KNOWLEDGE PROPOSAL

Proposer Name and Organisation: Mohammad Royapoor – CIBSE Data Centre Special Interest Group

Topic/ Title: Data Centre Computational Fluid Dynamics (CFD) simulation & analysis guidance

Date received:

1. Justification: Why is this guidance needed?

CFD is critical to a successful and resilient DC design as it is the most robust tool in visualising the behaviour of air (or a liquid) through the space prior to building the facility. It can successfully predict and resolve several problems, with the most notable being the removal of hot spots in data halls and entrainment with external heat rejection assets. Additionally, space planning and building form optimisation can also be supported by a CFD analysis by conducting comparative analysis and ‘what-if’ scenarios. In the absence of a robust CFD analysis, the design is often overengineered which leads to CapEx and embodied Carbon penalties. The densification of DCs resulting from next generation AI and high density compute together with the rising climatic temperatures particularly in suburban areas (where edge DCs are predicted to expand) make CFD a more instrumental solution for the CIBSE to consider a best practice guide. This research theme seeks to bring together leading industry expertise to compile a technical memo.

1. Format: What format will the guidance take?

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| --- | --- |
|  | a traditional publication with words and diagrams to be produced for CIBSE’s Knowledge Delivery Platform, and in PDF |
|  | a data set |
|  | a digital tool or software application |
|  | something else (please elaborate) |

1. Content: If guidance, please list proposed chapter and section headings. If a data set, digital tool, software application, or something else, please detail your proposed plan.

Technical Memo style of publication with the following as indicative outlines of chapter contents:

* Light treatment of the fundamentals of CFD.
* How CFD can act as a decision-making guide for the design team to systematically optimise and refine their solution at rack, row, data hall and ultimately at campus level.
* Guidance to identify all required parameter inputs and assumptions, build and run high fidelity models at the right stage of design and systematically use the model to validate the design airflows, cooling efficiencies and DC thermal management.
* Clarification on how CFD can assist compliance with ASHRAE TC 9.9 efficiency targets
* Outline of limitations of CFD so that analysts are able to set expectations of the wider design team on the limitation of the results, the need for quality input and clear assumptions but also the engineering judgement needed to use CFD predictions to achieve the most cost and Carbon efficient engineering outcome.

1. Readership: Who is likely to read this guidance?

Data centre professionals, but also the wider CIBSE readership particularly built environment MEP designers interested in high fidelity modelling work (for instance to conduct natural ventilation CFD work).

1. Authoring: Are authors in place? If so, please list them below.

No, authors are not in place, however a collection of practitioners exist in RED who can make significant contribution and the wider CIBSE community will also be consulted to identify the best possible talent for the work.

1. Timescale: When would you expect to complete the project? Please provide a rough timeline.

12 months

Fees: Will authors require funding? If so, how much?

Potentially yes, budget fee £2000.00

1. Landscape: Does any similar or complementary guidance exist, published by CIBSE or elsewhere?

There are guides that aim to guide verification and validation of CFD in mechanical engineering or aeronautical applications, not on the theme of data centres. The top 2 are:

* ASME Standard for Verification and Validation in Computational Fluid Dynamics and Heat Transfer.
* AIAA Guide for the Verification and Validation of Computational Fluid Dynamics Simulations.

1. **Collaboration**: Are there any organisations that may wish to be involved in the production of this guidance? (For example: membership organisations, trade associations, contractors, consultants, government departments).

Potentially IMechE, CFD software vendors & Leading academics in top tier universities in an advisory role.

1. Are there any organisations that may wish to sponsor the production financially?

Potentially (CFD software vendors in non-monetary staff equivalent economic cost contribution)

1. Categorisation: CIBSE has created a taxonomy of building services, the Knowledge Matrix. On the following pages, please tick the topics and sub-topics that will be covered in this project.

**Topic:**

Mechanical

Heating

Ventilation

Refrigeration and air conditioning

Extract/ exhaust systems

Smoke control

Pipeline distribution systems (natural gas, liquid fuels, medical gas, compressed air & vacuum)

Electrical

Extra low voltage

Low voltage

Medium voltage

High voltage

Local power generation & standby power

Earthing & bonding/ Lightning protection

Communications

Audio-visual

Electric vehicle charging

Public Health

Water

Drainage

Gas

Lighting

Daylight/ sunlight

Electric lighting

Lighting energy

Fire safety

Fire life safety

Fire protection

Fire detection

Fire notification

Building fabric

Façades

Access & maintenance

Transportation systems in buildings

Lifts

Escalators

Moving walks

Stairlifts and lifting platforms

Building intelligence

Controls

Smart buildings

Security

Physical security

Security systems (access control, surveillance, intruder alarm)

Cyber security

Digital

Building information modelling (BIM)

Digital engineering

Digital construction

Sustainability & ESG

Climate change mitigation

Climate change adaptation

Circular economy

Biodiversity & natural capital

Diversity & inclusion

Social value

Health, wellbeing and safety

Structure:

Introduction of project

Purpose (strategic/design context)

Project management (inc info requirements)

Drivers

Commercial

Contracts

BIM

Digital information management

Fundamentals

Physics

Design conditions/ data

Calculations and methods

Sustainability (key considerations)

Health, wellbeing and safety

Retrofit and refurbishment

Condition surveying

Modification/ adaptation

System selection

Selection (regulations, best practice, finance, operational energy, whole-life carbon)

Systems, plant, equipment (terminal equipment)

Systems, plant, equipment (network level, central plant, distribution)

System design principles

System sizing

System design conditions/ data

System sizing calculations

Health, wellbeing and safety

Modern methods of construction

Access and maintenance

Construction

Installation

Modern methods of construction

Health, wellbeing and safety

Records (drawings, operation and maintenance)

Controls

Strategy

Controls as specified, installed and commissioned

Commissioning

Plans

Procedures

Operation

Facilities management

Training

Maintenance

Health, wellbeing and safety

Performance (energy, carbon, water)

Performance (IEQ)

End of life

Reuse

Repurpose

Recycle

Demolition

Building Type:

**Residential**

Single dwelling

Multiple dwelling

Non-residential

Office

Education

Higher education

Healthcare

Retail

Leisure

Aviation

Road and rail

Government

Industrial

Logistics

Data centre

Heritage

Defence

Infrastructure

Utilities

Other

Intended Reader:

Owner

Occupier

Designer

Developer

Constructor

Installer

Commissioning engineer

Operator/ Facilities manager

Manufacturer

Apprentice

Student

Researcher

Expert witness

Other - please specify: