824-834 FOREST ROAD, PEAKHURST

Natural Ventilation Assessment

Prepared for:

Mono Constructions
c/- Zhinar Architects Pty Ltd
Suite 1, Level 2, 2 Rowe Street
Eastwood NSW 2122

SLR Ref: 610.18747-R01
Version No: -v1.2
May 2019

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Mono Constructions (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.18747-R01-v1.2	13 May 2019	Dr Neihad Al-Khalidy	Dr Peter Georgiou	Dr Neihad Al-Khalidy
610.18747-R01-v1.1	18 April 2019	Dr Neihad Al-Khalidy	Dr Peter Georgiou	Dr Neihad Al-Khalidy
610.18747-R01-v1.0	9 April 2019	Dr Neihad Al-Khalidy	Dr Peter Georgiou	Dr Neihad Al-Khalidy

EXECUTIVE SUMMARY

SLR Consulting Pty Ltd (SLR) has been engaged by Mono Constructions to undertake a natural ventilation assessment of the proposed mix-use development at 824-834 Forest Road, Peakhurst. This assessment forms part of the Development Application to Council.

The State Environmental Planning Policy (SEPP) 65 supported by the Apartment Design Guide (ADG) is relevant to the assessment of the natural ventilation through residential components of the proposed development.

Section 4B-3 of the Apartment Design Guide states that:

> At least 60% of apartments are naturally cross ventilated in the first nine storeys of the building. 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.

Developments which seek to vary from the minimum standards, must demonstrate how natural ventilation can be satisfactorily achieved, particularly in relation to habitable rooms.

The proposed development implements a number of the ADG recommendations to maximize the natural cross ventilation throughout the development.

- The proposed development has been provided with openings on multiple sides of the apartments for the majority of proposed floor plans, allowing it to make use of wind-induced natural ventilation throughout the year and thereby minimising energy costs. The building includes 32 dual aspect units.
- The overall depth of cross-over or cross-through units does not exceed 18 m as per the Design Criteria of Objective 4B-3.
- Natural cross ventilation to many single aspect apartments is achieved via building articulation (recesses, indentations, etc) which generates variable pressure zones across each façade. This is anticipated within ADG Section 4B which states in its opening paragraph that *"Natural cross ventilation is achieved by apartments having more than one aspect with direct exposure to the prevailing winds,* ***or*** *windows located in significant different pressure regions, rather than relying on purely wind driven air"*.

The following conclusions have been reached based on a qualitative review of the floorplans of the AGD complaint dual aspect units and quantitative numerical modelling of non-dual aspect units:

- 64.5% (45 of 72) of apartments will be naturally-ventilated. This meets the requirement stated above.

The number of naturally cross ventilation unit can be increased to 47 units (~65.2% of apartments) if operable skylights are added to units A34 and B32.

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1 Introduction

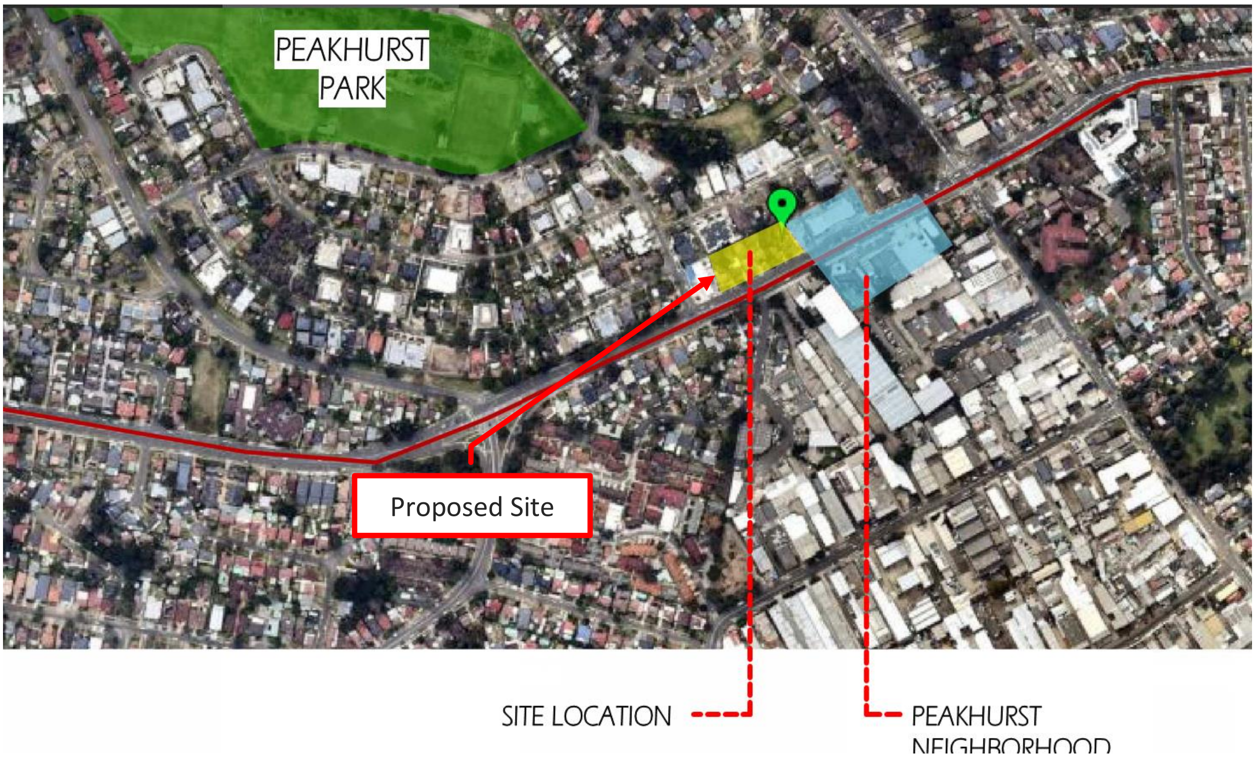
SLR has been engaged by Mono Constructions t to conduct a natural ventilation assessment of the proposed development at 824-834 Forest Road, Peakhurst. This assessment forms part of the Development Application to Council.

The proposed site is surrounded by low rise commercial and residential buildings:

- Low rise residential building to the north;
- Existing shopping centre and carpark to the east;
- Sports world Peakhurst to the south; and
- Existing petrol station to the immediate west.

Site location is shown in Figure 1.

Figure 1 Site Location



1.1 Proposed Development Description

The proposed four storey development consists of the following:

- One basement level with a total 82 car spaces; and
- Two blocks with a total of 72 residential apartments from Ground Floor to Level 3
    - Block A consists of 37 units
    - Block B consists of 35 units

Figure 2 3D View of the Proposed Development

2 Natural Ventilation

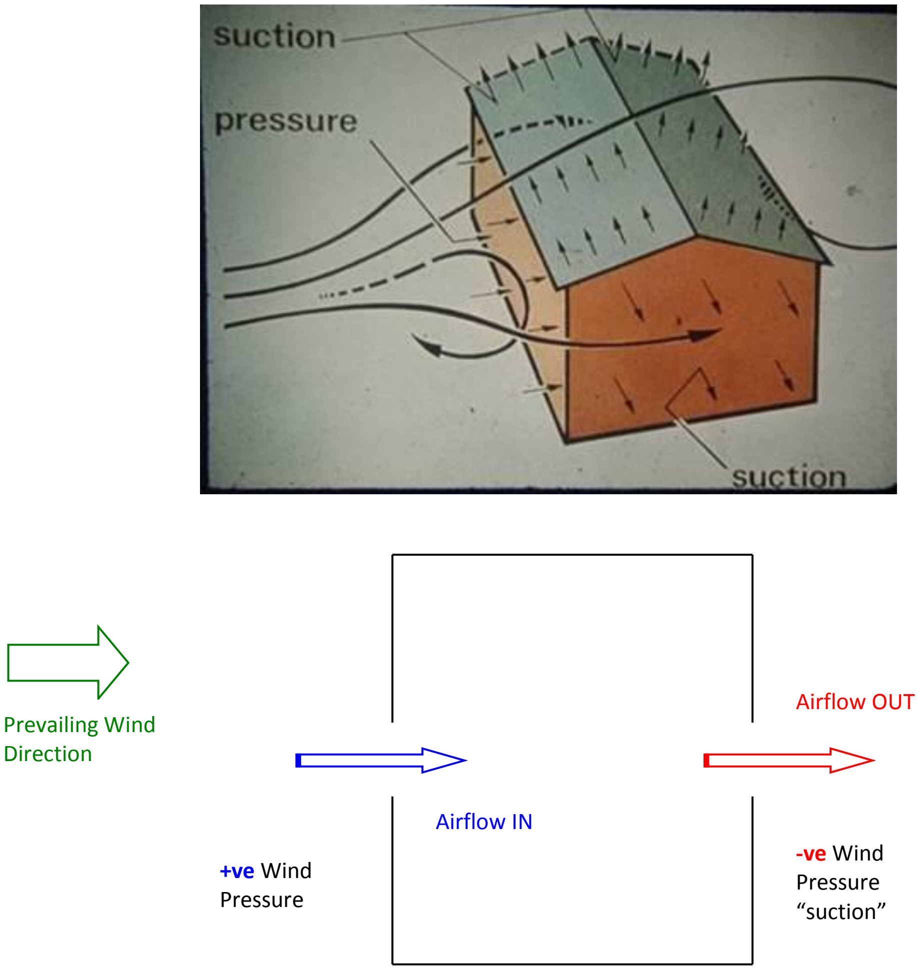
2.1 General Principles

A key feature of the proposed development is the incorporation of façade openings designed to enable various spaces within the development buildings to make use of wind–induced natural ventilation throughout the year thereby minimising energy costs.

Wind-induced natural ventilation works on the straightforward principle of differential pressure. If a building envelope has multiple openings and there exists a pressure difference between those openings, ie the wind pressure at one opening is greater than the pressure at the other opening, airflow will be pushed through the building in the direction higher pressure to lower pressure.

The resulting amount of airflow through the building envelope will be a function of the magnitude of the pressure differential, size of the various building openings and degree of "blockage" in between. These features are illustrated in **Figure 3**.

Figure 3 Wind Induced Natural Ventilation via Differential Pressure



3 SYDNEY'S WIND CLIMATE

The data of interest in this study are the annual mean hourly wind speeds experienced throughout the year, how these winds vary with azimuth, and the seasonal break-up of winds into the primary Sydney wind seasons.

3.1 Local Meteorological Conditions

Local wind speed and direction influence the naturally cross ventilation units. Wind speed determines areas of positive pressure on the windward side of a building and negative pressure on the leeward and sides of the building. Wind direction, and the variability in wind direction, determines the extent of crosswind spreading. Surface roughness (characterised by features such as the topography of the land and the presence of buildings, structures and trees) affects the degree of mechanical turbulence, which also influences the rate of ventilation.

The Bureau of Meteorology (BoM) maintains and publishes data from weather stations across Australia. The closest such station recording wind speed and wind direction data is the Sydney Airport Automatic Weather Station (AWS), located approximately 11.7 kilometres (km) east of the Development Site (Station ID 66037).

SLR has analysed the Sydney Airport Bureau of Meteorology (BoM) Weather Station data for the period 1999-2017. This dataset contains records at hourly intervals of:

- Mean Wind Speed - average wind speed during the 60-minute period
- Gust Wind Speed – peak 2-3 second gust occurring (sometime) within the 60-minute period
- Wind Direction – average wind direction during the 60-minute period

The annual wind rose and seasonal wind roses for the years 1997-2017 compiled from data recorded by the Sydney Airport AWS are presented in **Figure 4**.

On an annual basis, the predominant wind directions in the area are consistently from the northeast, south and northwest directions. Very low frequencies of winds from the east were recorded across all years. The annual frequency of calm wind conditions was recorded to be less than 3%.

Figure 4 Sydney (Kingsford Smith) Airport Wind Roses: 1999-2017

The Beaufort Wind Scale (consistent with terminology used by the BoM) is used to describe the wind speeds experienced at the Development site: these are outlined in **Table 1**.

Table 1 Beaufort Wind Scale

Beaufort Scale No	Description	m/s	Description on land
0	Calm	0-0.5	Smoke rises vertically
1	Light air	0.5-1.5	Smoke drift indicates wind direction
2-3	Light/gentle breeze	1.5-5.3	Wind felt on face, leaves rustle, light flags extended, ordinary vanes moved by wind
4	Moderate winds	5.3-8.0	Raises dust and loose paper, small branches are moved
5	Fresh winds	8.0-10.8	Small trees in leaf begin to sway, crested wavelets form on inland waters
6	Strong winds	>10.8	Large branches in motion, whistling heard in telephone wires, umbrellas used with difficulty

Source: http://www.bom.gov.au/lam/glossary/beaufort.shtml

The seasonal wind roses shown in **Figure 4** indicate that:

- In summer, wind speeds ranged from light to strong winds. The majority of winds blow from the north-northeast, northeast and south directions, with very few winds from the east, west quadrants and north. Calm wind conditions were observed to occur less than 3% of the time during summer.
- In autumn, wind speeds ranged from light to strong winds. The majority of winds blow from the northeast, southeast, south and northwest directions, with very few winds from the east direction. Calm wind conditions were observed to occur 1% of the time during autumn.
- In winter, wind speeds ranged from light to strong winds. The majority of winds blow from between the west-southwest and north-northwest directions, with very few winds from the northeast, east and southeast directions. Calm wind conditions were observed to occur less than 3% of the time during winter.
- In spring, wind speeds ranged from light to strong winds. The majority of winds blow from the northeast and south directions with a secondary peak from the northwest. Calm wind conditions were observed to occur just over 5% of the time during spring.

From this Sydney (KS) Airport BoM 1999-2017 dataset, SLR has derived the frequency of occurrence statistics for various mean wind speed levels at the proposed building height:

- **Figure 5** shows the annual frequency of occurrence of 10m height mean wind speeds.
- **Table 2** shows the same data by wind direction in 45° increments. The data has been converted to hours per year occurrence.
- **Table 3** presents the mean wind speed versus wind direction data as an exceedance frequency. The data has been presented as %age exceedance probability.

Figure 5 Mean Wind Speed Frequency of Occurrence for Sydney Airport: 1999-2017

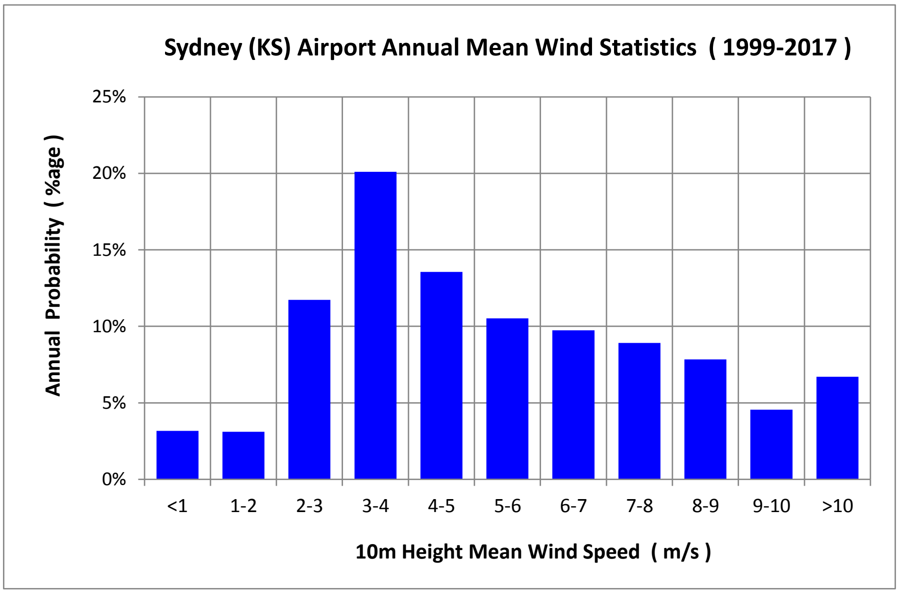


Table 2 Mean Wind Speed Frequency Statistics versus Wind Direction (1999-2017)

10m MEAN Wind Speed (m/s)	Wind Direction								
	N 0°	NE 45°	E 90°	SE 135°	S 180°	SW 225°	W 270°	NW 315°	ALL
2	75	47	24	19	21	31	55	81	550
4	490	262	148	180	168	221	355	1031	2788
6	261	278	208	304	275	192	304	340	2110
8	124	308	143	239	383	158	230	89	1635
10	52	261	36	109	366	106	132	51	1086
>10	14	117	6	29	265	65	72	37	591

Table 3 Mean Wind Speed Exceedance Statistics versus Wind Direction (1999-2017)

10m MEAN Wind Speed (m/s)	Wind Direction								
	N 0˚	NE 45˚	E 90˚	SE 135˚	S 180˚	SW 225˚	W 270˚	NW 315˚	ALL
2	10.7%	14.0%	6.2%	9.8%	16.6%	8.5%	12.5%	17.7%	93.7%
4	5.1%	11.0%	4.5%	7.8%	14.7%	5.9%	8.4%	5.9%	61.9%
6	2.2%	7.8%	2.1%	4.3%	11.6%	3.8%	4.9%	2.0%	37.8%
8	0.8%	4.3%	0.5%	1.6%	7.2%	2.0%	2.3%	1.0%	19.1%
10	0.2%	1.3%	0.1%	0.3%	3.0%	0.7%	0.8%	0.4%	6.7%

From the Sydney Airport data, the following can be seen:

- There were 550 hours total (6.3% probability) where the mean wind speed is below 2 m/s taking into account all wind directions.
- The annual frequency of mean 10m height wind speeds exceeding 2 m/s recorded at Sydney Airport was very high, at approximately 94%.
- The annual frequency of mean 10m height wind speeds exceeding 4 m/s recorded at Sydney Airport was relatively high, at approximately 62%.

4 Apartment Design Guide – Requirements

The Apartment Design Guide is relevant to the assessment of the natural ventilation through residential components of proposed development. Section 4B-3 of the Apartment Design Guide states that:

> *At least 60% of apartments are naturally cross ventilated in the first nine storeys of the building. 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.*

Natural cross ventilation is achieved by apartments having more than one aspect with direct exposure to the prevailing winds **or** windows located in significantly different pressure regions, rather than relying on purely wind driven air. Apartment layout and building depth have a close relationship with the ability of an apartment to be naturally ventilated. Generally as the building gets deeper, effective airflow reduces.

The following points from the design guide are also noted:

- Overall depth of a cross-over or cross-through apartment should not exceed 18m, measured glass line to glass line.
- Natural ventilation to single aspect apartments is achieved with a light well or stack effect ventilation (or similar) or courtyards or building indentations which have a width to depth ratio of 2:1 or 3:1 to ensure effective air circulation and avoid trapped smells.
- In cross-through apartments external window and door opening sizes/areas on one side of an apartment (inlet side) should be approximately equal to the external window and door opening sizes/areas on the other side of the apartment (outlet side).

There are no specific requirements (eg air change per hours) in the ADG guideline.

AS1668.2-2002 "The use of ventilation and airconditioning in buildings Part 2: Ventilation design for indoor air contaminant control (excluding requirements for the health aspects of tobacco smoke exposure)" recommends 3 air changes per hour for habitable rooms to satisfy the air quality requirements.

In the absence of specific criteria in the ADG guideline, SLR considers the 3 air change per hours appropriate for the cross ventilation system taking into account all wind directions and localised wind speeds.

In terms of air velocity within a room, magnitudes of between 0.2 m/s and 0.7 m/s are generally considered desirable for the provision of so-called comfort ventilation. Higher velocities are desired with higher apartment temperature (especially above 27°C).

5 NATURAL CROSS VENTILATION ASSESSMENT

5.1 Qualitative Assessment of Dual Aspect Apartment

The natural ventilation for the proposed residential development has been qualitatively assessed. Ventilation is achieved by the differential pressure between the different building facades.

The following comments are made with regard to the proposed natural ventilation system for the development:

- Operable windows are provided on all facades.
- There are balconies located on all building facades, with openings provided to all aspects. Minimal shielding is expected to upper levels; therefore the proposed development benefits from all prevailing winds, creating the potential for cross ventilation, refer to **Appendix B** for all flow assessed.
- Based on a qualitative assessment, 44.4 % (32 of 72) of the apartments within the proposed development comply with the cross ventilation requirements of the Apartment Design Guide (Refer **Table 4**).

Table 4 Dual Aspect Apartments with Openings to Support Natural Ventilation

Level	Number of Apartments	Number of Apartments with Openings to Support Cross Ventilation (as per ADG)	Number of Apartments	Number of Apartments with Openings to Support Cross Ventilation (as per ADG)	Percentage All Blocks
	BLOCK "A"		BLOCK "B"		
G	10	4	9	4	42.1%
L1	10	4	10	4	40.0%
L2	10	4	10	4	40.0%
L3	7	4	6	4	61.5%
Total	**37**	**16**	**35**	**16**	**44.4%**

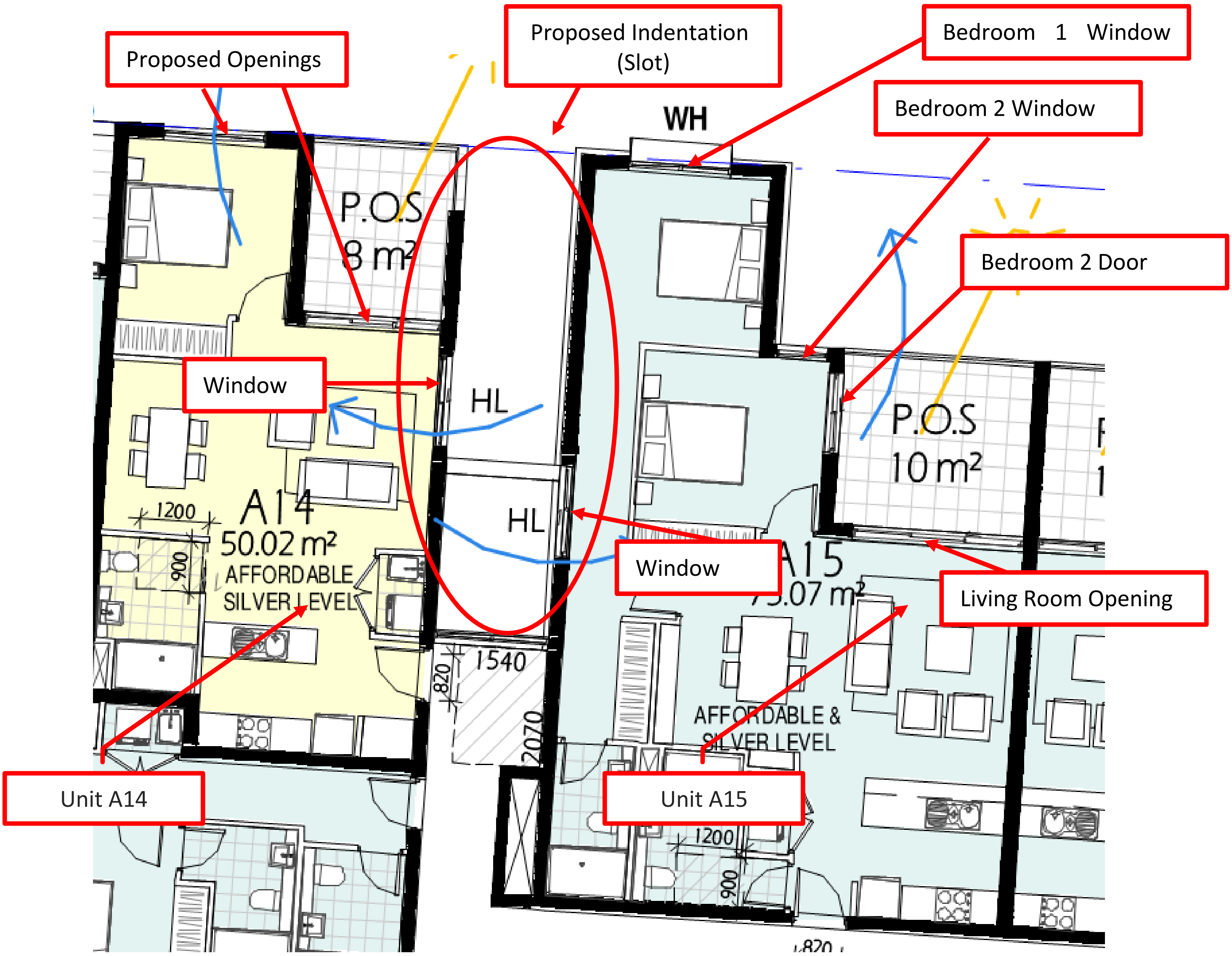
6 Quantitative Assessment of Non-Dual Aspect Apartment

Recesses and articulations create pressure and velocity differences across the various facades and encourage cross ventilation through an increased number of apartments. From extensive experience SLR has found that quantitative techniques including Computational Fluid Dynamics (CFD) and wind tunnel studies can demonstrate that these apartments provide appropriate ventilation and circulation, and can hence satisfy natural ventilation requirements.

The façade of the proposed development has been designed with recesses and slots for a number of non-dual aspect apartments. The slot in the north-western part of the building is shown below with its connecting windows on Level 1.

The main objective of this study is to assess the effectiveness of the proposed natural ventilation system.

Figure 6 Example Units for CFD Testing



6.1 CFD Modelling, Assumptions and Analysis

A 3D model of the proposed development and surrounding buildings and structure blocks was created from the architectural drawings and a conceptual AutoCAD Model of the proposed development supplied by Zhinar Architects Pty Ltd on 21 March 2010. Refer **Appendix A** for list of provided drawings and CAD models.

The 3D Model of the proposed development and surrounding blocks is shown in **Figure 7** and **Figure 8**.

A computer model of the development was created and apartments on levels one and three were included for detailed numerical assessment.

The CFD model accounts for detailed internal layout modelling, detailed building features and openings as per the provided architectural drawings. Refer **Figure 10** and **Figure 11** for a typical 2D section at 1.5 m above the floor of each modelled unit.

Figure 7 CFD Model of the Project Site and Surrounding Buildings

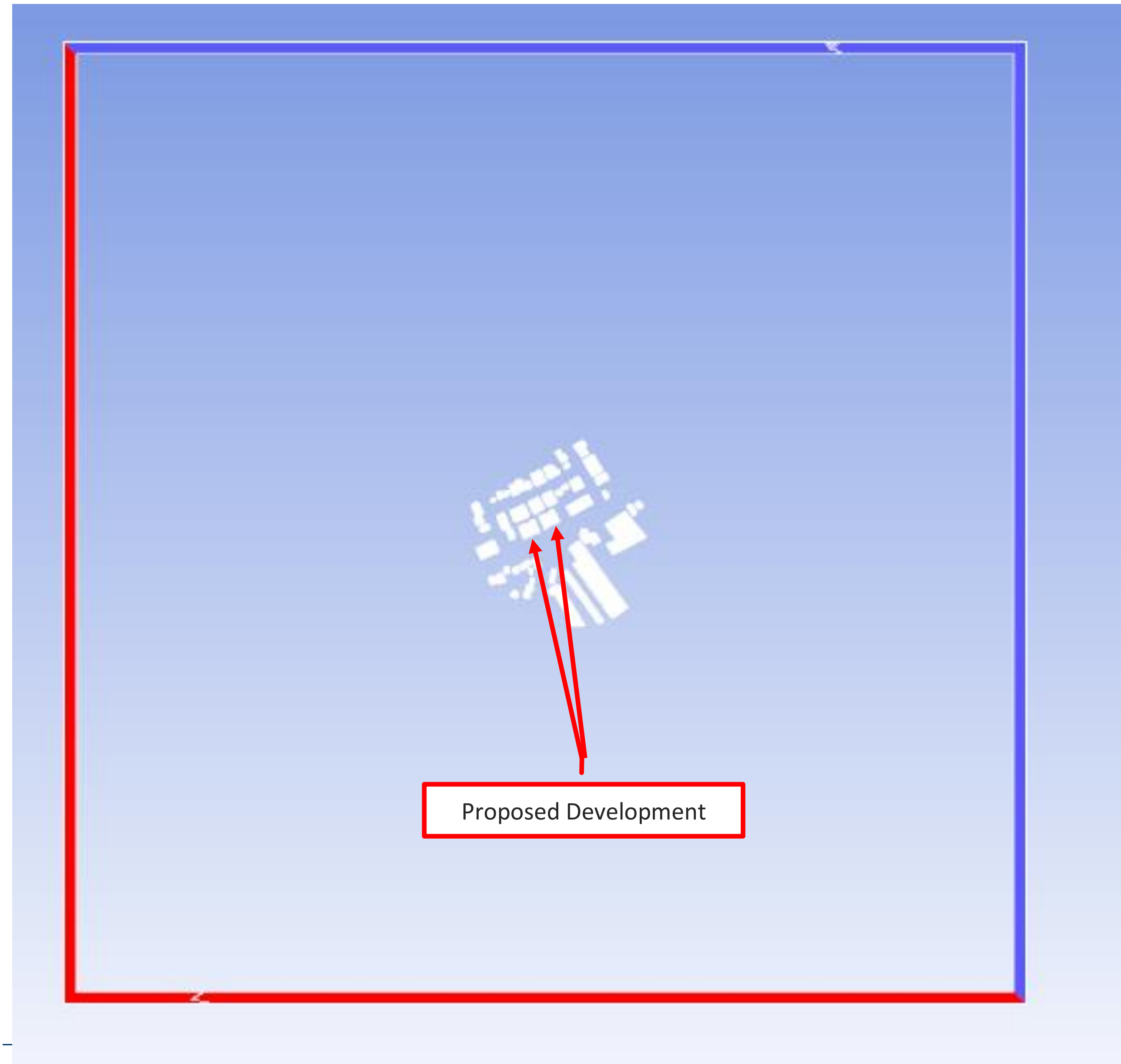


Figure 8 3D Model of the Project Site

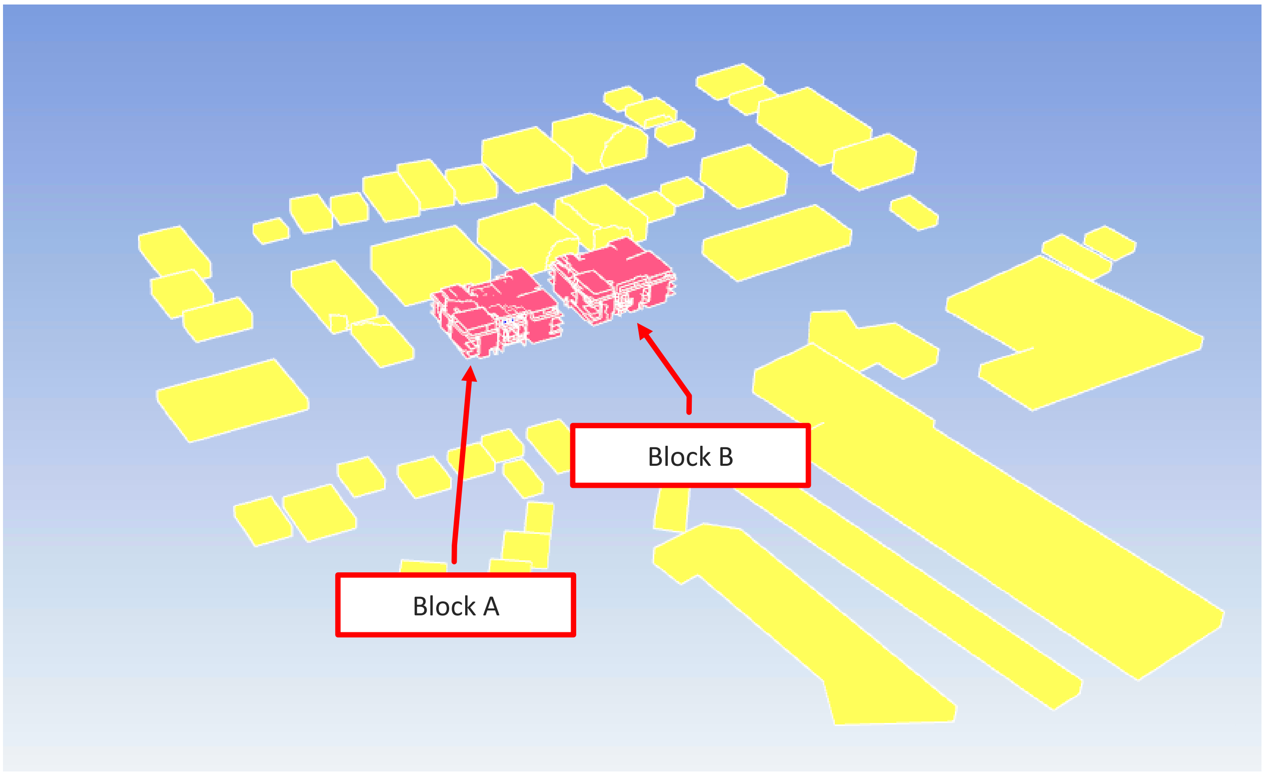


Figure 9 Area of Interest - Level 1 / Level 2

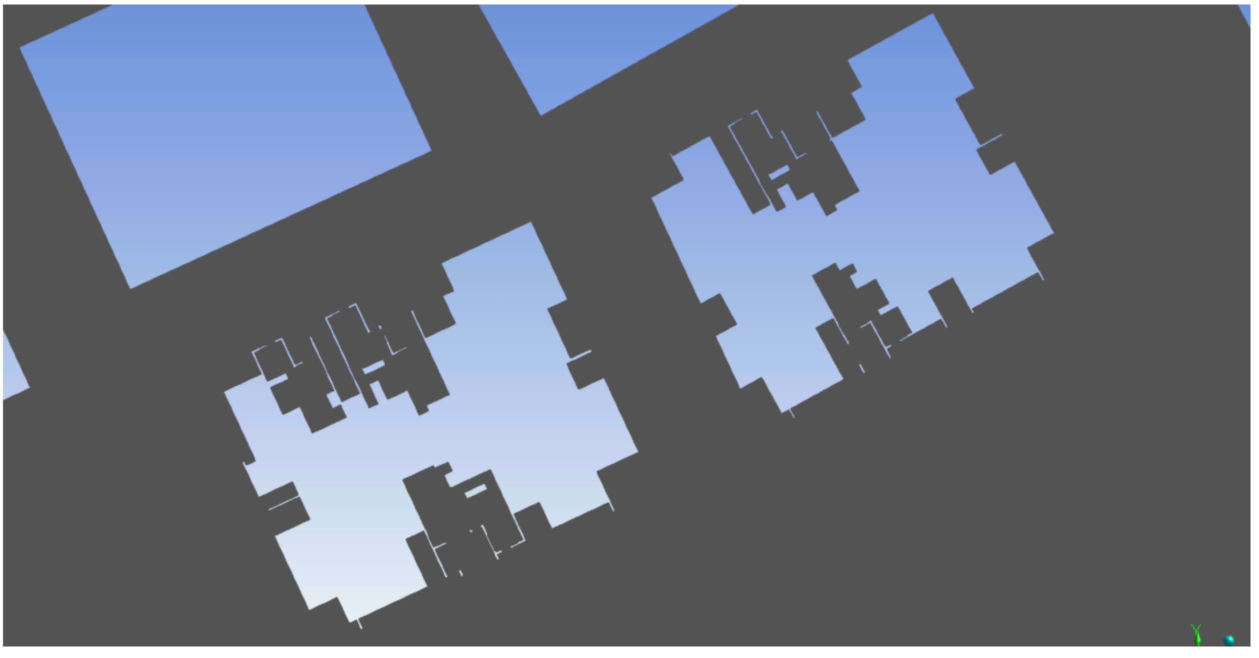
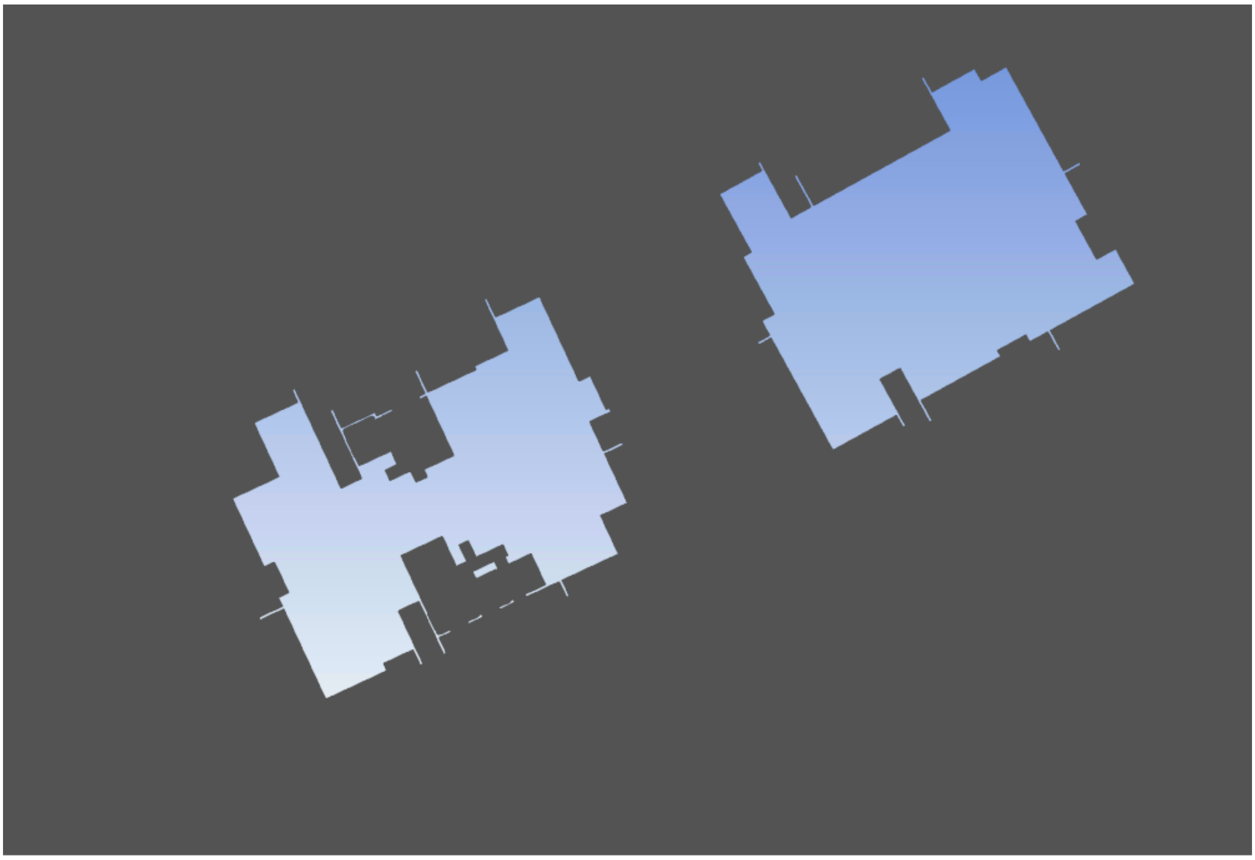


Figure 10 Area of Interest - Level 3



The Computational Fluid Dynamics (CFD) specialised software FLUENT was used to model the following wind directions.

- North
- Northeast
- East
- Southeast
- South
- Southwest
- West
- Northwest

In each case a wind speed of 2 m/s was used at reference height of 10 m. The frequency of wind speeds exceeding 2 m/s obtained from the Sydney (KS) Airport 1999-2017 data was high, at approximately 94%. The frequency of wind speeds exceeding 4 m/s for the period 2014-2018 recorded by the Sydney Airport AWS was also relatively high at approximately 62%.

SLR has made the following assumptions.

- Windows facing the slots were assumed to be fully open.
- Sliding doors to the balconies were assumed to be fully open.
- Living and bedroom windows openings are modelled as per the provided architectural drawings.

Simple blocks were used for nearby surrounding buildings to include the impact of the surroundings on the natural ventilation for the proposed building.

6.2 CFD Results

6.2.1 General Flow Characteristic

Figure 12 to **Figure 19** show mean airflow velocities through a two dimensional section at 1.5 m (typical chest level) above the ground. Velocity magnitudes are plotted on a colour coded scale between 0 and 2.5 m/s. Dark blue represents still conditions at 0 m/s and red representing the strongest wind speed.

One can see that the CFD model captures the fluid flow characteristics in great detail. Wind is approaching the site from the given wind speed and wind direction as per the given boundary conditions. Wind is then accelerated near building edges, channelled between buildings and stagnated and/or recirculated behind the buildings.

Figure 11 Northeast Flow

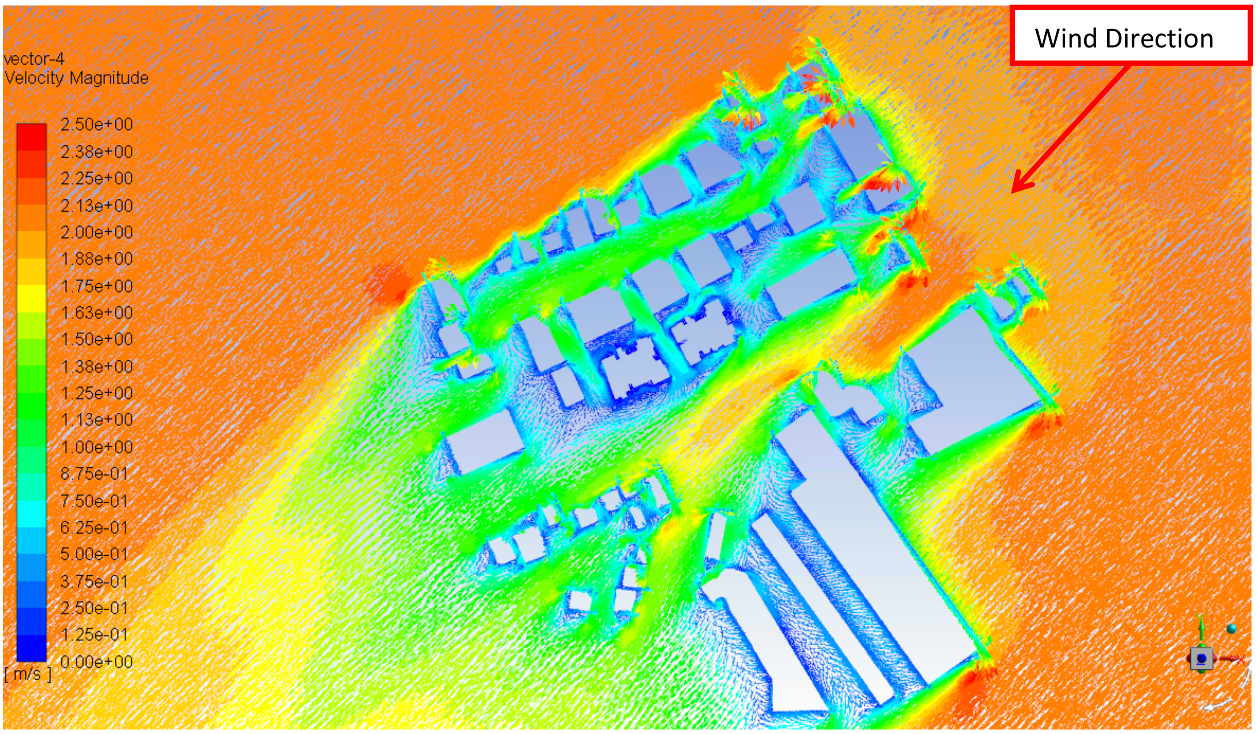


Figure 12 East Flow

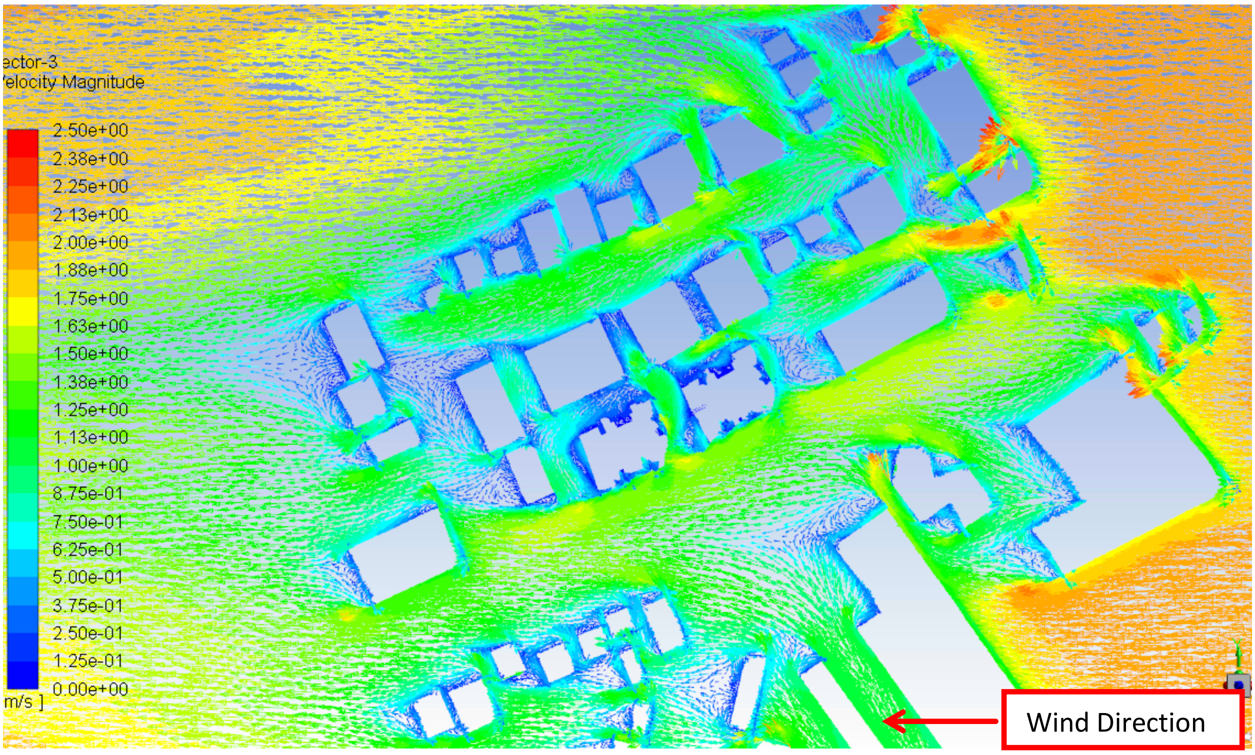


Figure 13 Southeast Flow

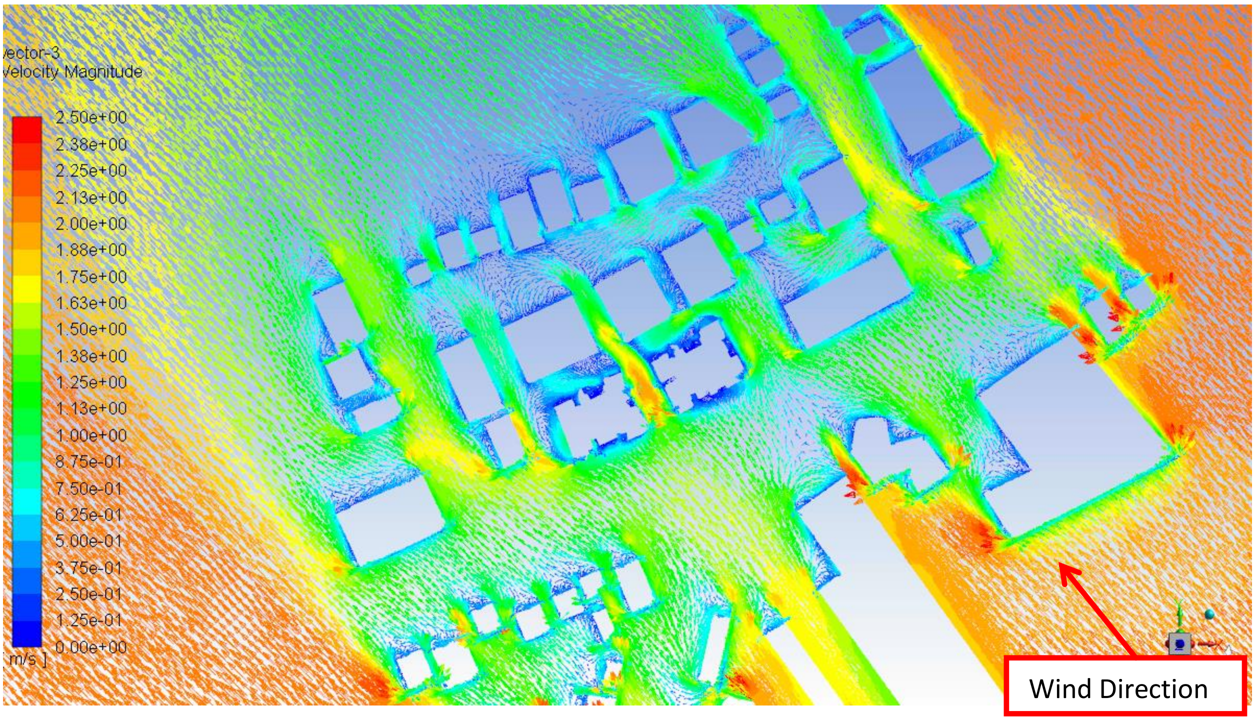


Figure 14 South Flow

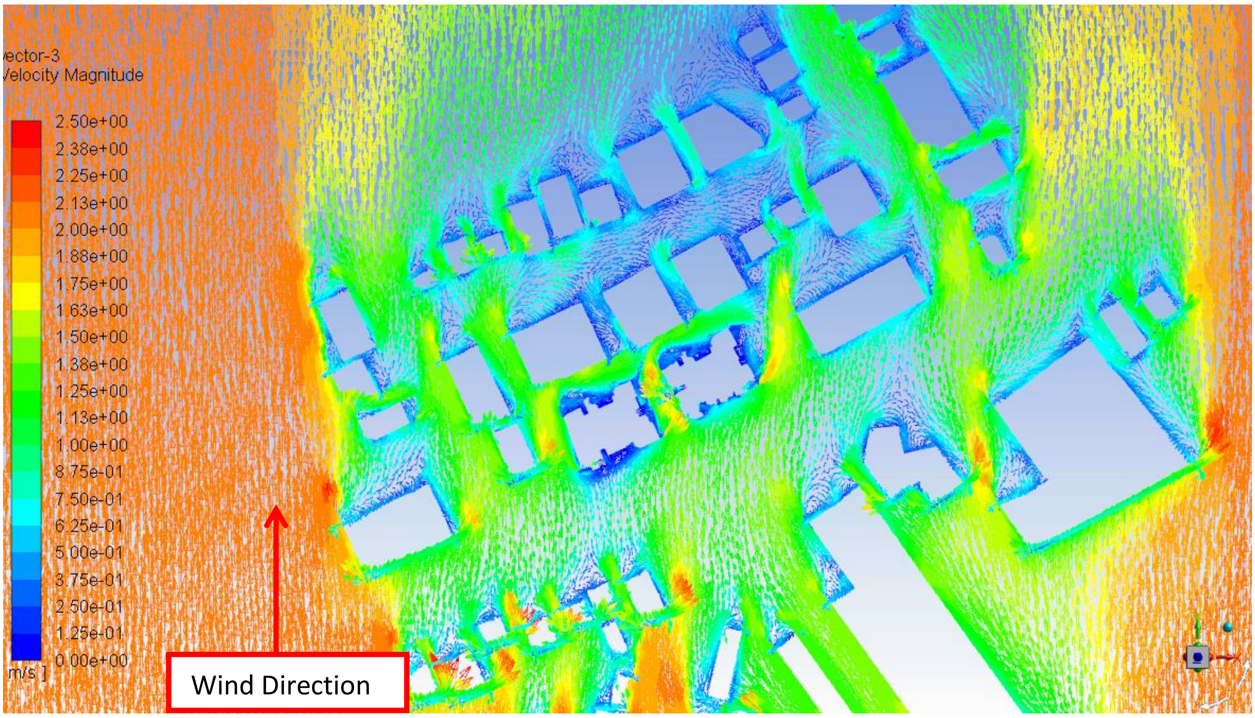


Figure 15 Southwest Flow

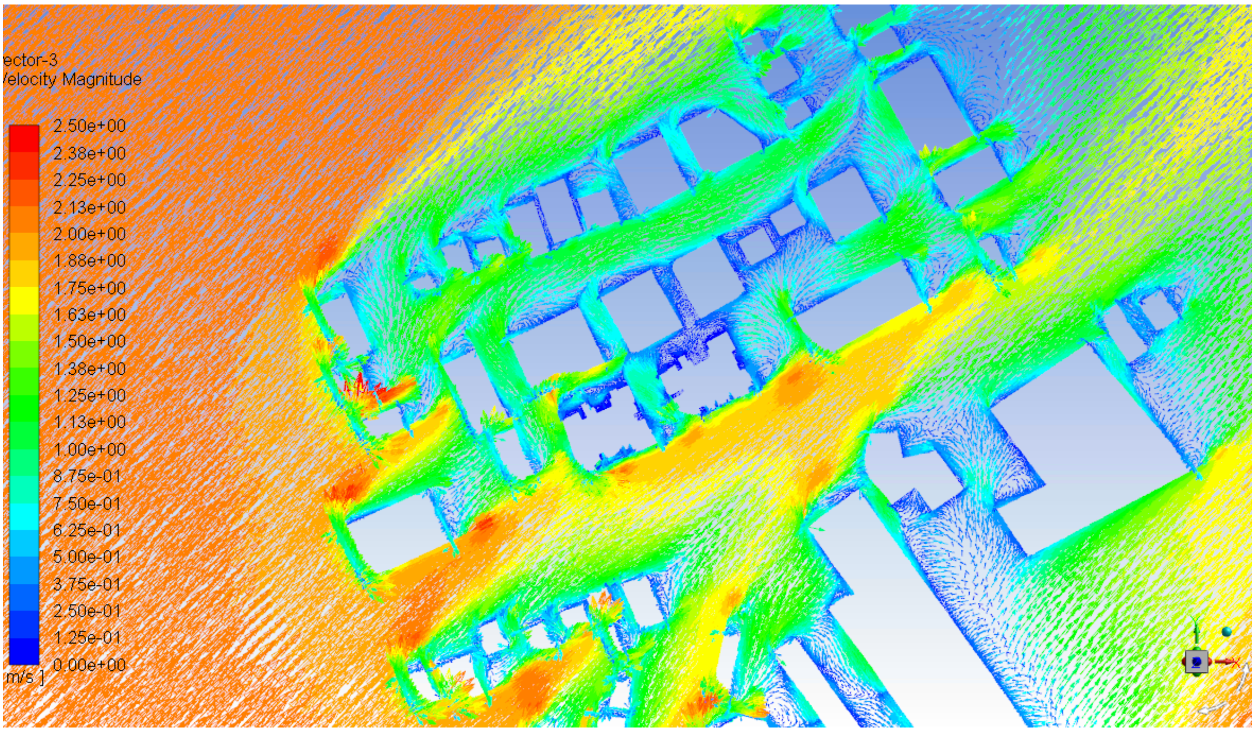


Figure 16 West Flow

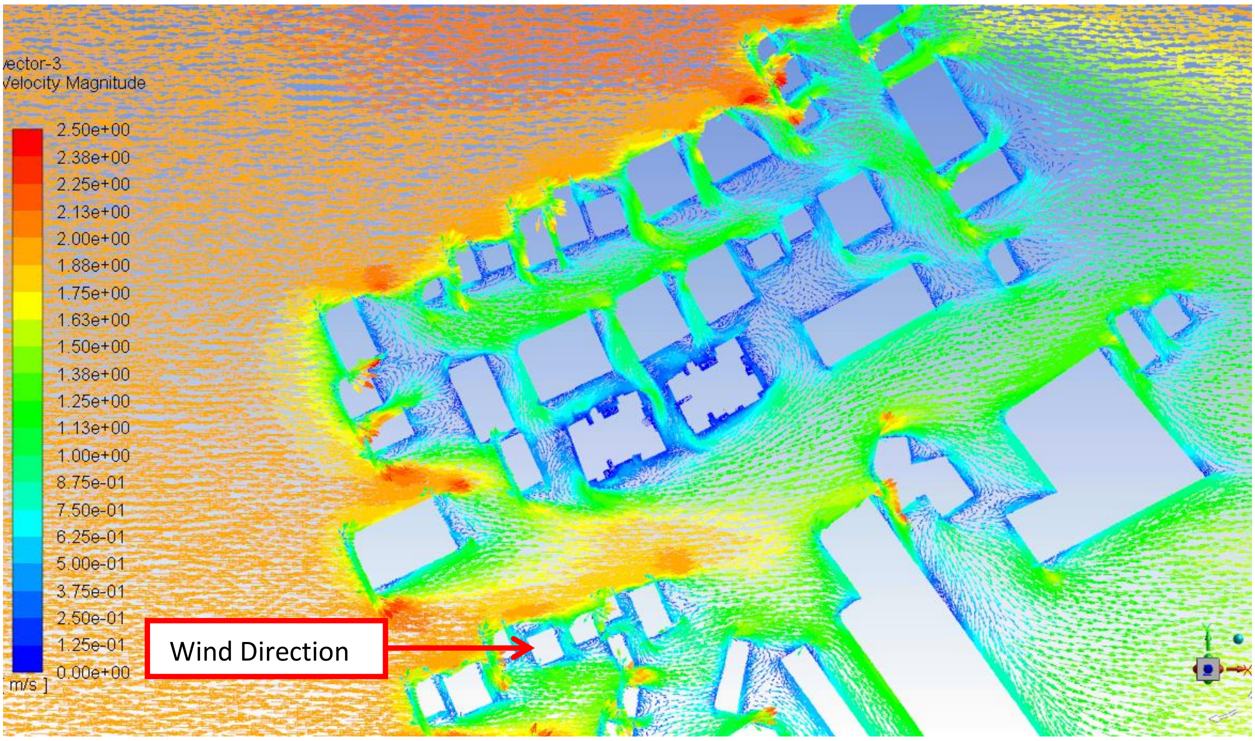


Figure 17 Northwest Flow

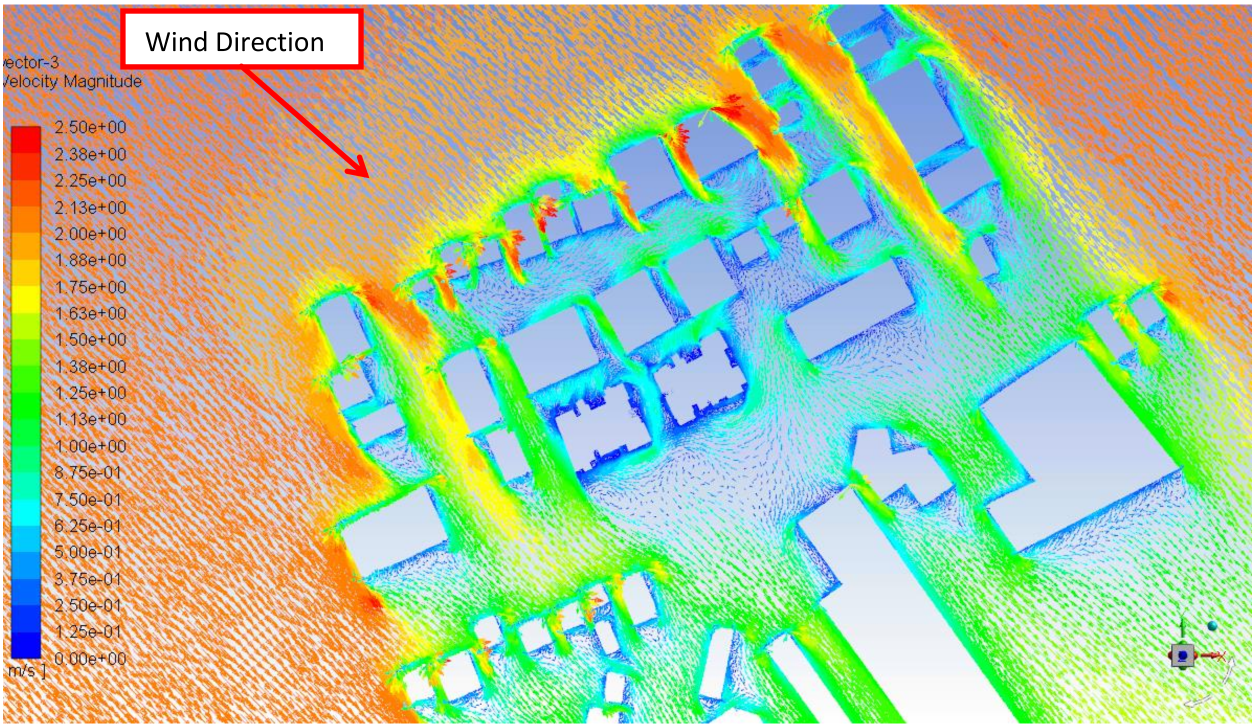
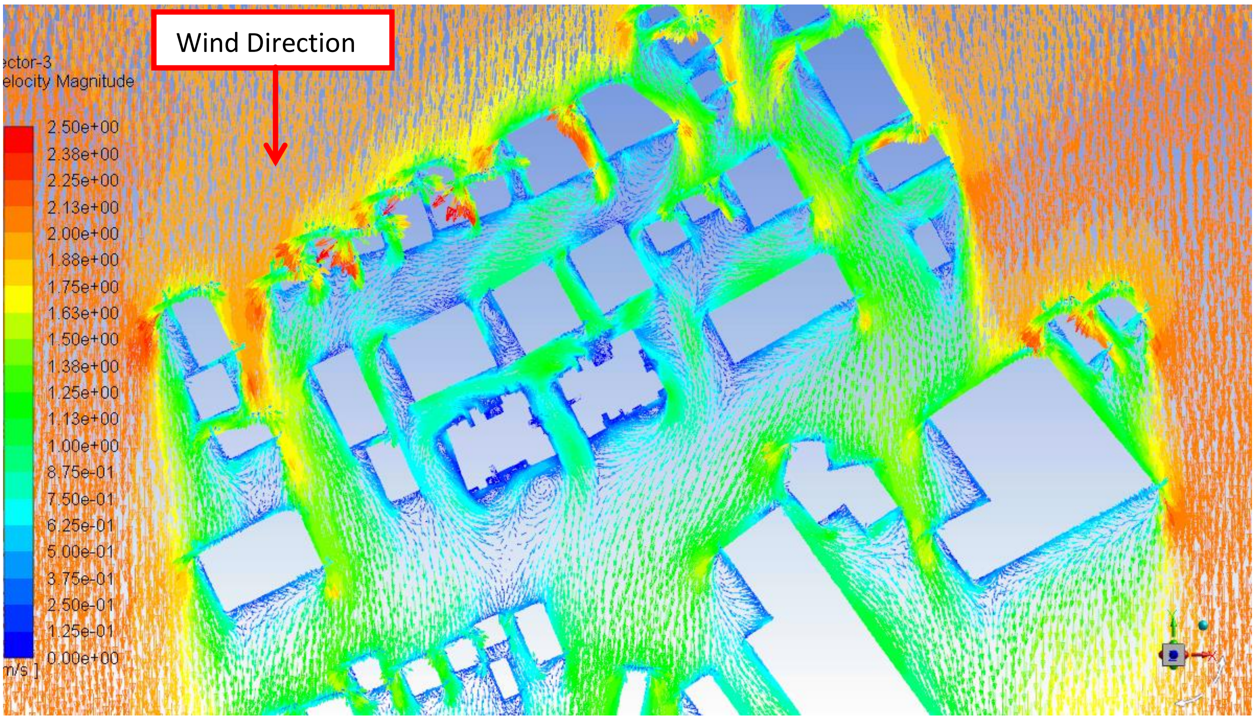


Figure 18 North Wind



6.2.2 Detailed Flow Characteristic

SLR deems an apartment to have adequate natural ventilation if it shows three air change per hour taking into all analysed wind directions and associated mean wind speed probability.

Figure 20 to **Figure 42** show mean airflow velocities through a typical chest level above the ground. Velocity magnitudes are plotted on a colour coded scale between 0 and 0.5 m/s and 0 -0.1 m/s for ease of interpretation. Dark blue represents still conditions at 0 m/s and red representing the strongest wind speed.

The north east wind results are shown in **Figure 20** to **Figure 22.** The following conclusions can be reached from the above figures:

- The proposed openings and indentation demonstrate reasonable airflow distribution. SLR deems airflow to be “reasonable” if the apartment has airflow velocities of at least 0.1 m/s for a light approaching wind of 2 m/s through living and bedroom areas and shows good flow from room to room without excessive short circuiting.
    - For example, unit A14.1 will experience a maximum wind speed 0.275 m/s and the predicted air change per hour for the NE wind direction is 5.5.

The wind speed inside the units will increase with increasing the approaching wind speed.

Results for all analysed wind directions are shown in **Figure 23** to **Figure 42**. One can see that the local wind environment changes with oncoming wind direction.

The predicted air change per hour for all wind directions are summarised in **Table 5**.

Table 5 Air Change Per Hour through Modelled Apartments – 10m Approach Mean Wind 2 m/s

Apartment	Wind Direction								
	N 0˚	NE 45˚	E 90˚	SE 135˚	S 180˚	SW 225˚	W 270˚	NW 315˚	Annual Average
A14	13.0	5.5	3.4	5.1	10.6	3.8	3.4	2.8	6.1
A15	8.7	3.8	2.5	5.5	3.7	14.1	3.5	5.6	5.6
A20	3.3	5.2	11.5	8.3	3.8	12.1	5.4	2.1	5.5
A33	7.6	0.8	1.4	3.9	0.5	4.8	10.5	11.3	5.5
A37	1.0	4.4	10.7	16.0	9.3	10.3	1.3	6.3	6.9
B13	14.2	15.3	10.4	9.9	3.8	1.8	5.4	7.0	8.3
B19	7.9	12.8	25.4	4.2	9.0	13.1	4.4	9.4	9.8

The following major conclusions can be achieved from **Table 5**:

- Taking into account all analysed wind directions and mean wind speed exceedance probability for each wind direction, the average air change per hour is higher than 3 for all analysed units when the 10 m height approaching mean wind speed is 2 m/s.
- The frequency of wind speeds exceeding 2 m/s obtained from the Sydney (KS) Airport 1999-2017 data was high, at approximately 94%.

The average air change per hours is increased between 2-3 times of that in **Table 5** when taking all wind directions and mean wind speed probability occurrence into consideration.

Figure 19 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block A – Northeast Wind, Approaching Wind Speed = 2 m/s

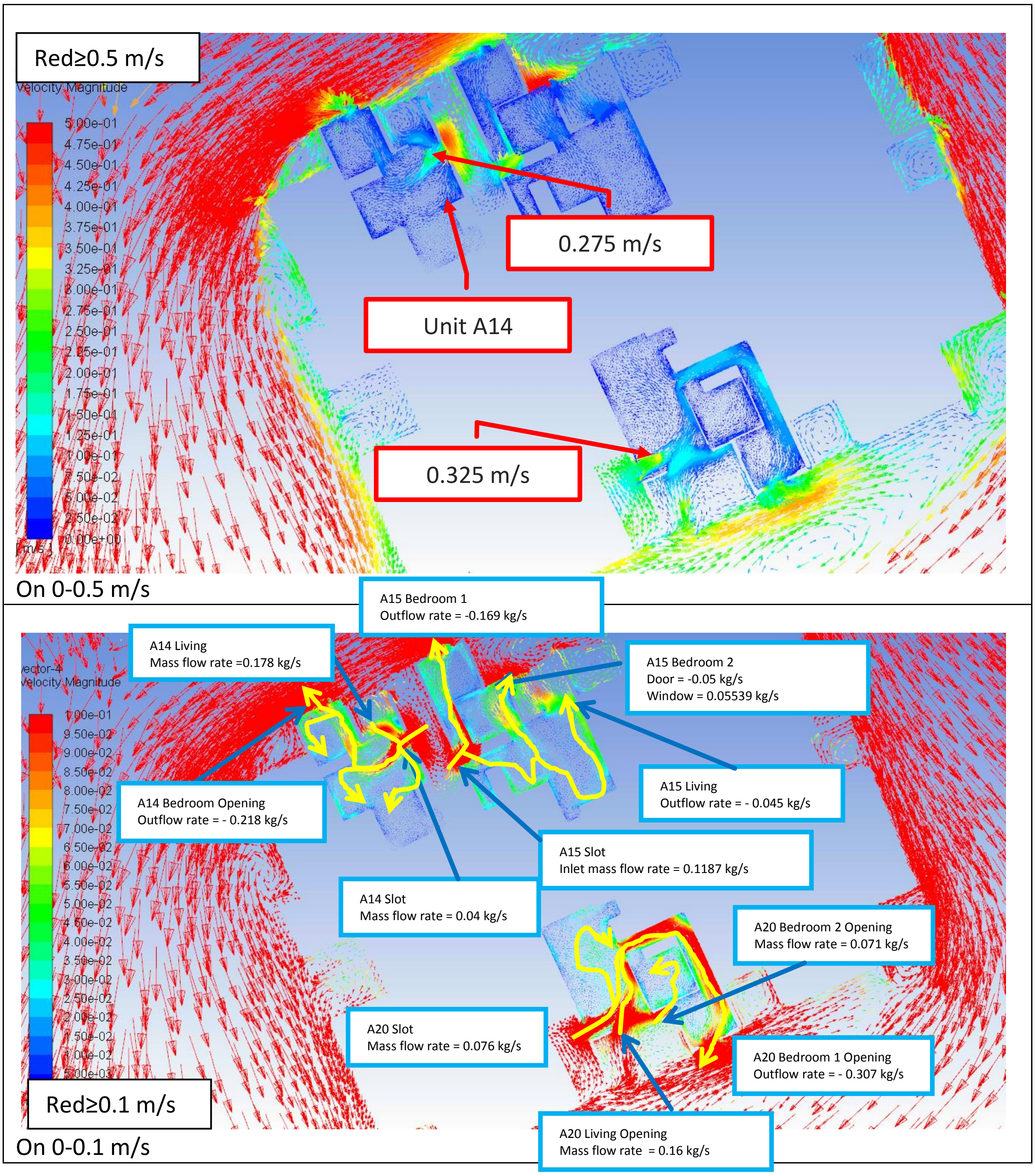


Figure 20 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block B – North East Wind, Approaching Wind Speed = 2 m/s

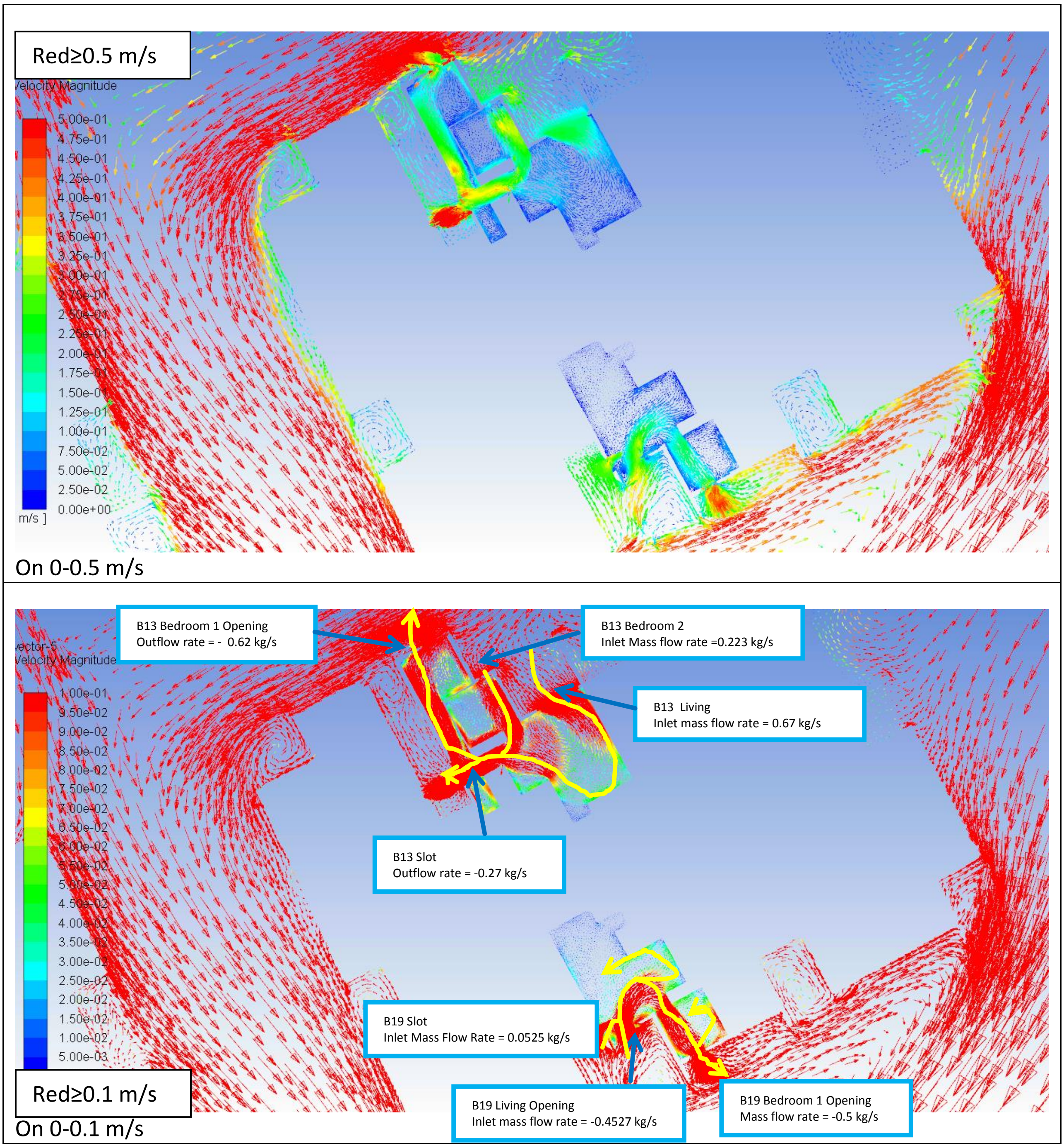
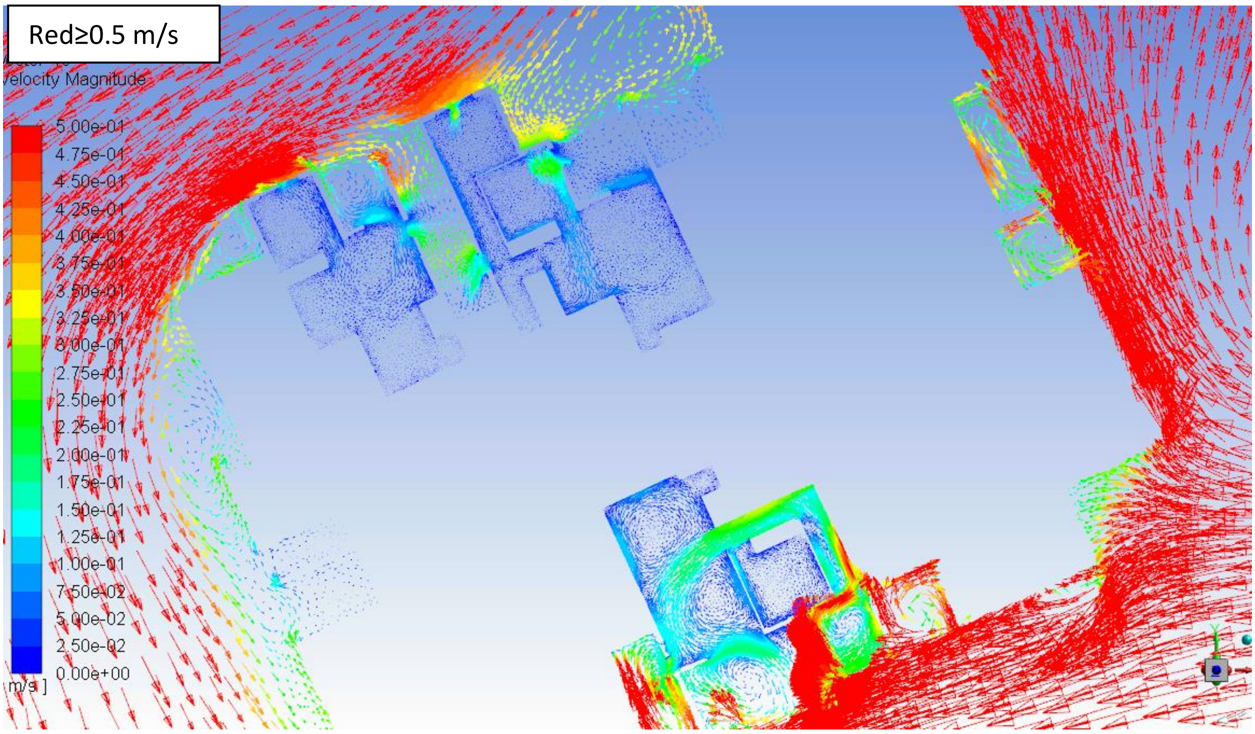
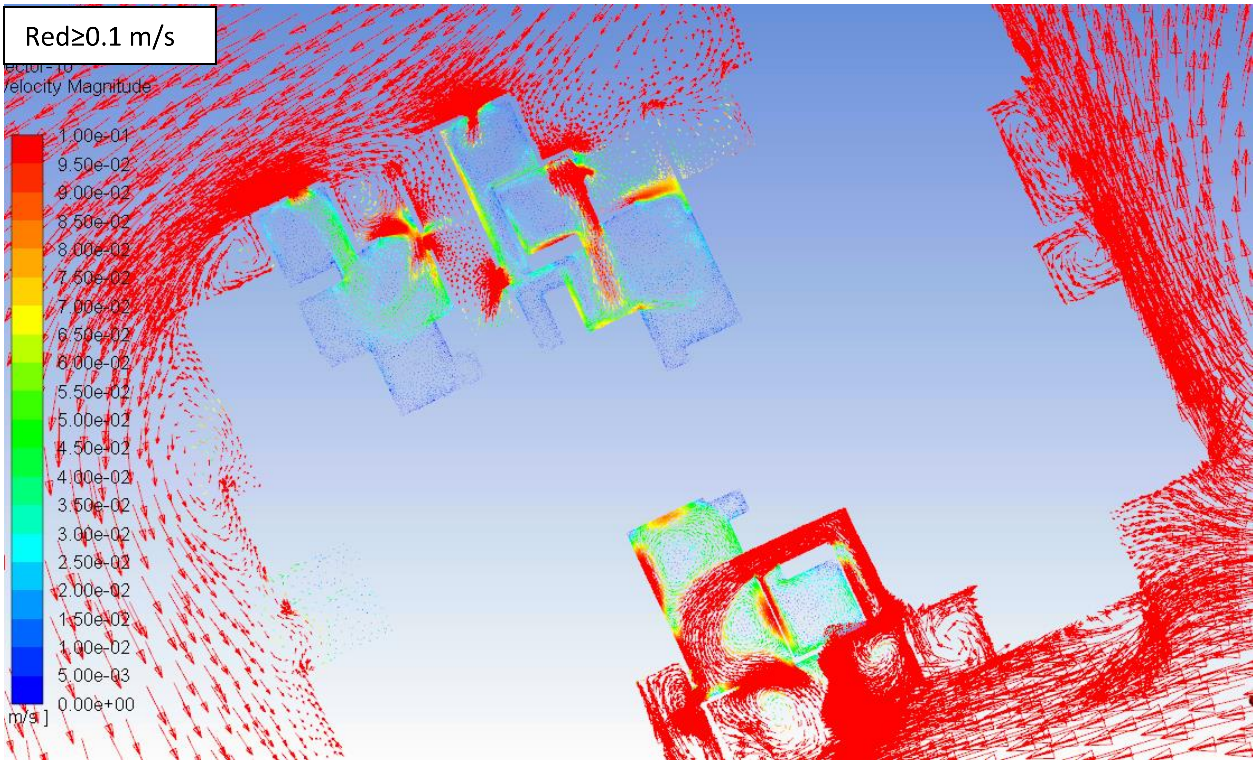


Figure 21 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block A – East Wind, Approaching Wind Speed = 2 m/s,



On 0-0.5 m/s



On 0-0.1 m/s

Figure 22 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block B – East Wind, , Approaching Wind Speed = 2 m/s

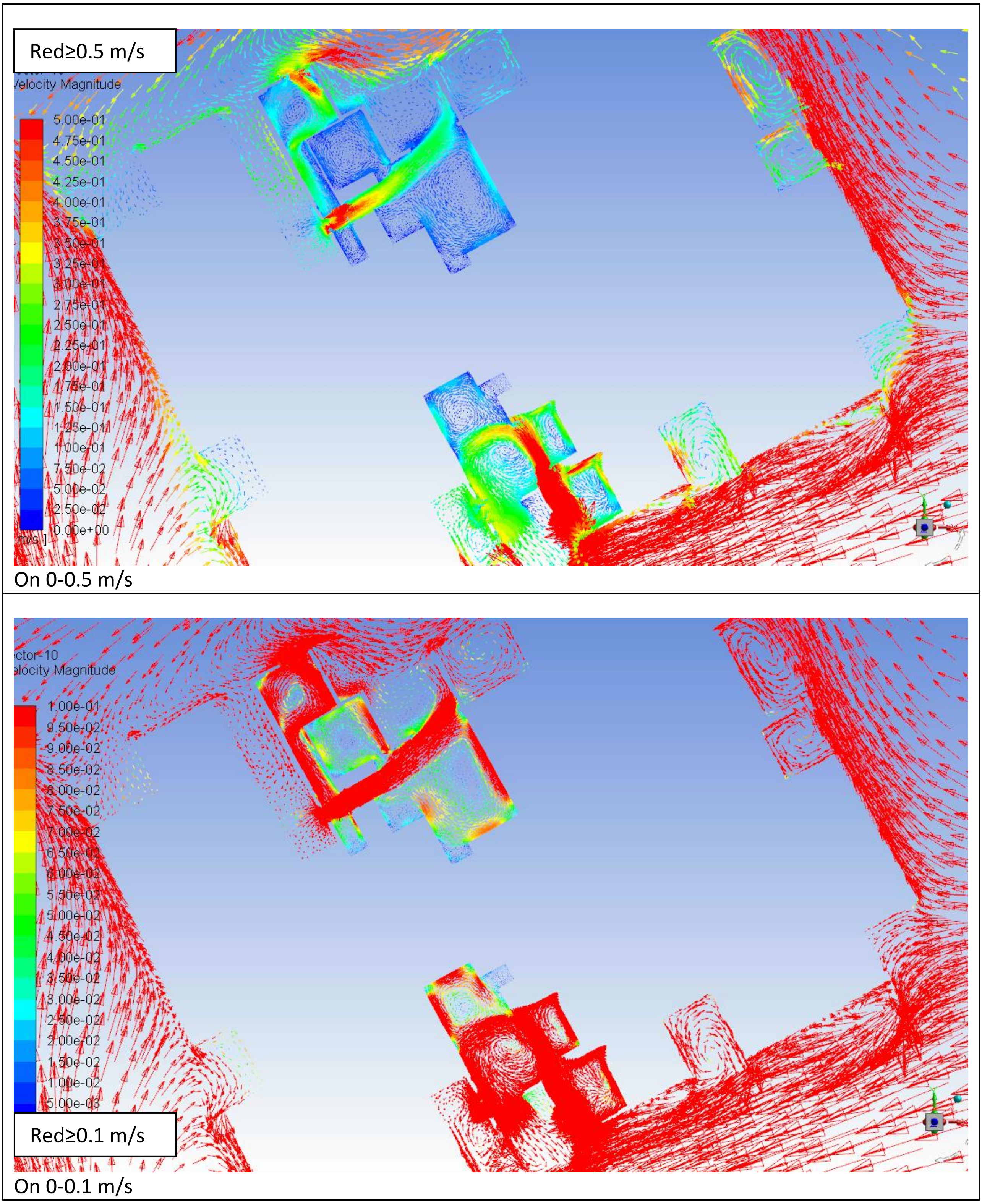
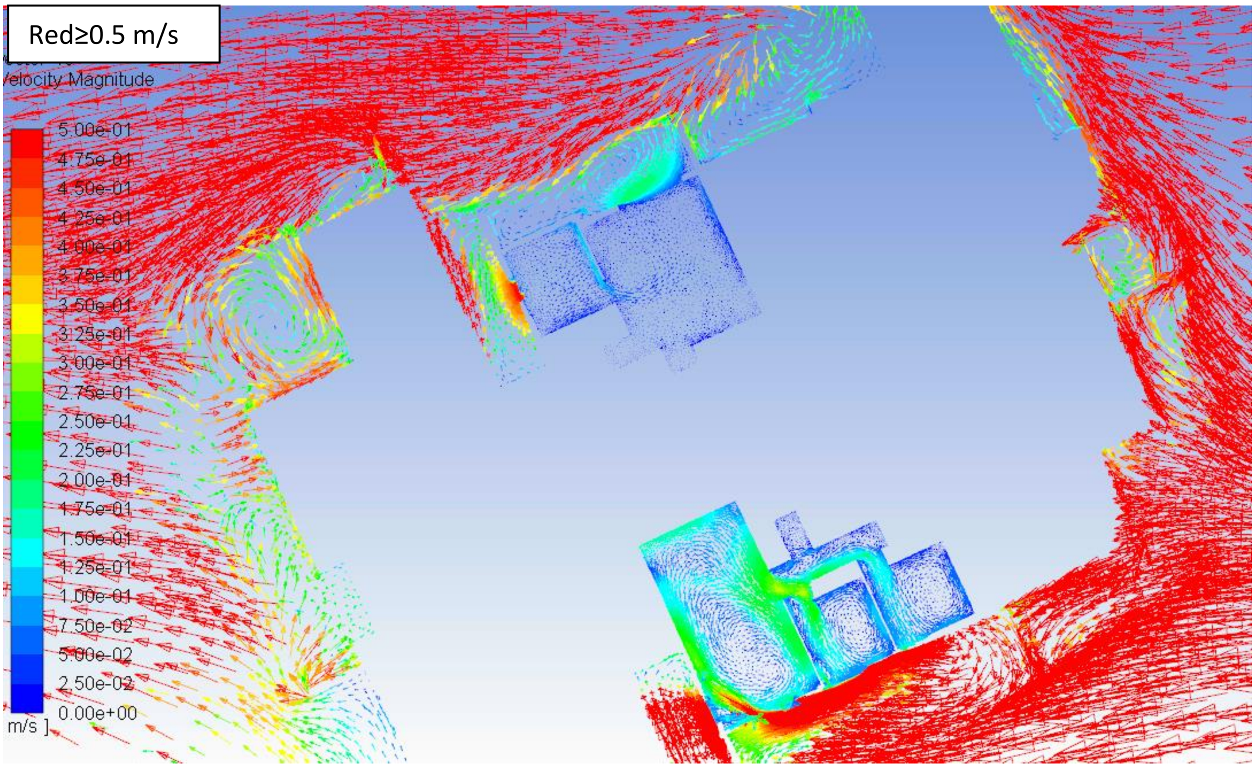
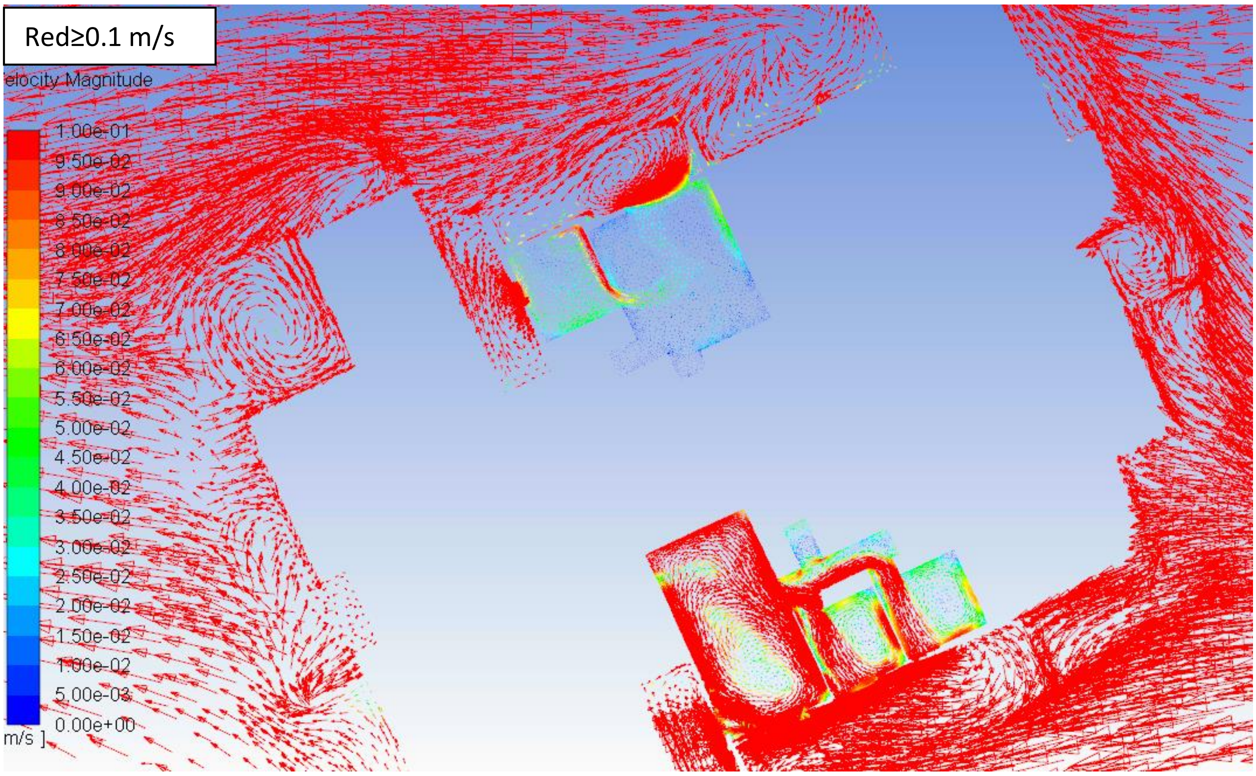


Figure 23 Contours of Velocity Magnitude in Analysed Apartments at Level 3, Block A – East Wind, Approaching Wind Speed = 2 m/s

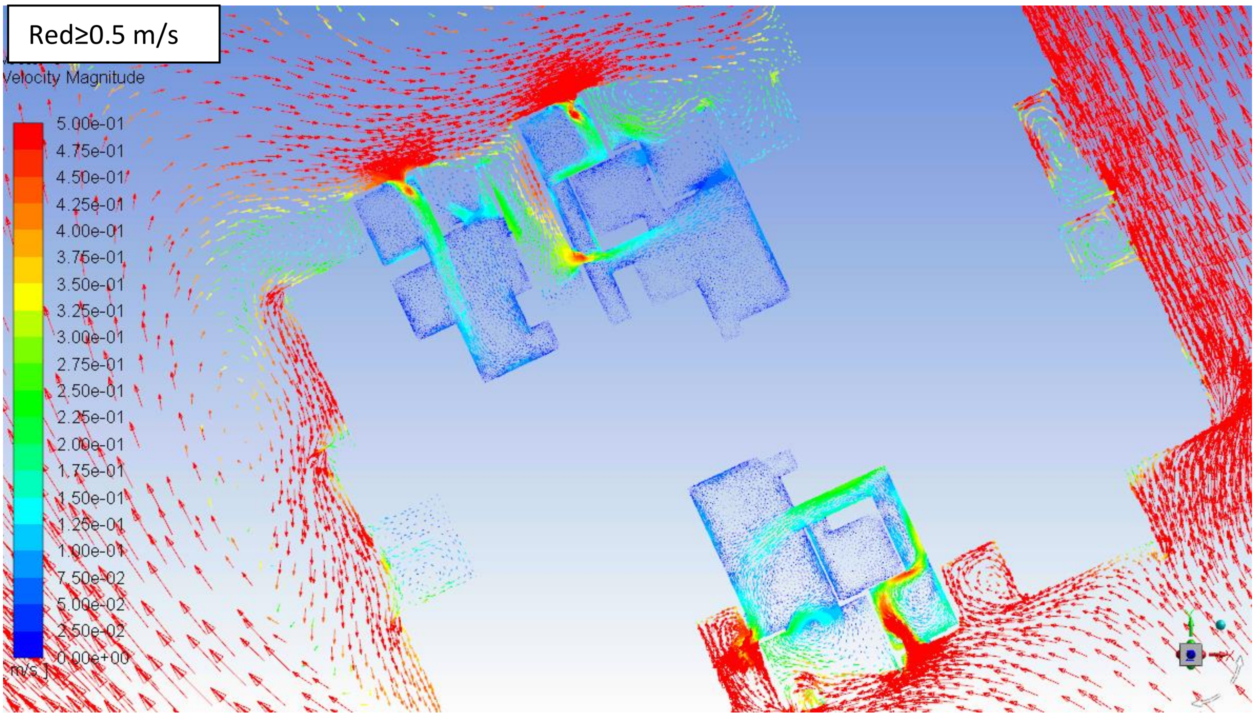


On 0-0.5 m/s

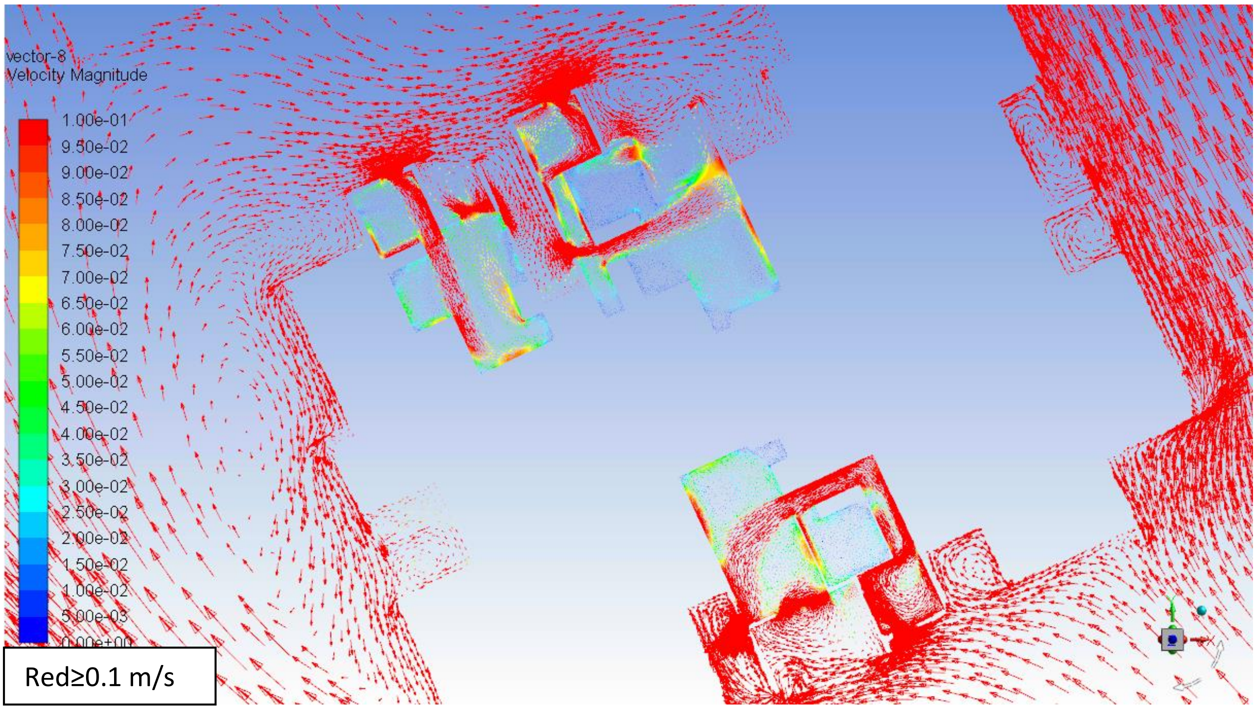


On 0-0.1 m/s

Figure 24 Contours of Velocity Magnitude in Analysed Apartments at Level 3, Block A – Southeast Wind, Approaching Wind Speed = 2 m/s



On 0-0.5 m/s



On 0-0.1 m/s

Figure 25 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block B – Southeast Wind, Approaching Wind Speed = 2 m/s

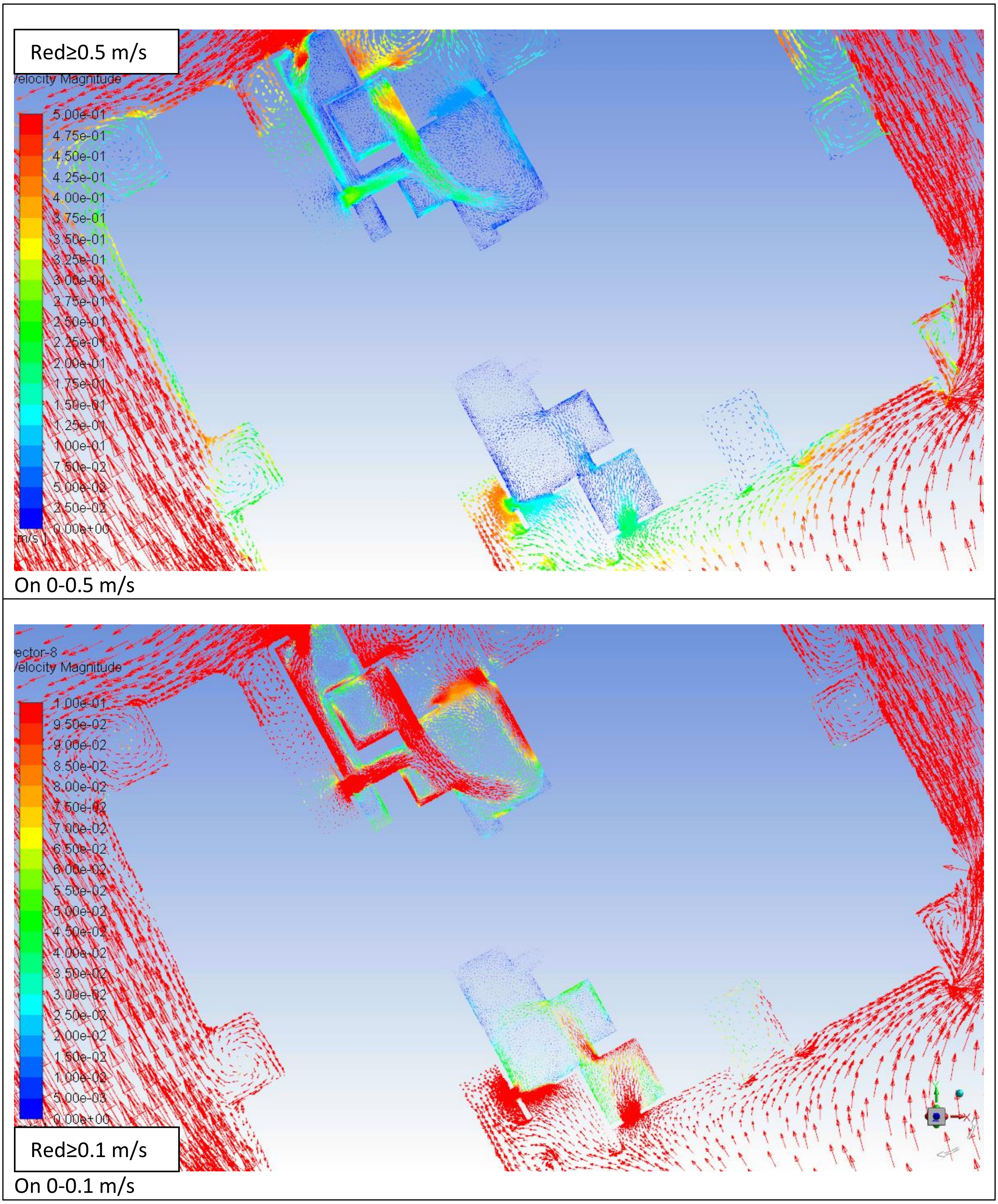
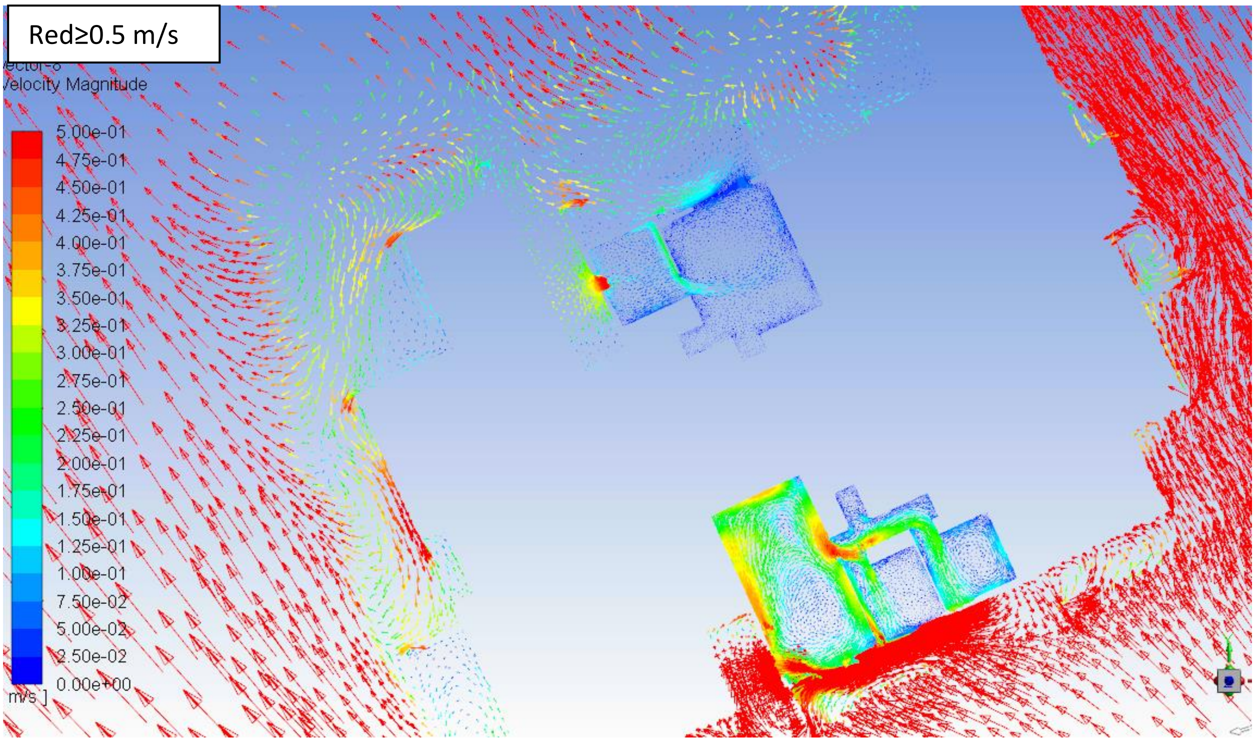
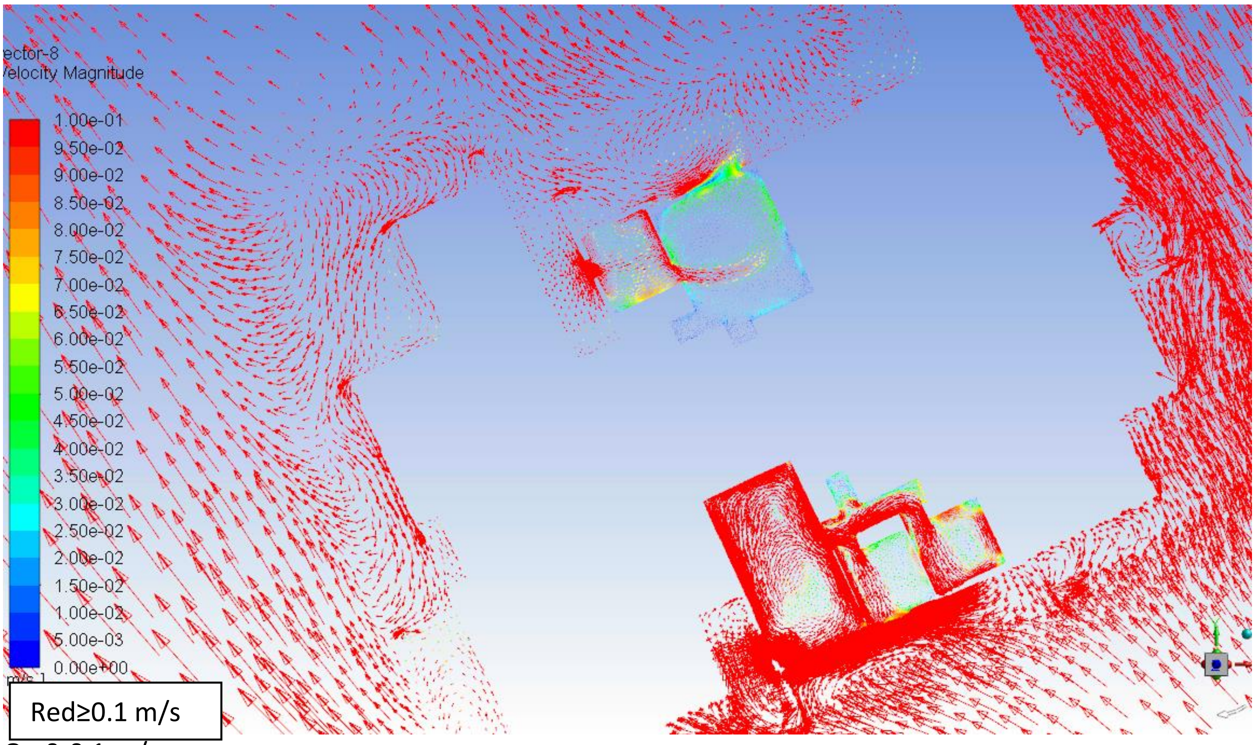


Figure 26 Contours of Velocity Magnitude in Analysed Apartments at Level 3, Block A – Southeast Wind, Approaching Wind Speed = 2 m/s,

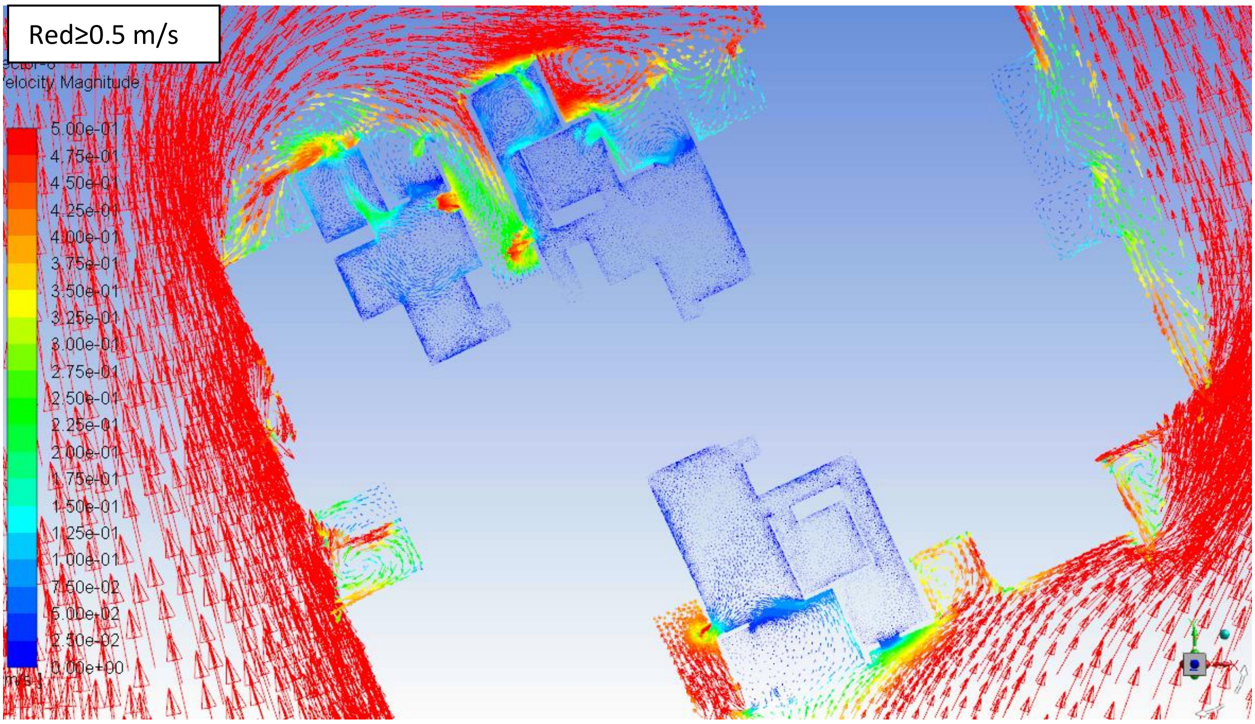


On 0-0.5 m/s

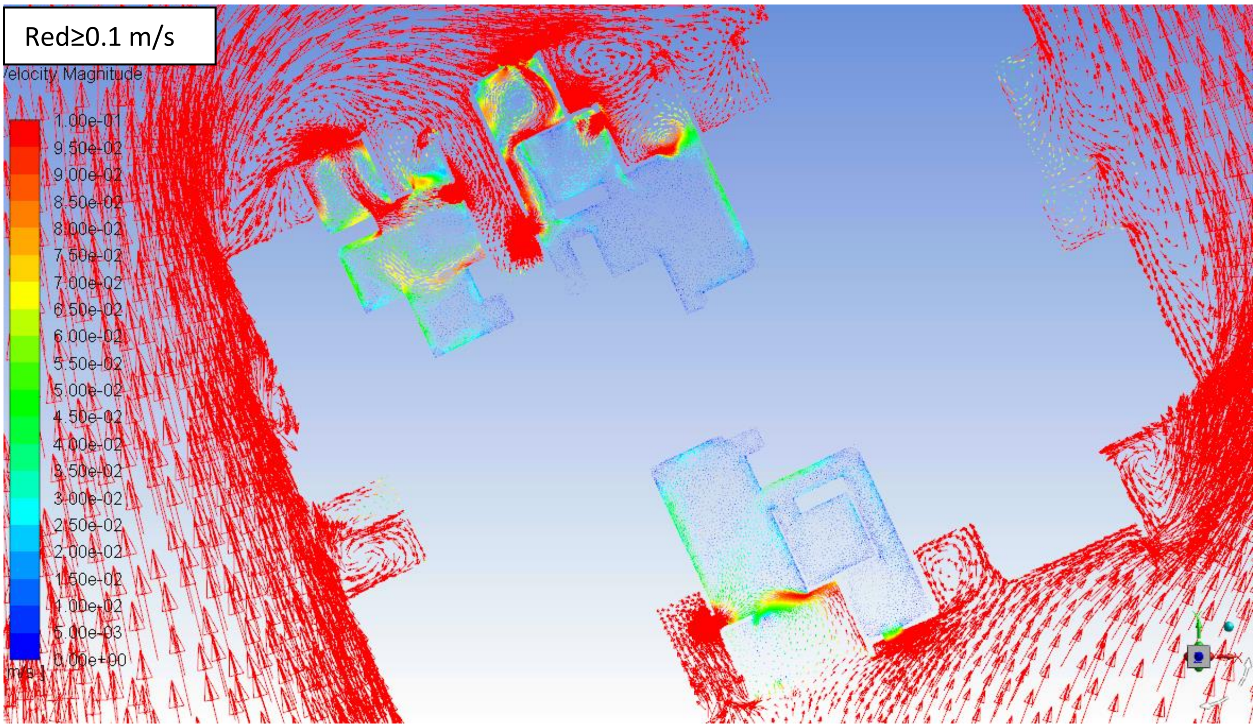


On 0-0.1 m/s

Figure 27 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block A – South Wind, Approaching Wind Speed = 2 m/s

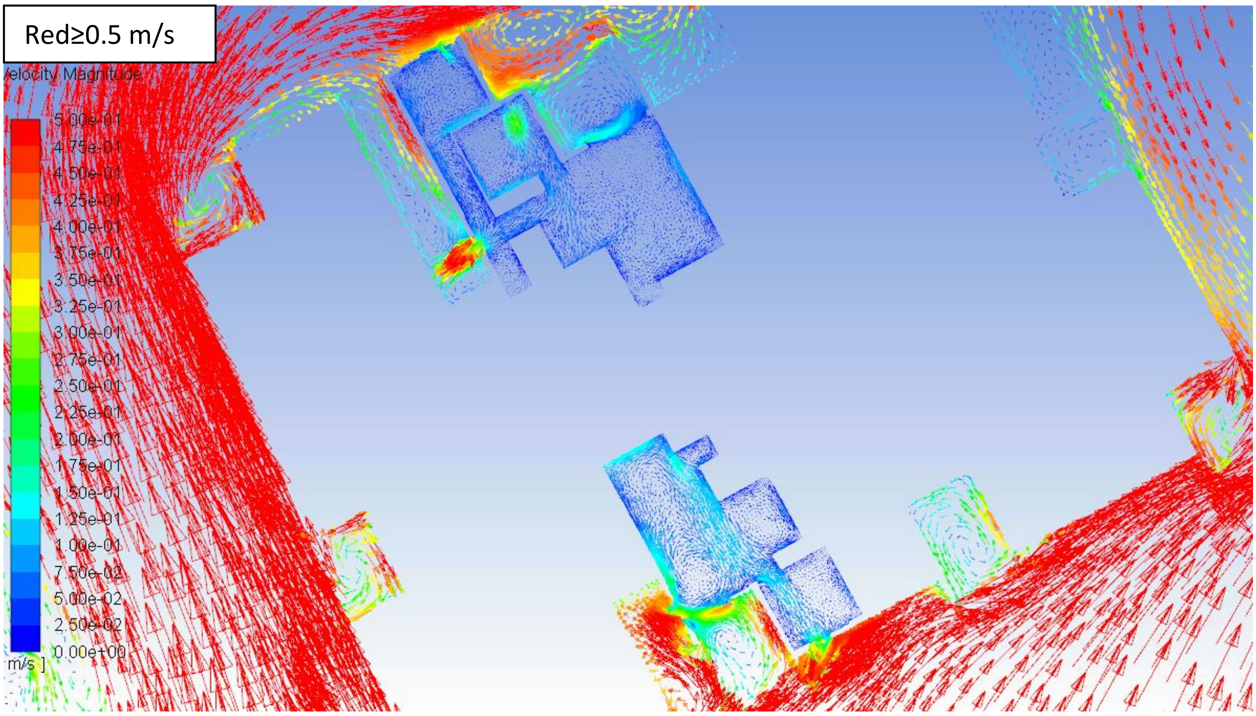


On 0-0.5 m/s

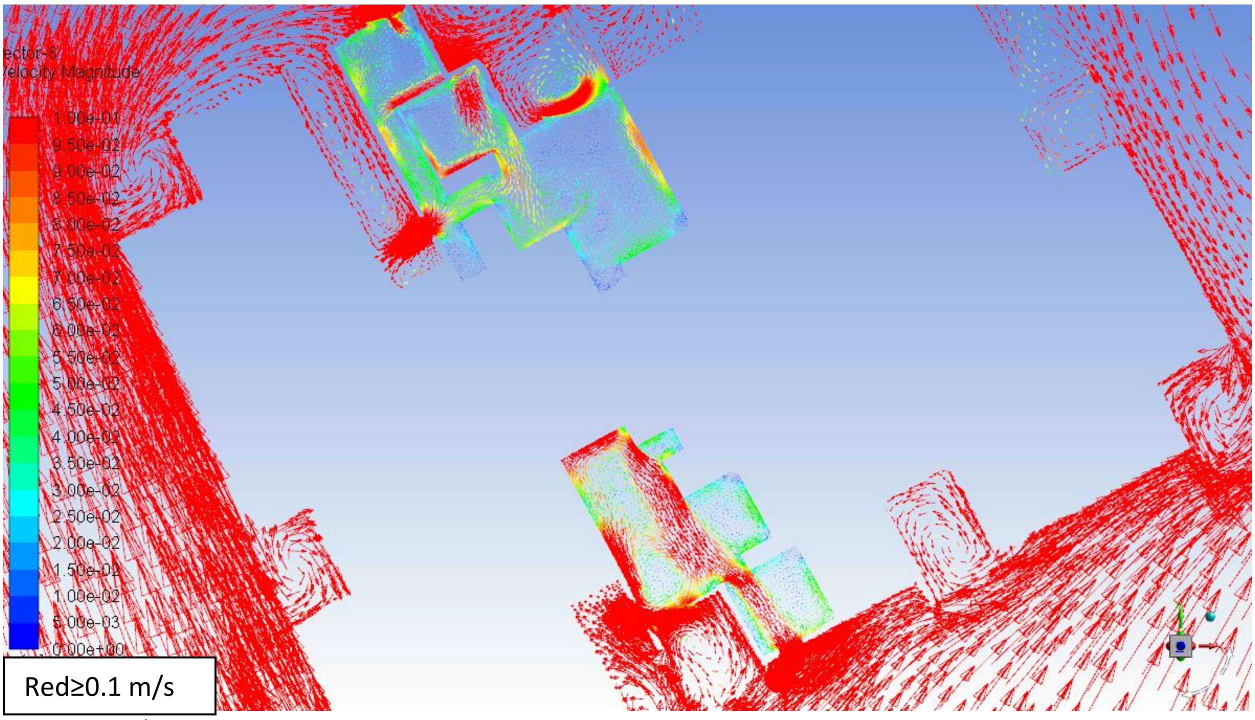


On 0-0.1 m/s

Figure 28 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block B – South Wind, Approaching Wind Speed = 2 m/s

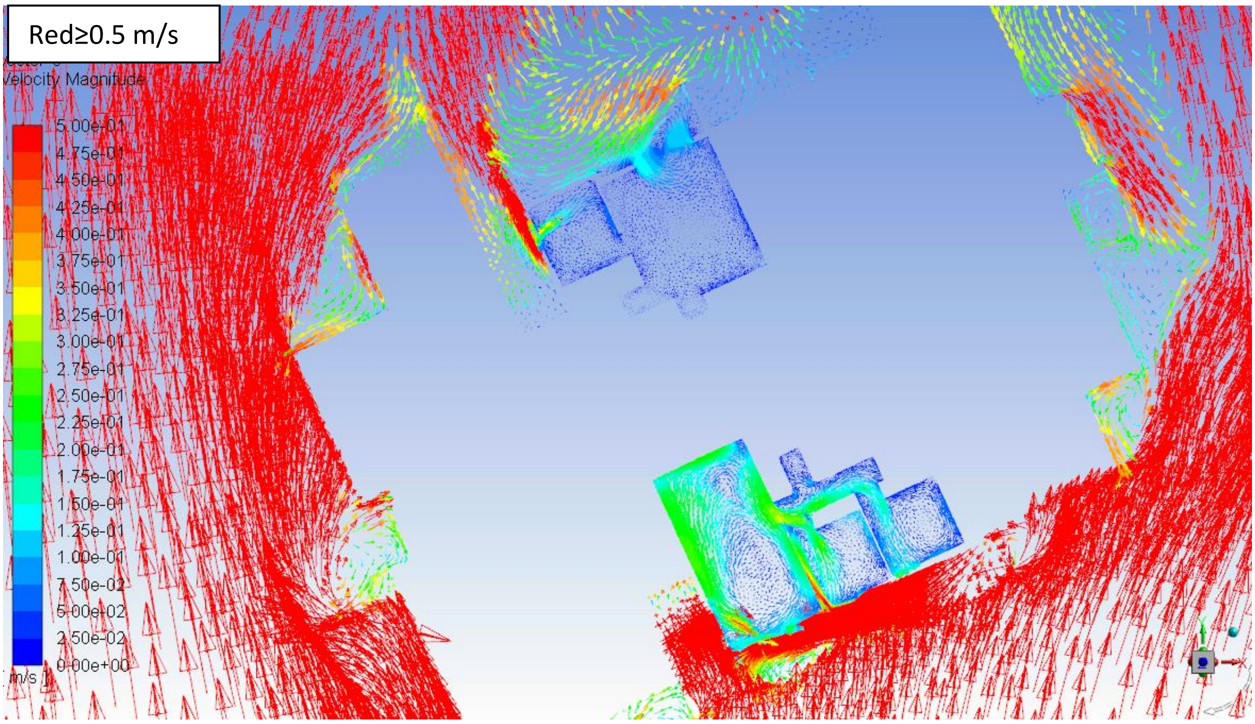


On 0-0.5 m/s

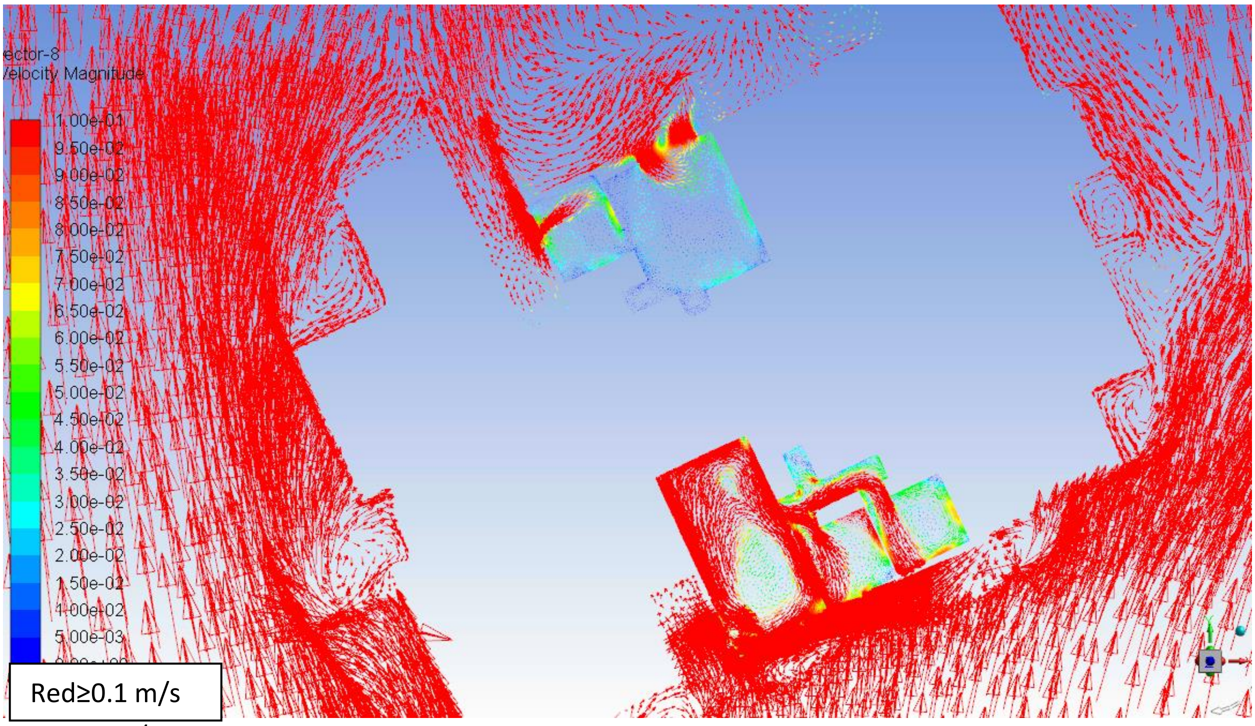


On 0-0.1 m/s

Figure 29 Contours of Velocity Magnitude in Analysed Apartments at Level 3, Block A – South Wind, Approaching Wind Speed = 2 m/s

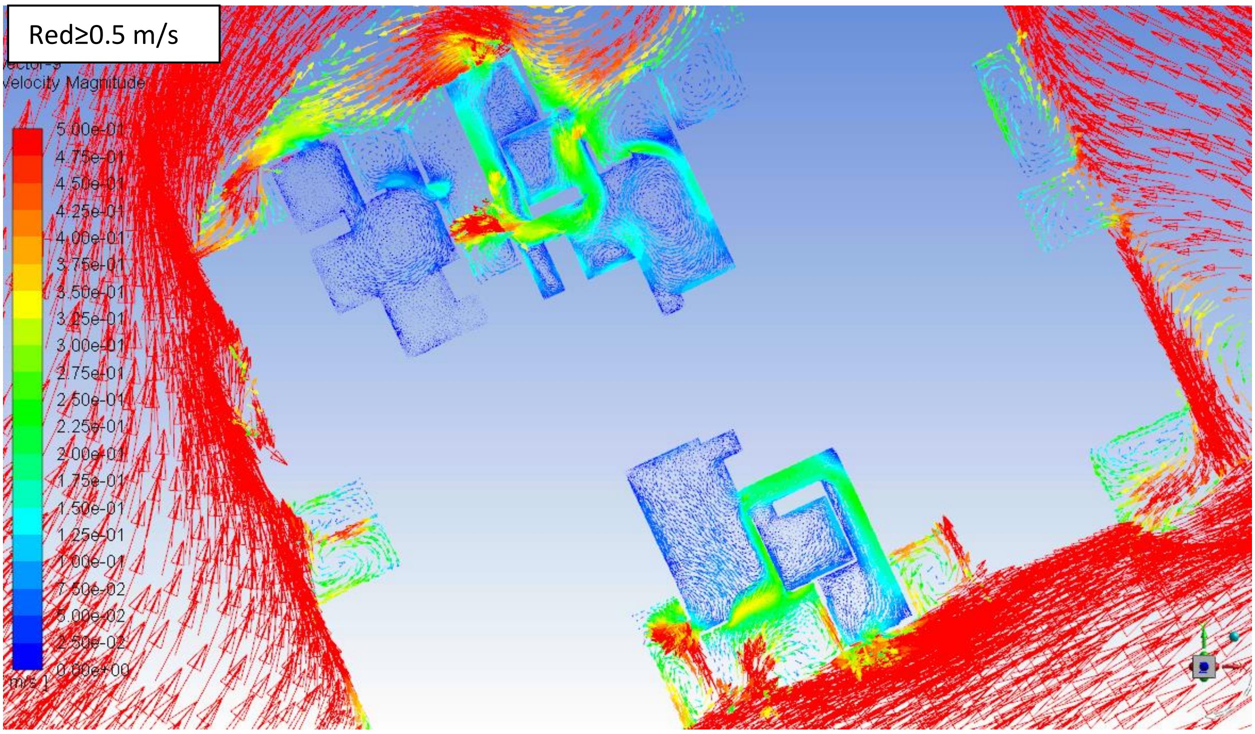


On 0-0.5 m/s

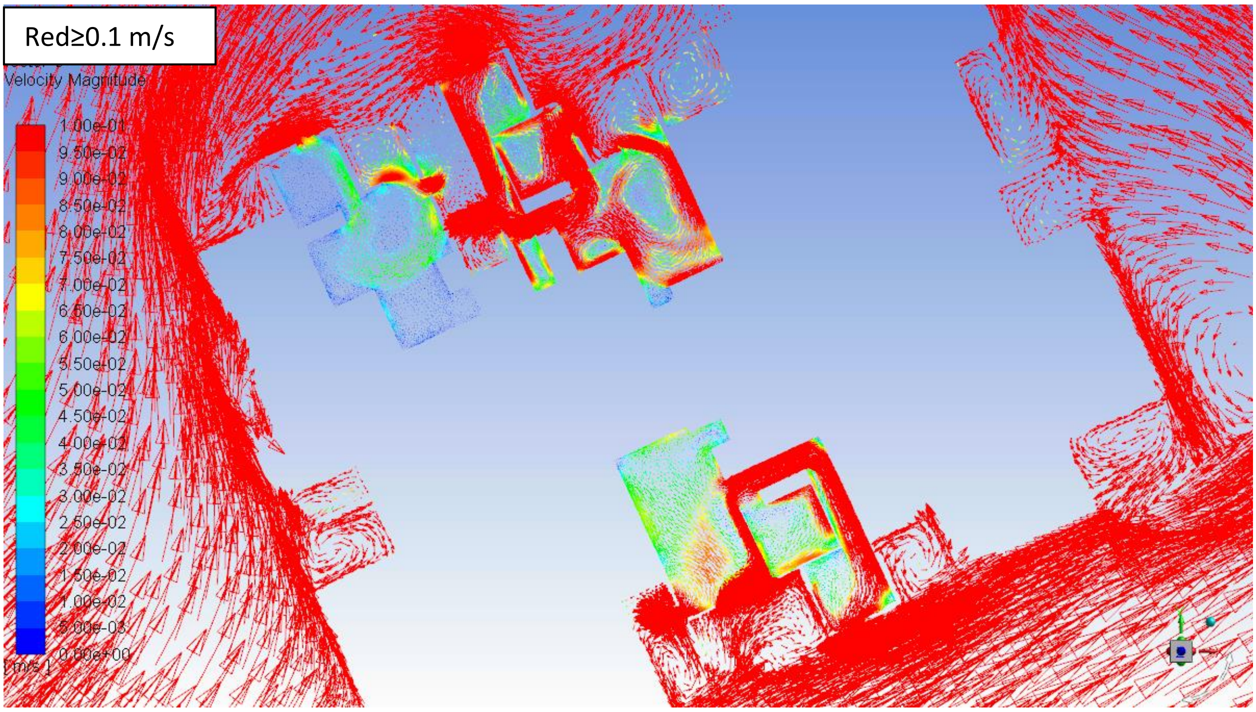


On 0-0.1 m/s

Figure 30 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block A – Southwest Wind, Approaching Wind Speed = 2 m/s

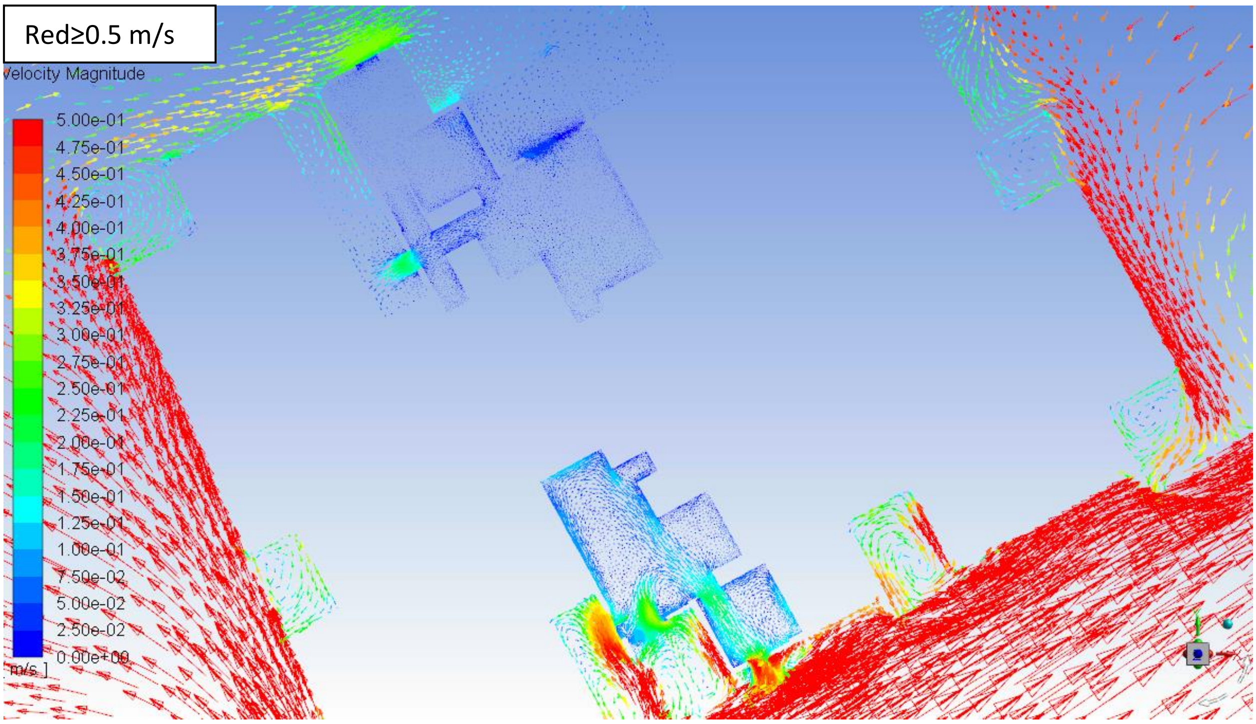


On 0-0.5 m/s

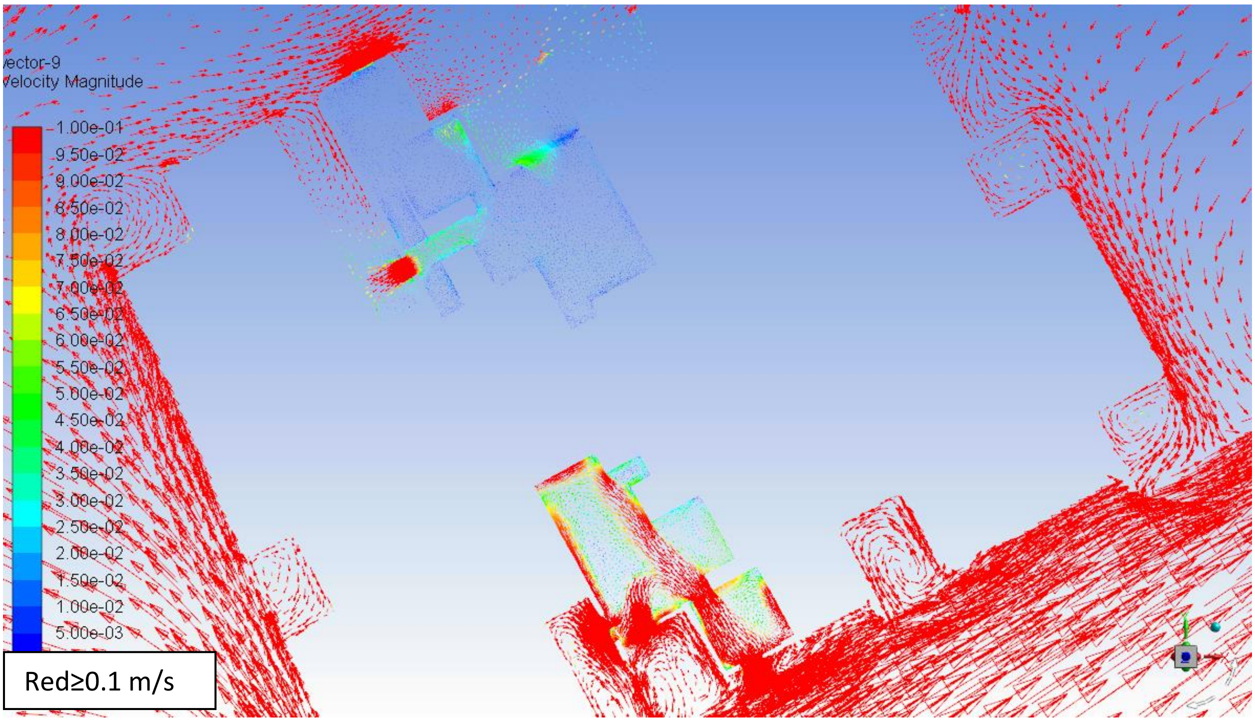


On 0-0.1 m/s

Figure 31 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block B – Southwest Wind, Approaching Wind Speed = 2 m/s



On 0-0.5 m/s



On 0-0.1 m/s

Figure 32 Contours of Velocity Magnitude in Analysed Apartments at Level 3, Block A – Southwest Wind, Approaching Wind Speed = 2 m/s

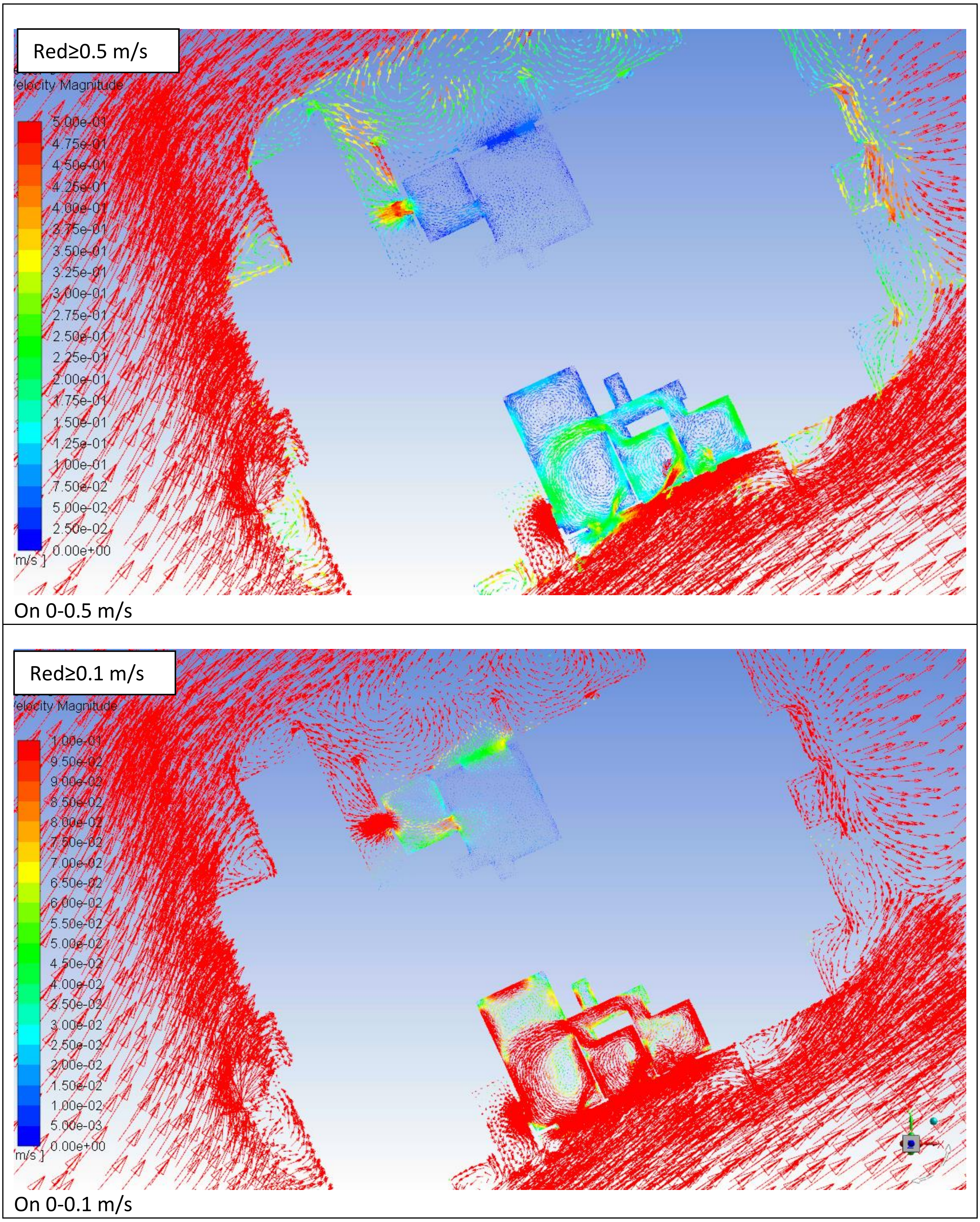
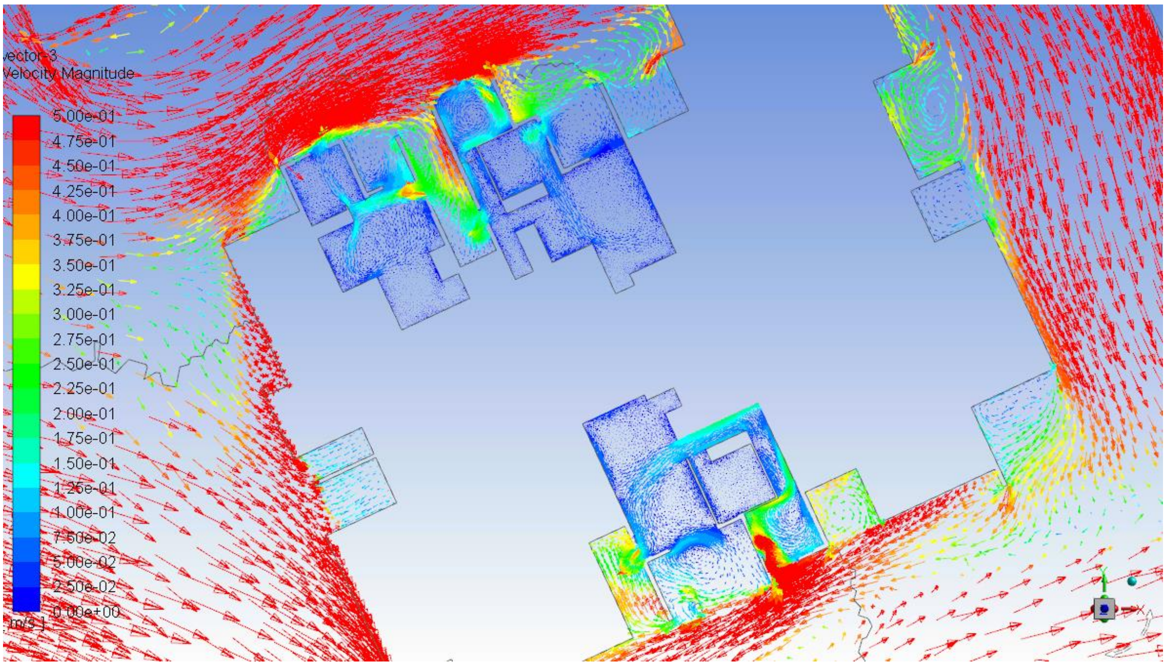
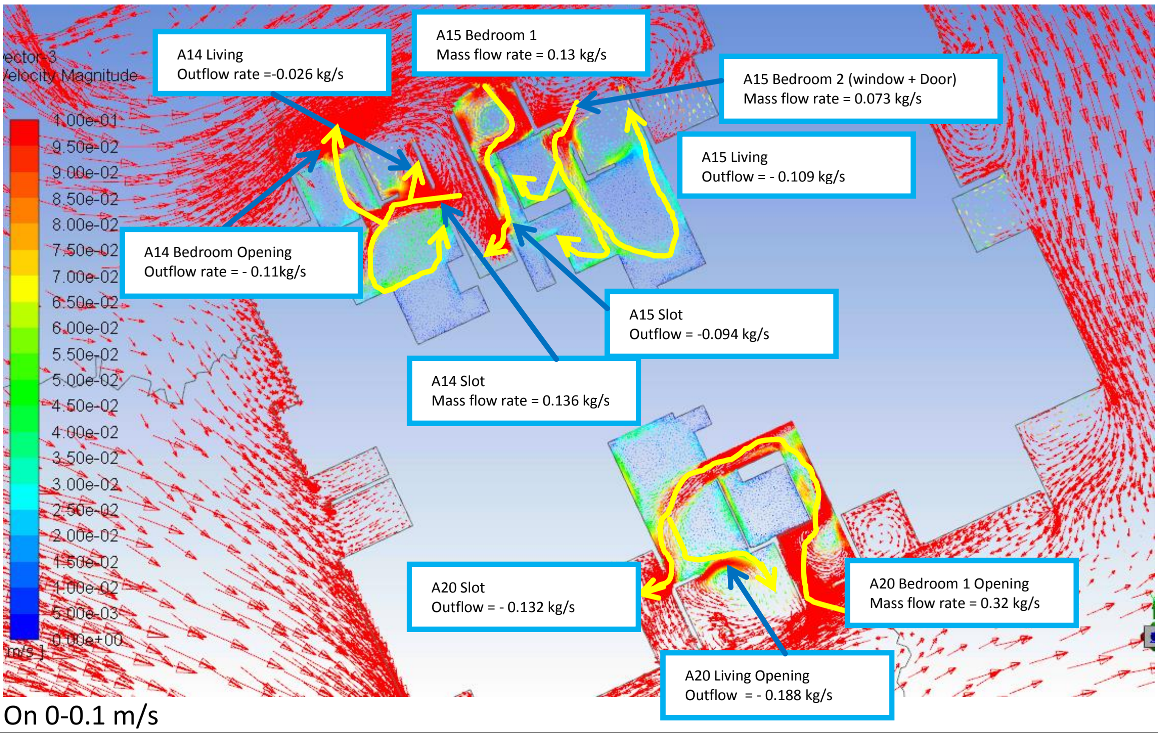


Figure 33 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block A – West Wind, Approaching Wind Speed = 2 m/s

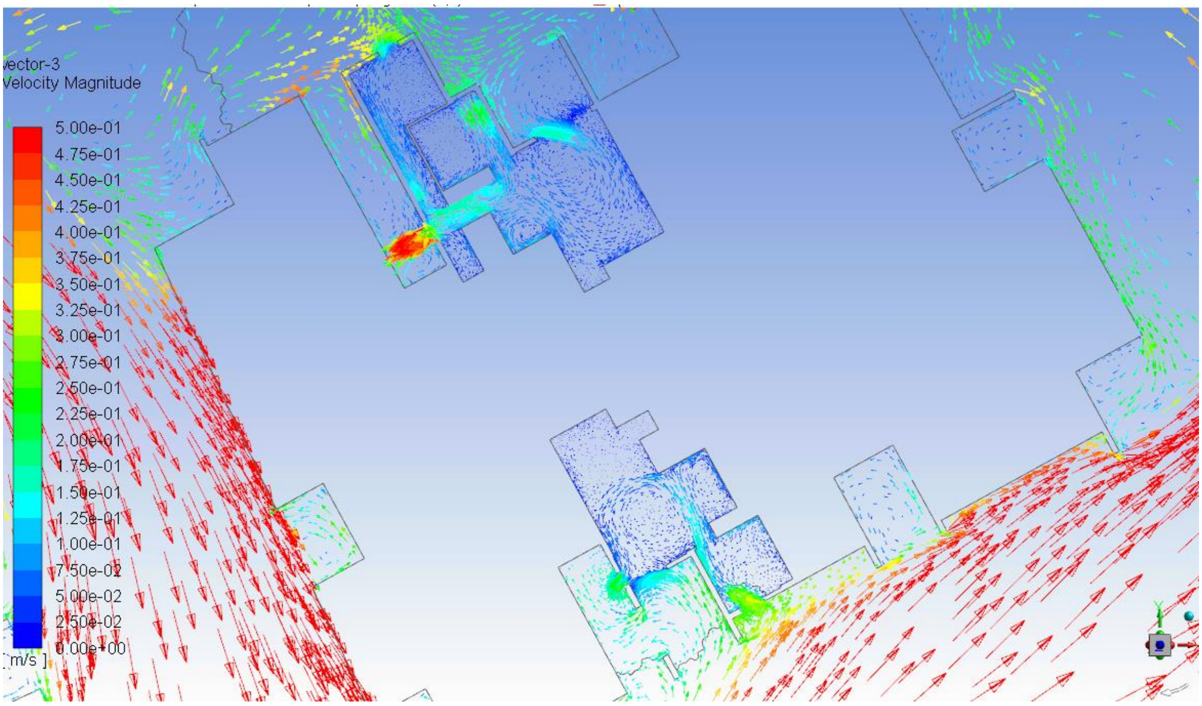


On 0-0.5 m/s

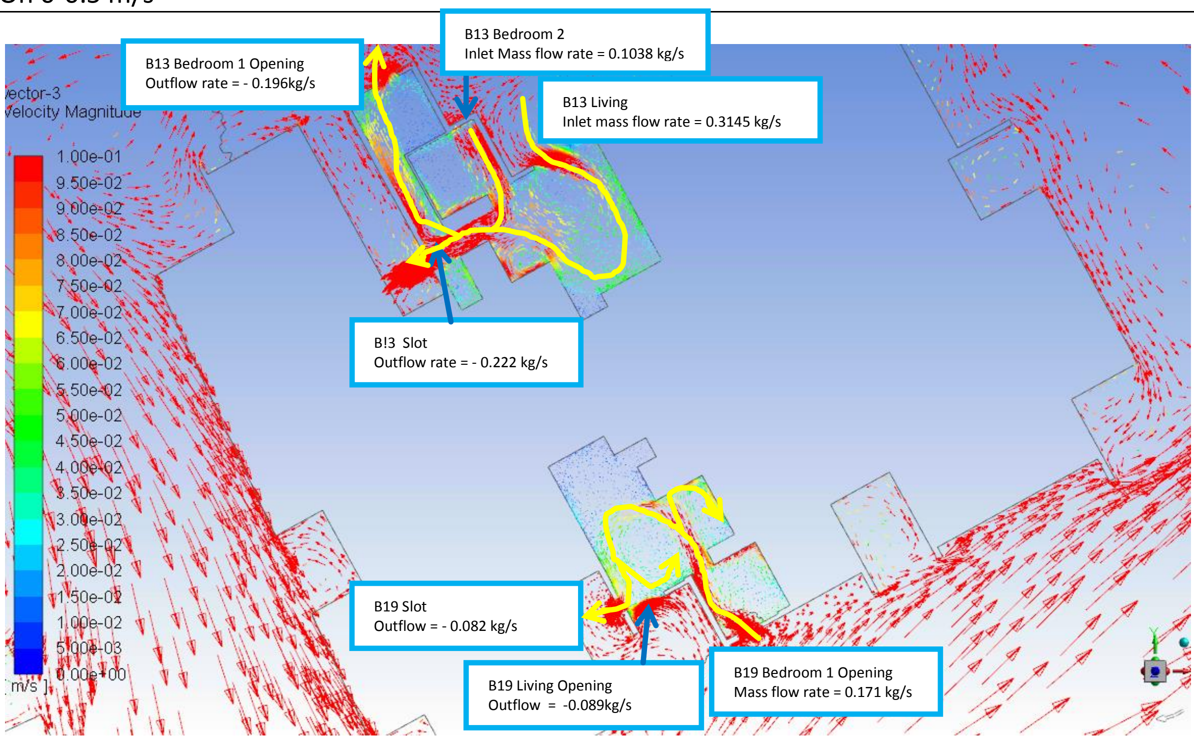


On 0-0.1 m/s

Figure 34 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block B – West Wind, Approaching Wind Speed = 2 m/s

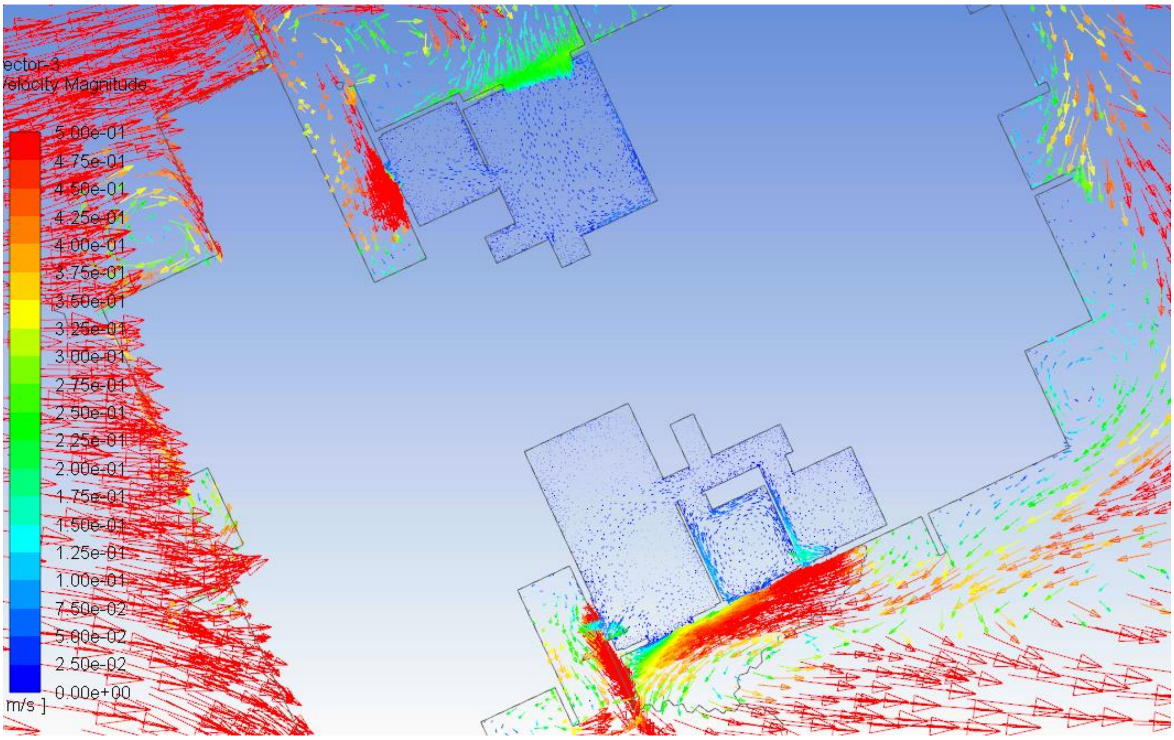


On 0-0.5 m/s

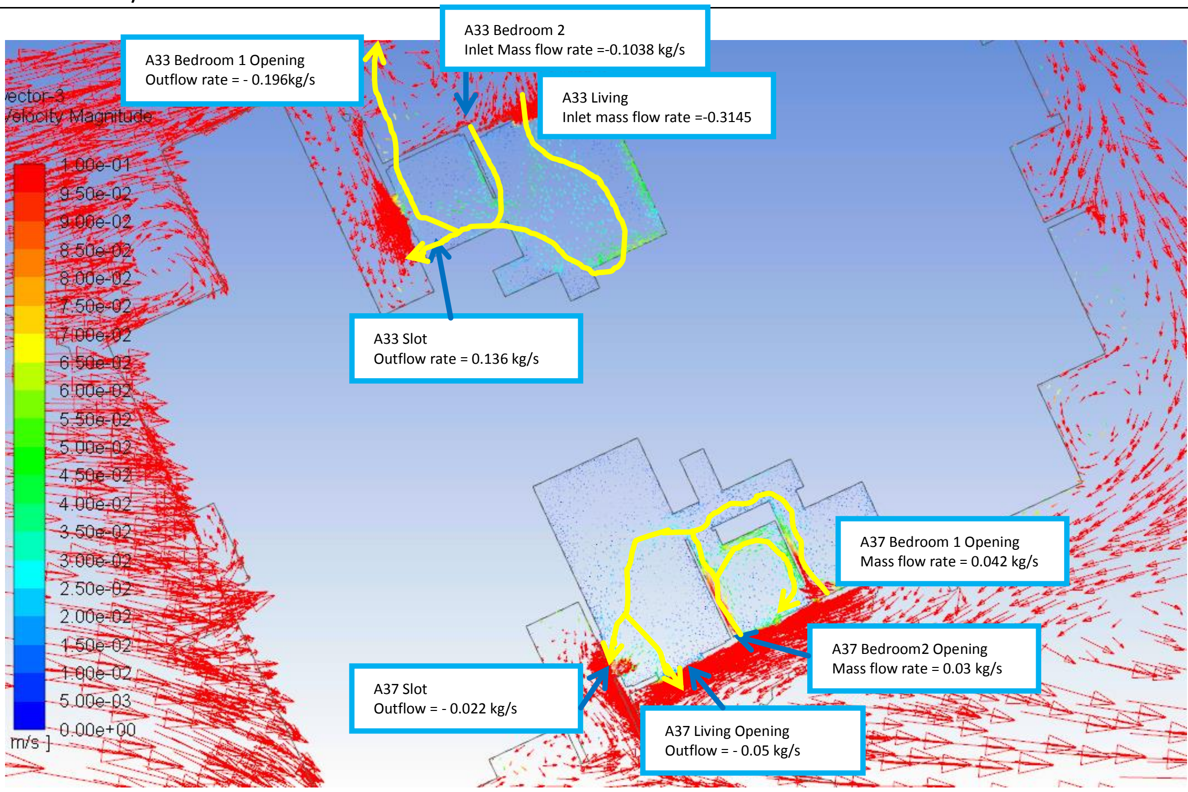


On 0-0.1 m/s

Figure 35 Contours of Velocity Magnitude in Analysed Apartments at Level 3, Block A – West Wind, Approaching Wind Speed = 2 m/s

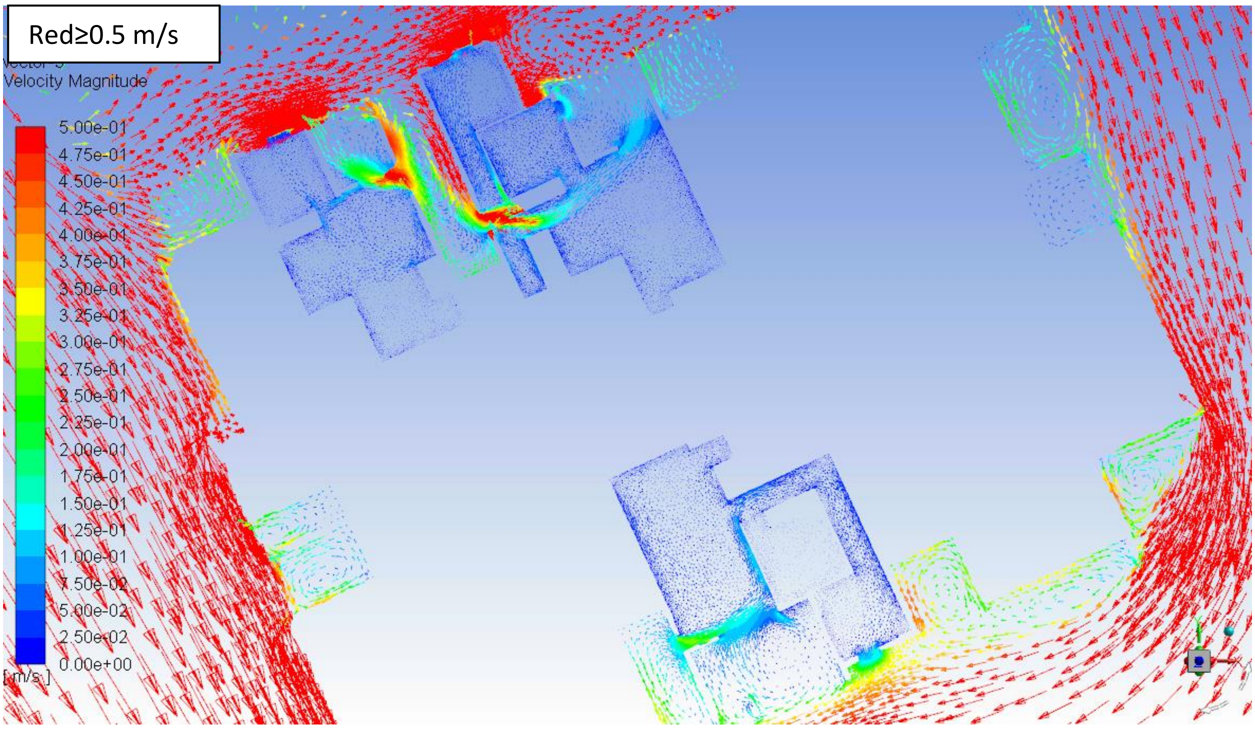


On 0-0.5 m/s

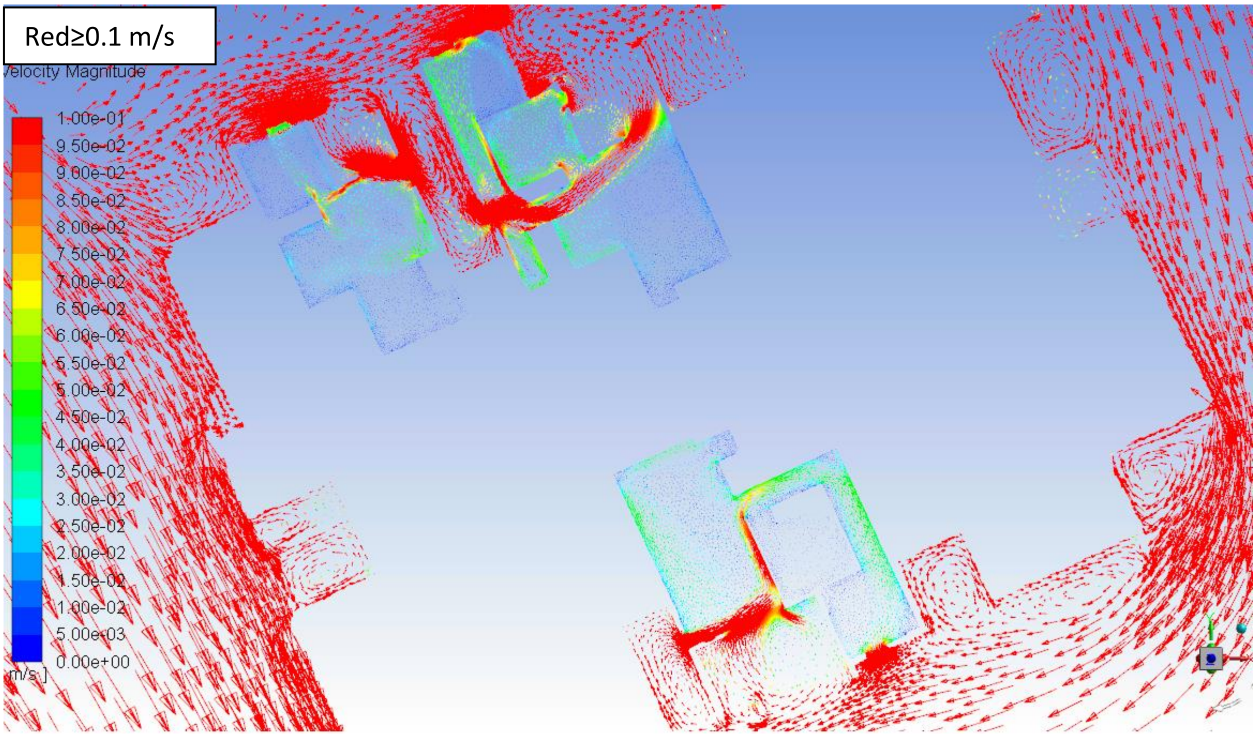


On 0-0.1 m/s

Figure 36 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block A – Northwest Wind, Approaching Wind Speed = 2 m/s



On 0-0.5 m/s



On 0-0.1 m/s

Figure 37 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block B – Northwest Wind, Approaching Wind Speed = 2 m/s

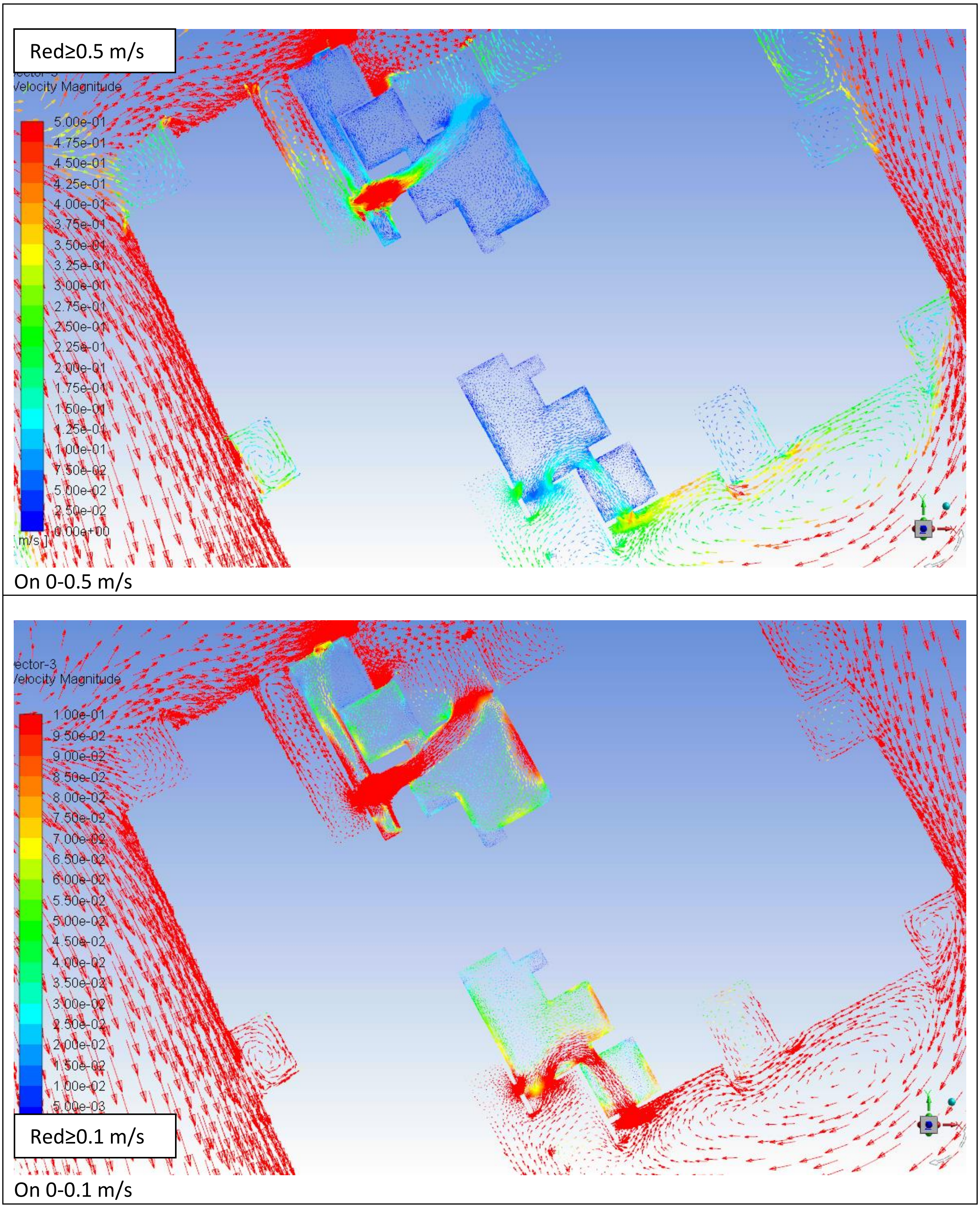
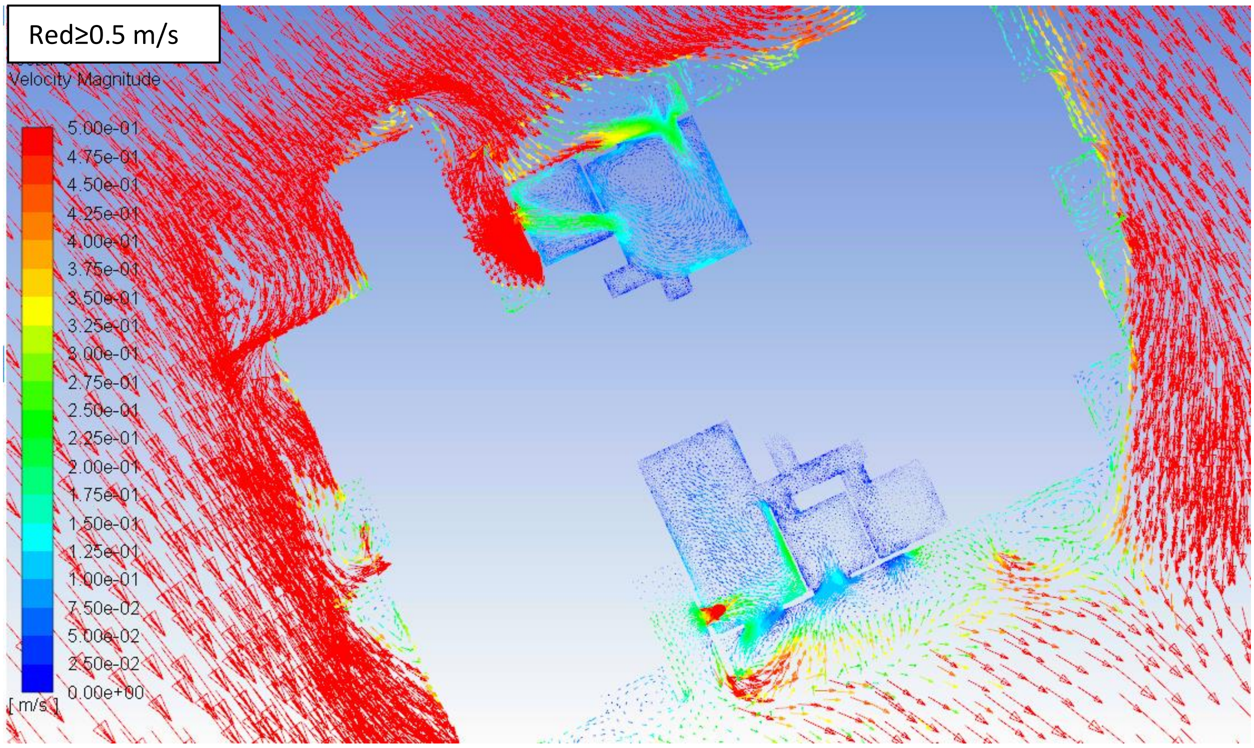
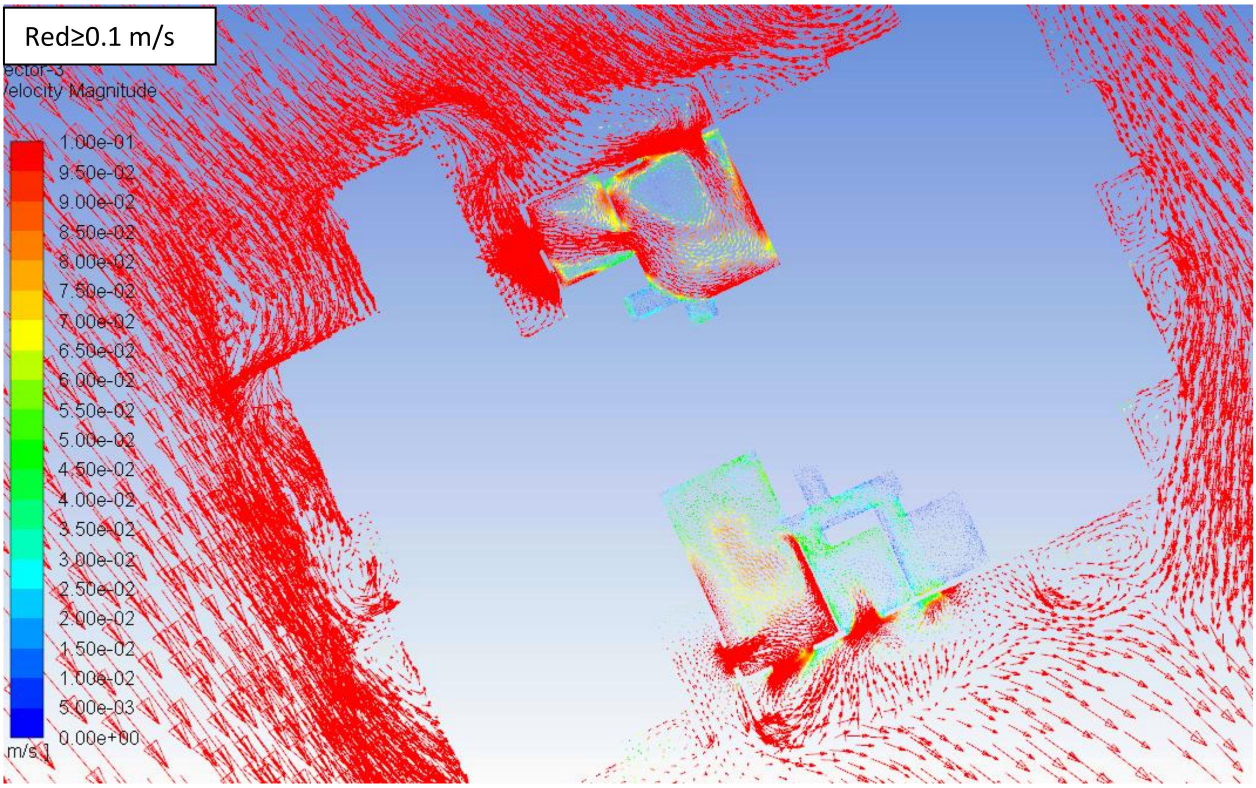


Figure 38 Contours of Velocity Magnitude in Analysed Apartments at Level 3, Block A – Northwest Wind, Approaching Wind Speed = 2 m/s



On 0-0.5 m/s



On 0-0.1 m/s

Figure 39 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block A – North Wind, Approaching Wind Speed = 2 m/s

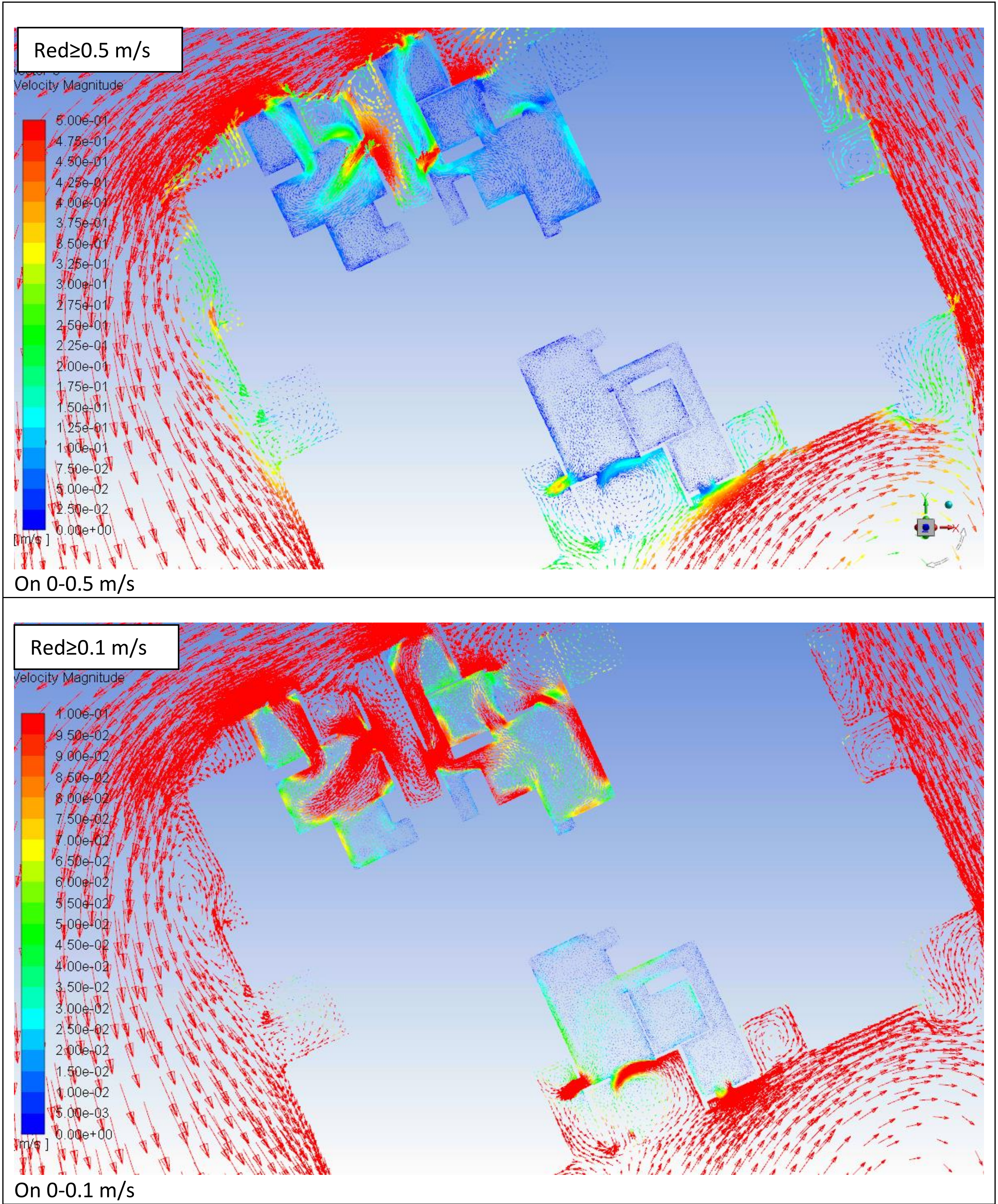
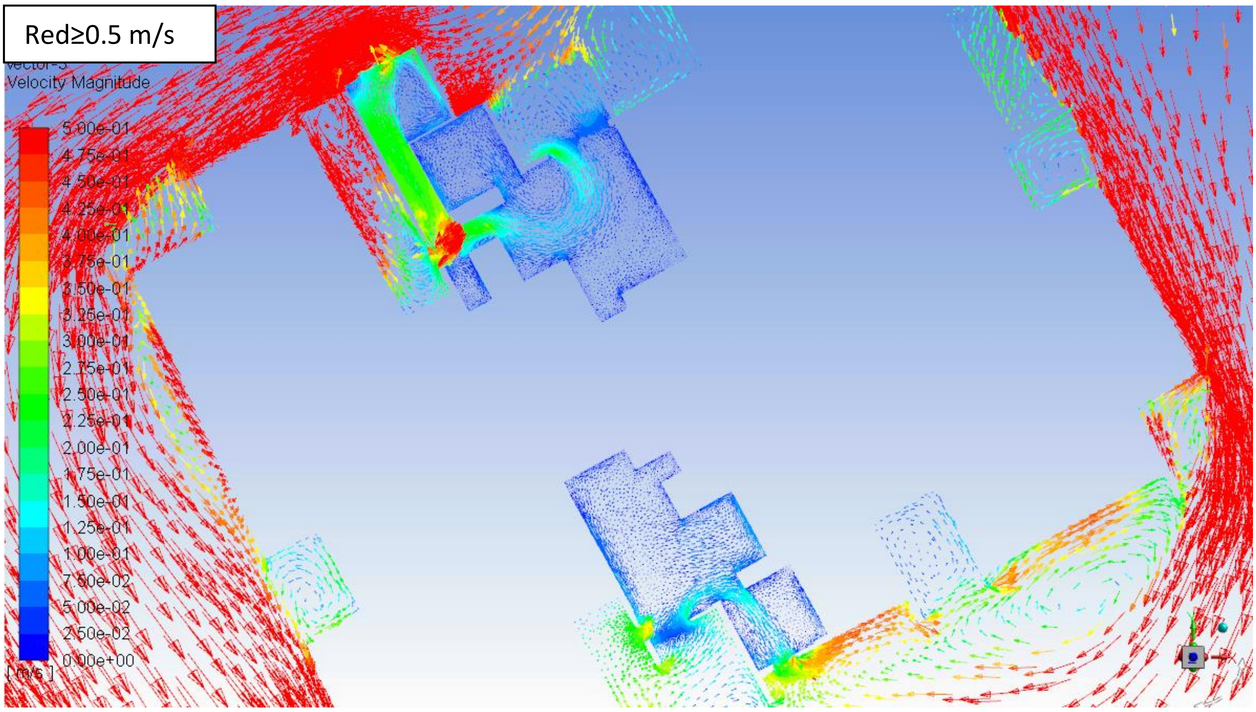
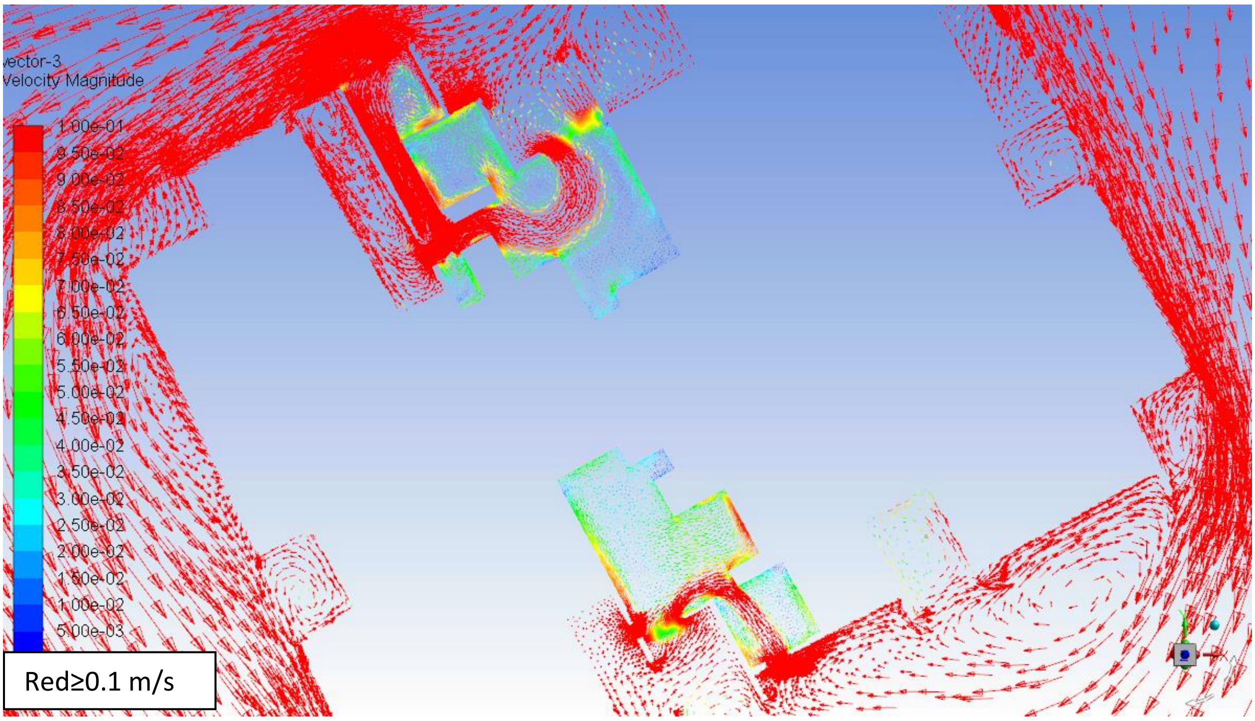


Figure 40 Contours of Velocity Magnitude in Analysed Apartments at Level 1, Block B – North Wind, , Approaching Wind Speed = 2 m/s

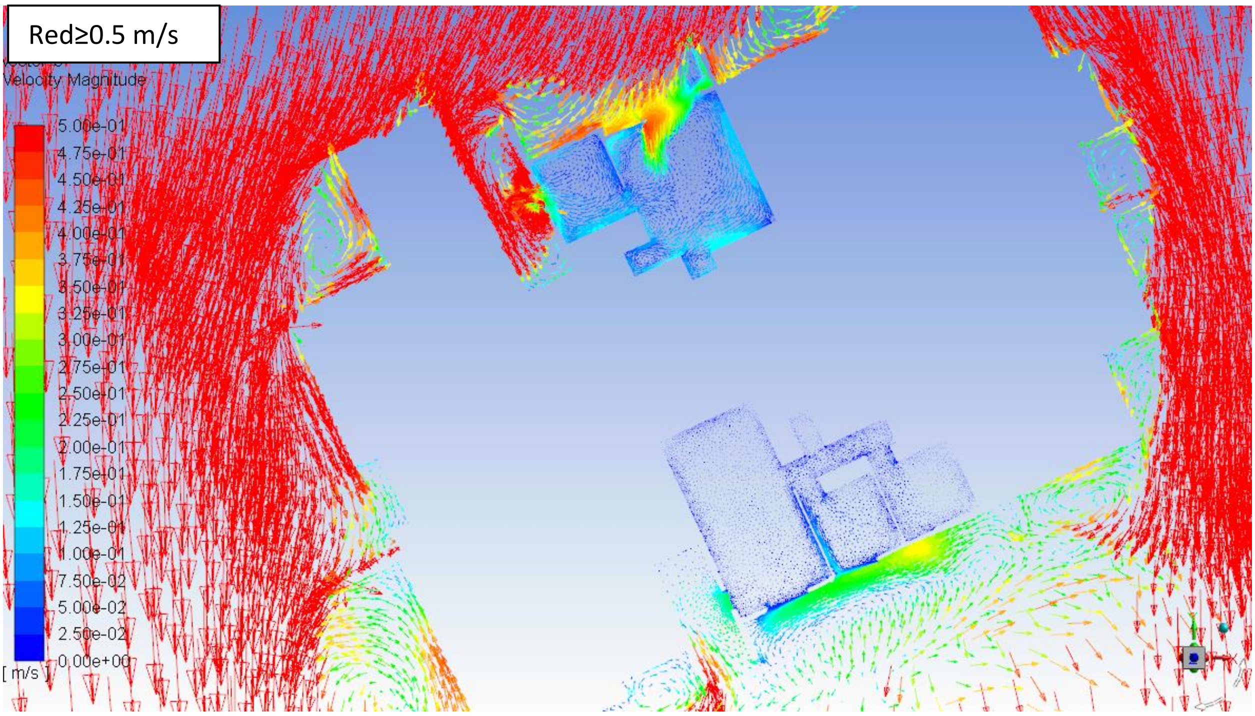


On 0-0.5 m/s

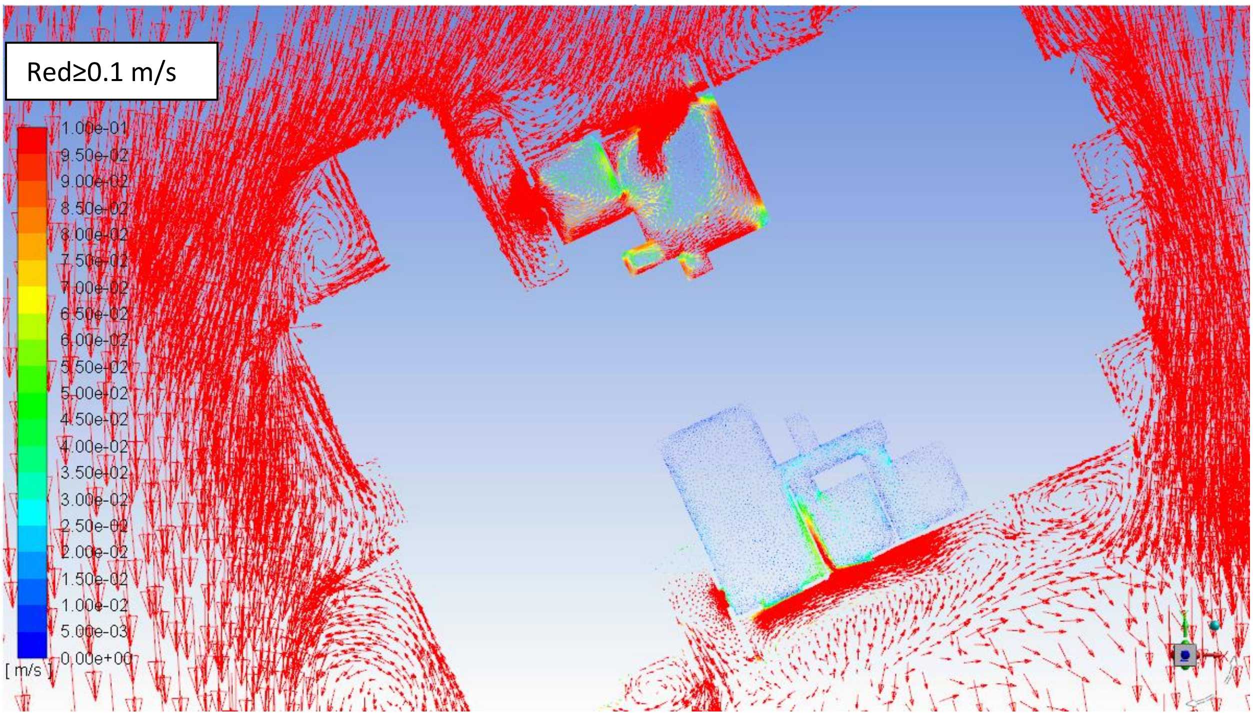


On 0-0.1 m/s

Figure 41 Contours of Velocity Magnitude in Analysed Apartments at Level 3, Block A – North Wind, Approaching Wind Speed = 2 m/s



On 0-0.5 m/s



On 0-0.1 m/s

7 Ventilation Results

SLR modelled apartments on level one and level three to gain an understanding of apartments across all levels. Apartments on level 2 are expected to perform in a similar manner to the nearest modelled apartment with Level 1 representative of Level 2.

The combined results of the AGD complaint dual aspect units and quantitative numerical modelling of non-dual aspect units are shown in **Table 6**.

Table 6 Apartments with Openings to Support Natural Ventilation – Combined Results

Level	Number of Apartments	Number of Apartments with Openings to Support Cross Ventilation (as per ADG)	Additional Apartment with (more than) Adequate Natural Ventilation (via CFD Modelling)	Combined Total	Percentage
G	19	8	0	8	42.1%
L1	20	8	5	13	65.0%
L2	20	8	5	13	65%
L3	13	8	3	11	84.6
Total	**72**	**32**	**13**	**45**	**62.5%**

By combining the CFD modelling and the qualitative analysis, it can be seen that 62.5% of the apartments will be naturally cross ventilated meeting the ADG requirements.

The number of naturally cross ventilation unit can be increased to 47 units if operable skylights are added to units A34 and B32.

APPENDIX A

List of Drawings and Cad Models

Name	Date modified	Type	Size
8578-3D.dwg	25-Mar-2019 12:3...	AutoCAD Drawing	9,388 KB
8578-Sheet - DA04 - BASEMENT PLAN.dwg	25-Mar-2019 12:3...	AutoCAD Drawing	1,095 KB
8578-Sheet - DA05 - GROUND LEVEL PLAN.dwg	25-Mar-2019 12:3...	AutoCAD Drawing	5,855 KB
8578-Sheet - DA06 - LEVEL 1 PLAN.dwg	25-Mar-2019 12:3...	AutoCAD Drawing	830 KB
8578-Sheet - DA07 - LEVEL 2 PLAN.dwg	25-Mar-2019 12:3...	AutoCAD Drawing	784 KB
8578-Sheet - DA08 - LEVEL 3 PLAN.dwg	25-Mar-2019 12:4...	AutoCAD Drawing	574 KB
8578-Sheet - DA09 - ROOF PLAN.dwg	25-Mar-2019 12:4...	AutoCAD Drawing	131 KB
8578-Sheet - DA10 - ELEVATION.dwg	25-Mar-2019 12:4...	AutoCAD Drawing	27,097 KB
8578-Sheet - DA11 - SECTION.dwg	25-Mar-2019 12:4...	AutoCAD Drawing	1,730 KB
Architectural drawings - 824-834 Forest Road, Peakhurst.pdf	18-Dec-2018 4:27 ...	PDF File	11,028 KB
Survey plan - 824-834 Forest Road, Peakhurst.pdf	10-Jul-2018 4:37 PM	PDF File	437 KB

APPENDIX B

Ventilation Method Summary

Apartment	Natural Ventilation Method
A01	
A02	Dual Aspect Apartment
A03	Dual Aspect Apartment
A04	
A05	
A06	
A07	Dual Aspect Apartment
A08	
A09	Dual Aspect Apartment
A10	
A11	Dual Aspect Apartment
A12	
A13	Dual Aspect Apartment
A14	Computational Fluids Dynamics analysis showed more than 3 air change per hour through the apartment taking into account 8 modelled wind directions
A15	Computational Fluids Dynamics analysis showed more than 3 air change per hour through the apartment taking into account 8 modelled wind directions
A16	
A17	Dual Aspect Apartment
A18	
A19	Dual Aspect Apartment
A20	Computational Fluids Dynamics analysis showed more than 3 air change per hour through the apartment taking into account 8 modelled wind directions
A21	Dual Aspect Apartment
A22	
A23	Dual Aspect Apartment
A24	Computational Fluids Dynamics analysis showed more than 3 air change per hour through the apartment taking into account 8 modelled wind directions
A25	Computational Fluids Dynamics analysis showed more than 3 air change per hour through the apartment taking into account 8 modelled wind directions
A26	
A27	Dual Aspect Apartment
A28	
A29	Dual Aspect Apartment
A30	Computational Fluids Dynamics analysis showed more than 3 air change per hour through the apartment taking into account 8 modelled wind directions
A31	Dual Aspect Apartment
A32	Dual Aspect Apartment
A33	Computational Fluids Dynamics analysis showed more than 3 air change per hour through the apartment taking into account 8 modelled wind directions
A34	
A35	Dual Aspect Apartment
A36	Dual Aspect Apartment
A37	Computational Fluids Dynamics analysis showed more than 3 air change per hour through the apartment taking into account 8 modelled wind directions

Apartment	Natural Ventilation Method
B01	Dual Aspect Apartment
B02	
B03	Dual Aspect Apartment
B04	
B05	
B06	Dual Aspect Apartment
B07	
B08	Dual Aspect Apartment
B09	
B10	Dual Aspect Apartment
B11	
B12	Dual Aspect Apartment
B13	Computational Fluids Dynamics analysis showed more than 3 air change per hour through the apartment taking into account 8 modelled wind directions
B14	
B15	Dual Aspect Apartment
B16	
B17	Dual Aspect Apartment
B18	
B19	Computational Fluids Dynamics analysis showed more than 3 air change per hour through the apartment taking into account 8 modelled wind directions
B20	Dual Aspect Apartment
B21	
B22	Dual Aspect Apartment
B23	Computational Fluids Dynamics analysis showed more than 3 air change per hour through the apartment taking into account 8 modelled wind directions
B24	
B25	Dual Aspect Apartment
B26	
B27	Dual Aspect Apartment
B28	
B29	Computational Fluids Dynamics analysis showed more than 3 air change per hour through the apartment taking into account 8 modelled wind directions
B30	Dual Aspect Apartment
B31	Dual Aspect Apartment
B32	
B33	Dual Aspect Apartment
B34	Dual Aspect Apartment
B35	Operable skylight

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