

Guidance Notes on Computational Fluid Dynamic Assessment of the Ventilation Performance in buildings

1 Introduction

Computational Fluid Dynamic (CFD) tools may be used for assessing the ventilation performance in buildings. Authorized Persons (APs) should substantiate the validity and appropriateness of the tools to the satisfaction of the Building Authority (BA). These guidance notes assist the APs to undertake CFD assessment of the ventilation performance in buildings. Any deviation from these guidance notes should be supported with substantiations to the satisfaction of the BA.

2 Site Wind Data

2.1 Wind data

Wind data should be adopted from the appropriate and reliable sources with substantiations to the satisfaction of the BA, examples of which are :

- (a) Nearby weather stations of Hong Kong Observatory with long term data of 10 years or more;
- (b) Simulated site wind data based on appropriate mathematical models, such as Fifth-Generation NCAR / Penn State Mesoscale Model (MM5) or CALMET;
or
- (c) Experimental site wind data from wind tunnel test in accordance with paragraph 16 in Annex A of the Housing, Planning And Lands Bureau and Environment, Transport And Works Bureau Technical Circular No. 1/06.

2.2 Wind profile

The vertical wind profiles should be determined by using appropriate mathematical method such as Power Law and Log Law with appropriate coefficient based on the roughness length of the concerned terrain.

3 Simulation Methodology and Parameters

3.1 General

- (a) Substantiations on the validity and appropriateness (including compliance with international standards/best practices) of the CFD software employed for the study shall be provided.
- (b) CFD analysis shall be carried out in accordance with relevant international standards/best practices. The analysis shall properly define:
 - (i) the physical model,
 - (ii) the computational domain (including the domain size, geometrical representation of details and boundary conditions),
 - (iii) the computational grid (including the grid resolution and expansion ratio),
 - (iv) the numerical approximations, and
 - (v) the solution.
- (c) The BA's in-principle agreement to the methodologies and scope of the CFD analysis may be sought prior to submission of the ventilation performance assessment.

3.2 Testing model

3.2.1 External area

- (a) The testing model should include all proposed buildings in the site and buildings / features in the surrounding area which shall be up to a perpendicular distance of $2H$ (H being the height of the tallest proposed building on site) or 300m, whichever is the less, from the site boundary, or may be enlarged if there are prominent features (e.g. tall buildings or large

and bulky obstructions) immediately outside the 2H/300m zone. APs can advise alternative extent of the surroundings to be included on a case-by-case basis, especially when there are nearby prominent topographical features.

- (b) All external features of the subject building that may significantly influence air flow must be included in the model.

3.2.2 Internal areas

The testing model should include the whole floor where the subject rooms are situated with the following criteria:

- (a) All internal features that may significantly influence air flow must be included in the model,
- (b) Fire rated doors (e.g. main entrance door and kitchen door) should be assumed to be closed,
- (c) Toilet and bathroom doors should be assumed to be closed unless some of the waste water from a waste fitment could be diverted to the U-trap of floor drains in these rooms in accordance with PNAP ADV-24,
- (d) If a ventilator would be provided in a room in the simulation, such provision should be indicated on the submitted plans for approval, and
- (e) Leakage assumption of a fire rated door should base on the bottom gap between such door and the floor not exceeding 10mm.

3.3 Scope of assessment

The assessment should cover all rooms adopting the performance-based approach on the following floors:

- (a) ***The lowest typical floor*** adopting the performance-based approach,
- (b) ***The topmost typical floor*** adopting the performance-based approach,

- (c) For $h > 60\text{m}$ (h being the total storey height of all typical floors adopting the performance-based approach), *the typical floor at $\frac{1}{2}h$* above the floor level of the lowest typical floor, and
- (d) *All non-typical floors.*

3.4 CFD Simulations

- (a) Stage 1 CFD simulation is for external areas under 16 wind directions for providing data for Stage 2 CFD simulation.
- (b) Stage 2 CFD simulation is for internal areas under 16 wind directions.
- (c) Alternatively, Stage 2 CFD simulation may be based on the three wind directions with lowest pressure difference (Δp) between openings of such room/interconnected rooms identified in Stage 1 simulation. The BA may request for the assessment of additional wind directions on a case-by-case basis.

4 Acceptance criteria

- (a) Rooms adopting performance-based design should have not less than 1.5 air change per hour (ACH) under the tested wind directions.
- (b) ACH under some test wind directions less than 1.5 may be accepted if it can be demonstrated by CFD simulation that the ventilation performance for such room will not be less than the situation installed with compliant windows.

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