Jesmond ENGINEERING

Airflow Through a Louvre System

Task Objectives

Industrial shutter systems – known as *louvres* – are commonly used in Civil Engineering to control airflow through a building, as illustrated in Figure 1. While serving to offer weather resistance and enhanced security over traditional windows, system effectiveness may be inhibited by external conditions such as the direction of wind speed.

Jesmond Engineering Ltd. was contacted to develop a means of testing the efficiency of louvre systems under a range of environmental and mechanical conditions, such as wind velocity and louvre blade pitch in relation to the flow.

Figure 1 *Typical example of a manufactured louvre ventilation system*

CAD Construction

A dynamic CAD model of a louvre system was constructed to closely correlate with the Client's specification, as illustrated in Figure 2. This was parameterised such that the blade width, thickness and pitch in relation to air flow could be adjusted for further simulations. An arbitrary building was constructed to reflect the Client's specification with regards to louvre positioning and relative size.

CFD Configuration

The CAD model was placed within a domain much larger than the dimensions of the building and meshed using hexahedra cells. Initial conditions were computed from average wind speed data for the Kingston-Upon-Hull area and geographical knowledge of the Client's intended construction sites. Like many practical engineering scenarios, the flow was ascertained to be turbulent through the calculation of the Reynolds number, and as such, a k-Omega model was utilised. Wind velocity was modelled at both ± 45° to the inlet louvre and ventilation through the building was determined to be primarily wind-driven. As such, any buoyant effects arising from differences in temperature were neglected. Furthermore, air circulation fans were not utilised to disperse inlet air flow across the building internals.

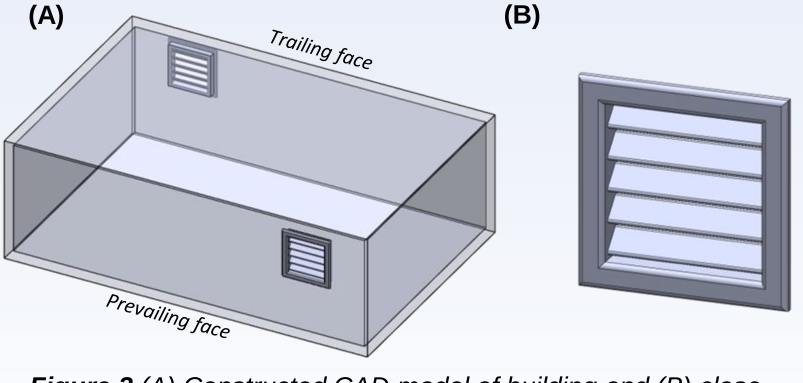

Figure 2 *(A) Constructed CAD model of building and (B) close-up of installed louvres*

Figure 3 *From CAD to CFD Mesh*

Continued overleaf

Simulation Results

Figure 4 illustrates a glyph plot of the external airflow over the building, highlighting the general flow characteristics at a snapshot in time. Furthermore, this has been represented as a cross-sectional clip of the flow domain in Figure 5, highlighting the relative flow stagnation within the building in comparison to the velocity acceleration over the building roof.

Under the current louvre configuration, flow velocity is shown to rapidly deteriorate within the inlet region. Slight flow velocity is maintained across the roofline of the building, with flow accelerating again at the outlet louvre due to an imposed negative external pressure.

Figure 6 provides an initial insight into the sensitivity of wind direction on the louvre design and placement. Intuitively, the case in which the airflow is inline with the direction of building through-flow (-45°) promotes the best dispersion of internal air across the building. In the +45° model, the louvre is less efficient at capturing the passing airflow and any flow entering the building is projected primarily across the rear face.

This work served as a precursor for a full building design and optimisation study, in which internal ventilation via natural and mechanical means could be optimised through effective louvre design and placement for a particular geographical location.

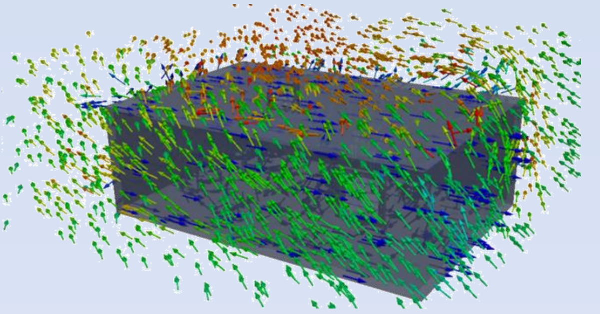

Figure 4 *External airflow across the building under the -45° model*

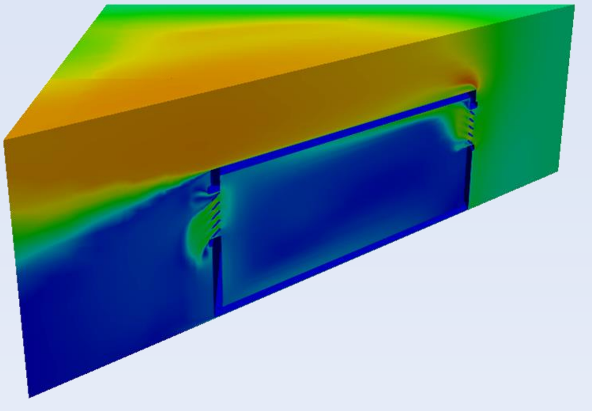

Figure 5 *Room cross-section within a proportion of the external domain, highlighting velocity acceleration over the building and relative stagnation within/behind it.*

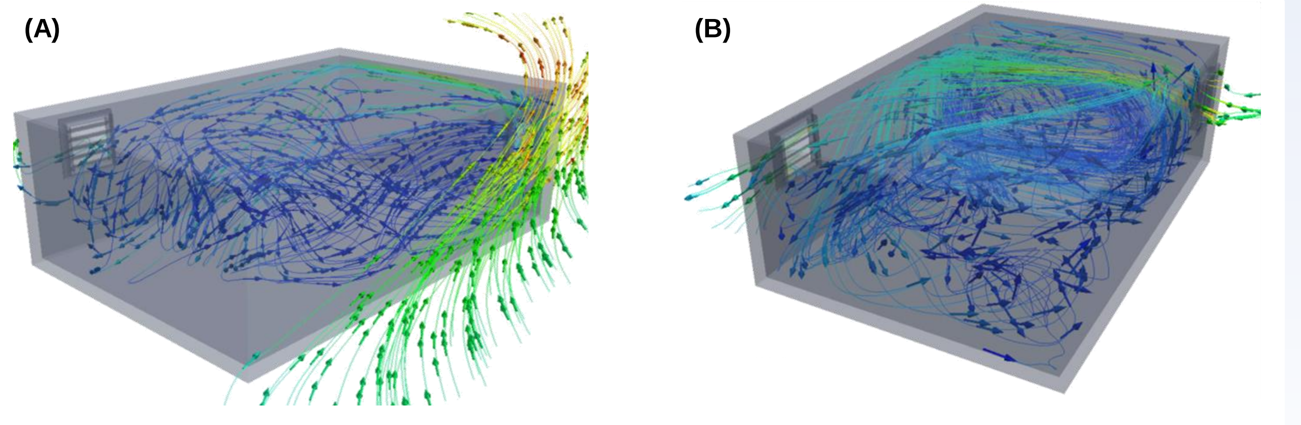

Figure 6 *Velocity streamlines under a (A)+45° wind direction and (B) -45° wind direction*

Jesmond Engineering Ltd
Brough Business Centre · Skillings Lane · Brough
East Yorkshire · HU15 1EN · UK
t: +44 (0)1482 665225 · e: info@jesmondengineering.com