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Far East Rocks Pty. Ltd c/o Essence Project Management

35-55 Harrington Street, The Rocks

Pedestrian Level Winds - Wind Tunnel Testing

30N-22-0105-TRP-42124-2

14 December 2022

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Report Title:	Pedestrian Level Winds - Wind Tunnel Testing
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Prepared For:	Prepared By:
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Rev. 00	Original issue	17 Oct 22	
Rev. 01	Updated drawings	23 Nov 22	R. Islam
Rev. 02	Minor amendments	14 Dec 22	R. Islam

Executive Summary

Far East Rocks Pty. Ltd c/o Essence Project Management commissioned Vipac Engineers and Scientists Pty Ltd to carry out a wind tunnel test to determine the likely pedestrian level wind conditions for the proposed development at **35-55 Harrington Street, The Rocks.** This report has been prepared in accordance with relevant requirements of the SEARs (Environmental Amenity and Public Space).

The model was constructed based on drawings supplied by **FJMT** in **September 2022**. The proposed development and surrounding buildings covering a circular area of approximately 500 m radius were modelled at a 1:400 scale. The approaching mean and turbulent flows of the Terrain Category 4 (150 to 210 azimuth degrees) and Terrain Category 2.5 (all other wind directions) Atmospheric Boundary Layer were modelled based on Australian Standard AS 1170.2-2011.

A comparison was made between the **September 2022** plans used for wind tunnel testing against the updated plans received in **November 2022**. As there were no significant massing changes, the results obtained for all other locations during the September 2022 testing remains valid with the updated drawings.

As such, findings of the comparative study are summarised as follows:

The proposed design of the development:

- fulfils the recommended criterion for **Safety** at all test locations;
- fulfils the recommended criterion for **Walking** at all footpath locations;
- fulfils the recommended criterion for **Standing** at all building entrances;
- fulfils the recommended criterion for **Sitting** at the seating areas **with recommendations**; and
- fulfils the recommended criterion for **Standing** at all communal terraces **with recommendations.**

The proposed development would not cause a significant adverse impact on the adjacent areas.

As a general statement, common to all new developments, educating occupants about wind conditions at high-level terraces/balconies during high-wind events and tying down loose furniture are highly recommended.

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1 Introduction

This pedestrian level wind assessment has been prepared by Vipac Engineers and Scientists on behalf of Far East Rocks Organisation (FEO) (the applicant) in support of a State significant development application (SSDA) submitted to the Minister of Planning under Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). This SSDA seeks development consent for the detailed design and construction of a new hotel with ancillary retail, through-site links, and associated works (the proposal) at 35-55 Harrington Street, The Rocks (the site).

The site is legally described as Lot 1 in Deposited Plan 775889. The site comprises the following buildings:

- The 'Clocktower building' at 35-55 Harrington Street (to which this SSDA predominately relates); and
- The existing Rendezvous Hotel at 75 Harrington Street.

The project has been declared as a State significant development (SSD) pursuant to Section 4.36(2) of the EP&A Act. In accordance with Schedule 2, Clause 6 of the State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP), the project is declared SSD for the reason that it is development on land within The Rocks Site and it has a capital investment value (CIV) of more than $10 million.

This SSDA seeks approval for the redevelopment of the existing building to facilitate the change of use of an existing building to new hotel accommodation. Specifically, the proposed development involves:

- Demolition of the existing mixed use building (referred to as the 'Clocktower' building) and site features;
- Construction of a new eight (8) storey hotel accommodation building comprising:
  - Two (2) levels of retail and commercial land uses at the ground level and first floor level
  - Five (5) levels of hotel accommodation, providing a total of 206 hotel rooms
  - One (1) level of roof-top space
- Establishment of new publicly accessible through-site links;
- Alterations to the existing basement car park to upgrade to contemporary code compliance;
- Public domain improvements, including three (3) new public spaces, landscaping, and paving; and
- Ancillary works, including site services.

Note. The proposed new hotel accommodation to which this SSDA relates will eventually connect with the existing Rendezvous Hotel which adjoins the subject site to the south (75 Harrington Street). This future connection will be facilitated by specific refurbishment works to the existing Rendezvous Hotel, consent for which will be sought via a separate approval(s).

Note. Vehicular access to the 'Clocktower building' is provided via an access point at 75 Harrington Street.

This pedestrian level wind assessment addresses the specific project requirements provided in the Secretary's Environmental Assessment Requirements (SEARs) issued by Department of Planning and Environment (DPE) on 14 December 2021 (DPE reference: SSD-32766230).

A satellite image of the proposed development site, and the ground floor plan with approximate dimensions overlaid are shown in Figure 1 and Figure 2, respectively.

The proposed development is located north of the Sydney CBD and is surrounded by low to high-rise developments, the bay and the Royal Botanic Garden. Considering the surroundings and terrain, within a 1.5km radius, the site of the proposed development is assumed to be within Terrain Category 4 for the azimuth degrees of 150° to 210° Terrain Category 2.5 for all other directions (Figure 3).

This report details the pedestrian level wind assessment results of the tests carried out on a 1:400 scale model of the proposed development in Vipac's Boundary Layer Wind Tunnel in Melbourne, during October 2022. The results show the wind effects in ground level public areas adjacent to the development as proposed.

The pedestrian wind environment study of the development was conducted using Omni-directional pressure sensor techniques to predict wind velocities. The study investigated safety and comfort in ground level pedestrian access-ways adjacent to the project.

The model was constructed to drawings supplied by **FJMT** in **September 2022**. Figure 4 and Figure 5 show the 1:400 scaled models in the wind tunnel. A complete list of the drawings used to construct the model is provided in Appendix A of this report.

Figure 1: Aerial view of the proposed development site.

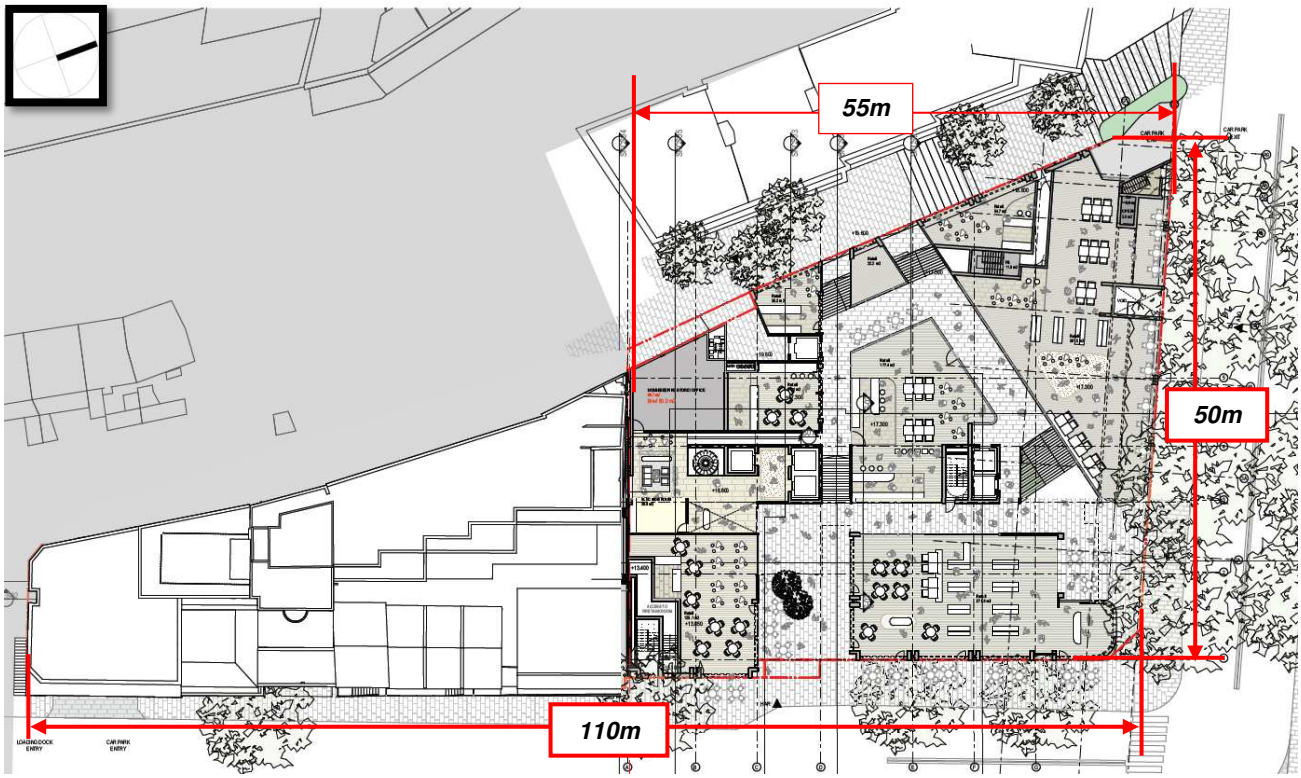


Figure 2: Ground floor plans (Lower Ground and Upper Ground combined) with the plan-form dimensions overlaid.

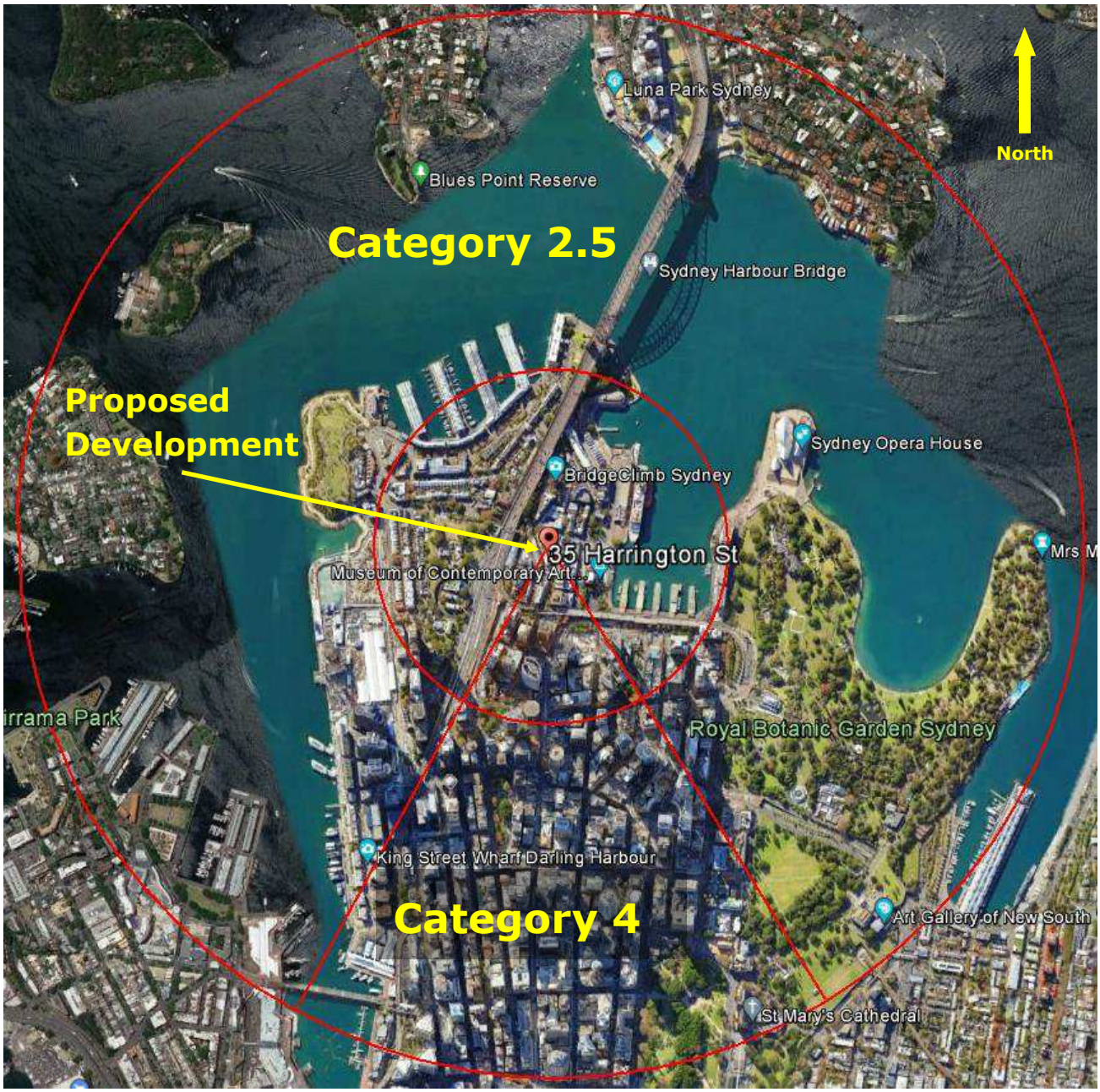


Figure 3: Assumed terrain roughness for wind speed estimation.

Figure 4: Overall view from north of the 1:400 scale model of the proposed development in the wind tunnel.

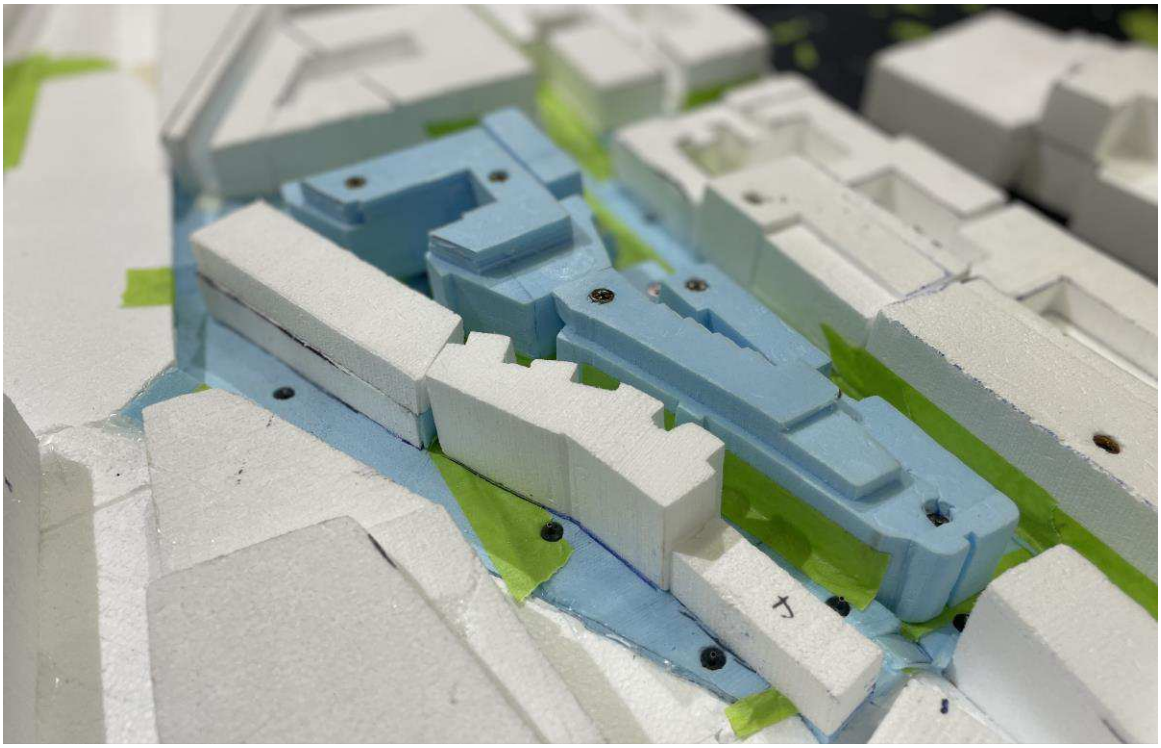


Figure 5: Close up view from the west of the 1:400 scaled model in the wind tunnel.

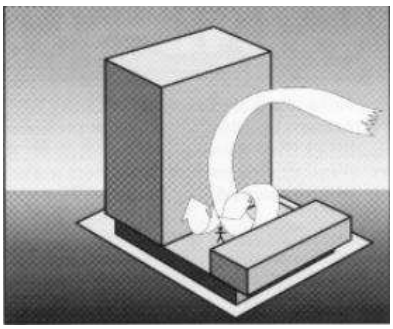
1.1 Environmental Wind Effects

Atmospheric Boundary Layer

As wind flows over the earth it encounters various roughness elements and terrain such as water, forests, houses and buildings. To varying degrees, these elements reduce the mean wind speed at low elevations and increase air turbulence. The wind above these obstructions travels with un-attenuated velocity, driven by atmospheric pressure gradients. The resultant increase in wind speed with height above ground is known as a wind velocity profile. When this wind profile encounters a tall building, some of the fast-moving wind at upper elevations is diverted down to ground level resulting in local adverse wind effects.

The terminology used to describe the wind flow patterns around the proposed Development is based on the aerodynamic mechanism, direction and nature of the wind flow.

Downwash – refers to a flow of air down the exposed face of a tower. A tall tower can deflect a fast-moving wind at higher elevations downwards.

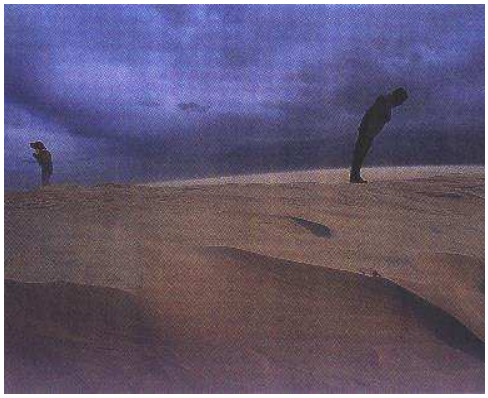


Corner Accelerations – when wind flows around the corner of a building it tends to accelerate in a similar manner to airflow over the top of an aeroplane wing.

Flow separation – when wind flowing along a surface suddenly detaches from that surface and the resultant energy dissipation produces increased turbulence in the flow. Flow separation at a building corner or at a solid screen can result in gusty conditions.

Flow channelling – the well-known "street canyon" effect occurs when a large volume of air is funnelled through a constricted pathway. To maintain flow continuity the wind must speed up as it passes through the constriction. Examples of this might occur between two towers, in a narrowing street or under a bridge.

Direct Exposure – a location with little upstream shielding for a wind direction of interest. The location will be exposed to the unabated mean wind and gust velocity. Piers and open water frontage may have such exposure.



2 Regional Wind Climate

The mean and gust wind speeds have been recorded in the Sydney area for over 30 years. The data from Sydney International Airport have been analysed and the directional probability distribution of wind speeds have been determined. The directional distribution of hourly mean wind speed at the gradient height once per year (i.e. 1 year return period) and with a probability of occurring 5% of the time are shown in Figure 6. The wind data at this free stream height is common to all Sydney sites and may be used as a reference to assess ground level wind conditions at the development site.

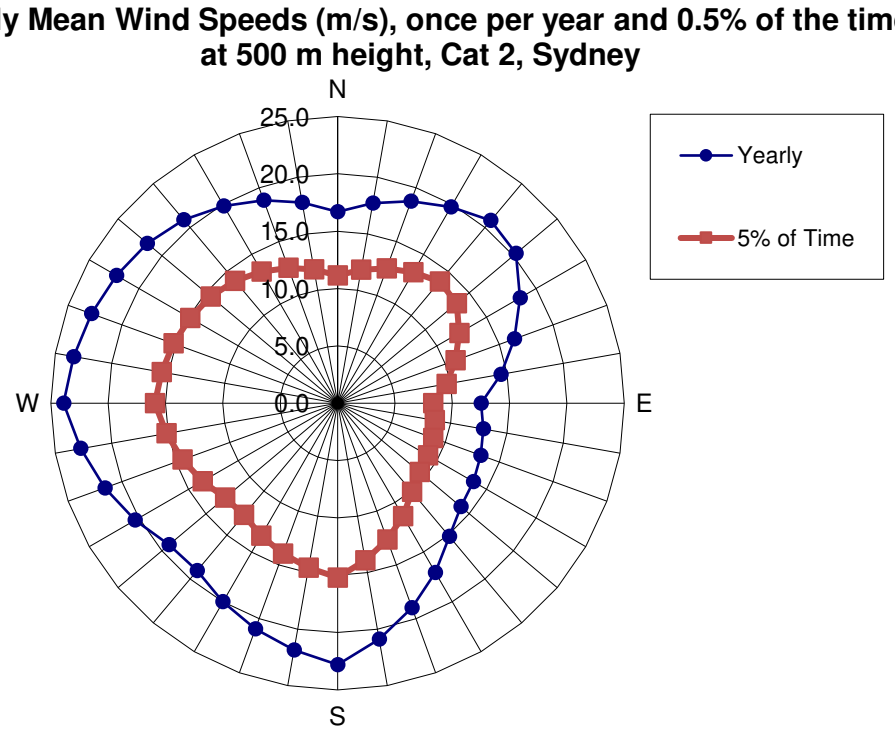


Figure 6: Directional Distribution of Mean Hourly Wind Velocities (m/s) of Annual Return Period and 5% of time at the gradient height for Sydney.

3 Assessment Criteria

The wind comfort criteria from the Central Sydney Planning Strategy has been applied to this study. The document recommends the following wind safety and comfort criteria (Table 1):

Table 1: Wind Criteria summarized from Central Sydney Planning Strategy.

Measurements	**Result on Perceived Pedestrian Comfort**
Peak wind speed (0.5 second gust) once per year, **≤24m/sec** for any direction*.	Accepted international criterion for human safety to avoid a healthy pedestrian losing balance
Hourly ***mean*** wind speed*, 5% of the time exceedance, **≤8m/sec**, for any directions.	Acceptable for **walking** (steady steps for most pedestrians)
Hourly ***mean*** wind speed, 5% of the time exceedance, **≤6m/sec,** for any directions.	Acceptable for **standing** (wind shopping, vehicle drop off)
Hourly ***mean*** wind speed, 5% of the time exceedance. **≤4m/sec,** for any directions.	Acceptable for **sitting** (outdoor cafes, gardens, park benches)

**Note: Hourly Mean wind speed is the maximum of mathematical mean or Gust equivalent mean (Gust divided by 1.85).*

The wind speed assessment is undertaken for winds occurring between 6am and 10pm (AEST).

3.1.1 Use of Adjacent Pedestrian Occupied Areas & Recommended Comfort Criteria

The following table lists the specific areas adjacent to the proposed development and the corresponding recommended criteria.

Table 3 – Recommended application of criteria.

Area	**Specific location**	**Recommended Criteria**
Public Footpaths, Accessways	Along Harrington Street, Argyle Street, Cambridge Street and internal plaza (Figure 7)	Walking
Building Entrances	Main building entrances throughout site (Figure 7)	Standing
Outdoor seating	Within internal plaza and along Harrington Street (Figure 7)	Sitting
Communal Terraces	*On Upper Ground Level, and Level 6 (**Note: Level 00 indicating Club Lounge Outdoor on Upper Ground level below*** Figure 8)	Standing
Private Balconies	Levels 1 and 2	Walking (See discussion below)

3.1.2 Terrace / balcony Recommended Criterion Discussion

Vipac recommends as a minimum that balcony and terrace areas meet the criterion for walking since:

- these areas are not public spaces;
- the use of these areas is optional; and
- many similar developments in Sydney and other Australian capital cities experience wind conditions on balconies and elevated deck areas in the vicinity of the criterion for walking.

However, it should be noted that meeting the walking criterion on elevated recreation areas will be no guarantee that occupants will find wind conditions in these areas acceptable at all times.

In this study, the communal terraces were assessed against the more stringent **standing** comfort criterion.

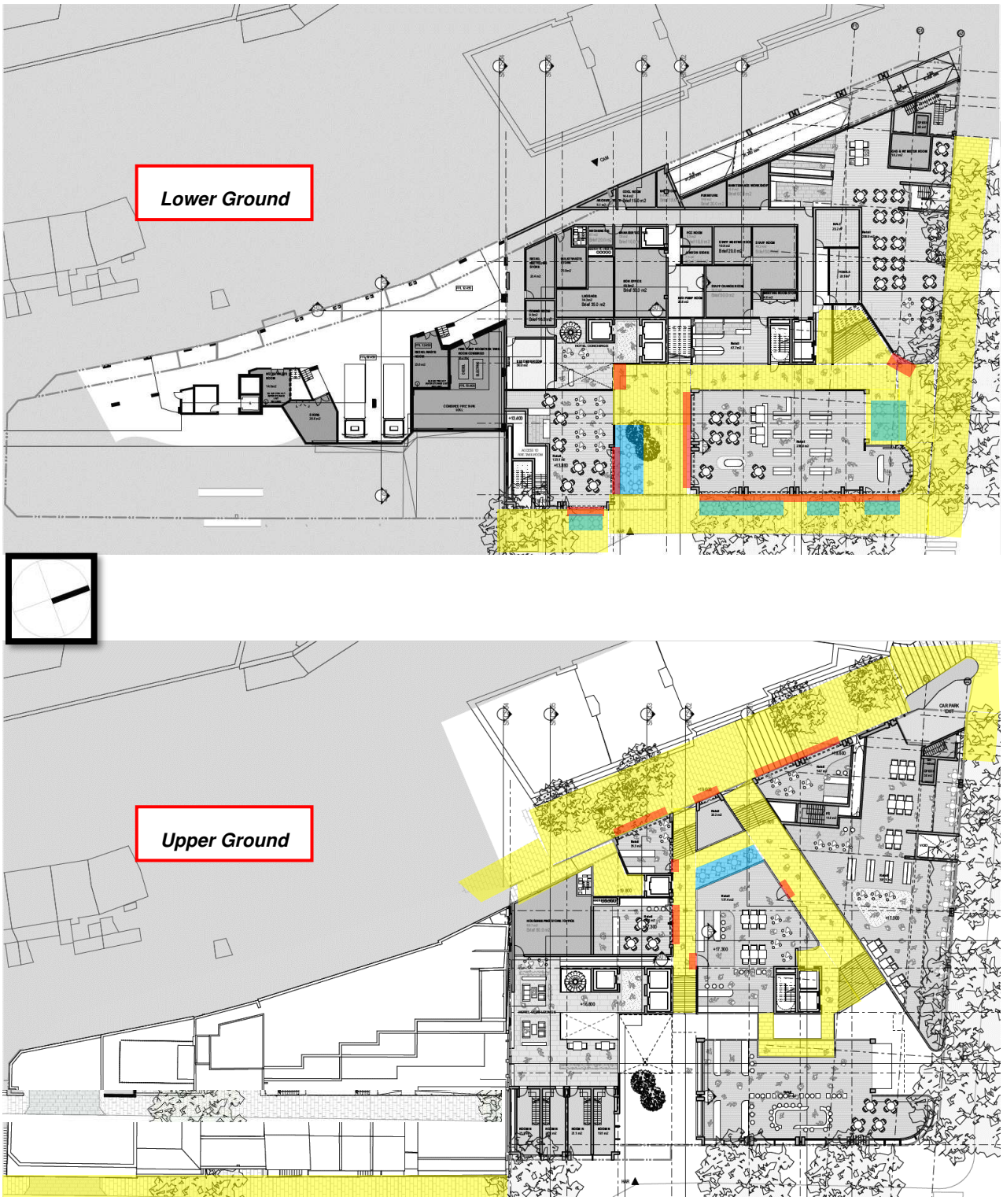
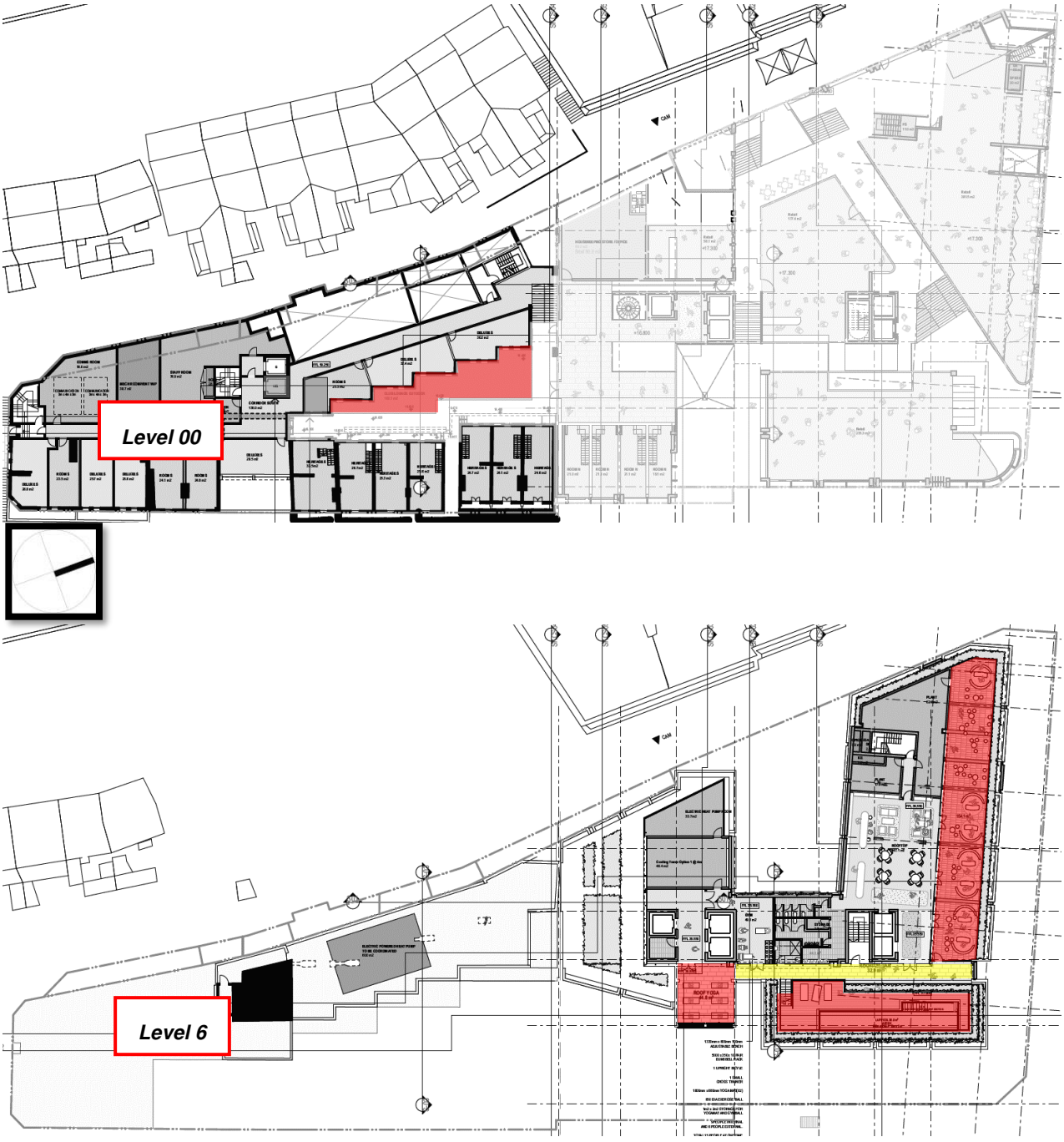


Figure 7: Lower Ground (top) and Upper Ground (bottom) floor plans with recommended wind criteria overlaid.



Note: Level 00 indicating Club Lounge Outdoor on Upper Ground level below

Figure 8: Level 00 (top) and Level 6 (bottom) with recommended wind criteria overlaid.

4 Wind Tunnel Simulation

4.1 Similarity Requirements

The validity of wind tunnel testing relies on the similarity between model and full-scale parameters. This requires undistorted length scaling (ie. geometric similarity), similarity of flow parameters (i.e. kinematic similarity) and finally similarity of pressures and forces.

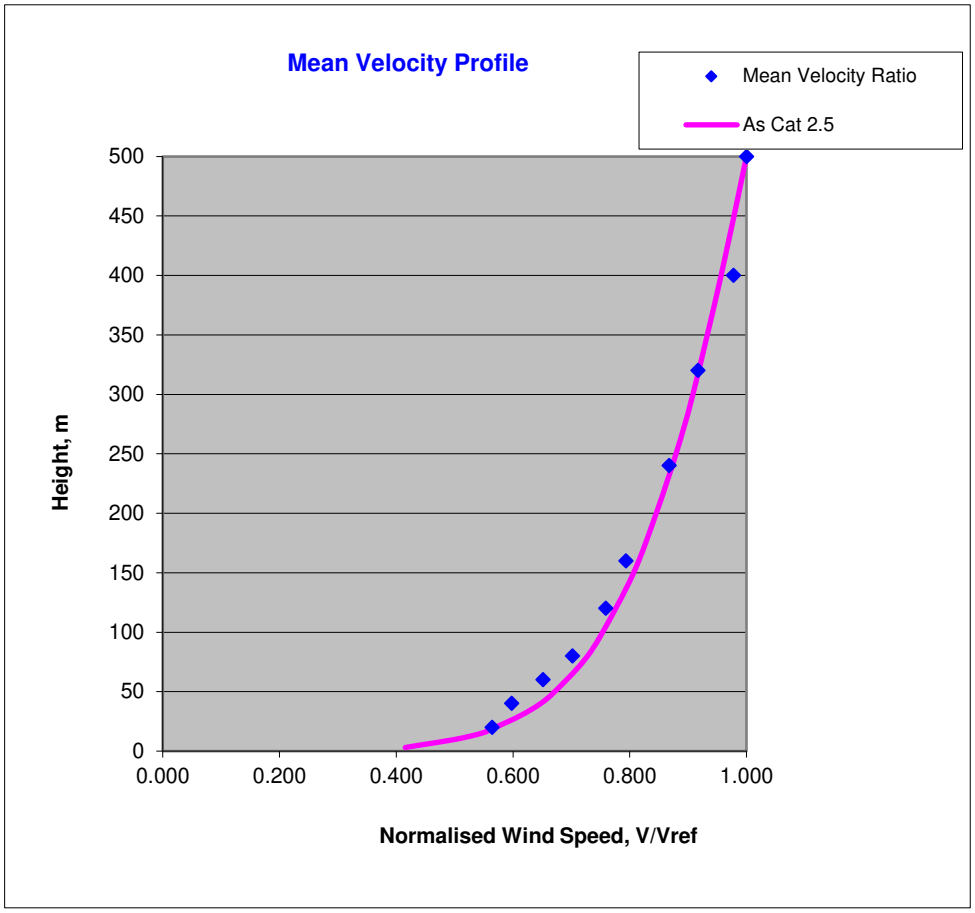
Complete similarity is usually impossible to obtain because of the competing requirements of the various non-dimensional parameters, (e.g. Reynolds Number, Rossby Number and Richardson Number). Some requirements (i.e. Reynolds Number equality) can be waived for sharp edged structures immersed in a neutrally stable atmospheric boundary layer and geometric and kinematic similarity suffice. These are the requirements specified in Section C1.4, AS/NZS 1170.2 Supplement 1: 2011 [4] and are employed in this study.

4.2 Approach Wind Simulation

The wind effects tests were carried out in the 3m wide × 2m tall × 16m long Boundary Layer Wind Tunnel at Vipac Engineers and Scientists Ltd in Melbourne. The Boundary Layer Wind Tunnel is designed to simulate the flow incident on a proposed development by modelling the upstream terrain characteristic roughness. To this end, an estimate of the upstream terrain properties for the Development has been made and reproduced in the wind tunnel.

The approaching mean and turbulent flows of the Terrain Categories 2.5 and 4 Atmospheric Boundary Layers for different exposures were modelled based on Australia Standard AS 1170.2-2011. The wind tunnel calibration velocity and turbulence intensity profiles for Terrain Categories 2.5 and 4 are shown in Figure 9 and Figure 10 respectively. These represent the wind velocity and turbulence intensity profiles approaching the model of the development. Closer to the ground the wind moves more slowly but with increased turbulence. The simulated approach is indicative of full-scale planetary boundary layer velocity and turbulence intensity profiles.

Velocity correction factors are used to adjust the measured wind speed to ensure that the ratio of mean roof-height to reference height wind speed in the wind tunnel matches expected full-scale values.



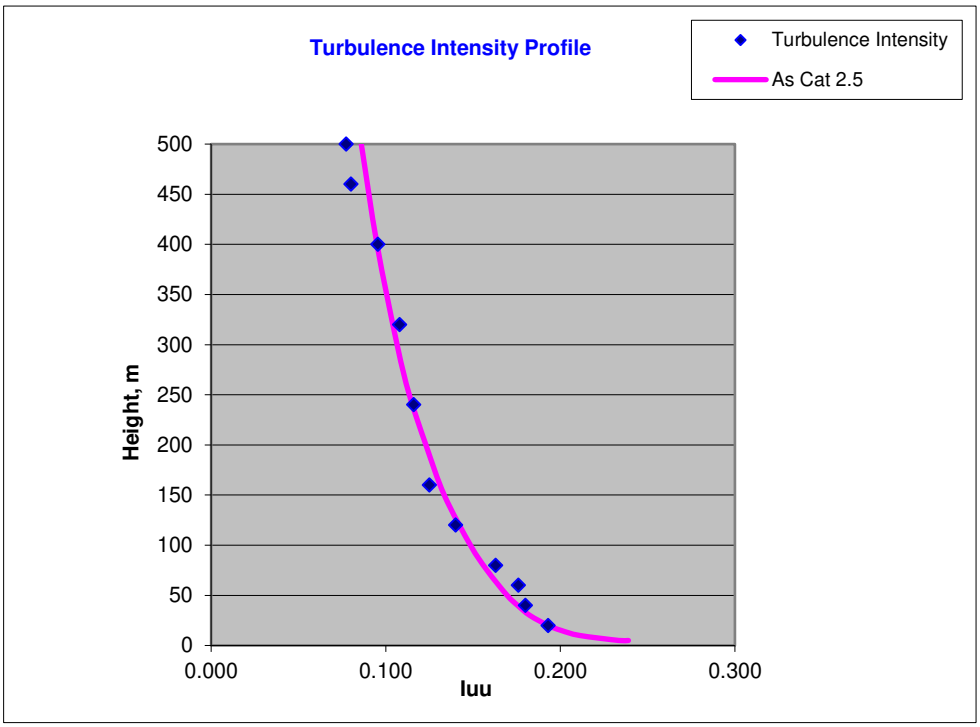
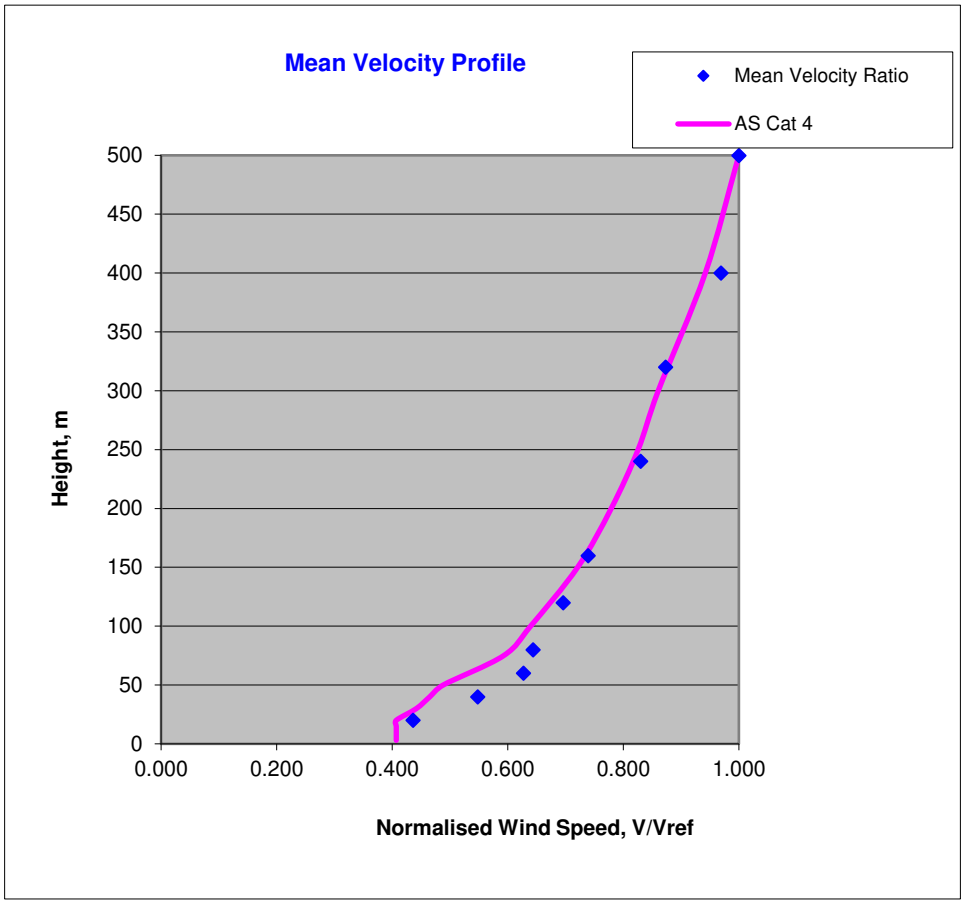


Figure 9: Mean Velocity and Turbulence Intensity Profiles for Terrain Category 2.5 (1:400 scale).



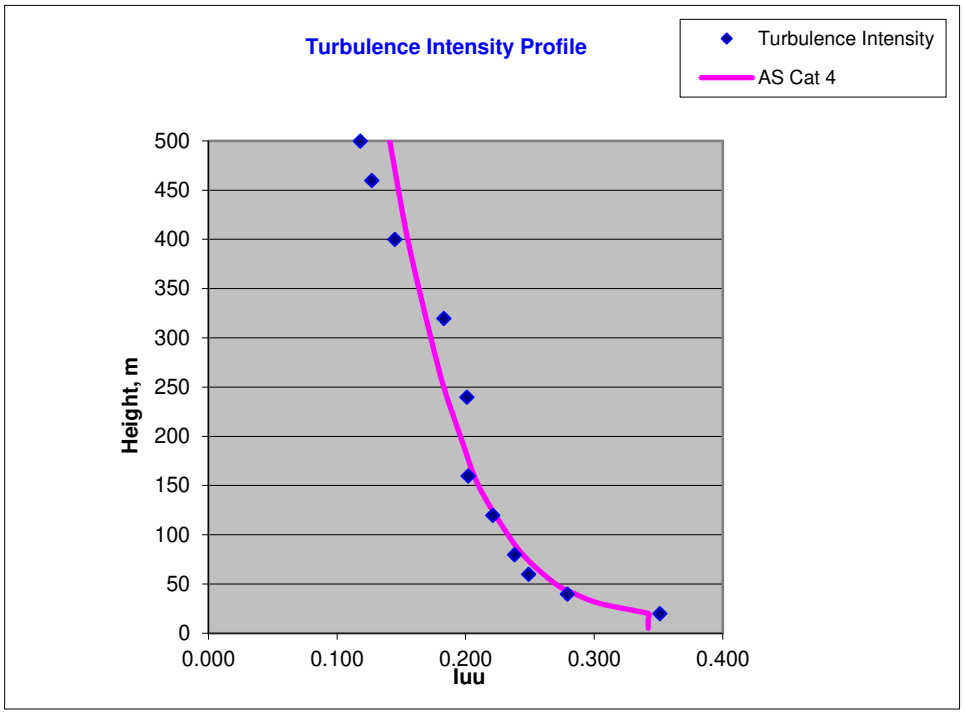


Figure 10: Mean Velocity and Turbulence Intensity Profiles for Terrain Category 4 (1:400 scale).

5 Test Procedure

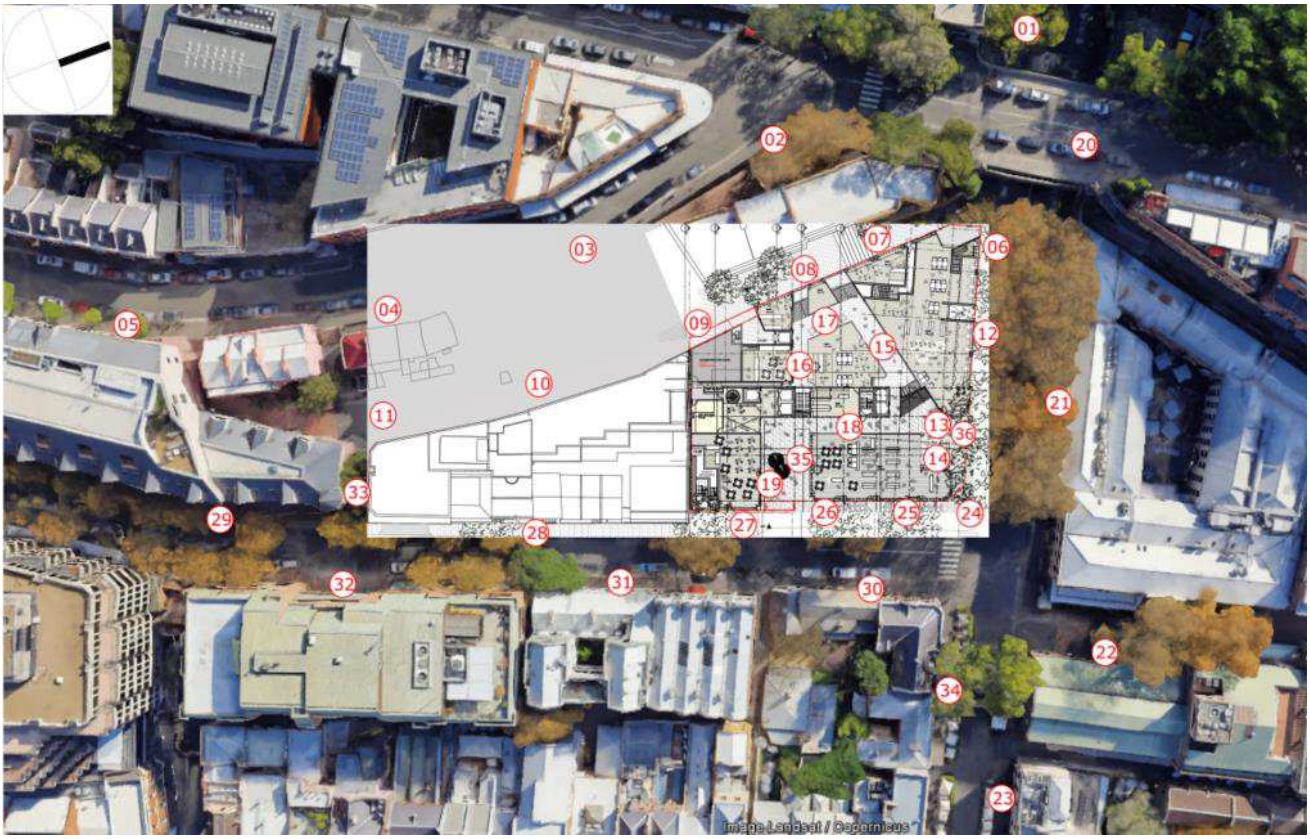
The pedestrian wind environment in the adjacent footpath areas along Harrington Street, Cambridge Street, Argyle Street and terrace areas were assessed using Omni-directional pressure sensor measurements [4].

Velocity measurements were made using Irwin sensors (Omni-directional pressure sensors) installed at various locations at the adjacent ground level footpath areas and podium level of the proposed development. The test was conducted without any landscaping. The distribution of Irwin sensors has allowed the determination of the variation in velocity sufficient to capture the changes in velocity distribution that can typically occur over such areas. The resolution of measurement locations is in accordance with that prescribed in the Wind Tunnel Testing Quality Assurance Manual of the Australasian Wind Engineering Society.

PVC tubes with 1.3 mm internal diameter linked the Irwin sensors to pressure transducer device using a tuned arrangement to prevent harmonic fluctuations.

Velocity measurements were obtained at 10° wind azimuth increments starting from 0° (north) for a full 360° circle. The sampling time is determined based on the similarity criteria and corresponds to a total time of one hour in full scale. Statistical analysis was carried out on the signals for the peak, mean and standard deviation. All velocity coefficients derived from the wind tunnel were converted to velocities by integrating the data with the regional wind climate and corresponding to design wind speeds with a probability of once per year exceedance for safety criterion assessment and 5% of the time for comfort criterion assessment.

A total of **44** sensors were used in order to provide a quantitative measure of the ground level wind speeds at various locations around the footpaths and garden. The sensor locations are shown in Figure 11 to Figure 13.



Note: Location 20 is located below the bridge on the footpath along Argyle Street.

Figure 11: Sensor numbers and locations on the ground level.

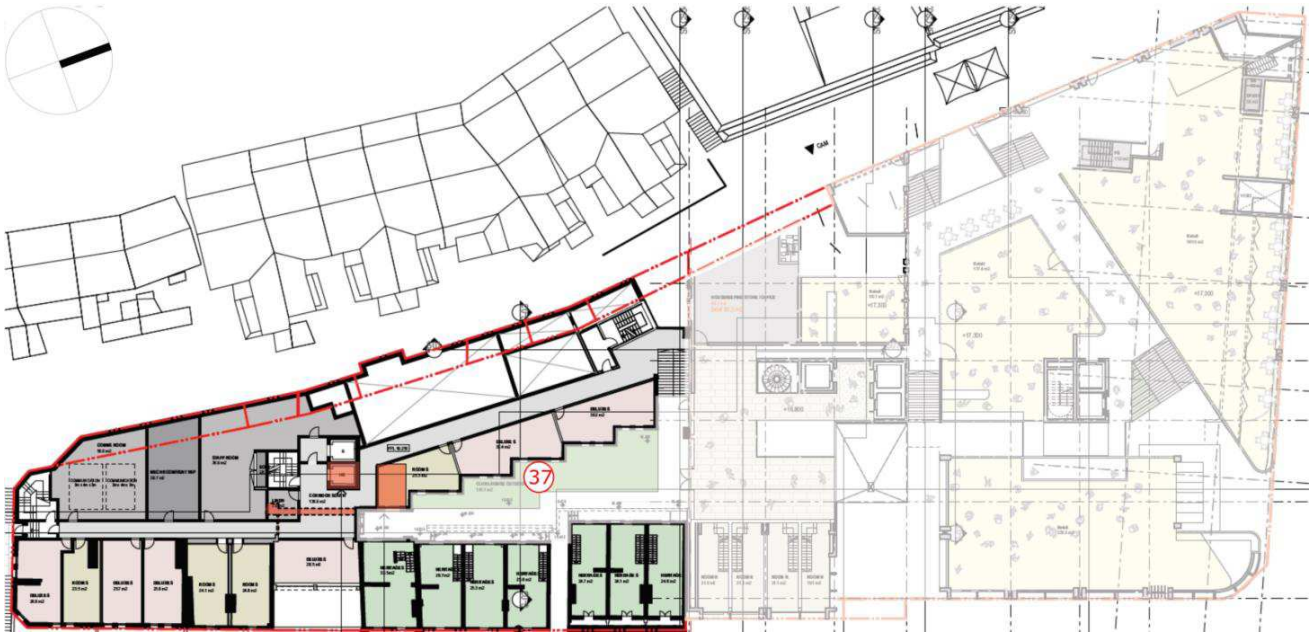


Figure 12: Sensor numbers and locations on Level 00.

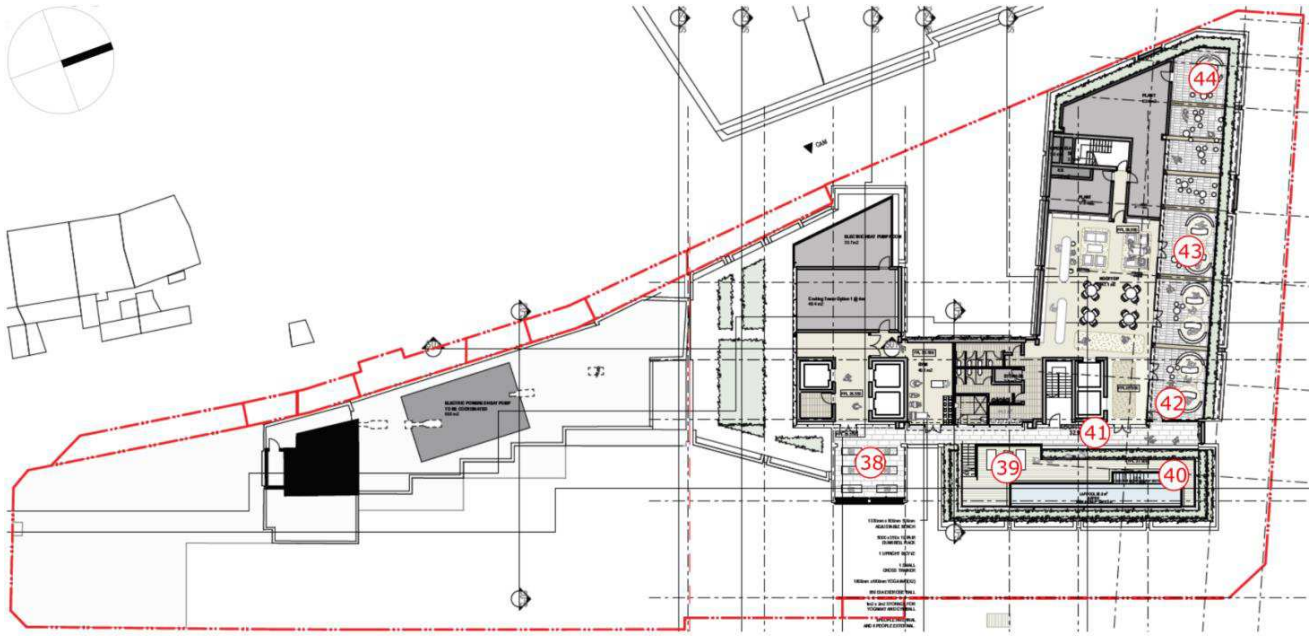


Figure 13: Sensor numbers and locations on Level 6.

6 Results and Discussion

The pedestrian wind environment in the footpath, main entrances and outdoor communal terraces were assessed using omnidirectional pressure sensor tests.

Two configurations were conducted, namely:

A) **Configuration 1**: test with the proposed development and existing surrounding developments (Figure 14).

B) **Existing**: test with the existing developments within the proposed site and the surrounding areas (Figure 15).

The tests were conducted without any landscaping at the ground level.

Figure 14: Overall view of the proposed development model in the wind tunnel (Configuration 1).

Figure 15: Overall view of the proposed development model in the wind tunnel (existing).

The results of omnidirectional pressure sensor tests are presented as polar plots for the gust and hourly mean wind speeds and are shown in Appendix B of this report. Figure 16 and Figure 17 show the examples of these plots respectively. In Figure 16, the red circle represents the gust velocities for the safety criterion and the sets of symbols with lines represent the test predicted gust velocity for the 36 directions. In Figure 17, the colour circles represent the mean velocities for the different comfort criteria and the sets of symbols with lines represent the test predicted hourly mean velocities (maximum of mean and GEM) for the 36 directions. The title of the plot also indicates the sensor number and the required criterion for this location.

Figure 16 and Figure 17 showed that at Location 26 measured wind speeds were within both the safety criterion and recommended sitting comfort criterion respectively for Configuration 1, with wind conditions slightly improving compared to Existing conditions.

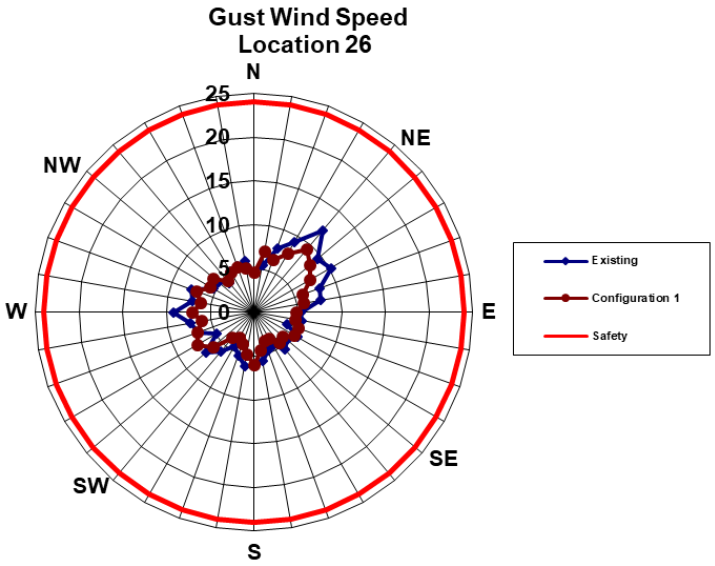


Figure 16: Polar plot of the gust wind speeds compared to the safety criterion (Location 26).

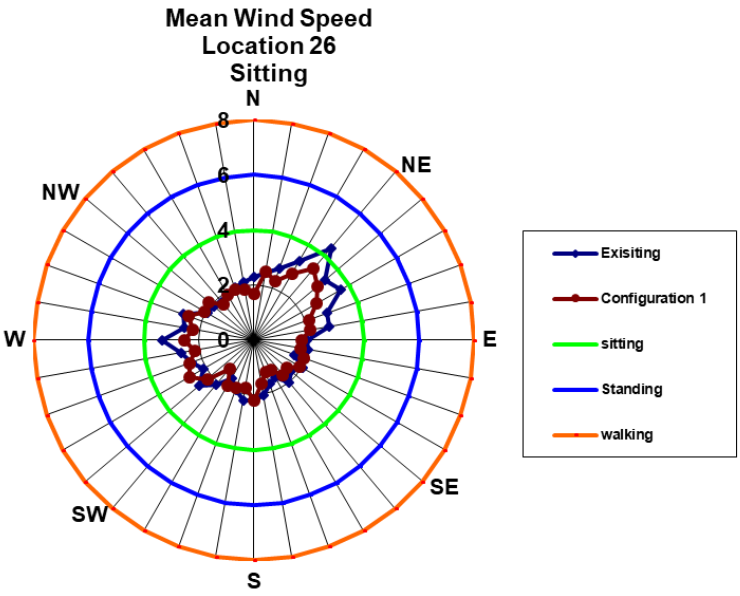


Figure 17: Polar plot of the hourly mean wind speeds compared to the comfort criterion (Location 26).

Based on the tests conducted, the following points were observed.

6.1 Safety Criterion Test

All locations within the immediate vicinity of the proposed development measured gust windspeeds within the recommended safety criterion. As such, no recommendations for wind amelioration was made.

6.2 Comfort Criteria

6.2.1 Pedestrian Footpath and Accessways

Locations 1-6, 10-12, 18, 20-24 and 28-36

All locations within the immediate vicinity of the proposed development measured wind speeds within the recommended walking comfort criterion. As such, no recommendations for wind amelioration was made.

6.2.2 Building Entrances

Locations 7-9, 13, 15 and 16

All main building entrances within the proposed development measured wind speeds within the recommended standing comfort criterion. As such, no recommendations for wind amelioration was made.

6.2.3 Seating Areas

Locations 14, 17, 19 and 25-27

Most outdoor seating areas within the proposed development measured wind speeds within the recommended sitting comfort criterion. Location 17 exceeded this criterion from the westerly direction. As such, an arbour structure above the seating area is recommended at this location (Figure 18).

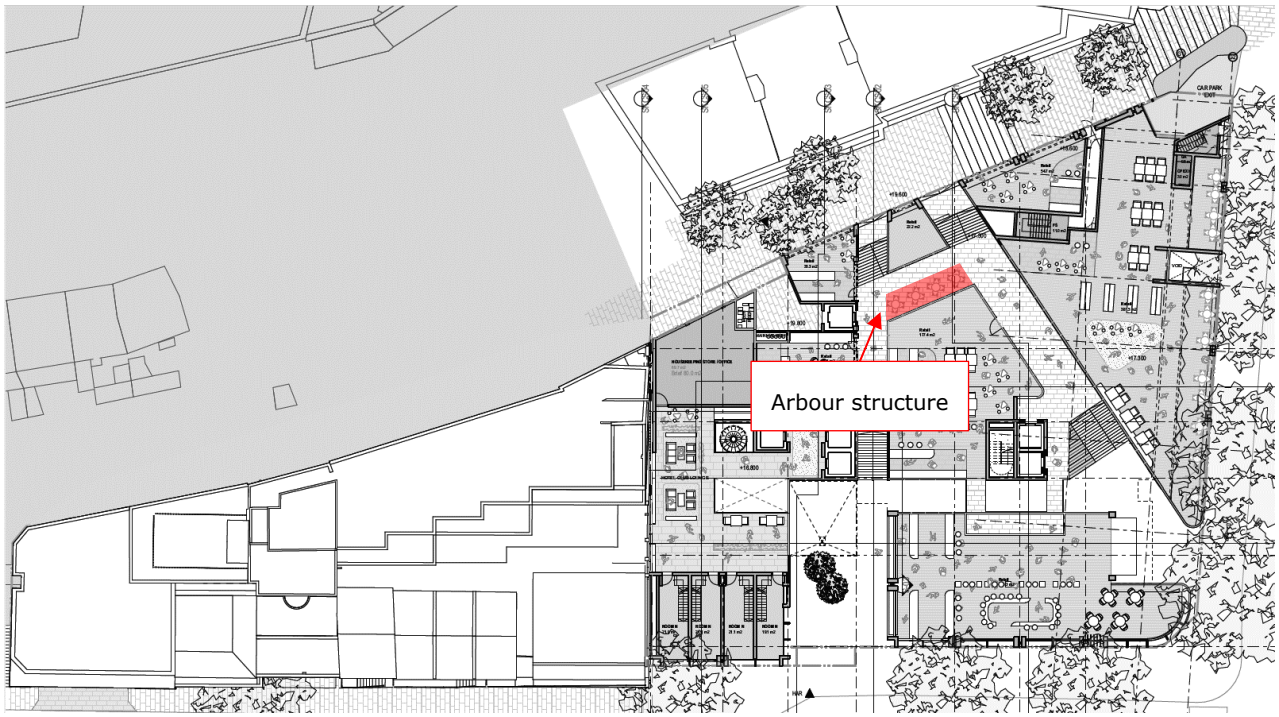


Figure 18: Recommendations for wind amelioration overlaid on Upper Ground level plan.

6.2.4 Communal Terraces

Locations 37-44

Many of the communal terrace areas within the proposed development measured wind speeds within the recommended standing comfort criterion.

Location 40 exceeded this criterion from the west and north east. As such, 1.5m high shrubbery is recommended at this location (Figure 19).

Locations 42-44 also exceeded this criterion from the west. As such, 1.5m high shrubbery is recommended along the perimeter, in addition to the western most seating bench back to be minimum 1m high (Figure 19).

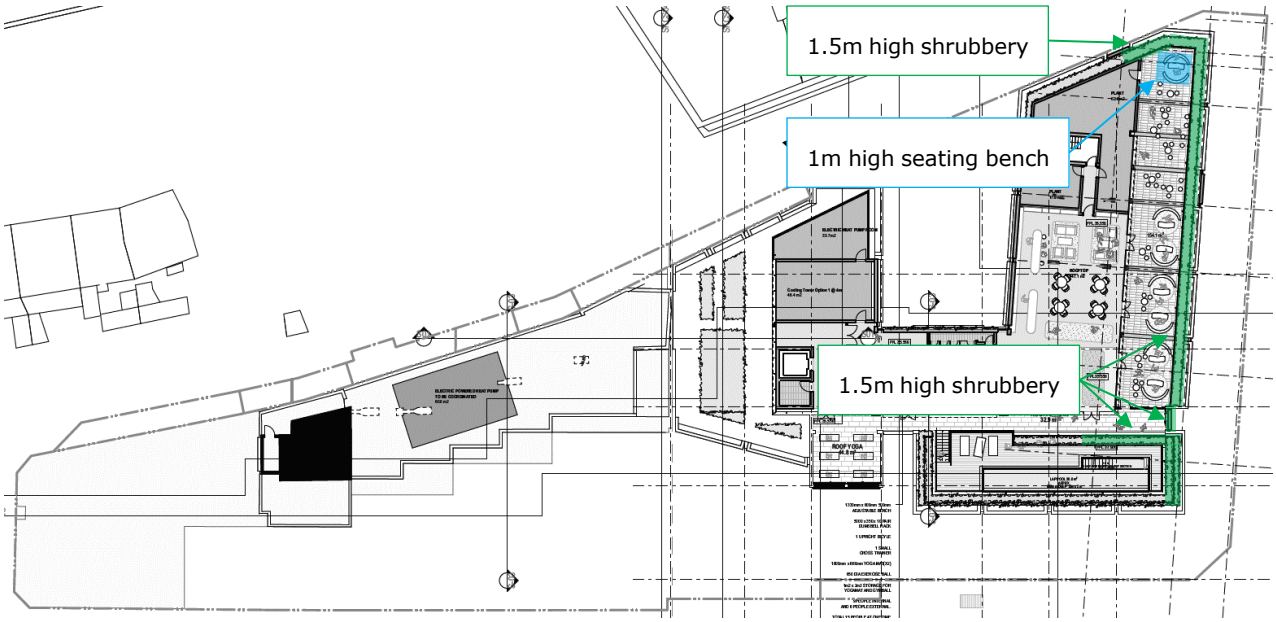


Figure 19: Recommendations for wind amelioration overlaid on the Level 6 plan.

7 Updated Drawing Assessment

Updated drawings were provided by **FJMT** in **November 2022**. A comparison between the **November 2022** drawings and the **September 2022** drawings used in the wind tunnel test were made and the following observations were drawn:

Lower Ground Level Plan (Figure 20)

No significant changes were made on this level in the updated plans. As such, wind speeds are expected to be within the recommended comfort criteria for their respective locations, as per the wind tunnel test.

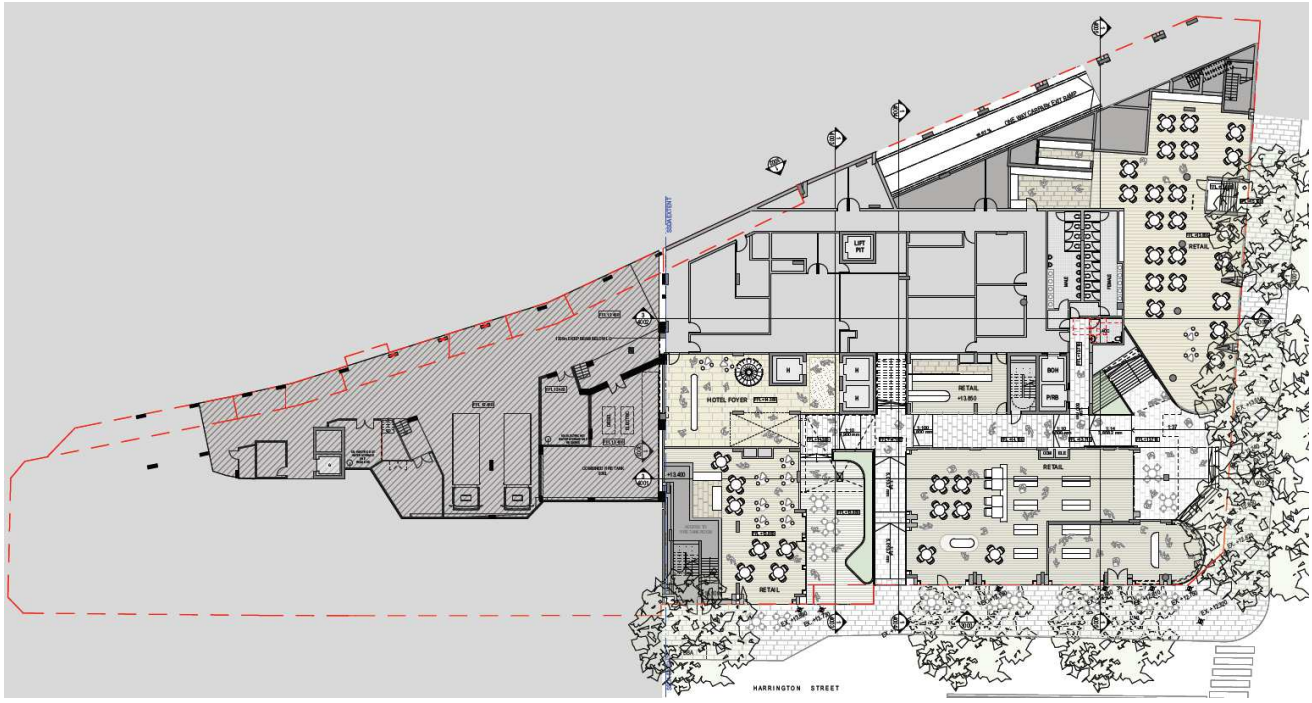


Figure 20: Lower ground floor plan (design received in November 2022).

Upper Ground Level Plan (Figure 21)

The Retail unit west of site along Cambridge Road (trapezoid in shape) has been removed in the updated plans, and the seating area has been relocated at this location while a new entrance is proposed. Wind tunnel testing has shown that this area (Location 17) exceeded wind speeds within the standing comfort criterion but over the sitting comfort criterion. As such, the arbour structure recommended during wind tunnel testing is still recommended for the updated plans (over the intended seating area).

A new entrance is proposed to the Retail unit on the east. However, considering the low wind speeds recorded during testing in the immediate area, wind speeds at this location is expected to be within the recommended standing comfort criterion.

No other significant changes were made on this level in the updated plans.

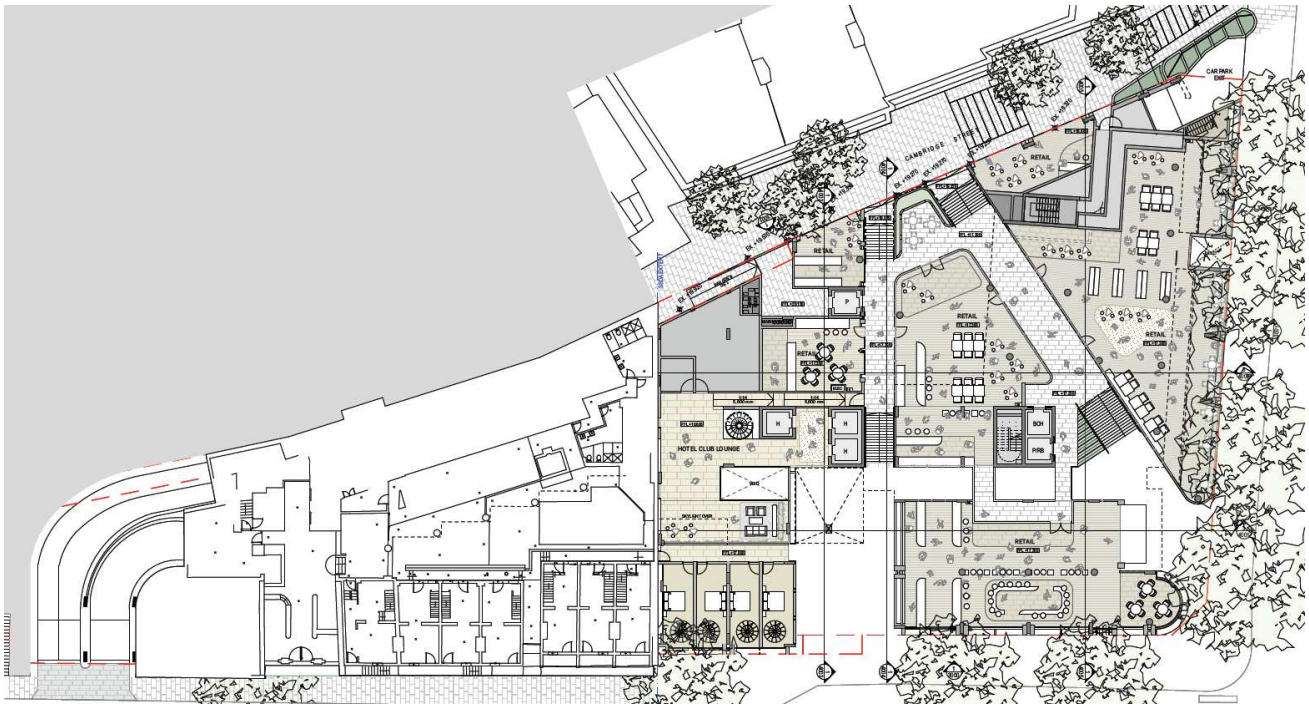


Figure 21: Upper ground floor plan (design received in November 2022).

Level 06 Plan (Figure 22)

The Pool area is approximately 0.5m above Roof Yoga and outdoor bar areas in the updated plans (previously 2.3m higher). This is not expected to significantly affect the wind environment. As such, the wind control measures recommended during wind tunnel testing are still recommended for the updated plans.

No other significant changes were made on this level in the updated plans.

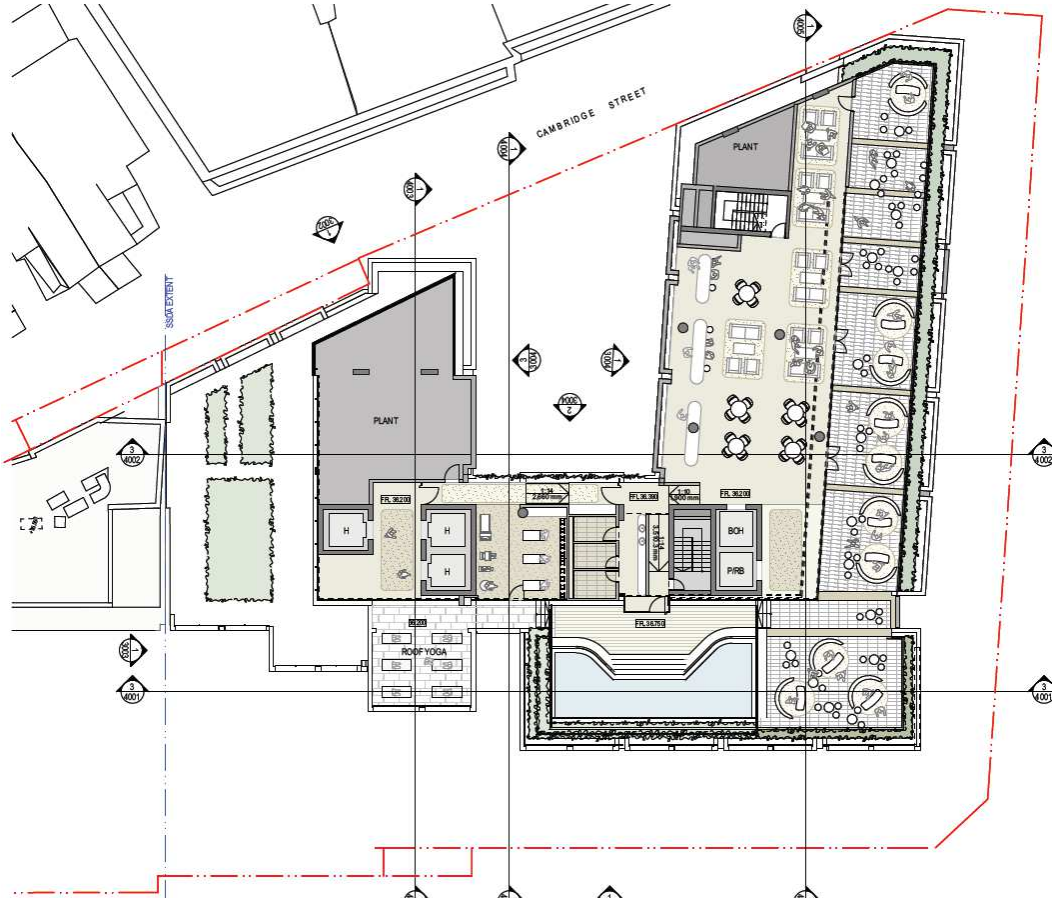


Figure 22: Level 6 floor plan (design received in November 2022).

Elevations (Figure 23)

The development height remains the same at approximately 23.3m from street level (varies on street). As such, wind speeds are expected to be within the recommended comfort criteria for their respective locations, as per the wind tunnel test.

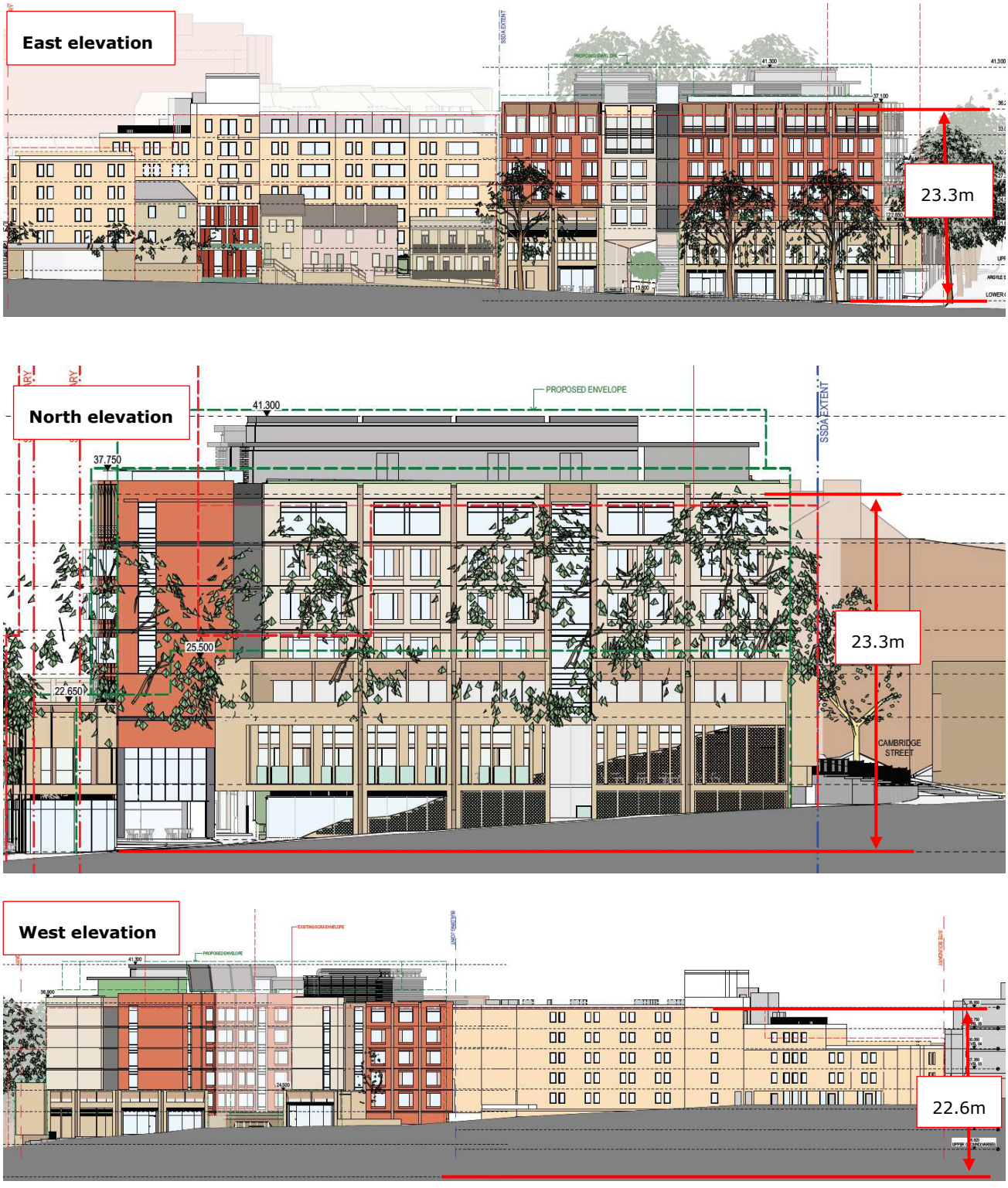


Figure 23: North, west and east elevations (design received in November 2022).

8 Conclusion

Vipac has carried out an assessment of the pedestrian level winds for the proposed development at **35-55 Harrington Street, The Rocks** based on a scaled wind tunnel test. This report has been prepared in accordance with relevant requirements of the SEARs (Environmental Amenity and Public Space).

A comparison was made between the **September 2022** plans used for wind tunnel testing against the updated plans received in **November 2022**. As there were no significant massing changes, the results obtained for all other locations during the September 2022 testing remains valid with the updated drawings.

As such, findings of the comparative study are summarised as follows:

The proposed design of the development:

- fulfils the recommended criterion for **Safety** at all test locations;
- fulfils the recommended criterion for **Walking** at all footpath locations;
- fulfils the recommended criterion for **Standing** at all building entrances;
- fulfils the recommended criterion for **Sitting** at the seating areas **with recommendations**; and
- fulfils the recommended criterion for **Standing** at all communal terraces **with recommendations.**

The proposed development would not cause a significant adverse impact on the adjacent areas.

As a general statement, common to all new developments, educating occupants about wind conditions at high-level terraces/balconies during high-wind events and tying down loose furniture are highly recommended.

Appendix A References

1. Australian/New Zealand Standard 1170.2:2002, Wind actions
2. Melbourne, W. H., "Criteria for Environmental Wind Conditions", Jour. Industrial Aerodynamics, Vol. 3, 241-249, 1978
3. Simiu E, Scanlan R, "*Wind Effects on Structures*". Wiley-Interscience
4. Aynsley R., Melbourne W., Vickery B., *Architectural Aerodynamics* Applied Science Publishers

Appendix B Drawing List

Received: November 2022

Name

DA-20B1 Basement Level 01.pdf

DA-20B2 Basement Level 02.pdf

DA-20LG Lower Ground Level.pdf

DA-20UG Upper Ground Level.pdf

DA-2000 Level 00 - 01.pdf

DA-2001 Level 02 - 04.pdf

DA-2002 Level 05 - 06.pdf

DA-2007 Roof Plan.pdf

DA-3000 East Elevation (Harrington Street).pdf

DA-3001 North Elevation (Argyle Street).pdf

DA-3002 West Elevation (Cambridge Street).pdf

DA-3003 South Elevation.pdf

DA-3004 Internal Elevation.pdf

DA-4001 Section 01.pdf

DA-4002 Section 02.pdf

DA-4003 Section 03.pdf

DA-4004 Section 04.pdf

DA-4005 Section 05.pdf

Received: September 2022

Name

SK-101[05] Carpark B2.pdf

SK-102[05] Carpark B1.pdf

SK-103[05] Lower Ground.pdf

SK-104[05] Upper Ground.pdf

SK-105[05] Level 00.pdf

SK-106[05] Level 01.pdf

SK-107[05] Level 02.pdf

SK-108[05] Level 03.pdf

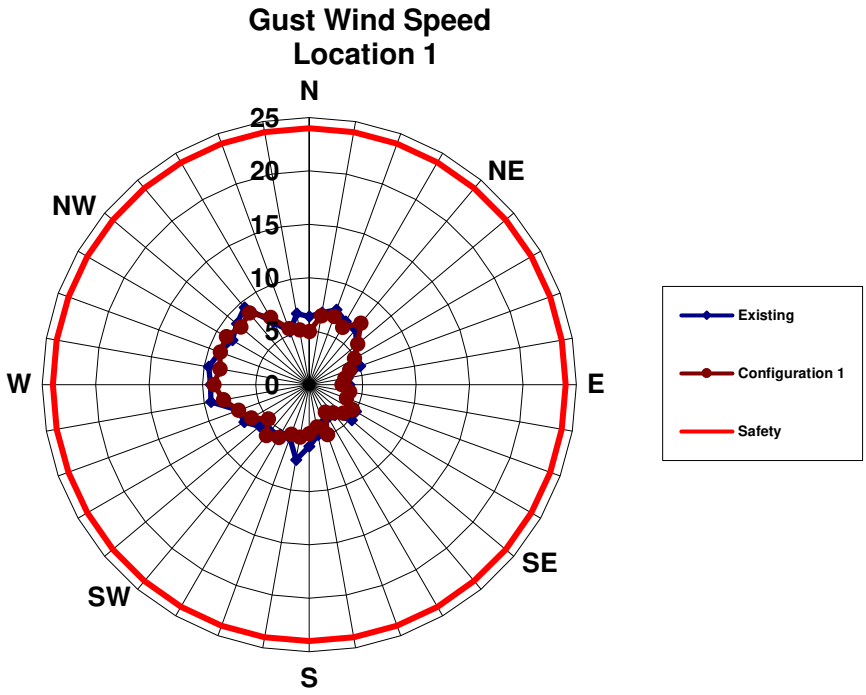
SK-109[05] Level 04.pdf

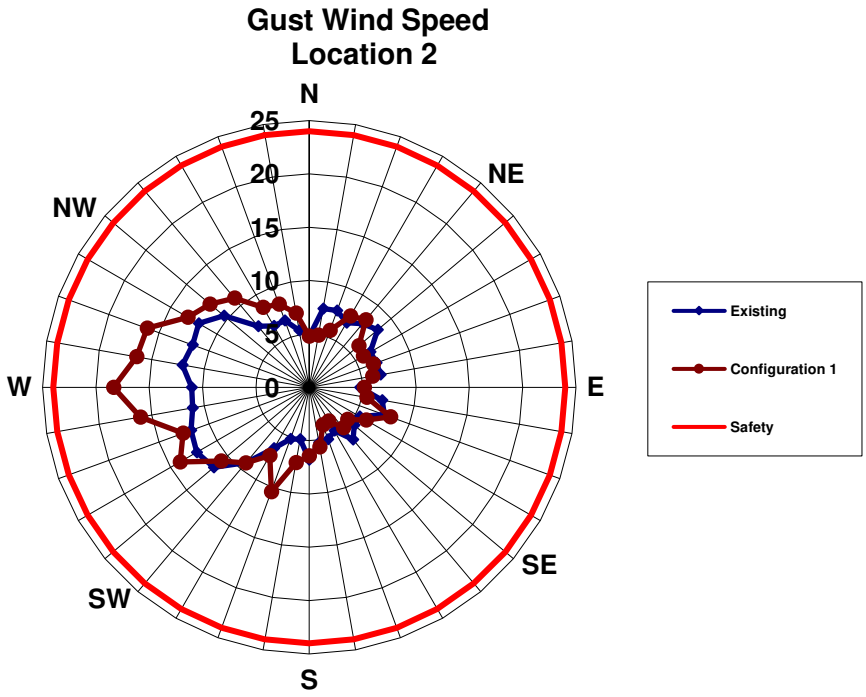
SK-110[05] Level 05.pdf

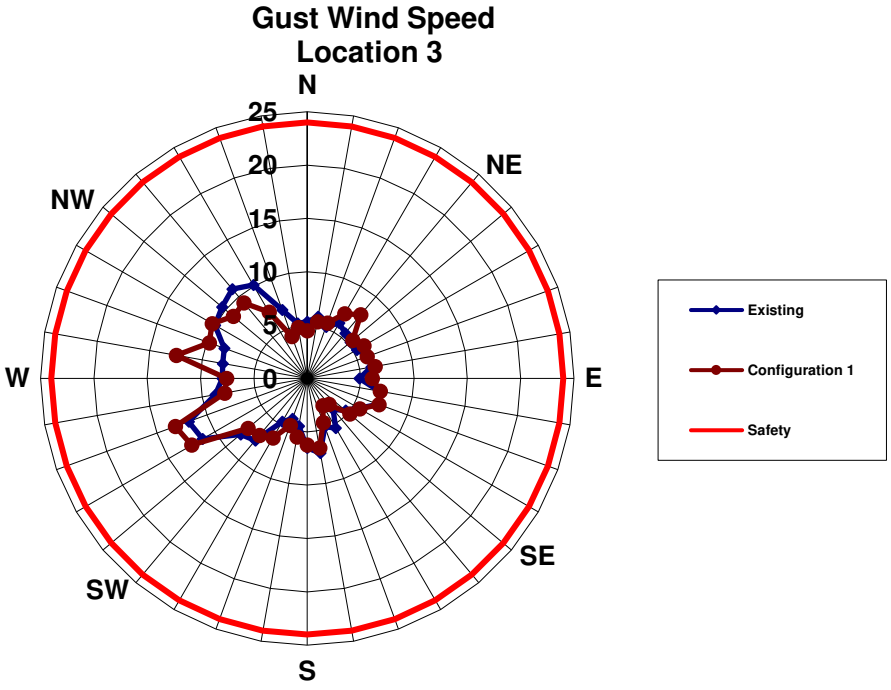
SK-111[05] Level 06.pdf

Appendix C Omni Polar Plots

C.1 Gust Wind Speed (Safety Criterion)



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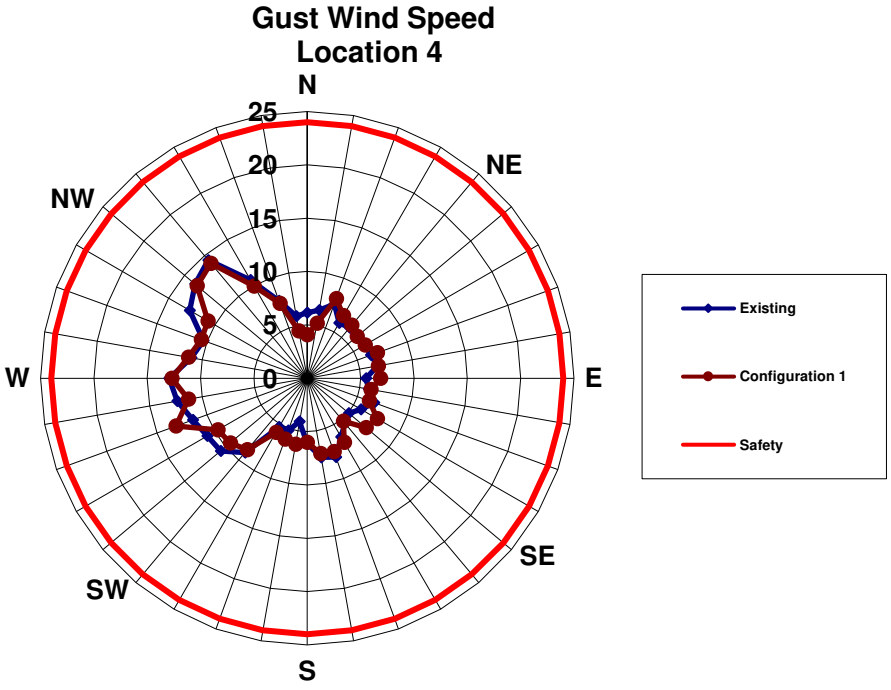
Existing
Configuration 1
Safety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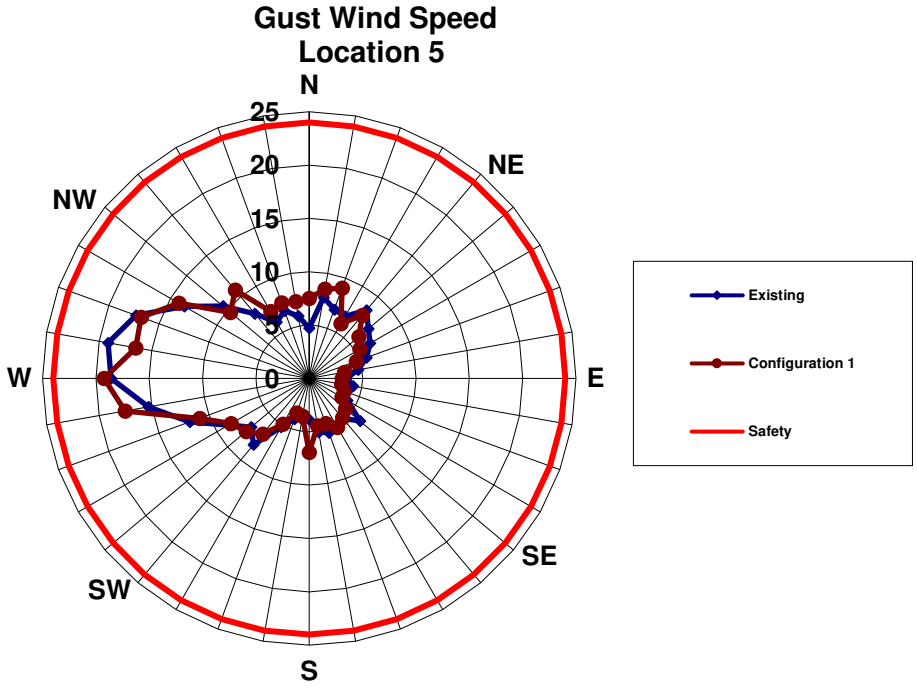
Existing
Configuration 1
Safety


Gust Wind Speed
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Configuration 1
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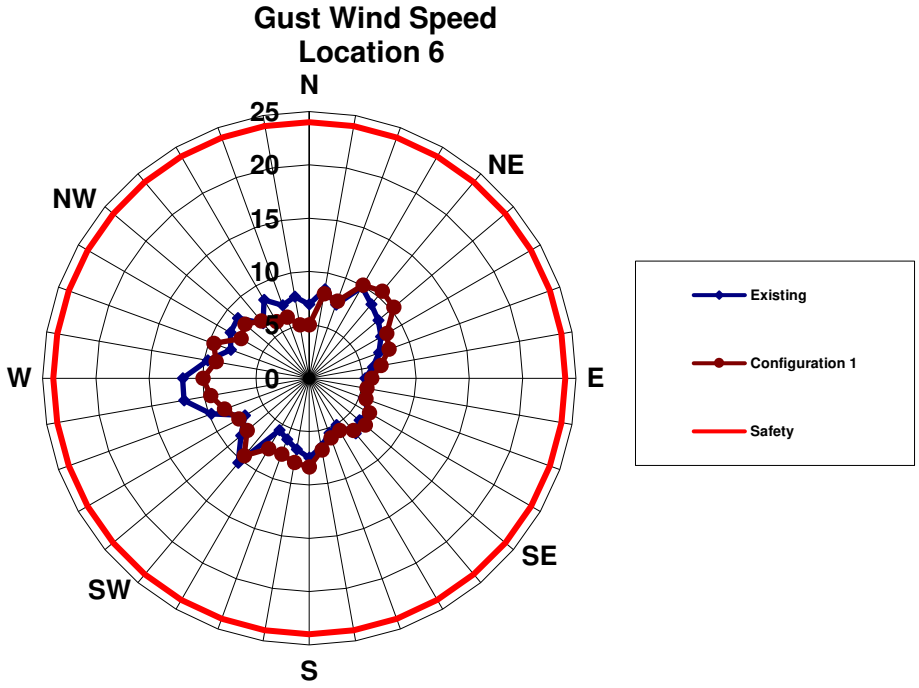
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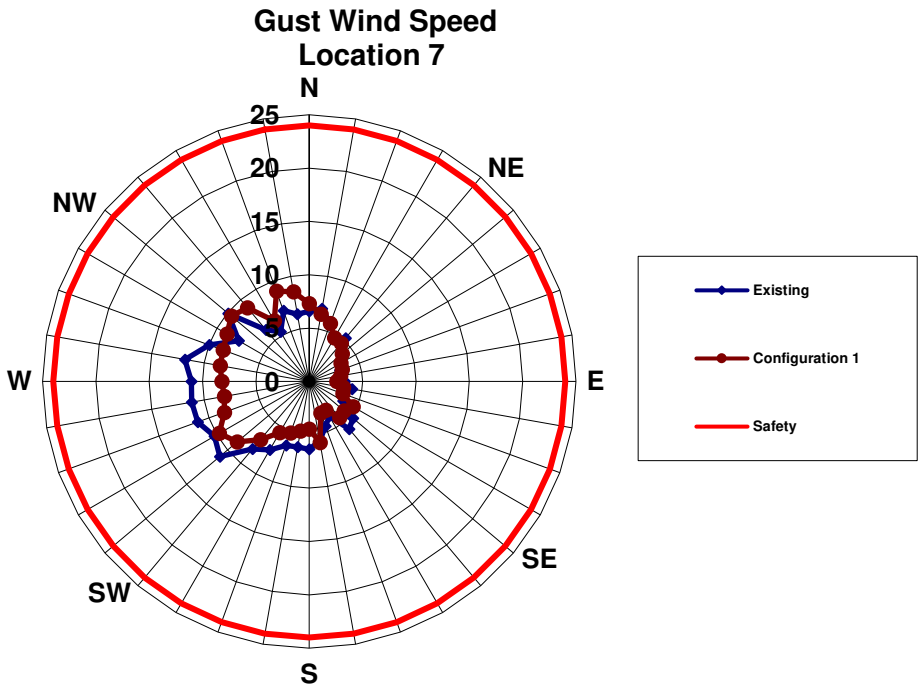
Configuration 1
Safety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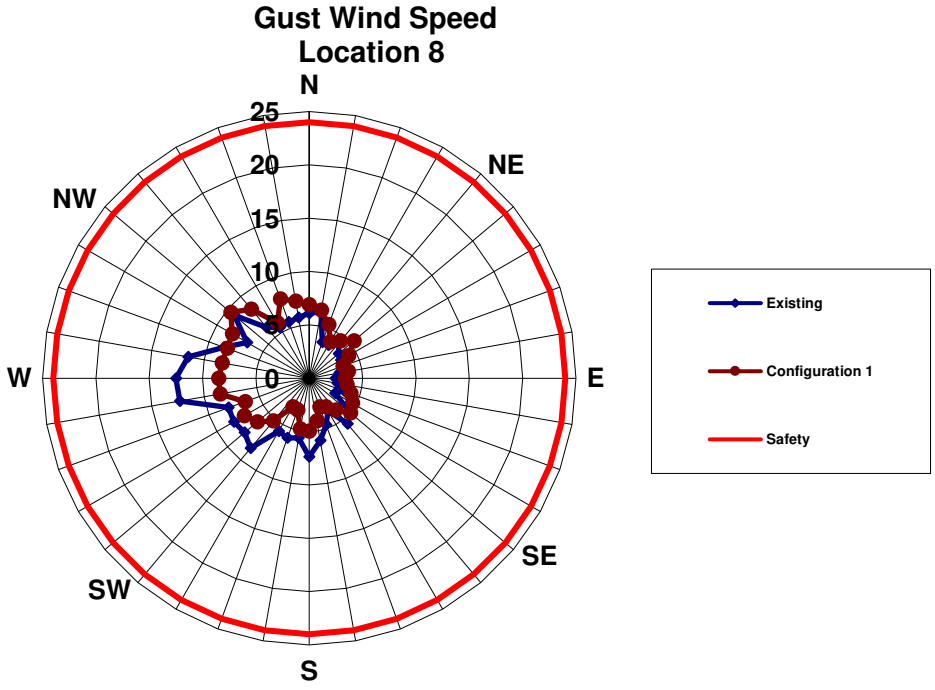
Configuration 1
Safety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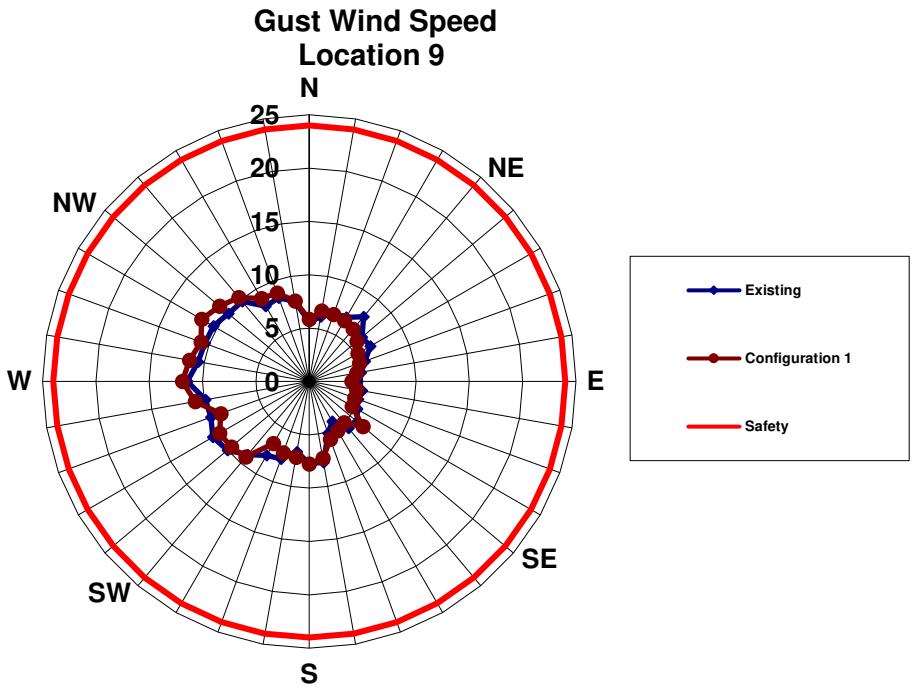
Existing
Configuration 1
Safety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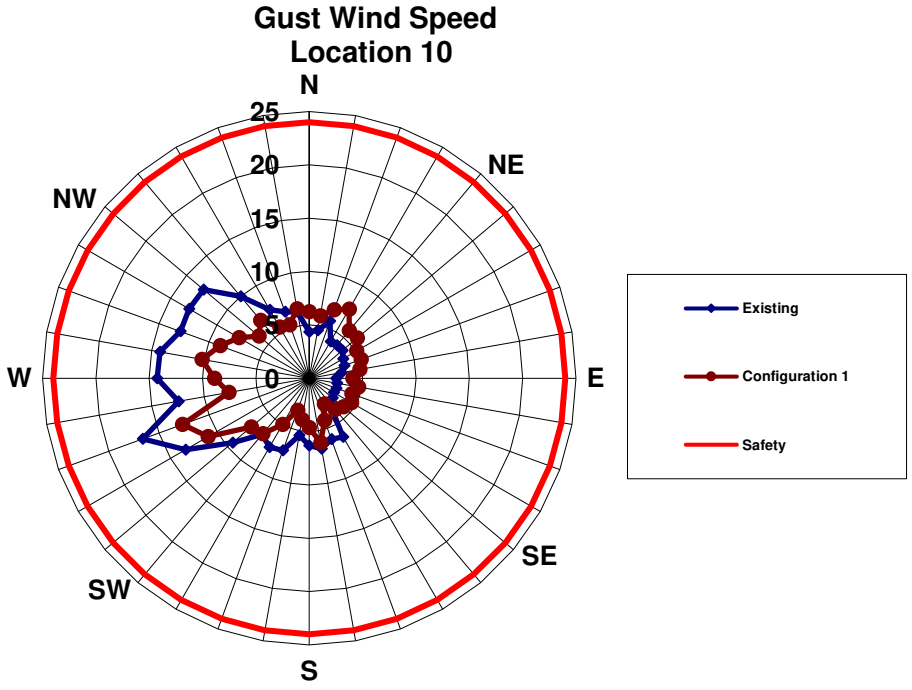
Configuration 1
Safety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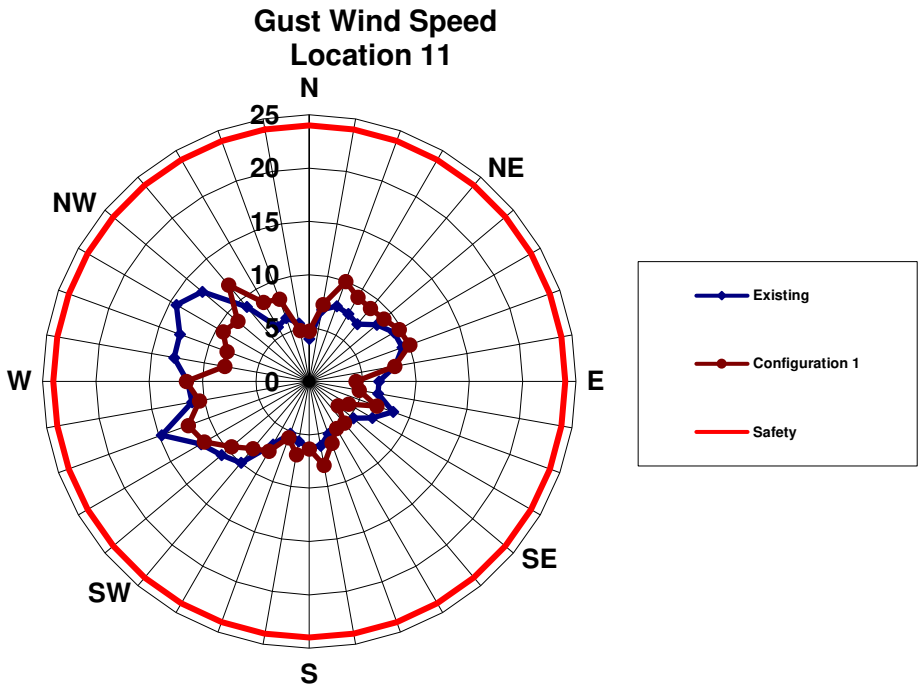
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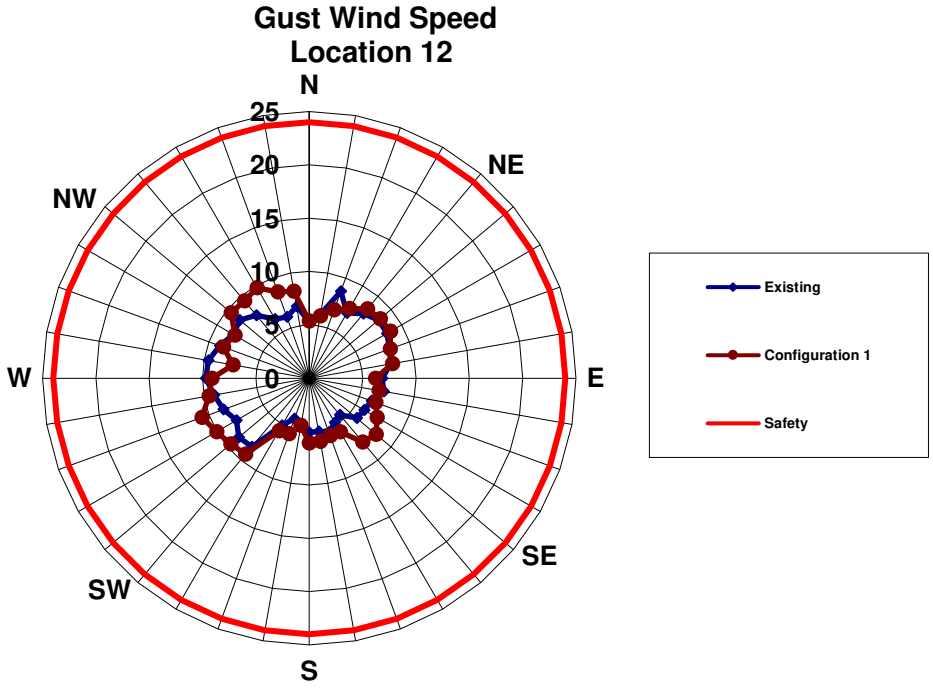
Safety


Gust Wind Speed
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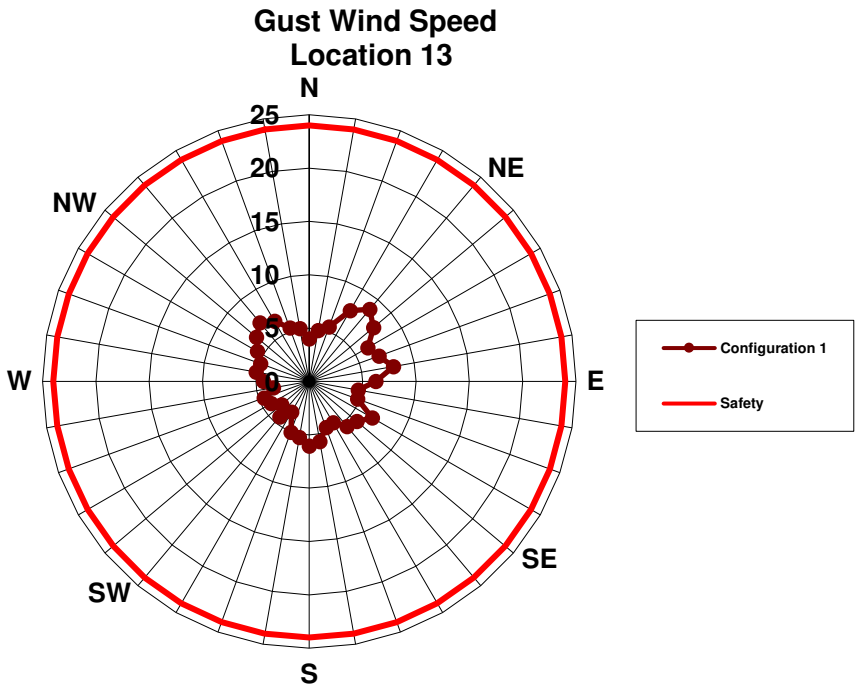
Gust Wind Speed
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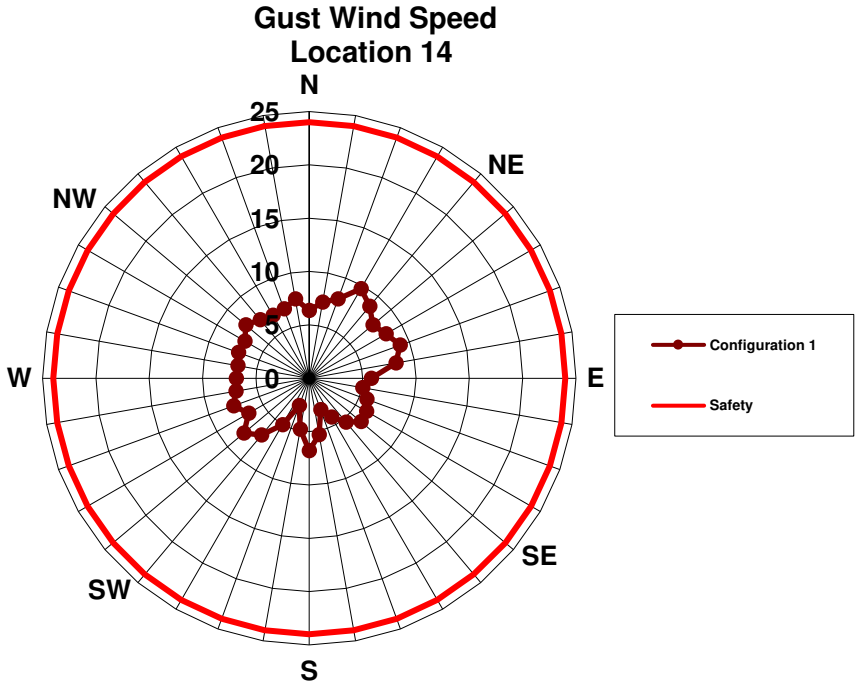
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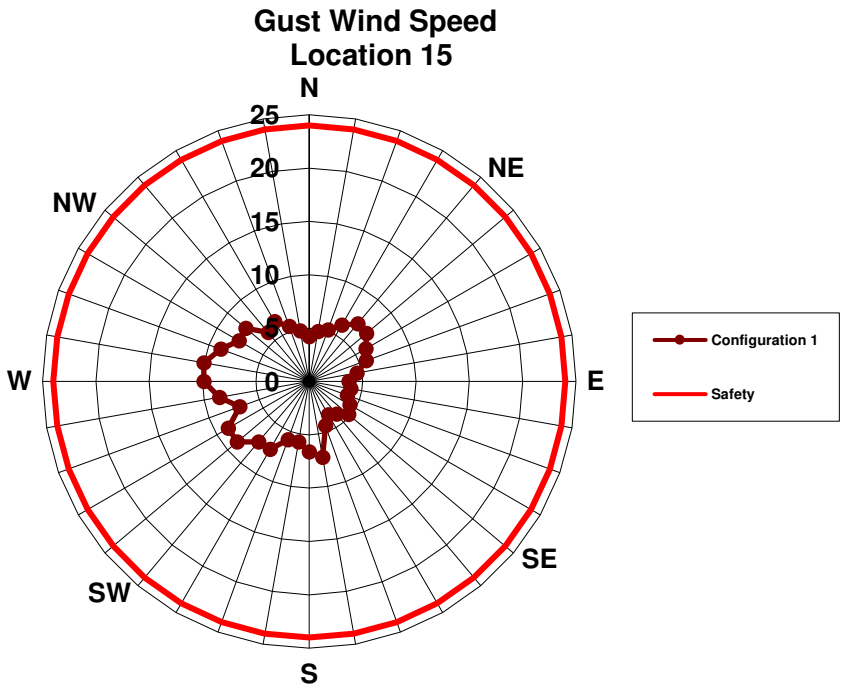
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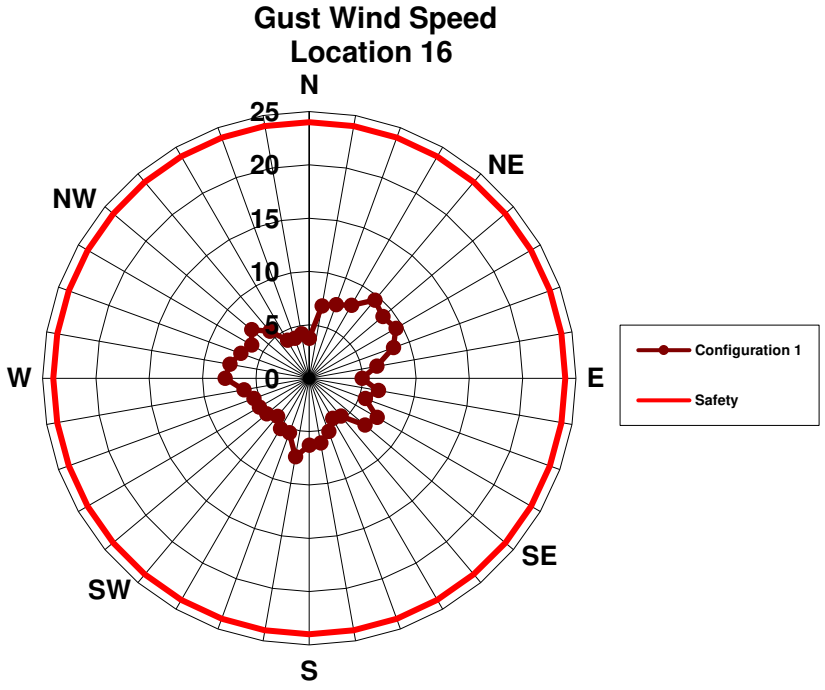
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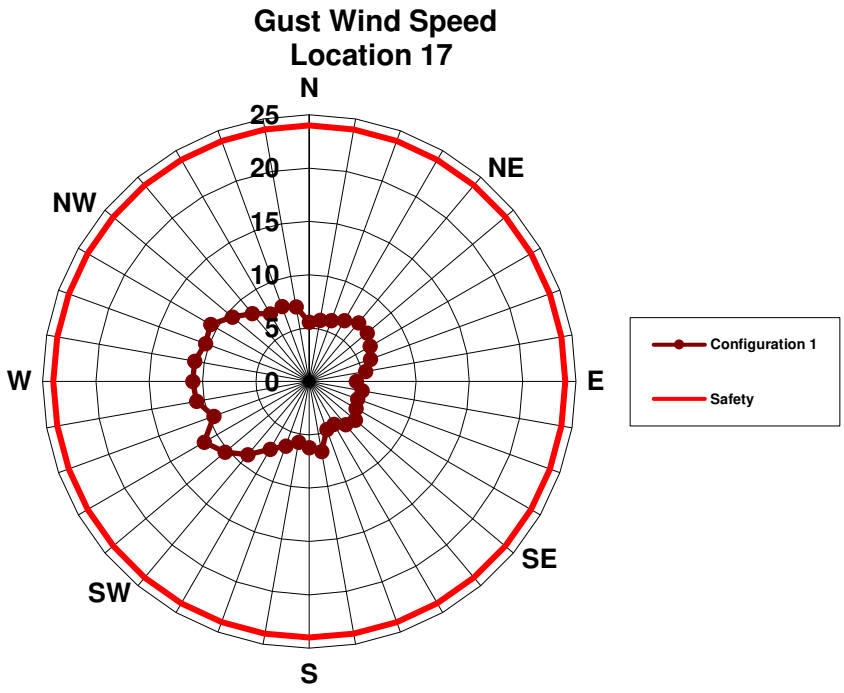
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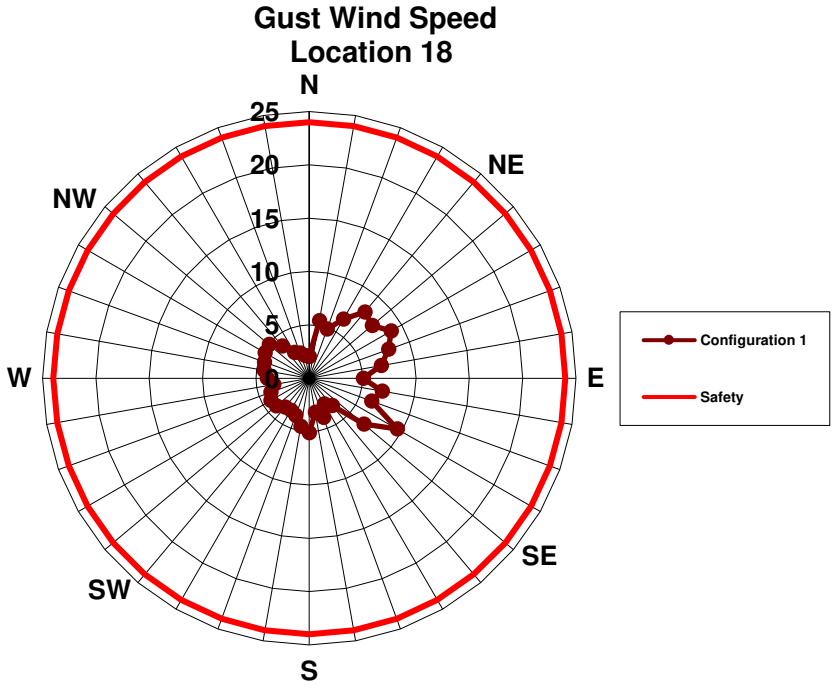
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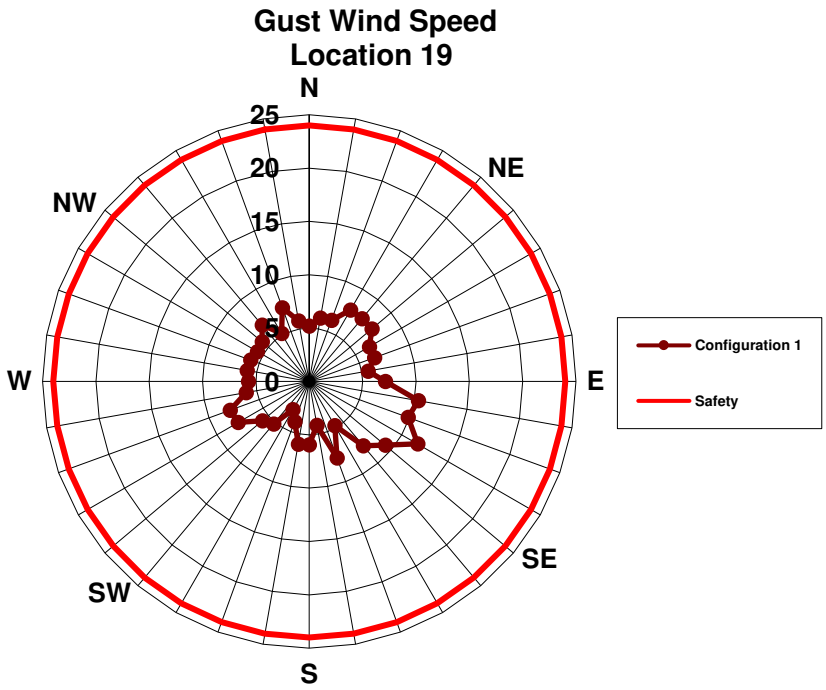
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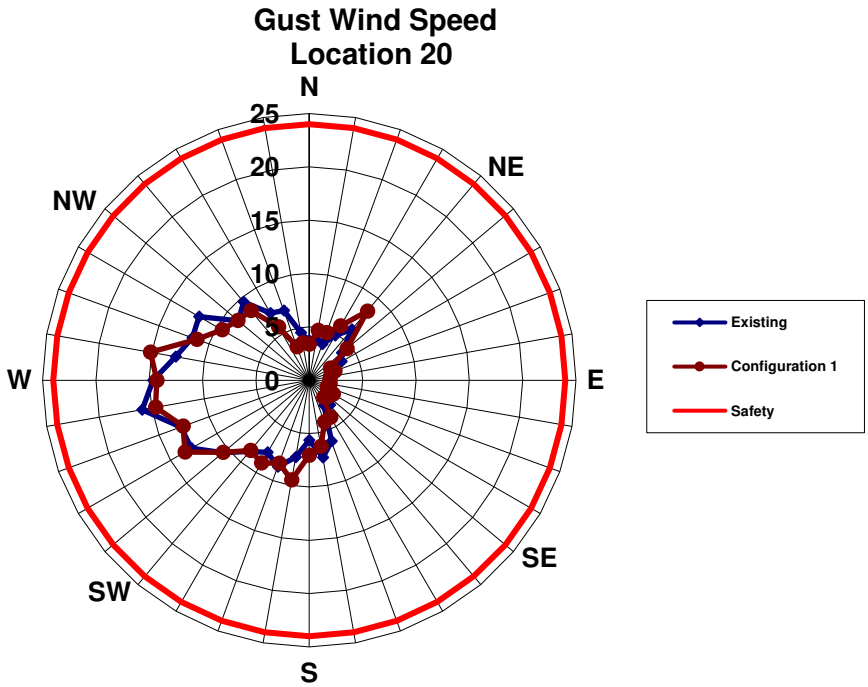
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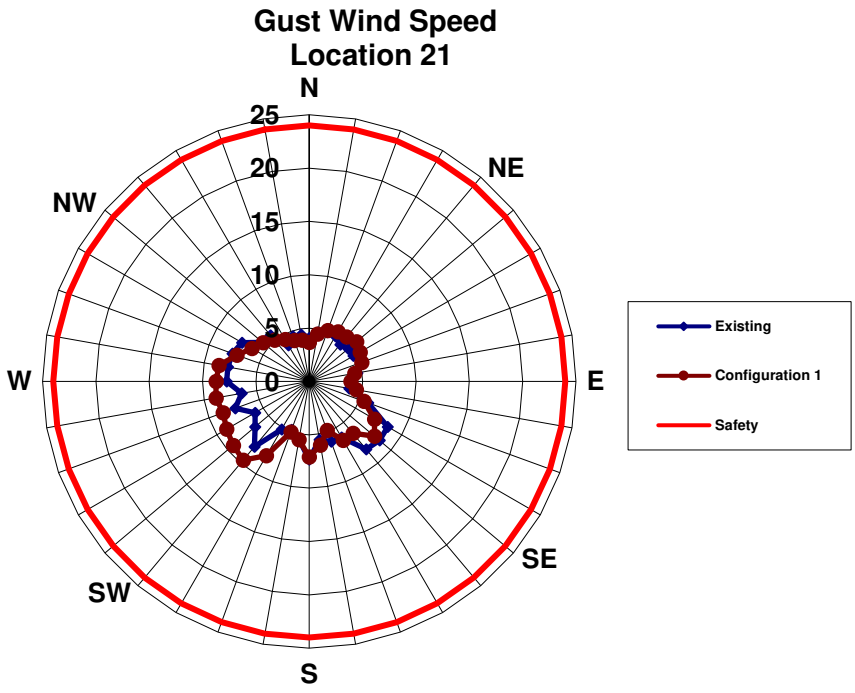
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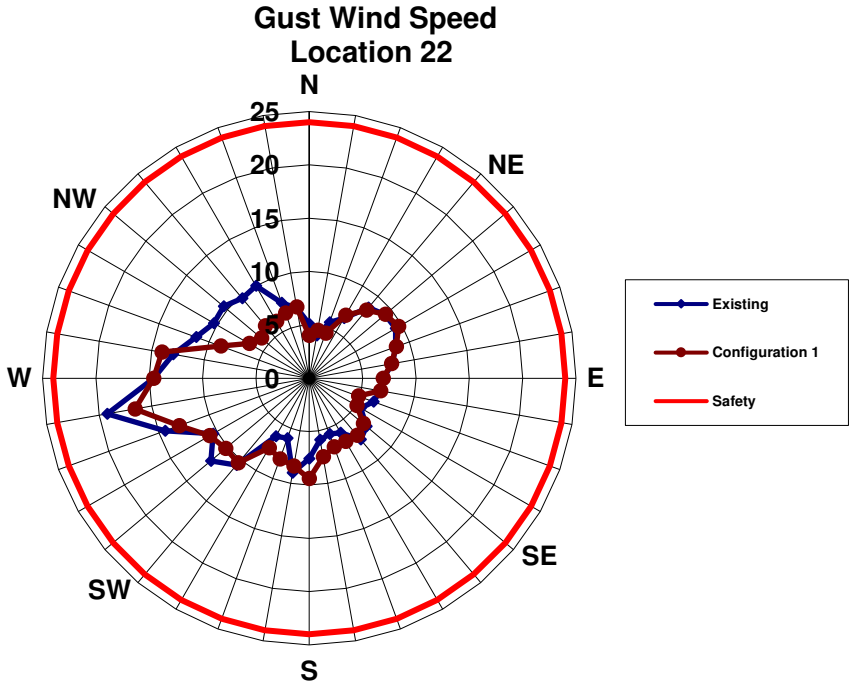
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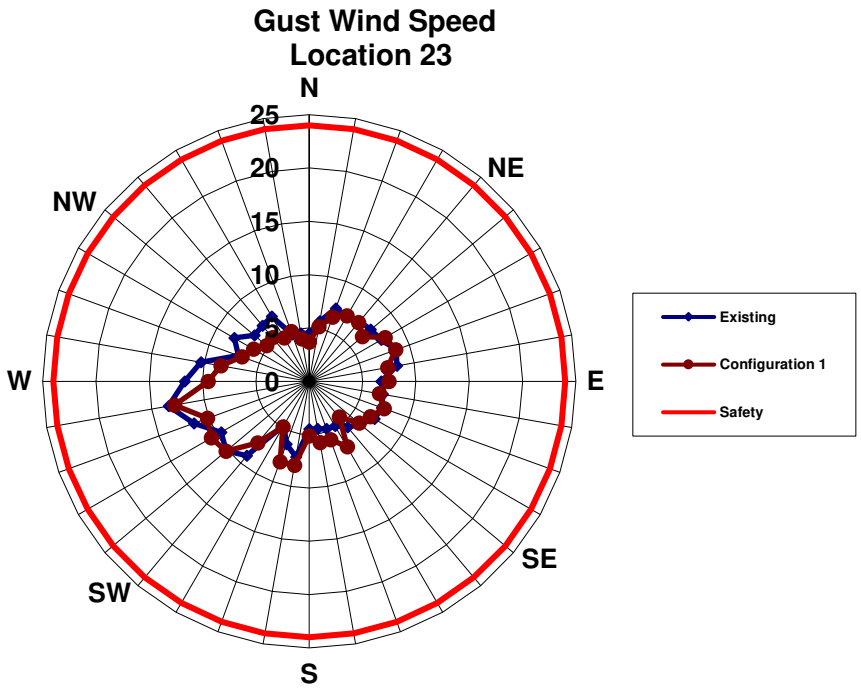
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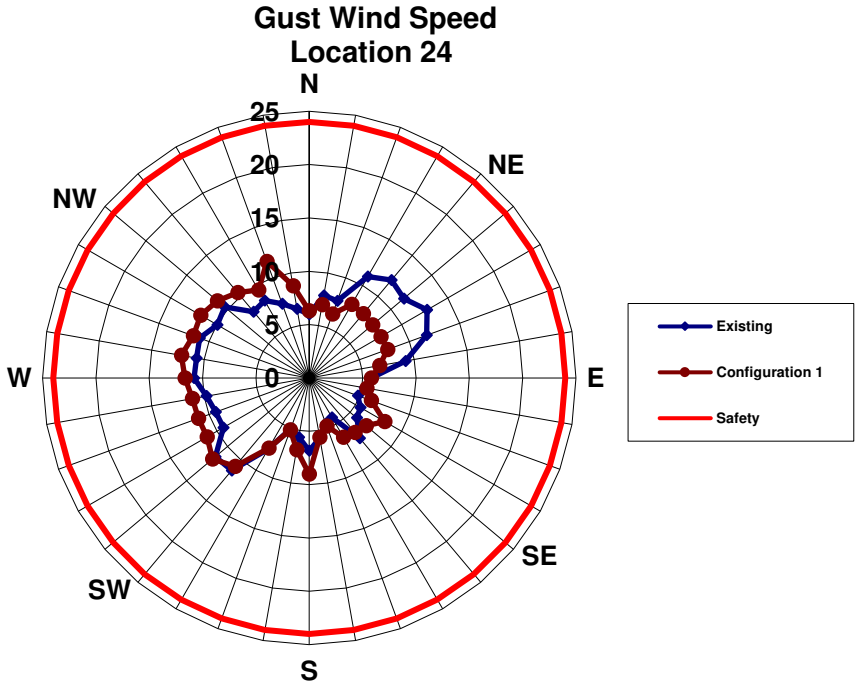
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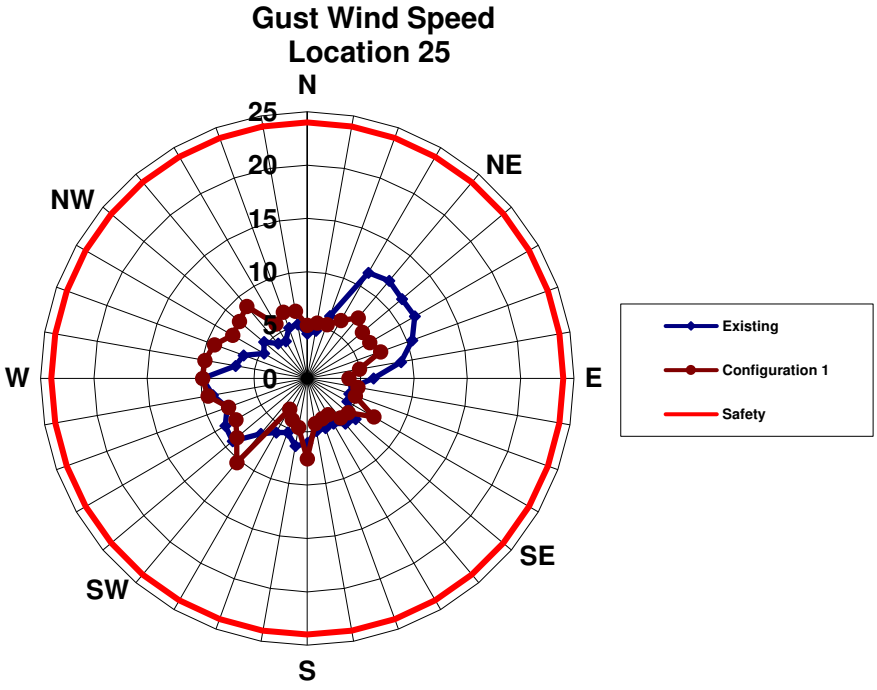
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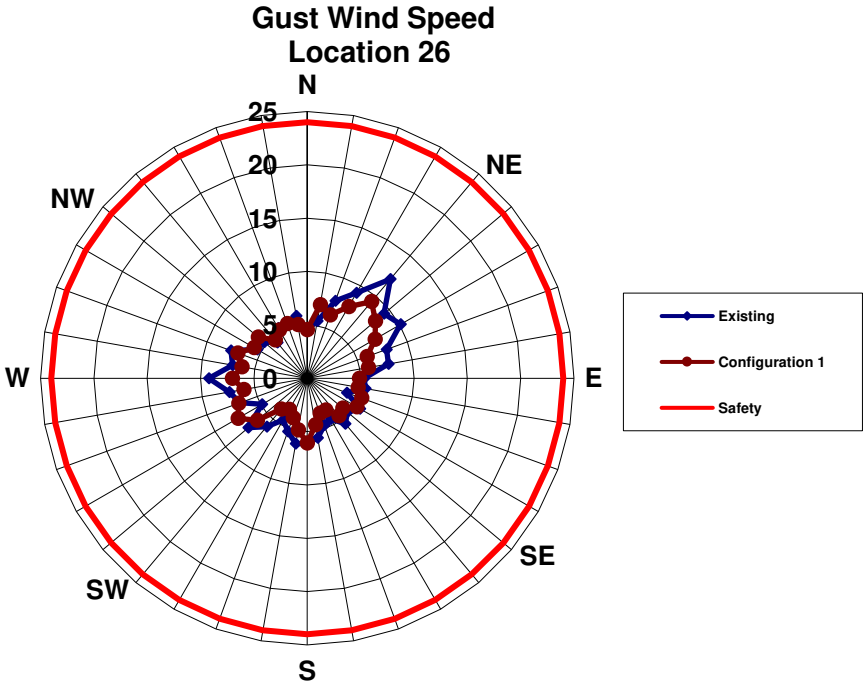
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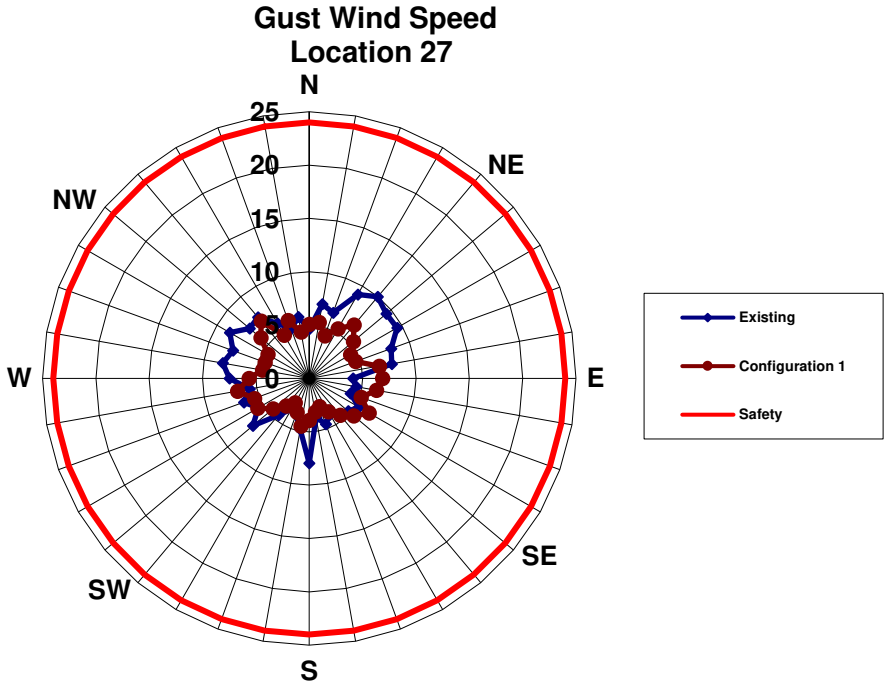
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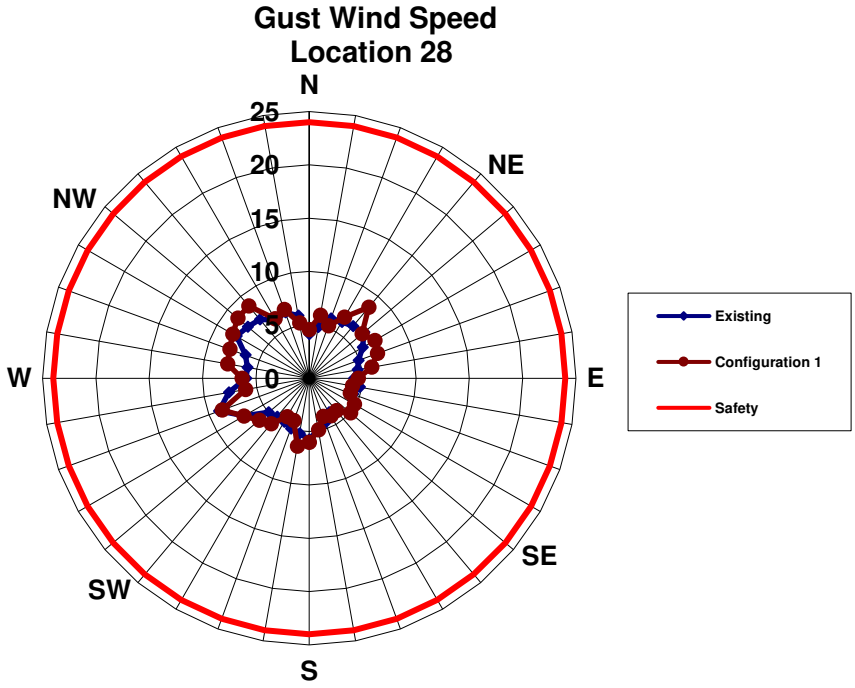
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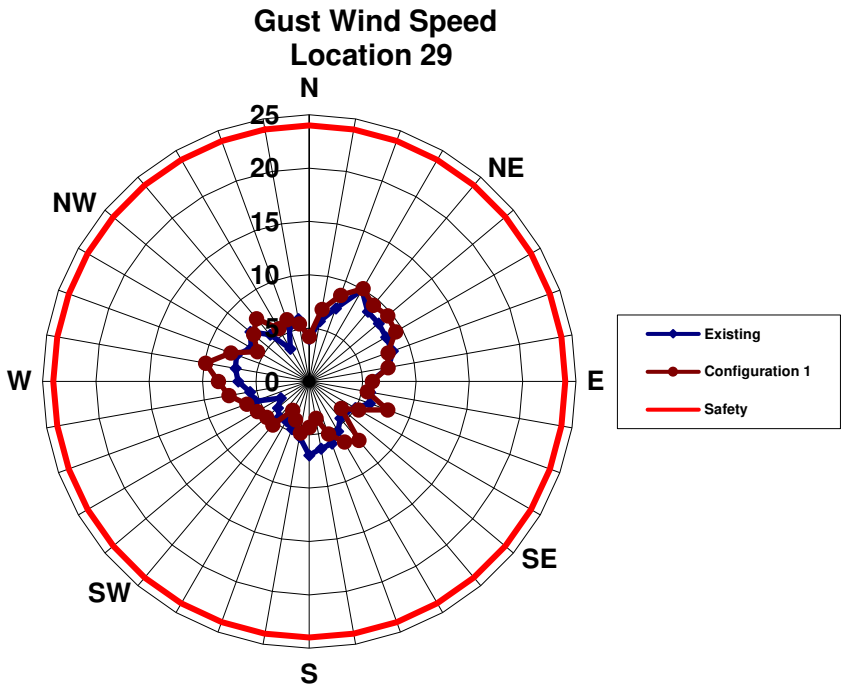
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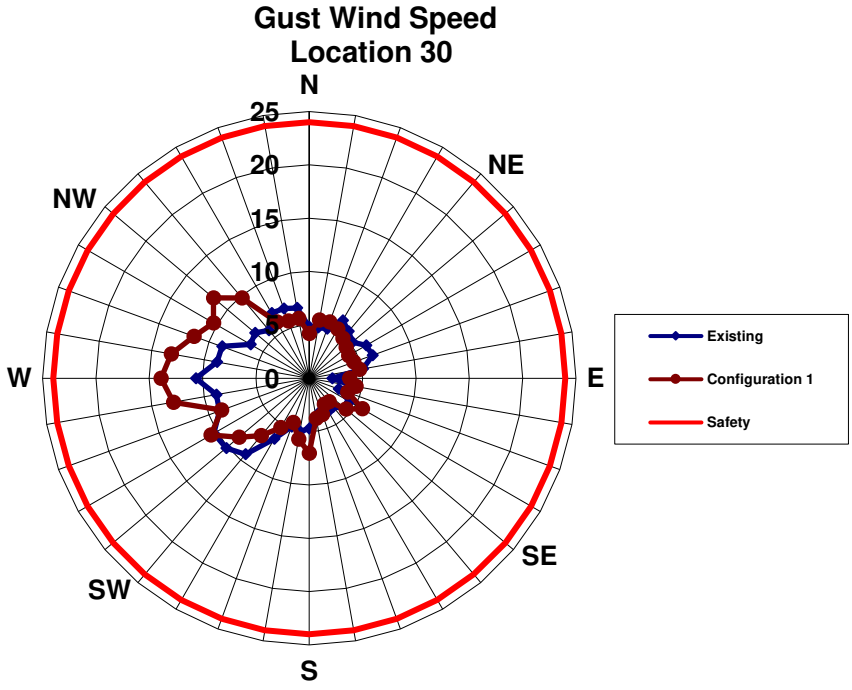
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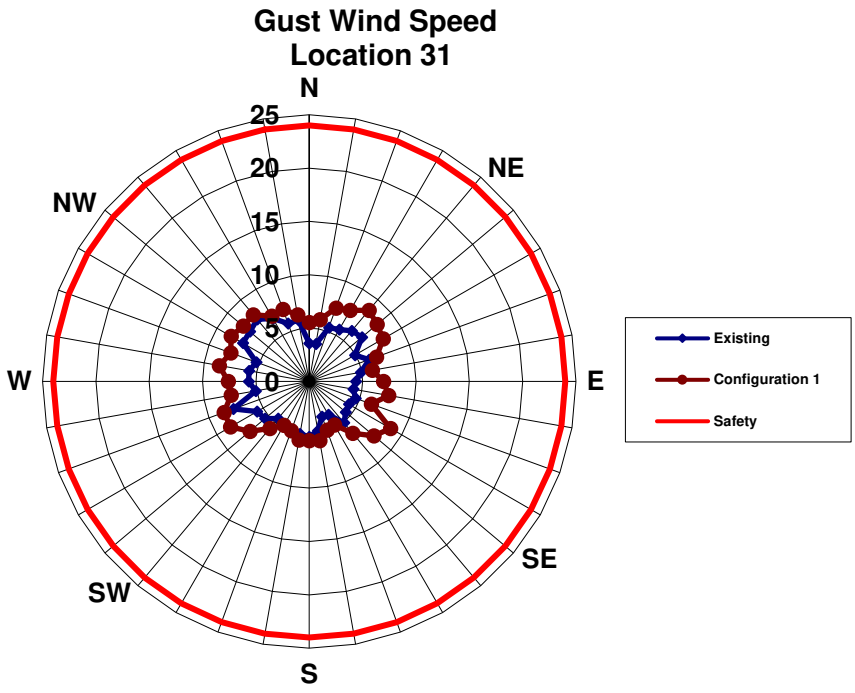
Gust Wind Speed
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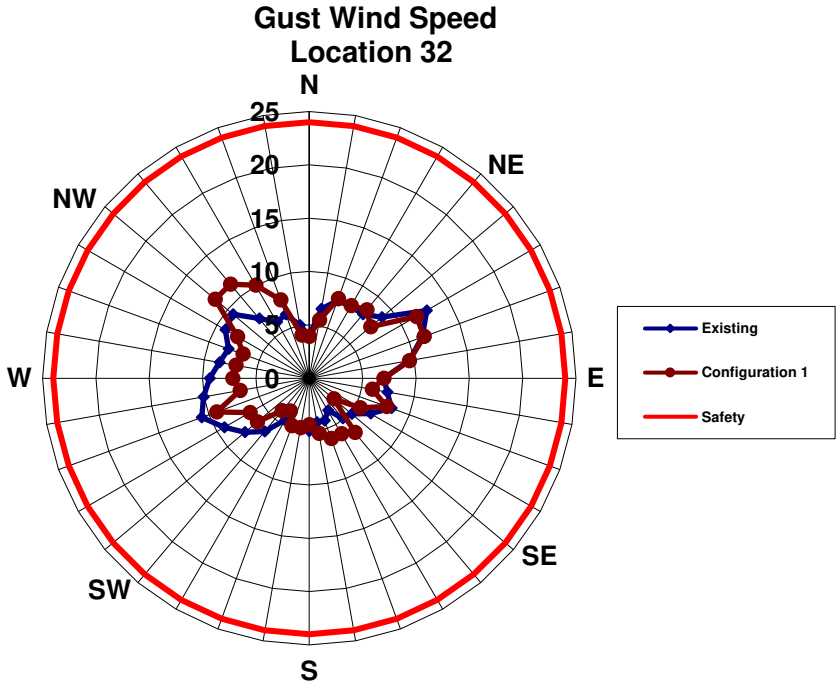
Safety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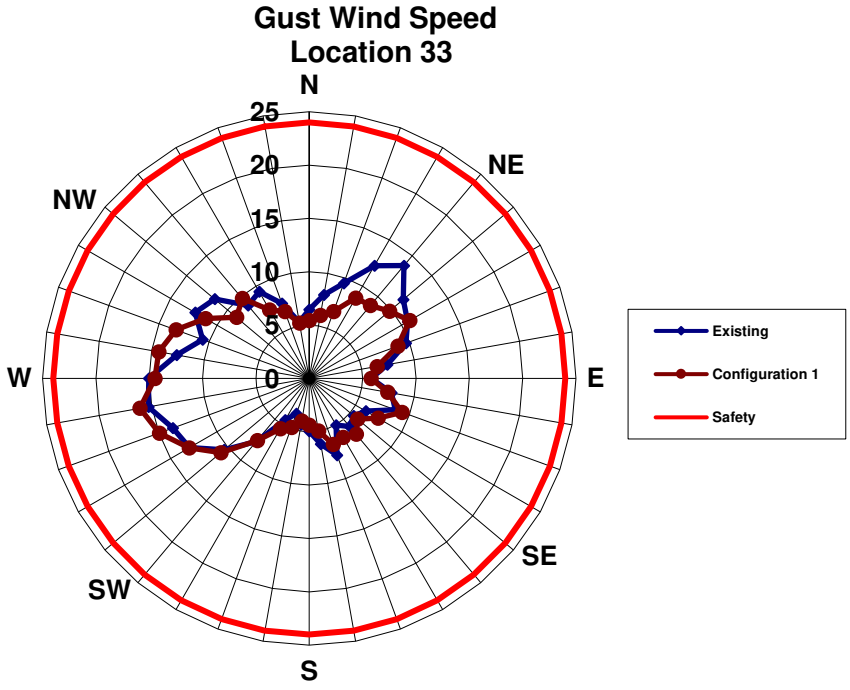
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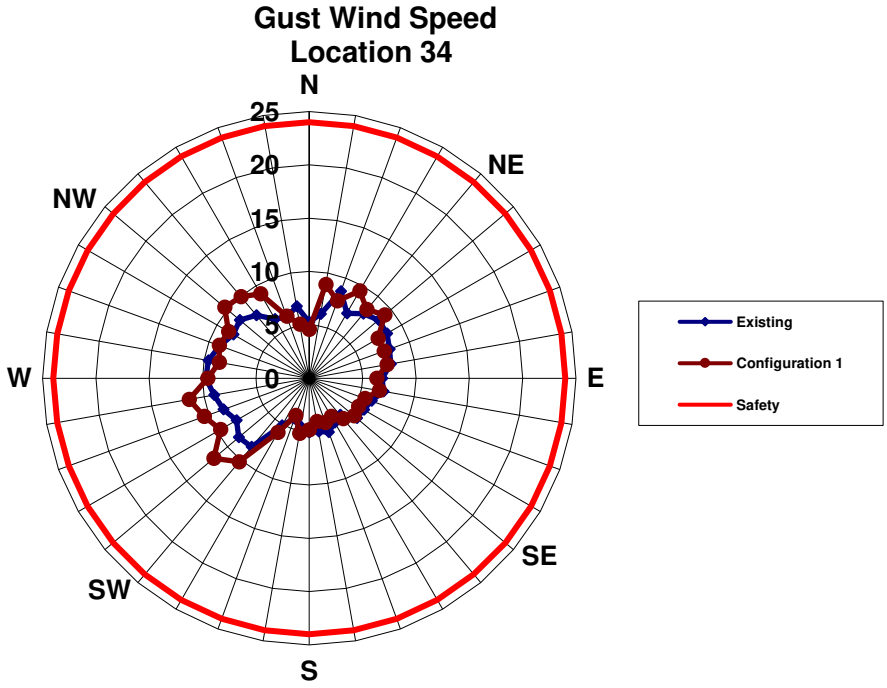
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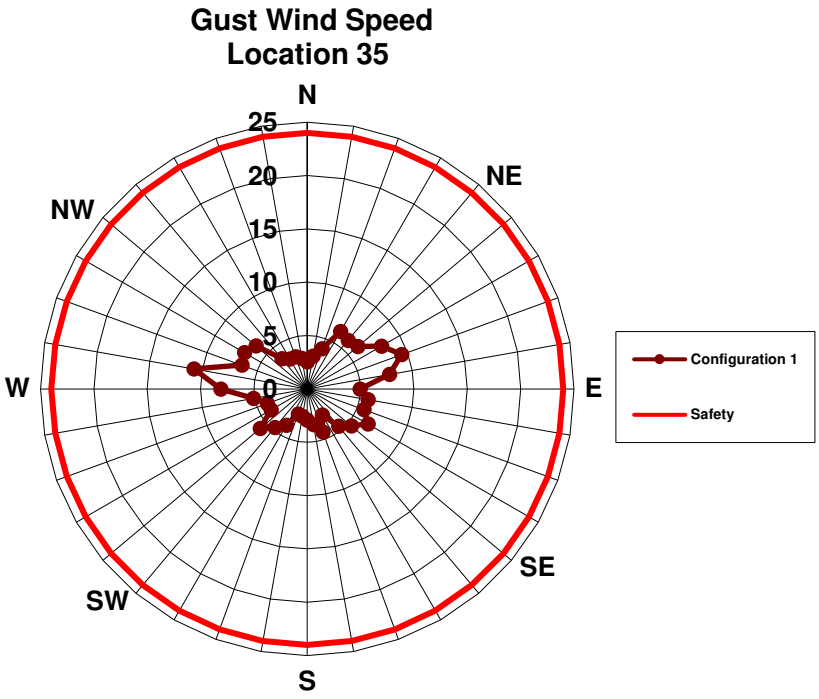
Safety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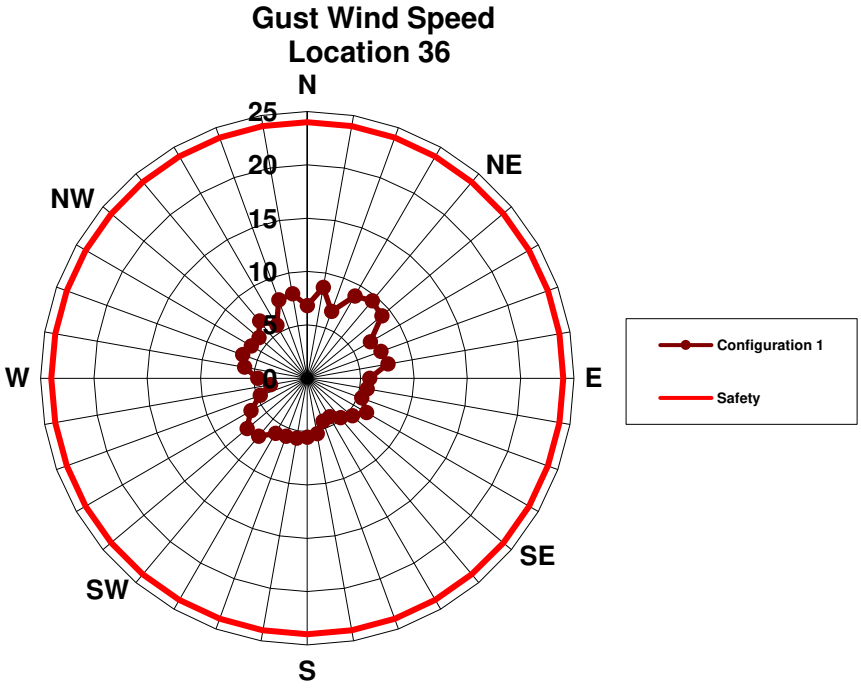
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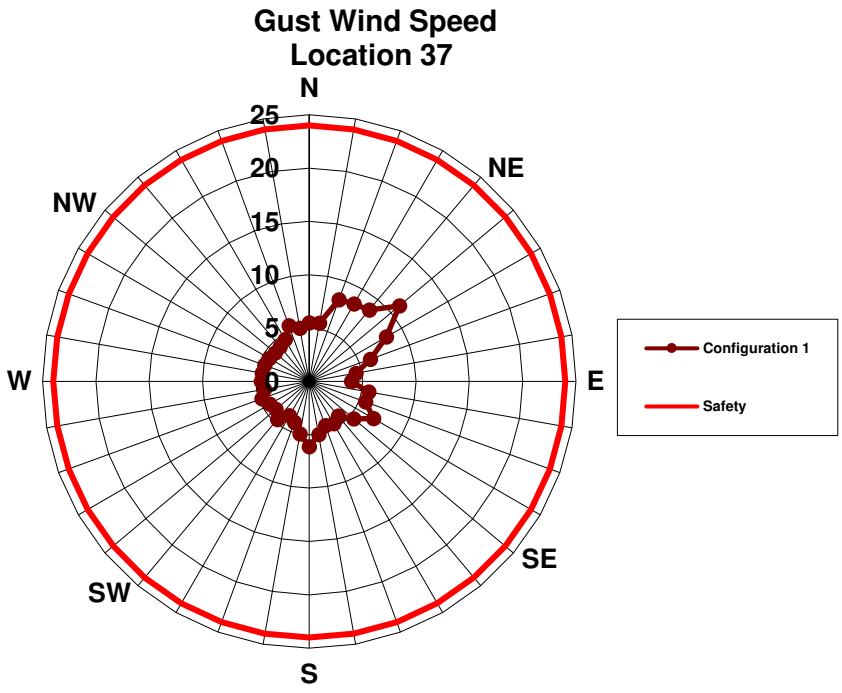
Gust Wind Speed
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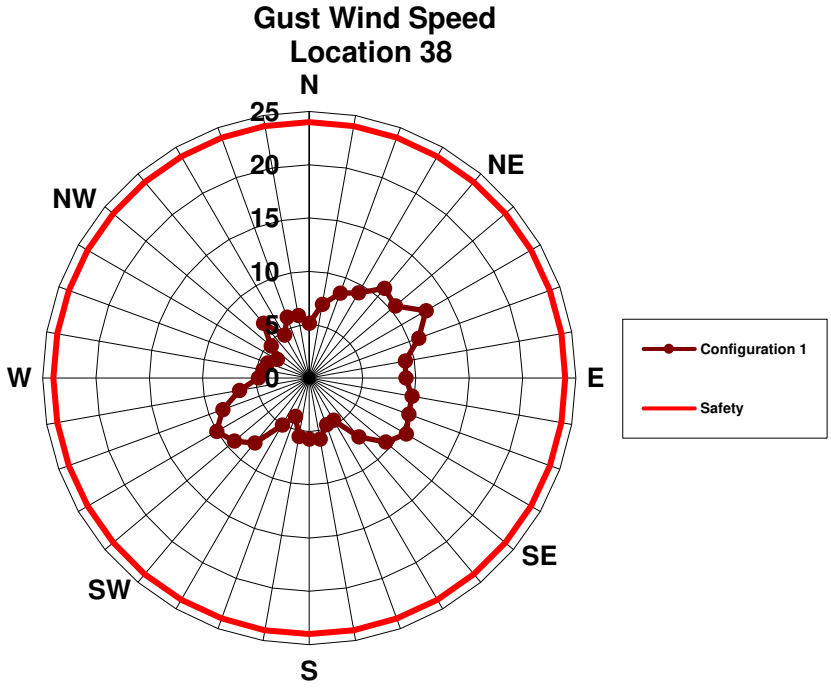
Gust Wind Speed
Location 38
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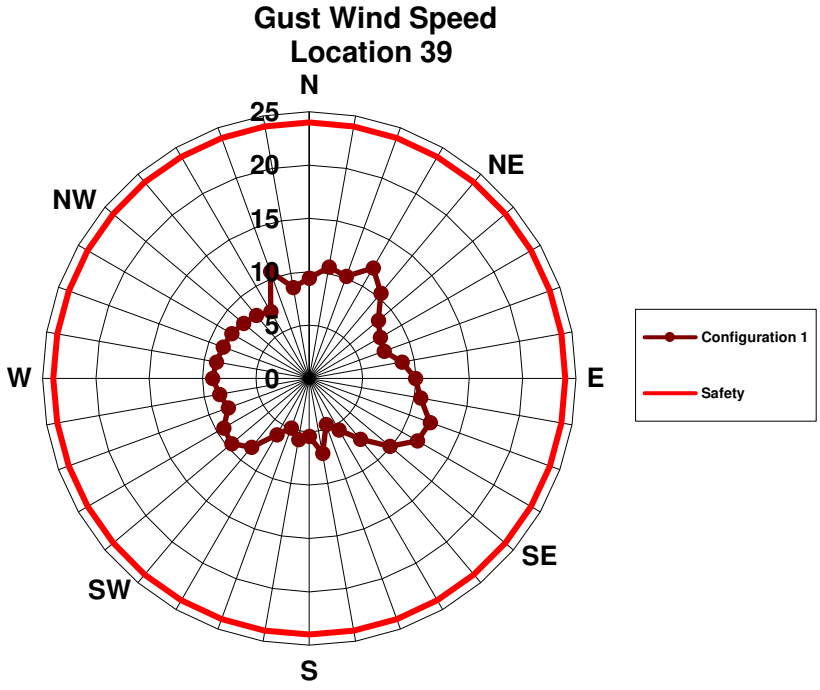
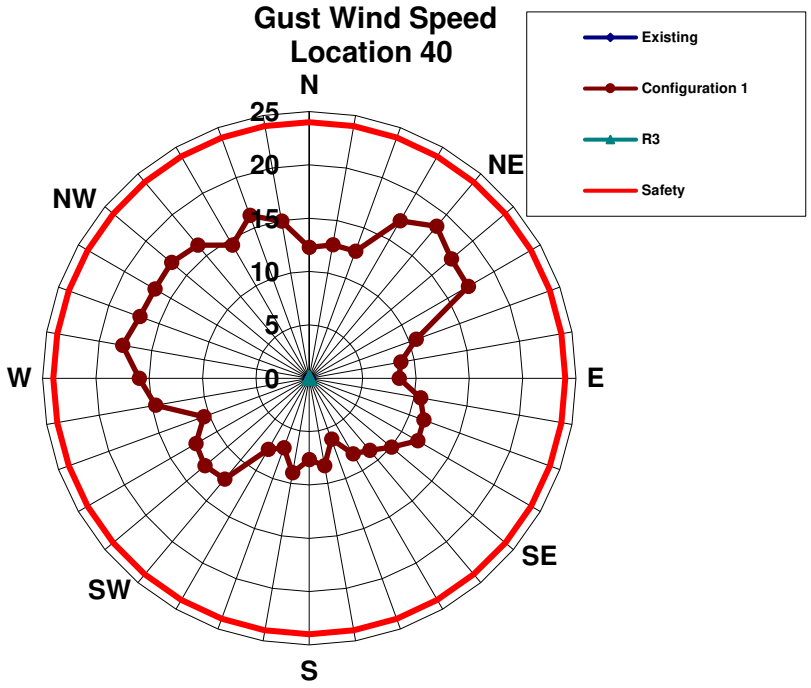
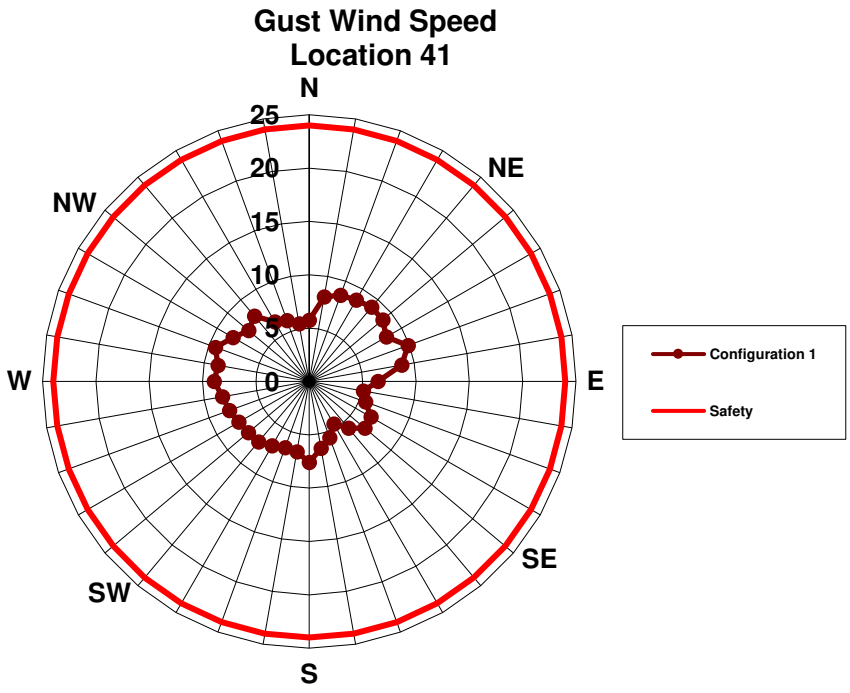
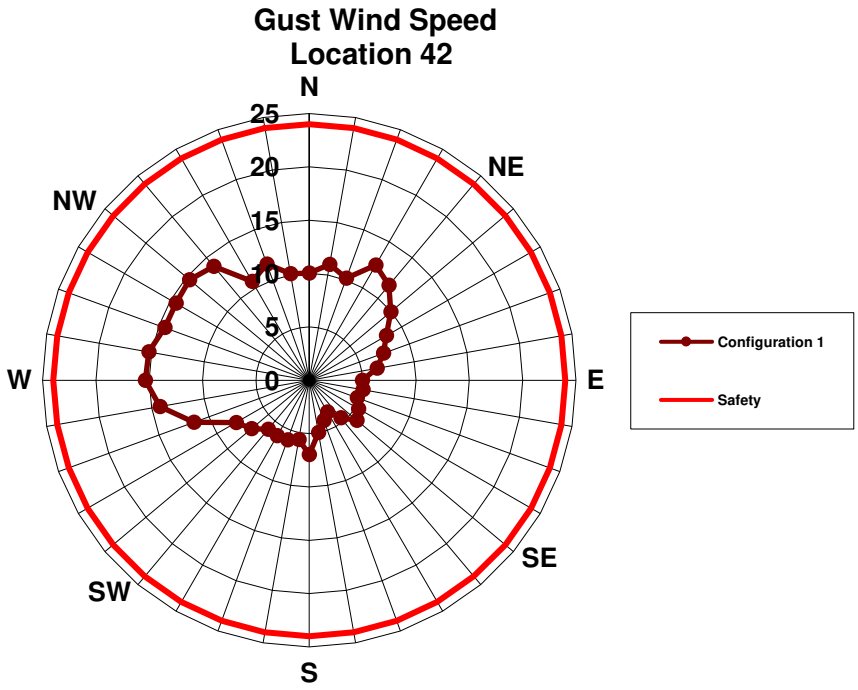
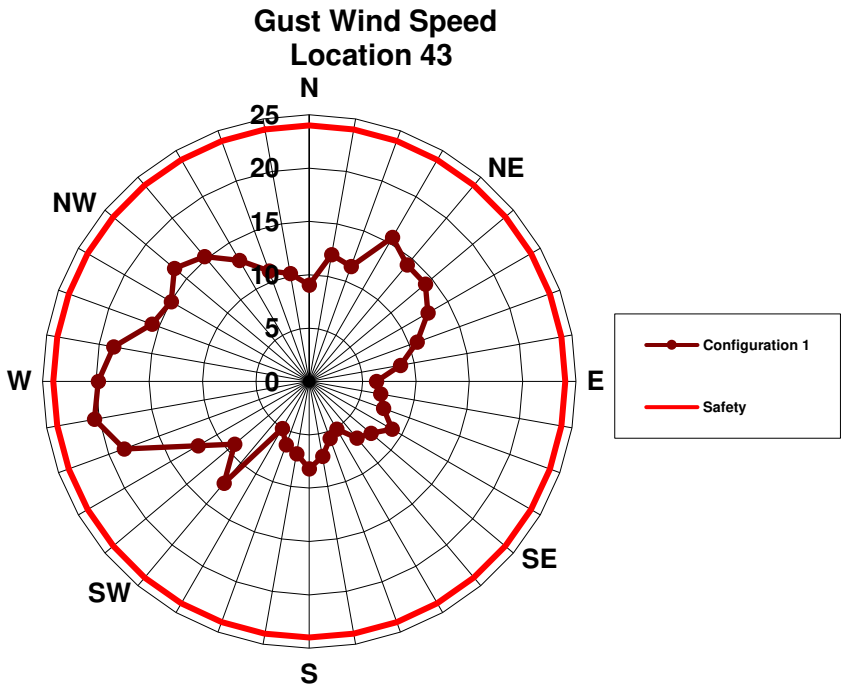
15
10
5
0
Configuration 1
Safety

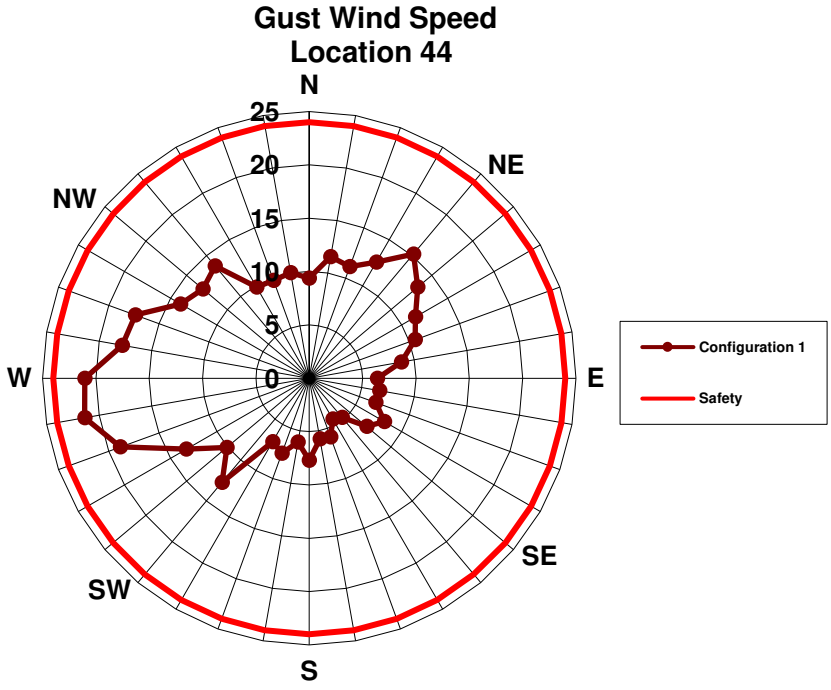

Gust Wind Speed
Location 39
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0
Configuration 1
Safety


Gust Wind Speed
Location 40
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0
Existing
Configuration 1
R3
Safety

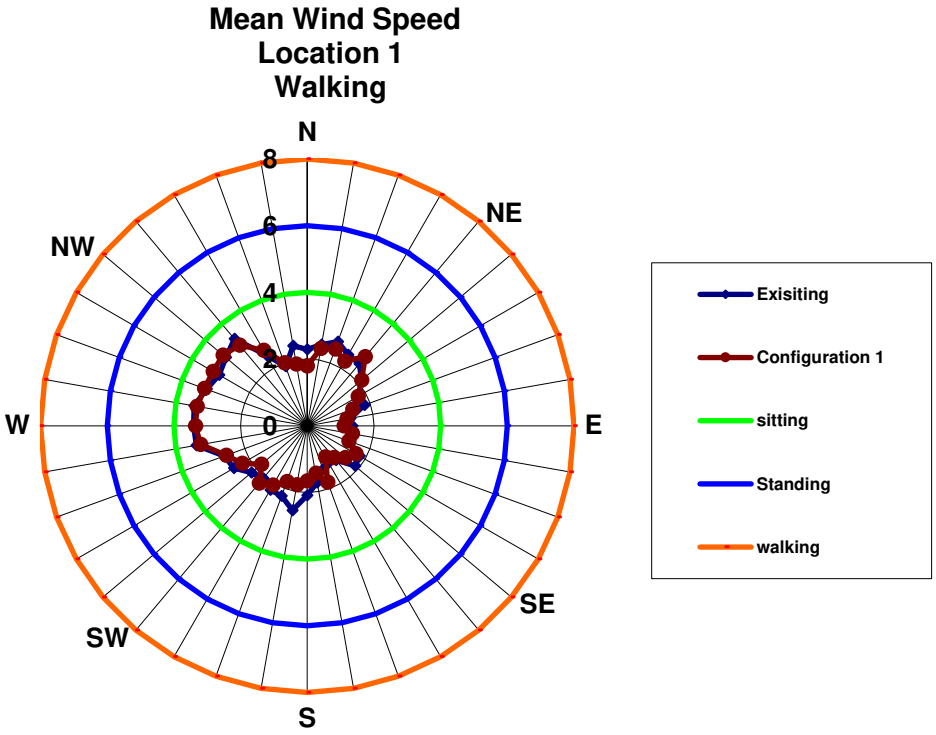

Gust Wind Speed
Location 41
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0
Configuration 1
Safety

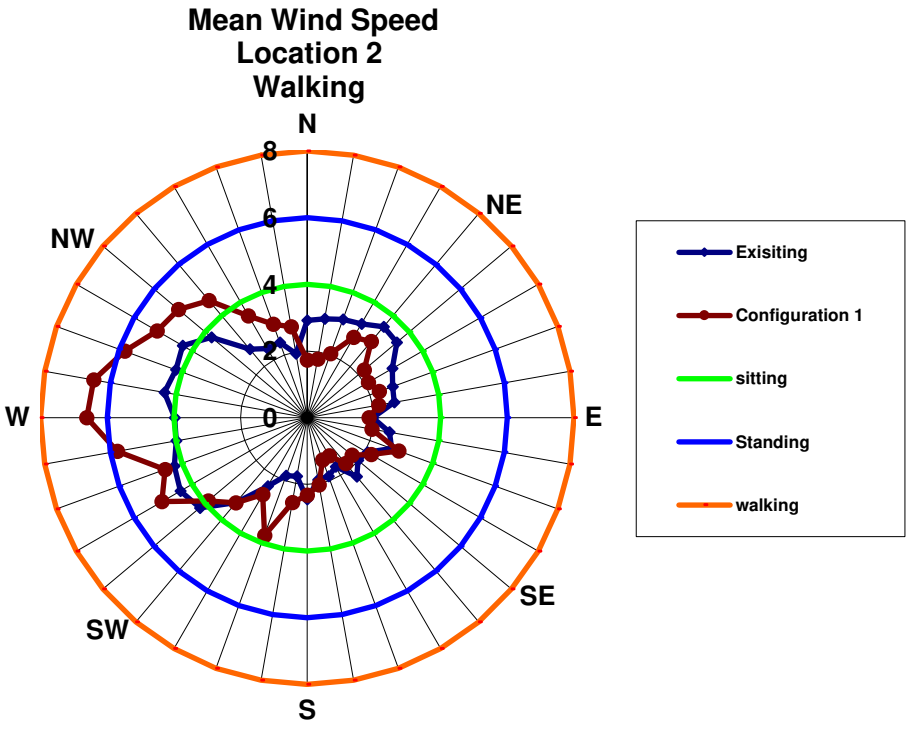

Gust Wind Speed
Location 42
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0
Configuration 1
Safety

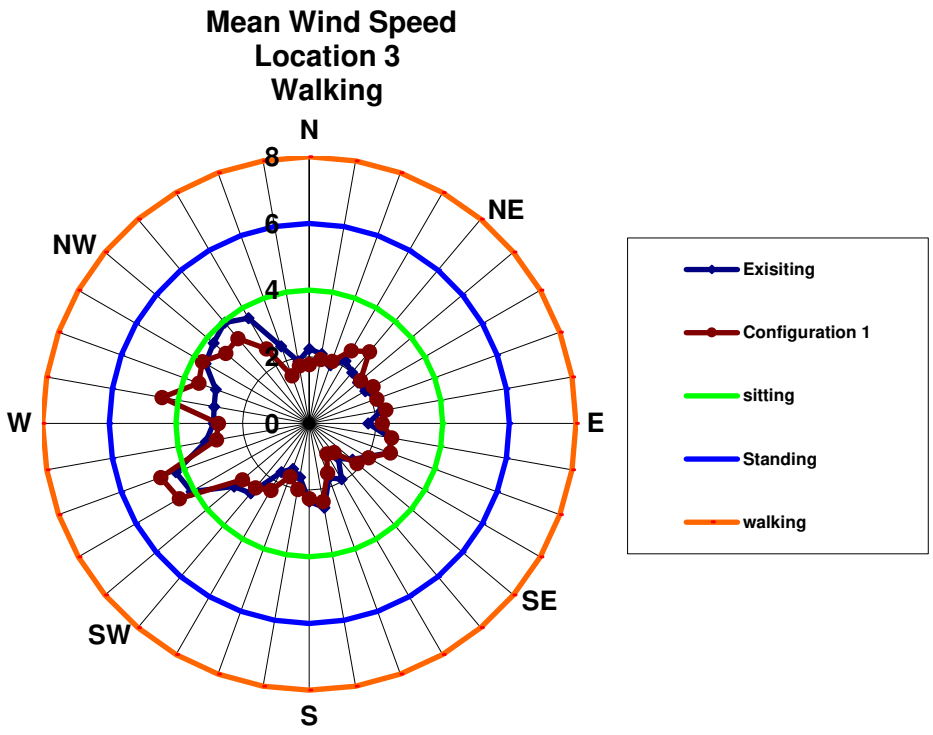

Gust Wind Speed
Location 43
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0
Configuration 1
Safety

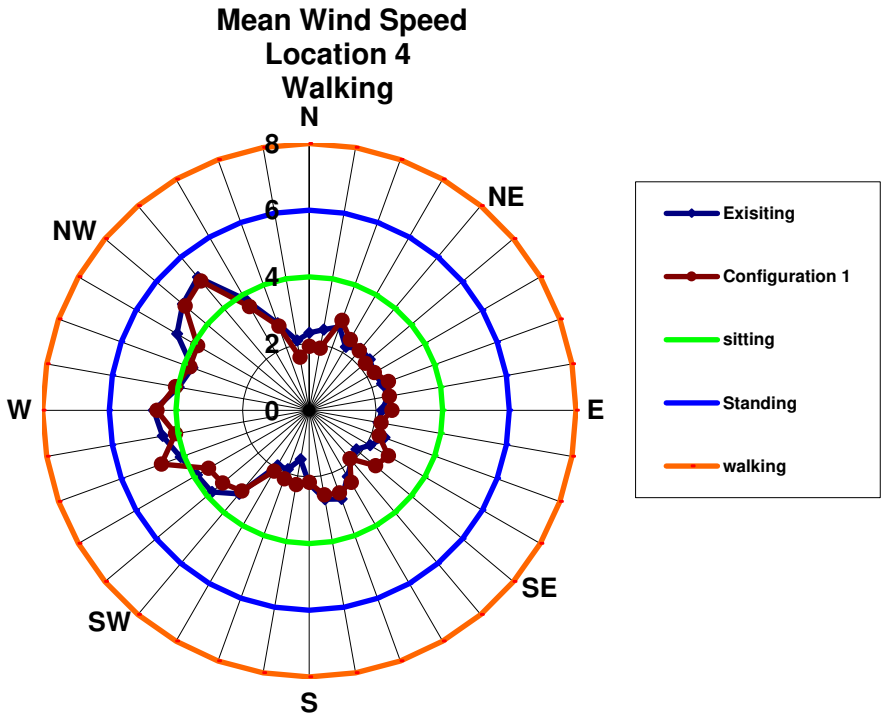

Gust Wind Speed
Location 44
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0
Configuration 1
Safety

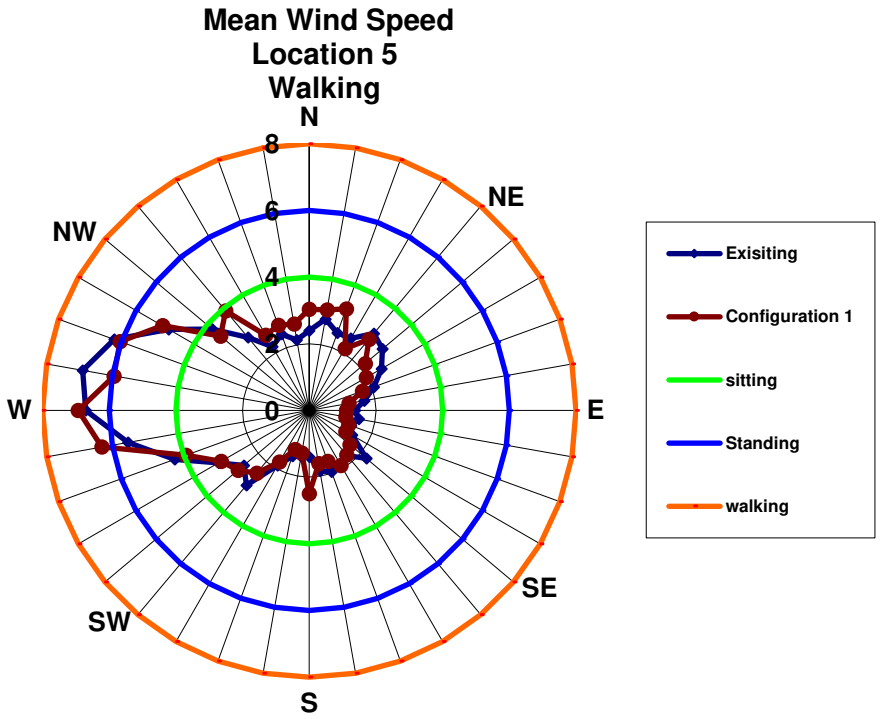
C.2 Mean Wind Speeds (Comfort Criteria)

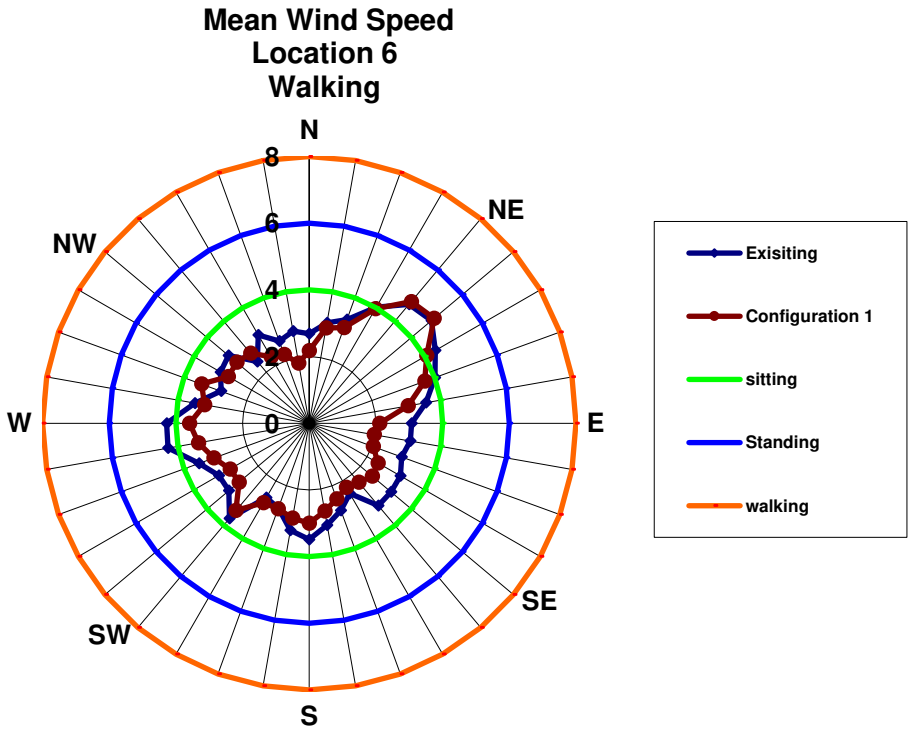


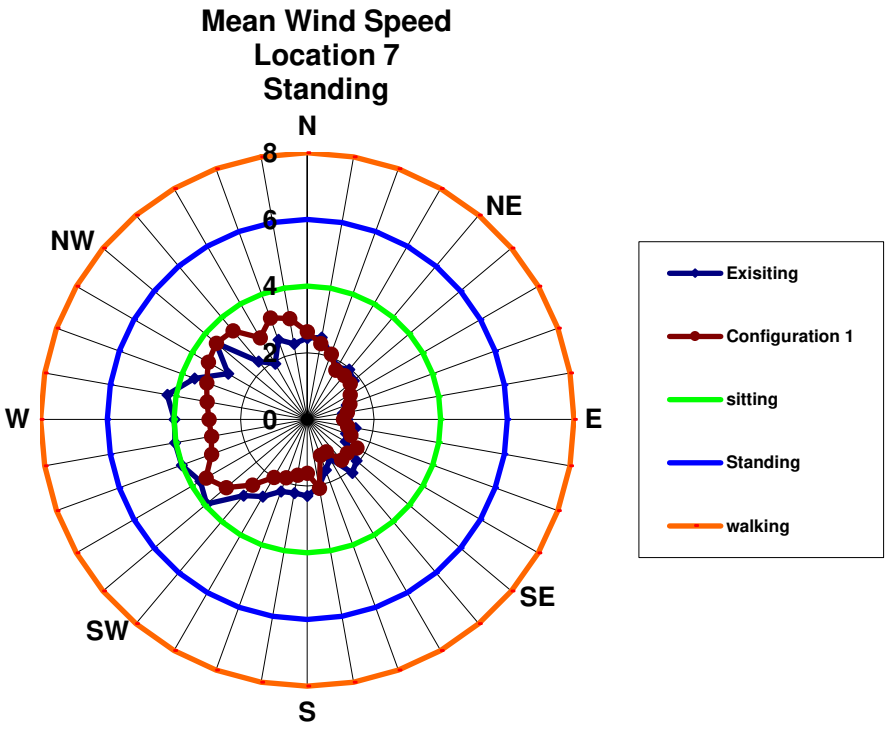


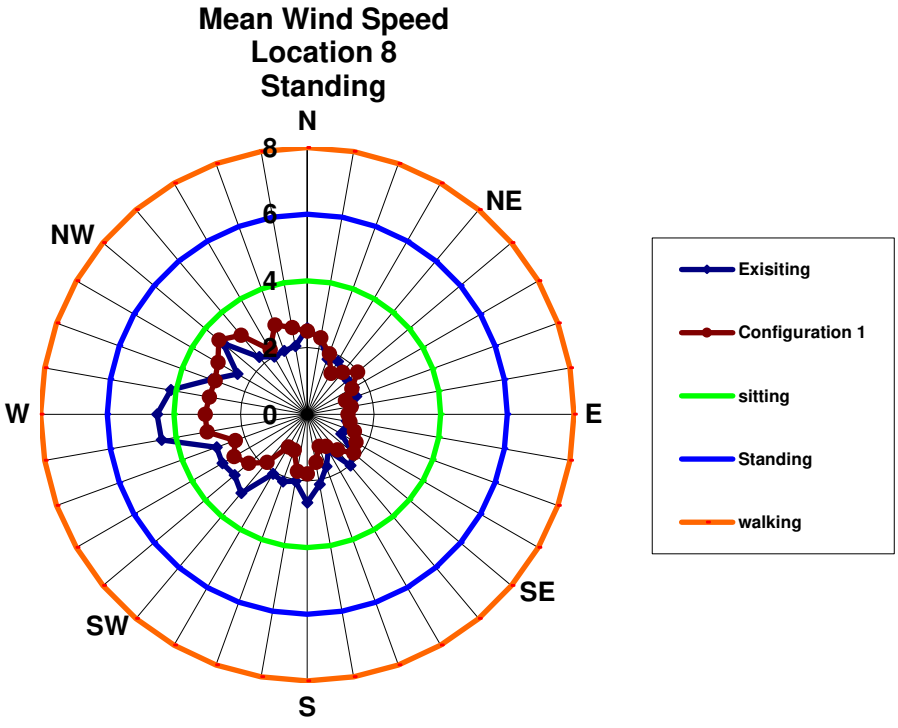

Mean Wind Speed
Location 3
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

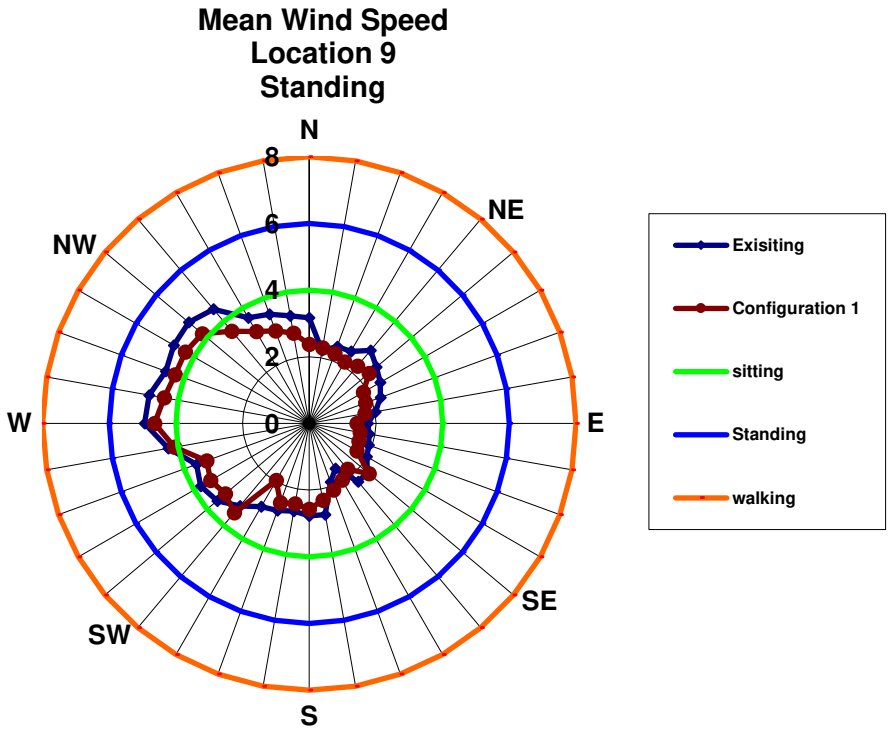

Mean Wind Speed
Location 4
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

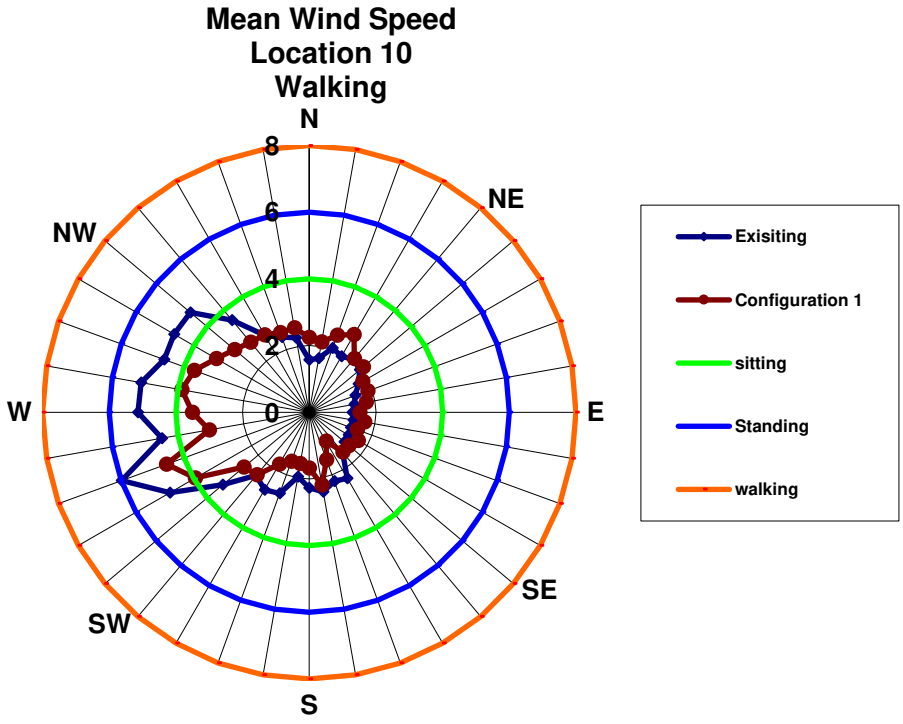

Mean Wind Speed
Location 5
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

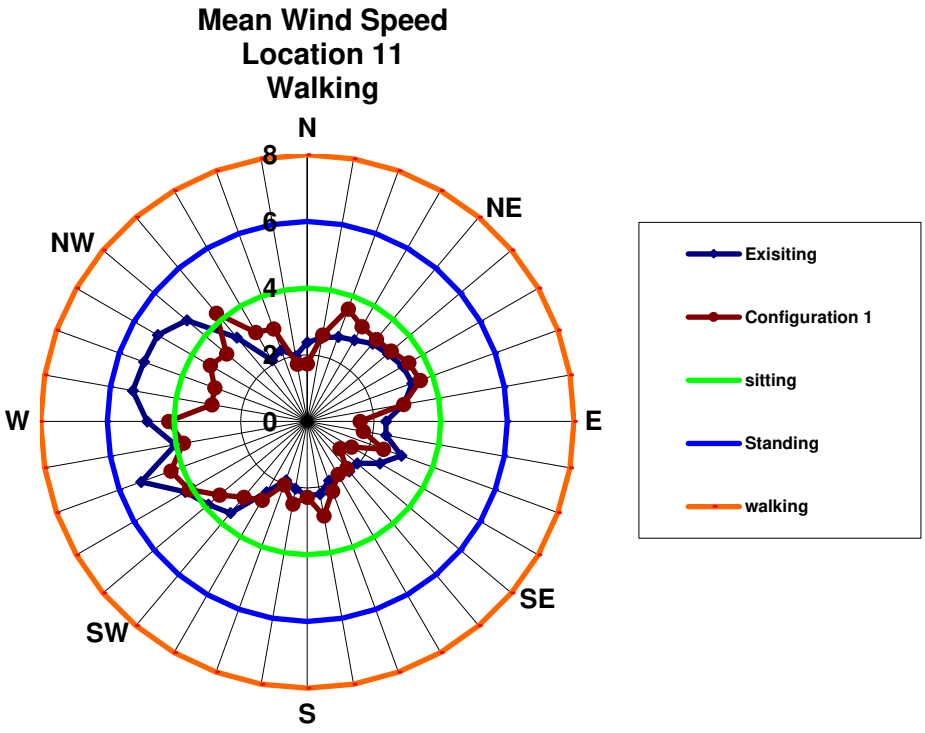

Mean Wind Speed
Location 6
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

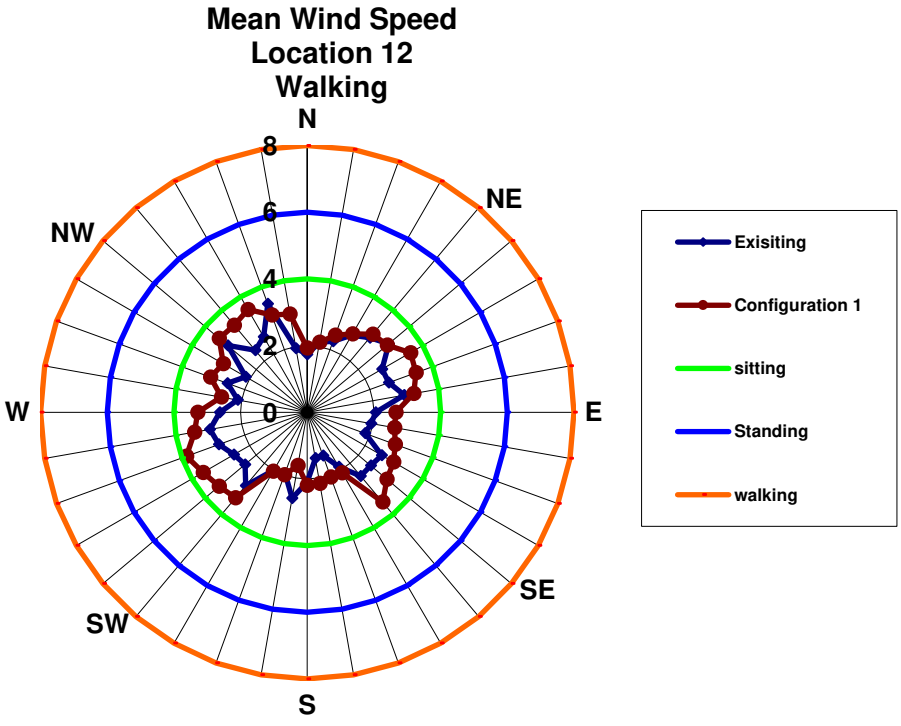

Mean Wind Speed
Location 7
Standing
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

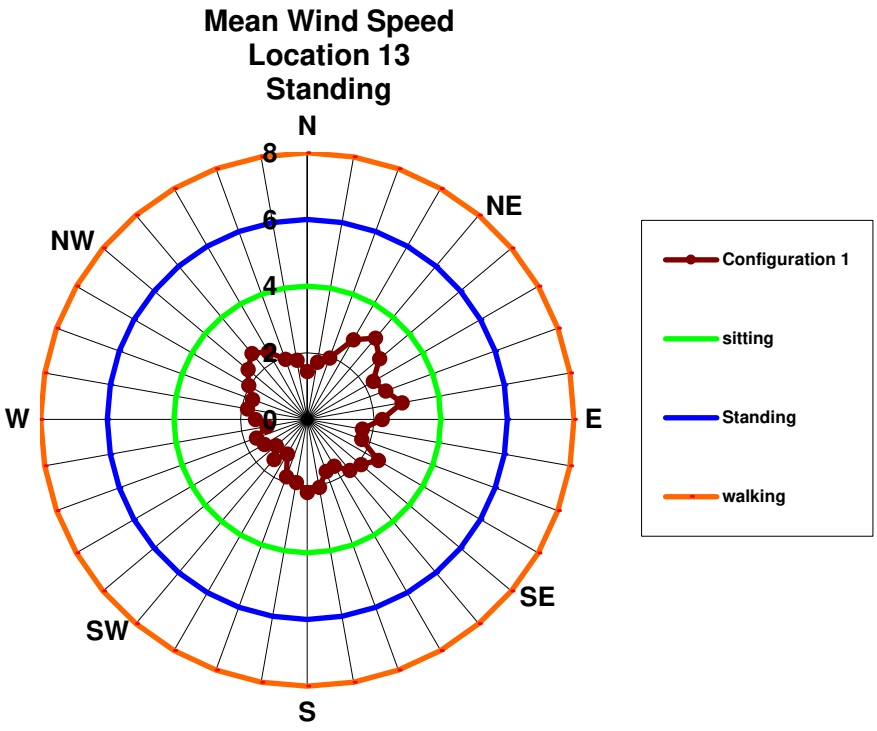

Mean Wind Speed
Location 8
Standing
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

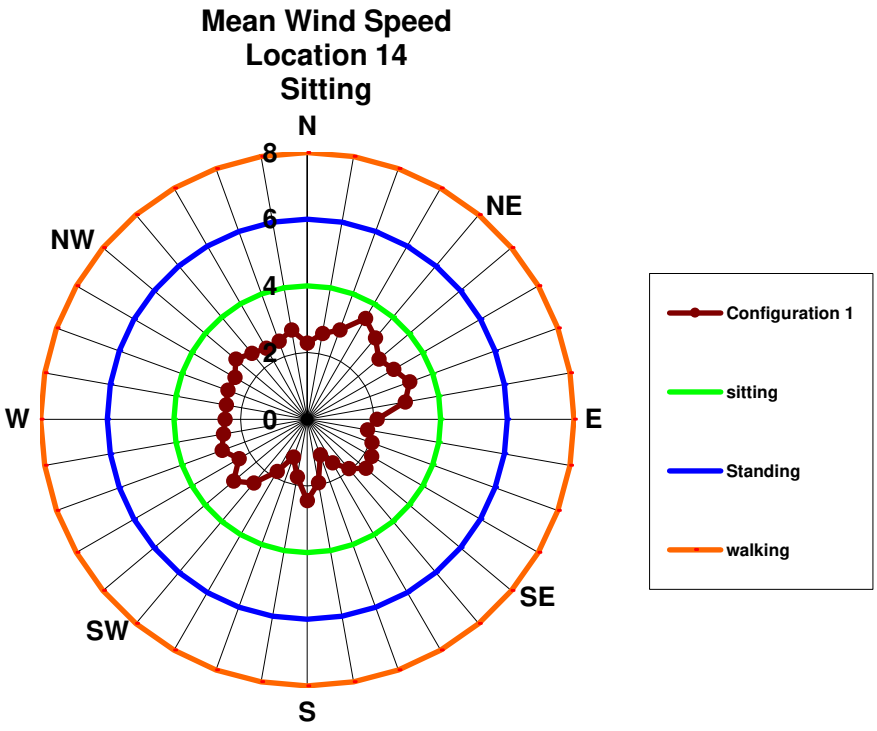

Mean Wind Speed
Location 9
Standing
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

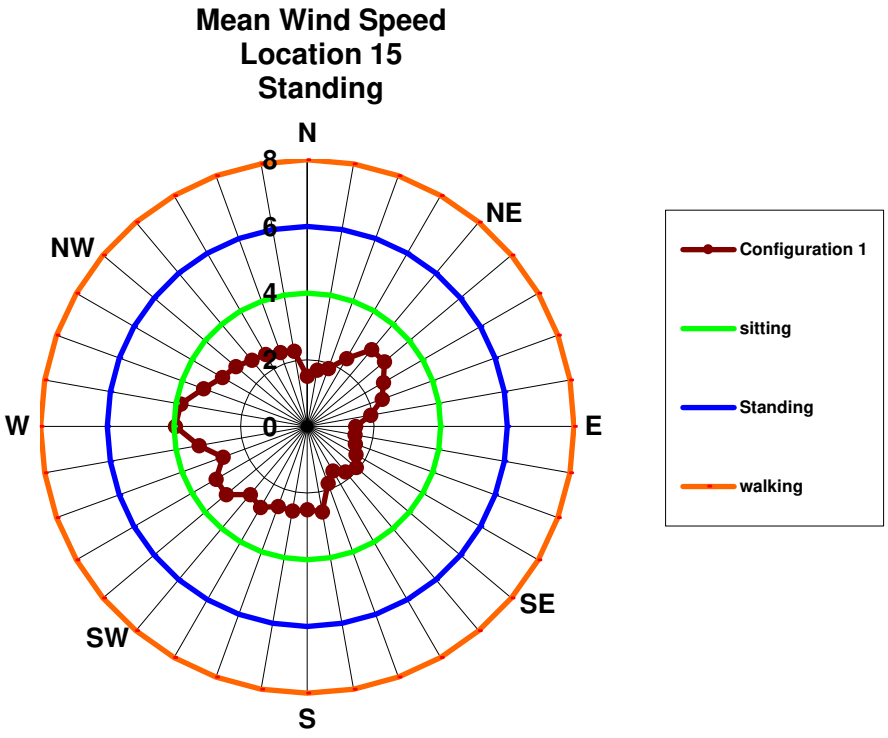

Mean Wind Speed
Location 10
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

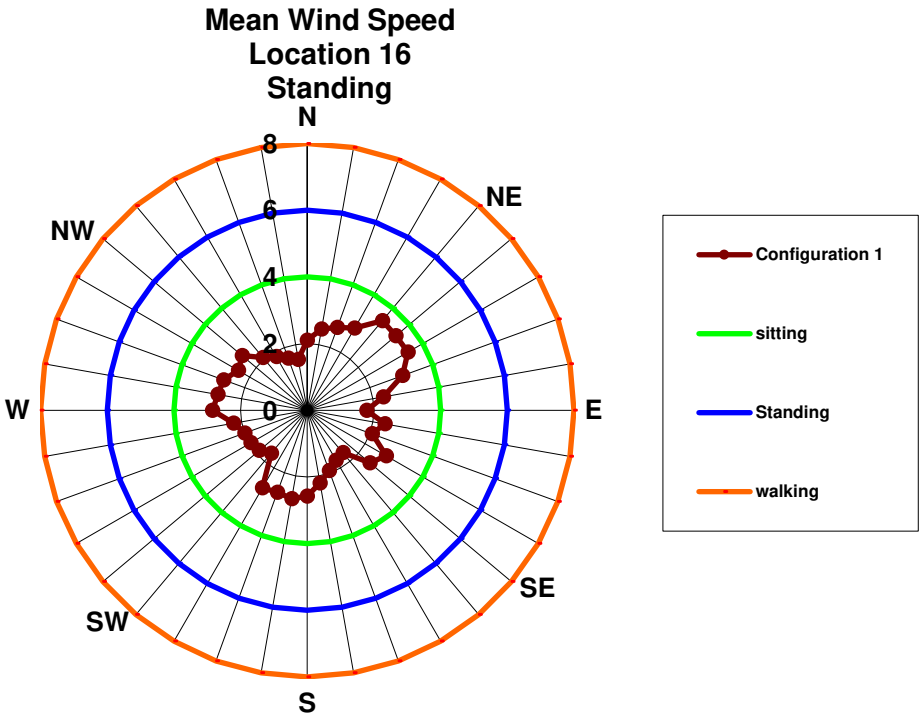

Mean Wind Speed
Location 11
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

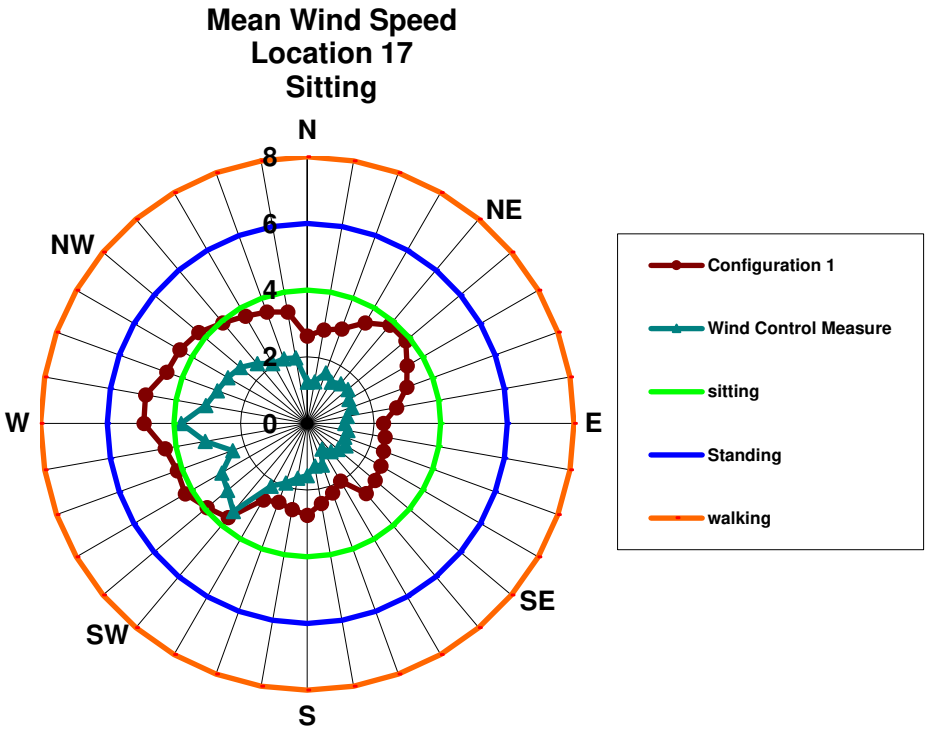

Mean Wind Speed
Location 12
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

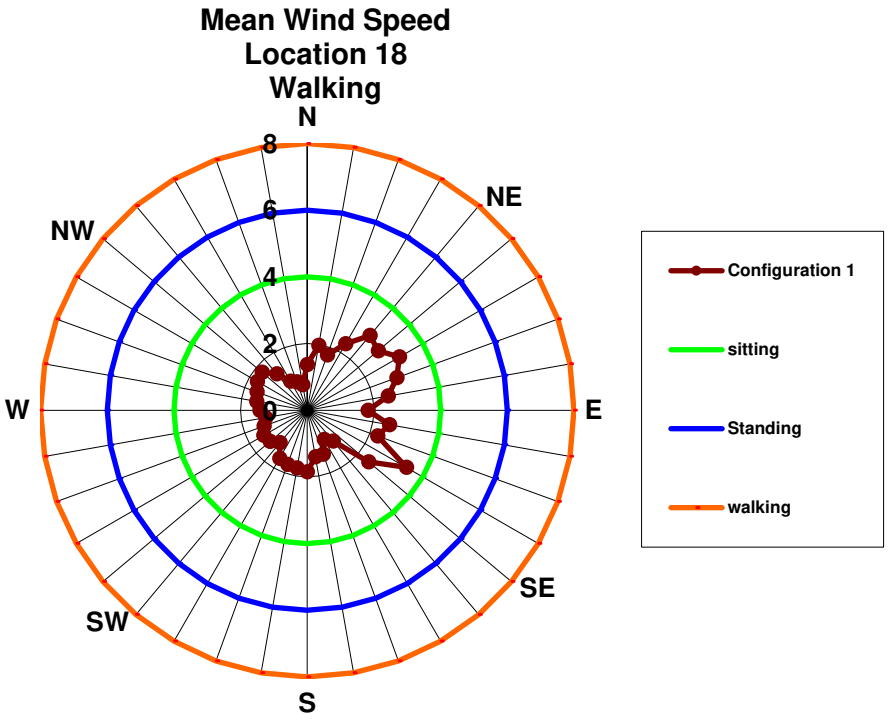

Mean Wind Speed
Location 13
Standing
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
sitting
Standing
walking

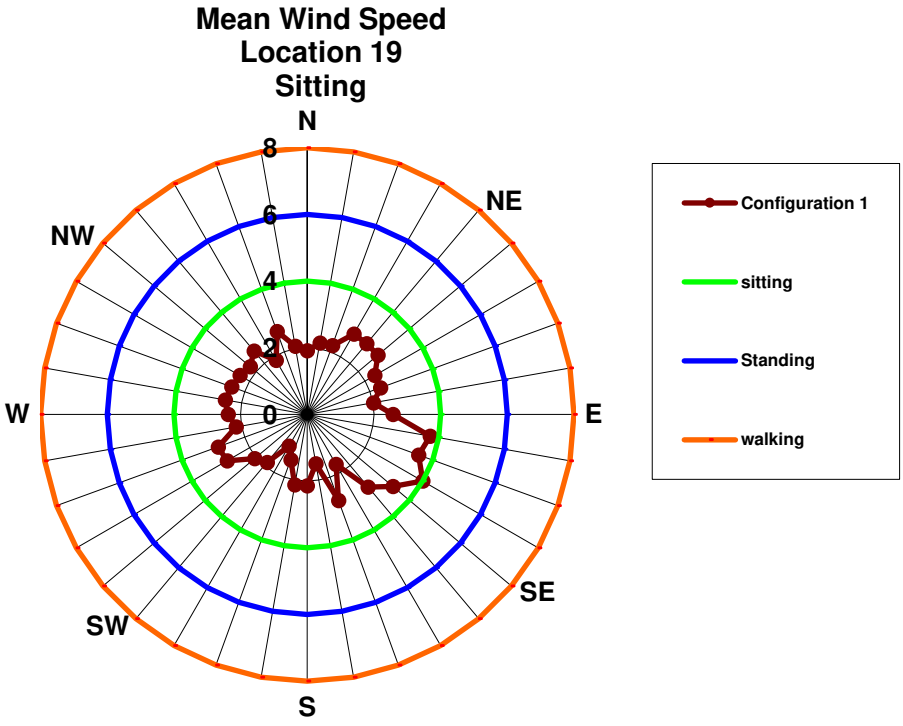

Mean Wind Speed
Location 14
Sitting
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
sitting
Standing
walking

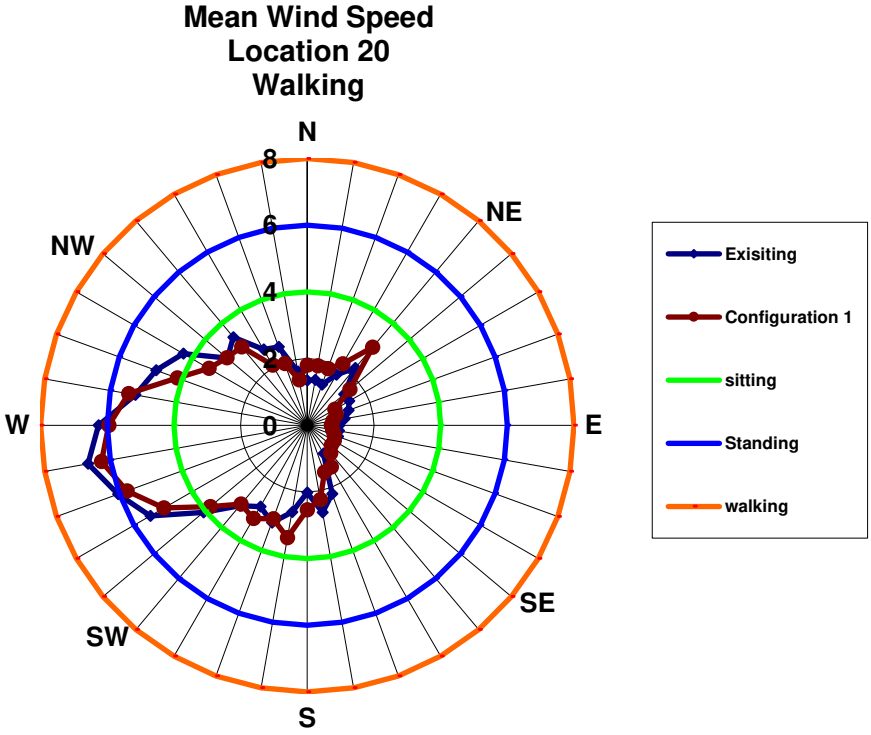

Mean Wind Speed
Location 15
Standing
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
sitting
Standing
walking

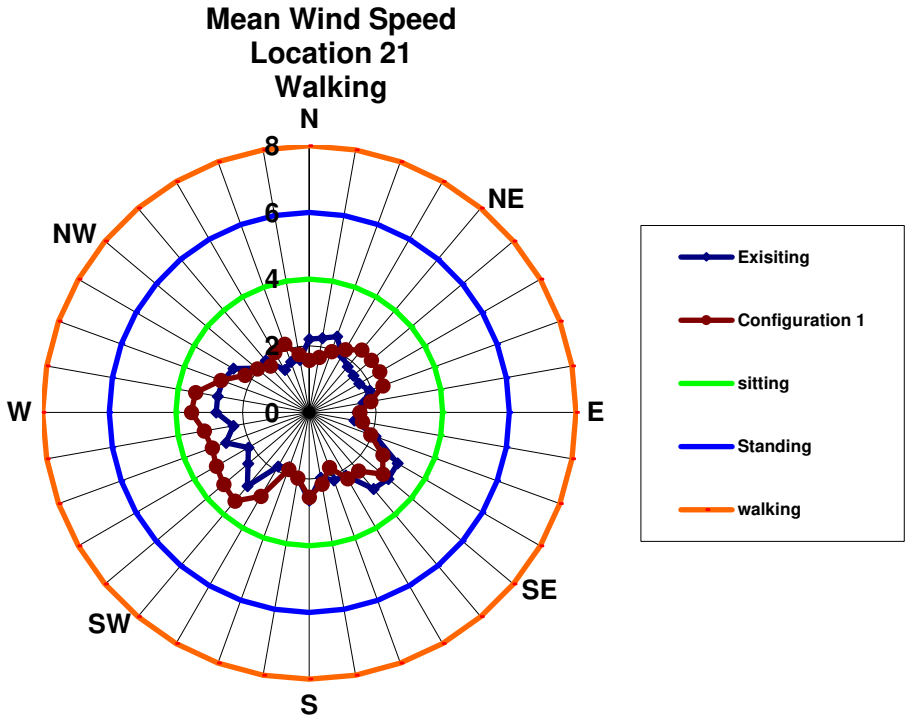

Mean Wind Speed
Location 16
Standing
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
sitting
Standing
walking

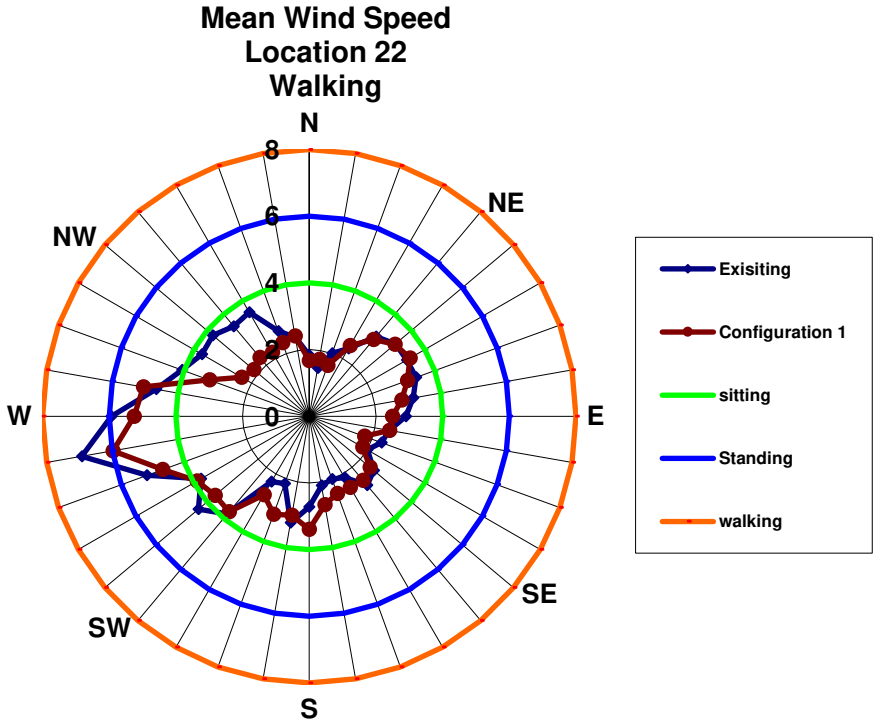

Mean Wind Speed
Location 17
Sitting
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
Wind Control Measure
sitting
Standing
walking

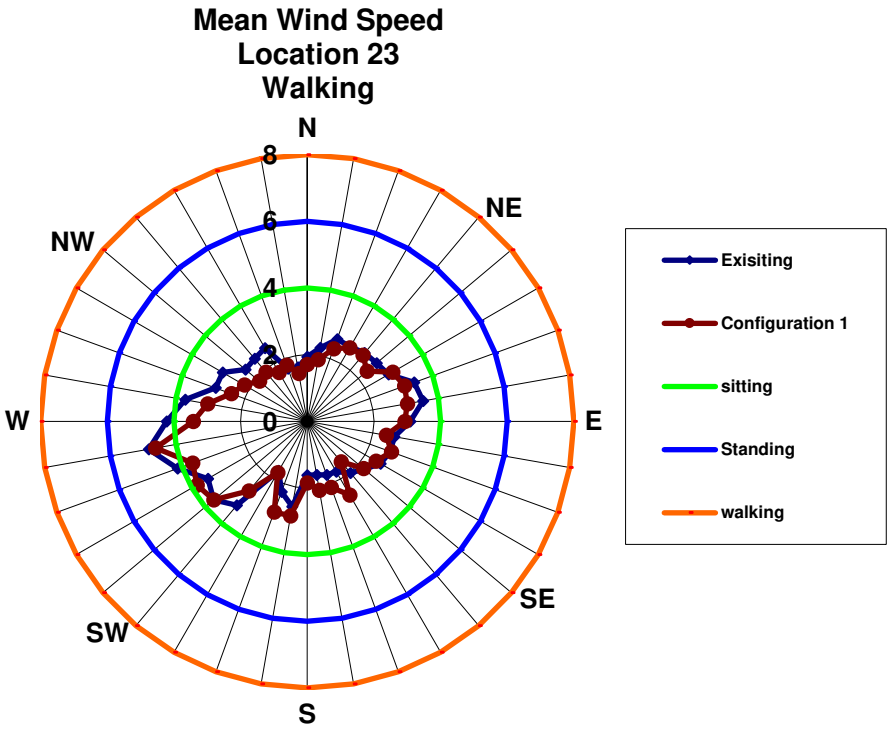

Mean Wind Speed
Location 18
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
sitting
Standing
walking

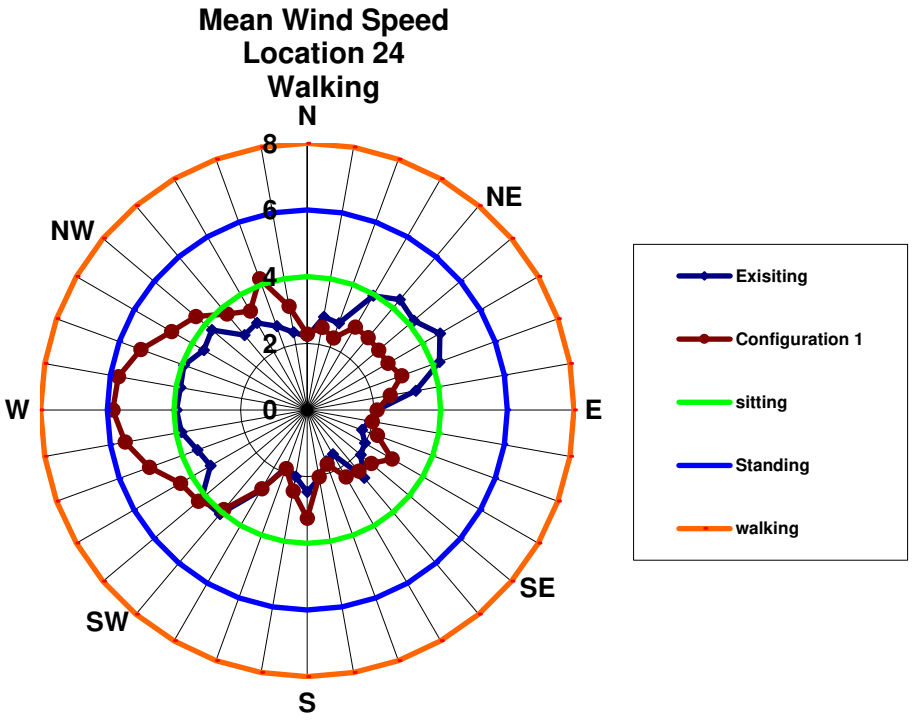

Mean Wind Speed
Location 19
Sitting
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
sitting
Standing
walking

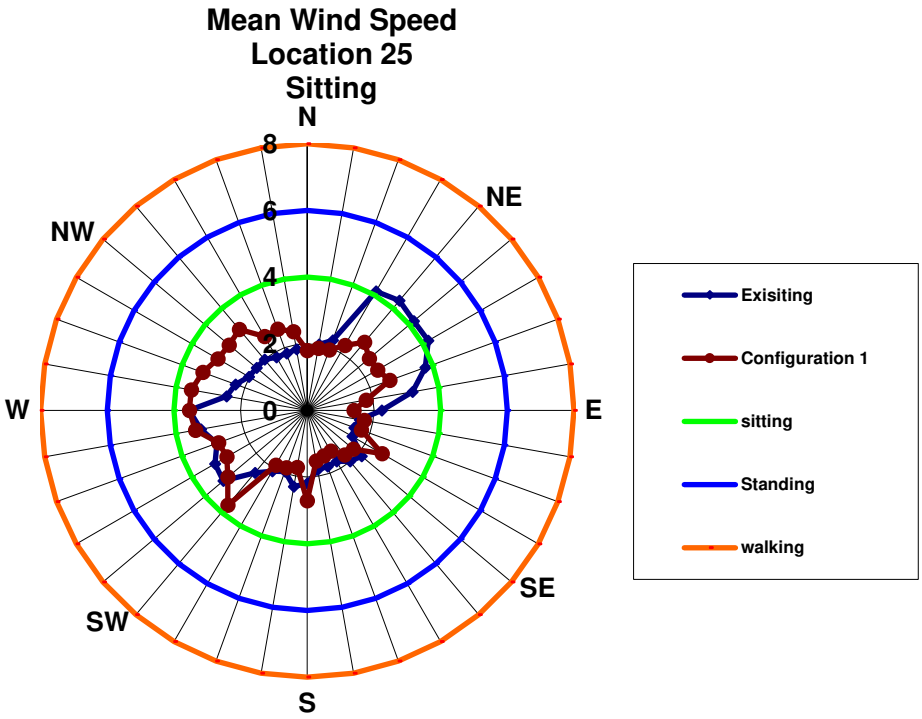

Mean Wind Speed
Location 20
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

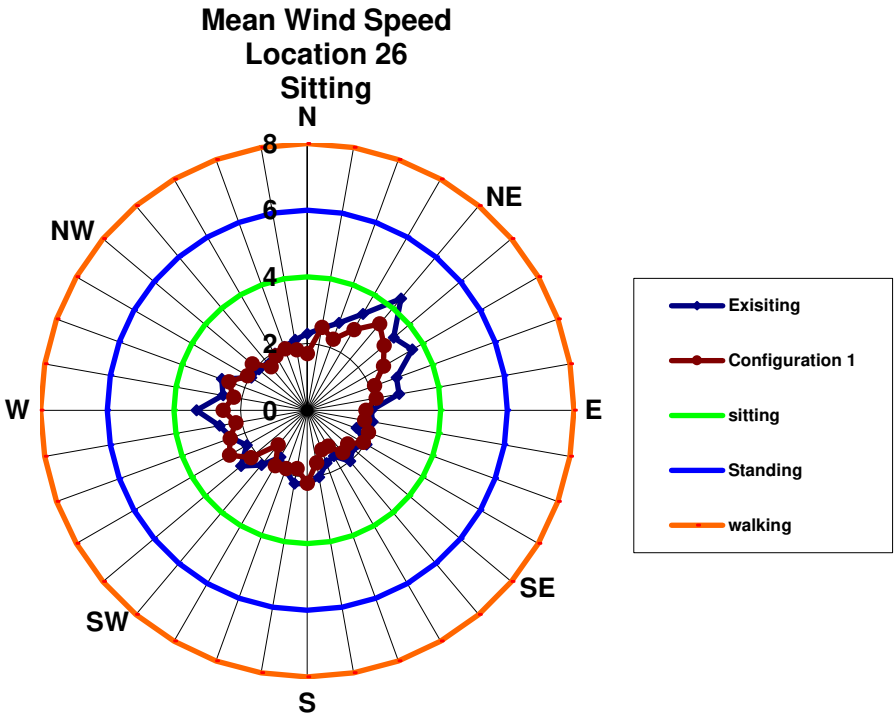

Mean Wind Speed
Location 21
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

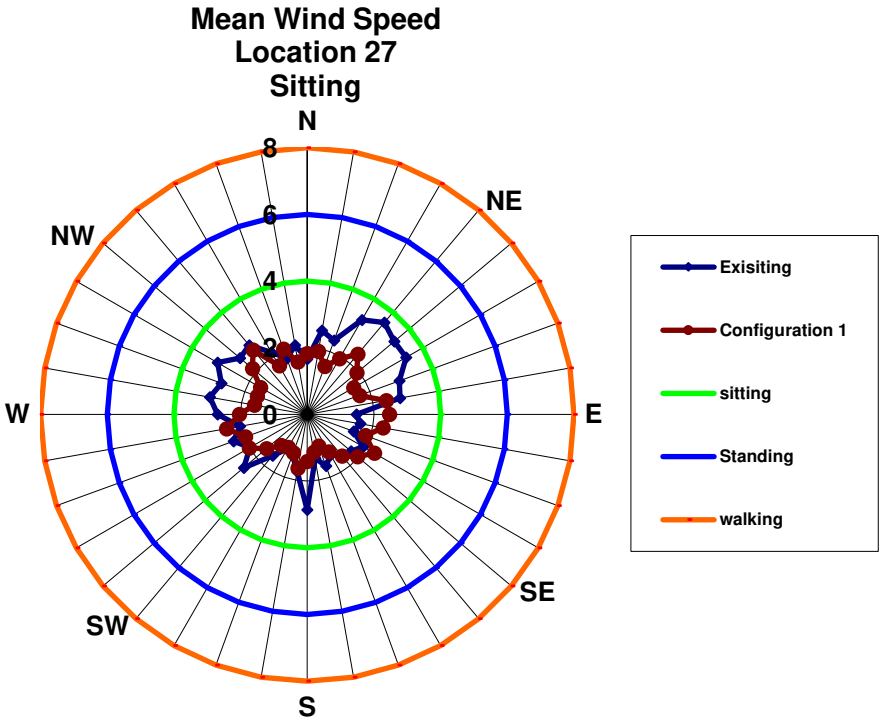

Mean Wind Speed
Location 22
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

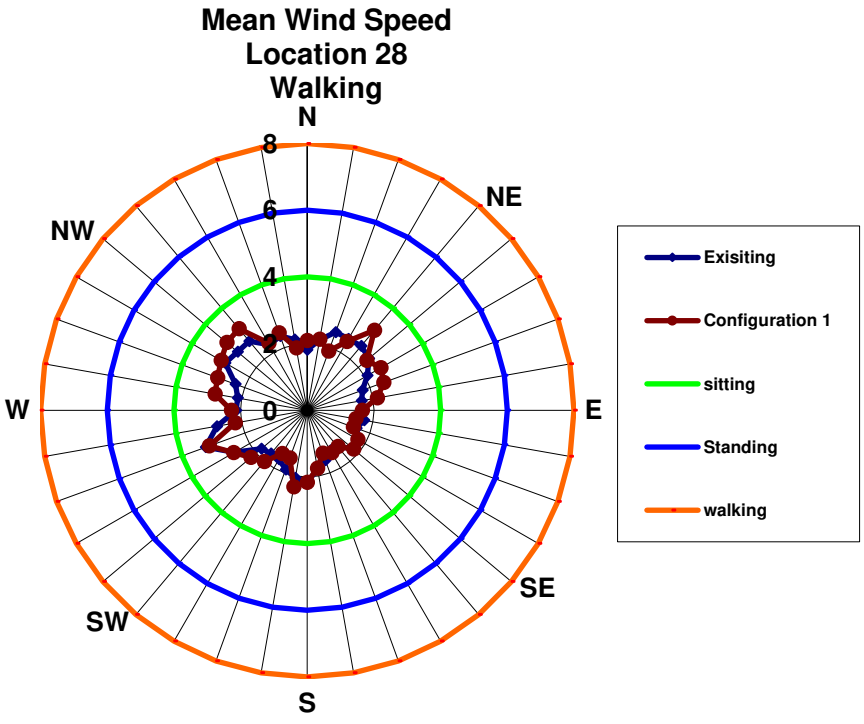

Mean Wind Speed
Location 23
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

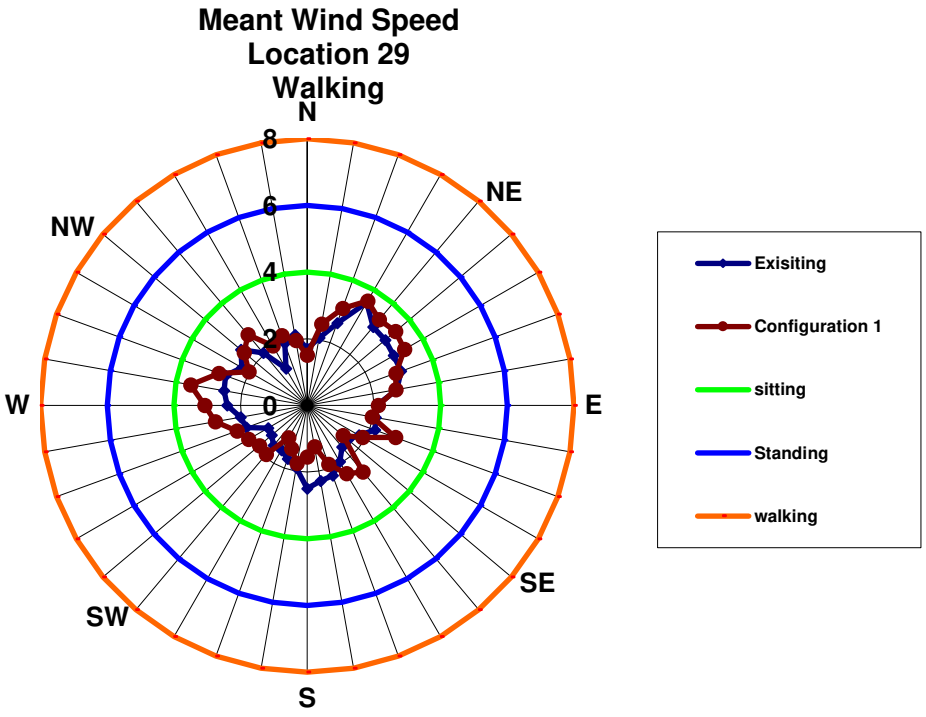

Mean Wind Speed
Location 24
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

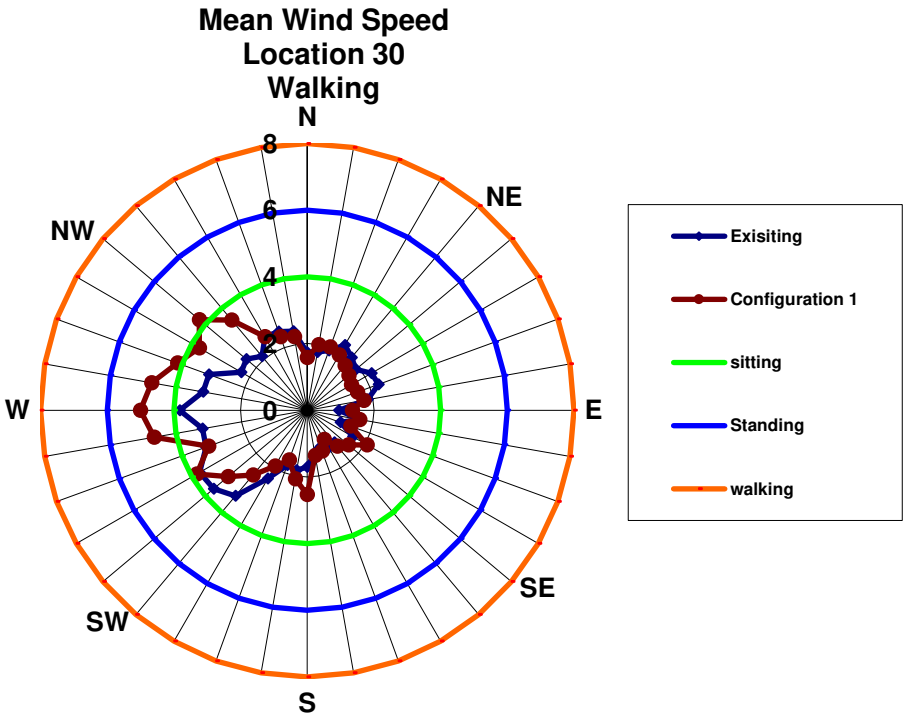

Mean Wind Speed
Location 25
Sitting
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

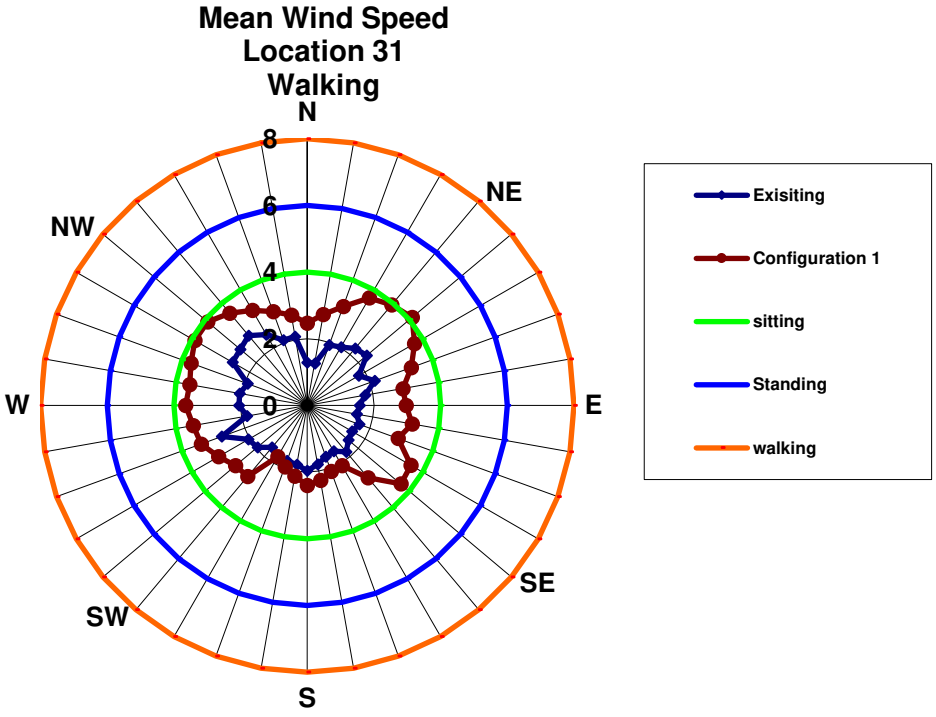

Mean Wind Speed
Location 26
Sitting
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

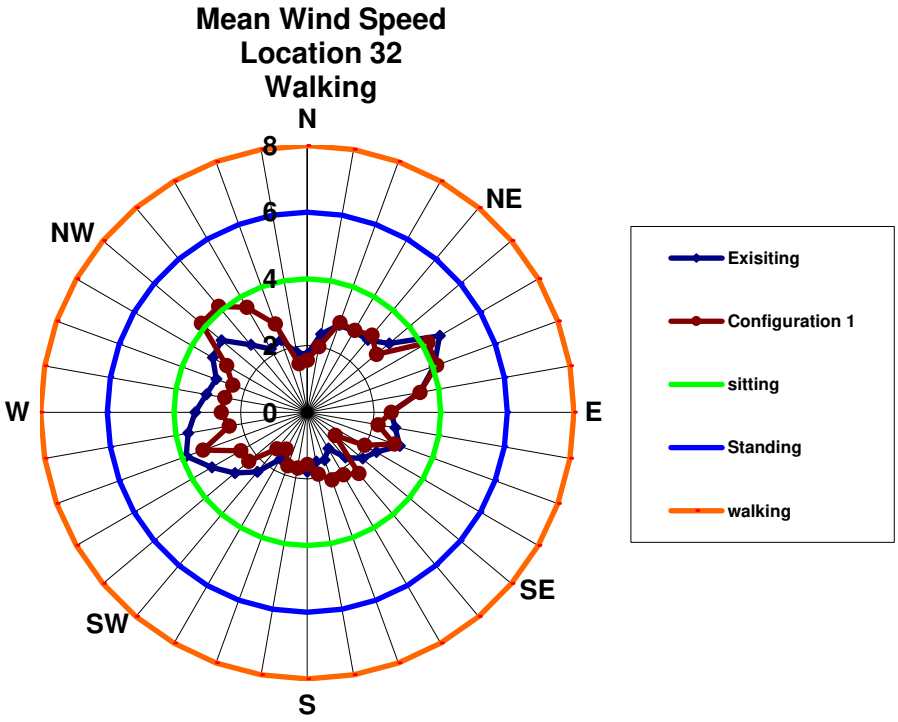

Mean Wind Speed
Location 27
Sitting
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

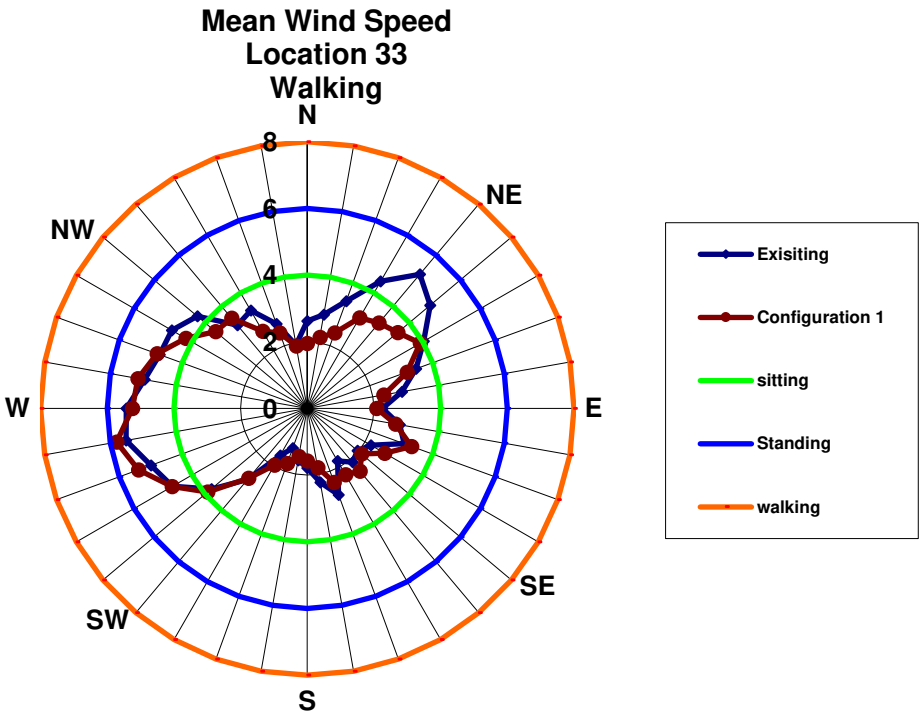

Mean Wind Speed
Location 28
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

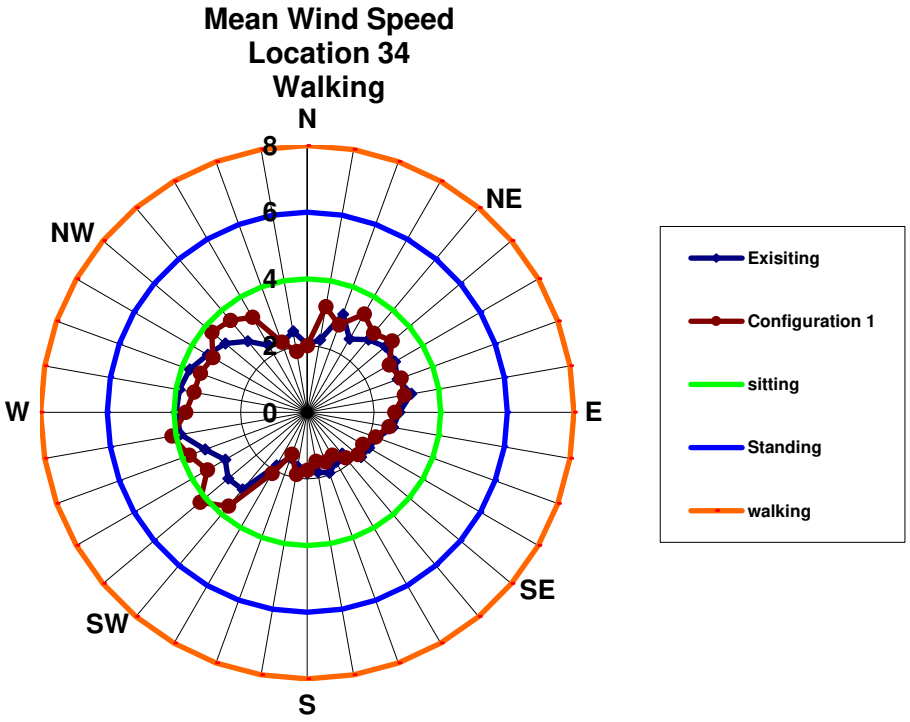

Meant Wind Speed
Location 29
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

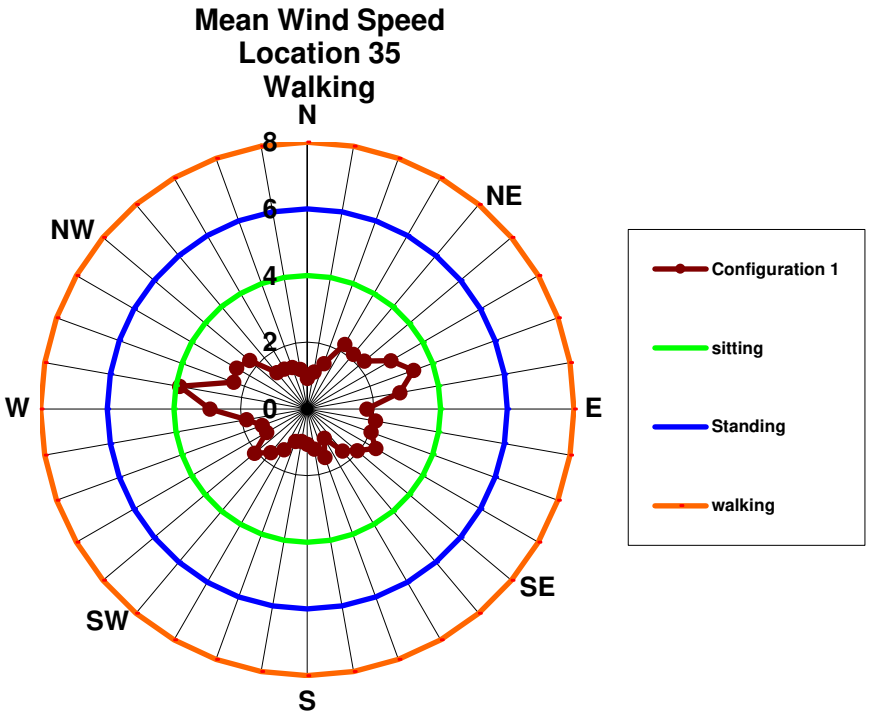

Mean Wind Speed
Location 30
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

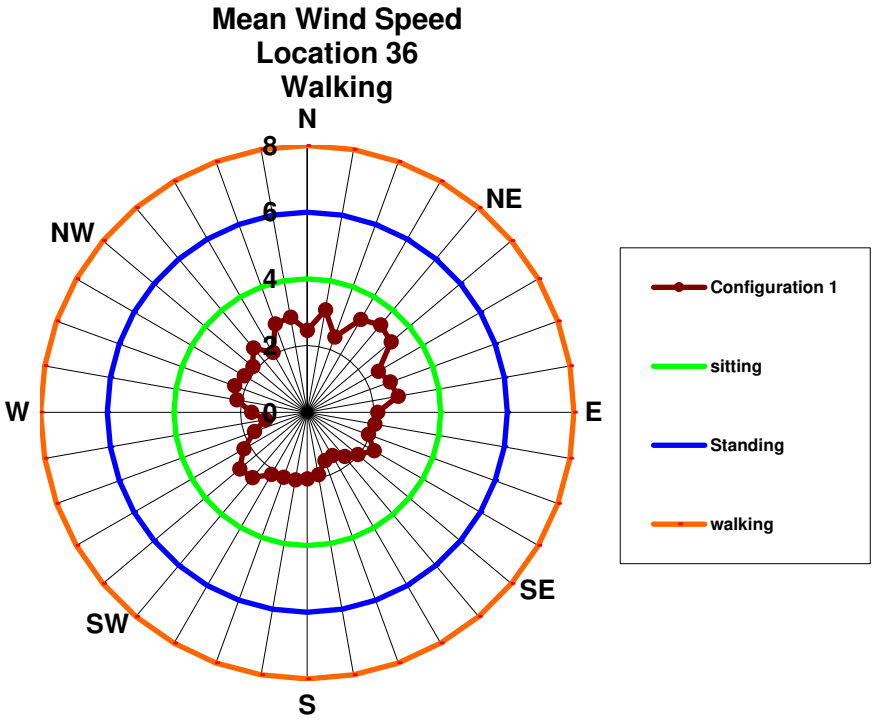

Mean Wind Speed
Location 31
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

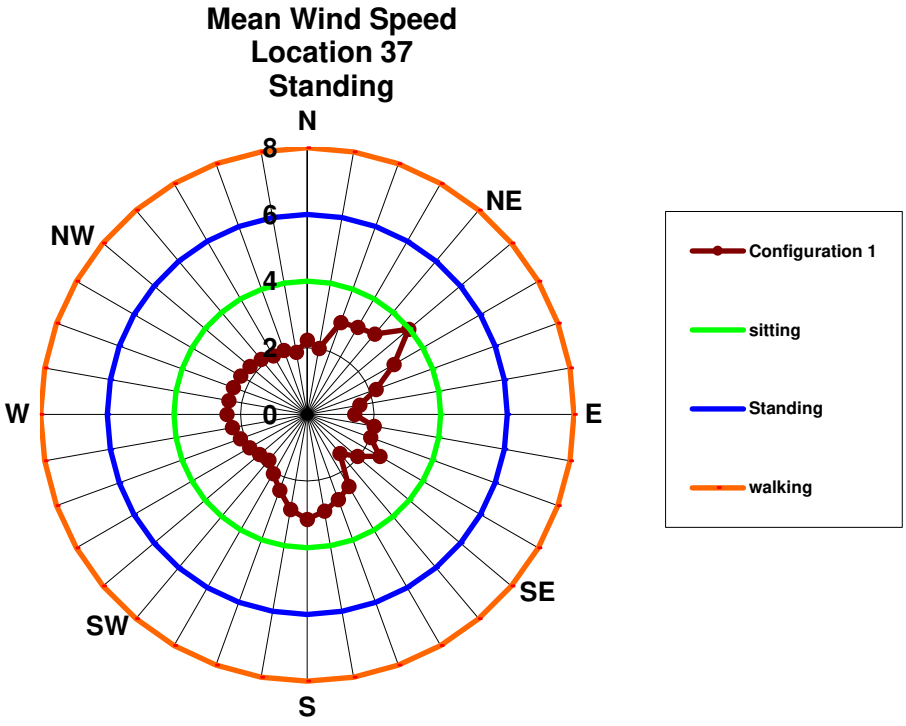

Mean Wind Speed
Location 32
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

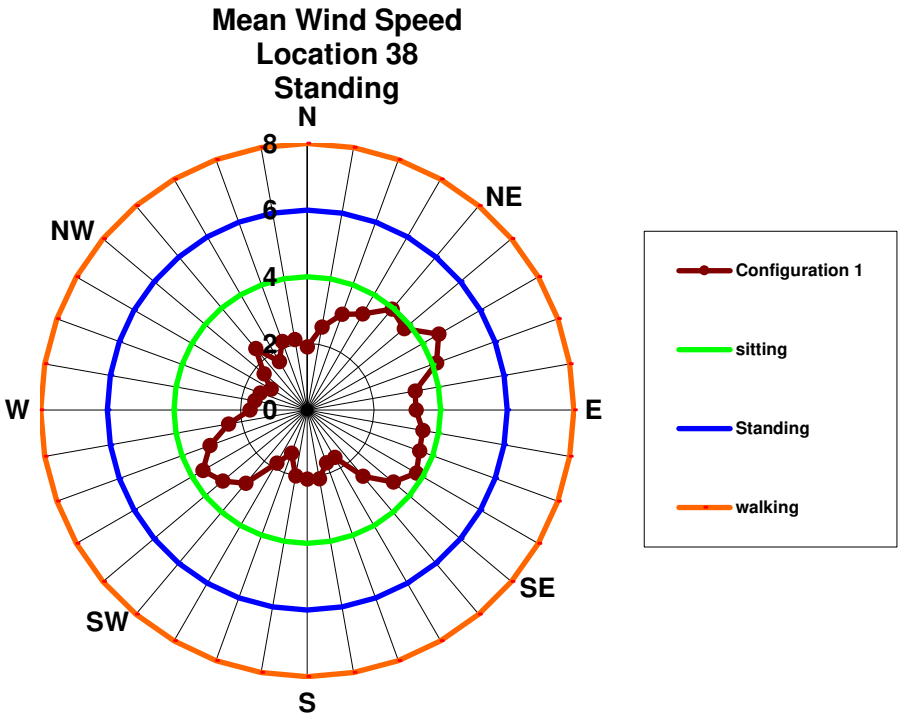

Mean Wind Speed
Location 33
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

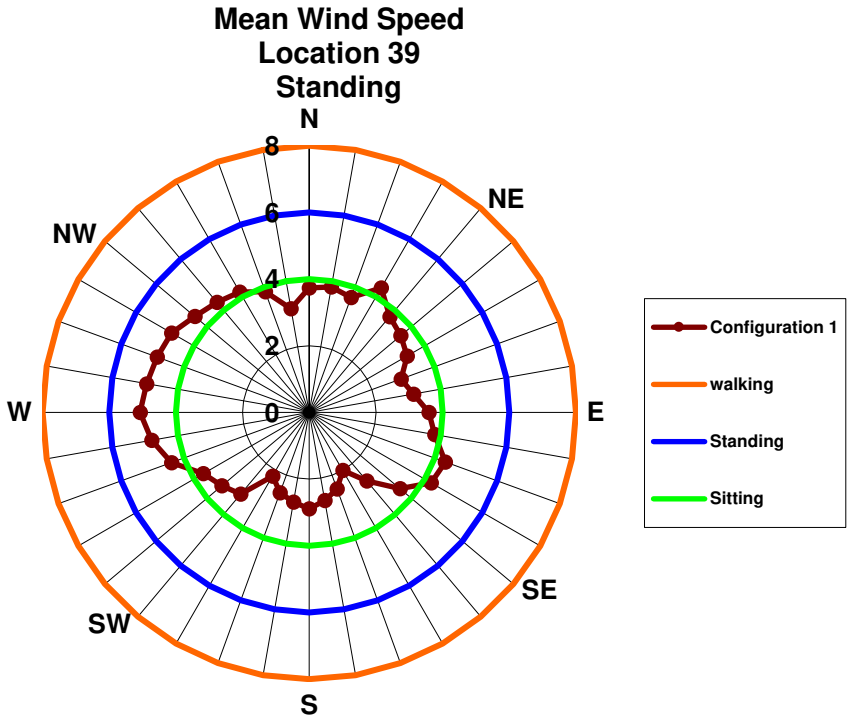

Mean Wind Speed
Location 34
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Exisiting
Configuration 1
sitting
Standing
walking

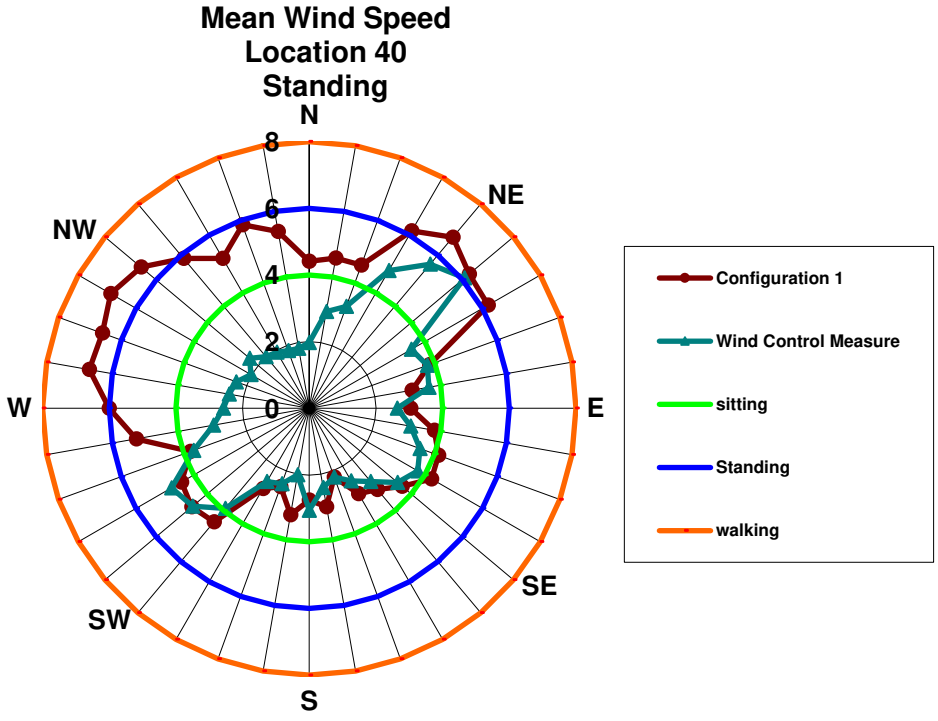

Mean Wind Speed
Location 35
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
sitting
Standing
walking

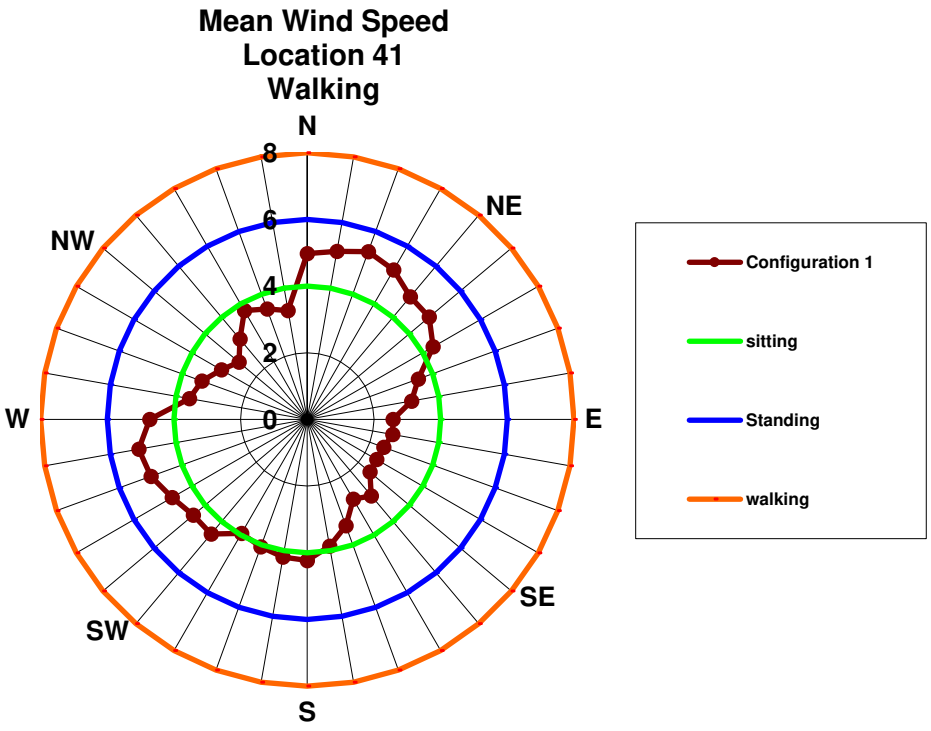

Mean Wind Speed
Location 36
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
sitting
Standing
walking

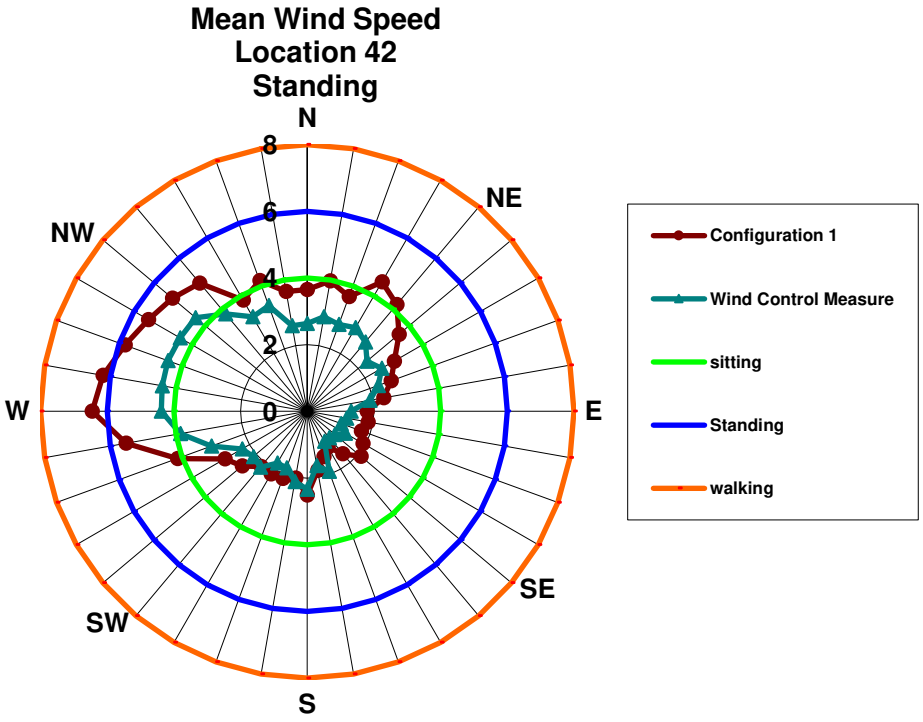

Mean Wind Speed
Location 37
Standing
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
sitting
Standing
walking

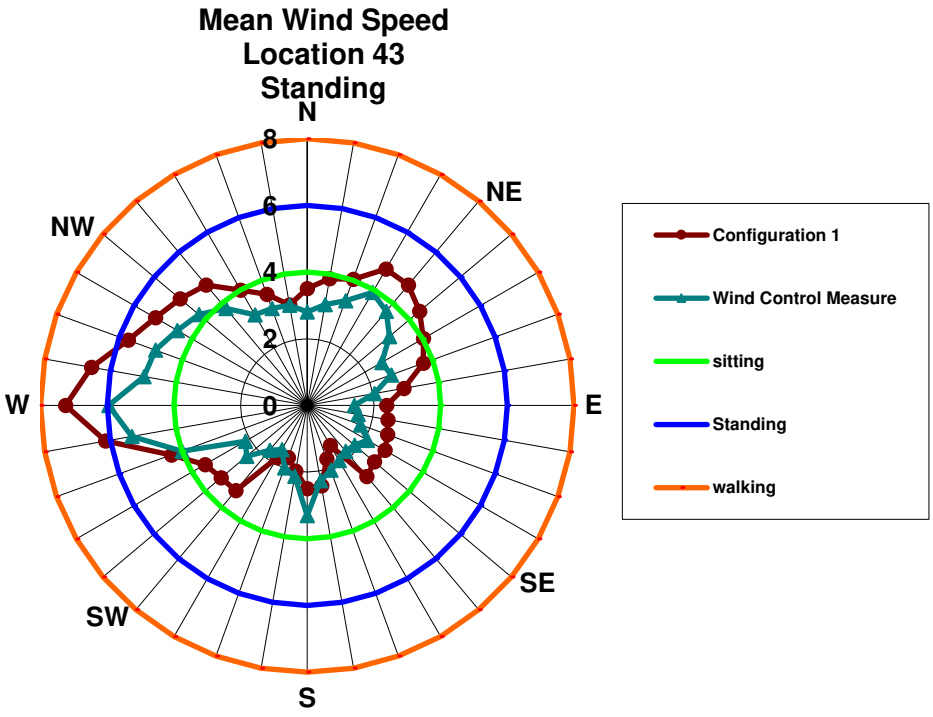

Mean Wind Speed
Location 38
Standing
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
sitting
Standing
walking

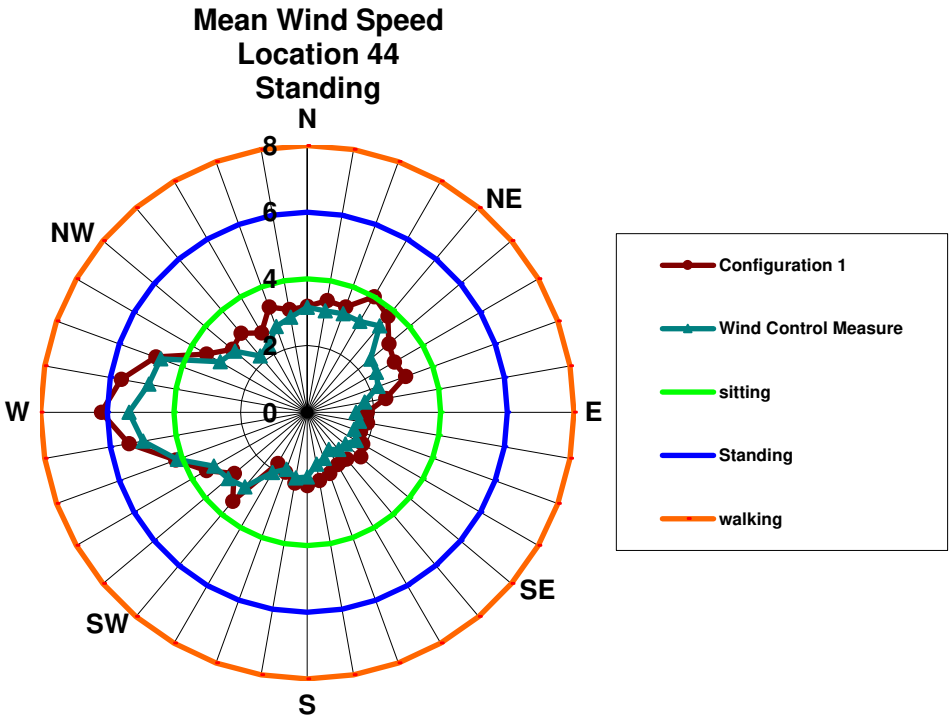

Mean Wind Speed
Location 39
Standing
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
walking
Standing
Sitting


Mean Wind Speed
Location 40
Standing
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
Wind Control Measure
sitting
Standing
walking


Mean Wind Speed
Location 41
Walking
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
sitting
Standing
walking


Mean Wind Speed
Location 42
Standing
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
Wind Control Measure
sitting
Standing
walking


Mean Wind Speed
Location 43
Standing
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
Wind Control Measure
sitting
Standing
walking


Mean Wind Speed
Location 44
Standing
N
NE
E
SE
S
SW
W
NW
8
6
4
2
0
Configuration 1
Wind Control Measure
sitting
Standing
walking