BALFOUR PLACE

Cross Ventilation Assessment

Prepared for:

Thirdi
343 pacific Hwy
North Sydney NSW 2060

SLR Ref: 610.30827.00000-R01
Version No: -v1.0
May 2022

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Thirdi (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
610.30827.00000-R01-v1.0	6 May 2022	Peter Hayman	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy

EXECUTIVE SUMMARY

SLR Consulting Pty Ltd (SLR) has been engaged by Thirdi to assess the natural ventilation potential for the proposed Cross Ventilation Assessment development known as Balfour Place in Lindfield. This report will combine a qualitative and quantitative assessment.

At least 60% of apartments are required to be 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.

Natural Ventilation Potential

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 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 can in some cases be achieved via building indentations. 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”

SLR has identified further apartments that could potentially achieve natural cross ventilation through utilising building slots and recesses with windows attached as well as confirming the ventilation potential of others. These were analysed using Computational Fluid Dynamics (CFD) numerical modelling.

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

- 62.7% (37 out of 59) of the apartments in the development will be naturally cross ventilated.

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1 Introduction

SLR Consulting Pty Ltd (SLR) has been engaged by Thirdi to undertake a natural ventilation assessment for the proposed development at 376-390 Pacific Highway and 1 Balfour Street in Lindfield. This report will use the combination of a qualitative review and a quantitative CFD assessment to assess the natural ventilation under the Apartment Design Guide (ADG).

This report will form part of the development application to Ku-ring-gai Council.

1.1 Development Site Location

The proposed site is located to the southwest side of the Pacific Highway at the corner of Balfour Street,

The surrounding area generally has residential housing to the west and the ground slopes downward in that direction. To the south along the Pacific Highway are commercial areas. There are also some newer low-medium rise developments on the eastern side of the trainline. Further afield is low level residential dwelling which are typical of the area.

Figure 1 Aerial View of Development Site

Image: Nearmap (April 2022)

1.2 Description of the Proposed Development

From the plans provided, the proposed development comprises the following features:

- Redevelopment of the current Coles Supermarket;
- Two levels of car parking;
- Coles Supermarket on the "Upper Ground" level with entrance from the Pacific Highway;
- Residential car park and apartments on Level 1;
- Apartments from levels one to four;
- Outdoor communal space on Level 2; and
- Rooftop terrace on Level 4.

Figure 2 Level 2 Floorplan

The objective of the ADG is to ensure that indoor air quality and thermal comfort is optimised, and reliance on mechanical ventilation reduced. The ADG provides design guidance to allow for effective cross ventilation well above the minimum ASHRAE or City of Sydney (Alternative natural ventilation of apartments in noisy environments) requirements.

SLR considers the 3 air changes per hour suitable to provide effective cross ventilation, reduce reliance on mechanical ventilation and satisfy the air quality requirements. The adopted air changes per hour in the current study is well above the minimum ASHRAE or City of Sydney requirements

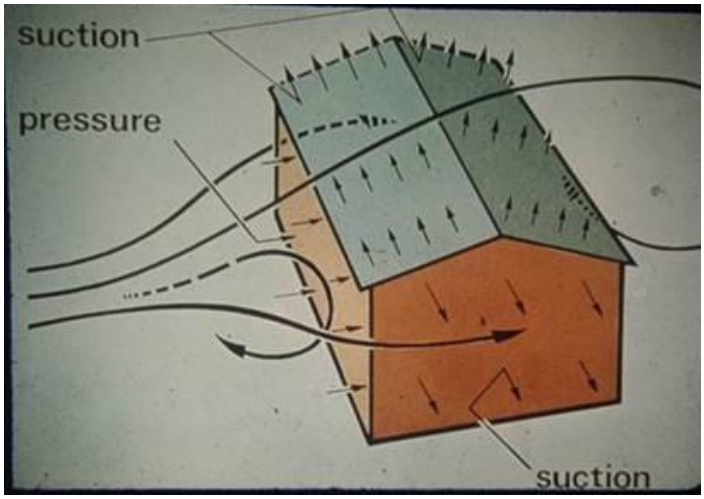
2 General Principles

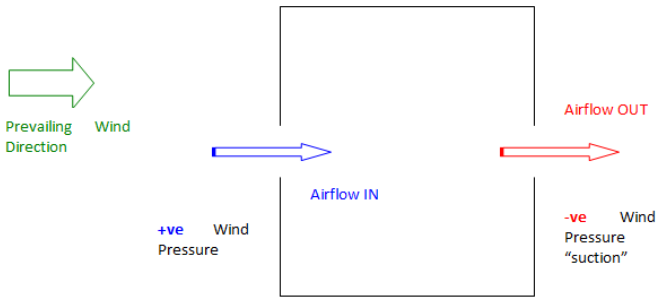
A key feature of the proposed development is the incorporation of façade openings designed to enable various spaces within the development buildings to make use of wind–induced natural ventilation throughout the year thereby minimising energy costs.

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, e.g. 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 positive to negative.

The resulting amount of airflow through the building envelope will be a function of the magnitude of the pressure differential, the 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 Qualitative Assessment

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

For the qualitative assessment SLR used the plans and model dated the 23rd February 2022, prepared by Rothe Lowman Architects. From an initial review of the plans SLR has made the following comments.

- 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 some single aspect apartments can be achieved via building indentations. 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"
- Based on a qualitative review of the architectural plans and numerical modelling experience with many similar developments, SLR is of the opinion that the current design scheme is capable of providing natural ventilation to 55.9% of the apartments in the first nine levels.

3.1 Qualitative Results

Table 1 Apartments with Openings to Support Natural Ventilation

Level	Number of Apartments	No. Apartments Cross Ventilated (Qualitative)	Total (%)	Possible Apartments to be Quantitively assessed (CFD)
Level 1	10	3	30.0%	
Level 2	21	10	47.6%	2
Level 3	21	14	66.7%	2
Level 4	7	6	85.7%	
Total	59	33	55.9%	4

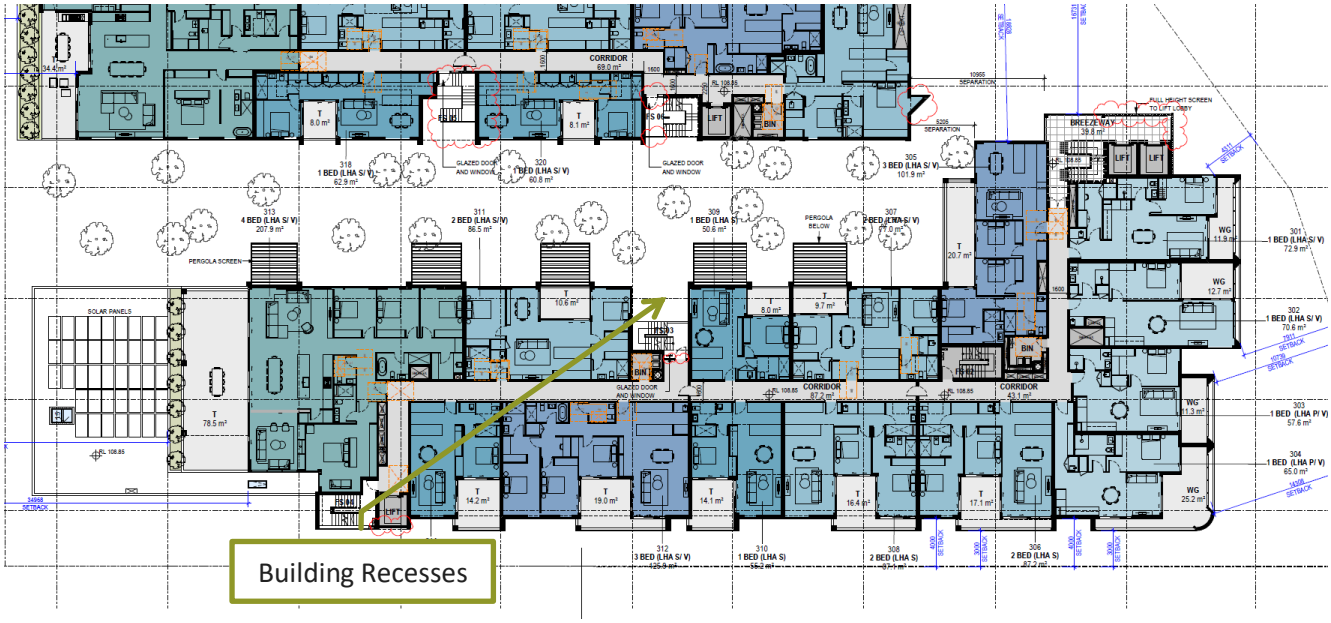
Some apartments achieve dual aspect via skylights which have been assumed to be operable. These apartments are identified in Appendix B

4 Quantitative CFD Assessment

Some of the units in the development have windows facing slots and recesses. To be passed qualitatively the ADG requires that these indentations have a width to depth ratio of 2:1 or 3:1 which is not the case for this development. From experience SLR has found that numerical solutions including Computational Fluid Dynamics (CFD) and wind tunnel studies can prove these apartments to provide appropriate through apartment ventilation and circulation, for natural ventilation requirements.

SLR has been asked to assess the apartments that connect to the “slots” of each building. The locations of which are shown in **Figure 4**.

Figure 4 Slots and Recesses



This included units 207, 210, 309 and 311.

Some apartments on the northeast end of the building have also been assessed as they have parts that protrude from the main bulk of the building and while they appear to be dual aspect, they have been modelled to confirm adequate ventilation. These included units 101, 201, 202, 301, 302 and 401.

A detailed computer model of the development was created using the Architectural Drawings supplied. Apartments on the Level 1, Level 2, Level 3 and Level 4 were included for detailed numerical assessment. The Computational Fluid Dynamics (CFD) specialised software FLUENT was used to model the following wind directions.

- North east
- South east
- South
- South West
- West
- North West

In each case a wind speed of 1.66 m/s was used at 10 m high. Based on actual wind data across 11 years, the average wind speed measured at Sydney Olympic Park is higher than 2 m/s 69% of the time. The site is numerical modelling results in this study are therefore conservative and the volume of cross ventilation will likely increase with increasing approaching wind speeds. The distance between the Sydney Olympic park and the project site is 12 km.

Higher wind speeds are measured at Sydney Airport. Based on actual wind data across 18 years, the average wind speed measured at Sydney Airport is higher than 2 m/s 93.7% of the time. The distance between the Sydney Airport and the project site is 18 km.

The project site has local winds characteristics closer to Sydney Olympic Park, given the project distance inland from the coast.

Simple blocks were used for nearby surrounding buildings to include the impact of the surroundings on the natural ventilation for the proposed building. All velocities in the images are in metres per second and the simulation results are presented at a height of 1.5 metres above the floor level. This height is indicative only to show the flow around the apartment. SLR uses the modelled speeds to check there is at least three air changes per hour for each apartment.

4.1 CFD Results

SLR deems an apartment to have adequate natural ventilation if it shows reasonable airflow for four of the six wind directions tested. Reasonable flow means the apartment has airflow of at least three air changes per hour and shows flow from room to room without short circuiting.

The CFD results are detailed in **Appendix A** and summarised in the following tables.

Table 2 Air Changes per Hour

Tested Apartment	North East Winds	South East Winds	South Winds	South West Winds	West Winds	North West Winds	Overall Result
U101	11.1	14.0	14.0	3.1	3.1	6.0	**PASS**
U201	11.9	10.7	6.4	3.0	4.6	5.2	**PASS**
U202	8.8	7.5	5.6	7.1	4.1	1.4	**PASS**

Tested Apartment	North East Winds	South East Winds	South Winds	South West Winds	West Winds	North West Winds	Overall Result
U207	8.7	5.7	4.4	8.6	6.6	7.4	**PASS**
U210	8.2	3.3	9.2	7.5	6.2	4.0	**PASS**
U301	14.7	14.9	3.4	4.8	5.2	5.2	**PASS**
U302	7.5	7.5	4.8	5.4	1.4	0.8	**PASS**
U309	7.8	5.6	10.3	15.4	14.4	6.9	**PASS**
U311	8.9	3.0	13.4	11.7	18.6	4.5	**PASS**

5 Overall Natural Ventilation Results

SLR modelled units on the Level 1, Level 2, Level 3 and Level 4. The overall results are summarised in **Table 3**.

The following conclusions have been reached based on both the qualitative and quantitative numerical modelling results:

- 62.7% (37 out of 59) of the apartments will be naturally cross ventilated, thereby meeting the ADG requirements.

Table 3 Apartments with Openings to Support Natural Ventilation

Level	Number of Apartments	No. Apartments Cross Ventilated (Qualitative)	Additional Apartments from Building slots (CFD)	Combined Total	Combined Total (%)
Level 1	10	3	0	3	30.0%
Level 2	21	10	2	12	57.1%
Level 3	21	14	2	16	76.2%
Level 4	7	6	0	6	85.7%
Total	59	33	4	37	62.7%

6 Feedback

At SLR, we are committed to delivering professional quality service to our clients. We are constantly looking for ways to improve the quality of our deliverables and our service to our clients. Client feedback is a valuable tool in helping us prioritise services and resources according to our client needs.

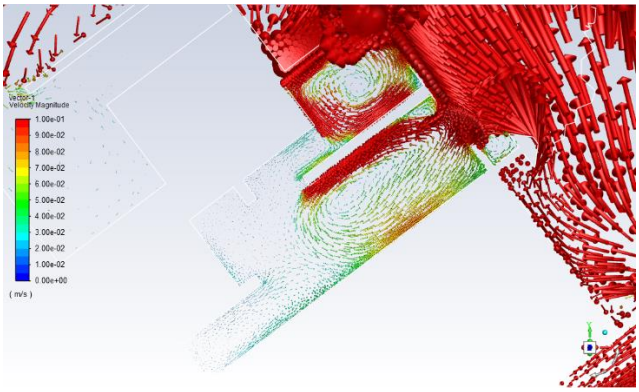
To achieve this, your feedback on the team's performance, deliverables and service are valuable and SLR welcome all feedback via hiips://www.slrconsulting.com/en/feedback . We recognise the value of your time and we will make a $10 donation to our 2022 Charity Partner – Lifeline, for every completed form.

APPENDIX A

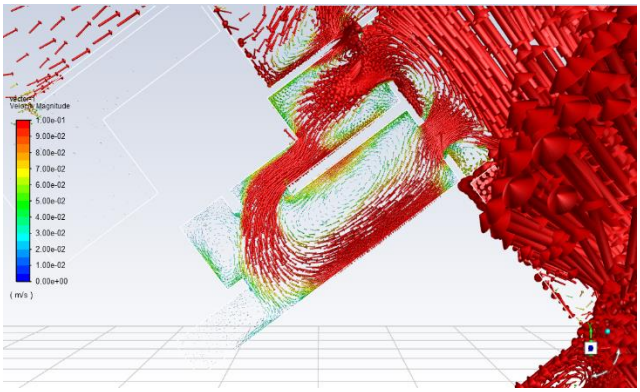
Vector Flow Diagrams

Red areas indicate speeds at or above 0.1 m/s

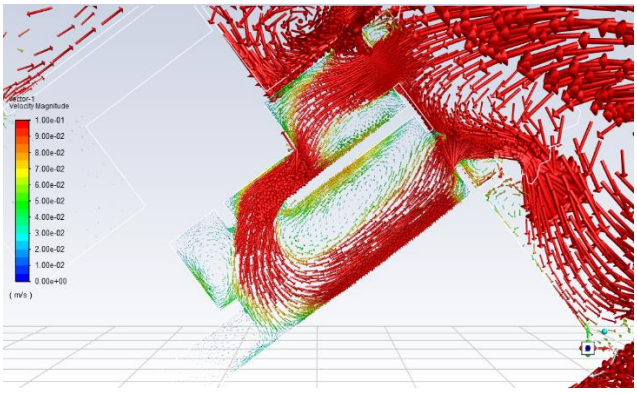
Level 1



North East



South East



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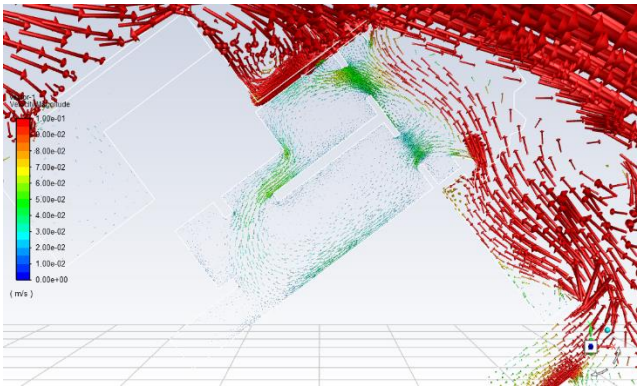

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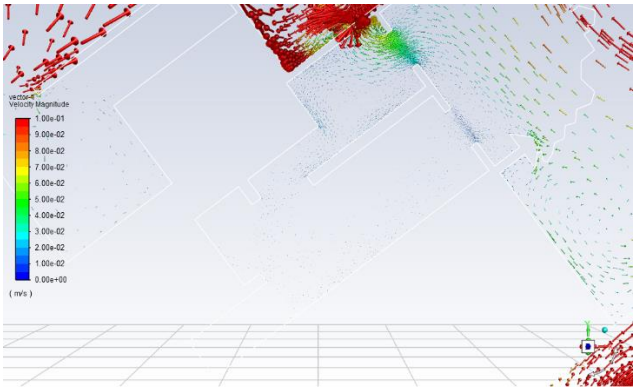
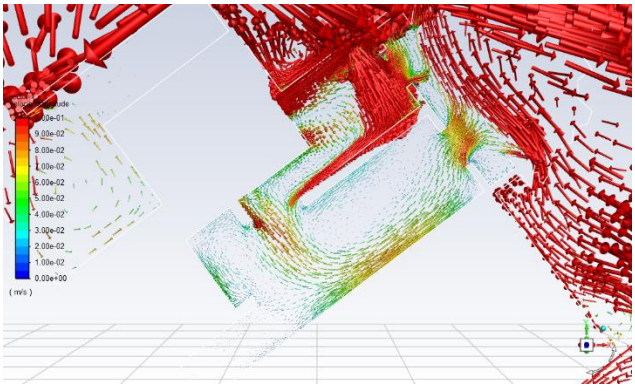
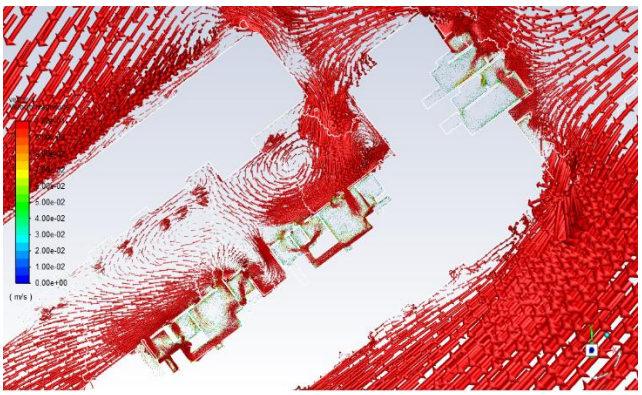


West



North West

Level 2



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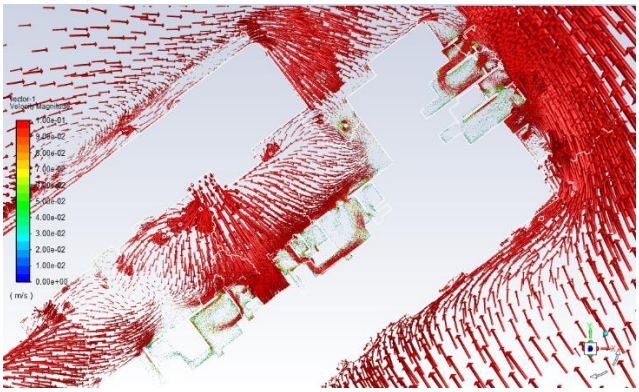

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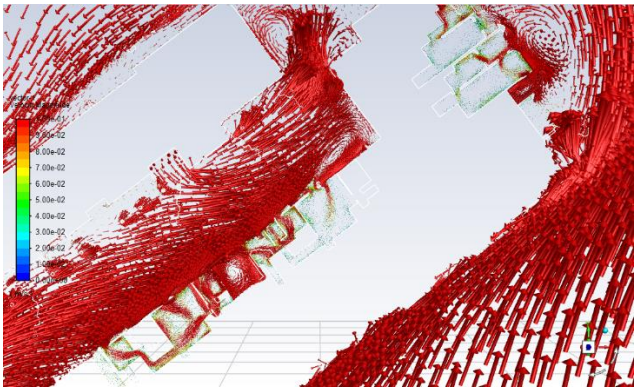
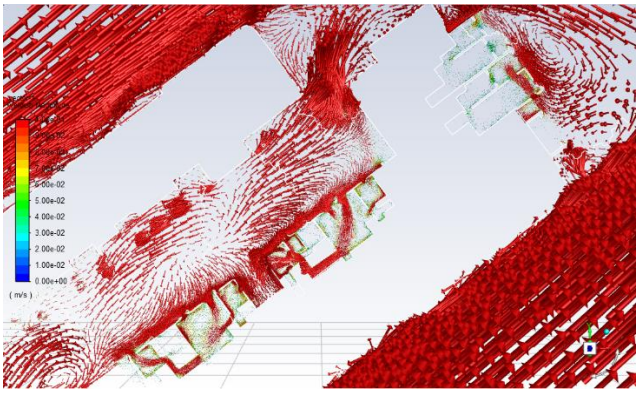


South



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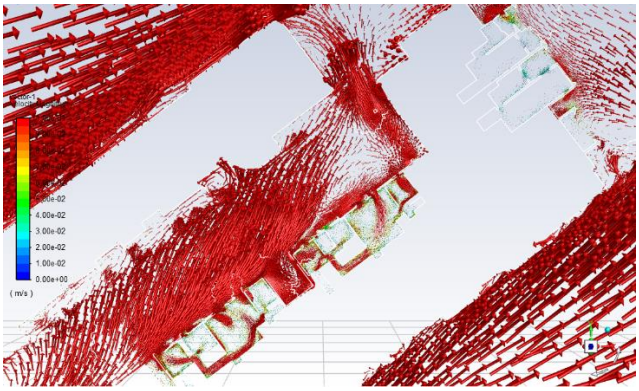

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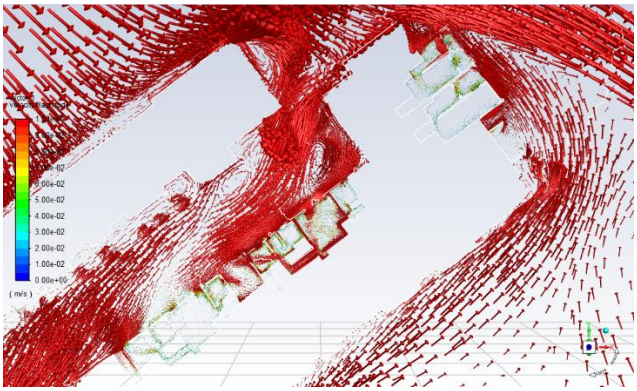
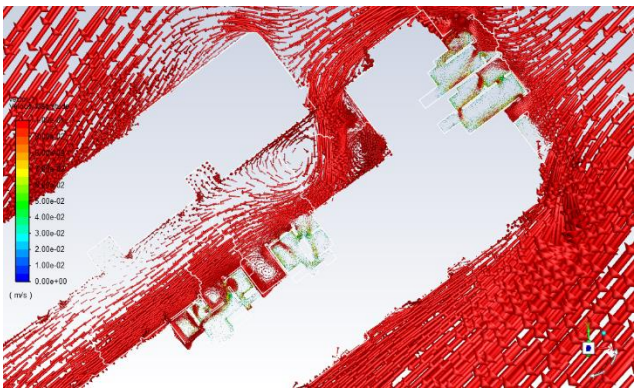


North West

Level 3



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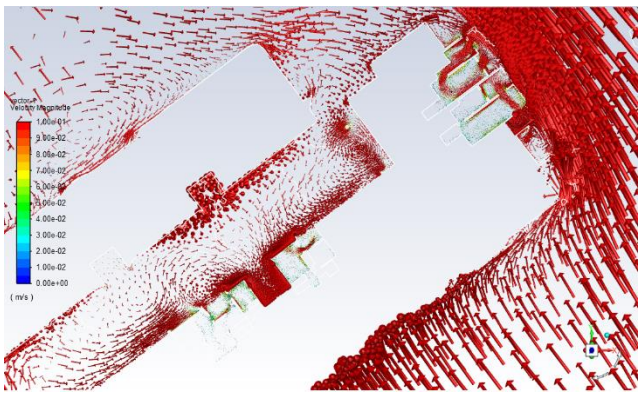

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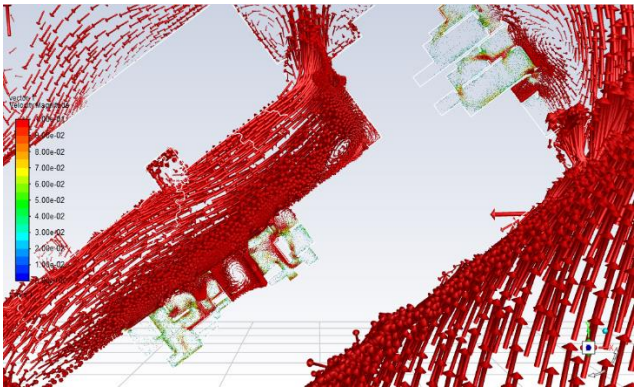

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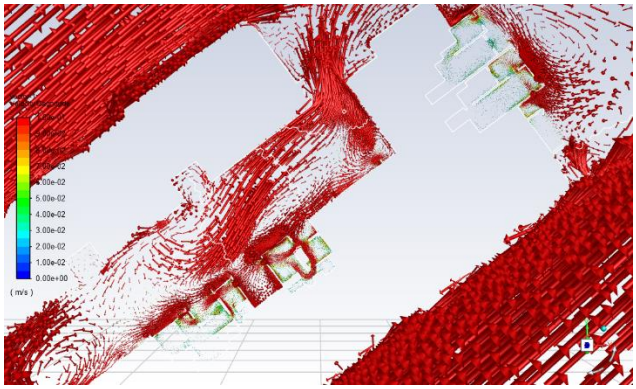

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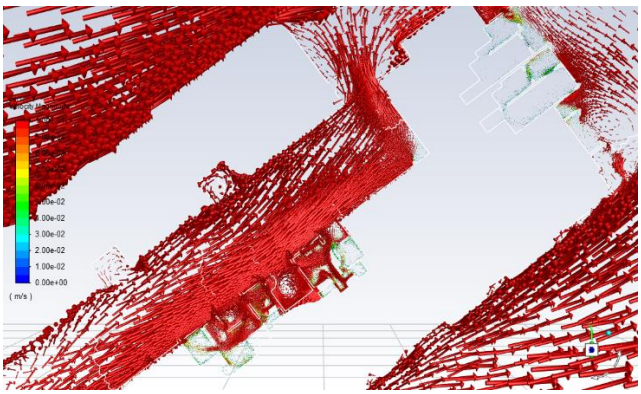

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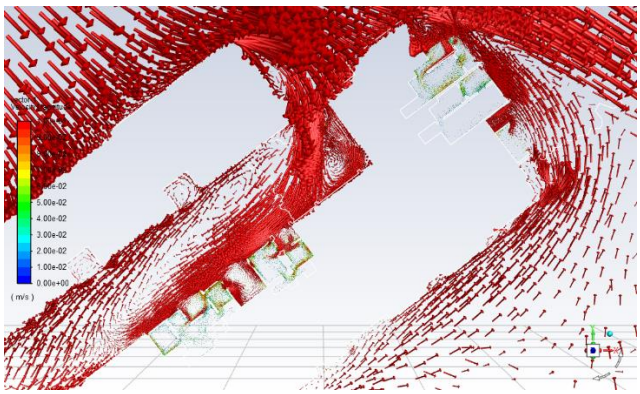
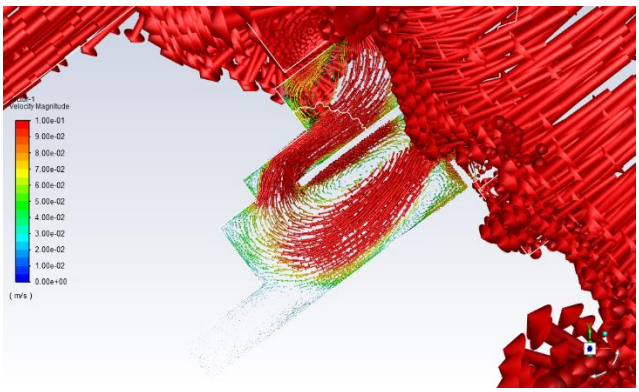


North West

Level 4



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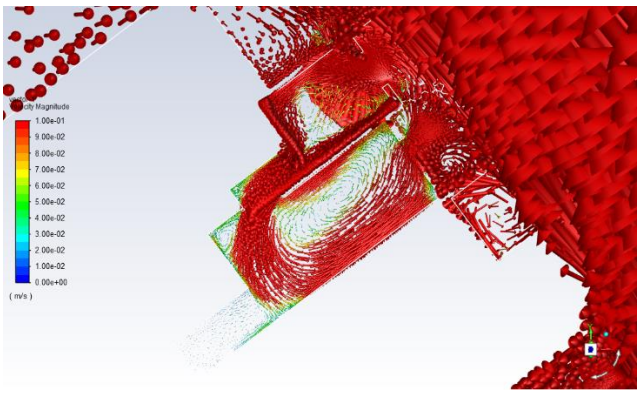

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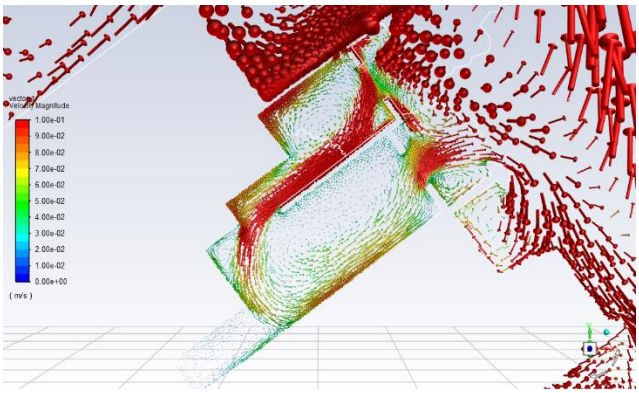

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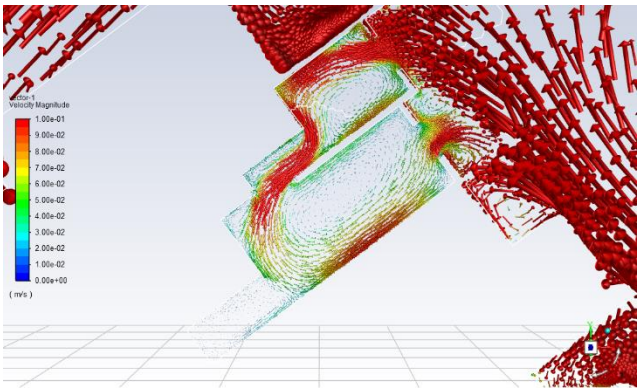

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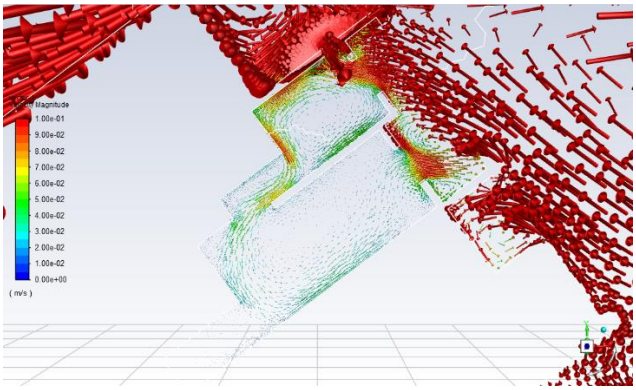

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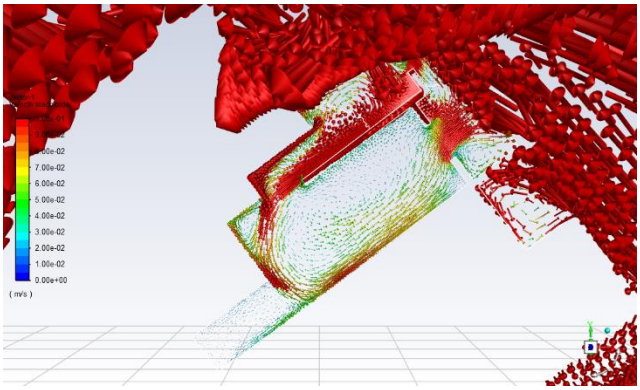

North West

APPENDIX B

Unit Passing Method

Level G	Passing Method	Level 1	Passing Method	Level 2	Passing Method	Level 3	Passing Method	Level 4	Passing Method
		101	Dual Aspect	201	Dual Aspect	301	Dual Aspect	401	Dual Aspect
		102		202	Dual Aspect	302	Dual Aspect	402	
		103		203		303		403	Skylight
		104	Dual Aspect	204	Dual Aspect	304	Dual Aspect	404	Dual Aspect
		105		205	Dual Aspect	305	Dual Aspect	405	Dual Aspect
		106		206		306		406	Dual Aspect
		107		207	Pass via CFD	307	Skylight	407	Dual Aspect
		108		208		308	Skylight		
		109		209		309	Pass via CFD		
		110	Dual Aspect	210	Pass via CFD	310	Skylight		
				211		311	Pass via CFD		
				212		312			
				213		313	Dual Aspect		
				214		314			
				215	Dual Aspect	315	Dual Aspect		
				216	Dual Aspect	317	Skylight		
				217	Dual Aspect	318	Skylight		
				220	Dual Aspect	319	Skylight		
				222	Dual Aspect	320	Skylight		
				223		321			
				224	Dual Aspect	322	Dual Aspect		

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