Donald Ballanti
Certified Consulting Meteorologist

1424 Scott Street
El Cerrito, CA 94530
(510) 234-6087
Fax: (510) 234-6087

August 26, 2011

Justin Murphy, AICP
Community Development Department
City of Menlo Park
701 Laurel Street
Menlo Park, CA 94025

Subject: Wind Impact Evaluation for the Facebook Campus Project, Menlo Park

Dear Mr. Murphy:

This letter-report summarizes my findings concerning potential wind and comfort impacts of the proposed Facebook campus in Menlo Park. I have based this analysis on a review of project plans and sections, a site visit, and my knowledge of comfort conditions and basic building aerodynamics gained from wind tunnel studies, and analysis of problem conditions at existing buildings within the East Campus.

Wind is an important factor in determing pedestrian comfort and safety. The Bay Area is noted for its cool, windy climate that, combined with frequent stratus clouds, can make outdoor space uncomfortably cool. The usability of outdoor space, parks and even the success of retail space is partially determined by wind conditions.

The following analysis examines wind qualitatively. The proposed project is examined to determine where the most important factors that determine wind exposure combine to accelerate winds that can adversely affect pedestrians and outdoor sitting/dining areas.

PROJECT DESCRIPTION

The project site, which is composed of a 57-acre East Campus and a 22-acre West Campus, is located in the City of Menlo Park, north of US 101. The East Campus and West Campus are separated by Bayfront Expressway/State Route (SR) 84, which runs east-west between the two campuses. The East Campus was formerly occupied by Sun Microsystems and Oracle and is bounded by the tidal mudflats and marshes of the San Francisco Bay and Ravenswood Slough to the north and west, and SR 84 to the east and south. The West Campus is bounded by SR 84 to the north, Willow Road to the east, and the Dumbarton Rail Corridor to the south.

The East Campus is currently developed with nine buildings, totaling approximately one million gross square feet. Facebook would reuse the existing buildings, and modifications of these buildings would be made to make the facilities functional for Facebook and to improve their sustainability/energy and water-conserving features.

Existing buildings at the West Campus would be demolished and the site would be developed with a new campus. Facebook's conceptual site plans for the West Campus propose up to five separate buildings with footprints of up to 36,000 square feet each, and a total building floor area of approximately 439,850 gross square feet. These buildings would range from two to four stories in height. In addition, a five-level parking structure with capacity for approximately 1,440 vehicles would be located in the western portion of the West Campus site. The five buildings would be organized around a central courtyard consisting of open spaces, landscaped areas, amenity centers and meeting rooms, and pedestrian linkages. Connection between the East Campus and West Campus would be enhanced via improvements to an existing undercrossing under Bayfront Expressway that links the campuses.

WIND SETTING

The wind monitoring site closest to proposed project site is at the Palo Alto Airport, located about 2 miles south of the project site. The Palo Alto Airport has an exposure to winds off San Francisco Bay similar to that of the proposed project site. As there are no intervening terrain features, winds measured at the Palo Alto Airport should be representative of conditions on the project site.

A wind rose (graphical presentation of wind direction and speed frequencies) for ten years of wind measurements from the Palo Alto Airport is attached. On an annual basis, winds from the northwest to north quadrant dominate, both in frequency and highest average speed.

In the Bay Area average wind speeds are greatest in the summer and least in the fall. Winds also exhibit a diurnal variation with the strongest winds occurring in the afternoon, and lightest winds occurring in the early morning.

Both the East Campus and West Campus sites are very exposed to winds from off San Francisco Bay. Neither site has protection from prevailing northwest to north winds. Vegetation on the site shows signs of deformation caused by the prevailing winds.

The existing buildings on the East Campus include 8 buildings clustered near the center of the site with pedestrian and outdoor spaces running roughly southwest to northeast between two rows of structures. The five wind-exposed structures on the northwest side of the pedestrian/outdoor corridor create four gaps between buildings that are aligned along northwest to north-northwest directions. All four of these gaps have two-story porous wind fences that appear to have been added after construction of the buildings to control adverse wind conditions within the central pedestrian/outdoor corridor.

REGULATORY FRAMEWORK

CEQA does not list any specific criterion for the evaluation of wind effects of a project. While some larger cities in the Bay Area (City of San Francisco and City of Oakland) have established both standards and criteria for the evaluation of wind impacts, these standards are applicable in zoning districts where high rise structures are permitted. CEQA significance levels in San Francisco and Oakland are based on pedestrian hazard.

The City of Menlo Park has not established any CEQA significance thresholds for wind. For this analysis, the project is considered to have a potentially significant climate or wind impact if the exposure, orientation and massing of structures can be expected to increase ground-level winds in pedestrian corridors or public spaces to hazardous levels.

IMPACTS

Generalized Effects of Buildings

The construction of a building or buildings results in severe distortions of the wind field because the building acts as an obstacle to wind flow. The deceleration of wind on the upwind side of the structure creates an area of increased atmospheric pressure, while an area of decreased atmospheric pressure develops on the downwind side. Accelerated winds generally occur on the upwind face of the building, particularly near the upwind corners. The downwind site has generally light, variable winds. Where two buildings are close together, the areas of accelerated wind may overlap within the gap between the two structures.

The strength of ground-level wind accelerations near buildings is controlled by exposure, massing and orientation. The potential for accelerated winds was evaluated based on a review of site exposure, building heights and building orientations to identify locations where exposure, massing or orientation to the prevailing winds would suggest that increased winds would affect pedestrian spaces.

Exposure is a measure of the extent that the building extends above surrounding structures or terrain into the wind stream. A building that is surrounded by taller structures or sheltered by terrain is not likely to cause adverse wind accelerations at ground level, while even a comparatively small building could cause wind effects if it is freestanding and exposed.

Massing is important in determining wind impact because it controls how much wind is intercepted by the structure and whether building-generated wind accelerations occur above-ground or at ground level. In general, slab-shaped buildings have the greatest potential for wind acceleration effects. Buildings that have an unusual shape, rounded faces or utilize set-backs have a lesser wind effect. A general rule is that the more complex the building is geometrically, the lesser the probable wind impact at ground level.

Building orientation determines how much wind is intercepted by the structure, a factor that directly determines wind acceleration. In general, buildings that are oriented with the wide axis across the prevailing wind direction will have a greater impact on ground-level winds than a building oriented with the long axis along the prevailing wind direction.

Project Impact Analysis

Changes within the East Campus would not affect wind on the site, as the existing buildings would be re-used and the existing wind fences located between buildings would remain. The preliminary landscape plan for the East Campus shows generous use of trees and shrubs that will provide wind shelter, and the main pedestrian/outdoor corridor would have ample sun. Major sitting areas appear to be in locations that would be wind sheltered and reasonably sunny.

The West Campus has little shelter from northwest to north prevailing winds. The proposed parking garage and Buildings 1, 2 and 3 would all have minimal wind shelter afforded by landscape trees. The parking structure, although exposed, is a porous structure that is not likely to generate ground level wind accelerations.

Building 1 is exposed to prevailing winds and has its long axis aligned across the prevailing wind direction, which suggests it would generate wind accelerations near the upwind corners. At the northwest corner of the building, a 1-story extension of the building is shown, which would intercept the wind acceleration coming down the building face and around the corner. At the northwest corner, the building's wind acceleration would occur above the rooftop of the 1-story portion of the building such that it would not reach pedestrian levels.

The gap between Buildings 1 and 2 and Buildings 2 and 3 have similar alignments as the gaps between buildings on the East Campus. Given the similarity in alignment and building height, it can be expected that the spaces between these buildings will have wind problems similar to those experienced at the East Campus. There do not appear to any pedestrian uses proposed for these areas, as they are shown as being stormwater runoff treatment areas. However, accelerated winds flowing between these buildings would eventually impact portions of the pedestrian/outdoor corridor south of Buildings 1-3.

Project plans show five unenclosed elevated pedestrian bridges between buildlings. Those pedestrian bridges running east to west (between Buildings 1 and 2, 2 and 3, and 4 and 5) are likely to experience accelerated wind due to the alignment of the gaps in the buildings with respect to prevailing winds and elevation above ground.

Buildings 4, 5 and the two story transit/public amenities buildings would be sheltered by other project components and would, therefore, not have the potential for substantial wind impacts.

Based on the preliminary site plan and landscaping plan for the West Campus, the exposure, massing and alignment of the buildings on the site indicate that there would be areas of the campus that would have accelerated winds, but the strongest winds would occur in areas not used by pedestrians, with the exception of the pedestrian bridges between Buildings 1 and 2, 2 and 3, and 4 and 5. The limited height of the structures means that hazardous winds would not be expected, but uncomfortably windy conditions could be expected in parts of the central pedestrian/outdoor corridor and pedestrian bridges. Project wind effects would not extend into surrounding neighborhoods, but would be felt only within the West Campus itself. The usability of portions of the site might be compromised, but these impacts would not be considered significant under CEQA.

West Campus plans show potential roof deck open space on several buildings. All rooftop decks would be windy and would need to be carefully landscaped to assure usability.

Recommendations

The north-south aligned gaps between Buildings 1 and 2 and Buildings 2 and 3 will accelerate winds, adversely affecting the usability of outdoor areas within the central pedestrian/outdoor corridor. There are at least two ways that these winds could be minimized.

If the location and alignment of Buildings 1, 2 and 3 are not changed, porous wind fences similar to those currently in use at the East Campus could be incorporated into the design. Combined with enhanced landscaping with trees and shrubs, the wind fences could dissipate winds within the gaps before reaching the main pedestrian/outdoor corridor. It is also recommended that pedestrian bridges with north-south exposures have a perforated or expanded metal wind screen on the north side of the structure to provide wind shelter to users.

Changes in the alignment, location or shape of Buildings 1, 2 and 3 could also mitigate wind accelerations between buildings. Realigning the structures so that their long axis is more along, rather than across, the prevailing north-northwest wind direction would reduce the amount of wind intercepted by the structures. Arranging the buildings so that the gaps between buildings are not aligned along the prevailing wind direction would additionally weaken the wind flow between the buildings and enhance the sheltering effect of the buildings for the central pedestrian/outdoor corridor.

West Campus plans show potential roof deck open space on several buildings. All rooftop decks would be windy and would need to be carefully landscaped to reduce wind and improve usability. Porous materials or structures (vegetation, hedges, screens, latticework, perforated or expanded metal) offer superior wind shelter compared to a solid surface, and should be used to create pockets of shelter where the most sensitive uses are proposed (sitting and dining areas, for example). Vegetation, sculptures, planter boxes, fences and hedges can all be used to reduce winds. For safety, outdoor furniture used on rooftops should be attached to the roof.

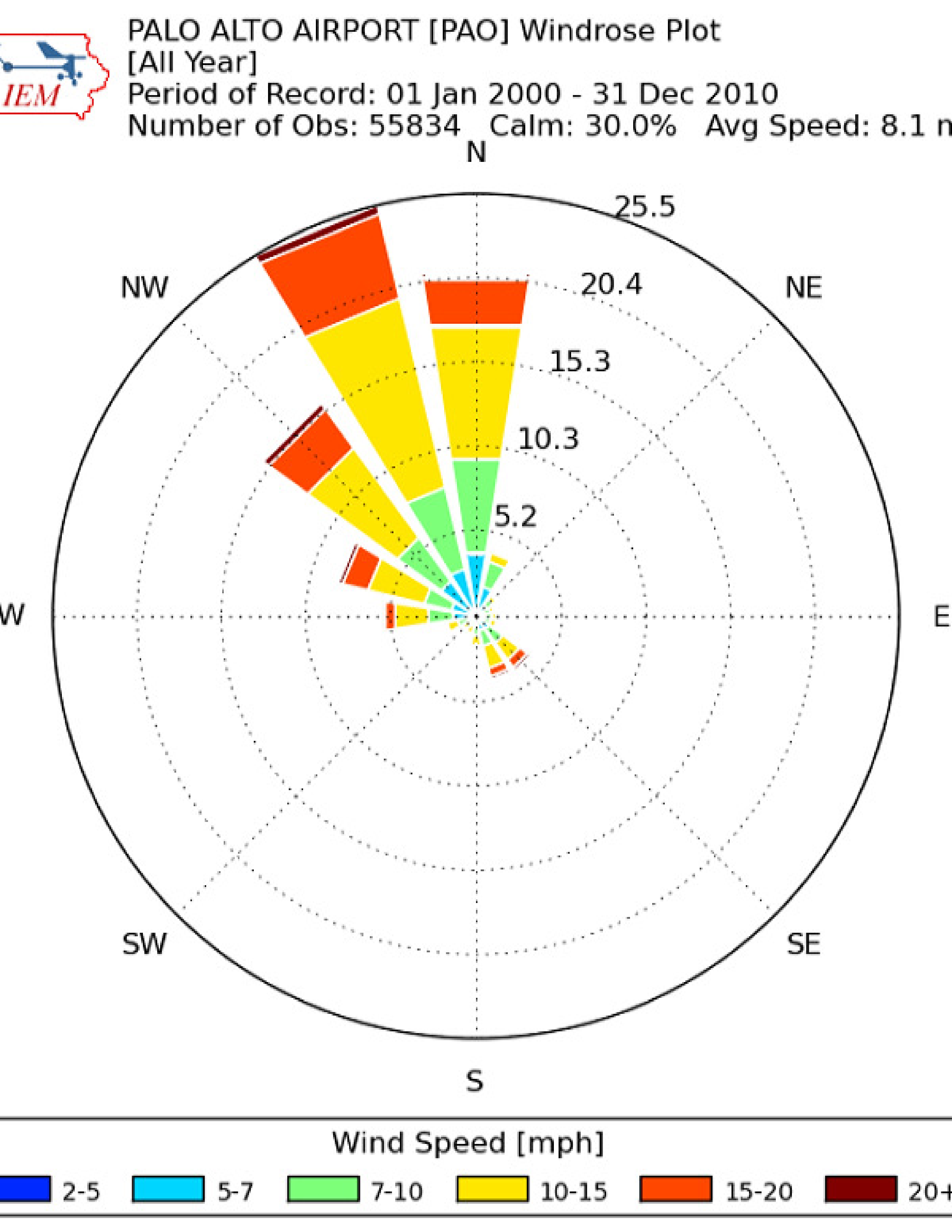
I hope you find this analysis useful. Please call me if you have any questions.

Sincerely,

Donald Ballanti

Donald Ballanti
Certified Consulting Meteorologist

Attachment


IEM
PALO ALTO AIRPORT [PAO] Windrose Plot
[All Year]
Period of Record: 01 Jan 2000 - 31 Dec 2010
Number of Obs: 55834 Calm: 30.0% Avg Speed: 8.1 m
N
NE
E
SE
S
SW
W
NW
25.5
20.4
15.3
10.3
5.2
Wind Speed [mph]
2-5
5-7
7-10
10-15
15-20
20+