Northwood Investors

Templar House

Overheating Risk Assessment

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1 Executive Summary

An overheating analysis was carried out for Templar House to assess the risk of overheating. A representative sample of apartments has been selected and assessed for the purpose of this analysis. Assumptions on the building fabric performance, glazing and openable areas are as per the architect's proposed design and outlined in this report.

The design incorporates a number of passive design measures that reduce the risk of overheating from the outset. These include: local shading; low g-value glass; minimising internal heat gains through energy efficient lighting; positioning of the utility cupboards by the entrance doors; super insulation of hot water pipework

The modelling assumptions and methodology are realistic and robust and included in this report. The assumptions, including internal gains profiles, occupancy and the methodology followed for the analysis are also included in the report. The test is based on the GLA guidance for energy assessments. The approach to the analysis is based on the standardised approach to overheating assessment of residential buildings being developed by Arup, CIBSE and others.

Based on the criteria (as described in Section 3.3.9) all of the sample apartments modelled pass the TM52 Criterion 1 overheating risk assessment test.

The GLA guidance is not clear on how heat wave years must perform against TM52. As a result, this report records the performance as follows:

LWC_2003 weather file:

- With the incorporation of internal blinds all rooms achieve compliance with TM52 Criterion 1.
- All bedrooms pass.

LWC_1976 weather file:

- Three out of seven living room spaces fail TM52 Criterion 1, in some cases marginally.
- All bedrooms pass

As bedrooms are considered most critical for health, additional fixed temperature tests have been performed as illustrated below.

In order to comply with the fixed temperature test. The bedrooms were assessed to ensure that the operative temperature does not exceed 26°C for more than 1% of the night time hours.

- All the bedrooms are well below the 1% set as a threshold when assessed with the 1989 weather data.

- With the incorporation of internal blinds; none of the bedrooms exceed the 1% threshold when assessed with the DSY01_2020 weather data despite increased night time outside air temperatures.

It should also be noted that all Apartments are mechanically cooled so in the event of temperature extremes supplementary cooling will be available from the mechanical plant.

2 Introduction

This report describes the assumptions and methods used and includes the results for the overheating risk analysis carried out for Templar House situated in the London Borough of Camden.

The proposed scheme includes the erection of 54 residential units up to a maximum GIA of approximately 5328 m^2 (without basement) or 5969m^2 (with Basement). The Residential unit to comprise thirteen stories (plus plant) rising to approximately 73.250m AOD.

Dynamic thermal simulations were carried out to assess the risk of overheating for Templar House as per the cooling hierarchy described in Policy 5.9 of the London Plan.

A dynamic thermal model was carried out to assess the risk of overheating for the development. The modelling methodology is based on the standardised approach to overheating assessment of residential buildings developed by Arup, CIBSE and other consultant partners. This approach is designed to encourage good design that is comfortable for occupants within sensible limits, without being so stringent that it over-promotes the use of mechanical cooling. It includes a set of internal gains profiles (loads and times).

Passive measures were incorporated in the design from the outset to reduce the risk of overheating such as:

- Reduction in glazing where possible. The design made several iterations to the façade design to rationalise the quantum of glazing on the façade
- Low g-value glass: 0.29-0.5 for clear glazed panels and 0.29-0.3 for the translucent panels. This requirement needed to be balanced against the requirement to provide good daylight levels within the apartments.
- Passive ventilation via openable windows and louvres.
- Minimising internal heat gains through energy efficient lighting, appropriate positioning of the utility cupboards by the entrance doors to minimise the hot water pipework distribution within the apartment.
- Super insulation of hot water pipework

3 Details of Assessment

3.1 Representative Sample Selection

The overheating assessment methodology takes a representative sample of apartments and assesses these to examine the risk of overheating to the overall building.

As well as an assessment of the likely solar exposure, a mix of apartments were selected including those with single, dual and triple aspect, different number of bedrooms and location on different floors of the building.

Table 1 below includes the references and the relevant selection criteria.

The elevation and plan views of the representative apartments modelled are appended to this document. The views illustrate the window/louvre opening type used for this analysis.

Table 1 Sample apartment selections

Apartment Reference	Level	NE	SE	SW	NW	Single Aspect	Dual Aspect	Triple Aspect	Top Floor
D1L1-2	1-2			✓		✓			
D4L1-2	1-2	✓				✓			
A4L3	3	✓		✓			✓		
A1L5-6	5-6		✓	✓	✓			✓	✓
D2L5-6				✓		✓			
A1L10	10			✓	✓				✓
A3L10	10			✓		✓			
D1L11-13	11-13	✓		✓					

3.2 Summary of methodology

A suitable number of units (8) were selected for the overheating risk assessment based on orientation, exposure and security concerns.

The approach to the analysis is based on the standardised approach to overheating assessment of residential buildings being developed by Arup, CIBSE and others.

The standardised methodology requires a number of key assumptions to make modelling more realistic and useful. These are more accurate assumptions than normally used. Most significant are:

- Bedrooms are modelled as occupied 24 hours per day.
- A standard set of occupancies and internal gains should be used, as are here.
- The impact of blinds should be explicitly demonstrated.

In addition, this methodology changes the test criteria as follows:

- The weather year DSY1 - London_LWC_2020High50 and must pass the tests.
- 1976 and 2003 should be used for heat wave performance analysis.
- TM52 Criterion 1 is the only important test for overheating in residential developments.
- This should be supplemented by a bedroom night time hours fixed temperature test.

Additional information on the methodology used:

- An AM11 approved software was used for the analysis (IES VE 2016).
- Each of the apartments were zoned into separate rooms (bedrooms, Kitchen/living area, bathroom and utility cupboards.
- Standard profiles were applied for each of the rooms based on types of room, occupancy and internal gains (see section 3.38).
- The apartments are naturally ventilated via openable windows.
- Internal blinds were incorporated into the model and the results are illustrated with and without to illustrate the effect.
- Mechanical Ventilation Heat Recovery (MVHR) unit is included in the apartment and assumed on bypass mode – i.e. supplying external air to the apartment.
- The CIBSE TM49 weather files for the London Weather Centre were used for the analysis in addition to the future weather file London_LWC_2020High50.

3.3 Dynamic Thermal Model

The dynamic thermal model used for the analysis is illustrated in Figure 1 below.

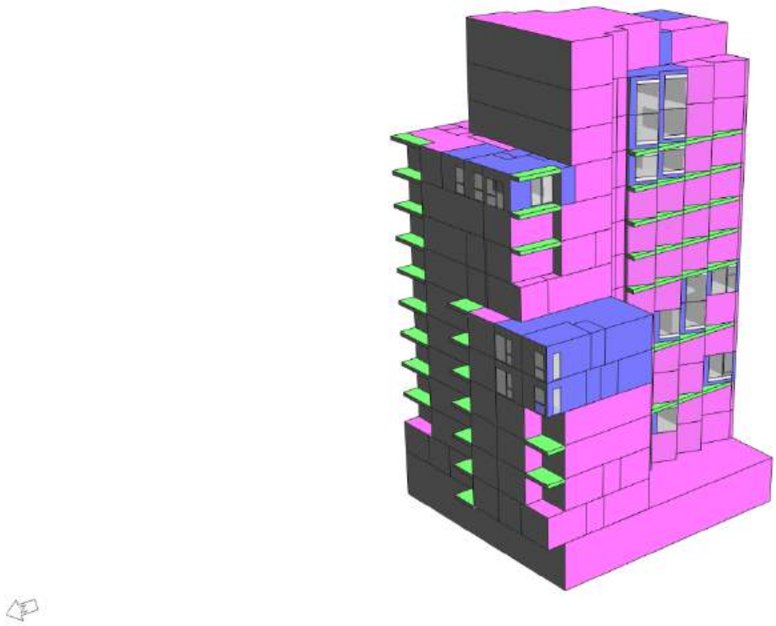

Figure 1 Templar House IES VE Dynamic Thermal Model

3.3.1 Site Location & Orientation

Templar House is located in the Borough of Camden, London. The orientation of the building is shown on Figure 1 and within the appendix A.

3.3.2 Building fabric performance

The following building envelope performance assumptions were made:

Table 2 Building Fabric Assumptions

	Criteria	Notes
Glazing U Value	1.1 W/m²K including frame	
Glazing G Value	0.5 NW &SE 0.3 NE & SW 0.29NE & SW	Provides reasonable balance with VLT. Levels 1-10 & 13 Levels 11&12
Translucent Panels U Value	1.1W/m²K	
Translucent Panels G Value	0.3	Levels 1-10 & 13 Levels 11&12
Louvre U Value	1.6W/m²K	

Wall U value	0.18 W/m².K	
Roof	0.13 W/m².K	
Floor between differently conditioned spaces	0.22 W/m².K	
Wall between differently conditioned spaces	0.18 W/m².K	Walls between apartments assumed to be fully filled and sealed.
Building air tightness	3 $m^3/h/m^2$ @ 50Pa	

3.3.3 Thermal Mass

The building is a heavy weight construction, largely of concrete. The internal finishes have not yet been finalised, but the presence of mass has a beneficial impact on summertime temperatures.

3.3.4 Ventilation Strategy

3.3.4.1 Infiltration & Mechanical Ventilation

The residential ventilation is provided year round with mechanical ventilation and heat recovery units (MVHR), at rates that exceed the minimum required by Part F of the Building Regulations. These higher rates are used to prevent mould growth as the building is relatively air tight for energy efficiency.   These units are also supplied with a timed boost rate to increase the ventilation rate when required.

These ventilation rates are more in line with CIBSE suggested supply requirements, as in CIBSE Guide A Table 1.5.

Utility cupboards are ventilated to remove excess heat.

Kitchens will have recirculating hoods with washable filters.

Ventilation is supplemented by opening windows for additional fresh air when needed and to prevent overheating.

Common corridors are naturally ventilated to prevent overheating due to heat gains.

The building's air tightness is assumed at $3m^3/h/m^2$ @ 50Pa. An infiltration rate of 0.15 ach/hr is used in the analysis.

3.3.4.2 Natural Ventilation

All the apartments have openable windows with the percentage of openable area varying between apartments.

Windows and Door Openings

The window types assigned to the model are included in the Appendix A.

Exposure Type

An exposure factor needs to be applied to the building model which corrects for its exposure to wind effects. Based on the site location, the building has been modelled as sheltered.

Air speed assumptions

Operative temperature calculations (used within TM52) require assumptions on air speed. The modelled air speed in a space was set at 0.1m/s as there are no other means of generating air movement assumed at this stage. This is consistent with a worst case warm day with limited wind.

3.3.5 Weather Data

The CIBSE TM49 weather file London_LWC1989 was used for the analysis as per London Plant policy 5.9. CIBSE guide TM49 *"Design Summer Years for London"* was produced by CIBSE in conjunction with the GLA. This guide provides a risk-based approach to address the challenges of developing in urban centres, especially in the south and south east of UK, were the Urban Heat Island (UHI) effect exacerbates the already intense and frequent summer hot events.

In order to consider the impact of warm weather conditions, the overheating modelling was conducted using three design weather years as advised by (CIBSE TM49):

- 1976: a year with a prolonged period of sustained warmth;
- 1989: a moderately warm summer (current design year for London);
- 2003: a year with a very intense single warm spell;

A future weather file (London_LWC_2020High50) was used in addition to above in order to understand the performance of the building for the near future conditions.

The standardised assessment method proposed by Arup and CIBSE proposes that the pass/ fail test should be the 1989 (DSY1) file most appropriate for the site location, for the 2020s, high emissions, 50% percentile scenario.

The other files for 1976 and 2003 (the more extreme DSY2 and DSY3 files) should be used to further test designs for heatwave performance.

3.3.6 Building Category

The building is assumed to be category II – new build as per TM52.

3.3.7 Blinds and Shading Devices

Blinds were assumed only for the fixed pane of the window (see appendix) as the blinds would obstruct either the opening or ventilation rate through the openable part of the window (shading coefficient 0.5). The results with and without blinds are included for each of the cases they were incorporated.

3.3.8 Internal Gains Profiles

The internal gains profiles principles are included below, and are based on an ongoing project in conjunction with CIBSE to set consistent internal gains for testing. It should be noted that the occupancies are typically more onerous than gains used in the past where occupancy was more limited, particularly in bedrooms. Communal pipework heat gains are also explicitly modelled.

- Bedrooms will be set with a 24h occupancy profile, which means that 1 person is always considered inside the room during the daytime, and two people in each double bedroom at night.
- For the 2-bedroom flat, 1 person will be considered during the daytime in both the bedrooms in order to assess robustly. This means that one excess person to the assumed total number of occupants will be considered in the flat during the daily hours (a visitor).
- Kitchen/Living rooms will be unoccupied during the sleeping hours and occupied during the rest of the day. This is the worst-case scenario since the room will be modelled as occupied only during the hottest hours of the day.
- For the 12th Floor Living Room/Single Bedroom, a 24hour occupancy profile will be assigned, during daytime hours the space will be modelled with living room occupancy. 1 person will be considered during sleeping hours.
- No differences between weekdays and weekend are considered. Moreover, the overall apartment will be modelled as occupied for 24 hours.
- The internal gains profiles are based on maximum values and modulating profiles which apply a fraction of the value for each hour of the day.

Occupancy Gains

Based on CIBSE Guide A, a Maximum Sensible Gain of 75 W/person and a Maximum Latent Gain of 55 W/person are assumed in living spaces. An allowance for 30% reduced gain during sleeping is made based on ANSI/ASHRAE Addendum g to ANSI/ASHRAE Standard 55-2010, Table 5.2.1.2 Metabolic Rates for Typical Tasks (ANSI/ASHRAE 2013).

1 bedroom – 2 people Apartment (Apartments D1L1-2, A4L3 & A1L10):

- Bedroom: 2 people are in the bedroom with 30% reduced gains from 11pm to 9am and with full gains from 9am to 10am and from 10pm to 11pm; 1 person at full gain is in the bedroom from 10am to 10pm.
- Kitchen/Living-room: only one person is in the kitchen from 10am to 10pm while the room is unoccupied for the rest of the day.

Studio – 2 people Apartment (Apartment A4L10):

- 2 people are modelled continuously in this space.

2 bedroom – 4 people Apartment (ApartmentsD4L1-2 & D2L5-6):

- Double Bedrooms: 2 people are in the bedroom with 30% reduced gains from 11pm to 9am and with full gains from 9am to 10am and from 10pm to 11pm; 1 person at full gain is in the bedroom from 10am to 10pm.
- Kitchen/Living-room: 3 people are in the space from 10am to 10pm while the room is unoccupied for the rest of the day.

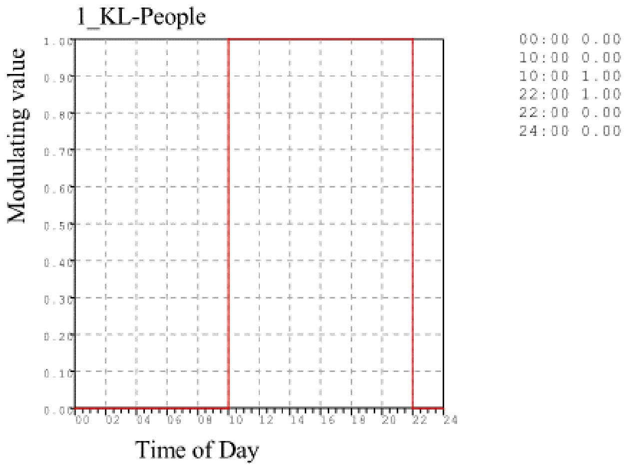

Figure 2 Kitchen/Living Room - Occupancy modulating profile

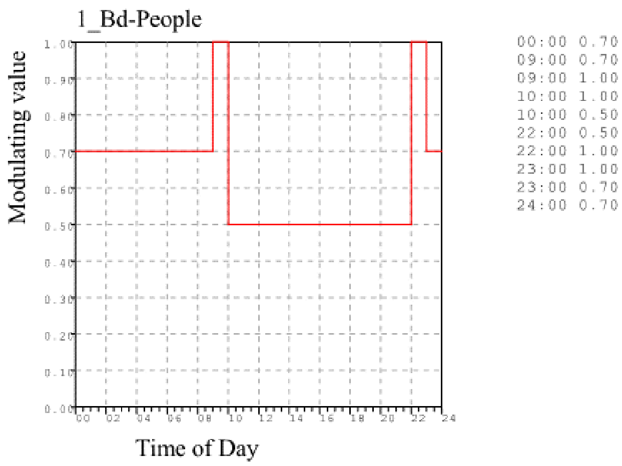

Figure 3Double Bedroom - Occupancy modulating profile

2 bedroom – 5 people Apartment (Apartment D1L11-13):

- Double Bedrooms: 2 People are in the bedroom with 30% reduced gains from 11pm to 9am and with full gains from 9am to 10am and from 10pm to 11pm; 1 person at full gain is in the bedroom from 10am to 10pm.
- Kitchen/Dining: only one person is in the kitchen from 10am to 10pm while the room is unoccupied for the rest of the day.

- Living/Single: Four people are in the Living space from 10am to 10pm, during sleeping hours the room is occupied by 1 person with 30% reduced gains.

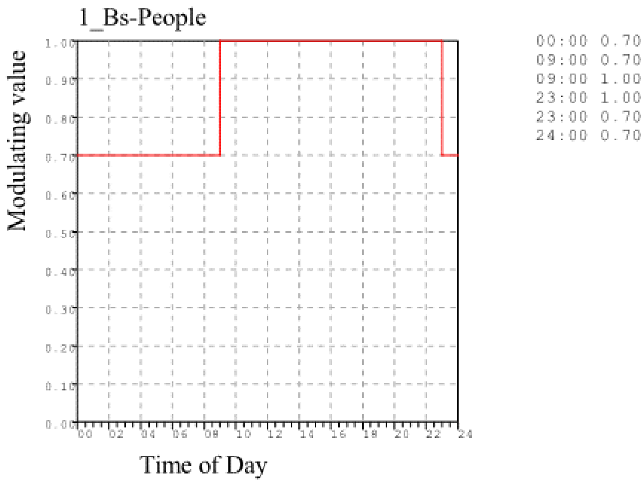

Figure 4 Single Bedroom - Occupancy modulating profile

<u>3 bedroom – 6 people Apartment (Apartment D1L5-6):</u>

- Double bedrooms: 2 people are in the bedroom with 30% reduced gains from 11pm to 9am and with full gains from 10am to 10am; 1 person at full gain is in the bedroom from 10am to 10pm.
- Kitchen/Dining: only 1 person is in the kitchen from 10am to 10pm, while the room is unoccupied for the rest of the day.
- Living: 5 people are in the Living space from 10am to 10pm, while the room is unoccupied for the rest of the day.

Equipment

It is assumed that apartments with the same number of occupants and bedrooms are usually provided with the same appliances, therefore the heat loads given by them should be assumed independent of floor area for the purpose of overheating risk assessment. Therefore, the equipment loads are defined in Watts.

<u>Double/Single Bedrooms:</u>

Assumed equipment in the bedroom (e.g. laptop or TV) with a peak load of 80 W from 9am to 11pm and a base load of 10 W during the sleeping hours.

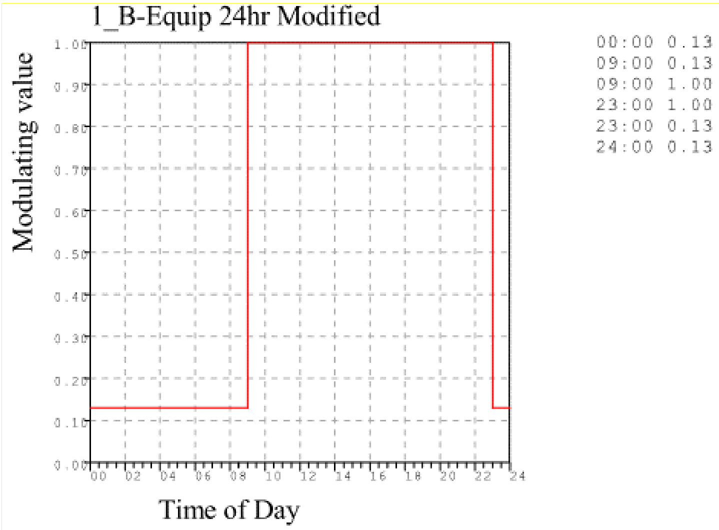

Figure 5 Double and single bedroom equipment gains profile

Kitchen/Living room:

The profile and the associated loads are based on DECC's Household Electricity Survey and Household energy (Intertek for DECC 2012).

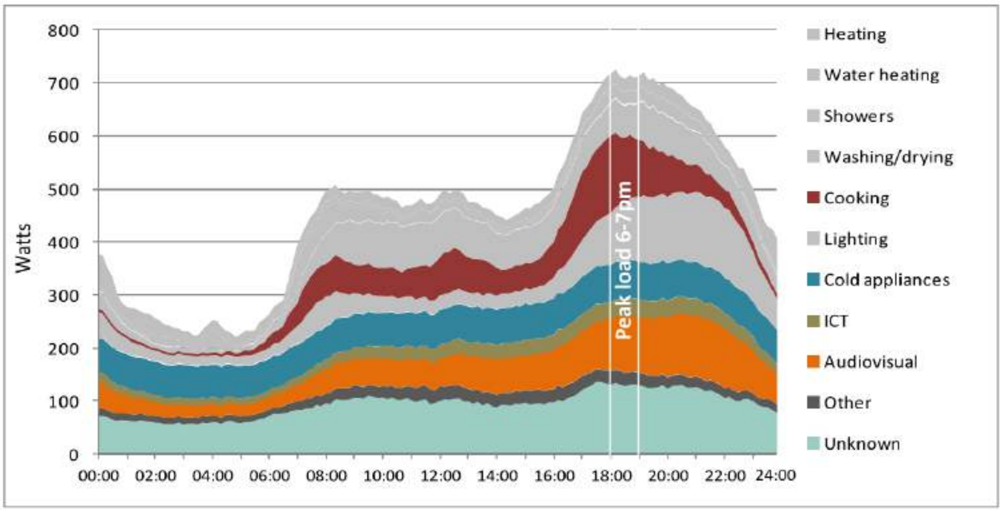

Figure 6 DECC's Household Electricity Survey and Household Energy consumption

Heating, water heating, showers, washing/drying and lighting were excluded from this profile type (grey colour) leading to a peak load of 450 W from 6pm to 8pm. 200 W is assumed from 8pm to 10pm. 110 W is assumed from 10am to 6pm and from 10pm to 12pm. For the rest of the day a base load of 85 W is assumed.

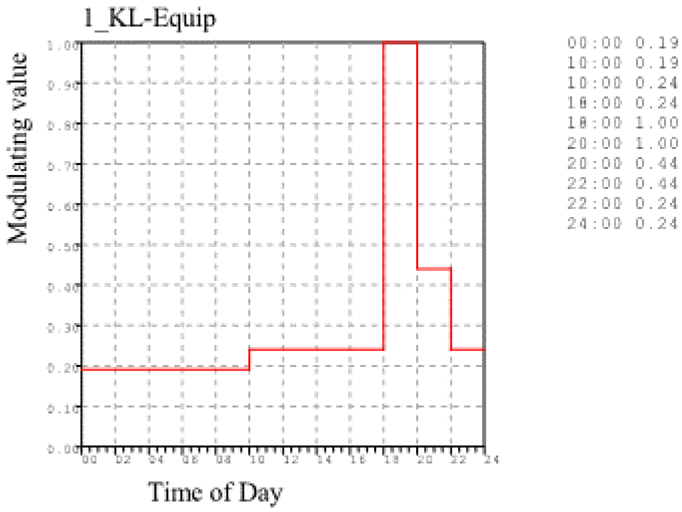

Figure 7 Kitchen/Living room equipment gains

Lighting

For the purposes of the assessment, lighting energy is assumed to be proportional to floor area, and lighting loads are measured in W/m^2. 2 W/m^2 from 6pm to 11pm should be assumed as the default for an efficient new build home. This assumes that good daylight is a requirement in new homes (also noting that only summer months are assessed within TM52).

Pipework Heat Losses

The pipework heat loss was assumed as an additional gain which is on continuously.

A 50W gain was assumed for each of the utility cupboards.

3.3.9 Thermal Comfort - Compliance Criteria

The results were analysed using the current industry standard (CIBSE TM52) which is an adaptive methodology for assessing the risk of overheating. The calculation uses a rolling average of the external temperature to assess adaptive thermal comfort. According to TM52, **spaces are assessed against 3 criteria, and are required to satisfy at least 2 of these in order to pass**.

- Criterion 1- Hours of Exceedence(H_e): *Sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature by one degree or more during the occupied hours(%Hrs* $T_{op} - T_{max} \geq 1K$*).*
- Criterion 2 - *Daily Weighted Exceedence (W_e): Deals with the severity of overheating, by setting a daily limit for acceptability($W_e \leq 6$ in any one day)*
- Criterion 3 – *Upper Limit Temperature (T_{upp}): Sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable ($T_{upp} \leq 4$).*

The dynamic thermal simulations were carried out with IES VE 2016 for a full summer period (1st May – 30th September) for the weather files mentioned above (as per CIBSE TM49 2014). The assumptions used in the dynamic thermal model and the table with the results for the occupied, naturally ventilated spaces are included in the results section.

It is worth noting, that the proposed methodology from CIBSE, Arup and others, based on consultation with the TM52 authors proposes the following test for homes that are predominantly naturally ventilated:

Compliance is based on passing BOTH of the following 2 criteria:

a) TM52 Criterion 1: operative temperature cannot exceed the upper comfort limit for more than 3% of the occupied summer hours.

b) Bedrooms only - an additional requirement must be checked for the bedrooms to guarantee comfort during the sleeping hours: the operative temperature in the bedroom from 10pm to 7am cannot exceed 26°C for more than 1% of hours (1% of hours between 22:00-07:00 for bedrooms is 32 hours).

TM52 criteria 2 and 3 are not deemed to be appropriate for residential properties. TM52 was developed based on office buildings.

4 Results

4.1 TM 52 Criteria Results – LWC 1989 Weather file

The table below includes the overheating risk analysis results with the use of TM49 – LWC1989 weather file. **No internal blinds were assumed for this simulation.**

Table 3 TM52 Criteria Results LWC - 1989 - no internal blinds included

Model Reference - TPH_11 No Blinds		Weather Data - LWC1989				
Apartment Reference	Room Reference	Criterion 1 (%Hrs Top-Tmax>=1K)	Criterion 2 (Max. Daily Deg.Hrs)	Criterion 3 (Max. DeltaT)	TM52 Pass/ Fail	Criterion 1 Pass/ Fail
A1L10	A1L10 Double	0.4	12	2		
	A1L10 Living/Kitchen	1.1	18	3		
A1L5-6	A1L5-6 Double 01	0.4	11	2		
	A1L5-6 Double 02	0.4	7	1		
	A1L5-6 Double 03	0.4	10	2		
	A1L5-6 Kitchen	0.8	8	2		
	A1L5-6 Living	0.8	11	2		
A3L10	A3L10 Studio	0.6	17	3		
A4L3	A4L3 Double	0.4	11	2		
	A4L3 Living/Kitchen	0.5	6	1		
D1L11-13	D1L11-13 Double 01	0.5	18	3		
	D1L11-13 Double 02	0.7	21	3		
	D1L11-13 Ktchen/Dining	1.3	18	3		
	D1L11-13 Living/Single Bedroom	0.5	18	3		
	D1L11-13 Sun Room	0.4	5	1		
	D1L1-2 Double	0.4	13	2		
D1L1-2	D1L1-2 Kitchen/Dining	0.8	14	2		
	D1L1-2 Living	0.8	12	2		
D2L5-6	D2L5-6 Double 01	0.5	17	3		
	D2L5-6 Double 02	0.4	11	2		
	D2L5-6 Kitchen/Dining	0.8	12	2		
	D2L5-6 Living	0.9	15	2		
D4L1-2	D4L1-2 Double 01	0.4	11	2		
	D4L1-2 Double 02	0.5	16	3		
	D4L1-2 Kitchen/Dining	1	17	3		
	D4L1-2 Living	1	15	2		

None of the rooms assessed fail more than one criteria. Based on these results all of the apartments modelled have a low risk of overheating.

4.2 TM 52 Criteria Results – LWC 1976 Weather file

The table below includes the overheating risk analysis results with the use of TM49 – LWC1976 weather file. Please note that TM49 LWC -1976 weather data is very extreme and should only be used for heat wave analysis. Considering the fact that the apartments are equipped with cooling we believe that the results included below are acceptable.

Table 4 TM52 Criteria Results 1976 – no internal blinds included

Model Reference - TPH_11 No Blinds		Weather Data - LWC1976				
Apartment Reference	Room Reference	Criterion 1 (%Hrs Top-Tmax>=1K)	Criterion 2 (Max. Daily Deg.Hrs)	Criterion 3 (Max. DeltaT)	TM52 Pass/ Fail	Criterion 1 Pass/ Fail
A1L10	A1L10 Double	1.6	32	4		
	A1L10 Living/Kitchen	3.8	40	6		
A1L5-6	A1L5-6 Double 01	1.6	31	4		
	A1L5-6 Double 02	1.4	29	3		
	A1L5-6 Double 03	1.5	31	4		
	A1L5-6 Kitchen	2.9	28	4		
	A1L5-6 Living	2.9	31	4		
A3L10	A3L10 Studio	2.2	43	6		
A4L3	A4L3 Double	1.5	34	4		
	A4L3 Living/Kitchen	1.9	22	3		
D1L11-13	D1L11-13 Double 01	1.9	42	5		
	D1L11-13 Double 02	2.1	42	5		
	D1L11-13 Ktchen/Dining	4.6	43	6		
	D1L11-13 Living/Single Bedroom	2.1	40	5		
	D1L11-13 Sun Room	1.9	21	3		
	D1L1-2 Double	1.6	34	4		
D1L1-2	D1L1-2 Kitchen/Dining	3.2	32	4		
	D1L1-2 Living	2.7	31	4		
D2L5-6	D2L5-6 Double 01	1.9	40	5		
	D2L5-6 Double 02	1.5	34	4		
	D2L5-6 Kitchen/Dining	2.9	29	4		
	D2L5-6 Living	3.2	32	4		
D4L1-2	D4L1-2 Double 01	1.4	33	4		
	D4L1-2 Double 02	2	44	5		
	D4L1-2 Kitchen/Dining	3.7	37	5		
	D4L1-2 Living	3.7	35	5		

All of the bedrooms pass criterion 1, however, 3 out of the 7 living rooms modelled fail.

4.2.1 Internal Blinds Included

The table below includes the overheating risk analysis results with the use of TM49 – LWC1976 weather file. In this case internal blinds were assumed for the simulation.

Table 5 TM52 Criteria Results 1976 –internal blinds included

Model Reference - TPH_12 With Blinds		Weather Data - LWC1976				
Apartment Reference	Room Reference	Criterion 1 (%Hrs Top-Tmax>=1K)	Criterion 2 (Max. Daily Deg.Hrs)	Criterion 3 (Max. DeltaT)	TM52 Pass/ Fail	Criterion 1 Pass/ Fail
A1L10	A1L10 Double	1.5	30	4		
	A1L10 Living/Kitchen	3.8	38	5		
A1L5-6	A1L5-6 Double 01	1.4	29	4		
	A1L5-6 Double 02	1.2	29	3		
	A1L5-6 Double 03	1.4	29	4		
	A1L5-6 Kitchen	2.5	26	4		
	A1L5-6 Living	2.6	28	4		
A3L10	A3L10 Studio	1.8	37	5		
A4L3	A4L3 Double	1.5	34	4		
	A4L3 Living/Kitchen	1.9	21	3		
D1L11-13	D1L11-13 Double 01	1.8	39	5		
	D1L11-13 Double 02	2	42	5		
	D1L11-13 Ktchen/Dining	4	37	5		
	D1L11-13 Living/Single Bedroom	1.9	39	5		
	D1L11-13 Sun Room	1.8	21	3		
	D1L1-2 Double	1.6	34	4		
D1L1-2	D1L1-2 Kitchen/Dining	3	31	4		
	D1L1-2 Living	2.6	29	4		
D2L5-6	D2L5-6 Double 01	1.8	36	5		
	D2L5-6 Double 02	1.4	32	4		
	D2L5-6 Kitchen/Dining	2.7	29	4		
	D2L5-6 Living	3.2	32	4		
D4L1-2	D4L1-2 Double 01	1.4	29	4		
	D4L1-2 Double 02	1.9	40	5		
	D4L1-2 Kitchen/Dining	3.5	35	5		
	D4L1-2 Living	3.3	33	4		

A large proportion of rooms fail for more than one TM52 criteria but only 5 out of 26 fail criterion 1 and in most cases marginally. The number of rooms failing criterion 1 has decreased with the inclusion of blinds, the percentage of hours of exceedance has likewise reduced.

4.3 TM 52 Criteria Results – LWC 2003 Weather file

The table below includes the overheating risk analysis results with the use of TM49 – LWC2003 weather file. No internal blinds were assumed for this simulation. Please note that the TM49 – LCW 2003 weather data is very extreme and should only be used for heat wave analysis. Considering that the apartments are equipped with cooling we believe that this result acceptable.

Table 6 TM52 Criteria Results 2003 – no internal blinds included

Model Reference - TPH_11 No Blinds		Weather Data - LWC2003				
Apartment Reference	Room Reference	Criterion 1 (%Hrs Top-Tmax>=1K)	Criterion 2 (Max. Daily Deg.Hrs)	Criterion 3 (Max. DeltaT)	TM52 Pass/ Fail	Criterion 1 Pass/ Fail
A1L10	A1L10 Double	1.1	32	5		
	A1L10 Living/Kitchen	2.9	42	7		
A1L5-6	A1L5-6 Double 01	1.1	33	5		
	A1L5-6 Double 02	1.1	31	4		
	A1L5-6 Double 03	1.1	32	5		
	A1L5-6 Kitchen	2.1	32	5		
	A1L5-6 Living	2.1	35	6		
A3L10	A3L10 Studio	1.7	41	6		
A4L3	A4L3 Double	1.1	34	5		
	A4L3 Living/Kitchen	1.6	28	4		
D1L11-13	D1L11-13 Double 01	1.5	42	6		
	D1L11-13 Double 02	1.7	45	7		
	D1L11-13 Ktchen/Dining	3.8	46	7		
	D1L11-13 Living/Single Bedroom	1.6	43	7		
	D1L11-13 Sun Room	1.6	25	4		
	D1L1-2 Double	1.1	35	6		
D1L1-2	D1L1-2 Kitchen/Dining	2.1	34	6		
	D1L1-2 Living	2	38	5		
D2L5-6	D2L5-6 Double 01	1.3	40	6		
	D2L5-6 Double 02	1.1	34	5		
	D2L5-6 Kitchen/Dining	2.1	32	5		
	D2L5-6 Living	2.2	41	6		
D4L1-2	D4L1-2 Double 01	1.1	34	5		
	D4L1-2 Double 02	1.5	44	6		
	D4L1-2 Kitchen/Dining	2.9	41	6		
	D4L1-2 Living	2.8	42	6		

All but three rooms fail for more than one TM52 criteria but only 1 out of 26 fail criterion 1 and only by a small margin.

4.3.1 Internal Blinds Included

The table below includes the overheating risk analysis results with the use of TM49 – LWC2003 weather file. In this case internal blinds were assumed for the simulation.

Despite no additional rooms passing all TM52 criteria, now all of the 26 rooms pass criterion 1. The incorporation of internal blinds has reduced the risk of overheating.

Table 7 TM52 Criteria Results 2003 – internal blinds included

Model Reference - TPH_12 With Blinds		Weather Data - LWC2003				
Apartment Reference	Room Reference	Criterion 1 (%Hrs Top-Tmax>=1K)	Criterion 2 (Max. Daily Deg.Hrs)	Criterion 3 (Max. DeltaT)	TM52 Pass/ Fail	Criterion 1 Pass/ Fail
A1L10	A1L10 Double	1.1	31	5		
	A1L10 Living/Kitchen	2.8	41	7		
A1L5-6	A1L5-6 Double 01	1.1	32	5		
	A1L5-6 Double 02	1	29	4		
	A1L5-6 Double 03	1.1	32	5		
	A1L5-6 Kitchen	1.8	29	5		
	A1L5-6 Living	1.9	34	5		
A3L10	A3L10 Studio	1.4	40	6		
A4L3	A4L3 Double	1	34	5		
	A4L3 Living/Kitchen	1.6	27	4		
D1L11-13	D1L11-13 Double 01	1.3	38	6		
	D1L11-13 Double 02	1.5	40	6		
	D1L11-13 Ktchen/Dining	2.9	40	7		
	D1L11-13 Living/Single Bedroom	1.4	41	6		
	D1L11-13 Sun Room	1.6	25	4		
	D1L1-2 Double	1.1	34	5		
D1L1-2	D1L1-2 Kitchen/Dining	2.1	33	5		
	D1L1-2 Living	2	35	5		
D2L5-6	D2L5-6 Double 01	1.2	39	6		
	D2L5-6 Double 02	1	33	5		
	D2L5-6 Kitchen/Dining	2	32	5		
	D2L5-6 Living	2.1	40	6		
D4L1-2	D4L1-2 Double 01	1.1	33	5		
	D4L1-2 Double 02	1.3	40	6		
	D4L1-2 Kitchen/Dining	2.7	40	6		
	D4L1-2 Living	2.6	41	6		

The L11-13 Kitchen dining, as expected is at greatest risk to overheating due to a double height south west facing facade. The incorporation of internal blinds reduces the overheating therefore, now achieving compliance with TM52 Criterion 1.

4.4 TM 52 Criteria Results – LWC DSY1 2020 Weather file

The table below includes the overheating risk analysis results with the use of TM49 – LWC –DSY 01 2020 weather file. No internal blinds were assumed for this simulation.

Table 8 TM52 Criteria Results DSY1 – no internal blinds included

Model Reference - TPH_11 No Blinds		Weather Data - LWC - DSY01 - 2020 -High 50%				
Apartment Reference	Room Reference	Criterion 1 (%Hrs Top-Tmax>=1K)	Criterion 2 (Max. Daily Deg.Hrs)	Criterion 3 (Max. DeltaT)	TM52 Pass/ Fail	Criterion 1 Pass/ Fail
A1L10	A1L10 Double	0.6	19	3		
	A1L10 Living/Kitchen	1.8	26	4		
A1L5-6	A1L5-6 Double 01	0.6	19	3		
	A1L5-6 Double 02	0.5	15	2		
	A1L5-6 Double 03	0.6	19	3		
	A1L5-6 Kitchen	1.1	14	2		
	A1L5-6 Living	1.1	15	2		
A3L10	A3L10 Studio	1.1	23	4		
A4L3	A4L3 Double	0.6	18	3		
	A4L3 Living/Kitchen	0.8	11	2		
D1L11-13	D1L11-13 Double 01	0.9	25	4		
	D1L11-13 Double 02	1.1	31	4		
	D1L11-13 Ktchen/Dining	2.9	27	4		
	D1L11-13 Living/Single Bedroom	0.8	23	3		
	D1L11-13 Sun Room	0.7	10	2		
	D1L1-2 Double	0.6	20	3		
D1L1-2	D1L1-2 Kitchen/Dining	1.1	21	3		
	D1L1-2 Living	1.1	16	2		
D2L5-6	D2L5-6 Double 01	0.9	24	4		
	D2L5-6 Double 02	0.5	18	3		
	D2L5-6 Kitchen/Dining	1.1	19	3		
	D2L5-6 Living	1.1	21	3		
D4L1-2	D4L1-2 Double 01	0.5	17	2		
	D4L1-2 Double 02	0.9	25	3		
	D4L1-2 Kitchen/Dining	1.6	24	3		
	D4L1-2 Living	1.4	22	3		

All of the rooms achieve compliance with both assessment criteria. It should be noted that the performance of the building improves significantly with the incorporation of internal blinds (see Table 9).

4.4.1 Internal Blinds Included

The table below includes the overheating risk analysis results with the use of TM49-LWC-DSY-01 2020 weather file. Internal blinds were assumed for this simulation.

Table 9 TM52 Criteria Results DSY 1 – internal blinds included

Model Reference - TPH_12 With Blinds		Weather Data - LWC - DSY01 - 2020 -High 50%				
Apartment Reference	Room Reference	Criterion 1 (%Hrs Top-Tmax>=1K)	Criterion 2 (Max. Daily Deg.Hrs)	Criterion 3 (Max. DeltaT)	TM52 Pass/ Fail	Criterion 1 Pass/ Fail
A1L10	A1L10 Double	0.5	17	3		
	A1L10 Living/Kitchen	1.6	23	3		
A1L5-6	A1L5-6 Double 01	0.5	15	2		
	A1L5-6 Double 02	0.5	12	2		
	A1L5-6 Double 03	0.5	14	2		
	A1L5-6 Kitchen	0.9	13	2		
	A1L5-6 Living	0.9	15	2		
A3L10	A3L10 Studio	0.7	21	3		
A4L3	A4L3 Double	0.5	18	3		
	A4L3 Living/Kitchen	0.8	10	2		
D1L11-13	D1L11-13 Double 01	0.8	24	3		
	D1L11-13 Double 02	0.9	28	4		
	D1L11-13 Ktchen/Dining	1.6	22	3		
	D1L11-13 Living/Single Bedroom	0.8	22	3		
	D1L11-13 Sun Room	0.7	8	2		
	D1L1-2 Double	0.6	18	3		
D1L1-2	D1L1-2 Kitchen/Dining	1.1	19	3		
	D1L1-2 Living	1	16	2		
D2L5-6	D2L5-6 Double 01	0.8	23	3		
	D2L5-6 Double 02	0.5	16	2		
	D2L5-6 Kitchen/Dining	1	17	3		
	D2L5-6 Living	1.1	19	3		
D4L1-2	D4L1-2 Double 01	0.5	16	2		
	D4L1-2 Double 02	0.8	23	3		
	D4L1-2 Kitchen/Dining	1.4	23	3		
	D4L1-2 Living	1.3	20	3		

Table 9 demonstrates the significance of internal blinds as the hours of exceedance for all rooms is well below the 3% threshold set as a guidance by CIBSE TM52.

4.5 Bedroom fixed temperature test

The operative temperature in the bedrooms from 10pm to 7am (sleeping hours) was assessed and included in the Table 7 below.

The operative temperature cannot exceed 26°C for more than 1% of hours (1% of hours between 22:00-07:00 for bedrooms is 32 hours).

- All the bedrooms are well below the 1% set as a threshold when assessed with the 1989 weather data.
- Due to the night time air temperatures, when assessed with the DSY 01 – 2020 weather data, a couple of cases are within close proximity to the 1% margin. During temperature extremes supplementary cooling will be available from the mechanical plant.
- The internal doors within the apartments and the living room windows are assumed closed during sleeping hours. Considering the height of the building and the lack of any security issues if kept open during the night the results would improve.

Table 10 Bedroom fixed temperature test

Model Reference - TPH_12 With Blinds		LWC - 1989	DSY - 01
Apartment Reference	Room Reference	% Sleeping Hours >26°C	% Sleeping Hours >26°C
A1L10	A1L10 Double	0.34	0.71
A1L5-6	A1L5-6 Double 01	0.34	0.74
	A1L5-6 Double 02	0.43	0.95
	A1L5-6 Double 03	0.34	0.77
A3L10	A3L10 Studio	0.28	0.58
A4L3	A4L3 Double	0.31	0.62
D1L11-13	D1L11-13 Double 01	0.25	0.58
	D1L11-13 Double 02	0.25	0.52
	D1L11-13 Living/Single Bedroom	0.25	0.43
D1L1-2	D1L1-2 Double	0.28	0.62
D2L5-6	D2L5-6 Double 01	0.25	0.55
	D2L5-6 Double 02	0.31	0.62
D4L1-2	D4L1-2 Double 01	0.31	0.74
	D4L1-2 Double 02	0.34	0.74

5 Conclusions

The overheating assessment has been carried out using the GLA guidance combined with the proposed standardised methodology produced by Arup, CIBSE and others.

The standardised methodology requires a number of key assumptions to make modelling more realistic and useful. These are more accurate assumptions than normally used. Most significant are:

- Bedrooms should be modelled 24 hours per day
- A standard set of occupancies and internal gains should be used, as are here
- The impact of blinds should be explicitly demonstrated

In addition, this methodology changes the test criteria as follows:

- The weather year DSY1 - London_LWC_2020High50 and must pass the tests.
- 1976 and 2003 should be used for heat wave performance analysis
- TM52 Criterion 1 is the only important test for overheating in residential

With these assumptions and criteria all sample apartments modelled pass the TM52 Criterion 1 overheating risk assessment test with benefits of internal blinds included.

The GLA guidance is not clear on how heat wave years must perform against TM52. As a result, this report records the performance as follows:

LWC_2003 weather file:

- With the incorporation of internal blinds all rooms achieve compliance with TM52 criterion 1.
- All bedrooms pass.

LWC_1976 weather file:

- Three out of seven living room spaces fail TM52 Criterion 3, in most cases marginally.
- All bedrooms pass

As bedrooms are considered most critical for health, additional fixed temperature tests have been performed as illustrated below.

In order to comply with the fixed temperature test. The bedrooms were assessed to ensure that the operative temperature does not exceed 26°C for more than 1% of the night time hours.

- All the bedrooms are well below the 1% set as a threshold when assessed with the 1989 weather data.
- With the incorporation of internal blinds; none of the bedrooms exceed the 1% threshold when assessed with the DSY01_2020 weather data despite increased night time outside air temperatures.

The Overheating Assessment has been carried out in accordance with the cooling hierarchy set out in the London Plan. The design has been optimised to minimise overheating whilst providing good amenity for the residential units. It should be noted that all apartments are mechanically cooled so in the event of temperature extremes supplementary cooling will be available from the mechanical plant.

Appendix A

Sample Apartments mark-up & Openings Assumptions

Apartments selection for overheating analysis

Templar House
06/03/17 | For Information | AM
TH-SK-M-157-1

ARUP

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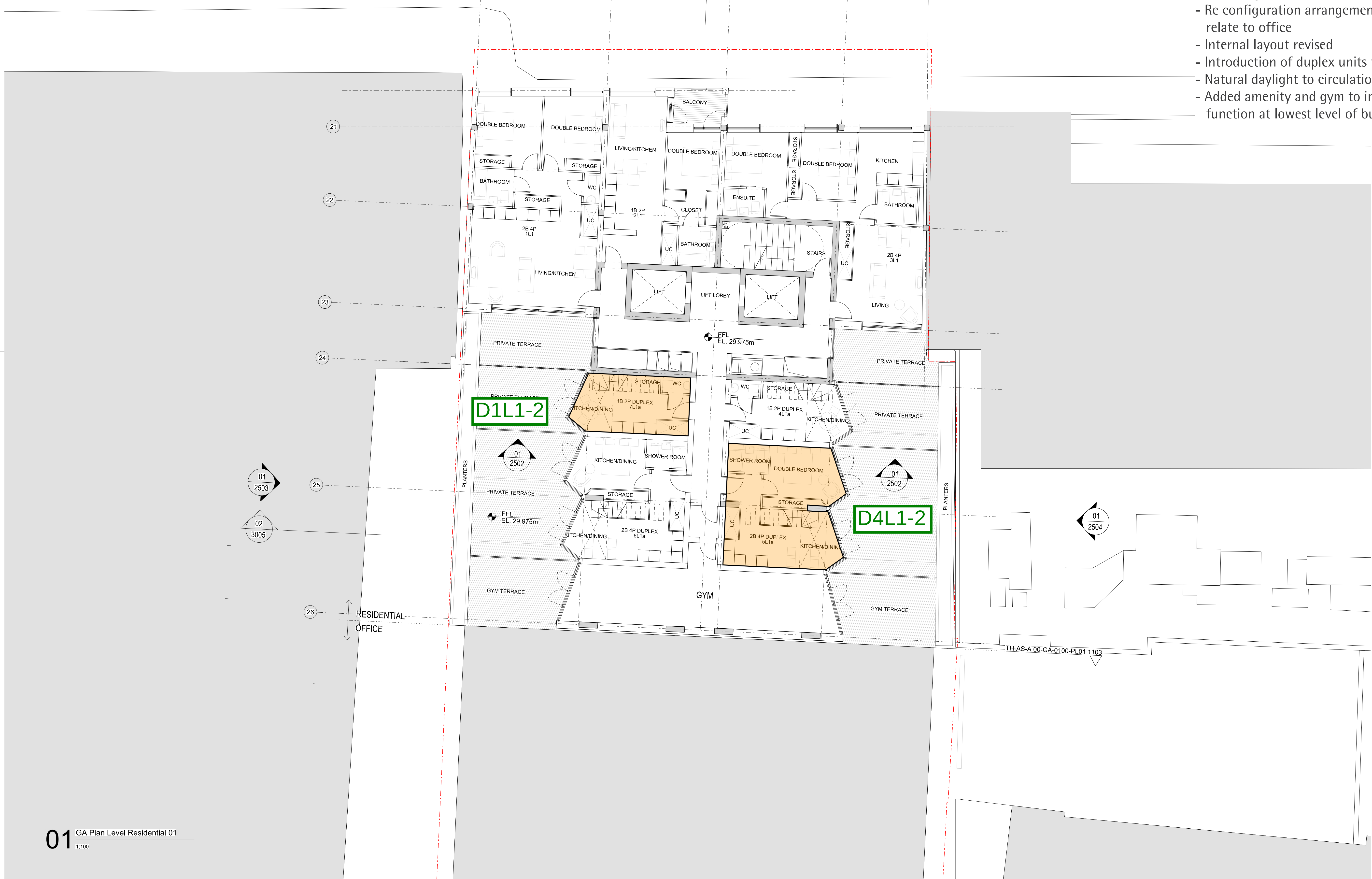
Page 57

AMENDMENTS:

- Re-configured core
- Re configuration arrangement of building to relate to office
- Internal layout revised
- Introduction of duplex units to improve amenity
- Natural daylight to circulation
- Added amenity and gym to improve outlook and function at lowest level of building



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P2	PLANNING AMENDMENT	26.02.2016	RB	DP
P3	PLANNING AMENDMENT 2	28.02.2017	NG	NG
original by ASTUDIO		19.06.2015	AL	MR

ASTUDIO architecture

Client: PLATFORM

Project: Templar_House

Drawing: Residential Level 1 Plan

Scale: 1:100 A1/1:200 A3

Project number: 14002

Issue status: PLANNING

Drawing number: TH-AS-A | 00-PL-0100-PLLM | 1302 | P3

Apartments selection for overheating analysis

Templar House

06/03/17 | For Information | AM

TH-SK-M-157-2

ARUP

PLANNING AMENDMENT DRAWING
MARCH 2017

ASTUDIO Architects | Templar House,
High Holborn, London |
Amendment to Planning Application 2015/4407/P
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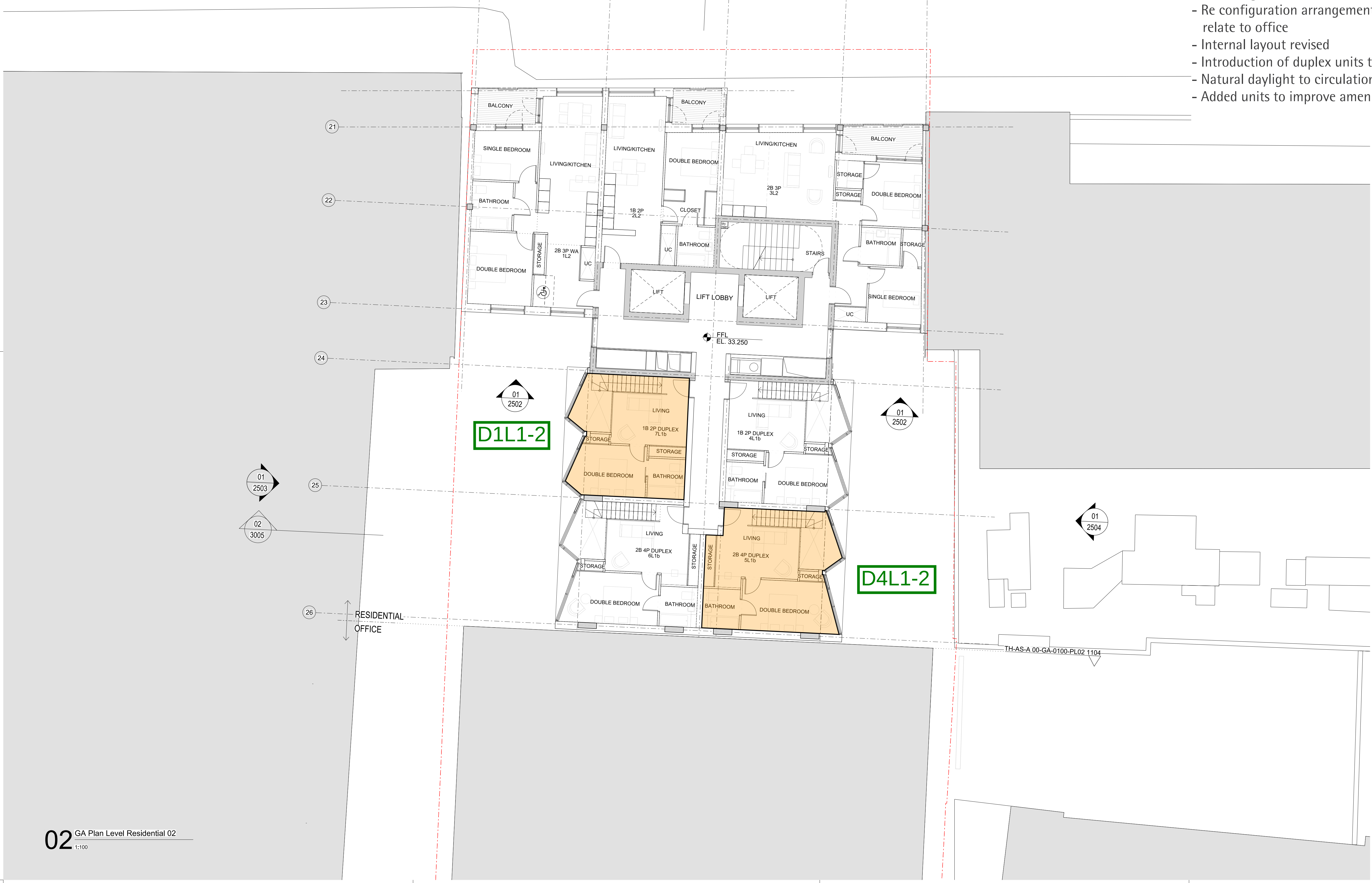
AMENDMENTS:

- Re-configured core
- Re configuration arrangement of building to relate to office
- Internal layout revised
- Introduction of duplex units to improve amenity
- Natural daylight to circulation
- Added units to improve amenity



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P3	PLANNING AMENDMENT 2	03.03.2017	NG	NG
original by ASTUDIO		19.06.2015	AL	MR

ASTUDIO architecture

Client: PLATFORM

Project: Templar_House

Drawing: Residential Level 2 Plan

Scale: 1:100 A1/1:200 A3

Project number: 14002

Issue status: PLANNING

Drawing number: TH-AS-A 00-PL-0100-PL01 1303 P3

Apartments selection for overheating analysis

Templar House

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TH-SK-M-157-3

ARUP

PLANNING AMENDMENT DRAWING
MARCH 2017

ASTUDIO Architects | Templar House,
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Page 61

AMENDMENTS:

- Re-configured core
- Re configuration arrangement of building to relate to office
- Internal layout revised
- Introduction of duplex units to improve amenity
- Natural daylight to circulation
- Added units to improve amenity

03 GA Plan Level Residential 03
1:100

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P3	PLANNING AMENDMENT 2	28.02.2017	NG	NG
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Client: PLATFORM

Project: Templar_House

Drawing: Residential Level 3 Plan

Scale: 1:100 A1/1:200 A3

Project number: 14002

Issue status: PLANNING

Drawing number: TH-AS-A 00-PL-0100-PL02 1304 P3

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Apartments selection for overheating analysis

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PLANNING AMENDMENT DRAWING
MARCH 2017

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High Holborn, London |
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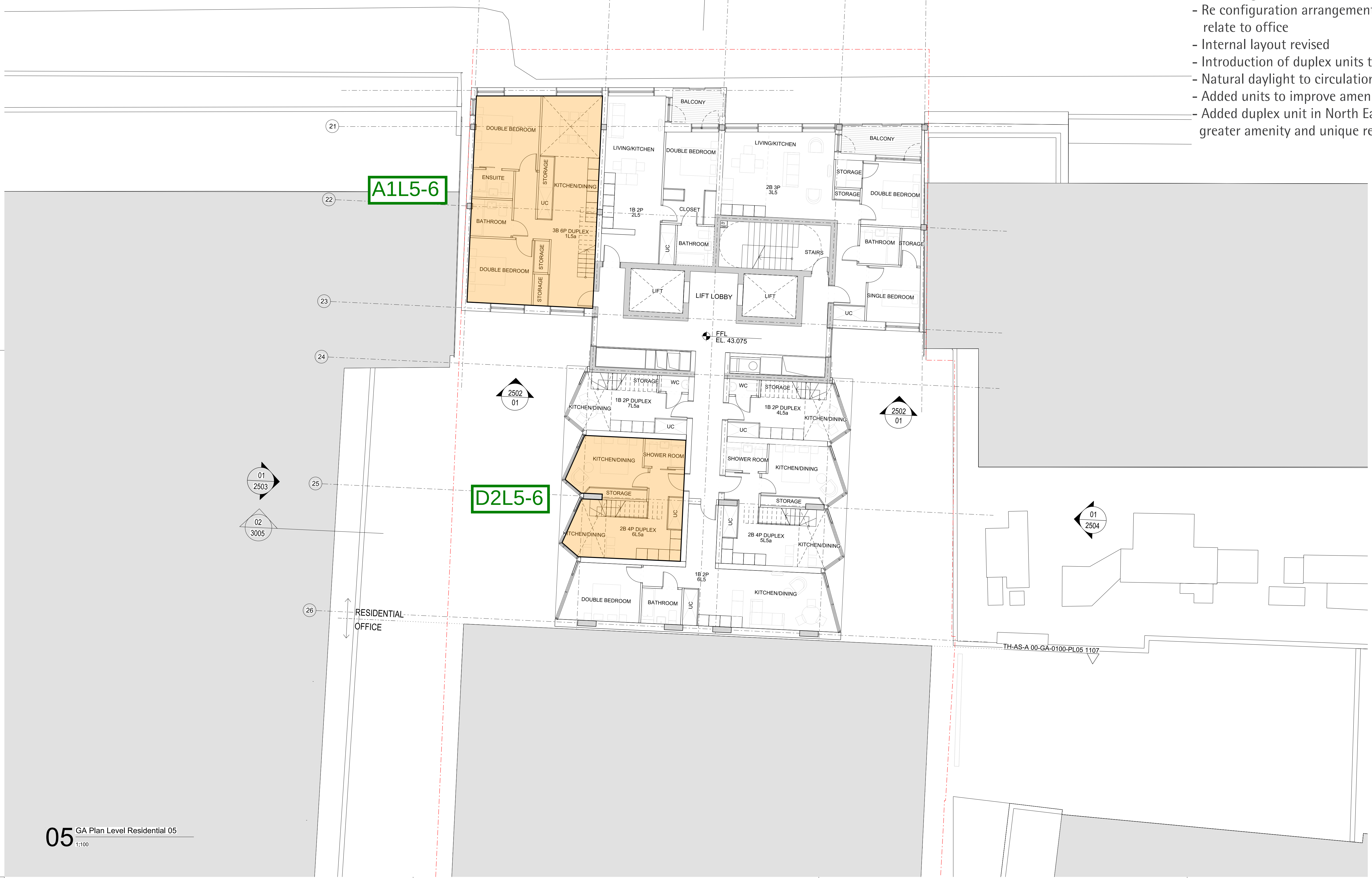
AMENDMENTS:

- Re-configured core
- Re configuration arrangement of building to relate to office
- Internal layout revised
- Introduction of duplex units to improve amenity
- Natural daylight to circulation
- Added units to improve amenity
- Added duplex unit in North East corner to create greater amenity and unique residential unit



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P2	PLANNING AMENDMENT	26.02.2016	RB	DP
P3	PLANNING AMENDMENT 2	26.02.2017	NG	NG
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Client: PLATFORM

Project: Templar_House

Drawing: Residential Level 5 Plan

Scale: 1:100 A1/1:200 A3

Project number: 14002

Issue status: PLANNING

Drawing number: TH-AS-A 00-PL-0100-PL04 1306 P3

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Apartments selection for overheating analysis

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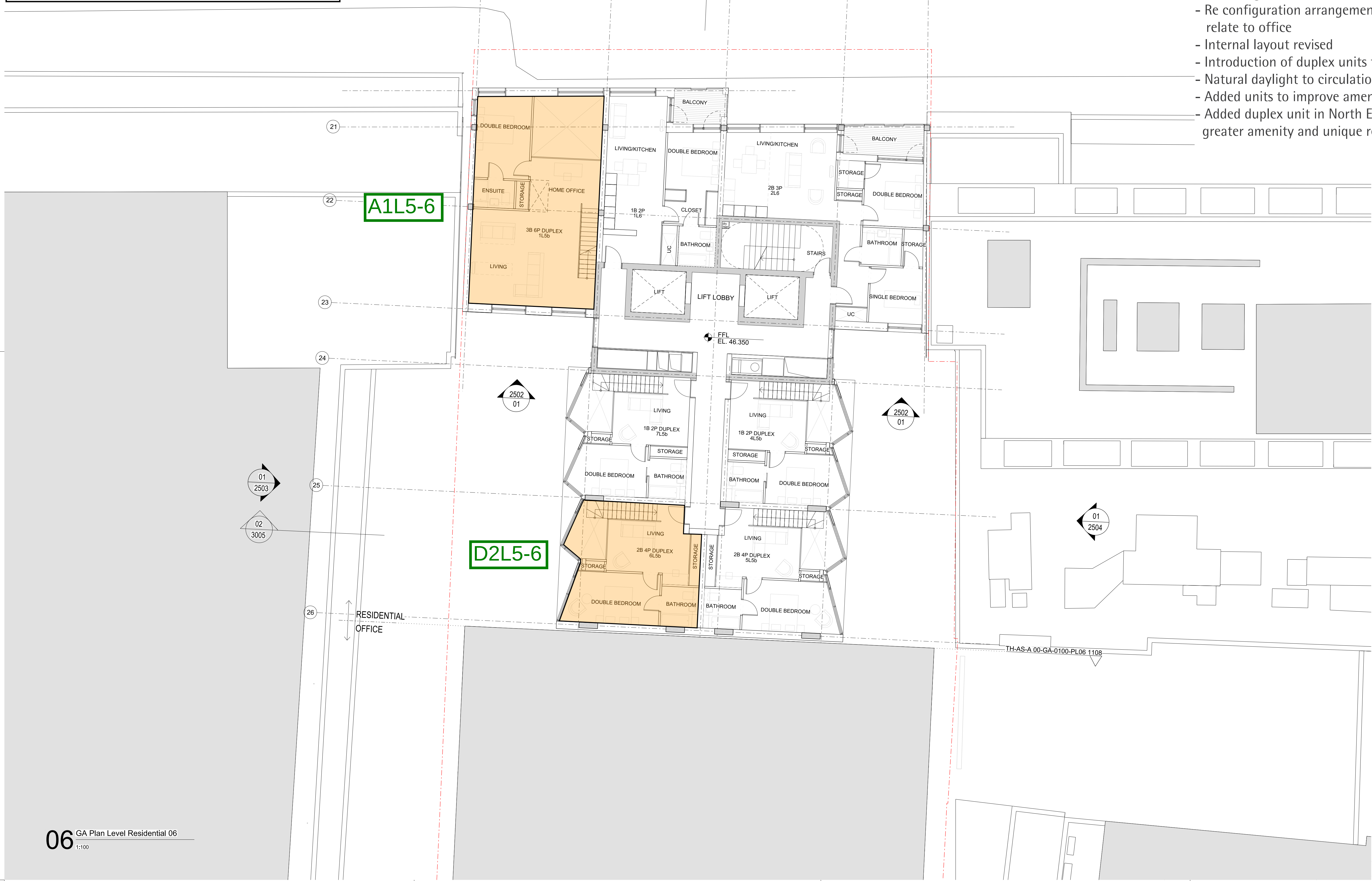
AMENDMENTS:

- Re-configured core
- Re configuration arrangement of building to relate to office
- Internal layout revised
- Introduction of duplex units to improve amenity
- Natural daylight to circulation
- Added units to improve amenity
- Added duplex unit in North East corner to create greater amenity and unique residential unit



06 GA Plan Level Residential 06

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Scale 1:100 @A1

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P2	PLANNING AMENDMENT	26.02.2016	RB	DP
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original by ASTUDIO		19.06.2015	AL	MR

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Client PLATFORM

Project: Templar_House

Drawing: Residential Level 6 Plan

Scale: 1:100 A1/1:200 A3

Project number: 14002

Issue status: PLANNING

Drawing number: TH-AS-A (ORIGINATOR) | 00-PL-0100-PL05 (ZONE-TYPE-PACK / TYPE-LEVEL/CODE) | 1307 (NUMBER) | P3 (REV)

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Apartments selection for overheating analysis

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TH-SK-M-157-6

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PLANNING AMENDMENT DRAWING
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Amendment to Planning Application 2015/4407/P
Page 75

AMENDMENTS:

- Re-configured core
- Natural daylight to circulation
- Added dual aspect to southern most apartments

Scale 1:100 @A1

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P2	PLANNING AMENDMENT	26.02.2016	RB	DP
P3	PLANNING AMENDMENT 2	28.02.2017	NG	NG
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Client: PLATFORM

Project: Templar_House

Drawing: Residential Level 10 Plan

Scale: 1:100 A1/1:200 A3

Project number: 14002

Issue status: PLANNING

Drawing number: TH-AS-A 00-PL-0100-PL09 1311 P3

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Apartments selection for overheating analysis

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PLANNING AMENDMENT DRAWING
MARCH 2017

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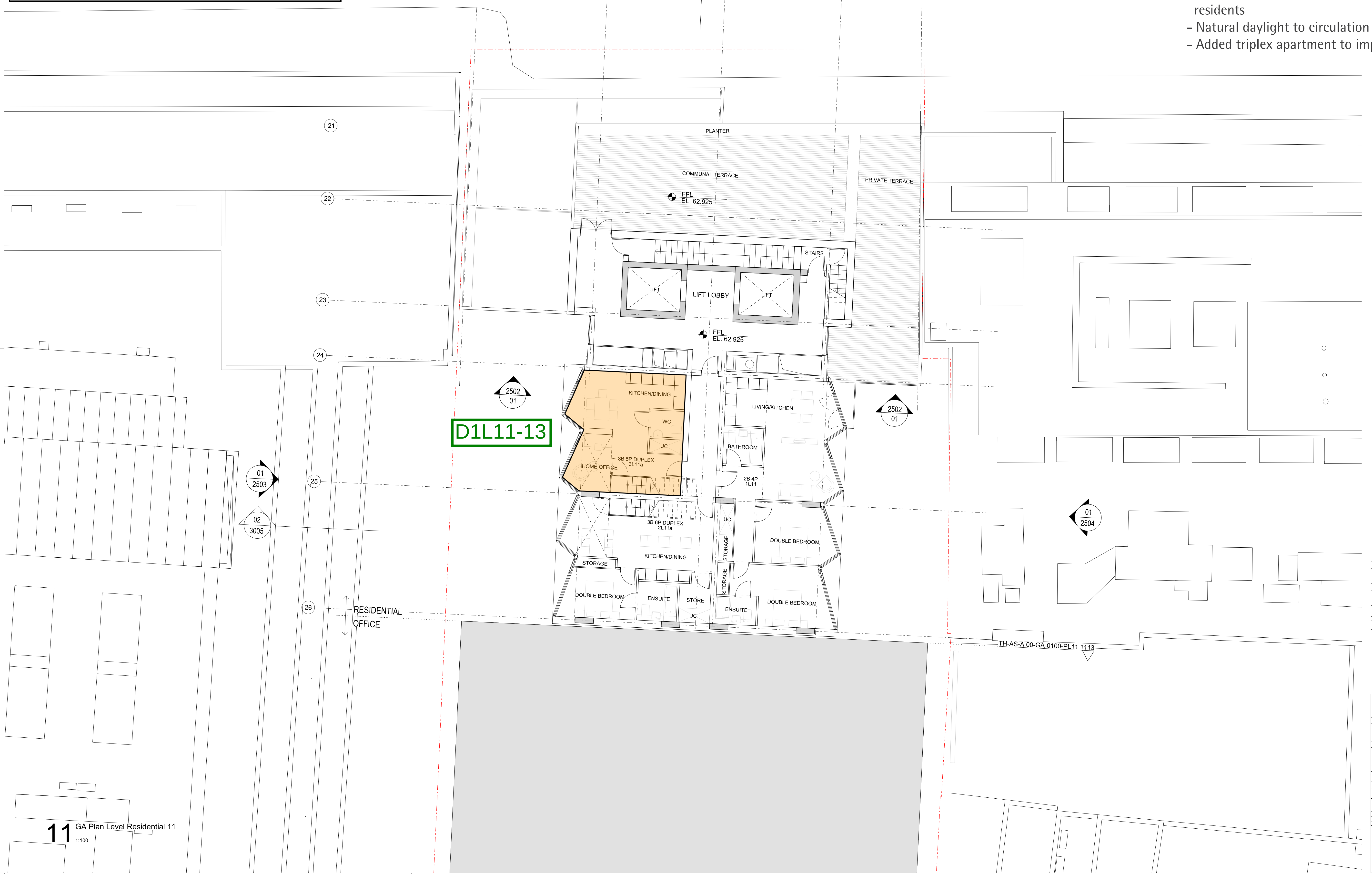
AMENDMENTS:

- Added communal terrace to improve amenity for residents
- Natural daylight to circulation
- Added triplex apartment to improve amenity



11 GA Plan Level Residential 11
1:100

Scale 1:100 @A1

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P2	PLANNING AMENDMENT	26.02.2016	RB	DP
P3	PLANNING AMENDMENT 2	28.02.2017	NG	NG
original by ASTUDIO		19.06.2015	AL	MR

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Client: PLATFORM

Project: Templar_House

Drawing: Residential Level 11 Plan

Scale: 1:100 A1/1:200 A3

Project number: 14002

Issue status: PLANNING

Drawing number: TH-AS-A (ORIGINATOR) | 00-PL-0100-PL10 (ZONE-TYPE-PACK TYPE-LEVEL/CODE) | 1312 (NUMBER) | P3 (REV)

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Apartments selection for overheating analysis

Templar House

06/03/17 | For Information | AM

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TH-SK-M-157-8

PLANNING AMENDMENT DRAWING MARCH 2017

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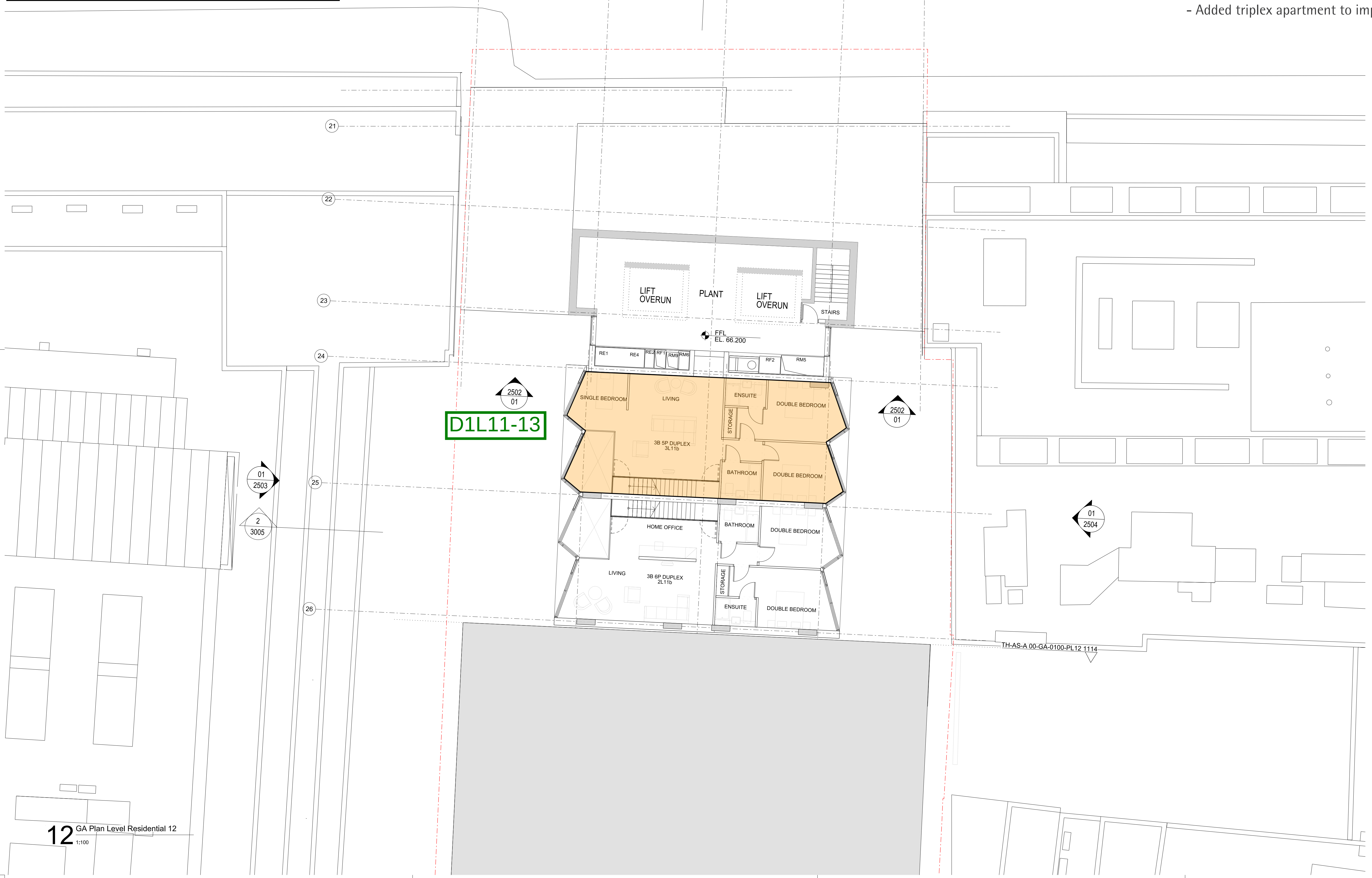
AMENDMENTS:

- Rationalised core
- Added triplex apartment to improve amenity



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P3	PLANNING AMENDMENT 2	28.02.2017	NG	NG
original by ASTUDIO		19.06.2015	AL	MR

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Client: PLATFORM

Project: Templar_House

Drawing: Residential Level 12 Plan

Scale: 1:100 A1/1:200 A3

Project number: 14002

Issue status: PLANNING

Drawing number: TH-AS-A | 00-PL-0100-PL11 | 1313 | P3

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Apartments selection for overheating analysis

Templar House

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PLANNING AMENDMENT DRAWING
MARCH 2017

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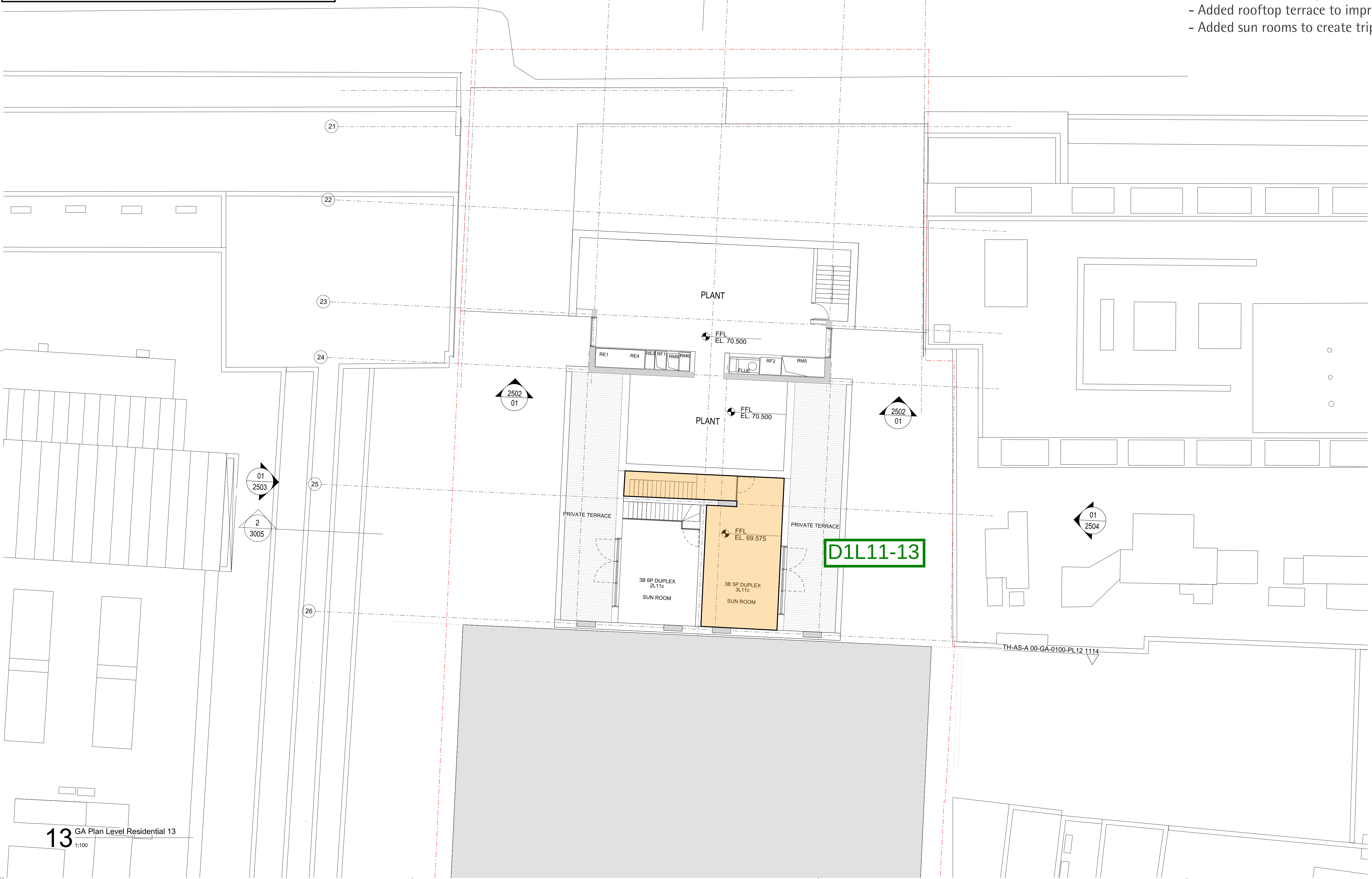
Amendment to Planning Application 2015/4407/P
Page 81

AMENDMENTS:
- Overall reduction in plant room height
- Added rooftop terrace to improve amenity
- Added sun rooms to create triplex apartments



Scale 1:100 @A1

rev	description	date	dr by	ap by
P1	PLANNING	16.07.2015	JK	DP
P2	PLANNING AMENDMENT	26.02.2016	RB	DP
P3	PLANNING AMENDMENT 2	28.02.2017	NG	NG
original by ASTUDIO		19.06.2015	AL	MR

ASTUDIO architecture

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Client PLATFORM

Project
Templar_House

Drawing
Residential Level 13 Plan

Scale
1:100 A1/1:200 A3

Project number
14002

Issue status
PLANNING

Drawing number

TH-AS-A	00-PL-0100-PL12	1314	P3
ORIGINATOR	ZONE-TYPE-PACK TYPE-LEVEL/CODE	NUMBER	REV

Disclaimer

Apartments selection for overheating analysis

Templar House

06/03/17 | For Information | AM

TH-SK-M-157-10

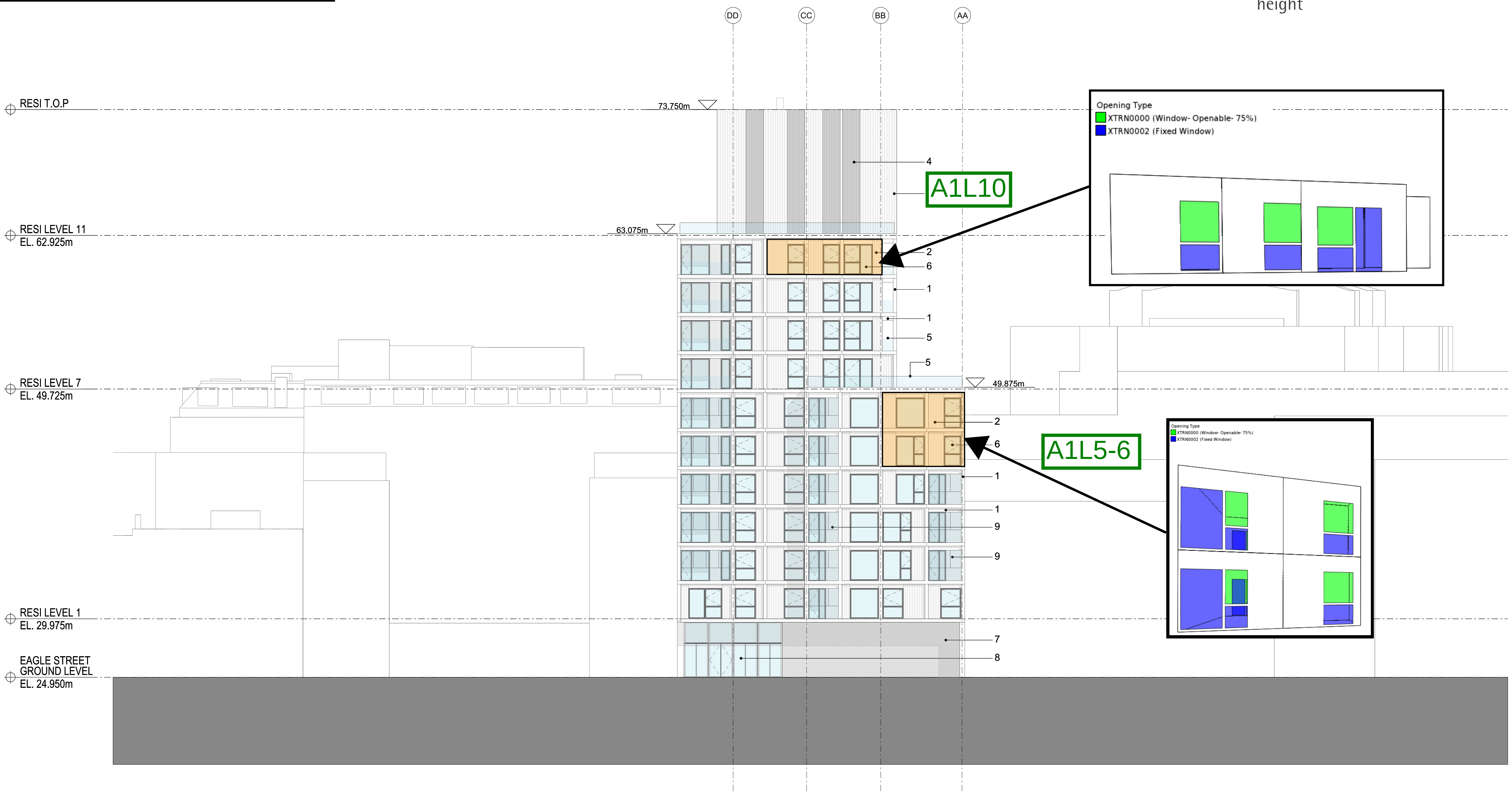
ARUP

PLANNING AMENDMENT DRAWING MARCH 2017

ASTUDIO Architects | Templar House, High Holborn, London | Amendment to Planning Application 2015/4407/P Page 93

AMENDMENTS:

- Overall reduction in height by reducing entrance height



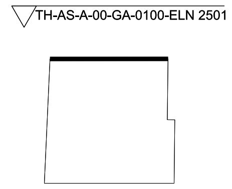
01 RESIDENTIAL: NORTH ELEVATION

1:200

MATERIALITY

1. Reconstituted stone
2. 50% flat/ 50% corrugated glazed terracotta
3. Flat glazed terracotta spandrel
4. Glazed terracotta baguettes
5. Structural glazed balustrade
6. Triple glazing windows and balcony doors
7. High quality metal louvred panels with integrated flushed doors
8. Double glazed curtainwall entrance
9. Winter garden glazing

KEY PLAN



0 2 4 6 8 10m

Scale 1:200

rev	description	date	dr by	ap by
P1	PLANNING	16/07/2015	JK	SW
P2	PLANNING AMENDMENT	26.02.2016	JK	SW
P3	PLANNING AMENDMENT 2	03.03.2017	AP	MR
original by ASTUDIO		29.06.2015	AL	MR

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Client: C-L-I-E-N-T

Project: P-R-O-J-E-C-T N-A-M-E

Drawing: Residential North Elevation

Scale: 1:200 A1

Project number: 0-0-0-0-0

Issue status: PLANNING

Drawing number:

ORIGINATOR	CODE 1	CODE 2	CODE 3	REV
	00-P	L-0100-EL	2501	P3

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Apartments selection for overheating analysis

Templar House

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TH-SK-M-157-11

ARUP

PLANNING AMENDMENT DRAWING MARCH 2017

ASTUDIO Architects | Templar House, High Holborn, London | Amendment to Planning Application 2015/4407/P

Page 95

AMENDMENTS:

- Overall reduction in height of building
- Introduction of glazing to circulation to provide natural daylight
- Addition of sun rooms and terraces reduce visual impact of top of building

MATERIALITY

1. Reconstituted stone
2. 50% flat/ 50% corrugated glazed terracotta
3. Flat glazed terracotta spandrel
4. Glazed terracotta baguettes
5. Structural glazed balustrade
6. Triple glazing windows and balcony doors
7. High quality metal louvred panels with integrated flushed doors
8. Double glazed curtainwall entrance
9. Winter garden glazing

KEY PLAN

TH-AS-A-00-GA-0100-ELN 2503

Scale 1:200

rev	description	date	dr by	ap by
P1	PLANNING	16/07/2015	JK	SW
P2	PLANNING AMENDMENT	26.02.2016	JK	SW
P3	PLANNING AMENDMENT 2	03.03.2017	AP	MR
original by ASTUDIO		29.06.2015	AL	MR

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Client: C-L-I-E-N-T

Project: P-R-O-J-E-C-T N-A-M-E

Drawing: Residential West Elevation

Scale: 1:200 A1

Project number: 0-0-0-0-0

Issue status: PLANNING

Drawing number: 00-PL-0100-EL 2503 P3

Disclaimer

This drawing is to be read in conjunction with all related drawings. Do not scale from this drawing. All dimensions must be checked and verified on site before commencing any work or producing shop drawings. The originator should be notified immediately of any discrepancy. This drawing is copyright and remains the property of and ASTUDIO Architecture.

Apartments selection for overheating analysis

Templar House
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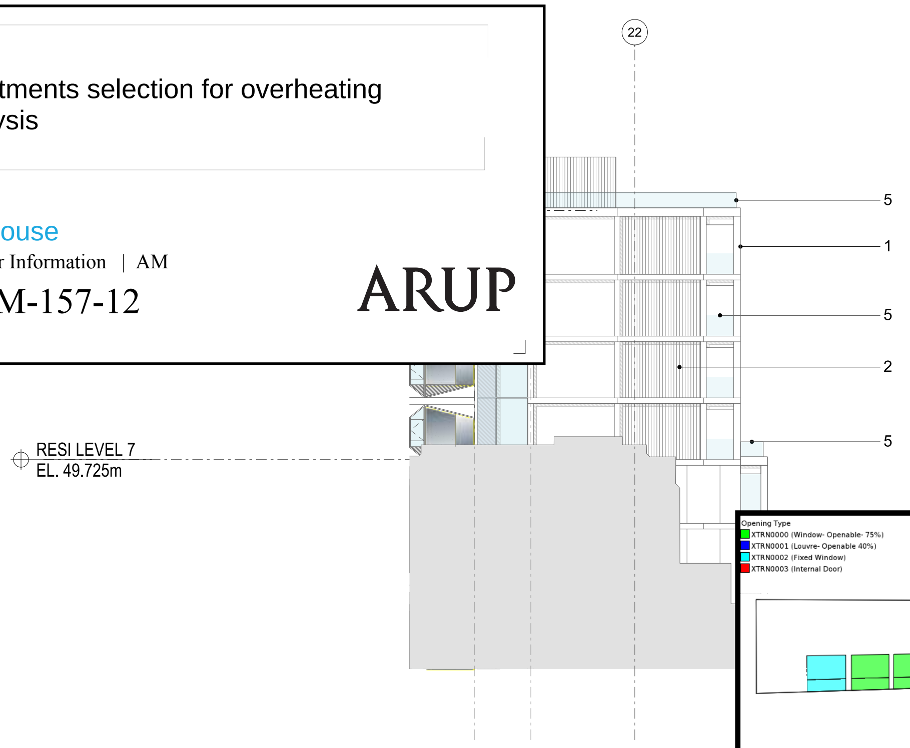
TH-SK-M-157-12

ARUP



01 RESIDENTIAL: EAST GABLE ELEVATION
1:200

PLANNING AMENDMENT DRAWING MARCH 2017

ASTUDIO Architects | Templar House, High Holborn, London | Amendment to Planning Application 2015/4407/P Page 97

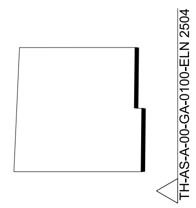
AMENDMENTS:

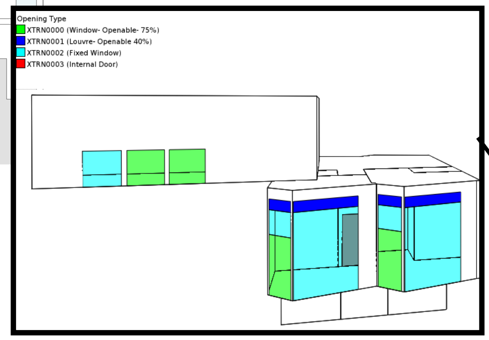
- Overall reduction in height of building
- Introduction of glazing to circulation to provide natural daylight
- Addition of sun rooms and terraces reduce visual impact of top of building

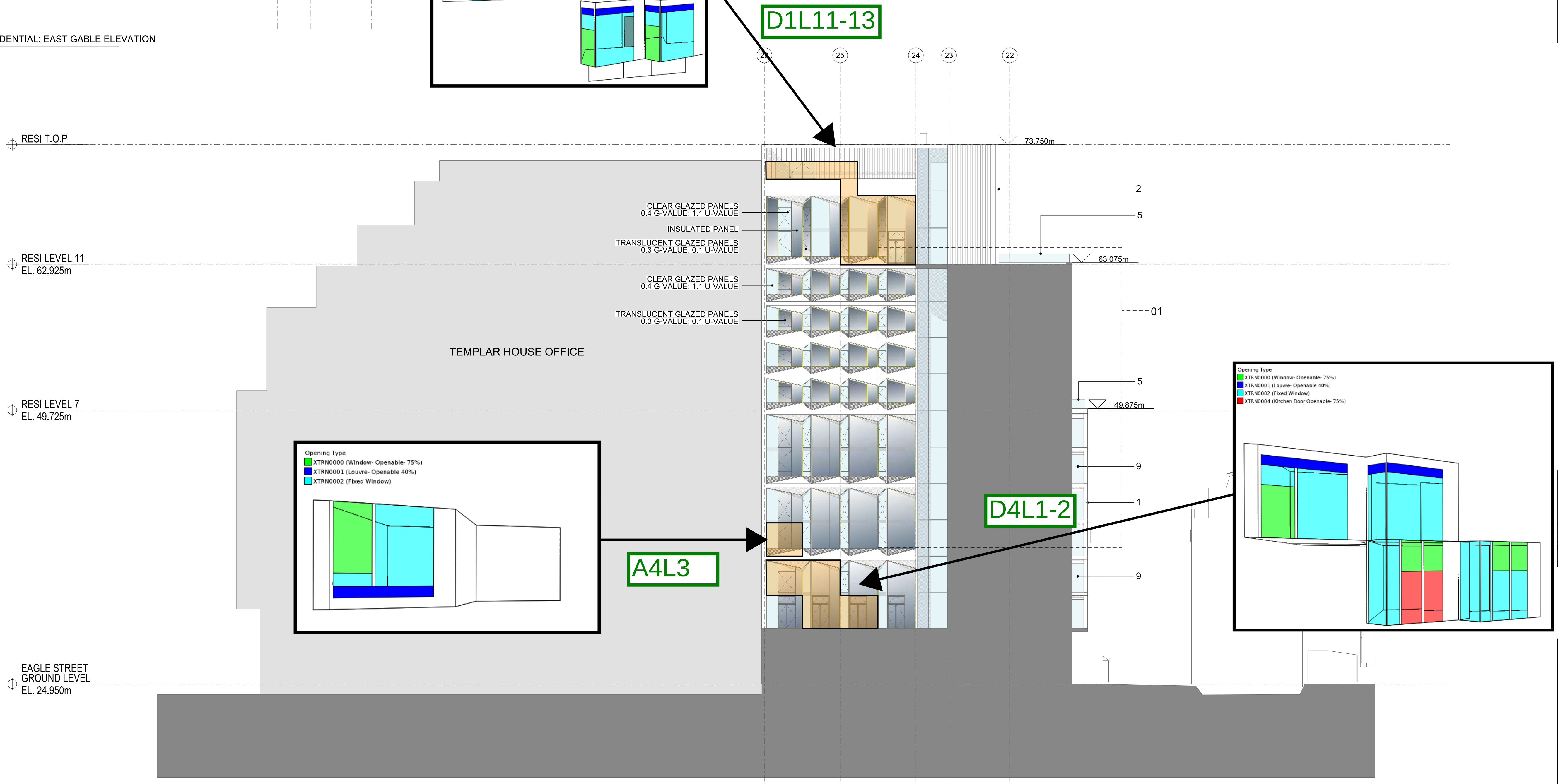
MATERIALITY

1. Reconstituted stone
2. 50% flat/ 50% corrugated glazed terracotta
3. Flat glazed terracotta spandrel
4. Glazed terracotta baguettes
5. Structural glazed balustrade
6. Triple glazing windows and balcony doors
7. High quality metal louvred panels with integrated flushed doors
8. Double glazed curtainwall entrance
9. Winter garden glazing

KEY PLAN







02 RESIDENTIAL: EAST ELEVATION
1:200

0 2 4 6 8 10m
Scale 1:200

rev	description	date	dr by	ap by
P1	PLANNING	16/07/2015	JK	SW
P2	PLANNING AMENDMENT	26.02.2016	JK	SW
P3	PLANNING AMENDMENT 2	03.03.2017	AP	MR
original by ASTUDIO		29.06.2015	AL	MR

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Client
C-L-I-E-N-T

Project
P-R-O-J-E-C-T N-A-M-E

Drawing
Residential East Elevation

Scale
1:200 A1

Project number
0-0-0-0-0

Issue status
PLANNING

Drawing number
00-PL-0100-EL 2504 P3

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