Architecture 4.411
Building Technology Laboratory
Spring 2004

Assignment 6   Airflow measurement and simulation

March 10 and 11, 2004

The second week of our airflow lab focuses on airflow measurements and analysis:

Measurements

1. Complete the construction of your balcony.
2. Read the instructions for use of the hot-wire anemometers.
3. Set up a test apartment on a table with a fan reasonable distance in front of the opening for the balcony, centered on the opening and parallel to it. No balcony at this point! Mark the position of the fan and the balcony opening, using masking tape or other means that do not scar the table.
4. Remove the apartment and turn on the fan (your choice of fan speed). Measure the average air speed at the location that represents the entrance to the apartment. Replace the apartment.
5. Measure the average air speed through each of the leeward windows that you have opened (your choice of how many). Turn off the fan and put the meter in a safe position.
6. Install your balcony. Do not move the apartment or adjust the window openings. Note the position balcony openings.
7. Turn on the fan and repeat the measurements and analysis of step 5.
8. Take a set of airflow readings at interior locations.
9. Adjust the fan such that it is at an angle of 30° relative to the normal. Repeat the measurements in steps 5 and 8.
10. Adjust the fan for a 60° angle and repeat again.
11. For one fan position, attempt to map flow patterns using baby powder. Consider moving the fan to the leeward side for draw-through operation.

Analysis (to be done for the report)

1. Data collected in step 5 (no balcony, balcony with three different wind directions). Multiplying each average air speed, in m/s, by the area of the opening, in m^2, compute the volumetric flow, V, through each opening. Sum to obtain the total airflow. Divide by the volume of the apartment and multiply by 3600 sec/hr to determine an air exchange rate, ACH.
2. Data collected in step 8. Tabulate the data. Normalize by the free-stream airspeed taken in step 4. Present the normalized data in an interesting graphical or tabular manner.
3. Flow visualization results. Sketch or digitally photograph, and comment.
4. Relate your measurements to airflow and thermal comfort in a real Beijing apartment, using the provided notes.