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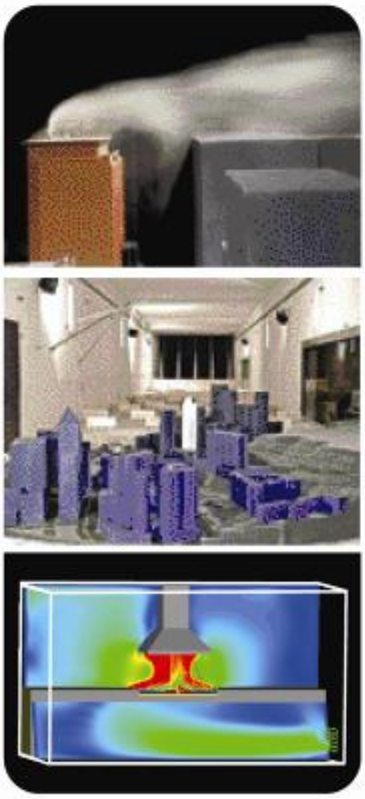
WIND ENGINEERING AND AIR QUALITY CONSULTANTS

FINAL REPORT



Wind Assessment for:

UTS THOMAS STREET BUILDING

Ultimo, NSW, Australia

Programme Management Office

Facilities Management Unit

University of Technology, Sydney

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CPP Project: 6322R1

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Introduction

Cermak Peterka Petersen Pty. Ltd. has been engaged by the University of Technology, Sydney to provide an opinion based assessment of the impact of the proposed Thomas Street Building on the pedestrian level local wind environment in and around the proposed development. This report is in accordance with the Director-General's Requirements Section 75F of the Environmental Planning and Assessment Act 1979, Major Project 09 0_213. In particular item 4 Wind Effects:

"Wind assessment to detail wind conditions on pedestrians within the site and public domain, and proposed mitigation measures".

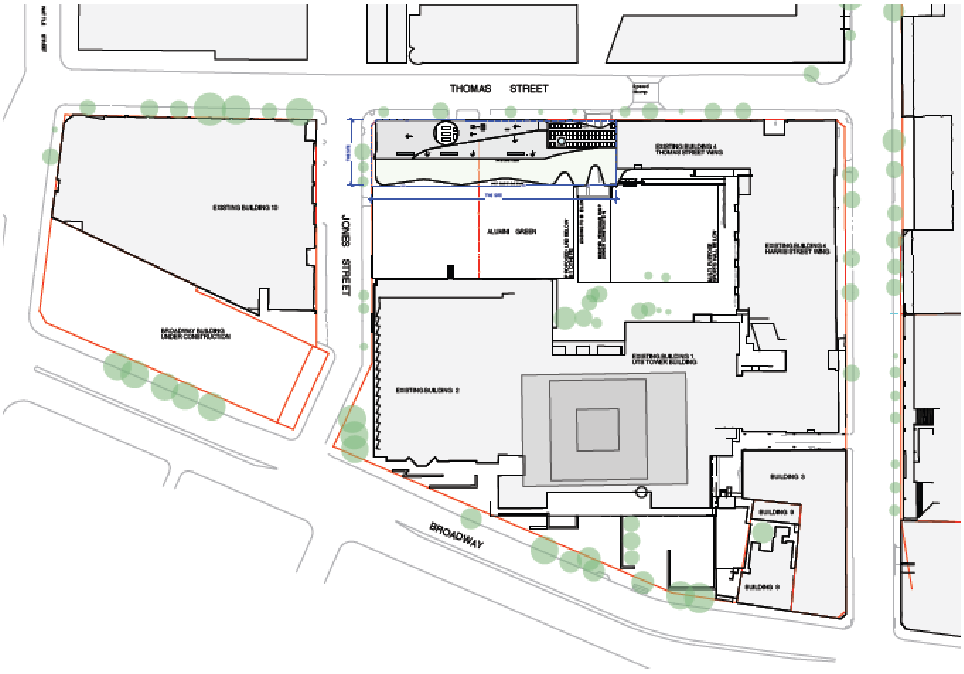

Figure 1: Location of the proposed Thomas Street Building

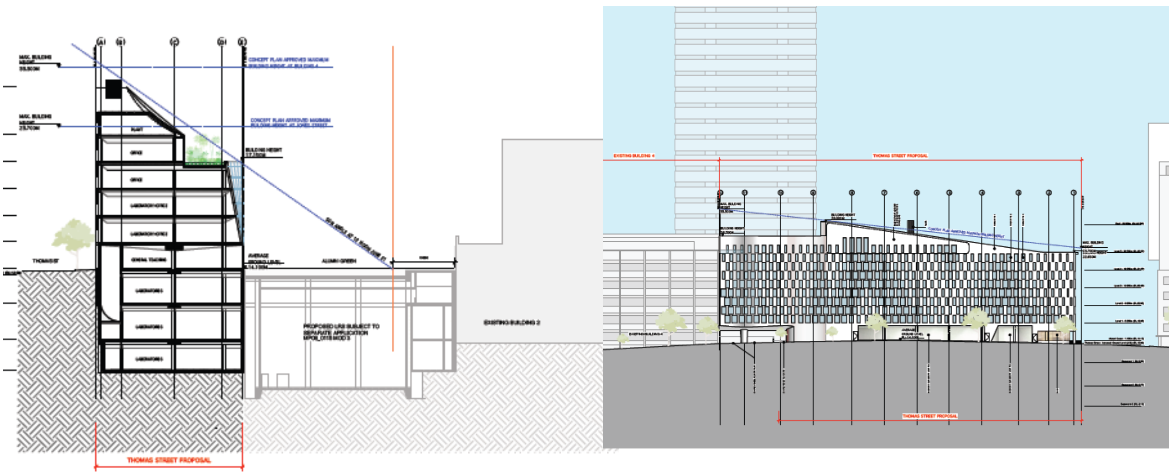

Figure 2: Section looking east, and north elevation views of the proposed Thomas Street Building

The site is rectangular in shape and has street frontages to Thomas Street to the north and Jones Street to the west, Figure 1. Alumni Green is to the south of the site. The new building will house new facilities for the Faculty of Science, extending the current faculty space in Building 4.

The new building will accommodate research offices and laboratories, teaching space, an activated retail space at ground level on Jones Street, and a connection through to Alumni Green, Figure 2. The building will have a maximum height of approximately 33 m with the majority of the building being limited to four storeys above ground.

The Thomas Street Building is located within a diverse range of building types and uses of similar height and massing. Significant institutions in close proximity to the building include the UTS Tower (Building 1) and other mid-rise campus buildings, the ABC headquarters, Sydney Institute of TAFE, and One Central Park development under construction on the south side of Broadway. Important in terms of wind impact is the interaction these surrounding developments have with the Thomas Street Building.

Ultimo Wind Climate

A wind climate assessment has been prepared based on data obtained from the Sydney Airport Bureau of Meteorology anemometer (BOM 066037) as described in Appendix 1. Key characteristics of the Sydney wind climate are:

- Summer winds occur mainly from the south, south-east, and north-east. Winds from the south generally provide the strongest gusts during summer and are associated with cold frontal systems. Onshore north-east sea breezes are of moderate intensity, but prolonged duration, bringing cooling breezes to coastal locations in the afternoon summer months. Summer thunderstorms come from the west and tend to have an intense, but short duration gust front.
- Winter and early spring winds occur mainly from the south and west quadrants.

West quadrant winds provide some of the strongest winds affecting Sydney throughout the year.

Environmental Wind Speed Criteria

Prior to assessing the wind environment, it is important to establish suitable targets in terms of the desired environmental wind conditions for particular pedestrian activities. With reference to Appendix 2, wind conditions in this qualitative report are described in terms of:

- Long term stationary - generally acceptable for stationary, long exposure activities (e.g., outdoor alfresco dining).
- Short term stationary - generally acceptable for stationary short exposure activities (e.g., window shopping, or sitting in plazas).
- Comfort of walking - generally acceptable for walking; wind conditions below safety concern. This is the maximum level of wind intensity generally considered acceptable for walking in public domain locations.
- Safety concerns - completely unacceptable for walking in main public accessways under the impact of strong gusty winds.

Wind Flow Mechanisms

Wind interaction with the built environment can be grouped into basic flow mechanisms commonly producing higher velocities at pedestrian level. Some key flow mechanisms relevant to the UTS City Campus Concept Plan site are discussed in Appendix 3.

Impact of Prevailing Winds on Existing Site

Most of the Thomas Street site receives shielding from Sydney's prevailing wind directions by surrounding mid to high-rise development described earlier. The staggered alignment of roads and passageways within and surrounding the precinct mitigate channelling of prevailing Sydney winds. Thomas Street has large building developments at its western end effectively blocking channelling westerly flows. Similarly, the impact of prevailing southerly winds is largely reduced at the site because of the available shielding offered by the Chippendale, Surry Hills, and Redfern built environments.

CPP has conducted wind tunnel tests on a 1:400 scale model for other development in the vicinity of the Thomas Street building. Whilst measurements on the exiting Thomas street site have not been made, measurements taken at nearby locations suggest winds are acceptable for long and short term stationary activities, i.e. the wind environment at the existing site is likely suitable for intended student usage and amenity.

Impact of Prevailing Winds on Proposed Thomas Street Building

Thomas Street has an approximate east-west alignment and will experience some channelling of westerly winds with a similar intensity to existing conditions. Westerly winds channelling along Thomas Street will have minimal impact on this development as there are no major building openings fronting Thomas Street.

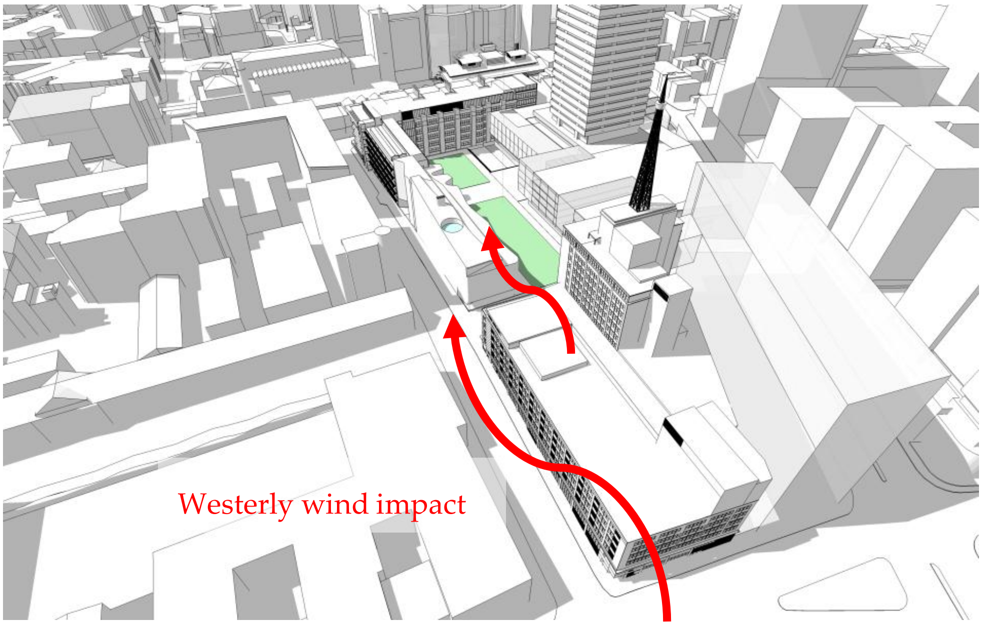

Figure 3: Interaction of prevailing westerly winds with the Thomas Street Building.

The ground floor of the Thomas Street Building has a colonnade along Jones Street and the length of the building along Alumni Green. There is a through-site link at the east end of the building. The Jones Street length of the colonnade will have some exposure to prevailing winds from the west and south. Whilst winds are expected to be at levels suitable for short term stationary type activities; it may be desirable to improve wind conditions through this colonnade during stronger wind events with temporary screening. Generally wind conditions along the Alumni Green length of the colonnade are expected to be calm and suitable for short term stationary type activities.

The lobby and circulation core of the new building fronts onto Alumni Green. Door seals to lift lobby as proposed are appropriate to avoid lift door operability and wind noise problems associated with pressure differentials across the building width (see Arcades Appendix 3).

The Level 4 terrace will receive some wind protection from northern and southerly winds by the Level 4&5 building massing. The terrace will be more exposed to westerly bias winds. Planting throughout the terrace as shown in current drawings is encouraged to deflect and disperse westerly winds, Figure 4. Local screening might later be developed for any activated space within the terrace.

The effectiveness of wind amelioration can be confirmed through later wind tunnel testing.

Figure 4: Westerly wind impact with the Level 4 terrace.

Previous measurements suggest a significant contribution from cooling north-east breezes to site winds. Natural ventilation can add to the amenity of the site and assist the Green Star score.

In terms of Air Quality impact, the Thomas Street Building is likely to be equipped with multiple types of building ventilation exhausts, such as kitchen, fume cupboard, various types of combustion equipment such as diesel generators. Emissions are planned to be released from roof stacks midway along the building length. Air quality at the neighbouring buildings may be affected by emissions from the various sources described above. Stack location and design parameters, such as volume flow rate and velocity, may require manipulation to ensure optimum air quality at all intake and other sensitive locations.

Conclusions

The wind assessment addresses the Director-General's Requirements Section 75F of the Environmental Planning and Assessment Act 1979, Major Project 09 0_213, item 4 Wind Effects. Surrounding buildings offer significant wind protection to the proposed Thomas Street Building. Wind conditions at pedestrian level around the development are expected to be similar to those currently experienced and suitable for intended use.

Air quality at the site may be affected by emissions from the various sources described in the report. These can be examined further during detailed design.

References

Lawson, T.V., (1990), The determination of the wind environment of a building complex before construction, *Department of Aerospace Engineering, University of Bristol*, Report Number TVL 9025.

Melbourne, W.H. (1978), Criteria for environmental wind conditions, Journal of Industrial Aerodynamics, 3, pp. 241-249.

Appendix 1: Sydney Wind Climate

The proposed development lies approximately 7 km to the north of the Sydney Airport Bureau of Meteorology anemometer (BOM 066037). In the absence of any surrounding development it is considered the wind climate at the UTS site would be similar to Sydney Airport given a similar proximity to the eastern seaboard. At the UTS site there is significant surrounding development which will perturb the local wind environment as discussed later in this report. Analysis based on Bureau of Meteorology mean wind speed data from 1986 through to 2007 was used to produce the local wind characteristics, Figure 5.

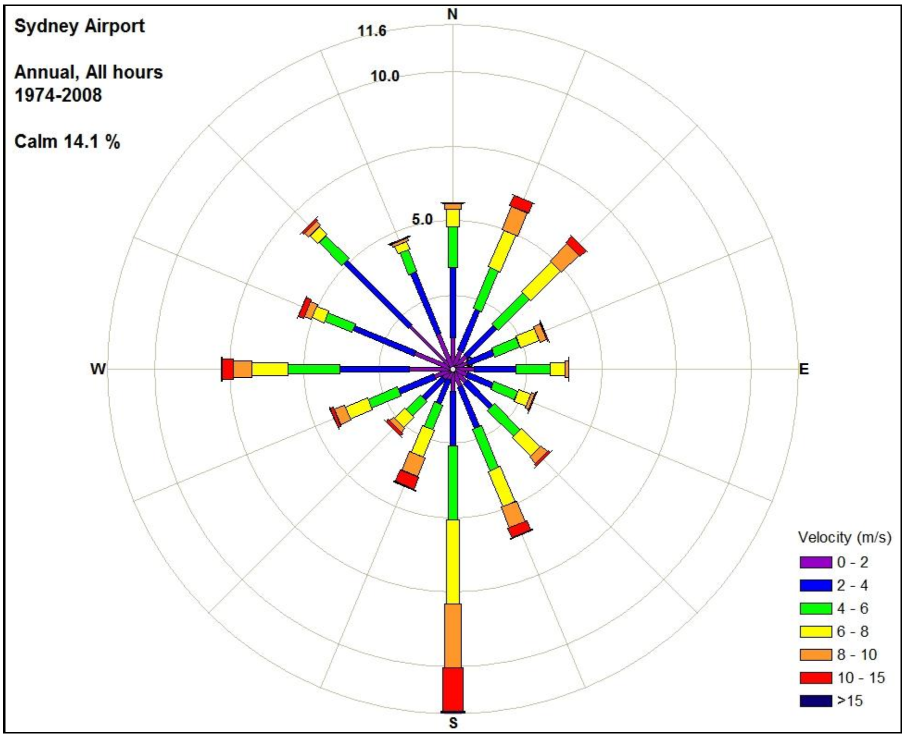

Figure 5: Wind rose for Sydney Airport anemometer site

Appendix 2: Environmental Wind Speed Criteria

Local wind effects can be assessed with respect to a number of environmental wind speed criteria established by various researchers, e.g. Melbourne (1978, referenced by Sydney City and other Australian Councils) and Lawson (1990). Common to the cited criteria is a suggested list of suitable human activities corresponding to the various levels of wind intensity and regularity.

Wind tunnel testing is required to quantify wind conditions at the site against these established criteria. Nevertheless, at this early planning stage CPP can provide a qualitative estimate of the level of wind intensity at different locations throughout the UTS site based upon experience gained from previous wind tunnel tests. For consistency with the Melbourne and Lawson criteria, wind conditions in this qualitative report are described in terms of:

- Long term stationary - generally acceptable for stationary, long exposure activities (e.g., outdoor alfresco dining).
- Short term stationary - generally acceptable for stationary short exposure activities (e.g., window shopping, or sitting in plazas).
- Comfort of walking - generally acceptable for walking; wind conditions below safety concern. This is the maximum level of wind intensity generally considered acceptable for walking in public domain locations.
- Safety concerns - completely unacceptable for walking in main public accessways under the impact of strong gusty winds.

Appendix 3: Bluff Body Aerodynamics

Wind interaction with the built environment can be grouped into basic flow mechanisms commonly producing higher velocities at pedestrian level. Some key flow mechanisms relevant to the UTS City Campus Concept Plan site are discussed below:

Downwash

Figure 6 illustrates the typical flow pattern around a tall building when the wind is perpendicular to the wide face. In this figure smoke is being injected at various points on the model surface and then being blown away by the wind giving an indication of the flow direction, strength, and level of turbulence. It is evident that the building stops the flow at a point about two thirds up the height of the building in the centre of the windward face, and then radiates out in all directions. The fastest flows are typically experienced along the top edge and at the bottom windward corners. At ground level there is a large vertical component of the wind coming down the face of the building – often referred to as downwash. To limit the amount of flow reaching ground level, the tower can be placed on a podium, or awning roofs can be attached to protect pedestrians.

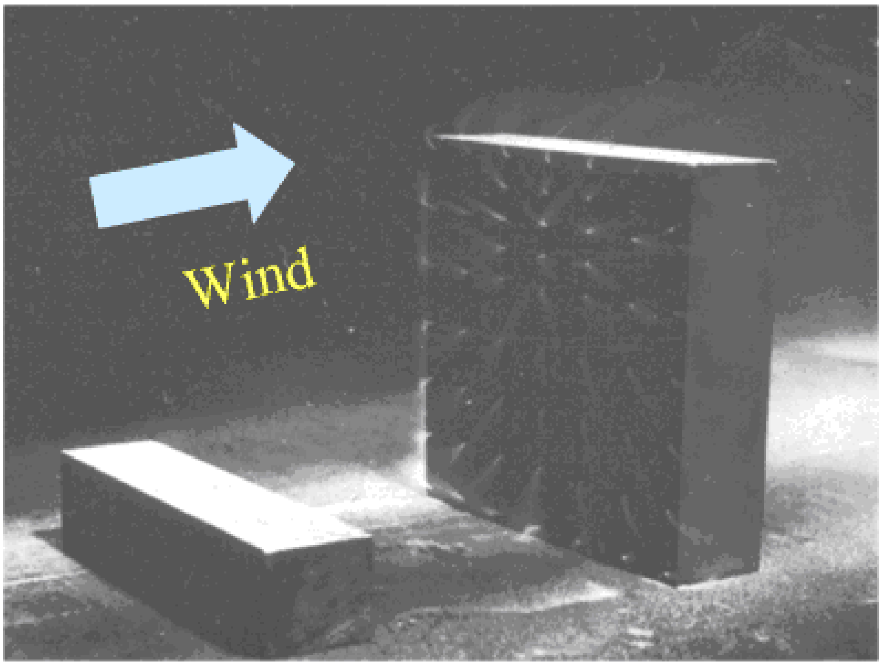

Figure 6: Flow visualisation of wind hitting a large building

Figure 7 shows the case where smoke is released in the approach flow in line with the centre of the building and below the stagnation point. Upon hitting the building the smoke is accelerated around the side of the building and drawn down to ground level in the form of downwash; once the wind reaches the ground it is then accelerated around the ground-level corners. This emphasises the complex nature and vertical component of the flow.

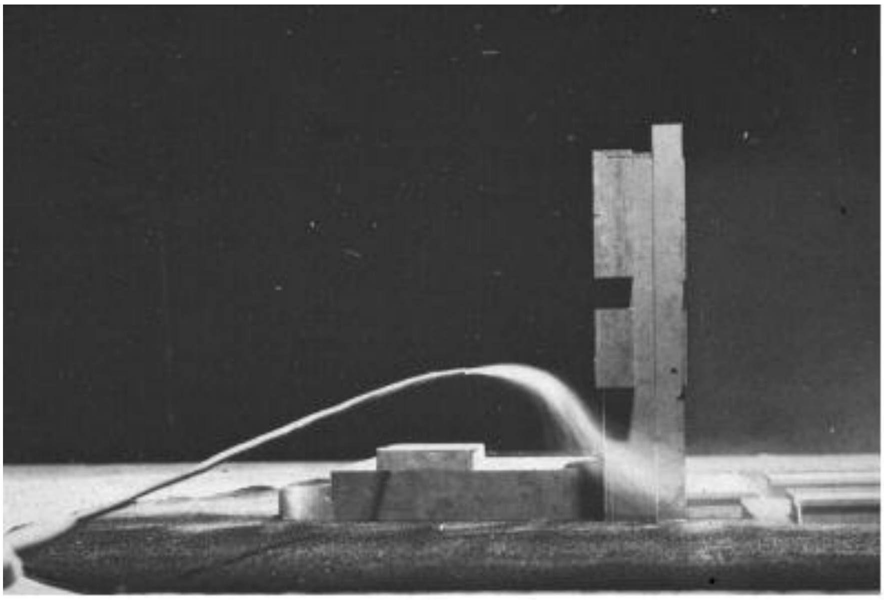

Figure 7: Flow visualisation around a tall building

Channelling Flow

Another important bluff body interaction is the channelling of winds between building gaps whereby upstream winds accelerate to higher velocities as wind is squeezed through building gaps, Figure 8.

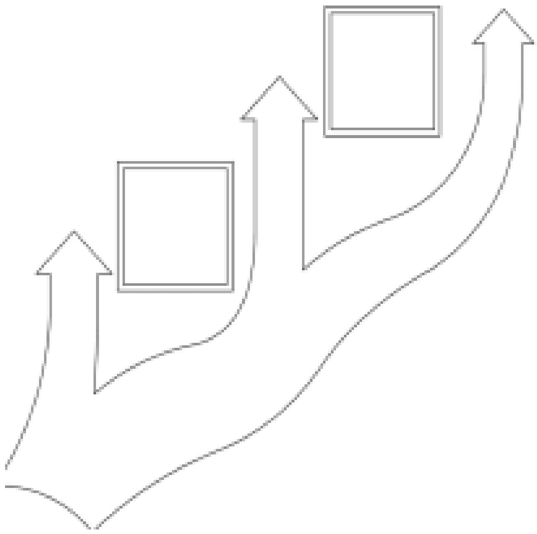

Figure 8: Wind channelling between buildings – venturi flow

Arcades

Another massing issue which may be a cause of strong ground level winds is an arcade or thoroughfare opening from one side of a building to the other. This effectively connects a positive pressure region on the windward side to a negative pressure region on the lee side; a strong flow through the opening results, Figure 9. To mitigate this effect an airlock can be installed; the best solution is a revolving door, with automatic sliding doors possible depending on the volume of pedestrian traffic.

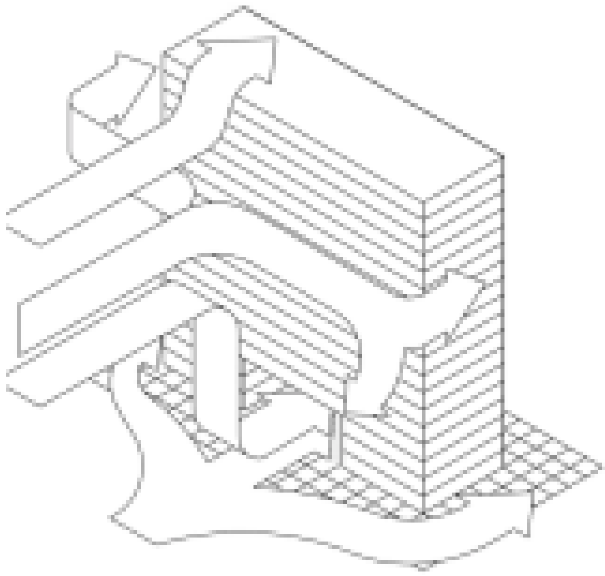

Figure 9: An arcade or open column plaza under a building frequently generates strong pedestrian wind conditions.