DKPartnership Dublin Cork London
T : 01-813-1930 T : 064-664-1686
E : post@dkpartnership.com

5020 Daylight Reception Report

DAYLIGHT RECEPTION IN HABITABLE ROOMS WITHIN THE PROPOSED DEVELOPMENT

Raheen Housing Development

Proposed Residential Development

Ballykeeffe,
Raheen,
Co. Limerick

DW Raheen Developments Ltd

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ING Gerard (Craig) van Deventer CEng., BE(mech)., HDip CIOB, MCIBSE

M : [00] 353 (0)87 260 8080
E : gerard@dkpartnership.com

DKPartnership
70 Main Street, Applewood , Swords, Co. Dublin, Ireland
Reen Kenmare Co. Kerry

post@dkpartnership.com
www.dkpartnership.com

T : [00] 353 (0) 1813 1930
T : [00] 353 (0)64664 1686

Contents

1 Introduction

1.1 Report purpose

This report gives information on the level of achieved daylight reception in habitable rooms within the proposed new development.

1.2 Instruction

DKPartnership (DKP) have been commissioned by DW Raheen Developments Ltd, to carry out the analysis and report for the proposed development at Ballykeeffe, Raheen, Co. Limerick.

1.3 Development description

DW Raheen Developments Ltd. are seeking a ten year permission for a strategic housing development consisting of the provision of 384 residential house and apartment units on a ca. 10.44 hectare site located in Ballykeeffe, Raheen, Co. Limerick. The site is greenfield land that is enclosed by existing residential development to the south and east, the R510 to the west and open land to the north. Access to the site is provided by an existing entrance off a roundabout on the R510 regional road. The proposed development will provide as follows:

- 202 no. housing units, comprising a variety of forms to include bungalows, detached, semi-detached and terraced houses. A mix of house sizes are proposed to include 20 no. two bedroom houses, 156 no. three bedroom houses and 26 no. four bedroom houses.
- 182 apartment and duplex units across 25 small scale blocks, 2 to 4 storeys in heights, throughout the development. The apartments and duplexes provide a mix of one, two, three and four bed units, comprising of 10 no. four bedroom duplex units, 10 no. three bedroom duplex units, 6 no. two bedroom duplex units, 18 no. three bedroom apartments, 92 no. two bedroom apartments and 46 no. one bedroom apartments.

The proposed development also includes;

- A childcare facility measuring 761.75m2, providing 79 childcare places (55 full time and 24 after school places), located at the south-western edge of the development.
- The provision of 377 no. car parking spaces and 311 secured bicycle parking spaces.
- The provision of 3 no. ESB sub-stations, ancillary services and infrastructure works including foul and surface water drainage, attenuation areas, landscaped public open spaces (approximately 29,500m2, or 28.2% of the total site area), landscaping, lighting, internal roads, cycle paths, and footpaths.

A Natura Impact Statement (NIS) and Environmental Impact Assessment Report (EIAR) have been prepared in respect of the proposed development.

1.4 Policy and building regulation requirements

There are no particular building regulations in relation day light/shadow effect standards other than recommendations outlined or referred to in the CIBSE lighting guide 10, BS EN17037/EN17037 and the BRE document" Site layout planning for daylight and sun light".

2 Executive summary

2.1 Analysis conducted

This report details the achieved calculated daylight reception in habitable rooms within the new development and compares these for compliance with the recommendations of the relevant guidelines and standards.

2.2 Daylight reception and building orientation

Day light reception in habitable rooms within the proposed development under the BRE, CIBSE and BS EN17037/EN17037 is calculated using the area of the glazed element, the room depth/height ratio, the room light reflection capability and the amount of direct or blocked/partially blocked daylight it receives. i.e. building orientation is not relevant to day light reception or daylight reception calculations. In other words day light factor analysis is equal to all orientations. This note is for clarity as day light is often confused with sunlight or sunlight energy which is effected by orientation.

2.3 Guidelines and standards applied

For this report we applied the recommendations and guideline of the following;

- The Building Research Establishment (BRE) report, site layout planning for daylight and sunlight – a guide to good practice (referred to as the BRE Report).
- British European Standard BS EN17037/EN17037 Day lighting standards and contains guidance on the minimum recommended levels of interior day lighting.
- CIBSE guide 10 Day light and lighting for buildings.

2.4 Technical analysis

The amount of daylight received in a room is calculated and expressed as a daylight factor. This calculated daylight factor is then compared with the BRE recommended room daylight factor to ensure sufficient daylight reception. Calculations were conducted in accordance with the BRE guidelines to determine the average day light factor in a number of selected rooms within the new development. These selected rooms are generally in (daylight) challenging locations typically based at the lowest (ground floor) levels given that these would receive the least amount of day light. Once the ground floor rooms achieve compliance all other rooms at higher levels with similar room/window configurations and parameters will also achieve compliance as the vertical daylight impact angle will improve increasing the daylight reception typically 0.3%-0.5% per floor level (3m).

2.5 Daylight reception in rooms within the new development conclusion

The calculation assessment was segregated according to building type, these are;
(I) Residential Apartment blocks – A, B, C, D and E.
(II) Residential Housing

The BRE report recommends as a methodology for assessing sufficient daylight reception in a habitable room, that the calculated average daylight factor (ADF) of a habitable room to be in excess of the BRE bench marks of a kitchen at 2%, a living room at 1.5%, a bedroom at 1% and a living room/bedroom at 1.5%. Calculation findings are as follows; (see images in chapter 5 for receptor locations):

(I) Residential Apartment blocks – A, B, C, D and E.
From the calculation results in table 5.1 we note;

Apartment Block A:

- Level 00: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines or are equal to minimum recommendations.
- Level 01: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines.
  All floors above the first floor apartments are further deemed compliant as they naturally would have an improved vertical daylight impact angle thus increasing the daylight reception factor typically 0.3%-0.5% per floor level.

Apartment Block B:

- Level 00: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines or are equal to minimum recommendations.
- Level 01: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines.

All floors above the first floor apartments are further deemed compliant as they naturally would have an improved vertical daylight impact angle thus increasing the daylight reception factor.

Apartment Block C:
- Level 00: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines or are equal to minimum recommendations.
  All floors above the ground floor apartments are further deemed compliant as they naturally would have an improved vertical daylight impact angle thus increasing the daylight reception factor.

Apartment Block D:
- Level 00: 2 no. receptors 88 and 93 (bedrooms) resulted in a ADF of 0.72%, which is below the recommended 1.00% ADF for bedrooms. All other selected habitable rooms have achieved an ADF in excess of the BRE guidelines.
- Level 01: 2 no. receptors 101 and 106 (bedrooms) had a ADF of 0.72%, which is below the recommended 1.00% ADF for bedrooms. All other selected habitable rooms have achieved an ADF in excess of the BRE guidelines.
  All floors above the first floor apartments are further deemed compliant as they naturally would have an improved vertical daylight impact angle thus increasing the daylight reception factor.

Apartment Block E1:
- Level 00: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines or are equal to minimum recommendations.
- Level 01: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines.
  All floors above the first floor apartments are further deemed compliant as they naturally would have an improved vertical daylight impact angle thus increasing the daylight reception factor.

Apartment Block E2:
- Level 00: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines or are equal to minimum recommendations.
- Level 01: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines.
  All floors above the first floor apartments are further deemed compliant as they naturally would have an improved vertical daylight impact angle thus increasing the daylight reception factor.

(II) Residential Housing
From the calculation results in table 5.2 we note;
- Level 00: All selected habitable rooms have achieved an ADF in excess of the recommended BRE guideline. Rooms above the ground floor are further deemed compliant as they naturally would have an improved vertical daylight impact angle thus increasing the daylight reception factor.

Mitigation measures:
4 no. receptors have been highligted in the result table 5.1, because these rooms resulted in ADF's below the minimum BRE guidelines. Receptor no. 88, 93, 101 and 106 are all located in block D, their room type all 'bedroom'.

In order to improve the ADF results, further analysis to receptors 88, 93, 101 and 106 was implemented using different calculation parameters.

The width of the window dimension was changed to 1200mm (currently taken as 800mm).

This significantly improved the result, thus receptor 88 and 93 resulted in a ADF of 1.10% with this mitigation measure in place and receptor 101 and 106 resulted in a ADF of 1.30%. See the before mitigation and after mitigation in table 5.3 below.

Before mitigation:

Receptor	Block	Unit ID	Receptor Level	Room / type	Hor Sec a Hor ∟°	Hor Sec a Vert ∟°	Hor Sec b Hor ∟°	Hor Sec b Vert ∟°	Hor Sec c Hor ∟°	Hor Sec c Vert ∟°	Hor Sec d Hor ∟°	Hor Sec d Vert ∟°	∑ Hor ∟	∑ VSC ∟	glass area m2	Room width m	Room depth m	Room height m	Room ADF %	BRE ADF %
88		Apt D	**00**	Bed room	80	77	42	57	9	10	49	27	180	15%	1.44	3.00	4.40	2.70	0.72	1.00
93		Apt D	**00**	Bed room	81	77	41	57	9	10	49	27	180	15%	1.44	3.00	4.40	2.70	0.72	1.00
101		Apt D	**01**	Bed room	80	74	42	52	9	8	49	22	180	17%	1.44	3.00	4.40	2.70	0.81	1.00
106		Apt D	**01**	Bed room	81	74	41	52	9	8	49	22	180	17%	1.44	3.00	4.40	2.70	0.81	1.00

With mitigation measures in place:

88		Apt D	**00**	Bed room	80	77	42	57	9	10	49	27	180	15%	2.16	3.00	4.40	2.70	1.10	1.00
93		Apt D	**00**	Bed room	81	77	41	57	9	10	49	27	180	15%	2.16	3.00	4.40	2.70	1.10	1.00
101		Apt D	**01**	Bed room	80	74	42	52	9	8	49	22	180	17%	2.16	3.00	4.40	2.70	1.30	1.00
106		Apt D	**01**	Bed room	81	74	41	52	9	8	49	22	180	17%	2.16	3.00	4.40	2.70	1.30	1.00

Table 5.3: mitigation results

Given the results and conclusions above, DKP deem the residential project at Raheen except for 4 no. receptors to be in line with the recommendations in the BRE design guidelines 'site layout and planning for daylight and sunlight - a guide to good practice' and therefore in compliance with the BRE design guide.

We further conclude that if the DKP recommended mitigation measures are carried out that the daylight reception in the receptors below minimum guidelines will also be in excess of the BRE recommendations.

3 Geographical overview

3.1 Project overview

Image 3.1 the (google) site map below indicates the location of the site approximately outlined.

Image 3.1 proposed development site boundary

4 Approach and methodology

4.1 General approach

This report covers the day light reception of habitable rooms within the new proposed development. The day light reception is expressed as the average day light factor (ADF) in the following rooms:
- Bed rooms within dwellings
- Living rooms/dining rooms
- Kitchens
- Any combination of the above

4.2 The nature and effects of day light and sun light

When assessing the effects of proposed building projects on the potential to cause issues relating to light, it is important to recognise the distinction between daylight and sunlight. Daylight is the combination of all direct and indirect sunlight during the daytime, whereas sunlight (for the purposes of this report) comprises only the direct elements of sunlight. For example, on a cloudy or overcast day diffused daylight still comes in through windows, even when sunlight is absent. Any development within a built-up area has the potential to alter the amount of daylight received by nearby residential properties.
Care should be taken when designing new buildings in built-up areas, especially when the proposed development is relatively tall or situated to the south of existing buildings, because in the northern hemisphere the majority of the sunlight comes from the south. In Ireland (and other northern hemisphere countries) south-facing facades will in general, receive the most sunlight, while the north facing facades will receive sunlight on only a handful of occasions, specifically early mornings and late evenings during the summer months. It is therefore important to ensure that new buildings to the south of any development do not cause over shadowing to existing dwellings and therefore reduce their capacity to receive sunlight.

4.3 Assessment criteria

National Policy/building regulations:
The government does not have an adopted policy on daylight, sunlight and the effects of overshadowing, and does not have targets, criteria or relevant planning guidance in the way it has for other environmental impacts such as noise, landscape or air quality. However, there are a number of guidance documents which are relevant when considering daylight, sunlight and overshadowing in dwellings:
- The Building Research Establishment (BRE) report, "Site layout planning for daylight and sunlight – a guide to good practice (referred to as the BRE Report).
  Although not Government guidance, this report is commonly referenced as the main guide in Ireland/UK in determining the minimum standards of daylight and sunlight and for determining the impact of a development.
- British European Standard BS EN17037 / EN17037 Day Lighting for buildings.
  BS EN17037/EN17037 contains guidance on the minimum recommended levels of interior day lighting and introduces some of the calculation procedures used in the BRE Report.
- CIBSE guide 10 Day light and lighting for buildings.
  CIBSE lighting guide 10, BS EN17037/EN17037 contains guidance on the minimum recommended levels of interior day lighting and introduces recommended day light levels for general buildings.

4.4 The BRE Report – "Site Layout and Planning for Daylight and Sunlight – A Guide to Good Practice"

The BRE report contains guidance on how to design developments whilst minimising the impacts on existing buildings from overshadowing and reduced levels of daylight and sunlight. The advice provided within the guide is not mandatory and should not be seen as an instrument of planning policy, its aim is to help rather than constrain the designer. Although it gives numerical guidance values these should be interpreted flexibly since natural lighting is one of many factors in site layout design. The guidance should be applied appropriately to developments to assist in gaining the best development possible without adverse impacts.

As well as advice the report contains a methodology to assess levels of daylight, sunlight and over shadowing and contains criteria to determine the potential impacts of a new development on surrounding buildings. Table 4.1 below details the BRE assessment criteria for daylight reception within the proposed development.

Analysis	Description	Acceptable parameters
Daylight reception criterion	Average daylight factor (ADF)	Habitable rooms to have ADF factors between 1% and 2% pending room type

Table 4.1

There are also recommendations with regards to minimum proposed glazed area in facades in relation to the available sky view component angle. BS EN17037/EN17037 gives guidance on the minimum glazed area with different virtual sky component angles to maintain sufficient daylight reception. Table 4.2 presents the minimum glazed areas fractions relative to the available sky view angle.

Room depth	VSC <=25°	VSC >=25° <=45°	VSC >=45° <=65°	VSC >=65°	Comments
1 to 8	20%	20% - 31%	31% - 35%	35% - 40%	
8 – 11	25%	25% - 40%	40% - 44%	44% - 50%	
11 – 14	30%	30% - 47%	47% - 53%	53% - 60%	
14 - 20	35%	35% - 54%	54% - 61%	61% - 70%	

Table 4.2

4.5 ADF or Average day light factor

The average day light assessment is the amount of day light received by the habitable rooms in the proposed development only. Whereas there are no standards applied for day light factors there are recommendations published in the CIBSE guides and BRE documents in relation to the percentage and minimum area of the room/area to conform to same. Table 4.4 below represents recommended minimum day light factors.

Habitable room types		Minimum day light factor	Minimum floor area cover
Multi-residential buildings	Kitchen	2%	75%
Multi-residential buildings	Living rooms, dining rooms,	1.50%	70%
Multi-residential buildings	Bedrooms	1%	50%

Table 4.3

4.6 ADF or Average Daylight Factor calculation method

The average daylight factor provides a useful technique for assessing the daylight potential of interior spaces under standard overcast conditions. The average daylight factor *df* is defined as;

$df = TAw\ q / [A\ (1-R^2)]\ \%$

where,
T is the diffuse visible transmittance of the glazing, including corrections for dirt on glass
Aw is the net glazed area of the window (m^2)
A is the total area of the room surfaces: ceiling, floor, walls and windows (m^2)
R is their average reflectance of the ceiling, walls and floor surfaces
q is the angle of visible sky in degrees (VSC)

4.7 Project ADF calculation parameters

The following calculation parameters have been applied. For T (Em), the overall maintained light transmittance into the room we applied a conservative 0.66. Current triple glazed elements can now be supplied with light emittance in excess of 0.72 effecting/improving the final resultant ADF by a further 0.3% to 0.5%.

Glass light emittance	0.72
Glazing maintenance factor	8%
Maintained light emittance Em	0.66

For R (Rf), the average reflectance of the walls, ceiling and floor we have used an overall average figure 0.61 representing a dark floor, medium dark walls and a light ceiling. R can also be significantly improved by implementing lighter colours on the walls and floor effecting/improving the ADF by 0.5% to 0.7%.

Ceiling	0.8	95%	Light
Walls	0.5	80%	Medium dark
Floor	0.4	70%	Dark
Combined Rf	0.61		

For q, the vertical sky component angle we use the combined calculated vertical sky component over the full visual horizontal plane from the relevant window/room point. i.e. at each obstacle in the general 180° horizontal view plane the vertical sky component is measured and combined to form the overall resultant VSC. The illustration 4.1 below shows the room analysed to be effected by 3 different vertical sky component angles A, B and C on its horizontal plane. The resultant VSC is a calculated combination of all three VSC angles.

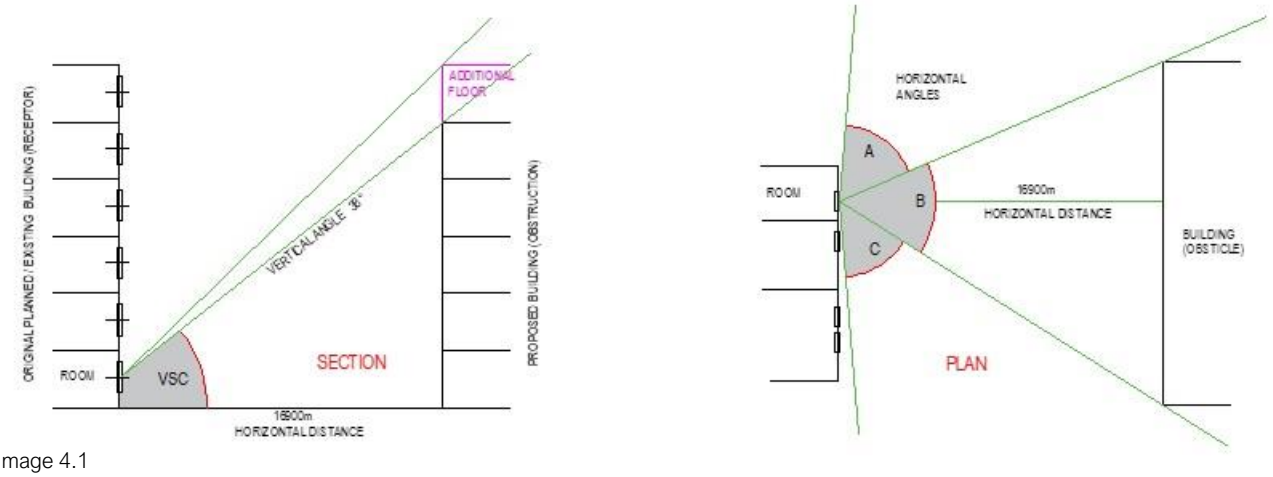

Image 4.1

5 Basis of receptor selection of habitable rooms within the development and Calculation results

5.1 Basis of receptor (room) selection

The daylight reception assessment has been targeted to rooms which are perceived to receive less day light i.e. ground floor rooms / first floor room / rooms facing close-by large obstacles. Once a (lowest level) room is compliant, rooms at higher levels with similar configuration / parameters are deemed compliant on the basis that the room daylight factor would have improved due to the better vertical sky view angle of higher located rooms. A combined total of 196 room locations have been selected on the basis that these locations are more daylight challenging.

5.2 Assessment approach and colour indicators

The result table provide the full calculation results of the selected rooms including the overall calculated vertical sky component together with the 'to-be-achieved' BRE minimum daylight factor standards.
The assessment has been segregated according to building type, these are;

(I) Residential Apartment blocks – A, B, C, D and E .
(II) Residential Housing

Note: The ADF calculation results have been given the following colour code guide depending on its level of resulting compliance. The overall conclusion is presented at the end of the chapter.

Compliance guide		
☑	0%	Over /equal to
☑	5%	Within
!!	10%	Within
x	10%	In excess of

5.3 (I) Residential Apartment Blocks – receptors and ADF calculation results

Receptors: Images 5.1 to 5.11 indicate the locations of the rooms chosen from residential apartment blocks A, B, C, D and E for the ADF analysis. Once a (lowest level) room is compliant, rooms at higher levels with similar configuration / parameters are deemed compliant on the basis that the room daylight factor would have improved due to the better vertical sky view angle of higher located rooms.

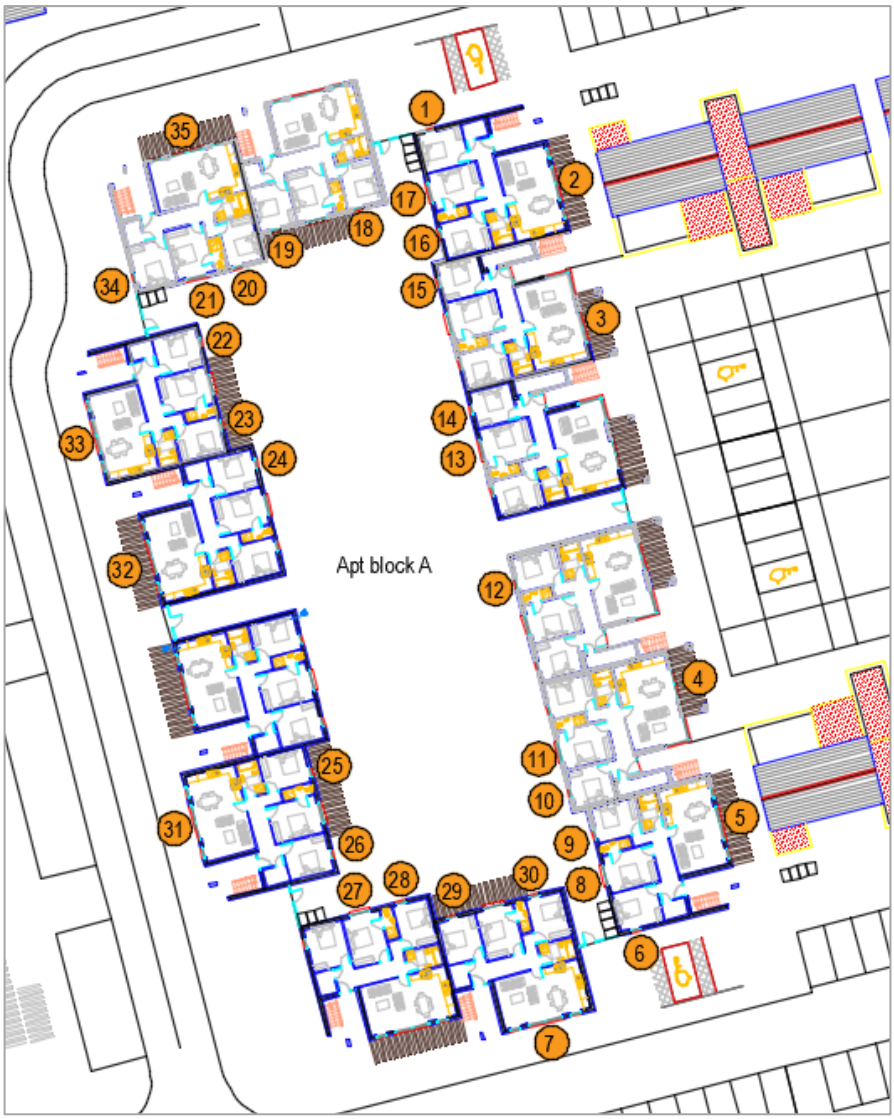

Image 5.1: Level 00 with selected rooms – Apartment block A

Image 5.2: Level 01 with selected rooms – Apartment block A

Image 5.3: Level 00 with selected rooms – Apartment block B

Image 5.4: Level 01 with selected rooms – Apartment block B

Image 5.5: Level 00 with selected rooms – Apartment block C

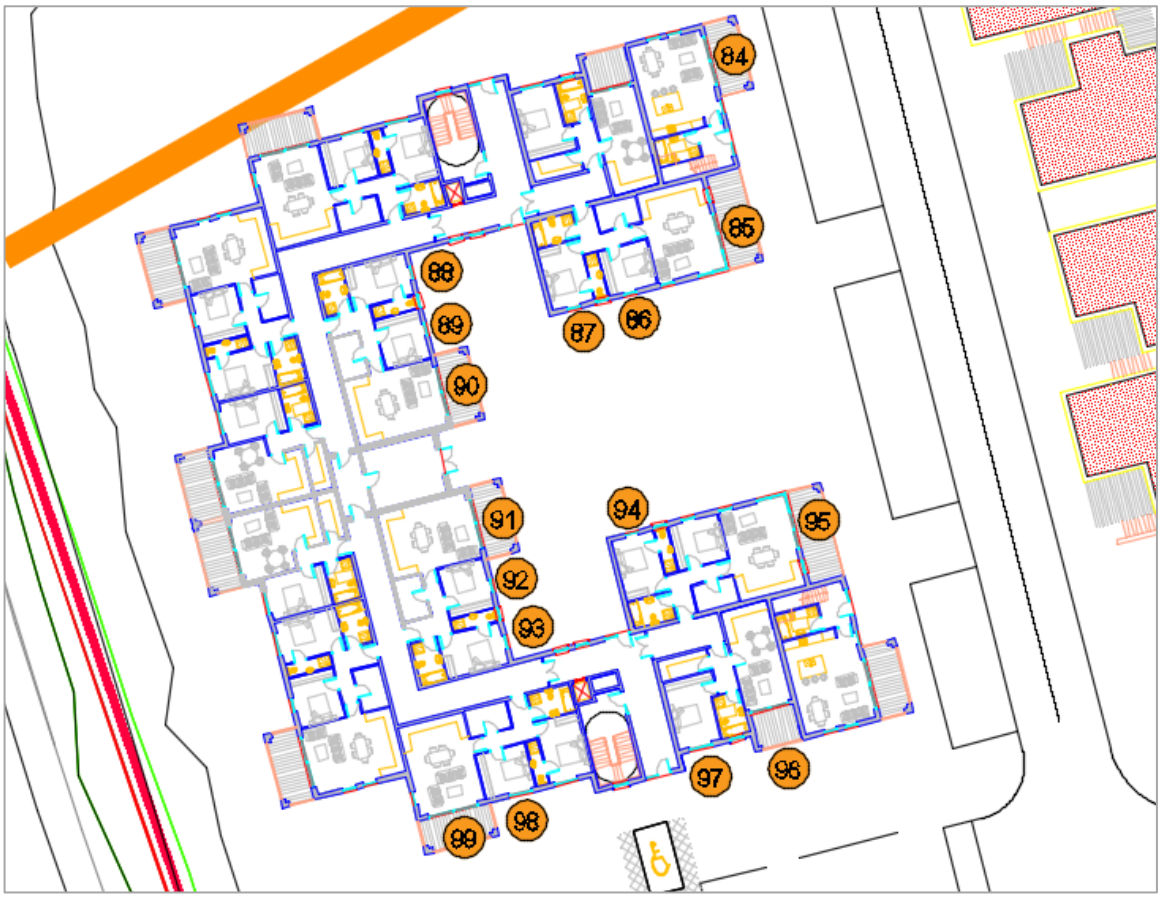

Image 5.6: Level 00 with selected rooms – Apartment block D

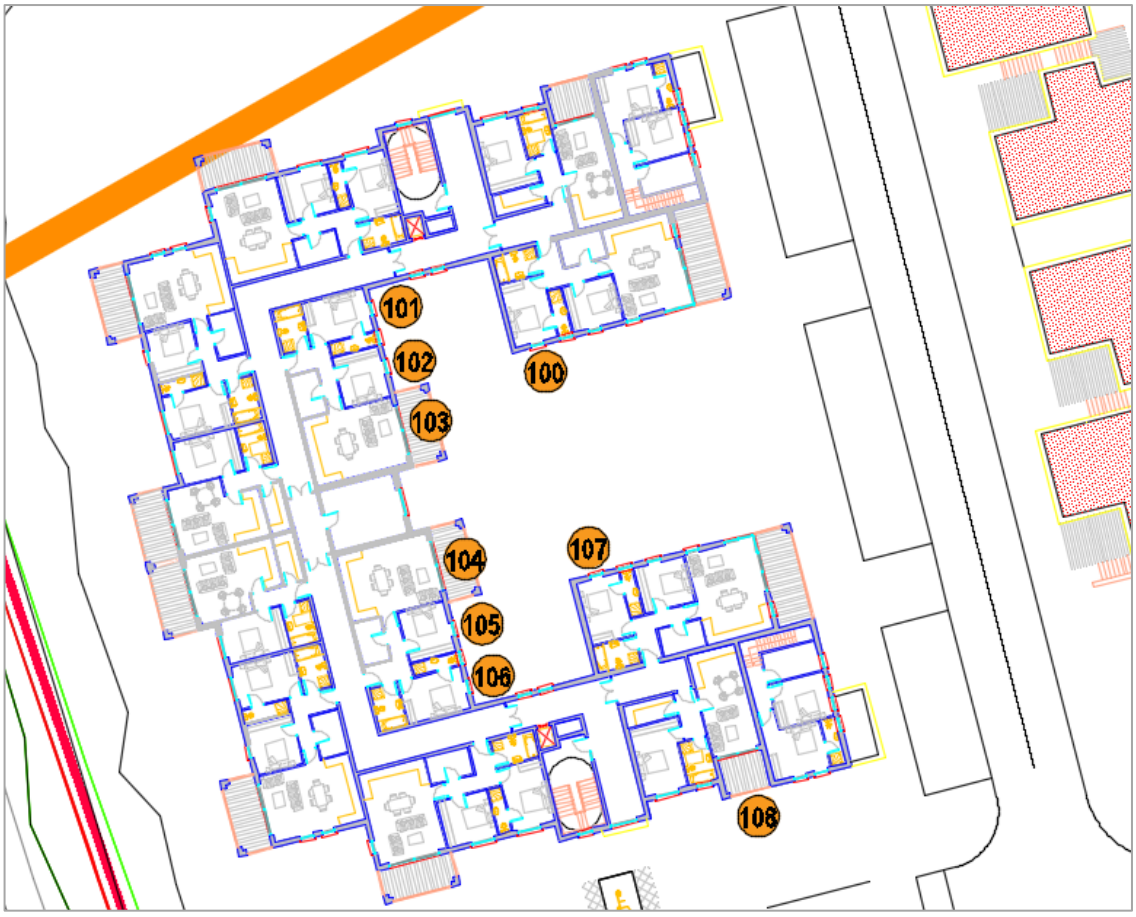

Image 5.7: Level 01 with selected rooms – Apartment block D

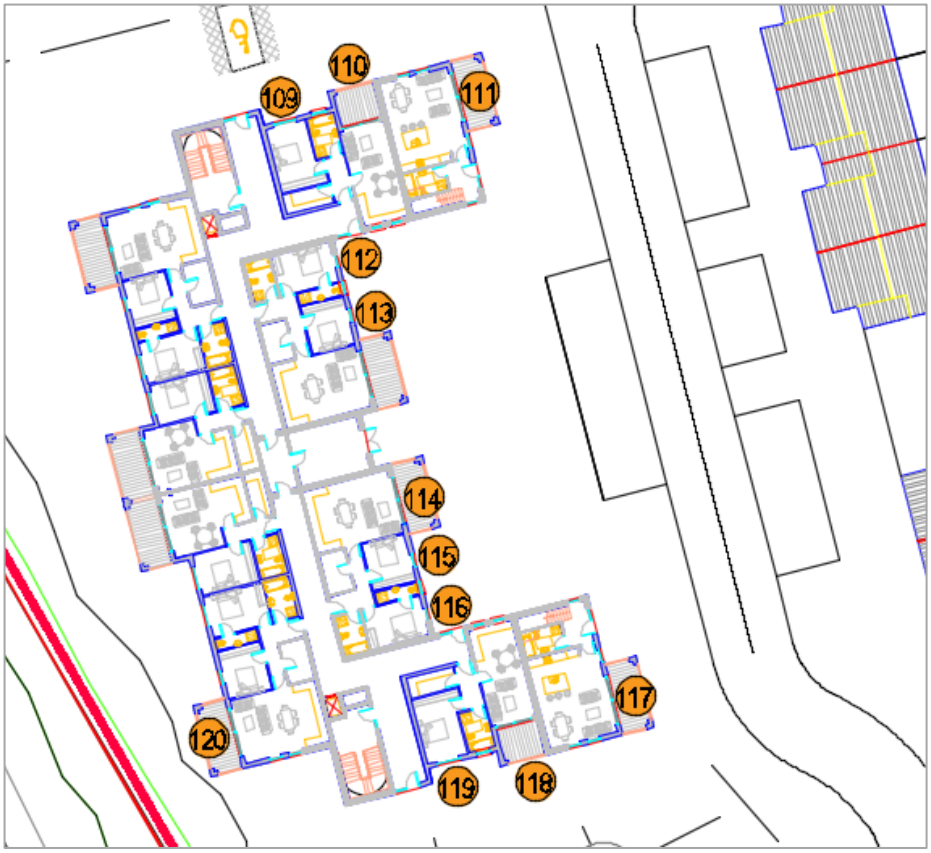

Image 5.8: Level 00 with selected rooms – Apartment block E1

Image 5.9: Level 01 with selected rooms – Apartment block E1

Image 5.10: Level 00 with selected rooms – Apartment block E2

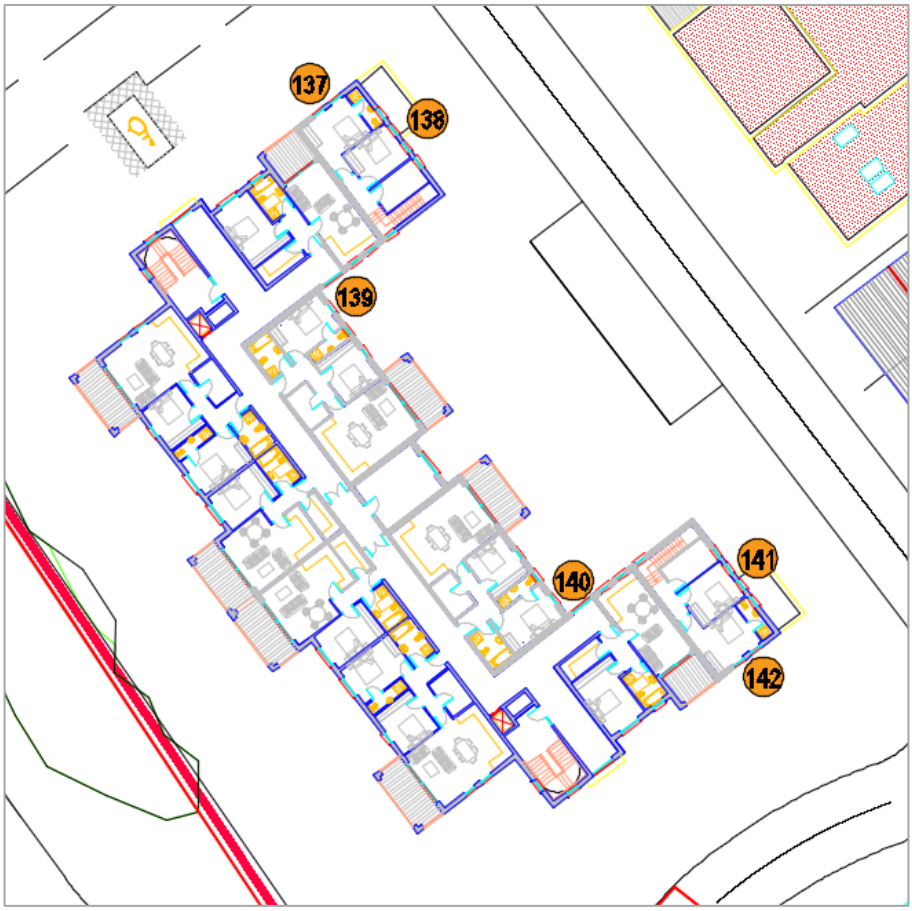

Image 5.11: Level 01 with selected rooms – Apartment block E2

ADF calculation results: Residential apartment blocks – A, B, C, D and E

The tables below provide the full calculation results of the selected rooms including the overall calculated vertical sky component together with the 'to-be-achieved' BRE minimum daylight factor standards.

Receptor	Block	Unit ID	Receptor Level	Room / type	Hor Sec a Hor ∟°	Hor Sec a Vert ∟°	Hor Sec b Hor ∟°	Hor Sec b Vert ∟°	Hor Sec c Hor ∟°	Hor Sec c Vert ∟°	Hor Sec d Hor ∟°	Hor Sec d Vert ∟°	∑ Hor ∟	∑ VSC ∟	glass area m2	Room width m	Room depth m	Room height m	Room ADF %	BRE ADF %
1		Apt A	00	Bed room	45	53	51	16	51	14	33	7	180	28%	1.44	3.70	3.25	2.70	1.50	1.00
2		Apt A	00	Living - Kitchen	55	7	92	73	33	14			180	20%	5.58	7.40	4.40	2.70	2.04	2.00
3		Apt A	00	Living - Kitchen	17	5	70	48	38	6	55	21	180	27%	5.58	7.40	4.40	2.70	2.69	2.00
4		Apt A	00	Living - Kitchen	64	18	31	6	85	50			180	25%	5.58	7.40	4.40	2.70	2.51	2.00
5		Apt A	00	Living - Kitchen	30	14	92	73	58	8			180	20%	5.58	7.40	4.40	2.70	2.04	2.00
6		Apt A	00	Bed room	46	53	41	14	54	16	39	4	180	28%	1.44	3.70	3.25	2.70	1.52	1.00
7		Apt A	00	Living - Kitchen	69	15	34	9	35	16	42	10	180	32%	5.58	7.40	4.40	2.70	3.28	2.00
8		Apt A	00	Bed room	17	7	82	67	59	19	22	12	180	22%	2.34	3.20	4.20	2.70	1.72	1.00
9		Apt A	00	Bed room	14	7	83	59	62	19	21	65	180	20%	1.44	3.00	3.85	2.70	1.11	1.00
10		Apt A	00	Bed room	85	46	71	21	24	13			180	25%	1.44	3.10	3.45	2.70	1.41	1.00
11		Apt A	00	Bed room	70	34	85	23	25	13			180	27%	2.34	3.10	3.45	2.70	2.53	1.00
12		Apt A	00	Bed room	46	19	99	24	35	13			180	29%	1.44	3.00	3.85	2.70	1.59	1.00
13		Apt A	00	Bed room	35	13	95	24	50	18			180	29%	2.34	3.30	4.20	2.70	2.30	1.00
14		Apt A	00	Bed room	30	13	94	24	56	19			180	29%	1.44	3.10	3.45	2.70	1.68	1.00
15		Apt A	00	Bed room	24	10	70	24	86	34			180	27%	1.44	3.10	3.45	2.70	1.53	1.00
16		Apt A	00	Bed room	13	6	84	59	60	24	23	65	180	20%	1.44	3.00	3.85	2.70	1.05	1.00
17		Apt A	00	Bed room	16	7	89	67	53	20	22	12	180	21%	2.34	3.20	4.20	2.70	1.65	1.00
18		Apt A	00	Bed room	89	48	18	9	54	22	19	43	180	23%	1.44	3.00	3.85	2.70	1.25	1.00
19		Apt A	00	Bed room	55	77	25	23	21	9	79	28	180	21%	1.44	3.20	3.70	2.70	1.13	1.00
20		Apt A	00	Bed room	79	55	27	9	39	19	35	28	180	23%	1.44	3.00	3.85	2.70	1.26	1.00
21		Apt A	00	Bed room	93	65	17	9	38	19	32	27	180	20%	2.34	3.20	4.20	2.70	1.57	1.00
22		Apt A	00	Bed room	67	52	102	20	11	41			180	24%	1.44	3.10	3.45	2.70	1.38	1.00
23		Apt A	00	Bed room	51	36	89	20	40	70			180	23%	1.44	3.00	3.85	2.70	1.25	1.00
24		Apt A	00	Bed room	41	25	112	20	27	12			180	29%	1.44	3.10	3.45	2.70	1.70	1.00
25		Apt A	00	Bed room	41	70	88	20	51	35			180	23%	1.44	3.10	3.45	2.70	1.32	1.00
26		Apt A	00	Bed room	12	41	100	21	68	52			180	24%	1.44	3.10	3.45	2.70	1.36	1.00
27		Apt A	00	Bed room	94	65	17	9	69	32			180	18%	2.34	3.10	3.45	2.70	1.69	1.00
28		Apt A	00	Bed room	74	56	23	9	83	28			180	22%	1.44	3.00	3.85	2.70	1.22	1.00
29		Apt A	00	Bed room	56	77	25	28	30	11	69	36	180	20%	1.44	3.10	3.45	2.70	1.13	1.00
30		Apt A	00	Bed room	14	42	59	22	26	9	81	48	180	24%	1.44	3.00	3.85	2.70	1.30	1.00
31		Apt A	00	Living - Kitchen	48	13	49	34	61	22	22	6	180	29%	5.58	7.40	4.40	2.70	2.94	2.00
32		Apt A	00	Living - Kitchen	49	8	102	34	29	9			180	28%	5.58	7.40	4.40	2.70	2.86	2.00
33		Apt A	00	Living - Kitchen	22	6	77	34	81	10			180	30%	5.58	7.40	4.40	2.70	2.99	2.00
34		Apt A	00	Bed room	31	13	73	6	36	27	40	56	180	28%	1.44	3.70	3.25	2.70	1.51	1.00
35		Apt A	00	Living - Kitchen	42	6	111	14	27	56			180	30%	5.58	7.40	4.40	2.70	3.05	2.00
36		Apt A	01	Bed room	90	6	22	50	68	60			180	25%	1.44	3.20	3.50	2.70	1.37	1.00
37		Apt A	01	Living - Kitchen	64	5	90	68	26	11			180	22%	6.30	5.90	6.90	2.70	2.18	2.00
38		Apt A	01	Living - Kitchen	27	12	108	68	45	5			180	20%	6.75	5.90	6.90	2.70	2.05	2.00
39		Apt A	01	Bed room	66	60	21	50	93	6			180	25%	1.44	3.20	3.50	2.70	1.39	1.00
40		Apt A	01	Living - Kitchen	24	4	103	24	53	8			180	31%	6.30	5.90	6.90	2.70	3.04	2.00
41		Apt A	01	Bed room	65	53	48	24	67	53			180	19%	1.44	3.20	3.50	2.70	1.05	1.00
42		Apt B	00	Bed room	29	9	134	65	17	27			180	16%	2.34	3.40	3.85	2.70	1.30	1.00
43		Apt B	00	Bed room	18	69	144	11	18	8			180	31%	2.34	3.40	3.80	2.70	2.55	1.00
44		Apt B	00	Bed room	44	11	120	82	16	16			180	14%	2.34	3.40	3.85	2.70	1.08	1.00
45		Apt B	00	Bed room	17	69	94	11	52	30	17	12	180	29%	2.34	3.40	3.80	2.70	2.36	1.00
46		Apt B	00	Bed room	32	9	47	26	79	15	22	65	180	28%	2.34	3.63	3.15	2.70	2.53	1.00

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47		Apt B	00	Living - Kitchen	29	9	45	26	56	15	50	78	180	24%	5.22	3.60	8.60	2.70	2.23	2.00
48		Apt B	00	Living - Kitchen	5	32	38	11	86	17	51	78	180	24%	5.22	3.60	8.60	2.70	2.26	2.00
49		Apt B	00	Living - Kitchen	8	32	119	17	53	78			180	23%	5.22	3.60	8.60	2.70	2.17	2.00
50		Apt B	00	Bed room	22	65	44	15	107	18	7	32	180	28%	2.34	3.63	3.15	2.70	2.51	1.00
51		Apt B	00	Living - Kitchen	5	32	104	18	21	16	50	78	180	23%	5.22	3.60	8.60	2.70	2.21	2.00
52		Apt B	00	Living - Kitchen	58	32	23	15	51	18	48	78	180	22%	5.22	3.60	8.60	2.70	2.07	2.00
53		Apt B	00	Bed room	75	33	11	16	74	18	20	65	180	26%	2.34	3.63	3.15	2.70	2.29	1.00
54		Apt B	00	Bed room	83	31	74	17	23	65			180	26%	2.34	3.63	3.15	2.70	2.28	1.00
55		Apt B	00	Living - Kitchen	54	32	23	15	51	18	52	78	180	22%	5.22	3.60	8.60	2.70	2.03	2.00
56		Apt B	00	Living - Kitchen	48	78	21	15	104	18	7	32	180	24%	5.22	3.60	8.60	2.70	2.23	2.00
57		Apt B	00	Living - Kitchen	6	32	44	12	80	18	50	78	180	24%	5.22	3.60	8.60	2.70	2.25	2.00
58		Apt B	00	Living - Kitchen	48	78	84	18	48	15			180	24%	5.22	3.60	8.60	2.70	2.27	2.00
59		Apt B	00	Bed room	18	66	110	12	34	10	18	8	180	31%	2.34	3.60	3.80	2.70	2.45	1.00
60		Apt B	00	Bed room	15	16	121	82	44	12			180	13%	2.34	3.40	3.85	2.70	1.06	1.00
61		Apt B	00	Bed room	26	47	135	13	19	65			180	28%	2.34	3.40	3.85	2.70	2.29	1.00
62		Apt B	01	Living - Kitchen	70	30	17	12	76	16	17	60	180	27%	5.22	3.60	8.60	2.70	2.59	2.00
63		Apt B	01	Bed room	62	30	19	12	67	16	32	70	180	25%	2.34	3.60	3.10	2.70	2.30	1.00
64		Apt B	01	Living - Kitchen	17	60	46	11	107	16	10	66	180	29%	5.22	3.60	8.60	2.70	2.73	2.00
65		Apt B	01	Bed room	35	19	44	7	73	15	28	67	180	29%	2.34	3.60	3.10	2.70	2.60	1.00
66		Apt B	01	Living - Kitchen	16	67	79	15	46	7	39	19	180	30%	5.22	3.60	8.60	2.70	2.86	2.00
67		Apt B	01	Living - Kitchen	73	33	14	15	77	14	16	60	180	27%	5.22	3.60	8.60	2.70	2.56	2.00
68		Apt B	01	Living - Kitchen	17	60	126	15	37	13			180	30%	5.22	3.60	8.60	2.70	2.84	2.00
69		Apt C	00	Bed room	60	55	25	21	22	6	73	13	180	26%	1.44	3.20	3.88	2.70	1.38	1.00
70		Apt C	00	Bed room	84	67	21	7	53	12	22	6	180	23%	1.44	4.00	2.85	2.70	1.24	1.00
71		Apt C	00	Bed room	78	66	22	7	57	13	23	6	180	24%	2.34	4.80	2.85	2.70	1.82	1.00
72		Apt C	00	Living - Kitchen	53	7	33	24	27	7	67	20	180	32%	4.86	4.90	6.20	2.70	2.97	2.00
73		Apt C	00	Living - Kitchen	58	63	18	16	27	7	77	21	180	25%	5.40	4.60	8.26	2.70	2.13	2.00
74		Apt C	00	Living - Kitchen	96	20	18	20	19	10	47	15	180	30%	5.40	4.90	6.20	2.70	3.18	2.00
75		Apt C	00	Living - Kitchen	61	63	29	20	25	10	65	18	180	24%	5.40	4.60	8.26	2.70	2.11	2.00
76		Apt C	00	Bed room	18	10	62	23	48	10	52	23	180	30%	1.44	3.20	4.08	2.70	1.52	1.00
77		Apt C	00	Bed room	55	63	24	21	22	10	79	12	180	26%	2.34	4.30	2.85	2.70	2.18	1.00
78		Apt C	00	Bed room	57	63	23	10	27	10	73	15	180	26%	1.44	3.20	3.88	2.70	1.34	1.00
79		Apt C	00	Living - Kitchen	62	63	35	12	39	6	44	13	180	26%	4.86	4.60	8.26	2.70	2.04	2.00
80		Apt C	00	Living - Kitchen	56	10	63	15	61	12			180	33%	4.86	4.90	6.20	2.70	3.07	2.00
81		Apt C	00	Bed room	54	58	23	21	19	7	84	13	180	27%	2.34	4.80	2.85	2.70	2.06	1.00
82		Apt C	00	Bed room	77	70	5	23	21	7	77	13	180	23%	1.44	4.00	2.85	2.70	1.22	1.00
83		Apt C	00	Bed room	58	63	22	7	20	10	80	21	180	25%	1.44	3.20	3.88	2.70	1.28	1.00
84		Apt D	00	Living - Kitchen	50	7	106	23	24	6			180	31%	5.40	6.70	5.10	2.70	2.97	2.00
85		Apt D	00	Living - Kitchen	32	69	116	23	26	6	6	31	180	26%	5.40	6.50	4.70	2.70	2.66	2.00
86		Apt D	00	Bed room	56	35	64	38	60	15			180	26%	1.44	3.50	3.30	2.70	1.40	1.00
87		Apt D	00	Bed room	67	38	65	38	48	14			180	25%	1.44	3.00	4.40	2.70	1.22	1.00
88		Apt D	00	Bed room	80	77	42	57	9	10	49	27	180	15%	1.44	3.00	4.40	2.70	0.72	1.00
89		Apt D	00	Bed room	55	64	42	57	27	10	56	31	180	20%	1.44	3.55	3.20	2.70	1.07	1.00
90		Apt D	00	Living - Kitchen	38	49	43	56	36	10	63	35	180	22%	4.86	4.70	6.40	2.70	2.07	2.00
91		Apt D	00	Living - Kitchen	32	32	29	33	36	10	83	51	180	23%	4.86	4.70	6.40	2.70	2.13	2.00
92		Apt D	00	Bed room	59	65	42	55	27	10	52	32	180	19%	1.44	3.55	3.20	2.70	1.05	1.00
93		Apt D	00	Bed room	81	77	41	57	9	10	49	27	180	15%	1.44	3.00	4.40	2.70	0.72	1.00
94		Apt D	00	Bed room	64	40	74	35	42	14			180	25%	1.44	3.00	4.40	2.70	1.21	1.00
95		Apt D	00	Living - Kitchen	31	69	100	23	49	7			180	27%	5.40	6.50	4.70	2.70	2.77	2.00
96		Apt D	00	Living - Kitchen	119	64	61	12					180	19%	4.99	3.30	7.20	2.70	2.05	2.00
97		Apt D	00	Bed room	48	62	85	12	47	9			180	28%	2.34	3.00	4.80	2.70	2.08	1.00
98		Apt D	00	Bed room	56	59	94	14	30	9			180	27%	2.34	3.55	3.20	2.70	2.38	1.00
99		Apt D	00	Living - Kitchen	93	55	48	14	39	6			180	24%	4.50	4.70	6.40	2.70	2.08	2.00

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100		Apt D	**01**	Bed room	67	34	65	34	48	11			180	26%	1.44	3.00	4.40	2.70	1.29	1.00
101		Apt D	**01**	Bed room	80	74	42	52	9	8	49	22	180	17%	1.44	3.00	4.40	2.70	0.81	1.00
102		Apt D	**01**	Bed room	55	60	42	52	27	8	56	26	180	21%	1.44	3.55	3.20	2.70	1.18	1.00
103		Apt D	**01**	Living - Kitchen	38	45	43	51	36	8	63	30	180	24%	4.86	4.70	6.40	2.70	2.24	2.00
104		Apt D	**01**	Living - Kitchen	32	29	29	30	36	8	83	46	180	24%	4.86	4.70	6.40	2.70	2.28	2.00
105		Apt D	**01**	Bed room	59	60	42	51	27	8	52	28	180	21%	1.44	3.55	3.20	2.70	1.15	1.00
106		Apt D	**01**	Bed room	81	74	41	52	9	8	49	22	180	17%	1.44	3.00	4.40	2.70	0.81	1.00
107		Apt D	**01**	Bed room	64	36	74	30	42	11			180	26%	1.44	3.00	4.40	2.70	1.31	1.00
108		Apt D	**01**	Living - Kitchen	115	59	65	12					180	20%	4.99	3.30	7.20	2.70	2.24	2.00
109		Apt E1	**00**	Bed room	97	27	35	9	48	66			180	24%	2.34	2.60	4.80	2.70	1.93	1.00
110		Apt E1	**00**	Living - Kitchen	115	66	65	13					180	18%	4.99	3.30	7.19	2.70	2.03	2.00
111		Apt E1	**00**	Living - Kitchen	28	5	79	16	73	11			180	33%	5.04	6.70	5.10	2.70	2.93	2.00
112		Apt E1	**00**	Bed room	83	72	75	10	22	19			180	21%	1.44	3.00	4.40	2.70	1.05	1.00
113		Apt E1	**00**	Bed room	64	61	92	10	24	23			180	25%	1.44	3.50	3.20	2.70	1.42	1.00
114		Apt E1	**00**	Living - Kitchen	30	30	101	10	49	40			180	29%	4.50	4.70	6.40	2.70	2.52	2.00
115		Apt E1	**00**	Bed room	26	23	91	10	63	61			180	25%	1.44	3.50	3.20	2.70	1.42	1.00
116		Apt E1	**00**	Bed room	82	72	76	10	22	19			180	22%	1.44	3.00	4.40	2.70	1.06	1.00
117		Apt E1	**00**	Living - Kitchen	27	6	63	16	90	11			180	33%	5.04	6.70	5.10	2.70	2.94	2.00
118		Apt E1	**00**	Living - Kitchen	115	66	30	12	35	8			180	19%	4.99	3.30	7.19	2.70	2.07	2.00
119		Apt E1	**00**	Bed room	66	8	69	12	45	66			180	28%	2.34	2.60	4.80	2.70	2.27	1.00
120		Apt E1	**00**	Living - Kitchen	15	66	73	6	92	9			180	32%	4.86	4.70	6.40	2.70	3.08	2.00
121		Apt E1	**01**	Bed room	35	5	76	27	69	11			180	31%	2.16	4.00	3.20	2.70	2.36	1.00
122		Apt E1	**01**	Bed room	70	11	81	14	29	8			180	33%	2.16	3.10	3.70	2.70	2.70	1.00
123		Apt E1	**01**	Bed room	83	68	75	8	22	16			180	23%	1.44	3.00	4.40	2.70	1.12	1.00
124		Apt E1	**01**	Bed room	82	68	76	8	22	16			180	23%	1.44	3.00	4.40	2.70	1.12	1.00
125		Apt E1	**01**	Bed room	27	6	68	14	85	8			180	34%	2.16	3.10	3.70	2.70	2.77	1.00
126		Apt E1	**01**	Bed room	48	12	47	13	85	7			180	34%	2.16	4.00	3.20	2.70	2.57	1.00
127		Apt E2	**00**	Living - Kitchen	115	66	41	16	24	9			180	18%	4.99	3.30	7.19	2.70	2.02	2.00
128		Apt E2	**00**	Living - Kitchen	92	10	73	11	15	7			180	33%	5.04	6.70	5.10	2.70	3.01	2.00
129		Apt E2	**00**	Bed room	85	72	76	10	19	19			180	21%	1.44	3.00	4.40	2.70	1.04	1.00
130		Apt E2	**00**	Bed room	64	61	92	10	24	23			180	25%	1.44	3.50	3.20	2.70	1.42	1.00
131		Apt E2	**00**	Living - Kitchen	52	42	101	10	27	26			180	29%	4.50	4.70	6.40	2.70	2.51	2.00
132		Apt E2	**00**	Bed room	26	23	91	10	63	61			180	25%	1.44	3.50	3.20	2.70	1.42	1.00
133		Apt E2	**00**	Bed room	82	72	76	10	22	19			180	22%	1.44	3.00	4.40	2.70	1.06	1.00
134		Apt E2	**00**	Living - Kitchen	26	7	97	16	57	13			180	32%	5.04	6.70	5.10	2.70	2.87	2.00
135		Apt E2	**00**	Living - Kitchen	115	66	44	13	21	5			180	19%	4.99	3.30	7.19	2.70	2.07	2.00
136		Apt E2	**00**	Bed room	45	5	84	13	51	64			180	27%	2.34	2.60	4.80	2.70	2.23	1.00
137		Apt E2	**01**	Bed room	63	6	36	12	81	10			180	34%	2.16	4.00	3.20	2.70	2.60	1.00
138		Apt E2	**01**	Bed room	80	10	81	8	19	5			180	34%	2.16	3.10	3.70	2.70	2.82	1.00
139		Apt E2	**01**	Bed room	85	68	76	8	19	16			180	22%	1.44	3.00	4.40	2.70	1.11	1.00
140		Apt E2	**01**	Bed room	82	68	76	8	22	16			180	23%	1.44	3.00	4.40	2.70	1.13	1.00
141		Apt E2	**01**	Bed room	25	6	103	9	52	8			180	34%	2.16	3.10	3.70	2.70	2.83	1.00
142		Apt E2	**01**	Bed room	36	8	90	8	54	6			180	35%	2.16	4.00	3.20	2.70	2.65	1.00

Table 5.1: Residential apartment blocks results

5.4 (II) Residential Housing – receptors and ADF calculation results

Receptors: Image 5.12 to 5.14 indicate the locations of the rooms chosen from the proposed residential houses for the ADF analysis. Once a (lowest level) room is compliant, rooms at higher levels with similar configuration / parameters are deemed compliant on the basis that the room daylight factor would have improved due to the better vertical sky view angle of higher located rooms.

Image 5.12: Level 00 with selected rooms – (receptors 143 to 170) Houses

Image 5.13: Level 00 with selected rooms – (receptors 171 to 184) Houses

Image 5.14: Level 00 with selected rooms – (receptors 185 to 196) Houses

ADF calculation results: Residential housing

The tables below provide the full calculation results of the selected rooms including the overall calculated vertical sky component together with the 'to-be-achieved' BRE minimum daylight factor standards.

Receptor	Block	Unit ID	Receptor Level	Room / type	Hor Sec a Hor ∟°	Hor Sec a Vert ∟°	Hor Sec b Hor ∟°	Hor Sec b Vert ∟°	Hor Sec c Hor ∟°	Hor Sec c Vert ∟°	Hor Sec d Hor ∟°	Hor Sec d Vert ∟°	∑ Hor ∟	∑ VSC ∟	glass area m2	Room width m	Room depth m	Room height m	Room ADF %	BRE ADF %
143		H no. 2	00	Living - Kitchen	57	4	58	18	65	4			180	34%	3.61	6.50	5.10	2.70	2.24	2.00
144		H no. 4	00	Living - Kitchen	57	4	62	13	61	4			180	35%	3.61	6.50	5.10	2.70	2.28	2.00
145		H no. 5	00	Living - Kitchen	39	13	127	13	14	4			180	33%	3.61	6.50	5.10	2.70	2.14	2.00
146		H no. 6	00	Living - Kitchen	54	4	32	8	64	4	30	13	180	35%	3.61	6.50	5.10	2.70	2.31	2.00
147		H no. 7	00	Living - Kitchen	32	5	130	13	18	4			180	33%	3.61	6.50	5.10	2.70	2.18	2.00
148		H no. 8	00	Living - Kitchen	54	4	62	13	64	4			180	35%	3.61	6.50	5.10	2.70	2.28	2.00
149		H no. 9	00	Living - Kitchen	20	4	134	13	26	5			180	33%	3.61	6.50	5.10	2.70	2.18	2.00
150		H no. 10	00	Living - Kitchen	54	4	62	13	64	4			180	35%	3.61	6.50	5.10	2.70	2.28	2.00
151		H no. 12	00	Living - Kitchen	49	4	60	13	53	9	18	4	180	34%	3.61	6.50	5.10	2.70	2.24	2.00
152		H no. 14	00	Living - Kitchen	32	5	60	15	37	7	51	9	180	34%	3.61	6.50	5.10	2.70	2.21	2.00
153		H no. 195	00	Living - Kitchen	19	5	51	11	47	23	63	9	180	32%	3.23	5.80	4.50	2.70	2.26	2.00
154		H no. 194	00	Living - Kitchen	22	5	72	12	38	23	48	8	180	33%	3.23	5.80	4.50	2.70	2.27	2.00
155		H no. 190	00	Living - Kitchen	24	6	40	12	44	23	72	11	180	32%	3.23	5.80	4.50	2.70	2.24	2.00
156		H no. 188	00	Living - Kitchen	61	7	103	12	16	8			180	34%	3.23	5.80	4.50	2.70	2.35	2.00
157		H no. 182	00	Living - Kitchen	23	5	112	13	35	10	10	8	180	33%	3.23	5.80	4.50	2.70	2.31	2.00
158		H no. 182	00	Living - Kitchen	14	4	101	12	65	23			180	31%	3.23	5.80	4.50	2.70	2.19	2.00
159		H no. 204	00	Living - Kitchen	30	11	39	10	48	23	63	11	180	32%	3.23	5.80	4.50	2.70	2.23	2.00
160		H no. 205	00	Living - Kitchen	33	12	64	10	34	23	49	11	180	32%	3.23	5.80	4.50	2.70	2.25	2.00
161		H no. 206	00	Living - Kitchen	65	7	36	21	57	18	22	4	180	32%	3.23	5.80	4.50	2.70	2.26	2.00
162		H no. 207	00	Living - Kitchen	46	7	43	21	69	18	22	4	180	32%	3.23	5.80	4.50	2.70	2.22	2.00
163		H no. 207	00	Living - Kitchen	56	24	50	10	45	20	29	10	180	31%	3.23	5.80	4.50	2.70	2.14	2.00
164		H no. 166	00	Living - Kitchen	32	7	103	21	45	14			180	31%	3.23	5.80	4.50	2.70	2.15	2.00
165		H no. 166	00	Living - Kitchen	57	14	55	13	68	13			180	32%	3.23	5.80	4.50	2.70	2.25	2.00
166		H no. 168	00	Living - Kitchen	67	18	46	21	15	5	52	13	180	31%	3.23	5.80	4.50	2.70	2.16	2.00
167		H no. 173	00	Living - Kitchen	67	13	44	21	46	13	23	6	180	32%	3.23	5.80	4.50	2.70	2.23	2.00
168		H no. 173	00	Living - Kitchen	50	13	56	12	74	12			180	33%	3.23	5.80	4.50	2.70	2.28	2.00
169		H no. 181	00	Living - Kitchen	71	11	44	22	65	9			180	32%	3.23	5.80	4.50	2.70	2.26	2.00
170		H no. 181	00	Living - Kitchen	42	10	96	14	23	10	19	5	180	33%	3.23	5.80	4.50	2.70	2.30	2.00
171		H no. 74	00	Living - Kitchen	25	8	54	8	101	14			180	33%	3.23	5.80	4.50	2.70	2.30	2.00
172		H no. 74	00	Living - Kitchen	71	11	52	23	57	9			180	32%	3.23	5.80	4.50	2.70	2.23	2.00
173		H no. 20	00	Living - Kitchen	39	18	97	11	31	7	13	18	180	33%	3.61	6.50	5.10	2.70	2.14	2.00
174		H no. 20	00	Living - Kitchen	16	11	75	12	89	9			180	33%	3.61	6.50	5.10	2.70	2.19	2.00
175		H no. 25	00	Living - Kitchen	28	8	106	11	46	8			180	34%	3.61	6.50	5.10	2.70	2.21	2.00
176		H no. 25	00	Living - Kitchen	48	7	65	9	58	8	9	5	180	34%	3.61	6.50	5.10	2.70	2.26	2.00
177		H no. 42	00	Living - Kitchen	47	8	104	11	29	6			180	34%	3.23	5.55	4.50	2.70	2.44	2.00
178		H no. 42	00	Living - Kitchen	27	29	54	11	71	13	28	7	180	32%	3.23	5.55	4.50	2.70	2.30	2.00
179		H no. 57	00	Living - Kitchen	45	22	40	20	69	13	26	7	180	31%	3.23	5.55	4.50	2.70	2.24	2.00
180		H no. 58	00	Living - Kitchen	43	37	108	9	29	7			180	31%	3.23	5.55	4.50	2.70	2.26	2.00
181		H no. 66	00	Living - Kitchen	42	15	39	19	72	13	27	7	180	32%	3.23	5.55	4.50	2.70	2.30	2.00
182		H no. 87	00	Living - Kitchen	28	35	47	11	80	13	25	7	180	31%	3.23	5.55	4.50	2.70	2.27	2.00
183		H no. 87	00	Living - Kitchen	64	8	28	26	26	7	62	14	180	32%	3.23	5.55	4.50	2.70	2.34	2.00
184		H no. 65	00	Living - Kitchen	41	34	37	13	51	13	51	5	180	31%	3.23	5.55	4.50	2.70	2.25	2.00
185		H no. 369	00	Living - Kitchen	41	34	36	13	46	13	57	5	180	31%	3.23	5.55	4.50	2.70	2.26	2.00
186		H no. 373	00	Living - Kitchen	43	17	39	19	65	13	33	8	180	32%	3.23	5.55	4.50	2.70	2.29	2.00
187		H no. 362	00	Living - Kitchen	36	9	82	13	38	16	24	34	180	31%	3.23	5.55	4.50	2.70	2.25	2.00
188		H no. 356	00	Living - Kitchen	18	4	43	12	57	26	62	13	180	31%	3.23	5.55	4.50	2.70	2.24	2.00
189		H no. 341	00	Living - Kitchen	16	4	58	11	50	30	56	13	180	31%	3.23	5.55	4.50	2.70	2.23	2.00
190		H no. 357	00	Living - Kitchen	32	5	111	23	37	8			180	31%	3.23	5.55	4.50	2.70	2.22	2.00
191		H no. 347	00	Living - Kitchen	38	5	110	23	13	18	19	5	180	31%	3.23	5.55	4.50	2.70	2.21	2.00
192		H no. 347	00	Living - Kitchen	27	21	57	17	62	13	34	8	180	32%	3.23	5.55	4.50	2.70	2.28	2.00
193		H no. 348	00	Living - Kitchen	54	54	48	14	51	7	27	15	180	28%	3.23	5.55	4.50	2.70	2.01	2.00
194		H no. 325	00	Living - Kitchen	51	5	50	13	51	16	28	22	180	32%	3.23	5.55	4.50	2.70	2.33	2.00
195		H no. 325	00	Living - Kitchen	32	5	74	14	74	19			180	32%	3.23	5.55	4.50	2.70	2.29	2.00
196		H no. 315	00	Living - Kitchen	29	4	57	18	70	25	24	5	180	31%	3.23	5.55	4.50	2.70	2.22	2.00

Table 5.2: residential housing ADF calculation results

5.5 Daylight reception in buildings within the new development overall conclusion

The calculation assessment was segregated according to building type, these are;
(I) Residential Apartment blocks – A, B, C, D and E.
(II) Residential Housing

The BRE report recommends as a methodology for assessing sufficient daylight reception in a habitable room, that the calculated average daylight factor (ADF) of a habitable room to be in excess of the BRE bench marks of a kitchen at 2%, a living room at 1.5%, a bedroom at 1% and a living room/bedroom at 1.5%. Calculation findings are as follows; (see images in chapter 5 for receptor locations):

(I) Residential Apartment blocks – A, B, C, D and E.
From the calculation results in table 5.1 we note;

Apartment Block A:
- Level 00: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines or are equal to minimum recommendations.
- Level 01: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines. All floors above the first floor apartments are further deemed compliant as they naturally would have an improved vertical daylight impact angle thus increasing the daylight reception factor typically 0.3%-0.5% per floor level.

Apartment Block B:
- Level 00: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines or are equal to minimum recommendations.
- Level 01: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines. All floors above the first floor apartments are further deemed compliant as they naturally would have an improved vertical daylight impact angle thus increasing the daylight reception factor.

Apartment Block C:
- Level 00: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines or are equal to minimum recommendations. All floors above the ground floor apartments are further deemed compliant as they naturally would have an improved vertical daylight impact angle thus increasing the daylight reception factor.

Apartment Block D:
- Level 00: 2 no. receptors 88 and 93 (bedrooms) resulted in a ADF of 0.72%, which is below the recommended 1.00% ADF for bedrooms. All other selected habitable rooms have achieved an ADF in excess of the BRE guidelines.
- Level 01: 2 no. receptors 101 and 106 (bedrooms) had a ADF of 0.72%, which is below the recommended 1.00% ADF for bedrooms. All other selected habitable rooms have achieved an ADF in excess of the BRE guidelines. All floors above the first floor apartments are further deemed compliant as they naturally would have an improved vertical daylight impact angle thus increasing the daylight reception factor.

Apartment Block E1:
- Level 00: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines or are equal to minimum recommendations.
- Level 01: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines. All floors above the first floor apartments are further deemed compliant as they naturally would have an improved vertical daylight impact angle thus increasing the daylight reception factor.

Apartment Block E2:
- Level 00: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines or are equal to minimum recommendations.
- Level 01: All selected habitable rooms have achieved an ADF in excess of the recommended guidelines. All floors above the first floor apartments are further deemed compliant as they naturally would have an improved vertical daylight impact angle thus increasing the daylight reception factor.

(II) Residential Housing
From the calculation results in table 5.2 we note;

- Level 00: All selected habitable rooms have achieved an ADF in excess of the recommended BRE guideline. Rooms above the ground floor are further deemed compliant as they naturally would have an improved vertical daylight impact angle thus increasing the daylight reception factor.

Mitigation measures:

4 no. receptors have been flagged in the result table 5.1, because these rooms resulted in ADF's below the minimum BRE guidelines. Receptor no. 88, 93, 101 and 106 are all located in block D, their room type all 'bedroom'.

In order to improve the below minimum ADF results, further analysis to receptors 88, 93, 101 and 106 was implemented using different calculation parameters.

The width of the window dimension was changed to 1200mm (currently taken as 800mm).

This significantly improved the result, thus receptor 88 and 93 resulted in a ADF of 1.10% with this mitigation measure in place and receptor 101 and 106 resulted in a ADF of 1.30%. See the before mitigation and after mitigation table below in 5.3.

Before mitigation:

Receptor	Block	Unit ID	Receptor Level	Room / type	Hor Sec a Hor ∟°	Hor Sec a Vert ∟°	Hor Sec b Hor ∟°	Hor Sec b Vert ∟°	Hor Sec c Hor ∟°	Hor Sec c Vert ∟°	Hor Sec d Hor ∟°	Hor Sec d Vert ∟°	∑ Hor ∟	∑ VSC ∟	glass area m2	Room width m	Room depth m	Room height m	Room ADF %	BRE ADF %
88		Apt D	**00**	Bed room	80	77	42	57	9	10	49	27	180	15%	1.44	3.00	4.40	2.70	0.72	1.00
93		Apt D	**00**	Bed room	81	77	41	57	9	10	49	27	180	15%	1.44	3.00	4.40	2.70	0.72	1.00
101		Apt D	**01**	Bed room	80	74	42	52	9	8	49	22	180	17%	1.44	3.00	4.40	2.70	0.81	1.00
106		Apt D	**01**	Bed room	81	74	41	52	9	8	49	22	180	17%	1.44	3.00	4.40	2.70	0.81	1.00

With mitigation measures in place:

88		Apt D	**00**	Bed room	80	77	42	57	9	10	49	27	180	15%	2.16	3.00	4.40	2.70	1.10	1.00
93		Apt D	**00**	Bed room	81	77	41	57	9	10	49	27	180	15%	2.16	3.00	4.40	2.70	1.10	1.00
101		Apt D	**01**	Bed room	80	74	42	52	9	8	49	22	180	17%	2.16	3.00	4.40	2.70	1.30	1.00
106		Apt D	**01**	Bed room	81	74	41	52	9	8	49	22	180	17%	2.16	3.00	4.40	2.70	1.30	1.00

Table 5.3: mitigation results

Given the results and conclusions above, DKP deem the residential project at Raheen except for 4 no. receptors to be in line with the recommendations in the BRE design guidelines 'site layout and planning for daylight and sunlight - a guide to good practice' and therefore in compliance with the BRE design guide.

We further conclude that if the DKP recommended mitigation measures are carried out that the daylight reception in the receptors below minimum guidelines will also be in excess of the BRE recommendations.