular System been developed for a particular façade System, and if so which façade System?

C2.1.3 How has the façade been designed for Resistance to Moisture in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering consultancy?

C2.1.4 Has Thermal Performance been achieved without Condensation Risk as L1.3 of this document?

C2.2 How has the Façade with Attachments been coordinated with the Modules?

C2.2.1 Have structural façade Brackets been installed with weathering on the Modules before being craned into the stack to achieve an interface with the façade?

C2.2.2 Are weathered and architecturally finished "Pods" installed around Windows and Doors on the Modules before being craned into the stack to achieve an interface with the façade?

C2.2.3 Has the Temporary Weathering Membrane on the Modules been retained or removed before undertaking the site built construction required to complete the façade?

C2.2.4 What approval was given by the façade contractor to the Temporary Weathering Membrane protecting the individual Modules retained in the façade?

C2.3 Has the Façade construction been Hose tested for Weathertightness?

C2.3.1 Were Hose Tests undertaken as CWCT TN41 and Clause 8.16.2 of the CWCT Standard for a minimum of 5% of the joints in the Weathering Membrane?

C2.3.2 Were Hose Tests undertaken before the installation of Cavity Barriers in the façade?

C2.3.3 Were Hose Tests carried out with full visibility of the inside of the façade System before being covered by internal linings that would prevent the verification that no leaks had occurred?

C2.3.4 Was a Third Party appointed to undertake Hose Testing, and who are they accredited by?

C2.3.5 Had the Hose Test method been calibrated in a Prototype test of the façade System as specified in the CWCT Standard for Systemised Building Envelopes 2006, or was the façade developed as a built-up construction without CWCT System testing?

C2.4 What measures were taken to prevent Water Leakage from Sanitary Areas?

C2.4.1 Which Waterproofing system has been repetitively used in the Modules?

C2.4.2 Were any waterproofing benchmarks Flood and Hose Tested before installation of the decorative finishes, and Reported upon by the Waterproofing system manufacturer?

C2.4.3 Was the quality of work 100% checked on installation by the Waterproofing system manufacturer to provide a Warranty before completion?

Part D Toxic substances

D1 Cavity insulation

Part E Resistance to the Passage of Sound

E0 Acoustic engineering

E0.1 What are the Acoustic issues for the site to be addressed by the Façade?

E0.1.1 How has the façade been designed to Resist to the Passage of Sound in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering and Acoustic Engineering consultancy?

E0.2 What Acoustic Engineering has informed both design and construction?

E0.2.1 Has an Acoustic Report been maintained through RIBA Plan of Work Stages, iteratively resolved as the technical design developed under constraints of space within the building height and layout?

E0.2.2 What was the scope and methodology of Sound Insulation Testing agreed with the Acoustic Engineer?

E0.2.3 Has the Sound Insulation Testing required by Regulation 41 of the *2010 Building Regulations* been completed by a Member of the Sound Insulation Testing and Measurement Association, part of the Building Compliance Testers Association, to the satisfaction of the Acoustic Engineer?

E0.2.4 Has a Sound Insulation Testing Report been signed as complete by the Acoustic Engineer?

E1 Protection against sound from other parts of the building and adjoining buildings

E2 Protection against sound within a dwelling-house etc.

E3 Reverberation in common internal parts of buildings containing flats or rooms for residential purposes

E4 Acoustic conditions in schools

Part F Ventilation

F1 Means of ventilation

F1.1 How is Ventilation achieved through the Façade?

F1.1.1 Is adequate ventilation to be achieved by Natural or Mechanical means, or by a combination of both?

F1.1.2 How do these Means of Ventilation vary for the different kinds of accommodation in the building in relation to façade types, perhaps at different levels in the site built and Modular construction?

F1.1.3 How has the façade been designed to provide a Means of Ventilation in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering and Building Services Engineering consultancy?

F1.2 How is any Mechanical Ventilation verified by Commissioning?

F1.2.1 How has Requirement F1-(2) of Schedule 1. been satisfied?

F1.2.2 Who has undertaken the Commissioning?

Part G Sanitation, Hot Water Safety and Water Efficiency

G1 Cold water supply

G2 Water efficiency

G3 Hot water supply and systems

G4 Sanitary conveniences and washing facilities

G5 Bathrooms

G6 Kitchens and food preparation areas

Part H Drainage and Waste Disposal

H1 Foul water drainage

H2 Wastewater treatment systems and cesspools

H3 Rainwater drainage

H3.1 How is Rainwater managed in the Façade from Roof, Terrace or Balcony areas?

H3.1.1 How has the façade been designed to provide Rainwater Drainage in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering and Building Services Engineering consultancy?

H4 Building over sewers

H5 Separate systems of drainage

H6 Solid waste storage

Part J Combustion Appliances and Fuel Storage Systems

J1 Air supply

J2 Discharge of products of combustion

J3 Warning of release of carbon monoxide

J4 Protection of building

J4.1 Does the building incorporate separate Combustion Appliances with Flues?

J4.1.1 How has the façade been designed for the Flues of Combustion Appliances in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering and Building Services Engineering consultancy?

J4.1.2 How has the roof been designed for the Flues of Combustion Appliances?

J5 Provision of information

J6 Protection of liquid fuel storage systems

J7 Protection against pollution

Part K Protection from Falling, Collision and Impact

K1 Stairs, ladders and ramps

K2 Protection from falling

K2.1 How does the Façade provide Protection from Falling?

K2.1.1 How has the façade been designed for Protection from Falling, taking into account applied load and impact on the façade, including any Balcony or Balustrade, in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering consultancy?

K3 Vehicle barriers and loading bays

K4 Protection from collision with open windows etc.

K5 Protection against impact from and trapping by doors

Part L Conservation of Fuel and Power

L1 Conservation of fuel and power

L1.1 How has Architectural Fenestration been designed to be Energy Efficient?

L1.1.1 How has the design development ensured that good practice daylighting levels have been achieved while providing Glare Control and avoiding over heating by Solar Gain?

L1.1.2 Does the glazing arrangement in the façade minimize the need for reliance on artificial lighting during daylight hours, or is an energy requirement for lighting the consequence of Architectural Fenestration?

L1.2 Does the need for Daylighting satisfy other Requirements?

L1.2.1 What consideration has been given to the arrangements of Windows and Doors at Balconies to reconcile daylighting, affecting Requirement L1(a), with other Parts of Schedule 1. of the *2010 Building Regulations*?

L1.3 How has Thermal Performance been achieved without Condensation Risk?

L1.3.1 How has the façade been designed for the Conservation of Fuel and Power in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering and Building Services Engineering consultancy?

L1.3.2 Has current Thermal guidance from the Building Research Establishment been referred to?

L1.3.3 Has a Thermal Performance Report been published for the Modular System?

L1.3.4 Has a specialist been employed to identify and design out Condensation Risk?

L1.3.5 Where in the Modular building will condensation lead to degradation of materials, products and systems, and the unintended staining of inherent or applied architectural finishes?

L1.3.6 Which Standards have been relied upon to demonstrate compliance with Requirement L1 of Schedule 1.?

L1.3.7 Which Thermal Bridges have been calculated as a linear thermal transmittance (Ψ-value) or “psi” value?

L1.4 Has the construction been monitored using Thermographic methods?

L1.4.1 Has a Survey involving Thermographic testing and inspection been undertaken for the whole building?

L1.4.2 Were any defects or deficiencies identified in the Thermographic Survey recorded and reported to the Architects on discovery, and remedied by the Contractor prior to building handover?

L1.4.3 Has a completed Thermographic Survey been submitted with a UKTA Level 2 Thermography Certificate to the Facilities Manager as an aspect of compliance with Regulation 7(1) of the *2010 Building Regulations* and Approved Document 7 – Materials and Workmanship?

L1.5 Has the completed building been Air Tightness Tested?

L1.5.1 Has Regulation 43 – Pressure Testing of the *2010 Building Regulations* been satisfied through Air Tightness Testing of the whole building by a Member of the Air Tightness Testing and Measurement Association (ATTMA), part of the Building Compliance Testers Association (BCTA)?

L1.5.2 What air permeability was achieved?

L1.5.3 Were temporary modifications made to the Modular building to achieve that result?

L1.5.4 Were any defects or deficiencies identified in the Airtightness Testing recorded and reported to the architect on discovery, and remedied by the contractor prior to building handover?

L1.5.5 Has a completed Air Tightness Test Report been submitted with a ATTMA Level 2 Air Tightness Certificate to the Facilities Manager as an aspect of compliance with Regulation 7(1) of the *2010 Building Regulations* and Approved Document 7 – Materials and Workmanship?

L1.6 How were the Building Services Commissioned?

L1.6.1 Was commissioning of Building Services completed to a Commissioning and Testing Schedule developed by a Specialist Commissioning Manager for the building during the design and construction Work Stages to ensure compliance with Requirement L1(b) of Schedule 1?

L1.6.2 How was commissioning and testing managed to achieve handover at Practical Completion and close-out of defects to the satisfaction of the Facilities Manager an aspect of compliance with Regulation 7(1) of the *2010 Building Regulations* and Approved Document 7 – Materials and Workmanship?

L1.7 How does the completed building relate to Energy and Emissions Regulations?

L1.7.1 How has Regulation 25 – Minimum energy performance requirements for new buildings been addressed?

L1.7.2 How has Regulation 26 – CO_2 emission rates for new buildings been addressed?

L1.7.3 How has Regulation 27 – CO_2 emission rate calculations been addressed?

L1.7.4 How has Regulation 30 – Energy assessors been addressed?

Part M Access to and Use of Buildings

M1 Access and use

M2 Access to extensions to buildings other than dwellings

M3 Sanitary conveniences in extensions to buildings other than dwellings

M4 Sanitary conveniences in dwellings

Part N Glazing – Safety in Relation to Impact, Opening and Cleaning

N1 Protection against impact

N1.1 How is Safety of Glazing ensured in the Façade?

N1.1.1 How has fixed and openable Glazing been designed to resist damage by impact in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering consultancy?

N1.1.2 How has the potential for spontaneous breakage from Nickel Sulfide inclusions in Glass been controlled to manage the risk of injury from falling glass?

N2 Manifestation of glazing

N2.1 What Glass Manifestation measures are provided?

N2.1.1 Where is Glass Manifestation required to make vision glazing apparent?

N2.1.2 How has Manifestation been achieved in glazing?

N3 Safe opening and closing of windows etc.

N3.1 How is the building envelope fitted with openable and adjustable elements?

N3.1.1 What provisions for openable and adjustable Windows been made in the façade?

N3.1.2 Have openable and adjustable Roof Lights been incorporated?

N3.1.3 Do the Windows and Roof Lights provide ventilation in contribution to Requirement F Ventilation of Schedule 1.?

N4 Safe access for cleaning windows etc.

N4.1 How is façade access safely achieved?

N4.1.1 What provisions have been made for safe maintenance and repair of the façade?

N4.1.2 What is the Glass Replacement Strategy?

Part P Electrical Safety

P1 Design and installation

P1.1 How has Earth Continuity been achieved?

P1.1.1 Has the primary structure and any metal infill construction been checked for Earth Continuity?

P1.2 What is the Lightning Protection System required on the building?

P1.1.2 Was a Member of the Association of Technical Lightning and Access Specialists appointed to design, manufacture, install and commission a Lightning Protection System coordinated by the Structural Engineer to unify the site built primary structure and the Module stack?

Part Q Security in Dwellings

Q1 Secured by Design

Q1.1 How is Security achieved in the building if Residential?

Q1.1.1 How has the Dwelling been designed for Security in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering consultancy?

Part R High Speed Electronic Communications Networks

Approved Document 7 – Material and Workmanship

AD7.1 Have the works been procured from Contractors operating a Quality Management System?

AD7.2 Where is the Register of Third Party verified As-Built record Drawings kept by the Facilities Manager?

AD7.3 Where are the Technical Submittals made during manufacturing, assembly and site built construction compiled in an Operations and Maintenance Manual maintained by the Facilities Manager?

AD7.4 How were the 2015 Construction (Design and Management) Regulations complied with prior to handover to the Facilities Manager?

AD7.5 Where are the maintenance requirements fully defined?

AD7.6 Has a programme of Building User Training been provided to the Facilities Manager?

Checklist Section 3: Technical Exploration of Lower Level Questions

The lower level answers address a range of issues that may require contributions from several specialists involved in the design and construction of the Permanent Stacked Modular Building. The text of the Parts of Schedule 1. Requirements are included in each Part of Section 3 of *Permanent Stacked Modular Buildings: Technical Checklist for England – Issue 01*, but reference shall be made to the arrangement of the published legislation online.

https://www.legislation.gov.uk/uksi/2010/2214/schedule/1

Part A Structure

A1 Loading

A2 Ground movement

A3 Disproportionate collapse

A1 Loading

A1-(1) The building shall be constructed so that the combined dead, imposed and wind loads are sustained and transmitted by it to the ground –

(a) safely; and

(b) without causing such deflection or deformation of any part of the building, or such movement of the ground, as will impair the stability of any part of another building.

A1-(2) In assessing whether a building complies with sub-paragraph (1) regard shall be had to the imposed and wind loads to which it is likely to be subjected in the ordinary course of its use for the purpose for which it is intended.

A1.1 Has a Movements and Tolerances Report been produced for the building?

A1.1.1 How are the manufacturing and installation tolerances resolved between site construction, such as the Foundations or the Core, and the manufacture of Modules to be stacked on site?

- The manufacturing and installation tolerances need to be defined in plan and to level at joints in construction, some of which become physical and organisational interfaces.
- Modular System manufacturers will be working to a more precise set of manufacturing and installation tolerances than are usually specified and contracted for site built construction.
- Aspects of site built construction shall need to be procured on the project to enhanced manufacturing and installation tolerances to interface with the Modular System.

A1.1.2 How do those tolerances relate to movements in the construction supported by primary structure?

- Tolerances need to be considered with directional movements, in both a non-fire and fire situation in anticipation of Schedule 1. Part B Fire Safety.
- Together that intelligence needs to be quantified and managed through a Movements and Tolerances Report. That contract document will be initiated by the structural engineer for the site built primary structure with an overview of Schedule 1. Part A Structure, and developed through collaboration with the specialist structural engineer for the manufacturer of the Modules.
- Foundations and Basements below Ground level shall comply with Requirement A2 of Schedule 1. of the *2010 Building Regulations*, to support the loads in Requirement A1., differentiated as:

  Dead Load

  Imposed Load

  Wind Load

A1.2 What is the form of construction above the below Ground works?

A1.2.1 What is the primary structural slab supporting the Module stack?

- The Module stack may commence at Ground level, but in urban areas the Ground level often has a high development value. A Podium is often built on site to establish a strong slab over Ground level accommodation with a greater Floor to Ceiling height upon which to start the Module stack.
- That Podium slab may be a primary structural frame of Concrete extending the Ground works contract, or a Hot Rolled Steel primary structural frame with a profiled metal deck as permanent shuttering to the composite Concrete slab.
- To achieve large span accommodation at Ground level the distribution and coordination of Service Risers through the Module stack and the Podium slab down to Ground works below is important.

A1.2.2 What is the form of the Stair and Lift Core which may contain a Fire Fighting Lift and Rising Main?

- Extending from the below Ground works the Stair and Lift Core construction is often Reinforced Insitu or Precast Concrete. Insitu Concrete Cores may be "Jump Formed" or "Slip Formed" rather than shuttered in Storey height Formwork. Landings and slabs may be Insitu or Precast Concrete. Rather than shutter flights and intermediate Landings of Concrete Stairs, Precast Concrete Stairs, Steel Stairs filed with Concrete, or Steel Stair fabrications may be combined. Reference shall be made to the National Structural Concrete Specification Fourth Edition which complies with *BS EN 13670: 2009 Execution of concrete structures*.
- Some Cores are Hot Rolled Steel with cross-bracing, which may also be combined with Precast Concrete Stairs, Steel Stairs filed with Concrete, or Steel Stair fabrications. Landings and slabs may be profiled metal deck permanent shuttering with a composite Concrete slab. A Core of Hot Rolled Steel is often not as commercially competitive as Concrete, since fire protection of the primary structure and the construction of fire resisting Internal Walls with acoustic performance is required. Acoustic treatment is a particular issue with Hot Rolled Steel. Reference shall be made to the National Structural Steelwork Specification Seventh Edition.
- Few commercial attempts are made to use Cross Laminated Timber for the fire resisting Stair and Lift Core. Reference shall be made to the National Structural Timber Specification Second Edition.

A1.2.3 What is the proprietary Modular System?

- Modules in the stack are commonly rectilinear primary structural frames of Hot Rolled Steel with bracing, infilled with Cold Rolled Light Steel Frames or Timber Stud Walls.
- Some Module bases are Concrete on Profiled Metal Decks, but are often Cold Rolled Light Steel Joists or Timber Joists, generally with Timber Board Floors.
- The tops of Modules are usually Cold Rolled Light Steel Joists or Timber Joists with Timber Board temporary Roofs, walked on by installation Operatives before enclosed within the Module stack.

A1.2.4 Does the Modular System have an Insurance backed Structural Warranty?

A1.2.5 Who is the Warranty provider?

- Several Warranty providers cover Modular buildings:

  LABC

  Premier Guarantee

  NHBC

A1.2.6 What is the Structural Warranty period?

A1.2.7 What are the Terms and Conditions of the Warranty in relation to the site built primary structure?

- To remain stable the stacked Modular structure is restrained by the fire resisting primary structure of the Stair and Lift Core above any Podium. Service Riser or Smoke Ventilation shafts may be located either within the Module stack or the Core, or both, penetrating any Podium.

A1.2.8 Is the Modular manufacturer a Member of Build Offsite as part of the Construction Industry Research and Information Association able to demonstrate a longevity of membership?

A1.2.9 Which CIRIA guidance has the Modular manufacturer complied with?

A1.2.10 Is the Modular System durability Certified by BOPAS for a 60 Year Design Life based on assessment by BLP Insurance, underwritten by Lloyds Register?

- The BLP durability assessment follows the principles of service life planning of constructed assets as defined in *BS ISO 15686-1: 2011 Buildings and constructed assets. Service life planning. General principles and framework*. It shall identify:

  Primary components that are structural, inaccessible, and prohibitively expensive to replace.

  Secondary components that are non-structural, accessible, and require major works to replace.

  Tertiary components that are non-structural, accessible, and require minor works to replace, including components that degrade rapidly to affect performance under anticipated conditions.

- The durability assessment is based on a Design Life of 60 years, unless the building is explicitly intended to be more temporary.

- The Service Life shall be equal to Design Life for supports or substrates as primary components.

- Where shorter life components are identified as secondary or tertiary components their expected Service Life shall be stated, and relevant maintenance requirements affecting their architectural finishes shall be fully defined as an aspect of compliance with Regulation 7.

A1.3 How has total Dead Load support been considered through the building?

Module Accommodation

A1.3.1 How have the Dead Load limits in the Modules been calculated, including their fit-out?

- The Module stack is not the total Dead Load on the Foundations. There will be Dead Load in the Roof level structure that may form additional Storeys, the single or multiple Stair and Lift Cores, any Podium, Ground and possibly Basement Storey, and the Foundations themselves.

- Allowance shall be made for the façade Systems including a Roof Plant Screen, the Roof, and External Building Services on the Roof.

- Maintenance of the Façade may require a Building Maintenance Unit on a fixed Pavement or Track System, which is a travelling Dead Load moving over the Module stack.

Façade

A1.3.2 How much of the façade is to be completed on site?

- The External Backing Wall as infill construction may be part of the Module Dead Load, as might be Windows and Doors, but other interfacing components of the façade may be completed on site.

A1.3.3 What are the characteristics of the different façade Systems, and which Product Standards apply?

- Reference shall be made to the Centre for Window and Cladding Technology publications for Systemised building envelopes and built-up External Wall construction.

- External Walls which are not to *BS EN 13830: 2015 + A1: 2020 Curtain walling as a Product* Standard will be built-up from components by different manufacturers as “Systems” for particular buildings.

A1.3.4 What is the allowance for the Dead Load of façade Systems built on site, which may include Balconies or other attachments,including the prospect of Rainwater Outlet blockage creating a head of water, and the weight of a depth of Snow?

- When weight during transportation and installation is a factor the Modular façade is unlikely to involve heavy Precast Concrete Panels. The Core or Podium may include a façade to *BS 8297: 2017 Design, manufacture and installation of architectural precast concrete cladding. Code of practice*.

- The Roof Plant Screen which may be braced by an External Support Frame for the Building Services is part of the façade, but not part of the Modular System.
- Thermal Insulation thicknesses in façade Systems can be substantial to achieve the requirements of Part L Conservation of Fuel and Power. Thermal Insulation has some weight in volume, but can also increase the size of Brackets and secondary structure, making façade Systems heavier.
- Extensively and Intensively planted Green Walls are often installed externally to the façade with depths of a growing medium that may hold water, and accumulate organic growth. Commitment to maintenance is required. Reference shall be made to the Department for Communities and Local Government guidance Fire Performance of Green Roofs and Walls, published August 2013.

External Roof and Terraces

A1.3.5 What is the allowance for the Dead Load of the built-up Roof or Terrace, which may be a Green or Blue Roof, including the prospect of Rainwater Outlet blockage creating a head of water, and the weight of a depth of Snow?

- Thermal Insulation depths on built-up Warm or Inverted Roof or Terrace areas can be substantial to achieve the requirements of Part L Conservation of Fuel and Power.
- Warm Roof Systems require positive 1:40 Falls to Rainwater outlets or gutters, which can increase the depths of Thermal Insulation. Thermal Insulation has some weight in volume.
- Some Inverted Roof Systems are developed as “Zero Fall”, but require depths of Screed to correct Dead load Deflections of Roof slabs on primary structure, to prevent negative Falls away from Rainwater outlets that lead to “Ponding”. Alternatively, 1:40 Falls to Rainwater outlets can again increase Screed or Thermal Insulation depths. Gravel Ballast is required, where not provided by a Green Roof planting, or by Paving, Decking or Walkways.
- Extensively and Intensively planted Green Roofs are often installed with depths of a growing medium that may hold water, and accumulate organic growth. Commitment to maintenance is required. Reference shall be made to the Department for Communities and Local Government guidance Fire Performance of Green Roofs and Walls, published August 2013.
- Paving, Decking and Walkway Dead Load is required, where the Roof is an accessible Terrace, and or for accessing Building Services or the BMU.
- A Blue Roof may include a permanent head of water.

External Building Services

A1.3.6 What is the allowance for the Dead Load distribution of anticipated Building Services in the Roof Plant Area in addition to a Roof Plant Screen and External Support Frame?

- The Service Life of Building Services shall require periodic replacement over the Design Life of the building, and Dead Loads will be redistributed over time.
- Photovoltaic Panels may represent a Fire Risk
- Access may not be limited to Maintenance Operatives, requiring separation of other building users from Mechanical and Electrical equipment installations.

Building Maintenance

A1.3.7 What is the allowance for a Building Maintenance Unit, which moves on a heavy Track system causing the Dead Load to travel over the primary structure?

- Maintenance of the building shall be considered in reference to *BS 8560: 2012 + A1: 2018 Code of practice for the design of buildings incorporating safe work at height*.
- The moving BMU Dead Load transfers between the Core and the Roof plan of the Module stack.

A1.4 What is the Differential Vertical Movement due to Dead Load?

A1.4.1 What are the critical Vertical Movement joints on the project?

- Connections restraining the Modules to the Core must accommodate Differential Vertical Movement if they are not to transfer Dead Load.
- Other project specific details may be critical to accommodate or prevent differential Vertical Movement, particularly in relation to below Ground conditions.

A1.4.2 How will the critical detail restraining the Module stack to the Core accommodate Differential Vertical Movement over time while being Fire Protected and achieving Compartmentation?

- Shortening occurs in the non-fire situation, but the building, and the critical restraint detail, has to be designed for the possibility of a fire situation.
- The restraint detail must be Fire Protected and achieve Compartmentation between the Access Corridor and the Stair and Lift Core, which may contain a Fire Fighting Lift and Rising Main.
- Access to Cavities between the Modules and the Core may only be available while the Module stack is erected, but must perform in a fire situation for the Design Life of the building.
- There may be versions of the critical restraint detail to consider.

A1.4.3 Has agreement on Differential Vertical Movement due to Dead Load been achieved between the structural engineer for the site built Concrete Core and the specialist structural engineer for the manufacturer of the Modules, to be resolved in a consolidated Movement and Tolerances Report?

- Although tied to each other the different forms of construction in the Core and the Module stack have a Differential Vertical Movement due to Dead Load.
- It is likely that the Concrete Core will shorten through settlement and "creep" more than the "elastic shortening" of Hot Rolled Steel Modular structure, at different rates over the Design Life of the building. The shortening of Steel is "elastic" because if the Dead Load were removed it would reverse, but, of course, the Dead Load is not removed from the Module stack.
- The Concrete Core Stair and Lift Lobby slabs are generally cast below the target level and are built-up with Screed 2 to 3 months following the construction and Dead Loading of the core, when much of the settlement occurs. Over the longer term the Concrete will shorten by "creep".

A1.4.4 Is there a dimensional range of possible shortening in the Concrete Core?

- It is difficult to accurately predict the total Concrete shortening over time. It is easier for a structural engineer to predict the shortening of the Module stack in Hot Rolled Steel sections.

A1.4.5 How is the difference in floor levels at the threshold between the Module and the Core resolved as a Vertical Movement Joint detail without creating a trip hazard?

A1.4.6 Have all pairs of Module columns in stacks been engineered to shorten equally without introducing shear into horizontal bolted connections between them?

- Shortening for each Storey will be negligible in a façade with movement joints, but the Vertical Movement accumulates over the Module stack height.

A1.4.7 Was shortening under Dead Load taken into account in the manufacture of Modules to design out the need for Shimming during installation?

- Shimming on site without understanding how the Core and Module stack are expected to shorten over time is not a methodology for resolving Differential Vertical Movement due to Dead Load.
- Insertion of Shims by Operatives, standing on the Module tops while the next Storey is lowered on the crane into the stack, is to be avoided. Even if Shimming can be undertaken safely, without the Operative walking under the Module on the crane, the Shims can easily be forgotten or installed incorrectly. It is not possible to check the Shims when the Modules are stacked in their permanent positions. Inspection access panels in fire resisting Soffits and Floors are not practical.

A1.4.8 What was the method statement as a sequence of installation for the Module stack anticipating the temporary Weathering, ensuring that horizontal and vertical Cavities between Modules are correctly Fire Stopped, and achieving Services connections in the Risers?

A1.5 How has Vertical Deflection as a result of imposed Live Loads been considered?

A1.5.1 What are the Live Loads imposed on the partly Modular building?

- Requirement A1-(2) of Schedule 1. expects assessment of whether compliance with Requirement A1-(1) has been undertaken with regard to the imposed Live Loads to which the building is likely to be subjected in the ordinary course of its use for the purpose for which it is intended.
- Reference shall be made to *BS EN 1990: 2002 + A1: 2005 Eurocode. Basis of structural design* for the imposed Live Loads in the site built primary structure, the Module stack and the structural interfaces of the Modules with site built primary structure.
- Modular buildings need to be structurally engineered for particular Live Load impositions, which affect aspects of the construction built into them, and the Cavities formed between Modules.

External Backing Wall infill construction, Cladding, Glazing and Balconies

A1.5.2 What are the Vertical Deflection limits for structural support of the External Backing Wall infill construction, Cladding, Glazing and Balconies or other attachments in a non-fire situation, either as Span/X or X mm, whichever is the lesser?

- Reference shall be made to Structural Aspects of Cladding, Institution of Structural Engineers, Version 1.1 February 2020. This guidance expands upon Aspects of Cladding, August 1995.
- Primary structure stiffness for Vertical Deflection lower than Span/1000 may be required to maintain the performance of joints between Cladding or Glazing panels in façade Systems.
- Sliding Doors to Balconies may require Span/2000 Vertical Deflection, or secondary structure at thresholds, bridging from nearer the columns to reduce the deflection at the threshold.
- Sheathing boards to the exteriors of External Backing Wall infill construction require horizontal movement joints between Modules for Vertical Deflection as a result of imposed Live Loads. There shall be no Vertical Differential Movement between adjacent Modules at vertical joints.
- Rotation of the primary structure supporting Balconies shall also be engineered to minimal criteria, and reference shall be made to *BS 8579: 2020 Guide to the design of balconies and terraces*.

A1.5.3 How have the Vertical Deflection limits for structural support of the External Backing Wall infill construction, Cladding, Glazing and Balconies or other attachments in a fire situation been anticipated, tested, assessed and engineered?

- Consideration of the fire situation requires fire testing and Fire Engineering assessments to identify the most onerous case of Span/X or X mm, whichever is the lesser.
- All non-loadbearing External Backing Wall infill construction requires a Deflection Head. No Deflection Head means the External Backing Wall infill construction is load bearing, and shall maintain load-bearing capacity in the fire situation.

A1.5.4 How is the fire situation Vertical Deflection accommodated to prevent mechanical failure in the components of the Cladding, Glazing and Balconies or other attachments?

A1.5.5 Where at the corners and on different elevations of the building does the structural support of the External Backing Wall infill construction, Cladding, Glazing and Balconies or other attachments also support the Internal Floor?

Internal Floor

A1.5.6 What are the Vertical Deflection limits for the Internal Floor accumulative to the Vertical Deflection limits of the primary structure in a non-fire situation, either as Span/X or X mm, whichever is the lesser?

A1.5.7 How have the Vertical Deflection limits for the Internal Floor accumulative to the Vertical Deflection limits of the primary structure in a fire situation been anticipated, tested, assessed and engineered?

- The primary structure supporting Internal Floors will deflect under Imposed Live Load. That primary structure supports the Module walls that are exposed to the weather when transported, but which form the External façade or become the Internal Walls between Modules when stacked.
- There may be primary structure along Internal Wall lines connecting Modules horizontally as Corridors, or vertically as Service Riser or Smoke Ventilation shafts.

- The Movement and Tolerances Report shall consider the non-fire and the fire situation, referring to fire testing and Fire Engineering Assessments to identify the most onerous case of Span/X or X mm, whichever is the lesser in the Internal Floor.

Interior of External Backing Wall infill construction and Internal Walls

A1.5.8 How have the most onerous Vertical Deflection limits for the Internal Floor accumulative to the Vertical Deflection limits of the primary structure in a non-fire or fire situation informed the construction of the interior of External Backing Wall infill construction and Internal Walls?

- All non-loadbearing interiors of External Backing Wall infill construction and Internal Wall construction requires a Deflection Head. No Deflection Head means the Wall construction is load bearing, and shall maintain load-bearing capacity in the non-fire and the fire situation.
- The base track of the interior of External Walls and Internal Walls must be sealed to the Internal Floor, which shall not deflect to rack the Wall construction in non-fire and fire situations.
- The Fire Resisting boards to the interior of External Walls and Internal Walls provide Fire Protection to primary structure in Modules. If Internal Floors deflect while the base remains fixed, the head will deflect away from the Internal Soffit.

A1.5.9 What are the Vertical Deflections due to imposed Live Load at the mid-span of the Floor?

- Excessive mid-floor Vertical Deflections will affect fittings and furniture, and a bouncy Internal Floor will affect the stability and balance of occupants while undertaking routine tasks.

Fire Stopping between Floors and Soffits of Modules

A1.5.10 How will the gaps between Modules in a stack be Fire Stopped to prevent extensive horizontal and vertical Cavities when the Internal Floor deflects and the Soffit receives no imposed Live Load?

- The Vertical Differential Movement between Module Floor and Soffit shall be accommodated by Fire Stopping over the Design Life of the building, in relation to Requirement B3-(4) of Schedule 1.

A1.6 What are the Wind Load assumptions based in Weather projections?

A1.6.1 What is the basis for the magnitude and direction of Wind Loads that are expected to be imposed on the partly Modular building over the Design Life, in the specific location?

- Requirement A1-(2) of Schedule 1. expects assessment of whether compliance with Requirement A1-(1) has been achieved with regard to the Wind Loads to which the building is likely to be subjected in the ordinary course of its use for the purpose for which it is intended.
- Wind Tunnel testing may have been carried out for the Modular building.
- Reference shall be made to *BS EN 1990: 2002 + A1: 2005 Eurocode. Basis of structural design* for the imposed Wind Loads in the site built primary structure, the Module stack and the structural interfaces of the Modules with site built primary structure.

A1.7 How has Horizontal Sway in the Structure due to Wind Load been considered?

A1.7.1 What are the Total absolute and accumulative Storey height Horizontal Displacement limits for the primary structure in a non-fire situation, either as Height/X or X mm, whichever is the lesser?

- The Total building height Sway may be referred to as “Global”, and a Storey height Sway should have a relationship to that overall limit in the Movement and Tolerances Report for the Façade.
- The stacked Modular structure is restrained by the fire resisting primary structure of the Stair and Lift Core above any Podium. Service Riser or Smoke Ventilation shafts may be located either within the Module stack or the Core, or both, penetrating any Podium.

A1.7.2 Do the Modules provide any structural resistance to Horizontal Displacement by Wind Loads on the Façade of the Module stack, or does the single or multiple Core resist all Wind Loads?

A1.7.3 How have the Horizontal Displacement limits for fire protected primary structure been anticipated, tested, assessed and engineered in a fire situation, whether within stacked Modules or a Core or Cores?

A1.7.4 Has Wind Sway been taken account of during construction to prevent damage to restraint fixings using temporary bracing related to the sequence of stacking Modules around a single Core, or between Cores?

- Temporary Bracing may be required between Cores before the Modules are stacked and restrained since the Cores may not otherwise sway together in the Wind.
- The use of a Core as a platform for a Crane, or the restraint of a Crane to a Core, may affect the way Cores sway differentially before the Module stack is built.
- Cores moving differentially while the Module stack is built may transfer loads in compression or tension to the restraint details between Module and Core, or the connections between Modules in the process of stacking, that are not intended in the completed building.

A1.8 How has the Façade Movement due to Wind Load been considered?

A1.8.1 How has the primary structure been designed in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering consultancy to assist the structural engineer?

- Structural movements shall be resolved with the need for the façade to satisfy Requirement C2 Resistance to moisture of Schedule 1. Satisfaction of Requirements A1 and C2 shall both be achieved in the design.
- Reference shall be made to a Registered Copy of the Centre for Window and Cladding Technology (CWCT) Standard for Systemised Building Envelopes 2006, as technically updated.
- Reference shall be made to CWCT Guidance on Built-up Walls 2017.
- Reference shall be made to CWCT Guidance on the actions on non-loadbearing building envelopes 2017
- Reference shall be made to CWCT Technical Notes that include, but are not limited to:

  TN55 – Movement accommodation in building envelopes

  TN78 – Interfaces and joints – Introduction

  TN95 – Weathertightness of windows, doors and curtain walls

A1.8.2 How are Wind Loads transferred through the façade System layers to the primary structure?

- Open joints in Rainscreen Cladding panels fixed to support rails with brackets in front of a ventilated Cavity result in Wind Loads on the Thermal Insulation fixed to the area of the External Backing Wall in addition to the panel, rail and bracket construction.
- Rainscreen panel, rail and bracket construction may span between primary structure, and not transfer their loads to the External Backing Wall infill construction. In contrast some constructions like External Insulated Render without Cavities are fixed to the area of the External Backing Wall and transfer Wind Loads directly.
- Rainscreen rails must not penetrate Cavity Barriers, which will impair their performance. Cavity barriers are not tested with penetrating Rainscreen rails. It is necessary to support the ends of rails both sides of Cavity Barriers on brackets.

A1.8.3 What are the Storey height Horizontal Displacement limits for the various façade Systems in a non-fire situation, either as Height/X or X mm, whichever is the lesser?

- Horizontal Displacement due to Wind Loads on the façade at each Storey is accumulative to the Sway due to Wind Loads on the primary structure in the non-fire situation.

A1.8.4 How is the façade system engineered to accommodate movement of the primary structure in a fire situation without mechanical failure at affected Storeys?

A1.8.5 What are the variations in the External Backing Wall infill construction to accommodate fenestration?

- Architectural fenestration of External Windows and Doors requires openings within or between External Backing Wall infill construction to primary structure. Where External Windows and Doors are not spanning between primary structure Wind Loads must be transferred through the External Backing Wall infill construction to the primary structure.

- External Windows and Doors including Sliding Doors are commercially manufactured to Product Standard *BS EN 14351-1: 2006 + A2: 2016 Windows and doors. Product standard, performance characteristics. Windows and external pedestrian doorsets*.
- Screens of linked External Windows and Doors shall not to be thought of as "Curtain Walling" because *BS EN 13830: 2015 + A1: 2020 Curtain walling* is a distinct Product Standard.
- External Window and Door Products can be glazed into Curtain Wall Systems.

A2 Ground movement

A2 The building shall be constructed so that ground movement caused by –

(a) swelling, shrinkage or freezing of the subsoil; or

(b) land-slip or subsidence (other than subsidence arising from shrinkage), in so far as the risk can be reasonably foreseen, will not impair the stability of any part of the building.

A2.1 How have Ground Conditions been ascertained by the Structural Engineer?

A2.1.1 What geotechnical investigations have been undertaken?

A2.1.2 Is the Foundation structure including any Basement Storey engineered and constructed to achieve compliance with Requirement A2 Ground Movement of Schedule 1.?

- Reference shall be made to *BS EN 1990: 2002 + A1: 2005 Eurocode. Basis of structural design* for the Foundations and Basements to all superstructure.
- Reference shall be made to the National Structural Concrete Specification 4th Edition which complies with *BS EN 13670: 2009 Execution of concrete structures*.
- The Foundations and Basement shall also comply with other Parts of Schedule 1., notably including, but not limited to:

  Part C Site Preparation and Resistance to Contaminants and Moisture

  Part H Drainage and Waste Disposal

  Part L Conservation of Fuel and Power

A2.2 What is the relationship of Foundation design to Movement Joint requirements?

A2.2.1 Where do the Foundations introduce critical Vertical Movement joints or require details that prevent Differential Vertical Movement on the project?

A2.2.2 Where do the Foundations introduce critical Horizontal Movement joints on the project?

A2.2.3 Have Horizontal Movement joints in Foundations been maintained through primary structure, infill construction and the façade?

A3 Disproportionate collapse

A3 The building shall be constructed so that in the event of an accident the building will not suffer collapse to an extent disproportionate to the cause.

A3.1 How has accidental Disproportionate Collapse been considered?

A3.1.1 What are the anticipated accidental hazards that may present a risk of disproportionate collapse?

- If there is Gas supply to the building, either to Plant Rooms or distributed throughout the Modules to Kitchens, the risk of Gas Explosion shall be addressed accordingly.
- The risk of road Vehicle impact damage shall be reduced in the external works.
- The risk of flying Vehicle impact damage shall be considered.

A3.1.2 What provision against disproportionate collapse has been factored into the Structural Engineering design submitted to Building Control, along with the consolidated Movement and Tolerances Report?

- The structural engineer for the site built primary structure shall collaborate with the specialist structural engineer for the manufacturer of the Modules to address disproportionate collapse.
- The prospect of disproportionate collapse is unlimited to a non-fire situation because an accident may result in a fire situation that is more severe than might be expected in accommodation fires considered in Schedule 1. Part B Fire Safety.
- Consideration shall be given to accidental damage to the Passive and Active measures required in Schedule 1. Part B Fire Safety, and whether that damage may pose a greater risk of Fire Spread.

Part B Fire Safety

B0 Fire engineering

B0.1 Has the discipline of Fire Engineering been adopted on the project?

B0.1.1 Which standards are referred to in the design and construction of the Modular building when the statutory guidance in Approved Document Part B Volumes 1 and 2 (2019 to 2020) is considered insufficient for the design and construction to comply with Part B Fire Safety of Schedule 1.?

- Reference may be made to either *BS 9991: 2015 Fire safety in the design, management and use of residential buildings. Code of practice* or *BS 9999: 2017 Fire safety in the design, management and use of buildings. Code of practice*, but these Codes of Practice should be consistently used in favour of Approved Document Part B Volumes 1 and 2 (2019 to 2020), and not "cherry picked".
- There is a difference between a "Fire Strategy" developed by an Architect, with or without professional advice from a Fire Engineer, and a Fire Engineering approach to the building design that departs from the Approved Document based in *BS 7974: 2019 Application of fire safety engineering principles to the design of buildings. Code of practice*.
- When the whole building is fire engineered to the procedure in BS 7974 three purposeful and structured stages are required from the Fire Engineer, starting with the "QDR":

  Qualitative Design Review in which the scope and objectives of the fire safety design are defined, performance criteria established and one or more potential design solutions proposed.

  Quantitative Analysis in which engineering methods are used to evaluate the potential solutions identified in the QDR.

  Assessment Against Criteria in which the output of the quantitative analysis is compared to the acceptance criteria identified in the QDR.
- The seven BS 7974 supporting Published Documents as "Sub-Systems" provide the discipline for the three stages of Fire Engineering:

  PD 7974-1:2019 Initiation and development of fire within the enclosure of origin

  PD 7974-2:2019 Spread of smoke and toxic gases within and beyond the enclosure of origin

  PD 7974-3:2019 Structural response and fire spread beyond the enclosure of origin

  PD 7974-4:2003 Detection of fire and activation of fire protection systems

  PD 7974-5:2014+A1:2020 Fire service intervention

  PD 7974-6:2019 Evacuation

  PD 7974-7:2019 Probabilistic fire risk assessment
- Sub-Systems in BS 7974 do not directly correspond with the Requirements in Part B of Schedule 1. of the *2010 Building Regulations*, but a Fire Engineer shall refer to those Requirements in the same way as Approved Document Part B Volumes 1 and 2 (2019 to 2020) relates.

B1 Means of warning and escape

B1 The building shall be designed and constructed so that there are appropriate provisions for the early warning of fire, and appropriate means of escape in case of fire from the building to a place of safety outside the building capable of being safely and effectively used at all material times.

Requirement B1 does not apply to any prison provided under section 33 of the Prison Act 1952 (power to provide prisons etc.), c.52, as amended by section 100 of the Criminal Justice and Public Order Act 1994 (c.33) and by S.I. 1963/597.

B1.1 How does the Detection and Alarm System relate to the Escape Provision?

B1.1.1 What are the assumptions made for the Evacuation of the building?

B1.1.2 How do the Fire and Rescue Service establish Fire Fighting Operations in the event of fire?

B1.2 What is the Means of Escape in the fire situation?

B1.2.1 How is Compartmentation maintained when the Escape Corridors are segmented in a series of Modules stacked adjacent to each other on a Storey?

B1.3 How is Smoke and Heat Exhaust Ventilation (SHEV) achieved in the Escape Corridors?

B1.3.1 What is the SHEV System to keep the Escape Corridor clear?

- Shev Systems may be either Natural or Mechanical, but combinations of both require caution.
- Mechanical SHEV Systems shall require either a SHEV Shaft or a Service Riser containing Fire Resisting Ductwork, both made segmentally from the Internal Wall construction of the Modules arranged in a stack.
- Fire Protection of primary structure, Compartmentation and Fire Resisting Movement Joints shall be achieved in the Smoke Shaft.
- Reference shall be made to the *BS EN 12101 Smoke and heat control systems* series to identify Natural or Mechanical SHEV Systems.
- Reference shall be made to Smoke Control Association guidance.

B1.4 How has the construction of the Mechanical SHEV System been achieved?

B1.4.1 How is the SHEV System contracted to avoid split responsibilities?

B1.4.2 What is the Mechanical SHEV System Equipment on the Roof?

B1.4.3 How is the Equipment protected from the weather at Roof level?

B1.4.4 What weathered Louvre arrangement is required to prevent water ingress?

B1.4.5 What were the access requirements of the specialist SHEV System contractors?

- Connection of Fire Resisting Ductwork within a Smoke Shaft constructed as a Service Riser Compartment is awkward when wasted space between the Ductwork and the Shaft has been reduced to the minimum. Segmental Ductwork requires a bolted connection.
- Reference shall be made to Fire Resisting Ductwork guidance by the Association of Specialist Fire Protection.

B1.4.6 What is the arrangement of Dampers and Doors in the Escape Corridor?

B1.4.7 Which Product Standard have the Dampers and Doors been specified and tested to?

B1.4.8 How does the Mechanical SHEV System relate to Alarm and Detection Systems and any Fire and Rescue Service control?

B1.5 How has the construction of the Mechanical SHEV System been verified?

B1.5.1 Was the segmentally stacked Smoke Shaft pressure tested for leakage either as a SHEV Shaft without Fire Resisting Ductwork or as a Riser Compartment containing Fire Resisting Ductwork?

B1.5.2 Has the operation of the Mechanical SHEV System been Third Party Certified?

B1.5.3 Has the same Third Party Certifier been instructed to verify any associated Natural SHEV Systems and report on their functional compatibility in design and construction?

B1.6 How has the construction of the Natural SHEV System been achieved?

B1.6.1 What is the arrangement of Natural Smoke Vents in the Escape Corridor?

B1.6.2 How are the Natural Smoke Vents electromechanically equipped and controlled to be Automated Opening Vents (AOV)?

B1.6.3 Which Product Standard have the Smoke AOVs been specified and tested to?

B1.6.4 How does the Natural Smoke AOV System relate to Alarm and Detection Systems and any Fire and Rescue Service control?

B1.7 How has the construction of the Natural SHEV System been verified?

B1.7.1 Has the operation of the Natural SHEV System been Third Party Certified?

B1.7.2 Has the same Third Party Certifier been instructed to verify any associated Mechanical SHEV Systems and report on their functional compatibility in design and construction?

B2 Internal fire spread (linings)

B2-(1) To inhibit the spread of fire within the building, the internal linings shall –

(a) adequately resist the spread of flame over their surfaces; and

(b) have, if ignited, either a rate of heat release or a rate of fire growth, which is reasonable in the circumstances.

B2-(2) In this paragraph "internal linings" means the materials or products used in lining any partition, wall, ceiling or other internal structure.

B2.1 What are the Internal Linings?

B2.1.1 Do the internal linings perform a fire resisting function in the Modular System?

- It is usual in Modular Systems for the lining construction to be reduced in weight as far as possible to assist with transportation and installation from a crane. Decorative linings may also be providing fire and acoustic performance, or be part of the Waterproofing.
- The linings shall not transfer an excess of heat to the Hot Rolled Steel sections in the primary structure, which loses 40% strength when temperatures reach 550°C, to frustrate compliance with Requirement B3-(1) of Schedule 1.

B2.1.2 What is the Reaction to Fire of the internal linings in the different parts of the building?

B3 Internal fire spread (structure)

B3-(1) The building shall be designed and constructed so that, in the event of fire, its stability will be maintained for a reasonable period.

B3-(2) A wall common to two or more buildings shall be designed and constructed so that it adequately resists the spread of fire between those buildings. For the purposes of this sub-paragraph a house in a terrace and a semi-detached house are each to be treated as a separate building.

B3-(3) Where reasonably necessary to inhibit the spread of fire within the building, measures shall be taken, to an extent appropriate to the size and intended use of the building, comprising either or both of the following –

(a) sub-division of the building with fire-resisting construction;

(b) installation of suitable automatic fire suppression systems.

Requirement B3-(3) does not apply to material alterations to any prison provided under section 33 of the Prison Act 1952.

B3-(4) The building shall be designed and constructed so that the unseen spread of fire and smoke within concealed spaces in its structure and fabric is inhibited.

B3.1 Has the Modular System been Fire Tested and Fire Engineering Assessed?

B3.1.1 What Fire Testing has been undertaken on the Modular System?

- Testing shall be required whether the building is designed and constructed to the Approved Document, to a "Fire Strategy", or to a Fire Engineered procedure with principles in *BS 7974: 2019 Application of fire safety engineering principles to the design of buildings. Code of practice*.

B3.1.2 How have Fire Engineering Assessments been carried out based on Test evidence?

- Fire Engineering Assessment shall be undertaken in accordance with the Passive Fire Protection Forum's 2019 Revision of the Guide to undertaking technical assessments of the fire performance of construction products and *BS EN 15725: 2010 Extended application reports on the fire performance of construction products and building elements*. They address the complexity of the assessment and the competency of the assessor.
- The PFPF Guide to undertaking technical assessments of the fire performance of construction products does not apply to the façade.
- Modular buildings require a Complex Fire Engineering Assessment that includes within its explicit Scope or "Field of Application" the project specific horizontal and vertical Cavities between Modules, and between the Module stack and the site built primary structure. Simple and Intermediate Assessments shall not be sufficient for a Modular building:

  Simple Assessments

  The assessment of relatively minor changes to a tested product or system. Such changes shall not be critical to the fire performance of the product or construction being assessed.

  Intermediate Assessments

  The assessment of intermediate complexity and significant changes to a tested product or system. Such changes may be critical to the fire performance of the product or construction being assessed.

  Complex Assessments

  The assessment of multiple changes to a group of tested products or systems. Such assessments often rationalise the results of several tests in a wider assessment report to cover ranges of products in different combinations and permutations. Such changes are always fundamental to the fire performance of the product or construction being assessed.

B3.1.3 How have the competency Levels of named Assessors undertaking Complex Fire Engineering Assessments been demonstrated?

- The Complex Fire Engineering Assessments shall be signed by a Level 1 Assessor, who as the Principal may supervise and take responsibility for the work of a Level 2 Assessor. Level 3, 4 and 5 Assessors are not competent to undertake Complex Assessments.

  Level 1

  Principal Assessor competent for Simple, Intermediate and Complex Assessments

  Level 2

  Senior Assessor competent for Simple, Intermediate and Complex Assessments

  Level 3

  Assessor competent for Simple and Intermediate Assessments

  Level 4

  Trainee Assessor competent for Simple Assessments

  Level 5

  Apprentice Assessor not competent for any Assessment

- The Level 1 Assessor shall explicitly sign that the building specific Movements and Tolerances Report corresponds with the Fire Engineering Assessment for the fire situation.

B3.2 How is Stability of the Primary Structure of the Module Stack maintained?

B3.2.1 Has Stability been tested to National or European Standards?

- Reference shall be made to the Classifications in *BS EN 13501-2: 2016: Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*.

B3.2.2 Is the fire resistance period of Stability expected of the primary structure in Requirement B3-(1) extended to allow time for compliance with Requirement B5 of Schedule 1., to provide a period of safe access and facilities for the Fire and Rescue Service to ensure the safety of occupants and fight the fire?

B3.2.3 What approach to Fire Protection is adopted to ensure that period of Stability in the Module stack?

- Fire Protection is not generally achieved around each Hot Rolled Steel section in the primary structure of a Modular System. Fire Protection is provided from inside the rooms only by the fire resisting and usually plasterboard internal linings to Soffit, Wall and Floor construction.
- The linings as Requirement B2 Internal fire spread (linings) of Schedule 1. shall not transfer an excess of heat to the Hot Rolled Steel sections in the primary structure, which loses 40% strength when temperatures reach 550°C.
- It is not possible to apply Intumescent Fire Protection to the primary structural Steel concealed within the internal linings to Soffit, Wall and Floor construction, which are also Compartmentation as Requirement B3-(3)(a) of Schedule 1.

B3.3 How is the Interior of the Module constructed to be Fire Resistant?

B3.3.1 Has Stability, Integrity and Insulation been tested to National or European Standards?

- Reference shall be made to the Classifications in *BS EN 13501-2: 2016: Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*.

B3.3.2 What is the fire resistance of the single sided Internal Floor in terms of Stability, Integrity and Insulation to achieve Compartmentation as Requirement B3-(3)(a) of Schedule 1.?

B3.3.3 How is the fire resistance of the Internal Floor achieved to prevent fire burning down into the Cavity above the top of the Module below?

- Often the Internal Floor construction of a Modular System is built-up from Cold Rolled Light Steel Joints supported on Hot Rolled Steel primary structure, with a Timber Board substrate to the decorative finish. To achieve acoustic performance,required in Part E Resistance to the Passage of Sound of Schedule 1., the void between Joists contains Acoustic Insulation, which has negligible fire resistance performance when it is a Glass Wool product.
- Some proprietary Modular Systems manufacturers have developed Concrete composite Floors on shallow profiled metal decks to improve fire resistance and acoustic performance, but these increase the weight of the Modules.
- Fire Protection of primary structure shall be maintained by the Internal Floor.

B3.3.4 How does the interface of the Floor with the Base of the Internal Wall maintain Compartmentation?

- The Floor has Vertical Deflection due to imposed Live Loads.
- Service Penetrations vertically require Fire Stopping. They are better avoided and designed out.

B3.3.5 What is the fire resistance of the single sided Internal Soffit in terms of Stability, Integrity and Insulation to achieve Compartmentation as Requirement B3-(3)(a) of Schedule 1.?

B3.3.6 How is the fire resistance of the Internal Soffit achieved above the non-fire resisting Ceiling to prevent fire burning up into the Cavity below the base of the Module above?

- Generally, the Internal Soffit construction of a Modular System is Cold Rolled Light Steel Joints supported on Hot Rolled Steel primary structure. Fire Protection of primary structure is provided by the fire resisting and usually plasterboard Lining. To achieve acoustic performance, as required in Part E Resistance to the Passage of Sound of Schedule 1., the void between Joists contains Acoustic Insulation, which has negligible fire resistance performance when it is a Glass Wool product.
- The Temporary Deck is on top for the Operative to walk over as Modules are installed off the crane into the stack. If that Temporary Deck is combustible it will be permanently retained in the horizontal Cavities of the Module stack beneath the Temporary Weathering Membrane.
- A non-fire resisting suspended Ceiling and Building Services are supported by the Soffit.

B3.3.7 How does the interface of the Soffit with the head of the Internal Wall maintain Compartmentation?

- The Soffit will not have Vertical Deflection because there are no imposed Live Loads when built into the Module stack.
- Service Penetrations vertically require Fire Stopping. They are better avoided and designed out.

B3.3.8 What are the fire resistances of single sided Internal Walls between Modules in terms of Stability, Integrity and Insulation to achieve Compartmentation as Requirement B3-(3)(a) of Schedule 1.?

- The adjacent Modules form a pair single sided Internal Walls with a vertical Cavity between that shall be Fire Stopped at every Compartment level, and made discontinuous with the horizontal Cavity between the Soffit to the top and the Floor to the base of a stacked Module.

B3.3.9 How is the fire resistance of the pair of Internal Walls achieved to prevent fire burning into the Cavity between the Modules?

- Generally, the Internal Wall construction of a Modular System is Cold Rolled Light Steel Frame as infill construction to Hot Rolled Steel primary structure. Fire Protection of primary structure is provided by the fire resisting and usually plasterboard Lining. To achieve acoustic performance, as required in Part E Resistance to the Passage of Sound of Schedule 1., the void between Studs contains Acoustic Insulation, which has negligible fire resistance performance when it is a Glass Wool product.
- To support wall mounted fittings the Internal Wall is often fitted with Pattresses between the studs because plasterboard will not support weight on fixings. If those Pattresses are combustible they will be permanently retained in the vertical Cavities of the Module stack behind the Temporary Weathering Membrane.

B3.3.10 How do the interfaces of the head of the single sided Internal Wall and the Soffit and the base of the single sided Internal Wall and the Floor maintain Compartmentation?

- The Internal Wall will have Vertical Deflection because imposed Live Loads on the Internal Floor will deflect the Hot Rolled Steel primary structure.
- All non-loadbearing Internal Wall infill construction requires a Deflection Head. No Deflection Head means the Internal Wall infill construction is load bearing, and shall maintain load-bearing capacity in the fire situation. But the Soffit of a Module is not load-bearing and does not deflect, so that a gap at the head will occur when the Internal Floor deflects if there is no Deflection Head. Conversely if the head is firmly fixed a gap will occur at the deflecting Internal Floor.
- Service Penetrations horizontally require Fire Stopping.

B3.3.11 What are the fire resistances of double sided Internal Walls between Module room accommodation and horizontal Corridors or vertical Service Risers in terms of Stability, Integrity and Insulation to achieve Compartmentation as Requirement B3-(3)(a) of Schedule 1.?

B3.3.12 How is the fire resistance of the Internal Walls forming Corridors and Service Risers achieved?

- Generally, the Internal Wall construction of a Modular System is Cold Rolled Light Steel Frame. Fire Protection of primary structure is provided by the fire resisting and usually plasterboard Lining. To achieve acoustic performance, as required in Part E Resistance to the Passage of Sound of Schedule 1., the void between Studs contains Acoustic Insulation, which has negligible fire resistance performance when it is a Glass Wool product.

- To support wall mounted fittings the Internal Wall is often fitted with Pattresses between the studs because plasterboard will not support weight on fixings.

B3.3.13 How do the interfaces of the head of the double sided Internal Wall and the Soffit and the base of the double sided Internal Wall and the Floor maintain Compartmentation?

- The Internal Wall will have Vertical Deflection because imposed Live Loads on the Internal Floor will deflect the Cold Rolled Steel Joists and the Hot Rolled Steel primary structure that trims the Service Riser which aligns with the Corridor.
- All non-loadbearing Internal Wall infill construction requires a Deflection Head. No Deflection Head means the Internal Wall infill construction is load bearing, and shall maintain load-bearing capacity in the fire situation. But the Soffit of a Module is not load-bearing and does not deflect, so that a gap at the head will occur when the Internal Floor deflects if there is no Deflection Head. Conversely if the head is firmly fixed a gap will occur at the deflecting Internal Floor.
- Service Penetrations horizontally require Fire Stopping.

B3.4 Where do Vertical Deflections in Risers and Shafts require Movement Joints?

B3.4.1 How are segmented Service Risers constructed to maintain their fire resistance as Compartments over the full height of the Module stack when Vertical Deflections require Movement Joints?

- The Modular System shall have fire tested a Fire Stopped Movement Joint detail at the repeating Module-to-Module interface within the Service Risers with quantified Vertical Deflections as Requirement A1 of Schedule 1. This detail shall maintain Fire Protection to primary structure.
- There may be an additional project requirement for a fire test on Fire Stopped Movement Joint details with the Modular Service Risers above site built Ground or Podium level, and below any site built Upper Storey or Roof level.

B3.4.2 How will access to initially install, subsequently inspect, maintain and periodically replace Fire Stopping in Service Risers be achieved?

B3.4.3 What is the Service Life of the Fire Stopping at Service Riser Movement Joints?

B3.4.4 How are segmented Smoke and Heat Exhaust Ventilation (SHEV) Shafts constructed to maintain their fire resistance as Compartments over the full height of the Module stack when Vertical Deflections require Movement Joints?

- There will be an additional project requirement for a fire test on a Fire Stopped Movement Joint detail at the repeating Module-to-Module interface within the SHEV Shaft with quantified Vertical Deflections as Requirement A1 of Schedule 1. if the Shafts is being used for smoke and heat exhaust ventilation rather than being a Service Riser containing Fire Resisting Ductwork. This detail shall maintain Fire Protection to primary structure.
- There may be an additional project requirement for a fire test on Fire Stopped Movement Joint details with the Modular SHEV Shafts above site built Ground or Podium level, and below any site built Upper Storey or Roof level.

B3.4.5 How will access to initially install, subsequently inspect, maintain and periodically replace Fire Stopping in the SHEV Shafts be achieved?

B3.4.6 What is the Service Life of the Fire Stopping at SHEV Shaft Movement Joints?

B3.5 How have extensive Cavities within the Module Stack been constructed?

B3.5.1 Have the concealed spaces of the horizontal and vertical Cavities between Modules, or between Modules and the Core, been constructed to comply with Requirement B3-(4) of Schedule 1. using non-combustible materials and Fire Stopping?

- For “Relevant Buildings” in Regulation 7(4) of the *2010 Building Regulations* following the 2018 Building (Amendment) Regulations, and subject to Regulation 7(3) exceptions, the External Wall is required in Regulation 7(2) to be non-combustible using construction materials and products of Class A2-s1,d0 or Class A1. Combustible materials and products are considered to be Class A2-s2,d1 or worse. Reference shall be made to *BS EN 13501-1: 2018 Fire classification of construction products and building elements. Classification using data from reaction to fire tests*.

- Cavities within the Compartmentation of Floors and Walls between Modules, or between Modules and the Core, shall not be considered in the same way as Cavities above Ceilings, below Raised Floors, or behind Internal Linings as Requirement B2 of Schedule 1.
- Cavities within the Compartmentation of Floors and Walls require Fire Stopping to continue the Compartment fire resistance. Cavities above Ceilings, below Raised Floors, or behind Internal Linings inside the Compartments only require Cavity Barriers which have their fire resistance defined as 30 Minutes Integrity and 30 Minutes Insulation.

B3.5.2 Has Integrity and Insulation for Fire Stopping been tested to National or European Standards?

- Reference shall be made to *BS EN 13501-2: 2016 Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*.

B3.5.3 Have the concealed spaces of the horizontal and vertical Cavities between Modules, or between Modules and the Core, been constructed with materials and products containing Fire Retardants to achieve better reaction to fire Classifications?

- The duration of the tests for National and European reaction to fire Classifications is shorter than the fire resistance required from Compartmentation and Fire Stopping.
- The use of Fire Retardants in otherwise combustible materials and products built into Cavities may achieve better reaction to fire Classifications for a short duration. However, by combusting in less time than the period required by the fire resisting Compartments the Fire Retarded Fire materials and products may cause the Fire Stopping to fail prematurely.
- Fire Retarded materials within Compartmentation containing Cavities may not comply with Requirement B3-(4) of Schedule 1.

B3.5.4 Has the Fire Stopping for Cavities between Modules, or between Modules and the Core, been fire tested for the proprietary Modular System, or the project specific Modular stack?

- The unseen spread of fire and smoke within concealed spaces between Modules, or between Modules and the Core, would not be inhibited were the Fire Stopping to fail.
- The Fire Stopping detailed in design and installed on site shall be exactly as fire tested.

B3.5.5 Were fire tests carried out on the range of compressions of the Fire Stopping due to Vertical Deflections expected in the primary structure engineered for compliance with Requirement A1-(1) of Schedule 1.?

- Vertical Deflections may be relieved with removal of imposed Live Loads and the Fire Stopping shall be able to recover or de-compress, without gaps opening to breach the Compartment.
- Project specific tests of Fire Stopping are required in early design development Work Stages where Movements and Tolerances shall be considered, where the Modular System has not technically established repeatable, generic detailing.

B3.5.6 What is the Design Life of the building?

- Conventionally the Design Life is 60 years.

B3.5.7 Has the Service Life of Fire Stopping been proven equal to the Design Life of the building?

- Fire Stopping has to be installed as the Module stack is built and is not accessible thereafter for the Design Life of the building.
- Intumescent Fire Stopping materials must react to fire to perform their function, but will deteriorate in performance over a shorter Service Life than the Design Life of the building, even if protected within the building interior. Fire Stopping that does not deteriorate in the required performance over its Service Life shall be provided.
- The use of “Open State” Cavity Barriers in a Rainscreen System requires replacement where Service Life is shorter than the building Design Life. Cladding panels can be removed and access provided for the works. There is no possibility to access the Cavities within the Module stack after the initial installation of Fire Stopping.

B3.5.8 If the Service Life of Fire Stopping is less than the Design Life, how will it be periodically replaced?

B3.5.9 What is the combustibility of Temporary Weathering Membrane protecting the individual Modules in storage, transportation, installation and while the Module stack is enclosed by any façade and the Roof built on site?

- The Module stack is built without removing the Temporary Weathering Membrane and all the tapes and straps that hold it in place, which either singly or in pairs become a permanent but modest fuel load within horizontal and vertical Cavities between Modules, or between Modules and Core.
- Each Cavity is temporarily weather sealed across the gaps between Temporary Weathering Membranes as the Storeys are stacked up to prevent rainwater damaging the linings and fittings of Modules below. The temporary weather seals shall not affect the performance of Fire Stopping.
- Approved Document Part B Volume 1 Paragraph 10.15 and Volume 2 Paragraph 12.16 (2019 to 2020) require that Membranes within the External Wall construction above Ground level shall be Class B-s3, d0, or better, to BS EN 13501-1.
- Commercially available Products which may be used as Temporary Weathering Membrane protecting the individual Modules are being innovated, and shall be tested to BS EN 13501-1 to show their Reaction to Fire. Subject to the manufacturer assessing their suitability within the Module System the Membrane products can include, but are not limited to:

  Class A2-s1,d0 Effisus Vapour FR System Vapour Control Layer

  Class A2-s1,d0 Obex Cortex 0200FR Waterproofing Membrane

  Class A2-s1,d0 Serge Ferrari Stamisol Safe ONE SF400 Breather Membrane

  Class B-s1,d0 Proctor Wraptite Breather Membrane

  Class B-s3,d0 Obex Cortex 0500FR Vapour Control Layer with Cortex 0771FR Adhesive

  Other products can be incorporated into the Module System.
- It may be decided on a Modular building that the Cavity construction of Internal Walls and Floors shall be non-combustible, including Temporary Weathering Membranes, so that all construction materials and products are Class A2-s1,d0 or Class A1 to BS EN 13501-1. That decision may assist with the fire testing of Fire Stopping that is either part of the proprietary Modular System or proven by testing for the project. That would exceed all current requirements for Membranes in Regulation 7(3) for the External Wall.
- Regulation 7(3) of the *2010 Building Regulations* following the 2018 Building (Amendment) Regulations excludes Membranes from the Regulation 7(2) requirement for "Relevant Buildings" in Regulation 7(4), to default to Class B-s3,d0, or better, to BS EN 13501-1 in Approved Document Part B Volume 1 and 2 (2019 to 2020).

B3.5.10 Is there Third Party evidence of installation of all fire resistance tested fire stopping of otherwise extensive cavities within the compartmentation at the horizontal and vertical joints between Modules, or between Modules and the Core(s), during construction?

- The building owner or operator and their insurers should be provided with assurance of fire stopping installation in accordance with test reports by the submission of a 100% photographic survey record of every identified void or cavity as the stack is built up, which extends to fire stopping around all openings between Modules, including around connecting door frames, throughout Service Risers and along Escape Corridor compartmentation.
- This 100% photographic survey record should also be provided to the "Responsible Person" appointed by the building owner or operator under the 2005 Regulatory Reform (Fire Safety) Order as part of the Regulation 38 Fire Safety Information exchange expected in the *2010 Building Regulations* and Approved Document B Volumes 1 and 2 (2019 as amended 2020). This survey record can only occur when the Modules are being stacked in permanent placement but may affect Handover at Work Stage 6 in the RIBA Plan of Work 2020.

  https://www.legislation.gov.uk/uksi/2010/2214/regulation/38

B3.5.11 When fire propagates to a hidden and potentially combustible void or cavity is there an understanding of how fire spread will be mitigated and ultimately extinguished?

B4 External fire spread

B4-(1) The external walls of the building shall adequately resist the spread of fire over the walls and from one building to another, having regard to the height, use and position of the building.

B4-(2) The roof of the building shall adequately resist the spread of fire over the roof and from one building to another, having regards to the use and position of the building.

B4.1 How is the Spread of Fire adequately resisted from one building to another?

B4.1.1 What is the extent of fire resisting construction in the façade?

- Reference shall be made to BRE BR187 External fire spread Building separation and boundary distances Second Edition, 2014 for the calculation of "Unprotected Area" as a consequence of Fire Intensity by building use, Compartment Size, and distance to the "Relevant Boundary".

B4.2 Where is the External Wall of the Module constructed to be Fire Resistant?

B4.2.1 Has Stability, Integrity and Insulation been tested to National or European Standards?

- Reference shall be made to the Classifications in *BS EN 13501-2: 2016: Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*.

B4.2.2 What are the fire resistances of double sided External Backing Wall as infill construction in terms of Stability, Integrity and Insulation to achieve Compartmentation as Requirement B3-(3)(a) of Schedule 1.?

- The arrangement of Cavity Barriers in the various façades shall determine whether the External Backing Wall as infill construction is, regardless of any "Unprotected Area" allowance, required to be an extension of the fire resisting Compartmentation achieved by the Internal Soffit and Floor construction, and in relation to the Cavity Barriers required around Window and Door openings.
- Modular construction tends to result in an opaque External Wall between vision glazed Windows to conceal the depth of the fire resisting Compartmentation as a combination of the Internal Floor and Internal Soffit around a horizontal Cavity. This depth of construction is often deepened by the non-fire resisting suspended Ceiling and Building Services.

B4.2.3 Does the specification of fire resistance address both sides of the External Backing Wall?

- There is an "inside-out" and an "outside-in" Fire Risk on the External Backing Wall.
- The External Backing Wall is a double sided Cold Rolled Light Steel Frame construction.
- The exterior Sheathing of the External Backing Wall not only provides support and weathering for the façade, but also provides Fire Protection to the Hot Rolled Steel primary structure, and Fire resistance to the double sided Cold Rolled Light Steel Frame. Sheathing interfaces with the Fire Stopping to the horizontal and vertical Cavities between Modules at Movement Joints, forms the penetration by Mechanical Ventilation Ductwork requiring Fire Stopping and a Terminal, and supports the Cavity Barriers which must relate to the Window and Door Openings, and seals to Balcony brackets.
- Sheathing for the façade shall achieve the many requirements of Part B Fire Safety of Schedule 1.

B4.2.4 Where required, how is the fire resistance of the External Backing Wall as infill construction achieved?

- Generally, the External Wall construction of a Modular System is Cold Rolled Light Steel Frame. Fire Protection of primary structure is provided by the fire resisting and usually plasterboard Lining. To achieve thermal performance as Part L Conservation of Fuel and Power of Schedule 1. the void between Studs contains Thermal Insulation, which has negligible fire resistance performance when it is a Glass Wool product.
- To support wall mounted fittings the External Wall may be fitted with Pattresses between the studs because plasterboard will not support weight on fixings.

- The External Wall is not simply providing an Internal Lining to the room. The External Backing Wall as infill construction must achieve the Dead, Live and Wind Load requirements for the façade as Requirement A1 of Schedule 1.

B4.2.5 How do the interfaces of the head of the External Wall and the Soffit and the base of the External Wall and the Floor maintain Compartmentation?

- The External Wall will have Vertical Deflection because imposed Live Loads on the façade and the Internal Floor will deflect the Cold Rolled Steel Joists and the Hot Rolled Steel primary structure.
- All non-loadbearing External Wall infill construction requires a Deflection Head. No Deflection Head means the External Wall infill construction is load bearing, and shall maintain load-bearing capacity in the fire situation. But the Soffit of a Module is not load-bearing and does not deflect, so that a gap at the head will occur when the Internal Floor deflects if there is no Deflection Head. Conversely if the head is firmly fixed a gap will occur at the deflecting Internal Floor.
- Service Penetrations horizontally require Fire Stopping. They are better avoided and designed out where possible, but Mechanical Ventilation as Part F Ventilation of Schedule 1. necessarily penetrates the External Backing Wall as infill construction and the façade.

B4.3 How is the Spread of Fire adequately resisted over the External Walls?

B4.3.1 How has the façade been designed for Fire Safety in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering and Fire Engineering consultancy?

- Fire Safety shall be resolved with the need for the façade to satisfy Requirement C2 Resistance to moisture of Schedule 1. Construction required for Fire Safety shall not be degraded. Satisfaction of Requirements B4-(1) and C2 shall both be achieved in the design.
- Reference shall be made to a Registered Copy of the Centre for Window and Cladding Technology (CWCT) Standard for Systemised Building Envelopes 2006, as technically updated.
- Reference shall be made to CWCT Guidance on Built-up Walls 2017.
- Reference shall be made to CWCT Technical Notes that include, but are not limited to:

  TN55 – Movement accommodation in building envelopes

  TN78 – Interfaces and joints – Introduction

  TN95 – Weathertightness of windows, doors and curtain walls

  TN98 – Fire performance of façades

  CWCT TN98 was published prior to the 2018 Building (Amendment) Regulations, which amended Building Regulation 7 for materials and workmanship. CWCT TN98 is subordinated by that amendment, and is not to be used to suggest relaxations to the Fire Strategy.

B4.3.2 Is the building a “Relevant Building” under Regulation 7(4) following the 2018 Building (Amendment) Regulations to the *2010 Building Regulations* which introduced the 2018 amendments to Approved Document 7 – Materials and workmanship 2013 edition?

B4.3.3 How has the External Wall been designed and constructed to comply with Regulation 7(2) if the building is a “Relevant Building” under Regulation 7(4)?

B4.3.4 Which materials and products in the External Wall have been exempted under Regulation 7(3) if the building is a “Relevant Building” under Regulation 7(4)?

B4.3.5 How has the External Wall otherwise been designed and constructed to comply with Requirement B4-(1) of Schedule 1. where the building is not a Relevant Building” under Regulation 7(4)?

- Having regard to the height, use and position of the building the external walls shall adequately resist the spread of fire:

  Over the External Walls

  From one building to another

- Cost saving is not an acceptable justification when Requirement B4-(1) of Schedule 1. is concerned with Life Safety.

B4.3.6 Have Paragraphs 10.6 of Volume 1 or 12.6 of Volume 2 of Approved Document Part B (2019 to 2020) been relied upon for buildings with a Storey over 18m which are not a "Relevant Building" under Regulation 7(4)?

B4.3.7 Where are Cavity Barriers located in the façade?

- Reference shall be made to:

  Approved Document Part B Volumes 1 and 2 (2019 to 2020)

  BS 9991 Sections 19.1 and 19.2 which shall be read with Figure 24

  BS 9999 Sections 33.1 and 33.3 which shall be read with Figure 35

  CWCT TN98 – *Fire performance of façades*

- Superseding CWCT TN98 both Volumes of Approved Document Part B (2019) have been published with a Note that the following do not necessarily achieve the performance specified in BS 9991 and BS 9999, and where proposed as construction on drawings shall be tested as a Cavity Barrier:

  Steel, a minimum of 0.5mm thick

  Timber, a minimum of 38mm thick

  Polythene-sleeved mineral wool, or mineral wool slab, under compression in the cavity

  Calcium silicate, cement-based or gypsum-based boards, a minimum of 12mm thick

- Cavity Barriers of a minimum 30 Minute Integrity and 15 Minute Insulation Fire Resisting construction are required:

  Around the edges of any opening;

  To close the edges of any cavities;

  At the top of the cavity; and

  In the continuation of compartment walls and compartment floor

- Modular stacks achieve Compartmentation by the combination of a fire resisting Internal Floor as the base of a Module over a fire resisting Internal Soffit as the top of the Module below, with a horizontal Cavity between. That horizontal Cavity shall be Fire Stopped from the façade to limit unseen fire spread as Requirement B3-(4), which requires a Movement Joint as Requirement A1 of Schedule 1. in the Sheathing.

- There is no solid fire resisting Compartment Floor, such as a Concrete Slab edge, along which to establish a horizontal Cavity Barrier line.

- External Walls of an equal Stability, Integrity and Insulation Fire Resistance to the Compartment Floors shall be constructed full height and full width to each storey against which to install the required Cavity Barriers, which may be moved in location, but not omitted.

B4.3.8 Has Stability, Integrity and Insulation been tested to National or European Standards?

- Reference shall be made to the Classifications in *BS EN 13501-2: 2016: Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*.

B4.4 How is the Spread of Fire adequately resisted over the Roof?

B4.4.1 How does the Roof relate to the activation of the Smoke and Heat Exhaust Ventilation (SHEV) System in a fire situation to ensure the Roof is unaffected by smoke and heat?

B4.4.2 Is there a Lightening Protection system for the building from the Roof through the façade to Ground?

B5 Access and facilities for the fire service

B5-(1) The building shall be designed and constructed so as to provide reasonable facilities to assist fire fighters in the protection of life.

B5-(2) Reasonable provision shall be made within the site of the building to enable fire appliances to gain access to the building.

B5.1 What facilities assist fire fighters in the protection of life and property?

B5.1.1 What advice from the Fire and Rescue Service was obtained in consultation early in the design development to determine the facilities required for life safety and further to protect the asset?

B5.1.2 Has an alternative approach been taken to providing the means of escape based on guidance other than the statutory guidance of the Approved Document?

B5.1.3 What enhanced internal fire facilities have been provided for firefighters to complete their tasks?

B5.1.4 What protected access into and within the building has been provided for firefighting personnel to search for and rescue people throughout the building?

B5.1.5 What protected access into and within the building has been provided for firefighting personnel to fight fire throughout the building?

B5.1.6 How have the activities of Fire and Rescue Service personnel in fighting fire and undertaking search and rescue been resolved with the evacuation of escaping occupants?

B5.1.7 What are the natural or mechanical smoke and heat exhaust ventilation systems provided throughout the building, which may include a basement?

B5.1.8 Is there a basement car park?

B5.1.9 Are electric car charging points installed within or around the building?

B5.1.10 How are gas and electric utilities to be turned off by the Fire and Rescue Service?

B5.1.11 What provision and location of firefighting shafts has been made?

B5.1.12 How are firefighting shafts designed and constructed?

B5.1.13 Is compartmentation provided by rolling shutters or fire and smoke curtains?

B5.1.14 What standard of rising fire mains have been designed and constructed?

B5.1.15 How are fire mains regularly serviced?

B5.1.16 Are private hydrants at ground level provided to a standard?

B5.1.17 Is there an alternative supply of water?

B5.2 What facilities are provided within the site of the building to enable fire appliances to be used near the building?

B5.2.1 How have the external access routes and hardstandings been arranged if the building is not fitted with fire mains?

B5.2.2 How have the external access routes and hardstandings been arranged where the building is fitted with fire mains?

B5.2.3 How have external access routes and hardstandings enabled fire appliances to be used near the building without obstruction of Fire and Rescue Service personnel in fighting fire and undertaking search and rescue during the evacuation of escaping occupants?

B5.2.4 What is the arrangement and construction of outlet ducts or shafts from basements anticipating deployment of fire appliances and emergency services vehicles around the building?

B6 Handover of building under contract

B6.1 How was Building Regulation 38 complied with?

B6.1.1 Who is the Responsible Person appointed under the 2005 Regulatory Reform (Fire Safety) Order?

B6.1.2 Was a complete Regulation 38 Information Exchange made to the Responsible Person at handover containing the Fire Safety information for the building as listed in Approved Document Part B?

B7 Occupation of building in use

B7.1 Which "purpose group" is the building within, or is it "mixed use"?

B7.2 What are the specific fire hazards and risks facing occupants?

Part C Site Preparation and Resistance to Contaminants and Moisture

C1 Preparation of site and resistance to contaminants

C2 Resistance to moisture

C1 Preparation of site and resistance to contaminants

C1-(1) The ground to be covered by the building shall be reasonably free from any material that might damage the building or affect its stability, including vegetable matter, topsoil and pre-existing foundations.

C1-(2) Reasonable precautions shall be taken to avoid danger to health and safety caused by contaminants on or in the ground covered, or to be covered by the building and any land associated with the building.

C1-(3) Adequate sub-soil drainage shall be provided, if it is needed to avoid –

(a) the passage of ground moisture to the interior of the building;

(b) damage to the building, including damage through the transport of water-borne contaminants to the foundations of the building.

C1-(4) For the purposes of this requirement, "contaminant" means any substance which is or may become harmful to persons or buildings including substances which are corrosive, explosive, flammable, radioactive or toxic.

C2 Resistance to moisture

C2 The walls, floors and roof of the building shall adequately protect the building and people who use the building from harmful effects caused by –

(a) ground moisture;

(b) precipitation including wind-driven spray;

(c) interstitial and surface condensation; and

(d) spillage of water from or associated with sanitary fittings or fixed appliances.

C2.1 How has the Façade been designed to provide Resistance to Moisture?

C2.1.1 How is the façade contracted to clearly resolve the split responsibilities in design and construction between the Modular manufacturer and installer, and the contractors for site built façade works?

C2.1.2 Has the Modular System been developed for a particular façade System, and if so which façade System?

C2.1.3 How has the façade been designed for Resistance to Moisture in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering consultancy?

- The façade shall satisfy Requirement C2 by providing adequate weather protection of the building and people who use the building from harmful effects caused by C2(b) precipitation including wind-driven spray and C2(c) interstitial and surface condensation, while satisfying all other functional Requirements in Schedule 1. These include, but are not limited to:

  A1 Loading

  B4-(1) Fire Spread in the External Wall

  C2(b) Resistance to Moisture from precipitation including wind-driven spray

  C2(c) Resistance to Moisture from interstitial and surface condensation with regard to L1(a)

  E1 Protection against sound from other parts of the building and adjoining buildings

  F1-(1) Means of Ventilation for people in the building

  H3-(1) Rainwater Drainage from Roofs, Terraces and Balconies

  J1 Air Supply for Combustion Appliances

  J2 Discharge of products of combustion by Flues

  J4 Protection of building against Fire from Combustion Appliances and Flues

J5 Provision of Information about Combustion Appliances and Flues

K2 Protection from falling

K4 Protection from collision with open Windows, Skylights or Ventilators

K5 Protection against impact from and trapping by Doors

L1(a) Conservation of fuel and power through the building fabric with regard to C2(c)

N1 Protection against impact with Glazing

N2 Manifestation of Glazing

N3 Safe opening and closing of Windows, Skylights and Ventilators

N4 Safe access for cleaning

With additional attention given to Approved Documents not following Schedule 1. Requirements:

Part Q Security in Dwellings

None of these additional considerations shall impair the Resistance to Moisture of the façade, some of which is manufactured and installed with the Modules, to be completed on site.

- Reference shall be made to a Registered Copy of the Centre for Window and Cladding Technology (CWCT) Standard for Systemised Building Envelopes 2006, as technically updated. Parts are:

  Part 1 – Scope, terminology, testing and classification

  Part 2 – Loads, fixings and movement

  Part 3 – Air, water and wind resistance

  Part 4 – Operable components, additional elements and means of access

  Part 5 – Thermal, moisture and acoustic performance

  Part 6 – Fire performance

  Part 7 – Robustness, durability, tolerances and workmanship

  Part 8 – Testing

  Part 0 – Specifiers' checklist and certification

- The CWCT Standard refers to the CWCT *Standard test methods for building envelopes 2005* that gives the basis for testing and verification, and shall also be referred to.

- The CWCT Standard shall be referred to with the following Technical Updates:

  TU11 – Acceptable water leakage – March 2008

  TU12 – Redundancy of fixings – April 2008

  TU13 – Measurement of displacement – March 2008

  TU14 – Load combinations – July 2009

  TU15 – Replacement of British Structural design codes by Eurocodes – November 2010

  TU17 – Calibration of test chamber for air leakage – October 2011

  TU18 – Allowable deflections – March 2014

  TU21 – Dynamic watertightness test – April 2015

  TU22 – Wind Resistance – Displacement at supports – August 2015

  TU15 clarifies that for the calculation of maximum wind pressure the CWCT Standard refers to the use of *BS 6399-2: 1997: Loading for buildings. Code of practice for wind loads*. This is withdrawn and is replaced by *BS EN 1991-1-4: 2005 + A1: 2010 Eurocode 1. Actions on structures. General actions. Wind actions*.

- Reference shall be made to CWCT Technical Notes additional to CWCT *TN41 – Site testing for watertightness*, that include, but are not limited to:

  TN47 – Overall building envelope U-values

  TN55 – Movement accommodation in building envelopes

  TN75 – Impact performance of building envelopes: guidance on specification

  TN76 – Impact performance of building envelopes: method for impact testing cladding panels

  TN77 – Assessment and certification of rainscreen systems

  TN78 – Interfaces and joints – Introduction

  TN95 – Weathertightness of windows, doors and curtain walls

  TN96 – Assessing cradle and suspended access equipment - Relevant for Section N25

  TN98 – Fire performance of façades

  CWCT TN98 was published prior to the *2018 Building (Amendment) Regulations*, which amended Building Regulation 7 for materials and workmanship. CWCT TN98 is subordinated by that amendment and is not to be used to suggest relaxations to the Fire Strategy.

C2.1.4 Has Thermal Performance been achieved without Condensation Risk as L1.3 of this document?

- Condensation Risk is an aspect of hygrothermal performance and is an essential aspect of the design of thermally insulated and moisture vapour permeable or impermeable construction.
- Manufacturers of thermal insulation provide assistance to architects using licensed software to show when and where interstitial and surface condensation may occur. The architect shall ensure the detailing of the building fabric is developed to design out Condensation Risk, perhaps assisted by a façade engineer where the construction is specialised.

C2.2 How has the Façade with Attachments been coordinated with the Modules?

C2.2.1 Have structural façade Brackets been installed with weathering on the Modules before being craned into the stack to achieve an interface with the façade?

C2.2.2 Are weathered and architecturally finished “Pods” installed around Windows and Doors on the Modules before being craned into the stack to achieve an interface with the façade?

C2.2.3 Has the Temporary Weathering Membrane on the Modules been retained or removed before undertaking the site built construction required to complete the façade?

C2.2.4 What approval was given by the façade contractor to the Temporary Weathering Membrane protecting the individual Modules retained in the façade?

C2.3 Has the Façade construction been Hose tested for Weathertightness?

C2.3.1 Were Hose Tests undertaken as CWCT TN41 and Clause 8.16.2 of the CWCT Standard for a minimum of 5% of the joints in the Weathering Membrane?

- Reference shall be made to CWCT *TN41 – Site testing for watertightness*, which develops upon the requirements of *BS EN 13051:2001 Curtain walling. Watertightness*. *Site test*, as practice that predates the CWCT Standard published in 2006.

C2.3.2 Were Hose Tests undertaken before the installation of Cavity Barriers in the façade?

C2.3.3 Were Hose Tests carried out with full visibility of the inside of the façade System before being covered by internal linings that would prevent the verification that no leaks had occurred?

C2.3.4 Was a Third Party appointed to undertake Hose Testing, and who are they accredited by?

C2.3.5 Had the Hose Test method been calibrated in a Prototype test of the façade System as specified in the CWCT *Standard for Systemised Building Envelopes 2006*, or was the façade developed as a built-up construction without CWCT System testing?

C2.4 What measures were taken to prevent Water Leakage from Sanitary Areas?

C2.4.1 Which Waterproofing system has been repetitively used in the Modules?

C2.4.2 Were any waterproofing benchmarks Flood and Hose Tested before installation of the decorative finishes, and Reported upon by the Waterproofing system manufacturer?

C2.4.3 Was the quality of work 100% checked on installation by the Waterproofing system manufacturer to provide a Warranty before completion?

Part D Toxic Substances

D1 Cavity insulation

D1 If insulating material is inserted into a cavity in a cavity wall, reasonable precautions shall be taken to prevent the subsequent permeation of any toxic fumes from that material into any part of the building occupied by people.

Part E Resistance to the Passage of Sound

E0 Acoustic Engineering

E1 Protection against sound from other parts of the building and adjoining buildings

E2 Protection against sound within a dwelling-house etc.

E3 Reverberation in common internal parts of buildings containing flats or rooms for residential purposes

E4 Acoustic conditions in schools

E0 Acoustic engineering

E0.1 What are the Acoustic issues for the site to be addressed by the Façade?

E0.1.1 How has the façade been designed to Resist to the Passage of Sound in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering and Acoustic Engineering consultancy?

- Acoustic performance shall be resolved with the need for the façade to satisfy Requirement C2 Resistance to moisture of Schedule 1. Satisfaction of Requirements E1 and C2 shall both be achieved in the design.
- Reference shall be made to a Registered Copy of the Centre for Window and Cladding Technology (CWCT) *Standard for Systemised Building Envelopes 2006*, as technically updated.
- Reference shall be made to CWCT *Guidance on Built-up Walls* 2017.
- Reference shall be made to CWCT Technical Notes that include, but are not limited to:

  TN55 – Movement accommodation in building envelopes

  TN78 – Interfaces and joints – Introduction

  TN95 – Weathertightness of windows, doors and curtain walls

E0.2 What Acoustic Engineering has informed both design and construction?

E0.2.1 Has an Acoustic Report been maintained through RIBA Plan of Work Stages, iteratively resolved as the technical design developed under constraints of space within the building height and layout?

E0.2.2 What was the scope and methodology of Sound Insulation Testing agreed with the Acoustic Engineer?

E0.2.3 Has the Sound Insulation Testing required by Regulation 41 of the *2010 Building Regulations* been completed by a Member of the Sound Insulation Testing and Measurement Association, part of the Building Compliance Testers Association, to the satisfaction of the Acoustic Engineer?

E0.2.4 Has a Sound Insulation Testing Report been signed as complete by the Acoustic Engineer?

E1 Protection against sound from other parts of the building and adjoining buildings

E1 Dwelling-houses, flats and rooms for residential purposes shall be designed and constructed in such a way that they provide reasonable resistance to sound from other parts of the same building and from adjoining buildings.

E2 Protection against sound within a dwelling-house etc.

E2 Dwelling-houses, flats and rooms for residential purposes shall be designed and constructed in such a way that –

(a) internal walls between a bedroom or a room containing a water closet, and other rooms; and

(b) internal floors,

provide reasonable resistance to sound.

Requirement E2 does not apply to –

(a) an internal wall which contains a door;

(b) an internal wall which separates an en suite toilet from the associated bedroom;

(c) existing walls and floors in a building which is subject to a material change of use.

E3 Reverberation in common internal parts of buildings containing flats or rooms for residential purposes

E3 The common internal parts of buildings which contain flats or rooms for residential purposes shall be designed and constructed in such a way as to prevent more reverberation around the common parts than is reasonable.

Requirement E3 only applies to corridors, stairwells, hallways and entrance halls which give access to the flat or room for residential purposes.

E4 Acoustic conditions in schools

E4-(1) Each room or other space in a school building shall be designed and constructed in such a way that it has the acoustic conditions and the insulation against disturbance by noise appropriate to its intended use.

E4-(2) For the purposes of this Part –

"school" has the same meaning as in section 4 of the Education Act 1996, c.56, as amended by Schedule 22 to the Education Act 2002 (c.32), section 95 of the Childcare Act 2006 (c.21), section 51 of and Schedule 7 and 8 to the Education Act 1997 (c.44) and S.I. 2010/1080; and

"school building" means any building forming a school or part of a school.

Part F Ventilation

F1 Means of ventilation

F1 Means of ventilation

F1-(1) There shall be adequate means of ventilation provided for people in the building.

Requirement F1 does not apply to a building or space within a building –

(a) into which people do not normally go;

(b) which is used solely for storage; or

(c) which is a garage used solely in connection with a single dwelling.

F1-(2) Fixed systems for mechanical ventilation and any associated controls must be commissioned by testing and adjusting as necessary to secure that the objective referred to in sub-paragraph (1) is met.

F1.1 How is Ventilation achieved through the Façade?

F1.1.1 Is adequate ventilation to be achieved by Natural or Mechanical means, or by a combination of both?

F1.1.2 How do these Means of Ventilation vary for the different kinds of accommodation in the building in relation to façade types, perhaps at different levels in the site built and Modular construction?

F1.1.3 How has the façade been designed to provide a Means of Ventilation in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering and Building Services Engineering consultancy?

- Means of Ventilation shall be resolved with the need for the façade to satisfy Requirement C2 Resistance to moisture of Schedule 1. Satisfaction of Requirements F1-(1) and C2 shall both be achieved in the design.
- Reference shall be made to a Registered Copy of the Centre for Window and Cladding Technology (CWCT) *Standard for Systemised Building Envelopes 2006*, as technically updated.
- Reference shall be made to CWCT Guidance on Built-up Walls 2017.
- Reference shall be made to CWCT Technical Notes that include, but are not limited to:

  TN55 – Movement accommodation in building envelopes

  TN78 – Interfaces and joints – Introduction

  TN95 – Weathertightness of windows, doors and curtain walls

F1.2 How is any Mechanical Ventilation verified by Commissioning?

F1.2.1 How has Requirement F1-(2) of Schedule 1. been satisfied?

F1.2.2 Who has undertaken the Commissioning?

Part G Sanitation, Hot Water Safety and Water Efficiency

G1 Cold water supply

G2 Water efficiency

G3 Hot water supply and systems

G4 Sanitary conveniences and washing facilities

G5 Bathrooms

G6 Kitchens and food preparation areas

G1 Cold water supply

G1-(1) There must be a suitable installation for the provision of –

(a) wholesome water to any place where drinking water is drawn off;

(b) wholesome water or softened wholesome water to any washbasin or bidet provided in or adjacent to a room containing a sanitary convenience;

(c) wholesome water or softened wholesome water to any washbasin, bidet, fixed bath and shower in a bathroom; and

(d) wholesome water to any sink provided in any area where food is prepared.

G1-(2) There must be a suitable installation for the provision of water of suitable quality to any sanitary convenience fitted with a flushing device.

G2 Water efficiency

G2 Reasonable provision must be made by the installation of fittings and fixed appliances that use water efficiently for the prevention of undue consumption of water.

Requirement G2 applies only when a dwelling is –

(a) erected; or

(b) formed by a material change of use of a building within the meaning of regulation 5(a) or 5(b)

G3 Hot water supply and systems

G3-(1) There must be a suitable installation for the provision of heated wholesome water or heated softened wholesome water to –

(a) any washbasin or bidet provided in or adjacent to a room containing a sanitary convenience;

(b) any washbasin, bidet, fixed bath and shower in a bathroom; and

(c) any sink provided in any area where food is prepared.

G3-(2) A hot water system, including any cistern or other vessel that supplies water to or receives expansion water from a hot water system, must be designed, constructed and installed so as to resist the effects of temperature and pressure that may occur either in normal use or in the event of such malfunctions as may reasonably be anticipated, and must be adequately supported.

G3-(3) A hot water system that has a hot water storage vessel must incorporate precautions to –

(a) prevent the temperature of the water stored in the vessel at any time exceeding 100°C;

(b) ensure that any discharge from safety devices is safely conveyed to where it is visible but will not cause a danger to persons in or about the building.

Requirement G3-(3) does not apply to a system which heats or stores water for the purposes only of an industrial process.

G3-(4) The hot water supply to any fixed bath must be so designed and installed as to incorporate measures to ensure that the temperature of the water that can be delivered to that bath does not exceed 48°C.

Requirement G3-(4) applies only when a dwelling is –

(a) erected; or

(b) formed by a material change of use of a building within the meaning of regulation 5(a) or 5(b)

G4 Sanitary conveniences and washing facilities

G4-(1) Adequate and suitable sanitary conveniences must be provided in rooms provided to accommodate them or in bathrooms.

G4-(2) Adequate hand washing facilities must be provided in –

(a) rooms containing sanitary conveniences; or

(b) rooms or spaces adjacent to rooms containing sanitary conveniences.

G4-(3) Any room containing a sanitary convenience, a bidet, or any facility for washing hands provided in accordance with sub-paragraph (2)(b), must be separated from any kitchen or any area where food is prepared.

G5 Bathrooms

G5 A bathroom must be provided containing a washbasin and either a fixed bath or a shower.

Requirement G5 applies only to dwellings and to buildings containing one or more rooms for residential purposes.

G6 Kitchens and food preparation areas

G6 A suitable sink must be provided in any area where food is prepared.

Part H Drainage and Waste Disposal

H1 Foul water drainage

H1-(1) An adequate system of drainage shall be provided to carry foul water from appliances within the building to one of the following, listed in order of priority –

(a) a public sewer;or, where that is not reasonably practicable,

(b) a private sewer communicating with a public sewer; or, where that is not reasonably practicable,

(c) either a septic tank which has an appropriate form of secondary treatment or another wastewater treatment system; or, where that is not reasonably practicable,

(d) a cesspool.

Requirement H1 does not apply to the diversion of water which has been used for personal washing or for the washing of clothes, linen or other articles to collection systems for reuse.

H1-(2) In this Part "foul water" means waste water which comprises or includes –

(a) waste from a sanitary convenience, bidet or appliance used for washing receptacles for foul waste; or

(b) water which has been used for food preparation, cooking or washing.

H2 Wastewater treatment systems and cesspools

H2-(1) Any septic tank and its form of secondary treatment, other wastewater treatment system or cesspool, shall be so sited and constructed that –

(a) it is not prejudicial to the health of any person;

(b) it will not contaminate any watercourse, underground water or water supply;

(c) there are adequate means of access for emptying and maintenance; and

(d) where relevant, it will function to a sufficient standard for the protection of health in the event of a power failure.

H2-(2) Any septic tank or holding tank which is part of a wastewater treatment system or cesspool shall be –

(a) of adequate capacity;

(b) so constructed that it is impermeable to liquids; and

(c) adequately ventilated.

H2-(3) Where a foul water drainage system from a building discharges to a septic tank, wastewater treatment system or cesspool, a durable notice shall be affixed in a suitable place in the building containing information on any continuing maintenance required to avoid risks to health.

H3 Rainwater drainage

H3-(1) Adequate provision shall be made for rainwater to be carried from the roof of the building.

H3-(2) Paved areas around the building shall be so constructed as to be adequately drained.

Requirement H3-(2) applies only to paved areas –

(a) which provide access to the building pursuant to requirement M1 (access and use), or requirement M2 (access to extensions to buildings other than dwellings);

(b) which provide access to or from a place of storage pursuant to requirement H6-(2) (solid waste storage); or

(c) in any passage giving access to the building, where this is intended to be used in common by the occupiers of one or more other buildings.

H3-(3) Rainwater from a system provided pursuant to sub-paragraphs (1) or (2) shall discharge to one of the following, listed in order of priority –

(a) an adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable,

(b) a watercourse; or, where that is not reasonably practicable,

(c) a sewer.

Requirement H3-(3) does not apply to the gathering of rainwater for reuse.

H3.1 How is Rainwater managed in the Façade from Roof, Terrace or Balcony areas?

H3.1.1 How has the façade been designed to provide Rainwater Drainage in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering and Building Services Engineering consultancy?

- Rainwater Drainage shall be resolved with the need for the façade to satisfy Requirement C2 Resistance to moisture of Schedule 1. Satisfaction of Requirements H3-(1) and C2 shall both be achieved in the design.
- Reference shall be made to a Registered Copy of the Centre for Window and Cladding Technology (CWCT) *Standard for Systemised Building Envelopes 2006*, as technically updated.
- Reference shall be made to CWCT *Guidance on Built-up Walls* 2017.
- Reference shall be made to CWCT Technical Notes that include, but are not limited to:

  TN55 – Movement accommodation in building envelopes

  TN78 – Interfaces and joints – Introduction

  TN95 – Weathertightness of windows, doors and curtain walls

H4 Building over sewers

H4-(1) The erection or extension of a building or work involving the underpinning of a building shall be carried out in a way that is not detrimental to the building or building extension or to the continued maintenance of the drain, sewer or disposal main.

Requirement H4 applies only to work carried out –

(a) over a drain, sewer or disposal main which is shown on any map of sewers; or

(b) on any site or in such a manner as may result in interference with the use of, or obstruction of the access of any person to, any drain, sewer or disposal main which is shown on any map of sewers.

H4-(2) In this paragraph "disposal main" means any pipe, tunnel or conduit used for the conveyance of effluent to or from a sewage disposal works, which is not a public sewer.

H4-(3) In this paragraph and paragraph H5 "map of sewers" means any records kept by a sewerage undertaker under section 199 of the Water Industry Act 1991, c.56, as amended by section 97 of the Water Act 2003 (c.37).

H5 Separate systems of drainage

H5 Any system for discharging water to a sewer which is provided pursuant to paragraph H3 shall be separate from that provided for the conveyance of foul water from the building.

Requirement H5 applies only to a system provided in connection with the erection or extension of a building where it is reasonably practicable for the system to discharge directly or indirectly to a sewer for the separate conveyance of surface water which is –

(a) shown on a map of sewers; or

(b) under construction either by the sewerage undertaker or by some other person (where the sewer is the subject of an agreement to make a declaration of vesting pursuant to section 104 of the Water Industry Act 1991, as amended by section 96 of and Schedule 9 to the Water Act 2003 (c.37) and is prospectively amended by section 42 of the Flood and Water Management Act 2010 (c.29).

H6 Solid waste storage

H6-(1) Adequate provisions shall be made for storage of solid waste.

H6-(2) Adequate means of access shall be provided –

(a) for people in the building to the place of storage; and

(b) from the place of storage to a collection point (where one has been specified by the waste collection authority under section 46 (household waste) of the Environmental Protection Act 1990, c.43, as amended by section 19 of the London Local Authorities Act 2007 (2007 cii) and section 76 of and Schedule 5 to the Climate Change Act 2008 (c.27), or section 47 (commercial waste)of the Environmental Protection Act 1990, c.43, as amended by section 19 of the London Local Authorities Act 2007 (2007 cii)), or to a street (where no collection point has been specified).

Part J Combustion Appliances and Fuel Storage Systems

J1 Air supply

J2 Discharge of products of combustion

J3 Warning of release of carbon monoxide

J4 Protection of building

J5 Provision of information

J6 Protection of liquid fuel storage systems

J7 Protection against pollution

J1 Air supply

J1 Combustion appliances shall be so installed that there is an adequate supply of air to them for combustion, to prevent over-heating and for the efficient working of any flue.

Requirement J1 applies only to fixed combustion appliances (including incinerators)

J2 Discharge of products of combustion

J2 Combustion appliances shall have adequate provision for the discharge of products of combustion to the outside air.

Requirement J2 applies only to fixed combustion appliances (including incinerators)

J3 Warning of release of carbon monoxide

J3 Where a combustion appliance is provided, appropriate provision having regard to the design and location of the appliances shall be made to detect and give early warning of the release of carbon monoxide at levels harmful to persons.

Requirement J3 applies only to fixed combustion appliances located in dwellings.

J4 Protection of building

J4 Combustion appliances and flue-pipes shall be so installed, and fireplaces and chimneys shall be so constructed and installed, as to reduce to a reasonable level the risk of people suffering burns or the building catching fire in consequence of their use.

Requirement J4 applies only to fixed combustion appliances (including incinerators).

J4.1 Does the building incorporate separate Combustion Appliances with Flues?

J4.1.1 How has the façade been designed for the Flues of Combustion Appliances in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering and Building Services Engineering consultancy?

- Flues for Combustion Appliances shall be resolved with the need for the façade to satisfy Requirement C2 Resistance to moisture of Schedule 1. Satisfaction of Requirements J1, J2, J4, J5 and C2 shall all be achieved in the design.
- Reference shall be made to a Registered Copy of the Centre for Window and Cladding Technology (CWCT) *Standard for Systemised Building Envelopes 2006*, as technically updated.
- Reference shall be made to CWCT Guidance on Built-up Walls 2017.
- Reference shall be made to CWCT Technical Notes that include, but are not limited to:

  TN55 – Movement accommodation in building envelopes

  TN78 – Interfaces and joints – Introduction

  TN95 – Weathertightness of windows, doors and curtain walls

J4.1.2 How has the roof been designed for the Flues of Combustion Appliances?

J5 Provision of information

J5 Where a hearth, fireplace, flue or chimney is provided or extended, a durable notice containing information on the performance capabilities of the hearth, fireplace, flue or chimney shall be affixed in a suitable place in the building for the purpose of enabling combustion appliances to be safely installed.

J6 Protection of liquid fuel storage systems

J6 Liquid fuel storage systems and the pipes connecting them to combustion appliances shall be so constructed and separated from buildings and the boundary of the premises as to reduce to a reasonable level the risk of the fuel igniting in the event of fire in adjacent buildings or premises.

Requirement J6 applies only to –

(a) fixed oil storage tanks with capacities greater than 90 litres and connecting pipes; and

(b) fixed liquefied petroleum gas storage installations with capacities greater than 150 litres and connecting pipes,

which are located outside the building and which serve fixed combustion appliances (including incinerators) in the building.

J7 Protection against pollution

J7 Oil storage tanks and the pipes connecting them to combustion appliances shall –

(a) be so constructed and protected as to reduce to a reasonable level the risk of the oil escaping and causing pollution; and

(b) have affixed in a prominent position a durable notice containing information on how to respond to an oil escape so as to reduce to a reasonable level the risk of pollution.

Requirement J7 applies only to fixed oil storage tanks with capacities of 3,500 litres or less, and connecting pipes, which are –

(a) located outside the building; and

(b) serve fixed combustion appliances (including incinerators) in a building used wholly or mainly as a private dwelling,

but does not apply to buried systems.

Part K Protection from Falling, Collision and Impact

K1 Stairs, ladders and ramps

K2 Protection from falling

K3 Vehicle barriers and loading bays

K4 Protection from collision with open windows etc.

K5 Protection against impact from and trapping by doors

K1 Stairs, ladders and ramps

K1 Stairs, ladders and ramps shall be so designed, constructed and installed as to be safe for people moving between different levels in or about the building.

Requirement K1 applies only to stairs, ladders and ramps which form part of the building.

K2 Protection from falling

K2 (a) Any stairs, ramps, floors and balconies and any roof to which people have access, and

(b) Any light well, basement area or similar sunken area connected to a building, shall be provided with barriers where it is necessary to protect people in or about the building from falling.

Requirement K2(a) applies only to stairs and ramps which form part of the building.

K2.1 How does the Façade provide Protection from Falling?

K2.1.1 How has the façade been designed for Protection from Falling, taking into account applied load and impact on the façade, including any Balcony or Balustrade, in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering consultancy?

- Protection from Falling shall be resolved with the need for the façade to satisfy Requirement C2 Resistance to moisture of Schedule 1. Satisfaction of Requirements K2, K4, K5 and C2 shall all be achieved in the design.
- Reference shall be made to a Registered Copy of the Centre for Window and Cladding Technology (CWCT) *Standard for Systemised Building Envelopes 2006*, as technically updated.
- Reference shall be made to CWCT Guidance on Built-up Walls 2017.
- Reference shall be made to CWCT *Design of façades for safe access maintenance and repair* 2005 with updated guidance provided by *BS 8560: 2012 + A1: 2018 Code of practice for the design of buildings incorporating safe work at height*.
- Reference shall be made to CWCT Technical Notes that include, but are not limited to:

  TN55 – Movement accommodation in building envelopes

  TN75 – Impact performance of building envelopes: guidance on specification

  TN76 – Impact performance of building envelopes: method for impact testing cladding panels

  TN78 – Interfaces and joints – Introduction

  TN95 – Weathertightness of windows, doors and curtain walls

  TN96 – Assessing cradle and suspended access equipment

K3 Vehicle barriers and loading bays

K3-(1) Vehicle ramps and any levels in a building to which vehicles have access, shall be provided with barriers where it is necessary to protect people in or about the building.

K3-(2) Vehicle loading bays shall be constructed in such a way, or be provided with such features, as may be necessary to protect people in them from collision with vehicles.

K4 Protection from collision with open windows etc.

K4 Provisions shall be made to prevent people moving in or about the building from colliding with open windows, skylights or ventilators.

Requirement K4 does not apply to dwellings.

K5 Protection against impact from and trapping by doors

K5-(1) Provision shall be made to prevent any doors or gate –

(a) which slides or opens upwards, from falling onto any person; and

(b) which is powered, from trapping any person.

K5-(2) Provision shall be made for powered doors and gates to be opened in the event of a power failure.

K5-(3) Provision shall be made to ensure a clear view of the space on either side of a swing door or gate.

Requirement K5 does not apply to –

(a) dwellings, or

(b) any door or gate which is part of a lift.

Part L Conservation of Fuel and Power

L1 Conservation of fuel and power

L1 Reasonable provision shall be made for the conservation of fuel and power in buildings by –

(a) limiting heat gains and losses –

(i) through thermal elements and other parts of the building fabric; and

(ii) from pipes, ducts and vessels used for space heating, space cooling and hot water services;

(b) providing fixed building services which –

(i) are energy efficient;

(ii) have effective controls; and

(iii) are commissioned by testing and adjusting as necessary to ensure they use no more fuel and power than is reasonable in the circumstances.

L1.1 How has Architectural Fenestration been designed to be Energy Efficient?

L1.1.1 How has the design development ensured that good practice daylighting levels have been achieved while providing Glare Control and avoiding over heating by Solar Gain?

- Reference shall be made to *BS EN 17037: 2018: Daylight in buildings* and *ISO 15469: 2004 Spatial distribution of daylight – CIE standard general sky*.
- Calculations shall include a maintenance factor for dirt on the windows?

L1.1.2 Does the glazing arrangement in the façade minimize the need for reliance on artificial lighting during daylight hours, or is an energy requirement for lighting the consequence of Architectural Fenestration?

L1.2 Does the need for Daylighting satisfy other Requirements?

L1.2.1 What consideration has been given to the arrangements of Windows and Doors at Balconies to reconcile daylighting, affecting Requirement L1(a), with other Parts of Schedule 1. of the *2010 Building Regulations*?

- Part B Fire Safety is affected by the arrangement of Openings as “Unprotected Area” within the External Wall, which may also be considered to be a percentage of “Unprotected Area” up to 100% in the consideration of Requirement B4-(1).
- Part E Resistance to the Passage of Sound is affected by the specification of glazing systems.
- Part F Ventilation depends upon openable components in the façade.
- Part N Glazing – Safety in Relation to Impact, Opening and Cleaning requires consideration in the early design of Architectural Fenestration.

L1.3 How has Thermal Performance been achieved without Condensation Risk?

L1.3.1 How has the façade been designed for the Conservation of Fuel and Power in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering and Building Services Engineering consultancy?

- Thermal Insulation shall be resolved with the need for the façade to satisfy Requirement C2 Resistance to moisture of Schedule 1. Satisfaction of Requirements L1(a) and C2 shall both be achieved in the design.
- Reference shall be made to a Registered Copy of the Centre for Window and Cladding Technology (CWCT) *Standard for Systemised Building Envelopes 2006*, as technically updated.
- Reference shall be made to CWCT Guidance on Built-up Walls 2017.
- Reference shall be made to CWCT Thermal assessment of window assemblies, curtain walling and non-traditional building envelopes (Second edition) 2011

- Reference shall be made to CWCT Technical Notes that include, but are not limited to:

  TN47 – Overall building envelope U-values

  TN55 – Movement accommodation in building envelopes

  TN77 – Assessment and certification of rainscreen systems

  TN78 – Interfaces and joints – Introduction

  TN95 – Weathertightness of windows, doors and curtain walls

L1.3.2 Has current Thermal guidance from the Building Research Establishment been referred to?

- Reference shall be made to the following BRE publications in detailed design development:

  BR 262 Thermal Insulation – Avoiding Risks – Third Edition 2002

  BR 443 Conventions for U Value Calculations – Third Edition 2019

  BR 497 Conventions for Linear Thermal Transmittance – Second Edition 2016

  BRE IP 1/06 Assessing Thermal Bridging at Openings – 2006 [Superseding IP 17/01]

  BRE Digest 465 -U-Values for Light Steel Frame Construction - 2002

L1.3.3 Has a Thermal Performance Report been published for the Modular System?

- Reference shall be made to *BS EN ISO 7345: 2018 Thermal performance of buildings and building components. Physical quantities and definitions*.
- The internal and external psychrometric conditions under which condensation shall not form on the surfaces or within the layers or interstices of the construction unless adequately removed by drainage or ventilation through defined cavities shall be declared.

L1.3.4 Has a specialist been employed to identify and design out Condensation Risk?

- Reference shall be made to *BS 5250: 2011 + A1: 2016 Code of practice for control of condensation in buildings*, and read with BRE publications.
- Reference shall additionally be made to *BS EN 15026: 2007 Hygrothermal performance of building components and building elements. Assessment of moisture transfer by numerical simulation* where hygrothermal simulation software is used by a specialist to design out Condensation Risk that cannot be calculated under steady state psychrometric conditions.

L1.3.5 Where in the Modular building will condensation lead to degradation of materials, products and systems, and the unintended staining of inherent or applied architectural finishes?

L1.3.6 Which Standards have been relied upon to demonstrate compliance with Requirement L1 of Schedule 1.?

- Reference shall be made to the Hygrothermal Properties of the Modular System construction:

  BS EN 12524: 2000 Building materials and products. Hygrothermal properties. Tabulated design values

  BS EN ISO 10456: 2007 Building materials and products. Hygrothermal properties. Tabulated design values and procedures for determining declared and design thermal values

  BS EN ISO 12572: 2016 Hygrothermal performance of building materials and products. Determination of water vapour transmission properties. Cup method

  BS EN ISO 13788: 2012 Hygrothermal performance of building components and building elements. Internal surface temperature to avoid critical surface humidity and interstitial condensation. Calculation methods

- Reference shall be made to International calculation methods:

  BS EN ISO 6946: 2017 Building components and building elements. Thermal resistance and thermal transmittance. Calculation methods

  BS EN ISO 10211: 2017 Thermal bridges in building construction. Heat flows and surface temperatures. Detailed calculation

  BS EN ISO 13789: 2017 Thermal performance of buildings. Transmission and ventilation heat transfer coefficients. Calculation method

  BS EN ISO 14683: 2017 Thermal bridges in building construction. Linear thermal transmittance. Simplified methods and default values

- Reference shall be made to the following Standards for Windows, Doors and Shutters:

  BS EN ISO 10077-1: 2017 Thermal performance of windows, doors and shutters. Calculation of thermal transmittance. General

  BS EN ISO 10077-2: 2017 Thermal performance of windows, doors and shutters. Calculation of thermal transmittance. Numerical method for frames

L1.3.7 Which Thermal Bridges have been calculated as a linear thermal transmittance (Ψ-value) or "psi" value?

L1.4 Has the construction been monitored using Thermographic methods?

L1.4.1 Has a Survey involving Thermographic testing and inspection been undertaken for the whole building?

- A survey of treated spaces including internal walls separating treated and untreated zones, shall be undertaken by a qualified Thermographic Surveyor holding a UK Thermography Association Level 2 certificate in thermography, trained through the British Institute of Non-Destructive Testing.
- The extent and programme of the testing and inspection as a check on the construction shall be recommended by the Thermographic Surveyor in reference to *BS EN 13187: 1999 Thermal performance of buildings. Qualitative detection of thermal irregularities in building envelopes. Infrared method*

L1.4.2 Were any defects or deficiencies identified in the Thermographic Survey recorded and reported to the Architects on discovery, and remedied by the Contractor prior to building handover?

- Remediation work shall have the performance characteristics and Service Life of the construction.
- Where remedial works involved interfaces between Contractors they shall have collaborated on the remediation to share the responsibility.

L1.4.3 Has a completed Thermographic Survey been submitted with a UKTA Level 2 Thermography Certificate to the Facilities Manager as an aspect of compliance with Regulation 7(1) of the *2010 Building Regulations* and Approved Document 7 – Materials and Workmanship?

L1.5 Has the completed building been Air Tightness Tested?

L1.5.1 Has Regulation 43 - Pressure Testing of the *2010 Building Regulations* been satisfied through Air Tightness Testing of the whole building by a Member of the Air Tightness Testing and Measurement Association (ATTMA), part of the Building Compliance Testers Association (BCTA)?

- The whole building shall achieve air permeability of less than 3.0 $m^3/hr/m^2$ at 50 Pa in accordance with ATTMA *Technical Standard Level 2 Measuring air permeability of building envelopes (non-dwellings)*, Issue 1, October 2010.
- ATTMA TSL2 shall be undertaken by a qualified Air Tightness Tester holding an ATTMA Level 2 certificate, in accordance with:

  BS EN 13829: 2001 Thermal performance of buildings. Determination of air permeability of buildings. Fan pressurization method, or, with ATTMA approval, its replacement;

  BS EN ISO 9972: 2015 Thermal performance of buildings. Determination of air permeability of buildings. Fan pressurization method

L1.5.2 What air permeability was achieved?

L1.5.3 Were temporary modifications made to the Modular building to achieve that result?

L1.5.4 Were any defects or deficiencies identified in the Airtightness Testing recorded and reported to the architects on discovery, and remedied by the contractor prior to building handover?

- Remediation work shall have the performance characteristics and Service Life of the construction.
- Where remedial works involved interfaces between contractors they shall have collaborated on the remediation to share the responsibility.

L1.5.5 Has a completed Air Tightness Test Report been submitted with a ATTMA Level 2 Air Tightness Certificate to the Facilities Manager as an aspect of compliance with Regulation 7(1) of the *2010 Building Regulations* and Approved Document 7 – Materials and Workmanship?

L1.6 How were the Building Services Commissioned?

L1.6.1 Was commissioning of Building Services completed to a Commissioning and Testing Schedule developed by a Specialist Commissioning Manager for the building during the design and construction Work Stages to ensure compliance with Requirement L1(b) of Schedule 1.?

- The Specialist Commissioning Manager shall undertake design reviews and give advice on the suitability of the design for ease of commissioning. This is particularly important in a Modular building where the Building Services are segmented in Modules and Service Risers, requiring repetitive jointing on site.
- The Building Services installation shall be fully coordinated through iterative Drawings, Technical Submittals, Samples, Mock-Ups, Prototypes and Benchmarks. A list of awkward interfaces shall be managed to a successful conclusion. In Modular buildings this coordination of integrated Building Services has to be achieved before Module manufacture commences.
- The Specialist Commissioning Manager shall provide commissioning management input to construction programming, during installation within Modules, and in their jointing on site.

L1.6.2 How was commissioning and testing managed to achieve handover at Practical Completion and close-out of defects to the satisfaction of the Facilities Manager an aspect of compliance with Regulation 7(1) of the *2010 Building Regulations* and Approved Document 7 – Materials and Workmanship?

L1.7 How does the completed building relate to Energy and Emissions Regulations?

L1.7.1 How has Regulation 25 – Minimum energy performance requirements for new buildings been addressed?

L1.7.2 How has Regulation 26 – CO_2 emission rates for new buildings been addressed?

L1.7.3 How has Regulation 27 – CO_2 emission rate calculations been addressed?

L1.7.4 How has Regulation 30 – Energy assessors been addressed?

Part M Access to and Use of Buildings

M1 Access and use

M2 Access to extensions to buildings other than dwellings

M3 Sanitary conveniences in extensions to buildings other than dwellings

M4 Sanitary conveniences in dwellings

M1 Access and use

M1 Reasonable provision shall be made for people to –

(a) gain access to; and

(b) use the building and its facilities.

The requirements of this Part do not apply to –

(a) an extension of or material alteration of a dwelling; or

(b) any part of a building which is used solely to enable the building or any service or fitting in the building to be inspected, repaired or maintained.

M2 Access to extensions to buildings other than dwellings

M2 Suitable independent access shall be provided to the extension where reasonably practicable.

Requirement M2 does not apply where suitable access to the extension is provided through the building that is extended.

M3 Sanitary conveniences in extensions to buildings other than dwellings

M3 If sanitary conveniences are provided in any building that is to be extended, reasonable provision shall be made within the extension for sanitary conveniences.

Requirement M3 does not apply where there is reasonable provision for sanitary conveniences elsewhere in the building, such that people occupied in, or otherwise having occasion to enter the extension, can gain access to and use those sanitary conveniences.

M4 Sanitary conveniences in dwellings

M4-(1) Reasonable provision shall be made in the entrance storey for sanitary conveniences, or where the entrance storey contains no habitable rooms, reasonable provision for sanitary conveniences shall be made either in the entrance storey or principal storey.

M4-(2) In this paragraph “entrance storey” means the storey which contains the principal entrance and “principal storey” means the storey nearest to the entrance storey which contains a habitable room, or if there are two such storeys equally near, either such storey.

Part N Glazing – Safety in Relation to Impact, Opening and Cleaning

N1 Protection against impact

N2 Manifestation of glazing

N3 Safe opening and closing of windows etc.

N4 Safe access for cleaning windows etc.

N1 Protection against impact

N1 Glazing, with which people are likely to come into contact whilst moving in or about the building shall –

(a) if broken on impact, break in a way which is unlikely to cause injury; or

(b) resist impact without breaking; or

(c) be shielded or protected from impact.

N1.1 How is Safety of Glazing ensured in the Façade?

N1.1.1 How has fixed and openable Glazing been designed to resist damage by impact in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering consultancy?

- Safety of Glazing shall be resolved with the need for the façade to satisfy Requirement C2 Resistance to moisture of Schedule 1. Satisfaction of Requirements N1, N2, N3, N4 and C2 shall all be achieved in the design.

- Reference shall be made to a Registered Copy of the Centre for Window and Cladding Technology (CWCT) *Standard for Systemised Building Envelopes 2006*, as technically updated.

- Reference shall be made to CWCT Technical Notes that include, but are not limited to:

  TN55 – Movement accommodation in building envelopes

  TN75 – Impact performance of building envelopes: guidance on specification

  TN76 – Impact performance of building envelopes: method for impact testing cladding panels

  TN78 – Interfaces and joints – Introduction

  TN95 – Weathertightness of windows, doors and curtain walls

N1.1.2 How has the potential for spontaneous breakage from Nickel Sulfide inclusions in Glass been controlled to manage the risk of injury from falling glass?

- Reference shall be made to CWCT *Glass in buildings: Breakage - the influence of nickel sulfide* 2002 to mitigate the risk of spontaneous breakage.

N2 Manifestation of glazing

N2 Transparent glazing, with which people are likely to come into contact while moving in or about the building, shall incorporate features which make it apparent.

Requirement N2 does not apply to dwellings.

N2.1 What Glass Manifestation measures are provided?

N2.1.1 Where is Glass Manifestation required to make vision glazing apparent?

N2.1.2 How has Manifestation been achieved in glazing?

N3 Safe opening and closing of windows etc.

N3 Windows, skylights and ventilators which can be opened by people in or about the building shall be so constructed or equipped that they may be opened, closed or adjusted safely.

Requirement N3 does not apply to dwellings.

N3.1 How is the building envelope fitted with openable and adjustable elements?

N3.1.1 What provisions for openable and adjustable Windows been made in the façade?

N3.1.2 Have openable and adjustable Roof Lights been incorporated?

N3.1.3 Do the Windows and Roof Lights provide ventilation in contribution to Requirement F Ventilation of Schedule 1.?

N4 Safe access for cleaning windows etc.

N4 Provision shall be made for any windows, skylights, or any transparent or translucent walls, ceilings or roofs to be safely accessible for cleaning.

Requirement N4 does not apply to –

(a) dwellings; or

(b) any transparent or translucent elements whose surface are not intended to be cleaned.

N4.1 How is façade access safely achieved?

N4.1.1 What provisions have been made for safe maintenance and repair of the façade?

- Reference shall be made to CWCT *Design of façades for safe access maintenance and repair* 2005 with updated guidance provided by *BS 8560: 2012 + A1: 2018 Code of practice for the design of buildings incorporating safe work at height*.
- Reference shall be made to CWCT Technical Notes that include, but are not limited to:

  TN75 – Impact performance of building envelopes: guidance on specification

  TN76 – Impact performance of building envelopes: method for impact testing cladding panels

  TN96 – Assessing cradle and suspended access equipment

N4.1.2 What is the Glass Replacement Strategy?

Part P Electrical Safety

P1 Design and installation

P1 Reasonable provision shall be made in the design and installation of electrical installations in order to protect persons operating, maintaining or altering the installations from fire or injury.

The requirements of this Part apply only to electrical installations that are intended to operate at low or extra-low voltage and are –

(a) in or attached to a dwelling;

(b) in the common parts of a building serving one or more dwellings, but excluding power supplies to lifts;

(c) in a building that receives its electricity from a source located within or shared with a dwelling; or

(d) in a garden or in or on land associated with a building where the electricity is from a source located within or shared with a dwelling.

P1.1 How has Earth Continuity been achieved?

P1.1.1 Has the primary structure and any metal infill construction been checked for Earth Continuity?

P1.2 What is the Lightning Protection System required on the building?

P1.1.2 Was a Member of the Association of Technical Lightning and Access Specialists appointed to design, manufacture, install and commission a Lightning Protection System coordinated by the Structural Engineer to unify the site built primary structure and the Module stack?

- Reference shall be made to:

  BS EN 62305-1: 2011 Protection against lightning. General principles

  BS EN 62305-2: 2012 Protection against lightning. Risk management

  BS EN 62305-3: 2011 Protection against lightning. Physical damage to structures and life hazard

  BS EN 62305-4: 2011 Protection against lightning. Electrical and electronic systems within structures

Part Q Security in Dwellings

No Schedule 1. Requirements

Q1 Secured by Design

Q1.1 How is Security achieved in the building if Residential?

Q1.1.1 How has the Dwelling been designed for Security in reference to Centre for Window and Cladding Technology (CWCT) guidance, which may require Façade Engineering consultancy?

- Security in Dwellings shall be resolved with the need for the façade to satisfy Requirement C2 Resistance to moisture of Schedule 1. Security in Dwellings shall be achieved without compromise of Requirement C2 in the design.
- Reference shall be made to a Registered Copy of the Centre for Window and Cladding Technology (CWCT) *Standard for Systemised Building Envelopes 2006*, as technically updated.
- Reference shall be made to CWCT Guidance on Built-up Walls 2017.
- Reference shall be made to CWCT Technical Notes that include, but are not limited to:

  TN55 – Movement accommodation in building envelopes

  TN75 – Impact performance of building envelopes: guidance on specification

  TN76 – Impact performance of building envelopes: method for impact testing cladding panels

  TN78 – Interfaces and joints – Introduction

  TN95 – Weathertightness of windows, doors and curtain walls

Part R High Speed Electronic Communications Networks

No Schedule 1. Requirements

R1 To be developed

Approved Document 7 – Material and Workmanship

AD7.1 Have the works been procured from Contractors operating a Quality Management System?

- Contractors shall be Third Party accredited to *BS EN ISO 9001: 2015: Quality management systems. Requirements*.

AD7.2 Where is the Register of Third Party verified As-Built record Drawings kept by the Facilities Manager?

AD7.3 Where are the Technical Submittals made during manufacturing, assembly and site built construction compiled in an Operations and Maintenance Manual maintained by the Facilities Manager?

- Operations and Maintenance Manual records available shall include, but are not limited to:

  COSHH Assessments under the 2002 Control of Substances Hazardous to Health

  Test Reports from a UKAS accredited Test Authority

  Third Party Certification of materials, products, systems and elements

  Third Party Accreditation of workmanship.

AD7.4 How were the 2015 Construction (Design and Management) Regulations complied with prior to handover to the Facilities Manager?

- Risk Assessments for the works shall have been collated in the Project Risk Register by the Principal Designer and Principal Contractor identifying:

  Relevant Hazard

  Associated Risks

  Design Constraint

  Risk Reduction Measure

AD7.5 Where are the maintenance requirements fully defined?

- The service life for the primary, secondary and tertiary components of this Section of the works shall be declared in accordance with *BS 7543: 2015 Guide to Durability of Buildings and Building Components*. The following terminology shall be used:

Lifelong, where a primary component lasts for the life of the building without replacement or maintenance.

Maintainable, where a non-replaceable primary component lasts for the life of the building with maintenance.

Replaceable, where replacement is envisaged at design stage because a secondary or tertiary component has a shorter service life than the life of the building even with maintenance.

- *BS 8210: 2012 Guide to Facilities Maintenance Management* defines maintenance as planned, preventive or unplanned. *BS EN 13306: 2017 Maintenance Terminology* allows other definitions of maintenance, but the Facilities Manager may anticipate planned or preventive maintenance only.

AD7.6 Has a programme of Building User Training been provided to the Facilities Manager?

RISCAuthority

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