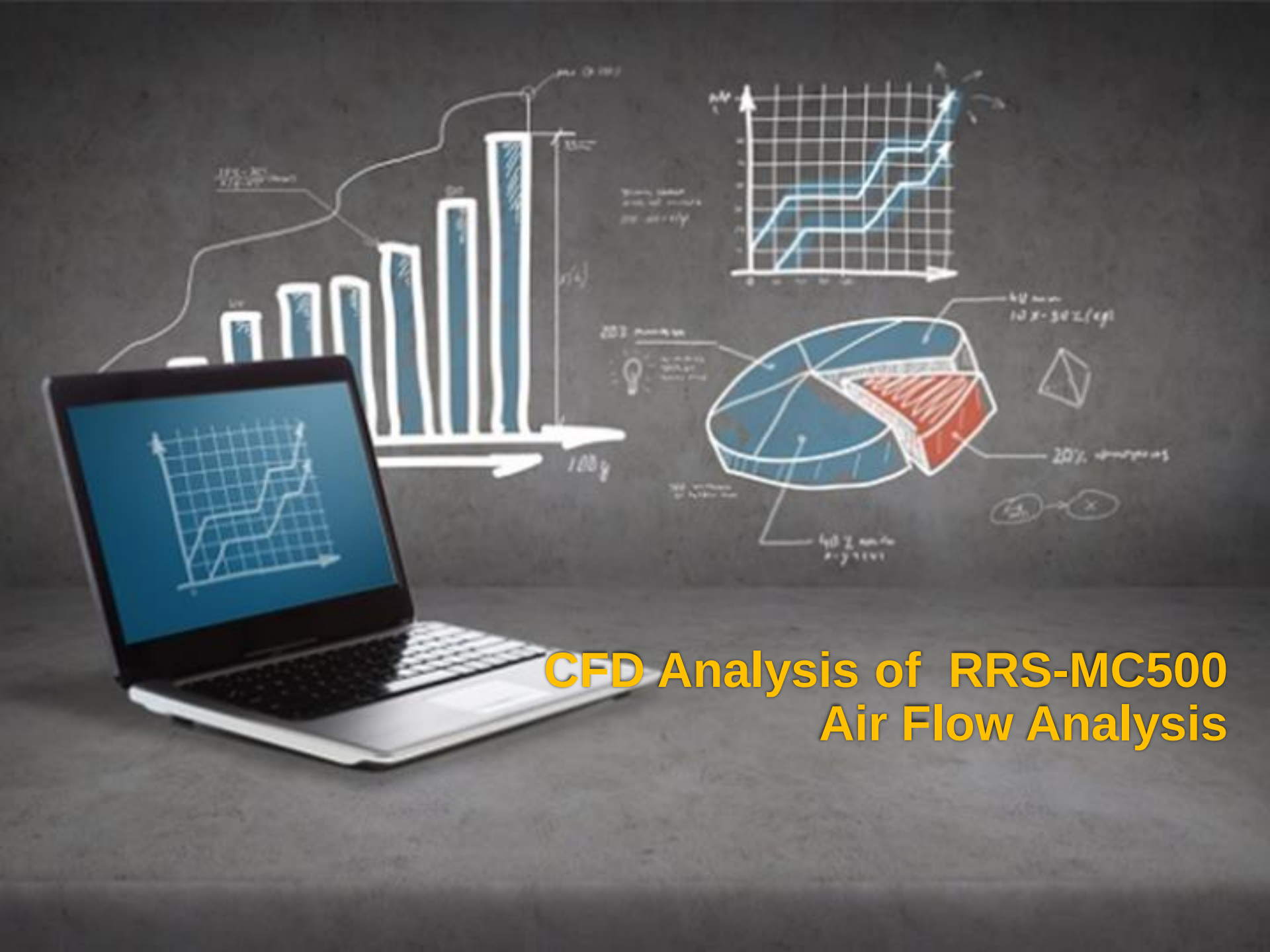


CFD Analysis of RRS-MC500
Air Flow Analysis

Objective and Scope - CFD

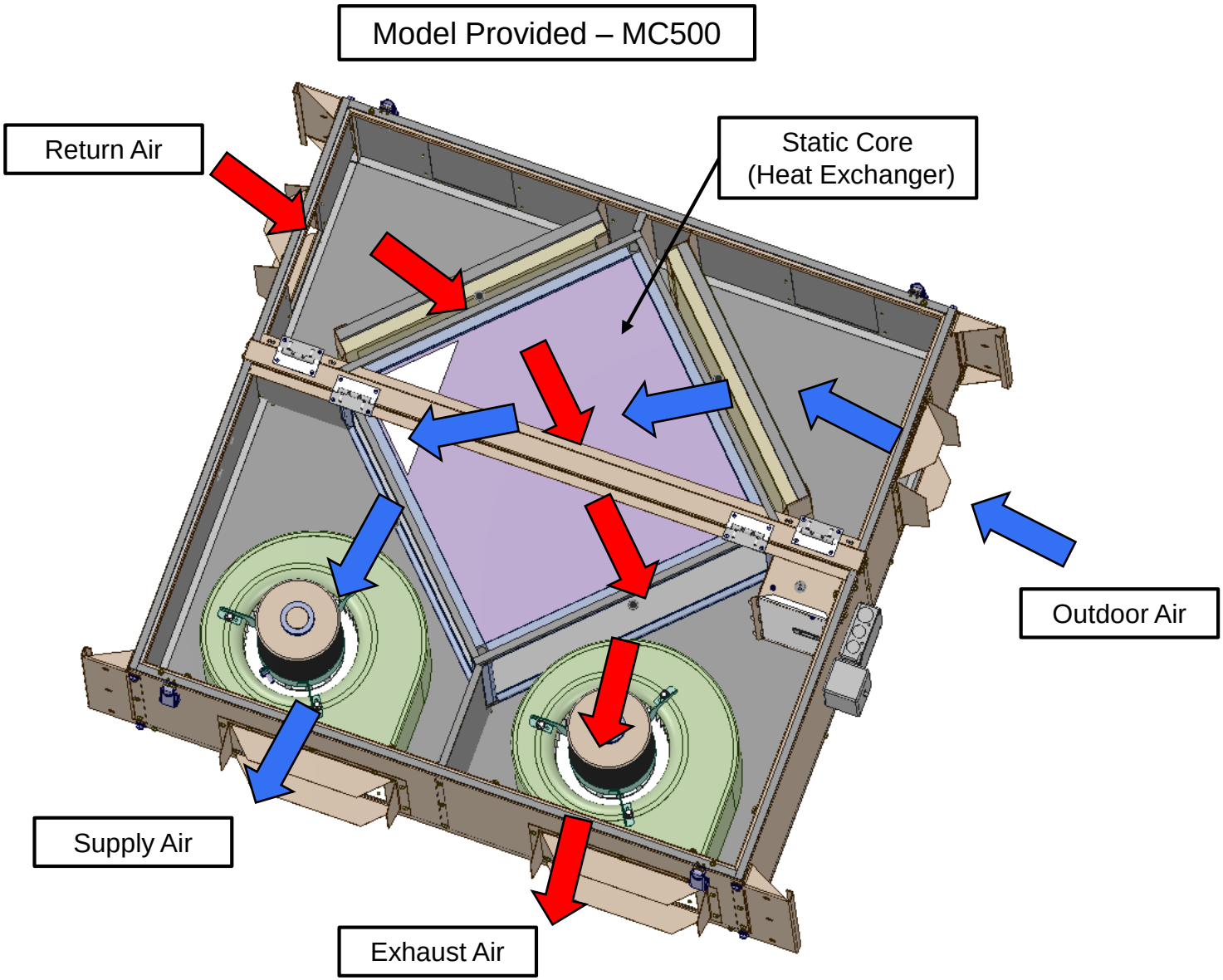
Objective:

- Run the CFD analysis to check the Airflow performance and identify turbulence region if any inside MC500 unit.

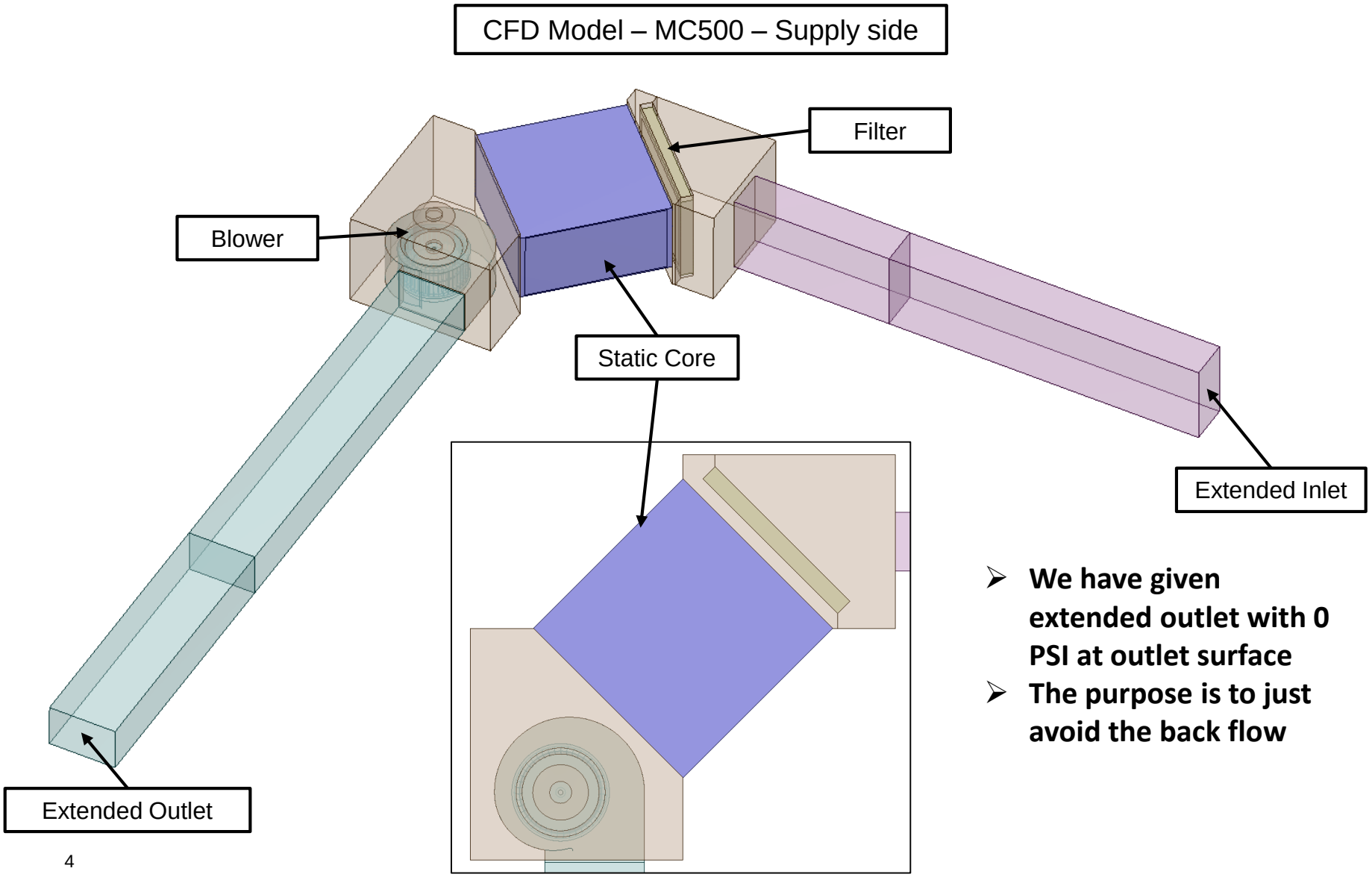
Scope:

- To predict the Air Flow pattern inside the MC500 unit

CAD Model – MC500

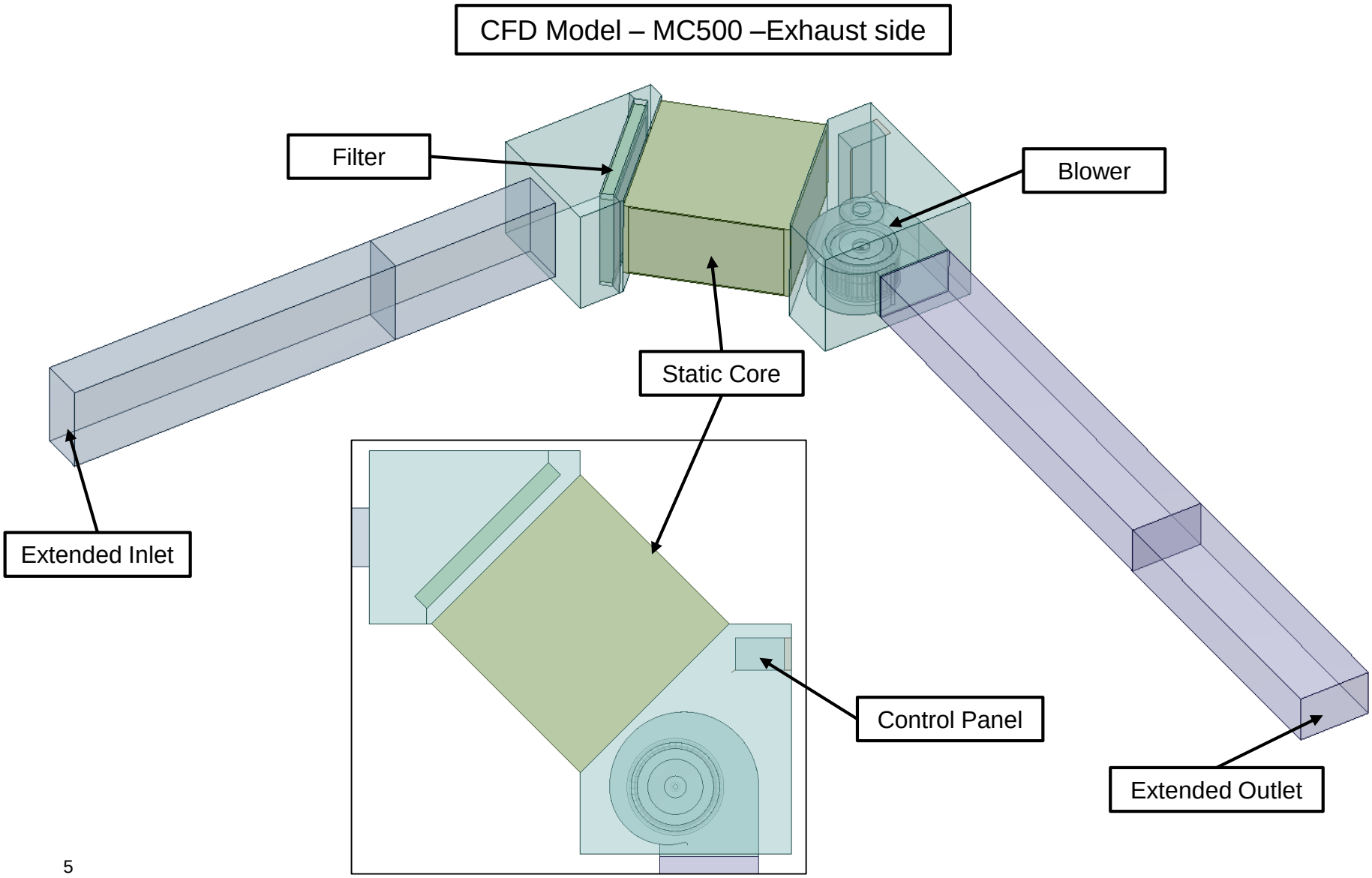


CFD Model – MC500 – Supply side



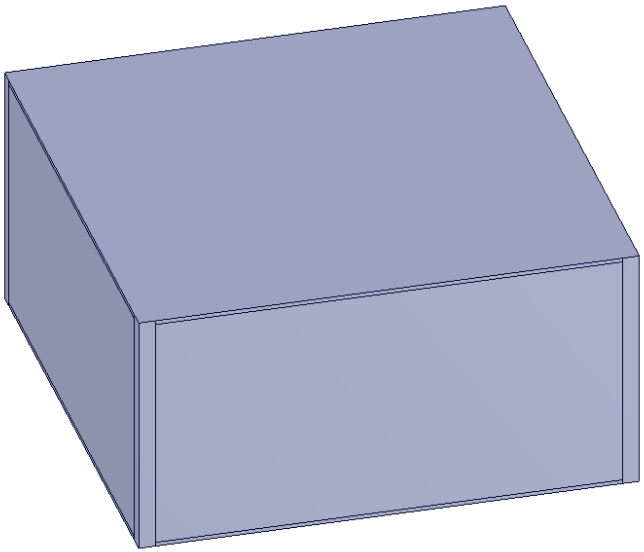
- **We have given extended outlet with 0 PSI at outlet surface**
- **The purpose is to just avoid the back flow**

CFD Model – MC500 – Return side



Modeling Details – Static Core

CFD Model – MC500 – Supply side

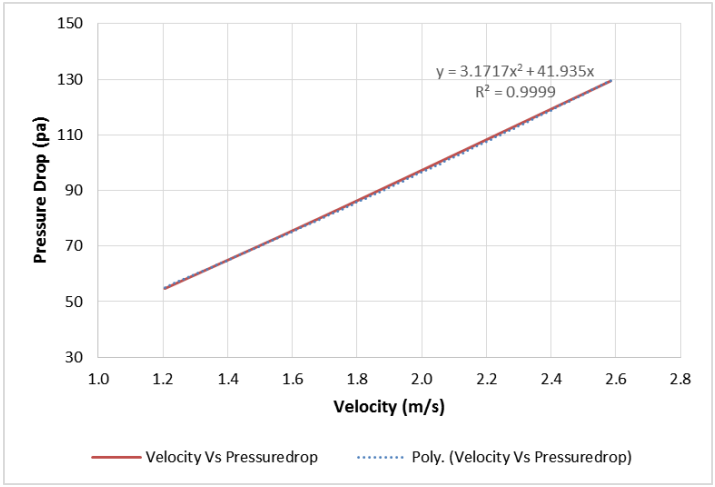


Airflow Direction

Static Core
(21.65” X 10.86” X 21.65”)

Static core modelled as block (porous media) in CFD

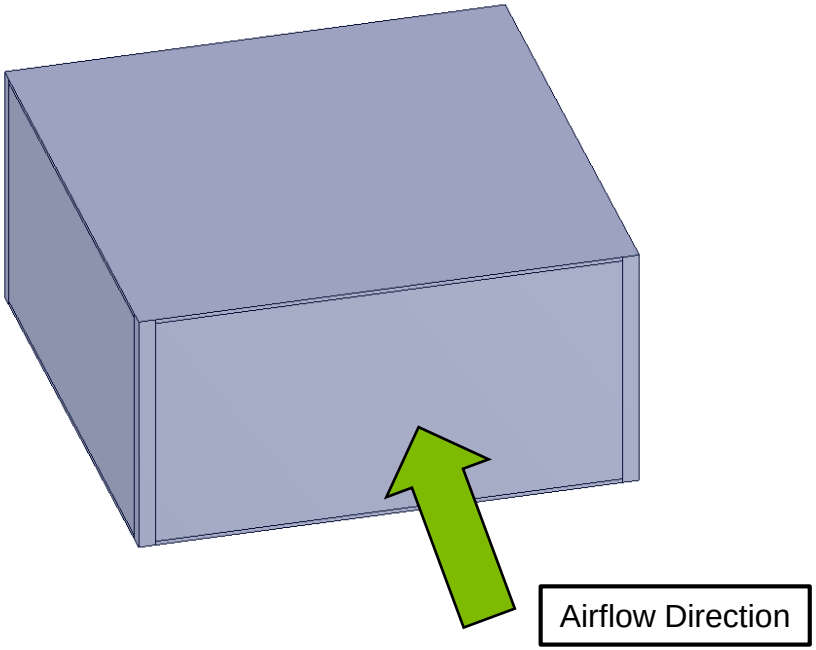
Static Pressure Drop Static core – MC500	
Volume Flowrate (CFM)	**Pressure Drop (In Wg)**
350	0.22
500	0.33
750	0.52



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

Modeling Details – Static Core

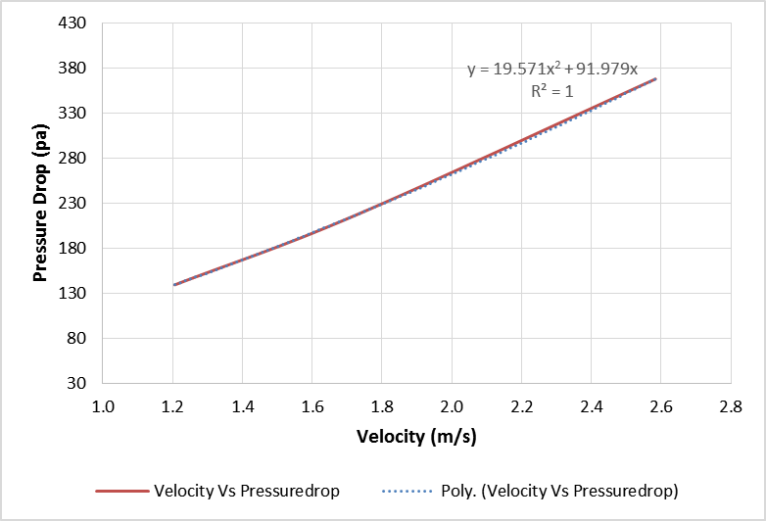
CFD Model – MC500 – Exhaust side



Static Core
(21.65” X 10.86” X 21.65”)

Static core modelled as block (porous media) in CFD

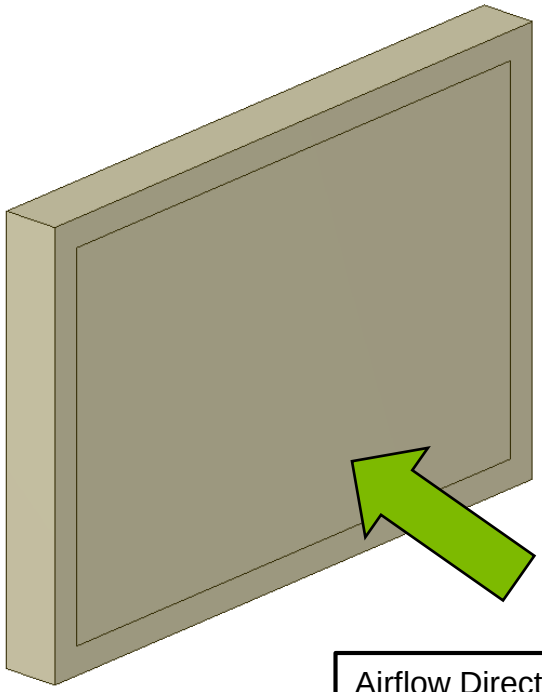
Static Pressure Drop Static core – MC500	
Volume Flowrate (CFM)	**Pressure Drop (In Wg)**
350	0.56
500	0.87
750	1.48



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

Modeling Details – Filter

CFD Model – MC500 – Filter

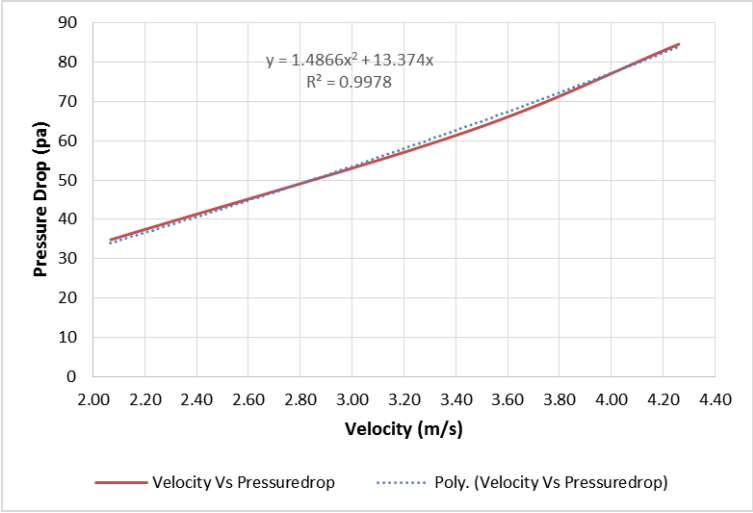


Airflow Direction

Filter
(19.5” X 13.5” X 1.75”)

Filter modelled as block (porous media) in CFD

Static Pressure Drop Filter – MC500	
Volume Flowrate (CFM)	**Pressure Drop (In Wg)**
590	0.14
980	0.25
1215	0.34



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

Boundary Conditions

Boundary Conditions – MC500

Boundary Conditions (Supply & Exhaust)	
Extended Inlets	Pressure Inlet (0 PSI)
Extended Outlets	Pressure Outlet (0 PSI)
Fan Blades	Moving Reference Frame (1500 RPM)
Filters	Porous Medium
Static Core	Porous Medium

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

Results

CFD Results

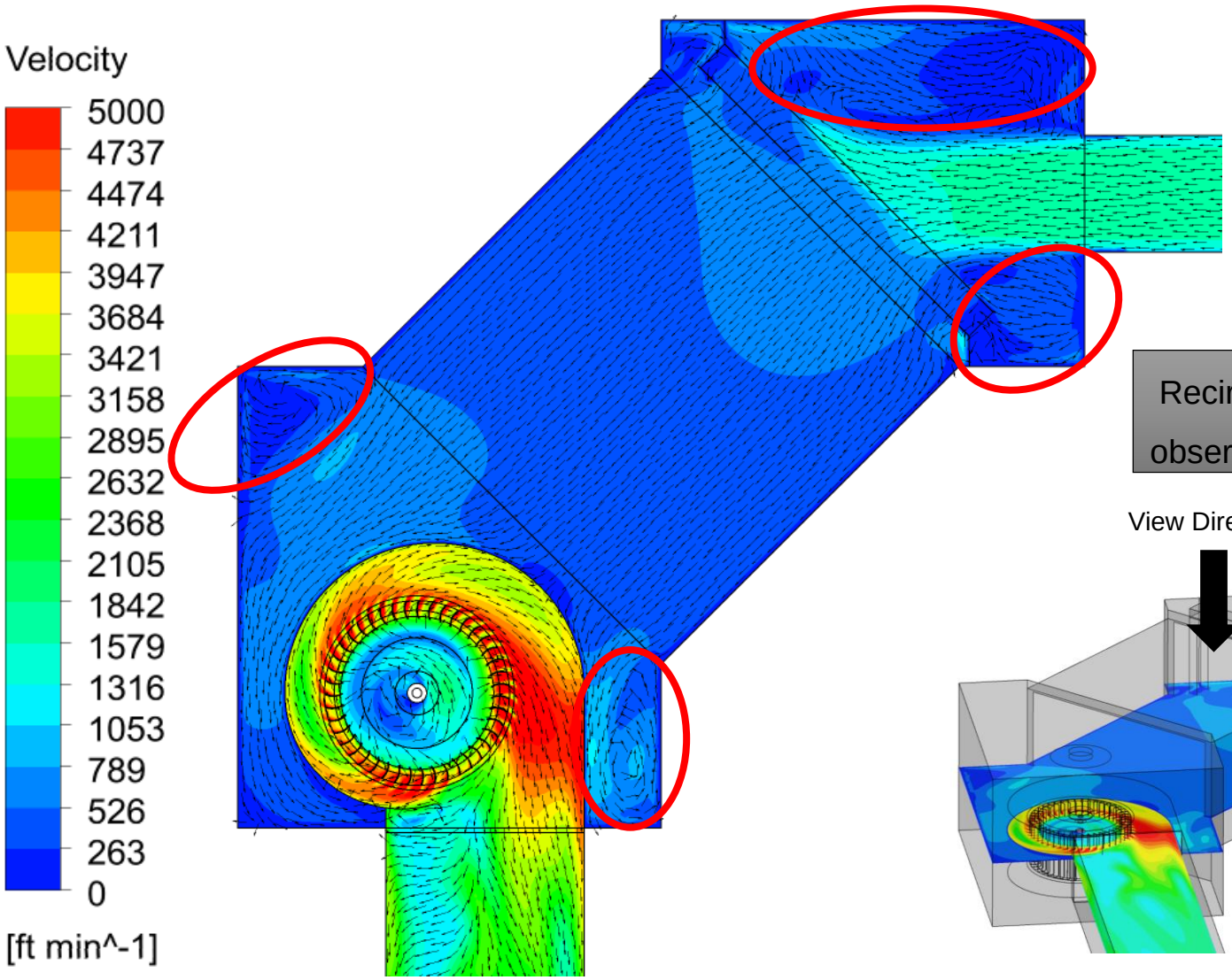
- Pressure drop for MC 500 Filter and Static Core has been recorded in the table below

	Supply Air Unit	Exhaust Air Unit
Flowrate (CFM)	808	592.2

	Supply Air Unit Δ Ps (in.w.g.)	Exhaust Air Unit Δ Ps (in.w.g.)
Filter	0.151	0.107
Static Core	0.428	0.687

CFD Results – MC500 Supply Side

Results : Velocity Contour

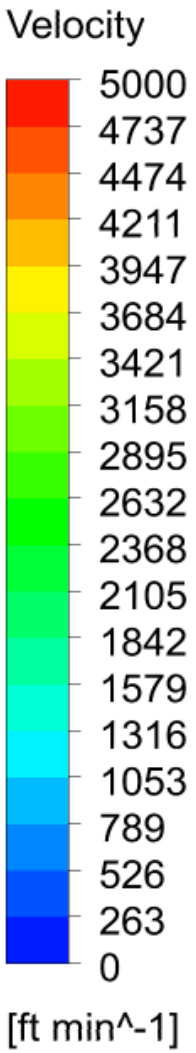


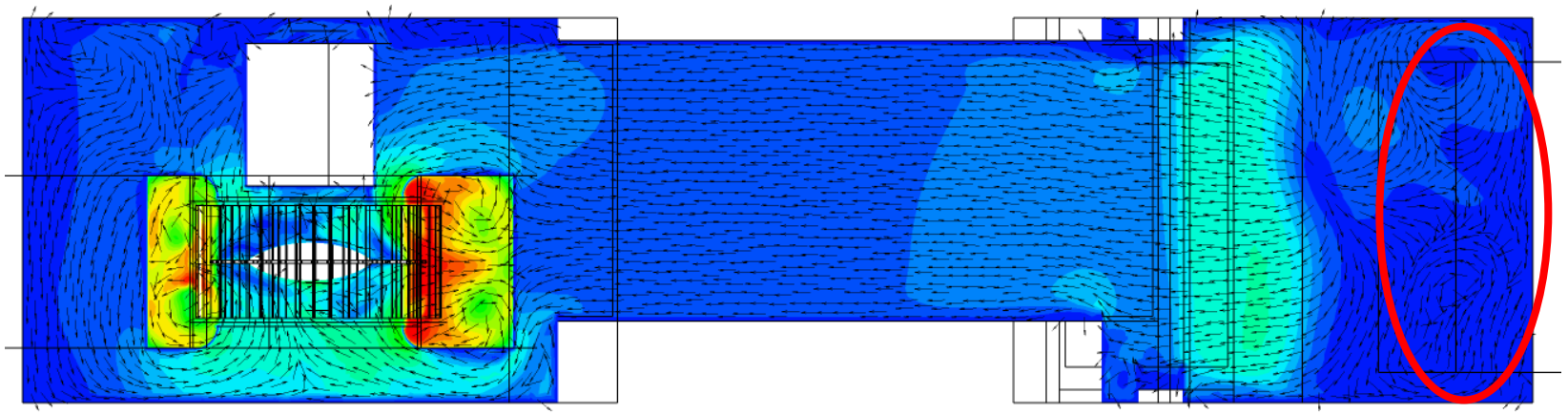
Recirculation of the air has been observed in marked regions

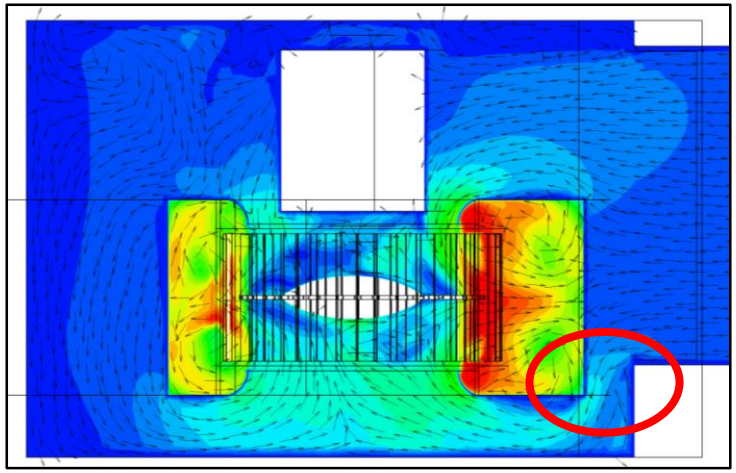
View Direction

Plane at Mid Blower

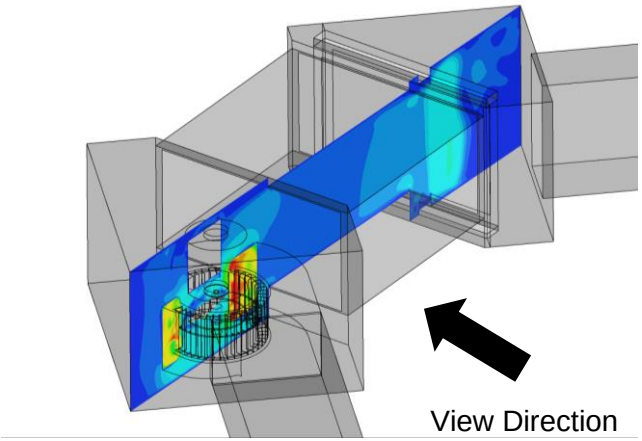
Results : Velocity Contour



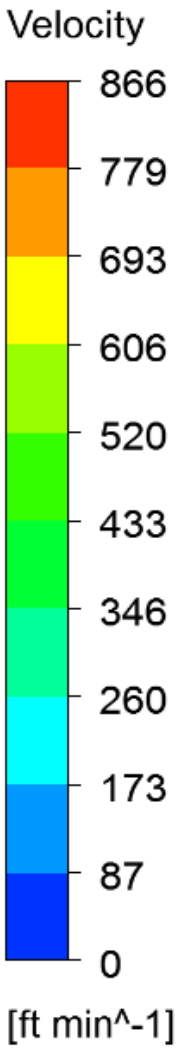


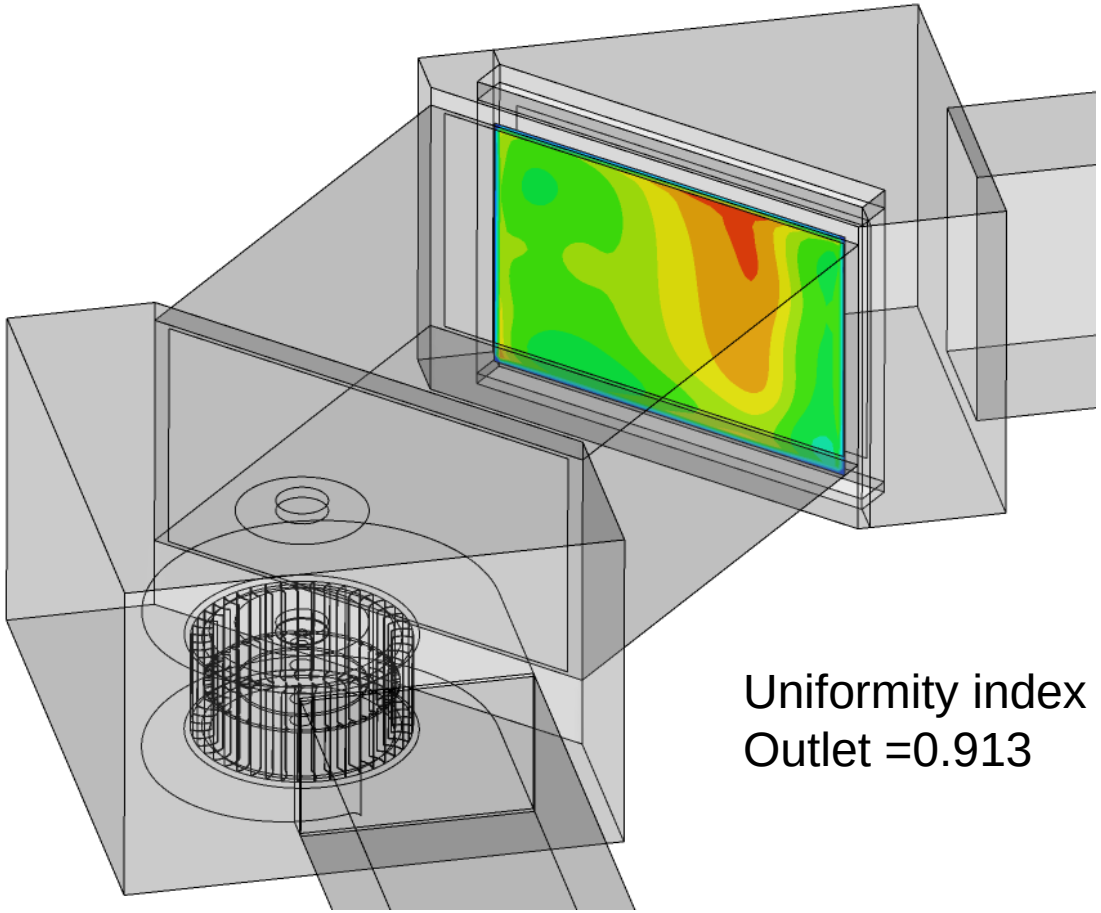


Recirculation of the air has been observed in marked regions



Results : Velocity Contour at Filter Outlet



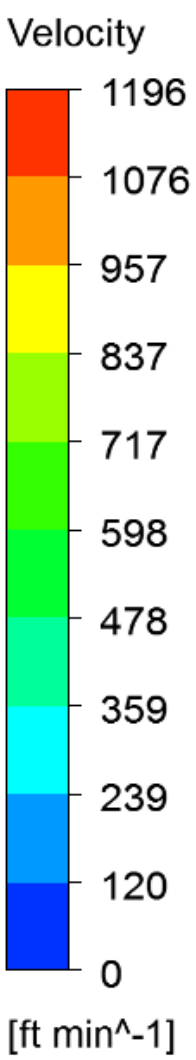


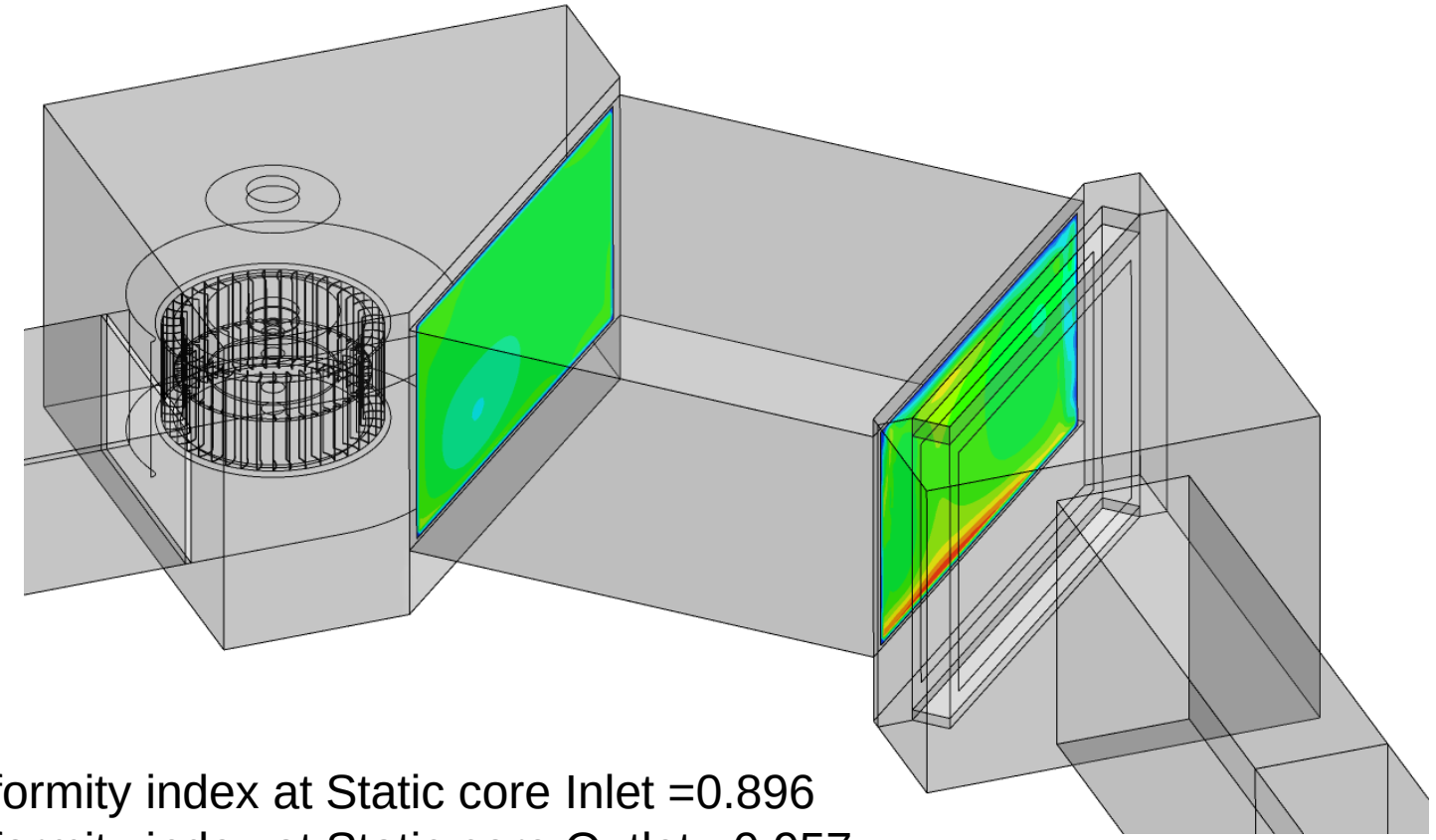
Uniformity index on Filter Outlet =0.913

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





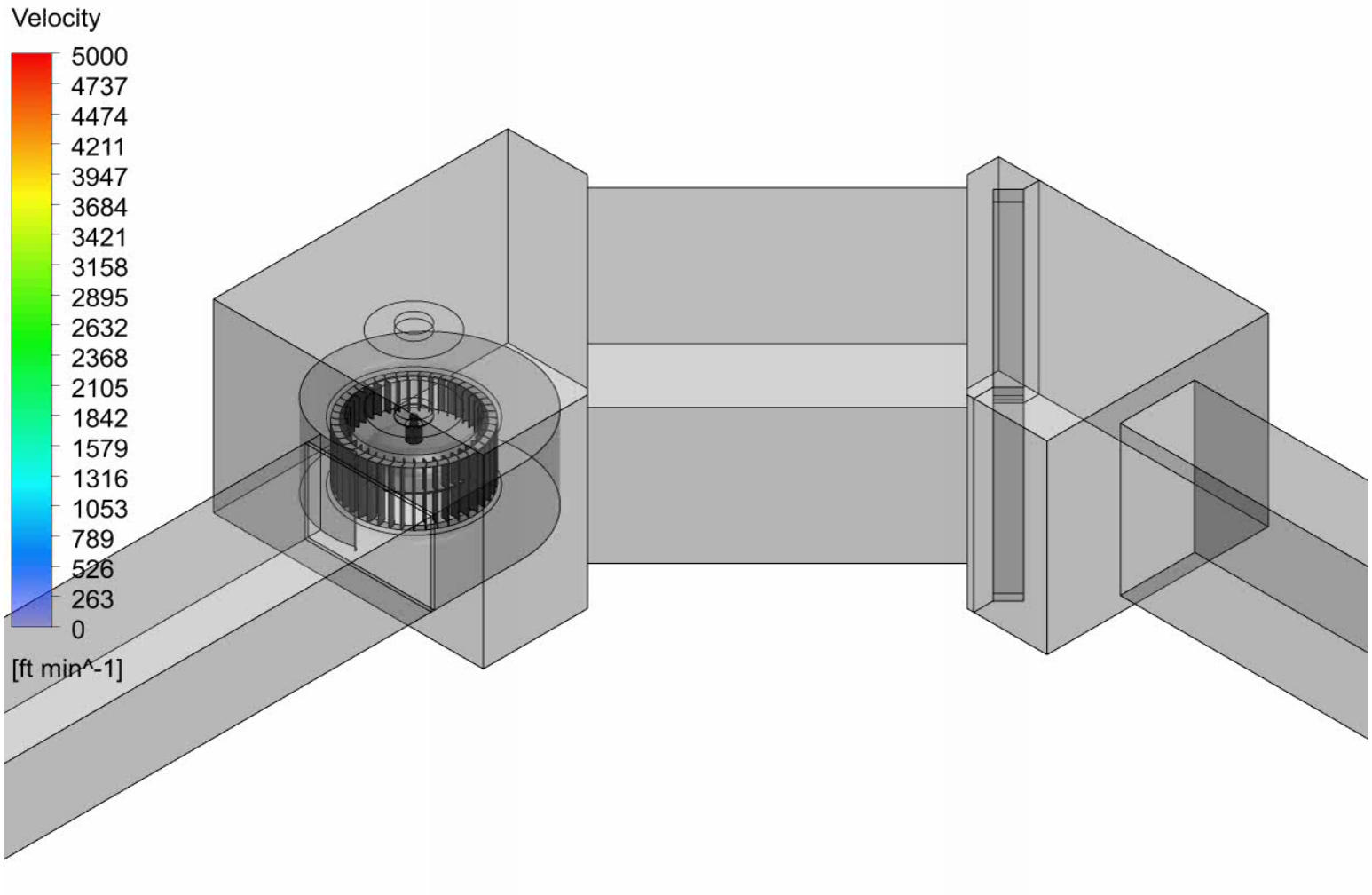
Uniformity index at Static core Inlet =0.896

Uniformity index at Static core Outlet =0.957

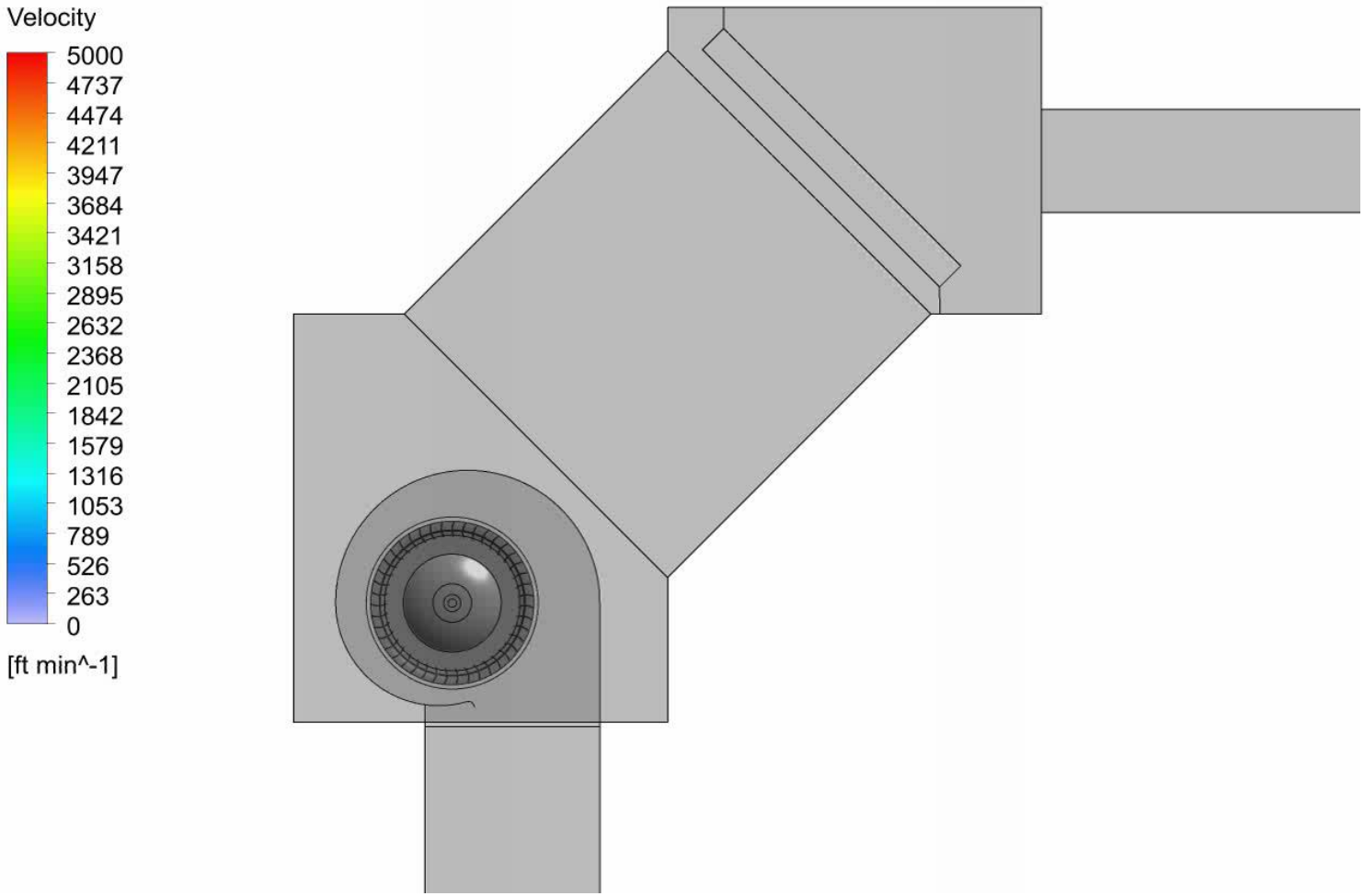
Uniformity Index for velocity = $\gamma = 1 - \frac{\sum_{i=1}^{n} [(|U - U_{avg}|)A_i]}{2|U_{avg}|\sum_{i=1}^{n} A_i}$

Uniformity index close to 1 which indicates uniform air-flow

Results :Streamlines

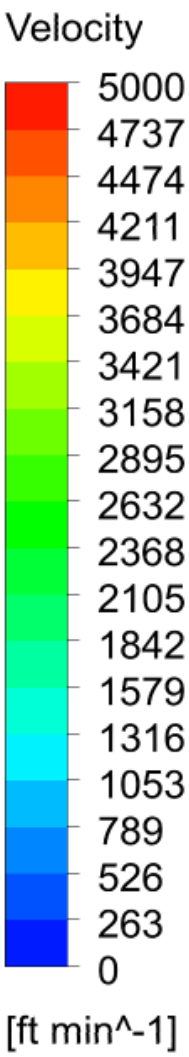


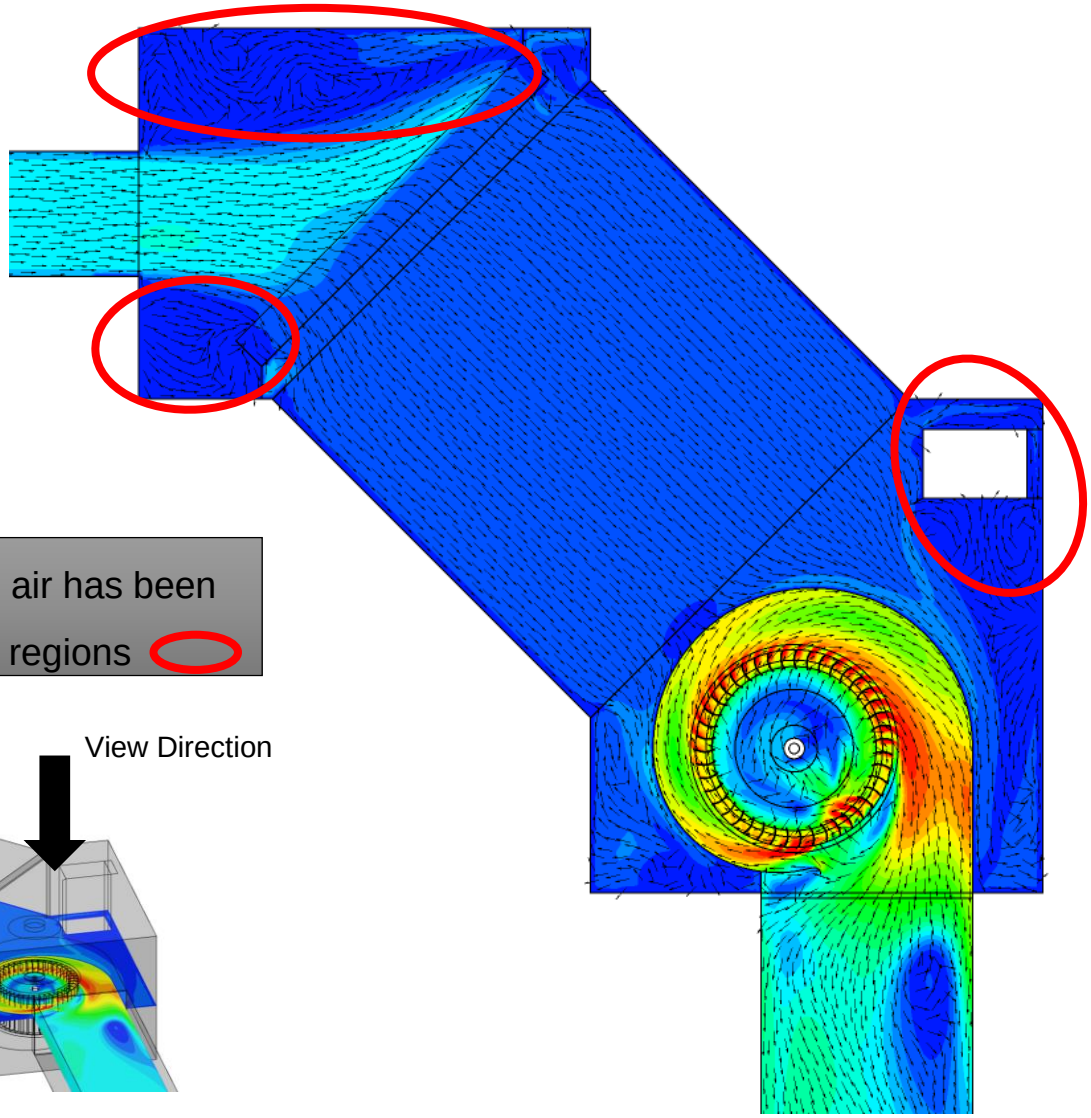
Results :Streamlines



CFD Results –MC500 Exhaust Side

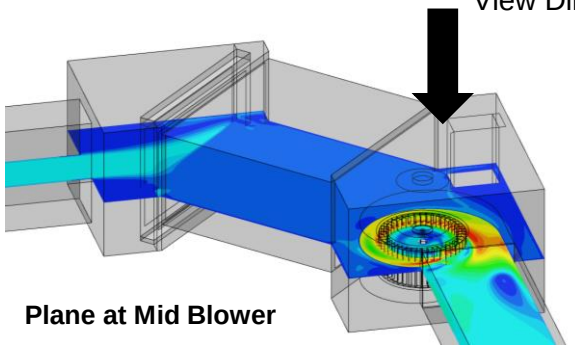
Results : Velocity Contour





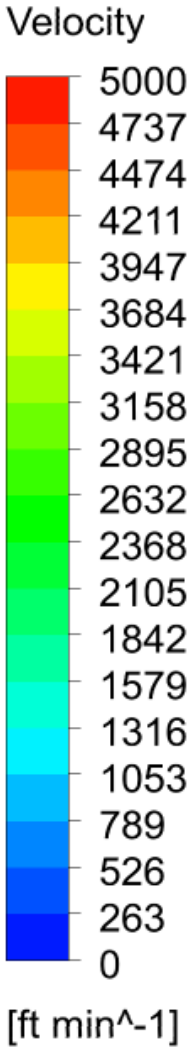
Recirculation of the air has been observed in marked regions

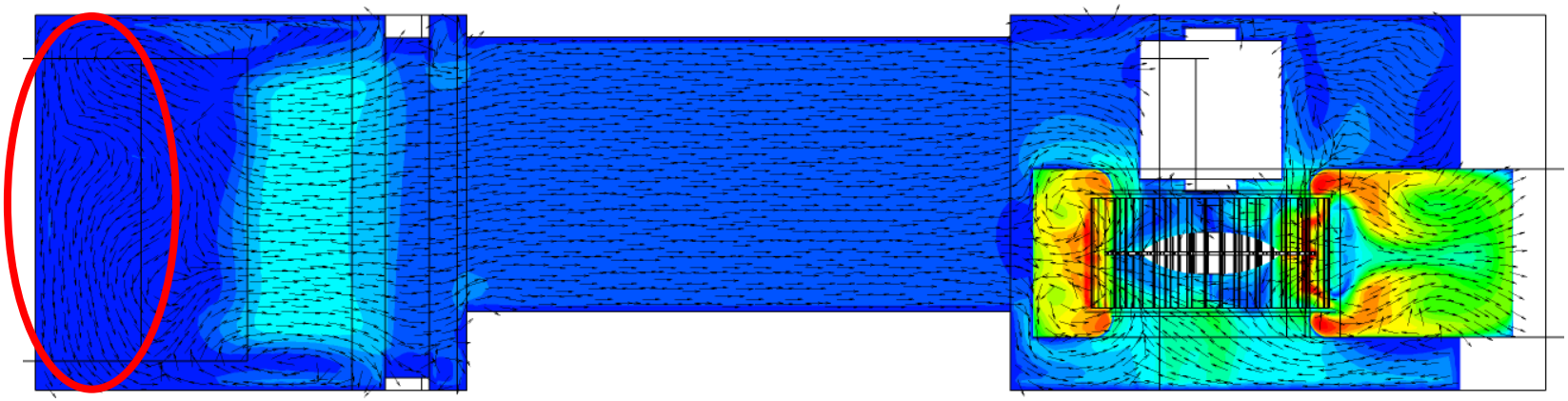
View Direction



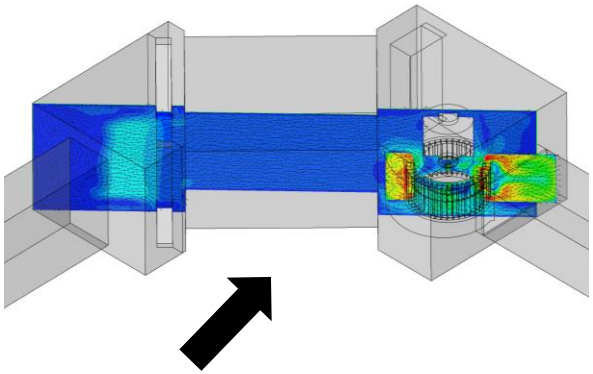
Plane at Mid Blower

Results : Velocity Contour

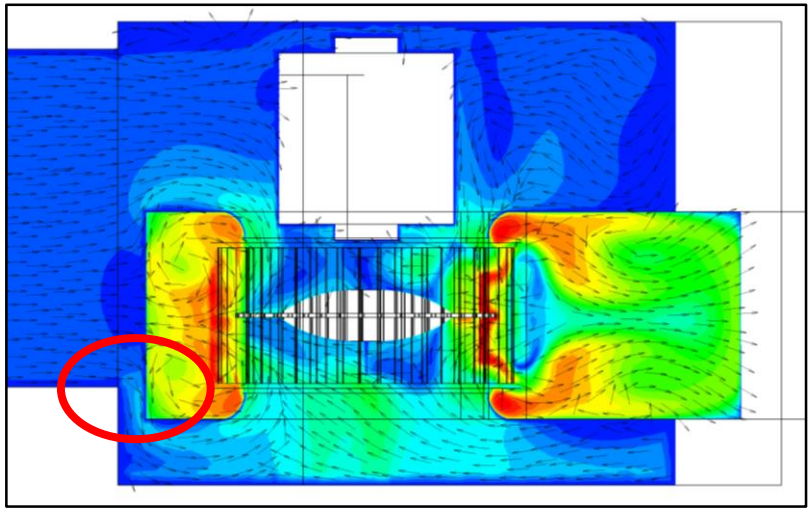




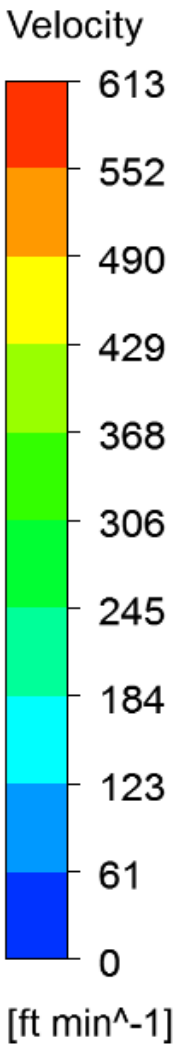
Recirculation of the air has been observed in marked regions

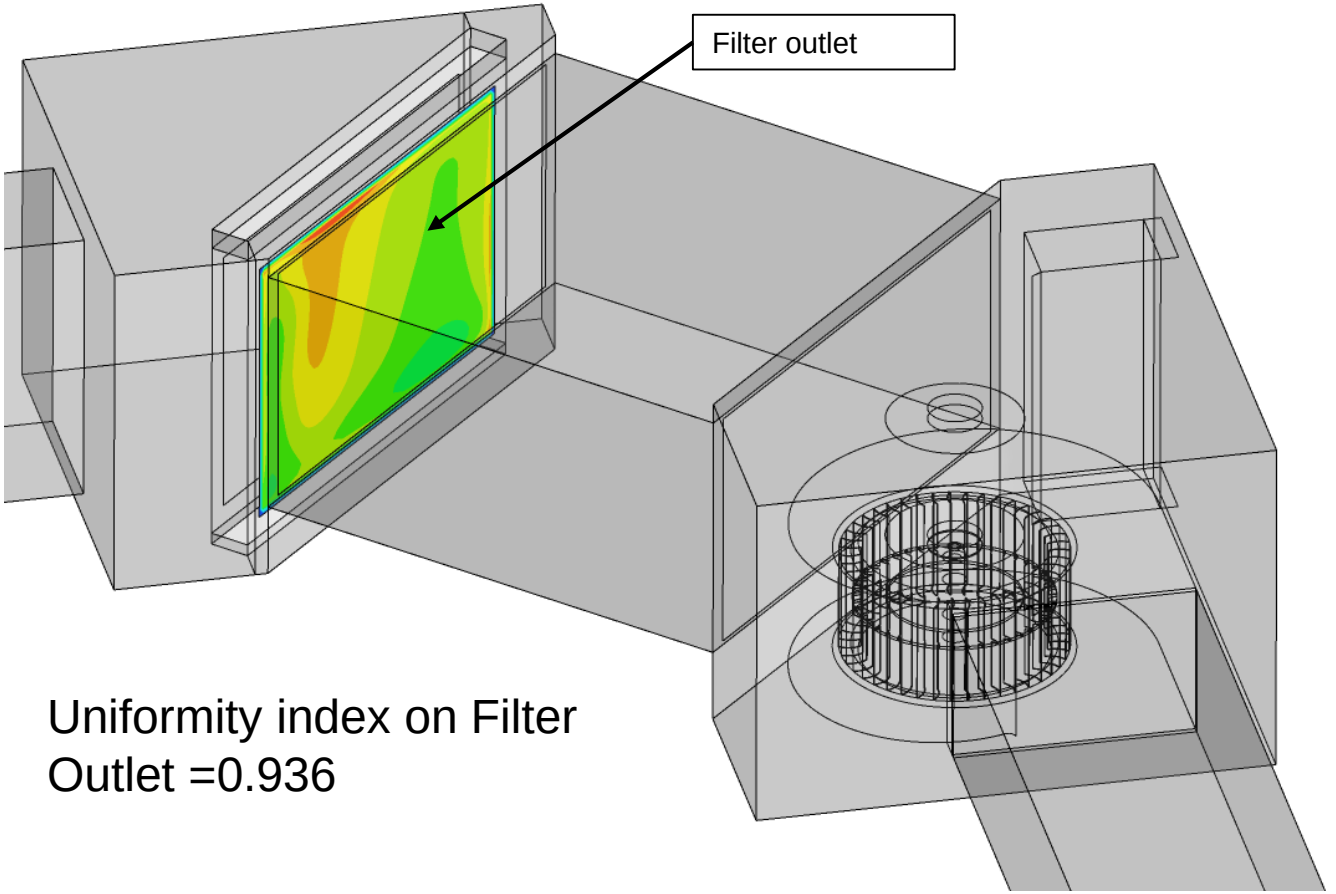


View Direction



Results : Velocity Contour at Filter Outlet



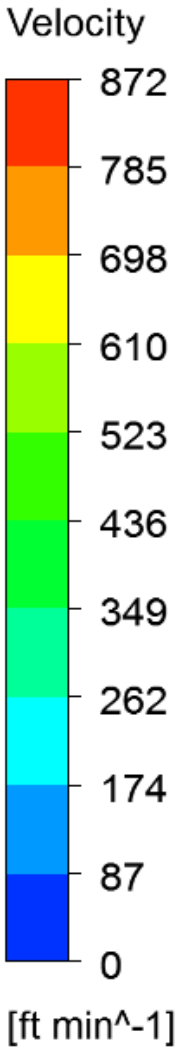


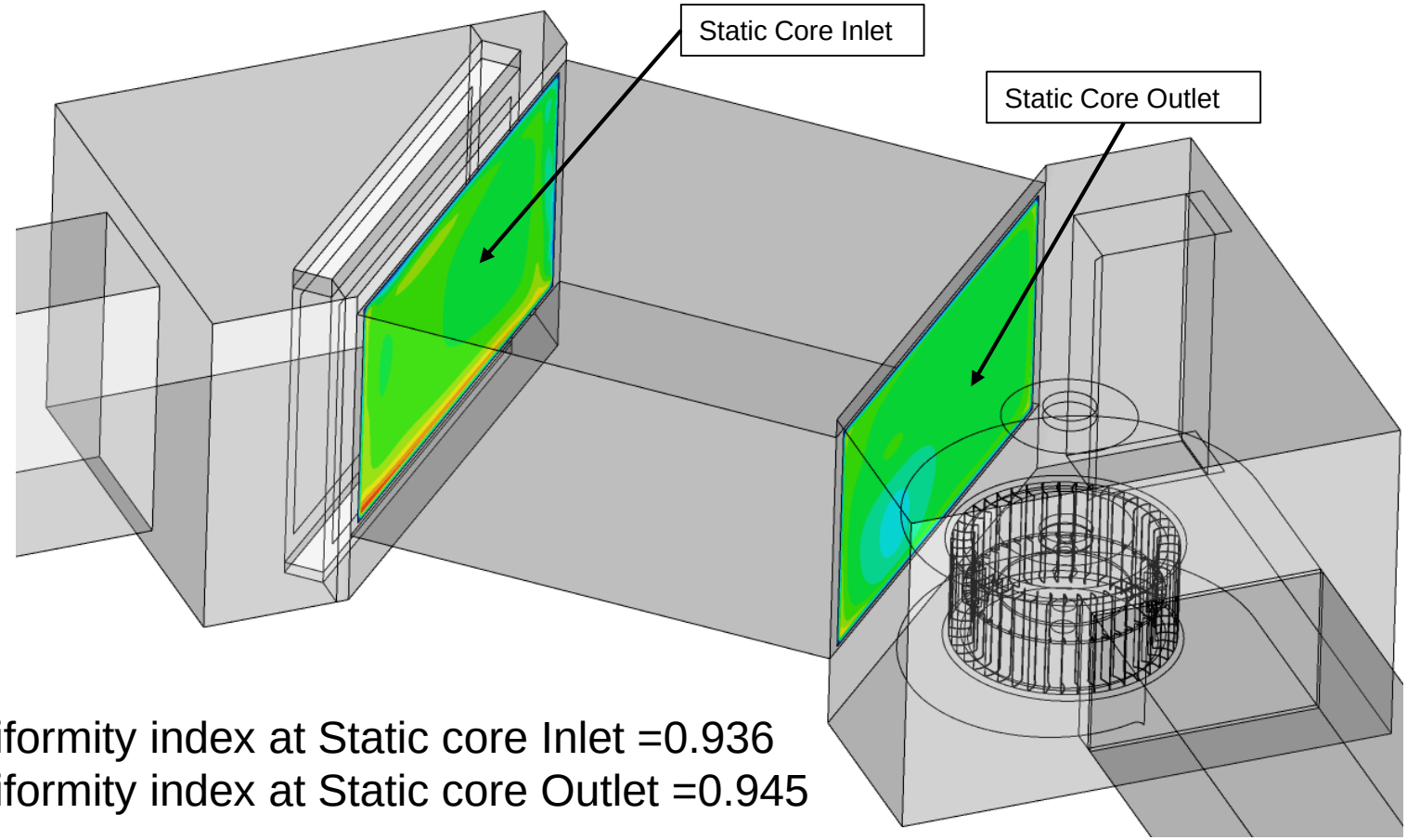
Uniformity index on Filter Outlet =0.936

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



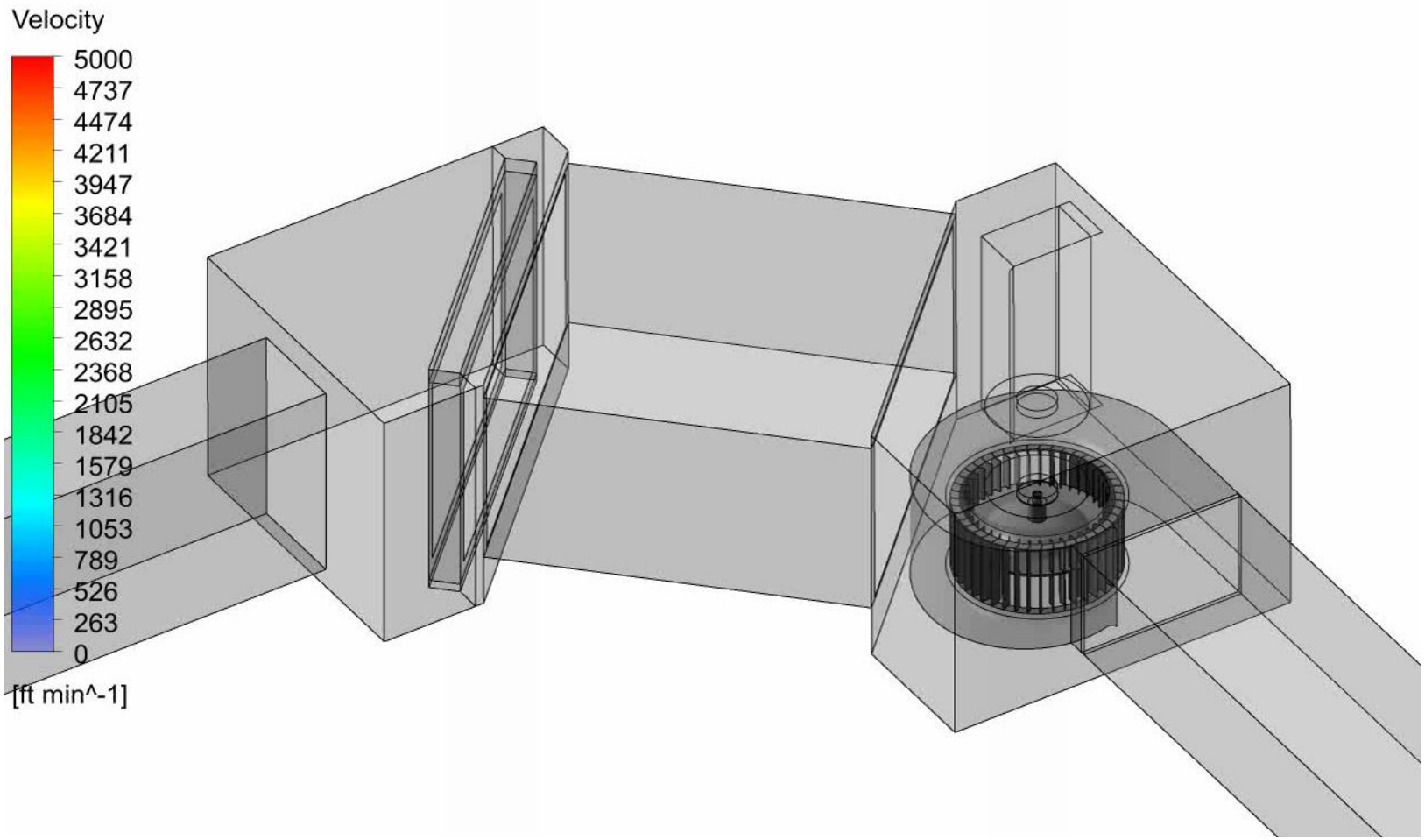


Uniformity index at Static core Inlet =0.936
Uniformity index at Static core Outlet =0.945

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