BUROHAPPOLD ENGINEERING

Revised Proposal for Bridgewater Place Wind Microclimate Monitoring, Leeds

Introduction

The purpose of this study is to quantify the improvements to the wind microclimate as a result of the installation of wind screens, canopies and baffles proposed to calm conditions around the perimeter of the Bridge Water Place building

The objectives of this study are to:

- Measure the wind microclimate around the existing building
- Measure the wind microclimate around Bridgewater Place following the installation of wind screens, canopies and baffles
- Compare measured data with Met Office wind data from a suitable reference point
- Quantify the wind microclimate benefits of the wind screens, canopies and baffles and compare the site measured data with the CFD and wind tunnel predictions within CPP reports.
- Identify remaining areas that fail the Lawson's Safety Criteria for pedestrians

A report will describe the benefits achieved by the mitigation scheme for the surroundings of the Bridgewater Place building.

This proposal has been updated following a meeting with Leeds City Council on the 22 of June 2015 and 20 of November 2015, and reflects the following agreed points:

- The locations for wind speeds measurement are agreed. The revised locations are shown on the attached plan.
- A long term (permanent evergreen) roof anemometer will be provided on BWP lower roof – at the southern end adjacent to Grove Inn. 6 monthly wind data reports will be available from this anemometer, as well as should an adverse incident occur. The long term anemometer will be installed, run and maintained by a specialist wind measurement company who will back up the data on a regular basis.
- LCC wind anemometer – this will retained in position until after the mitigation has been installed to allow correlation of data.
- .
- Only W and SW wind directions will be monitored for a short-term.
- Monitoring to occur when mean wind speeds at the airport are greater than 10 m/s (or 22.40 mph) from the W and SW directions
- All anemometers will be pointed to the same specified point, to reduce magnetic north discrepancies

Scope and plan of proposed services

Monitoring locations

A major challenge on a complex site is selecting points which will be representative of the range of conditions across the site and which are not overly sensitive to unknown factors such as the precise atmospheric conditions on the day.

On the basis of 3D mean velocity fields from the wind tunnel and CFD models for the key south-westerly and westerly wind directions, a number of points have been selected and agreed with the LCC which are expected to be representative of the range of wind conditions across the site before and after the installation of wind protection measures. The selection criteria has been developed in collaboration with LCC and the client and will include:

- Proximity to locations of extreme wind speed on the site
- Insensitivity to atmospheric conditions
- Ability to safely and robustly position the anemometers
- Ability to measure local wind speeds without significant interference from passing traffic and pedestrians.
- Suitable locations for anemometers to be installed with least impact to the public – both pedestrians and vehicle users

Methodology

The following equipment is proposed to be used to carry out the monitoring:

- One short term reference anemometer at 7.2m height on top of a telescopic mast placed on the roof of the lower southern portion of Bridgewater Place by the Grove Inn (picture attached). This anemometer will remain in position for around 6 to 12 months. Beyond the construction period, a permanent anemometer (for the lifetime of the building) will remain in place and can provide 6 monthly wind data reports plus in the event of an adverse incident. Reference anemometer speeds will initially be referenced to undisturbed speeds via localised CFD modelling results. This will ultimately be replaced by correlation analysis with the regional MET office station once sufficient simultaneous data is acquired from both sites (at least 6 months).
- Portable 3D ultrasonic anemometers will be used for point measurements - The measurement points will ideally be located at 1.5m above ground level and as they will be accessible to the public will require constant supervision to avoid interference, theft, and vandalism.
- Wind speed measurements will be taken for medium to strong (but not extreme) westerly and south westerly winds above 10m/s (22.4 mph).

Access to the current data measured at the existing 5m mast at the top of Water Lane will also be used to help the correlation development. It is assumed that LCC will provide access to the existing & future data gathered. This anemometer is to remain in position until after the mitigation works have been completed and monitored, to allow correlation of data.

Wind speed measurements

Wind speed measurements will be taken for medium to strong (but not extreme) southwest to westerly winds above 10 m/s (or 22.40 mph). Monitoring will occur when wind speeds at Leeds Bradford Airport are greater than 10m/s (22.4 mph). These are the critical wind directions identified from the CFD and wind tunnel analyses (see table 9 wind tunnel CPP report CPP6900 for Bridgewater place, July 2014). The West and South-westerly winds are also the wind directions that generate the threshold wind speed interventions.

It is proposed to measure the wind speeds at 16 locations for a time period of an hour, pre and post mitigation works for W and SW wind directions above 10 m/s average wind speed. Wind speeds will be measured for a cumulative total of one hour at 16 critical locations (as identified on the attached C005 and C006 wind monitoring plans). This hour of data measurement may be taken in one session, or may be made up of several separate sessions greater than 10 minutes in duration.

Measurements for other non-critical wind directions have been excluded since the strongest winds experienced by the surroundings are westerly and south-westerly winds.

Pedestrian and vehicle comfort and safety assessment

The wind speeds measured will be compared with comparable measurements carried out prior to the construction of the Installation. The variation between the insitu and the wind tunnel results (before and after the Installation) will be assessed

The relative performance of the Installation in situ as against that tested in the wind tunnel will also be assessed.

A measure-correlate-predict (MCP) analysis will be carried out to correlate the locally measured wind speeds with data from the MET Office station at Leeds Bradford Airport and up to 2 other local meteorological stations. The raw data and methodology will be made available to LCC. Wind speed ratios across the site will be developed to enable correlation of wind speeds back to a reference MET Office station to build up the full picture of likely conditions. We will then interpret that picture in terms of comfort levels (where possible the results will be compared with the Lawson criteria) and present the results in a clear way to enable correlation with the wind tunnel measurements for westerly or south-westerly wind directions (W & SW). This will be carried out for both pre and post mitigation wind speeds.

The mean and gust wind speed factors drawn from the MCP analysis will then be combined with weather data from the airport and site (from the fixed anemometer at high level) to predict the frequency of exceedance of LCC provided trigger thresholds. The performance of the mitigation will be quantified by measuring before and after construction.

Correlated statistical occurrence rates will be created for W and SW directions of remaining exceedances for Lawson Criteria of safety for pedestrians as measured after installation, similar to the table within the CPP report, based on the above safety criteria Statistical occurrence rates for W and SW gust wind speeds of 35, 45 and 65mph, as measured after installation will be correlated back to the table within the CPP report (Figure 9).

It should be noted that there is a likely to be some variation between the wind tunnel results and actual measured wind values. There will probably need to be some interpolation carried out to predict the frequency of future wind values.