

**To: Bapak Yanto Liem  
Bapak Agus  
PT. Graha Sumber Prima Elektronik**

# **Flow Circulation Analysis on Cabinet ODC 14U**

**By: Dena Hendriana, B.Sc. S.M. Sc.D  
Swiss German University**

# Purpose of the Analysis

- *To analyze air circulations*
  - *To improve electric component and battery cooling*
- *Aims:*
  - *To give recommendations to improve air circulations in a cabinet with 2 (two) options of fans*

# Job Itemizations

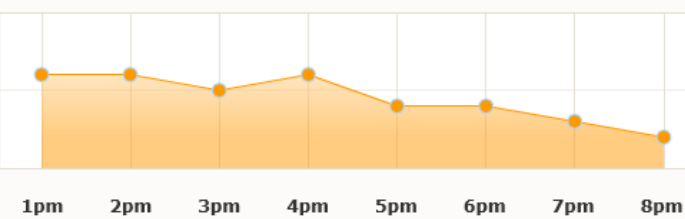
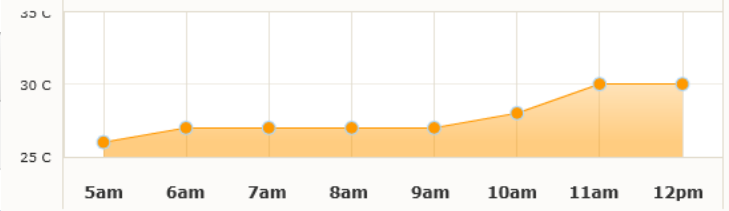
- ***Pre-processing***
  - Cleaning 2 geometries, completing geometries, modeling, etc.
- ***CFD Simulations***
  - Cabinet with fan axial
  - Cabinet with fan centrifugal
- ***Post-processing***
  - 2 CFD results
  - Presentation

# Introduction

- BTS outdoor cabinet is protecting Electronic component and battery from rain, solar heat and hot air environment
- Ambient temperature in jakarta can be up to 35C, but in rooftop temperature can be ~50C
- Electronic components release heat and require air circulation to cool them; They can withstand ambient temperature up to ~70C
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# Jakarta Ambient Temperature

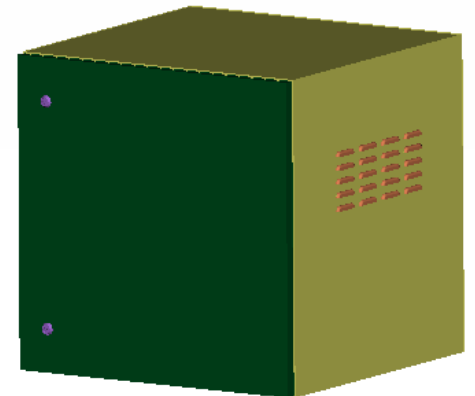
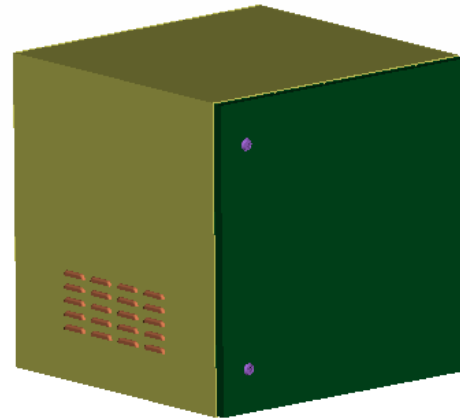


- Peak temperature in Jakarta is about 35C
- High temperature from 11am to 4pm
- Rooftop temperature is higher (T~45C)

# Cabinet with Fan Options

- Dimension of the Cabinet: 700 x 700 x 700 mm
- Cabinet has air circulation holes on the left lower panel as inlets and on the right upper panel as outlets

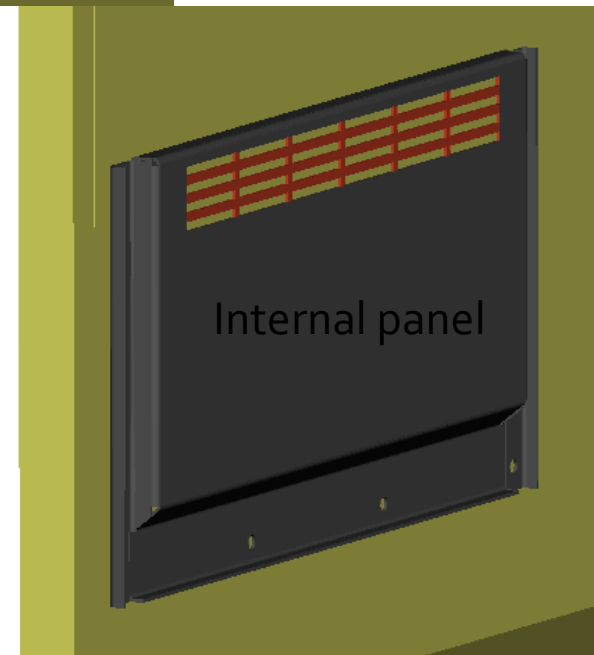
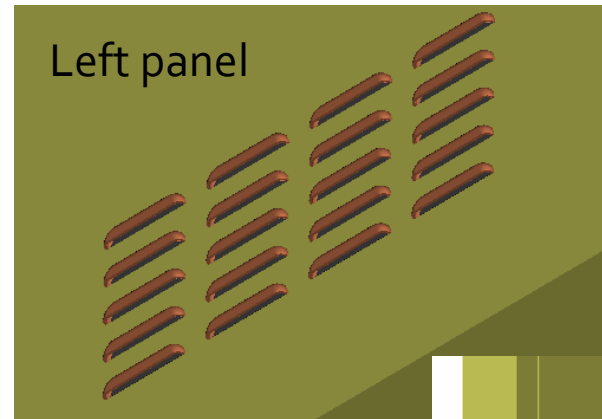
Front iso-view



# Inlet details

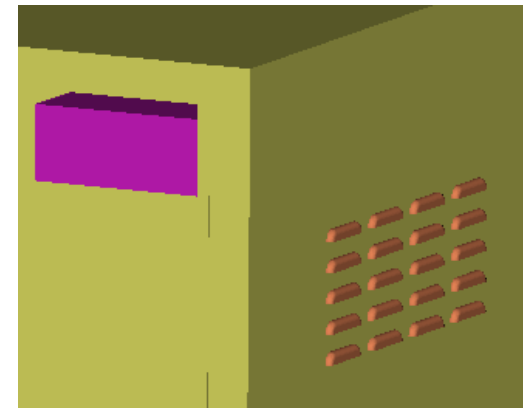
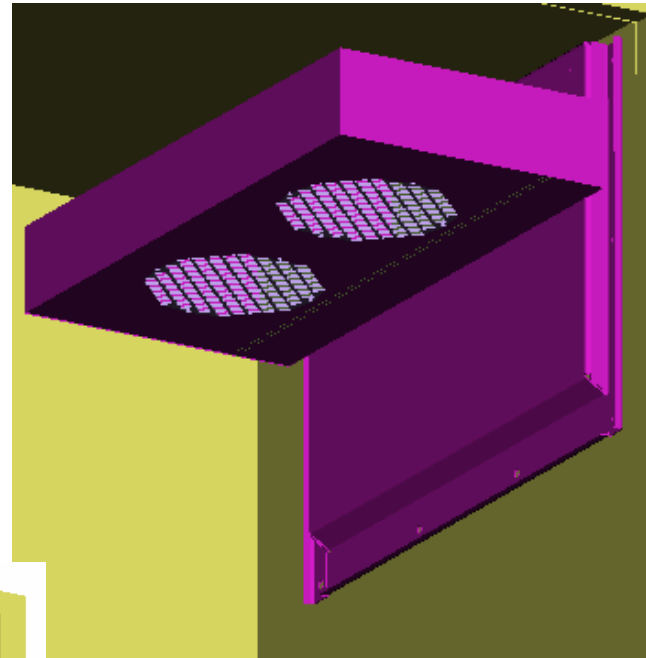
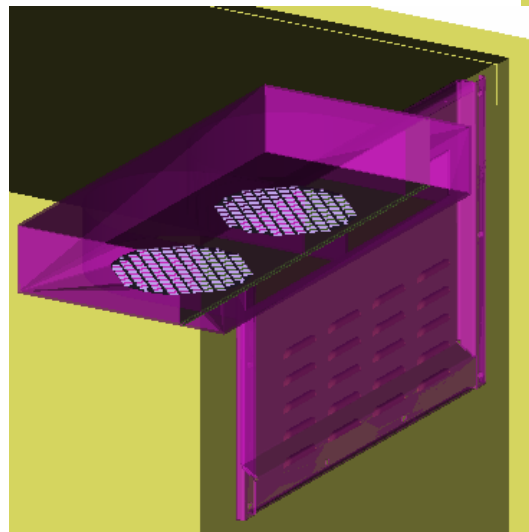
- The left panel has holes and covered with an internal panel. Individual hole size: 4 x 65mm. 20 holes
- The internal panel has holes in the location higher than left panel holes. Individual hole size: 5 x 56 mm, 24 holes.

Rear iso-view



# Centrifugal fan details

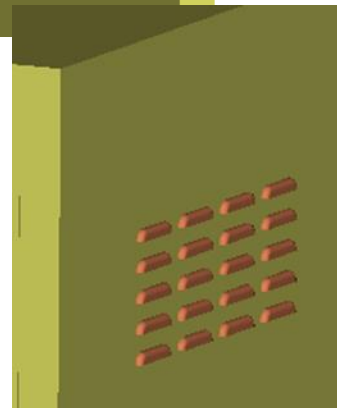
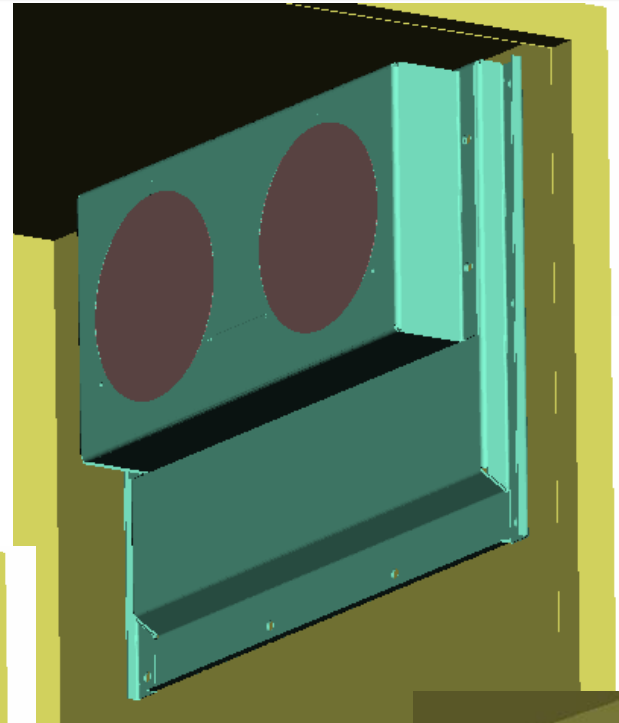
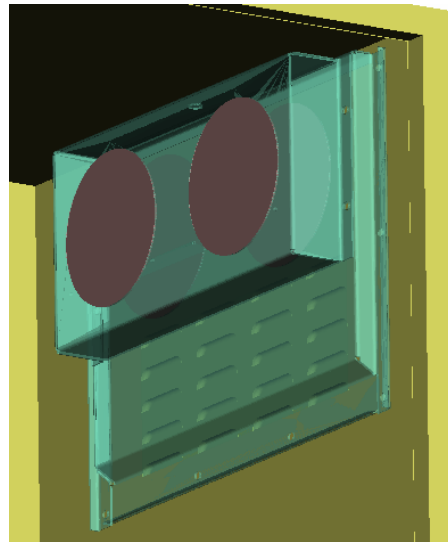
- Centrifugal fan inlets on lower part of internal panel.
- The right panel has outlet holes. Individual hole size: 4 x 65mm, 20 holes.





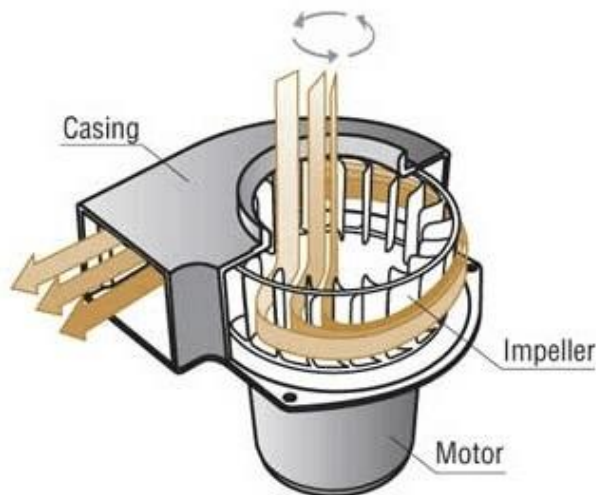
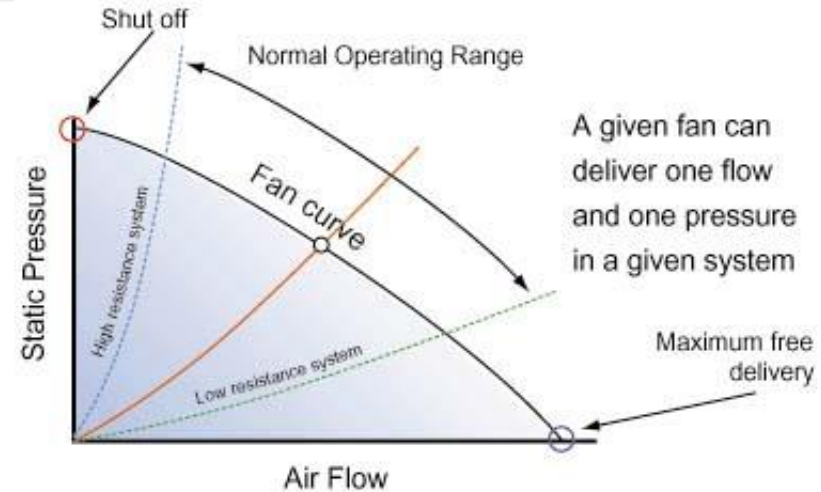
# Axial fan details

- Axial fan inlets on side part of internal panel.
- The right panel has outlet holes. Individual hole size: 4 x 65mm, 20 holes.

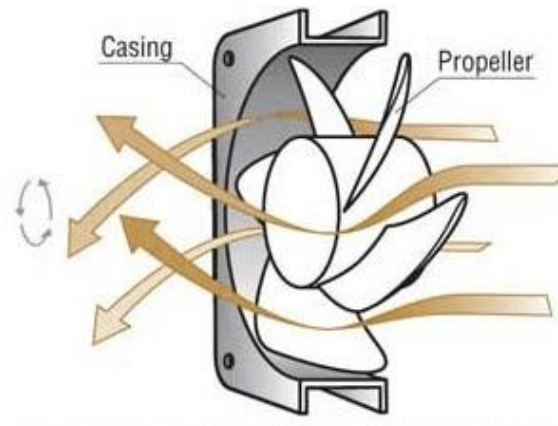


# General Information on Fans

- Double fans cooler on the top of the upper cabinet
- Centrifugal blowers
- The lower the system resistance, the higher the air flow



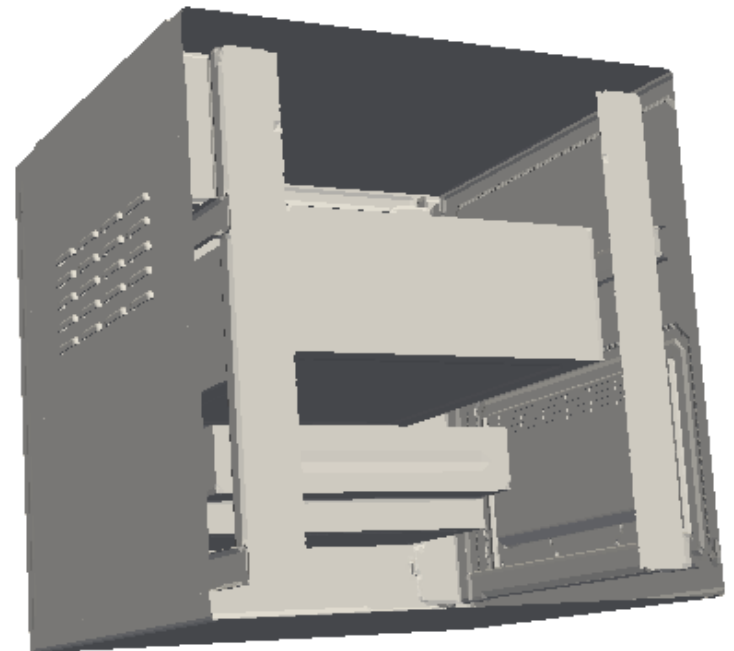
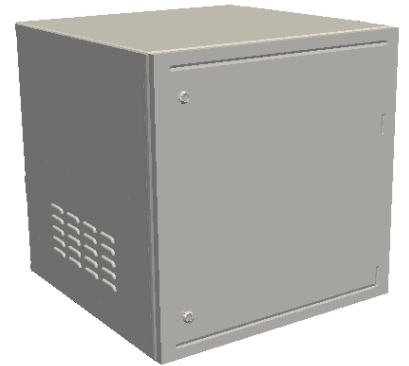
Centrifugal Blower



Axial Blower

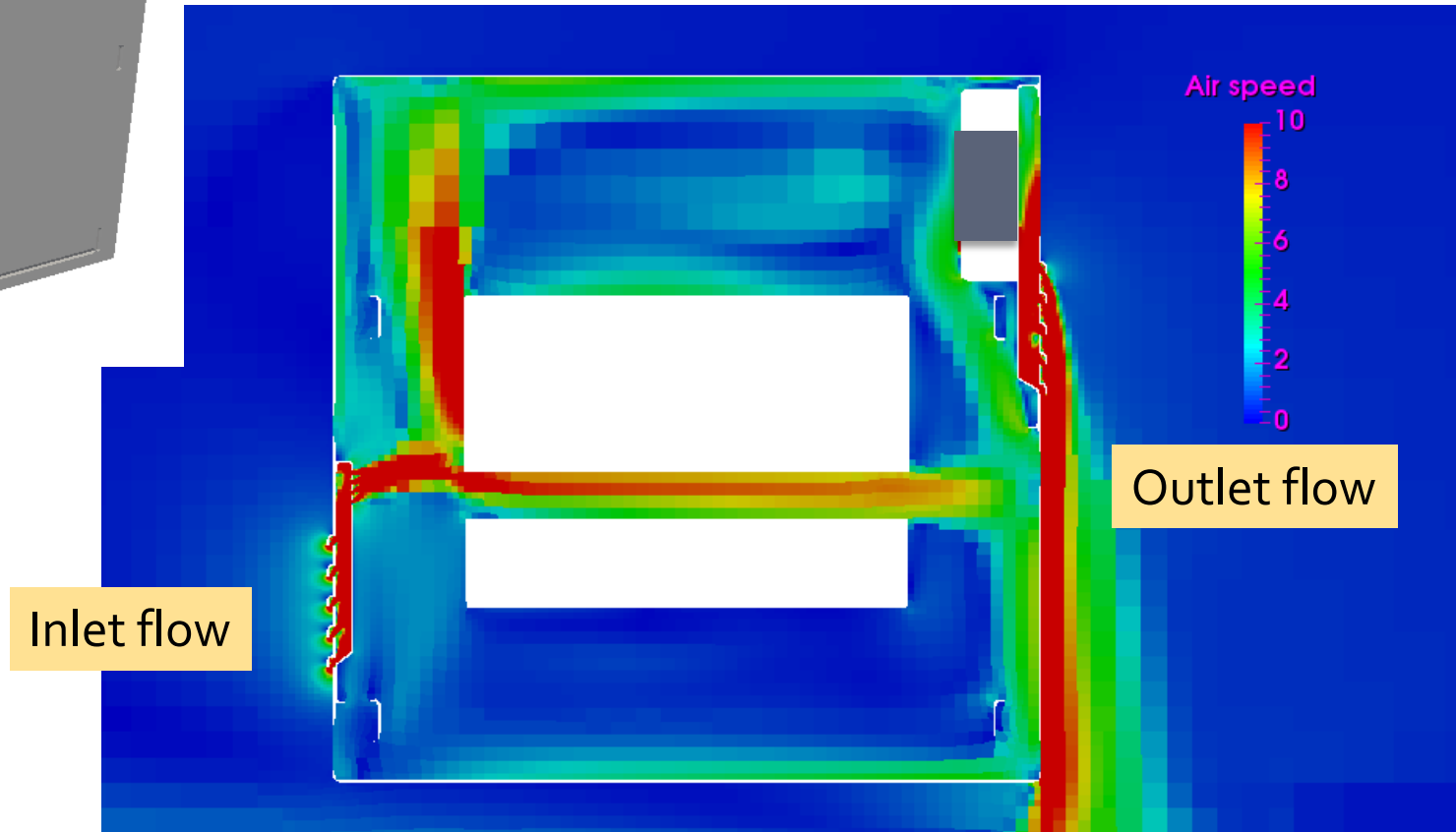
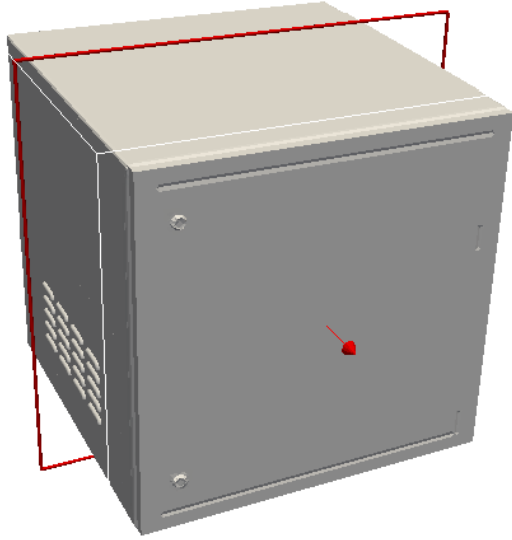
# CFD Modeling

- Door is closed.
- With 3 boxes of electronic components .
- With detailed frames.
- Assumption:  
Centrifugal and axial fans provide  $\sim 5$  m/s air speed.



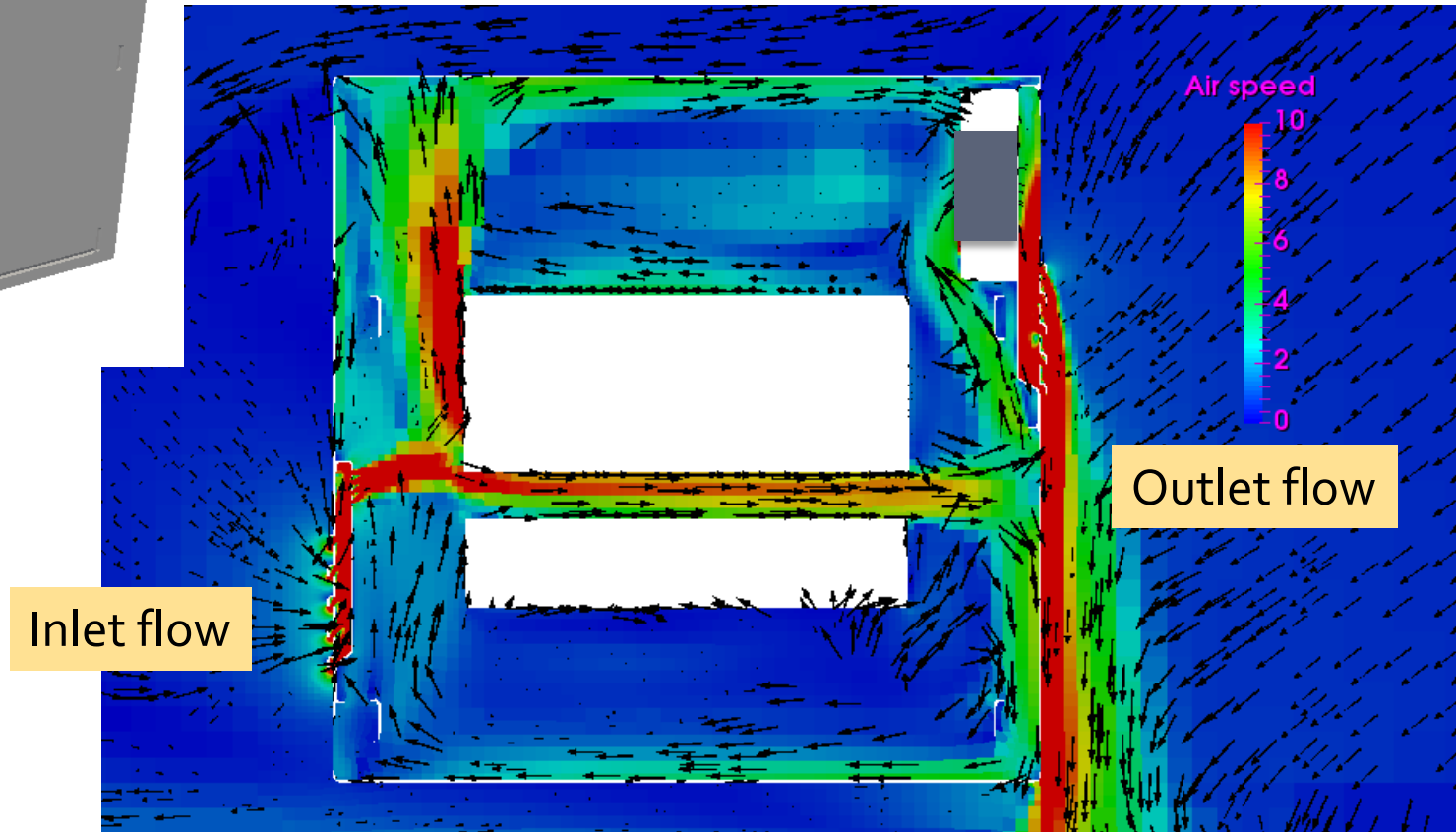
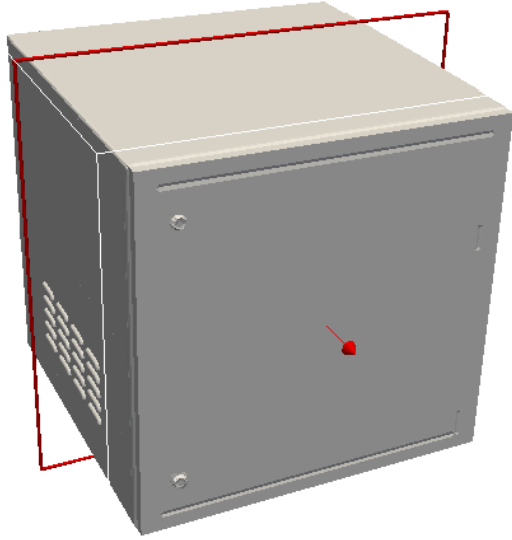
# CFD Result – Axial Fan

## *Air speed distribution on center plane*



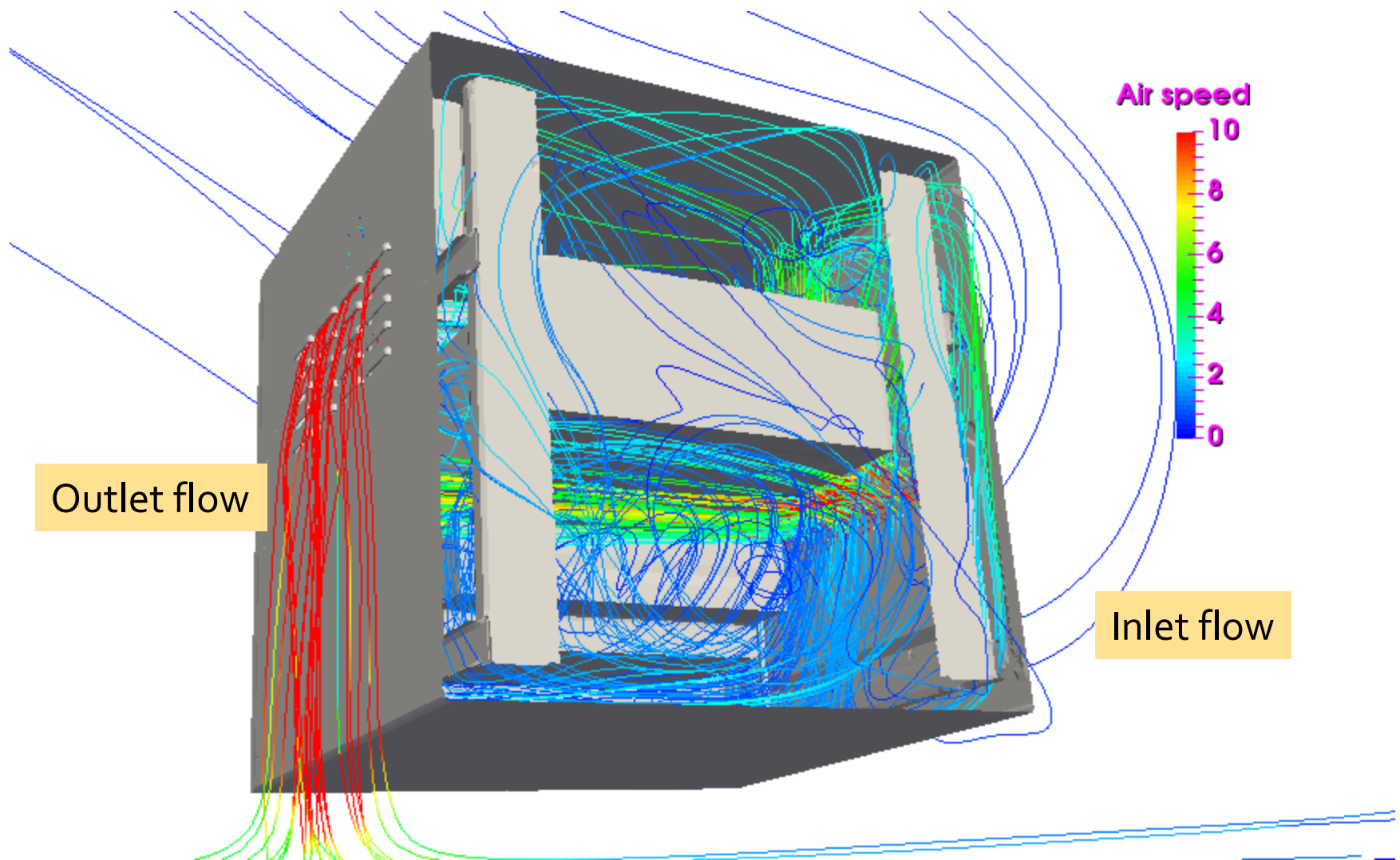
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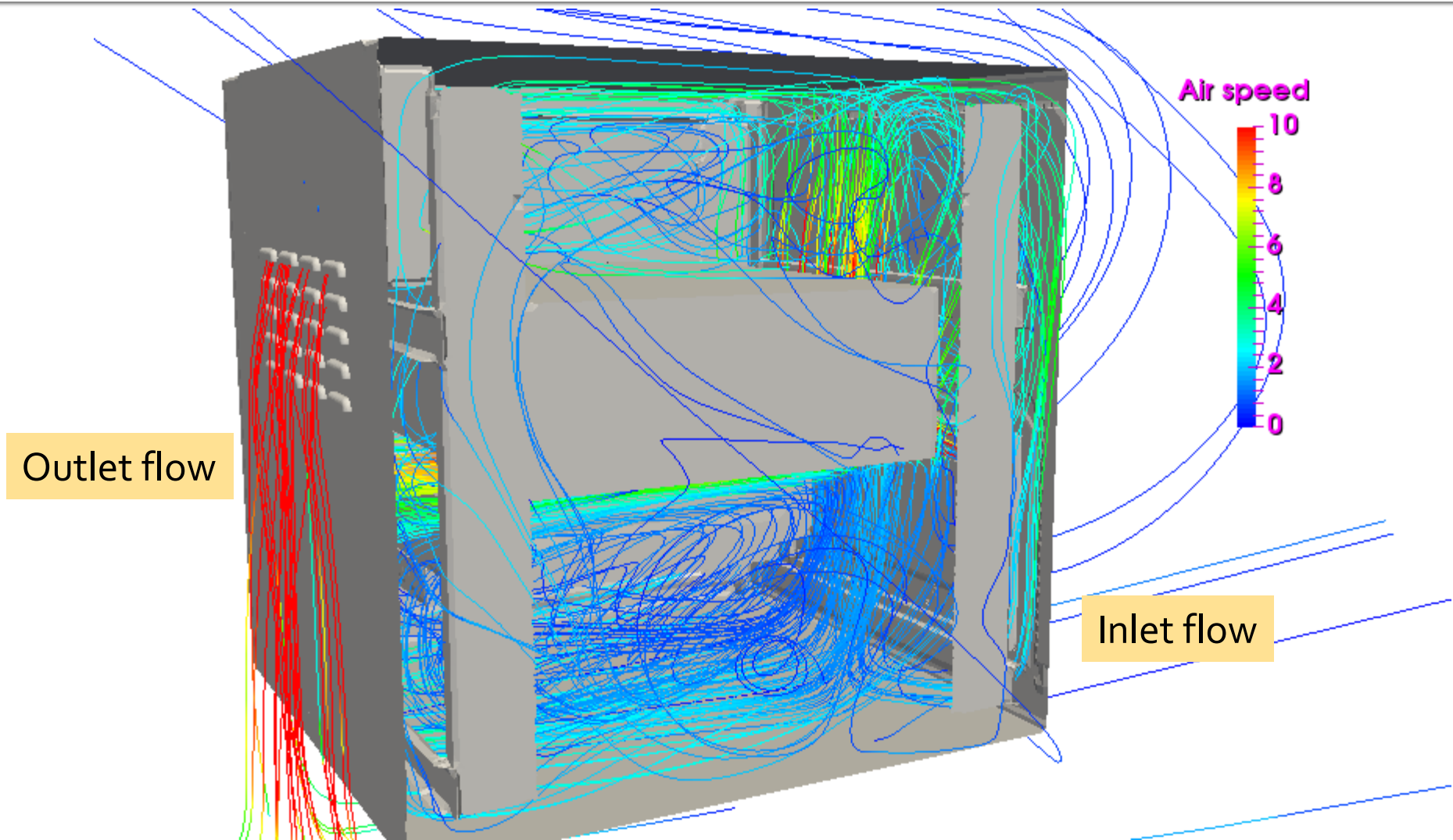
# CFD Result – Axial Fan

## *Air circulation inside cabinet*



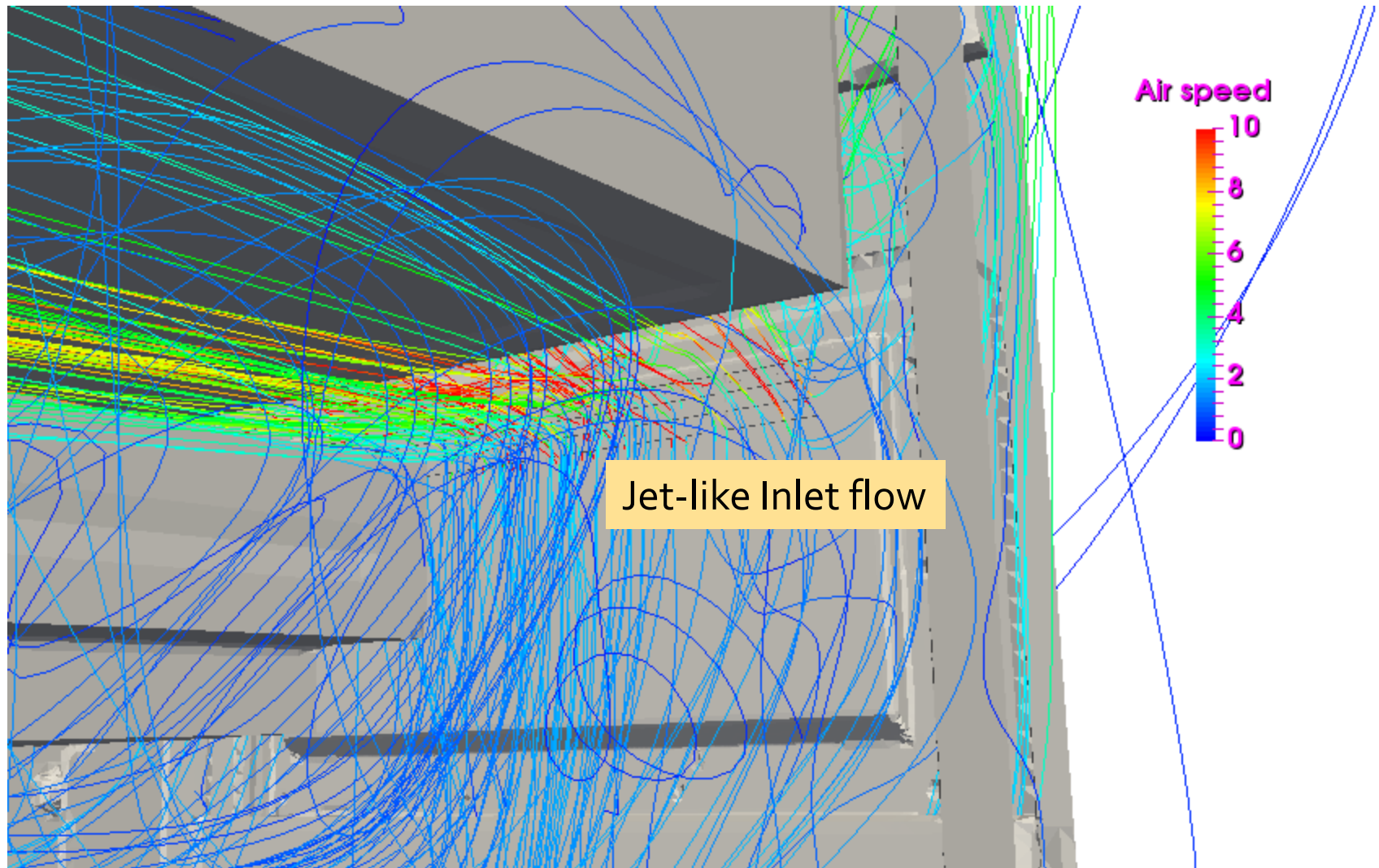
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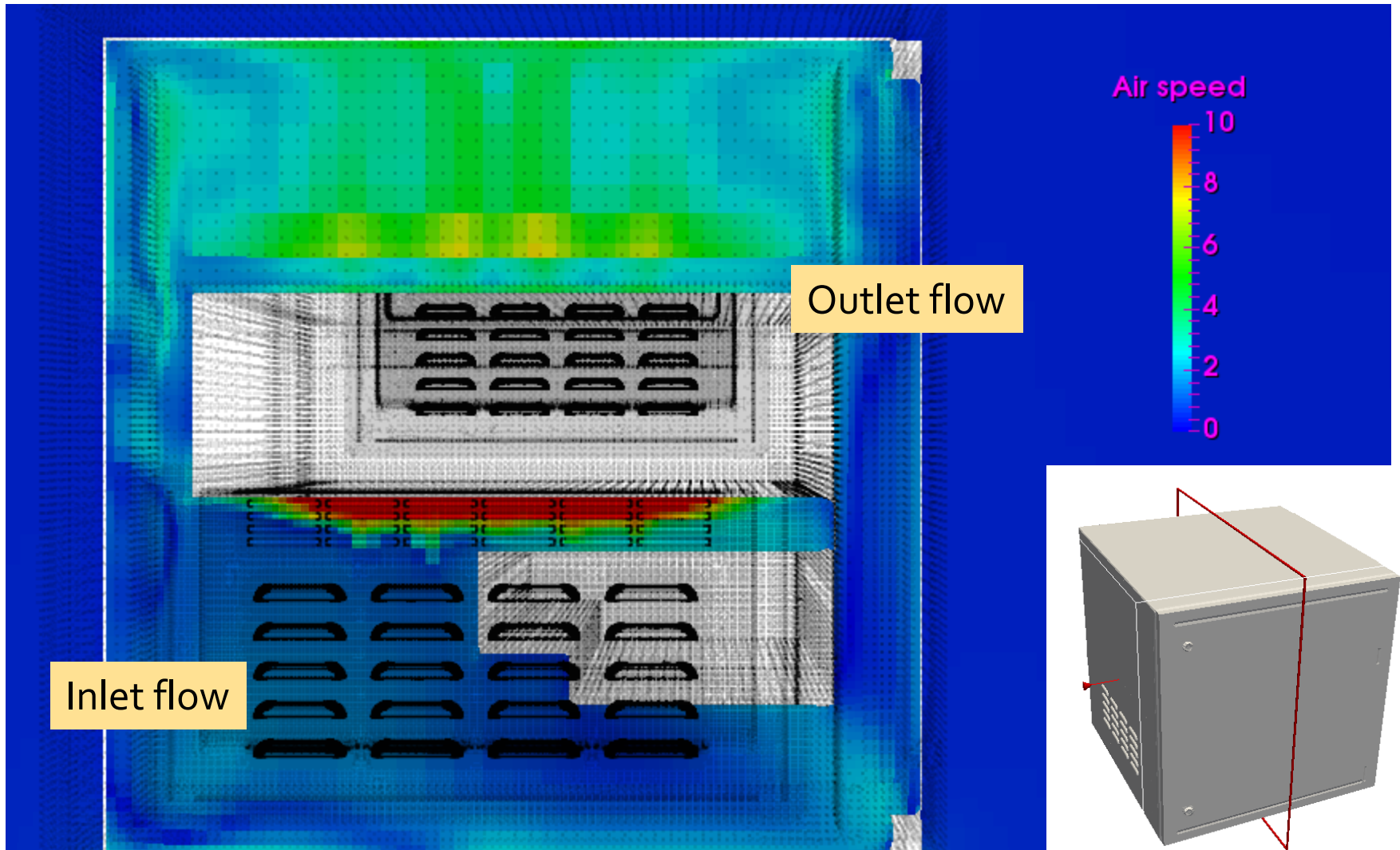
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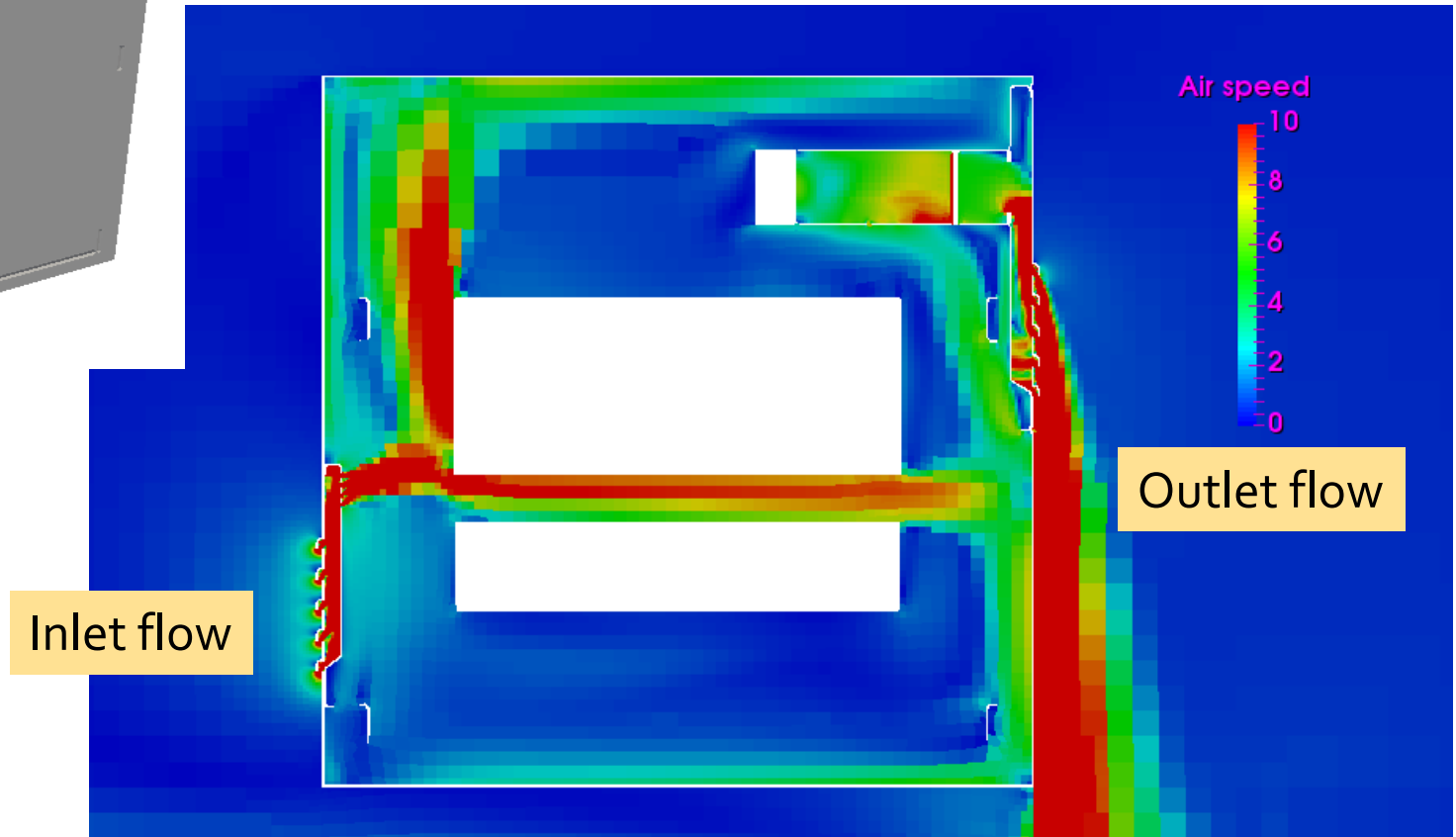
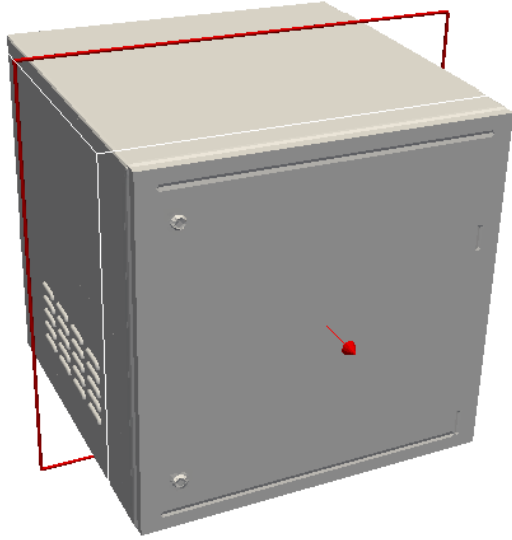
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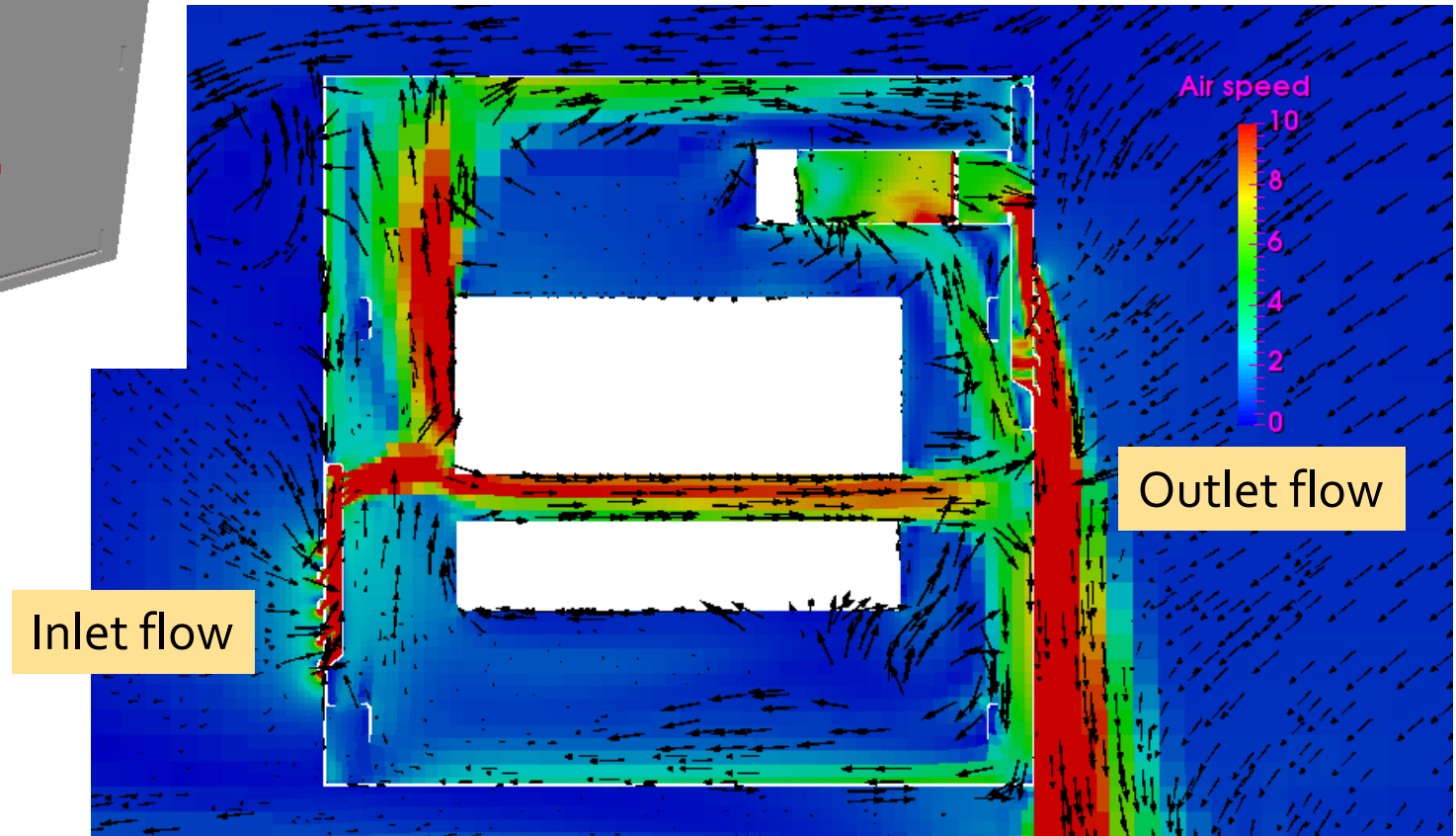
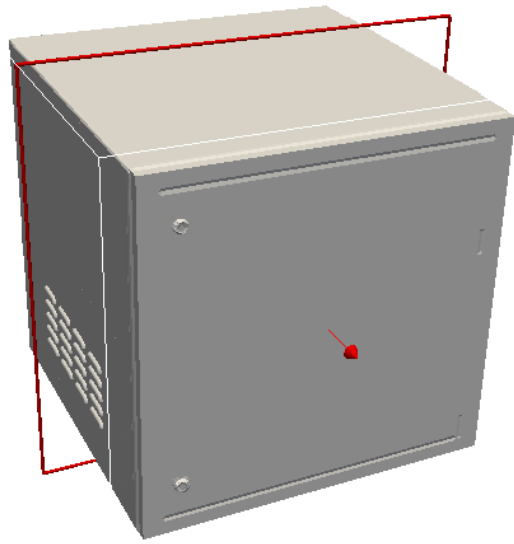
# CFD Result – Centrifugal Fan

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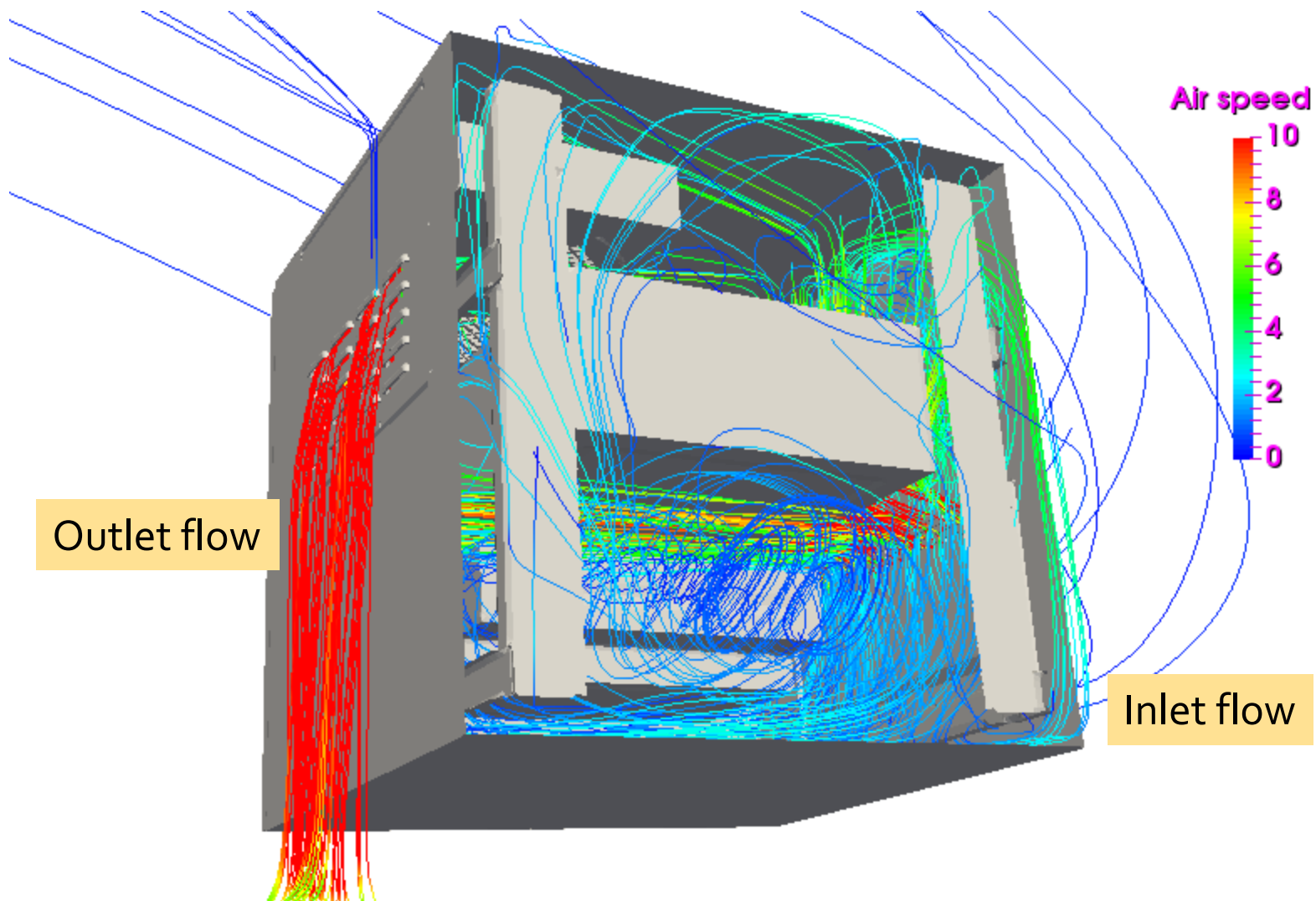
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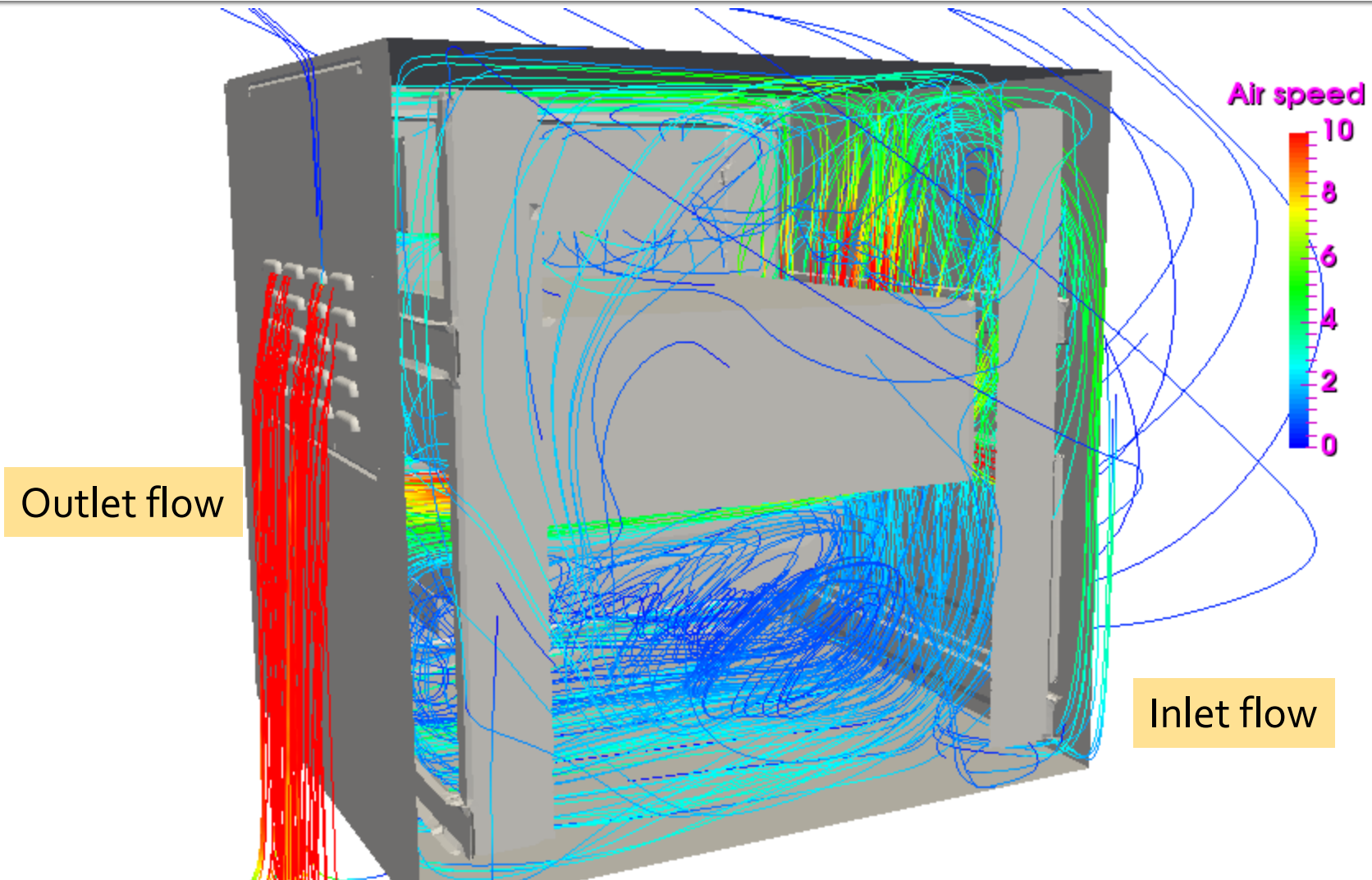
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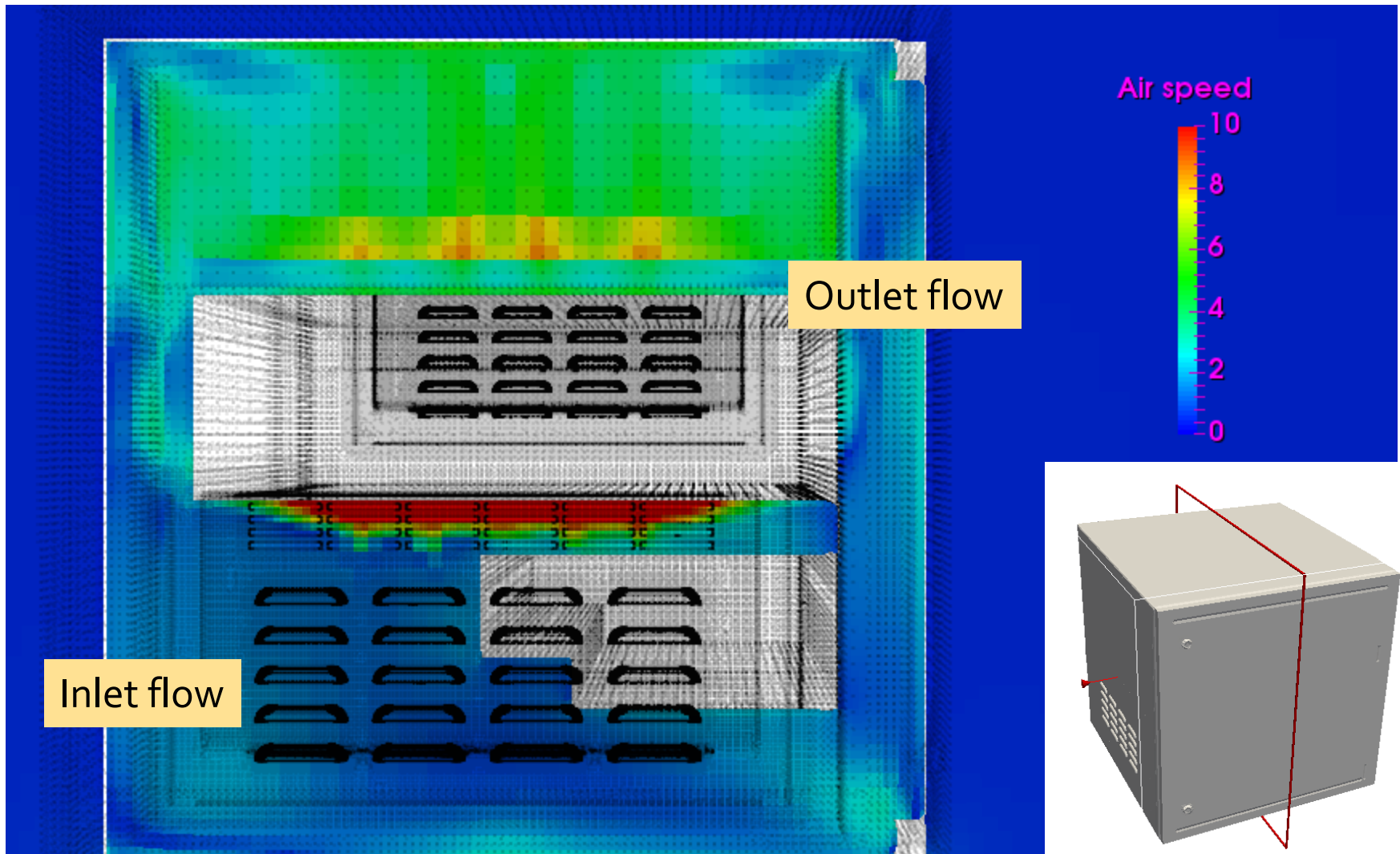
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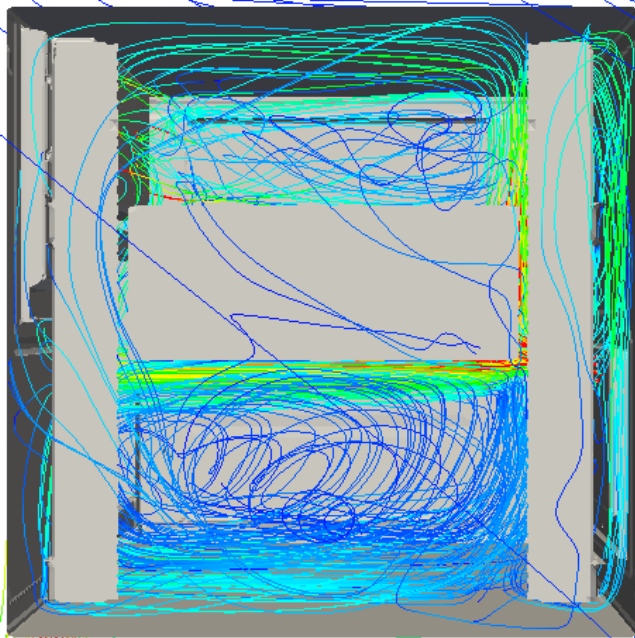
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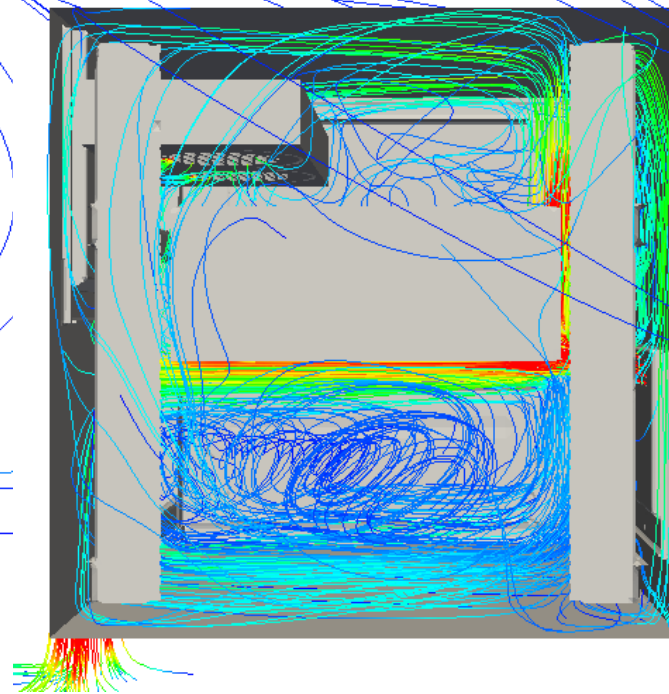


# CFD Results - Comparison Centrifugal vs. Axial Fans

Axial fan  
More simple air flow  
path on upper part



Centrifugal fan



# Conclusions and Recommendations

- Axial fan works better or similar to the centrifugal fan.
- Centrifugal fan system needs larger space than the axial fan system.
- Strong jet like flow coming from inlet holes from internal panel. More well distributed holes in the internal panel will be better.
- Bottle necks of flow are at inlet holes and outlet holes. More holes are recommended.



## Assignment Letter / *Surat Tugas*

No. AL/ARCS/1858/VIII/2019  
Date August 1<sup>st</sup>, 2019  
Page 1 of 1  
Doc. Type Main Document / *Dokumen Utama*

**Dena Hendriana, BSc., S.M., Sc.D,**

### Activity Assignment

### Penugasan Kegiatan

Director of Academic Research and Community Services

*Direktur Lembaga Penelitian Akademik dan Pengabdian kepada Masyarakat*

#### In consideration of:

His appointment as Director of Academic Research and Community Services of Swiss German University under Decree nr. SK/020/HR/XI/19, dated November 18<sup>th</sup>, 2019

#### Mengingat:

*Pengangkatannya sebagai Direktur Lembaga Penelitian Akademik dan Pengabdian kepada Masyarakat dengan SK pengangkatan no. SK/020/HR/XI/19, tertanggal 18 November 2019*

#### Herewith gives the task to:

Name : **Dena Hendriana, BSc., S.M., Sc.D,**  
Position : **Head of Master of Mechanical Engineering Study Program**  
Employee ID : **11211528**

#### Dengan ini menugaskan kepada:

Name : **Dena Hendriana, BSc., S.M., Sc.D,**  
Position : **Kepala Program Studi Master Teknik Mesin**  
NIK : **11211528**

To follow the activity below:

*Untuk berpartisipasi pada kegiatan berikut ini:*

Nr.	Activity/ <i>Kegiatan</i>	Organizer/ <i>Penyelenggara</i>	Day & Date/ <i>Hari &amp; Tanggal</i>	Venue/ <i>Tempat</i>
1.	Penelitian simulasi sirkulasi udara dalam kabinet BTS bekerja sama dengan PT. GSPE	Swiss German University	Agustus 2019 – Februari 2020	Swiss German University The Prominence Office Tower

The appointed shall accomplish the task in responsible ways in line with the related guidelines and other regulations given by SGU.

*Pihak yang bersangkutan harus melaksanakan tugas dan tanggung jawab sebaik-baiknya, sesuai dengan petunjuk dan peraturan dari SGU.*

#### Assignor / *Pemberi Tugas:*



#### Dr.-Ing Evita H Legowo

Director of Academic Research and Community Services  
*Direktur Lembaga Penelitian dan Pengabdian kepada Masyarakat*



**SWISS GERMAN UNIVERSITY**

**LAPORAN**

**PENELITIAN SIMULASI SIRKULASI UDARA DALAM  
KABINET UNTUK PERANGKAT BTS  
BEKERJA SAMA DENGAN PT. GSPE**

Dena Hendriana, B.Sc., S.M., Sc.D – Team Leader  
Agus Supriyatna (PT. GSPE) – Team Member

**MASTER OF MECHANICAL ENGINEERING**

**2020**

**Swiss German University**  
The Prominence Tower Alam Sutera  
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[www.sgu.ac.id](http://www.sgu.ac.id)

Judul Penelitian : Penelitian Simulasi Sirkulasi Udara dalam Kabinet untuk Perangkat BTS Bekerja Sama dengan PT. GSPE

Nama Team Leader : Dena Hendriana, B.Sc., S.M., Sc.D

Research Center/Dept. : Master of Mechanical Engineering

E-mail : dena.hendriana@sgu.ac.id

Mobile phone : 081213715844

Masa program : Agustus 2019 – Februari 2020 (6 bulan)

Keterangan Aktifitas : PT. GSPE sedang mengembangkan produk kabinet untuk penempatan perangkat elektronik BTS seperti pemancar, rektifier, baterai, dll. Dikarenakan perangkat elektronik ini menghasilkan panas yang perlu untuk didinginkan oleh udara, maka perlu adanya optimasi sirkulasi udara dalam kabinet. Telah dilakukan simulasi dengan menggunakan software CFD OpenFOAM yang merupakan software OpenSource. Simulasi dilakukan untuk mengoptimalkan sirkulasi udara dalam kabinet dengan cara pengaturan posisi fan dan bukaan ventilasi di dinding kabinet. Kegiatan ini merupakan kegiatan pengabdian masyarakat dari Swiss German University yang memanfaatkan keilmuan akademik dari Komputasi Fluida untuk kebutuhan masyarakat yang disini adalah dari pihak Industri yaitu PT. GSPE. Hasil dari penelitian ini tidak dipublikasikan dikarenakan kerahasiaan dari produk PT. GSPE.

Alam Sutera, Tangerang

Date: Februari 2020



Dena Hendriana, B.Sc., S.M., Sc.D

NIK: 11211528

**To: Bapak Yanto Liem  
Bapak Agus  
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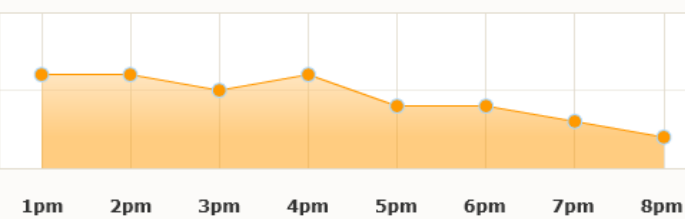
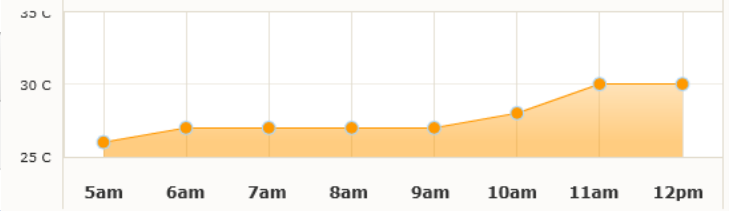
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