

Duplex Apartment CFD Model Results

China Project – Beijing

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Figure 1 - Final configuration for the second floor. One window on the south face (sitting room) and four on the north face (one in the north east bedroom, two in the northwest bedroom, and one in the west bedroom).

The goal of this flow simulation for the Beijing floor plan was to optimize the window placement, and to comment on wall and door placement in the floor plan. The pressure distribution around a specific apartment was given by a CFD analysis of the total site plan (John Zhai, 2/2000). The size and location of the windows are based upon personal conjecture as to typical apartment style layouts (sizes were chosen to be as large as possible).

Windows

Windows for the first duplex apartment simulation were placed in the lower level living room and the second floor master bedroom (both on the south side). On the north side, windows are on the north walls of the two bedrooms. Stagnation regions in the sitting room and the adjacent bedroom resulted. (see *Figures 1 and 5* for pictures of the final CFD model – with revised windows)

A revised version of window placement included a window on the north wall of the middle bedroom, and another window on the west side of the northwestern bedroom. In addition, an increased size of the window on the lower level allows more light to enter and improves overall ventilation rate. Although a window would prove to be beneficial for the west wall of the sitting room (second floor), privacy concerns may arise between the occupants of the bedrooms in adjacent apartments.

Internal Wall and Door Placement

It is highly recommended that the walls around the stairwell balcony to the lower level be lowered or converted into a more open baluster design to improve flow between levels. The typically unadulterated interior of this particular apartment makes the flow relatively easy to track. (The CFD model assumed no wall on the second floor of the stairwell.)

Problematically fast flows occur at the entrance of the two northern bedrooms, since there is a flow convergence (see *Figures 2 through 4* for plan and section flow patterns on both levels). Velocities in the area can be as high as 1.4 m/s, which raises serious draft comfort issues (blowing papers, etc). Differing door placements might alleviate this problem, where their separation might reduce the “wind-tunnel” effect. Possible solutions to the second floor sitting room stagnation problem could be to include adjustable acoustical louvers that will allow airflow to pass between the sitting room and the bedroom (on the bedroom’s south wall), while still blocking out noise. Locating the bedroom door on the south side of the bedroom (adjacent to the sitting room) would also greatly improve flow through both the sitting room and that bedroom.



Figure 2 - Second floor flow pattern (velocity vectors). Note the stagnation areas in the sitting room and bathroom. Also note the high velocity concentration near the doors to the northern bedrooms.



Figure 3 - First floor flow pattern (velocity vectors). Note the even flow except for the bathroom.

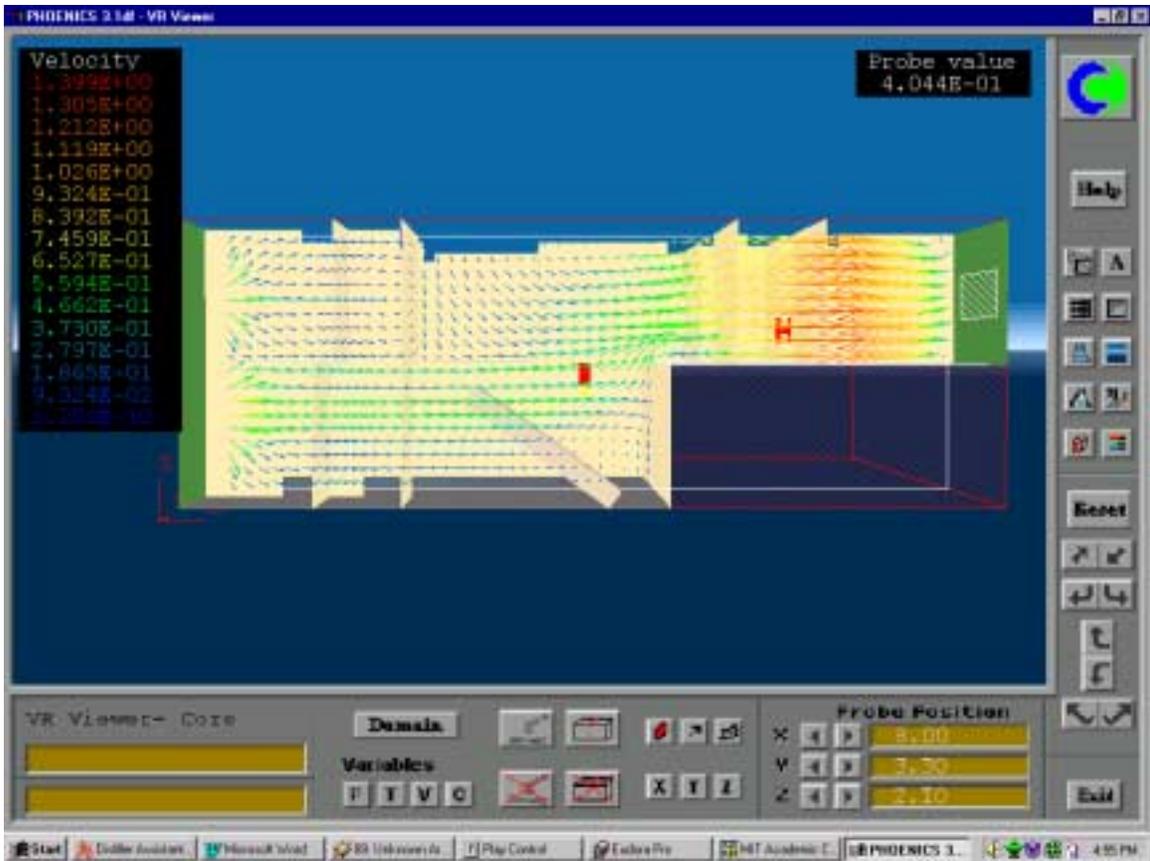


Figure 4 - Section view of the flow pattern. Note the even distribution through the stairwell.

Problems in the Bathrooms and Kitchen

To ensure that there are no unwanted smells from the bathrooms and kitchen entering the rest of the apartment, the doors should remain closed while the facilities are in use. We recommend a mechanical ventilation system for bath and kitchen areas (not natural ventilation). The CFD model did not include any windows in bathrooms or the kitchen.

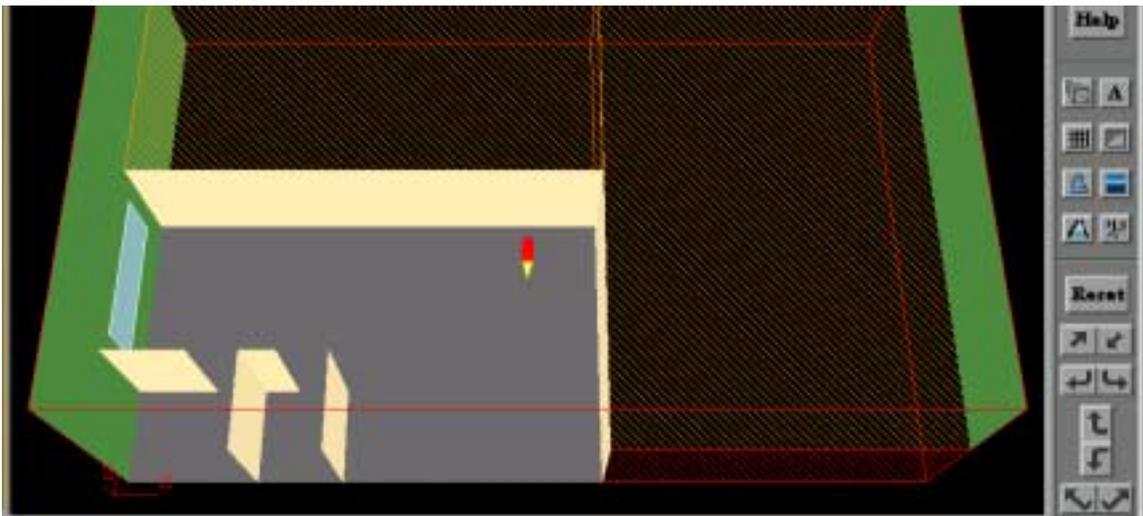


Figure 5 - First floor layout. Only one window in the living room.