Data Canter CFD Simulations
For Optimal Design ?

CAS Ltd. - Computerized Analysis & Simulation

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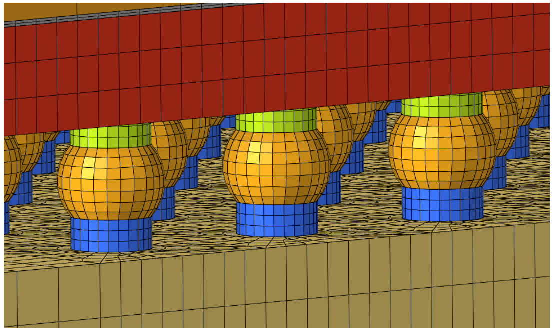
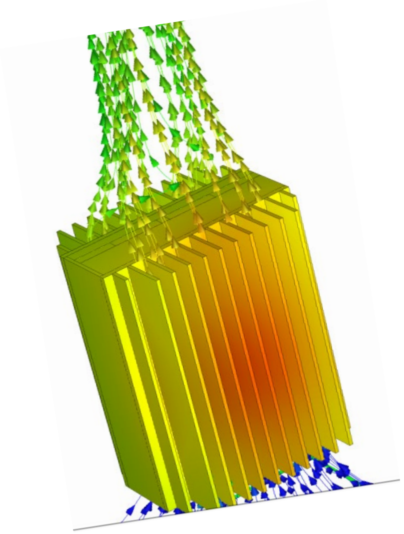
Who We Are

- Innovative CA service provider in the field of mechanical, thermal, dynamical and CFD systems.
- Established in 1995, Today we are 12 workers.
- Specialization in providing a complete range of engineering consulting, starting from the first conceptual design, and up to the final testing stages, using cutting edge computerized tools such as, FE (Finite Elements) and CFD (Computerized Fluid Dynamic) software.
- Engineering Consulting, Conceptual Design and Simulation:
    - Mechanical
    - Dynamical and rigid body
    - CFD design aspects
    - Optimization
    - Thermal
    - Full system modeling
    - Multi discipliner

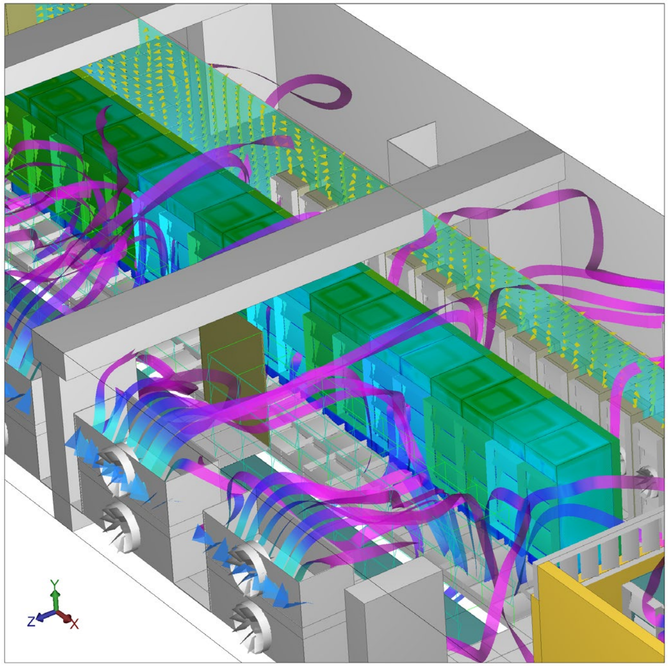




- Environmental and Verification Testing
- Marketing & Supporting – Simulation and CAD Software

Introduction

- *The AI booming, increases dramatically the need for computing and storage needs, due to it the Demand for Data Centers.*
- *Data center today face new challenges:*
  - *Large hot spot/ power need to be cooled*
  - *Due to the large amount of needed cooling energy, the cooling must be more efficient.*
- ***It is not sufficient anymore to cool out the total heat**, the designer must take in to account the hot spot, as well !*
- *The traditional data centers includes racks with 3-6 KW, the new racks can dissipate up to 30 KW per rack and more.*



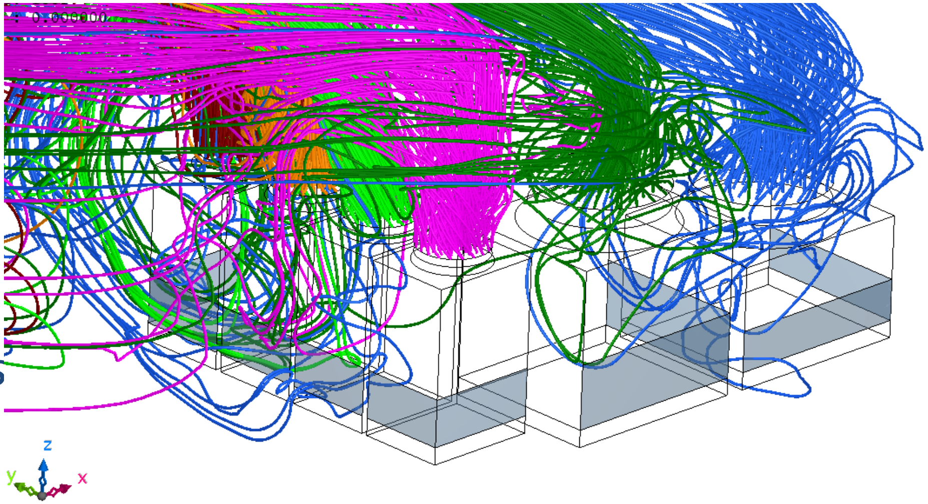
In the US, *which the report said is home to 33 percent of the world's data centers, consumption is expected to rise from 200TWh in 2022 to 260TWh in 2026, some six percent of all power use across the country.*

In Ireland , by 2026, data centers could account for 32 percent of all power consumption due to a high number of new builds planned. This compares to 17 percent in 2022. As reported by DCD, calls to limit the number of new data center projects in Ireland because of their energy use were rejected by the Irish government last year.

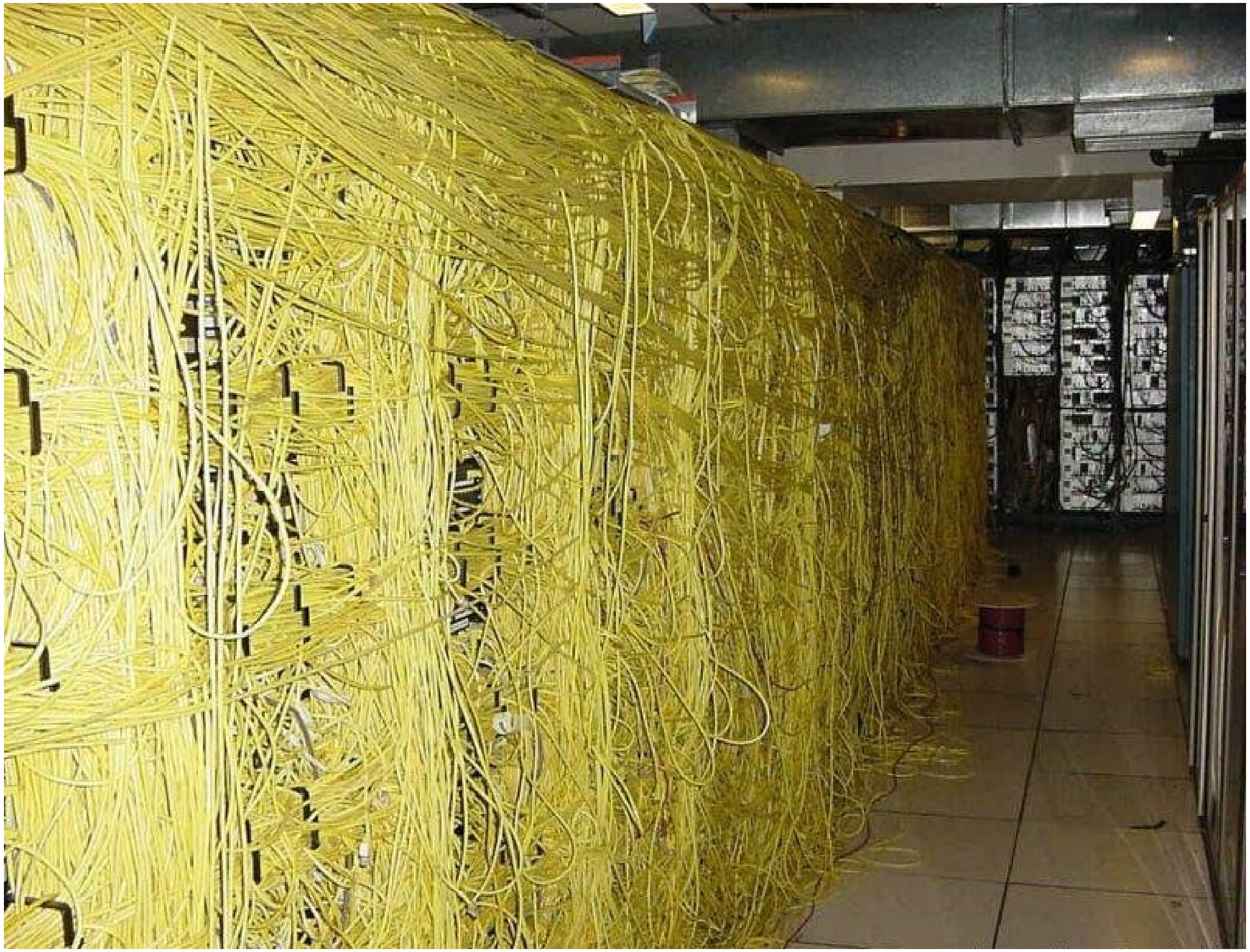
Way CFD ?

By CFD we constructs a computer model of the System structure and areaand uses the technique of Computational Fluid Dynamics (CFD) to calculate the airflow pattern and pressure/temperature distributions.

- *Designing efficient cooling*
- *Examining "what if" scenarios*
- *Examining failure scenarios*
- *Evaluating options for positioning new equipment*
- *Making cost-effective investments in cooling-related hardware*



Practical Data Center Solutions ?



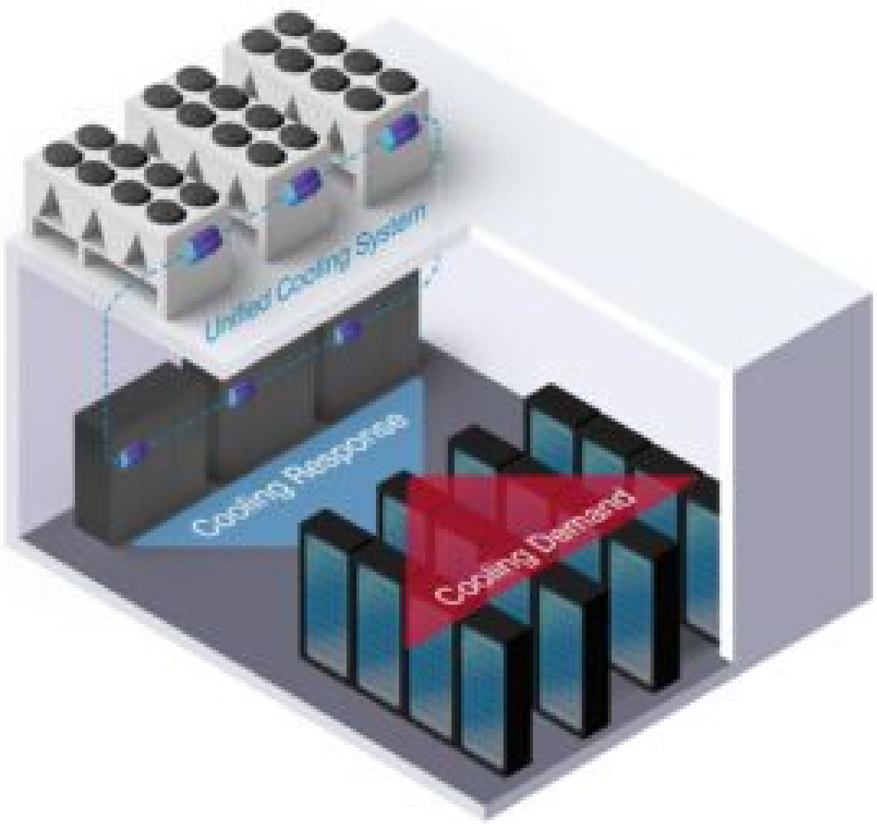
General Full Data Center System
Chillier/Cooling Tower – CRAC - Racks

Chillier/Cooling Tower

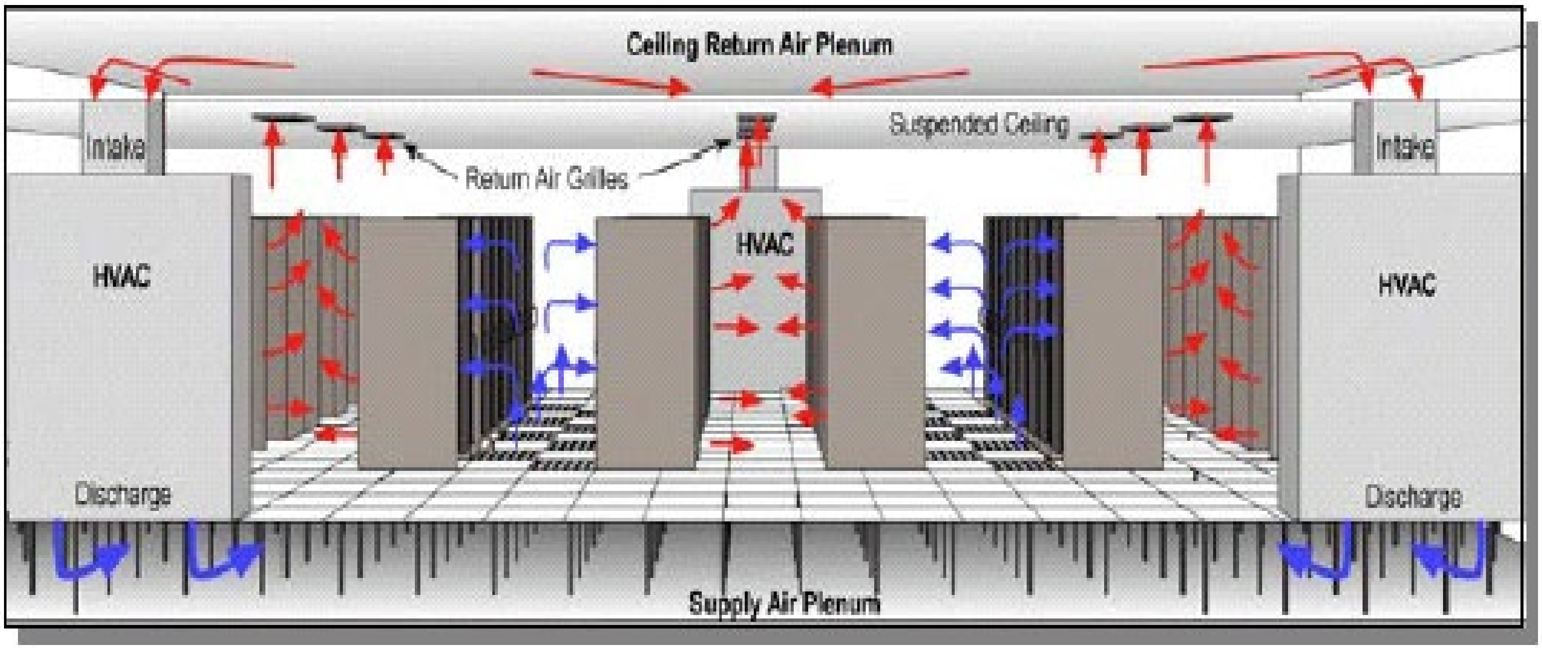
(Generators/ chiller)

CRAC

Racks



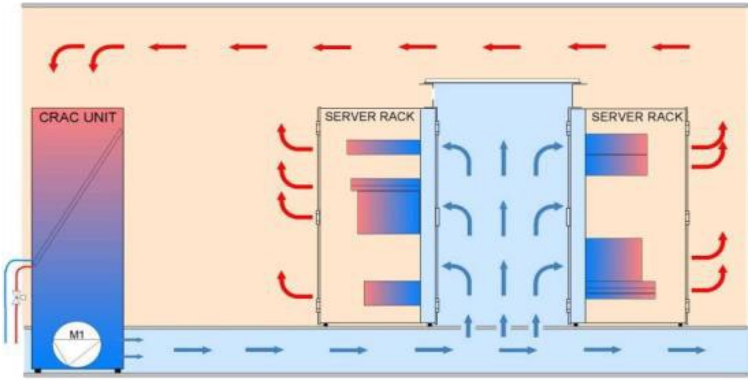
Common Rack Airflow Distribution

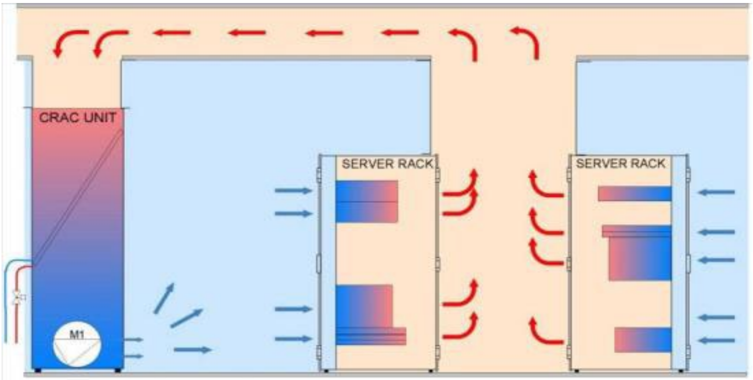


[redacted]

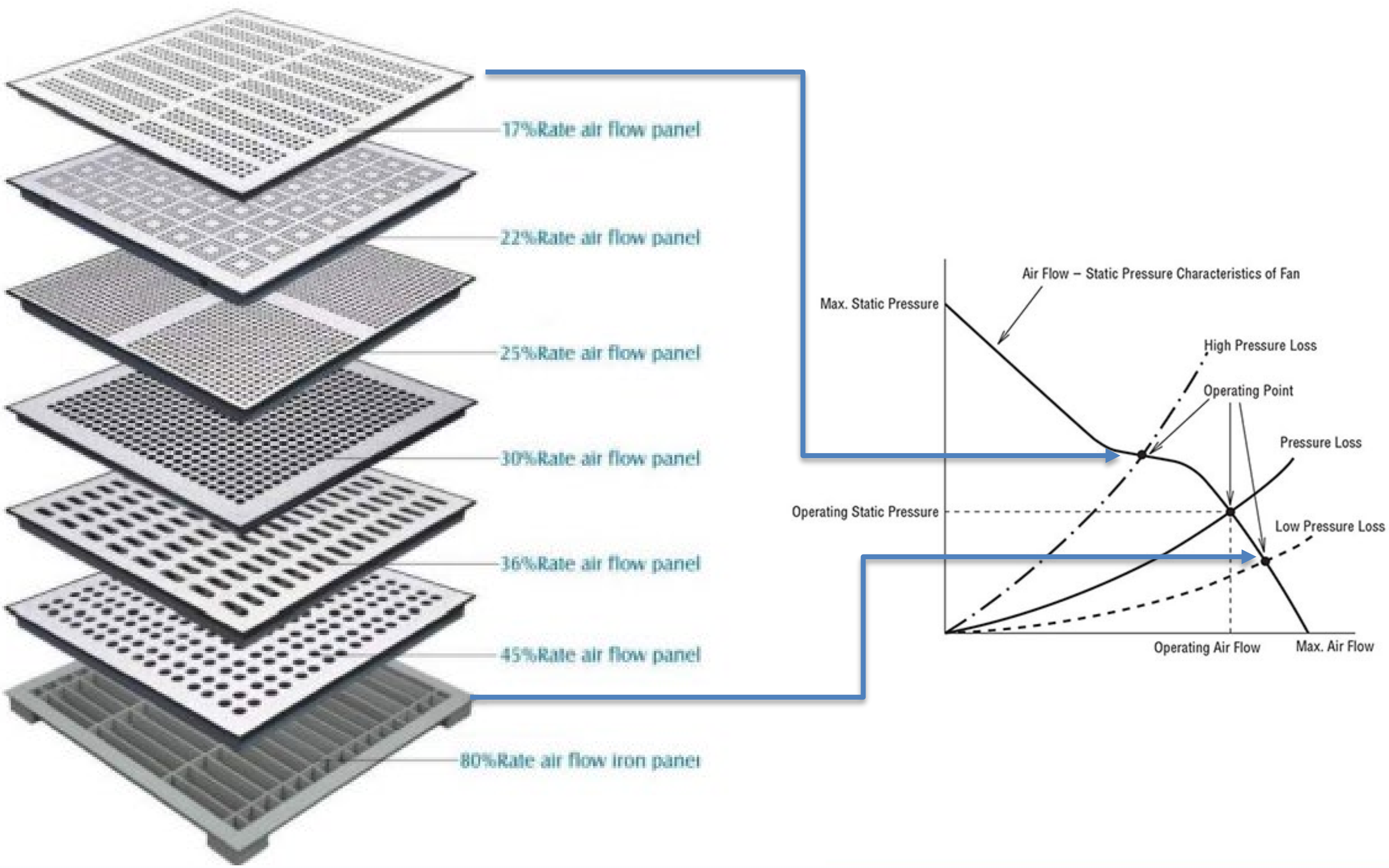
- *Limit to LD system due to tile limits and raised floor limits*

Hot/Cold Aisle Containment System Concept



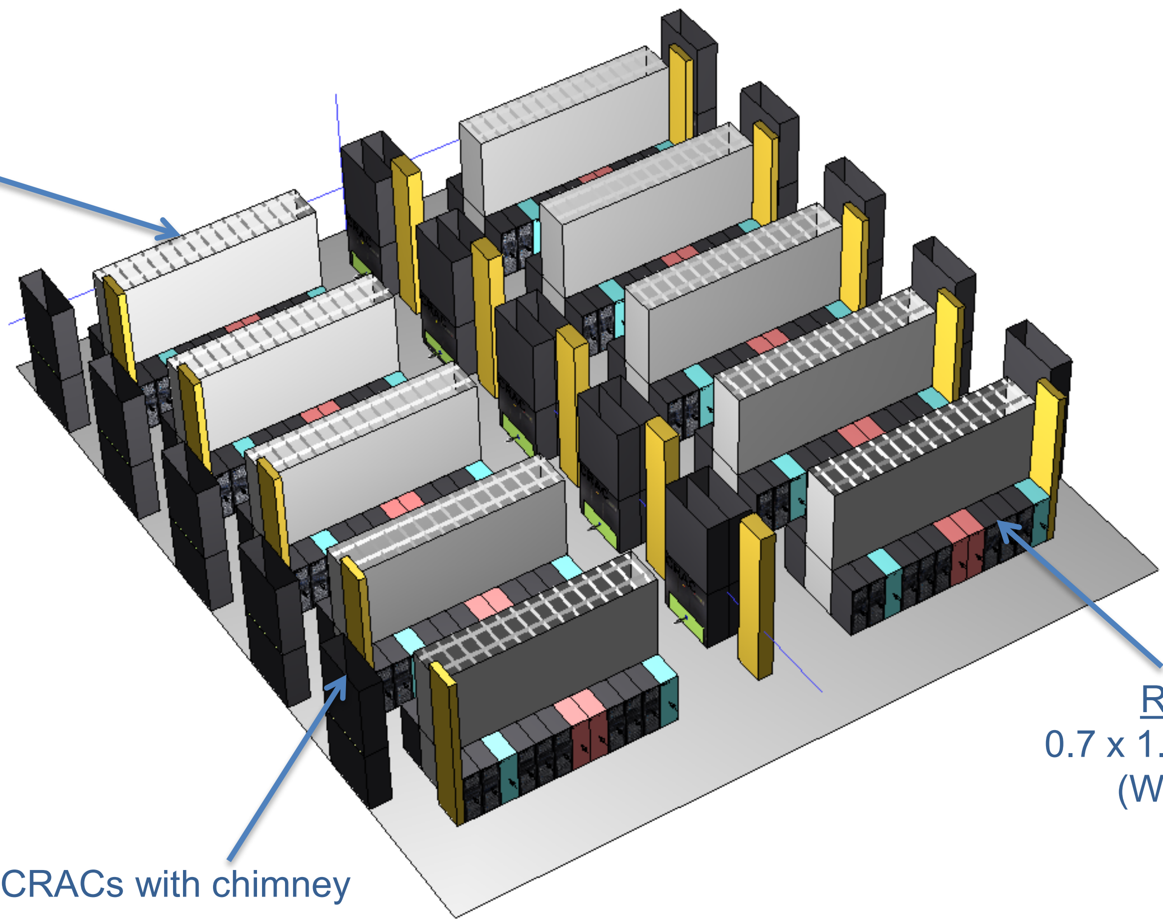


Tile Perforations



CRAC Cooling System With Chimney

Chimney

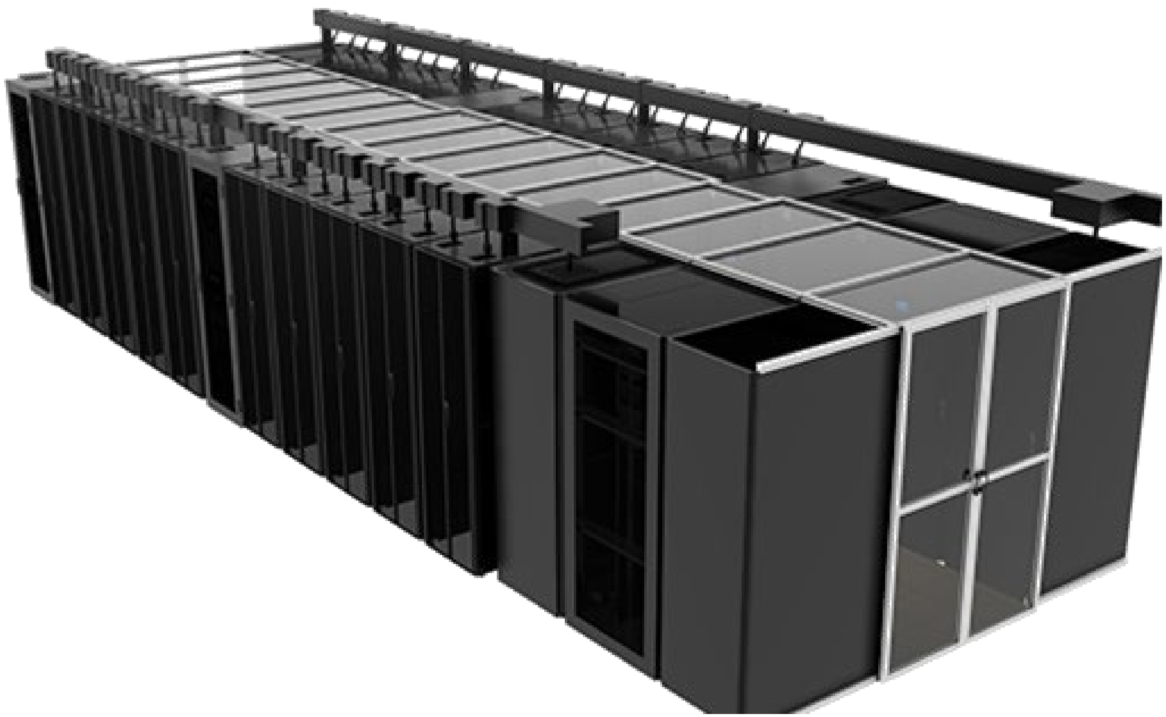


RACK
0.7 x 1.2 x 2.14 m
(WxDxH)

CRACs with chimney

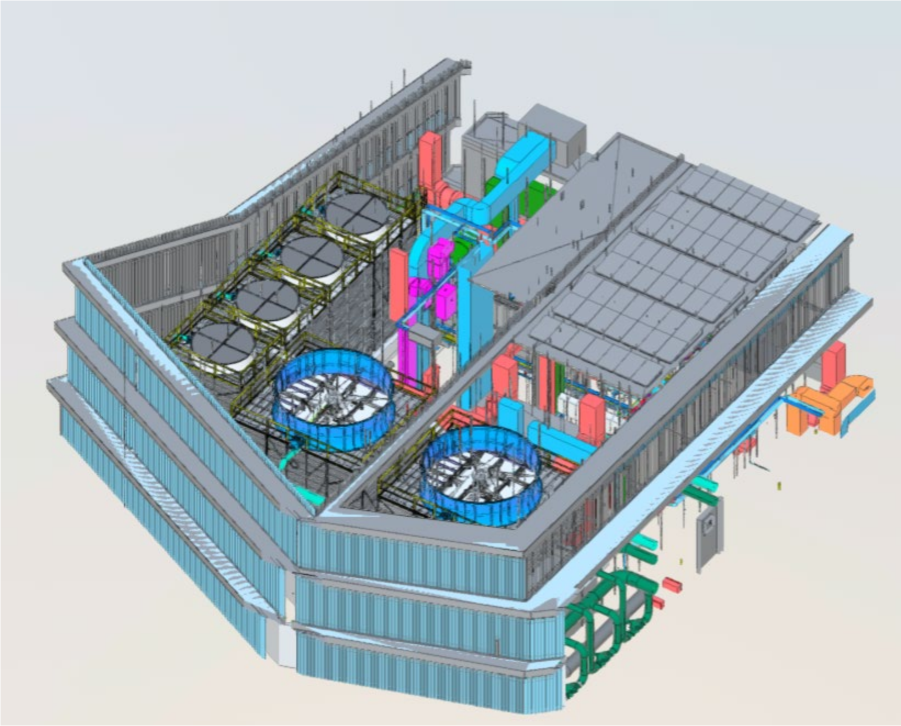
Ceiling is hidden

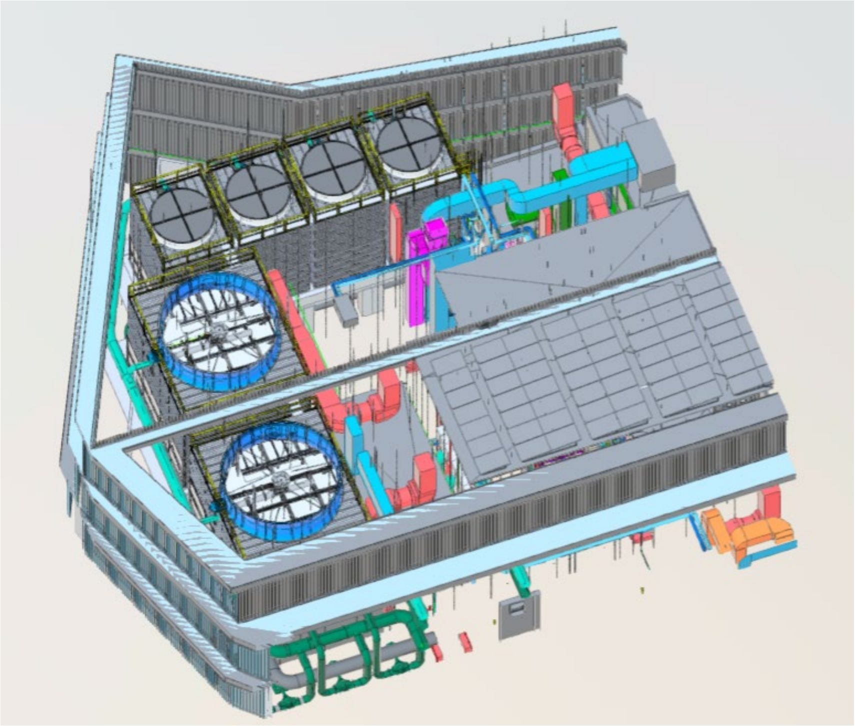
"POD" – Hot and Cold Aisle System – For HD Rack With "in row"



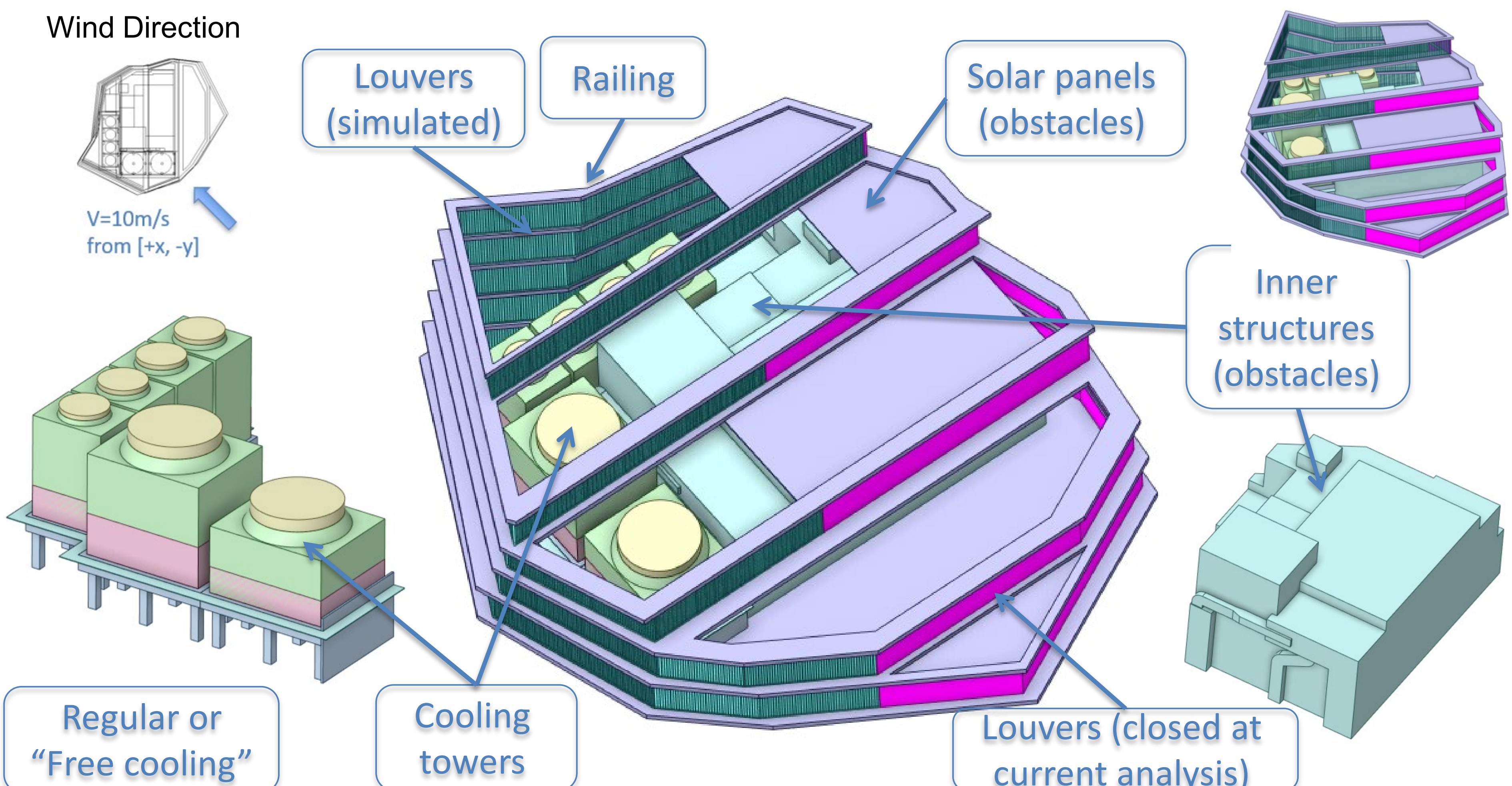
Example 1 - Roof With Cooling Towers

Roof Model Drawing Description



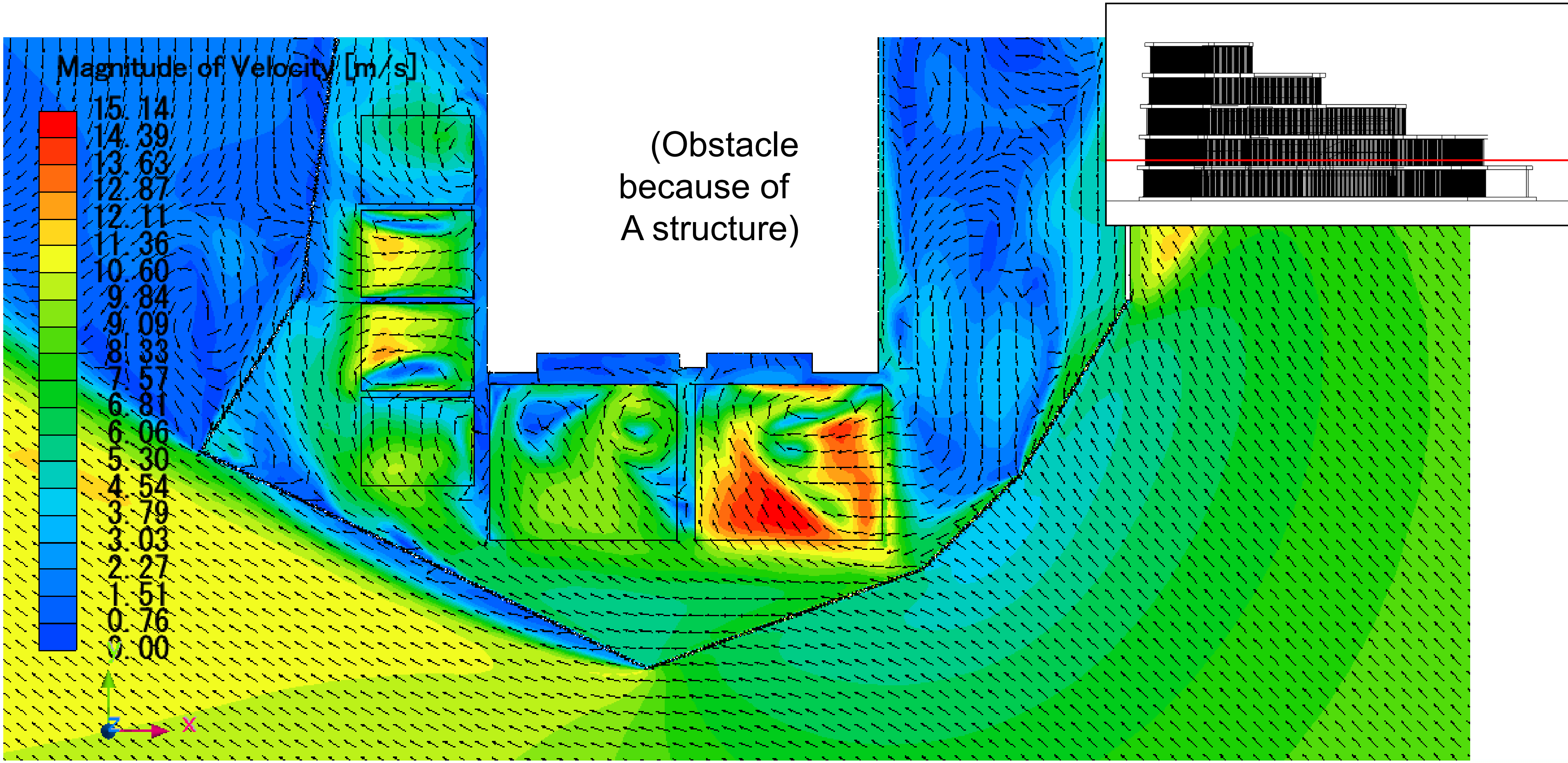


Example 1 – Roof CFD Model

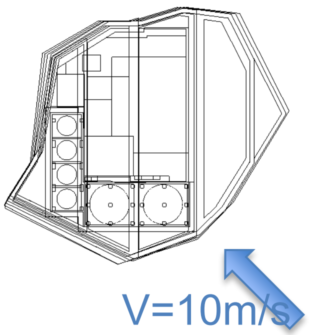


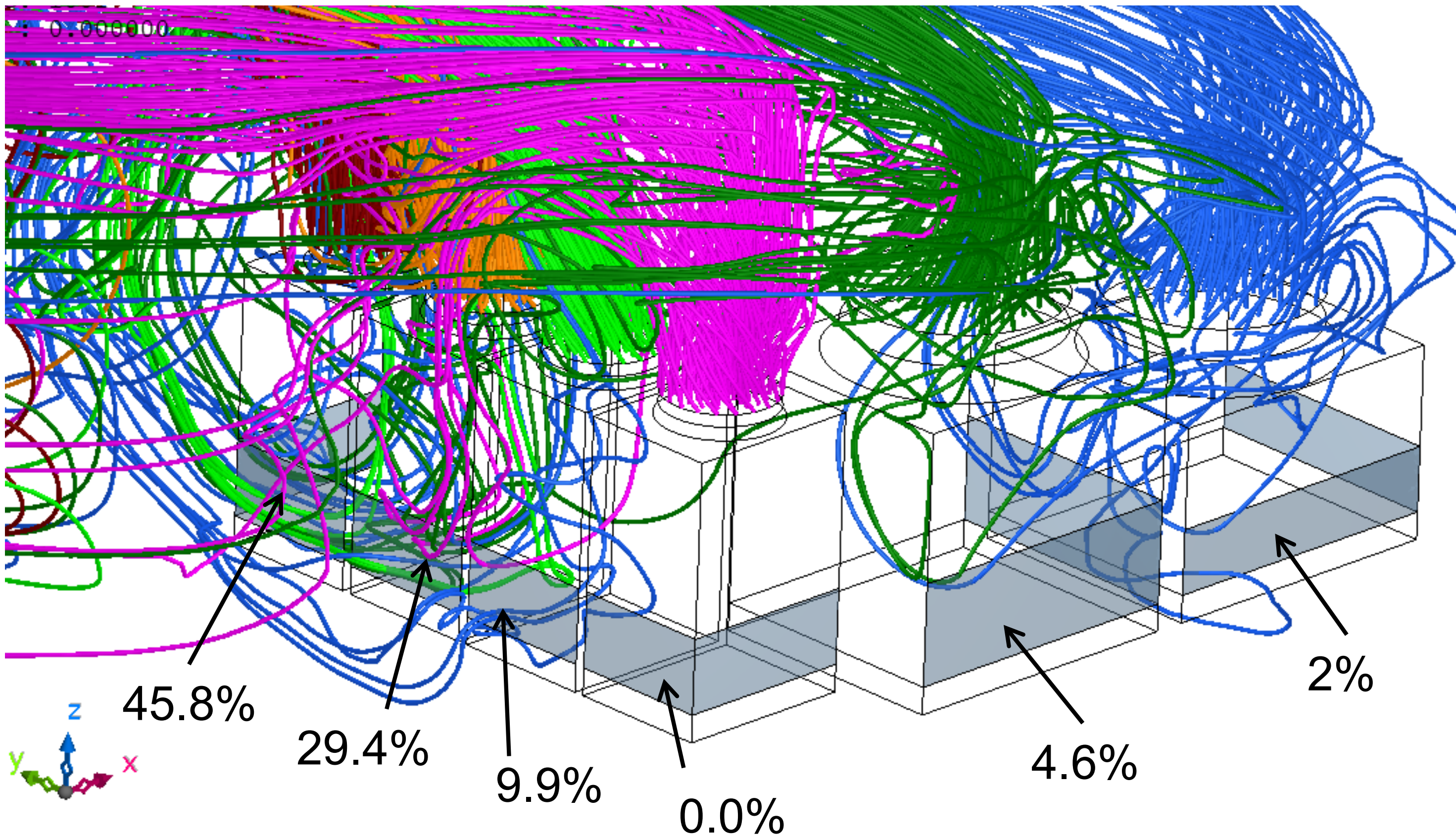
Example 1 –Simulation Results - Velocity Distribution

Horizontal Cross Section Through Center of Towers



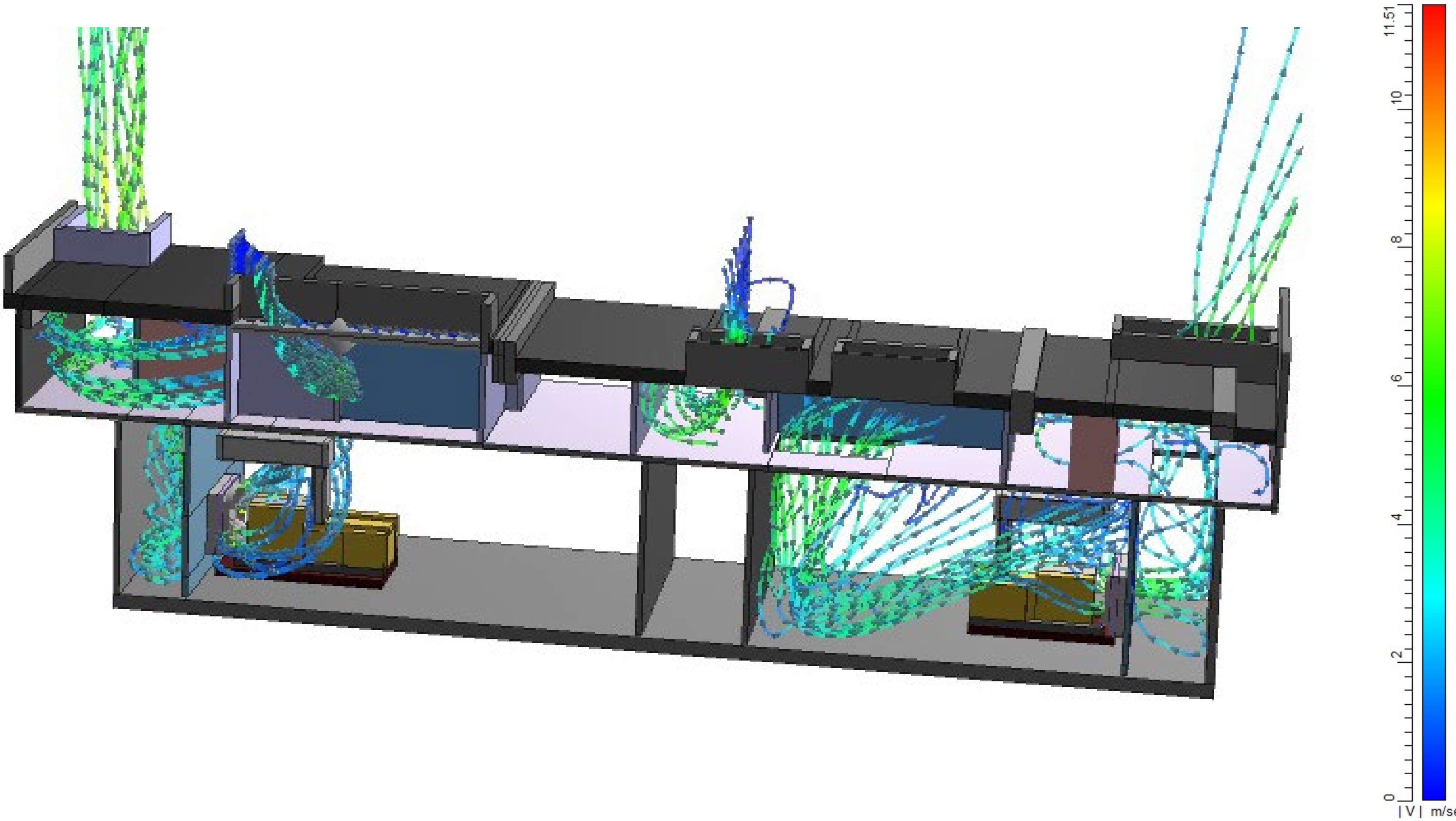
Example 1 – Simulation Results - Air Flow
At Outlets Of Tower – Back Flow Percentage





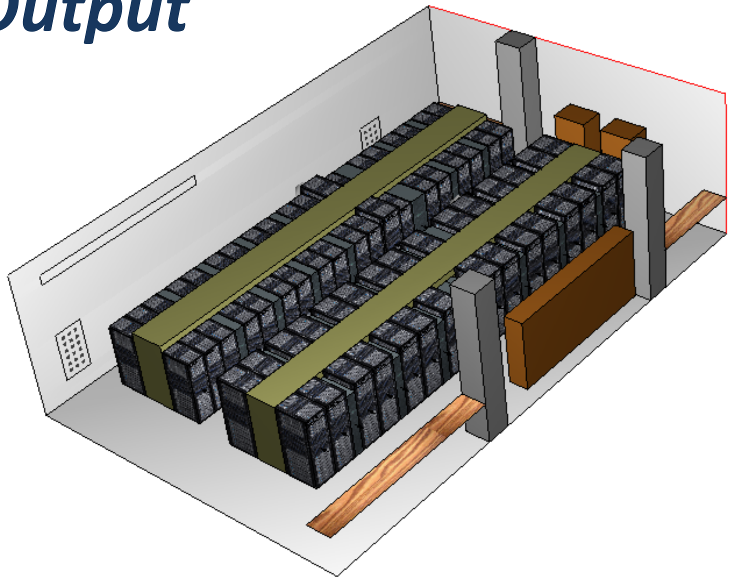
In each tower the percent of returning air from the total flow that enters the tower is given in black

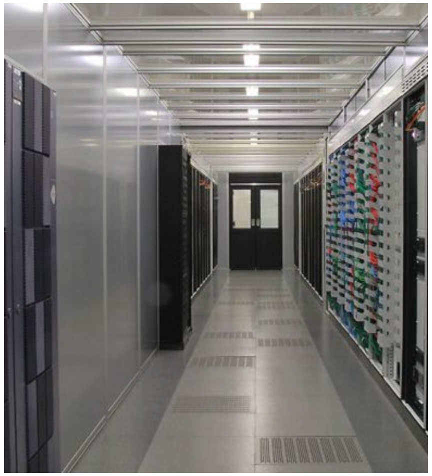
Generators /Chiller Level



Simulations Input/Output

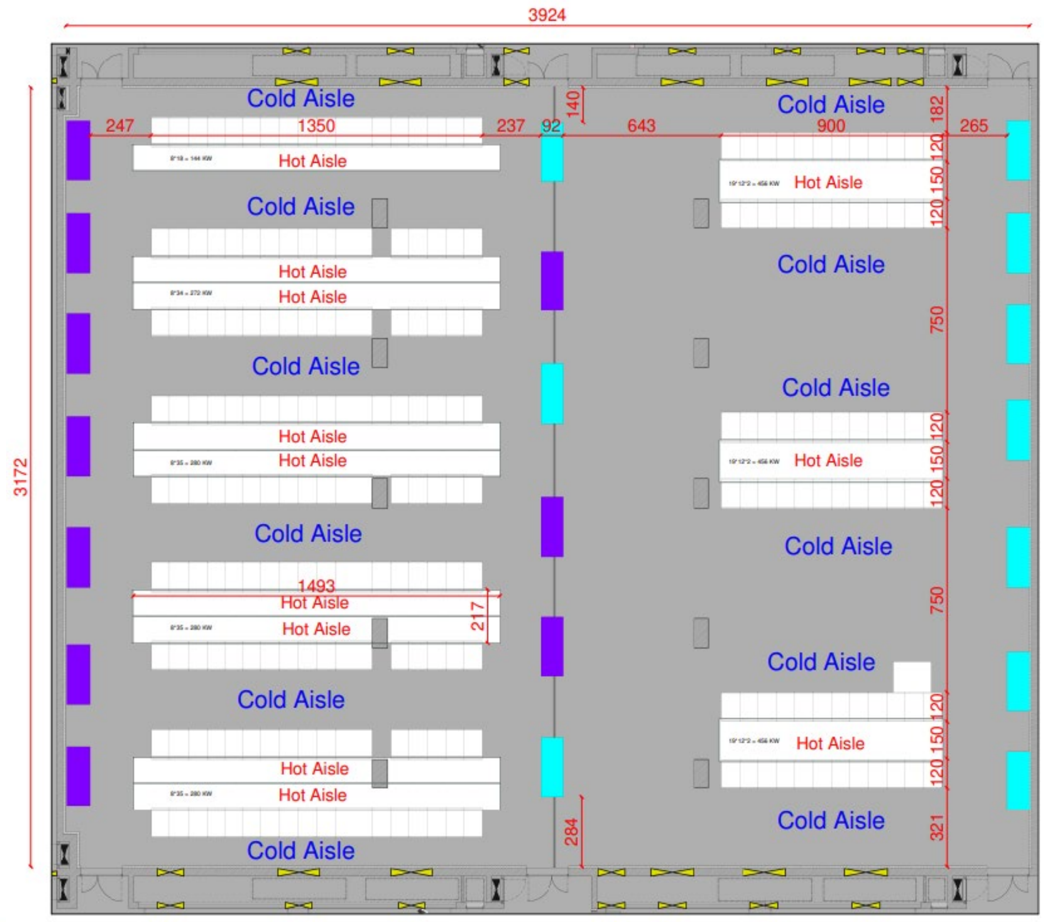
- **_Input_**
  - Geometrical model (structure, rise floor/roof)
  - Tile opening
  - Rack/CRAC performances
  - Powers
- **_Output_**
  - Temperature distribution
  - Air velocity distribution
  - Pressure distribution
  - Tile - air flow/pressure droop
  - Rack Characteristics
    - Air flow
    - Pressure drop
    - Temperature differences
  - CRAC/Inrow Characteristics
    - Air flow
    - Pressure drop
    - Temperature differences





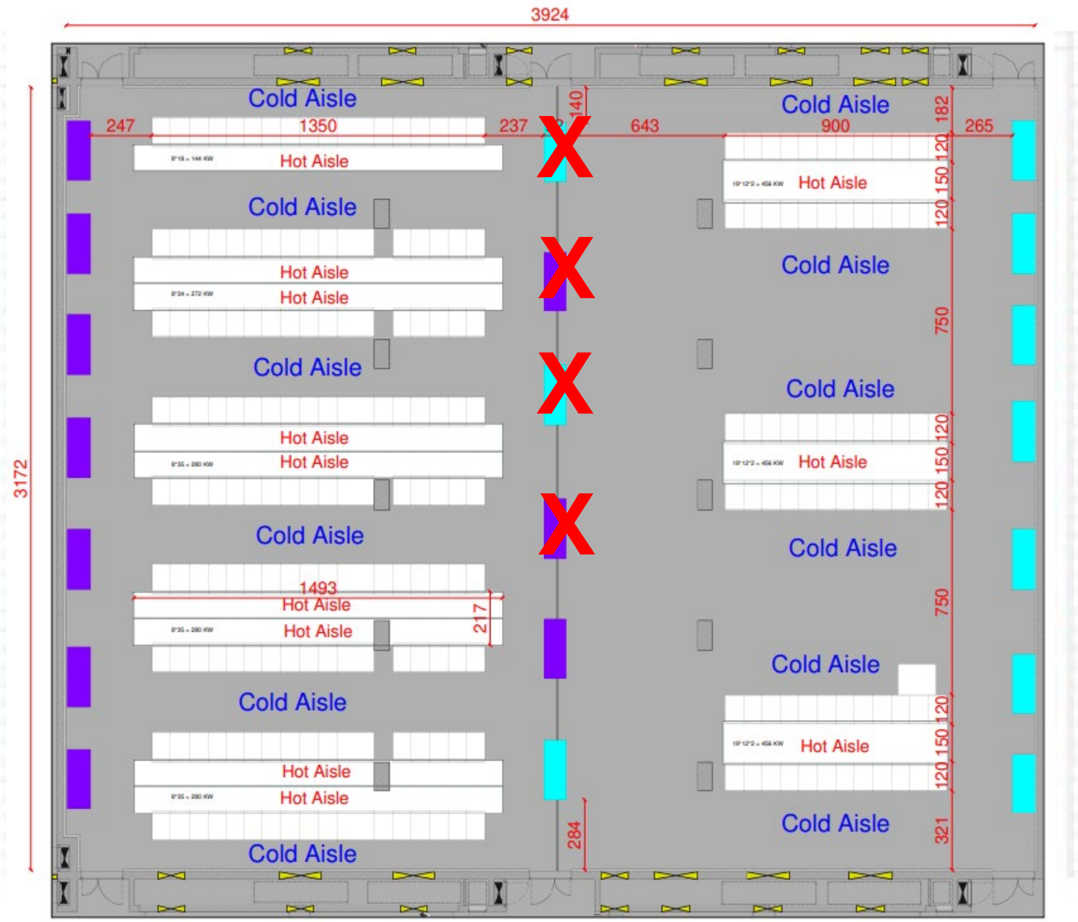
Example 2 - Data Center

Room Layout - 229 Racks With Powers 8/19KW- Total =2624 KW



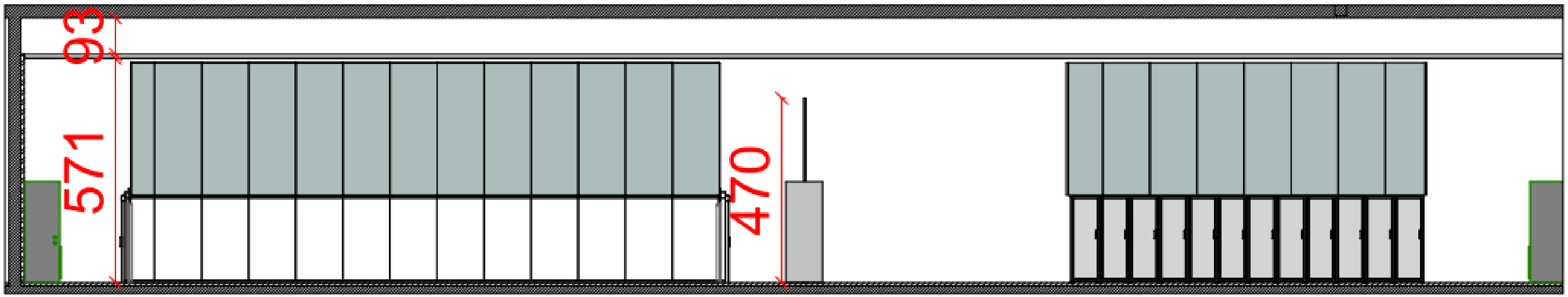
Example 2 - Data Center

Case With CRAC Failure



Example 2 - Data Center

Room Side Cross Section View

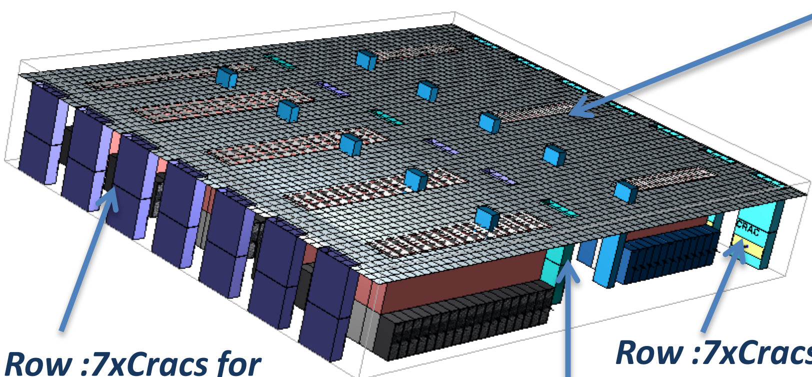


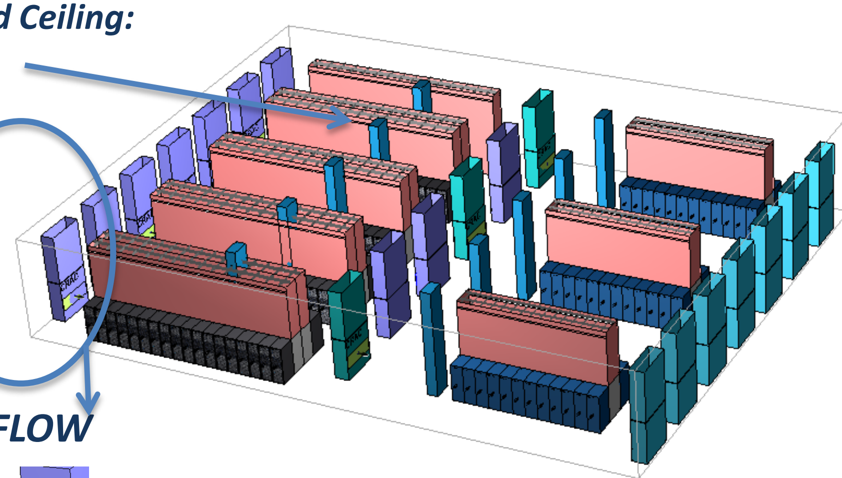
Example 2 - Data Center

Thermal Model General Isometric View

Row :20xCRACs
Return air are from the top to front (supply air)

Suspended Ceiling: Open 60%



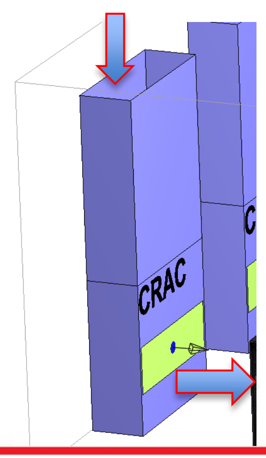


Row :7xCracs for Racks 8watt

Row :7xCracs for Racks 19watt

Row :3xCracs for Racks 8watt
3xCracs for Racks 19watt

AIR FLOW



CRAC Dimensions:255x257x89cm(WxDxH)

Example 2 - Data Center

Racks – Thermal Model Description

Rack

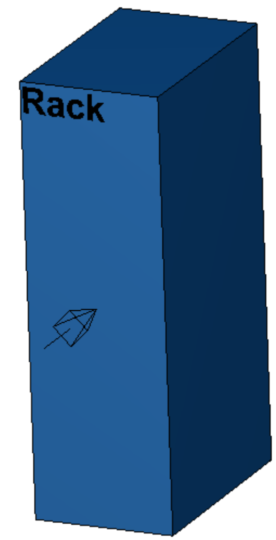
General | Flow Configuration | Air Flow and Heat Load

☐ Turned off / Failed

Name	rack
Nameplate	Rack
Color	...

Dimensions

Width (cm)	75
Height (cm)	230
Depth (cm)	120



General | Flow Configuration | Air Flow and Heat Load

Servers (from bottom to top)

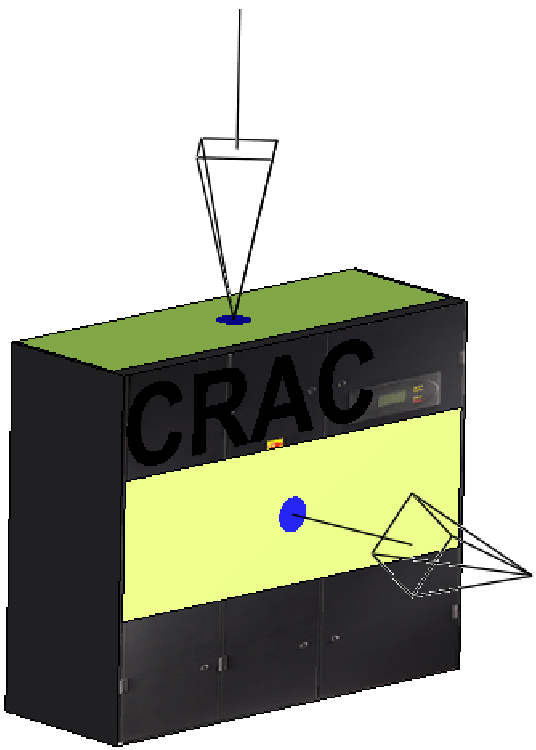
Type	Height (cm)	Heat Load (kW)	T Rise (°C)	Flow Rate (ft^3/min)
Whole Rack	198.12	8	11.7	1198.95

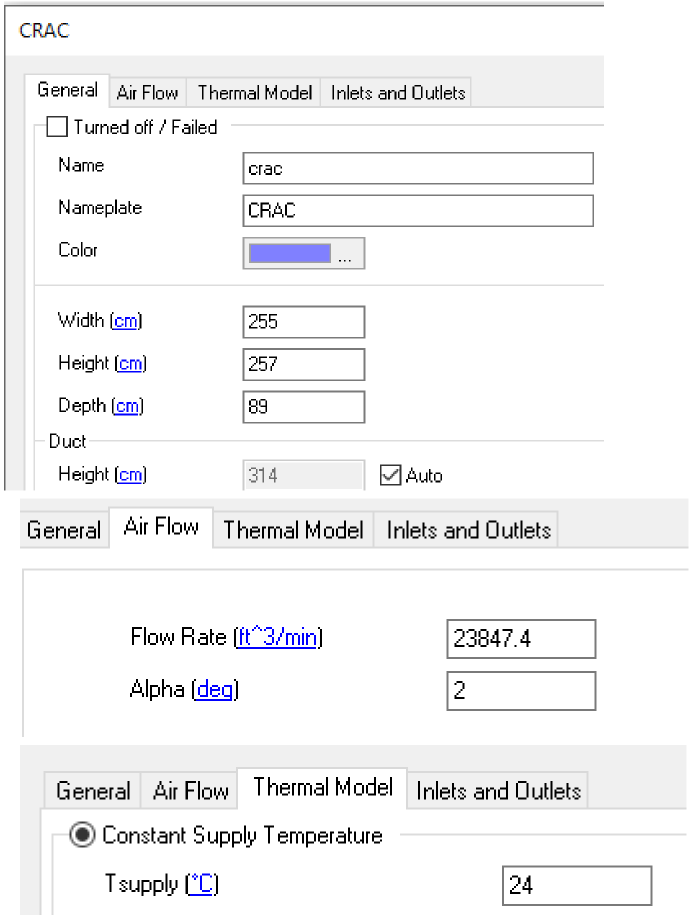
General | Flow Configuration | Air Flow and Heat Load

Servers (from bottom to top)

Type	Height (cm)	Heat Load (kW)	T Rise (°C)	Flow Rate (ft^3/min)
Whole Rack	198.12	19	12.6	2644.11

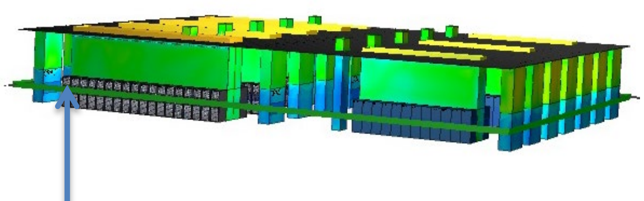
Example 2 - Data Center
CRAC – Thermal Model Description



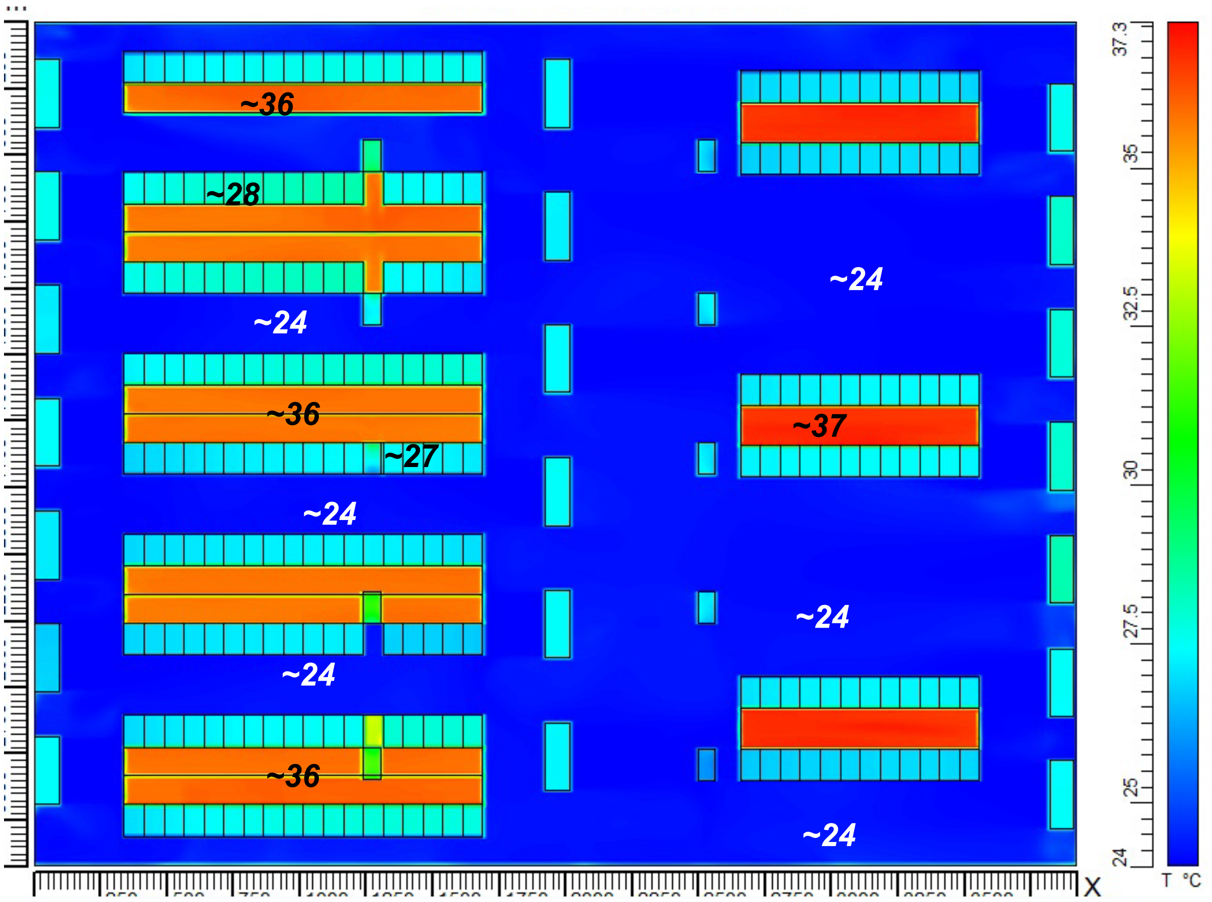


Example 2 - Data Center – Simulation Results

Temperature Distribution – Horizontal Cross Section

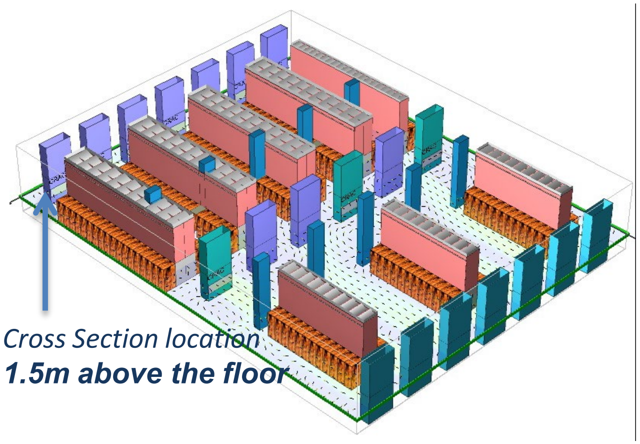


Cross Section location
1.5m above the floor



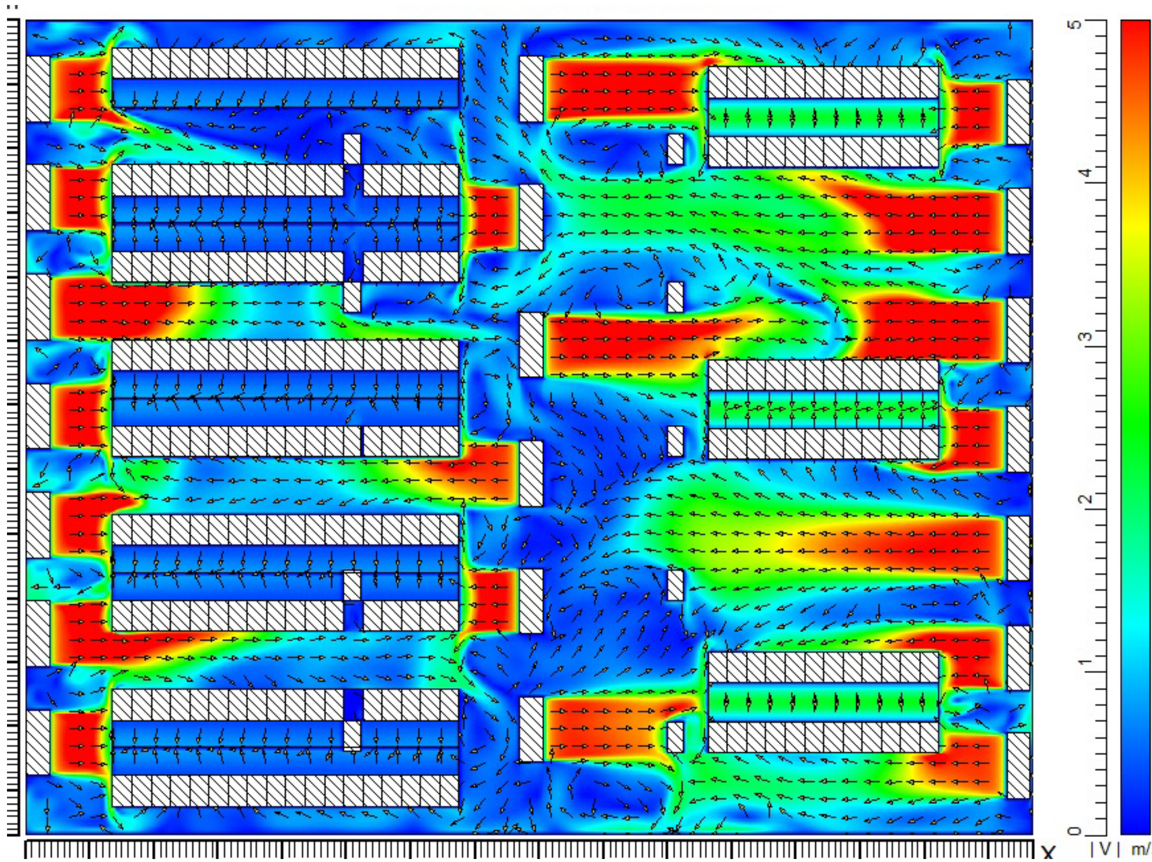
Example 2 - Data Center – Simulation Results

Air Flow Distribution Horizontal Cross Section



Cross Section location
1.5m above the floor

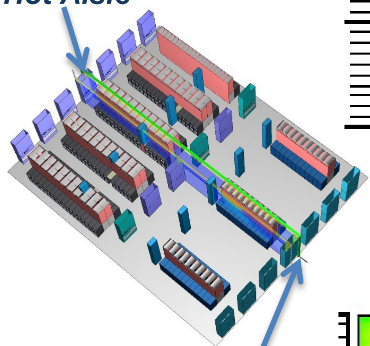
The legend value reduced from the max. of 9.5m/sec



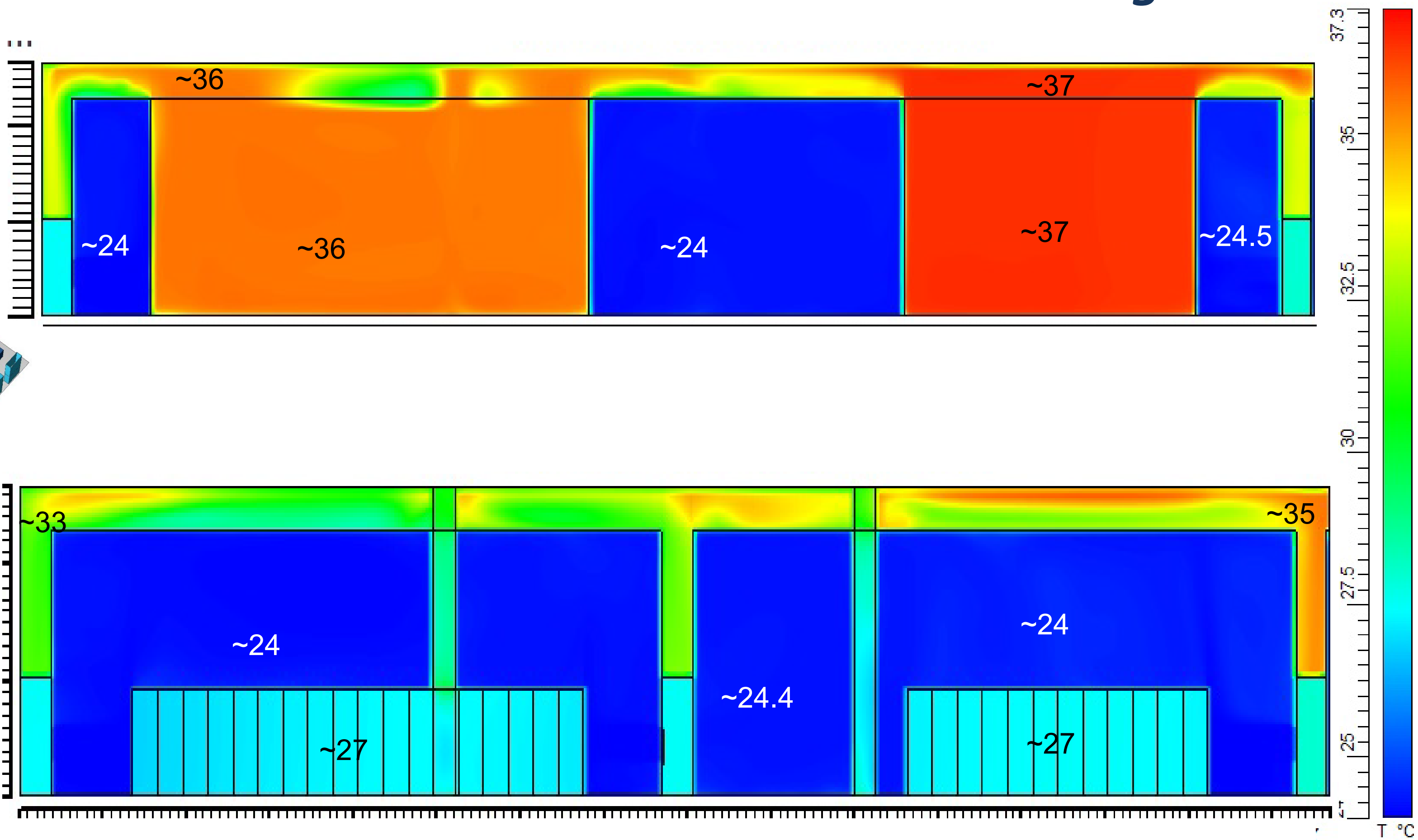
Example 2 - Data Center – Simulation Results

Temperature Distribution Vertical Cross Section Through CRAC

Cross Section Through Hot Aisle



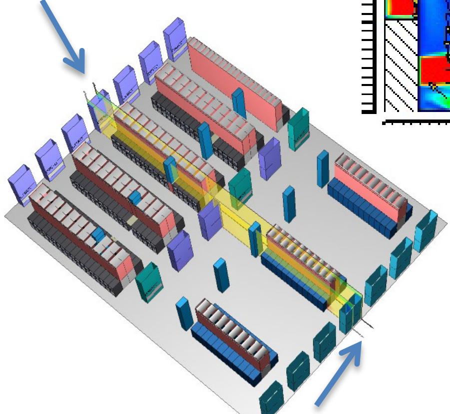
Cross Section Through Cold Aisle



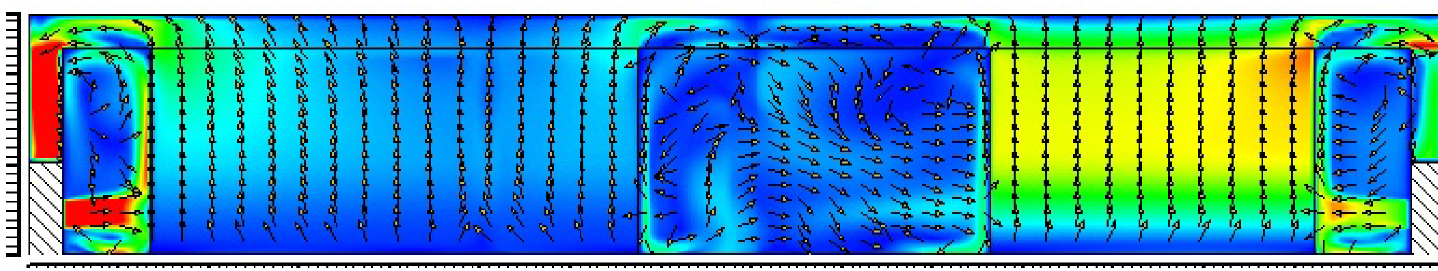
Example 2 - Data Center – Simulation Results

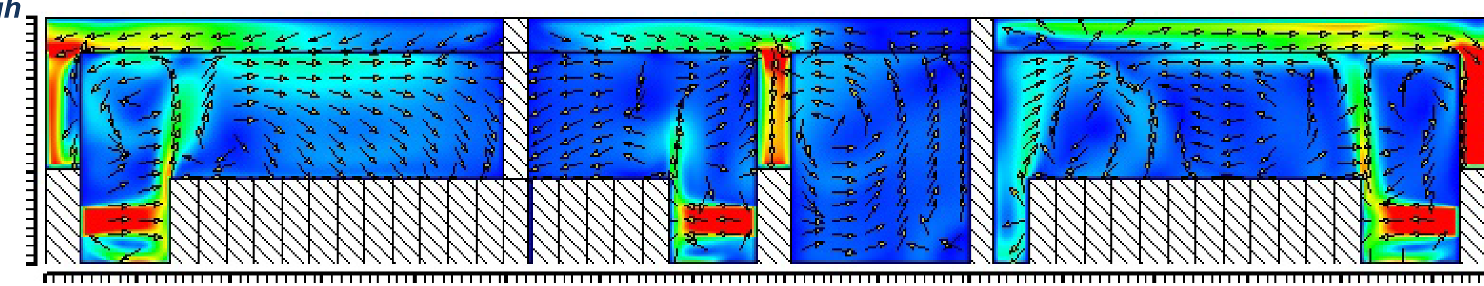
Air Flow Velocity Distribution Cross Section Through CRAC & HOT and Cold Aisle

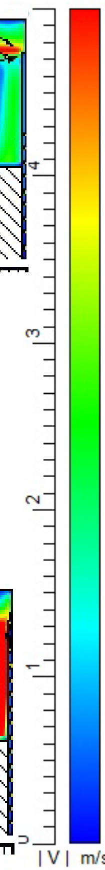
Cross Section Through HOT Aisle



Cross Section Through Cold Aisle



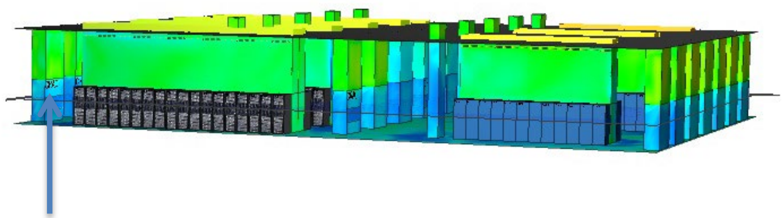




Example 2 - Data Center – Simulation Results

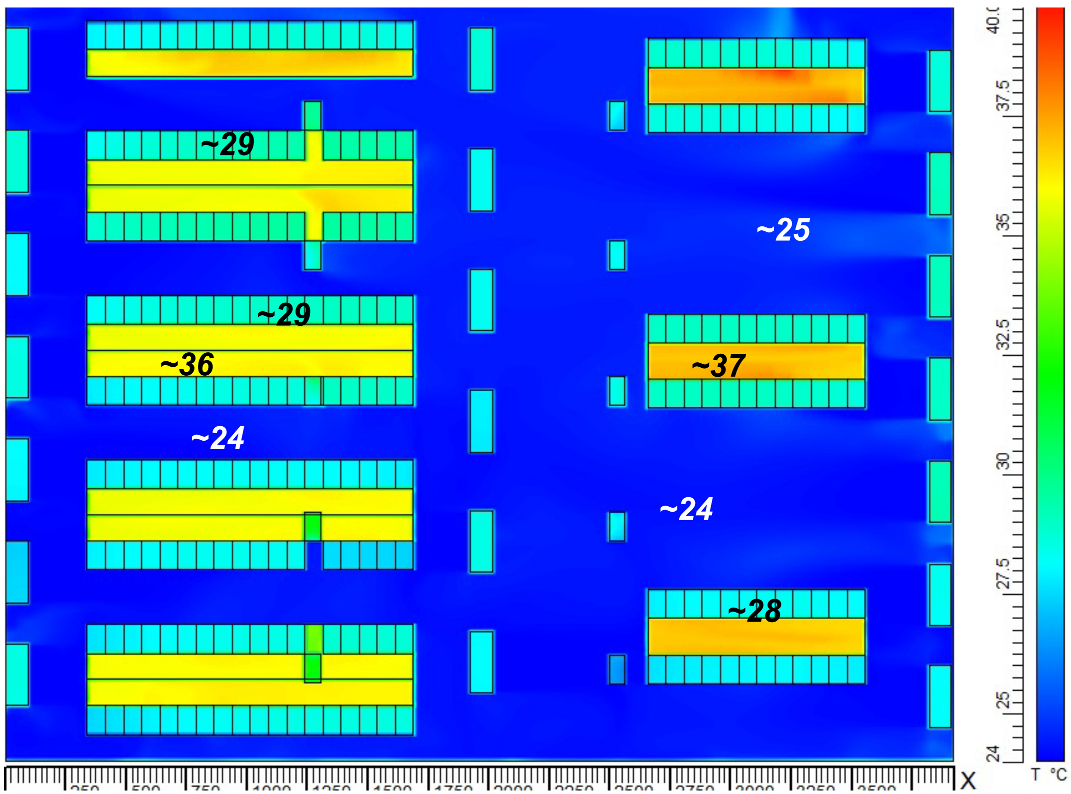
Temperature Distribution – Case With CRAC Failure

Horizontal Cross Section



Cross Section location

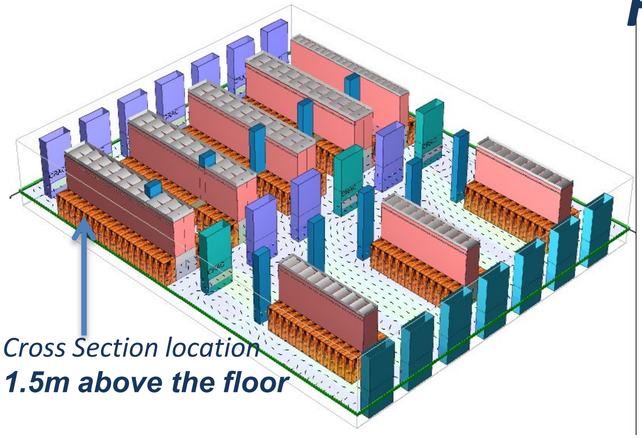
1.5m above the floor



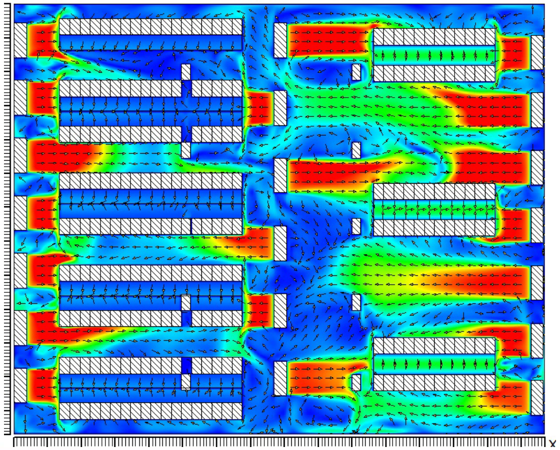
Example 2 - Data Center – Simulation Results

Air flow Distribution – Case With CRAC Failure

Horizontal Cross Section



Basic Case for comparison



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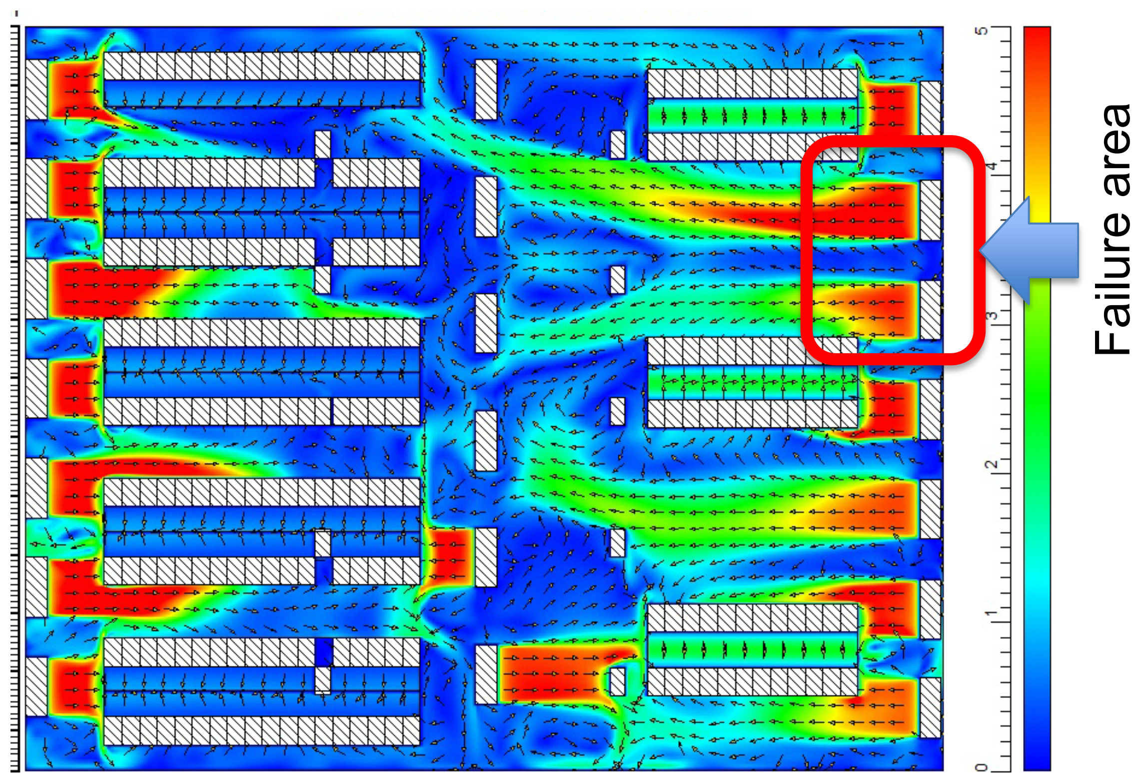

Thanks

Questions ?