



NATURAL VENTILATION STATEMENT

ESQ STAGE 4 & 5, PANTHERS NORTH PRECINCT, PENRITH

WH648-01 F02(REV3)- NVS REPORT

SEPTEMBER 28, 2023

CABE DEVELOPMENTS NSW PTY LTD

Atlas Norwest, Level 5, Suite 502, 2-8 Brookhollow Avenue,
Norwest NSW 2153

DOCUMENT CONTROL

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September 28, 2023	Updated Figure 3k.	3	EH	SWR	AFM

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EXECUTIVE SUMMARY

This report presents an opinion on the natural ventilation performance of the various residential apartments of the proposed development known as ESQ Stage 4 & 5, Panthers North Precinct, located in Penrith, based on our extensive experience in this field and the architectural drawings prepared by the project architect Turner, received September 01, 2023, for the assessment of Buildings H, J and K with drawings received September 20, 2023, and September 25, 2023, for the assessment of Building L. The results of the assessment are based on:

- Relative height of the subject building with respect to the adjacent buildings and exposure to the prevailing winds.
- Our extensive experience in modelling of natural ventilation in buildings.
- Our understanding of the guidelines for wind-driven natural cross ventilation provided in the Apartment Design Guide (ADG) within the State Environmental Planning Policy No. 65 (SEPP65).

The results of the assessment indicate that a total of **61.6% (196 out of 318)** of the residential apartments will achieve adequate levels of natural cross ventilation as per SEPP65, which is greater than the required minimum of 60%. Natural cross ventilation has been achieved through openings on orthogonal or opposite aspects (for example corner or cross-through apartments), with direct exposure to prevailing winds or windows located in significantly different pressure regions as defined within Section 4B of the ADG. The individual assessments for Buildings H, J, K and L are as follows:

- Building H 62.5% (40 out of 64)
- Building J 61.2% (60 out of 98)
- Building K 61.4% (43 out of 70)
- Building L 61.6% (53 out of 86)

Important Note: It is important that the naturally cross ventilated flow path does not flow through a bathroom in order to avoid issues with odours. Additionally, each habitable room should have an unobstructed opening size of at least of 5% of the floor area served by the opening, in accordance with Objective 4B-1 of the ADG and have a minimum free area of 0.4m² in order to provide effective natural ventilation.

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REGIONAL WIND CLIMATE

The region is governed by three principal wind directions, and these can potentially affect the subject development. These winds prevail from the north-east, south-east and west. This summary is based on an analysis of wind rose data obtained by the Bureau of Meteorology from Bankstown Airport between 1993 and 2016. Directional plots of the daily average winds when temperatures are between 20-29.5°C; which is the thermal comfort range for this region is shown in Figure 1 below (when occupants tend to open windows for ventilation).

Natural ventilation for a residential apartment is most beneficial during the warmer times of the year, when the occupants of the apartment are most likely to open the windows and/or doors and also when the cooling effect of airflow through the apartment is most effective. An analysis of the Sydney wind climate data within the thermal comfort zone range indicates that more than half of the wind events occur from the 'WNW' to 'WSW' sector, where the 'WNW' to 'WSW' and 'S' to 'SE' sector winds are the most dominant.

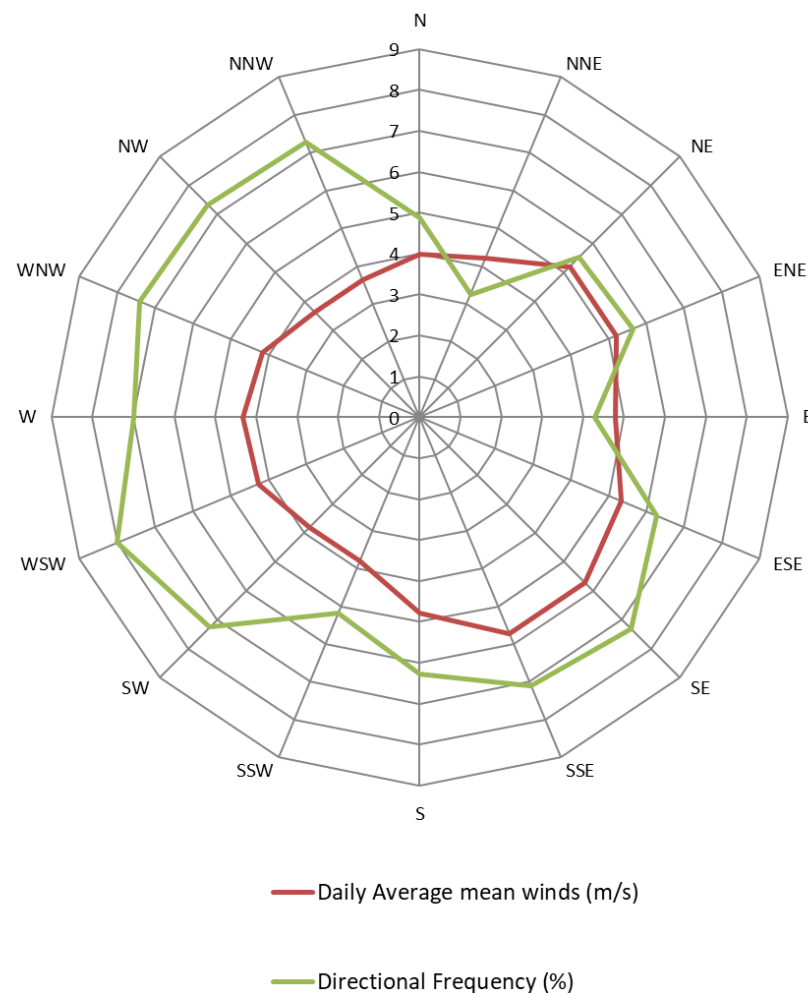


Figure 1: Daily Average Hourly Mean Wind Speeds, and Frequencies Occurrences, for the Bankstown Region for Outdoor Temperatures between 20-29.5°C (based on observations from Bankstown Airport from 1993 to 2016, corrected to open terrain at 10m)

NATURAL CROSS VENTILATION OF DEEMED TO SATISFY APARTMENTS

Natural ventilation of indoor areas can be used to improve both the level of occupant comfort and the air quality of an internal space. Natural ventilation is beneficial in improving occupant comfort during the warmer months of the year when the occupants will generally have windows and doors open, while during the winter months it is considered primarily beneficial for air quality purposes only.

The predominant wind directions for the region have been analysed in Section 1 of this report, and from this analysis only the north-easterly and south-east and westerly winds should be considered as contributors to natural ventilation for occupant comfort purposes, since these are the predominant wind directions during the warmer months of the year. The westerly winds are predominant during the cooler winter months and would be beneficial for air quality purposes only.

The NSW State Environmental Planning Policy No. 65 (SEPP65) states that, for a development to be considered naturally ventilated, at least 60% of the individual apartments in the first nine storeys of the building must be considered to be naturally cross ventilated. Apartments at ten storeys or greater are deemed to be cross ventilated only if any enclosure of the balconies at these levels allows adequate natural ventilation and cannot be fully enclosed. To be considered to be naturally cross ventilated, the overall depth of a cross-over or cross-through apartment must not exceed 18m, measured glass line to glass line. Examples of apartments which are classified as being naturally ventilated by SEPP65 are shown in Figures 2 below, which also show the flow paths for natural cross ventilation through the apartments.

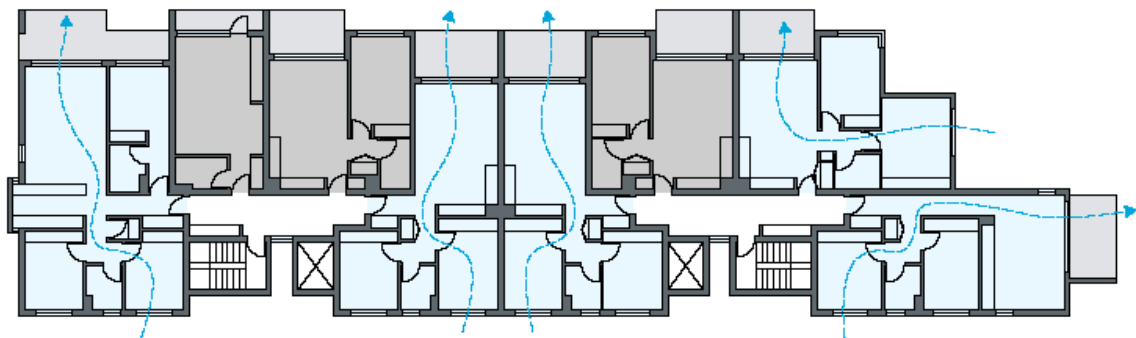


Figure 2a: Examples of Apartments Achieving Effective Natural Cross Ventilation
(from Apartment Design Guide, floor plan of a typical residential building)

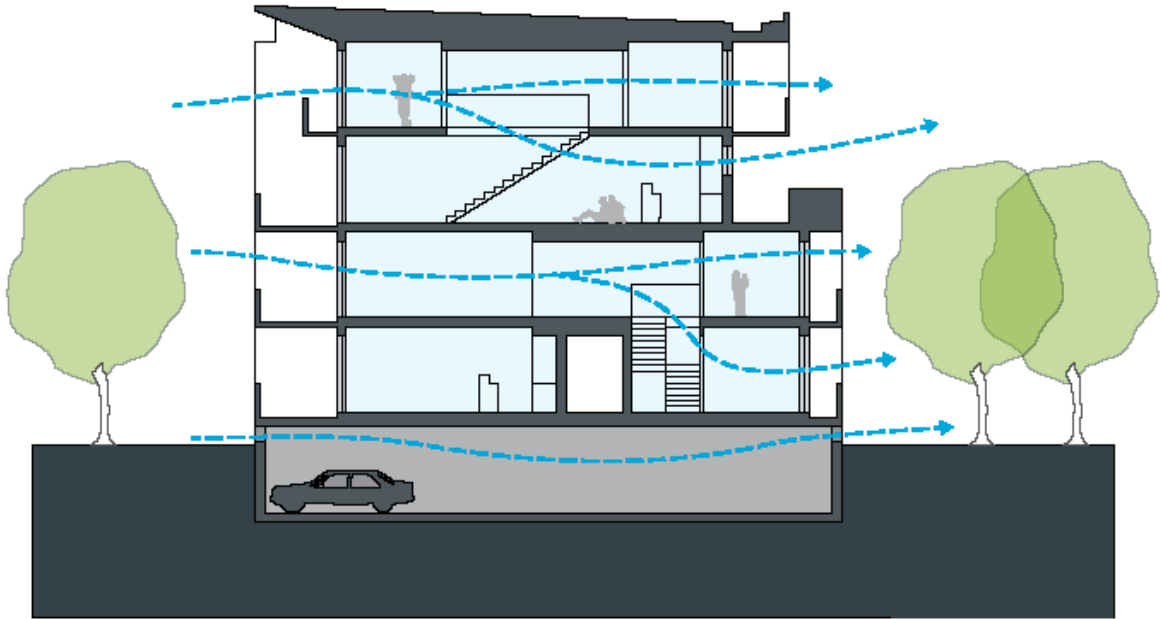


Figure 2b: Examples of Apartments Achieving Effective Natural Cross Ventilation
(from Apartment Design Guide, section elevation of a typical residential building)

Apartments have been considered to have dual aspects if the two openings are able to be located on aspects which are less than 135° in plan orientation from each other. Openings which are located on aspect orientations greater than this are more likely to have similar pressures at the opening, and their performance cannot be considered to satisfy based on the SEPP65 guidelines. These apartments may still be considered to be naturally ventilated, but will require further analysis, as outlined in Section 3.

The Apartment Design Guide does provide design guidance for the layout and design of single aspect apartments to maximise natural ventilation. While these are not considered naturally cross ventilated, they allow for site restraints for design excellence in single aspect apartments. The design allows for the inclusion of plenums, vertical ventilation shafts and building indentations with a width to depth ratio of 2:1 or 3:1 to ensure effective air circulation and avoid trapped smells.

It is important that the naturally cross ventilated flow path does not flow through a bathroom in order to avoid issues with odours.

It should be noted that deviations in the apartment layout shown in SEPP65 can have the potential to provide effective natural ventilation through the apartment. However, due to the complicated nature of flow paths driven by pressure differentials at different openings of an apartment, the effectiveness of natural ventilation for apartments which are outside of those presented in Figures 2 should be demonstrated by means of a detailed wind tunnel study. A comparison between the predicted natural ventilation characteristics of an apartment obtained from wind tunnel testing with the observed full-scale characteristics of the same apartment have been published in the paper titled 'Designing for Natural Ventilation for Tall Residential Buildings' by Peddie and Rofail (2011), which demonstrates close agreement.

3 RESULTS AND DISCUSSION

The results of the assessment indicate that a total of 61.6% (196 out of 318) of the residential apartments within the first nine storeys will achieve adequate levels of natural cross ventilation as per SEPP65, which is greater than the required minimum of 60%. Natural cross ventilation has been achieved through openings on orthogonal or opposite aspects (for example corner or through apartments), with direct exposure to prevailing winds or windows located in significantly different pressure regions as defined within Section 4B of the ADG.

The natural ventilation performance and flow path figures of the various residential apartments for each building of the subject development is summarised in Tables 1a-d, Tables 2a-d and Figures 3a-m.

Important Note: It is important that the naturally cross ventilated flow path does not flow through a bathroom in order to avoid issues with odours. Additionally, each habitable room should have an unobstructed opening size of at least of 5% of the floor area served by the opening, in accordance with Objective 4B-1 of the ADG and have a minimum free area of 0.4m² in order to provide effective natural ventilation.

Table 1a: Natural Ventilation Performance - Summary (Building H)

Apartments	Number	Percentage
Satisfies ADG (Deemed to Satisfy)	40	62.5%
Does not Satisfy	24	37.5%
Total	64	100%

Table 1b: Natural Ventilation Performance - Summary (Building J)

Apartments	Number	Percentage
Satisfies ADG (Deemed to Satisfy)	60	61.2%
Does not Satisfy	38	38.8%
Total	98	100%

Table 1c: Natural Ventilation Performance - Summary (Building K)

Apartments	Number	Percentage
Satisfies ADG (Deemed to Satisfy)	43	61.4%
Does not Satisfy	27	38.6%
Total	70	100%

Table 1d: Natural Ventilation Performance - Summary (Building L)

Apartments	Number	Percentage
Satisfies ADG (Deemed to Satisfy)	53	61.6%
Does not Satisfy	33	38.4%
Total	86	100%

APPENDIX A – ADG COMPLIANCE (INDIVIDUAL UNITS)

Table 2a: Natural Ventilation Performance – Individual Units (Building H)

Unit Number	Meets ADG Guidelines for Natural Cross Ventilation
H.G01	NO
H.G02	YES
H.G03	NO
H.G04	NO
H.G05	NO
H.G06	YES
H.G07	NO
H.G08	YES
H.G09	YES
H.101	NO
H.102	YES
H.103	YES
H.104	YES
H.105	YES
H.106	NO
H.107	YES
H.108	NO
H.109	NO
H.110	YES
H.201	NO
H.202	YES
H.203	YES
H.204	NO
H.205	NO
H.206	YES
H.207	NO
H.208	YES
H.209	YES
H.210	NO
H.211	YES
H.212	YES
H.213	NO
H.214	YES
H.215	YES

Unit Number	Meets ADG Guidelines for Natural Cross Ventilation
H.301	NO
H.302	YES
H.303	YES
H.304	NO
H.305	NO
H.306	YES
H.307	NO
H.308	YES
H.309	YES
H.310	NO
H.311	YES
H.312	YES
H.313	NO
H.314	YES
H.315	YES
H.401	YES - Ventilated Skylight
H.402	YES
H.403	YES
H.404	NO
H.405	NO
H.406	YES
H.407	YES - Ventilated Skylight
H.408	YES
H.409	YES
H.410	YES
H.411	YES
H.412	YES
H.413	NO
H.414	YES
H.415	YES

Table 2b: Natural Ventilation Performance – Individual Units (Building J)

Unit Number	Meets ADG Guidelines for Natural Cross Ventilation
J.101	YES
J.102	YES
J.103	NO
J.104	YES
J.105	NO
J.106	NO
J.107	YES
J.108	YES
J.109	YES
J.110	NO
J.111	NO
J.112	YES
J.113	YES
J.114	NO
J.115	YES
J.201	YES
J.202	YES
J.203	YES
J.204	YES
J.205	YES
J.206	NO
J.207	YES
J.208	YES
J.209	YES
J.210	YES
J.211	YES
J.212	YES
J.213	YES
J.214	NO
J.215	YES
J.301	NO
J.302	YES
J.303	YES
J.304	NO

Unit Number	Meets ADG Guidelines for Natural Cross Ventilation
J.305	NO
J.306	NO
J.307	NO
J.308	NO
J.309	YES
J.310	NO
J.311	NO
J.312	YES
J.313	YES
J.314	NO
J.315	NO
J.401	NO
J.402	YES
J.403	YES
J.404	NO
J.405	NO
J.406	NO
J.407	NO
J.408	NO
J.409	YES
J.410	NO
J.411	NO
J.412	YES
J.413	YES
J.414	NO
J.415	NO
J.501	YES
J.502	YES
J.503	YES
J.504	YES
J.505	YES
J.506	YES - Ventilated Skylight
J.507	YES
J.508	NO
J.509	YES

Unit Number	Meets ADG Guidelines for Natural Cross Ventilation
J.510	NO
J.511	NO
J.512	YES
J.513	YES
J.514	NO
J.515	NO
J.601	YES
J.602	YES
J.603	NO
J.604	YES
J.605	YES
J.606	NO
J.607	NO
J.701	YES
J.702	YES
J.703	YES
J.704	YES
J.705	YES
J.706	YES
J.707	NO
J.708	YES
J.801	YES
J.802	YES
J.803	YES
J.804	YES
J.805	YES
J.806	YES
J.807	NO
J.808	YES

Table 2c: Natural Ventilation Performance – Individual Units (Building K)

Unit Number	Meets ADG Guidelines for Natural Cross Ventilation
K.G01	NO
K.G02	YES
K.G03	NO
K.G04	NO
K.G05	NO
K.G06	YES
K.G07	NO
K.G08	YES
K.101	NO
K.102	YES
K.103	YES
K.104	YES
K.105	YES
K.106	YES
K.107	NO
K.108	YES
K.109	YES
K.110	YES
K.111	NO
K.112	NO
K.201	NO
K.202	YES
K.203	YES
K.204	NO
K.205	NO
K.206	YES
K.207	NO
K.208	YES
K.209	YES
K.210	YES
K.211	NO
K.212	YES
K.213	YES
K.214	NO
K.215	YES

Unit Number	Meets ADG Guidelines for Natural Cross Ventilation
K.301	NO
K.302	YES
K.303	YES
K.304	NO
K.305	NO
K.306	YES
K.307	NO
K.308	YES
K.309	YES
K.310	YES
K.311	NO
K.312	YES
K.313	YES
K.314	NO
K.315	YES
K.401	NO
K.402	YES
K.403	YES
K.404	NO
K.405	NO
K.406	YES
K.407	NO
K.408	YES
K.409	YES
K.410	YES
K.411	NO
K.412	YES
K.413	YES
K.414	NO
K.415	YES
K.501	YES
K.502	YES
K.503	YES
K.504	YES
K.505	YES

Table 2d: Natural Ventilation Performance – Individual Units (Building L)





Unit Number	Meets ADG Guidelines for Natural Cross Ventilation
L.101	YES
L.102	YES
L.103	YES
L.104	NO
L.105	NO
L.106	NO
L.107	YES
L.108	NO
L.109	YES
L.110	NO
L.111	NO
L.112	YES
L.113	YES
L.114	NO
L.115	NO
L.201	YES
L.202	YES
L.203	YES
L.204	YES
L.205	YES
L.206	NO
L.207	YES
L.208	NO
L.209	YES
L.210	NO
L.211	NO
L.212	YES
L.213	YES
L.214	NO
L.215	NO
L.301	YES
L.302	YES
L.303	YES
L.304	YES

Unit Number	Meets ADG Guidelines for Natural Cross Ventilation
L.305	YES
L.306	NO
L.307	YES
L.308	NO
L.309	YES
L.310	NO
L.311	NO
L.312	YES
L.313	YES
L.314	NO
L.315	NO
L.401	YES
L.402	YES
L.403	YES
L.404	YES
L.405	YES
L.406	NO
L.407	YES
L.408	NO
L.409	YES
L.410	NO
L.411	NO
L.412	YES
L.413	YES
L.414	NO
L.415	NO
L.501	YES
L.502	YES
L.503	YES
L.504	YES
L.505	YES
L.506	NO
L.507	YES
L.508	NO
L.509	YES

Unit Number	Meets ADG Guidelines for Natural Cross Ventilation
L.510	NO
L.511	NO
L.512	YES
L.513	YES
L.514	NO
L.515	NO
L.601	YES
L.602	YES
L.603	YES
L.604	NO
L.605	YES
L.701	YES
L.702	YES
L.703	YES
L.801	YES
L.802	YES
L.803	YES

APPENDIX B – ADG COMPLIANCE (FLOW PATH MARK-UPS)

Natural Ventilation Legend

-  Meeting ADG Requirements for Natural Cross-Ventilation (Corner / Cross-Through)
-  Meeting ADG Requirements for Natural Cross-Ventilation (Skylight)
-  Breezeway louvred glazing assumed to be in default state (Open)
-  Recommended inclusion of window (at least 0.4m2 opening)

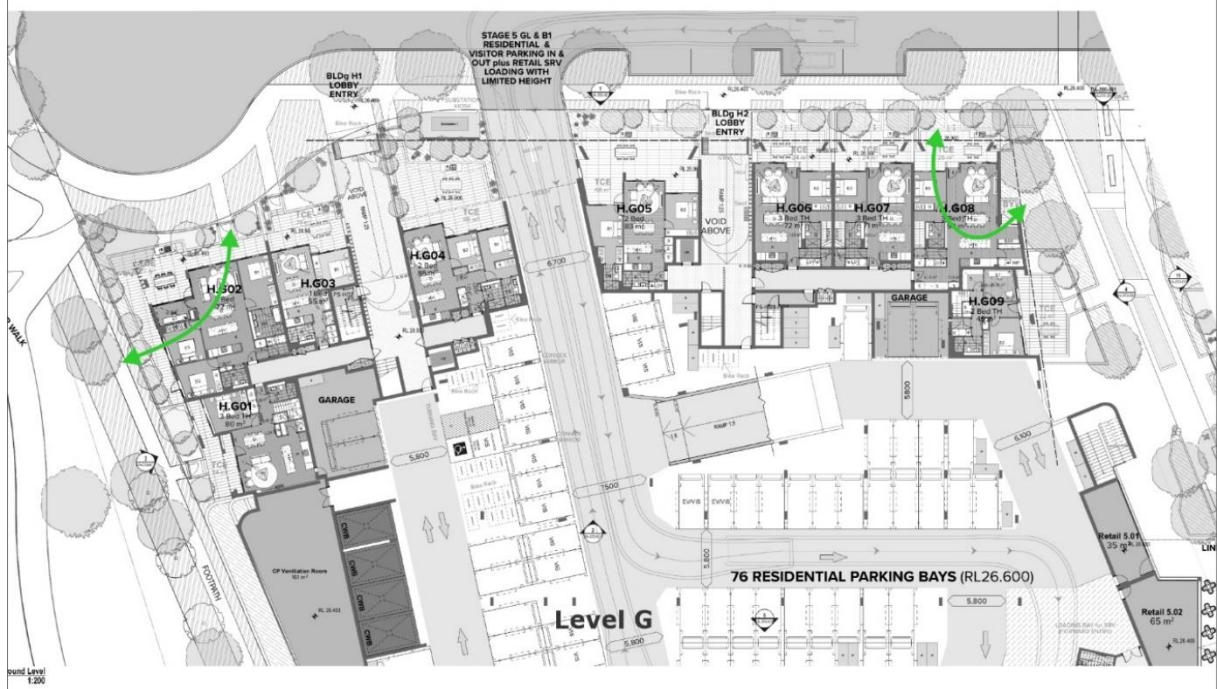






Figure 3a: Flow Paths of Apartments (Building H) (Level G) Achieving Effective Natural Cross Ventilation



Figure 3b: Flow Paths of Apartments (Building H) (Level 01-03) Achieving Effective Natural Cross Ventilation

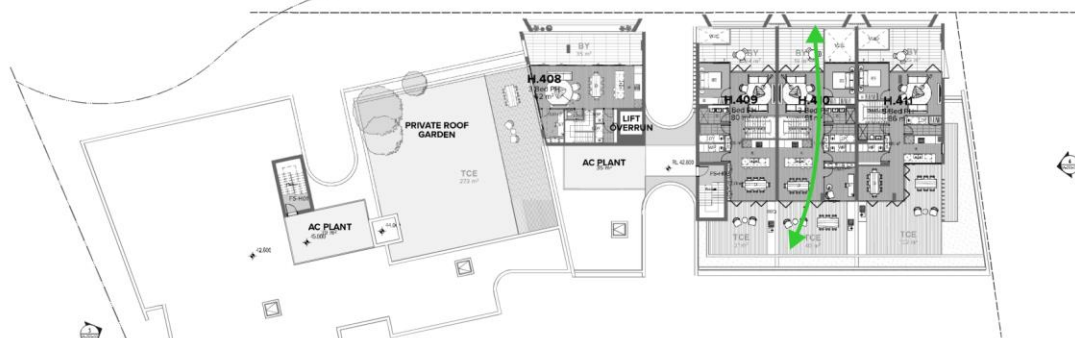
Natural Ventilation Legend

-  Meeting ADG Requirements for Natural Cross-Ventilation (Corner / Cross-Through)
-  Meeting ADG Requirements for Natural Cross-Ventilation (Skylight)
-  Breezeway louvred glazing assumed to be in default state (Open)
-  Recommended inclusion of window (at least 0.4m2 opening)



Level 04

Level 04
1:200







Level 05

Level 05
1:200

Figure 3c: Flow Paths of Apartments (Building H) (Level 04-05) Achieving Effective Natural Cross Ventilation

Natural Ventilation Legend

-  Meeting ADG Requirements for Natural Cross-Ventilation (Corner / Cross-Through)
-  Meeting ADG Requirements for Natural Cross-Ventilation (Skylight)
-  Breezeway louvred glazing assumed to be in default state (Open)
-  Recommended inclusion of window (at least 0.4m2 opening)

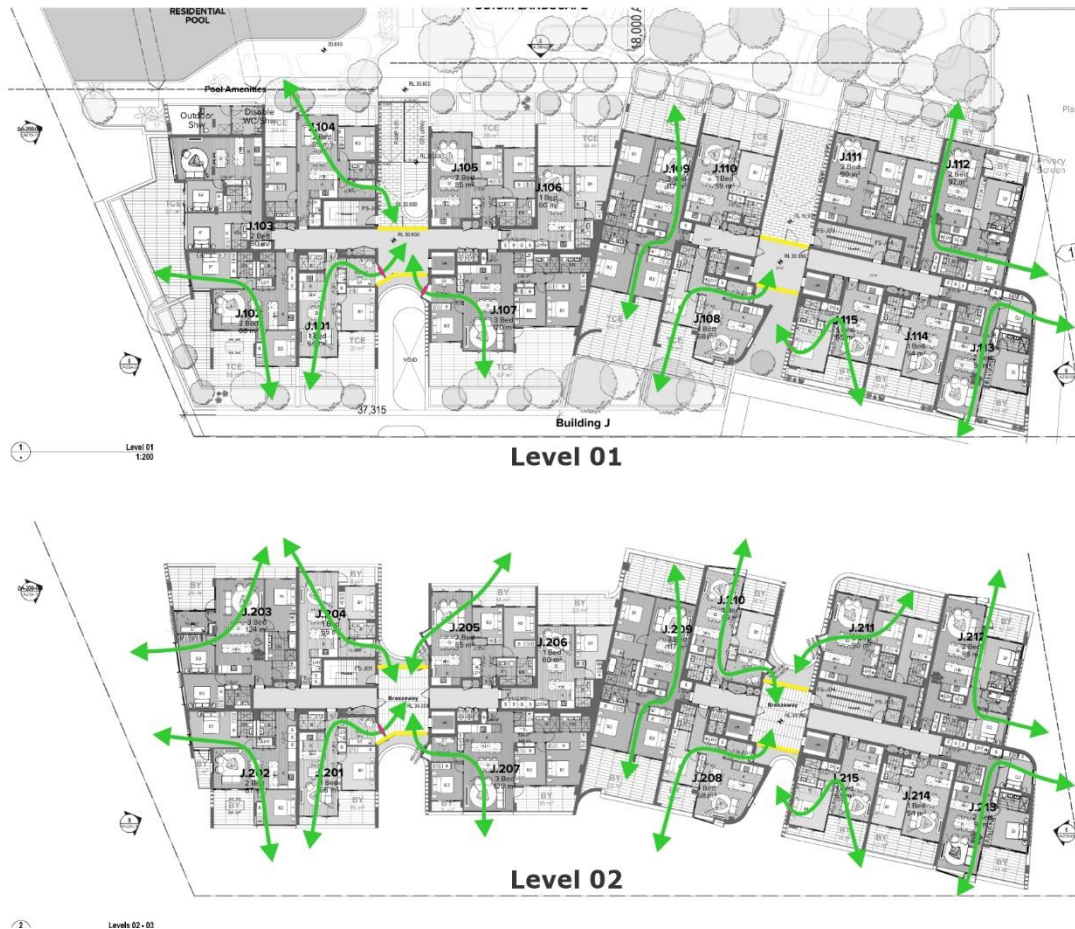






Figure 3d: Flow Paths of Apartments (Building J) (Level 01-02) Achieving Effective Natural Cross Ventilation

Natural Ventilation Legend

-  Meeting ADG Requirements for Natural Cross-Ventilation (Corner / Cross-Through)
-  Meeting ADG Requirements for Natural Cross-Ventilation (Skylight)
-  Breezeway louvred glazing assumed to be in default state (Open)
-  Recommended inclusion of window (at least 0.4m2 opening)

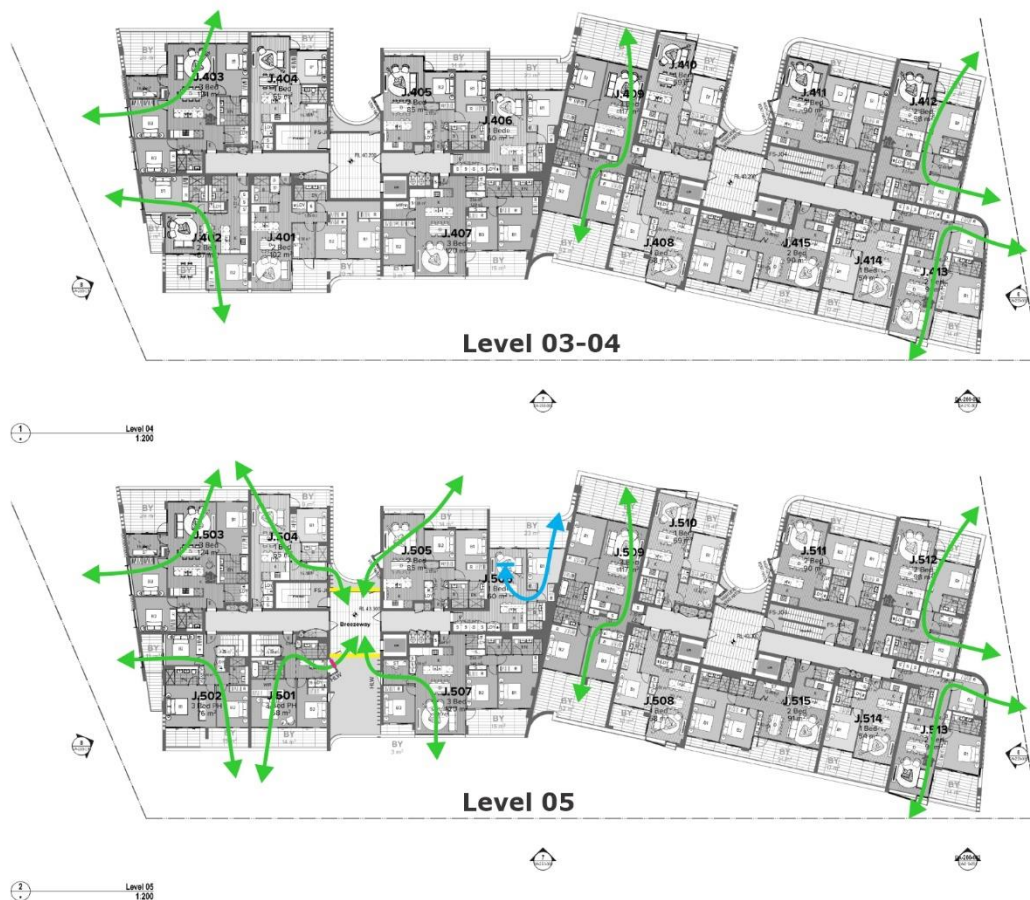






Figure 3e: Flow Paths of Apartments (Building J) (Level 03-05) Achieving Effective Natural Cross Ventilation

Natural Ventilation Legend

-  Meeting ADG Requirements for Natural Cross-Ventilation (Corner / Cross-Through)
-  Meeting ADG Requirements for Natural Cross-Ventilation (Skylight)
-  Breezeway louvred glazing assumed to be in default state (Open)
-  Recommended inclusion of window (at least 0.4m2 opening)

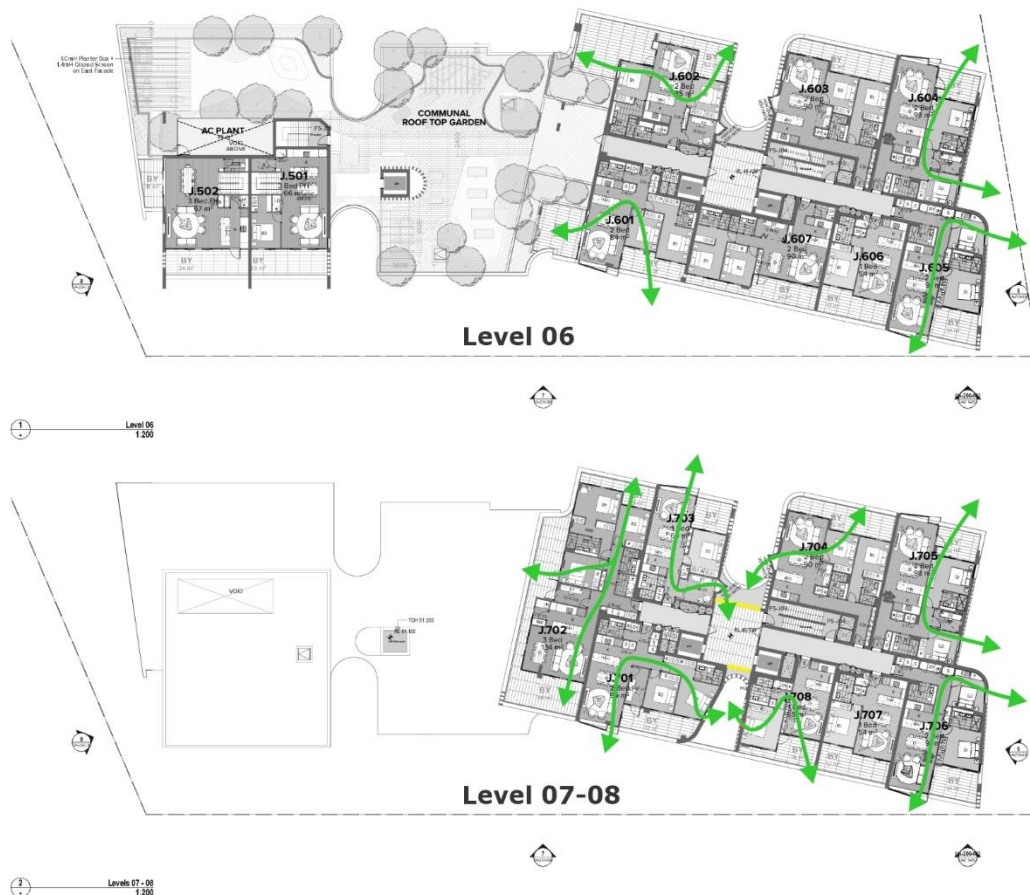





Figure 3f: Flow Paths of Apartments (Building J) (Level 06-08) Achieving Effective Natural Cross Ventilation

Natural Ventilation Legend

-  Meeting ADG Requirements for Natural Cross-Ventilation (Corner / Cross-Through)
-  Breezeway louvred glazing assumed to be in default state (Open)
-  Recommended inclusion of window (at least 0.4m2 opening)

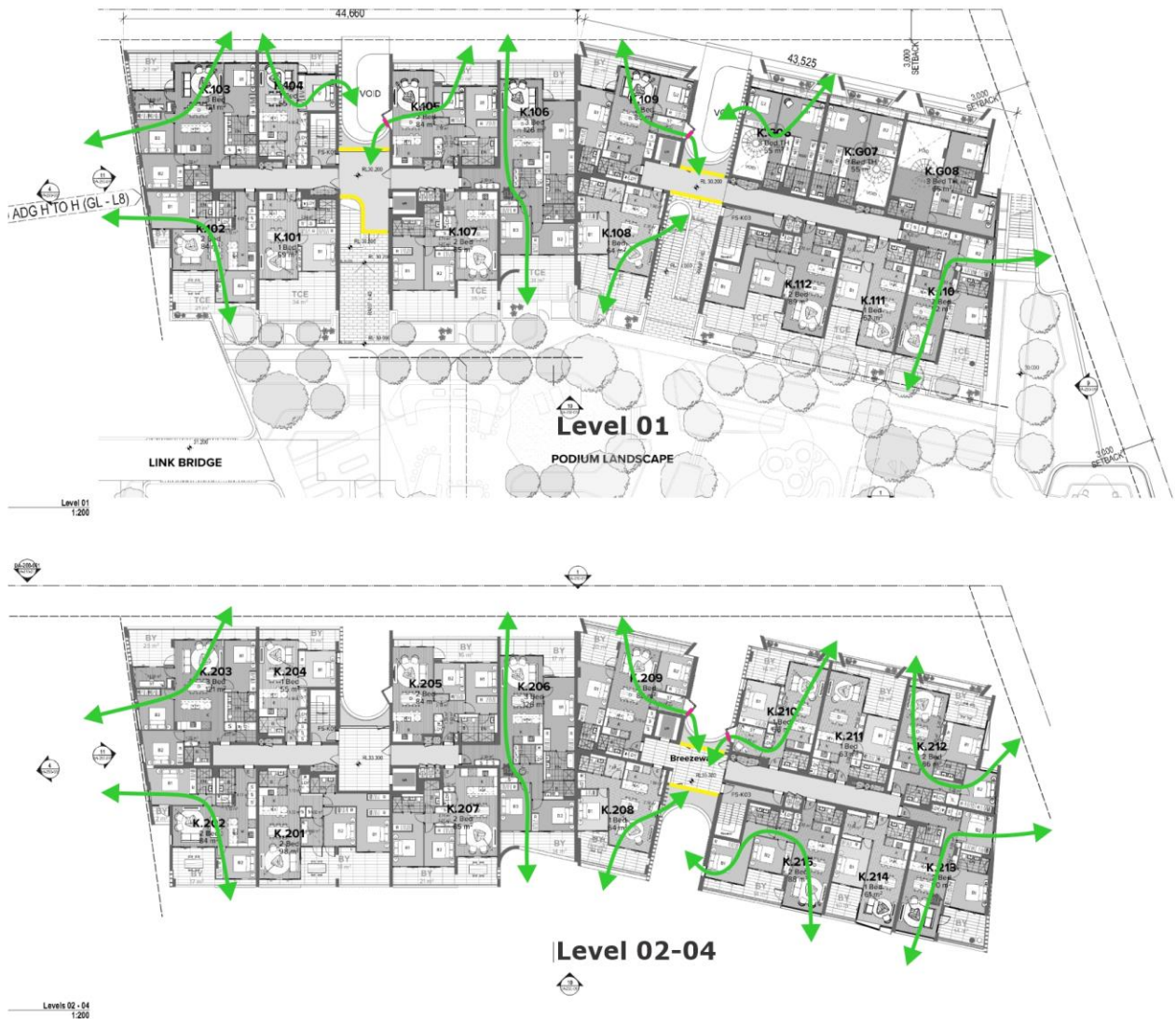





Figure 3h: Flow Paths of Apartments (Building K) (Level 01-04) Achieving Effective Natural Cross Ventilation

Natural Ventilation Legend

-  Meeting ADG Requirements for Natural Cross-Ventilation (Corner / Cross-Through)
-  Breezeway louvred glazing assumed to be in default state (Open)
-  Recommended inclusion of window (at least 0.4m2 opening)

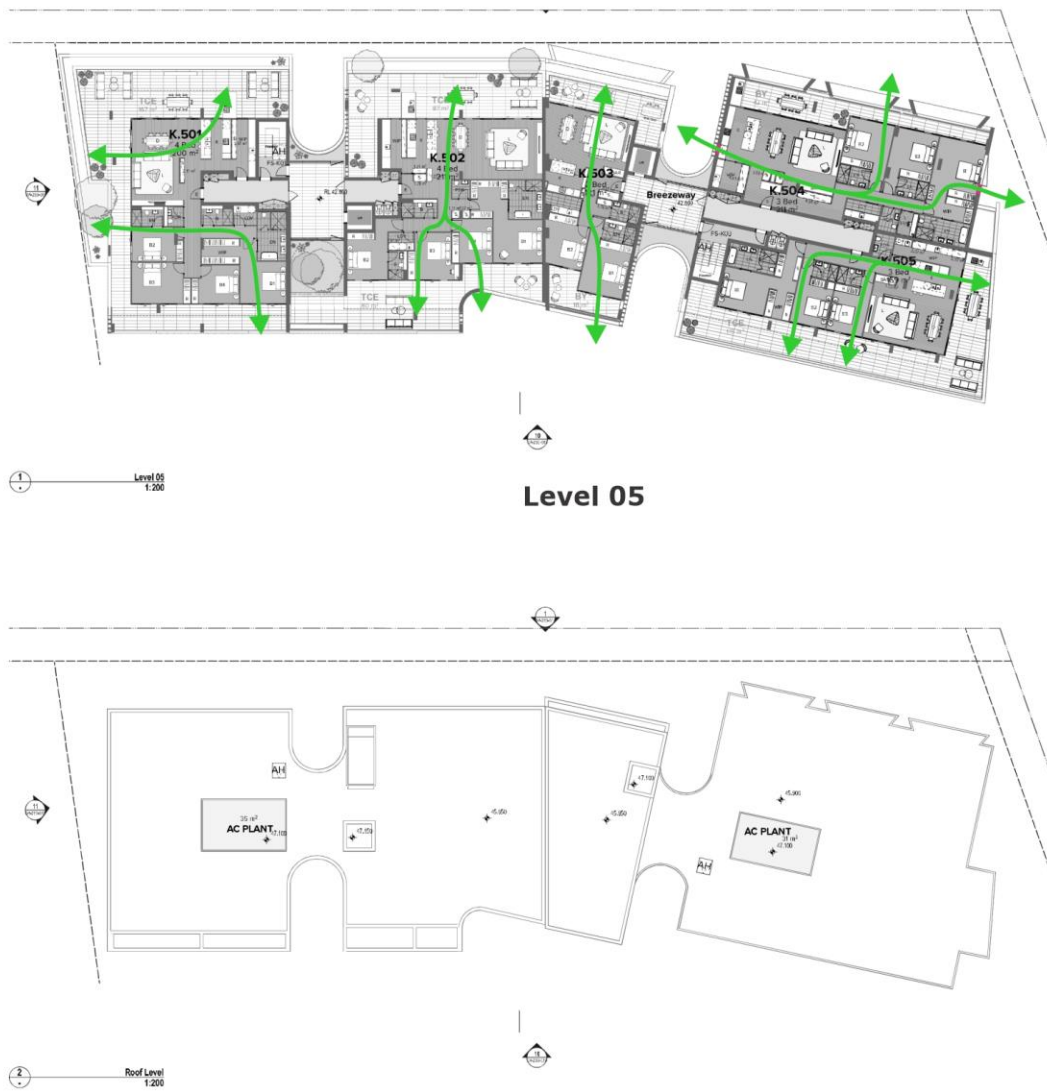





Figure 3i: Flow Paths of Apartments (Building K) (Level 05) Achieving Effective Natural Cross Ventilation

Natural Ventilation Legend

-  Meeting ADG Requirements for Natural Cross-Ventilation (Corner / Cross-Through)
-  Breezeway louvred glazing assumed to be in default state (Open)
-  Recommended inclusion of window (at least 0.4m2 opening)

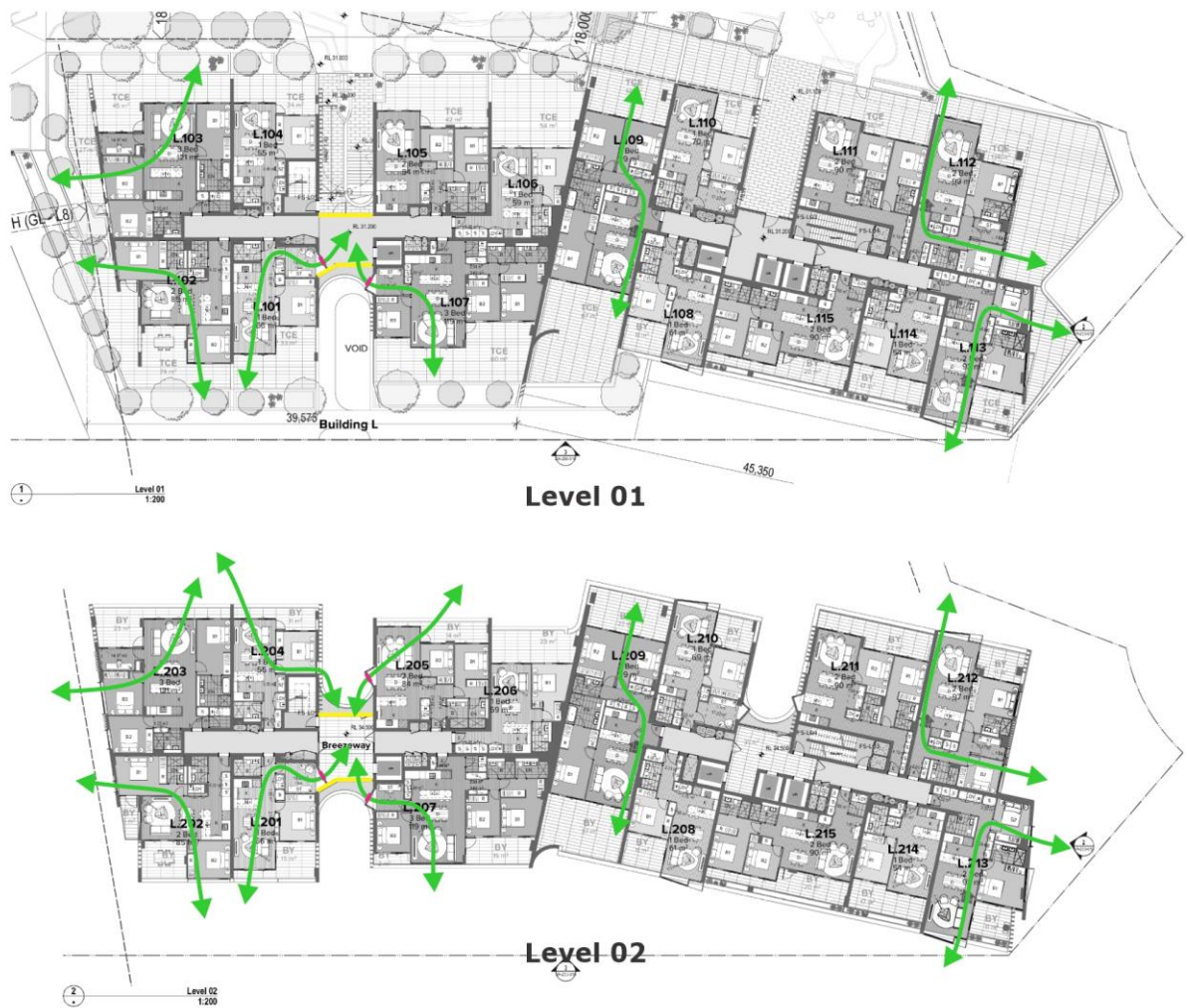





Figure 3j: Flow Paths of Apartments (Building L) (Level 01-02) Achieving Effective Natural Cross Ventilation

Natural Ventilation Legend

-  Meeting ADG Requirements for Natural Cross-Ventilation (Corner / Cross-Through)
-  Breezeway louvred glazing assumed to be in default state (Open)
-  Recommended inclusion of window (at least 0.4m2 opening)

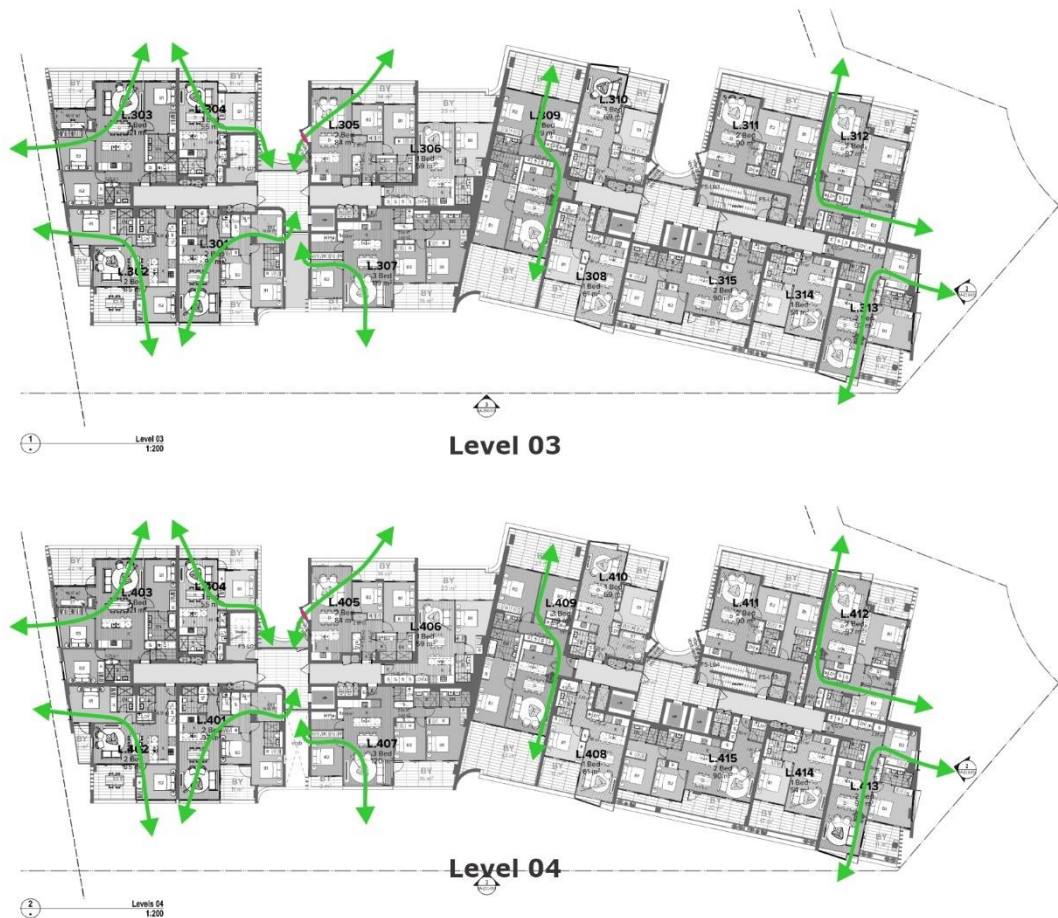





Figure 3k: Flow Paths of Apartments (Building L) (Level 03-04) Achieving Effective Natural Cross Ventilation

Natural Ventilation Legend

-  Meeting ADG Requirements for Natural Cross-Ventilation (Corner / Cross-Through)
-  Breezeway louvred glazing assumed to be in default state (Open)
-  Recommended inclusion of window (at least 0.4m2 opening)

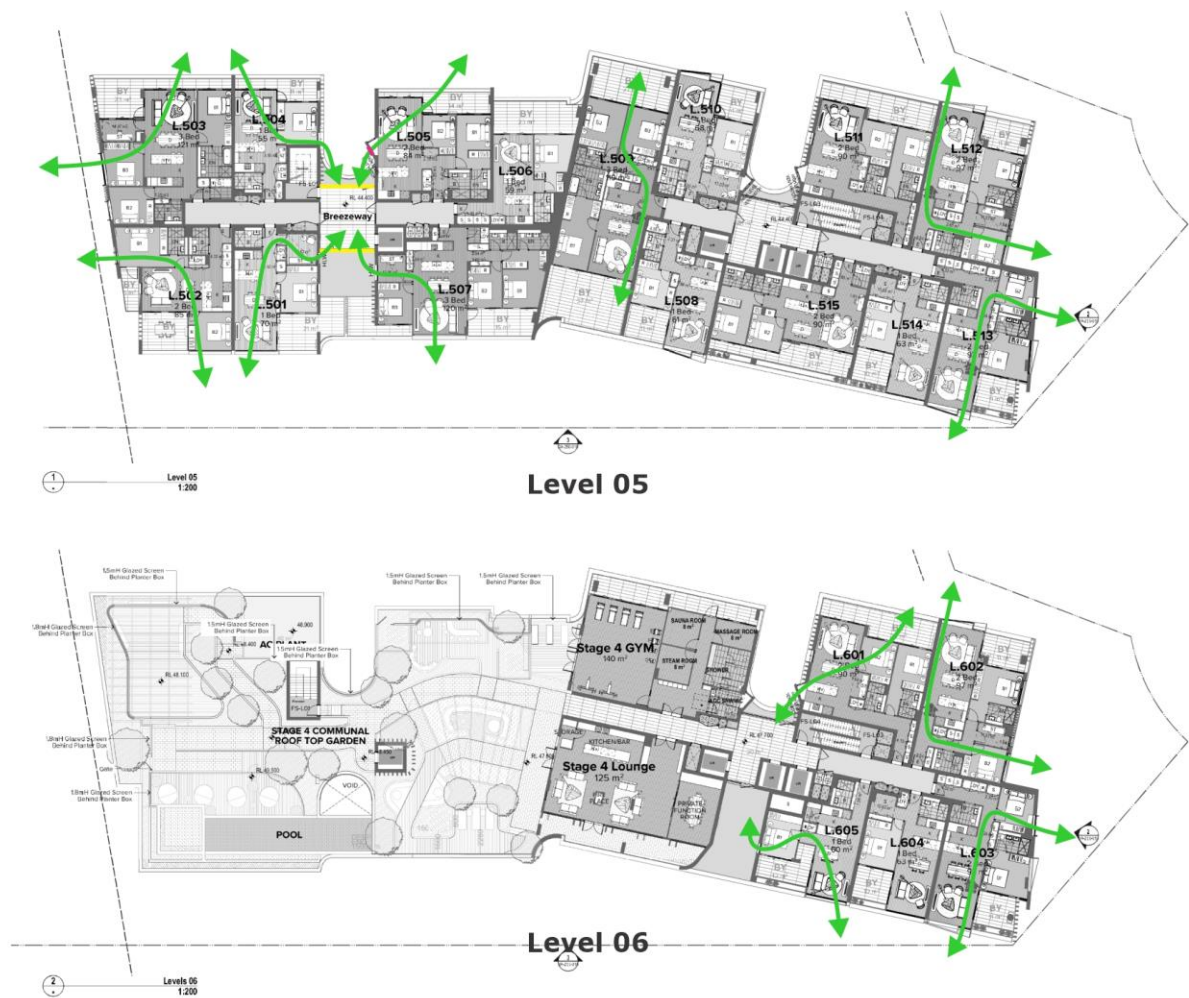


Figure 3l: Flow Paths of Apartments (Building L) (Level 05-06) Achieving Effective Natural Cross Ventilation

Natural Ventilation Legend




-  Meeting ADG Requirements for Natural Cross-Ventilation (Corner / Cross-Through)
-  Breezeway louvred glazing assumed to be in default state (Open)
-  Recommended inclusion of window (at least 0.4m² opening)



Figure 3m: Flow Paths of Apartments (Building L) (Level 07-08) Achieving Effective Natural Cross Ventilation

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