

An MND Statutory Board In Collaboration with



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For enquiries, please contact:

Building Plan Management Group (#10-01)

Tel: 1800 3425 222 (1800DIALBCA) or use our Online Feedback Form at: https://www.bca.gov.sg/feedbackform/

Dear Sir / Madam

JOINT BCA/ACES/IES CIRCULAR 2022

GUIDELINES ON CFD SIMULATION AND REPORT FOR ADOPTION OF JET FANS AS ALTERNATIVE SOLUTION IN-LIEU OF DUCTWORK FOR MECHANICAL VENTILATION IN CARPARKS

Objective

This circular is to inform the industry of a set of guidelines on Computational Fluid Dynamics (CFD) simulation and the report to be submitted to the Commissioner of Building Control (CBC) for approval for the adoption of jet fans as an Alternative Solution in-lieu of ductwork for mechanical ventilation (MV) in carparks.

Background

2. Jet fans are commonly used in carparks for MV systems of vehicular exhaust. Currently, projects using jet fans in the MV system design will require the submission of Alternative Solution to the CBC for the adoption of jet fans as an alternative to conventional ductwork of MV systems for carpark as specified in Singapore Standard SS553: Code of Practice for Air-conditioning and Mechanical Ventilation in Buildings. To establish the effectiveness of the jet fans in dissipating the vehicular exhaust, an appointed Professional Engineer in the branch of Mechanical Engineering (PE(Mech)) will conduct CFD simulations for the project. The results obtained from the CFD simulations would be used



to justify the PE(Mech)'s assessment on the sufficiency of the jet fan design in the application for approval of Alternative Solution (AS) from the CBC in-lieu of MV ductwork in the carpark.

3. Today, there is differing industry practice in carrying out CFD simulation (e.g. values to be adopted for critical parameters). BCA has thus collaborated with Association of Consulting Engineers Singapore (ACES) and Institution of Engineers Singapore (IES) and in consultation with CFD and jet fans specialists, a set of guidelines to standardise the key aspects of the CFD simulation and necessary content was developed.

Guidelines

- 4. The guidelines on the CFD simulation and CFD report for the adoption of jet fans as an AS in-lieu of ductwork for MV in carparks are detailed in <u>Annex A</u>. Notwithstanding, as design and expected operations of a development vary, the PE(Mech), being a specialist in the alternative solution, should assess the suitability of the adoption of the guidelines for the CFD simulation to guide their design of the jet fan system for the development. The PE(Mech)should provide details of the design and expected operating conditions of the development and indicate any scenarios which may require more stringent assumptions in the CFD simulations in the report. Should there be any deviation from the recommended parameters in the guidelines, it should be supported with sufficient justification.
- 5. In addition, PEs(Mech) are reminded of their duty under section 9(3) of the Building Control Act 1989 to take all reasonable steps and exercise due diligence to ensure that the alternative solution satisfies the objectives and performance requirements that are prescribed in the building regulations in respect of ventilation, before issuing the certification of supervision for the jet fans system.

Effective Date

6. It is recommended that the guidelines in Annex A be adopted with immediate effect in respect of the CFD simulation and the report submitted to the CBC on the adoption of jet fans as an AS in-lieu of ductwork for MV in carparks.

For clarification

7. We would appreciate it if you could convey the contents of this Circular to the relevant members of your respective organisations. If you or your members have any queries concerning this Circular, please submit your enquiry through BCA's Online Feedback Form at https://www.bca.gov.sg/feedbackform/.

Thank you.



AR. ONG YU ZI JANE
DIRECTOR
BUILDING PLAN & MANAGEMENT GROUP
BUILDING AND CONSTRUCTION AUTHORITY
FOR COMMISSIONER OF BUILDING CONTROL

.Um.,

ER. CHUCK KHO
PRESIDENT
ASSOCIATION OF CONSULTING ENGINEERS
SINGAPORE (ACES)

MR. DALSON CHUNG PRESIDENT THE INSTITUTION OF ENGINEERS SINGAPORE (IES)



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Part 1: CFD Simulation Part 2: Report Guideline Criteria Software Follow BCA's GM Guideline on CFD Simulation under Green Mark 2021 1. For each of the criteria, the report shall clearly state the provision and assumption. For example, a. Write up of the software and simulation methodology indicating provision and compliance with Simulation RANS or LES is acceptable each of the guideline Methodology and (minimally k-e turbulence model for RANS) b. Building plans showing location and size of natural ventilation openings Standard wall function **Boundary Conditions** c. Information of MV and jet fans system including air-change rate (ACH), flowrate, model, Ambient CO concentration level = 0ppm quantity and plans showing location of system. The PE for ACMV shall confirm that MV system No wind (fresh air and exhaust fans) is provided as per SS553. MV system in continuous operation d. Calculation of exhaust emission from vehicles and any references made in the calculation Discretization Follow BCA's GM Guideline on CFD Simulation on Discretization Schemes 2. The report shall clearly demonstrate and explain how the CFD results demonstrates the below. **Schemes and** and Convergence Criteria Where applicable to demonstrate the below, there shall be CFD results at different timeframes **Convergence Criteria** (e.g. every 400s) furnished in the report. a. steady state condition achieved Follow BCA's GM Guideline on CFD Simulation on Grid size and Mesh Grid size and mesh b. performance of the system in meeting the acceptance criteria 3. Where there is deviation from the suggested default conditions, for example if the QP/Specialist **Building Model and** Accurate model of: assessed that occupancy of lower values may be adopted, supporting information and data for MV system 1) building layout and openings such development shall be provided in the report. In line with SCDF, any down-stand beams and other obstructions that are of depths of more than 1/10 of the car park floor to ceiling height shall 4. Similarly, should there be a need to adopt higher values due to different operating conditions, the be considered. assumed value shall be stated. 2) MV system in continuous operation 3) Maximum expected number of vehicles parked in the carpark

ANNEX A

Guidelines for CFD Simulation and Report

Cars in operation and	As a default, assume 25% of vehicles (evenly distributed) are cruising at
-	
exhaust rate	10km/hr in the carpark, continuously emitting exhaust as below. Should
	there be areas where built-up of cars may be expected, CFD simulation
	shall be based on the expected operating scenario.
	Exhaust Emission of Carbon Monoxide (CO)
	Petrol-driven vehicles – Euro VI (1.0g/km)
	Diesel-driven vehicles – Euro IV (3.5 tonnes or below: 0.74g/km,
	greater than 3.5 tonnes: 1.5g/kWh)
	Motorcycles – Euro III (2.0g/km)
	miscoreyeles 22.0 m (2.08) mm)
	Note:
	 For the modelling of the exhaust from the vehicles, detailed modelling of the exhaust pipe is not required. Emission from a grid is acceptable.
	For ease of assumption, unless the use of the carpark is distinctly different, you may assume vehicles in carpark of
	office/commercial buildings/shopping centers are petrol-driven
	vehicles such as passenger cars.
Acceptance criteria	No hotspot of CO more than 25ppm should be observed on the CFD
	result at height of 0.5m and 1.7m at steady state



DISTRIBUTION (via e-mail):

President
Singapore Institute of Architects (SIA)
79 Neil Road
Singapore 088904

President

Association of Consulting Engineers, Singapore (ACES) 18 Sin Ming Lane #06-01 Midview City Singapore 573960

President

Institution of Engineers, Singapore (IES) 70 Bukit Tinggi Road Singapore 289758

President

Real Estate Developers Association of Singapore (REDAS) 190 Clemenceau Avenue #07-01 Singapore Shopping Centre Singapore 239924

President

Singapore Contractors Association Limited (SCAL)

1 Bukit Merah Lane 2

Construction House

Singapore 159760

President

Singapore Green Building Council (SGBC) 200 Braddell Road Block H, Level 2 BCA Braddell Campus Singapore 579700

President

Singapore Institute of Building Limited (SIBL) 9 Ah Hood Road #02-04 Singapore 329975

President

Singapore Institute of Surveyors & Valuers (SISV) 110 Middle Road #09-00, Chiat Hong Building Singapore 188968 President Association of Property & Facility Managers (APFM) 110 Middle Road #09-00, Chiat Hong Building Singapore 188968

President

International Facility Management Association, Singapore Chapter (IFMA) Killiney Road Post Office P.O. Box 2104 Singapore 912352 President Society of Project Managers (SPM) Macpherson Road P.O. Box 1083

Registrar Board of Architects (BOA) 5 Maxwell Road 1st Storey Tower Block, MND Complex Singapore 069110

Singapore 913412

Registrar Professional Engineers Board, Singapore (PEB) 52 Jurong Gateway Road #07-03 Singapore 608550

Director **Building and Infrastructure** Defence Science & Technology Agency (DSTA) 1 Depot Road Defence Technology Tower A Singapore 109679

Deputy Chief Executive Officer Building Housing & Development Board (HDB) 480 Lorong 6 Toa Payoh **HDB Hub** Singapore 310480



Deputy Chief Executive
Infrastructure & Development
Land Transport Authority (LTA)
1 Hampshire Road
Block 8 Level 1
Singapore 219428

Director
Land Planning Division
JTC Corporation (JTC)
8 Jurong Town Hall Road
The JTC Summit
Singapore 609434

Director of Infrastructure School Campus Department Ministry of Education (MOE) 1 North Buona Vista Drive Office Tower Level 9 Singapore 138675

Chief

Healthcare Infrastructure Project MOH Holdings Pte Ltd (MOHH) 1 Maritime Square #11-25, Harbourfront Centre Singapore 099253

Chief Engineer
Development Control Department
National Environment Agency (NEA)
40 Scotts Road
Environment Building
Singapore 228231

Group Director
Policy & Planning Division
National Parks Board (NPARKS)
Singapore Botanic Gardens
1 Cluny Road
Singapore 259569

Senior Director (Building & Estates Management) People's Association (PA) 9 King George's Avenue Singapore 208581

Deputy Director
Centralised Service Department, Building Plan
Public Utilities Board (PUB)
40 Scotts Road
Environment Building
Singapore 228231

Senior Director
Fire Safety Department
Singapore Civil Defence Force (SCDF)
HQ Singapore Civil Defence Force
91 Ubi Avenue 4
Singapore 408827

Deputy Chief Executive Officer Sentosa Development Corporation (SDC) 33 Allanbrooke Road, Sentosa Singapore 099981

Chief Sport Infrastructure Group Sport Singapore (SportSG) 3 Stadium Drive Singapore 397630

Assistant Chief Executive Policy & Planning Group Singapore Tourism Board (STB) 1 Orchard Spring Lane Tourism Court Singapore 247729

Chief Executive Officer
Urban Redevelopment Authority (URA)
45 Maxwell Road
The URA Centre
Singapore 069118

All CORENET e-Info subscribers

