Detaljplan för Sätra centrum
i stadsdelen Sätra i Stockholm

Sätra Centrum Fastigheter AB

Vindstudie

Samrådshandling
Dnr 2018-15976

Stockholm 20-02-21

Inkom till Stockholms stadsbyggnadskontor - 2020-03-30, Dnr 2018-15976

Vindstudie

Samrådshandling detaljplan Sätra centrum

Datum 20-02-21
Uppdragsnummer 1320040556-0114
Utgåva/Status 1

Observera att vindstudien bygger på tidigare underlag och kompletteras vid behov efter samråd.

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Unr 1320040556-011 Organisationsnummer 556133-0506

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SÄTRA CENTRUM
PEDESTRIAN LEVEL WIND ASSESSMENT

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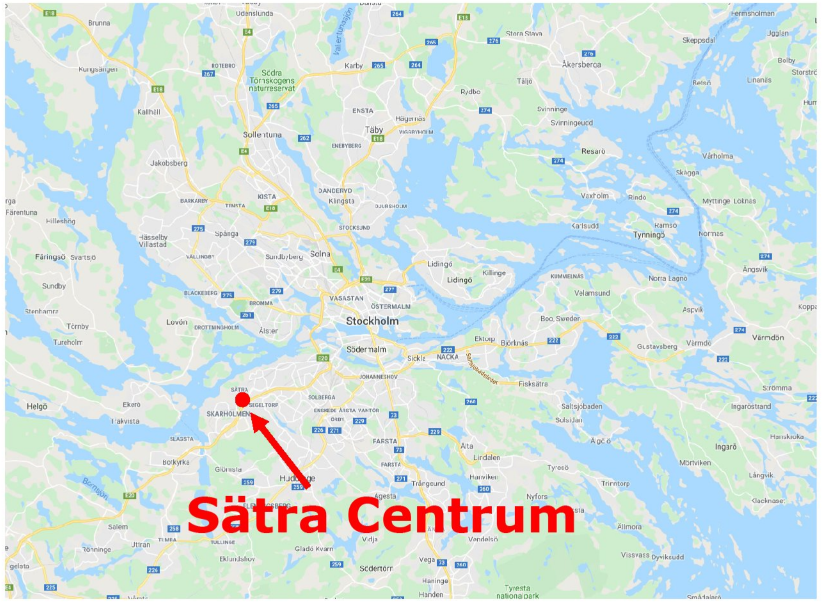
DRAFT

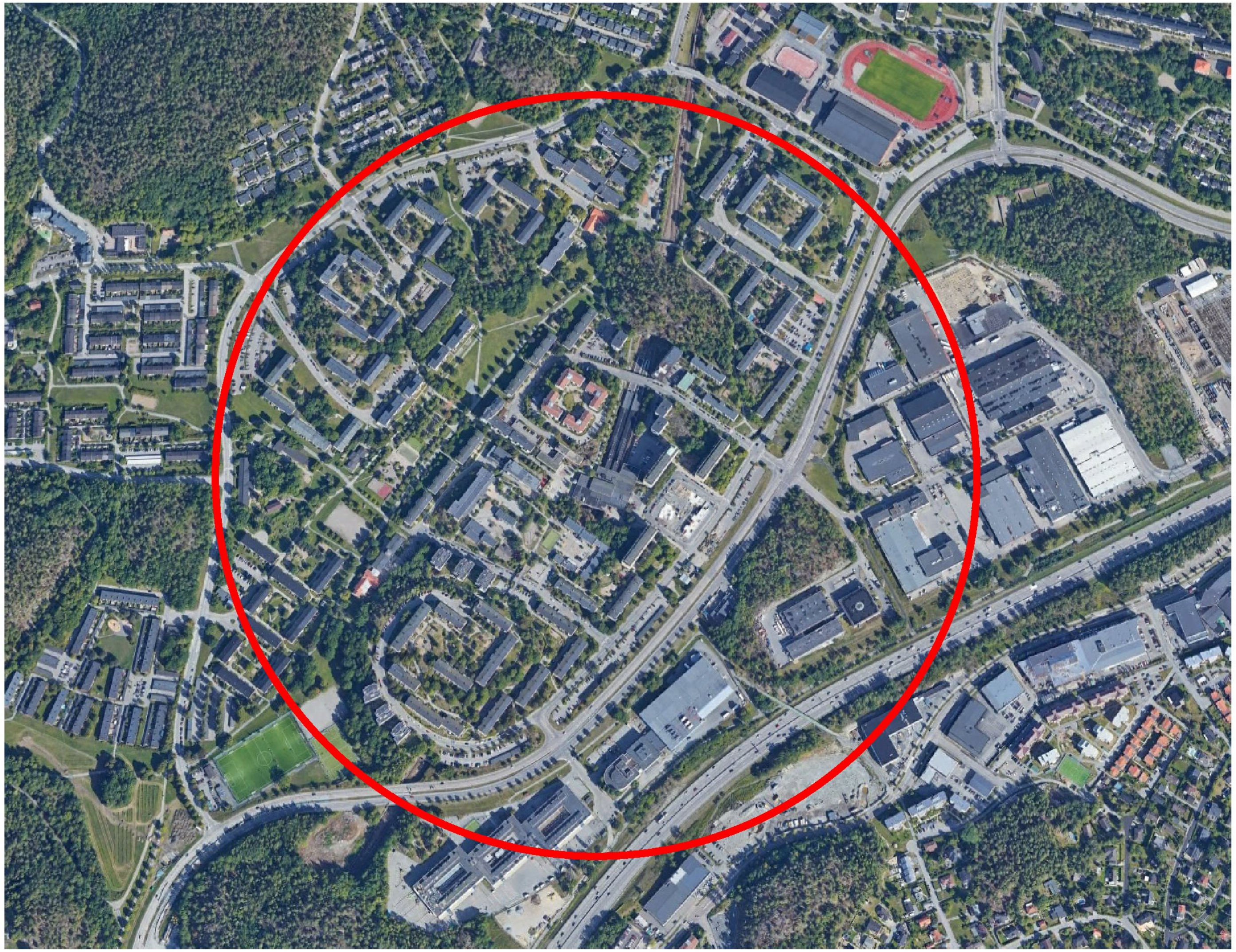
S. CAPRA – J.C. BENNETSEN

01/11/2019

RAMBOLL Bright ideas. Sustainable change.

THE SITE: SÄTRA CENTRUM





- Re-development of Sätra Centrum
- The existing Sätra Centrum main building is planned to be demolished and replaced with a main square surrounded by mixed used buildings with commercial and retail space at lower level and housing on the upper level

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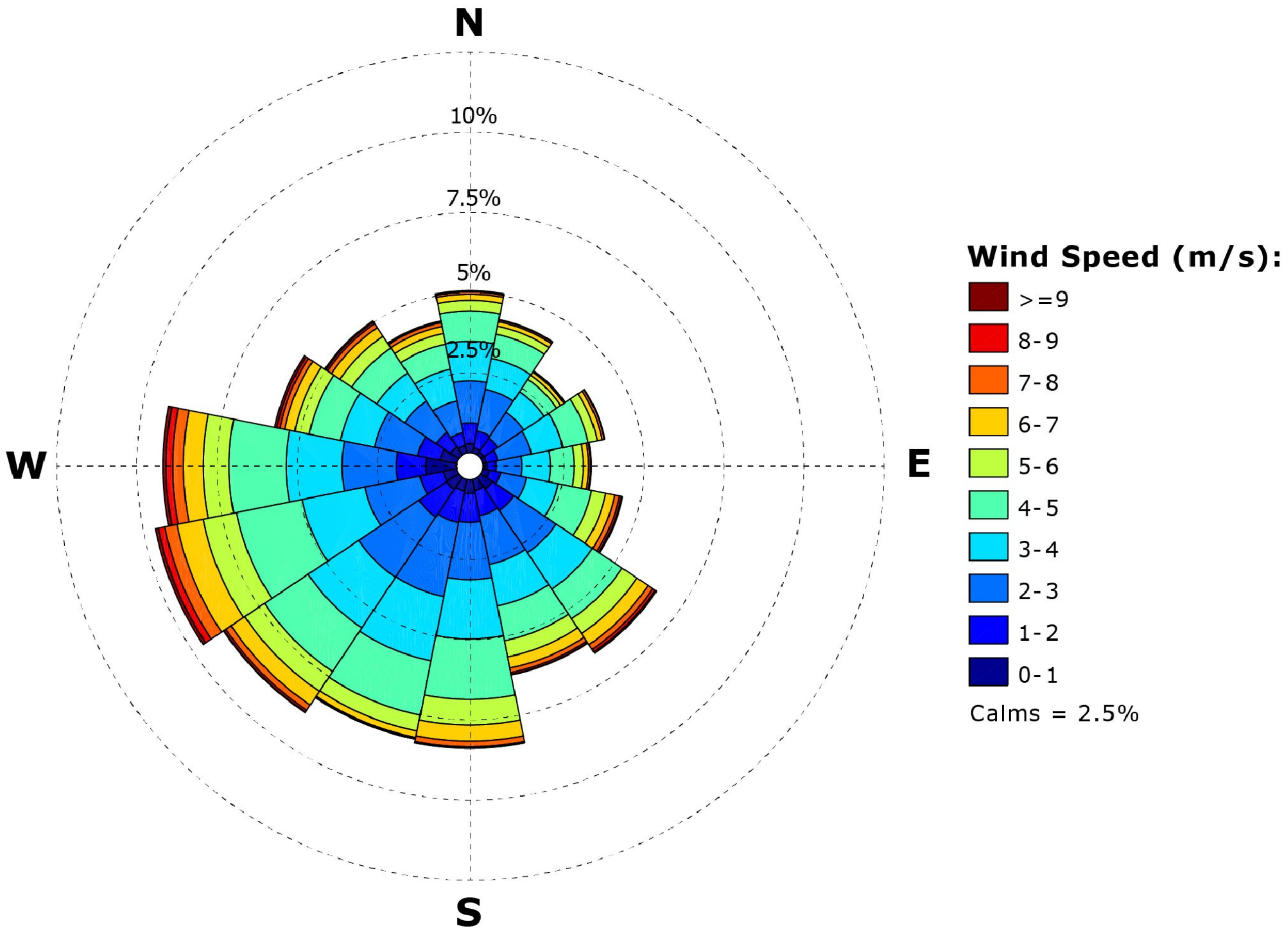
THE WIND ENVIRONMENT: BROMMA AIRPORT

Map

- Wind statistics based on 15 years of wind data recorded at the Bromma Stockholm Airport.
- The dataset has been obtained from NOAA NCDC climatic data service, DS3505

Annual Wind Rose



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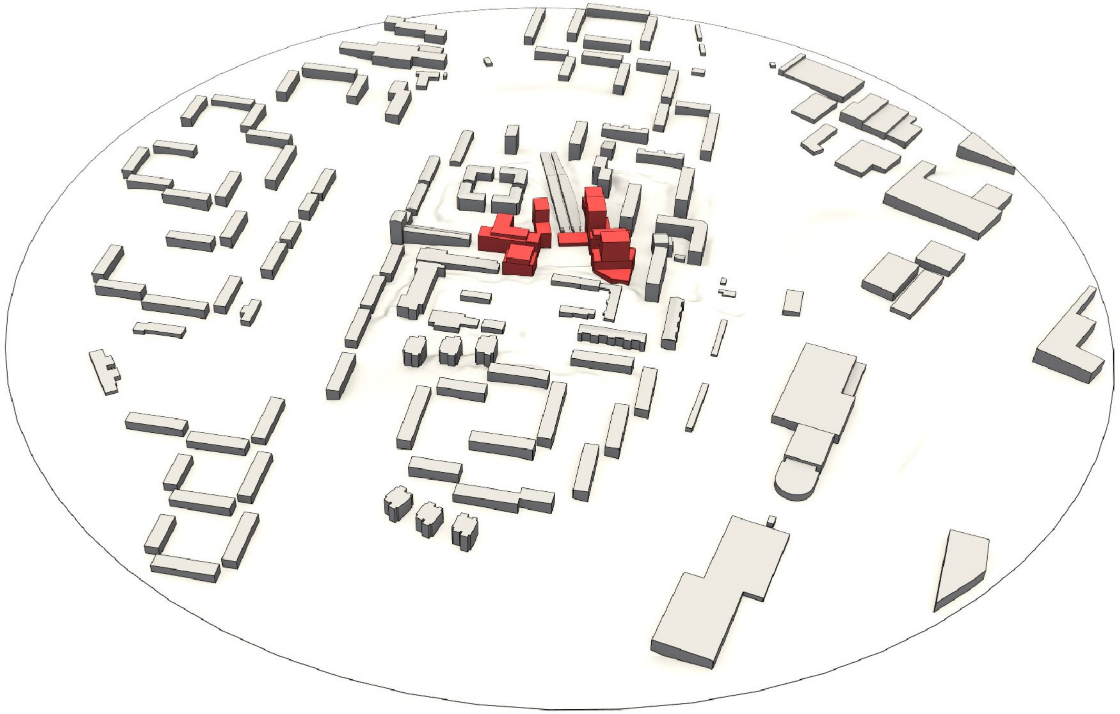
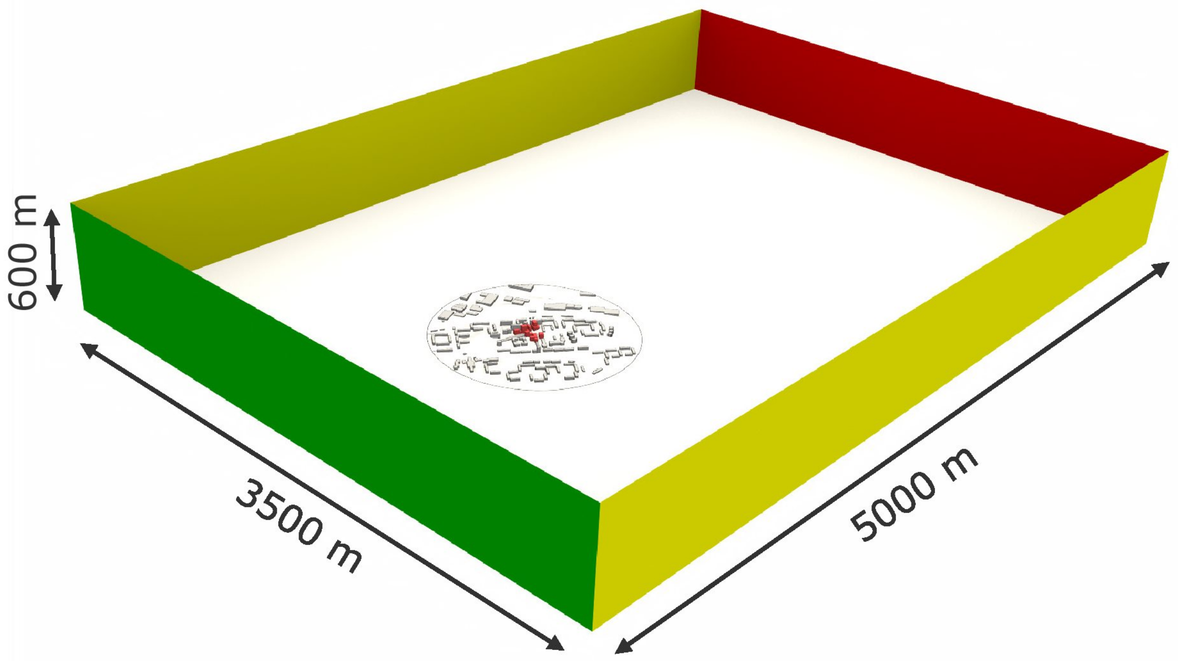
CFD MODEL

CFD Model Detail



- Surroundings explicitly modelled within 500m radius
- Wall functions used in the far field
- Trees and vegetation ignored, prudent to approach according to industry standards

CFD Model Extent



Blockage Ratio < 3%

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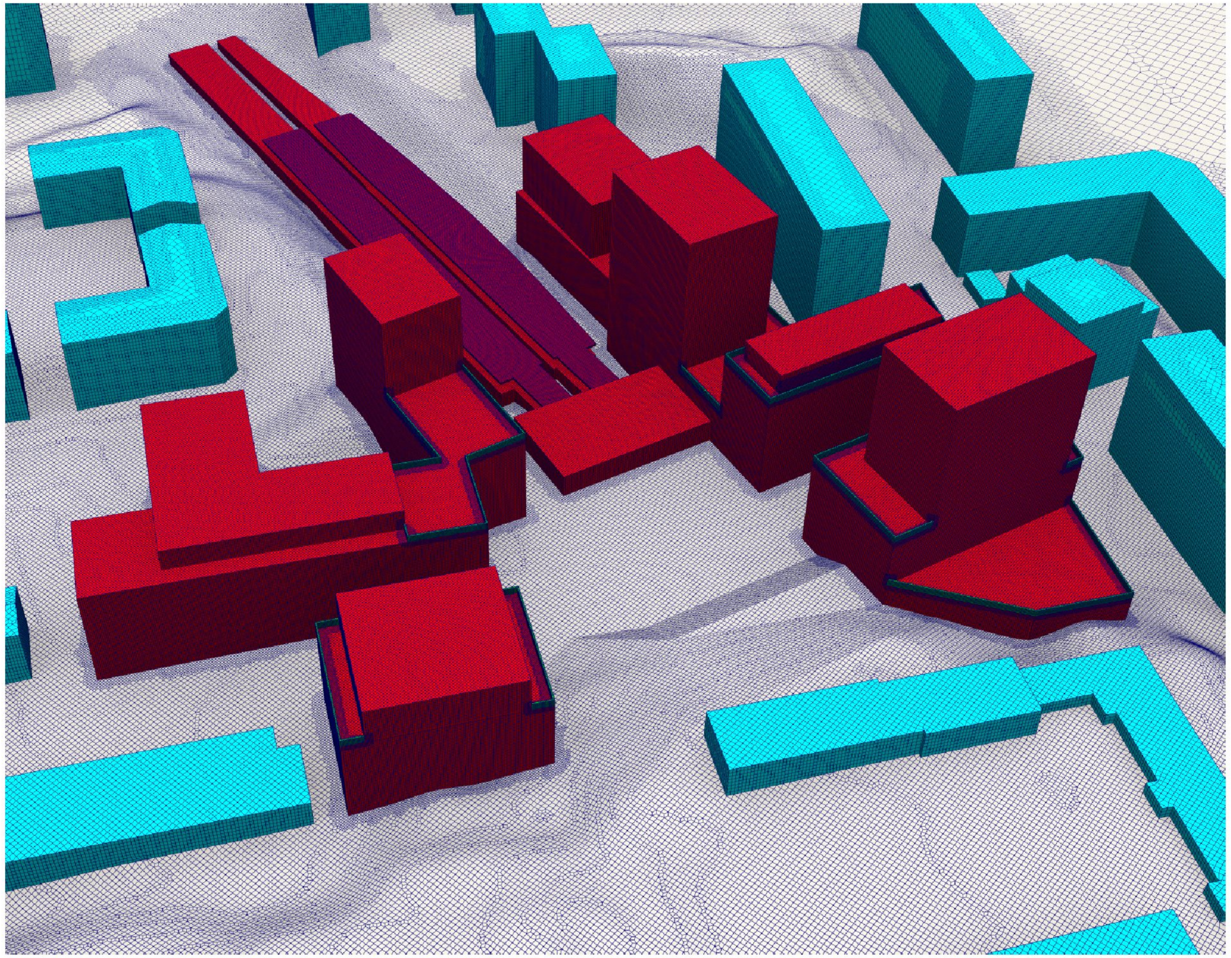
CFD MESH AND SETTINGS



MESH SETTINGS :

- Mesh size: approx. 24M Cells
- 4 Prism Layers on all the surfaces
- Minimum of 3 prism layers below 1.5m
- More than 10 cells used across all the relevant narrow passages

SOLVER SETTINGS:

- Steady state simulation
- SIMPLE algorithm, consistent formulation
- Realizable k-ε turbulence model
- Second order discretization schemes
- Solver: Engys Helyx v3.1.1
- Convergence monitored using both the simulation residuals and velocity probes

RAMBOLL

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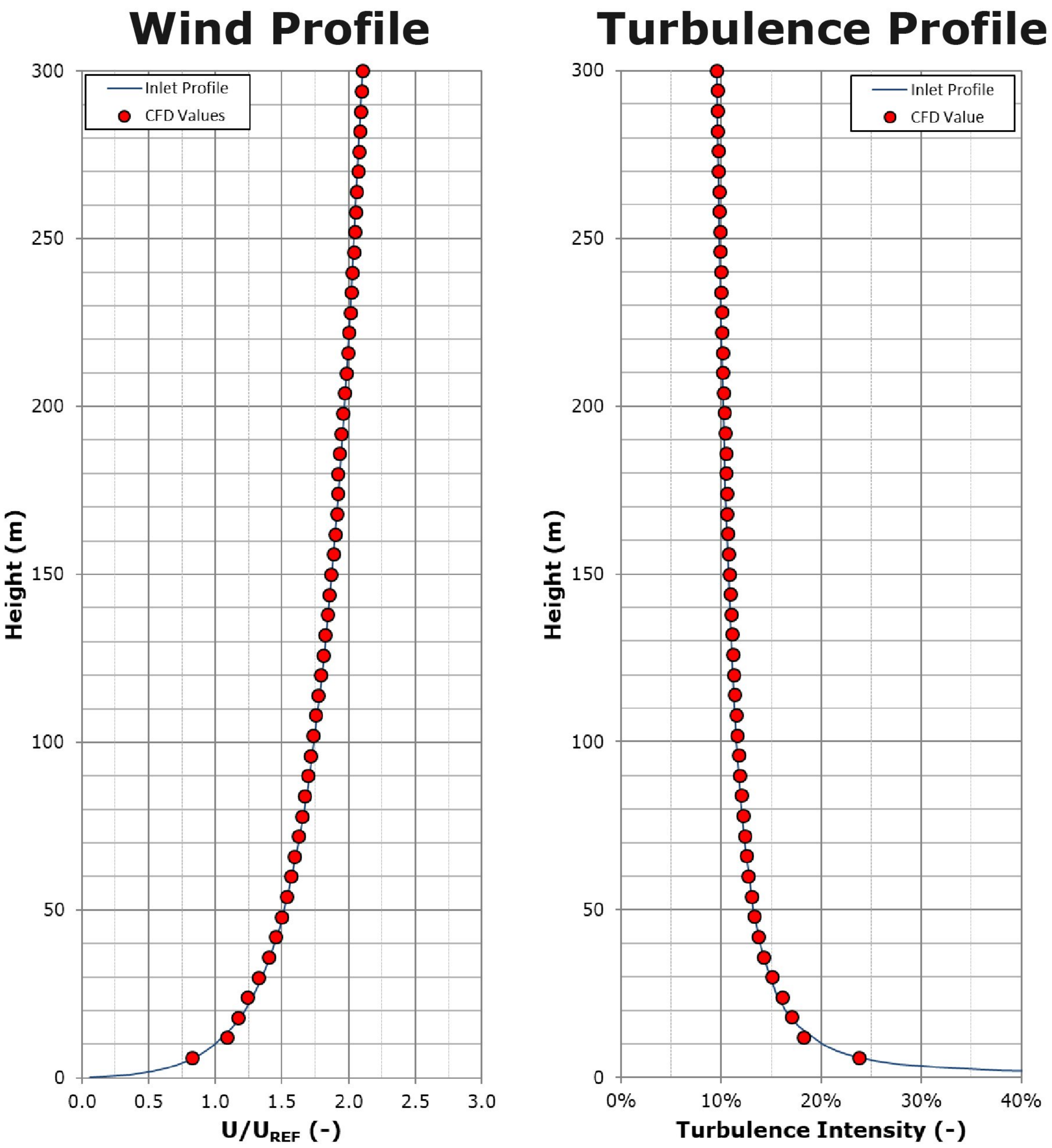
INFLOW CONDITIONS

INFLOW CONDITIONS:

- Neutral logarithmic mean wind speed profile
- Turbulent inlet quantities values set according to Richards and Hoxey recommendations
- Aerodynamic roughness length chosen in order to represent the surroundings of the site (suburban area)
- Mesh and wall functions settings appropriately tuned in order to preserve the desired velocity and turbulent profile up to the area of the CFD domain where the buildings have been explicitly modelled
- The image on right shows a comparison between the desired profiles and the ones achieved in the simulation



RAMBOLL

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WIND COMFORT AND SAFETY STANDARD: NEN8100

- The wind comfort and safety condition on site has been assessed using CFD
- A single simulation has been run for each one of the 16 wind directions representing the whole wind rose
- Wind statistics from Stockholm Bromma Airport have been combined with the CFD data in order to predict the annual probability of exceedance of a given Gust Equivalent Mean (GEM) wind speed
- The full-scale wind predictions have been evaluated with the NEN8100 Dutch standard for pedestrian comfort and safety

WIND COMFORT:

Percentage of Time GEM > 5 m/s	Quality Category	Traversing	Strolling	Sitting
< 2.5%	A	Good	Good	Good
2.5 - 5%	B	Good	Good	Moderate
5 – 10%	C	Good	Moderate	Poor
10 – 20%	D	Moderate	Poor	Poor
> 20%	E	Poor	Poor	Poor

RAMBOLL

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WIND COMFORT AND SAFETY STANDARD: NEN8100

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WIND SAFETY:

Percentage of Time GEM > 15 m/s	Quality Category
< 0.05%	No Risk
0.05-0.3%	Limited Risk
> 0.3%	Dangerous

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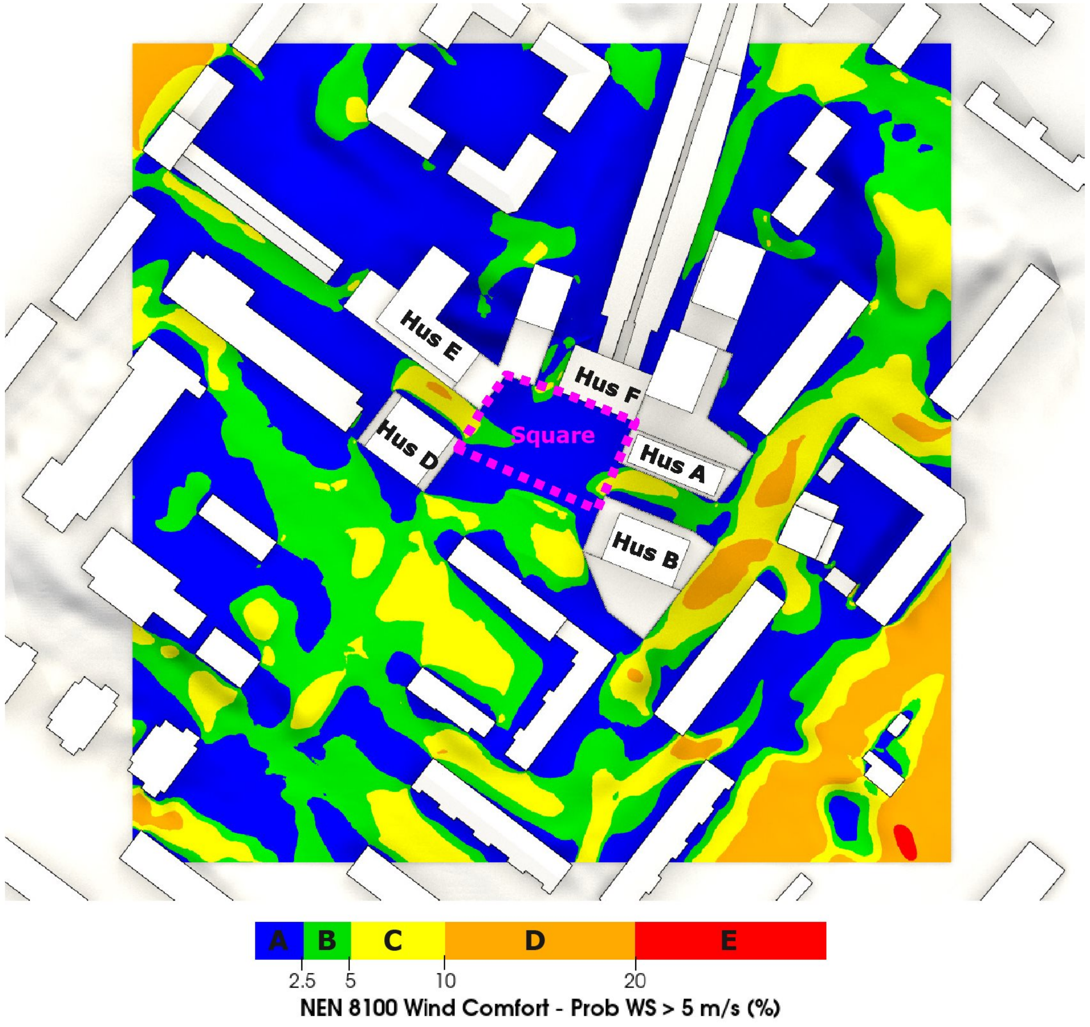
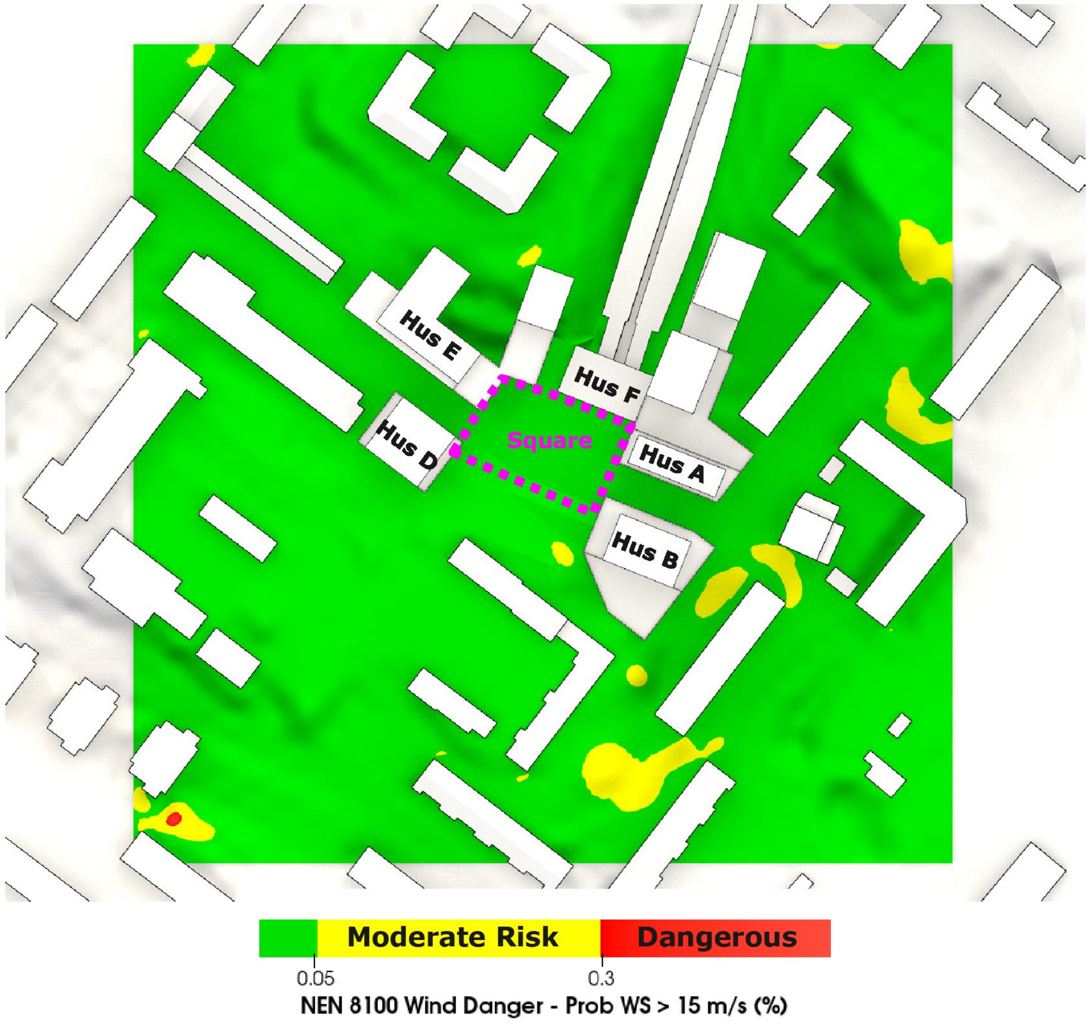
WIND COMFORT AND SAFETY STANDARD:
PEDESTRIAN LEVEL – PLANE 1.5M ABOVE GROUND

Wind Comfort



Wind Safety



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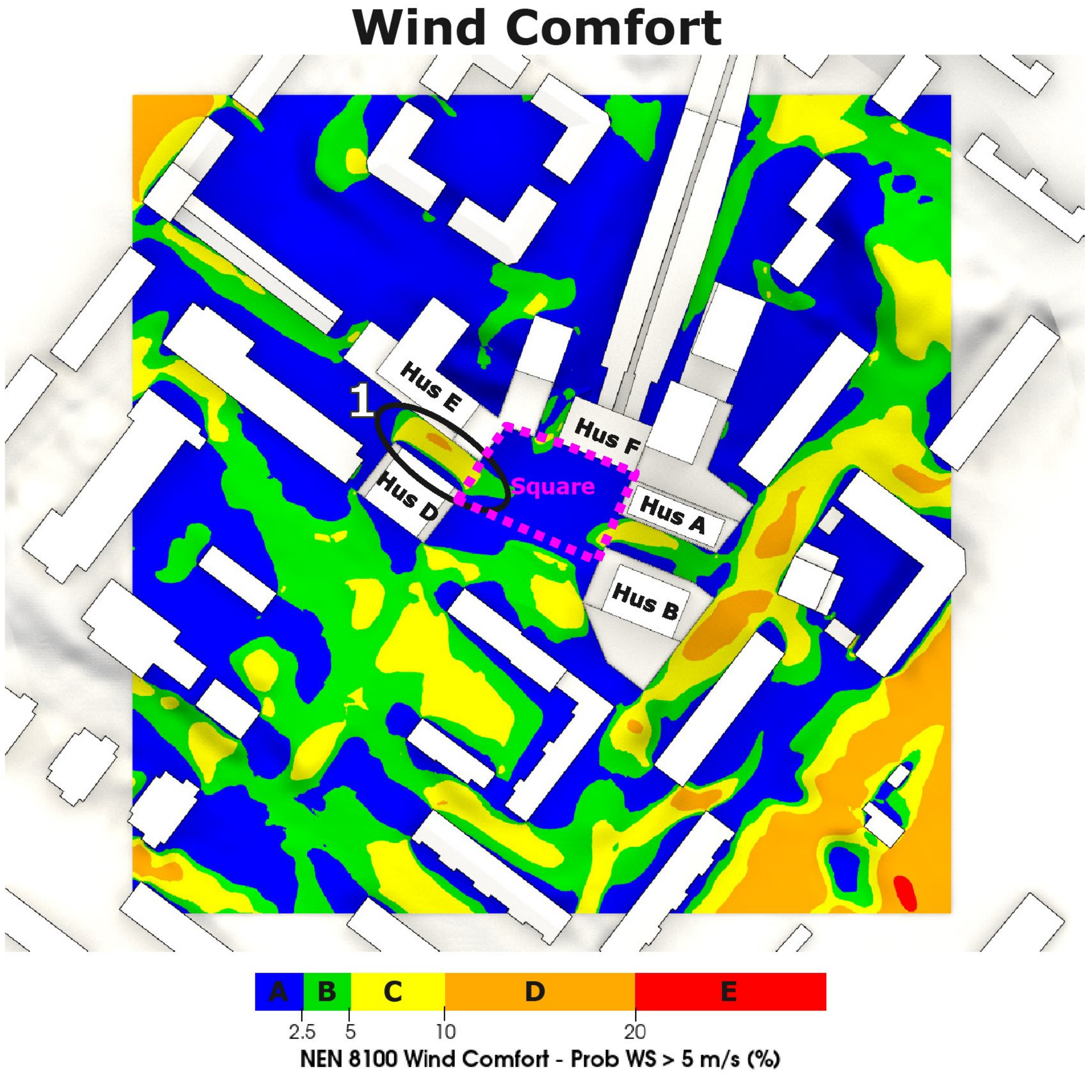
WIND COMFORT COMMENTS:
PEDESTRIAN LEVEL – PLANE 1.5M ABOVE GROUND



The wind comfort assessment at pedestrian level does not highlight uncomfortable areas, and the majority of the square appears to be suitable for long term activities. However, the local wind conditions achieved in some areas of the new development might not be suitable for the intended pedestrian activity.

1) Wind channelling between Hus D and Hus E:

The wind comfort levels are still suitable for short term activities like strolling and fast walking. If some long term activities are expected to happen in this area, for example sitting on benches, local wind mitigation strategies should be implemented. It is however recommended to design a wind mitigation strategy to alleviate the wind conditions in the area ranking as category D.

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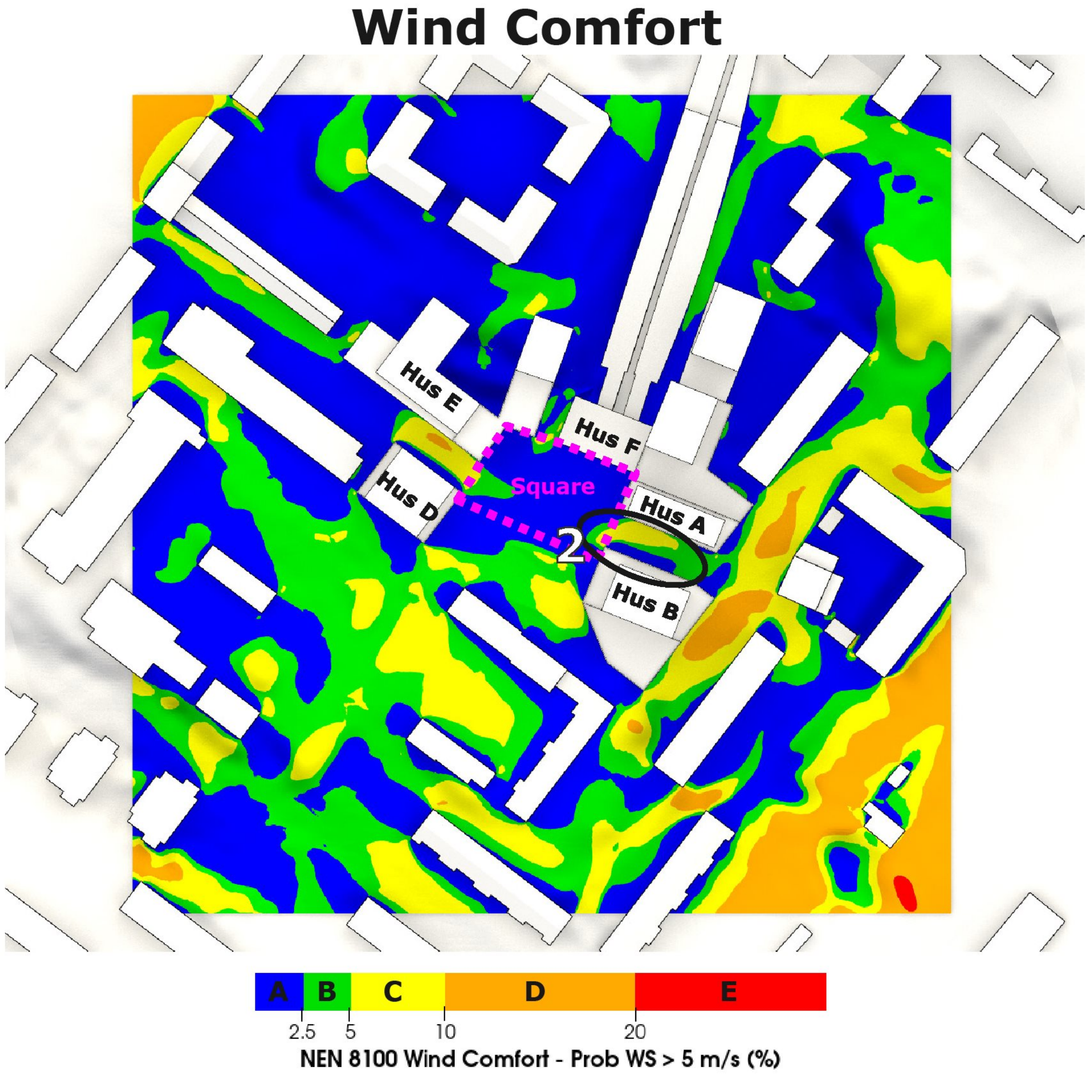
WIND COMFORT COMMENTS: PEDESTRIAN LEVEL – PLANE 1.5M ABOVE GROUND



The wind comfort assessment at pedestrian level does not highlight uncomfortable areas, and the majority of the square appears to be suitable for long term activities. However, the local wind conditions achieved in some areas of the new development might not be suitable for the intended pedestrian activity.

2) Wind channelling between Hus A and Hus B:

The wind comfort levels are still suitable for short term activities like strolling and fast walking. If some long term activities are expected to happen in this area, for example sitting on benches, local wind mitigation strategies should be implemented.

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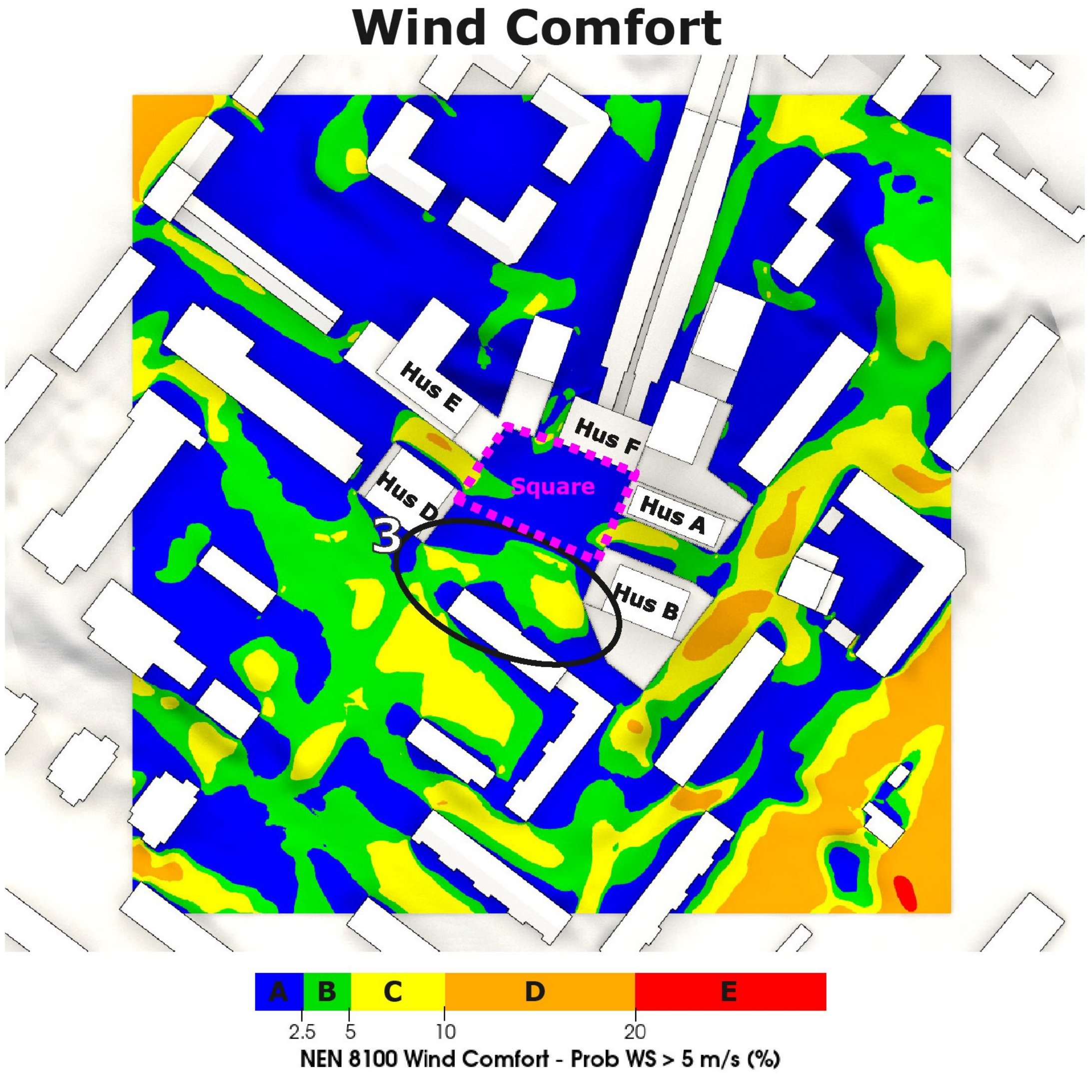
WIND COMFORT COMMENTS: PEDESTRIAN LEVEL – PLANE 1.5M ABOVE GROUND



The wind comfort assessment at pedestrian level does not highlight uncomfortable areas, and the majority of the square appears to be suitable for long term activities. However, the local wind conditions achieved in some areas of the new development might not be suitable for the intended pedestrian activity.

3) Wind accelerating between Hus B-D and Sätraskolan:

The wind comfort levels are still suitable for short term activities like strolling and fast walking. If some long term activities are expected to happen, in particular on the stairs, local wind mitigation strategies should be implemented. The slope and steps in this area can potentially make it more sensitive to high wind speeds. It is therefore recommended to mitigate all the areas ranking category as C.

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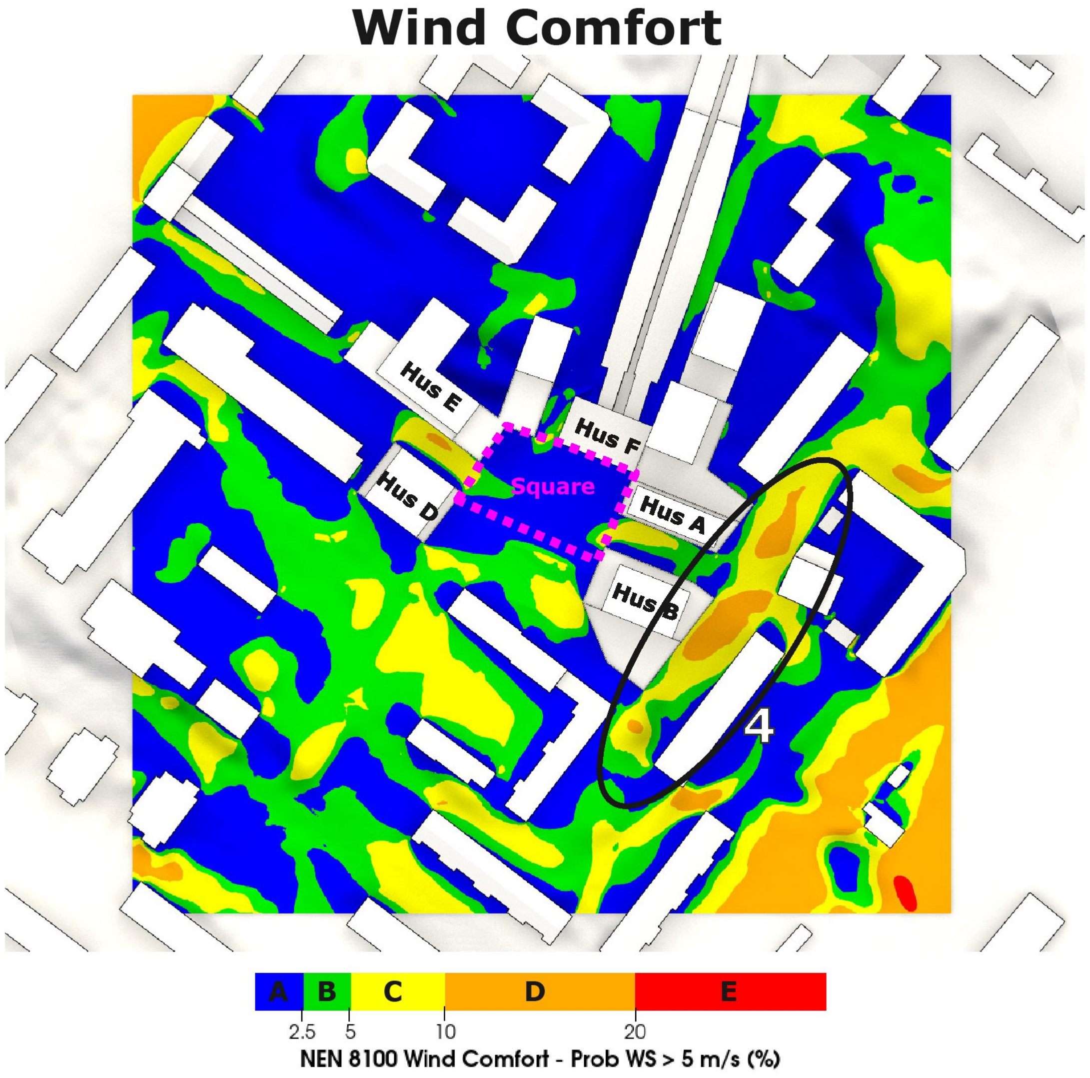
WIND COMFORT COMMENTS: PEDESTRIAN LEVEL – PLANE 1.5M ABOVE GROUND



The wind comfort assessment at pedestrian level does not highlight uncomfortable areas, and the majority of the square appears to be suitable for long term activities. However, the local wind conditions achieved in some areas of the new development might not be suitable for the intended pedestrian activity.

4) Wind accelerating between Hus A-B and the surrounding buildings:

The wind comfort levels are still suitable for short term activities like strolling and fast walking. Large areas rank as category D and will require wind mitigation.

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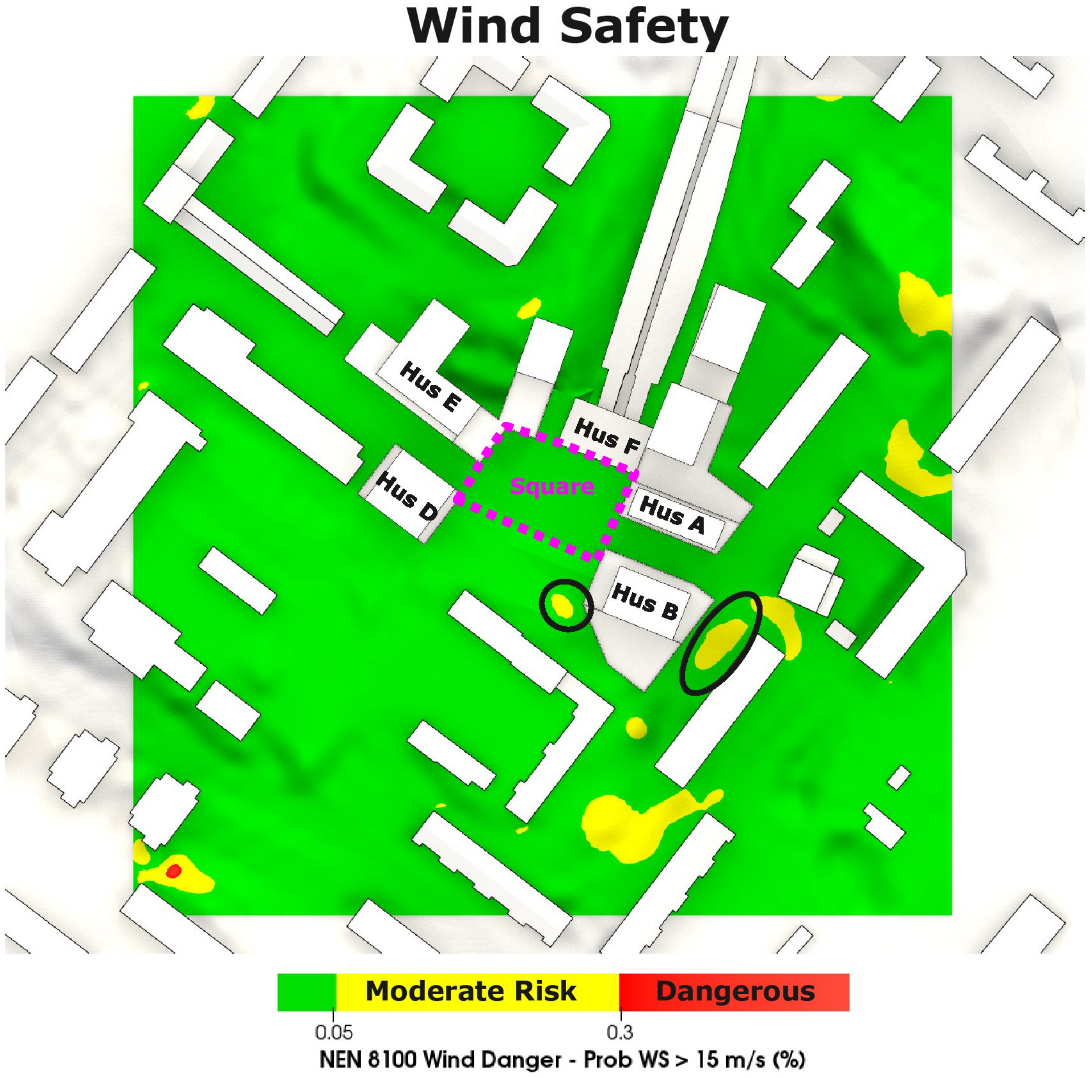
WIND SAFETY COMMENTS:
PEDESTRIAN LEVEL – PLANE 1.5M ABOVE GROUND



The wind safety assessment at pedestrian level does not highlight dangerous areas.

The few areas ranking as moderate risk correspond to locations where wind mitigation has been already suggested for comfort reasons. Any mitigation implemented to increase wind comfort will also help improving the safety conditions.

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POSSIBLE MITIGATION STRATEGIES AT PEDESTRIAN LEVEL : VEGETATION

Considering that no areas at pedestrian level ranked as uncomfortable (E) or dangerous, vegetation and landscaping can represent an effective wind mitigation strategy

Please note that:

- Trees alone, in particular the ones with high and lean trunks and slender canopies, do not provide enough shelter from the wind
- A mixture of shrubs and low trees is generally preferred
- Vegetation screens should primarily be placed across the prevailing wind direction
- It is important to select species that are capable of withstanding relatively high wind speeds and

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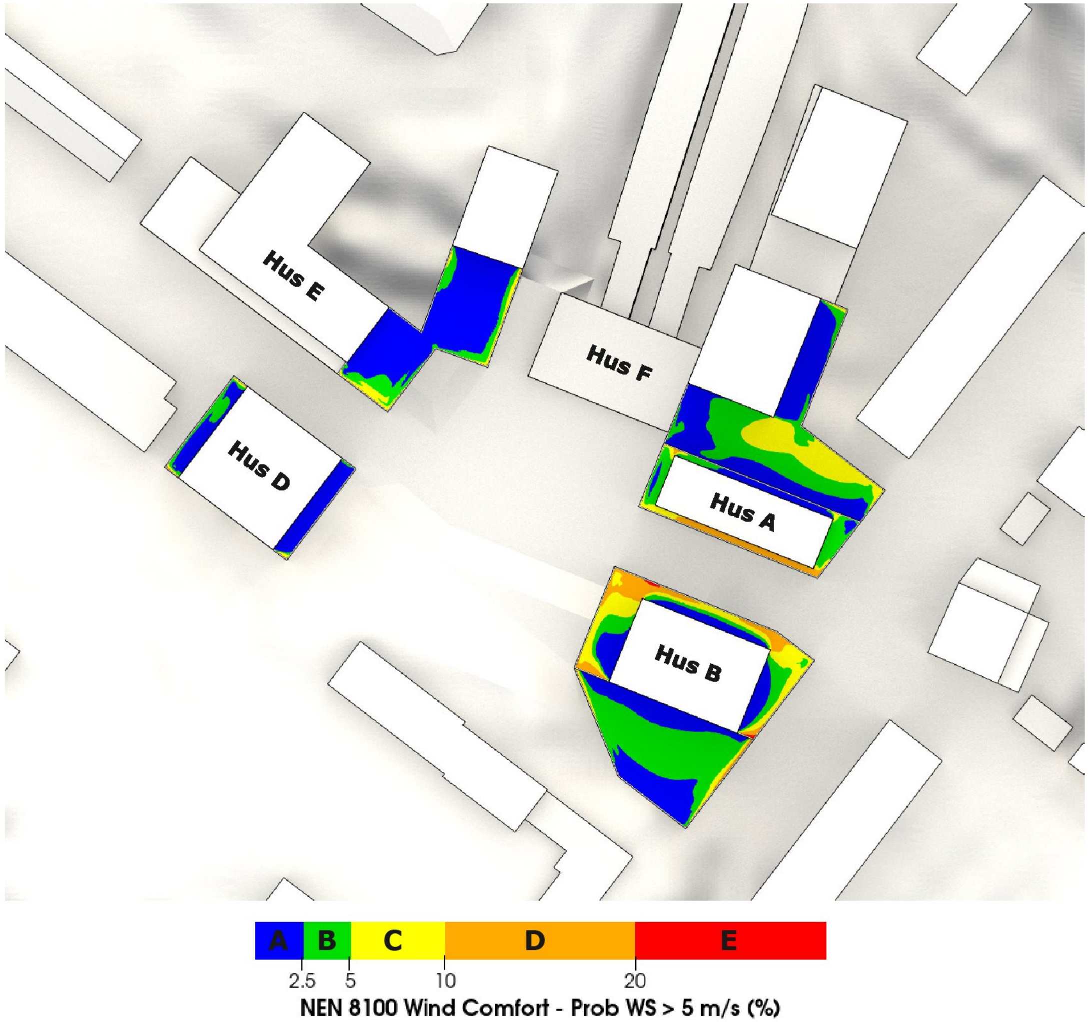
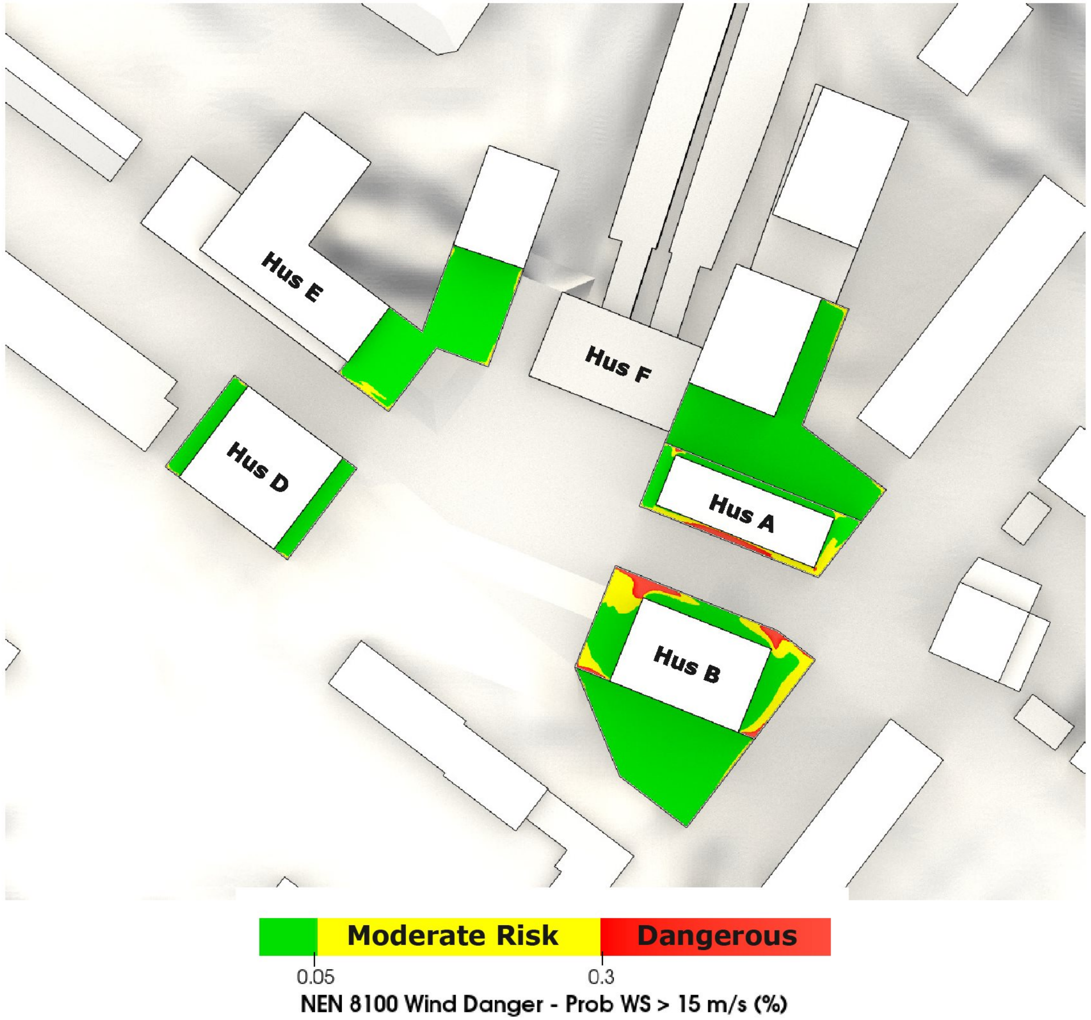
WIND COMFORT AND SAFETY STANDARD: ROOF LEVEL – PLANE 1.5M ABOVE ROOF LEVEL

Wind Comfort



Wind Safety



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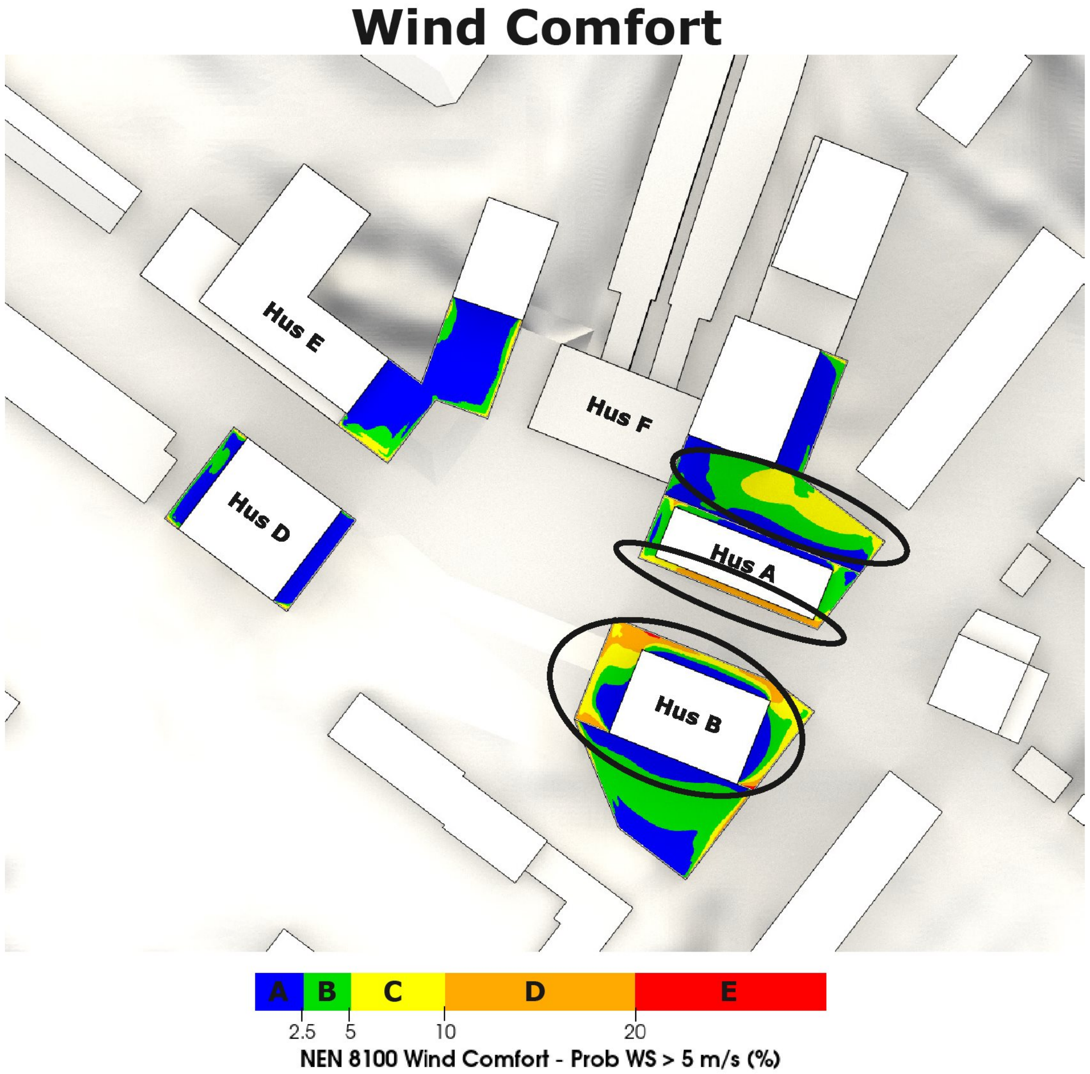
WIND COMFORT COMMENTS:
PEDESTRIAN LEVEL – PLANE 1.5M ABOVE ROOF LEVEL



The wind comfort assessment at roof level has identified a few very confined uncomfortable areas located on the upper roof terrace of Hus B.

Both upper terraces on Hus A and Hus B will have areas ranking as D. These areas will still be suitable for transient activities, like fast walking, but will definitively require a wind mitigation strategy.

Depending on the intended occupants' activity the areas ranking as category C might require mitigation as well, in particular the area between the two higher structures on Hus A.

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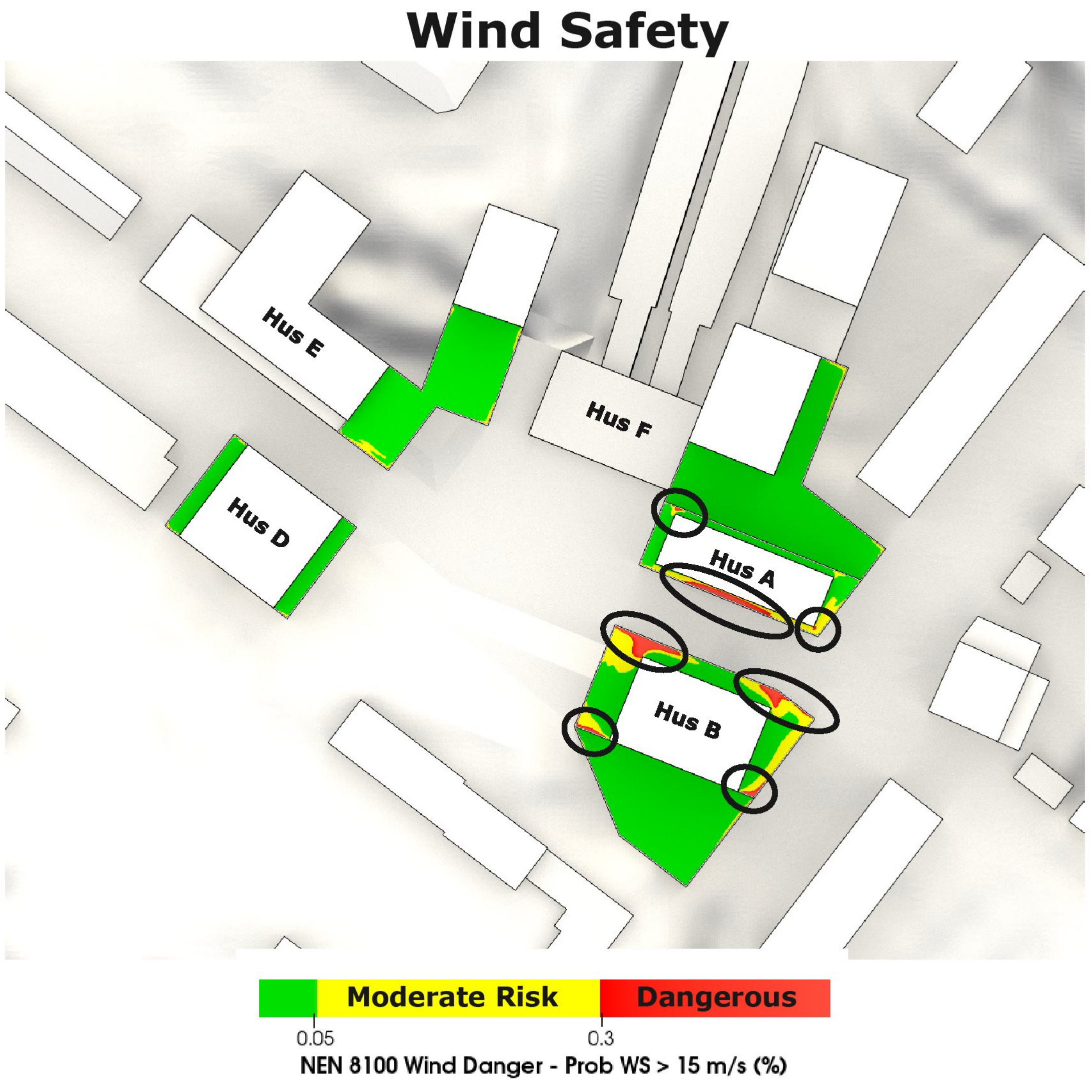
WIND SAFETY COMMENTS:
PEDESTRIAN LEVEL – PLANE 1.5M ABOVE ROOF LEVEL



The wind comfort assessment at roof level has identified some potentially dangerous areas located on the upper roof terraces of Hus A and Hus B.

The balusters currently in place do not provide enough shelter from the wind and these areas will have to be mitigated.

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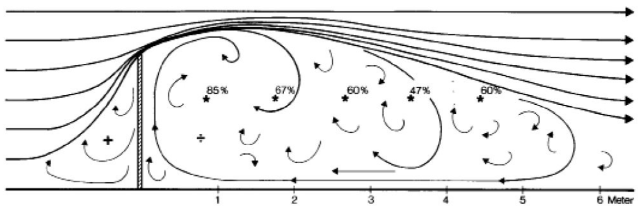
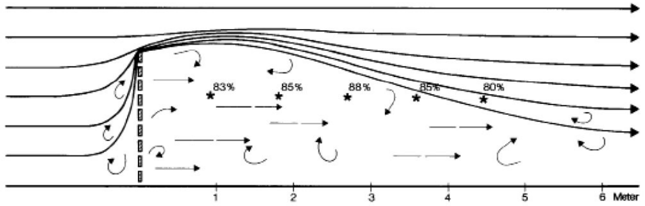
POSSIBLE MITIGATION STRATEGIES AT ROOF LEVEL : WIND BARRIERS AND LANDSCAPING



Solid Screen



Porous Screen

Some areas at roof level ranked as uncomfortable (E) and dangerous. For this reason a combination of wind barriers and landscaping is recommended as wind mitigation strategy

Please note that:

- The balusters currently in place are not providing enough shelter from the wind. Increasing the height of the balusters, at least on the two terraces struggling the most (Hus A and Hus B), will help mitigating the wind environment
- The sheltering effect induced by a wind barrier is only noticeable only up to a distance downstream equal to 5-6 times the height of the barrier itself. Windy conditions in areas further from the edge of the roof terraces will have to be mitigated with additional screens or bespoke landscaping
- It is generally recommended to introduce some porosity in the wind barrier in order to create a sheltered area with more uniform conditions and avoid strong recirculation zones

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OVERALL CONCLUSIONS

PEDESTRIAN LEVEL:

- The wind comfort assessment at pedestrian level does not highlight uncomfortable areas
- The majority of the main square appears to be sheltered from the wind and suitable for long term pedestrian activities (NEN8100 CAT A)
- The local wind conditions achieved in some areas of the new development might not be suitable for the intended pedestrian activity and will require local wind mitigation strategies
- Vegetation and landscaping represent a viable wind mitigation strategy at pedestrian level

ROOF TERRACE:

- The wind comfort assessment at roof level has identified a few areas uncomfortable and potentially dangerous areas
- Wind mitigation is required in these areas
- A combination of wind barriers and landscaping represent a viable wind mitigation strategy at roof level

Please note that the efficacy of any wind mitigation strategy should be tested and validated with a dedicated wind study

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RAMBOLL

APPENDIX

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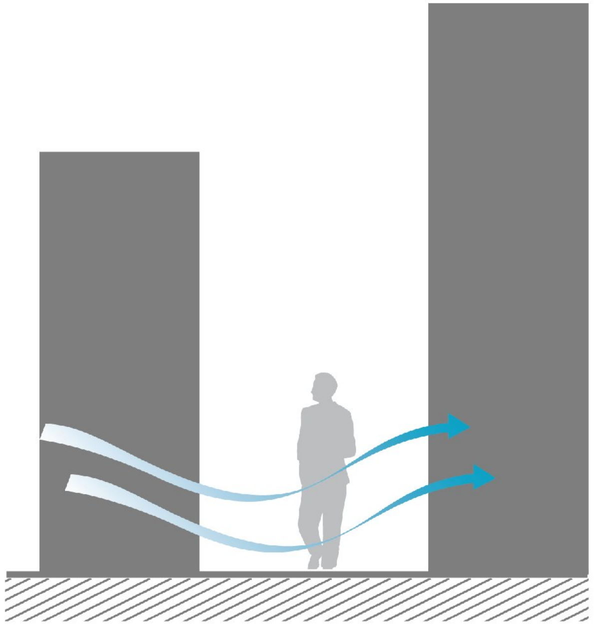
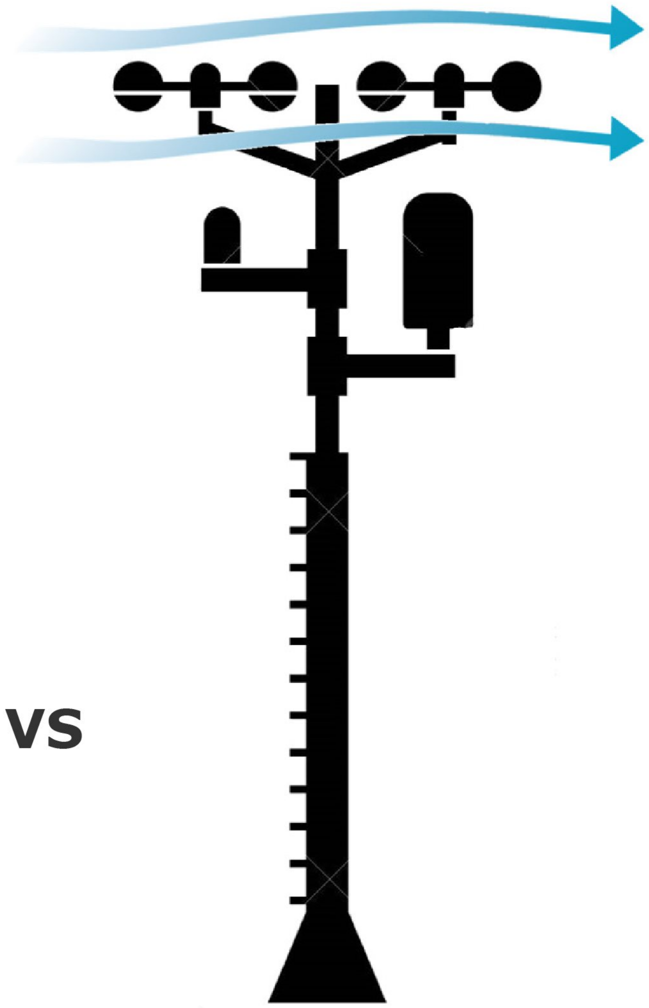
VELOCITY RATIO



SITE

VS



AIRPORT

DEFINITION:

- Ratio between the velocity recorded on site and the velocity recorded at the airport at 10m of height
- High velocity ratio values will generally correspond to windy areas while low values are typical of protected areas

NOTE:

- The site and the airport can have different exposure. This can affect the wind profile and the expected wind speed at pedestrian level. We need to account for both when we calculate the correlation between the wind speed recorded at the airport and the expected wind speed at the site
- The effect of wind gustiness at the site location is accounted for using the Gust Equivalent Mean Wind. The GEM used for the wind comfort calculations is used in the following plots

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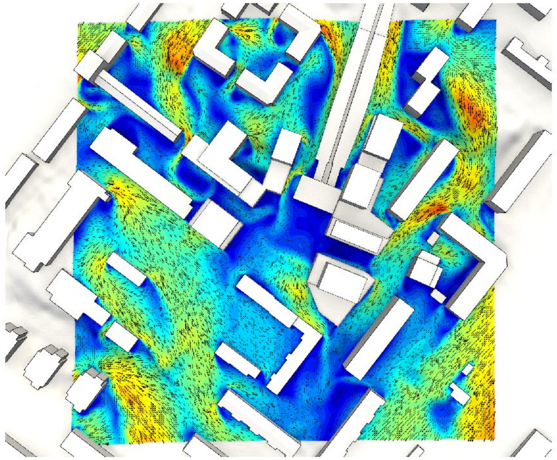
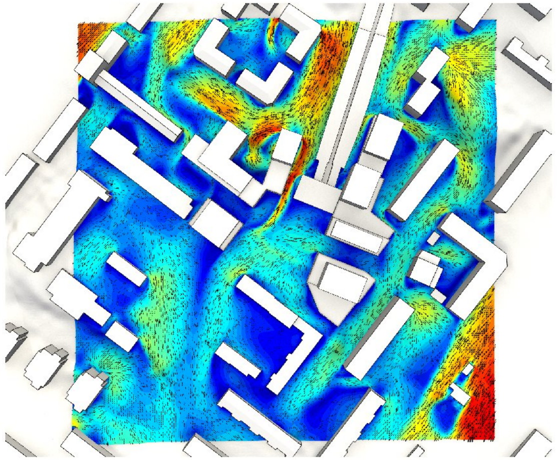
VELOCITY RATIO: PLANE 1.5M ABOVE GROUND

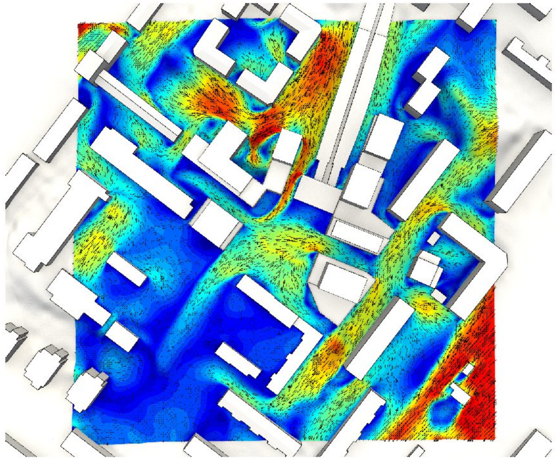
Wind Direction = 0°



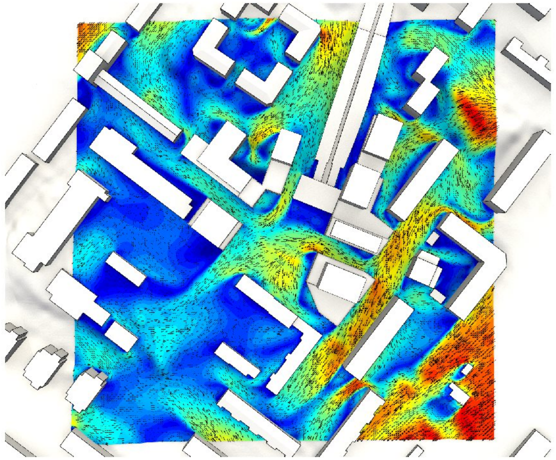
Wind Direction = 22.5°



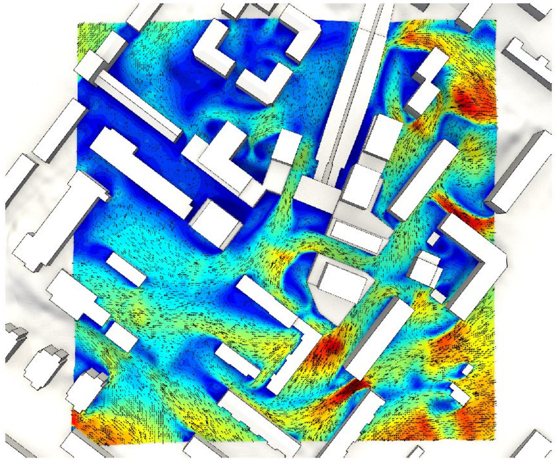
Wind Direction = 45°



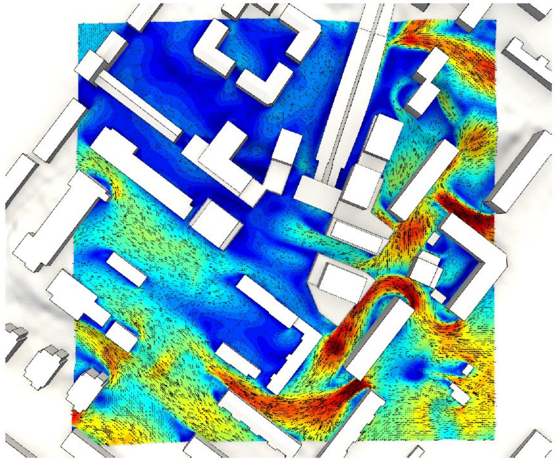
Wind Direction = 67.5°



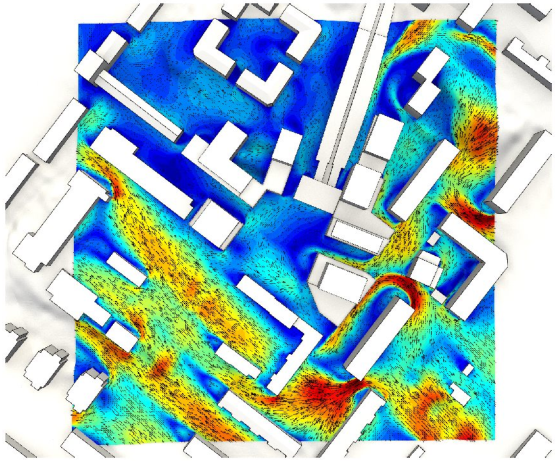
Wind Direction = 90°



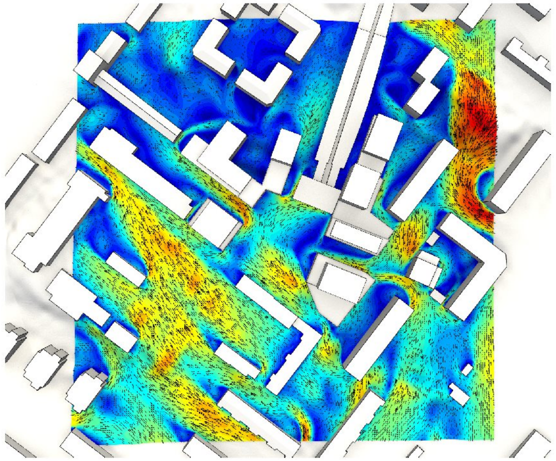
Wind Direction = 112.5°

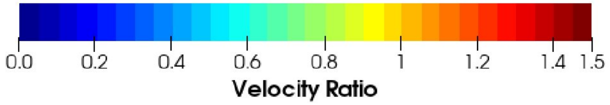


Wind Direction = 135°



Wind Direction = 157.5°





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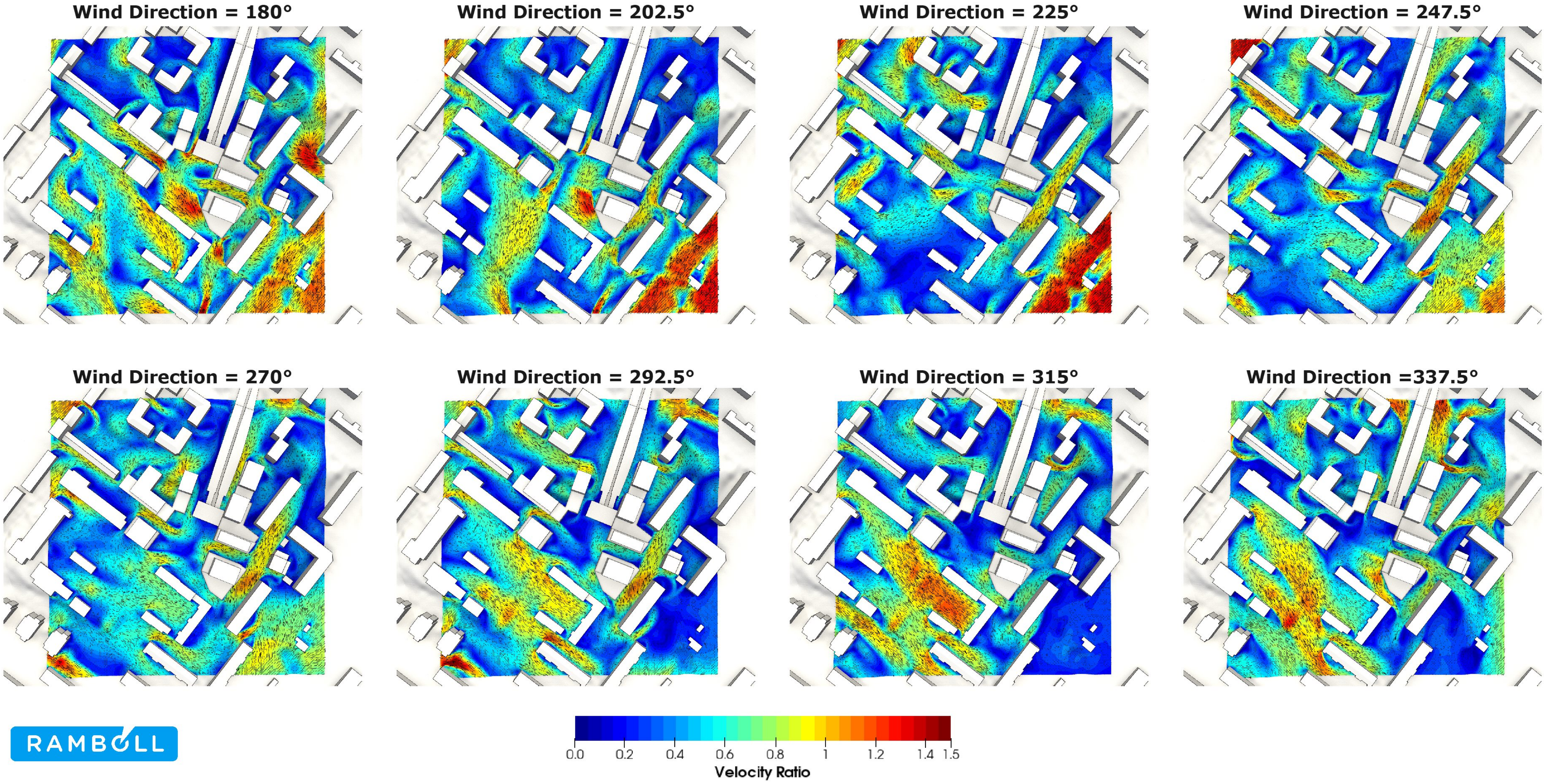
VELOCITY RATIO: PLANE 1.5M ABOVE GROUND



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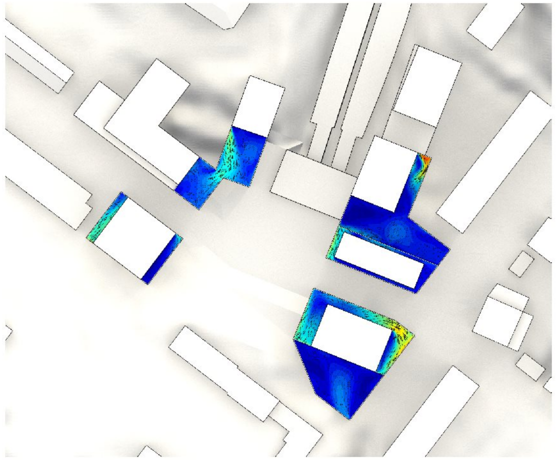
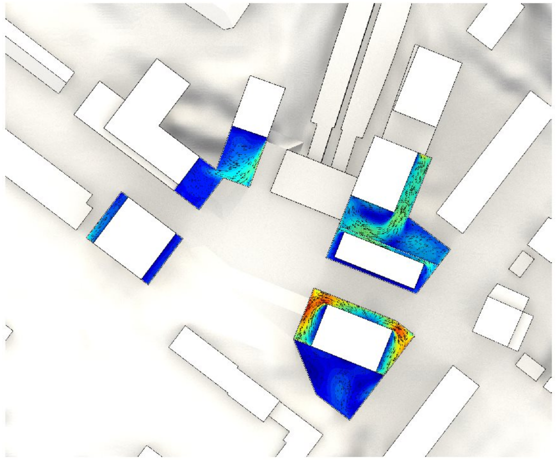
VELOCITY RATIO: PLANE 1.5M ABOVE ROOF LEVEL

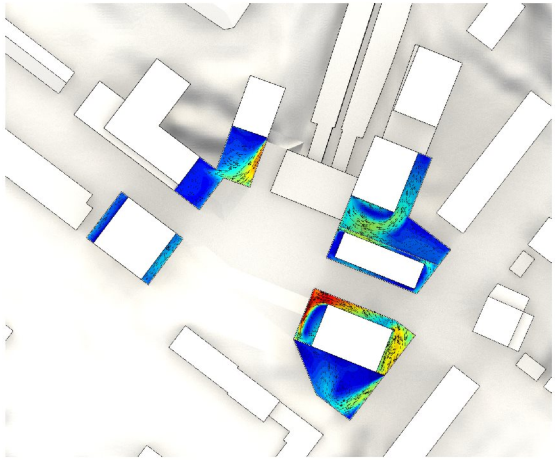
Wind Direction = 0°



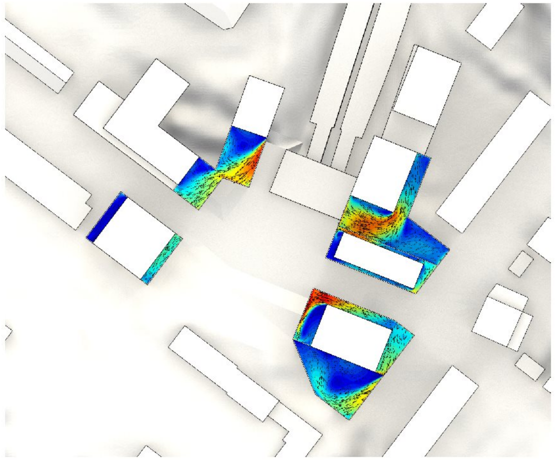
Wind Direction = 22.5°



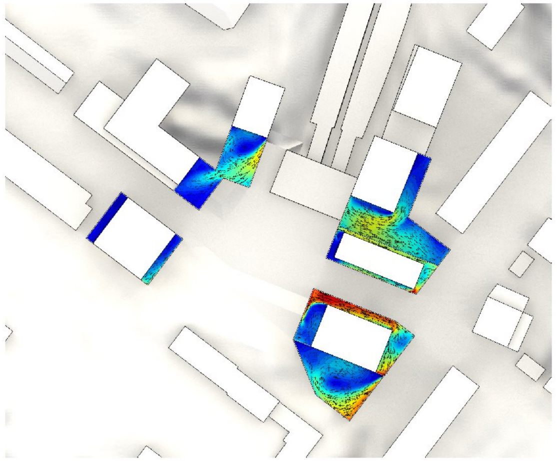
Wind Direction = 45°



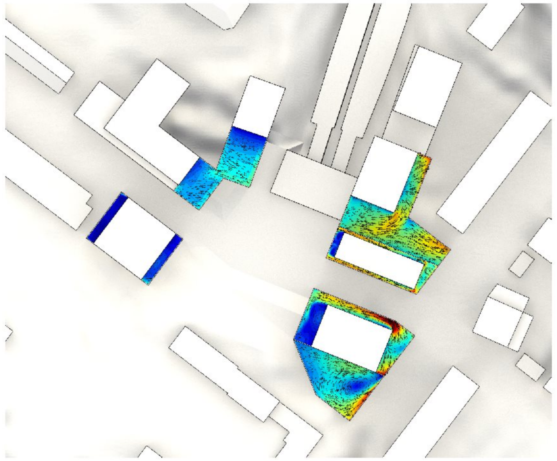
Wind Direction = 67.5°



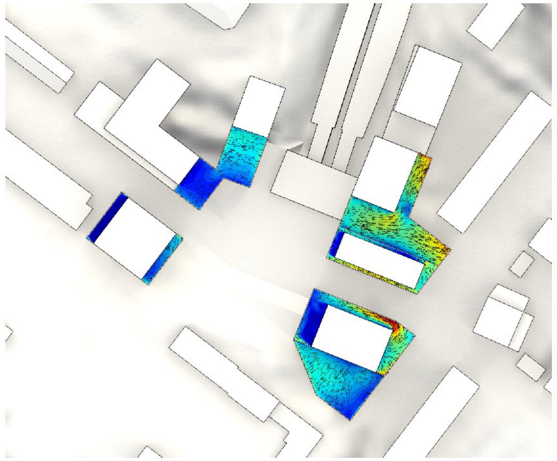
Wind Direction = 90°



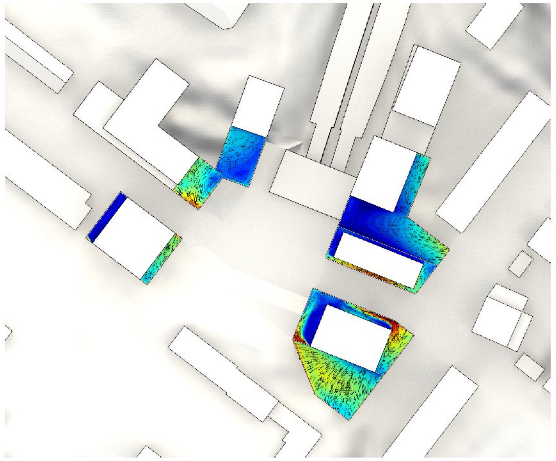
Wind Direction = 112.5°

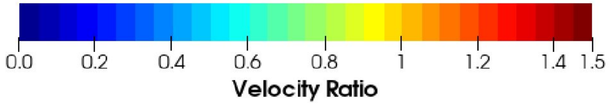


Wind Direction = 135°



Wind Direction = 157.5°





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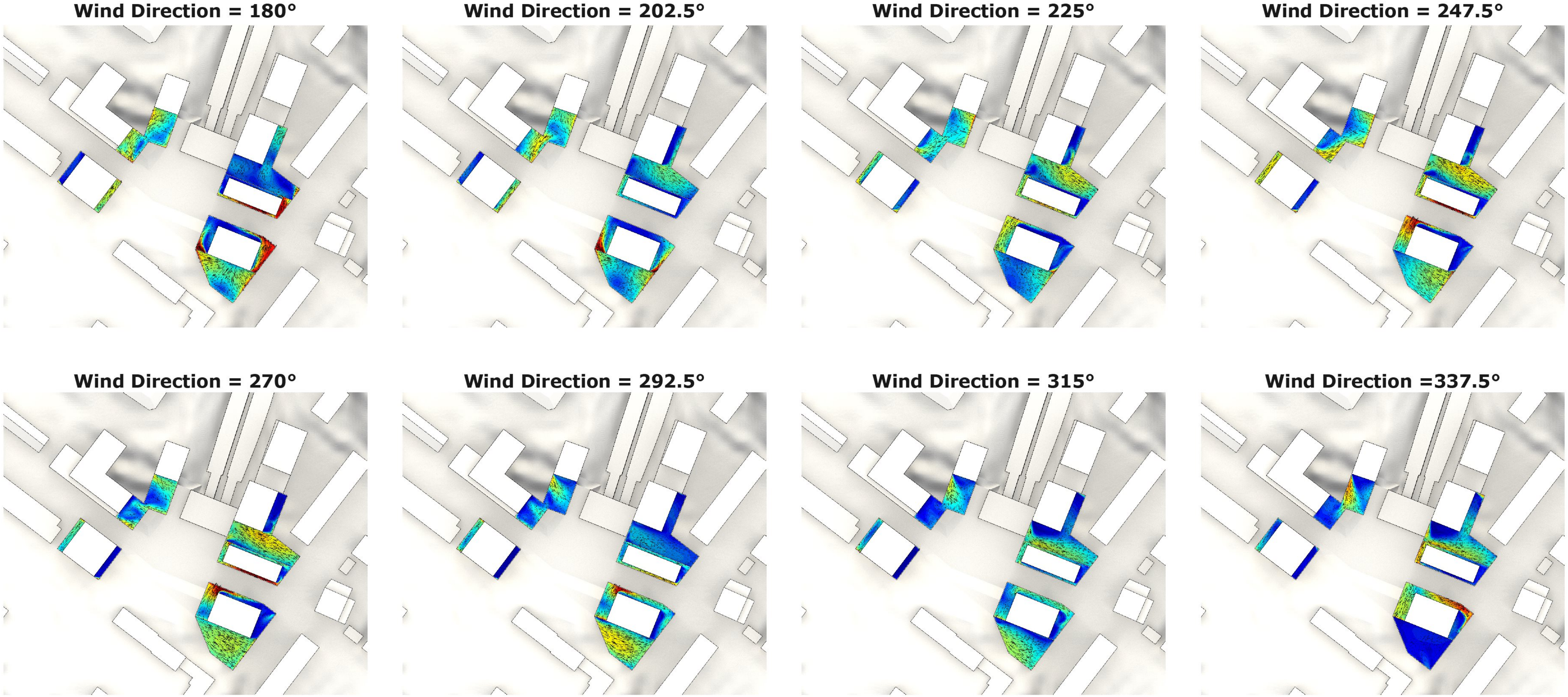
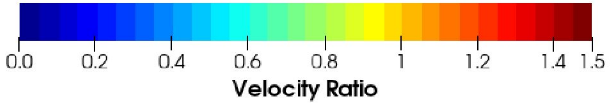
VELOCITY RATIO: PLANE 1.5M ABOVE ROOF LEVEL





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