Waterman Moylan
Engineering Consultants

Daylight Assessment

Strategic Housing Development at Auburn, Malahide, Co. Dublin

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Content

1. Introduction

Waterman Moylan have been appointed to complete the daylight analysis for the proposed residential development in lands around Auburn House in Malahide, Co. Dublin. The purpose of this analysis is to determine if the daylight factors and sunlight to amenity areas in the proposed development meet the recommendations of BRE document 'Site Layout Planning for Daylight and Sunlight: a Guide to Good Practice' Second Edition 2011.

The proposed development has been analysed using a number of qualitative and quantitative methods to identify the areas of the development which were likely to receive the least daylight and to identify measures that could be taken to improve the daylight penetration. IES Virtual Environment simulation software was used to build a model of the proposed development to enable the necessary analysis to be completed.

This Daylight Analysis Report presents the requirements set out in the relevant guidance documents, describes the methodologies employed to complete the analysis and details the results that were achieved.

2. Site Overview and Nature of Proposed Development

2.1 Site Location

The site is located between the existing Abington residential development and the Malahide Road. The site entrance is from the Malahide Road, adjacent to the Malahide Road/Back Road junction.

The subject lands form the western, northern, and eastern boundaries of Auburn House, an eighteenth century three-storey mansion located within a wooded demesne. Malahide Castle is approximately 900m north-east of the site.

Figure 2.1 – Proposed development site.

2.2 Proposed Layouts

The proposed development consists of a total of 411 residential units, comprising of 101 houses, 43 duplex units and 266 apartments over 8 apartment blocks and Auburn House. The apartment blocks referred to as Block 1, 2, 3, 4, 5, 6, 7 & 8 and Duplex Apartments, referred to as Blocks 1 & 2A, will be the focus of this report due to their height and their proximity to each other.

Typical layouts of Blocks 1 to 8 are indicated below.

Figure 2.2 – Proposed arrangement of Blocks 1, 2 & 3

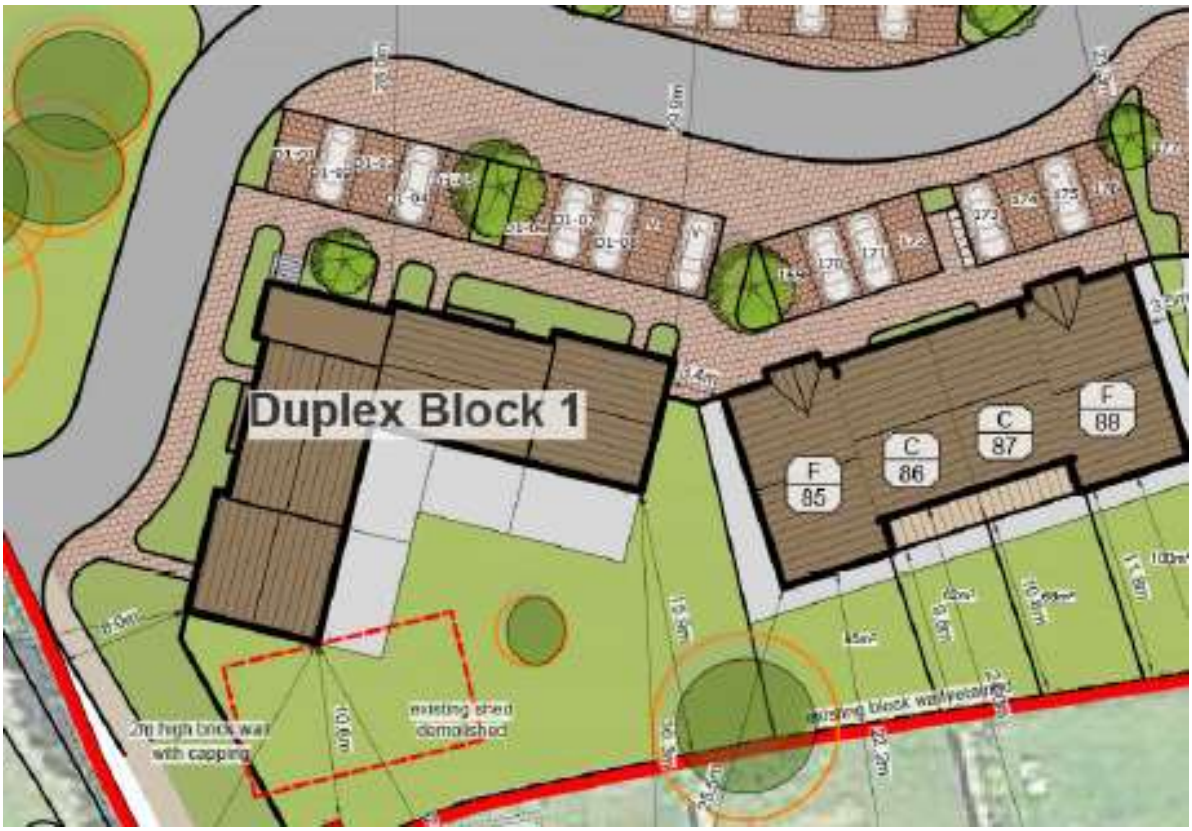

Figure 2.3 – Proposed arrangement of Duplex Apartment Block 1

Figure 2.4 – Proposed arrangement of Blocks 4 & 5 and Duplex Block 2A, 2B, 2C & 2D

Figure 2.5 – Proposed arrangement of Blocks 6, 7 & 8

Figure 2.6 – Typical Elevations Blocks 1, 2 & 3

The elevations of the scheme have been developed with a view to increasing daylight penetration by maximising window sizes and arranging balconies such that they minimise shading on the units below.

2.3 Design Development Process

The daylight modelling results presented in Section 4 of this report have been achieved following a design development process between the Architect, Conroy Crowe Kelly and Waterman Moylan. Preliminary drawings were analysed for compliance and feedback was given to the Architect.

In areas where non compliances were identified, the Architect looked to improve the access to daylight by increasing window sizes where possible and by modifying the position of the balconies to minimise the over-shading of the living areas. These changes had a positive impact on the daylight levels achieved and these improved results are reported in Section 4.

2.4 Schedule of Accommodation

Block 1					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	8	0	4	0	12
Level 1	6	0	6	0	12
Level 2	6	0	6	0	12
Level 3	6	0	4	0	10
Level 4 Penthouse	1	0	2	2	5
Total	27	0	22	2	51

Block 2					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	7	0	3	0	10
Level 1	6	0	6	0	12
Level 2	6	0	6	0	12
Level 3	6	0	4	0	10
Level 4	3	1	4	0	8
Level 5 Penthouse	1	1	2	1	5
Total	29	2	25	1	57

Block 3					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	8	0	4	0	12
Level 1	6	0	6	0	12
Level 2	6	0	6	0	12
Level 3	6	0	4	0	10
Level 4 Penthouse	1	0	1	3	5
Total	27	0	21	3	51

Block 4					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor*	2	0	2	0	4
Level 1 / Podium	4	0	6	0	10
Level 2	3	1	6	0	10
Level 3	0	0	2	1	3
Level 4 Penthouse	0	0	0	0	0
Total	9	1	16	1	27

Block 5					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0/Ground Floor	2	0	2	0	4
Level 1 / Podium	2	0	6	0	8
Level 2	1	1	6	0	8
Level 3	1	1	4	0	6
Level 4 Penthouse	0	0	1	1	2
Total	6	2	19	1	28

Block 6					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	1	0	4	0	5
Level 1	1	0	5	0	6
Level 2	1	0	5	0	6
Level 3 Penthouse	2	0	0	2	4
Total	5	0	14	2	21

Block 7					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	0	0	0	0	0
Level 1	0	0	2	0	2
Level 2	0	0	2	0	2
Level 3 Penthouse	0	0	2	0	2
Total	0	0	6	0	6

Block 8					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	1	0	4	0	5
Level 1	1	0	5	0	6
Level 2	1	0	5	0	6
Level 3	1	0	3	1	5
Level 4 Penthouse	2	0	0	1	3
Total	6	0	17	2	25

Duplex Apartment Block 1					
Unit mix by floor	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	0	0	2	2	4
Level 1	0	0	0	0	0
Level 2	1	0	1	0	2
Total	1	0	3	2	6

Duplex Apartment Block 2A					
Unit mix by floor	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	4	0	0	0	4
Level 1	2	0	2	0	4
Total	6	0	2	0	8

3. Relevant Standards and Assessment Approach

The Building Research Establishment (BRE) in the UK published a document entitled "***Site Layout Planning for Daylight and Sunlight. A Guide to Good Practice*** (Building Research Establishment Report, 2011) which is one of the primary sources of guidance on the subject of daylight and sunlight in residential developments.

Guidance on daylight levels in residential buildings is also provided in ***British Standard (BS) 8206: Part 2 – Code of Practice for Daylighting.*** Both the BRE document and BS 8206 describe similar approaches to assessing daylight levels in residential buildings and set the same minimum performance levels for daylighting. The BRE document refers to BS 8206 and provides more practical advice and greater clarity around the assessment methodologies and will therefore form the basis for the assessment described in this report.

3.1 Assessment Methodologies

The BRE report identifies a number of metrics that can be used to assess the levels of daylight that can be expected in a dwelling

3.1.1 Angle of Visible Sky

The Angle of Visible Sky can be used to provide a qualitative assessment of the amount of daylight that can be expected based on the angle between the mid pane of the window a continuous obstruction opposite to it.

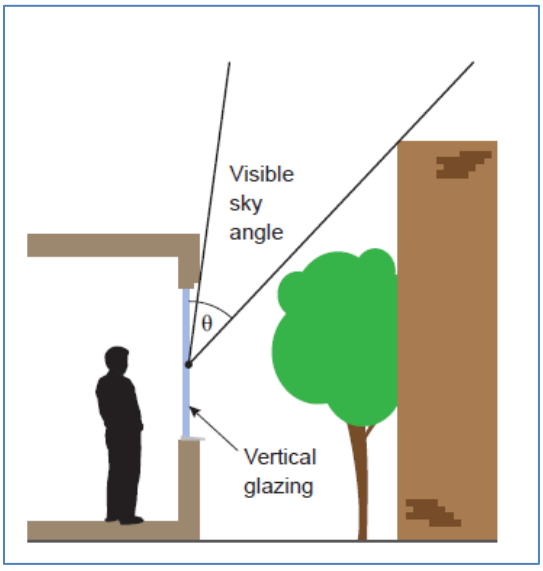

Figure 3.1 – Angle of Visible Sky (Θ)

3.1.2 Vertical Sky Component (VSC)

The Vertical Sky Component (VSC) is the ratio of direct sky illuminance that falls on a vertical wall at a particular reference point to the simultaneous horizontal illuminance under an unobstructed sky. The maximum VSC is typically 40% for an unobstructed wall. The assessment of VSC assumes that the sky is completely overcast (CIE Overcast Sky), with no direct sunlight. As the sky model brightness is assumed unidirectional, there is therefore no difference in calculation for VSC for different orientations: i.e. Northerly aspect facades will receive identical natural light potential to Southerly, etc.

3.1.3 Average Daylight Factor (ADF)

The ADF is the ratio of illuminance at a point on a given plane due to light received from a sky of known or assumed luminance distribution, to illuminance on a horizontal plane due to an unobstructed hemisphere of this sky. Similar to the measurement of VSC, the assessment of ADF is also based on the CIE Overcast Sky.

The Angle of Visible Sky and the VSC are effectively different ways of representing the same information, both will allow an assessment to be made of the day light available at a point on a building façade, and by extension the likelihood of adequate daylight being available within the rooms of a building, however they do not provide a method for measuring the specific internal daylight levels.

The Average Daylight Factor does provide a method for making a quantitative assessment of the daylight that will be achieved internally. The ADF is assessed using numerical modelling which takes account of the external factors (such as shading from balconies or other buildings), the size and shape of the windows and the internal room layouts.

In assessing a scheme of the size that proposed for the Auburn site, the most effective way to assess the overall daylight levels in the scheme is to use a combination of the methods described above. Sectional views of apartments will be assessed to determine which apartments will have the lowest value for the Angle of Visible Sky, then, once these apartments have been identified, ADF calculations will be carried on these units to confirm the actual level of daylight that will be achieved.

4. Daylight Assessment of Dwellings

As discussed in Section 3, a combination of methods was used to make an assessment of the daylight levels that be achieved within the various apartments within the development. Initially, an assessment of the *Angle of Visible Sky* for all apartments in the scheme was undertaken. This assessment identifies the apartments that will have the most restricted access to daylight and these apartments are then assessed using the Average Daylight Factor method.

4.1 Angle of Visible Sky Assessment

In order to use the Angle of Visible Sky method to critically assess the scheme, a series of sections through the buildings were analysed to determine which apartments had the least advantageous “Angle of Visible Sky” as these are the apartments that are likely to perform the worst in terms of Average Daylight Factor.

Due to the low rise nature of the scheme overall and the fact that the apartment blocks are generally well spaced out, the majority of apartments have a favourable Angle of Visible Sky. This analysis did however highlight the fact that the apartments on the lower levels of Blocks 1,2 and 3 had the least favourable value due to the fact that the blocks were located next to each other and due to the geometry of some of the balconies.

As such, these units were the focus of the most detailed initial Average Daylight Factor ADF analysis. This initial analysis identified rooms where the ADF did not meet the required minimum standards and where changes needed to be made. Waterman Moylan liaised with CCK to identify the required changes and to remodel the performance of the changes made. Once satisfied that these changes had the desired effect, they were implemented. ADF modelling was then completed for all units, starting at ground level and working up through the floors until it became self-evident that all non-compliant units had been identified and all rooms could be deemed to have met the minimum standards.

4.2 Average Daylight Factor Assessment

Having analysed the scheme as described in Section 4.1 above to identify the apartments that were not achieving the minimum standard and to work with the architect to make the necessary changes, a systematic ADF modelling approach was then undertaken to work through all apartments in the scheme.

This involved the use of ***IES Virtual Environment program Radiance*** *to* systematically model apartments at ground floor level in Blocks 1 – 8 and then to continue up through the floors until it became evident that all possible apartment geometries had been captured and until it could be proved beyond doubt that all units were in compliance with the required standards.

The results of this modelling exercise are shown in Table 4.1 to 4.8. Typical daylight mapping are provided in Appendix A.

Figure 4.1 – Block 1 layout to be analysed using ADF method

Figure 4.2 – Block 2 layout to be analysed using ADF method

Figure 4.3 – Block 3 layout to be analysed using ADF method

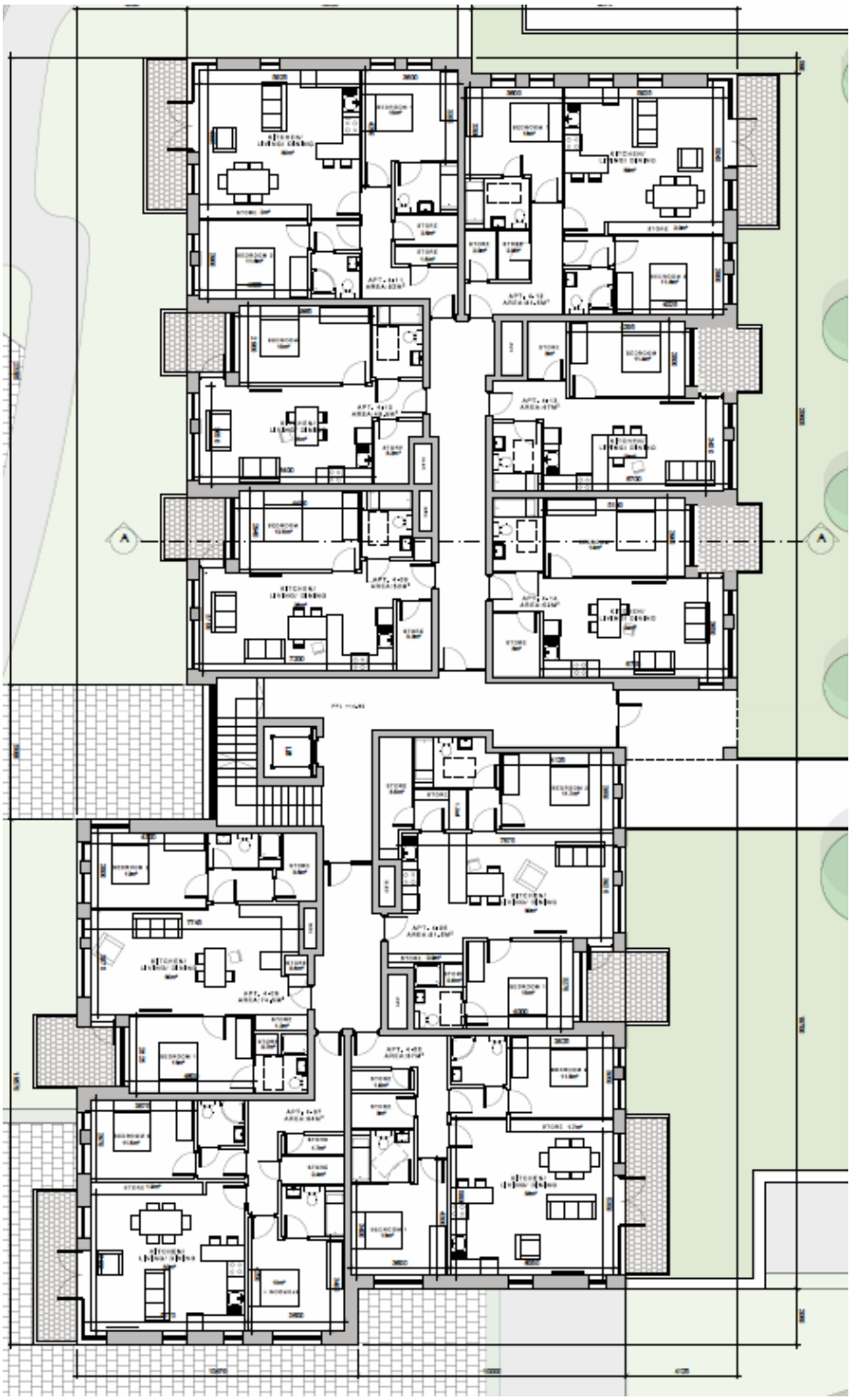

Figure 4.4 – Block 4 layout to be analysed using ADF method

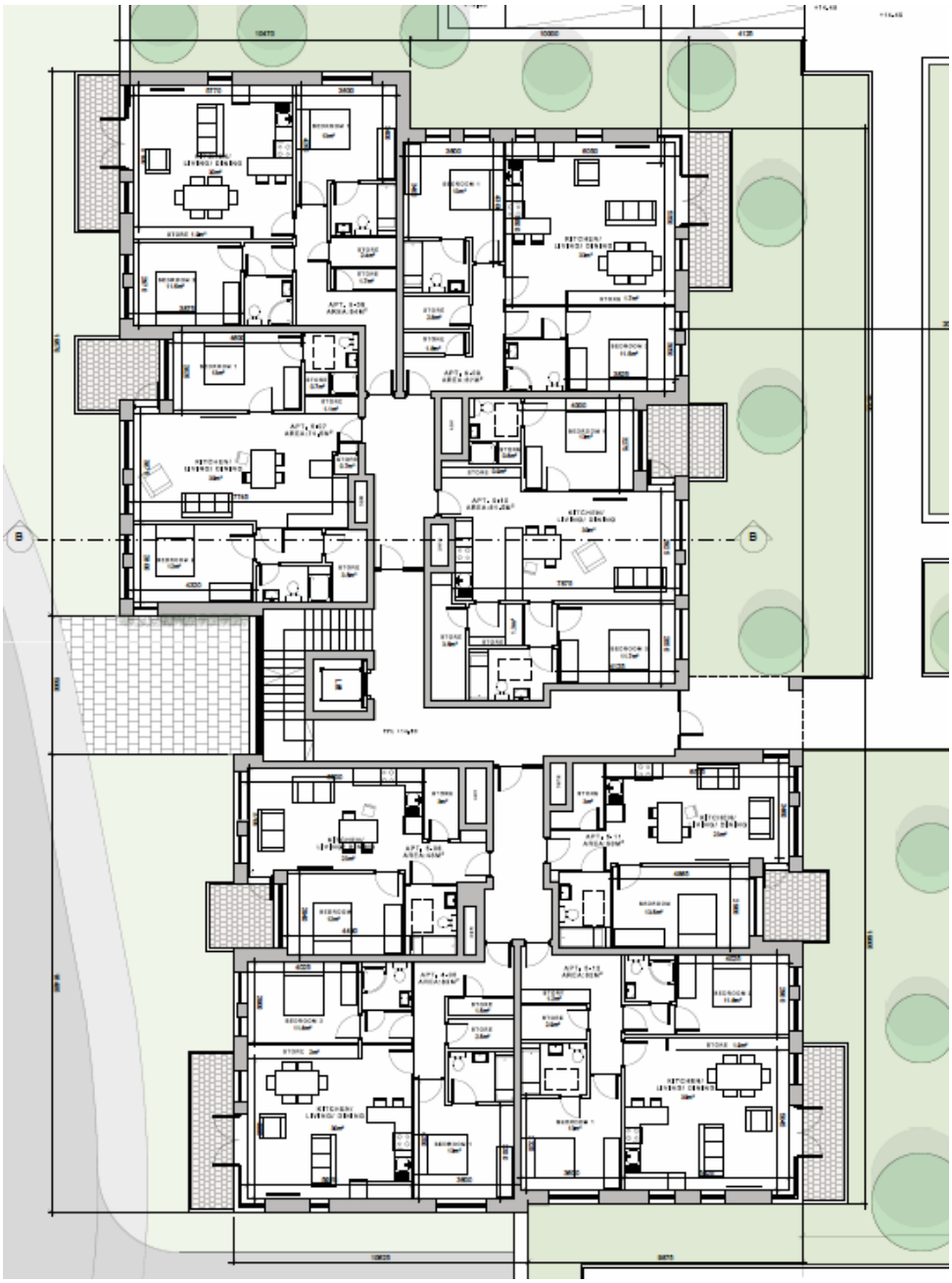

Figure 4.5 – Block 5 layout to be analysed using ADF method

Figure 4.6 – Block 6 layout to be analysed using ADF method

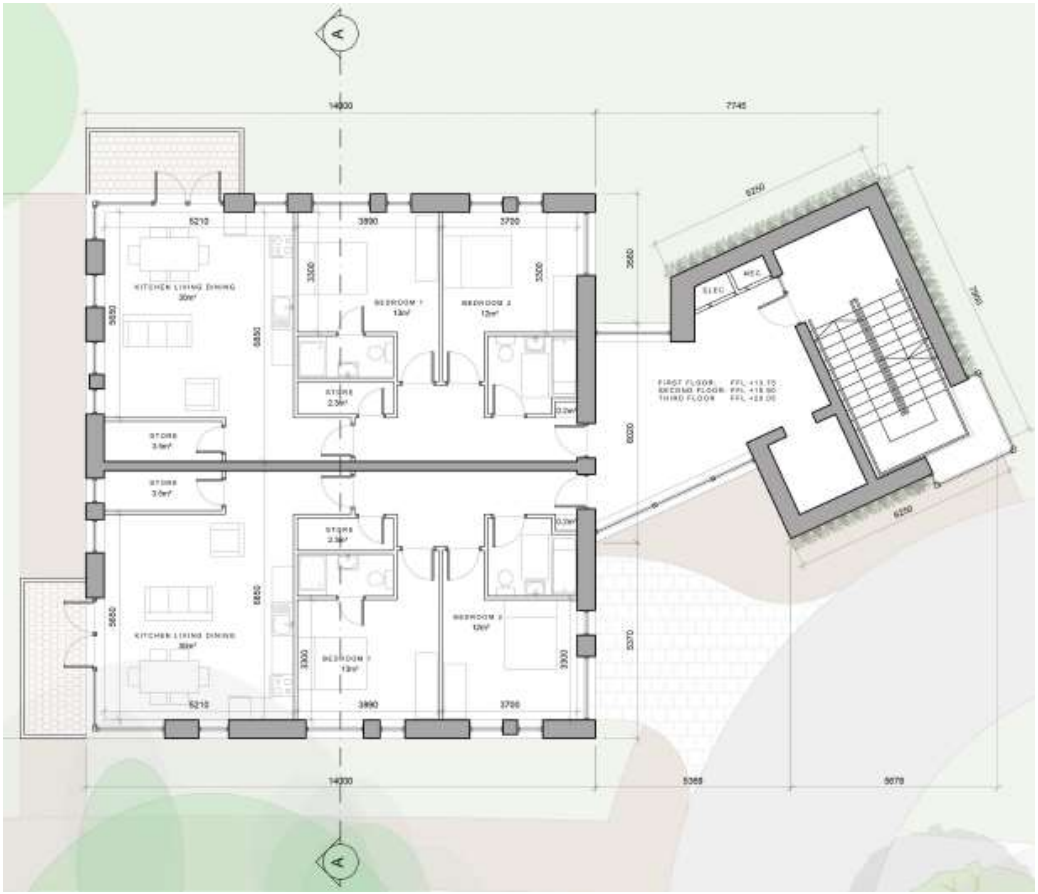

Figure 4.7 – Block 7layout to be analysed using ADF method

Figure 4.8 – Block 8 layout to be analysed using ADF method

Figure 4.9 – Duplex Apartment Block 1 Ground Floor layout to be analysed using ADF method

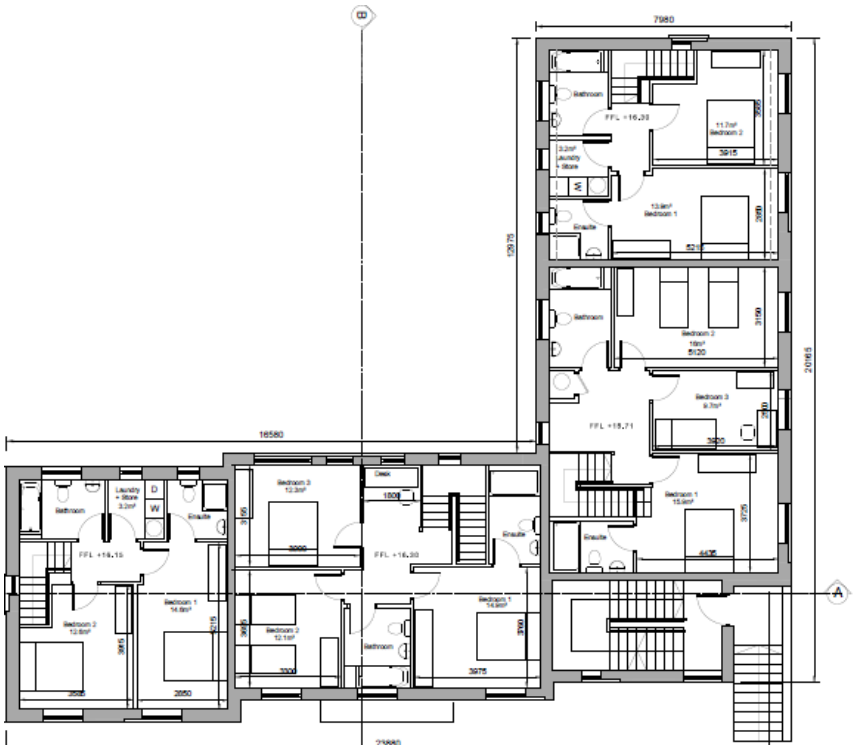

Figure 4.10 – Duplex Apartment Block 1 First Floor layout to be analysed using ADF method

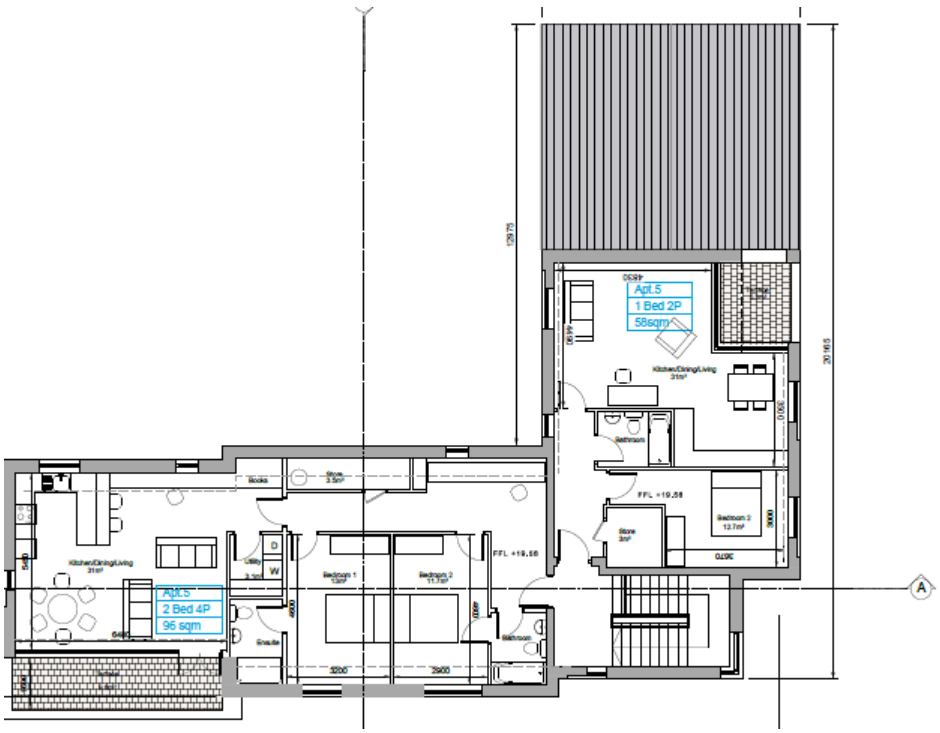

Figure 4.11 – Duplex Apartment Block 1 Second Floor layout to be analysed using ADF method

Figure 4.12 – Duplex Apartment Block 2A Ground Floor layout to be analysed using ADF method

Figure 4.13 – Duplex Apartment Block 2A First Floor layout to be analysed using ADF method

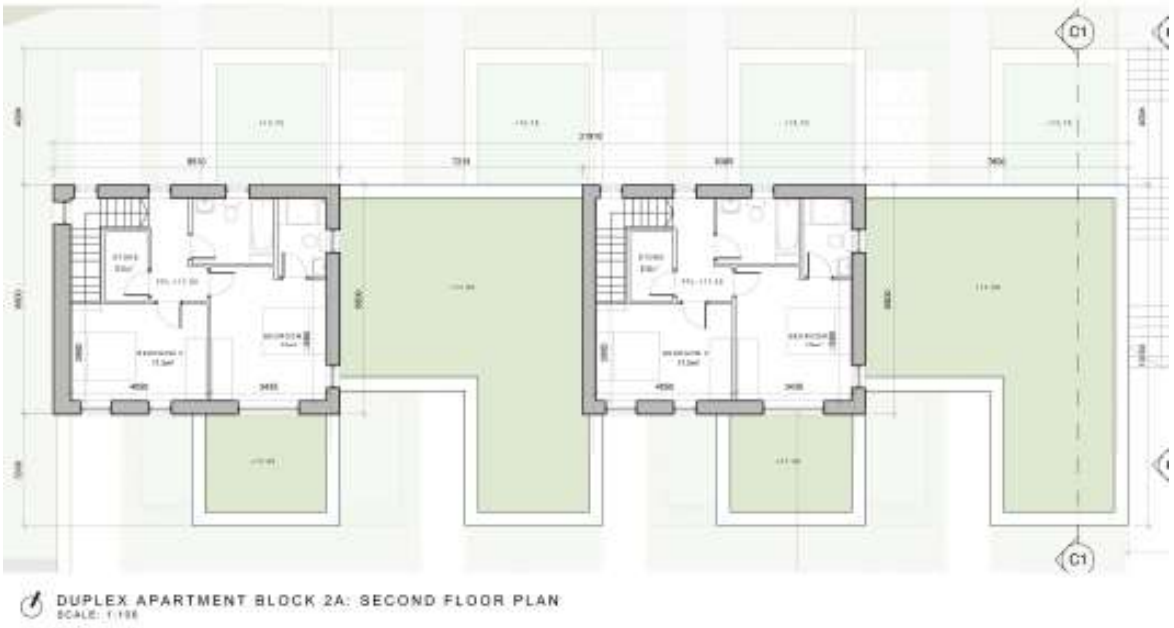

Figure 4.14 – Duplex Apartment Block 2A Second Floor layout to be analysed using ADF method

4.2.1 IES Model Data

The model was built in accordance with architectural Auto CAD layouts issued by CCK Architects which included all blocks in the proposed development. Images of the model are presented below

The following assumptions were made when modelling the ADF in each of the apartments selected

- The CIE Overcast Sky was used in accordance with CIBSE and BRE Guidance
- The following material properties were assigned in the model:
    - Glazing Visible Light Transmittance - 0.70
    - Internal Wall Reflectance - 0.80
    - Ceiling Reflectance - 0.80
    - Internal Floor Reflectance - 0.68
- Working Plane Height

  The working plane height in the model was taken as 0.85m. This is a typical value for domestic applications based on guidance within the BRE Guide “Site Layout Planning for Daylight and Sunlight” Second Edition 2011.

Figures 4.15 to 4.21 below show views from the IES model that has been created. Note that window openings are entered into the model as single frameless entities. The frames are then accounted for numerically within the model through the addition of a “Frame Factor” which effectively reduces the glazed area from that which appears in the images below.

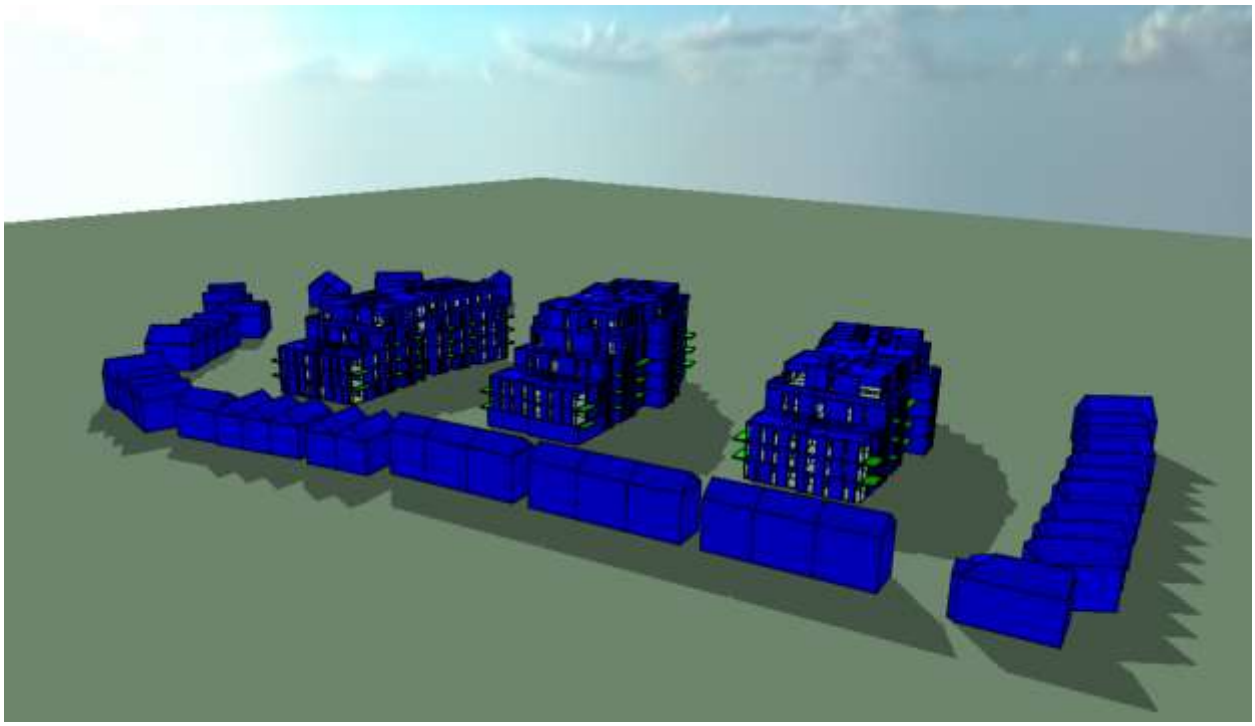

Figure 4.15 – Image of IES Model Blocks 1, 2 & 3

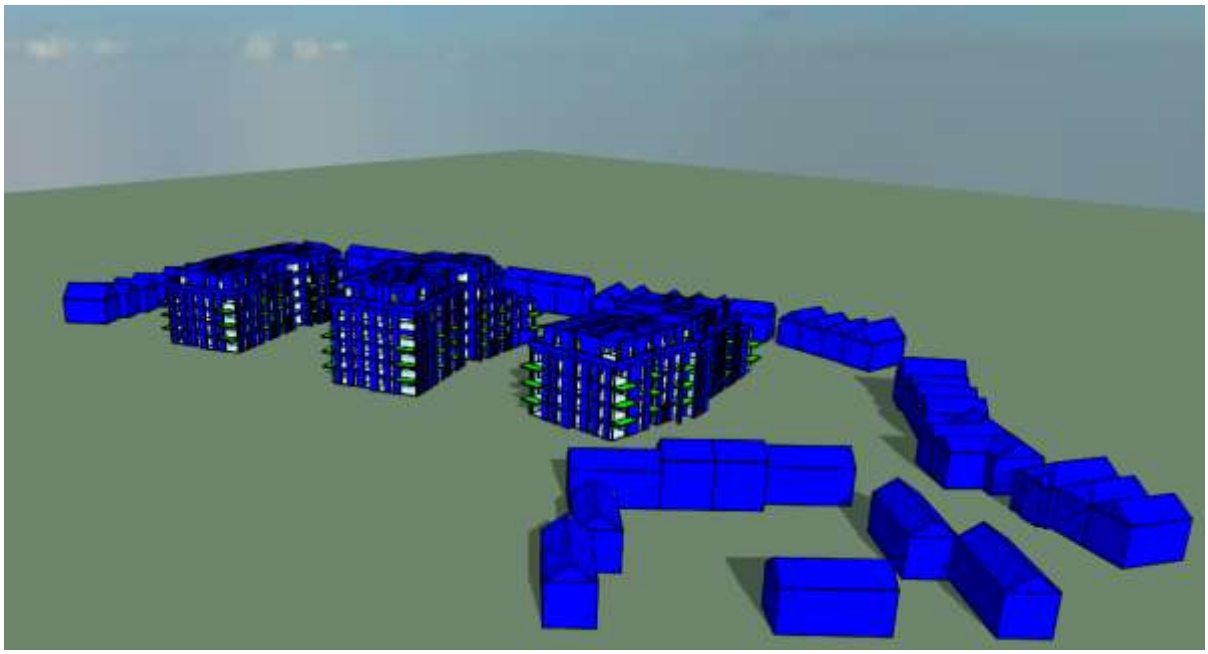

Figure 4.16 – Image of IES Model Blocks 1, 2 & 3

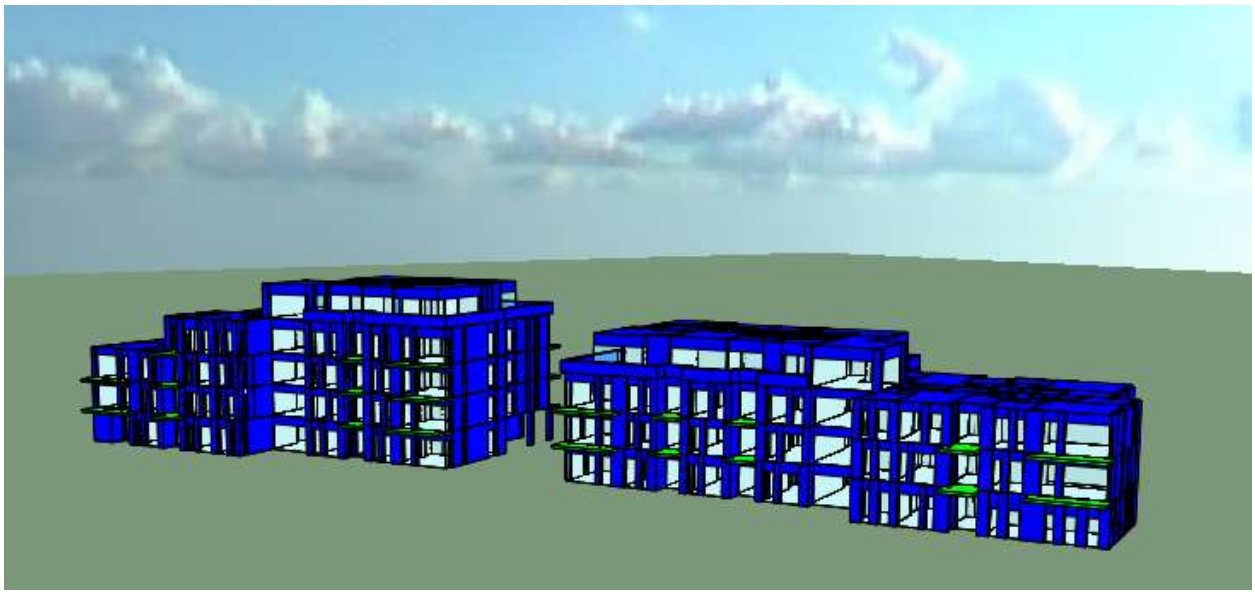

Figure 4.17 – Image of IES Model Blocks 4 & 5

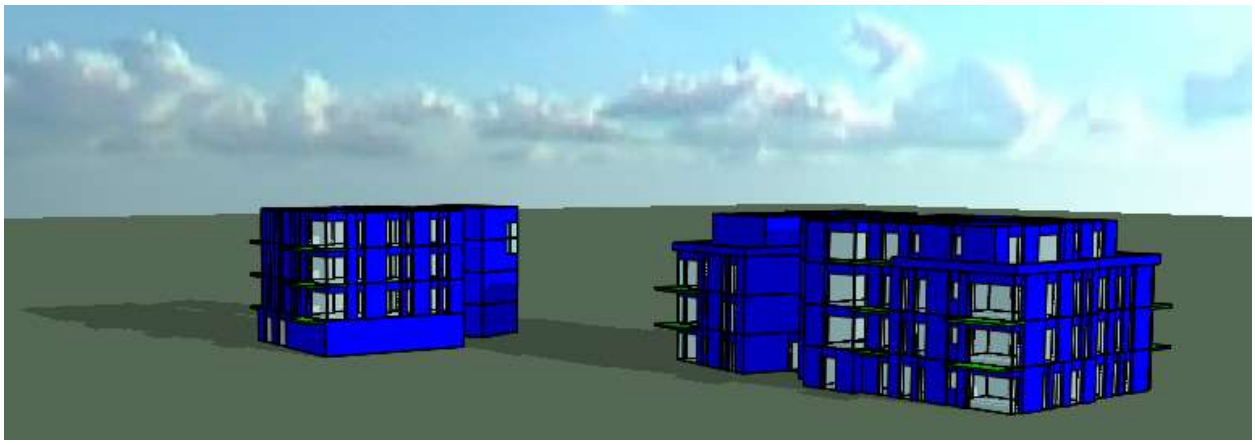

Figure 4.18 – Image of IES Model Blocks 6 & 7

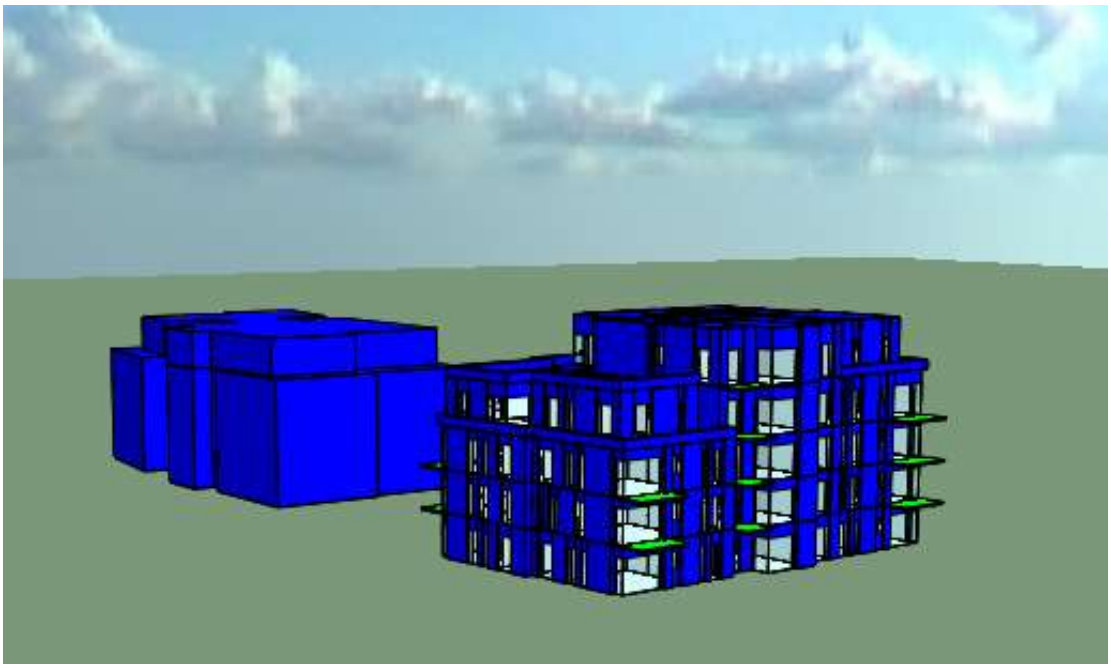

Figure 4.19 – Image of IES Model Blocks 8

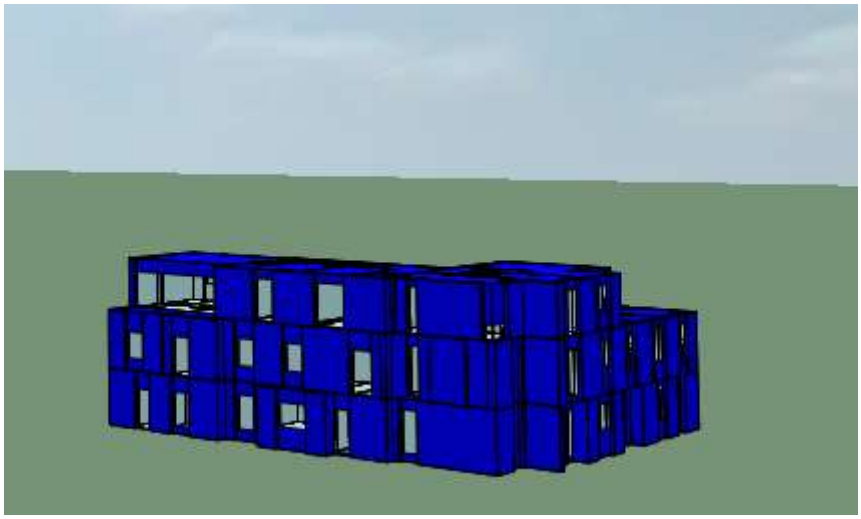

Figure 4.20 – Image of IES Model Duplex Apartment Block 1

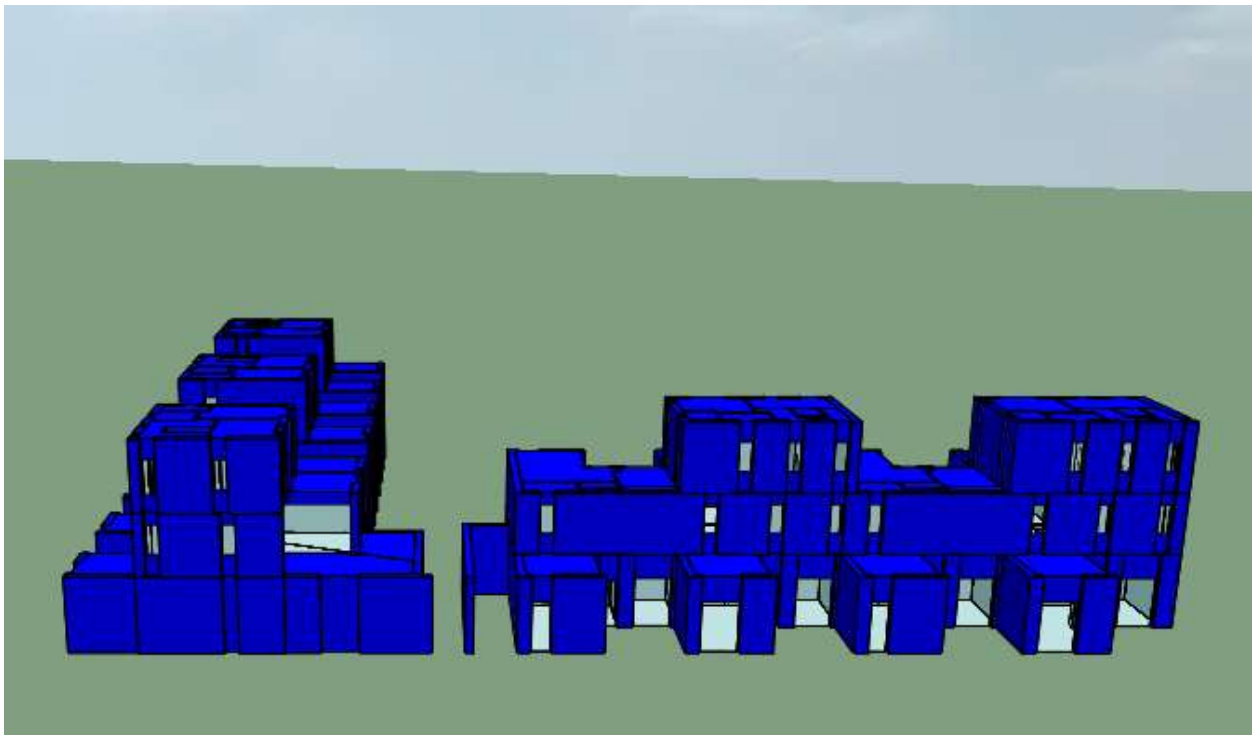

Figure 4.21 – Image of IES Model Duplex Apartment Block 2A

Note: Not all windows in Figure 4.21 were modelled as only a sample mid-terrace duplex/apartment was assessed as the layouts are identical for Duplex Apartment Block 2A.

4.2.2 Average Daylight Factor Results

The results of the daylight simulations are presented below. The BRE report suggests a daylight level of 1.5% for living areas and 1% for bedrooms. The tables below indicate the daylight levels achieved and their compliance with minimum standards.

Block	Unit	Type	ADF Required	GF-00	FF-01	SF-02
1	B1-01-01	Living	1.5	2.3	2.65	3.26
1	B1-01-02	Bed 1	1.0	1.03	1.18	1.45
1	B1-02-01	Living	1.5	2.42	2.78	3.42
1	B1-02-02	Bed 1	1.0	1.01	1.16	1.43
1	B1-03-01	Bed 1	1.0	2.24	2.57	3.16
1	B1-03-02	Living	1.5	3.75	4.31	5.30
1	B1-03-03	Bed 2	1.0	3.54	4.08	5.02
1	B1-04-01	Bed 2	1.0	3.93	4.49	5.52
1	B1-04-02	Living	1.5	4.20	4.84	5.89
1	B1-04-03	Bed 1	1.0	3.73	4.26	5.24
1	B1-05-01	Bed 1	1.0	1.17	1.35	1.66
1	B1-05-02	Living	1.5	1.93	2.25	2.77
1	B1-06-01	Bed 2	1.0	1.54	1.78	2.19
1	B1-06-02	Living	1.5	2.35	2.68	3.30
1	B1-06-03	Bed 1	1.0	N/A	1.36	1.68
1	B1-07-01	Bed 1	1.0	N/A	1.43	1.76
1	B1-07-02	Living	1.5	2.22	2.56	3.15
1	B1-07-03	Bed 2	1.0	2.47	2.84	3.49
1	B1-08-01	Bed 1	1.0	1.13	1.32	1.63
1	B1-08-02	Living	1.5	1.98	2.95	3.63
1	B1-09-01	Bed 1	1.0	3.01	3.44	4.23
1	B1-09-02	Living	1.5	3.30	3.76	4.62
1	B1-09-03	Bed 2	1.0	2.37	2.84	3.49
1	B1-10-01	Bed 2	1.0	2.23	2.56	3.15
1	B1-10-02	Living	1.5	2.85	3.22	3.96
1	B1-10-03	Bed 1	1.0	2.55	2.98	3.67
1	B1-11-01	Living	1.5	2.08	2.33	2.87
1	B1-11-02	Bed 1	1.0	1.19	1.35	1.66
1	B1-12-01	Living	1.5	2.01	2.34	2.88
1	B1-12-02	Bed 1	1.0	1.18	1.35	1.63

Table 4.1 – Block 1 ADF Results

Block	Unit	Type	ADF Required	GF-00	FF-01	SF-02
2	B2-01-01	Living	1.5	2.43	2.77	3.41
2	B2-01-02	Bed 1	1.0	1.08	1.24	1.53
2	B2-02-01	Living	1.5	2.52	2.89	3.55
2	B2-02-02	Bed 1	1.0	1.03	1.17	1.44
2	B2-03-01	Bed 1	1.0	2.53	2.86	3.52
2	B2-03-02	Living	1.5	3.65	4.16	5.12
2	B2-03-03	Bed 2	1.0	3.48	3.98	4.90
2	B2-04-01	Bed 2	1.0	3.98	4.56	5.61
2	B2-04-02	Living	1.5	4.29	4.91	6.04
2	B2-04-03	Bed 1	1.0	2.85	3.23	3.97
2	B2-05-01	Bed 1	1.0	1.07	1.22	1.50
2	B2-05-02	Living	1.5	1.75	2.00	2.42
2	B2-06-01	Bed 1	1.0	1.31	1.48	1.83
2	B2-06-02	Living	1.5	2.15	2.49	3.06
2	B2-06-03	Bed 2	1.0	1.43	1.63	2.01
2	B2-07-01	Bed 1	1.0	1.31	1.52	1.87
2	B2-07-02	Living	1.5	2.23	2.54	3.13
2	B2-07-03	Bed 2	1.0	1.53	1.75	2.15
2	B2-08-01	Bed 1	1.0	1.10	1.22	1.51
2	B2-08-02	Living	1.5	1.76	2.01	2.47
2	B2-09-01	Bed 1	1.0	NA	3.52	4.33
2	B2-09-02	Living	1.5	NA	3.78	4.65
2	B2-09-03	Bed 2	1.0	NA	2.92	3.59
2	B2-10-01	Bed 2	1.0	NA	2.53	3.11
2	B2-10-02	Living	1.5	NA	3.36	4.14
2	B2-10-03	Bed 1	1.0	NA	3.02	3.72
2	B2-11-01	Living	1.5	2.13	2.42	2.98
2	B2-11-02	Bed 1	1.0	1.23	1.39	1.71
2	B2-12-01	Living	1.5	2.11	2.04	2.51
2	B2-12-02	Bed 1	1.0	1.26	1.42	1.76

Table 4.2 – Block 2 ADF Results

Block	Unit	Type	ADF Required	GF-00	FF-01	SF-02
3	B3-01-01	Living	1.5	2.37	2.71	3.31
3	B3-01-02	Bed 1	1.0	1.08	1.26	1.54
3	B3-02-01	Living	1.5	2.49	2.91	3.55
3	B3-02-02	Bed 1	1.0	1.04	1.22	1.49
3	B3-03-01	Bed 1	1.0	2.31	2.70	3.29
3	B3-03-02	Living	1.5	3.86	4.52	5.54
3	B3-03-03	Bed 2	1.0	3.65	4.27	5.21
3	B3-04-01	Bed 2	1.0	4.05	4.74	5.79
3	B3-04-02	Living	1.5	4.33	5.07	6.19
3	B3-04-03	Bed 1	1.0	3.84	4.49	5.48
3	B3-05-01	Bed 1	1.0	1.21	1.43	1.75
3	B3-05-02	Living	1.5	2.01	2.42	2.95
3	B3-06-01	Bed 2	1.0	1.59	1.86	2.27
3	B3-06-02	Living	1.5	2.42	2.83	3.45
3	B3-06-03	Bed 1	1.0	1.09	1.28	1.56
3	B3-07-01	Bed 1	1.0	N/A	1.39	1.70
3	B3-07-02	Living	1.5	2.29	2.68	3.27
3	B3-07-03	Bed 2	1.0	2.54	2.97	3.62
3	B3-08-01	Bed 1	1.0	1.16	1.37	1.68
3	B3-08-02	Living	1.5	2.04	2.39	2.92
3	B3-09-01	Bed 1	1.0	3.10	3.63	4.48
3	B3-09-02	Living	1.5	3.40	3.99	4.87
3	B3-09-03	Bed 2	1.0	2.44	2.85	3.48
3	B3-10-01	Bed 2	1.0	2.30	2.69	3.29
3	B3-10-02	Living	1.5	2.94	3.44	4.21
3	B3-10-03	Bed 1	1.0	2.63	3.08	3.76
3	B3-11-01	Living	1.5	2.14	2.50	3.06
3	B3-11-02	Bed 1	1.0	1.21	1.42	1.73
3	B3-12-01	Living	1.5	2.07	2.42	2.91
3	B3-12-02	Bed 1	1.0	1.22	1.43	1.77

Table 4.3 – Block 3 ADF Results

Block	Unit	Type	ADF Required	GF-00	FF-01
4	B4-01-01	Bed 1	1.0	1.07	
4	B4-01-02	Living	1.5	2.78	
4	B4-01-03	Bed 2	1.0	5.94	
4	B4-02-01	Living	1.5	3.99	
4	B4-02-02	Bed 1	1.0	1.46	
4	B4-03-01	Living	1.5	4.08	
4	B4-03-02	Bed 1	1.0	1.47	
4	B4-04-01	Bed 1	1.0	3.72	
4	B4-04-02	Living	1.5	2.65	
4	B4-04-03	Bed 2	1.0	3.97	
4	B4-05-01	Bed 2	1.0		3.63
4	B4-05-02	Living	1.5		2.56
4	B4-05-03	Bed 1	1.0		1.16
4	B4-06-01	Bed 2	1.0		5.51
4	B4-06-02	Living	1.5		2.36
4	B4-06-03	Bed 1	1.0		5.45
4	B4-07-01	Bed 1	1.0		6.89
4	B4-07-02	Living	1.5		3.44
4	B4-07-03	Bed 2	1.0		3.56
4	B4-08-01	Bed 1	1.0		1.15
4	B4-08-02	Living	1.5		4.37
4	B4-08-03	Bed 2	1.0		7.46
4	B4-09-01	Living	1.5		3.91
4	B4-09-02	Bed 1	1.0		1.25
4	B4-10-01	Living	1.5		3.85
4	B4-10-02	Bed 1	1.0		1.31
4	B4-11-01	Bed 2	1.0		3.95
4	B4-11-02	Living	1.5		2.70
4	B4-11-03	Bed 1	1.0		2.74
4	B4-12-01	Bed 1	1.0		2.86
4	B4-12-02	Living	1.5		2.91
4	B4-12-03	Bed 2	1.0		6.78
4	B4-13-01	Bed 1	1.0		1.03
4	B4-13-02	Living	1.5		3.99
4	B4-14-01	Bed 1	1.0		1.23
4	B4-14-02	Living	1.5		2.93

Table 4.4 – Block 4 ADF Results

Block	Unit	Type	ADF Required	GF-00	FF-01
5	B5-01-01	Bed 1	1.0	5.07	
5	B5-01-02	Living	1.5	3.92	
5	B5-01-03	Bed 2	1.0	3.68	
5	B5-02-01	Bed 1	1.0	1.62	
5	B5-02-02	Living	1.5	4.43	
5	B5-03-01	Bed 2	1.0	5.71	
5	B5-03-02	Living	1.5	4.58	
5	B5-03-03	Bed 1	1.0	1.15	
5	B5-04-01	Living	1.5	3.75	
5	B5-04-02	Bed 1	1.0	1.12	
5	B5-05-01	Bed 1	1.0		4.40
5	B5-05-02	Living	1.5		3.61
5	B5-05-03	Bed 2	1.0		4.64
5	B5-06-01	Bed 1	1.0		1.32
5	B5-06-02	Living	1.5		5.25
5	B5-07-01	Bed 2	1.0		7.08
5	B5-07-02	Living	1.5		4.64
5	B5-07-03	Bed 1	1.0		1.31
5	B5-08-01	Bed 2	1.0		4.58
5	B5-08-02	Living	1.5		2.45
5	B5-08-03	Bed 1	1.0		7.73
5	B5-09-01	Bed 1	1.0		3.44
5	B5-09-02	Living	1.5		3.27
5	B5-09-03	Bed 2	1.0		5.88
5	B5-10-01	Bed 1	1.0		1.03
5	B5-10-02	Living	1.5		3.90
5	B5-10-03	Bed 2	1.0		4.98
5	B5-11-01	Living	1.5		3.58
5	B5-11-02	Bed 1	1.0		1.31
5	B5-12-01	Bed 2	1.0		7.64
5	B5-12-02	Living	1.5		3.30
5	B5-12-03	Bed 1	1.0		5.21

Table 4.5 – Block 5 ADF Results

Block	Unit	Type	ADF Required	GF-00	FF-01	SF-02
6	B6-01-01	Bed 2	1.0	2.23	2.62	3.77
6	B6-01-02	Living	1.5	2.37	2.44	3.85
6	B6-01-03	Bed 1	1.0	1.76	1.83	3.07
6	B6-02-01	Bed 1	1.0	1.23	1.46	1.76
6	B6-02-02	Living	1.5	1.85	1.93	2.11
6	B6-02-03	Bed 2	1.0	2.10	N/A	N/A
6	B6-03-01	Bed 2	1.0	1.84	1.85	2.17
6	B6-03-02	Living	1.5	2.17	2.39	3.55
6	B6-03-03	Bed 1	1.0	1.79	2.15	3.89
6	B6-04-01	Bed 1	1.0	1.89	2.17	2.18
6	B6-04-02	Living	1.5	1.93	2.37	3.25
6	B6-04-03	Bed	1.0	N/A	1.84	1.86
6	B6-05-01	Bed 1	1.0	1.04	1.08	1.34
6	B6-05-02	Living	1.5	1.62	2.33	4.57
6	B6-05-03	Bed 2	1.0	2.18	2.65	4.05
6	B6-06-01	Bed 2	1.0	N/A	1.75	1.84
6	B6-06-02	Living	1.5	N/A	2.16	2.95
6	B6-06-03	Bed 1	1.0	N/A	2.65	2.66

Table 4.6 – Block 6 ADF Results

Block	Unit	Type	ADF Required	GF-00	FF-01	SF-02
7	B7-01-01	Living	1.5	N/A	1.68	1.72
7	B7-01-02	Bed 2	1.0	N/A	3.34	3.45
7	B7-01-03	Bed 1	1.0	N/A	1.66	1.70
7	B7-02-01	Living	1.5	N/A	2.13	2.38
7	B7-02-02	Bed 1	1.0	N/A	2.18	2.24
7	B7-02-03	Bed 2	1.0	N/A	1.79	1.82

Table 4.7 – Block 7 ADF Results

Block	Unit	Type	ADF Required	GF-00	FF-01
8	B8-01-01	Bed 1	1.0	1.67	
8	B8-01-02	Living	1.5	3.46	
8	B8-02-01	Bed 1	1.0	3.71	
8	B8-02-02	Bed 2	1.0	4.28	
8	B8-02-03	Living	1.5	3.54	
8	B8-03-01	Bed 1	1.0	3.12	
8	B8-03-02	Bed 2	1.0	4.51	
8	B8-03-03	Living	1.5	3.75	
8	B8-04-01	Bed 1	1.0	2.29	
8	B8-04-02	Bed 2	1.0	2.13	
8	B8-04-03	Living	1.5	3.78	
8	B8-05-01	Bed 1	1.0	3.15	
8	B8-05-02	Bed 2	1.0	4.71	
8	B8-05-03	Living	1.5	3.35	
8	B8-06-01	Bed 1	1.0		1.98
8	B8-06-02	Living	1.5		4.25
8	B8-07-01	Bed 1	1.0		3.98
8	B8-07-02	Bed 2	1.0		4.54
8	B8-07-03	Living	1.5		3.85
8	B8-08-01	Bed 1	1.0		3.42
8	B8-08-02	Bed 2	1.0		4.72
8	B8-08-03	Living	1.5		4.03
8	B8-09-01	Bed 1	1.0		3.01
8	B8-09-02	Living	1.5		5.15
8	B8-09-03	Bed 2	1.0		2.48
8	B8-10-01	Bed 1	1.0		2.73
8	B8-10-02	Bed 2	1.0		2.91
8	B8-10-03	Living	1.5		3.82
8	B8-11-01	Bed 1	1.0		3.73
8	B8-11-02	Bed 2	1.0		5.03
8	B8-11-03	Living	1.5		3.51

Table 4.8 – Block 8 ADF Results

Block	Unit	Type	ADF Required	ADF Results
DB1	DB1-01-01	Living	1.5	7.15
DB1	DB1-01-02	Bed 1	1.0	2.80
DB1	DB1-01-03	Bed 2	1.0	2.93
DB1	DB1-02-01	Living	1.5	8.61
DB1	DB1-02-02	Bed 1	1.0	3.44
DB1	DB1-02-03	Bed 2	1.0	2.56
DB1	DB1-02-04	Bed 3	1.0	5.62
DB1	DB1-03-01	Living	1.5	5.36
DB1	DB1-03-02	Bed 1	1.0	3.12
DB1	DB1-03-03	Bed 2	1.0	2.02
DB1	DB1-03-04	Bed 3	1.0	1.88
DB1	DB1-04-01	Living	1.5	8.03
DB1	DB1-04-02	Bed 1	1.0	2.49
DB1	DB1-04-03	Bed 2	1.0	3.71
DB1	DB1-05-01	Living	1.5	9.45
DB1	DB1-05-02	Bed 1	1.0	2.57
DB1	DB1-05-03	Bed 2	1.0	3.75
DB1	DB1-06-01	Living	1.5	9.86
DB1	DB1-06-02	Bed 1	1.0	2.22

Table 4.9 – Duplex Apartment Block 1 ADF Results

Block	Unit	Type	ADF Required	ADF Results
DB2A	DB2A-03-01	Living	1.5	10.48
DB2A	DB2A-03-02	Bed 1	1.0	2.61
DB2A	DB2A-07-01	Living	1.5	10.87
DB2A	DB2A-07-02	Bed 1	1.5	10.02
DB2A	DB2A-07-03	Bed 2	1.0	9.49

Table 4.10 – Duplex Apartment Block 2A (Unit 3 & 7) ADF Results

5. Sunlight Analysis of Amenity Areas

The site map below identifies seven amenity areas (highlighted red) across the development. The BRE report provides guidance on the accumulation of the hourly sunshine that will reach these amenity areas on the 21st of March (spring equinox). The threshold identified by BRE is that at least 50% of an amenity area will receive at least 2 hours of direct sunlight on the 21st of March.

Figure 5.1 – Proposed Site Amenity Areas

It is evident that the amenity areas between Blocks 1 & 2 and Blocks 2 & 3 will be the worst-case areas due to the fact that they are shaded on two sides by Blocks 1, 2 and 3. As such, the focus of this analysis will be on determining if these amenity areas achieve the minimum amount of direct sunlight recommended by BRE. All other amenity areas are only shaded on one side or by two or three storey structures and as such will clearly receive more than two hours of direct sunlight on March 21st. The results are presented below.

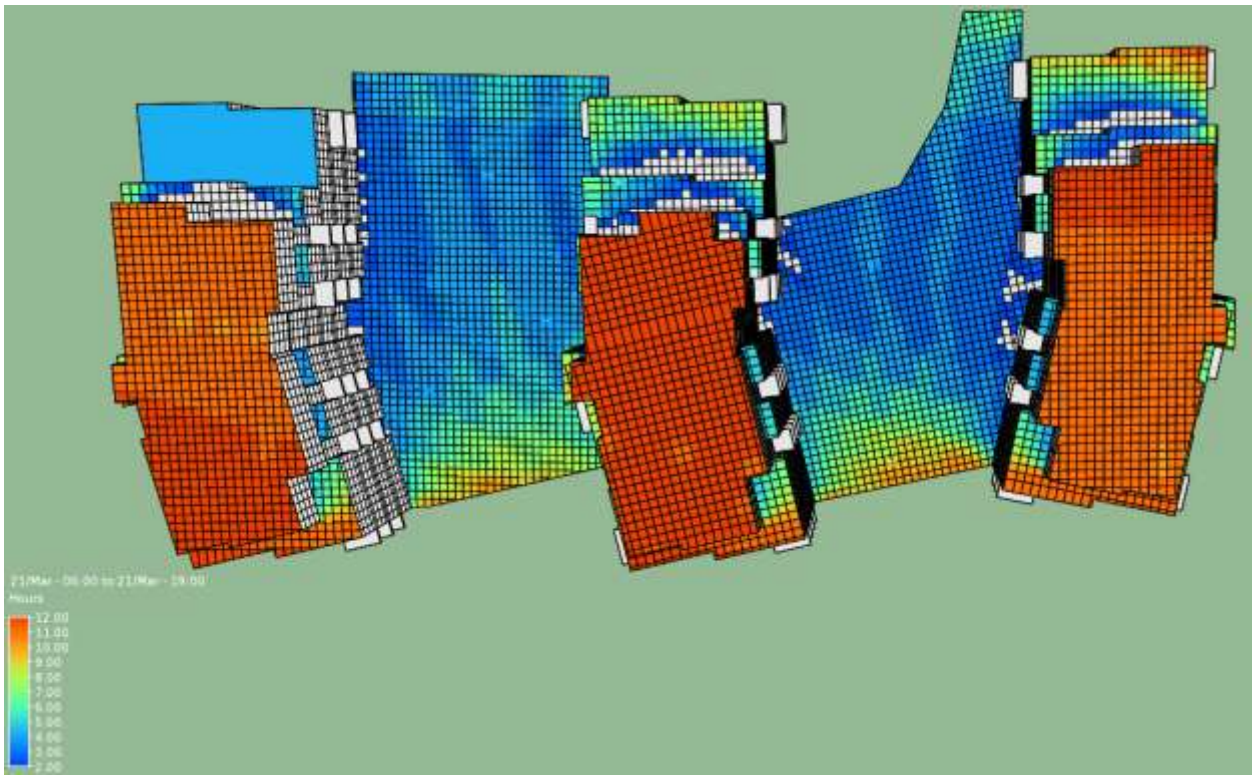

Figure 5.2 – Blocks 1, 2 & 3 Amenity Areas

The IES VE SunCast software is used for this analysis. This software uses a high-resolution grid with 1m^2 sections to identify the direct daylight hours for a predetermined space. The blue squares indicate a minimum of 2 hours direct sunlight. The colour coding transitions from blue to red signifying higher amounts of direct sunlight for a particular 1m^2 section. The white 1m^2 sections indicate areas that fall below the BRE recommendations. It is evident from the image above that only very small areas of the amenity space fail to reach the two hour threshold and these do not to compromise the overall compliance of the amenity areas between Blocks 1 & 2 & Blocks 2 & 3.

The amenity areas between Blocks 1 & 2 and Blocks 2 & 3 receive sufficient sunlight to achieve the BRE recommend 50% over 2 hours of direct sunlight.

Due to the proximity of the amenity areas between to the adjacent structures of Blocks 1, 2 & 3 it is evident that these will be the most heavily shaded amenity spaces within the development. Therefore, it can be determined by extension that all other amenity areas within the scheme will benefit from higher levels of direct sunlight as they are only shaded from one side, are further from shading structures or are shaded by lower two and three storey structures.

6. Impact on Adjacent Existing Buildings

The BRE guidance report suggests that analyses of the impact of new developments on existing adjacent properties should be considered. In order to assess the potential impacts of a new structure the report identifies a number of conditions that can be assessed, to determine if further detailed numerical daylight analysis is required.

The guidance suggests that if **either** of the following criteria are met that the development can be deemed to have no discernible impact on the daylight levels of the existing building.

- If the distance of each part of the new development is three or more times greater than its height above the midpoint of the of a window in the existing property or
- If the angle from the horizontal between the mid pane of a window of the existing dwelling and the highest point of the new structure is less than 25 degrees

All the apartment buildings on the site are a considerable distance from the site boundary and the from the neighbouring properties.

The closest apartment blocks top neighbouring properties are Block 5 and Block 6, of which Block 5 is approximately 50m from the nearest existing property and Block 6 is approximately 45m from the nearest existing property. Block 4/5 are 5 storey blocks and Block 6 is a 4 storey block. The relevant angle, as described above, is 15 degrees in the case of Block 6 and 19 degrees in the case of Blocks 4/5.

All of the remining blocks are further from the site boundary and adjacent structures and comply with the criteria described above more comfortably. As such both of the above conditions are satisfied and it can be confirmed that there will be no impact on the access to daylight of any of the neighbouring properties.

7. Results & Conclusions

The results of the ADF analysis demonstrate the following:

- Living areas across the scheme demonstrate excellent compliance with 100% of theses spaces achieving compliance with the BRE recommended daylight levels across all 8 of the apartment blocks that were analysed.
- The smaller bedrooms in Blocks 1, 2 and 3 demonstrate compliance although due to these spaces being recessed and shaded by balconies they do not perform as well as similar rooms across Blocks 1 to 8.
- Overall, across the scheme, 100% of the spaces analysed demonstrate compliance with the BRE daylighting levels.

Blocks 1&2 and Blocks 2&3 amenity areas demonstrate adequate levels of daylight on the design test day 21st March.

The results of sunlight access to amenity areas demonstrate the following

- The amenity areas between blocks 1, 2 & 3 were deemed to be the worst performing spaces due to their proximity to the apartment blocks and due to the fact that that they are shaded on two sides
- A detailed computer analysis of these spaces indicated that close to 100% of these areas achieved at least two hours of direct sunlight on March 21st and are compliant with the minimum BRE standards
- All other amenity areas will receive significantly more direct sunlight due to the fact that they are shaded only on one side, are further from the shading structures and the buildings in question are only 2 or 3 storeys.

The results of the assessment of the impact the development will have on the access to daylight of existing neighbouring structures demonstrates the following

- The apartment blocks are a sufficient distance from the site boundary and from neighbouring properties so as not to impact on the access to daylight
- The conditions identified in the BRE report are satisfied in relation to all neighbouring properties.

A. Appendix

The images below provide visual representations from IES VE Radiance of bedrooms with differing levels of average daylight factors. The sequence of apartments is in a clockwise pattern beginning with Apartment 1 located on the east side of Block 1. Apartments 1 and 2, due to their proximity to Block 2 and the balconies above, demonstrate a lower level of daylight factor. The bedrooms in apartments 3 and 4 demonstrate higher levels of daylight factor due to the reduced obstruction from Block 2. Apartments located on the west side of Block 1 generally show adequate levels of daylight and show improvement throughout the floors above.

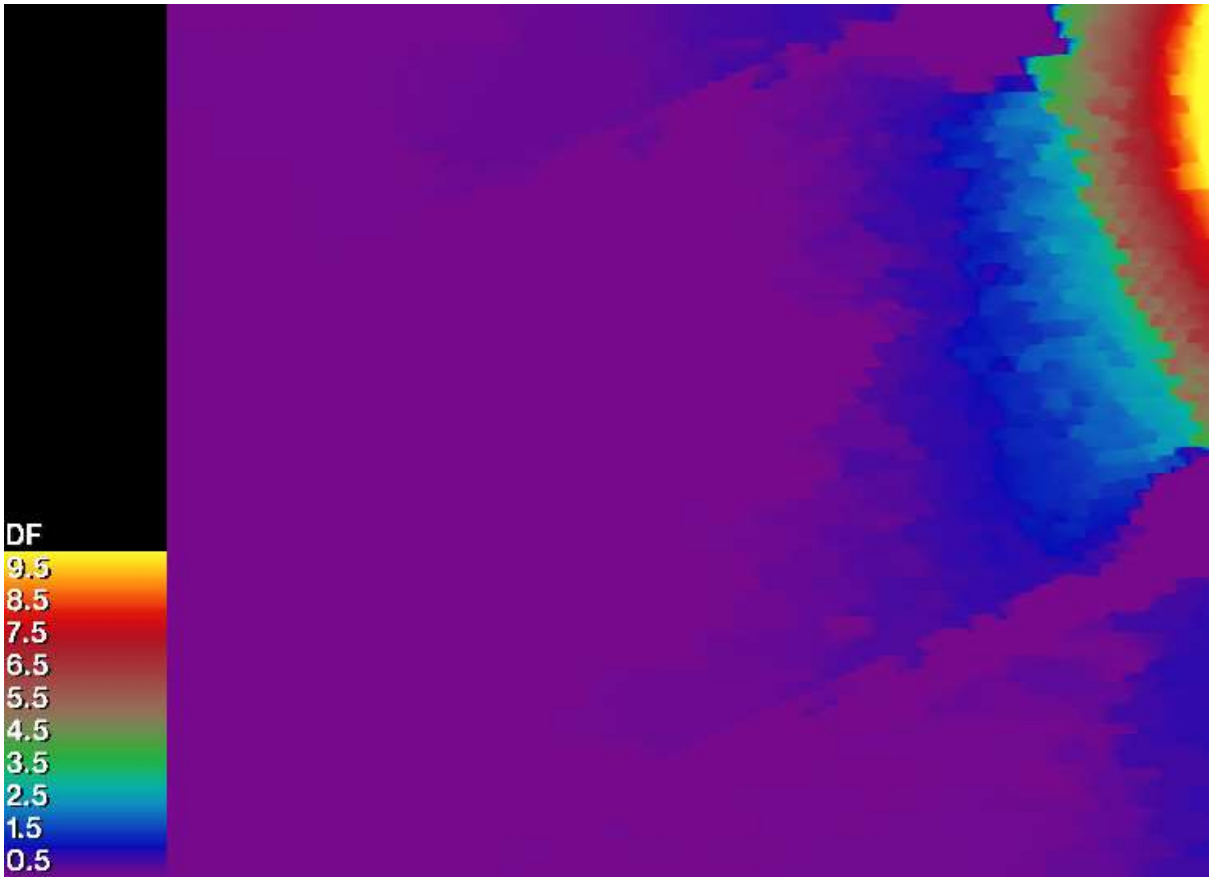

Figure 7.1 – Block 1/Ground Floor/Unit 1/Bedroom (B1-01-02) ADF Result -1.03

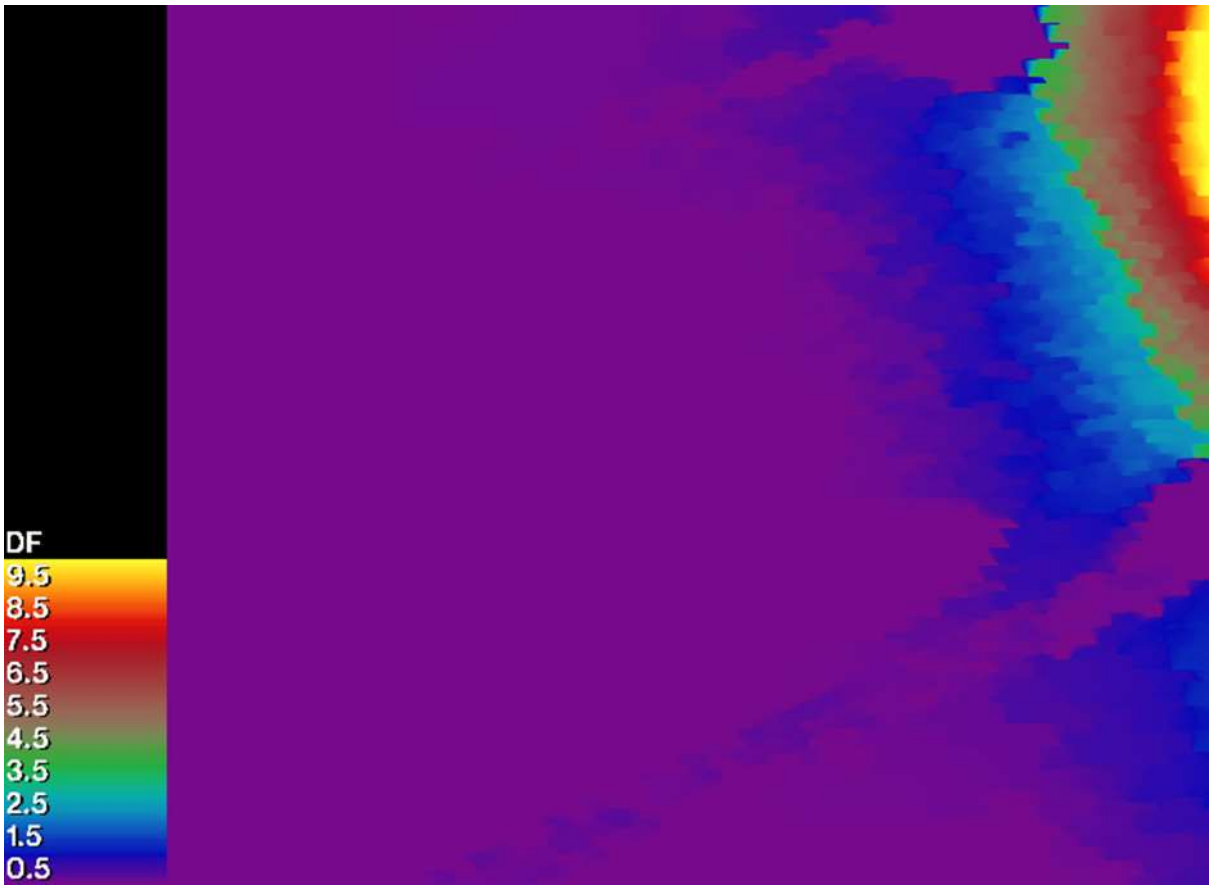

Figure 7.2 – Block 1/Ground Floor/Unit 2/Bedroom (B1-02-02) ADF Result -1.01

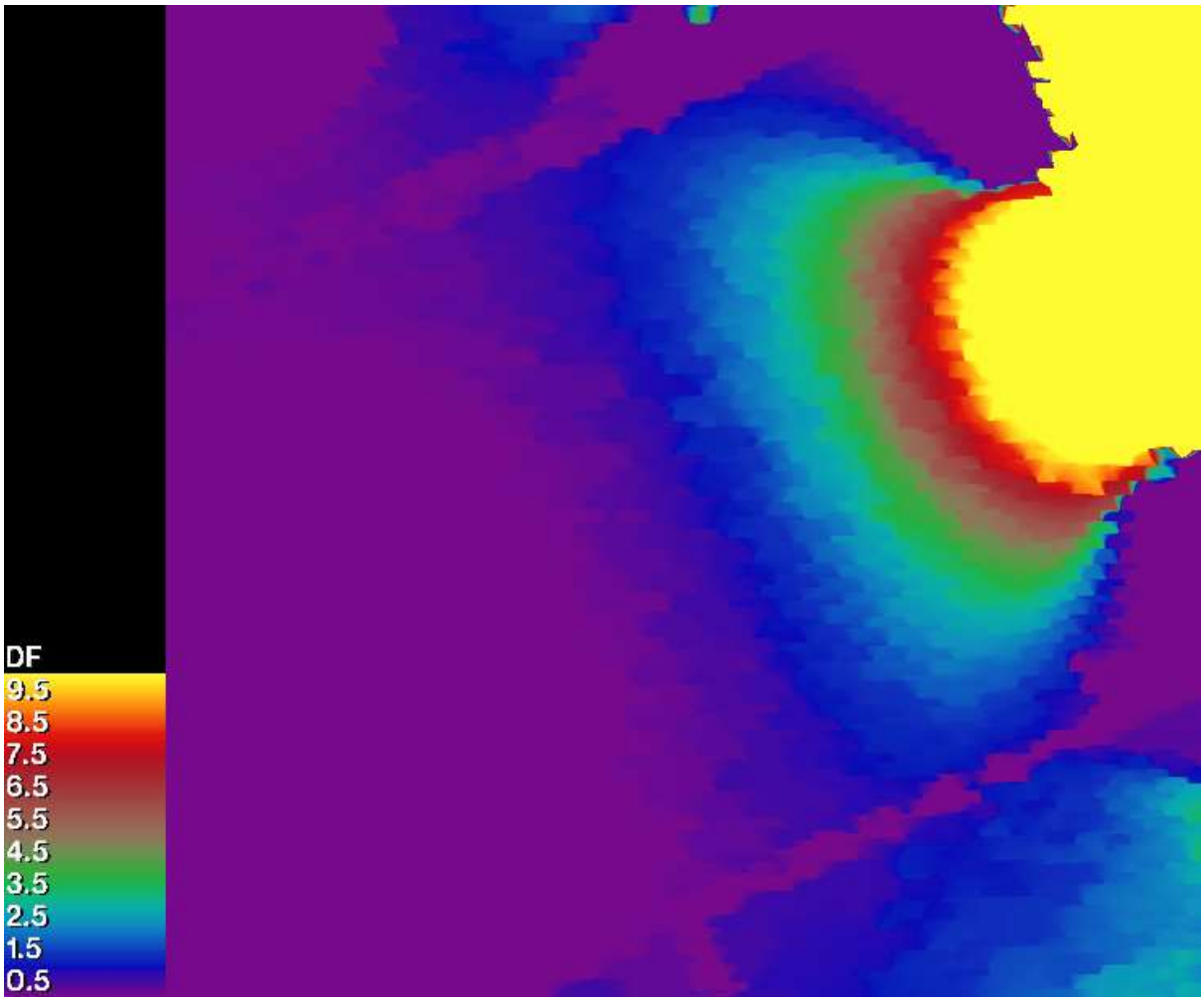

Figure 7.3 – Block 1/Ground Floor/Unit 3/Bedroom 1 (B1-03-01) ADF Result -2.24

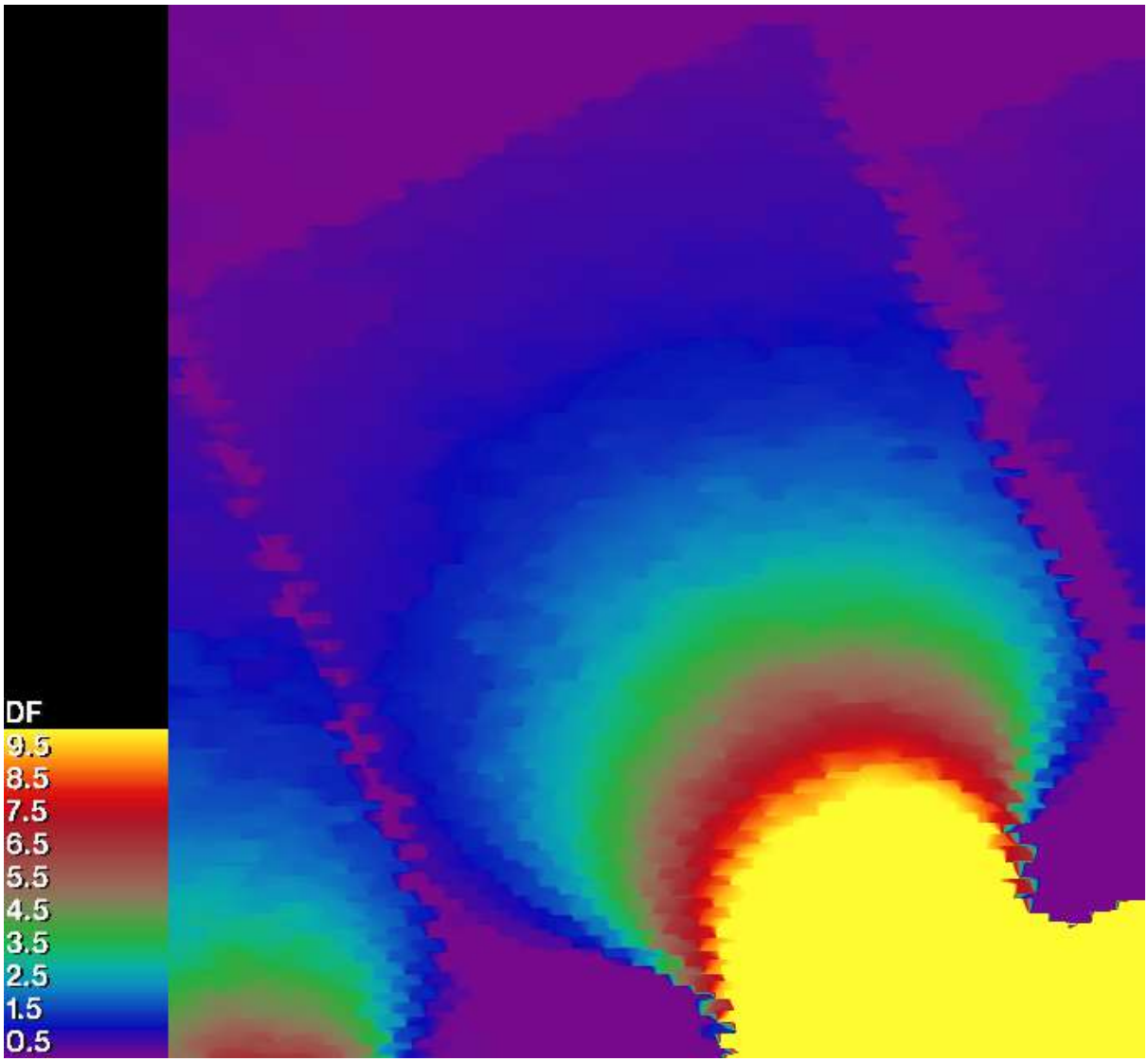

Figure 7.4 – Block 1/Ground Floor/Unit 4/Bedroom 2 (B1-04-01) ADF Result -3.93

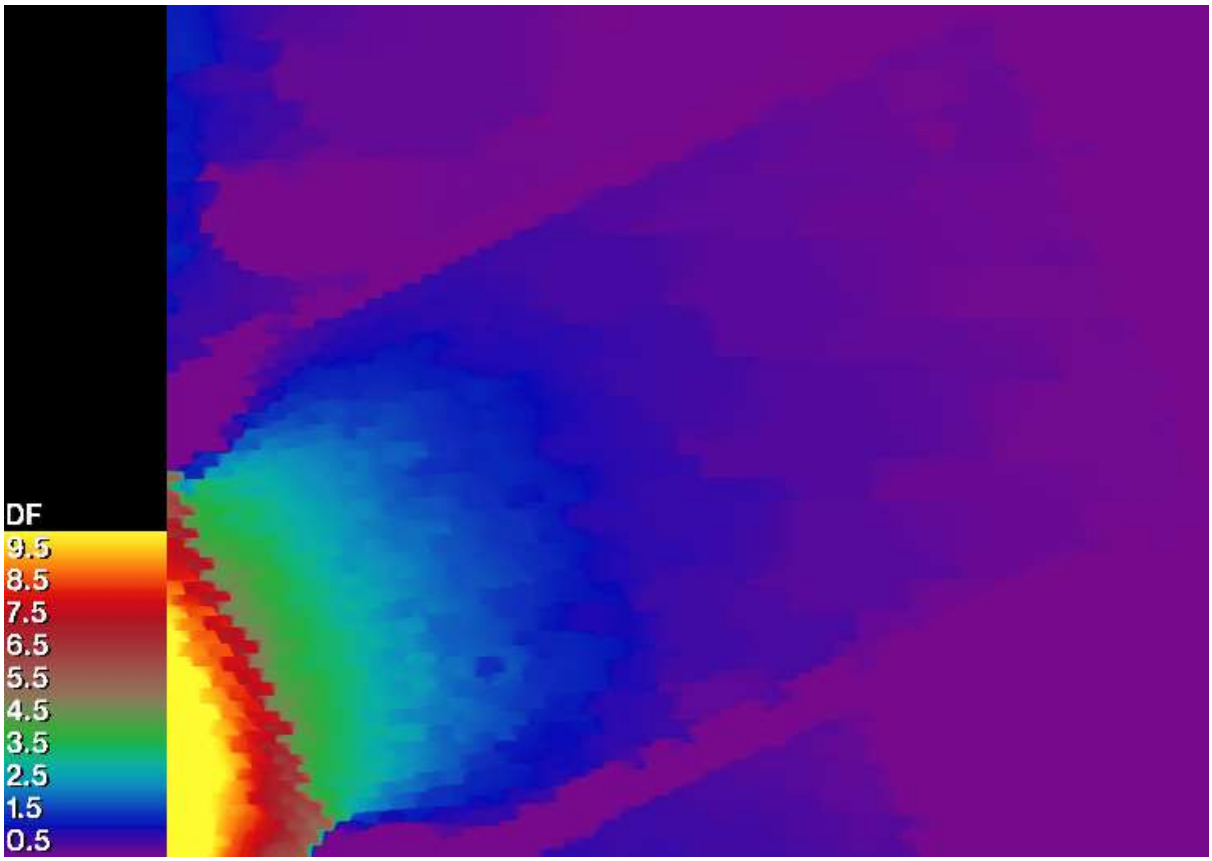

Figure 7.5 – Block 1/Ground Floor/Unit 5/Bedroom 1 (B1-05-01) ADF Result -1.17

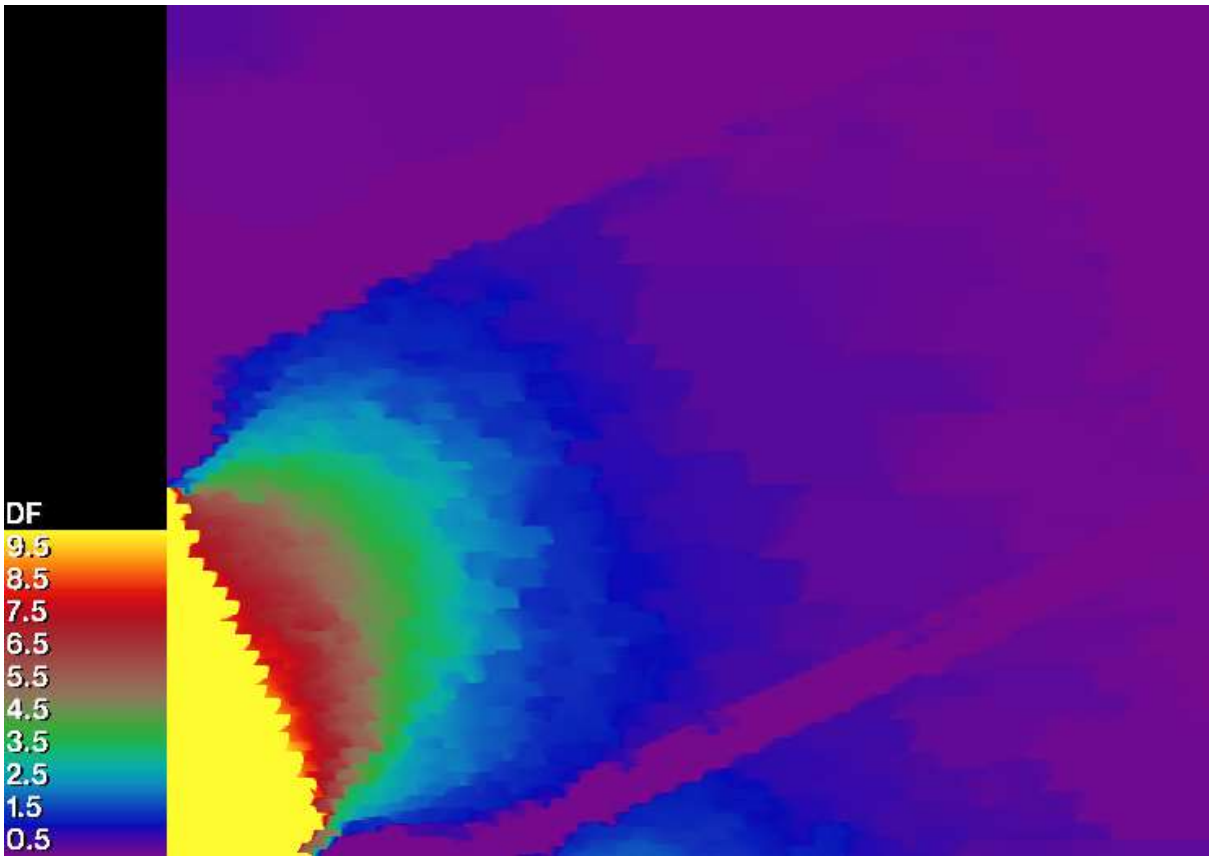

Figure 7.6 – Block 1/Ground Floor/Unit 6/Bedroom 2 (B1-06-01) ADF Result -1.54

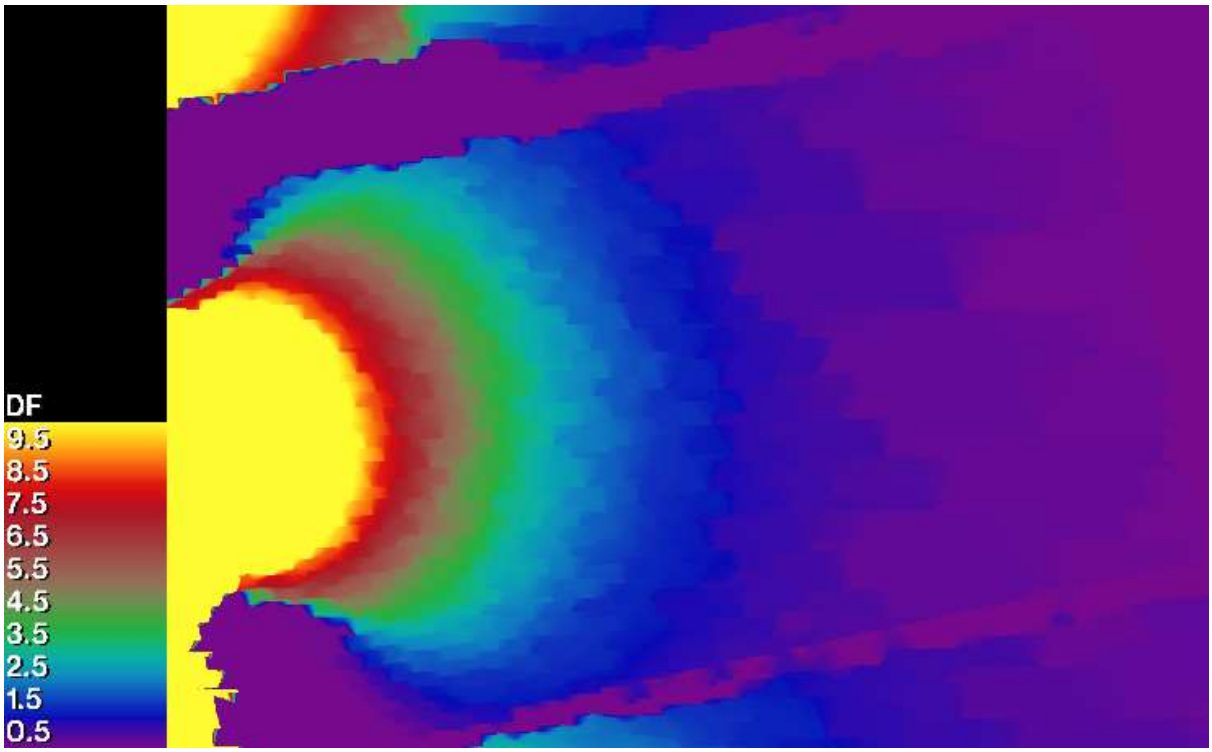

Figure 7.7 – Block 1/Ground Floor/Unit 7/Bedroom 2 (B1-07-03) ADF Result -2.47

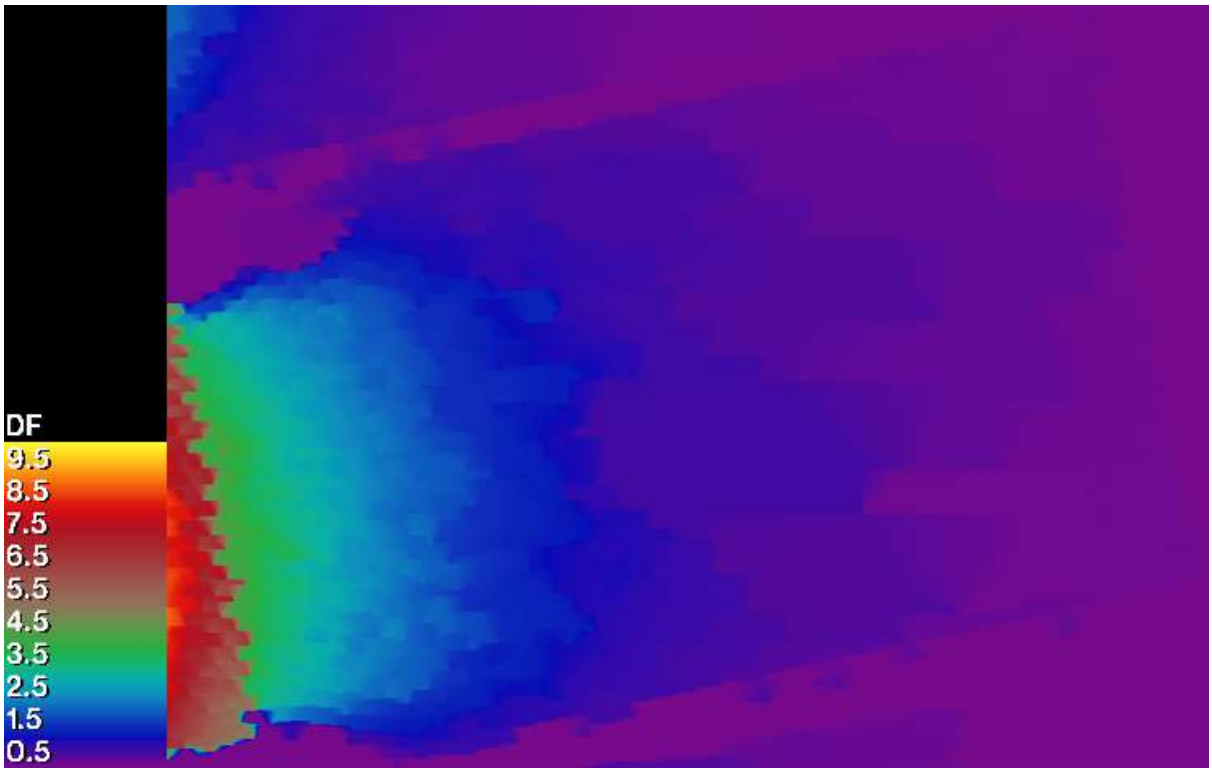

Figure 7.8 – Block 1/Ground Floor/Unit 8/Bedroom 1 (B1-08-01) ADF Result -1.13

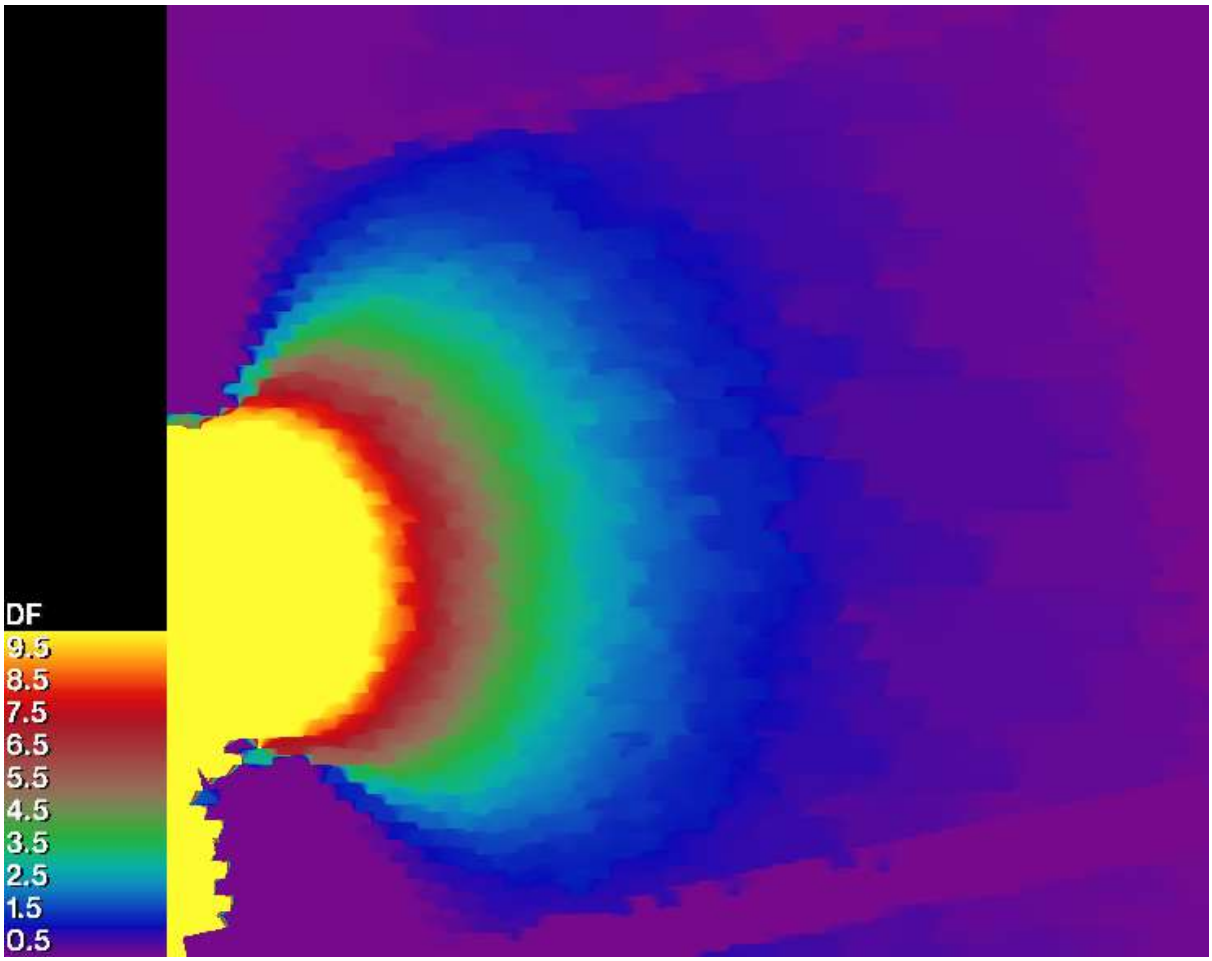

Figure 7.9 – Block 1/Ground Floor/Unit 9/Bedroom 1 (B1-09-01) ADF Result -3.01

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