Campion House, London:
Wind Microclimate Desk Study

Linden Homes

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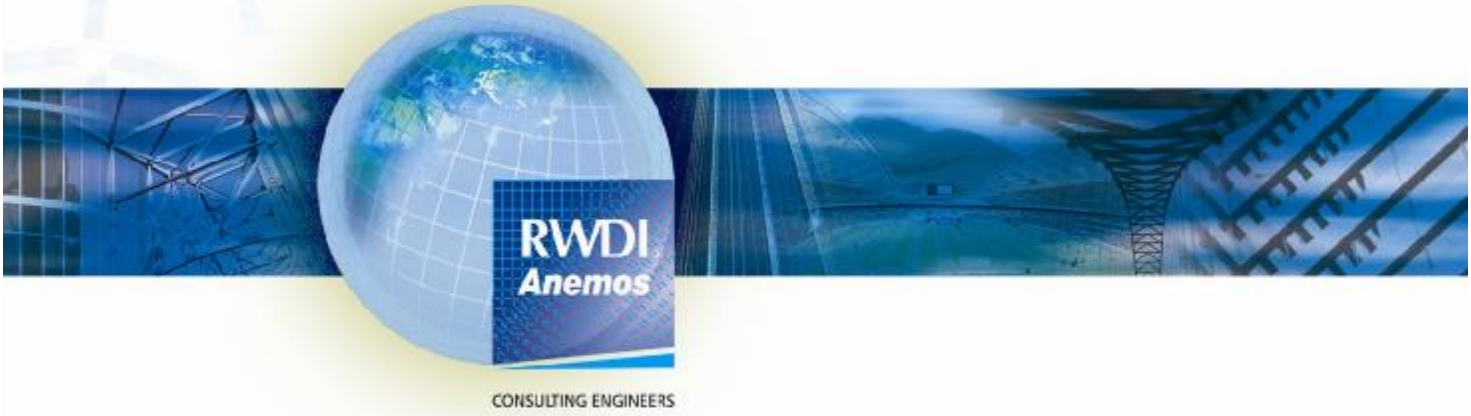

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OBJECTIVE

The objective of this study was to review architectural drawings of the proposed Campion House development in west London and to make a desk-based assessment of the expected environmental wind conditions at street level. The assessment is based on our extensive experience of similar urban developments and our expert knowledge of the flow of wind around buildings.

VERSION HISTORY

INDEX	*DATE*	*PAGES*	*AUTHOR*
A	*18th February 2008*	*All*	*M. Caminiti*
B	*6th March 2008*	*All*	*M. Caminiti*
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1. SUMMARY

This is an assessment of the likely wind conditions around the proposed Campion House development in west London. It outlines the overall methodology and the use of the Lawson Comfort Criteria to describe the wind conditions expected on site. The assessment is based upon RWDI Anemos' experiences with other similar schemes and our expert knowledge of the interaction of wind with the built environment.

The site description is used mainly to identify building massing and features that are pertinent to the wind microclimate on site. Meteorological data for the London area are analysed and adjusted to the site conditions by modelling the effect of ground roughness on the wind speeds approaching the site. The expected main flow interactions around the site are then described and quantified in terms of the familiar Lawson Comfort Criteria used for around thirty years throughout the UK in assessments of this kind.

2. SITE DESCRIPTION

2.1 Site location and context

The OS grid reference for the site is (514836, 176951) and is located in west London just south of the A4 Road. The site is bounded by Thornbury Avenue to the north, Thornbury Road to the east, Kilberry Close to the south and there are open playing fields to the west of the site which extend for approximately 300m. The surrounding areas appear to be largely residential and so mainly comprise two or three storey buildings.

2.2 Proposed development

The site comprises a number of Blocks labelled A through J (Figure 2). For the purpose of this assessment the Site is divided into a north and a south area.

The north area of the Site comprises Blocks A, B (the existing Campion House building), C, & D. Blocks A and B, in the north part of the Site, are separate blocks which are respectively 3- and 4-storey buildings (the latter equivalent in height to a modern 5-storey residential block). Blocks C, & D comprise components of different heights but the maximum height is similar to the existing Campion House building.

Buildings in the south area of the Site (E through to J) are generally three to four storeys, but the existing Tigar Hall building (in the south-east corner of the Site) is one storey. The layout of the proposed buildings in the south area of the Site is relatively dense, compared to the north area. Most blocks are aligned to the prevailing winds (nominally south-west to north-east). Blocks H and J have semi-enclosed communal gardens.

There are numerous entrances to the buildings at ground floor.

3. METEOROLOGICAL DATA

Knowledge of the prevailing wind direction allows us to focus attention on the likely impact of these winds on the site except where the building massing/layout indicates that winds from other directions are likely to be important. This means that, taking account of other design constraints, it is desirable that the site is arranged so that the maximum acceleration of the wind due to the building massing occurs for the lightest and most infrequent wind speeds and directions. In this way pedestrian comfort is optimised.

3.1 General Meteorological Data

Joint frequency tables of wind speed, divided into ranges of the Beaufort Scale, and direction on an annual basis for 30° sectors around the compass were obtained for London. The presentation of results in this report is for annual and seasonal data defined as spring (March, April, and May), summer (June, July and

August), autumn (September, October, November) and winter (December, January, February). Data for London were used in this investigation and are presented for standard open-country terrain.

The frequency tables are fitted by standard Weibull curves. In this way the data are smoothed and converted into a format more suitable for analysis. The Weibull curve is defined by the parameters, c, a measure of dispersion, k, a shape parameter and p, the percentage of time the wind occurs. The meteorological data indicates the expected peak from the south-westerly direction which would be expected to be prevalent throughout the year and secondary north-easterly during the spring and summer months (refer to Figure 4).

3.2 Surface Roughness Around the Site

Another consideration is the ground roughness in each wind direction because wide, open spaces permit the wind to blow down to ground level generating conditions similar to that of open countryside even within a built-up area. An assessment of the ground roughness for the Campion House site was conducted using the BREVe2 software[1].

Table 3 presents the 'mean factors' for the site where the mean factor represents the ratio of wind speed on site, at the stated reference height, as a fraction of the wind speed in open, flat countryside at a height of 10m. The mean factors for the site at 10m above ground cover a range from 0.59 to 0.91. This range shows some local variation due to the open playing-fields area immediately to the west of the site and the impact of Osterley Park north of the A4 Roadway, with mean factors that are broadly typical for an urban area in other wind directions, i.e. with wind speeds being nominally two-thirds of those that would occur in open countryside.

4. LAWSON COMFORT CRITERIA

4.1 Pedestrian Comfort Criteria

RWDI Anemos routinely use criteria developed by Lawson[2]. Lawson devised a twelve-point scale (not shown here) to represent equal increments of annoyance or reaction to the wind and these were then used to set threshold values for particular pedestrian activities. The criteria account for the fact that the wind conditions perceived as tolerable by pedestrians depend on the activity they are engaged in. For example, wind conditions in an area designated for sitting need to be calmer than a location that people merely walk past. In total six pedestrian activities are described in Table 1 in ascending order of activity: sitting, standing, entrances, leisure walking, business walking and roadways/car parks. Table 2 summarises the Beaufort Land Scale and quantifies the wind speeds associated with each Beaufort Range.

4.2 Pedestrian Safety

The Lawson Criteria also specify a lower limit safety criterion when winds exceed Beaufort Force 6. If this safety criterion is exceeded then there may be a need for mitigation measures or a careful assessment of the expected use of that location, e.g. is it reasonable to expect vulnerable pedestrians to be present at the location on the windiest day of the year?

In order to ascribe a measure of significance to wind speeds greater than Beaufort 6, RWDI Anemos defines three threshold levels above Beaufort 6 denoted as S_0, S_1 and S_2, but these cannot be resolved in a study of this kind. However, experience has shown that occurrences of business walking and roadway wind conditions are associated with wind speeds in excess of the B6 safety criterion and therefore pedestrian safety as well as comfort should be considered if such conditions occur.

[1] *BREVe2 – A publicly available software implementation of the design wind speed rules of BS6399-2 sold by BSI, BRE and RWDI-Anemos. The program includes terrain and topography information from BRE and Ordnance Survey.*
[2] T.V. Lawson, 'Building Aerodynamics', Imperial College Press, © 2001

5. BASELINE CONDITIONS

Often a new development dramatically alters the pedestrian activity on site and consequently a comparison of the original wind conditions with those on the developed site can be meaningless. For example, wind conditions currently suitable for pedestrian walking and which remain suitable for pedestrian walking after development may lead to the conclusion that there is negligible impact due to the development. However, if on the new development the location of interest is outside a main entrance then the impact is adverse and will require remedial action.

5.1 The current wind conditions on site.

Analysis of the meteorological data for the existing open site indicates that the existing conditions on site are likely to be tolerable for standing/entrances or better. The implication of this result is that, after development, if the site has a number of locations where the conditions are tolerable for (say) leisure walking, then these are likely to be perceived to be 'windy' relative to general conditions in the area.

5.2 The current wind conditions around the site (on neighbouring properties).

It is desirable, as part of a good neighbour policy, to minimise adverse changes to the wind conditions on neighbouring buildings due to a development. Generally, development may lead to increased wind speeds on adjacent properties for some wind directions but increased shelter for other directions.

5.3 Comparison of the wind conditions with the desired conditions.

In the assessment of the proposed development, comparison is made between the wind conditions expected on the developed site and the desired wind conditions. This is generally the most useful baseline for comparison because it is an assessment which indicates whether the wind conditions are suitable for the intended pedestrian activity at a location.

The proposed development is exposed to the west and because the prevailing winds blow from this direction, the west elevation of the existing site is expected to be relatively windy, wind conditions around the westerly corners being suitable for leisure walking during the windiest season, but more typically suitable for standing/entrance use (or better). The existing buildings on the site run along Thornbury Road and so provide an effective screen against the prevailing winds for the existing buildings on the east side of Thornbury Road.

6. WIND CONDITIONS AROUND THE PROPOSED DEVELOPMENT

Appendix A contains a number of general comments on the way wind interacts with the built environment and is provided for reference purposes. The following sections consider the specific issues related to the Campion House site. The expected comfort levels, for the windiest season, within and around the Site are shown in Figure 3.

6.1 Entrance(s)

There are numerous operable doors/windows, at ground level, all around the perimeter of the site which open into the communal garden areas and onto the outer perimeter of the site. This report will not discuss each of these in turn because of the number of entrances. However, entrances located in areas where wind conditions are expected to be stronger than those suitable for an entrance require mitigation, as described within Section 6.5.

6.2 Open Spaces – Communal Gardens

The Site includes several open areas/communal gardens. These are listed below:

- Green open area in the north of the site;

- Communal gardens within Block H (south area of the Site);
- Communal garden within Block J (west area of the Site);
- Green open area along Thornbury Road (east of the Site);

Our calculations for the idealised open site show that the expected wind conditions would be standing/entrance during the winter, and sitting during the summer season.

The areas where there is either an increase or reduction in the wind speeds, as a result of the building geometry and massing, are highlighted in Figure 3. The windier zones, suitable for leisure walking are shown in yellow. The calmer zones, suitable for sitting are indicated in green.

Overall, the wind microclimate at the open areas within the Site is expected to be suitable for the intended pedestrian use of the site. No substantial impact is expected on the wind microclimate at neighbouring areas (e.g. along the edges of the site) as a result of the Proposed Development. Therefore, the wind microclimate along Thornbury Road is expected to be largely similar to the existing conditions, suitable for standing/entrance.

6.3 Blocks in the North Area of the Site

The north area of the Site comprises Blocks A, B (existing Campion House building), C, & D. The layout of buildings in this area of the Site is relatively sparse.

However, Blocks A to D are relatively low rise (with a maximum height of 5-storeys for Block D); the wind conditions are expected to be generally suitable for standing/entrance use or better even during the worst-case season (winter). The only exceptions to this are building corners exposed to the prevailing winds, where the wintertime conditions are locally expected to be suitable for leisure walking. This is in-keeping with the intended use of these areas.

6.4 Blocks in the South Area of the Site

The south area of the Site comprises Blocks E, F, G, H, I & J. The layout of these buildings is relatively dense, compared to the north area of the Site.

Blocks in the south area of the Site are relatively low rise, one to four storeys, and their layout and orientation relative to the prevailing winds is expected to be beneficial in terms of wind microclimate. The wind conditions in the south area of the Site are generally suitable for standing/entrance use or sitting. There are several building corners with a windier classification due to acceleration of the prevailing winds, where conditions are locally suitable for leisure walking. This is in-keeping with the desired pedestrian usage of these areas.

6.5 Mitigation Measures

If any entrances are present in areas where the expected wind conditions are suitable for leisure walking, then these require mitigation. Suitable recessing/screening is expected to achieve the desired standing/entrance conditions at these locations.

The assessment above assumed that no planting was present around or within the development whereas, the plans indicate that there is planting planned over most of the Site.

The whole of the western boundary is lined by existing Leylandii which are approximately 6m to 7m tall. These are being retained and so will shelter the western side of the development but additional shelter will be provided by the proposed row of trees to the east of western boundary.

There is further planting planned for most open areas on the Site, as shown within Figure 2. These measures are expected to be particularly beneficial during the summer months, when the trees are in full leaf.

These wind conditions are considered to be compatible with the intended pedestrian use of the site.

7. CUMULATIVE IMPACT OF ADJACENT DEVELOPMENTS

We are not aware of any developments of surrounding sites which would significantly alter the assessment presented above.

8. CONCLUDING REMARKS

In conclusion:

1. The meteorological data for the site indicate prevailing winds from the south westerly quadrant throughout the year, and secondary winds from the north easterly direction particularly during the springtime.
2. The existing conditions for an idealised open site are expected to be suitable for standing/entrance use, a classification which is in the lower half of the Lawson Comfort Scale and typical of urban areas in the southern UK.
3. The site is exposed to the west and is also exposed to northerly winds because of the proximity of Osterley Park, but benefits generally from the shelter provided by the urban areas of London in other directions.
4. The conditions in open green areas on the Site are expected to be suitable for standing/entrance use or better during the worst-case season (winter), and sitting during the summer season.
5. The conditions around the Site are expected to be suitable for the desired pedestrian activity with leisure walking conditions near building corners and standing/entrance conditions in the central areas of most building facades.
6. The wind conditions along Thornbury Road are expected to be largely unchanged by the proposed development and suitable for standing/entrance use.
7. No mitigation measures have been proposed (or are considered necessary), the development is relatively low-rise and the assessment indicates that the wind conditions are compatible with the desired pedestrian use of the site. The proposed planting is expected to be beneficial and to enhance the wind environment particularly during the summer season when trees are in full leaf.

DESCRIPTION	LETTER	THRESHOLD
Roads and Car Parks	A	6% > B5
Business Walking	B	2% > B5
Leisure Walking	C	4% > B4
Pedestrian Standing	D	6% > B3
Entrance Doors	E	6% > B3
Sitting	F	1% > B3

Table 1: Lawson Comfort Criteria

BEAUFORT FORCE	HOURLY-AVERAGE WIND SPEED (m/s)	DESCRIPTION OF WIND	NOTICEABLE WIND EFFECT
0	< 0.45	Calm	Smoke rises vertically
1	0.45 - 1.55	Light Air	Direction shown by smoke drift but not by vanes
2	1.55 - 3.35	Gentle Breeze	Wind felt on face; leaves rustle; wind vane moves
3	3.35 - 5.60	Light Breeze	Leaves & twigs in motion; wind extends a flag
4	5.60 - 8.25	Moderate Breeze	Raises dust and loose paper; small branches move
5	8.25 – 10.95	Fresh Breeze	Small trees, in leaf, sway
6	10.95 - 14.10	Strong Breeze	Large branches begin to move; telephone wires whistle
7	14.10 - 17.20	Near Gale	Whole trees in motion
8	17.20 - 20.80	Gale	Twigs break off; personal progress impeded
9	20.80 - 24.35	Strong Gale	Slight structural damage; chimney pots removed
10	24.35 - 28.40	Storm	Trees uprooted; considerable structural damage
11	28.40 - 32.40	Violent Storm	Damage is widespread; unusual in the U.K.
12	> 32.40	Hurricane	Countryside is devastated; only occurs in tropical countries

Table 2: The Beaufort Land Scale

	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°
2m	0.62	0.61	0.61	0.45	0.43	0.44	0.45	0.45	0.67	0.67	0.65	0.43
10m	0.91	0.89	0.89	0.61	0.59	0.60	0.62	0.62	0.78	0.77	0.76	0.59

Table 3: BREVe2 mean factors at 2m and 10m above ground at the site

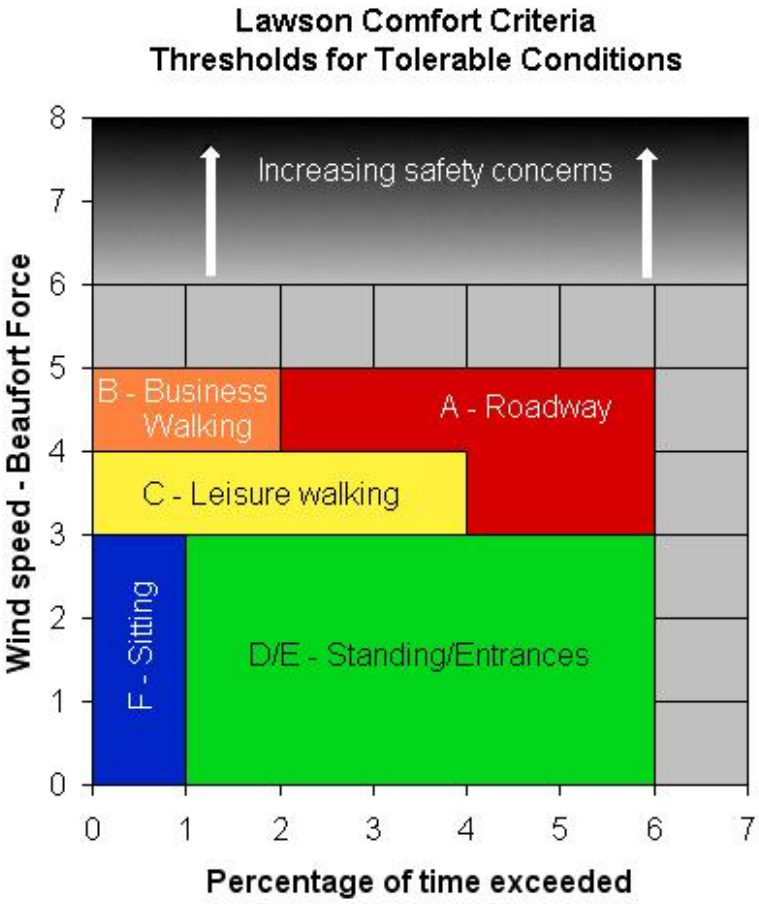

Figure 1: Lawson Comfort Criteria

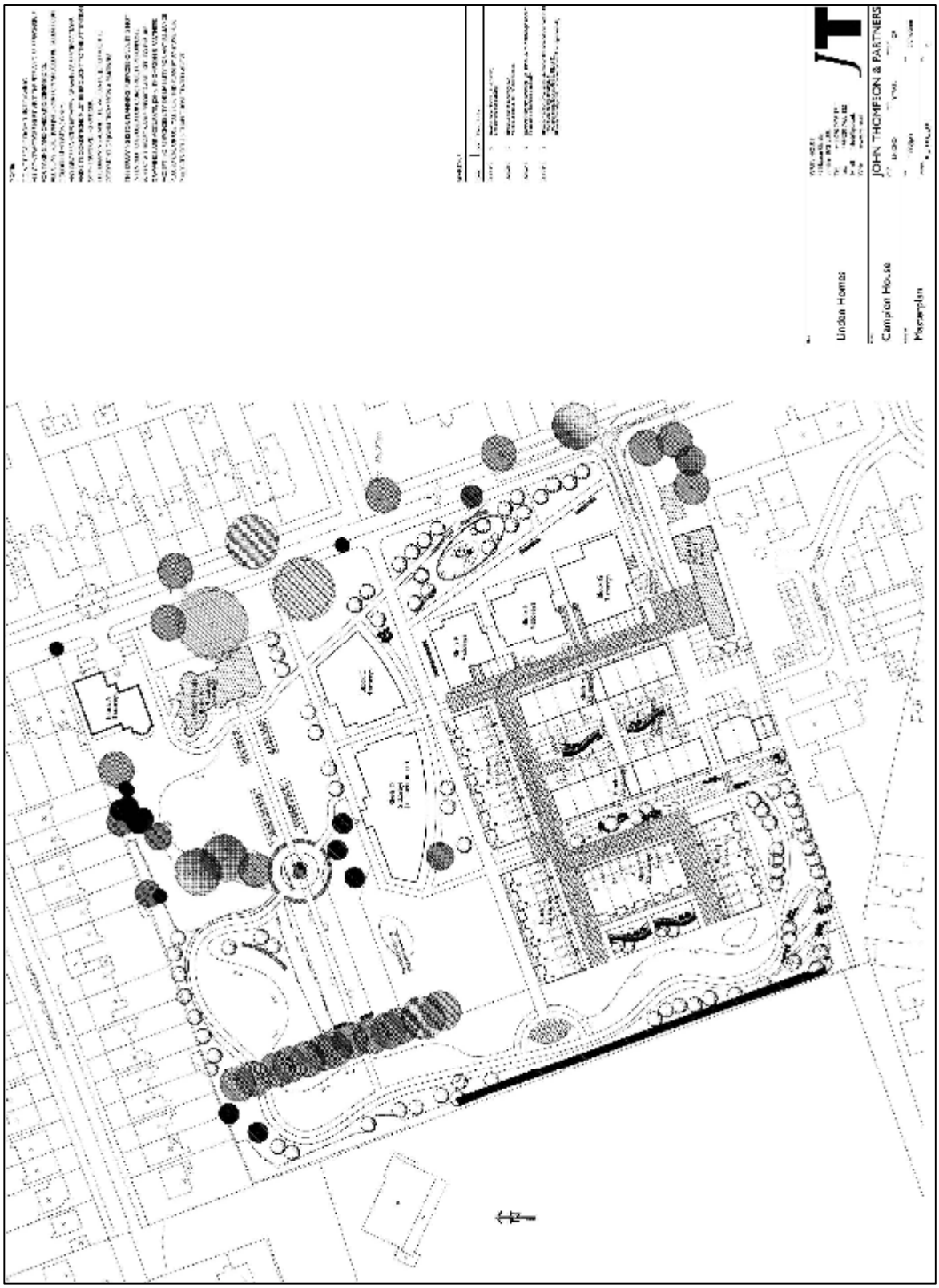

Figure 2: Site Plan, Proposed Development

Figure 3: Expected Comfort Levels around the Proposed Development

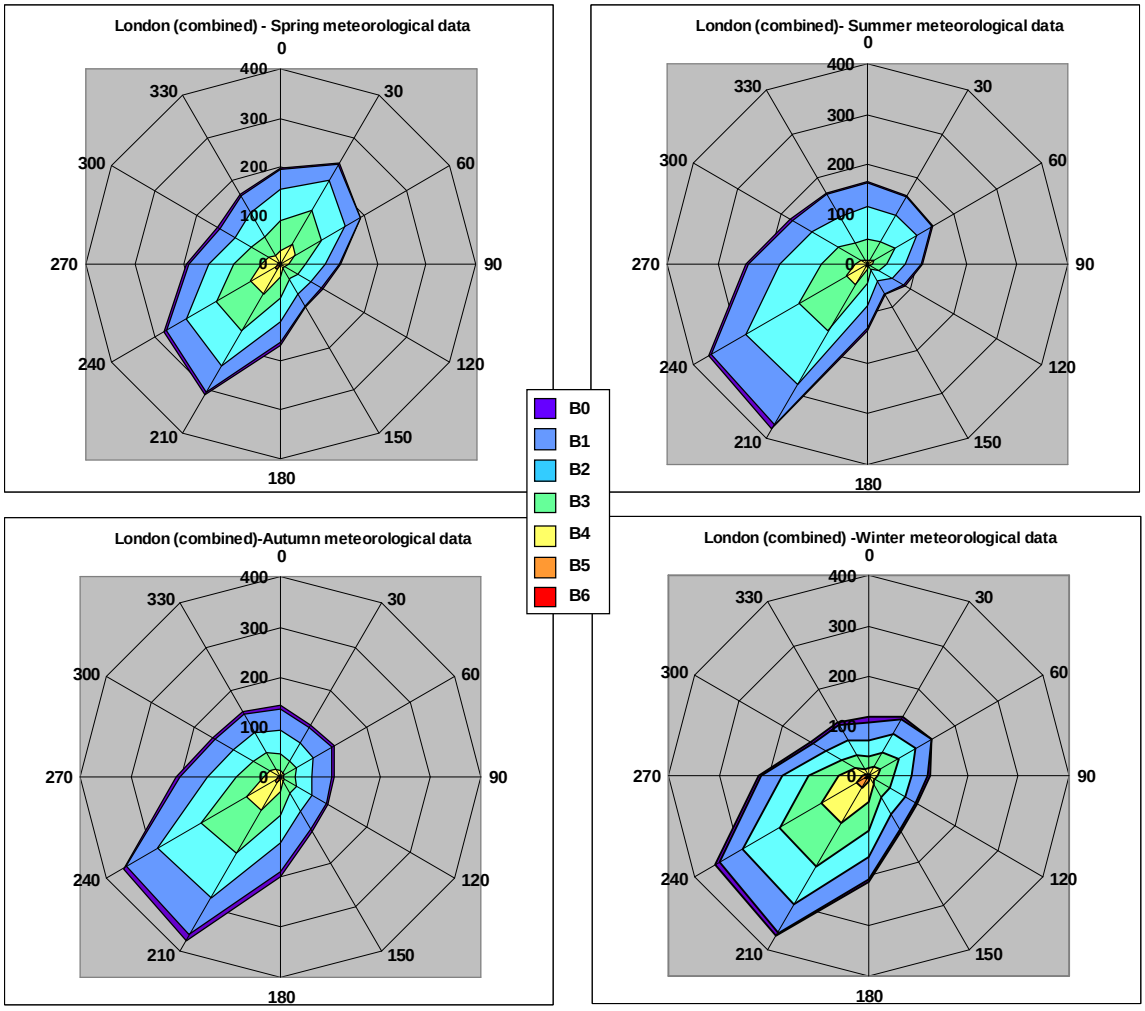

Figure 4: Seasonal wind roses for London (in Beaufort Force)

(Beaufort Force and hours of wind stated range is exceeded)

APPENDIX A: GENERAL COMMENTS ON WIND IN THE BUILT ENVIRONMENT

Urban airflow

As the wind approaches a built-up area it is displaced upwards to roof level and tends to blow across the roof tops with gusts down to street level that are a function of the relative heights-to-width of the street canyon. When the height-to width ratio of the street canyon is greater than 0.7 the skimming flow regime dominates and the wind blows across the top of the street with little penetration down to ground level, whereas a height-to-width ratio less than 0.4 produces conditions similar to the isolated building scenario[3]. However, when there is an increase in building height across the street this can reinforce the rotating, or vortex, air movements within the street. Relatively open spaces, even inside a city, can be windy as the wind blows down from roof level into the open space.

Calm areas are generally desirable for pedestrian comfort. However, very slow air movement can result in poor ventilation of pollutants and in these areas it is desirable that pollutant sources are limited.

Seasonal variability

Pedestrian activity differs during the summer and winter months when other climatic conditions, for example air temperature, have a marked impact. The Lawson Criteria assume that pedestrians will be suitably dressed for the season and when making a worst-case assessment it is reasonable to assume that pedestrians will not be sitting at a street-side café on the windiest days of the year.

Entrances

Pedestrians are particularly sensitive to wind conditions at entrances because of the potentially marked change between the controlled environment inside the building and external conditions. For this reason it is important that conditions immediately adjacent to an entrance are relatively benign or that there is a sheltered 'buffer' zone, which allows pedestrians time to acclimatise. For recessed entrances the recess creates a buffer zone but is also prone to accumulating wind-blown debris because of the trapped vortex, or rotational, flows that can occur in the recess. Entrances are also used throughout the year so that even during the windiest days of the year the entrance should be relatively sheltered.

Entrances on different building elevations are also susceptible to pressure-driven through flows when opened simultaneously. The windward façade is generally positively pressurised whereas the side and/or downwind façades are at a lower pressure. If the entrances are into a central atrium then the different external surface pressures can be directly connected when doors are opened simultaneously. This can lead to nuisance draughts and in extreme cases difficulty in opening doors or whistling as the pressure difference forces the doors slightly ajar. Revolving doors eliminate the problem because the pressure seal across the building envelope is maintained. The extent of any potential nuisance is in part related to the footfall through the entrances because this will affect the probability of doors being opened simultaneously. Lobby doors are another means of limiting the impact of nuisance draughts but again the likelihood of both sets of lobby doors being opened simultaneously should be considered when selecting and sizing this option.

Landscaping

Landscaping is a very useful means of softening the streetscape and creating naturalised shelter within and around the site. There are generally two ways in which landscaping works; relatively dense lines of planting act like a solid screen deflecting the wind, whereas more open planting removes energy from the wind as it flows through the screen. In both cases shelter is created but for the case of the more solid screen winds can remain relatively strong at the extreme ends of the screen. If we consider the case of street

[3] T. R. Oke, 'Boundary Layer Climates', Routledge, © 1987

canyons in UK towns and cities, the tree canopy minimises the penetration of vertical gusts down to pedestrian level and horizontal winds are displaced upwards by the canopy.

Another consideration is the seasonal variation of the species. Deciduous varieties create a denser screen during the summer months but during the winter months offer limited protection due to the bare branches. Evergreen varieties offer more consistent shelter throughout the year. When considering seasonal variability, account should be taken of the more transient pedestrian activity during the winter months where other climatic factors, e.g. air temperature, impact upon the way in which pedestrians will use a site. Finally, the maturity of the planting is significant; semi-mature species offer reasonable protection from an early stage in the life of the development, whereas immature planting will take time to establish.

Balconies

If there are buildings with recessed balconies then it is generally the case that these will be sheltered unless they are particularly long balconies when the wind can blow along and into the balcony. Partition walls/screens between the balconies of adjoining properties are usually sufficient to eliminate this potential wind nuisance.

Protruding balconies are potentially more susceptible to wind nuisance because the main flow along the surface of the building can blow directly across the balcony. This condition is exacerbated if the protruding balcony skirts around a corner of the building where the strong corner winds will blow across the balcony. There is usually a requirement to screen the ends of the protruding balconies in order to displace the wind away from the balcony.

Colonnades

In this discussion a colonnade is defined as a covered walkway where the cover is generally provided by overhanging upper storeys of the building. In other words the building footprint at ground level is set-back. Colonnades create shelter from the direct effects of downdraught but are exposed to horizontal winds which can be channelled along the colonnade. If the colonnade connects windward and leeward elevations of the building then a pressure-driven flow is generated through the colonnade. If the building façade at ground level is curved then this can also be expected to accelerate the winds through the colonnade.

Colonnades do not necessarily provide shelter from the wind. Consequently, it may be necessary to increase resistance to air movement along the colonnade, and/or to prevent penetration of wind into the colonnade, by suitable screening.

Covered open spaces

Developments which are covered but open, either along the sides of the roof or at low level, will have internal environmental conditions that are variable and dependent upon the prevailing weather conditions. The canopy, typically a lightweight glazed canopy or fabric roof, may increase shelter from the rain and thereby improve the utility of the covered space; however, when the external air temperature is low and there is a breeze along the street it will generally be the case that pedestrians will need to be suitably dressed.

The challenge with these covered but open spaces is that the perception of shelter due to the canopy roof creates an expectation of shelter from both rain and wind. Put another way, if the wind conditions on a ‘normal’ street are identical to those in a covered street the pedestrian perception will be that the conditions beneath the canopy are less benign.

To design against this it is necessary that the wind conditions along a covered street are relatively benign. It is also important that the retail tenants on the street, particularly those operating food kiosks or cafes with ‘external’ seating, appreciate the variability of the weather conditions or are suitably catered for in terms of demountable screens and (say) patio heaters to enhance conditions locally.