# Ealing xxx

DRAFT

# Housing site identification and guidance on the use of Modern Methods of Construction for housing delivery

## Part 2 - Pattern Book

July 2024
2301-RCK-XX-XX-RP-A-00004

RIBA Stage 1
Revision Number - P03
Status - S0: Work In Progress

RCKa

Ealing
www.ealing.gov.uk

# Contents

**House Types**



**Apartment Types**

# Contents

| Revision Number | Status Code | Date Issued |
|---|---|---|
| P00 | S0: Work In Progress | 10.05.2024 |
| P01 | S0: Work In Progress | 05.07.2024 |
| P02 | S0: Work In Progress | 12.07.2024 |
| P03 | S0: Work In Progress | 31.07.2024 |
| | | |

# Introduction

# About RCKa

RCKa is one of the leading experts in small sites housing in London.

As well as designing award-winning housing projects, we have written small sites Supplementary Planning Documents for several London Boroughs including Lewisham and Bexley, and contributed to others such as Croydon.

Furthermore, we provide advice and guidance to planning officers across London on how to embrace small site housing development as a key component of meeting the city's housing need. This includes delivering regular seminars and running workshops on behalf of Urban Design London, as well as directly for the boroughs themselves. Members of the practice sit on ten of London's Design Review Panels, including Hounslow, Haringey, Newham and LLDC.

Our approach is always highly site-specific and sensitive to local concerns. We work alongside communities to ensure that new development is embraced rather than feared – whilst recognising the unique challenges and sensitivities that small site planning applications represent to both clients and planning authorities. What is common to every scheme we design, however, is a passion for how our work can remain relevant to users, stakeholders and beneficiaries through designing for flexibility and longevity. At the core of all the practice's work is an interest in how the buildings we design can promote community cohesion, encourage social interaction and support adoption by those who live in and around them.

Our work is widely recognised for its innovation and design quality. Among others, we have won four Housing Design Awards, the Mayor's Prize, an RIBA National Award, and on two occasions we have been named the Social Value Architect of the Year.

**[Figure 1]**

RCKa recently completed work on a guidance document for Ealing Council, setting out how modern methods of construction can be deployed to assist in small site housing delivery.


**[Figure 2]**

RCKa's Small Sites Design Guide Supplementary Planning Document (SPD) was formally adopted by Lewisham Council in October 2021, and sets out how the borough can meet its London Plan H2 policy housing targets over the next 10 years. The document won the 2023 Planning Award for Improved Housing Delivery. The judges praised "a clear example of making positive steps to try and increase housing delivery" and "an approach that could be replicated by other local planning authorities".

# Executive Summary

RCKa is a leading expert in the design and delivery of housing on small sites, and our experience extends beyond architectural services to include the preparation of dedicated small sites planning policy and procurement strategies.

The practice has recently completed work on guidance which provides Ealing Council with recommendations setting out how it might deliver its affordable housing and temporary accommodation pipeline using small sites; a piece of work which has included several months of intensive research into the available public sector frameworks dedicated to modern methods of construction, a thorough analysis of the borough's character, demographics and accessibility, and recommendations on how these could be brought together to help address the council's acute housing challenges.

As an outcome of this initial piece of work, RCKa supported Ealing Council in its successful bid for the GLA "Small Sites, Small Builders" round two funding. The outcome of this funding is to be a pattern book home which could be deployed using modern methods of construction (MMC) on small sites in the borough. This was one component of a wider study, which forms the suite of documents you are reading now. The initial work (stage one) is the identification of all of Ealing's landholdings, its categorisation and assessment for potential development. The second part consists of a set of site capacity studies for a small number of the sites identified within stage one. Based on these two workstreams, the third and final element (stage three) is the pattern book itself. Each of these activities are described briefly below, and in more detail in the subsequent chapters.

**Part 0–Site Identification**

As part of the earlier commission, RCKa developed a series of bespoke mapping tools to enable the collation of geographic data, and an online display to assist council staff with locating potential sites for development. The underlying mapping data, and the platform on which it is hosted, is proprietary, and was created specifically for Ealing Council. This was utilised, and expanded, to include the sites that were located as part of this second commission.

This first stage of work comprised the identification of additional council-owned sites which did not form part of the initial tranche and developing a methodology to verify their suitability for development leading to the identification of a pipeline of sites for development

by the council. This work was carried though to a mixture of analysis of council data, on-the-ground research, and workshops. The council filtered out the most high risk sites, then carried out a manual review of over 600 sites, looking at ownership, use, planning policy and physical characteristics of each. Thirty sites were tested with colleagues across the council, and eight were taken forward for further due diligence.

The output of this work is a database of sites, together with a GIS map locating each. Each site was categorised according to the site "types" set out in the Ealing Small Sites MMC guidance, and a distinction made between those sites which we do not consider appropriate for a "pattern book" housing development, and those that we do. This informed the division of sites into the two subsequent workstreams.

**Part 1–Site Capacity Studies**

We prepared a series of site capacity studies based on a shortlist of eight sites covering a mix of affordable homes and temporary accommodation (in both permanent and meanwhile condition): four for affordable homes, and four for temporary accommodation, evenly split between meanwhile and permanent installations.

**Part 2–Small Sites, Small Builders Round 2**

Using the outcome of the initial site identification work, we identified a range of locations with the potential for development using standardised house types that can be delivered using MMC.

Based on this study we prepared an outline design for these "pattern book" homes, including key dimensional information, such as overall widths, wall build-ups, internal layouts and so on, working together with the council's housing delivery and temporary accommodation teams to incorporate any existing employer's requirements, as well as undertaking soft market testing with a range of manufacturers to understand which approach to MMC might be suited to the task.

A key finding of the initial MMC guidance was the volatility of the modular market and the high rate of failure of manufacturers and suppliers. It was a therefore a key objective if this exercise to propose a standardised house type which is not reliant on any proprietary modular system, but can be adopted by a range of different suppliers using a variety of systems. There should be sufficient flexibility within the dimensional requirements, including wall build-ups and floor-to-floor heights, to allow for multiple delivery systems and even category 1 (volumetric) and category 2 (panellised) classification.

# Principles and Parameters

We have developed a standardised “west London” house-type that could be deployed across Ealing, and potentially adjoining boroughs.

Given the volatility in the modular housing market, our goal is to ensure that these homes can be delivered to the council’s specifications by a range of providers, avoiding reliance on proprietary designs or a single supplier.

These “pattern book” homes include key dimensional information such as overall widths, wall build-ups, and internal layouts, but allow for flexibility in the delivery model to ensure that they can be constructed in different ways, such as type 1 (volumetric), type 2 (panellised) and, if required, conventional means.

# Design Drivers

The pattern book aims to provide a series of system-agnostic typologies that can be delivered by the London Borough of Ealing on sites suited for MMC delivery.

To achieve this goal, we established the following design principles:

**Flexible**
System agnostic typologies deliverable by various manufacturers.

**Deliverable**
Suitable for Category 2 (panellised) and Category 1 (volumetric) MMC to allow delivery in London.

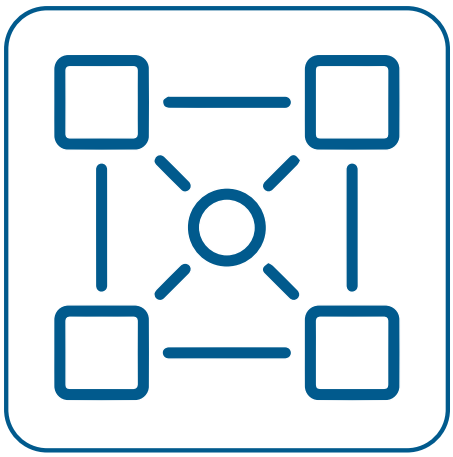
**Configurable**
Configurable in various arrangements to suit different site types

**Sustainable**
Achieving, where viable, net zero carbon in operational and embodied energy, and Passivhaus certified.

**Comfortable**
Best practice internal ceiling heights and flexible layouts to provide for a diverse range of needs.

**Contextual**
Interchangeable façades adaptable to different contexts in west London.

These aims were establised by the project team based on wider ambitions set out in the council's development guide.

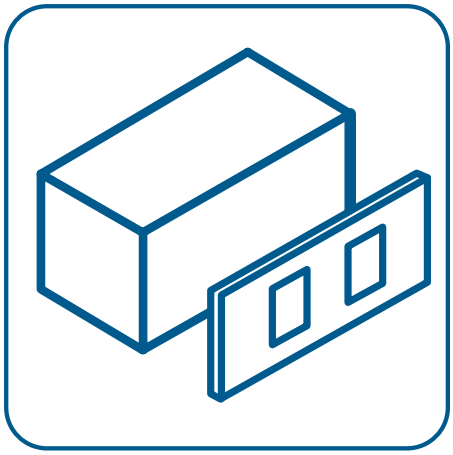


**Flexible**

System agnostic typologies deliverable by various manufacturers.

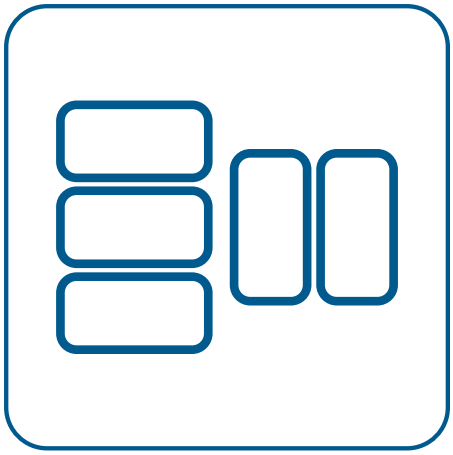
**Sustainable**

Net zero carbon in operational and embodied energy, and Passivhaus certified.



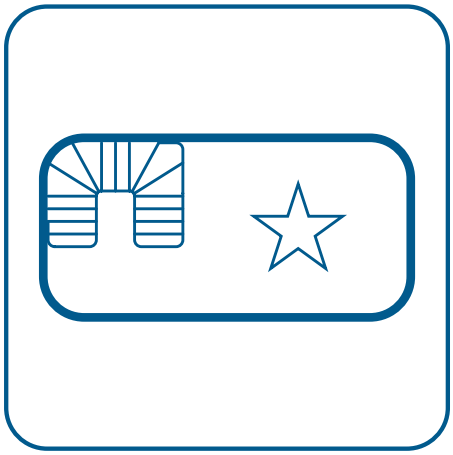
**Deliverable**

Suitable for Cat 2 and Cat 1 MMC to allow delivery in London.



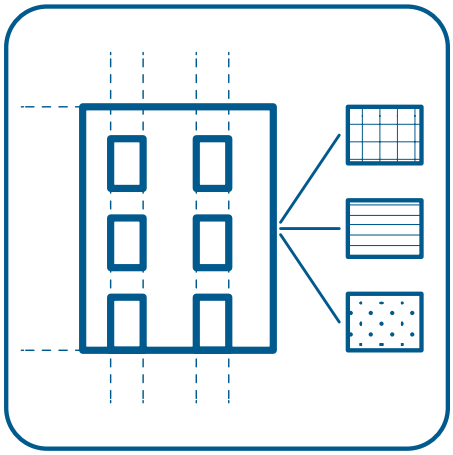
**Configurable**

Configurable in various arrangements to suit different site types.



**Comfortable**

Generous internal heights and flexible internal spaces to provide for a diverse range of needs

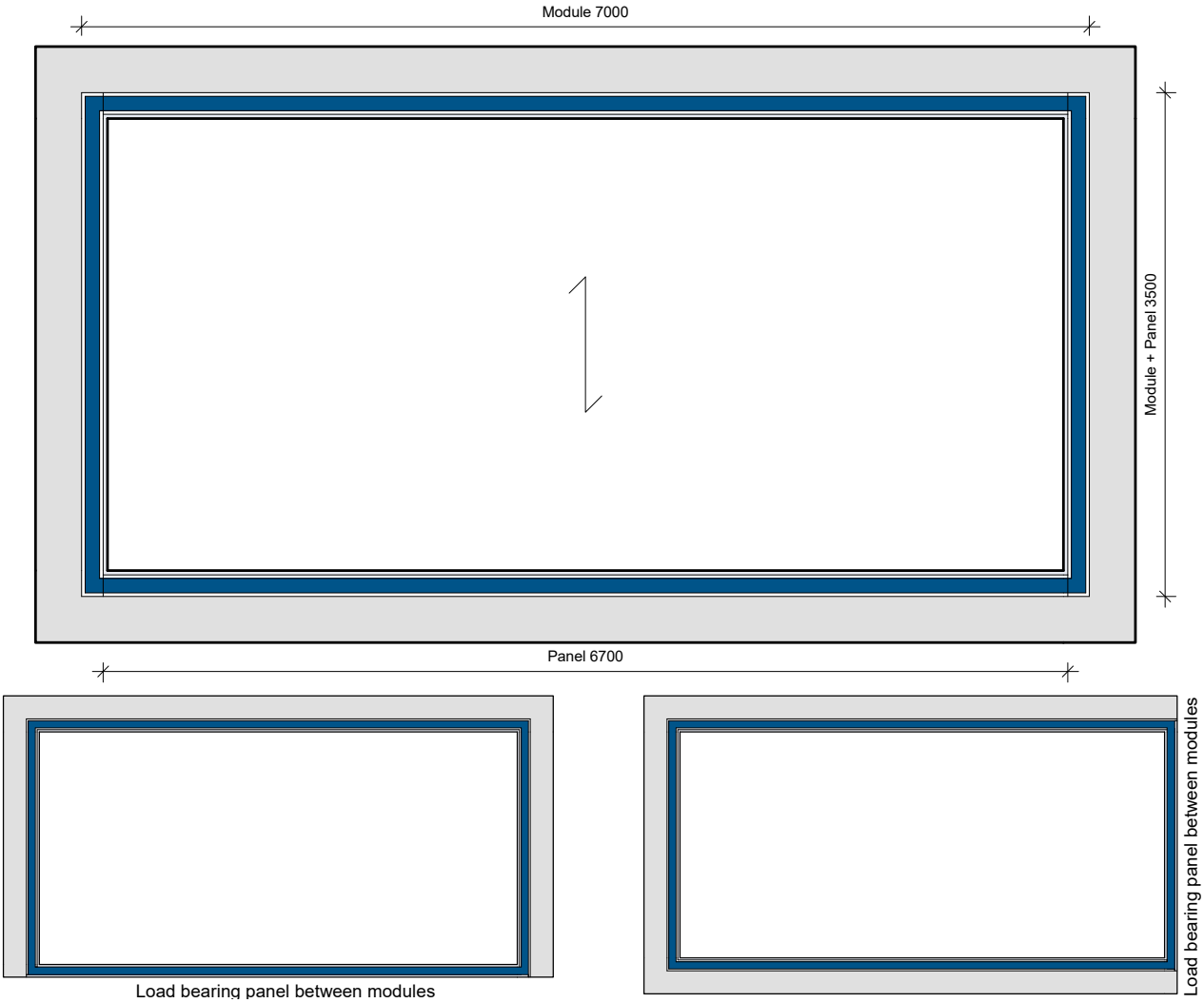


**Contextual**

Interchangeable façades adaptable to different contexts in west London.

# Module Principles

## Interoperability

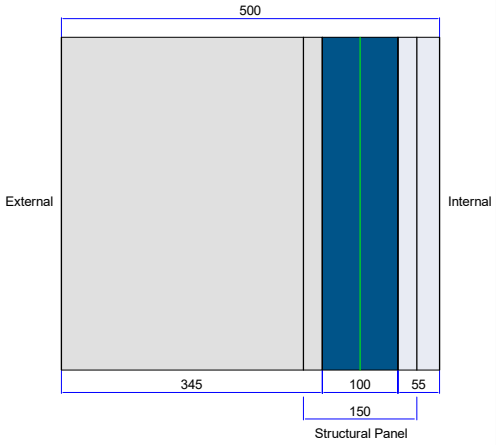



We referred to a variety of sources to develop building elements that comply with Ealing's brief. This information was then used to develop a module that could be tessellated to create various housing typologies. Key features of the module include:

- Panel height: 3,075 mm
- Panel length: 6,700mm & 3,500mm
- Panel depth: 150mm (100mm structure + 2x25mm boards)
- Length is double the width to allow tessellation
- Optimised to achieve Best Practice
- Likely to need floor structure to span the shorter span.
- Category 1: 2no. modules load length = 14m
- Category 2: 6.7m and 3.5m panels laid flat = 10.2m

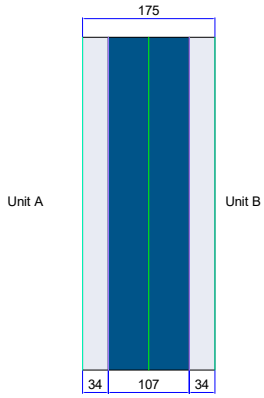
Build-up allowances can be seen on the next page. The build ups have been developed to suit various construction methods. Appendix A shows the build-ups that we assessed to develop our system-agnostic building elements.

External Wall



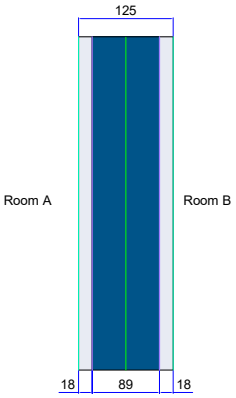

Notes:
- Overall allowance based on Timber Stud with additional tolerance - as the wider option
- Would accommodate both LGS and Timber Stud construction.
- Would not accommodate CLT construction - additional 79mm width required.

Load Bearing Compartment Wall




Notes:
- Overall allowance based on Timber Stud with additional tolerance - as the wider option
- Would accommodate both LGS and Timber Stud construction.
- Would not accommodate CLT construction - additional 91mm width required.

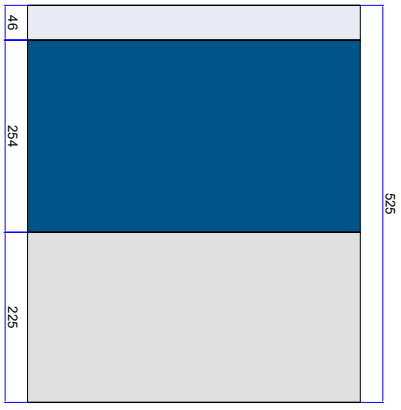
Internal Partition Wall (non-Load Bearing)



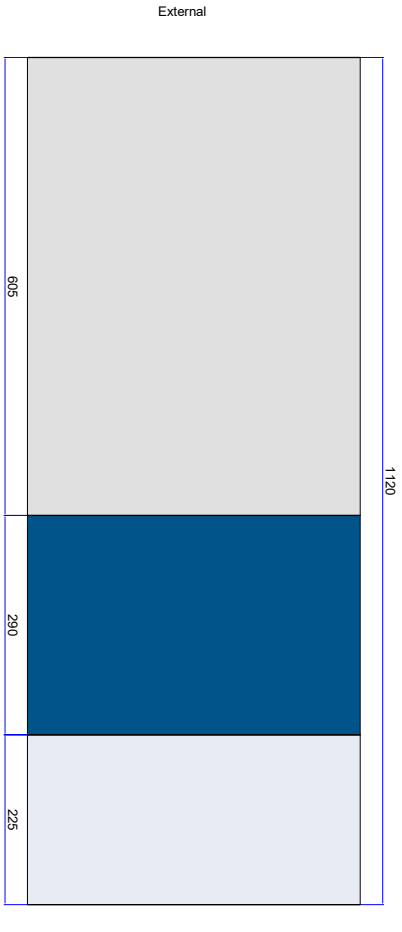

Notes:
- Overall allowance based on Timber Stud with additional tolerance - as the wider option
- Would accommodate both LGS and Timber Stud construction.
- Would not accommodate CLT construction - additional 47mm width required.

Intermediate Floor

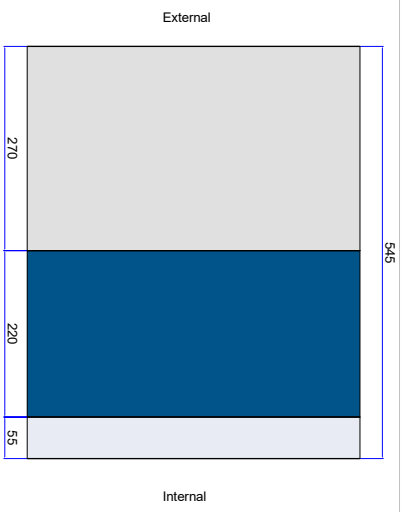

Intermediate Floor with Service Void




Flat Green Roof




Pitched Roof




Notes:
- 30-40 degree pitch, decided after asessment of context

Structure
External
Internal

# Module Principles

## Logistics and Tessellation

The module has been developed with focus on Cat 2 delivery, as such we have envisaged the pattern book will facilitate the process illustrated below.

We envisage the design in the pattern book can also be adopted by Cat 1 manufacturers, and so the steps described below can be adapted to suit this form of delivery.

**Base module and performance**

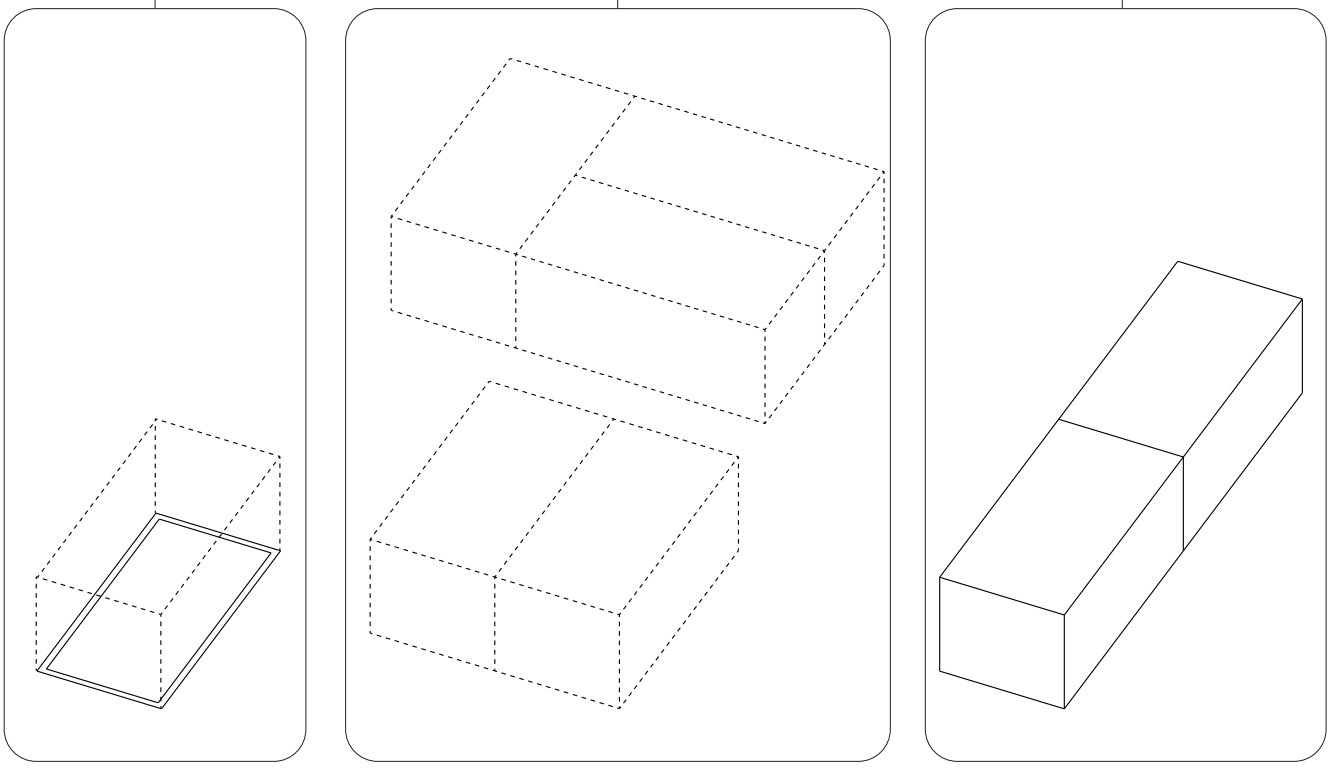
Develop a base module that meets Ealing's Employer's Requirements based on pattern book design.

**Strategy**

Understand the site and the suitability of the typologies available. Assess logistical challenges.

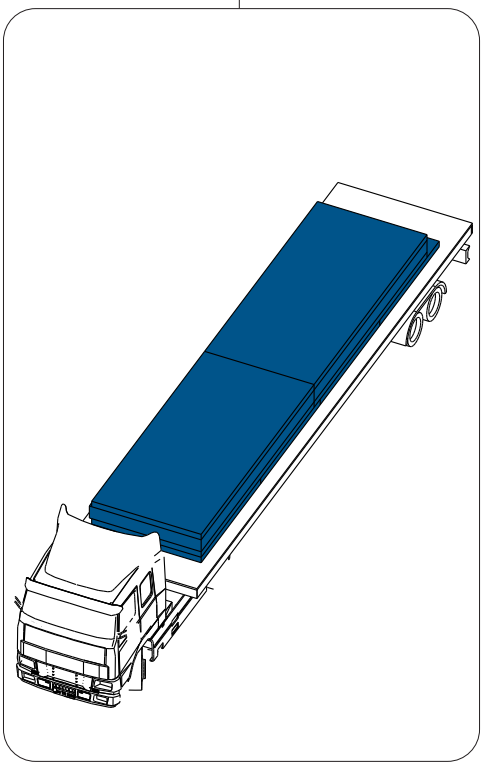
**Manufacture**

Select suitable typology and manufacture panels.



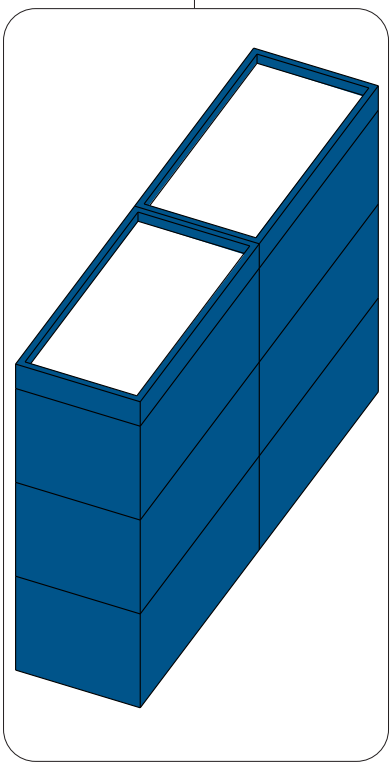
**Transportation and logistics**

Coordinate delivery of panels and agree storage location prior to assembly.



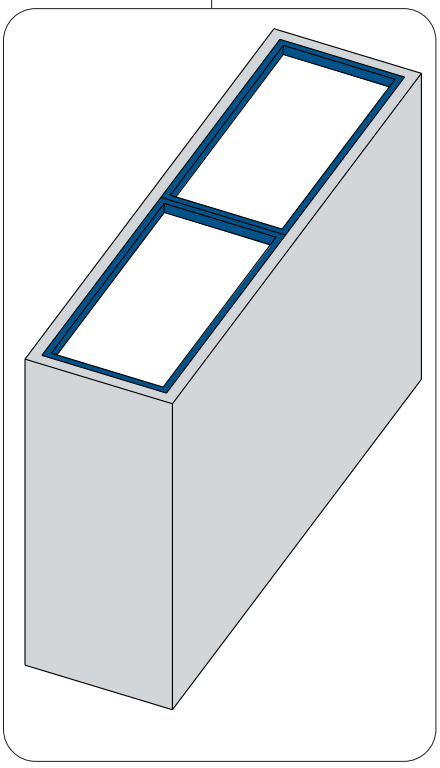
**Assembly**

Assess construction sequence to understand what works are to be carried out before panels are assembled.



**Envelope and finishes**

Apply envelope and finishes on site, if required. Select materials that allow quick construction to minimise disruption.



# Sustainability Principles

Ealing Council has committed to the following standards for new council-owned housing, where financially viable:

- Designed to be certified Passivhaus from 2020
- Built to zero carbon standards from 2022
- Operating at zero carbon on-site by 2025

Achieving these goals will depend on several factors, as set out below:

**Grant Funding and Combustible Materials**

The Mayor of London's grant funding guidance requires the exclusion of any combustible elements within the external wall build-up of any dwelling, regardless of height. This precludes the use of most standardised timber-based systems.

The publication New Model Building by Waugh Thistleton Architects (an extract of which is shown opposite) proposes a strategy for the use of timber within residential buildings by adopting a hybrid approach, utilising structural timber for the primary structure and non-combustible (probably steel) elements for the external envelope. This approach has been endorsed by warranty providers including NHBC.

To the best of our knowledge there are not yet any established systems which meet these requirements. It goes without saying that the effective ban on the use of timber in external walls makes environmental targets more difficult to achieve, and collective pressure should be applied on the GLA to adopt a more flexible approach to the use of timber that does not compromise the fire safety performance of new homes.

**Reliance on Steel**

The manufacturers of most modern methods of construction (MMC) utilise hot-rolled and cold-rolled steel as the primary structural element in their products. There is some evidence that manufacturers use recycled steel within their products (in 2021 Sigmat was reporting the use of 42% recycled steel) although we have not captured this data for most manufacturers. The obvious benefit of steel is that it is easily recycleable in the future, although there is some debate over the difficulties of recovery during demolition of modular homes.

**Site Considerations**

Passivhaus relies heavily on the optimal orientation of new homes, which can be challenging for small sites where other constraints prevent this. It may not be possible to arrange homes on every site to meet the requirements, and in these cases it may be necessary to adopt Passivhaus principles, rather than full certification.

**U-Values and Airtightness**

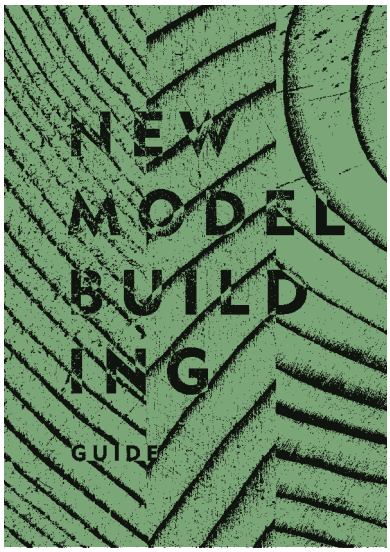
Where viable, new homes delivered through this programme will need to meet Passivhaus standards. In other cases, we will target Local Plan compliance. It is important to understand if selected manufacturers are able to deliver on these targets.

**Finishes and Cladding**

In the current market there are few materials that are both fire-resistant and have low embodied carbon. This limits the options for finishes and cladding. This is further explored in the façade principles section.

**[Figure 1 — right, and below]**

Extracts from Waugh Thistleton's "New Model Building" which provides guidance on the use of timber within new buildings.

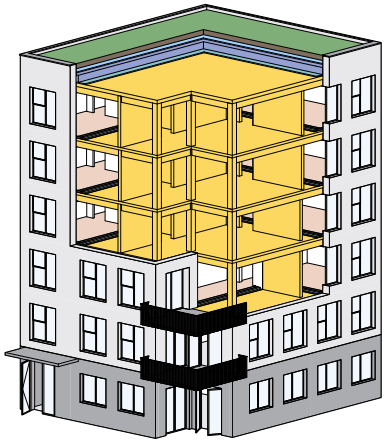





**ROOF**
Timber roof structure, installed to minimum 1:40 falls with BROOF(t4) certified roof build-up

**STRUCTURE**
Fully encapsulated, low embodied carbon, engineered timber structure

**FAÇADE**
Class A2-s1, D0 external wall system, designed in accordance with Part B Regulation 7



**PENETRATIONS**
Penetrations through structure protected using compliant penetration details

**BALCONIES**
Non-combustible steel balconies, designed in accordance with MHCLG guidance documents

**WATERPROOFING**
Best practice methods for prevention and mitigation of moisture ingress





## NEW MODEL BUILDING DESIGN PARAMETERS

The New Model Building is a methodology for delivering residential projects within the following parameters

**BUILDING HEIGHT**
<18m

**FLOOR TO FLOOR**
2925 mm

**FIRE COMPARTMENT**
REI 60 and K2 60

**SPRINKLERS**
Automatic sprinkler system

**UPFRONT EMBODIED CARBON (A1-A5)**
326 kgCO2e/m2 (excluding sequestration)

**EMBODIED CARBON (A-C)**
271 kgCO2e/m2 (RIBA 2030 Built Target)

**BUILDING REGULATIONS**
Complies with all current Approved Documents

**EWS1 FORM**
No combustible materials are used in the external walls
Allowing the buildings to achieve an EWS1 Form and meet GLA funding requirements

**NHBC LETTER OF COMFORT**
A pre-assessed design philosophy

The drawing to the left highlights the key elements of a building that the New Model Building principles address.

# Dwelling Principles

## Spatial Brief

**Tenure and Dwelling Size**

Aside from the detailed sustainability objectives, Ealing has required that new homes delivered via this programme achieve a number of other criteria.

The new homes should be tenure blind, in that no distinction is made in respect of design, materials or finishes between different tenure types and levels of affordability.

The internal layouts of new homes should adhere to Ealing's Development Guide. For this project London Plan "best practice" space standards have been targeted where possible. These are typically 10% larger than the minimum requirements, but also include further enhancements such as the inclusion of a study space for larger family homes in addition to bedrooms.

The homes should provide for a range of accommodation types, including flats and houses with the following configurations, and specified in the table opposite:

- Flats
  1 bed 1 person, 1 bed 2 person
  2 bed 3 person, 2 bed 4 person
  3 bed 5 person, 3 bed 6 person

- Houses
  2 bed 3 person, 2 bed 4 person
  3 bed 5 person, 3 bed 6 person
  4 bed 6 person, 4 bed 8 person
  and 4 bed 8 person
  5 bed 6 person, 5 bed 7 person
  and 5 bed 8 person

**Open Plan**

Where possible, open plan have been avoided.

**Floor to Ceiling Height**

A minimum ceiling height of 2.5m is required for at least 75% of the gross internal area (GIA), in line with London Plan "best practice" requirements.

**Inclusive Design**

Building Regulations Part M covers the accessibility of buildings for people with mobility issues. All new homes should meet Building Regulations Part M4(2) standards and some should meet M4(3) standards.

Generally, minimum M4(3) dimensions have been used throughout 1,200mm corridors and 850mm Effective Clear Width (ECW) doors. Where there are some 1,050mm corridors these have been highlighted in the plans.

Where step-free access cannot be achieved, ground floor homes should still meet these standards.

**Table A1.1 Minimum and best practice internal space standards for new dwellings^**

| Type of dwelling | | Minimum gross internal floor areas (GIA)+ and storage (sqm) | | | | | | | | Best practice extra space |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of bedrooms | Number of bedspaces | 1-storey dwellings | | 2-storey dwellings | | 3-storey dwellings | | Built-in storage | | |
| 1b | 1p | 39/37 | 43/41* | | | | | 1.0 | 1.5 | +4 |
| | 2p | 50 | 55 | 58 | 63 | | | 1.5 | 2.0 | +5 |
| 2b | 3p | 61 | 67 | 70 | 76 | | | 2.0 | 2.5 | +6 |
| | 4p | 70 | 77 | 79 | 86 | | | | | +7 |
| 3b | 4p | 74 | 84 | 84 | 94 | 90 | 100 | 2.5 | 3.0 | +10 |
| | 5p | 86 | 97 | 93 | 104 | 99 | 110 | | | +11 |
| | 6p | 95 | 107 | 102 | 114 | 108 | 120 | | | +12 |
| 4b | 5p | 90 | 101 | 97 | 108 | 103 | 114 | 3.0 | 3.5 | +11 |
| | 6p | 99 | 111 | 106 | 118 | 112 | 124 | | | +12 |
| | 7p | 108 | 121 | 115 | 128 | 121 | 134 | | | +13 |
| | 8p | 117 | 131 | 124 | 138 | 130 | 144 | | | +14 |
| 5b | 6p | 103 | 115 | 110 | 122 | 116 | 128 | 3.5 | 4.0 | +12 |
| | 7p | 112 | 125 | 119 | 132 | 125 | 138 | | | +13 |
| | 8p | 121 | 135 | 128 | 142 | 134 | 148 | | | +14 |
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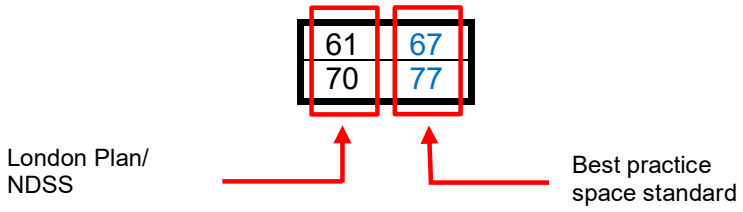
| | 8p | 125 | 139 | 132 | 146 | 138 | 152 | | | +14 |




**[Figure 2 — above]**

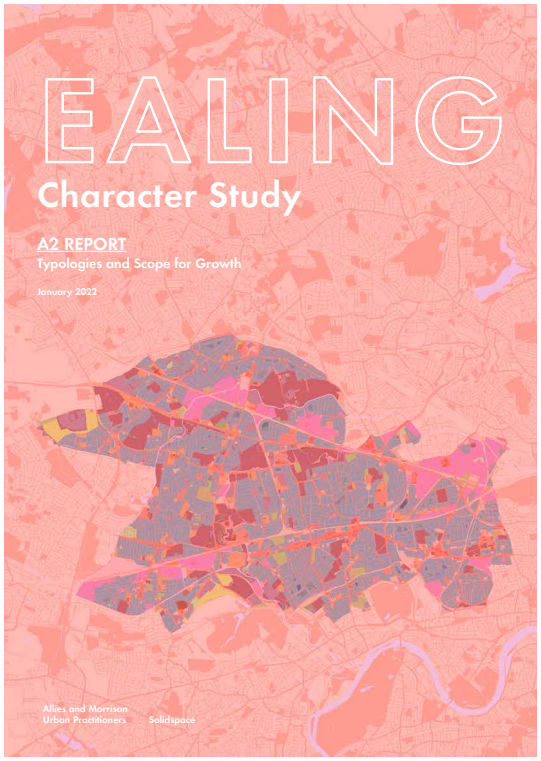
Appendix 1 from Housing Design Standards London Plan Guidance, setting out minimum and "best practice" space standards for new homes.

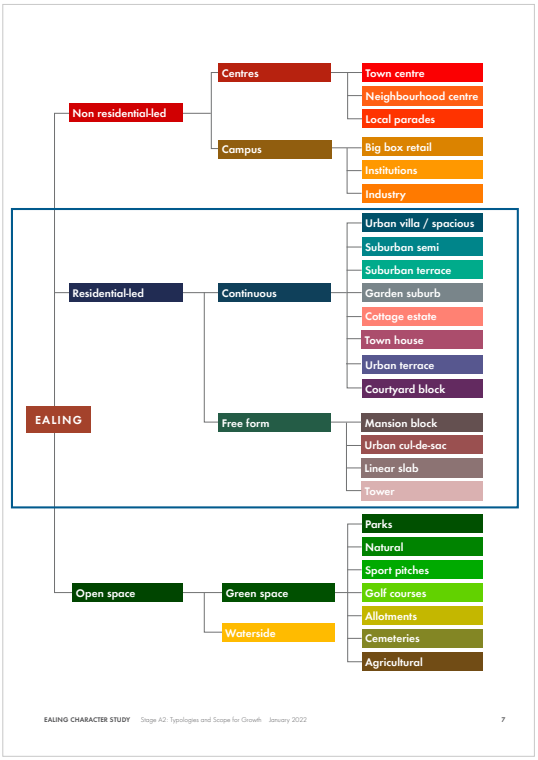
# Façade Principles

## Character Study

To create a versatile kit of parts adaptable to various configurations for the Ealing context, we examined the council's comprehensive research on the residential typologies in the Borough, and the West London area, found in the document shown below.

This enabled us to set out some rules to build flexibility into the pattern book to suit various contexts.




**[Figure 3 — above, and opposite page]**

Front cover and extract from Ealing's Character Study, produced by Allies & Morrison.

**Continuous**
**Villa / spacious**

May villas have seen front gardens paved

North Ealing area

Central Ealing double fronted villa

**Continuous**
**Suburban semi**

Inter-war semi-detached homes

Victorian semi-detached homes

Some homes have cottage estate quality

**Continuous**
**Suburban terrace**

Boston Manor suburban terraces

Many have paved front gardens

Some suburban terraces have Cottage Estate characteristics

**Continuous**
**Garden Suburb**

Corner set piece at Brentham garden suburb

Preserving symmetry of elements is essential to maintaining townscape integrity

Boundary treatments are intact

**Continuous**
**Cottage estate**

Cottage estate set piece framing a shared lawn, set back from the street

Cottage estates are often off set to the street

Short terraces with cross gable at each end are typical features of cottage estates

**Continuous**
**Townhouse**

A terrace of townhouses in Acton with proud Georgian detailing and strong group value

1960s town houses in Montpelier

Town houses as part of a mixed street

**Continuous**
**Urban terrace**

Stepped maisonette terraces with loft conversions

Flat fronted single home terraces

Acton terraces, incorporating both maisonettes and family homes

**Continuous**
**Courtyard block**

Southall Green Quarter where decent investment was made in landscaping and the public realm

Podium access to car and bike parking at St Bernards Gate by Ealing Hospital

Recent redevelopment at Green Man estate in West Acton

**Free form**
**Mansion block**

A series of mansion blocks on an urban street

A mansion block set back from the street, with open space and parking

Single central doors provide access to many flats within

**Free form**
**Urban cul-de-sac**

Parking courts and inactive frontages characterise the streetscape

Buildings often front pedestrian routes rather than streets, creating a lack of surveillance

Buildings often don't relate to surrounding streets or landscape

**Free form**
**Linear slabs**

t-facing two storey 1930s block with rous windows with clear boundary

Four storey block with contained balconies

Three storey block in Boston Manor fronting the street but with a significant step back

**Free form**
**Tower**

Recent towers developed at North Acton

South Acton Estate towers, being replaced by Acton Gardens perimeter blocks and townhouses

Recent development at Greenford Quays, which is a broad tower

# Façade Principles

## Character Study

To draw some conclusions from the character study we abstracted the architectural character identified within the document, and used these to inform a set of guiding principles for the design of the new homes. These included:

**Colour Palette**

There are two prevalent colour palettes found within the samples, which we have described as “cool” and “warm”.

**Materials and Tones**

Most properties feature at least two tones or materials, such as red brick with a dark shingle roof.

Highlight colours are often used for ornamental details, door frames, or window frames.

**Horizontal Banding**

Horizontal banding is prevalent at various scales, appearing as decorative cornicing in certain typologies or simple brick banding in others.

**Architectural Detail**

In many single-dwelling buildings, the entrance area is where architectural detail is concentrated. The remainder of the external elevations tend to be more modest.

**Dormer Windows**

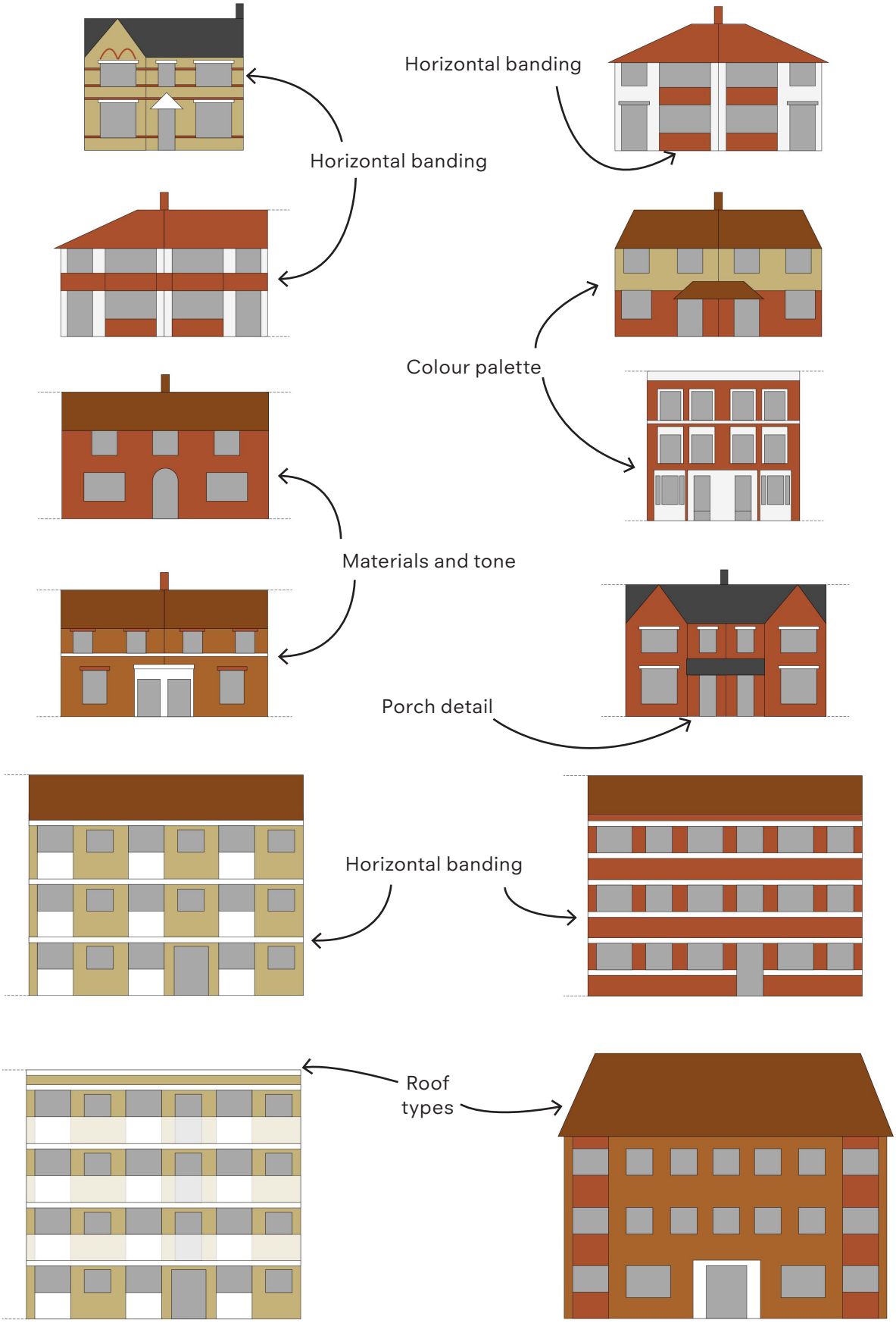
Dormer windows are also a common feature found across the borough.

**Roof Types**

Both pitched and flat roofs are both present in the sample buildings.

**Height**

The prevailing height of residential buildings within the characters study is two storey with a roof,  to four storeys. This sets a reasonable range for us to target when considering opportunities for infill development.


Horizontal banding
Horizontal banding
Colour palette
Materials and tone
Porch detail
Horizontal banding
Roof
types

# Façade Principles

## Pattern Book Parameters

The character study established the diverse range of characters found across Ealing, and enabled us to identify design elements that might be integrated into the façade design to allow various configurations, whilst also limiting the number of 'parts' that form the envelope of the buildings.

With this in mind, we developed a pattern book which allows for maximum flexibility of base components, to fit in with these local contexts—but which has a distinct identity through flavour elements such as doors, porches, banding and cornicing.

Examples of the elevations are included in the typologies section.

The Façade principles are established by following a series of components, as described in the sequence below.

Colour palettes are illustrative, these need to be developed through closer material selection as a contextual response to individual sites or clusters.

**2 'Base' materials**

**1 'Accent' colour**

\+

**'Standard' Elements:** Windows

\+

**'Flavour' Elements:** Front door, porch and cornicing

\+ (if needed)

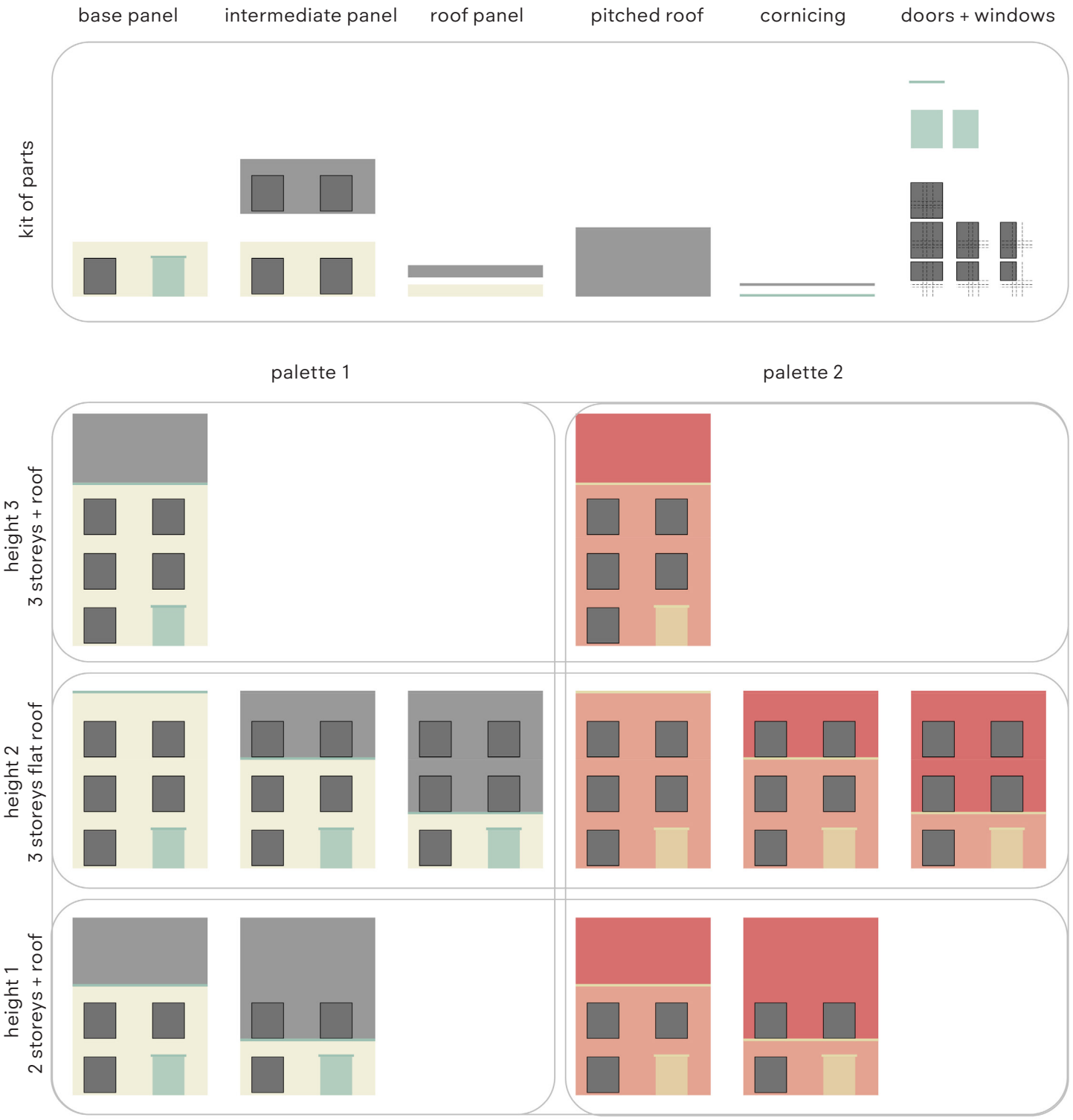
Oriel window for sites with overlooking issues

### 2 colours palettes:

| light | dark | accent |
|---|---|---|
| base | upper floor or roof | distinctive elements |

**OR**

| light | dark | accent |
|---|---|---|
| base | upper floor or roof | distinctive elements |


base panel
intermediate panel
roof panel
pitched roof
cornicing
doors + windows
kit of parts
palette 1
palette 2
height 3
3 storeys + roof
height 2
3 storeys flat roof
height 1
2 storeys + roof

# Façade Components

## Windows

Windows form the 'base element' of the Façade composition, and have been developed with a focus on operation and performance.

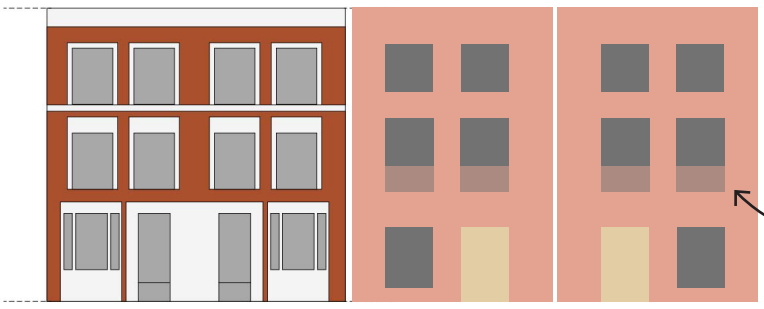
A limited suite of window types have been developed which offer flexibility in arrangement and application, allowing the Façade design to respond to the particular character of each small site, on a case-by-case basis.

The diagram below demonstrates how this suite of windows can be utilised to respond to each of the diverse residential typologies and character areas across Ealing.

Usage of window options with spandrels to be limited and impact on furniture layouts to be considered.


Suburban Terrace Example

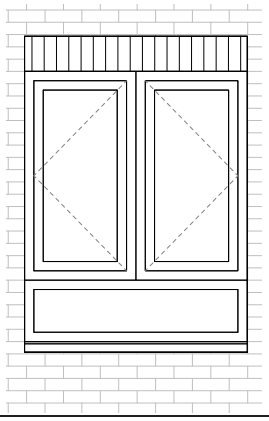
Victorian Villa / Townhouse Example



spandrel types add verticality when needed.

**Living Room Window**
1360W x 1650H

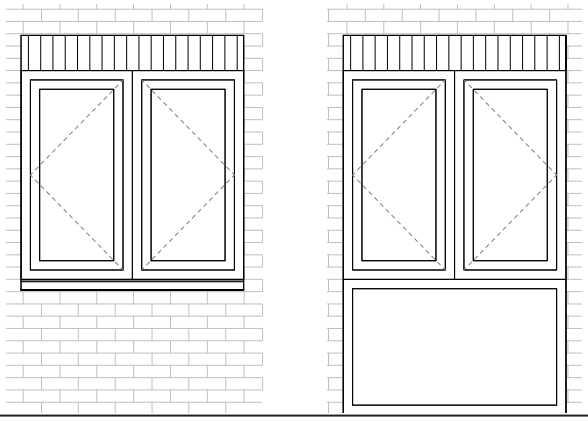
- Double opening window, with fixed safety glass lower transom.
- Dropped 450mm sill height provides views out from a seated position (sofa or wheelchair).
- Sill heights are set out at heights avoid the need for protective railings.



Windows have concealed catnic steel lintels. This can be clad in a brick slip soldier course, or precast panel, to suit local character.

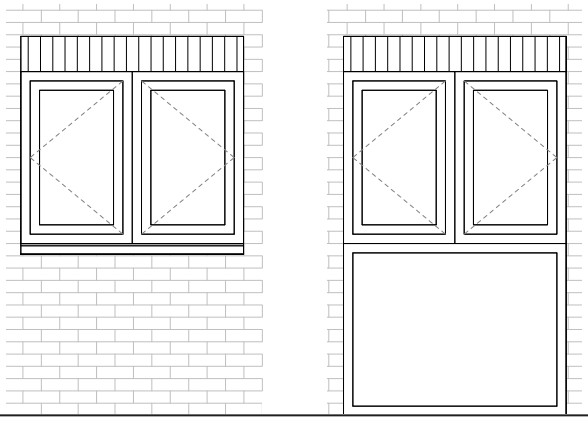
**Bedroom Window**
1360W x 1275H

- Double opening window.
- Standard 825mm sill height allows for the positioning of furniture or a desk below the window.
- Solid spandrel version adds verticality when needed to align with local character.



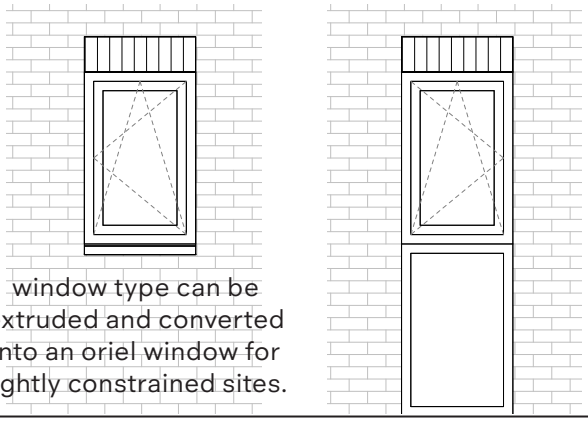
**Kitchen Window**
1360W x 1050H

- Double tilt/turn opening window.
- Raised 1050mm sill height allows the window to be positioned above a kitchen worktop or sink with 150mm splashback.
- Solid spandrel version adds verticality when needed to align with local character.



**Bathroom / Stair Window**
680W x 1050H

- Single tilt/turn opening window.
- Raised 1050mm sill height and smaller width allows the window to be positioned above a bathroom counter or beside a bathroom cabinet.
- Solid spandrel version adds verticality when needed to align with local character, or to highlight a stair location.

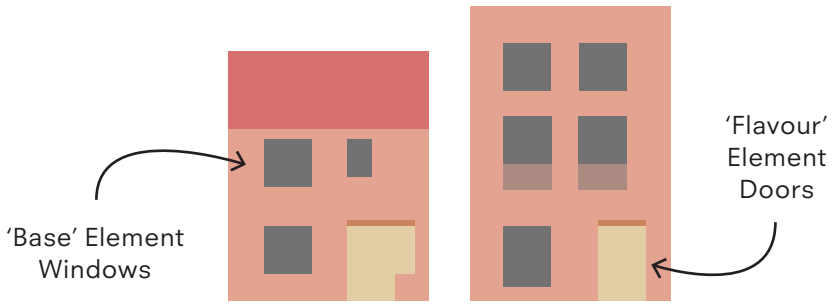


window type can be extruded and converted into an oriel window for tightly constrained sites.

# Façade Components

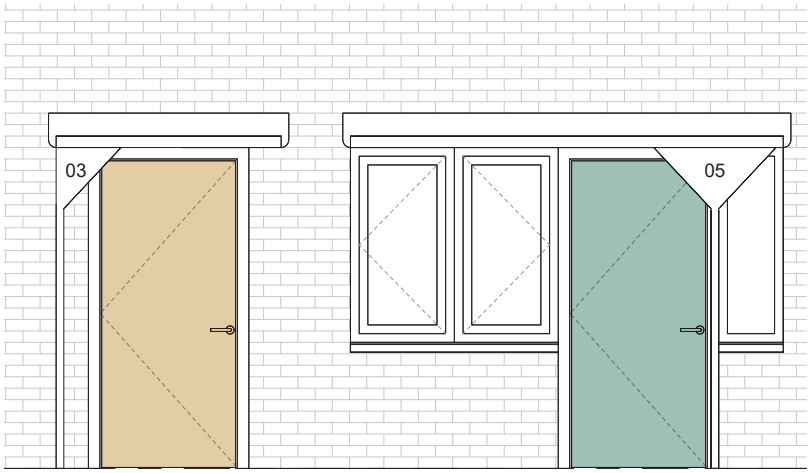
## Front Doors

Front doors are a 'flavour element' of the façade composition, and have been developed to offer a distinct visual identity and expression to the housetypes. A canopy has been introduced to make the main entrance more visible and provide shelter.



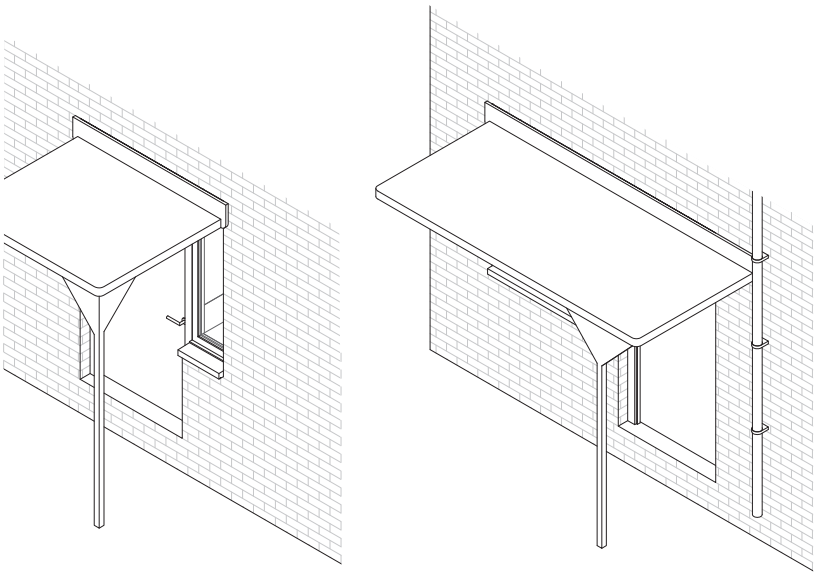

**Front Door + Sidelight**
1050W x 2100H Door

- Solid door panel allows for the application of a material or accent colour to give the entrance a distinct appearance, offering the ability for personal expression whilst aiding in wayfinding.
- Sidelights can be integrated with the front door to suit the house typology or local context. Adding a raised height sidelight creates a space for items such as shoes or an umbrella.
- Front door and sidelight avoided in homes more than two storeys where possible. Assess structural implications where this is present.




**Porch Canopy**
Standard 1500D x 1500L
Long 1500D x 2800L

- A single metal canopy element, integrated with the door lintel.
- Integrated flat profile metal column, with allowance for CNC routed house number.

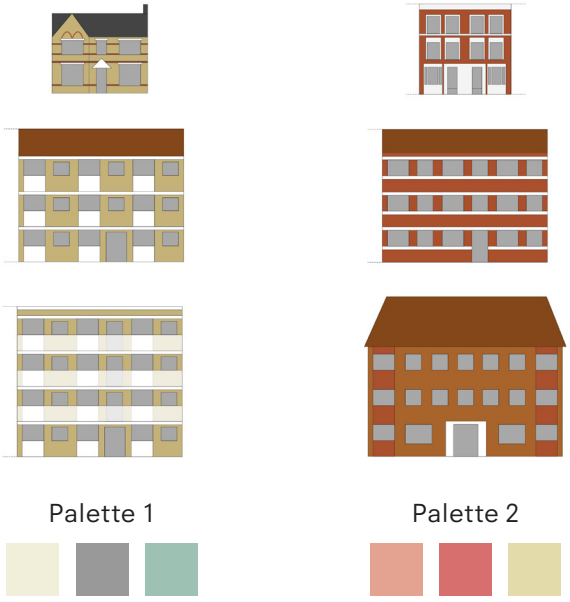


# Façade Components

## Colour and Banding

Colour palette and material/colour banding allows for the proposed typologies to adapt to the particular context of each site.

**Colour Palette**
The two colour palettes have been developed to respond to the diverse character areas of Ealing. Each colour scheme has two base colours, with an accent colour for 'flavour' elements. It is likely that the base colours will come from the natural qualities of the materials chosen (ie. different brick types), with the 'flavour' supplied by powder-coated windows, doors or metalwork, which could relate to more abstract local references.




**Colour Banding**
Banding can be used to mediate scale between existing and proposed buildings, establish visual hierarchy and respond to the immediate context.

# Façade Components

## Materiality

We have determined seven key attributes for the selection of appropriate materials for the external envelope. These are as follows:

1. Low or zero embodied carbon
2. Lightweight
3. Available in a range of colours
4. High durability
5. Fire resistant
6. Thin profile
7. Suitable for MMC use

Meeting all these criteria is challenging in the current market, as there is a limited range of fire-resistant materials with or zero low embodied carbon.

Architectural practice Make has undertaken an exercise to understand the embodied carbon of different Façade systems, as summarised within the chart below. Based on this research we believe that to achieve Ealing's sustainability goals, stone bricks may be the most suitable material for use in this application. The market for stone bricks is expanding, and we have provided additional details on costs and suppliers in the appendix.

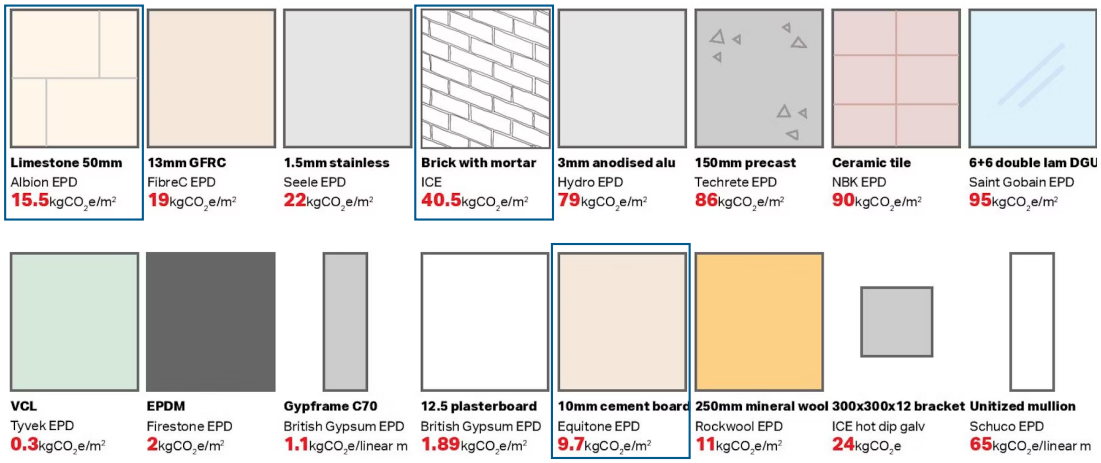
**A -Stone Bricks**
As a natural material, stone has a low carbon footprint and, although currently slightly more costly than traditional brick, results in less waste; although as a natural material, the range of colours is more limited.

**B - Brick**
Brick production is carbon intensive, and its use often wasteful when used for MMC applications as the faces are often sliced off to be compatible with veneer casette systems, resulting in significant material waste.

**C - Cementitious Panels**
Cementitious panels are available in many colours and textures, and are lightweight and non-combustible. However, their appearance may not always be appropriate for sensitive locations such as conservation areas.

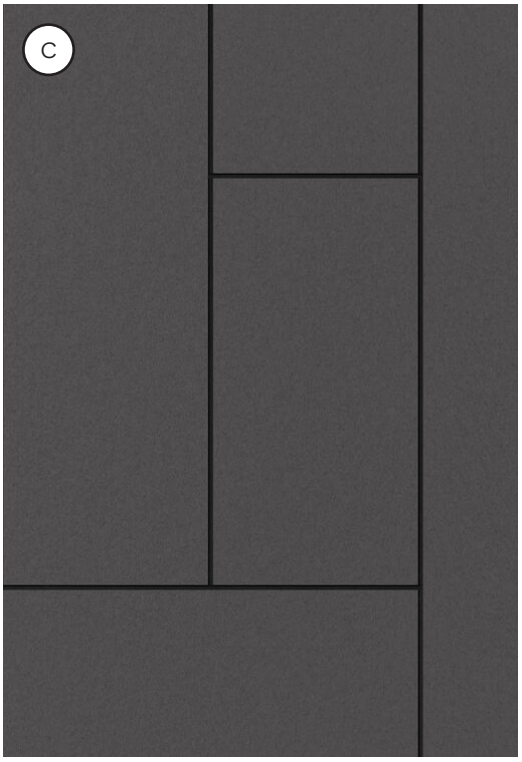
**D - Timber**
Timber cladding can be attractive if well specified and detailed, and is highly sustainble if obtained from appropriate sources. However, combustibility and spread of flame is a concern and will likely preclude its use in most applications.

**Facade materials**
**Embodied carbon, stages A1 - A3**




A


B


C


D

# Site Categorisation

# Overview

Based on the work completed within Part 0 of this study, the sites with most potential for development fall into two broad categories: backland sites, and street-facing sites. In addition, we have identified a significant number of small sites within larger estates which might also fall into one of these categories.

The London Plan space standards require new homes to meet a strict set of spatial requirements, including setting minimum internal areas and widths of living rooms and bedrooms. These are described in the Housing Design Standards LPG which was adopted in June 2023. We are targeting the Best Practice standards, which exceed the minimum requirements by around 10%.

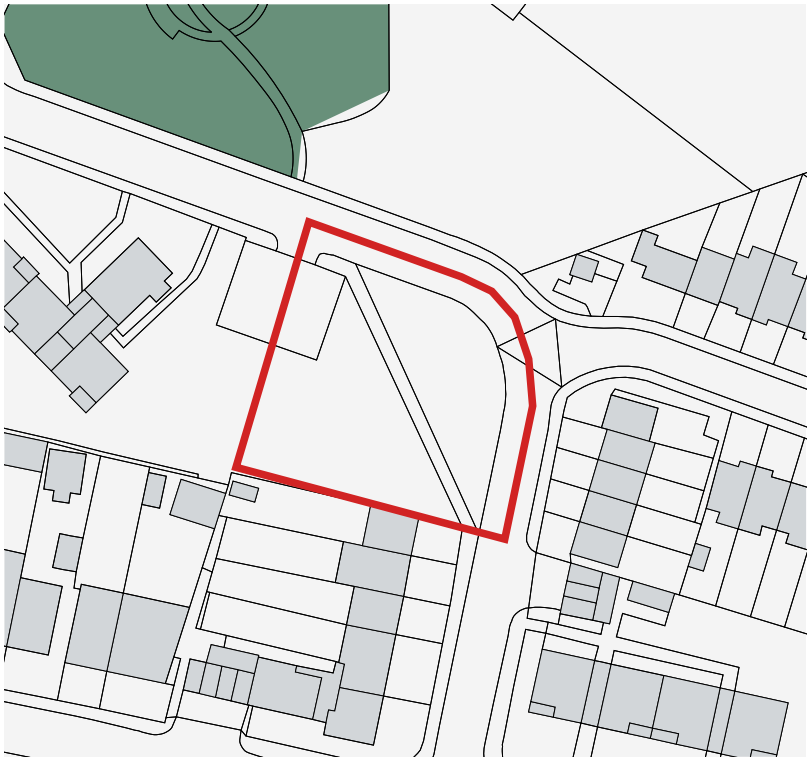
The LPG sets, for example, a minimum width of a living room of 3m, extending to 3.5m for homes with three bedrooms or more. These dimensional requirements will generally preclude prefabricated homes from being delivered to site as a finished module, and the lateral splicing of at least one module will be required on site.

These limitations have focused this study on Category 2 (panelised) MMC as a more appropriate method for housing delivery in Ealing, although Category 1 is also being considered where suitable, and the pattern book house has been designed to accommodate both.

**Street-Facing Sites**

A “street-facing” sites is, as its name suggests, one which has direct and unfettered access to the public highway. Providing that a safe route from the factory to the site can be identified, and that site has reasonable access to the highway and the wider road network (free of red routes, which is unlikely in Ealing), it may be suitable for volumetric construction, where the modules can be moved directly from the delivery vehicle and into position.

Sites such as Canberra Drive (right) and Bournemead Road fall into this category. Other constraints should be considered too, however: the presence of protected street trees over which the modules need to be lifted can also inhibit installation.



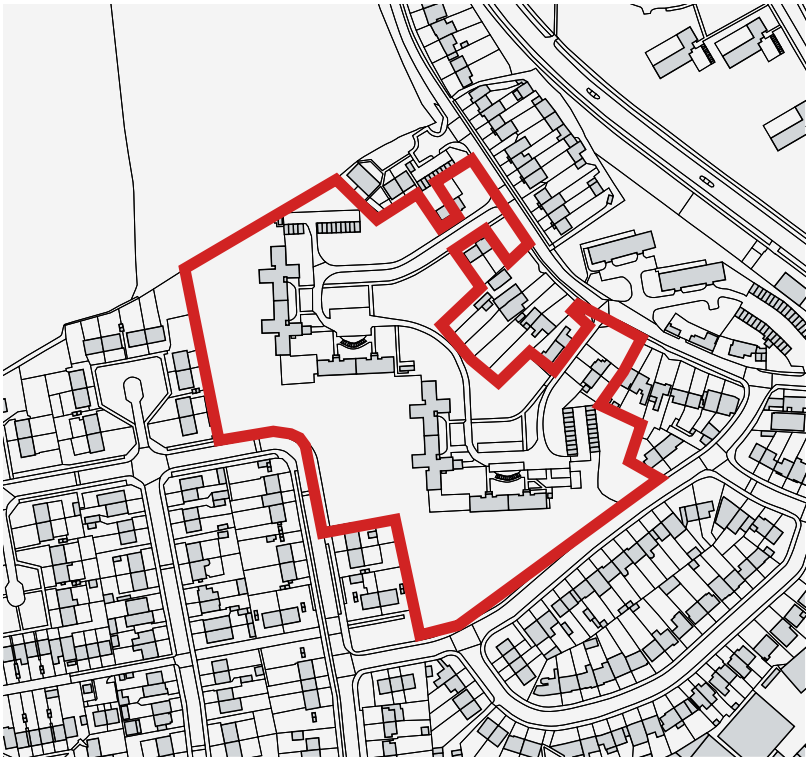
**Backland Sites**

Backland sites are defined as those surrounded on all sides by existing development, with one or more access routes to the public highway. Where there is insufficient space for a delivery vehicle to enter the site, either because the accessway is insufficiently wide, the junction with the public highway too limited, or there is not enough space to manoeuvre on the site itself, Category 1 MMC is unlikely to be practical.

A panellised system, on the other hand, could actually assist due to the reduction of large deliveries required. The panels themselves may need to be offloaded and moved to the site with some form of secondary handling equipment.

**Estate Intensification**

There are a number of large housing estates within Ealing which may be suitable for new homes, where there is no plan for more comprehensive regeneration. Within these estates there are likely to be areas of land (surplus open space, hard standings, car parks or garages) which could accommodate new homes. An early utilities survey is recommended for th se sites as often these can constrain the amount of developable space.  We would advocate for a site-wide masterplan-led approach, however, as the net effect of multiple small sites coming forward could result in areas already suffering from a deficit of public open space, or limited access to public transport, losing vital areas for play or car parking, placing additional pressure on existing residents.



# Methodology

Sites identified using the tools set out in Part  0 will then need to be assessed against the parameters set in this section to understand what category they fall under. This should enable the council to carry out a quick assessment of the sites and understand what delivery method is more suitable.

We believe there an MMC options using the typologies created can be developed for most sites. However, a bespoke option might deliver a higher number of homes for particularly complex sites.

# House Types

# Principles

The external appearance of the pattern book homes has been determined by an understanding of Ealing's particular character and built form.

Using the library of site types we have identified through the identification and categorisation process we have developed a suite of standard layouts for houses and flats. These have been designed to be flexible enough so that they can be delivered through various means: Cat 1 (volumetric), Cat 2 (panelised) and traditional construction, if required. However, the emphasis is certainly on some degree of modular delivery, where these homes will achieve their optimum efficiency.

A summary of the dwelling types is shown in the following table.Each dwelling type includes the following summary:

**Storey Height**
The number of floors within the dwelling, including the ground floor. For the avoidance of doubt, the top level of a four-storey building is known as the third floor.

**Type**
Expressed as the number of bedrooms, and maximum occupancy based on the available bed spaces. A 3b5p dwelling sleeps five people: probably within two double bedrooms and a single bedroom.

**Areas**
GIA (gross internal area) of dwelling, together with the combined size of kitchen, living and dining room (KLD). Dimensions are taken from the internal face of the external walls, and include the area occupied by partitions that lie entirely within the dwelling.

**London Plan Best Practice Target**
The target areas for a dwelling of this size as described within the London Housing Design Guide "Best Practice" standards. Other areas, such as storage, are set out in the Nationally-Described Space Standards (NDSS).

| Name | Storeys | No. Bedroom | No. Bed Spaces | GIA sqm | LKD sqm | Storage sqm | Page |
|---|---|---|---|---|---|---|---|
| House Type 01a | 2 | 2b | 4p | 86.4 | 31.9 | 2.2 | 42 |
| House Type 01b | 3 | 3b | 5p | 106.8 | 31.9 | 4.1 | 44 |
| House Type 01c | 3 | 4b | 7p | 129.2 | 31.9 | 4.1 | 46 |
| House Type 02a | 2 | 2b | 4p | 88.2 | 31.5 | 3.5 | 48 |
| House Type 02b | 3 | 4b | 7p | 132.3 | 31.4 | 8.2 | 50 |
| House Type 03a | 2 | 5b | 7p | 134.7 | 30.8 | 7.6 | 52 |
| House Type 04a | 2 | 5b | 8p | 134.7 | 34.6 | 7.4 | 54 |

# House Type 01a

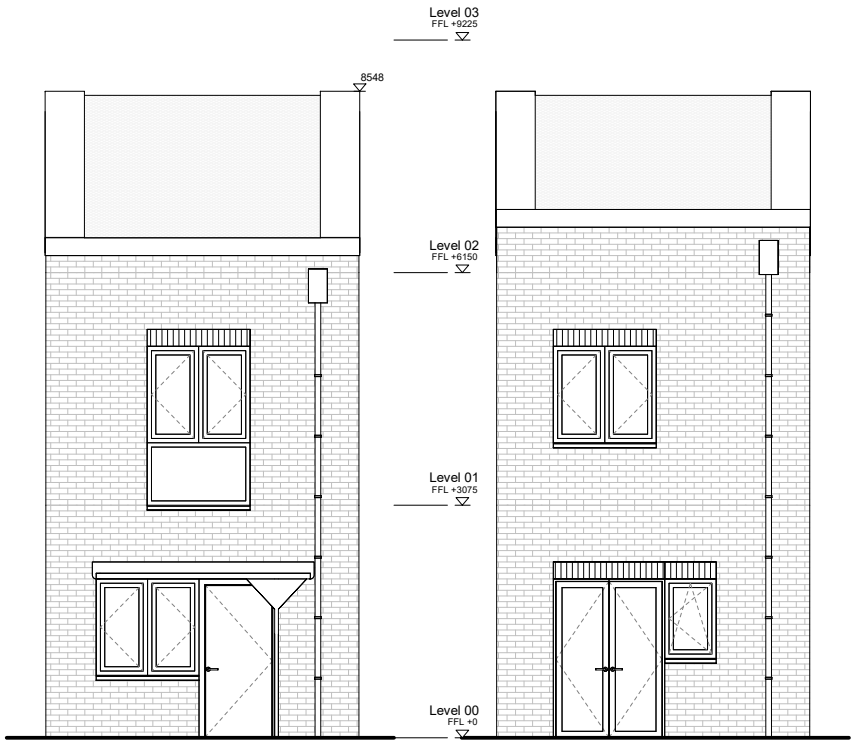
## Narrow Terrace

**Storey Height:**
2

**Type:**
2 bed 4 person

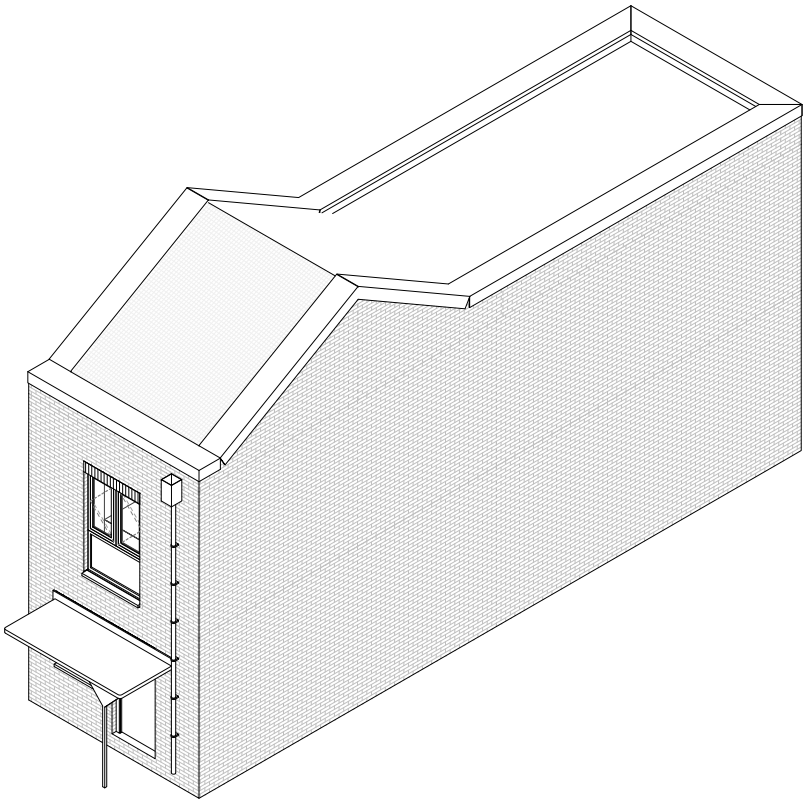
**Areas:**
GIA: 86.4 sqm
KLD: 31.9 sqm
Storage: 2.1 sqm (allowance for 0.5 sqm within services cupboard as stated in NDSS)

**London Plan Best Practice Target 2b4p:**
GIA: 86 sqm
KLD: 27 sqm (2p4p)
Storage: 2.5 sqm (2 sqm NDSS/London Plan)



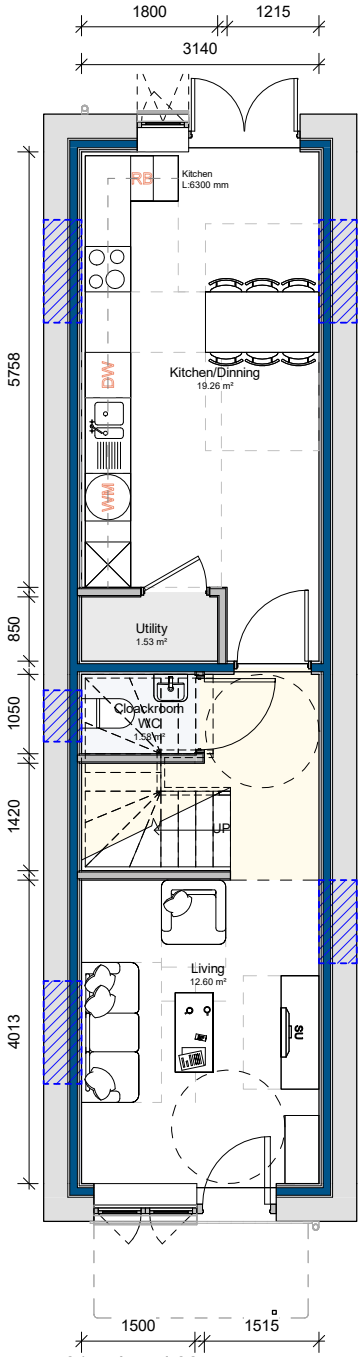

5 / 01a — 01a - Front Elevation
1 : 50@A1

6 / 01a — 01a - Back Elevation
1 : 50@A1



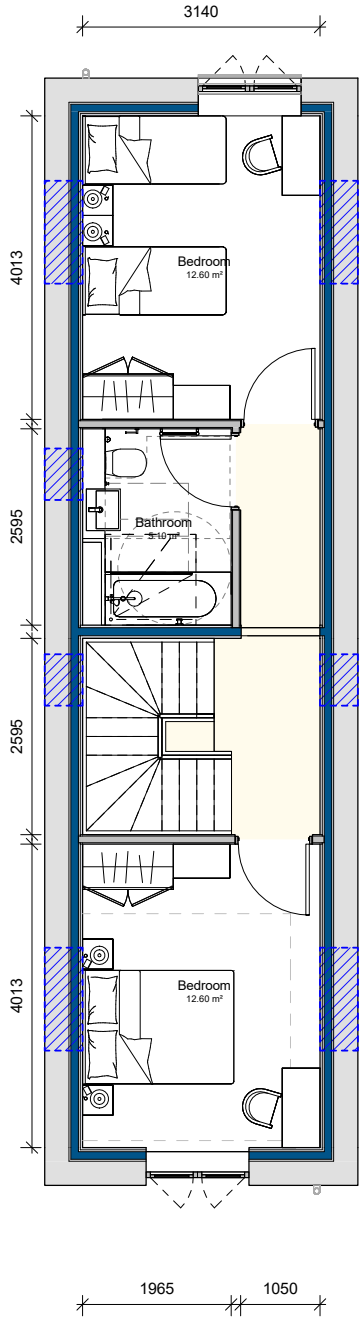
1 / 01a — 01a - 3D View
@A1

| | |
|---|---|
| DW | Dishwasher |
| WM | Washing machine |
| RB | Recycle bin |
| | Circulation |
| | Utility |
| | Storage |
| | Alternative Window |




2 01a - Level 00

01a 1 : 50@A1




3 01a - Level 01

01a 1 : 50@A1

0 5m

0.5m 1m 2m 3m

# House Type 01b

## Narrow Terrace

**Storey Height:**
3

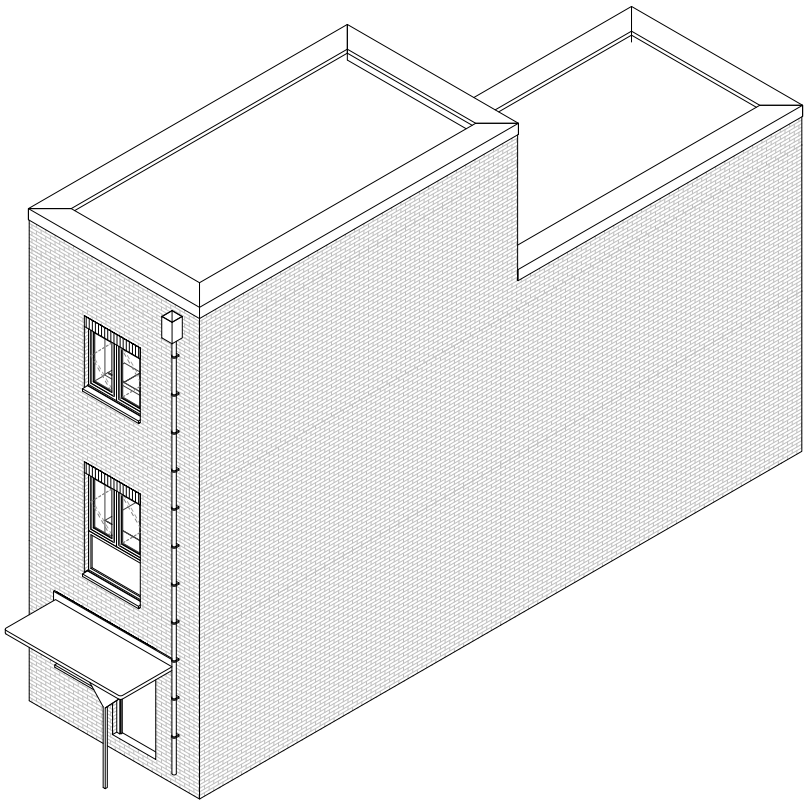
**Type:**
3 bed 5person

**Areas:**
GIA: 106.8 sqm
KLD: 31.9 sqm
Storage: 4.1 sqm (allowance for 0.5 sqm within services cupboard as stated in NDSS)

**London Plan Best Practice Target 3b5p:**
GIA: 110sqm (99 sqm NDSS/London Plan)
KLD: 29 sqm (3b5p)
Storage: 3 sqm (2.5 sqm NDSS/London Plan)

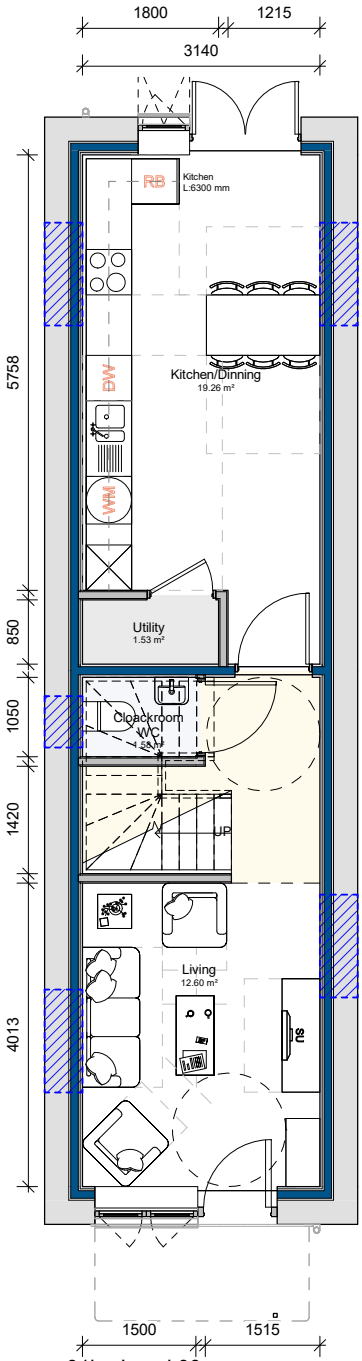

5 01b - Front Elevation
01b 1 : 50@A1

6 01b - Back Elevation
01b 1 : 50@A1

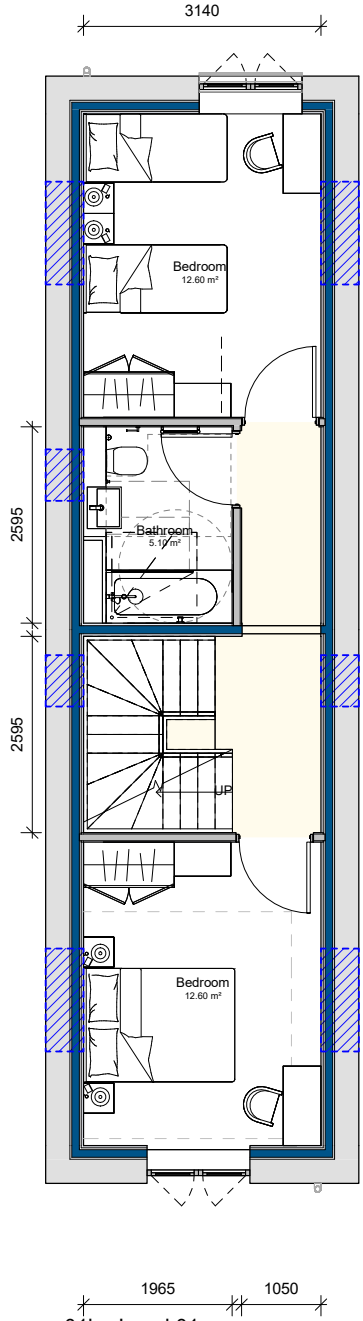


1 01b - 3D View
01b @A1

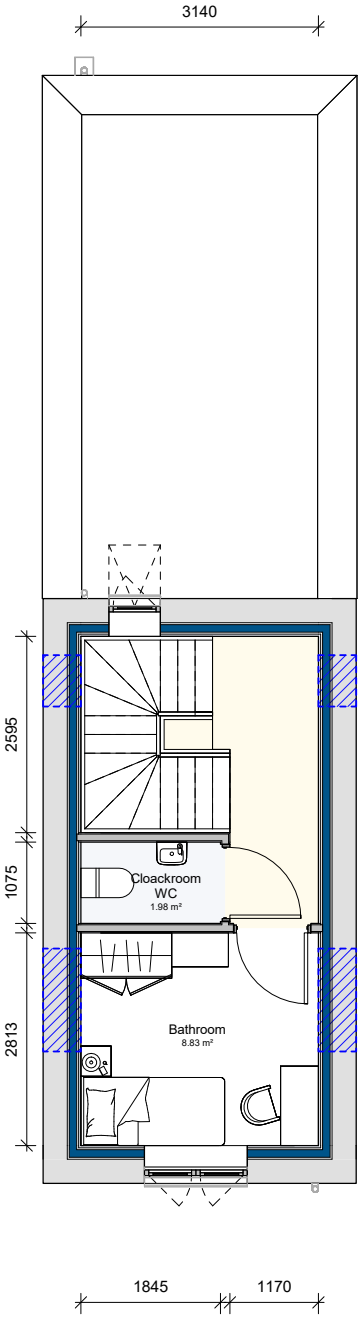
| | |
|---|---|
| DW | Dishwasher |
| WM | Washing machine |
| RB | Recycle bin |
| | Circulation |
| | Utility |
| | Storage |
| | Alternative Window |



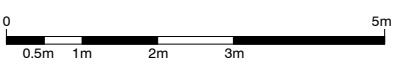

2 01b - Level 00
01b 1 : 50@A1




3 01b - Level 01
01b 1 : 50@A1




4 01b - Level 02
01b 1 : 50@A1



# House Type 01c

## Narrow Terrace

**Storey Height:**
3

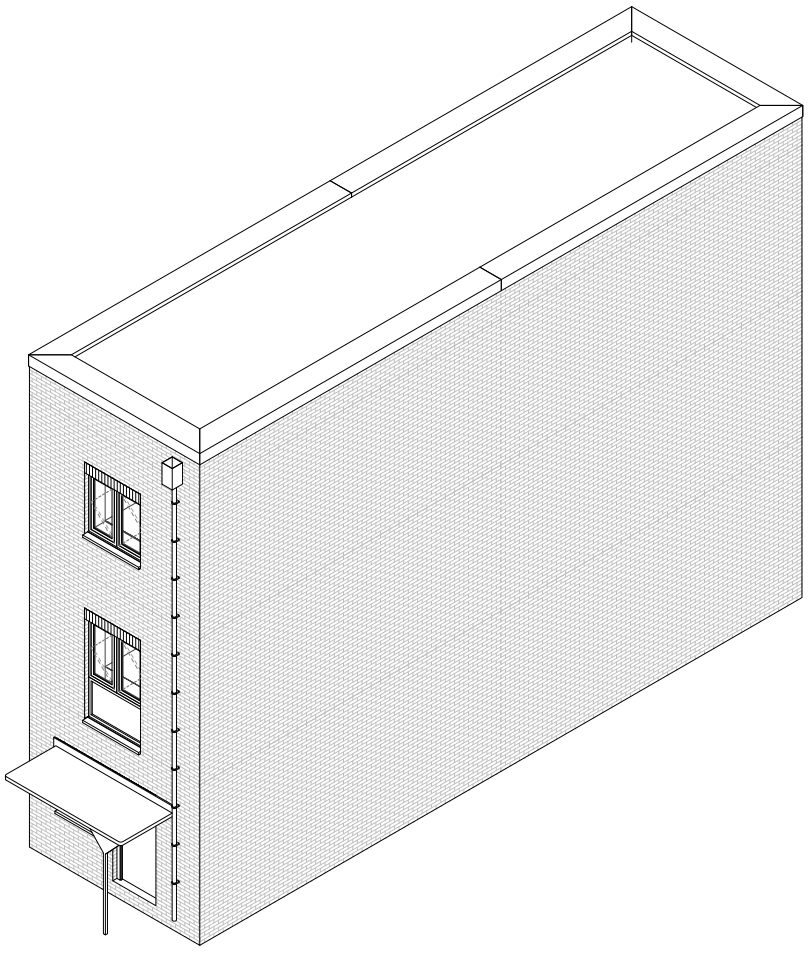
**Type:**
4 bed 7 person

**Areas:**
GIA: 129.2 sqm
KLD: 31.9 sqm
Storage: 4.2 sqm (allowance for 0.5 sqm within services cupboard as stated in NDSS)
*Study used as storage area

**London Plan Best Practice Target 4b7p:**
GIA: 134 sqm (121 sqm NDSS/London Plan)
KLD: 31 sqm (4p6p)
Storage: 3.5 sqm (3 sqm NDSS/London Plan)


5 01c - Front Elevation
01c 1 : 50@A1

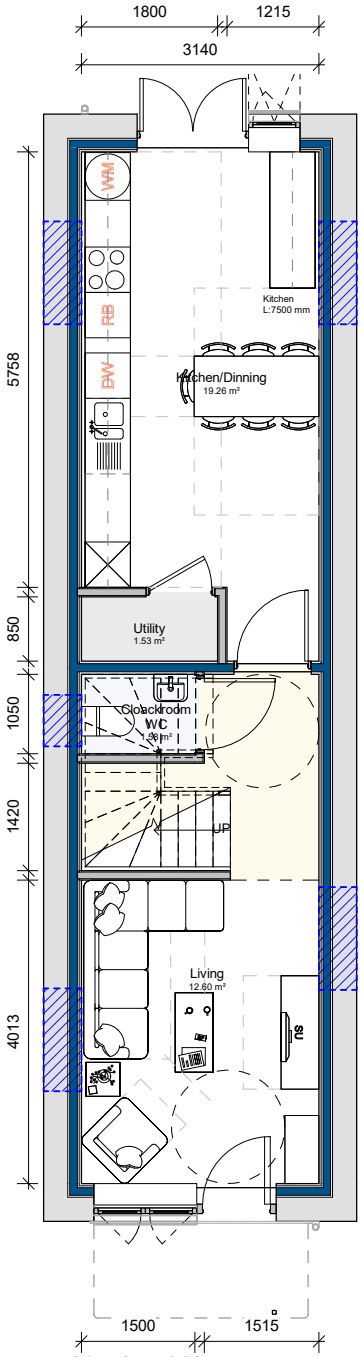
6 01c - Back Elevation
01c 1 : 50@A1



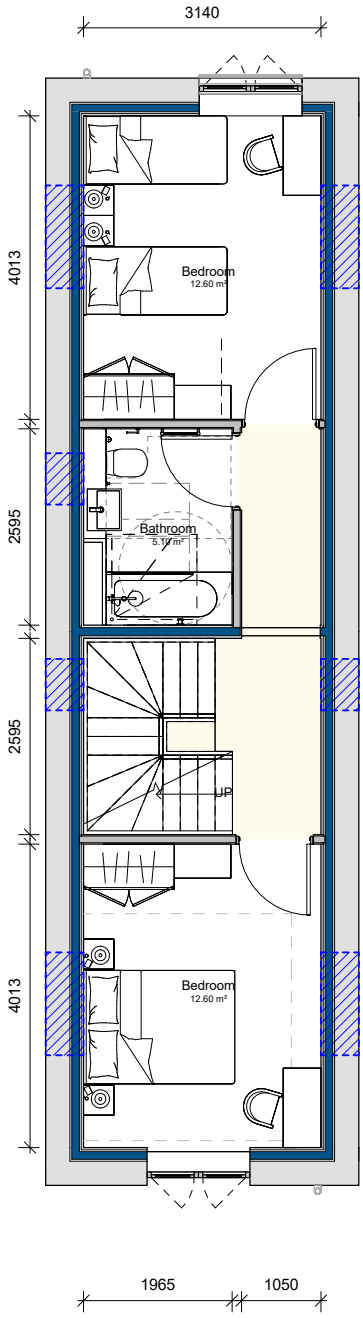
1 01c - 3D View
01c @A1

DW Dishwasher
WM Washing machine
RB Recycle bin

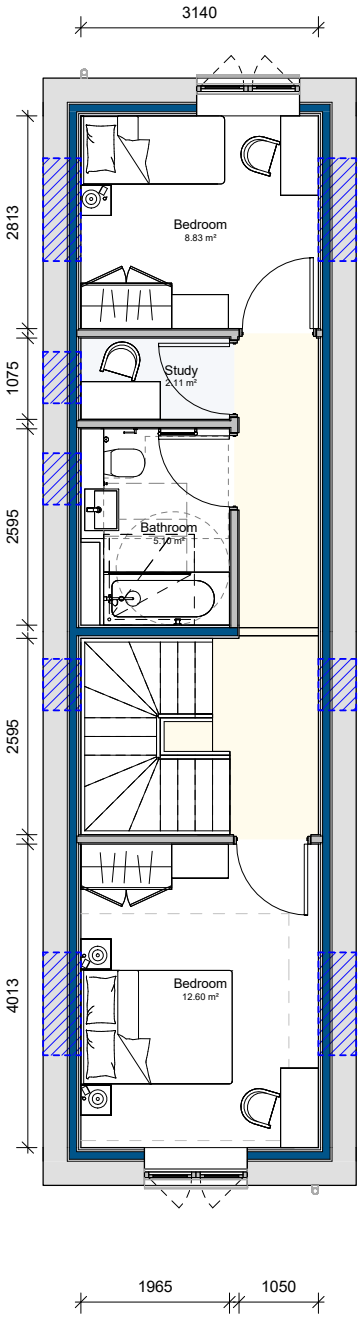
Circulation
Utility
Storage
Alternative Window



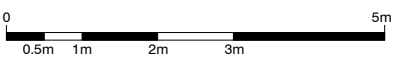

2 01c - Level 00
01c 1 : 50@A1




3 01c - Level 01
01c 1 : 50@A1




4 01c - Level 02
01c 1 : 50@A1



# House Type 02a

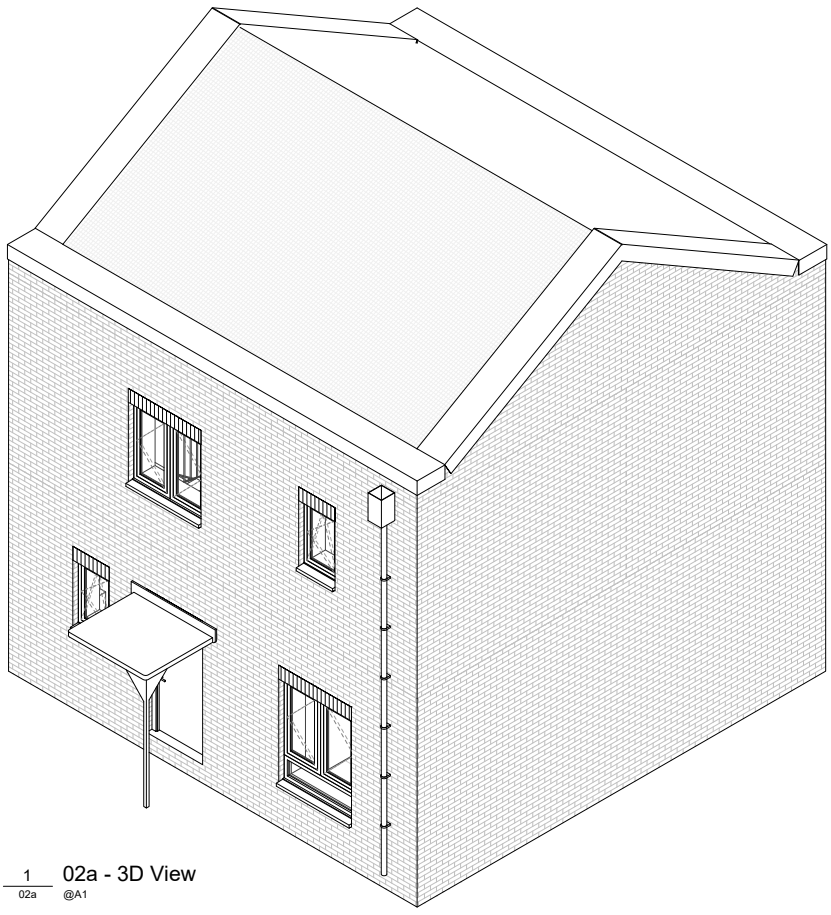
## Wide Terrace & Maisonette

**Storey Height:**
2

**Type:**
2 bed 4 person

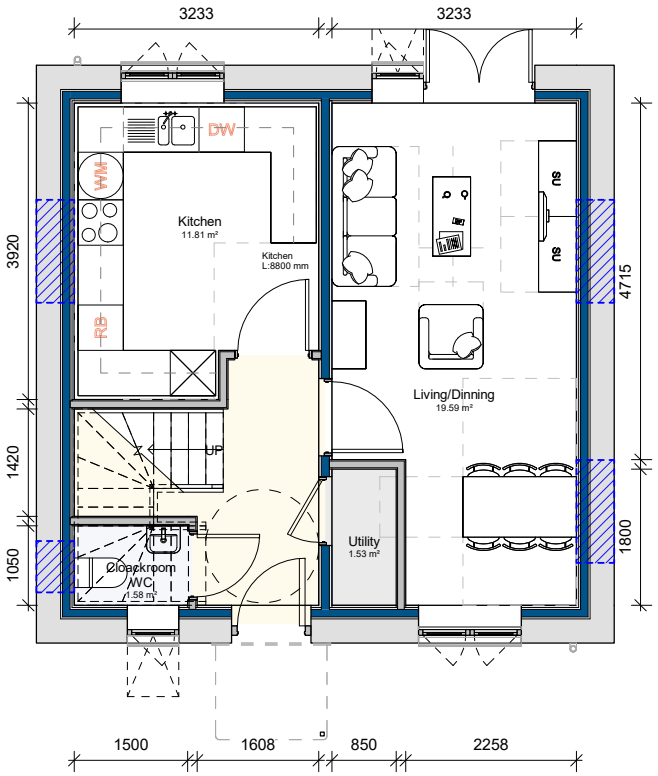
**Areas:**
GIA: 88.2 sqm
KLD: 31.5 sqm
Storage: 3.5 sqm (allowance for 0.5 sqm within services cupboard as stated in NDSS)

**London Plan Best Practice Target 2b4p:**
GIA: 86 sqm
KLD: 27 sqm (2p4p)
Storage: 2.5 sqm (2 sqm NDSS/London Plan)



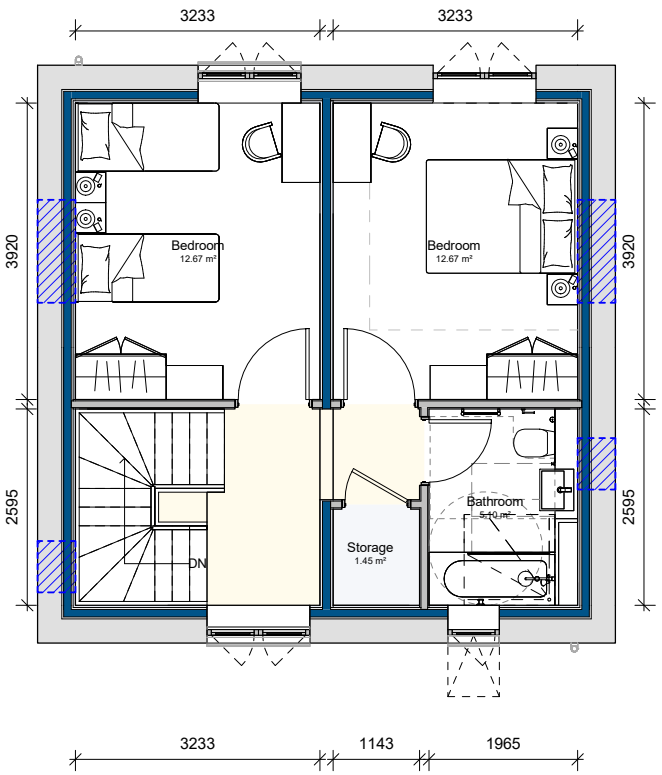
1/02a 02a - 3D View @A1

| | |
|---|---|
| DW | Dishwasher |
| WM | Washing machine |
| RB | Recycle bin |
| | Circulation |
| | Utility |
| | Storage |
| | Alternative Window |



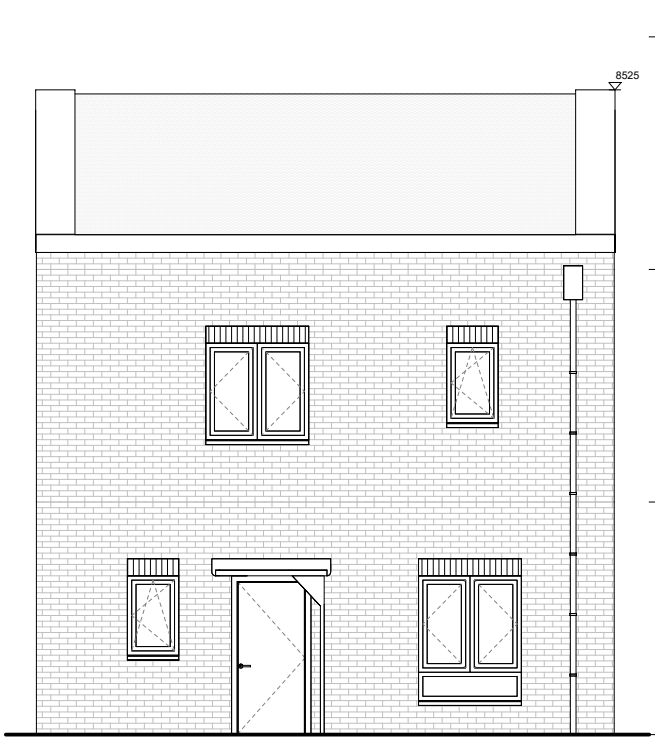

2 02a - Level 00

02a 1 : 50@A1



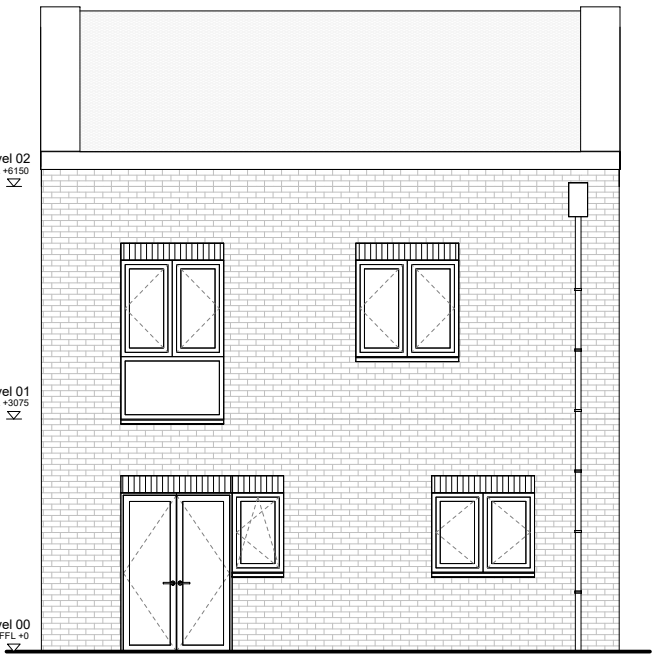

3 02a - Level 01

02a 1 : 50@A1



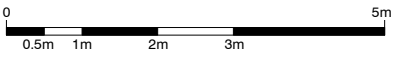

5 02a - Front Elevation

02a 1 : 50@A1



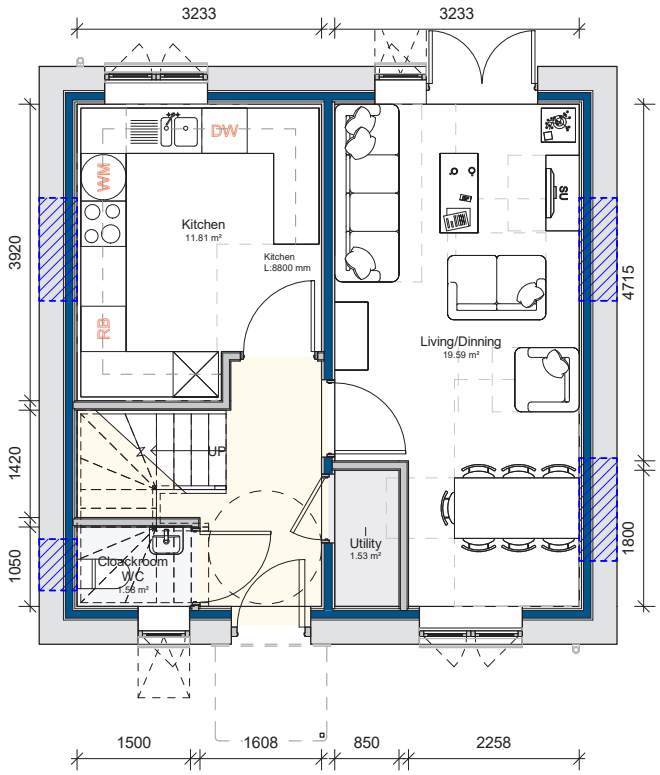

6 02a - Back Elevation

02a 1 : 50@A1



# House Type 02b

## Wide Terrace & Maisonette



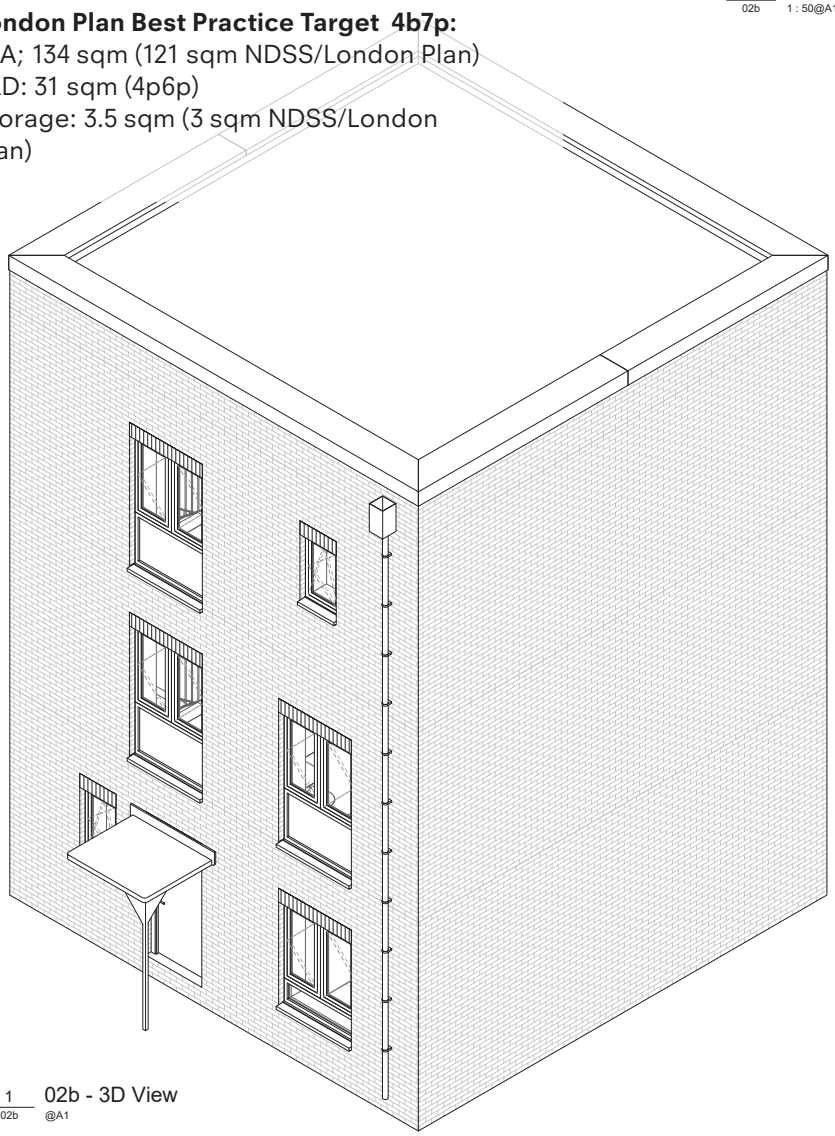

2 02b - Level 00
02b 1 : 50@A1

**Storey Height:**
3

**Type:**
4 bed 7 person

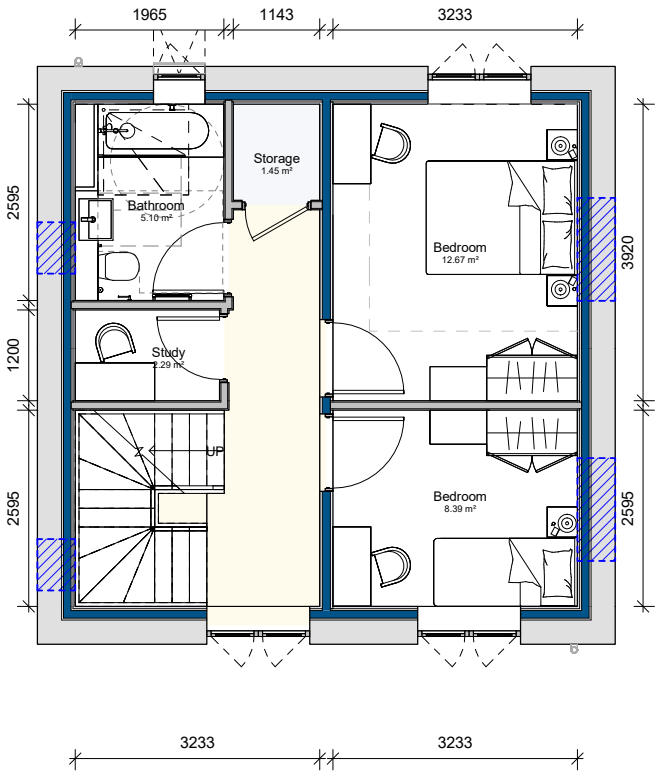
**Areas:**
GIA: 132.3 sqm
KLD: 31.4sqm
Storage: 5 sqm (allowance for 0.5 sqm within services cupboard as stated in NDSS)

**London Plan Best Practice Target 4b7p:**
GIA; 134 sqm (121 sqm NDSS/London Plan)
KLD: 31 sqm (4p6p)
Storage: 3.5 sqm (3 sqm NDSS/London Plan)



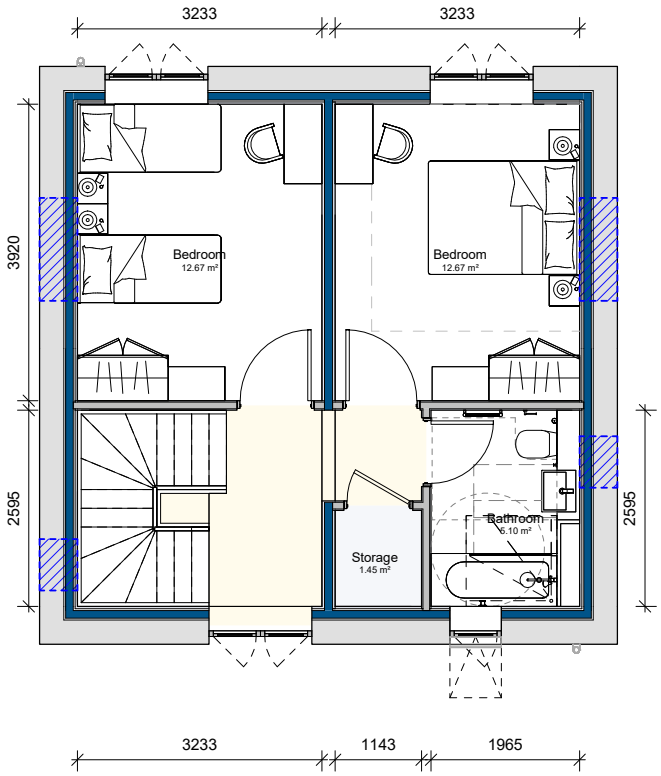
1 02b - 3D View
02b @A1

| | |
|---|---|
| DW | Dishwasher |
| WM | Washing machine |
| RB | Recycle bin |
| | Circulation |
| | Utility |
| | Storage |
| | Alternative Window |



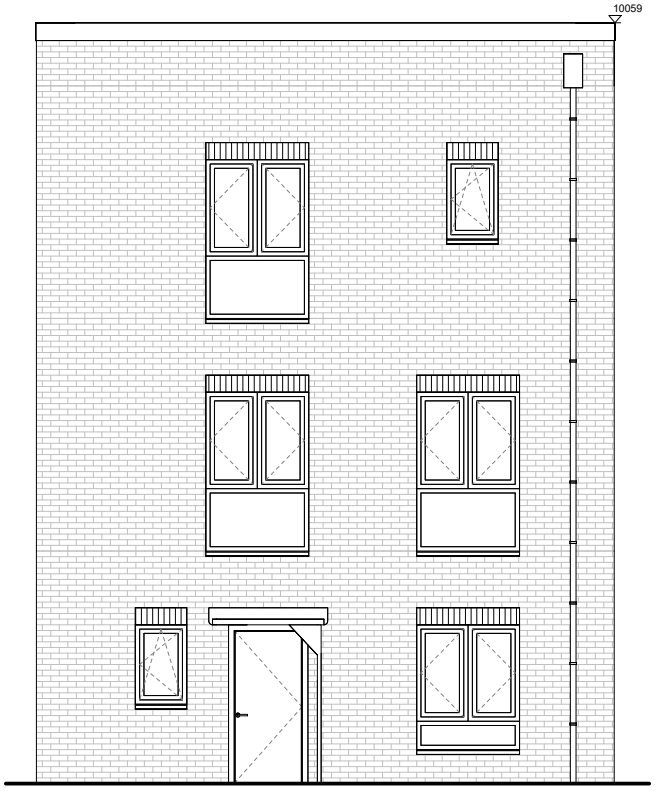

3 02b - Level 01

02b 1 : 50@A1



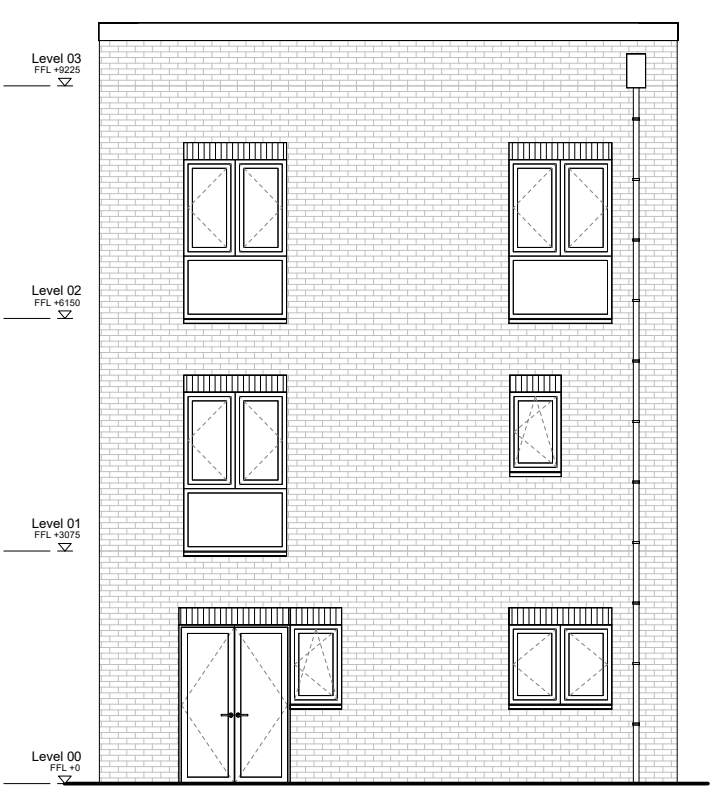

4 02b - Level 02

02b 1 : 50@A1



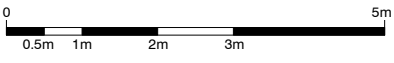

5 02b - Front Elevation

02b 1 : 50@A1




6 02b - Back Elevation

02b 1 : 50@A1



# House Type 03a

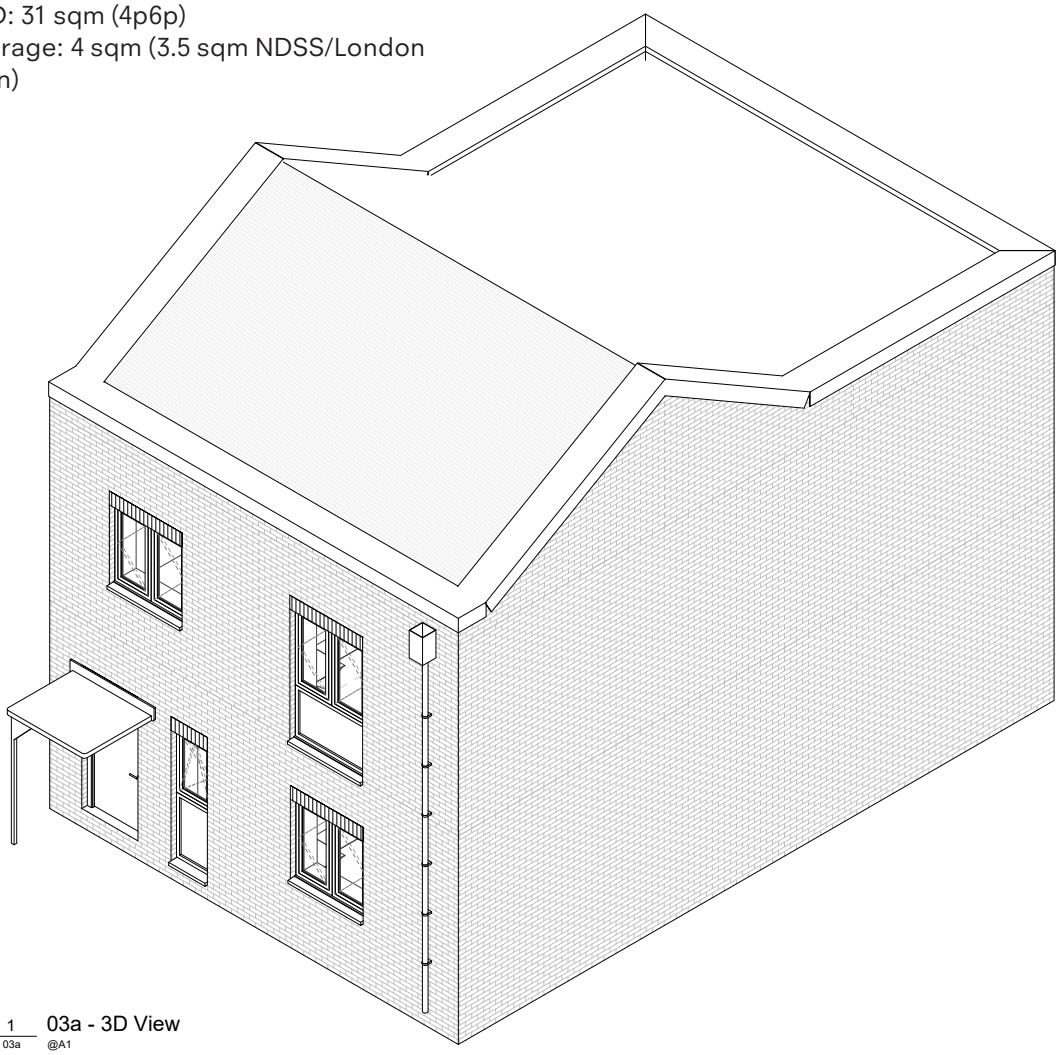
## Wide & Deep Terrace

**Storey Height:**
2

**Type:**
5 bed 7 person

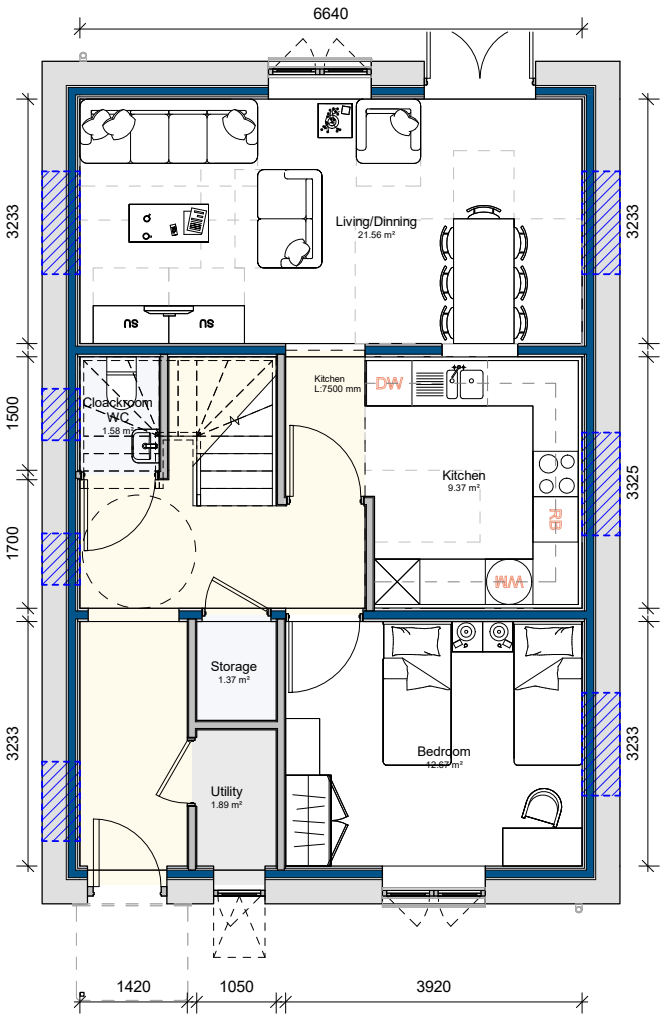
**Areas:**
GIA: 134.7 sqm
KLD: 30.8 sqm
Storage: 5.3 sqm (allowance for 0.5 sqm within services cupboard as stated in NDSS)

**London Plan Best Practice Target 5b7p:**
GIA: 132 sqm
KLD: 31 sqm (4p6p)
Storage: 4 sqm (3.5 sqm NDSS/London Plan)



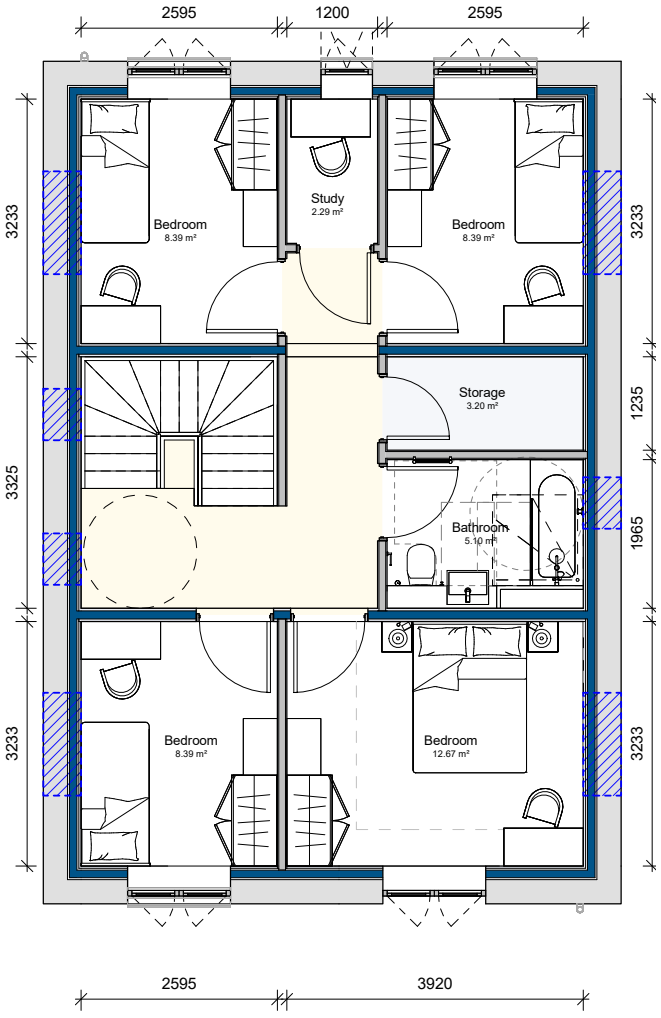
1/03a 03a - 3D View @A1

| | |
|---|---|
| DW | Dishwasher |
| WM | Washing machine |
| RB | Recycle bin |
| | Circulation |
| | Utility |
| | Storage |
| | Alternative Window |




2 03a - Level 00

03a 1 : 50@A1




3 03a - Level 01

03a 1 : 50@A1


5 03a - Front Elevation

03a 1 : 50@A1

6 03a - Back Elevation

03a 1 : 50@A1

0 5m

0.5m 1m 2m 3m

# House Type 04a

## Wide Shallow Terrace & Maisonette

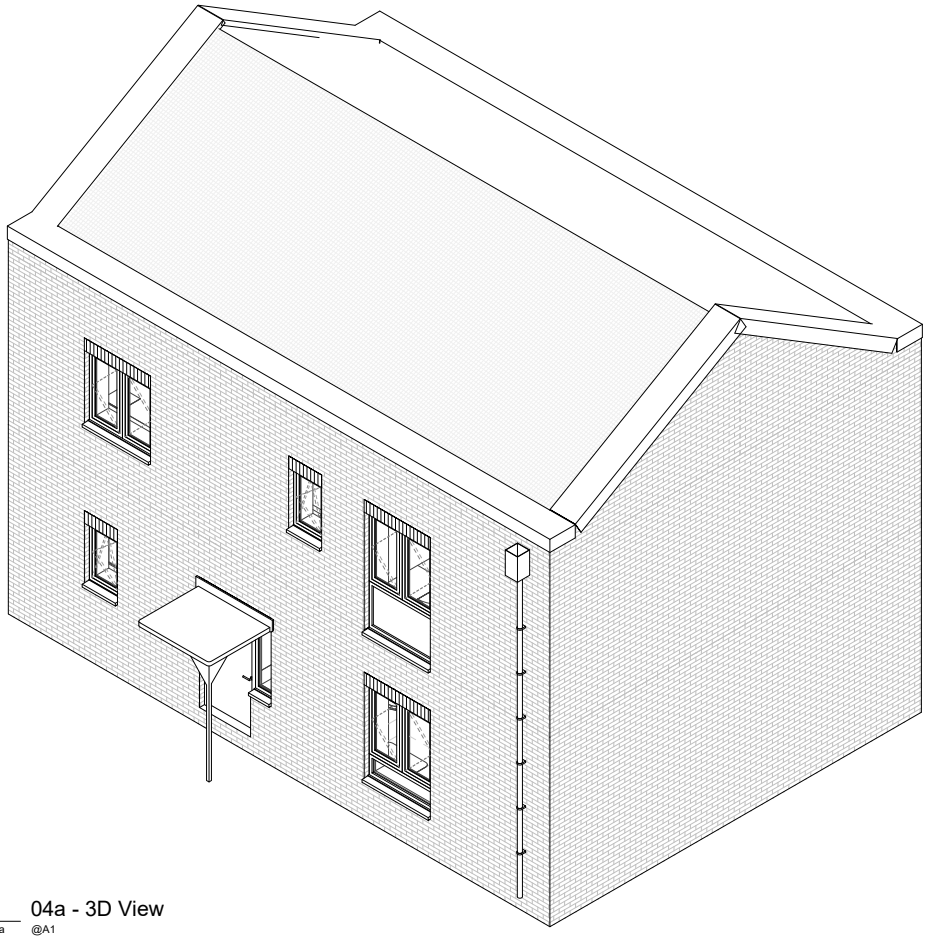
**Storey Height:**
2

**Type:**
5 bed 8 person

**Areas:**
GIA: 134.7 sqm
KLD: 34.6 sqm
Storage: 5.1 sqm (allowance for 0.5 sqm within services cupboard as stated in NDSS)

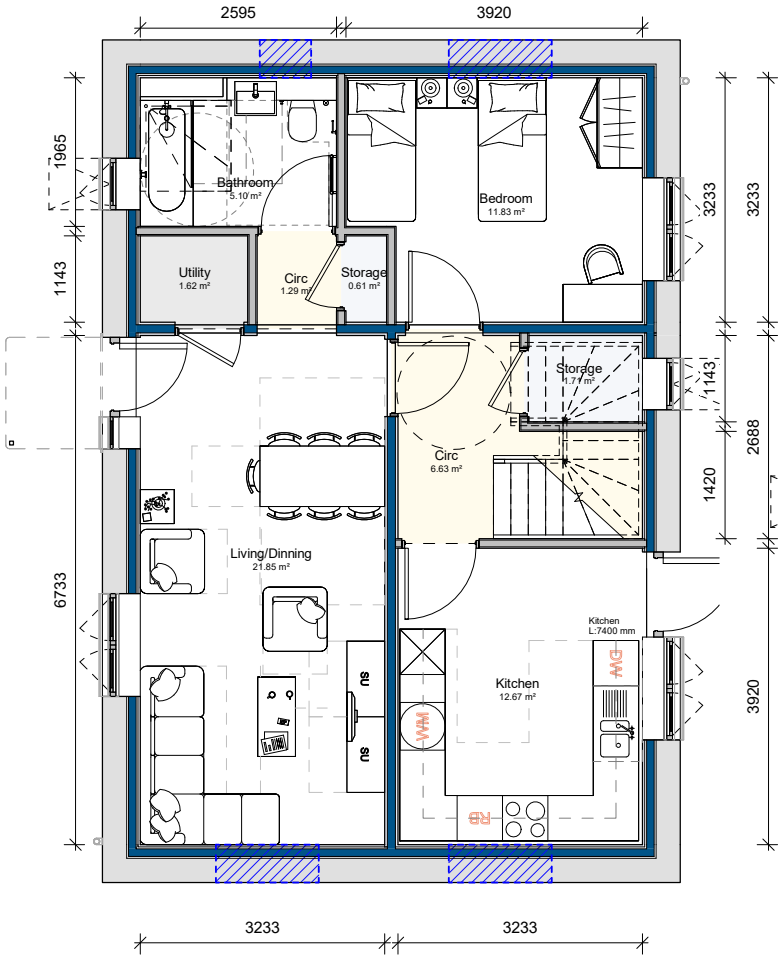
**London Plan Best Practice Target 5b8p:**
GIA: (142 sqm)
KLD: 31 sqm (4p6p)
Storage: 4 sqm (3.5 sqm NDSS/London Plan)

5 / 04a 04a - Front Elevation
1 : 50@A1

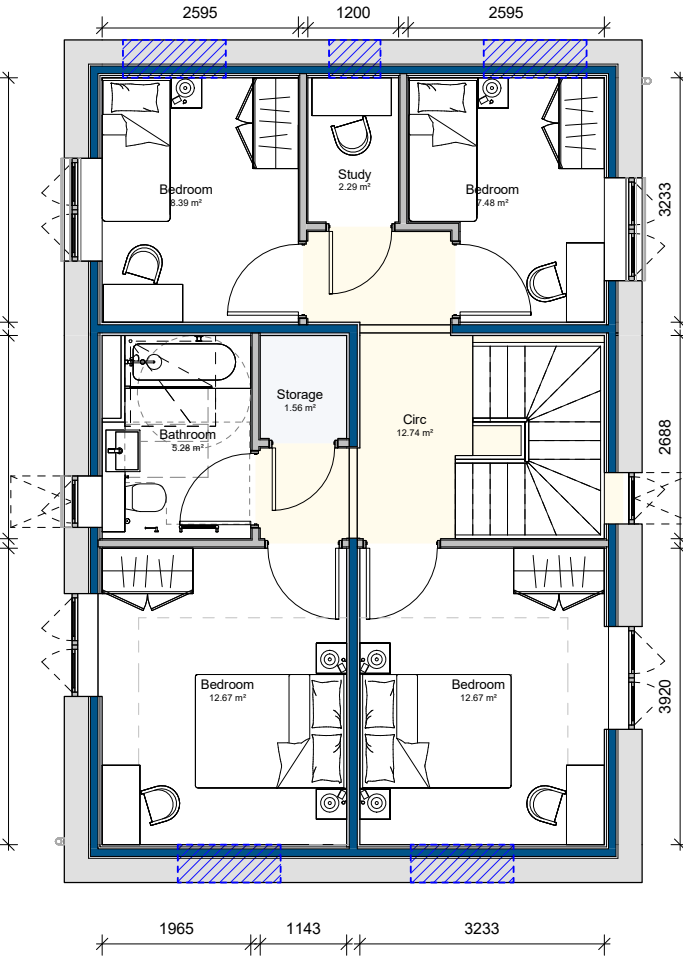


1 / 04a 04a - 3D View
@A1

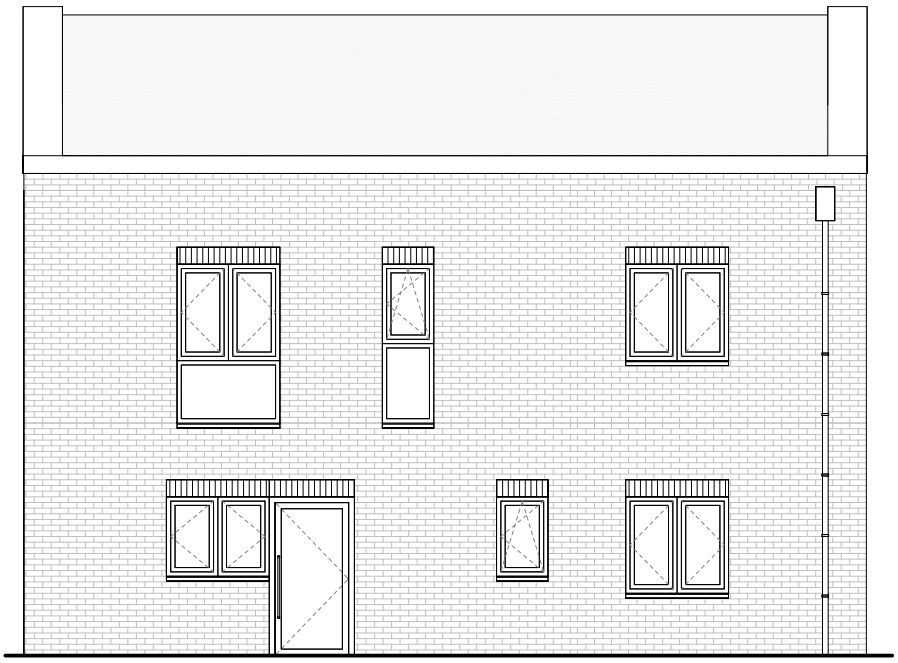
| | |
|---|---|
| DW | Dishwasher |
| WM | Washing machine |
| RB | Recycle bin |
| | Circulation |
| | Utility |
| | Storage |
| | Alternative Window |




2 04a - Level 00
04a 1 : 50@A1




3 04a - Level 01
04a 1 : 50@A1



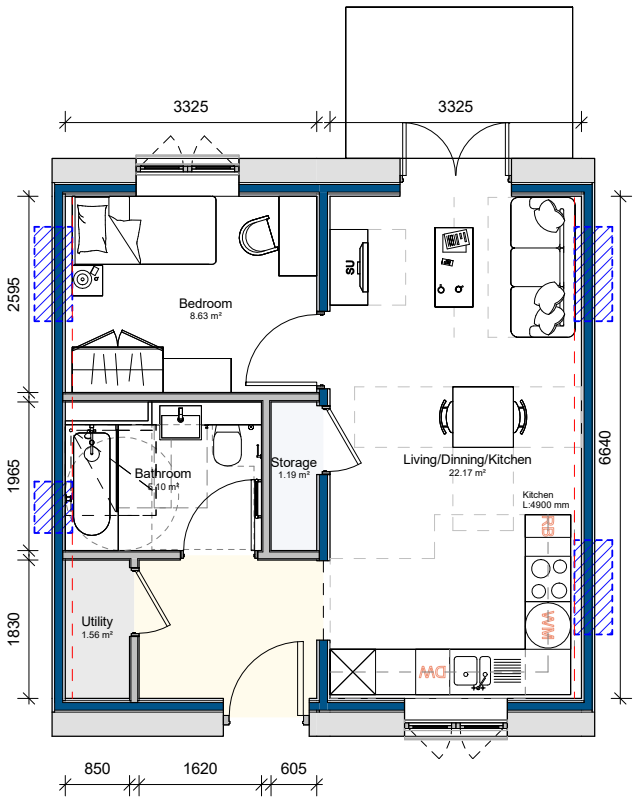
6 04a - Back Elevation
04a 1 : 50@A1

0 5m
0.5m 1m 2m 3m

# Apartment Types

| Name | Storeys | No. Bedroom | No. Bed Spaces | GIA sqm | LKD sqm | Storage sqm | Page |
|---|---|---|---|---|---|---|---|
| Apartment Type 05a | 1 | 1b | 1p | 45.3 | 22.2 | 1.7 | 56 |
| Apartment Type 05b | 1 | 1b | 2p | 56.7 | 31.7 | 1.7 | 57 |
| Apartment Type 05c | 1 | 2b | 3p | 68.6 | 33.2 | 2.3 | 58 |
| Apartment Type 05d | 1 | 2b | 4p | 80.0 | 33.2 | 4.1 | 59 |
| Apartment Type 05e | 1 | 3b | 5p | 91.8 | 32.4 | 4.8 | 60 |
| Apartment Type 05f | 1 | 3b | 6p | 103.2 | 33.2 | 5.3 | 61 |

# Apartment Type 05a




1/05 05a - 1b1p
1 : 50@A1

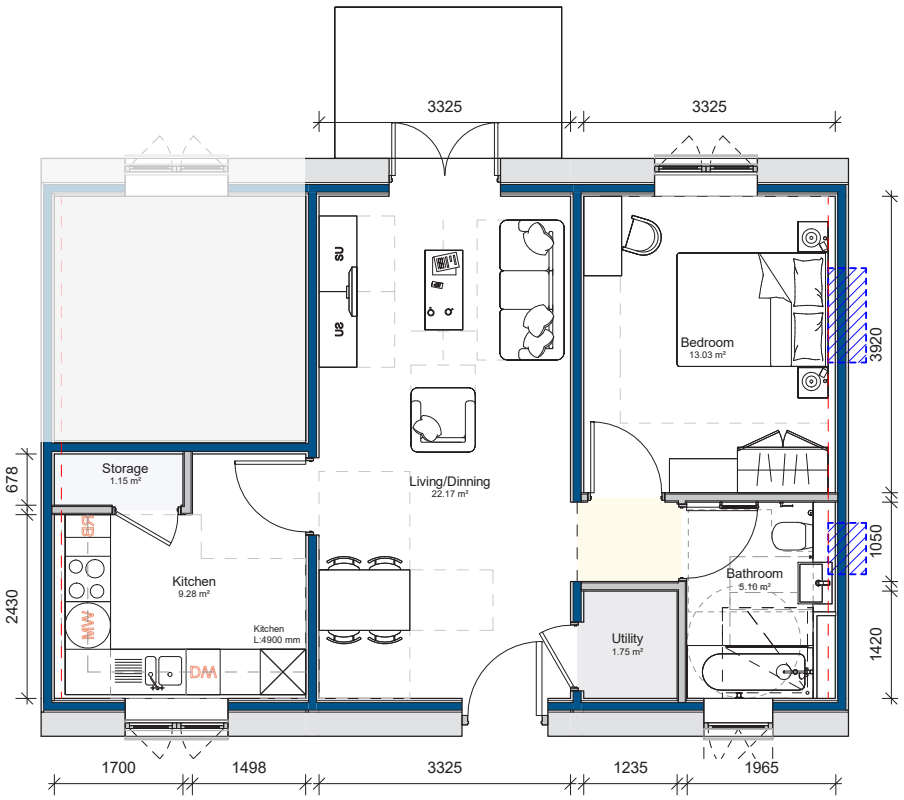
**Type:**
1 bed 1 person

**Area:**
GIA: 45.3 sqm
KLD: 22.2 sqm
Storage: 1.7 sqm (allowance for 0.5 sqm within services cupboard as stated in NDSS)

**London Plan Best Practice Target 1b1p:**
GIA: 43 sqm
KLD: 21 sqm (1b1p)
Storage: 1.5 sqm (1 sqm NDSS/London Plan)

| | |
|---|---|
| DW | Dishwasher |
| WM | Washing machine |
| RB | Recycle bin |
| | Circulation |
| | Utility |
| | Storage |
| | Alternative Window |

# Apartment Type 05b

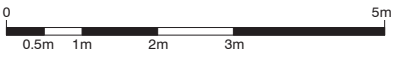



2/05 05b - 1b2p
1 : 50@A1

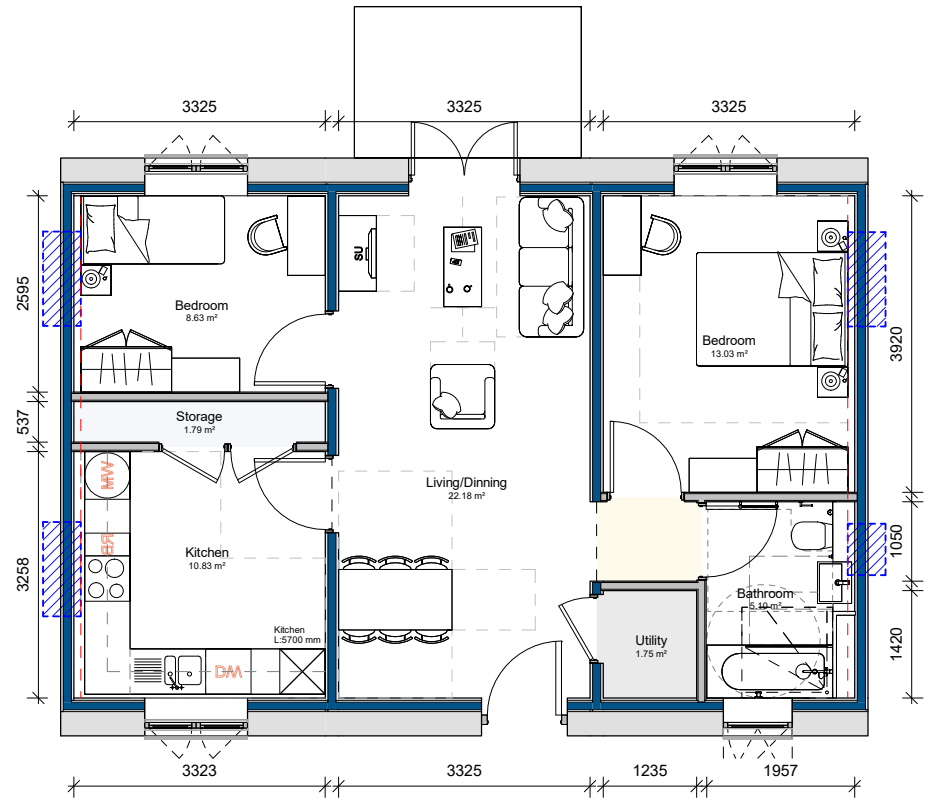
**Type:**
1 bed 2 person

**Area:**
GIA: 56.7 sqm
KLD: 31.7 sqm
Storage: 1.7 sqm (allowance for 0.5 sqm within services cupboard as stated in NDSS)

**London Plan Best Practice Target 1b2p:**
GIA: 55 sqm
KLD: 23 sqm (1p2p)
Storage: 2 sqm (1.5 sqm NDSS/London Plan)



# Apartment Type 05c




3 05c - 2b1p Copy 1
05.5 1 : 50@A1

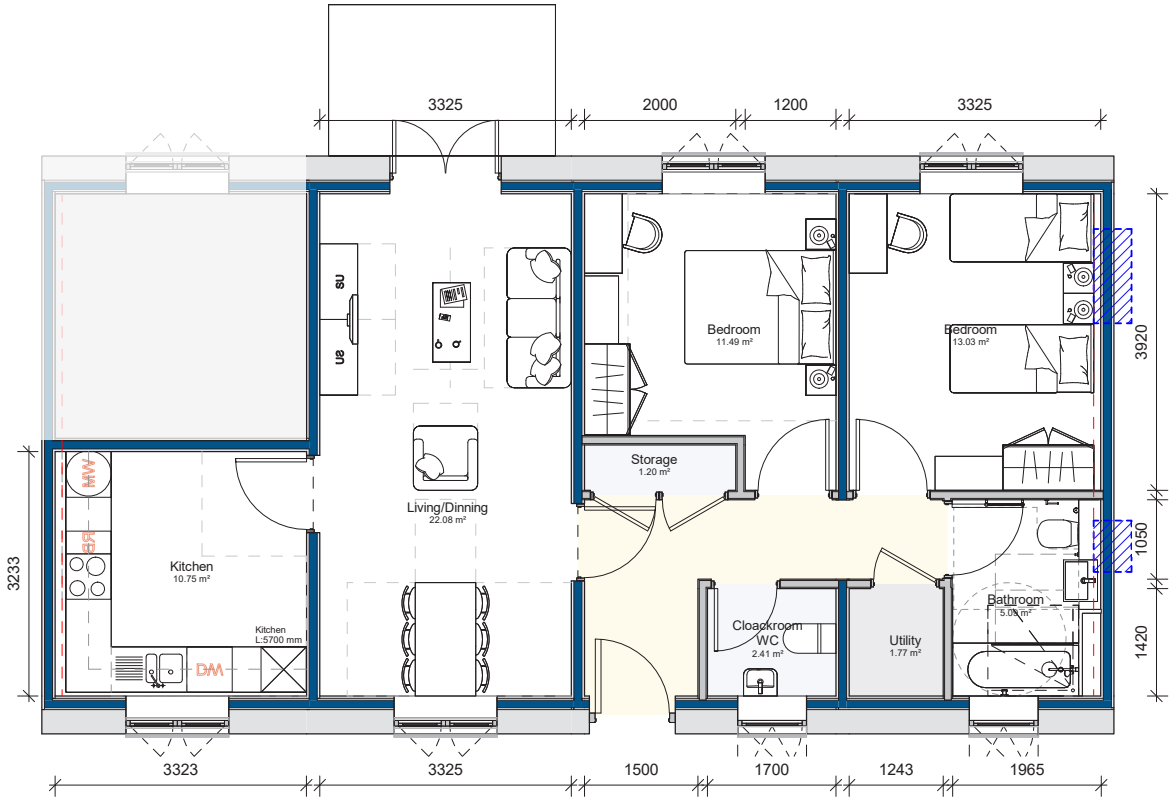
**Type:**
2b3p

**Area:**
GIA: 68.6 sqm
KLD: 33.2 sqm
Storage: 2.3sqm (allowance for 0.5 sqm within services cupboard as stated in NDSS)

**London Plan Best Practice Target 2b3p:**
GIA: 67 sqm
KLD: 25 sqm (1p3p)
Storage: 2.5 sqm (2 sqm NDSS/London Plan)

| | |
|---|---|
| DW | Dishwasher |
| WM | Washing machine |
| RB | Recycle bin |
| | Circulation |
| | Utility |
| | Storage |
| | Alternative Window |

# Apartment Type 05d

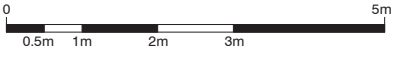



4 05d - 2b2p Copy 1
05.5 1 : 50@A1

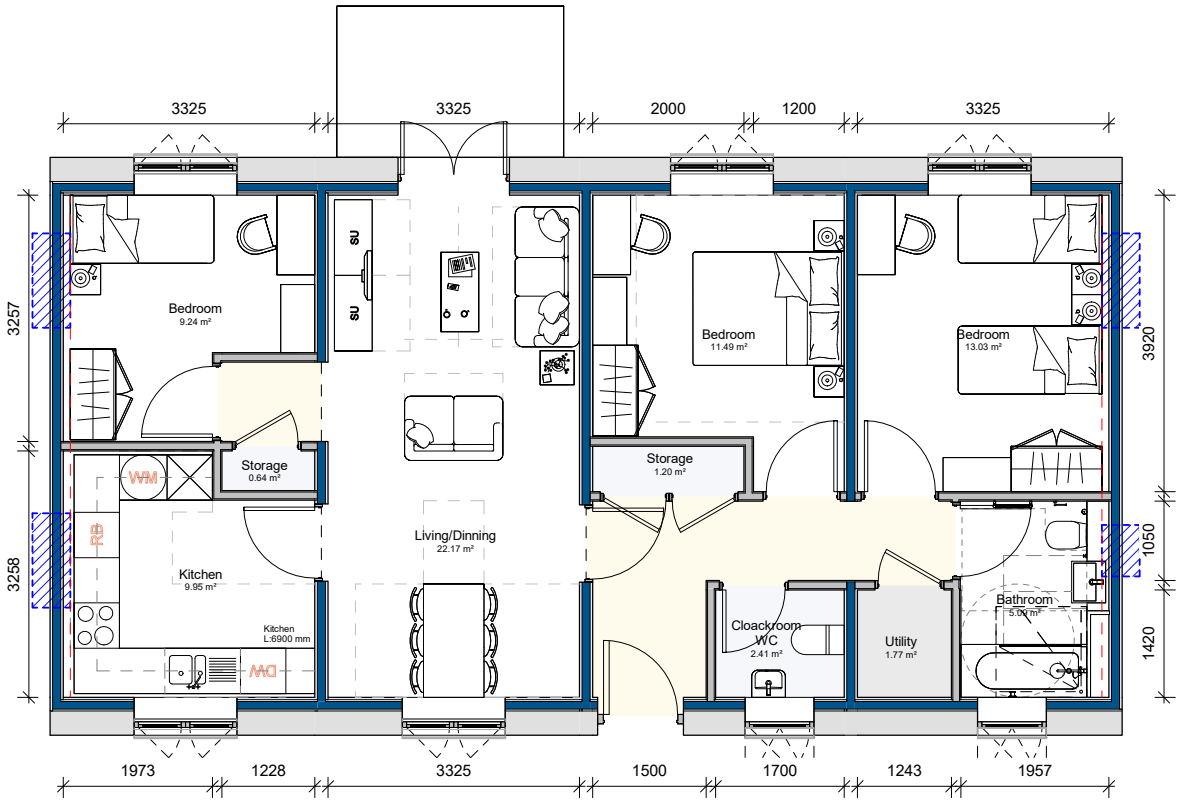
**Type:**
2b4p

**Area:**
GIA: 80.0 sqm
KLD: 33.2 sqm
Storage: 4.1 sqm (allowance for 0.5 sqm within services cupboard as stated in NDSS)

**London Plan Best Practice Target 2b4p:**
GIA: 77 sqm
KLD: 27 sqm (2p4p)
Storage: 2.5 sqm (2 sqm NDSS/London Plan)



# Apartment Type 05e




1/06 05e - 3b5p
1 : 50@A1

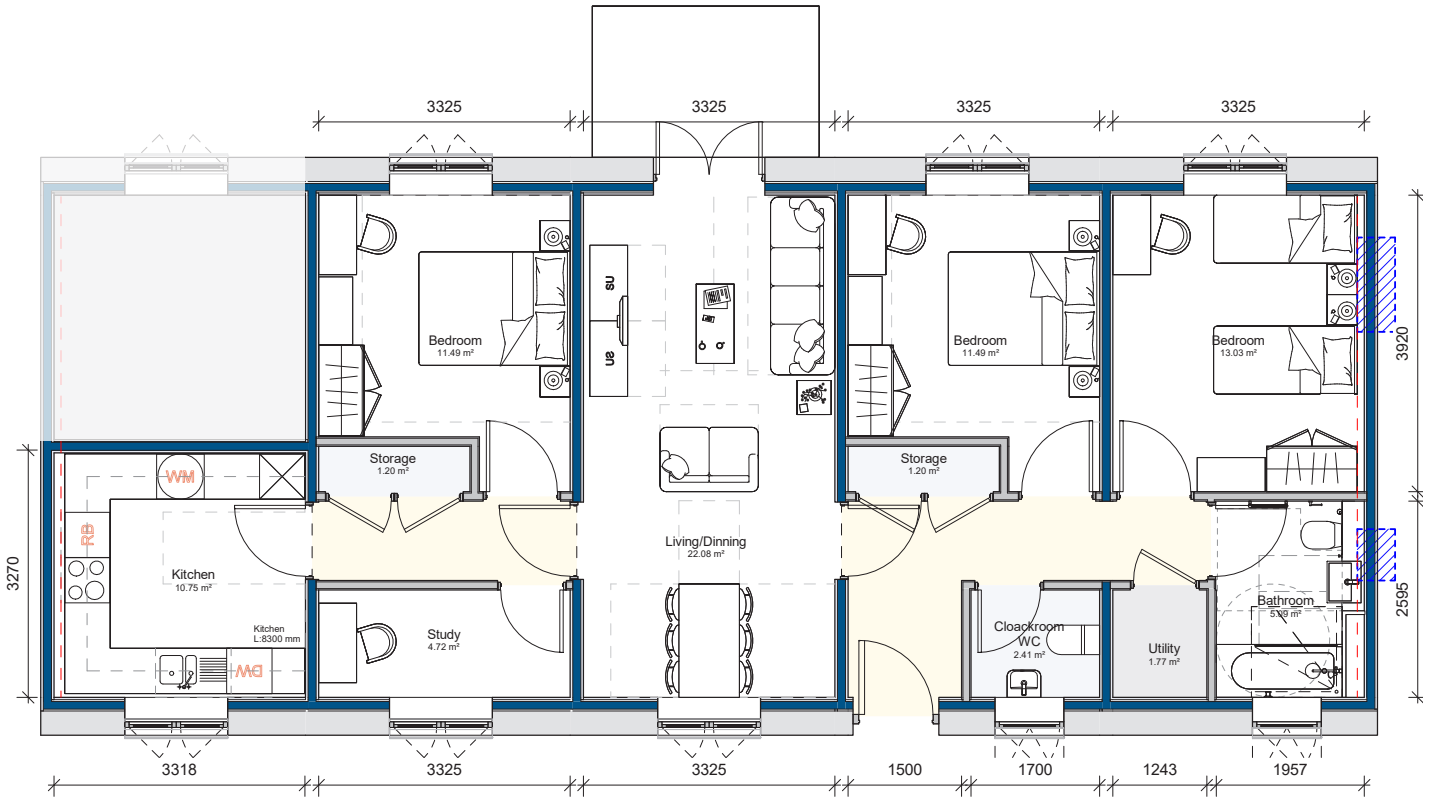
**Type:**
3b5p

**Area:**
GIA: 91.8 sqm
KLD: 32.4 sqm
Storage: 4.8 sqm (allowance for 0.5 sqm within services cupboard as stated in NDSS)

**London Plan Best Practice Target 3b5p:**
GIA: 97 sqm
KLD: 29 sqm (3b5p)
Storage: 3sqm (2.5 sqm NDSS/London Plan)

| | |
|---|---|
| DW | Dishwasher |
| WM | Washing machine |
| RB | Recycle bin |
| | Circulation |
| | Utility |
| | Storage |
| | Alternative Window |

# Apartment Type 05f

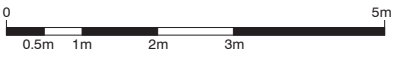



2 / 06 05f - 3b6p
1 : 50@A1

**Type:**
3b6p

**Area:**
GIA: 103.2 sqm
KLD: 33.2 sqm
Storage: 5.3 sqm (allowance for 0.5 sqm within services cupboard as stated in NDSS)

**London Plan Best Practice Target 3b6p:**
GIA: 107 sqm
KLD: 31 sqm (4b6p)
Storage: 3 sqm (2.5 sqm NDSS/London Plan)



# Example Apartment Floorplate Layouts

# Appendix A - Typical Building Elements

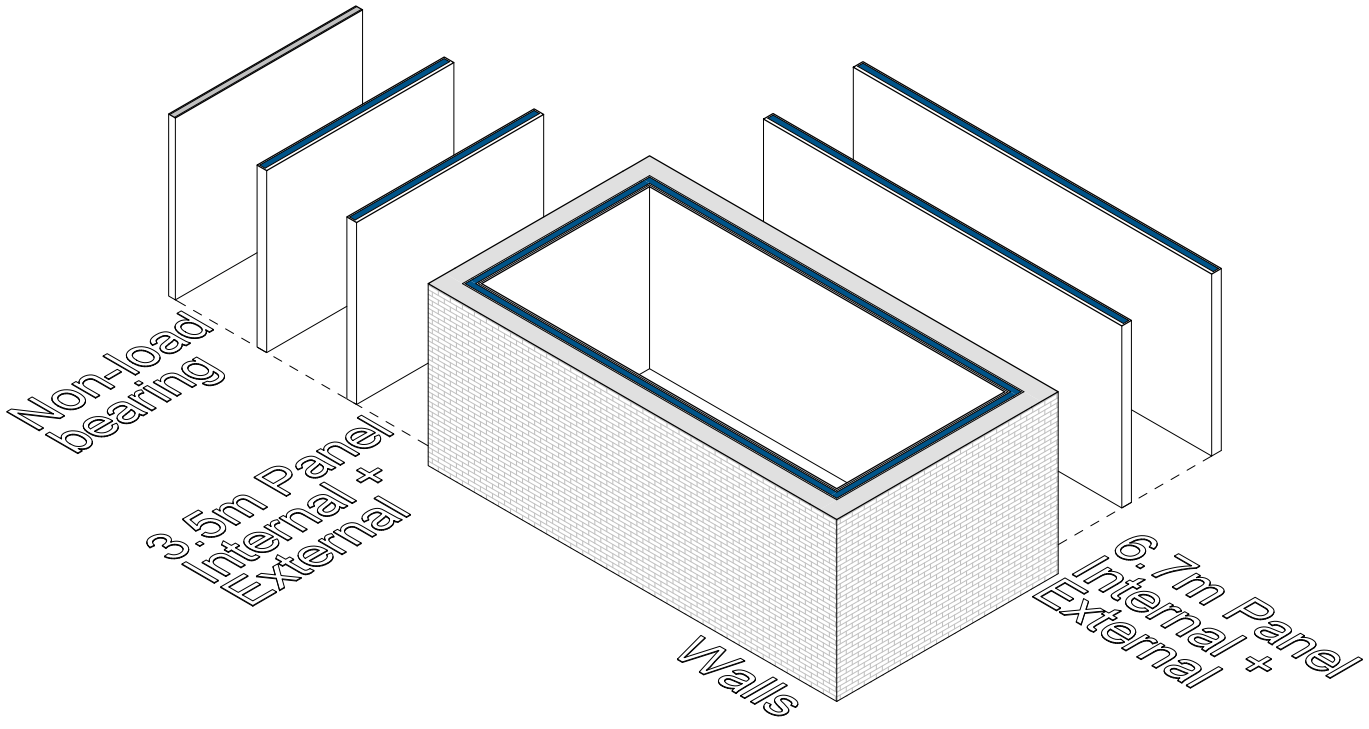
# Building Elements

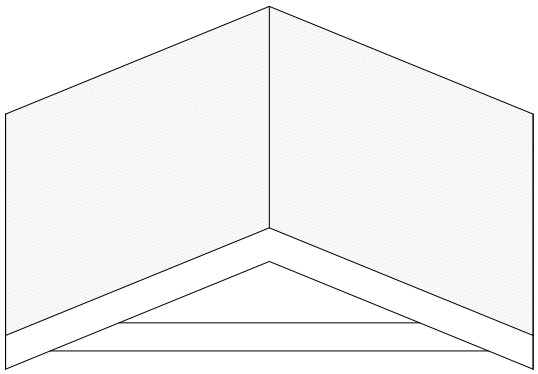
The pattern book layouts set out in the preceding pages have been designed around a suite of standard components that will allow for efficient manufacture and assembly, and an economy of scale.

Over the following pages we examine each of these building elements in more detail. The intention is that each can be supplied in several ways to allow a range of manufacturers to deliver the homes, or even to diversify the supply chain within an individual development.

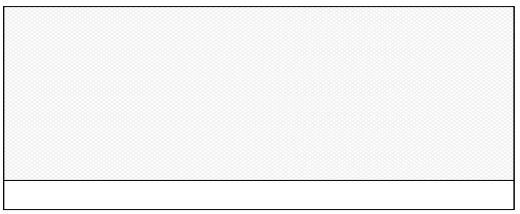
These consist of the following elements:

- internal and external wall, floor and flat roof panels
- pitched roof panels and trusses
- decorative external cornicing or coping
- internal doors
- external porches or canopies
- external doors
- external windows
- stairs

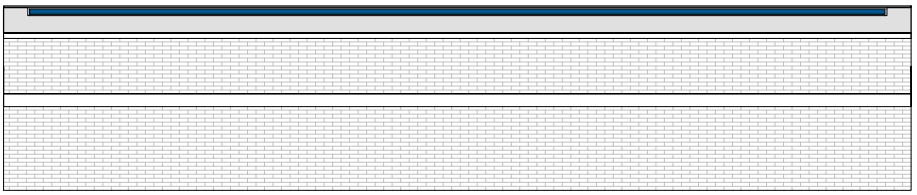




Roofs

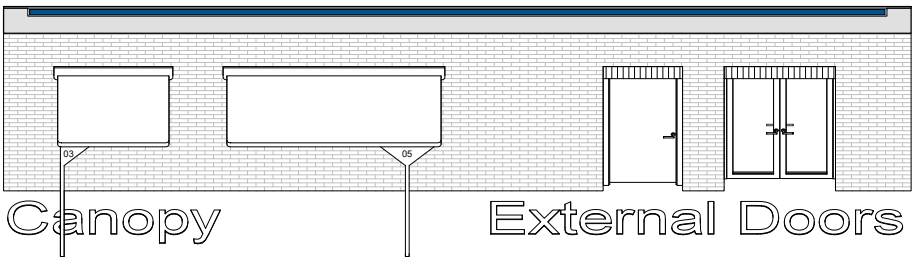


Floors



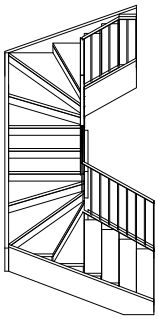
Cornicing/Copings

Internal Doors




Canopy

External Doors

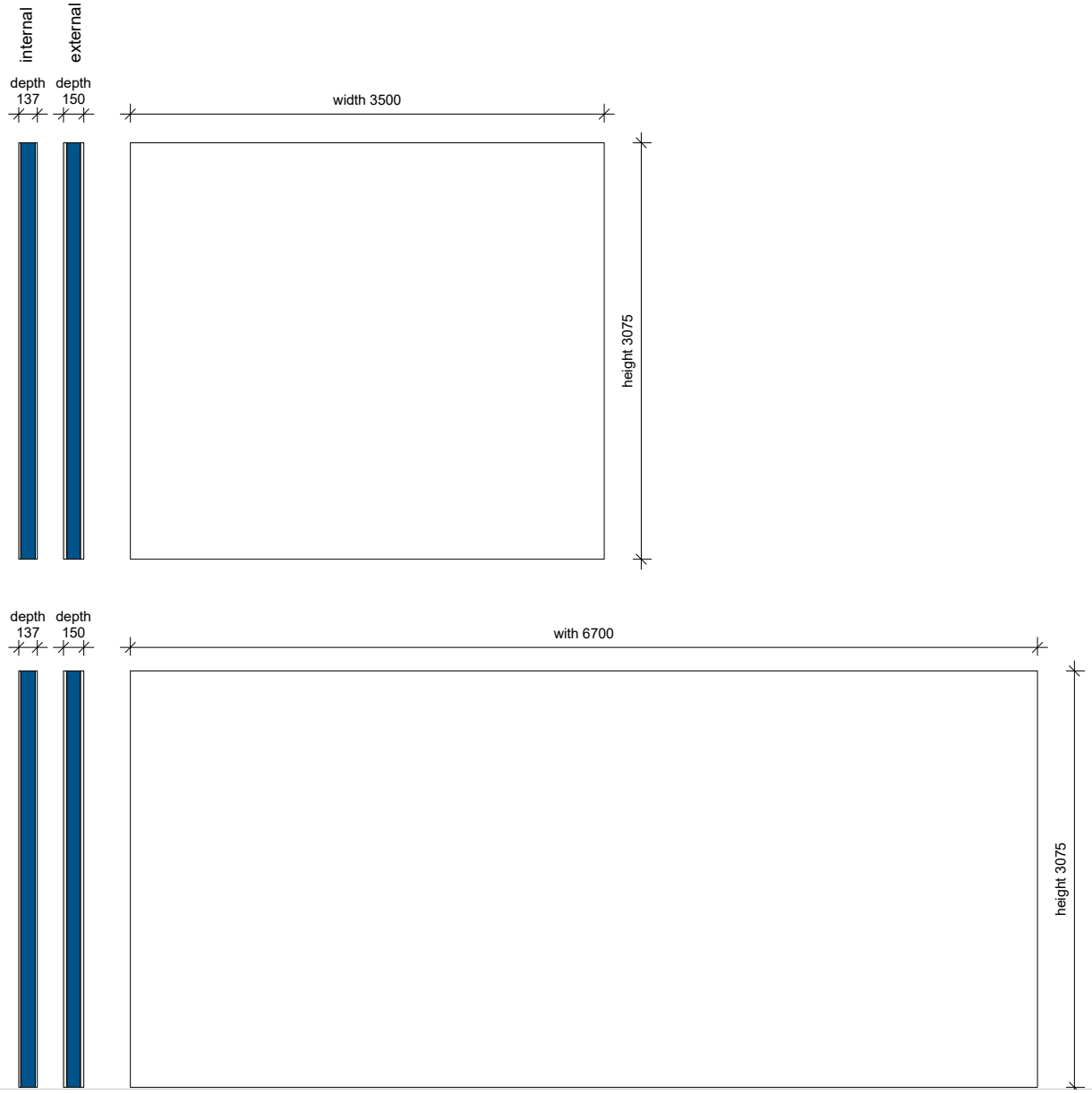


Stair

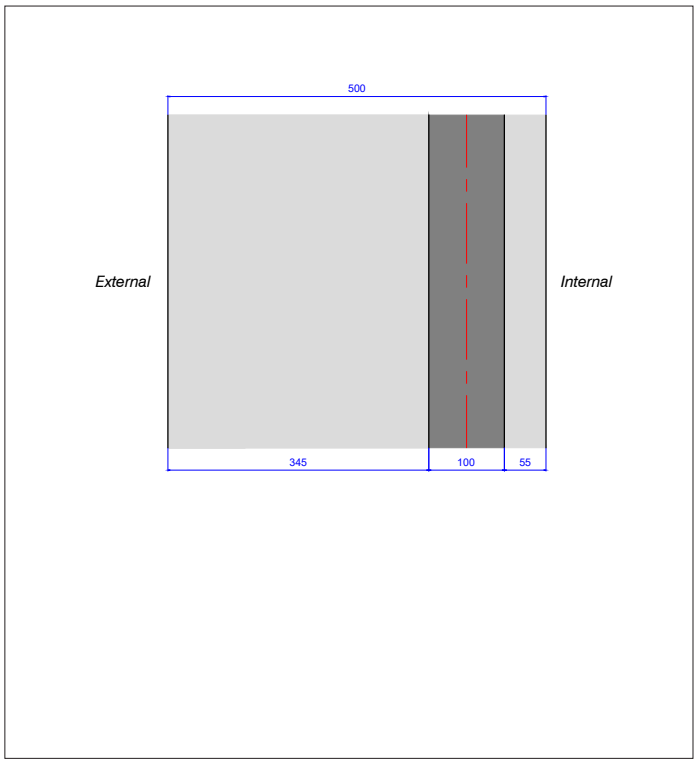
Windows

# Panels

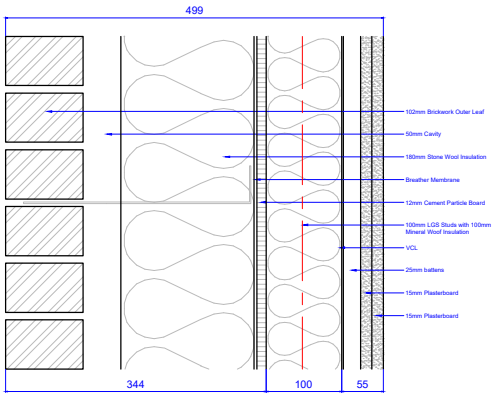
2 types of panels: external and internal
(between two dwellings)



# External Wall - Passivhaus

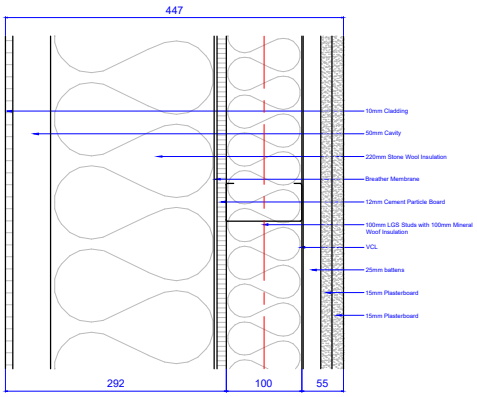



**WT01 - External Wall - Brick**



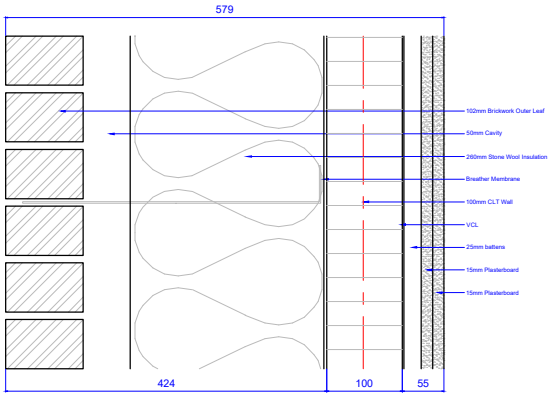

**Target U-Value - 0.12 W/m2K**

**WT02 - External Wall - Cladding**



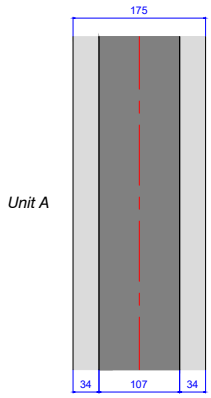

**Target U-Value - 0.12 W/m2K**

**WT03 - External Wall - CLT**




**Target U-Value - 0.12 W/m2K**

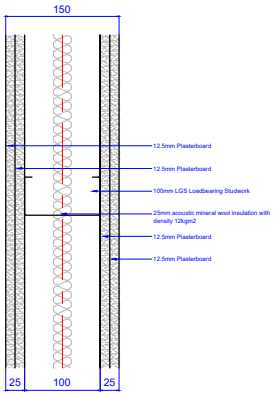
# Load Bearing Compartment Wall




Notes:

- Overall allowance based on Timber Stud with additional tolerance - as the wider option
- Would accommodate both LGS and Timber Stud construction.
- Would not accommodate CLT construction - additional 91mm width required.

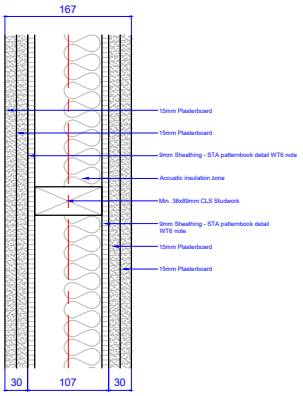
**Assumed Loadbearing Compartment Wall - LGS**




Notes:

- Based on DLUHC - Typical non-loadbearing Partitions for use in dwellings (<11m, compartment/separating Walls) 60 min REI - LGS
- Based on British Gypsum A206198 (EN) and MCC product database
- LGS element increased to 100mm to become a typical size capable of being loadbearing
- All plasterboard penetrations to be sealed for fire and air tightness

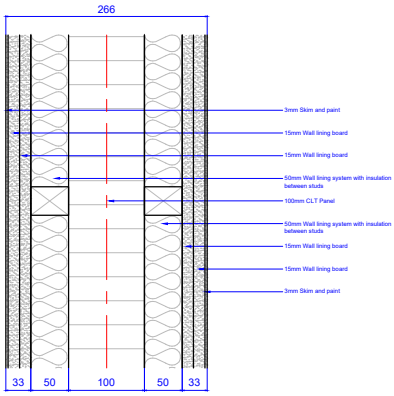
**Loadbearing Compartment Wall - Timber**




Notes:

- Based on DLUHC - Typical non-loadbearing Partitions for use in dwellings (<11m, compartment/separating Walls) 60 min REI - Timber
- Incorporating note - *STA patternbook detail WT6, a variation of this partition can also be used as a loadbearing partition with the addition of 9mm sheathing board to one of both sides of the frame,*
- All plasterboard penetrations to be sealed for fire and air tightness

**Assumed Loadbearing Compartment Wall - CLT**

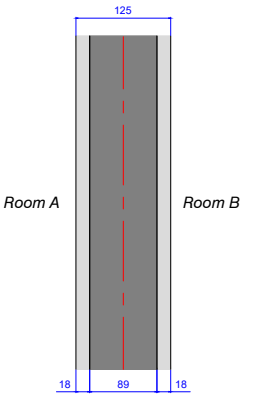



Notes:

- Linings based on New Model Building - NMB - IW-01-A
- 100mm CLT panel based in DLUHC average structural frame depth
- All plasterboard penetrations to be sealed for fire and air tightness

# Internal Wall

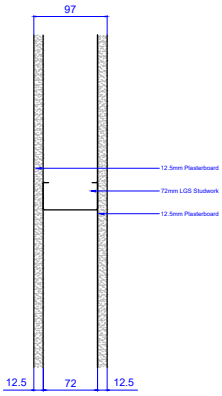
**Internal Partition Wall (non-Load Bearing)**




Notes:

- Overall allowance based on Timber Stud with additional tolerance - as the wider option
- Would accommodate both LGS and Timber Stud construction.
- Would not accommodate CLT construction - additional 47mm width required.

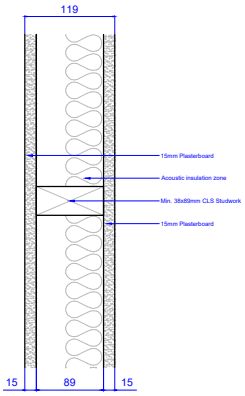
**Internal Partition Wall - LGS**




Notes:

- Based on DLUHC - Typical non-loadbearing Internal Partitions for use in dwellings (<11m, non-compartment/) 30 min REI - LGS
- Based on British Gypsum A206164 (EN) and MCC product database
- All plasterboard penetrations to be sealed for fire and air tightness

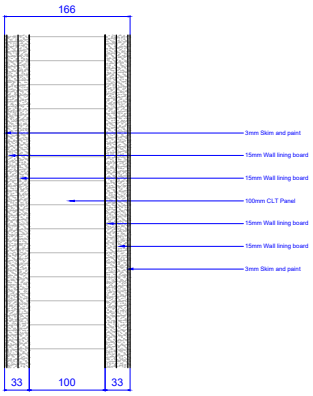
**Internal Partition Wall - LGS**




Notes:

- Based on DLUHC - Typical non-loadbearing Internal Partitions for use in dwellings (<11m, non-compartment/) 30 min REI - LGS
- All plasterboard penetrations to be sealed for fire and air tightness

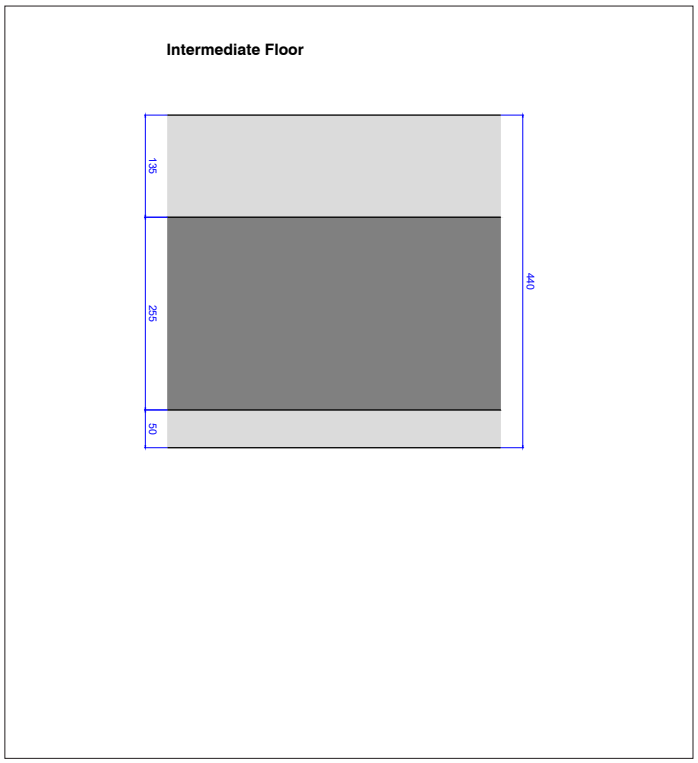
**Internal Partition Wall - CLT**

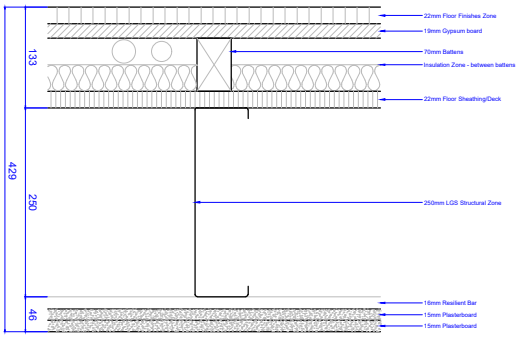


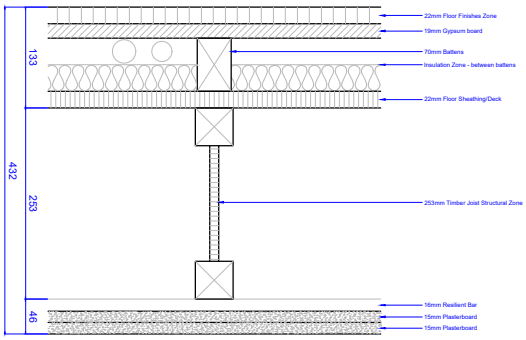

Notes:

- Linings based on New Model Building - NMB - IW-02-A
- 100mm CLT panel based in DLUHC average structural frame depth
- All plasterboard penetrations to be sealed for fire and air tightness

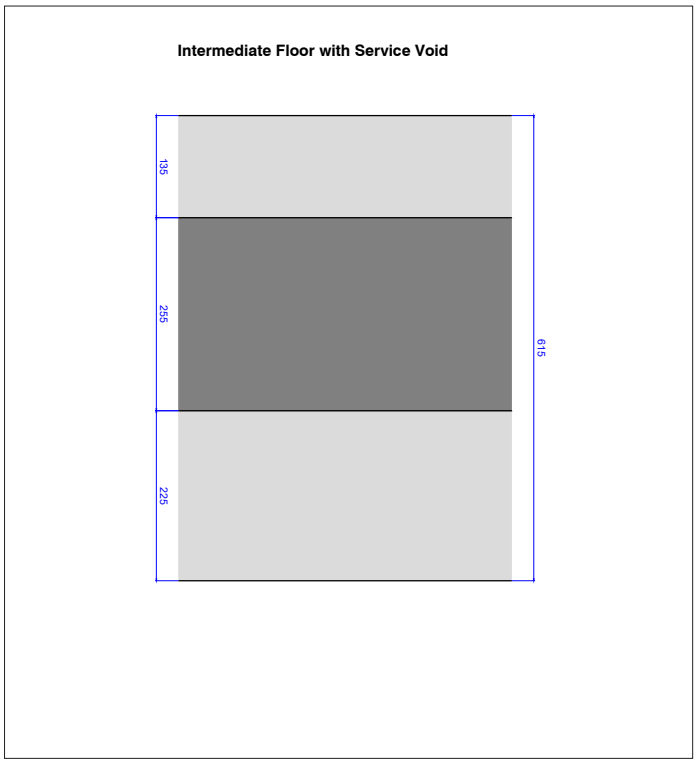
# Intermediate Floor

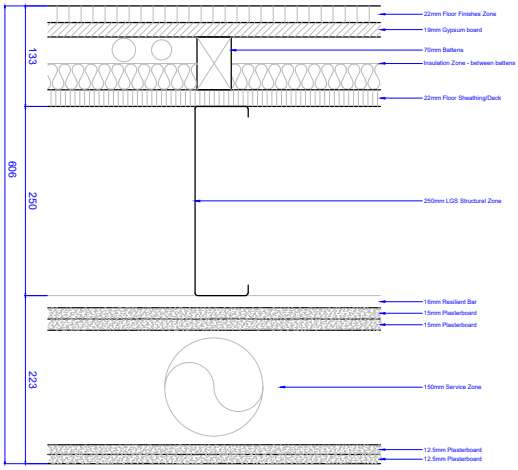


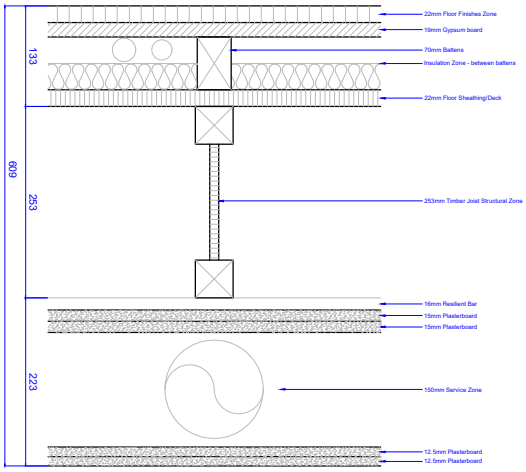



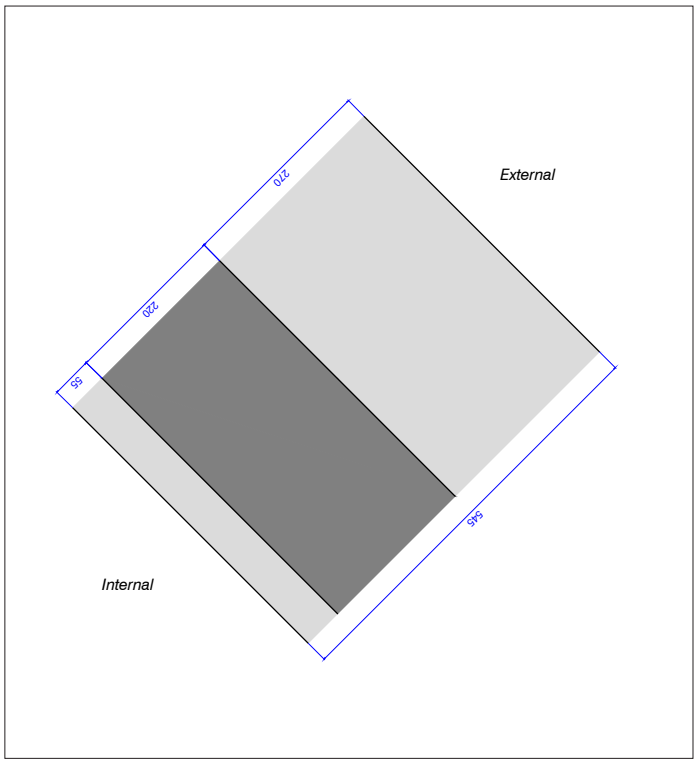
# Intermediate Floor with Service Zone

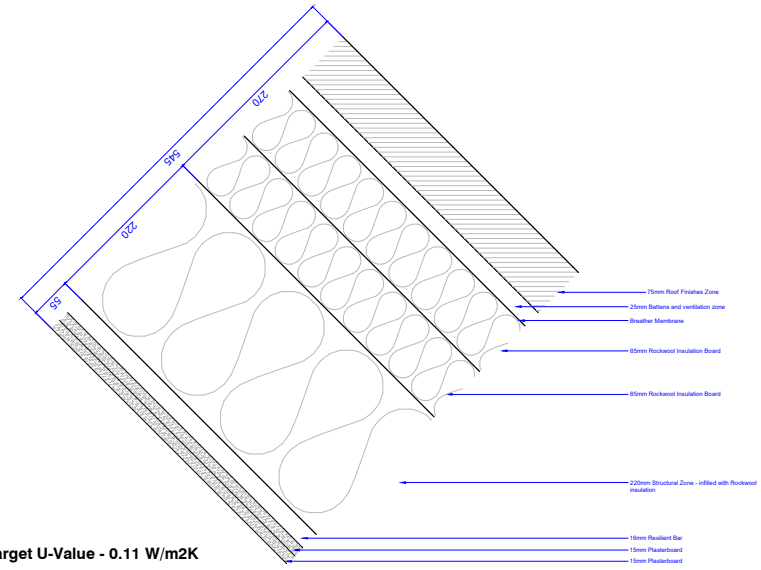


# Pitched Roof



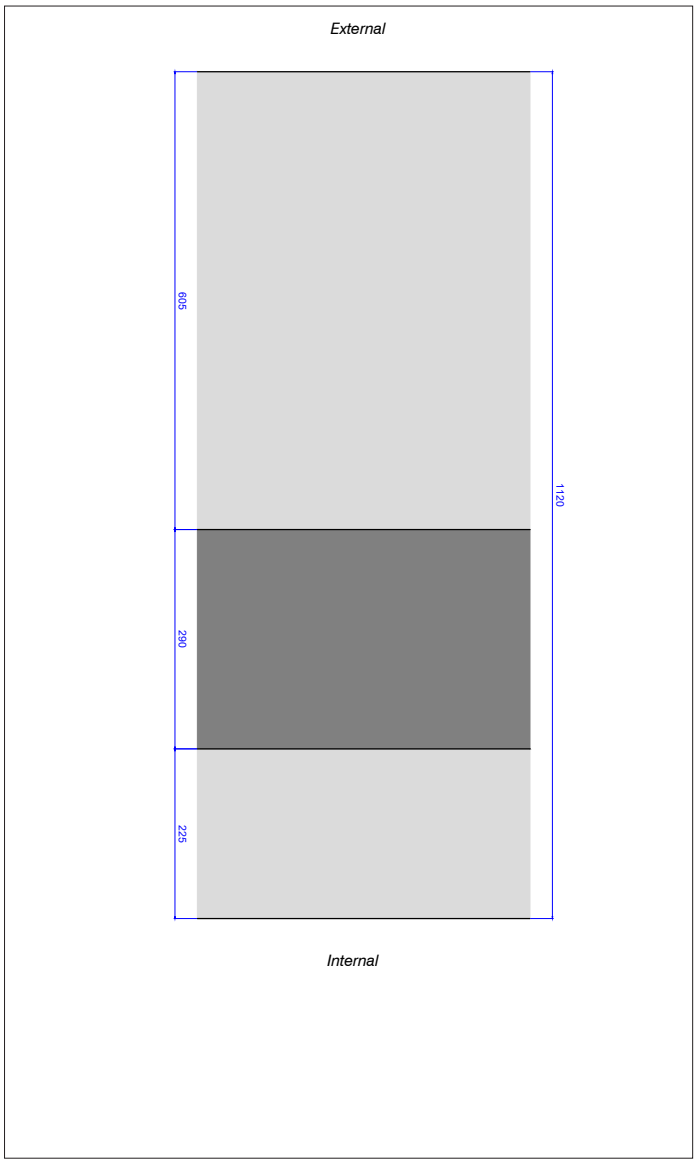



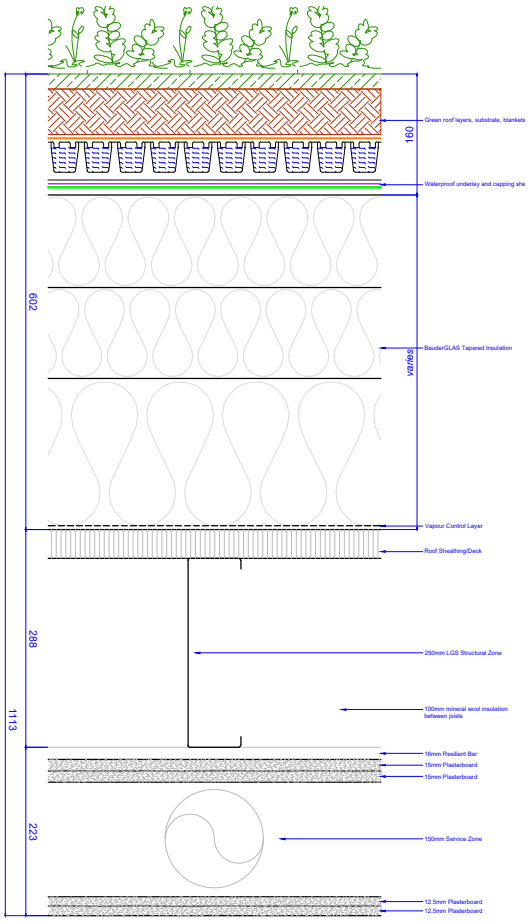

**Target U-Value - 0.11 W/m2K**

Notes:

- 30-45 degrees

# Flat Roof



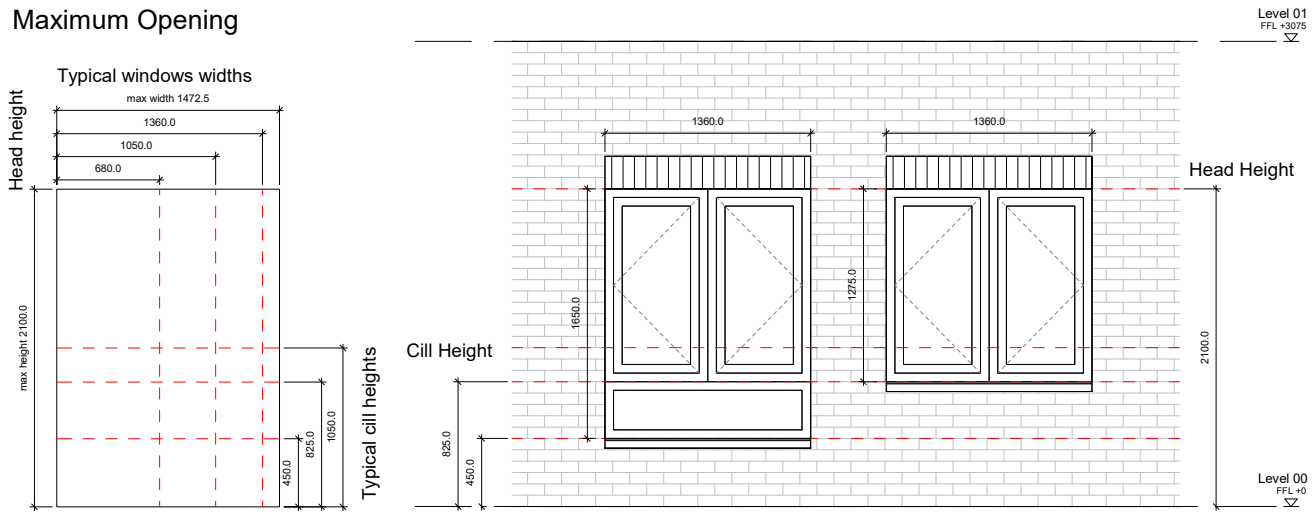

**Target U-Value - 0.11 W/m2K**

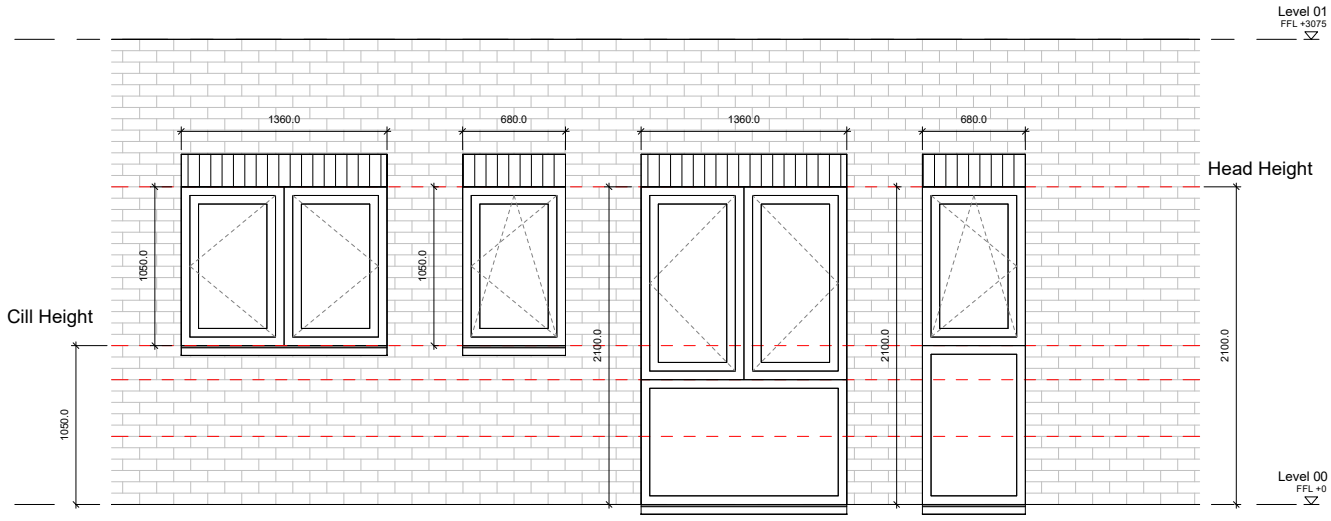
Notes:

# Windows

A maximum opening has been set out based on typical window sizes. We have identified five standard window types to use across the various dwellings. All are set out to brick dimensions, although we recognise that other cladding materials might be used and that other windows options could be developed within the maximum opening parameters set out below.

The typical elevations included here show baseline options for window openings, however it is important to note that a review of windows and glazing percentages will need to be carried on a site by site basis to meet Passivhaus and/or Building Regulations Approved Documents O (overheating) and K (protection from falling, collision and impact) and LETI targets. This pattern book should not be strictly interpreted without ensuring compliance with these requirements on a case-by-case basis.



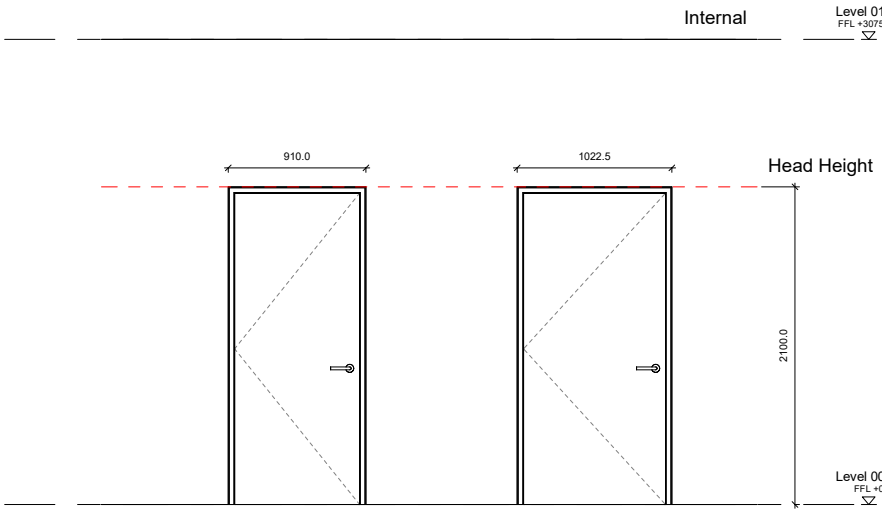



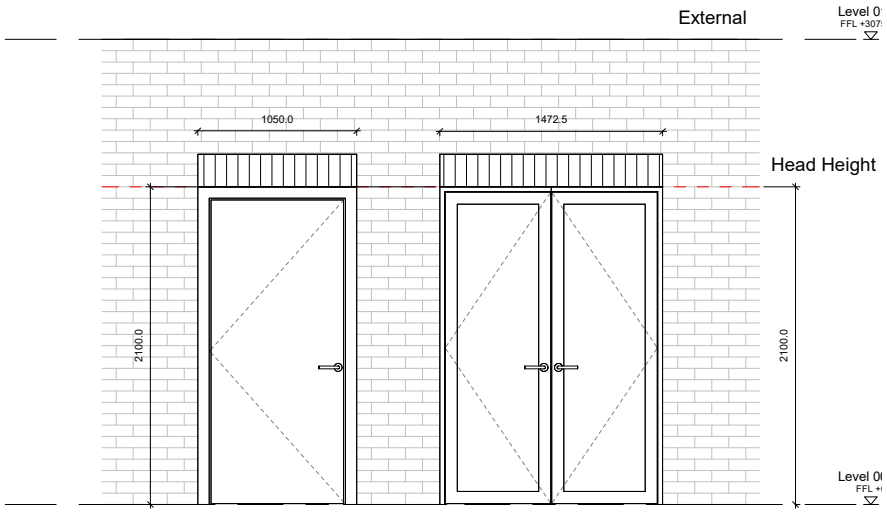
# Doors

To meet Ealing's briefing requirements, all new dwellings must be constructed to Building Regulations Part M4(2) accessibility standards, and some will also need to be meet the requirements of M4(3). As such, the pattern book proposes three doors widths for the five door types identified below:

- 1472.5mm for external doors
- 1022.5mm for internal doors
- 910mm for doors to cloak rooms or storage areas

Door and frame widths impact effective clear widths so measurements that fall below this must be checked again effective clear widths from Approved Document B once a specific product is selected.

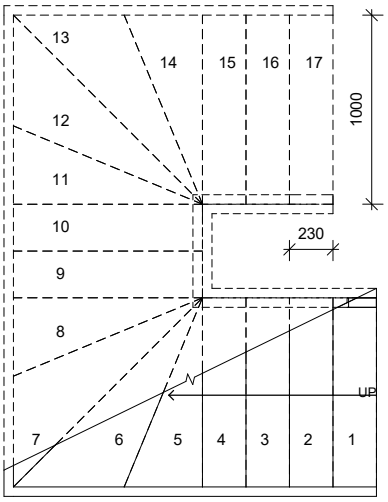


# Stair

Every dwelling type is designed to use a single stair type, with the dimensions set out on the drawing to the right.

This is designed as a private stair under the definition established by Building Regulations Approved Document K, with a rise of between 150 - 220 mm and a going of 220 - 300mm. Designers should ensure compliance with the Regulations as these dimensions will vary depending upon the modular type employed.



# Canopy

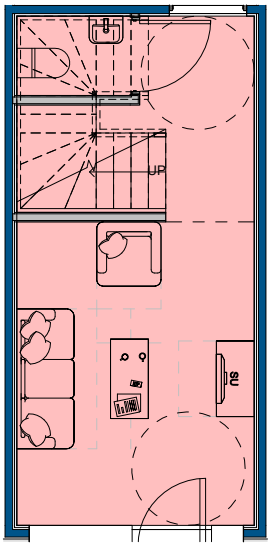
- Slender column with fanned top for house number placement
- Slim folded metal canopy tied back to structure and supported by column

# Appendix B - Repeating Modules

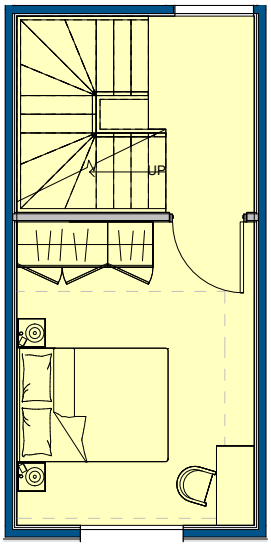
# Repeating Modules

Internal layouts within the structural module have been developed to maximize repetition, for example the same stair is used in all the dwelling types. Bathrooms, bedrooms and kitchens are consistent where possible.

The illustration below shows each of the standard modules we have designed, which can be assembled in a range of configurations to achieve the various standard house types set out in the House and Apartment typology pages.




1/10 Module 1
1 : 50@A1




2/10 Module 2
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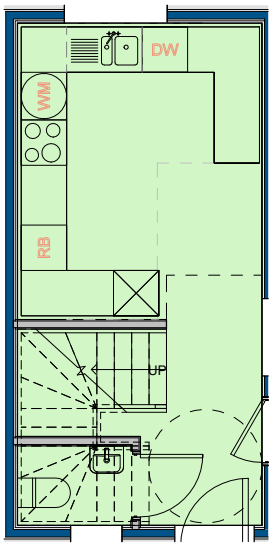


3/10 Module 3
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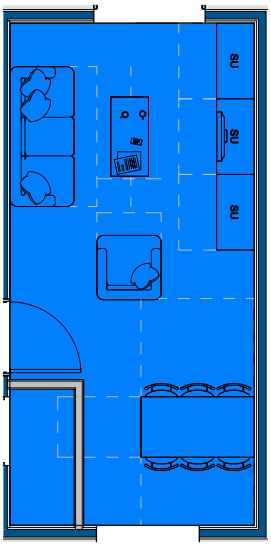


4/10 Module 4
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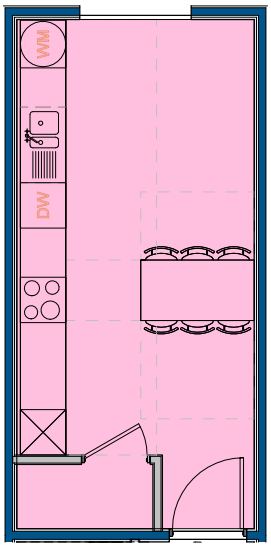


5/10 Module 5
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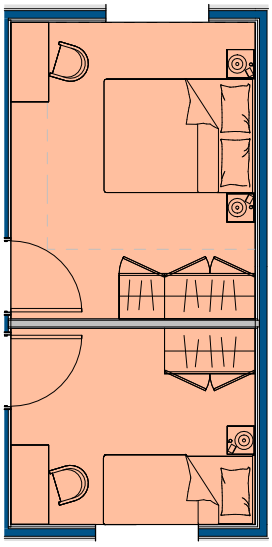

6/10 Module 6
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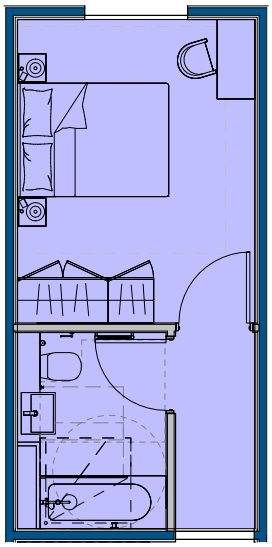

7/10 Module 7
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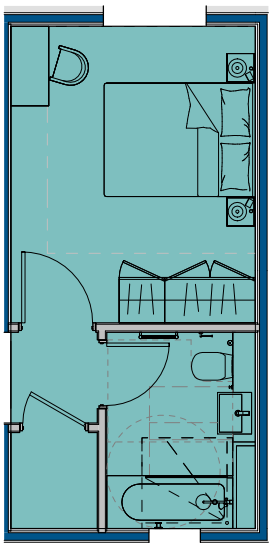
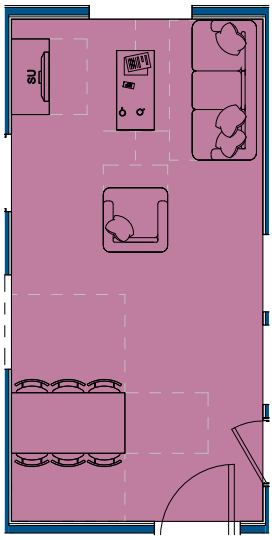


8/10 Module 8
1 : 50@A1




9/10 Module 9
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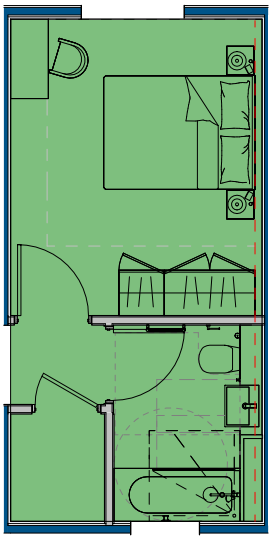

10/10 Module 10
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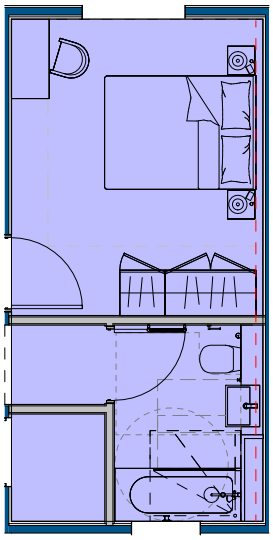

11/10 Module 11
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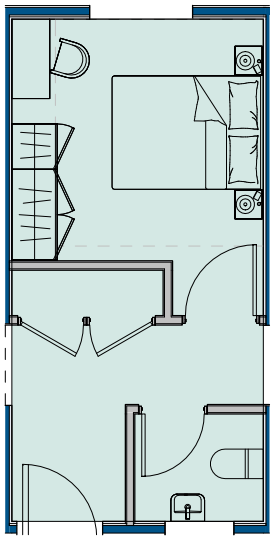

12/10 Module 12
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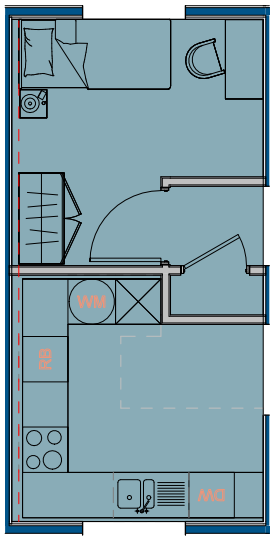


13/10 Module 13
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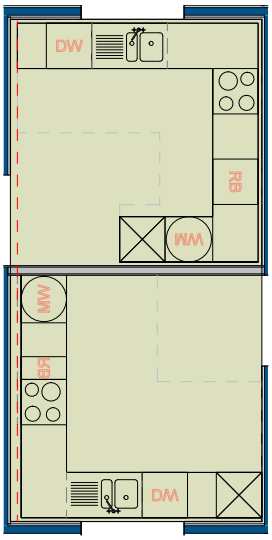



14/10 Module 14
1 : 50@A1

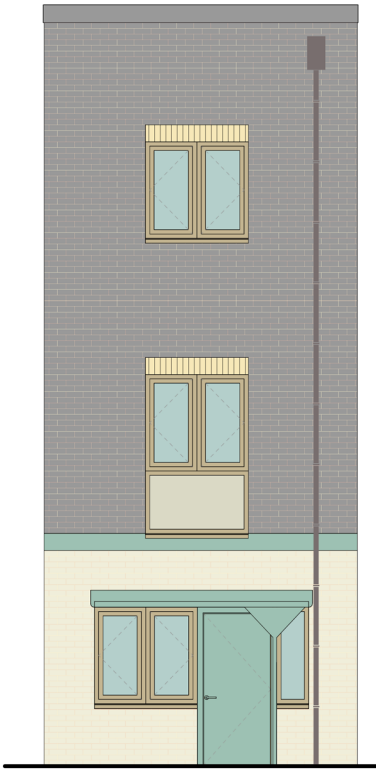
# Appendix C - Façade Development

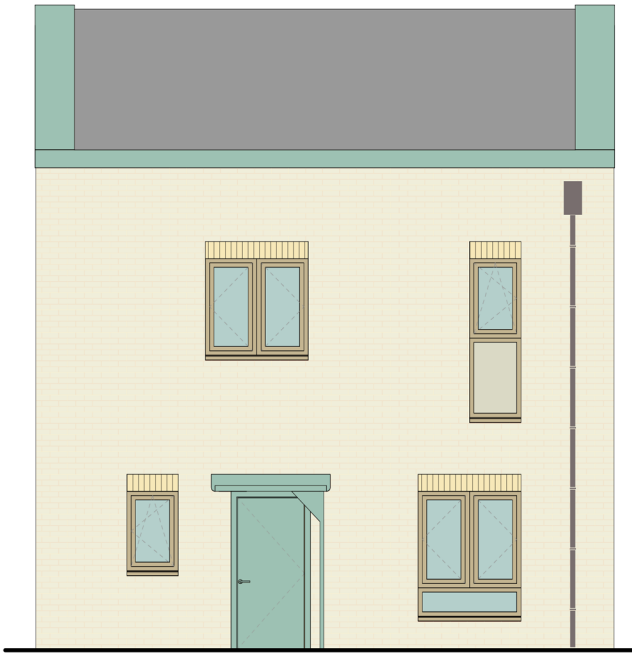
# Elevation Examples

Based on the Façade rules set out in the document and the typologies developed, a series of Façade examples have been developed to illustrate the flexibility of the system set out in the pattern book.

Colours are illustrative, these need to be developed through closer material selection as a contextual response.

| light | dark | accent |
|---|---|---|
| base | upper floor or roof | distinctive elements |





light

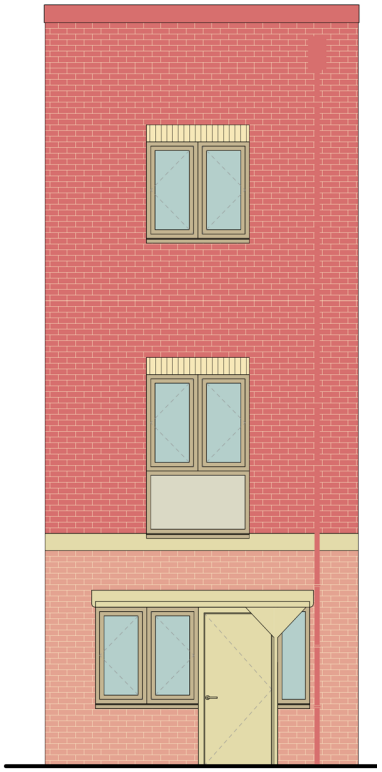
base

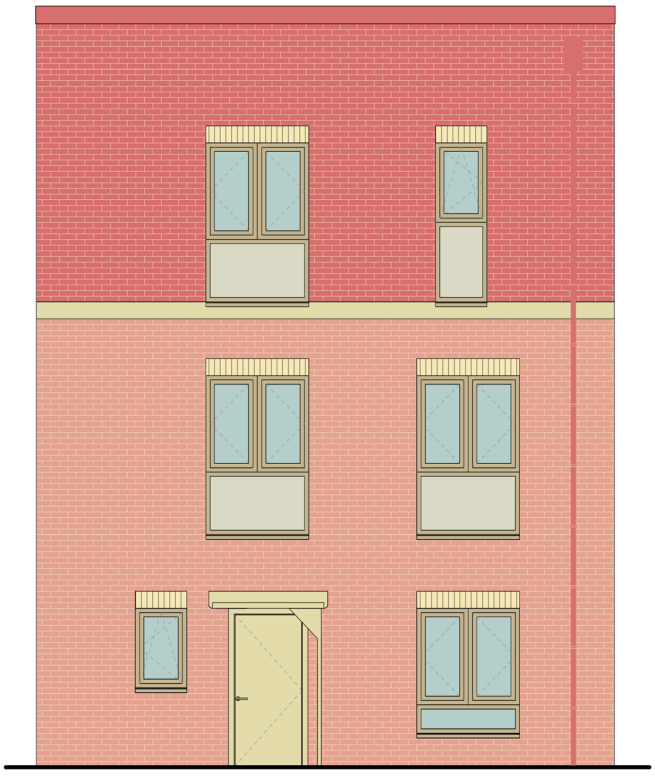
dark

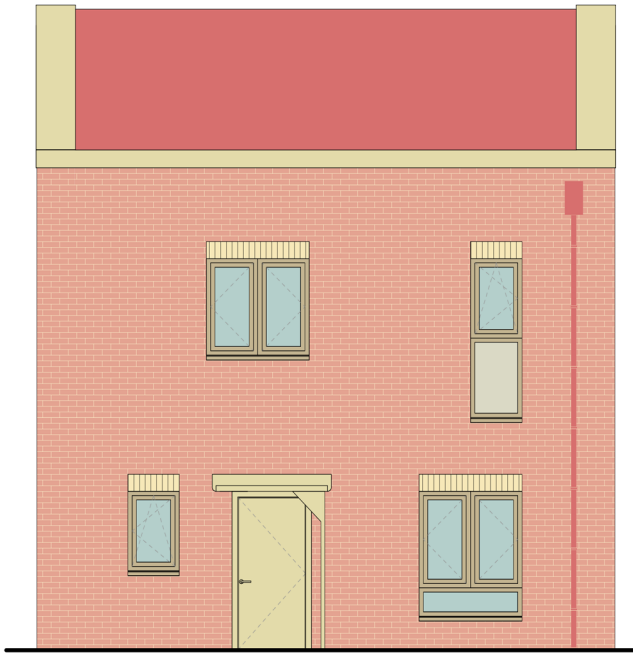
upper floor or roof

accent

distinctive elements







# Stone Brick Pricing

GROUPWORK have been championing the use of stone brick in the architectural industry. The prices and companies below are from a LinkedIn post by Amin Taha in July 2023. The information needs updating but it should give an an indication of the cost of stone brick against traditional brick and the suppliers that can be contacted for further information.

**Albion Stone** (£2.00/brick – white and buff/dark cream... rough split face)
Michael Poultney mjp@albionstone.com
01737 771772

**Germans Balague** (£0.65-£1.50 – white, cream, red, grey, charcoal....clean cut, polished or rough split)
Lliorence Balague llorencbv@germansbalague.com
+34 973 150 603 – 666 40 14 56

**AteliersRomeo** (£1.00-£2.00 - white, red/brown, orange/brown, dark red/brown and red/pink...anything desired, clean cut, polished or rough split face)
Nicolas Dubois dubois@ateliers-romeo.com
+39 327 909 98 56

**Carrieres du Hainaut** (£0.80/brick – grey/Belgium blue and "Bath Stone"...dense stone very clean cut, polished or rough split face)
Jan Devroey J.Devroey@carrieresduhainaut.com
+32 (0)67 34 78 22

Hutton Stone (£1.00/brick - buff/dark cream and other colours on request... sandstone granular appearance and rough split face)
Marcus Paine marcus@huttonstone.co.uk
01289 386056

**Franken-Schotter GmbH&Co.KG** (£1.00/brick – white, buff/dark cream and other colours on request...very clean cut and dense with a polished appearance or rough split face)
Jonah Wurzer-Kinsler j.wurzer-kinsler@franken-schotter.de
+49 9142802-412 +49 160 3616537

**Polycor** (£1.90/brick – buff/dark cream... very precisely clean cut, dense and gentle granular texture)
Valérie Bergeron Valerie.Bergeron@polycor.com
+33 (0) 7 86 72 41 03

# Appendix D - Methodology and Brief

# Methodology

## Developing a Pattern Book

Based on our previous experience in delivering new homes and temporary accommodation using modern methods of construction, we have devised an approach to this project which mitigates the impact of failures within the supply chain through the adoption of a “system agnostic” design which can accommodate multiple system types and procurement methods. This page describes the steps we went through to reach this conclusion.

Our research has included reference to useful information from a number of sources, including:

- Social Rent Housing At Pace: The MMC Playbook by the Housing Festival
- DLUHC Digital Kit of Parts
- WikiHouse
- New Model Building Guide by Waugh Thistleton Architects
- How to Build a Passivhaus: Rules of Thumb by the Passivhaus Trust

Next, we analysed the sites we located during Part 0 of the project, and defined a series of typologies using the building elements developed.

Finally, we undertook soft-market testing with a range of suppliers and manufacturers to ensure that our proposals could be delivered using different systems and MMC delivery methods. This iterative process resulted in a robust set of typologies that we believe can be used cross a variety of small sites across Ealing and west London.

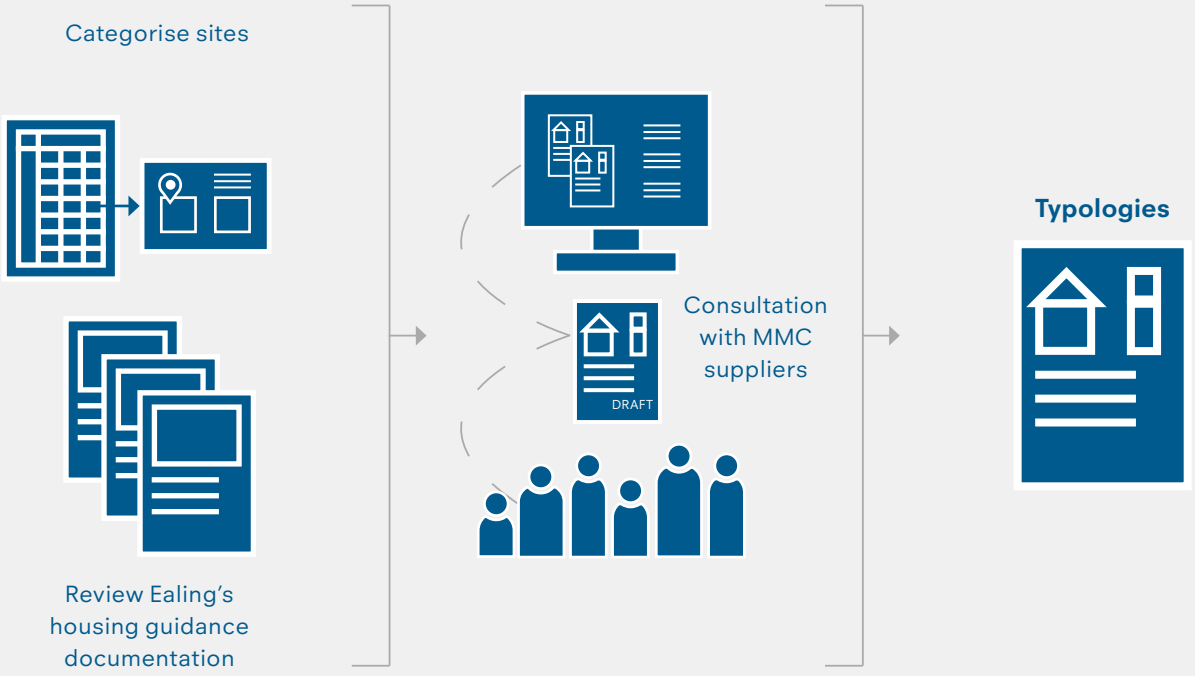

**[Figure 1]**

Methodology diagram showing the process we developed to develop the Pattern Book.

Define the housing typologies

Undertake soft-market testing

Create pattern book



# Employer's Requirements

## Brief for Typology Design

Below we have set out elements of the brief that were considered during the development of the Pattern Book and the resulting typologies. We recommend that Ealing carries out an internal exercise updating their existing residential ERs and integrating the items below when procuring new homes via the MMC route, using this Pattern Book.

**Relevant Guidance and Standards**

- The Nationally Described Space Standards NDSS
- The London Plan
- Small Site Design Codes LPG
- Housing Design Standards LPG
- London Borough of Ealing Local Plan
- London Borough of Ealing, Broadway Living Development Guide 2021
- London Borough of Ealing Housing Design Guidance B Report
- London Borough of Ealing Character Study A2 Report
- Homes For Londoners: Affordable Homes Programme 2021-2026 Funding Guidance

**Tenure and Dwelling size**

- Tenure blind
- Space standards apply to affordable and temporary accommodation
- Dwelling sizes target Best Practice set out in the Housing Design Standards LPG
- Dwelling types:
  - Flats:
    1b1p, 1b2p
    2b3p, 2b4p
    3b5p, 3b6p
  - Houses
    2b3p, 2b4p
    3b5p, 3b6p
    4b6p, 4b8p, 4b8p
    5b6p, 5b7p, 5b8p

**Floor to Ceiling Height**

A minimum ceiling height of 2.5m is required for at least 75 per cent of the gross internal area (GIA)

**Inclusive Design**

- All new homes should meet M4(2) standards and some should meet M4(3) standards
- Where step-free access cannot be achieved, ground floor homes should still meet these standards

**Building Safety/Fire**

- Modular systems will not be used for high-risk buildings (HRB) under the Building Safety Act
- Affordable Homes Programme funding requirements:
  - Automatic Fire Suppression System required
  - Evacuation lift required
  - No combustible materials in the external walls, regardless of height.
- Consideration needs to be given to the possibility that the HRB height will be lowered to 11m + in a couple of years' time
- If 11m +firefighting lift to be included in anticipation of the change noted above
- Fire compliance for some of the typologies will require fire engineered solution and CFD modelling.

**Sustainability**

- Ealing Council requires all new buildings should target zero carbon on site by 2025, with a maximum carbon offset payment of 30%. By 2030, it aims to meet the definition of net zero carbon in line with the RIBA, The London Energy Transformation Initiative (LETI) and the UK Green

Building Council (UKGBC).

- This definition is formed of two key components: Operational carbon and embodied carbon (see
- objective 1.3).
- U-values:
  - Wall, roof and floor: 0.10 W/m2 K to 0.15 W/m2 K
  - Windows: 0.80W/m2 K or less. Likely to be achieved with triple glazing only.

Other targets include:

- Form factor values between <0.8 - 1.2 are considered best practice.
- A total glazing ratio between 15- 40% are considered best practice.
- Preference for dual aspect homes, to enhance cross ventilation and support overheating risk mitigation.
- Incorporate Mechanical Ventilation with Heat Recovery (MVHR), and Waste Water Heat Recovery (WWHR) to reclaim waste heat from both space and hot water heating systems.
- Develop a whole building airtightness strategy, and seek to limit Façade air leakage to < 1 m3/h/m2 at 50Pa.
- Ensure that space heating and hot water generation are fossil fuel free.
- Consider how to include energy storage options such as PV cell related water cylinders.
- Design and choose materials to limit embodied carbon. Ensure 30% are from re-used sources, perhaps including existing materials from the site.
- Design 'light' structures. Substructures and superstructures account for 57% of small scale housing embodied carbon.
- Choose local materials where possible and seek to limit carbon associated with transportation of materials from extraction to manufacturing to project site.
- Specify 50% of project materials that can be re-used at the end of the building life.

For further information see London Borough of Ealing Housing Design Guidance B Report.

**Landscape**

- Meet or exceed an Urban Greening Factor of 0.3 for major schemes and small sites.
- Private outside space targets per dwelling might be relaxed for temporary accommodation proposals.

**Character**

- Typology to be developed for Ealing/ West London house style. Provide a range of interchangeable façades to work with varying context.
- See section xx for more details

# Employer's Requirements

## MMC Parameters

A set of assumptions have also been made in relation to the usage of MMC, these are outlined below:

**General**

System agnostic typology that can be delivered to the council's specification by a range of providers rather than relying on proprietary designs or a single supplier.

**Delivery:**

- Challenges of MMC usually occur through the delivery process, either from issues of procurement, manufacturing or construction processes. A methodology for delivery for each typology will be critical for Ealing to develop .
- Typologies will be developed for direct-delivery sites.
- Ealing will need to build in a quality control approach with monthly factory visits during the manufacturing process (lessons learned from other MMC developments).

**Logistics:**

- Logistics of site delivery will need to be considered alongside site categorisation.
  - Street-facing sites suitable for volumetric and/or panellised MMC
  - Back-land sites suitable for panellised
  - Estate intensification requires a masterplan-led approach.

- Typologies designed for delivery as penalised or volumetric. It is assumed that a panellised type will be applicable across all site categories.

**Construction & Procurement:**

- A critical quantum of development with a guaranteed pipeline will be required to encourage MMC contractors to manufacture the Ealing typology.
- The module will need to be standardised and designed to reduce manufacturer-specific systems to safeguard against failure of individual companies.
- Challenge to deliver social value targets as manufacturing facilities geographically remote from point of installation.
- Hybrid approach where panels are manufactured elsewhere and then delivered 'flatpack' for local assembly into volumetric modules and last mile delivery principles can provide training opportunities and up skilling for local people.
- Hub and spoke arrangement where 'cluster' of sites available. Benefits of offsite pre-fabrication but also address issue of social value, where local factory could provide training opportunities to local people and to reinvest in the local economy.

# Employer's Requirements

## Review of Existing ERs

Currently there is very little MMC specific content in the ERs, what is included covers Ealing when contractors propose the introduction of MMC into projects procured for delivery with traditional construction.

Focus is on warranties and insurance which is understandable as this is one of the grey areas in the market. From our engagement with the mmc sector some companies provide NHBC warranties whereas other, particular the MMC manufacturers, opt for BOPASS which appears to be more common in the market at present.

On *'Employer's Requirements MMC Parameters'* we provide a list of content we believe should be included in the ERs under a separate section dedicated to MMC delivery. We recommend that Ealing carries out additional engagement with the MMC sector to refine the necessary MMC content within the residential ERs. This could be done through the LHC instead of specific manufacturers to ensure the impartiality in the feedback.

During our review of the exiting ERs we have also noticed contradictions or areas that need to be reviewed against the requirements of the LPG Housing Design Guidance June 2023, the council Design Guidance Nov 2022 and the brief for the typologies.

**Space Standards:**

We recommend these are updated to follow the best practice guidance used for this project. LPG Housing Design Guidance June 2023.

**Bathrooms:**

Bathroom provision is more onerous in the updated guidance. Things to consider:

- WC in every floor that has a bedroom.
- Provide an additional bathroom or shower room in homes for six or more people.

**Storage:**

Numbers do not align with guidance, needs review. Other areas to consider:

- Provide a utility room in dwellings with two or more bedrooms. Where part of the utility room is contributing to the general storage requirement, the area claimed should be clearly identified.
- Best practice: Provide a dedicated study room in dwellings with three or more bedrooms

**Energy Strategy:**

These targets do not reflect the ambitions outlined in Ealing Housing Design Guidance. U-values and airtightness for example, are below the targets needed to achieve the ambitions to meet Passivhaus standards.

# Appendix E - Manufacturer engagement

# Soft Market Testing

## Part 1

As part of our work we undertook soft market testing with a range of MMC suppliers and manufacturers to gauge interest in our proposals and to obtain feedback on the emerging design proposals.

Our previous recommendations were that the LHC New Homes 3 (NH3) framework was the most suitable route to procuring MMC homes due the flexibility of the framework, the lotting structure and the fact that it had a range of manufacturers, suppliers and main contractors within it. LHC assisted in undertaking this engagement and initiated contact with each of the providers. After this initial contact was made, we held held online meetings with a selection of the providers to talk throught the principles of our work and to obtain feedback on the emerging pattern book homes.

Our enquiries included comments on the design, feasibility, cost and economy of scale; lead-in times, minimum order levels, and any other risks and considerations that we may have missed.

Part 1 of this engagement process was carried out through LHC. Each of the suppliers on the London framework lot were approached and asked for a high level response. The suppliers were told that the client was a London borough that is located north of the River Thames. The name of the architect was also not shared at this point. The suppliers' comments have been colour-coded to provide additional information on the lots they are appointed to on the framework:

**2DP** 2D Panellised Systems
**3DM** 3D Modular Systems (Volumetric)
**MC** Main Contractor

A summary of the comments received from each of the suppliers is as follows:

**2DP Remagin**

Reimagin expressed interest in the project and were pleased to hear about this being a collaborative delivery as this is what they are typically interested in being involved with. They also confirmed that bespoke house types would not be an issue for them, and would welcome the opportunity to see the design when it is available. They had several queries around performance and materials, including the sustainability requirements, whether there would be a PMV metric, and if steel was an acceptable construction material.

**2DP LoCal Homes**

LoCal Homes confirmed interest in the project, and welcomed the opportunity to participate in a collaborative partnership that could deliver bespoke house types to our designs. They have examples of bespoke delivery previously and are comfortable working on sensitive sites that have a lot of inherent complexities. They had several questions regarding the pattern book design, including whether we were considering flats or houses, and whether the client was able to share key drivers for this method of delivery. They also asked whether planning approval has been secured on any of the sites (it has not).

**2DP Donaldson Timber Systems (DTS)**

Donaldon Timber Systems expressed interest in the project and confirmed that the company has completed a large number of homes for private housebuilders and housing associations (including L&Q), delivering standardised housetypes, and therefore has considerable relevant experience and would welcome a collaborative partnership with the council. They had

some questions around performance and material, please see below. DTS had a number of queries about the project, including around the thermal performance of the external envelope, and whether the client would be open (or able) to utilise timber construction.

**3DM/2DP JG Hale**

JG Hale indicated that were interested in this project and would welcome an opportunity to discuss further. It has participated in a collaborative MMC delivery in Wales, where they were one of several manufacturers supplying a standardised house type. They indicated that they would add value to this project and could share insights about their experience with the Welsh scheme. They had several questions about the project, including whether a decision had been made regarding the format of MMC (volumetric or panelised), whether we could share any further dimensional information about the pattern book homes, and how the delivery of the dwellings might be structured.

**3DM Building With Frames (BWF)**

BWF confirmed their interest in the project, however expressed some concerns regarding the client's expectations in terms of procurement: particularly regarding turnover requirements and insurances, as the business has scaled back over the past couple of years. There were further queries around the type of dwellings proposed (ie. houses or flats), how the distribution of manufacturing might be handled, and whether there were any estimated dates for when the projects might come forward. They also indicated that they could arrange a visit for the architect and client to their factory, and that they would also be prepared to build a prototype if required.

**3DM REDS10**

REDS10 welcomed the collaborative approach and indicated that have worked in this way for other clients previously. They confirmed their understanding that the pattern book houses are still being developed, so asked about whether there was a rough timetable for delivery, or if we had an indication of when planning approval might be secured. They also made a recommendation that "lessons learned" sessions should be held during the delivery programme to allow for regular feedback to be incorporated into the delivery of the new homes. REDS10 also added that they are based in London Bridge, so can either host, or attend in person, any meetings that might be required.

**3DM TopHat Communities**

TopHat's interest depends upon some criteria to be met before they would be able to become involved with the project. TopHat is unable to provide bespoke house types for the next five years that fall outside their own catalogue unless the order exceeds 500 homes. TopHat suggested that the design team review their catalogue to see if there was a close match between the two, however, unless there was alignment between the two, given the restrictions set out above they would be unable to assist.

**3DM/MC ZedPods**

ZedPods expressed interest in the project and are on the LHC framework in the capacity of both volumetric and main contractor services and are

interested. They do have a strong design identity within the organisation, and so their queries related mainly to this. Constructing to a bespoke design would not be an issue, however, they would welcome the opportunity to work with the client or architect to optimise the factory setup. They were also interested in the client's sustainability targets and, as with others, would welcome the design team and client to visit their factory in Peterborough to see their production and quality in a show unit.

**3DM/MC Rollalong**

Rollalong indicated that it was interested in the project and could provide both volumetric and main contractor services. Their questions related to the types of dwelling being proposed, particularly around whether houses or flats, overall dimensions, and number of floors. Rollalong's preference is for low-level housing, and would need further information to ensure that they are the right partner for this project.

**MC Elkins Construction**

Elkins is a main contractor with experience in delivering small number of MMC homes through their supply chain with public sector clients including the Royal Borough of Greenwich, where they were appointed main contractor to manage the delivery of a standardised house type that was being produced by several different manufacturers. They expressed interest in the project and welcomed the opportunity to discuss this in more detail, and suggested that this experience would be useful for our work.

**MC Kind & Company**

Kind & Company is also a main contractor which can deliver various forms of MMC through their supply chain. They expressed interest in the project and have no issues with the standardised house type and are really pleased about the collaboration model that the client is considering. They appreciate that more detail on the design will be shared in time so the questions they had were around the specification, including whether the homes would need to meet carbon net zero or Passivhaus standards.

**Generally**

In summary, most of the suppliers responded positively to working to a bespoke set of house types we have developed as part of this study. TopHat was the only company to decline their interest, as they need to work with their their own design, or require a minimum order of 500 modules if adopting a bespoke design.

Across the board there was a clear interest from the providers in sustainability targets and certification, so this should be an area of clarity and focus within any MMC-specific additions to Ealing's Employer's Requirements.

# Soft Market Testing

## Part 2

Following the written feedback we received from interested members of the LHC NH3 framework, we conducted a series of online meetings with each. At this point we revealed the name of the borough with which we were working, and took them through the emerging pattern book design.

The format of these conversations consistend of a one-hour online meeting with each company where we gave a high level introduction to the project, took the attendees through the draft pattern book, asking for feedback, and then had a general discussion about any recommendations the respondent would make were Ealing to adopt an MMC strategy to housing delivery.

During this process we also spoke to several companies which had previously approached Ealing about its affordable housing and MMC programme.

A summary of these discussions are included below.

**Wikihouse**

WikiHouse is an open source modular building system that makes it easy to design, manufacture and assemble high-performance buildings. It is not on the LHC NH3 framework.

We asked Wikihouse for feedback on the emerging pattern book design, and the representatives offered a range of specific advice and commentary.

There was support for dogleg stair arrangement, although this would require a module to either side of it. They also advised that narrow houses are hard to optimise.

There were some general comments on the demands of GLA funding in respect of fire performance and combustibility, as well as embodied carbon of foundations and brick elevations.

The Wikihouse system is very flexible when it comes to door and window openings. Flexibility is built into the system, other there are rules about where to position openings, based on structural requirements. The wall type we had indicated for internal partitions could be built into the Wikihouse system.

They validated our maximum structural opening width of 6m, but had questions over the practicality of party walls between the row houses, particularly in respect of fire barriers and the potential for voids. Further work will be required on how to avoid voids between new and existing dwellings.

**Valorem Investment Partners**

Valorem had contacted Ealing with an offer to provide a number of volumetric housing modules they had acquired from Hugg Homes, which went into administration in the autumn of 2023. The modules were manufactured by Thurston Group (still trading) and were fully finished, including internal fittings and white goods. However, the homes are designed below London Plan space standards, with the layout provided to us indicating a two bed, four person dwelling with an internal area of around 45sqm - well below the 70 - 75sqm required by Ealing's brief. It is also not on the LHC NH3 framework.

**The Seismic Group**

The Seismic Group is a consultancy with a proprietary platform which helps connect different MMC systems. We

expect that any main contractor engaged to deliver new homes through the small sites programme would need to make a decision as to whether this method would be useful for their purposes. It was not clear to us how they might get involved in the early stages of a project without Ealing committing to a proprietary building system and all of the challenges that this entails. There is also no apparent procurement route for direct engagement, other than through appointment as a consultant or via a contractor or supplier on one of the public sector frameworks.

Seismic uses standardised and interoperable components and assemblies to facilitate the development of any building typology. The Seismic platform is available though a licensing agreement.

**Elkins**

The representatives from Elkins responded positively to the proposals in the draft pattern book. They had a number of questions about the proposals themselves, and the wider MMC strategy.

Elkins asked whether the intention was for Ealing's building control officers to approve the new housing, in which case it may be that some up-skilling or familiarisation with MMC would be useful as this had been an issue with other boroughs. They also indicated that they would be happy to undertake a high-level pricing exercise on the house types.

Elkins noted potential issues with transportation and logistics in regard to 3.5m wide loads, and the Metropolitan Police restrictions that could require an attendant or overnight transportation. They confirmed that they had previously installed volumetric modules with a width of 4.6m.

We discussed the potential for "flying factories", but Elkins advised that this would not work for small volumes of the scale being considered here. They also added that the pattern book houses should be detailed to suit modern methods of construction, and some details - such as brick soffits - should be avoided. Having completed several small MMC projects for the Royal Borough of Greenwich, Elkins would welcome the opportunity to show the client around these, and how different materials have been deployed.

Elkins was interested to understand the sustainability objectives, for example, might this include connection to a district heating network, or alternatively installed with air source heat pumps or photovoltaics. They also noted that the cost of achieving 100% reduction in carbon use would provide very expensive and wondered if 95% together with offset payments would be acceptable as an alternative. Although it was recognised that this was not an approach which other planning authorities have accepted.

They noted that there were economise of scale, although Elkins has delivered projects from anywhere between two and 80 homes. They noted that there might be restrictions on numbers set out in the framework lots. Finally, we discussed the construction contracts that might be needed for the delivery of these homes, and that standard Design & Build forms of contract are not always suitable for MMC and that alternatives should be explored.

**Kind & Co**

Kind & Co has worked with light-gauge steel (LGS) panelised systems before,

and one member of its team was previously at Beattie Passive, a category 1 manufacturer which specialises in Passivhaus-certified modular homes. Kind & Co is currently working with both Newham and Sutton on Passivhaus-certified dwellings, and so is comfortable achieving the necessary standards of construction quality.

They asked whether rooftop development was part of our current scope, and made the same observation as others around timber construction and GLA funding restrictions. Like Elkins, they had questions about the hot water system, and whether this would utilise MVHR or air source heat pumps, favouring the former. They had a further suggestion around the use of two-storey pre-fabricated pods for mechanical and electrical services, which they have used in the past.

In terms of project size, Kind & Co will generally not tender for projects with a construction value of less than £3m, with a favoured range of between £4m and £20m. They have a varied supply chain, and have worked with modular manufacturer Rollalong previously. Other providers in their supply chain can supply LGS or timber frame to a height of five storeys, and these can be covered by standard building warranties, including Premier. Alternatively, BOPAS is available for volumetric modules.

Kind & Co was amenable to the idea of a "hub and spoke" arrangement, and also a flying factory arrangement, although the viability of this would rely on scale. We also discussed the potential for meanwhile homes for temporary accommodation, and whether relocatable modules would be required, which Kind & Co can also provide.

**REDS10**

REDS10 is comfortable working on pattern book homes designed by others. Their contracts are typically between £500,000 and £100m, but would need a certain quantum of homes to make this approach viable.
They confirmed that they can often be cheaper than traditional methods of construction when there is sufficient capacity for efficient delivery.

REDS10 modules are approximately 3.6 wide and 14m long, so two of our pattern book modules could be transported on a single lorry, based on the dimensions we showed in the meeting. Where using brick as a facing material, these would be a slip system clipped into a rail. They were complimentary about the pattern book design, describing it as one of the best they had seen; and they were confident that it could be delivered using their system. Their logistics team is based in London and is comfortable accessing typical sites within the city, including the centre - although the 3.5m transport restriction from the Metropolitan Police was also mentioned.

Their recommendation was to adopt a fabric-first approach to sustainability, rather than full certification, as this is expensive to achieve and limiting to future residents.

BOPAS is available for their products too, and would recommend the use of an Approved Inspector rather than the council's own building control department who may not be familiar with modern methods of construction.

In terms of building contracts, REDS10 has worked with both JCT and NCT contracts without issue, although they stated that they sometimes found local

authorities' professional indemnity insurance and warraty requirements unneccesarily onerous.

Their minimum order would be between 40-50 homes, but stated that the efficiencies of MMC would only start to appear with between 50 and 100 homes. They were happy to provide us with some high-level costings if this was useful.

**Remagin**

Reimagin expressed interest in the project and asked how the main contractor might be appointed, assuming that this might be through a framework. (It's worth noting that this response was a surprise to us as we assumed that all suppliers on the LHC NH3 framework could act in this capacity).

Reimagin suggested that we investigate a new technology from TopHat which allows the 3D printing of an external cladding system to match any facade material. Their primary panel system is LGS.

We discussed the delivery of social value, which many MMC providers have historically struggled with. Remagin is finding ways of better dealing with this, and often works with local partners to ensure there are training and supply opportunities in the local economy. They have experience in delivering Passivhaus-certified homes, usually with an external wall U-value of 0.11W/m²K.

Finally, they had some questions regarding warranties, and how this might work with a hybrid contractor / supply arrangement, and how BOPAS or NHBC might work in this instance.

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