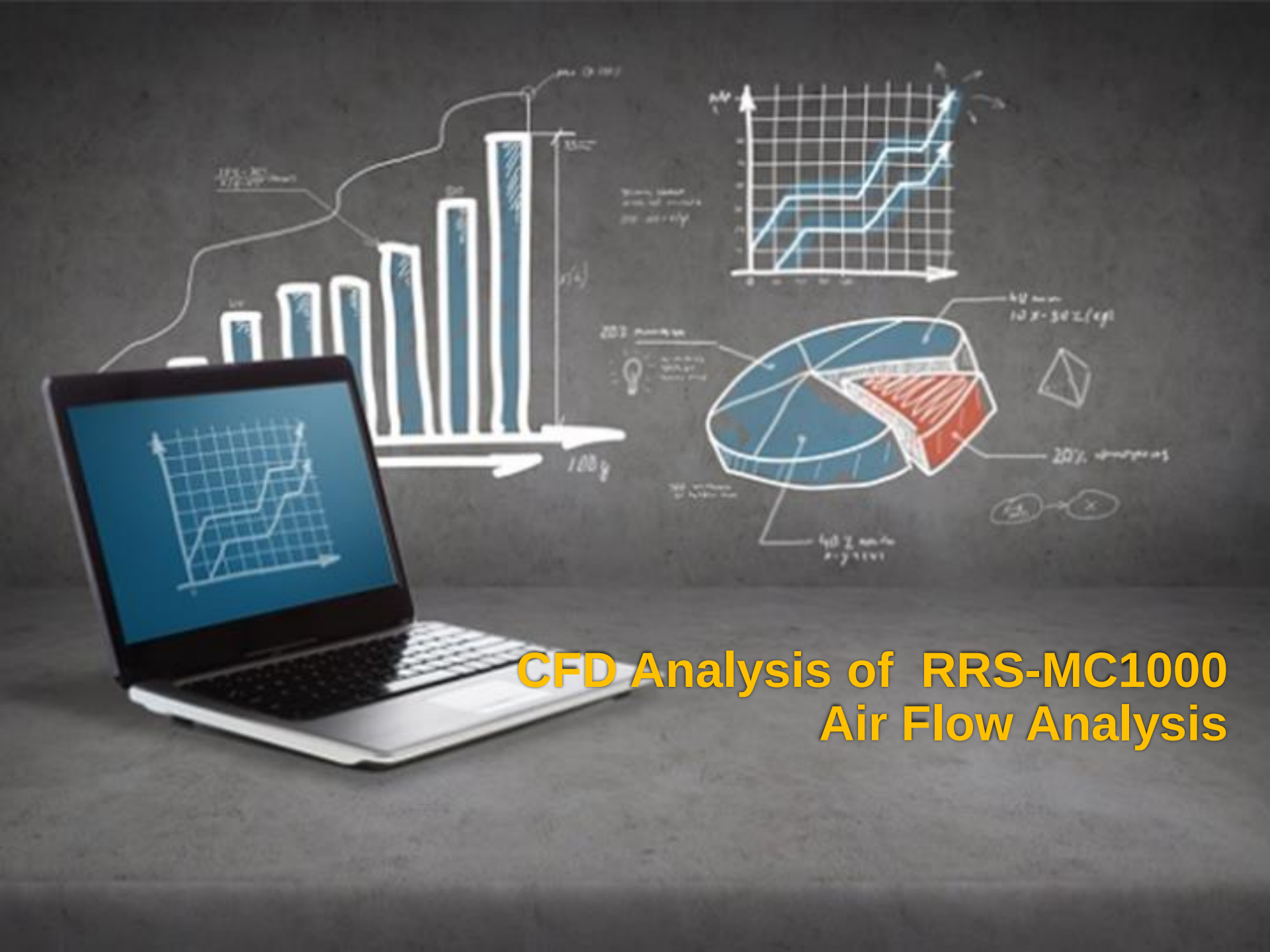


CFD Analysis of RRS-MC1000
Air Flow Analysis

Objective and Scope - CFD

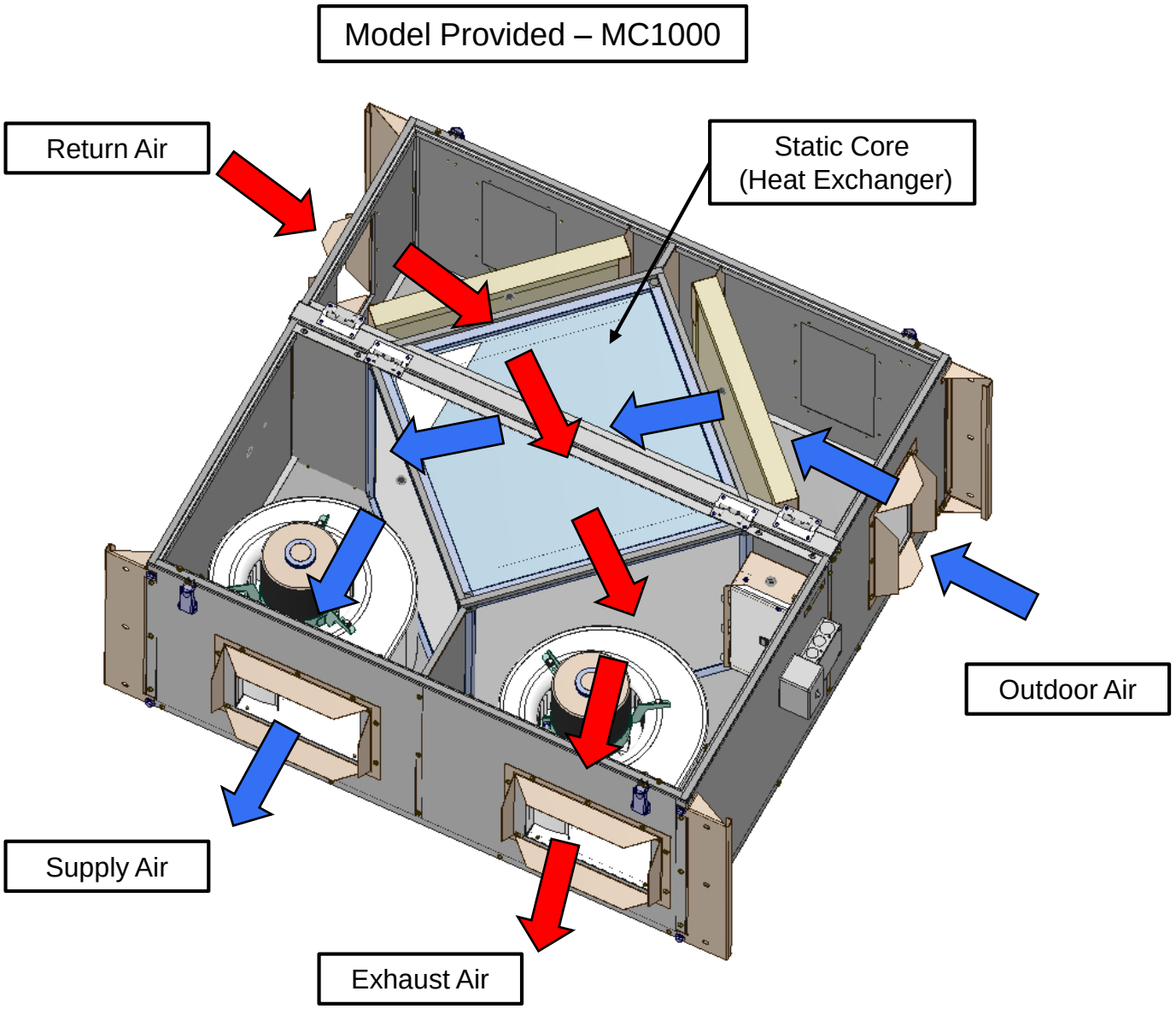
Objective:

- Run the CFD analysis to check the Airflow performance and identify turbulence region if any inside MC1000 unit.

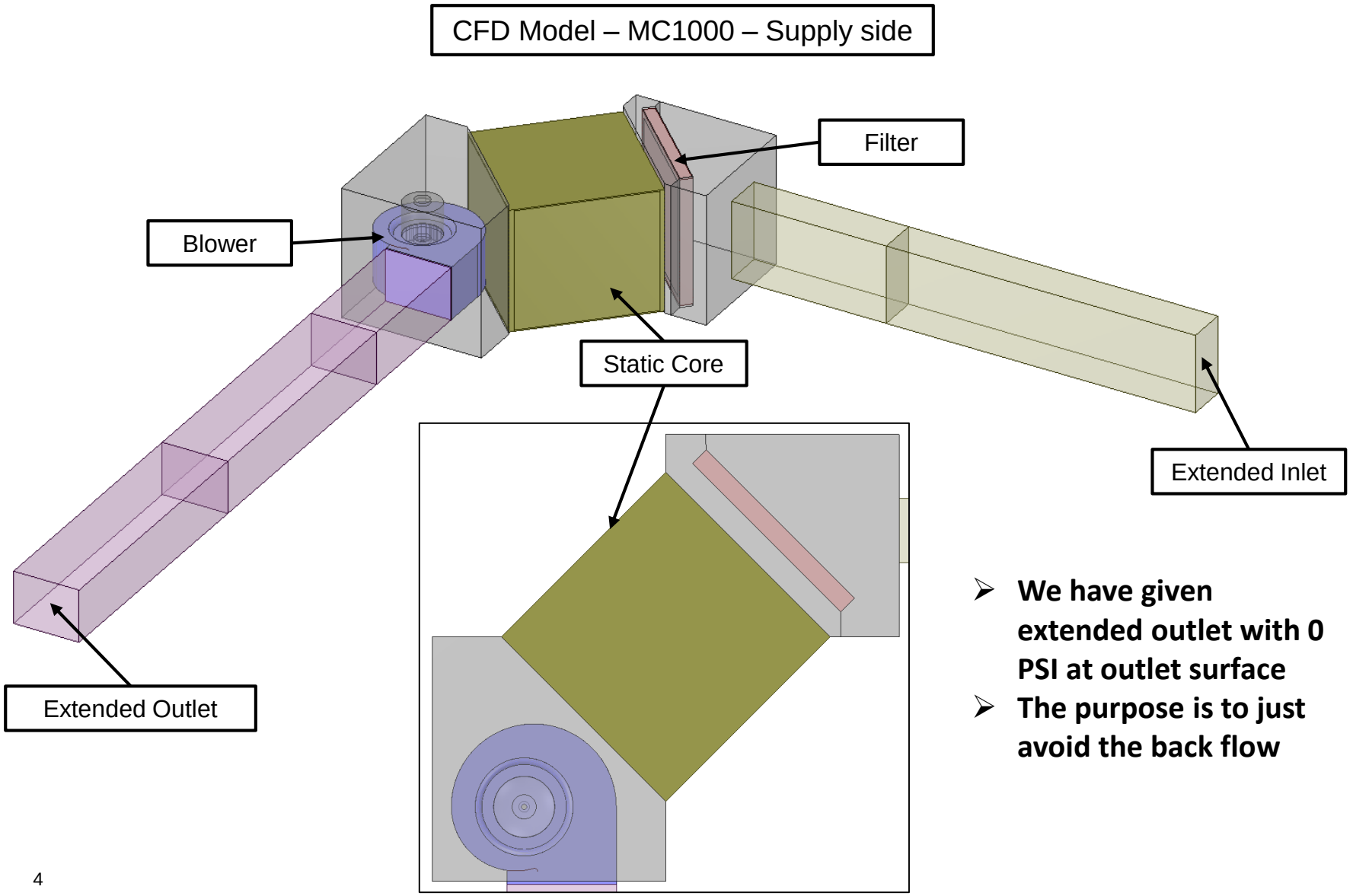
Scope:

- To predict the Air Flow pattern inside the MC1000 unit

CAD Model – MC1000

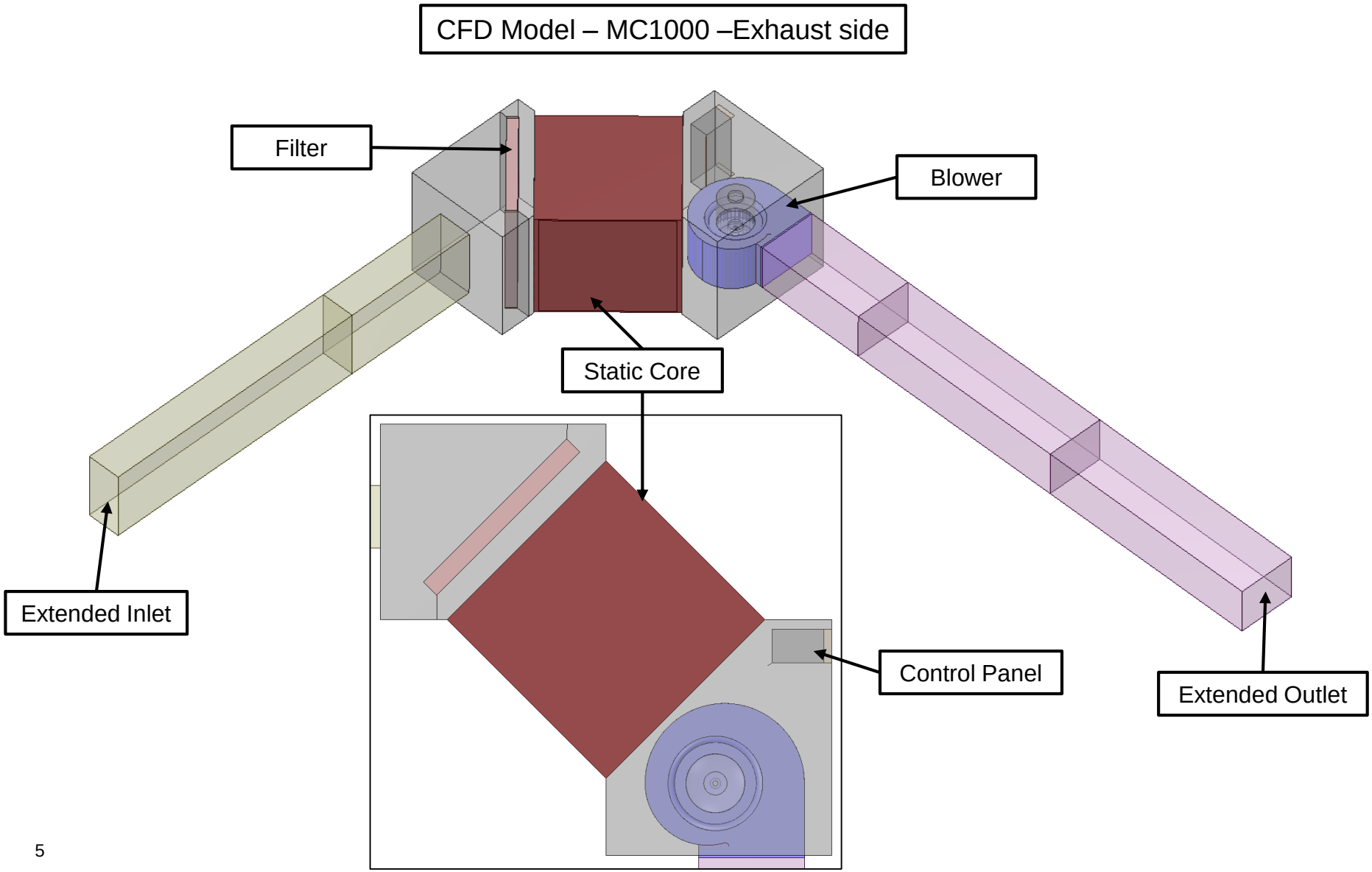


CFD Model – MC1000 – Supply side



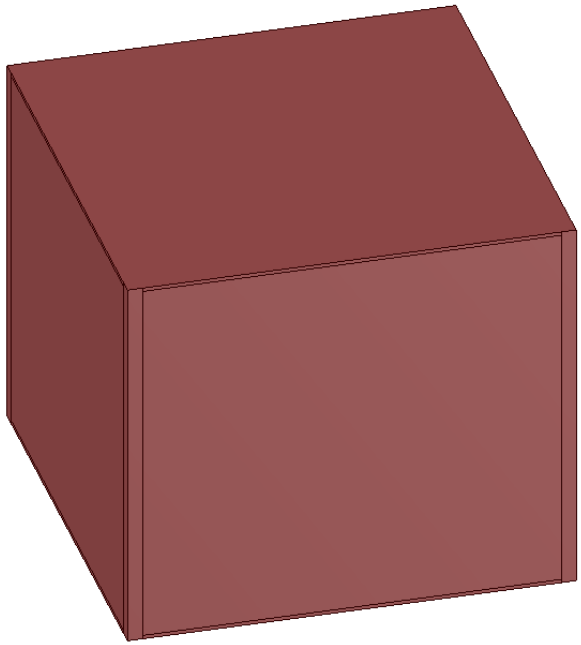
- **We have given extended outlet with 0 PSI at outlet surface**
- **The purpose is to just avoid the back flow**

CFD Model – MC1000 – Return side



Modeling Details – Static Core

CFD Model – MC1000 – Supply side

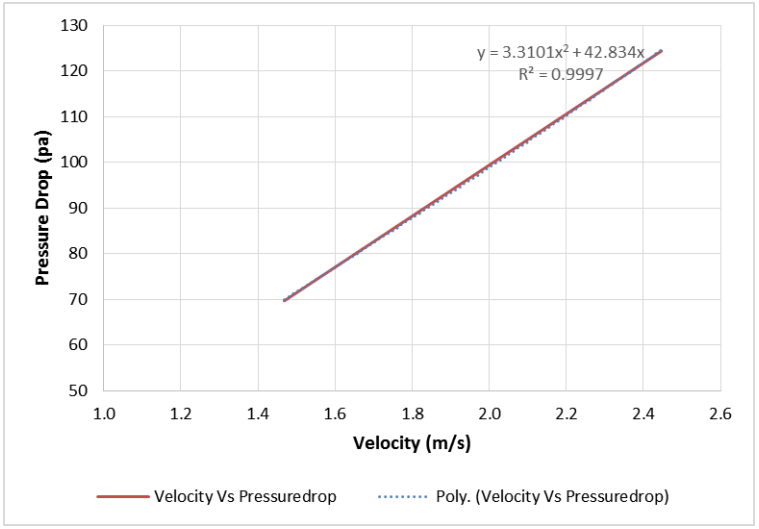


Airflow Direction

Static Core
(21.65” X 18.85” X 21.65”)

Static core modelled as block (porous media) in CFD

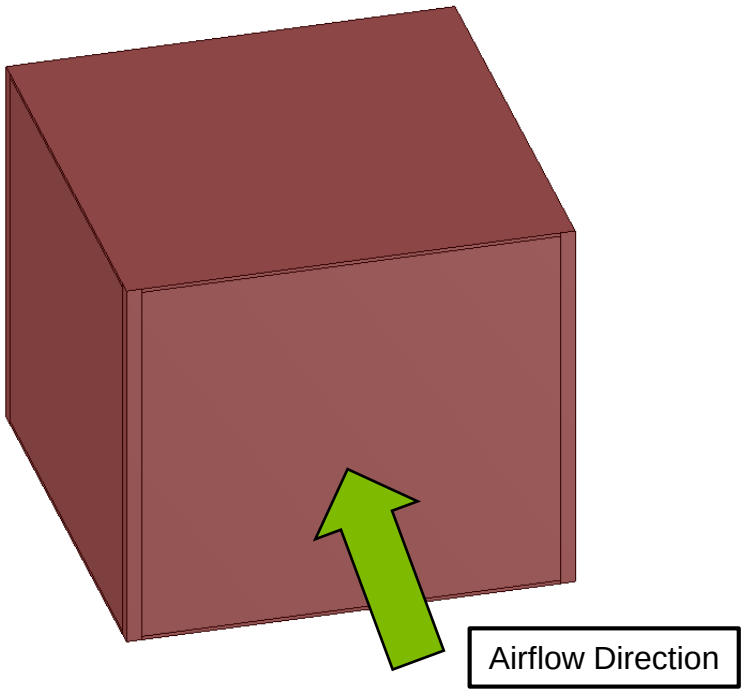
Static Pressure Drop Static core – MC1000	
Volume Flowrate (CFM)	**Pressure Drop (In Wg)**
750	0.28
1000	0.39
1250	0.5



Y – Pressure Drop (pa) X – Velocity (m/s)

Modeling Details – Static Core

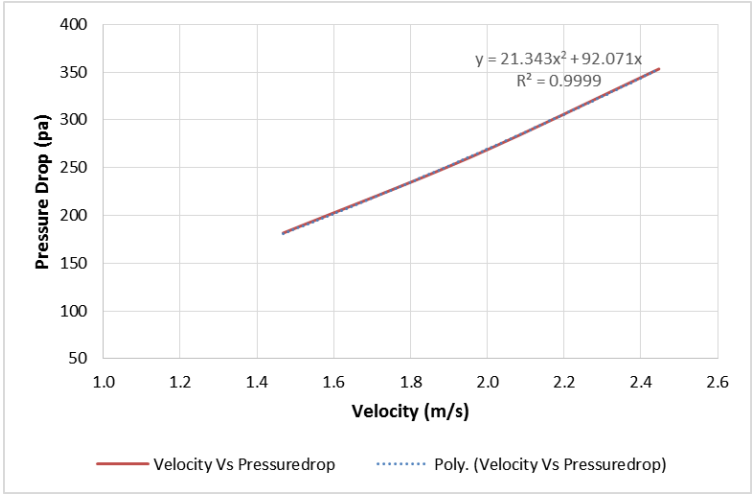
CFD Model – MC1000 – Exhaust side



Static Core
(21.65” X 18.85” X 21.65”)

Static core modelled as block (porous media) in CFD

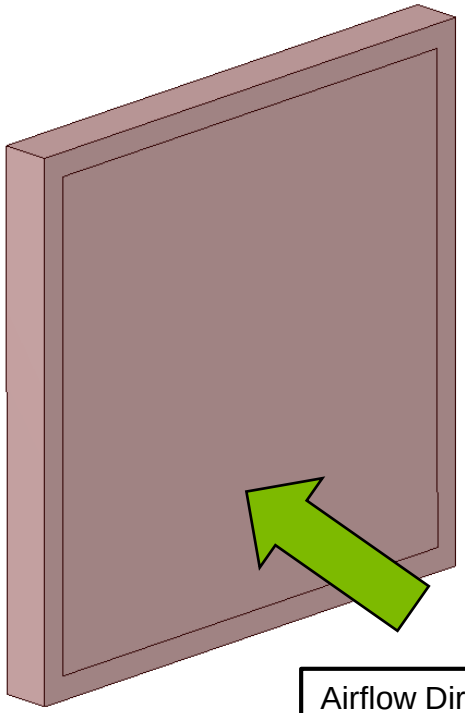
Static Pressure Drop Static core – MC1000	
Volume Flowrate (CFM)	**Pressure Drop (In Wg)**
750	0.73
1000	1.05
1250	1.42



Y – Pressure Drop (pa) X – Velocity (m/s)

Modeling Details – Filter

CFD Model – MC1000 – Filter

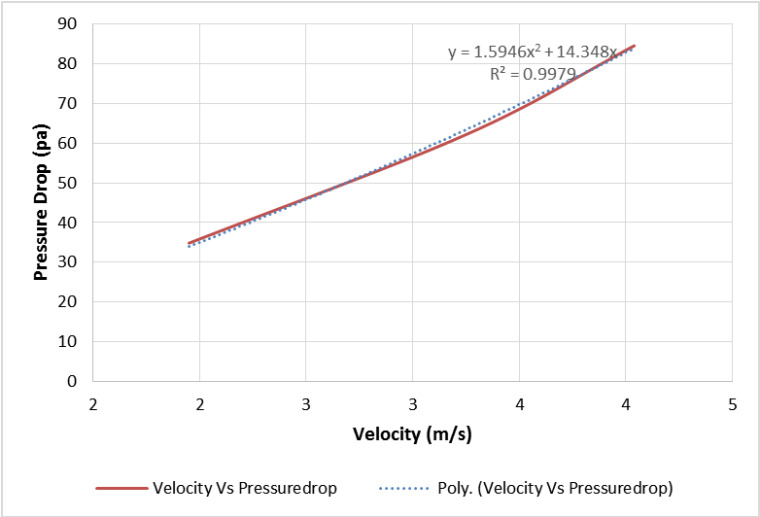


Airflow Direction

Filter
(19.5” X 19.5” X 1.785”)

Filter modelled as block (porous media) in CFD

Static Pressure Drop Filter – MC1000	
Volume Flowrate (CFM)	**Pressure Drop (In Wg)**
840	0.14
1400	0.25
1740	0.34



Y – Pressure Drop (pa) X – Velocity (m/s)

Boundary Conditions

Boundary Conditions – MC1000

Boundary Conditions (Supply & Exhaust)	
Extended Inlets	Pressure Inlet (0 PSI)
Extended Outlets	Pressure Outlet (0 PSI)
Fan Blades	Moving Reference Frame (1800 RPM)
Filters	Porous Medium
Static Core	Porous Medium

- **Fan blades rotation are modelled by the Moving Reference Frame (MRF) method.**

Results

CFD Results

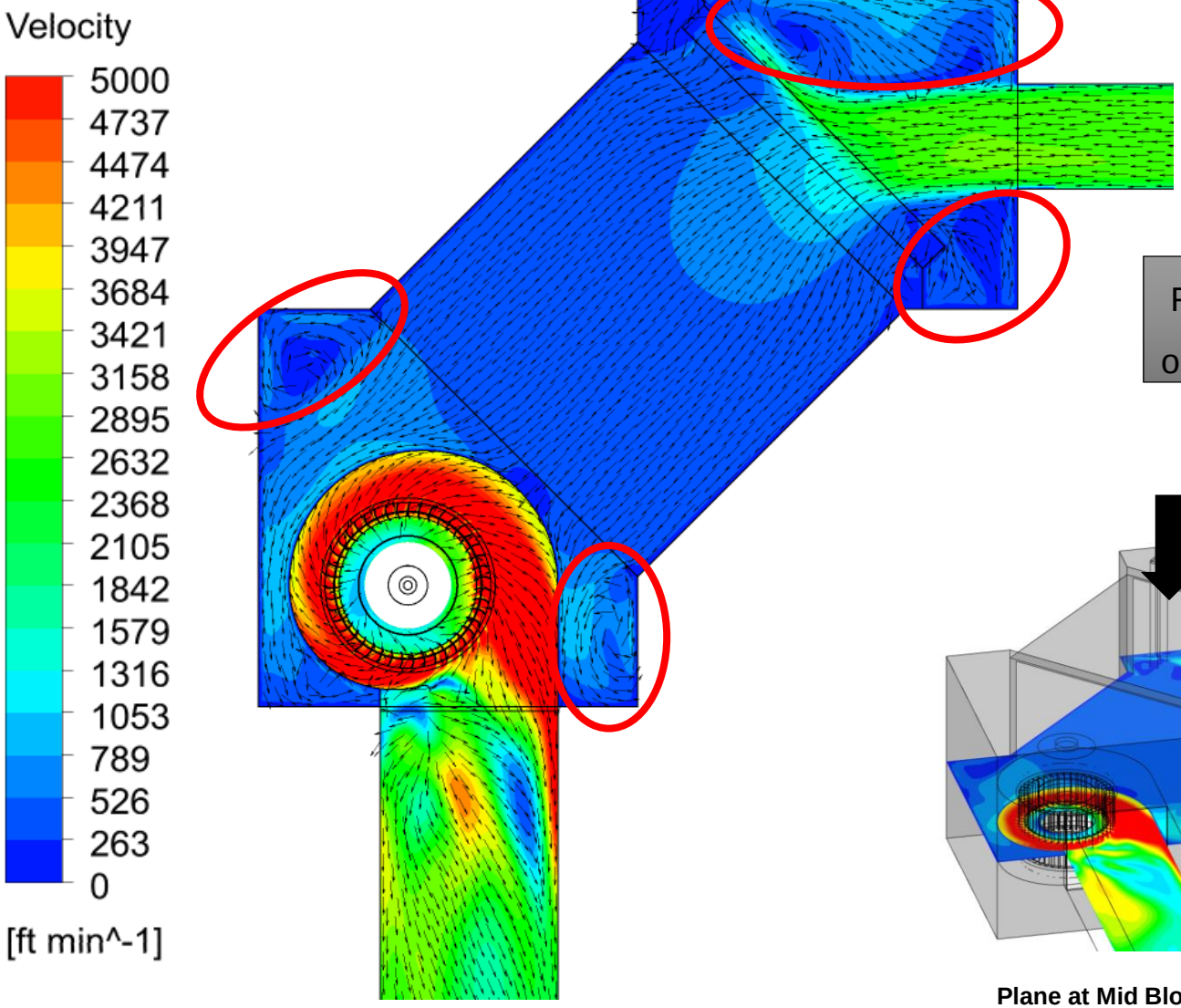
- Pressure drop for MC1000 Filter and Static Core has been recorded in the table below

	Supply Air Unit	Exhaust Air Unit
Flowrate (CFM)	1335	1073

	Supply Air Unit Δ Ps (in.w.g.)	Exhaust Air Unit Δ Ps (in.w.g.)
Filter	0.209	0.128
Static Core	0.420	0.714

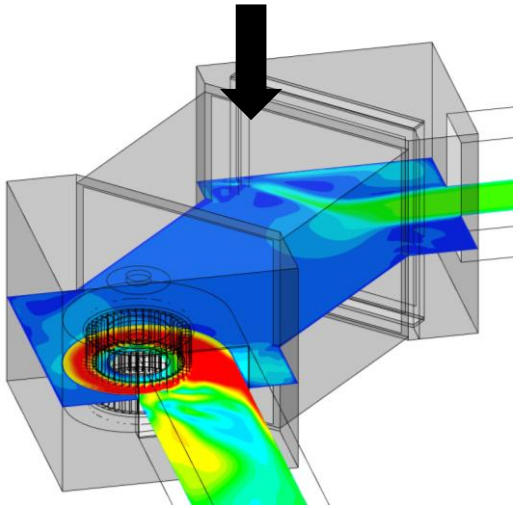
CFD Results – MC1000 Supply Side

Results : Velocity Contour



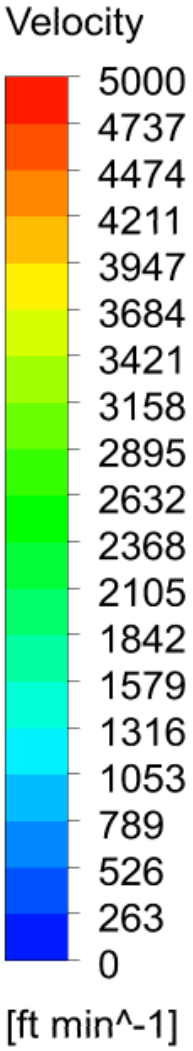
Recirculation of the air has been observed in marked regions

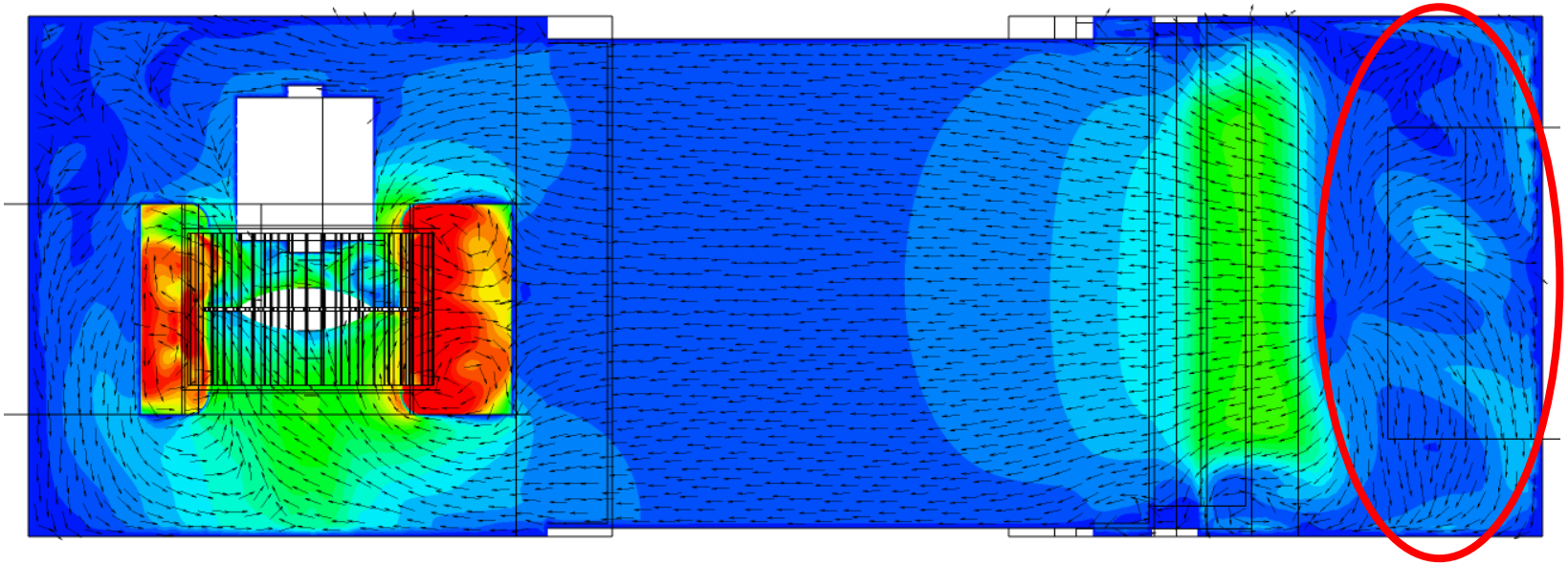
View Direction

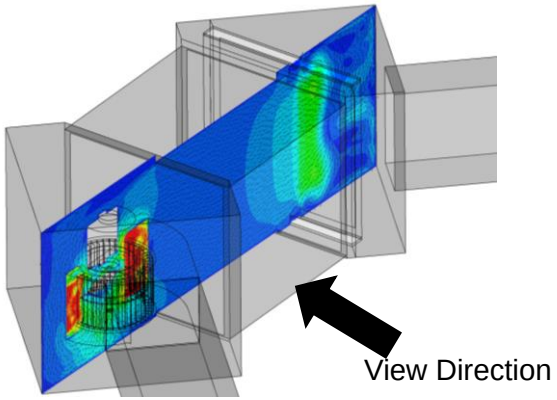


Plane at Mid Blower

Results : Velocity Contour

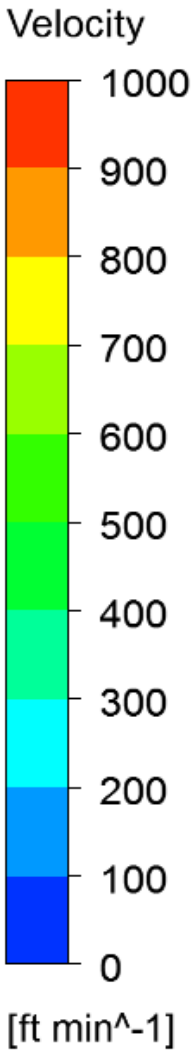


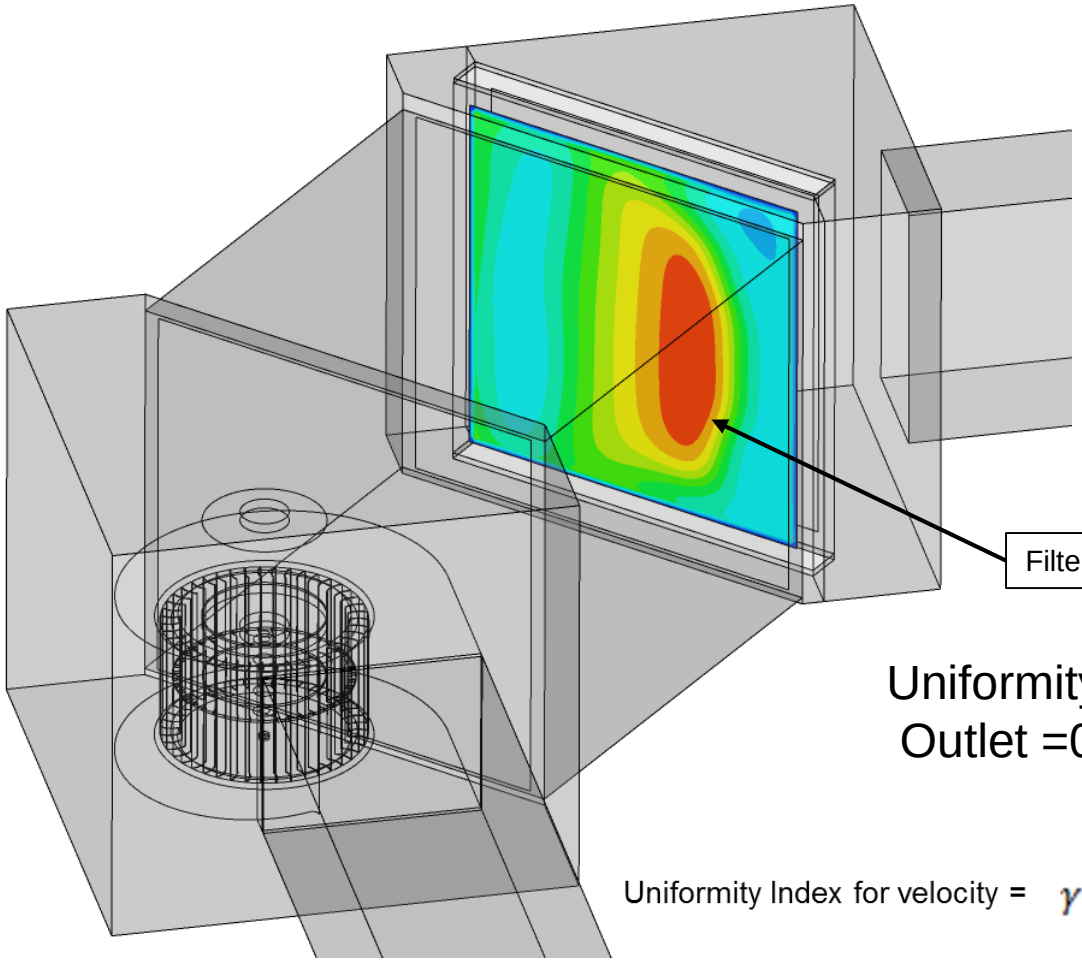




Recirculation of the air has been observed in marked regions

Results : Velocity Contour at Filter Outlet



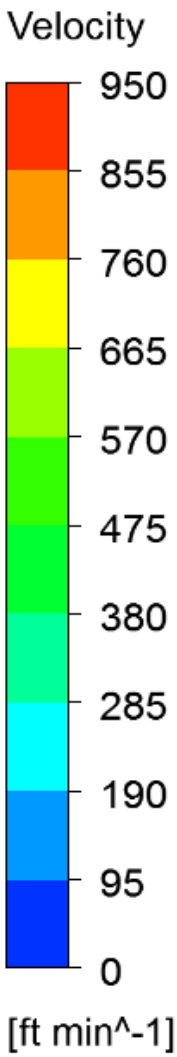


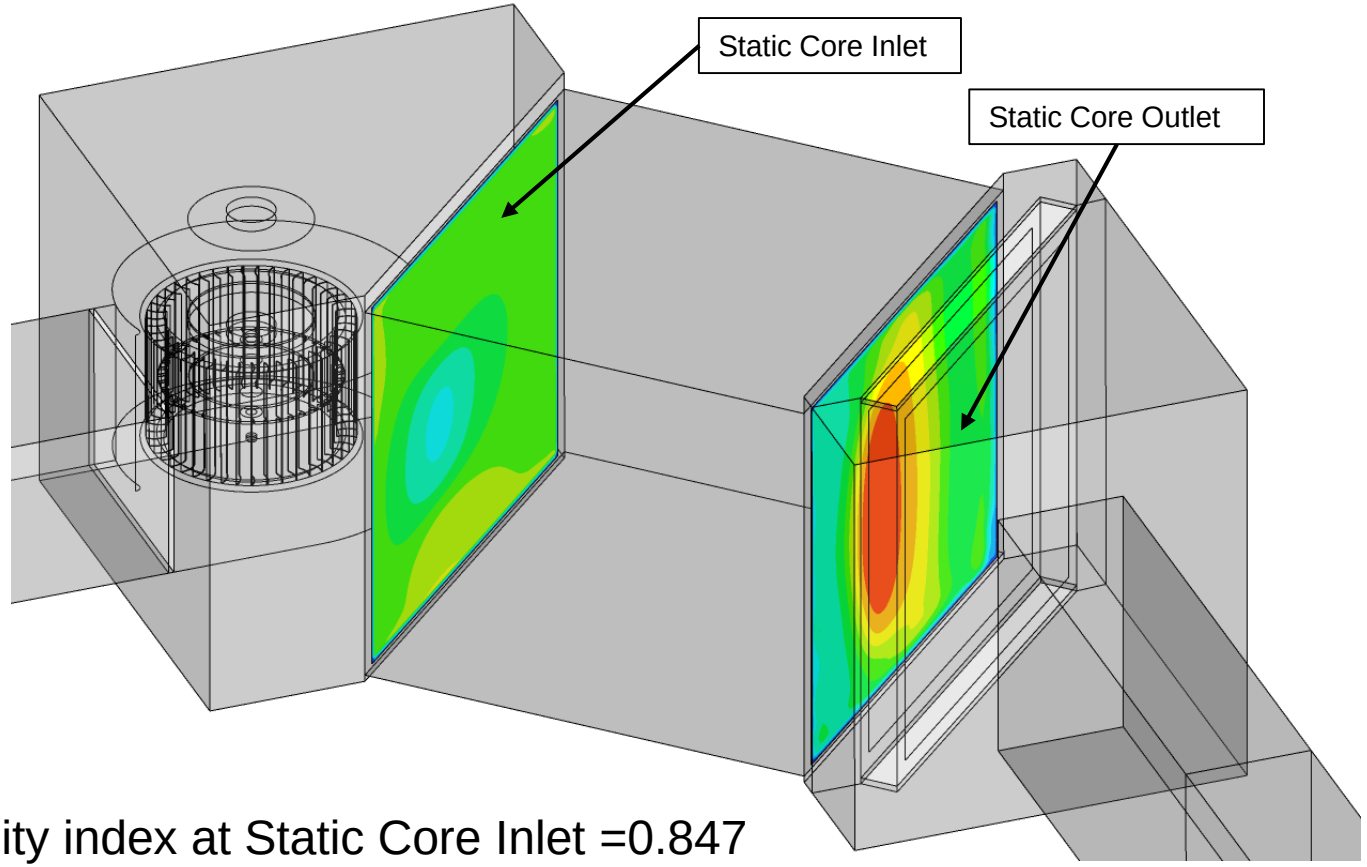
Uniformity index on Filter Outlet =0.854

Uniformity Index for velocity = $\gamma = 1 - \frac{\sum_{i=1}^{n} [(|U - U_{avg}|)A_i]}{2|U_{avg}|\sum_{i=1}^{n} A_i}$

Uniformity index close to 1 which indicates uniform air-flow

Results : Velocity Contour at Static Core





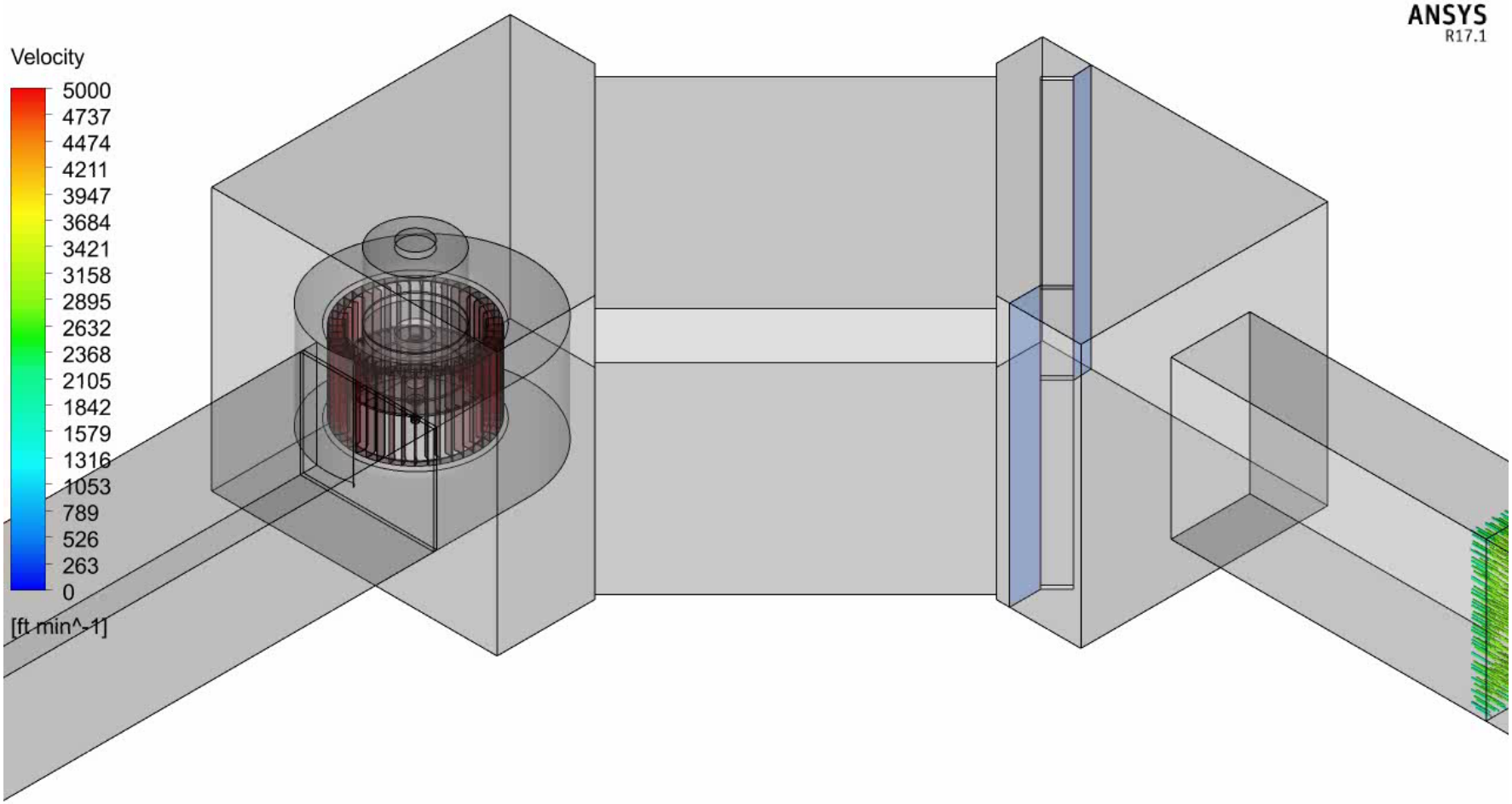
Uniformity index at Static Core Inlet =0.847

Uniformity index at Static Core Outlet =0.940

Uniformity Index for velocity = $\gamma = 1 - \frac{\sum_{i=1}^{n} [(|U - U_{avg}|)A_i]}{2|U_{avg}|\sum_{i=1}^{n} A_i}$

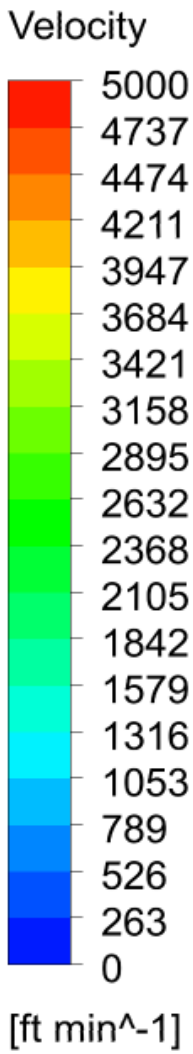
Uniformity index close to 1 which indicates uniform air-flow

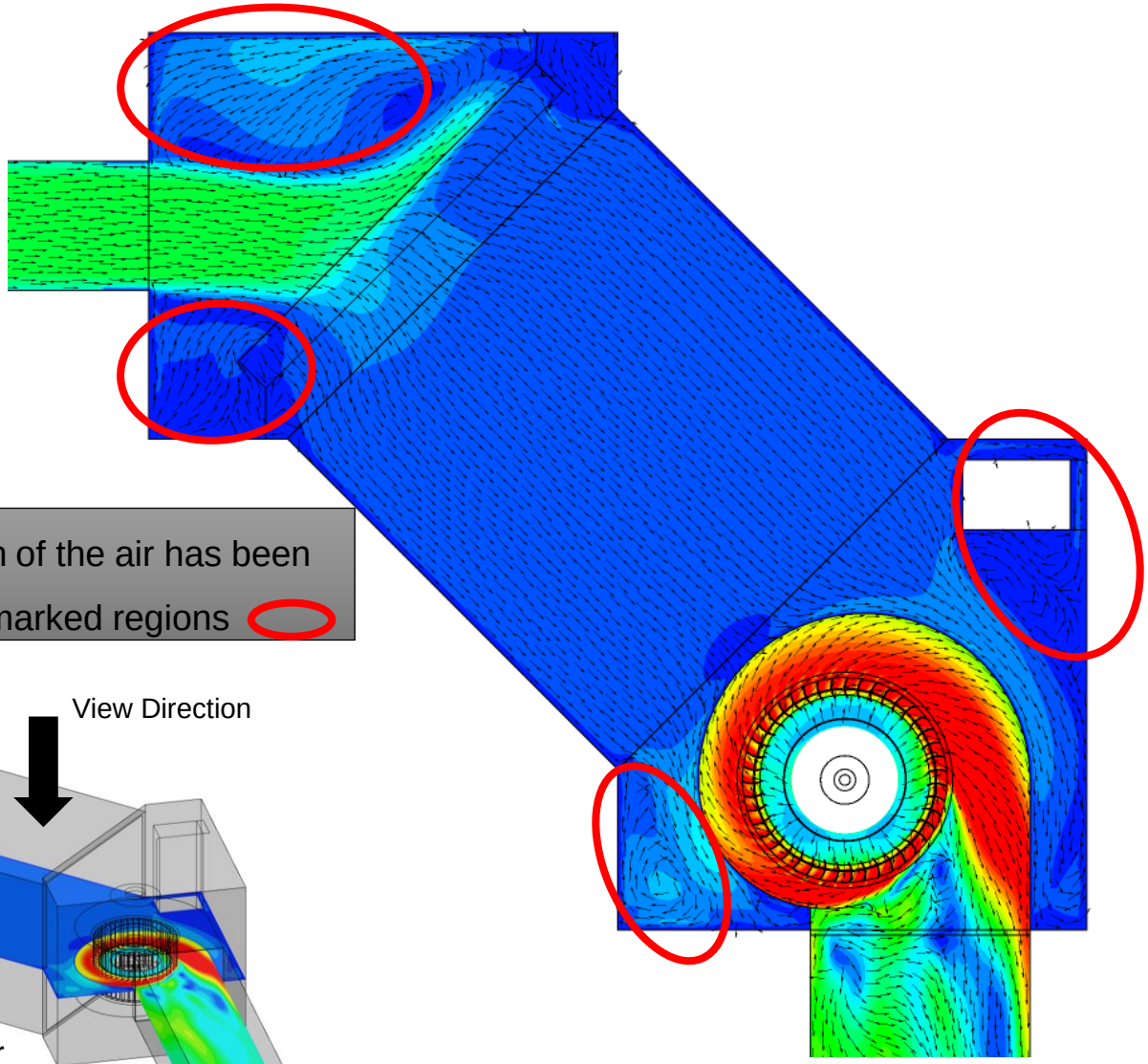
Results :Streamlines



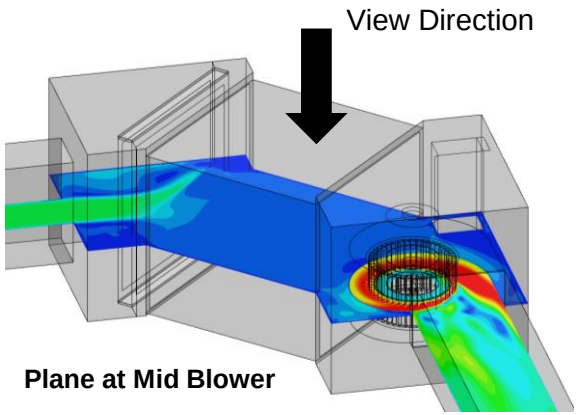
CFD Results – MC1000 Exhaust Side

Results : Velocity Contour



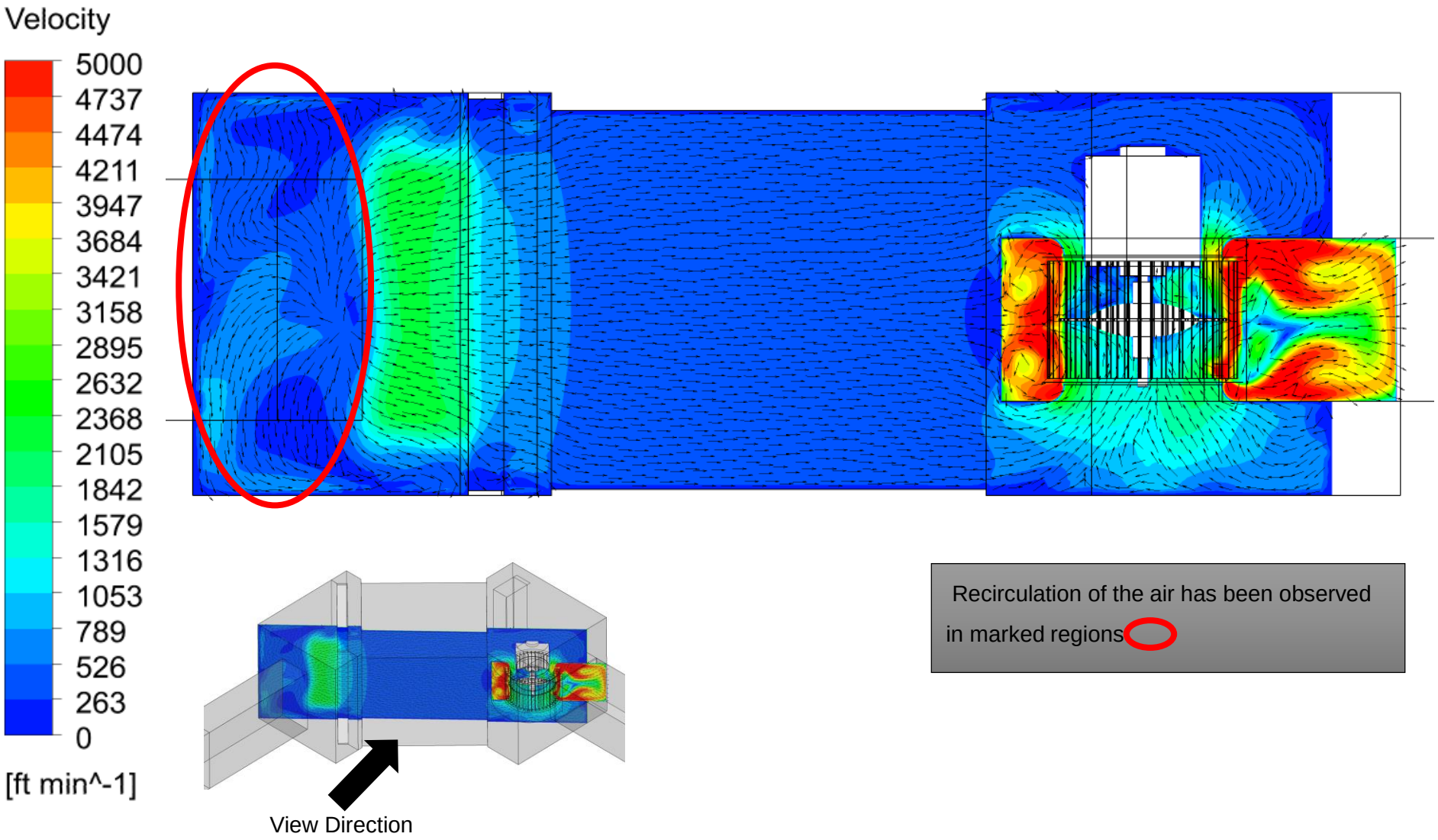


Recirculation of the air has been observed in marked regions



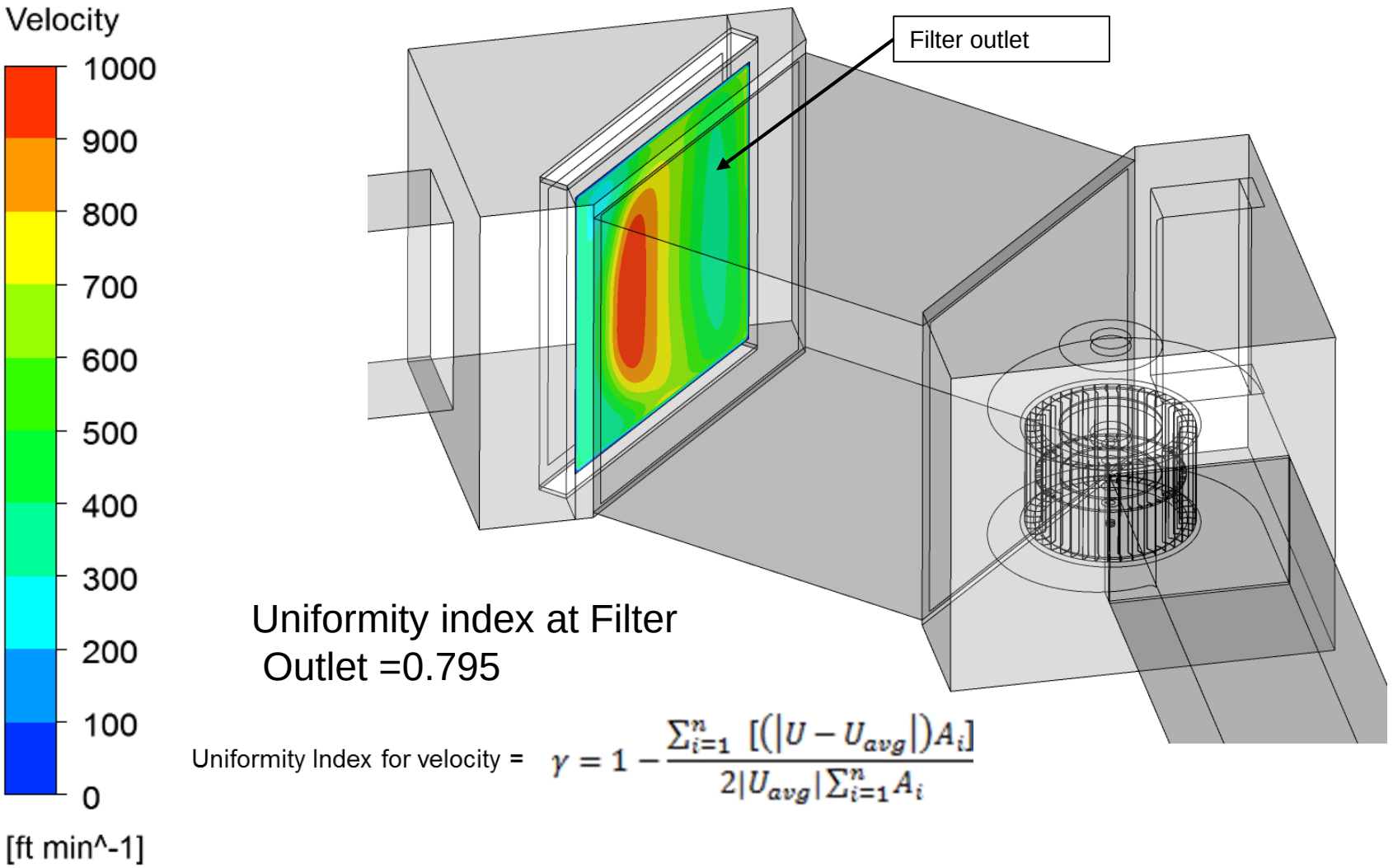
Plane at Mid Blower

Results : Velocity Contour



Recirculation of the air has been observed in marked regions

Results : Velocity Contour at Filter Outlet

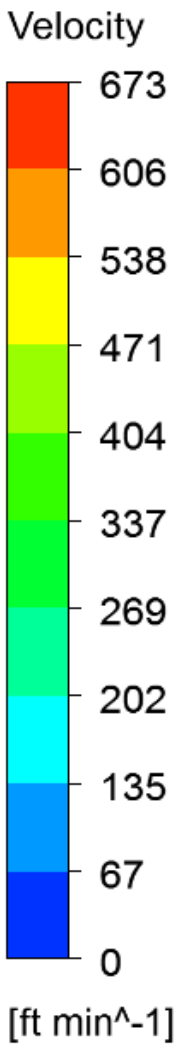


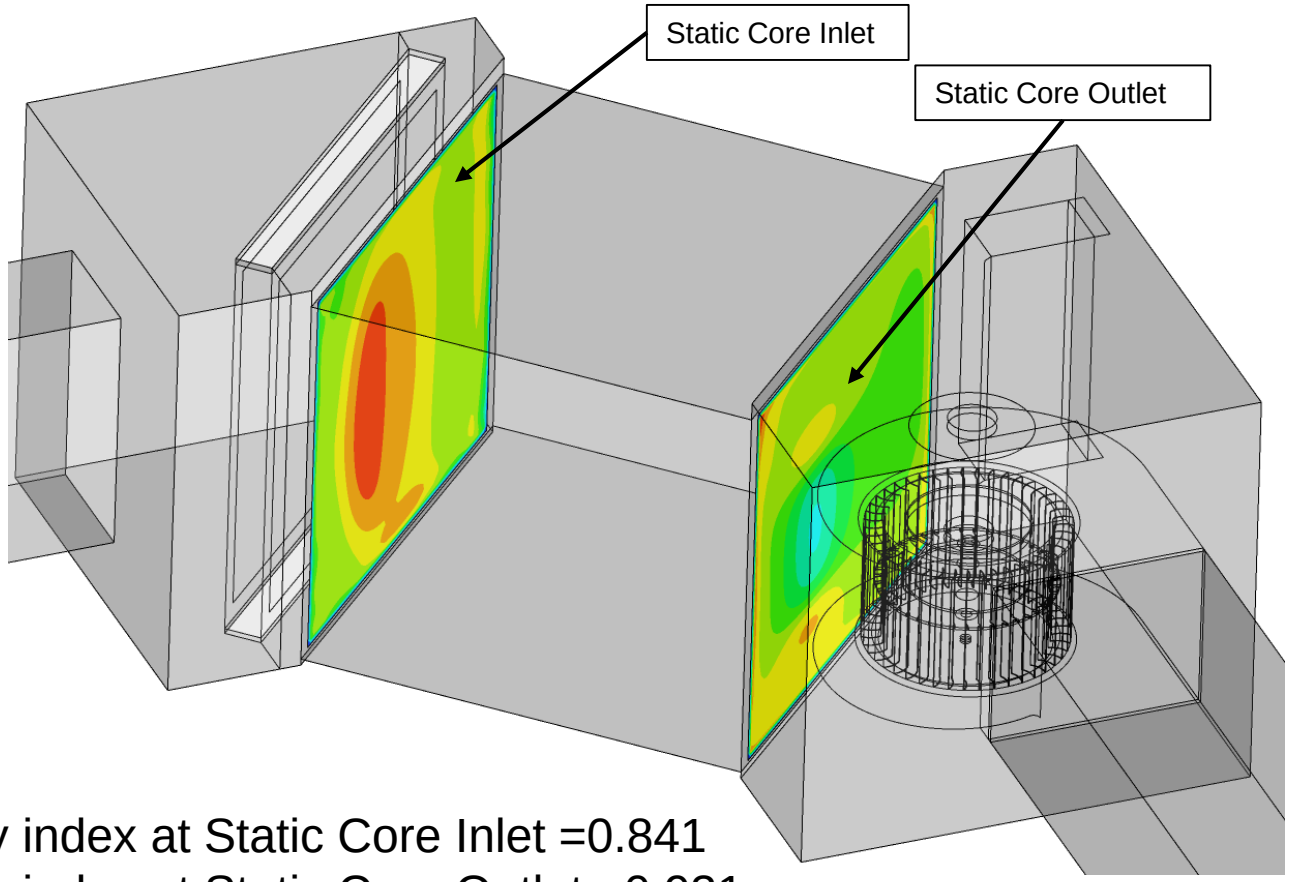
Uniformity index at Filter Outlet =0.795

Uniformity Index for velocity = $\gamma = 1 - \frac{\sum_{i=1}^{n} [(|U - U_{avg}|)A_i]}{2|U_{avg}|\sum_{i=1}^{n} A_i}$

Uniformity index close to 1 which indicates uniform air-flow

Results : Velocity Contour at Static Core Inlet & Outlet





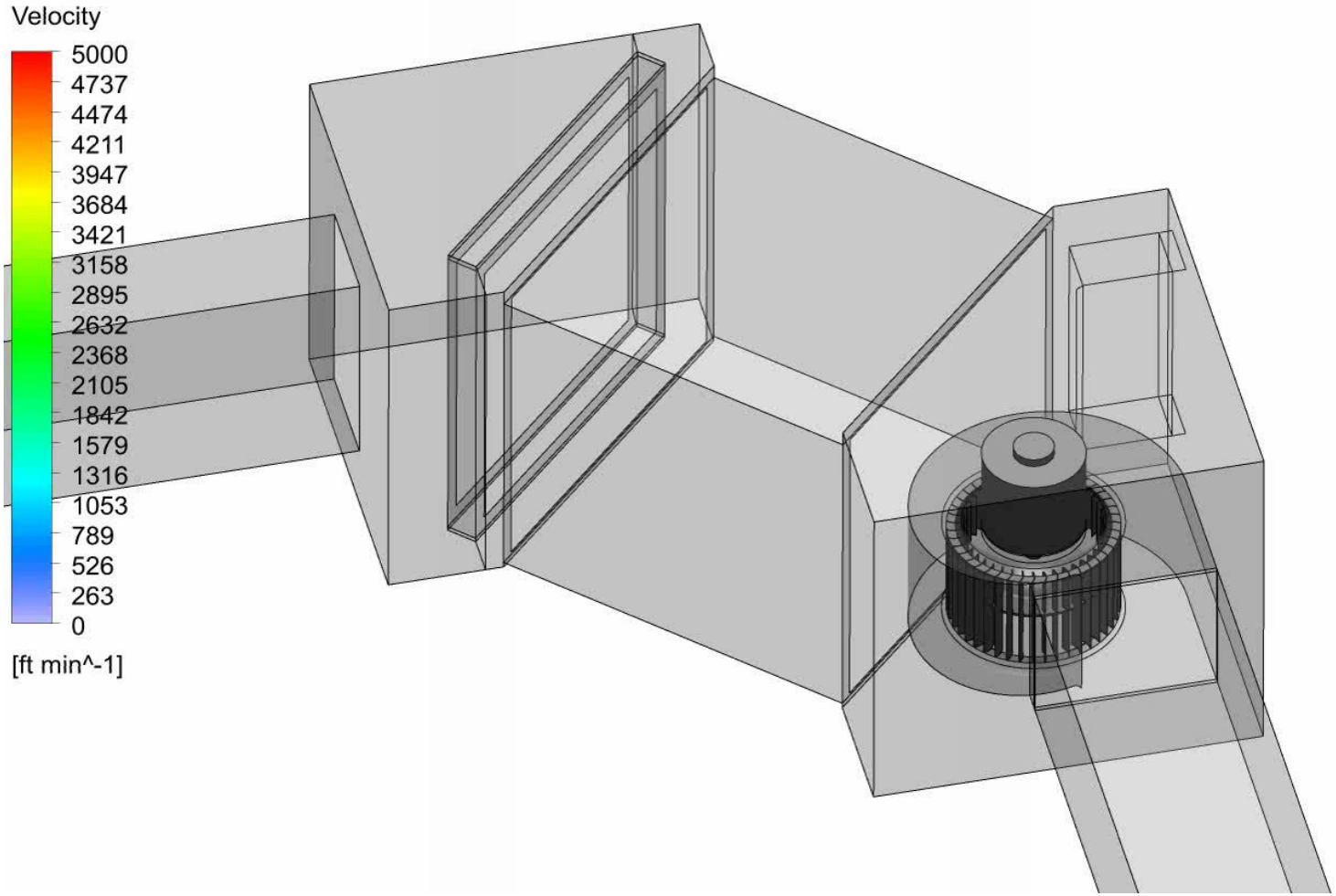
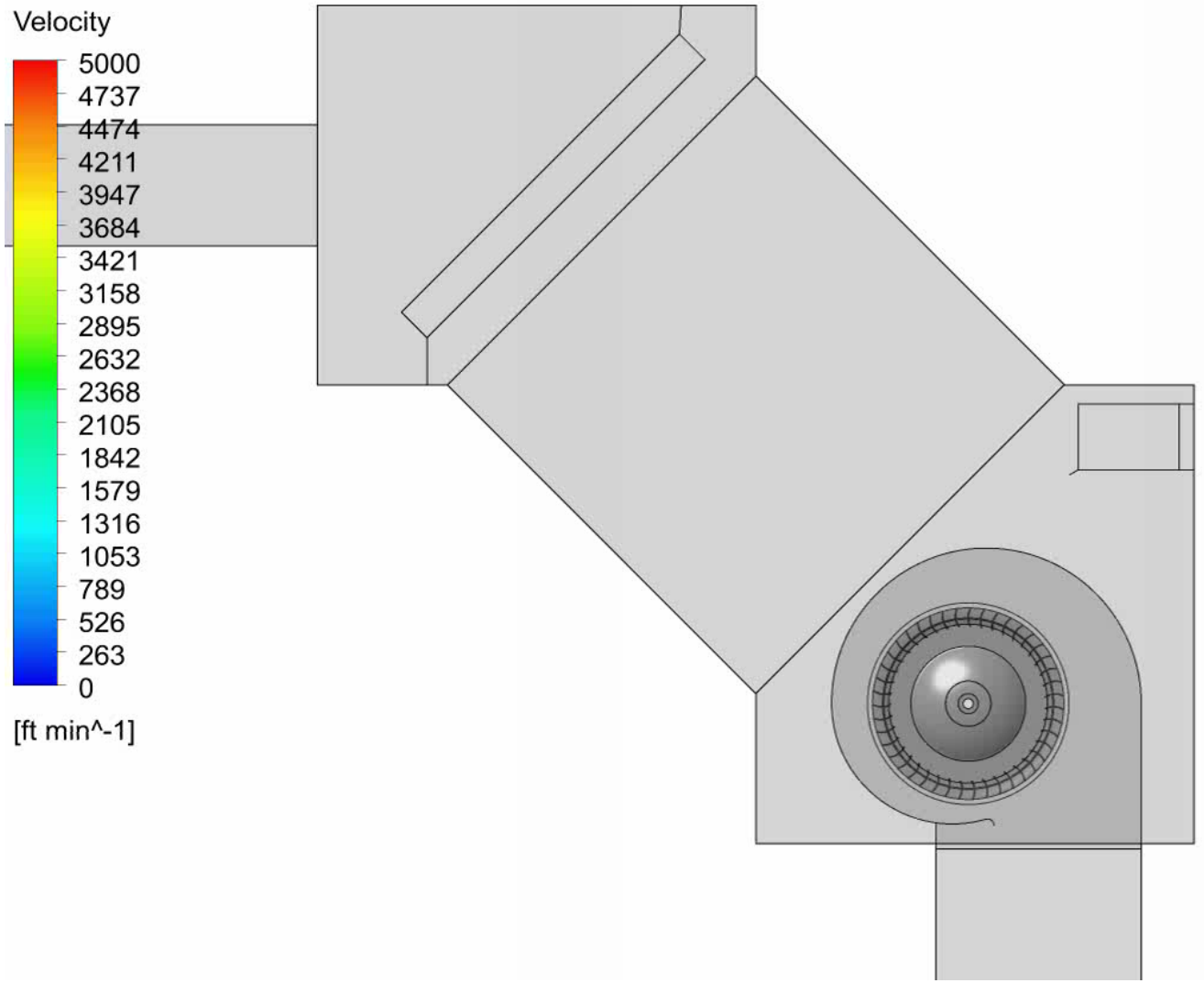
Uniformity index at Static Core Inlet =0.841

Uniformity index at Static Core Outlet =0.931

Uniformity Index for velocity = $\gamma = 1 - \frac{\sum_{i=1}^{n} [(|U - U_{avg}|)A_i]}{2|U_{avg}|\sum_{i=1}^{n} A_i}$

Uniformity index close to 1 which indicates uniform air-flow

Results :Streamlines



Results :Streamlines