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Lampiran 01 Lembar Pengesahan Skripsi

LEMBAR PENGESAHAN SKRIPSI

POTENSI PENGGUNAAN TABUNG VORTEKS UNTUK PENGKONDISIAN UDARA PADA RUANG AKOMODOSI KAPAL *FERRY RO-RO* 2000 GT MENGGUNAKAN *COMPUTATIONAL FLUID DYNAMICS (CFD)*

Disusun dan diajukan oleh

MUHAMMAD AINUL ISMAWAN
D091 19 10 63

Telah memenuhi syarat untuk melaksanakan Seminar Proposal/Hasil
Pada tanggal ……

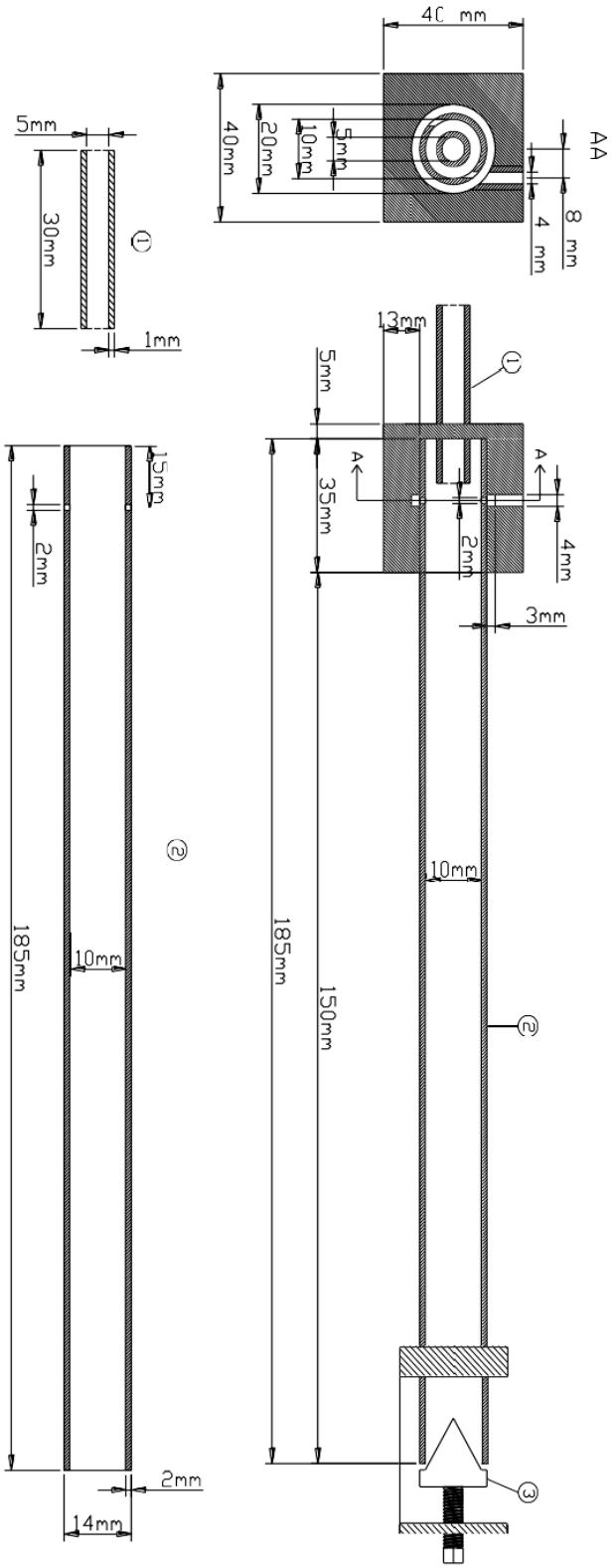
Menyetujui,

Pembimbing Utama,	Pembimbing Pendamping,
Andi Husni Sitepu, S.T., M.T.	M. Iqbal Nikmatullah, S.T., M.T.
NIP 197702712001121001	NIP 198701312019031007

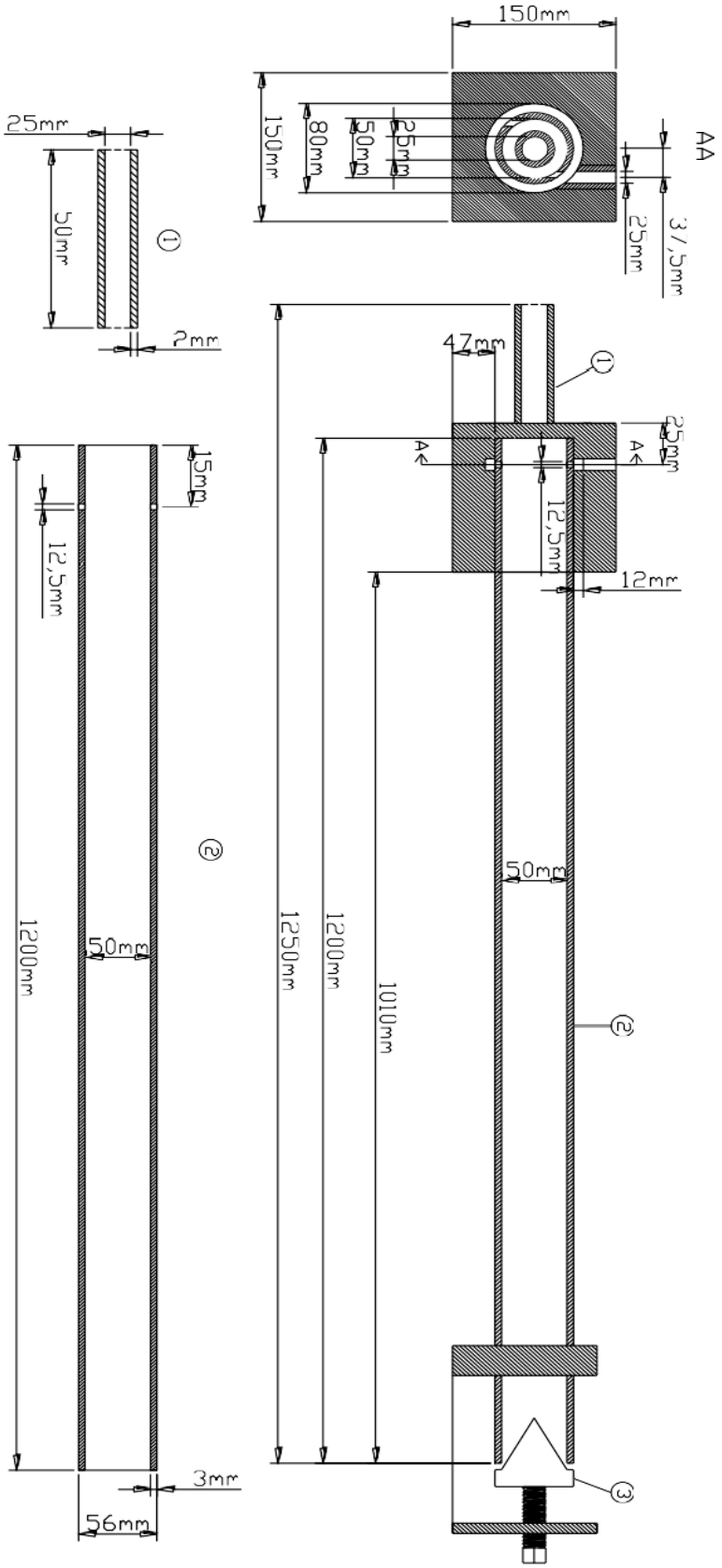
Ketua Program Studi,

Dr.Eng. Ir. Faisal Mahmuddin, S.T., M.Inf.Tech., M.Eng.
NIP 198102112005011003

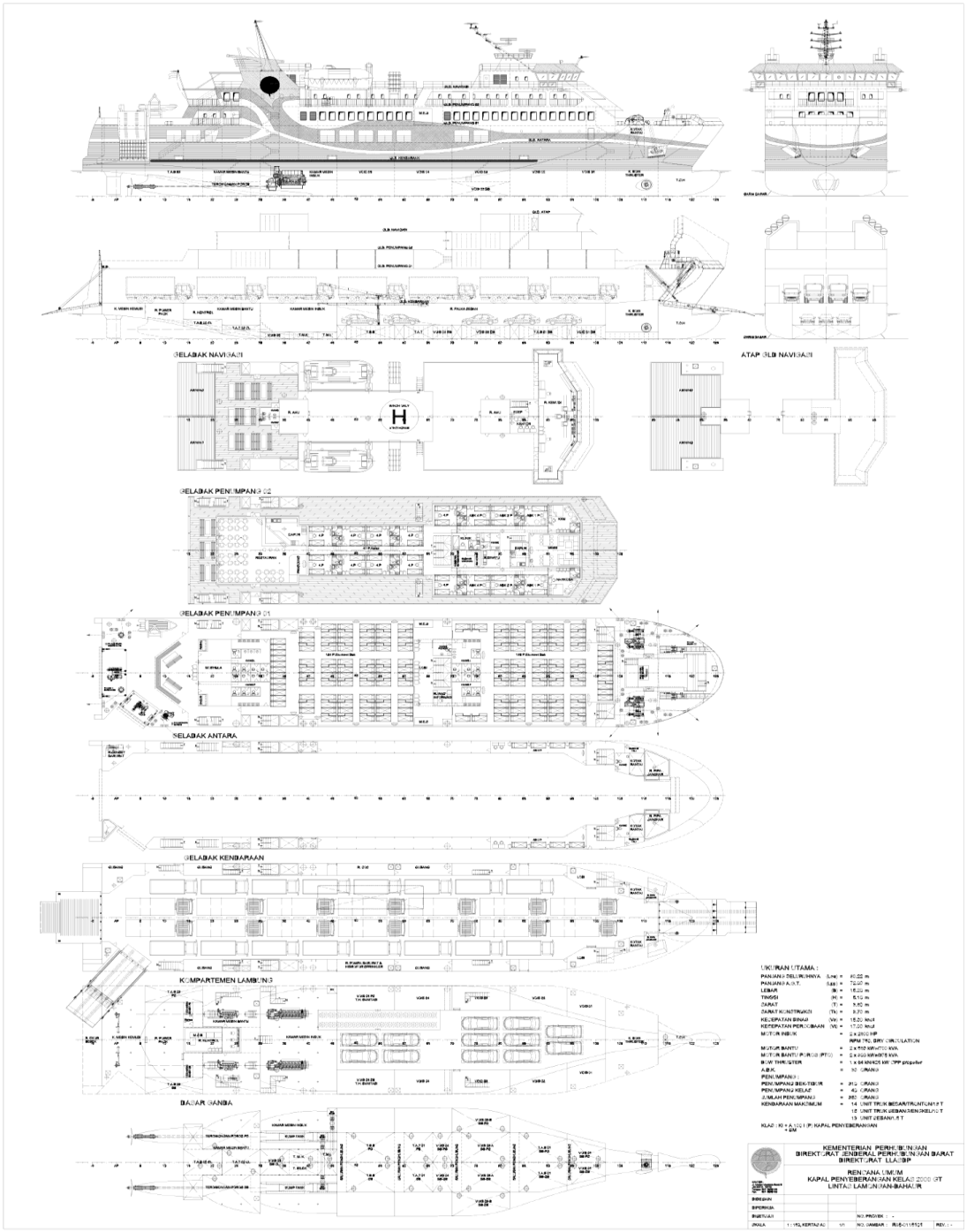
Lampiran 02 Dimensi Ukuran Tabung Vorteks Prototipe



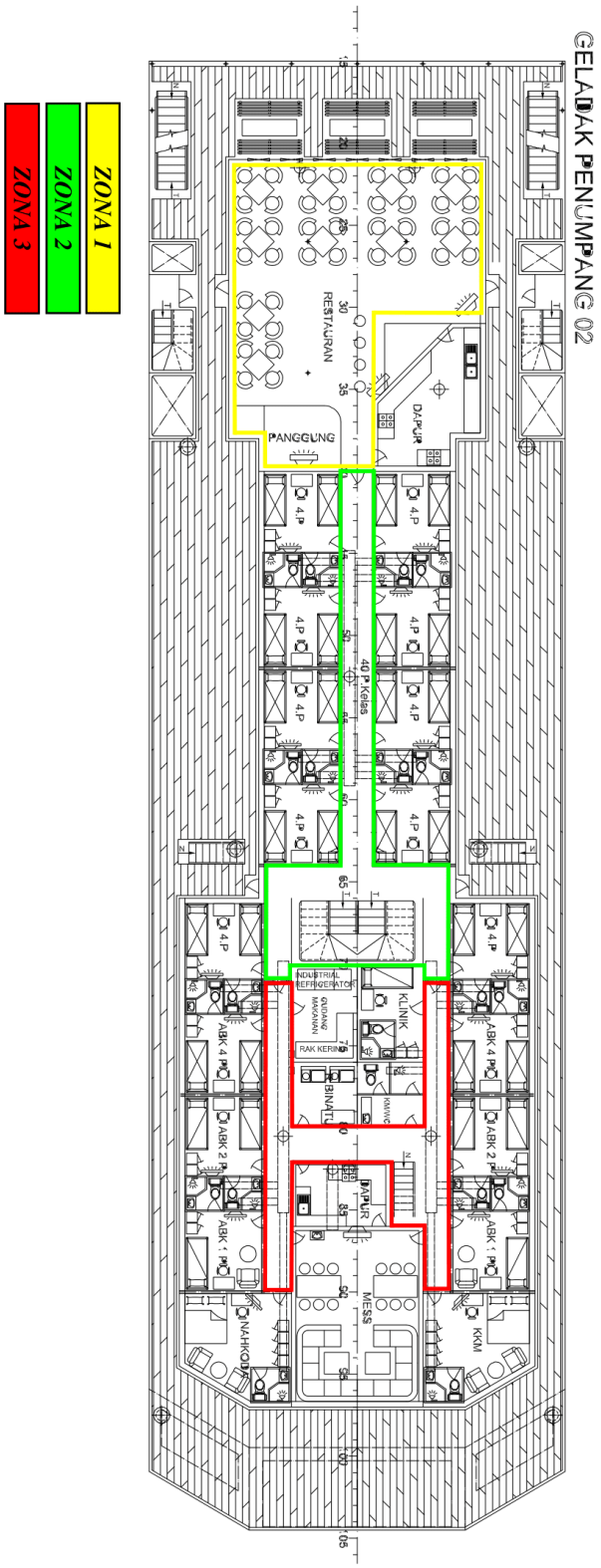
Lampiran 03 Dimensi Ukuran Tabung Vorteks Desain Alternatif

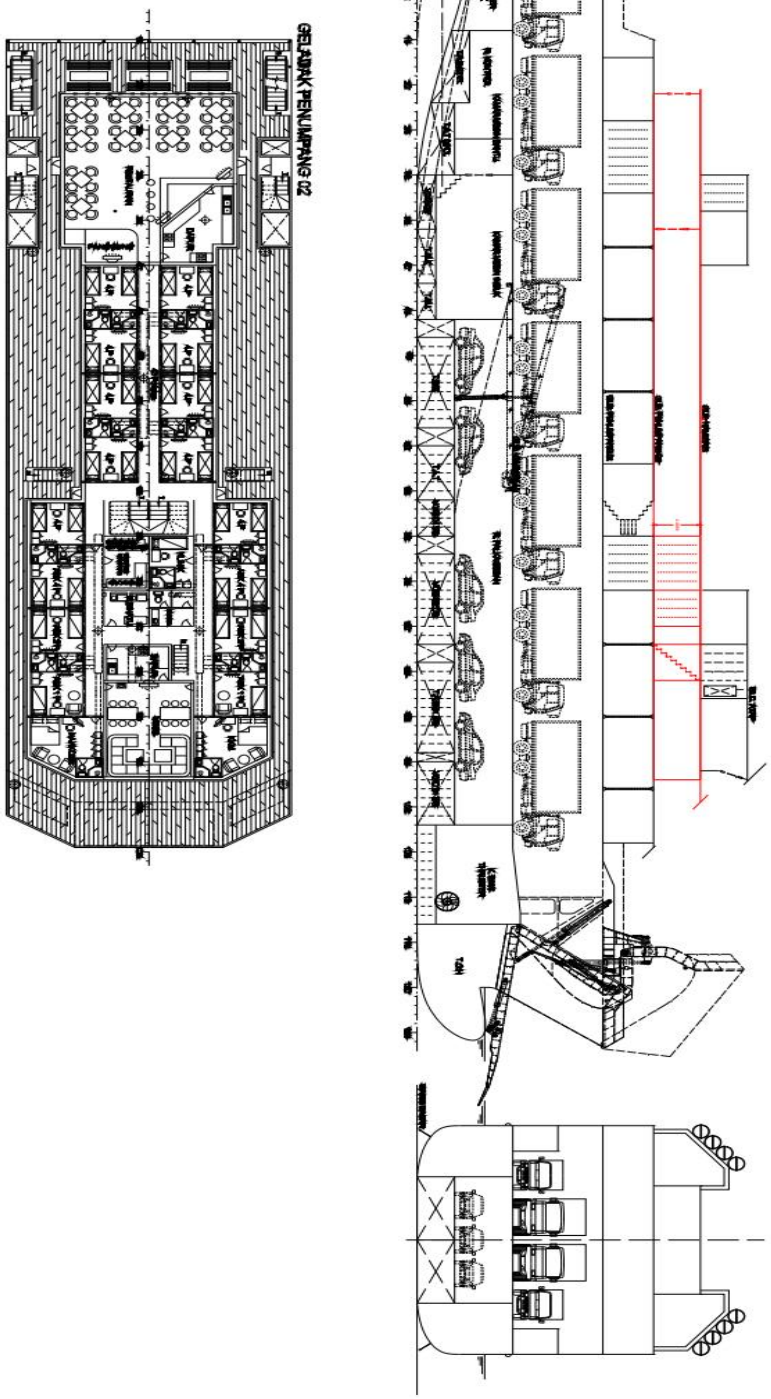


Lampiran 04 Rencana Umum (*General Arrangements*) Kapal *Ferry Ro-Ro* 2000 *GT* Lintas Lamongan-Bahaur

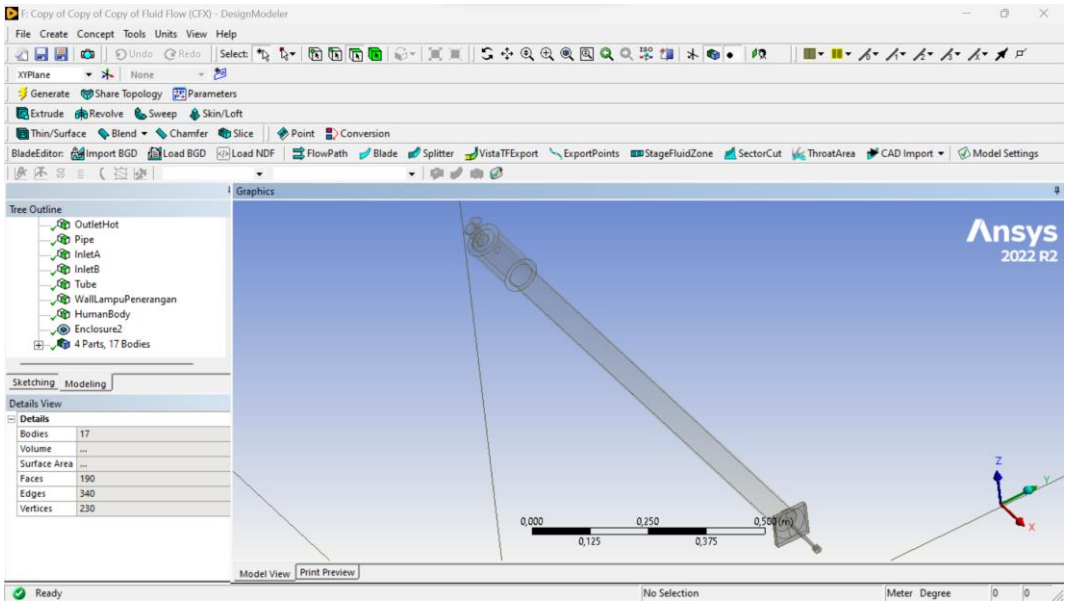


Lampiran 05 Geladak Akomodasi 02 Kapal *Ferry Ro-Ro* 2000 *GT*

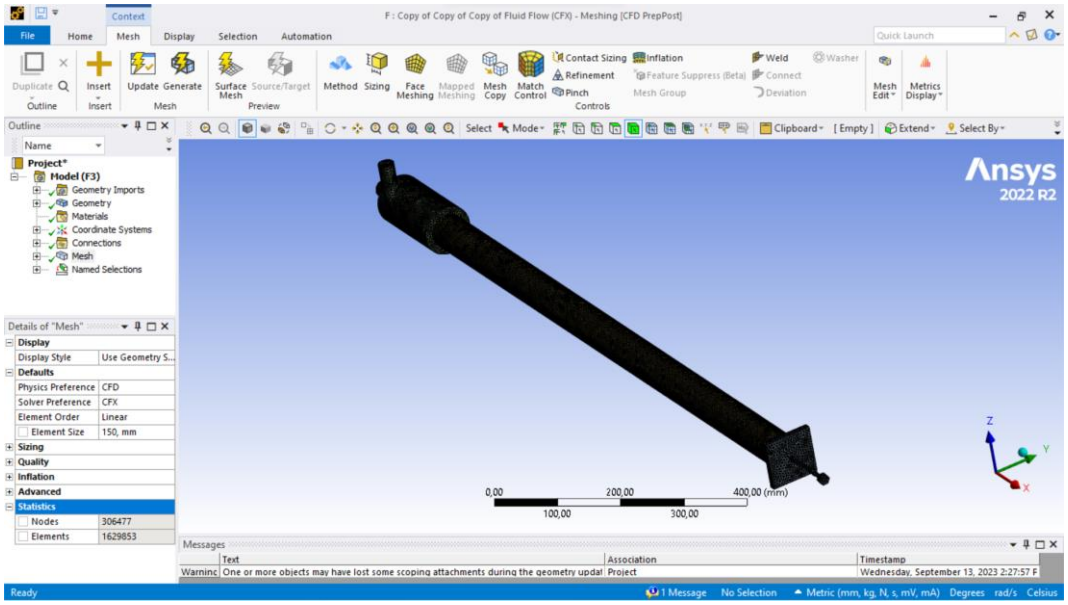



GELADAK PENUMPANG 02

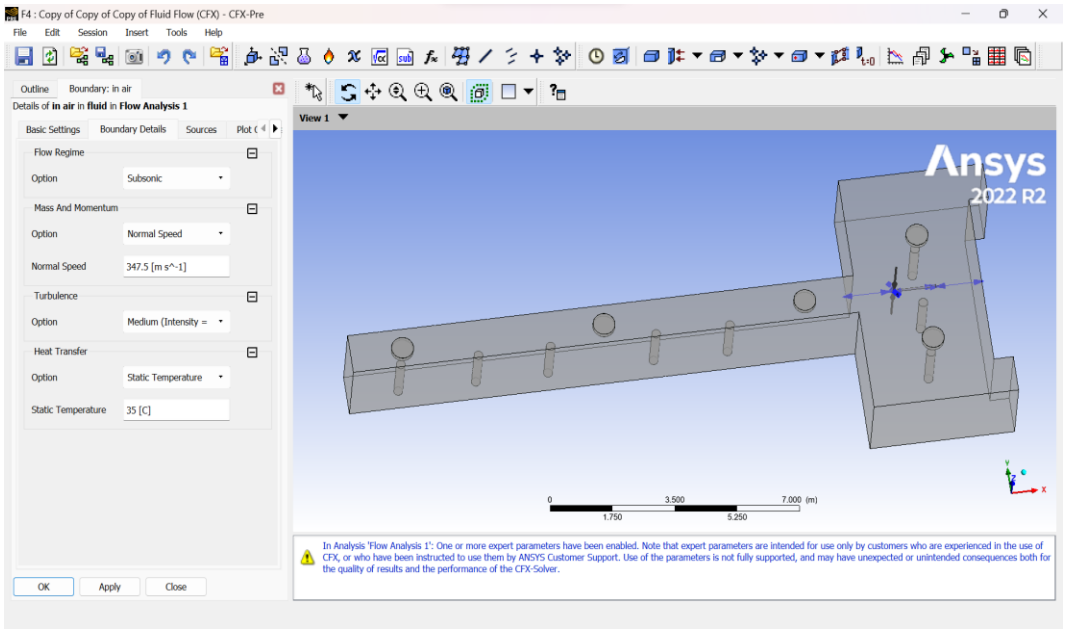
Lampiran 06 Tahap *Geometry* Tabung Vorteks Desain Alternatif Variasi P_{in} = 2,5 Bar



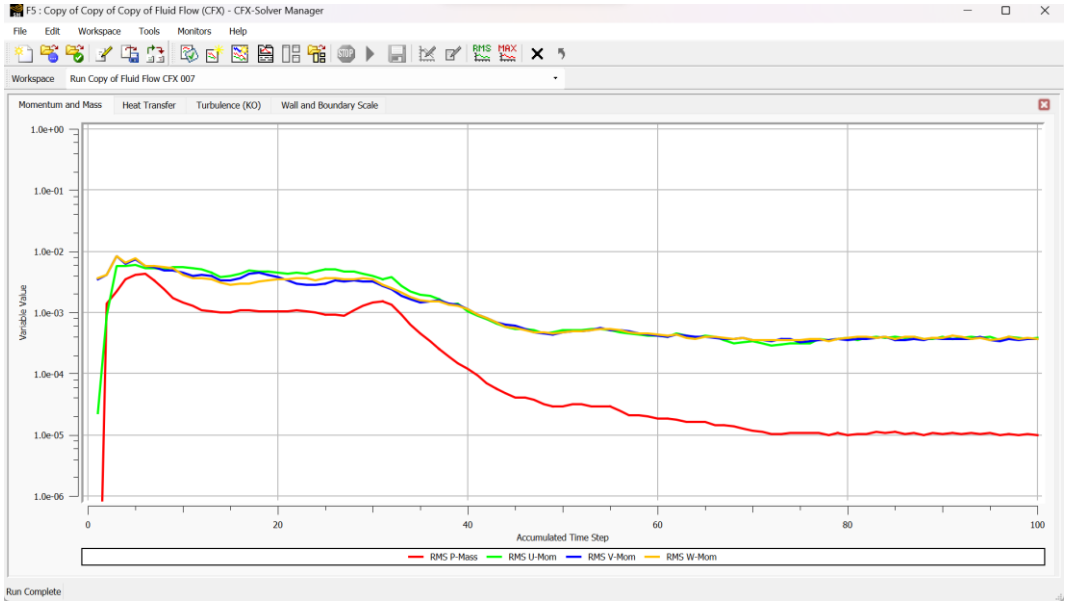
Lampiran 07 Tahap *Meshing* Tabung Vorteks Desain Alternatif Variasi P_{in} = 2,5 Bar

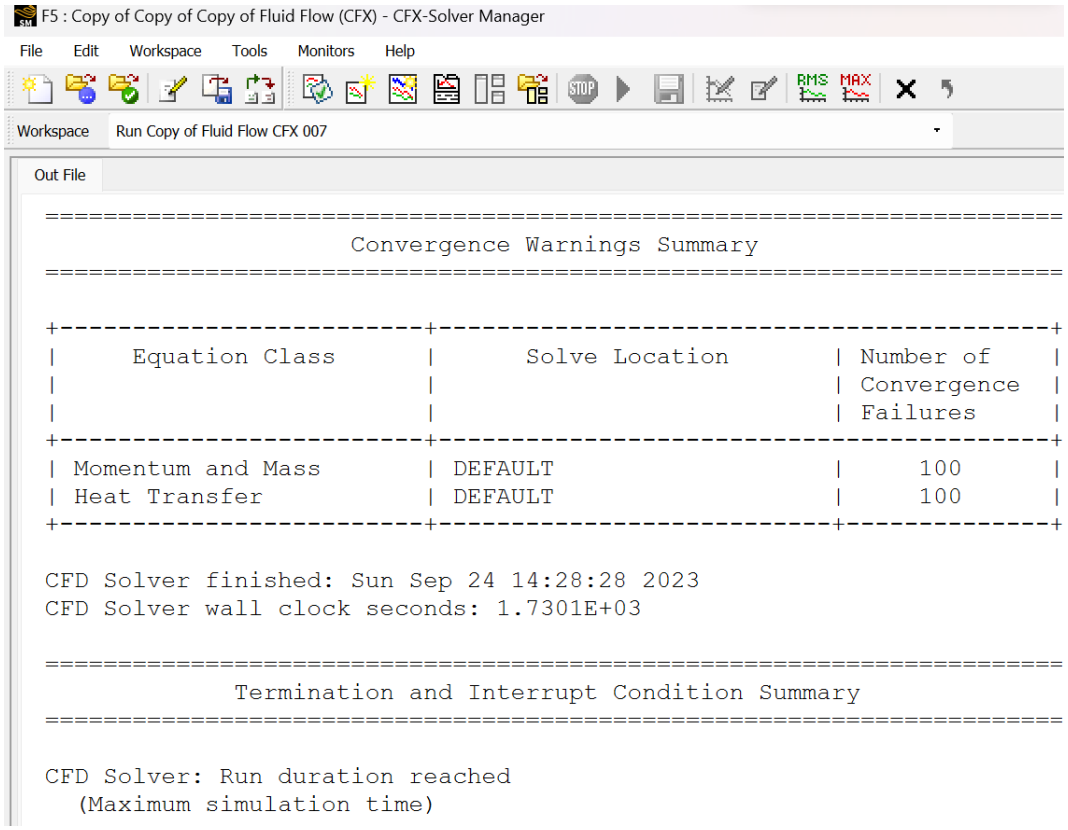


Lampiran 08 Tahap *Setup* Tabung Vorteks Desain Alternatif Variasi P_{in} = 2,5 Bar



Lampiran 09 Tahap *Solution* Tabung Vorteks Desain Alternatif Variasi P_{in} = 2,5 Bar





F5 : Copy of Copy of Copy of Fluid Flow (CFX) - CFX-Solver Manager

File Edit Workspace Tools Monitors Help

Workspace Run Copy of Fluid Flow CFX 007

Out File

```
+--------------------------------------------------------------------+
|                     Average Scale Information                      |
+--------------------------------------------------------------------+

Domain Name : fluid
    Global Length                                        = 4.6676E+00
    Minimum Extent                                       = 2.5000E+00
    Maximum Extent                                       = 1.8440E+01
    Density                                              = 1.1850E+00
    Dynamic Viscosity                                    = 1.8310E-05
    Velocity                                             = 5.8121E+01
    Advection Time                                       = 8.0310E-02
    RMS Courant Number                                   = 3.3125E+05
    Maximum Courant Number                               = 7.2766E+06
    Reynolds Number                                      = 1.7557E+07
    Thermal Conductivity                                 = 2.6100E-02
    Specific Heat Capacity at Constant Pressure          = 1.0044E+03
    Prandtl Number                                       = 7.0462E-01
    Temperature Range                                    = 1.6683E+01

Domain Name : solid
    Global Length                                        = 9.4738E-01
    Minimum Extent                                       = 2.4921E+00
    Maximum Extent                                       = 1.5549E+01
    Density                                              = 2.7020E+03
    Thermal Conductivity                                 = 2.3700E+02
```

F5 : Copy of Copy of Copy of Fluid Flow (CFX) - CFX-Solver Manager

File Edit Workspace Tools Monitors Help

Workspace Run Copy of Fluid Flow CFX 007

Out File

```
    Specific Heat Capacity at Constant Pressure          = 9.0300E+02
    Thermal Diffusivity                                  = 9.7135E-05
    Average Diffusion Timescale                          = 9.2400E+03
    Minimum Diffusion Timescale                          = 6.3937E+04
    Maximum Diffusion Timescale                          = 2.4890E+06
    Temperature Range                                    = 1.0081E-01

+--------------------------------------------------------------------+
|                    Variable Range Information                      |
+--------------------------------------------------------------------+

Domain Name : fluid
+--------------------------------------------------------------------+
|      Variable Name                          |    min    |    max    |
+---------------------------------------------+-----------+-----------+
| Density                                     |  1.19E+00 |  1.19E+00 |
| Specific Heat Capacity at Constant Pressure|  1.00E+03 |  1.00E+03 |
| Dynamic Viscosity                           |  1.83E-05 |  1.83E-05 |
| Thermal Conductivity                        |  2.61E-02 |  2.61E-02 |
| Static Entropy                              | -1.43E+01 |  4.12E+01 |
| Velocity u                                  | -3.41E+02 |  2.40E+02 |
| Velocity v                                  | -3.85E+02 |  4.87E+02 |
| Velocity w                                  | -6.08E+02 |  6.50E+02 |
| Pressure                                    |  8.33E+04 |  4.49E+05 |
| Turbulence Kinetic Energy                   |  7.95E-13 |  1.67E+03 |
| Turbulence Eddy Frequency                   |  4.84E-01 |  2.14E+06 |
```

F5 : Copy of Copy of Copy of Fluid Flow (CFX) - CFX-Solver Manager

File Edit Workspace Tools Monitors Help

Workspace Run Copy of Fluid Flow CFX 007

Out File

```
| Eddy Viscosity                                |  1.19E-16 |  5.08E-02 |
| Temperature                                   |  2.94E+02 |  3.11E+02 |
| Static Enthalpy                               | -4.22E+03 |  1.25E+04 |
| Wall Scale                                    |  1.57E-07 |  4.38E-01 |
| Wall Distance                                 |  6.70E-07 |  9.13E-01 |
+-----------------------------------------------------------------------+

Domain Name : solid
+-----------------------------------------------------------------------+
|      Variable Name                            |    min    |    max    |
+-----------------------------------------------------------------------+
| Density                                       |  2.70E+03 |  2.70E+03 |
| Specific Heat Capacity at Constant Pressure|  9.03E+02 |  9.03E+02 |
| Thermal Conductivity                          |  2.37E+02 |  2.37E+02 |
| Static Entropy                                |  2.98E+01 |  3.01E+01 |
| Temperature                                   |  3.08E+02 |  3.08E+02 |
| Static Enthalpy                               |  9.03E+03 |  9.12E+03 |
+-----------------------------------------------------------------------+
```

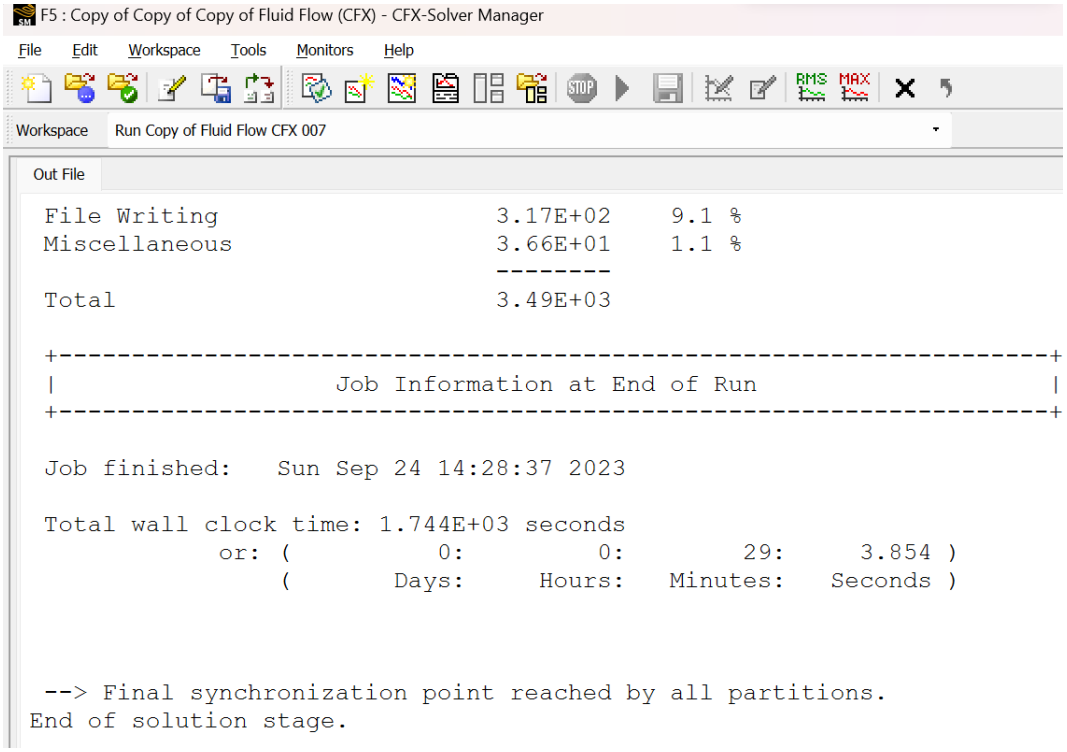
F5 : Copy of Copy of Copy of Fluid Flow (CFX) - CFX-Solver Manager

File Edit Workspace Tools Monitors Help

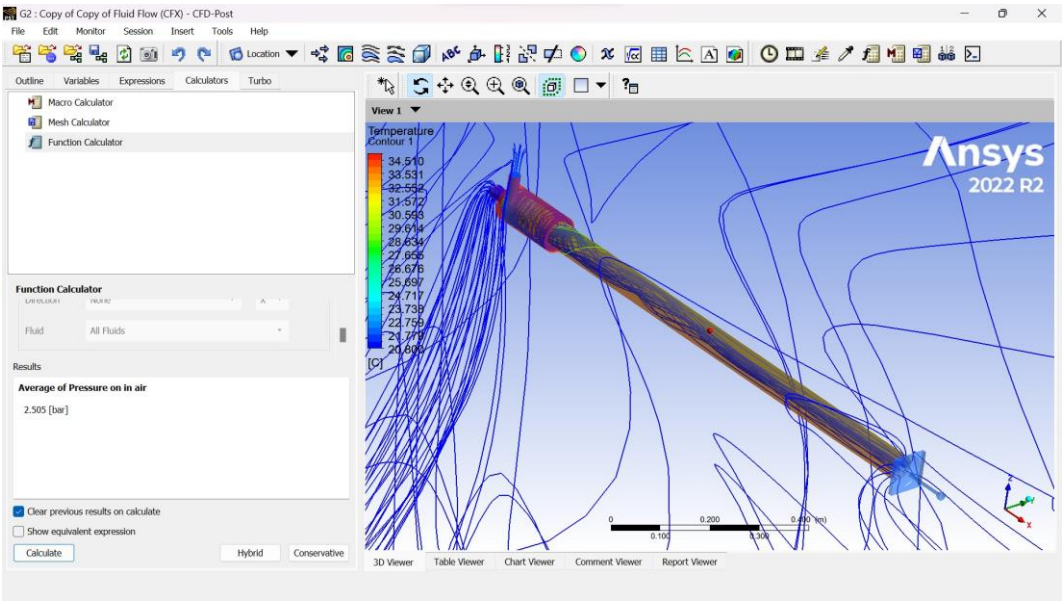
Workspace Run Copy of Fluid Flow CFX 007

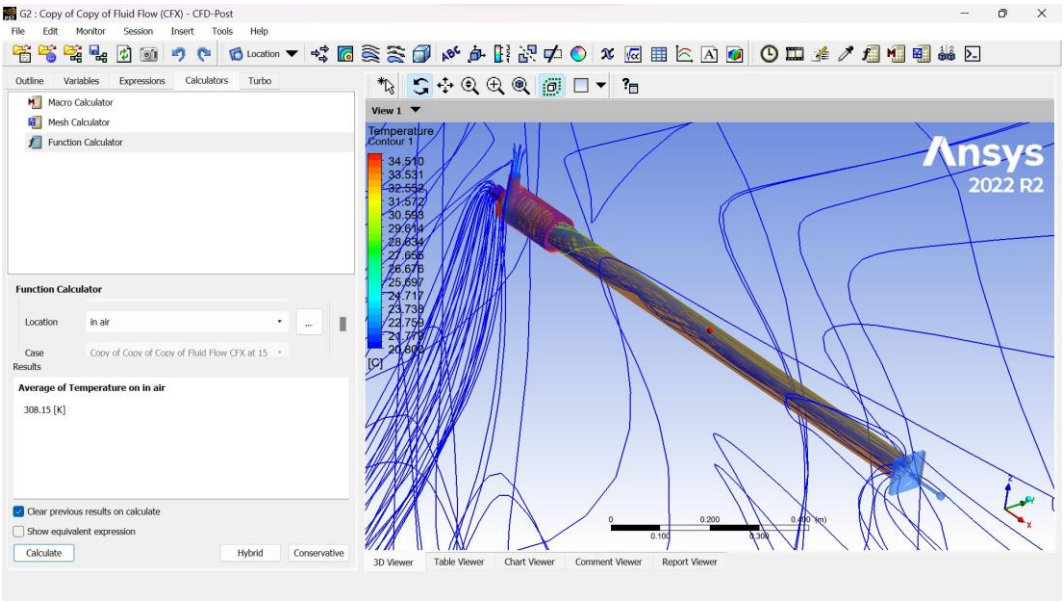
Out File

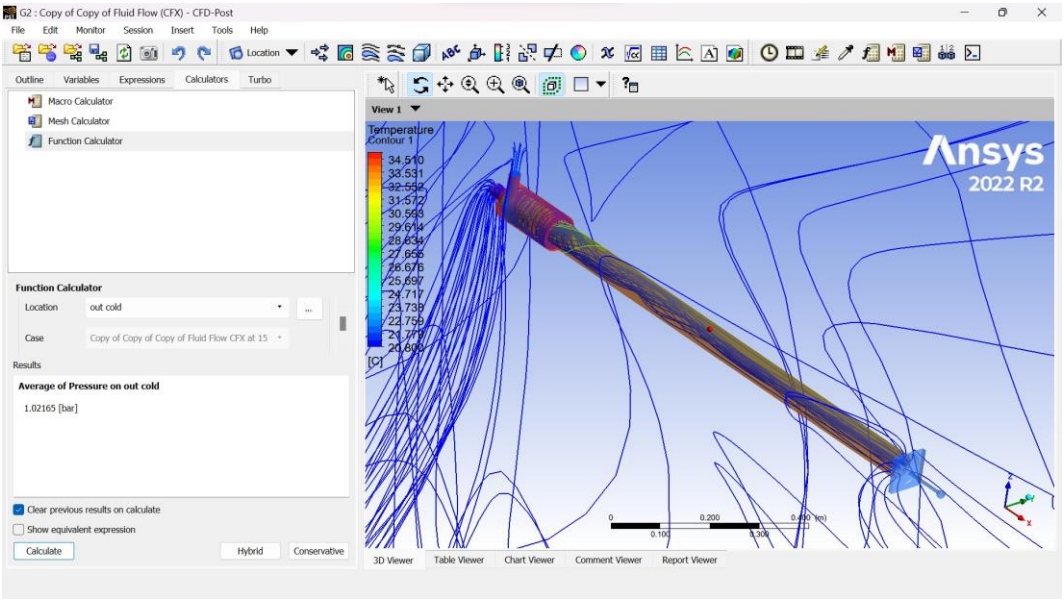
```
+-----------------------------------------------------------------------+
|            Host Memory Information (Mbytes): Solver                   |
+-----------------------------------------------------------------------+
|           Host          | Npart |    System    |     Peak     |   %   |
+-------------------------+-------+--------------+--------------+-------+
| MAIZHY                  |    2  |      6005.99 |      1470.50 | 24.48 |
+-------------------------+-------+--------------+--------------+-------+

+-----------------------------------------------------------------------+
|              CPU Time Requirements of Solver - Total                  |
+-----------------------------------------------------------------------+

Subsystem Name                  Discretization       Linear Solution
                               (secs.   %total)     (secs.   %total)
-------------------------------------------------------------------------
Wall Scale                   9.03E+00    0.3 %     4.48E+00    0.1 %
Momentum and Mass            1.09E+03   31.3 %     2.28E+02    6.5 %
Heat Transfer                4.86E+02   13.9 %     1.32E+02    3.8 %
TurbKE and TurbFreq          4.38E+02   12.6 %     1.61E+02    4.6 %
                             -------- -------     -------- ------
Subsystem Summary            2.02E+03   58.0 %     5.26E+02   15.1 %

GGI Intersection             3.90E-02    0.0 %
File Reading                 5.14E+00    0.1 %
Search Calculations          5.86E-03    0.0 %
Variable Updates             5.79E+02   16.6 %
```

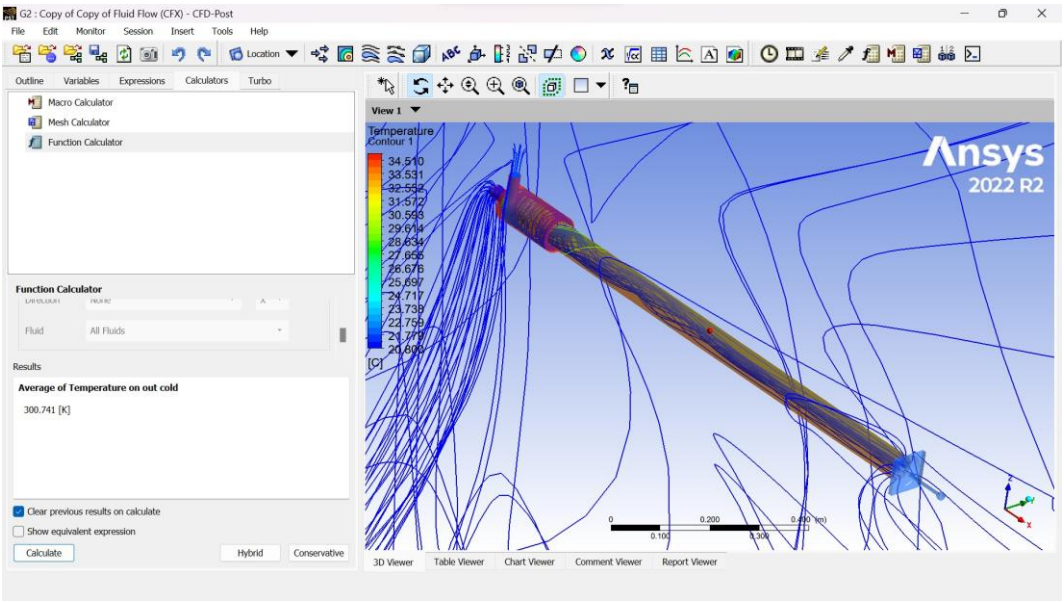

F5 : Copy of Copy of Copy of Fluid Flow (CFX) - CFX-Solver Manager
File
Edit
Workspace
Tools
Monitors
Help
Workspace
Run Copy of Fluid Flow CFX 007
Out File
File Writing 3.17E+02 9.1 %
Miscellaneous 3.66E+01 1.1 %
Total 3.49E+03
Job Information at End of Run
Job finished: Sun Sep 24 14:28:37 2023
Total wall clock time: 1.744E+03 seconds
or: (0: 0: 29: 3.854)
(Days: Hours: Minutes: Seconds)
--> Final synchronization point reached by all partitions.
End of solution stage.

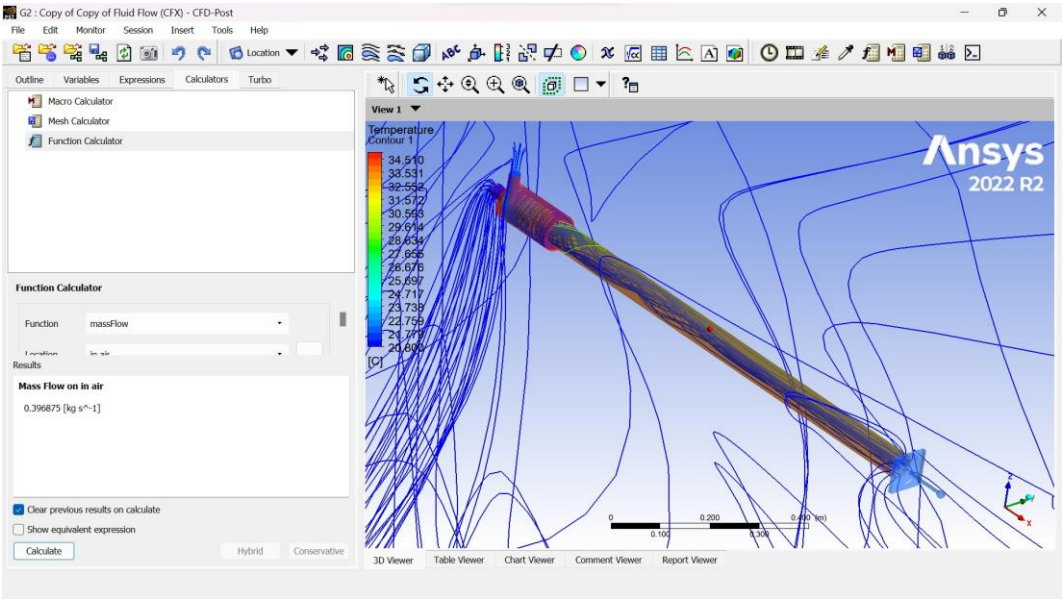
Lampiran 10 Tahap *Result* Tabung Vorteks Desain Alternatif Variasi P_{in} = 2,5 Bar

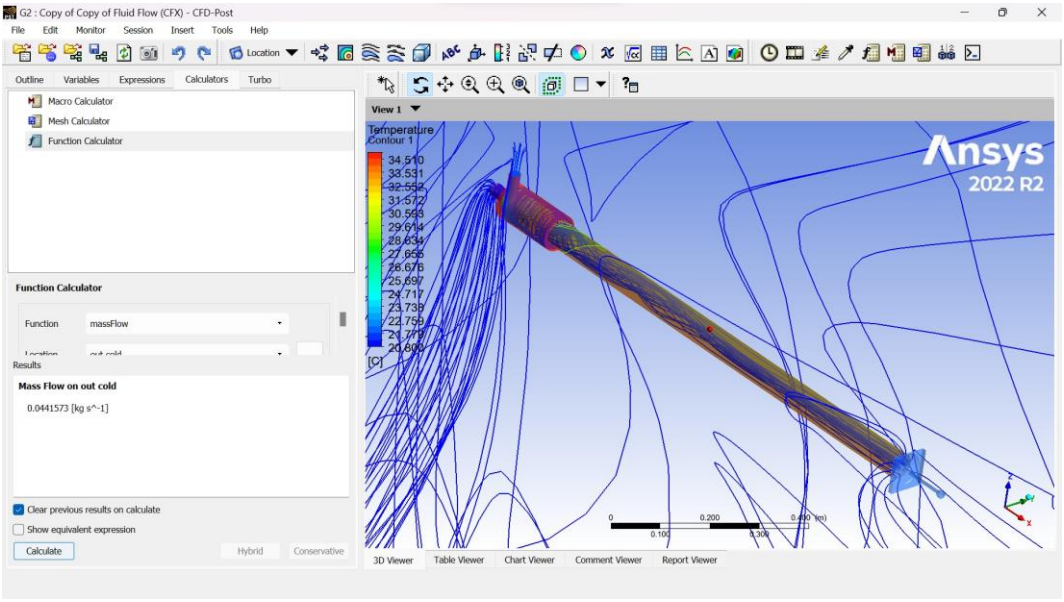




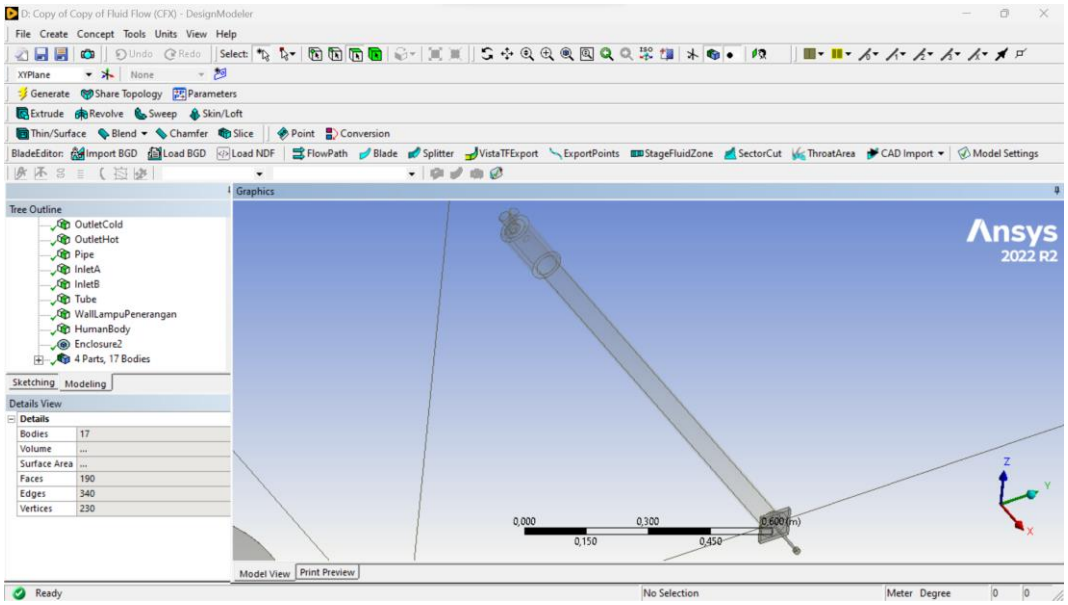



G2 : Copy of Copy of Fluid Flow (CFX) - CFD-Post
File Edit Monitor Session Insert Tools Help
Outline Variables Expressions Calculators Turbo
Macro Calculator
Mesh Calculator
Function Calculator
Function Calculator
Fluid All Fluids
Results
Average of Temperature on out cold
300.741 [K]
Clear previous results on calculate
Show equivalent expression
Calculate
Hybrid Conservative
View 1
Temperature
Contour 1
34.510
33.531
32.552
31.572
30.593
29.614
28.634
27.655
26.676
25.697
24.717
23.738
22.759
21.779
20.800
[C]
Ansys
2022 R2
3D Viewer Table Viewer Chart Viewer Comment Viewer Report Viewer

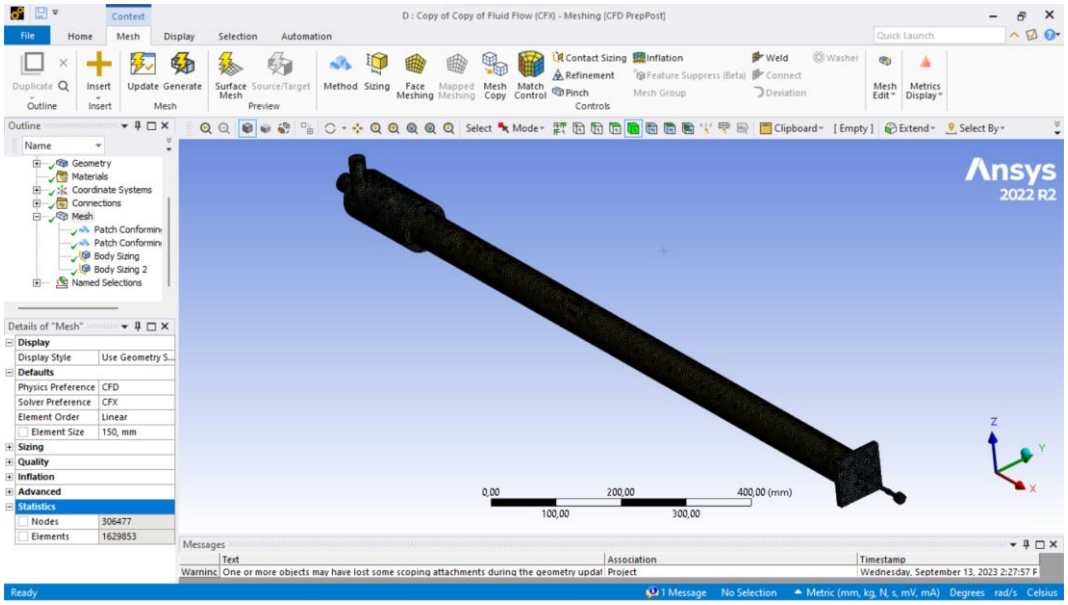

G2 : Copy of Copy of Fluid Flow (CFX) - CFD-Post
File Edit Monitor Session Insert Tools Help
Outline Variables Expressions Calculators Turbo
Macro Calculator
Mesh Calculator
Function Calculator
Function Calculator
Function massFlow
Results
Mass Flow on in air
0.396875 [kg s^-1]
Clear previous results on calculate
Show equivalent expression
Calculate
Hybrid Conservative
View 1
Temperature
Contour 1
34.510
33.531
32.552
31.572
30.593
29.614
28.634
27.655
26.676
25.697
24.717
23.738
22.759
21.779
20.800
[C]
Ansys
2022 R2
3D Viewer Table Viewer Chart Viewer Comment Viewer Report Viewer


G2 : Copy of Copy of Fluid Flow (CFX) - CFD-Post
File Edit Monitor Session Insert Tools Help
Outline Variables Expressions Calculators Turbo
Macro Calculator
Mesh Calculator
Function Calculator
Function Calculator
Function massFlow
Results
Mass Flow on out cold
0.0441573 [kg s^-1]
Clear previous results on calculate
Show equivalent expression
Calculate
Hybrid Conservative
View 1
Temperature
Contour 1
34.510
33.531
32.552
31.572
30.593
29.614
28.634
27.655
26.676
25.697
24.717
23.738
22.759
21.779
20.800
[C]
Ansys
2022 R2
3D Viewer Table Viewer Chart Viewer Comment Viewer Report Viewer

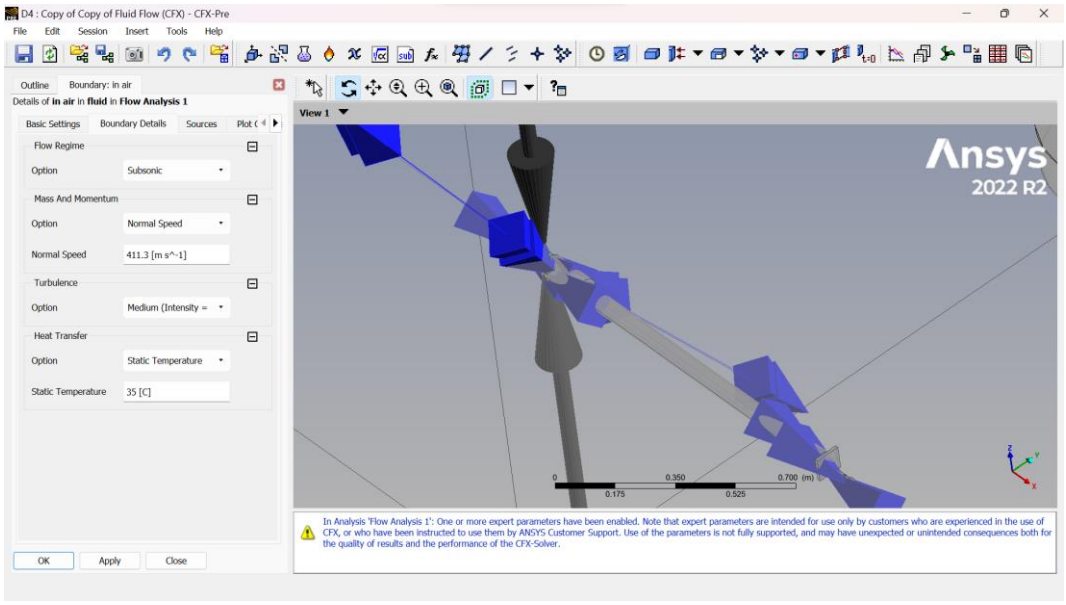
Lampiran 11 Tahap *Geometry* Tabung Vorteks Desain Alternatif Variasi P_{in} = 3 Bar



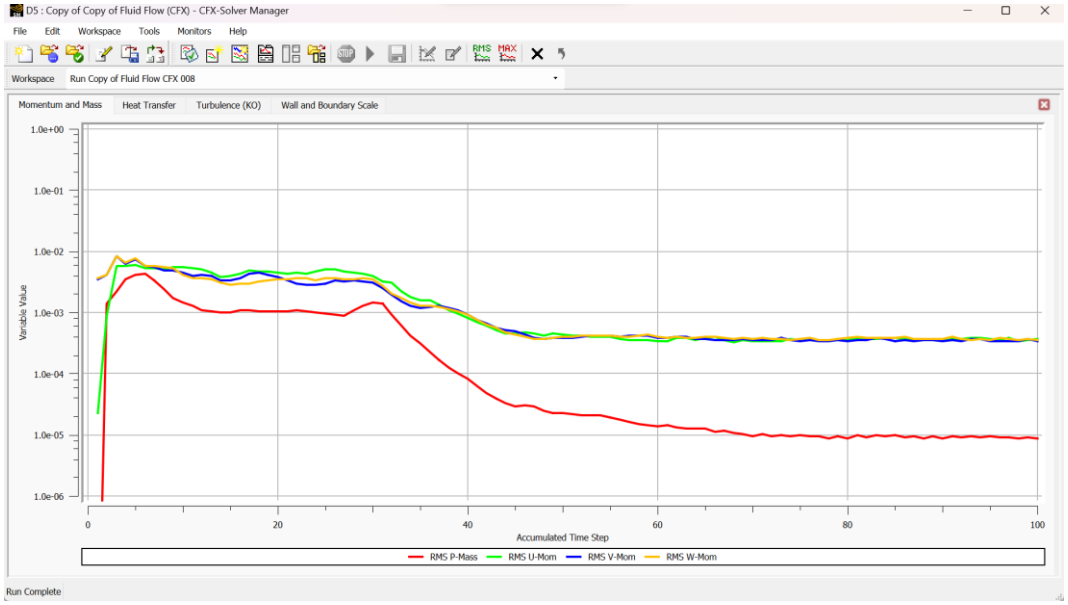
Lampiran 12 Tahap *Meshing* Tabung Vorteks Desain Alternatif Variasi P_{in} = 3 Bar

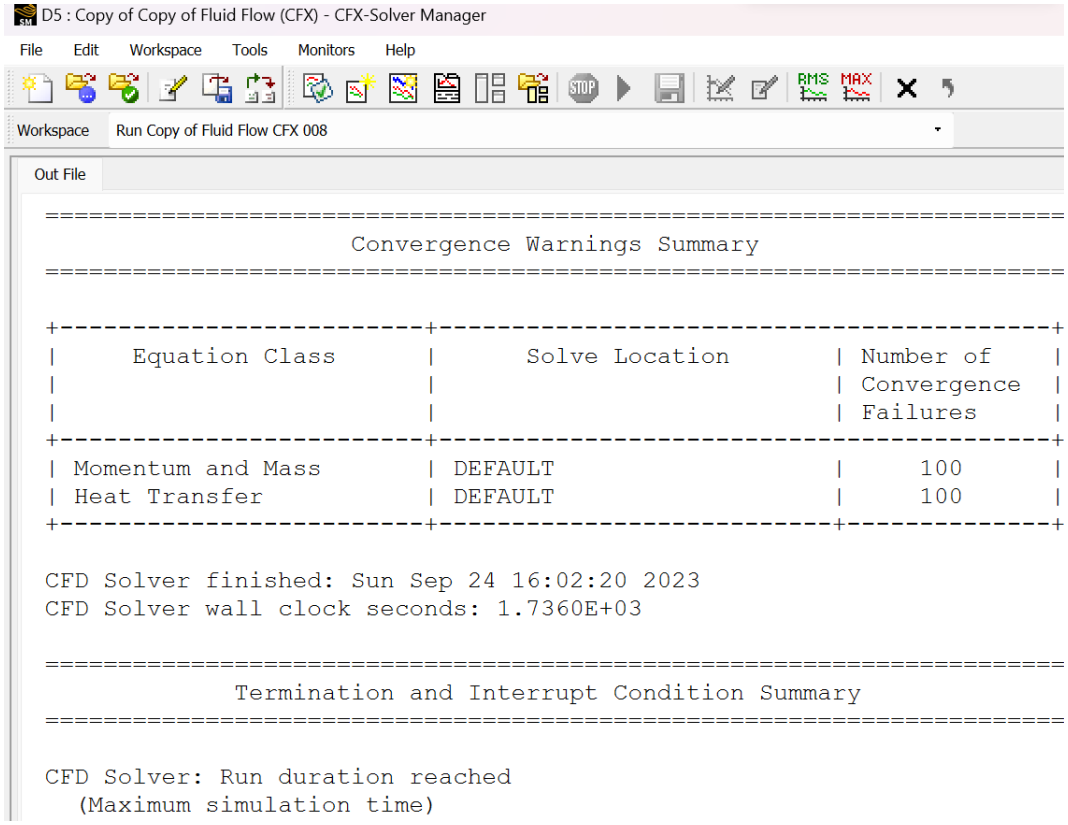


Lampiran 13 Tahap *Setup* Tabung Vorteks Desain Alternatif Variasi P_{in} = 3 Bar



Lampiran 14 Tahap *Solution* Tabung Vorteks Desain Alternatif Variasi P_{in} = 3 Bar





D5 : Copy of Copy of Fluid Flow (CFX) - CFX-Solver Manager

File Edit Workspace Tools Monitors Help

Workspace Run Copy of Fluid Flow CFX 008

Out File

```
+--------------------------------------------------------------------+
|                    Average Scale Information                       |
+--------------------------------------------------------------------+

Domain Name : fluid
    Global Length                                      = 4.6676E+00
    Minimum Extent                                     = 2.5000E+00
    Maximum Extent                                     = 1.8440E+01
    Density                                            = 1.1850E+00
    Dynamic Viscosity                                  = 1.8310E-05
    Velocity                                           = 6.8364E+01
    Advection Time                                     = 6.8276E-02
    RMS Courant Number                                 = 3.8988E+05
    Maximum Courant Number                             = 8.8994E+06
    Reynolds Number                                    = 2.0652E+07
    Thermal Conductivity                               = 2.6100E-02
    Specific Heat Capacity at Constant Pressure        = 1.0044E+03
    Prandtl Number                                     = 7.0462E-01
    Temperature Range                                  = 2.0291E+01

Domain Name : solid
    Global Length                                      = 9.4738E-01
    Minimum Extent                                     = 2.4921E+00
    Maximum Extent                                     = 1.5549E+01
    Density                                            = 2.7020E+03
    Thermal Conductivity                               = 2.3700E+02
```

D5 : Copy of Copy of Fluid Flow (CFX) - CFX-Solver Manager

File Edit Workspace Tools Monitors Help

Workspace Run Copy of Fluid Flow CFX 008

Out File

```
    Specific Heat Capacity at Constant Pressure        = 9.0300E+02
    Thermal Diffusivity                                = 9.7135E-05
    Average Diffusion Timescale                        = 9.2400E+03
    Minimum Diffusion Timescale                        = 6.3937E+04
    Maximum Diffusion Timescale                        = 2.4890E+06
    Temperature Range                                  = 1.0081E-01

+--------------------------------------------------------------------+
|                    Variable Range Information                      |
+--------------------------------------------------------------------+

Domain Name : fluid
+-----------------------------------------------------------------+
|      Variable Name                          |    min    |    max    |
+-----------------------------------------------------------------+
| Density                                     |  1.19E+00 |  1.19E+00 |
| Specific Heat Capacity at Constant Pressure|  1.00E+03 |  1.00E+03 |
| Dynamic Viscosity                           |  1.83E-05 |  1.83E-05 |
| Thermal Conductivity                        |  2.61E-02 |  2.61E-02 |
| Static Entropy                              | -2.66E+01 |  4.12E+01 |
| Velocity u                                  | -3.90E+02 |  2.75E+02 |
| Velocity v                                  | -4.34E+02 |  5.70E+02 |
| Velocity w                                  | -7.34E+02 |  7.52E+02 |
| Pressure                                    |  8.34E+04 |  5.69E+05 |
| Turbulence Kinetic Energy                   |  1.80E-13 |  2.19E+03 |
| Turbulence Eddy Frequency                   |  3.77E-01 |  2.81E+06 |
```

D5 : Copy of Copy of Fluid Flow (CFX) - CFX-Solver Manager

File Edit Workspace Tools Monitors Help

Workspace Run Copy of Fluid Flow CFX 008

Out File

```
| Eddy Viscosity                                |  2.70E-17 |  6.04E-02 |
| Temperature                                   |  2.90E+02 |  3.11E+02 |
| Static Enthalpy                               | -7.83E+03 |  1.25E+04 |
| Wall Scale                                    |  1.57E-07 |  4.38E-01 |
| Wall Distance                                 |  6.70E-07 |  9.13E-01 |
+-----------------------------------------------------------------------+

Domain Name : solid
+-----------------------------------------------------------------------+
|      Variable Name                            |    min    |    max    |
+-----------------------------------------------------------------------+
| Density                                       |  2.70E+03 |  2.70E+03 |
| Specific Heat Capacity at Constant Pressure|  9.03E+02 |  9.03E+02 |
| Thermal Conductivity                          |  2.37E+02 |  2.37E+02 |
| Static Entropy                                |  2.98E+01 |  3.01E+01 |
| Temperature                                   |  3.08E+02 |  3.08E+02 |
| Static Enthalpy                               |  9.03E+03 |  9.12E+03 |
+-----------------------------------------------------------------------+
```

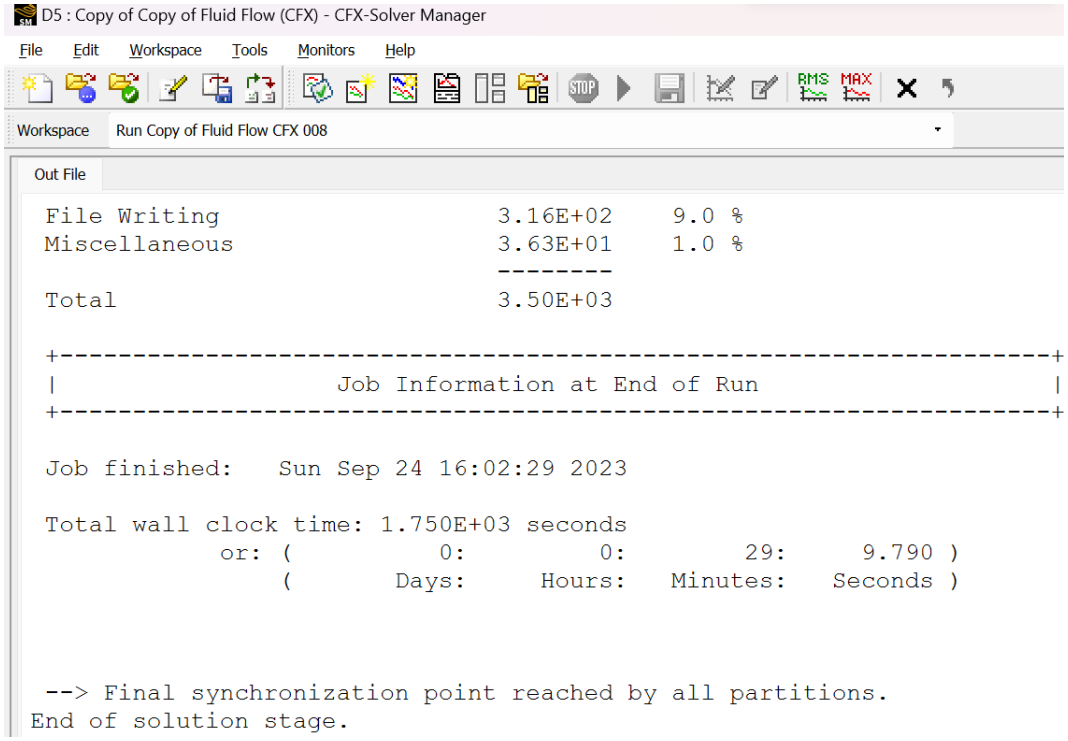
D5 : Copy of Copy of Fluid Flow (CFX) - CFX-Solver Manager

File Edit Workspace Tools Monitors Help

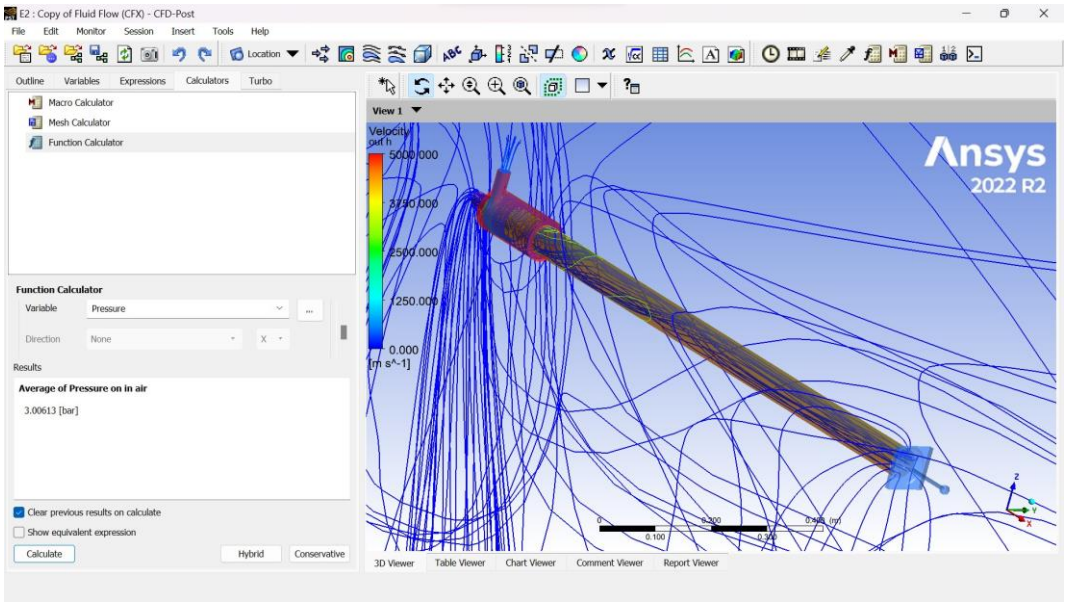
Workspace Run Copy of Fluid Flow CFX 008

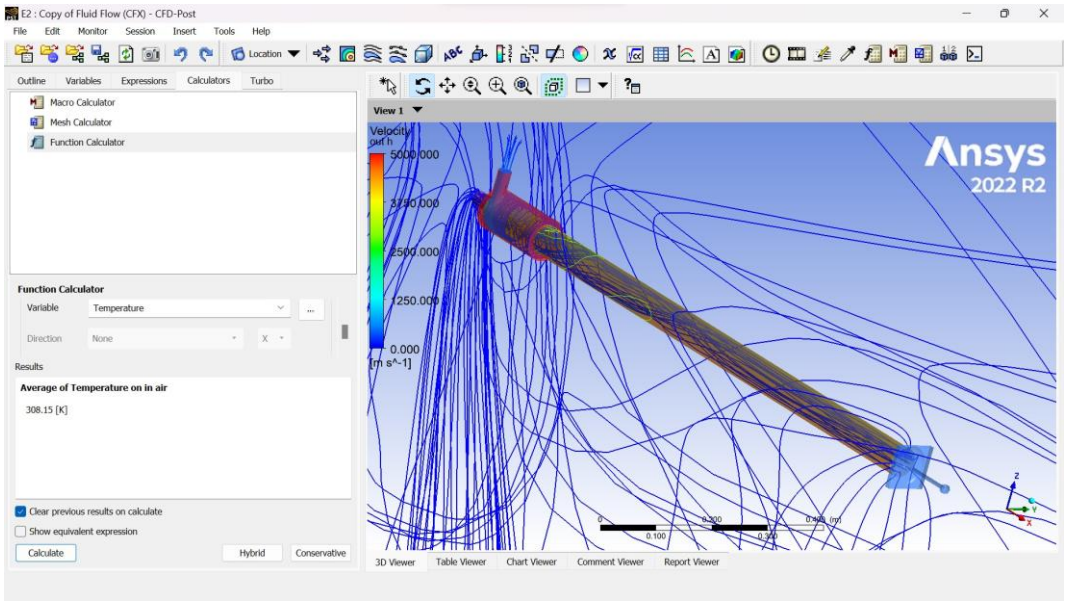
Out File

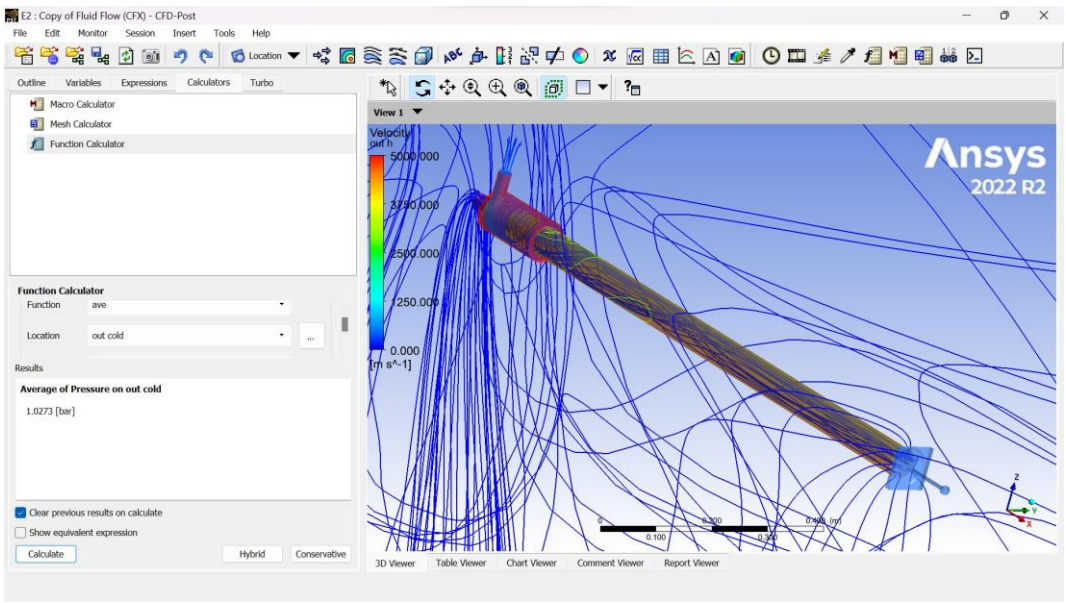
```
+-----------------------------------------------------------------------+
|            Host Memory Information (Mbytes): Solver                   |
+-----------------------------------------------------------------------+
|           Host          | Npart |    System    |     Peak     |   %   |
+-------------------------+-------+--------------+--------------+-------+
| MAIZHY                  |    2  |      6005.99 |      1473.77 | 24.54 |
+-------------------------+-------+--------------+--------------+-------+

+-----------------------------------------------------------------------+
|              CPU Time Requirements of Solver - Total                  |
+-----------------------------------------------------------------------+

Subsystem Name                  Discretization       Linear Solution
                               (secs.   %total)     (secs.   %total)
-------------------------------------------------------------------------
Wall Scale                   8.96E+00    0.3 %     4.32E+00    0.1 %
Momentum and Mass            1.09E+03   31.2 %     2.40E+02    6.8 %
Heat Transfer                4.87E+02   13.9 %     1.31E+02    3.7 %
TurbKE and TurbFreq          4.39E+02   12.5 %     1.60E+02    4.6 %
                             -------- -------     -------- ------
Subsystem Summary            2.03E+03   57.9 %     5.35E+02   15.3 %

GGI Intersection             3.80E-02    0.0 %
File Reading                 5.19E+00    0.1 %
Search Calculations          4.18E-03    0.0 %
Variable Updates             5.80E+02   16.6 %
```

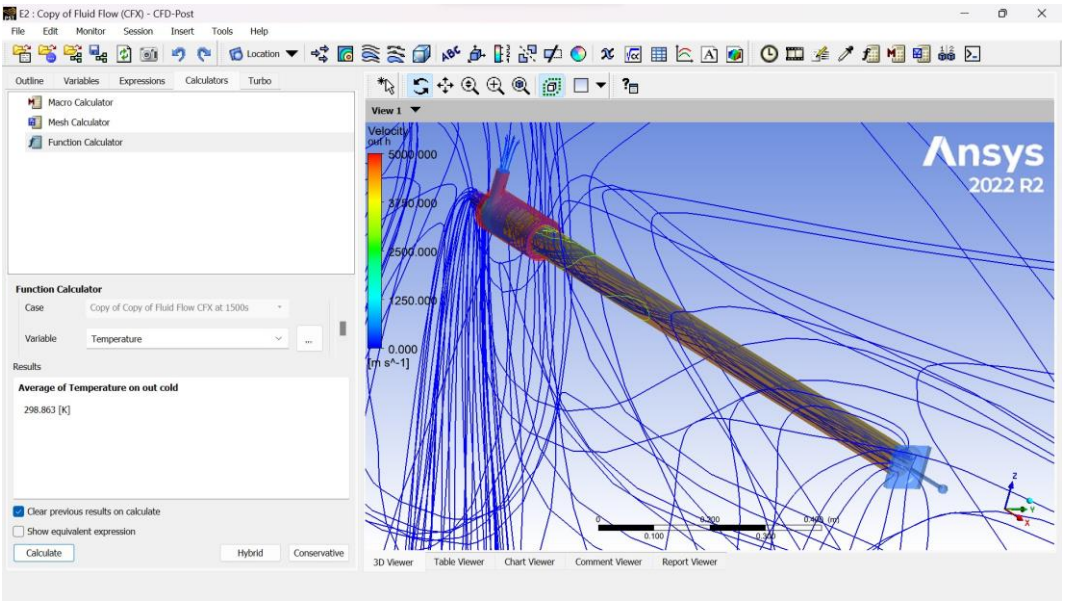

D5 : Copy of Copy of Fluid Flow (CFX) - CFX-Solver Manager
File Edit Workspace Tools Monitors Help
Workspace Run Copy of Fluid Flow CFX 008
Out File
File Writing 3.16E+02 9.0 %
Miscellaneous 3.63E+01 1.0 %
Total 3.50E+03
Job Information at End of Run
Job finished: Sun Sep 24 16:02:29 2023
Total wall clock time: 1.750E+03 seconds
or: (0: 0: 29: 9.790)
(Days: Hours: Minutes: Seconds)
--> Final synchronization point reached by all partitions.
End of solution stage.

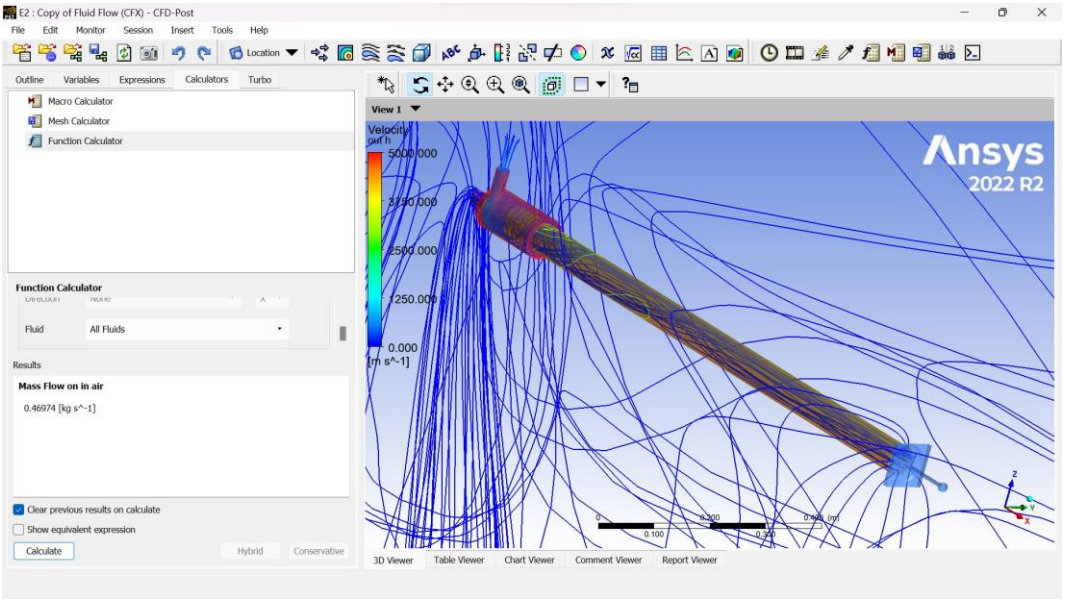
Lampiran 15 Tahap *Result* Tabung Vorteks Desain Alternatif Variasi P_{in} = 3 Bar

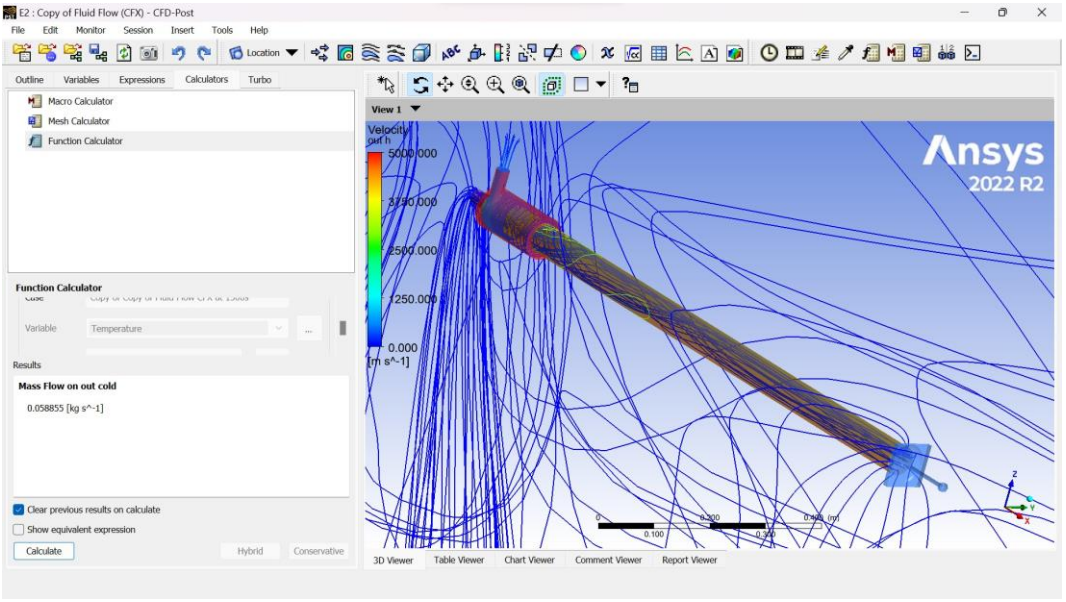




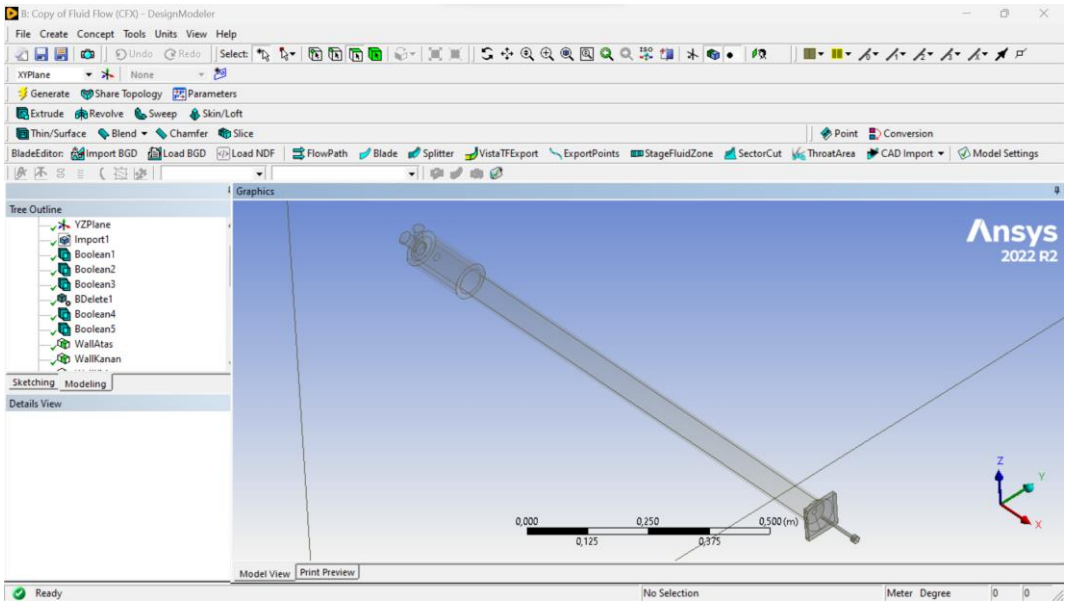



E2 : Copy of Fluid Flow (CFX) - CFD-Post
File Edit Monitor Session Insert Tools Help
Outline Variables Expressions Calculators Turbo
Macro Calculator
Mesh Calculator
Function Calculator
Function Calculator
Case
Copy of Copy of Fluid Flow CFX at 1500s
Variable
Temperature
Results
Average of Temperature on out cold
298.863 [K]
Clear previous results on calculate
Show equivalent expression
Calculate
Hybrid
Conservative
View 1
Velocity
5000.000
3750.000
2500.000
1250.000
0.000
[m s^-1]
Ansys
2022 R2
3D Viewer
Table Viewer
Chart Viewer
Comment Viewer
Report Viewer

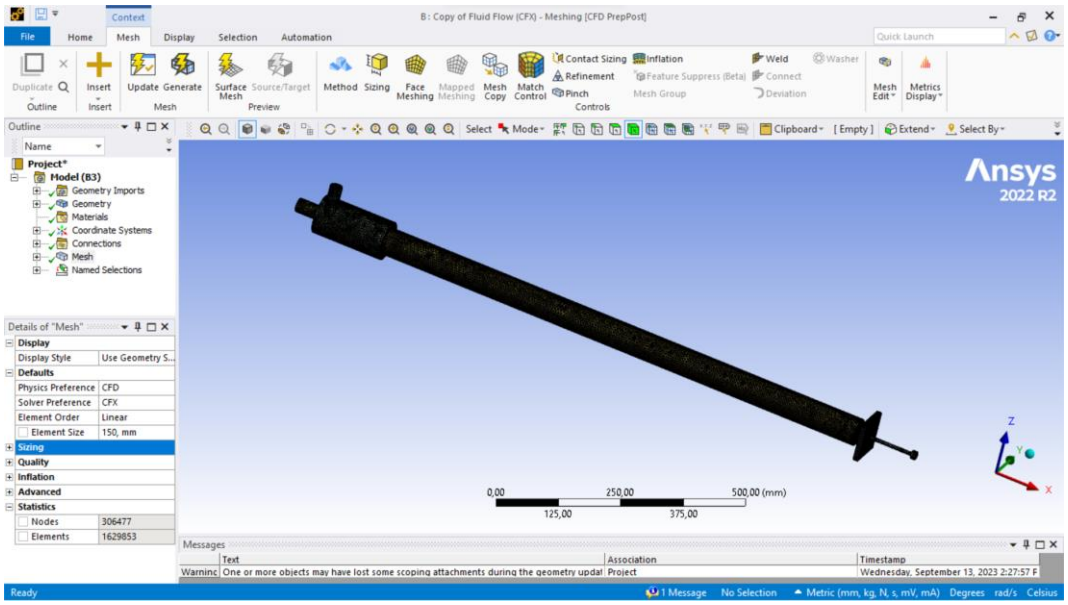

E2 : Copy of Fluid Flow (CFX) - CFD-Post
File Edit Monitor Session Insert Tools Help
Outline Variables Expressions Calculators Turbo
Macro Calculator
Mesh Calculator
Function Calculator
Function Calculator
Fluid
All Fluids
Results
Mass Flow on in air
0.46974 [kg s^-1]
Clear previous results on calculate
Show equivalent expression
Calculate
Hybrid
Conservative
View 1
Velocity
5000.000
3750.000
2500.000
1250.000
0.000
[m s^-1]
Ansys
2022 R2
3D Viewer
Table Viewer
Chart Viewer
Comment Viewer
Report Viewer


E2 : Copy of Fluid Flow (CFX) - CFD-Post
File Edit Monitor Session Insert Tools Help
Outline Variables Expressions Calculators Turbo
Macro Calculator
Mesh Calculator
Function Calculator
Function Calculator
Variable
Temperature
Results
Mass Flow on out cold
0.058855 [kg s^-1]
Clear previous results on calculate
Show equivalent expression
Calculate
Hybrid
Conservative
View 1
Velocity
5000.000
3750.000
2500.000
1250.000
0.000
[m s^-1]
Ansys
2022 R2
3D Viewer
Table Viewer
Chart Viewer
Comment Viewer
Report Viewer

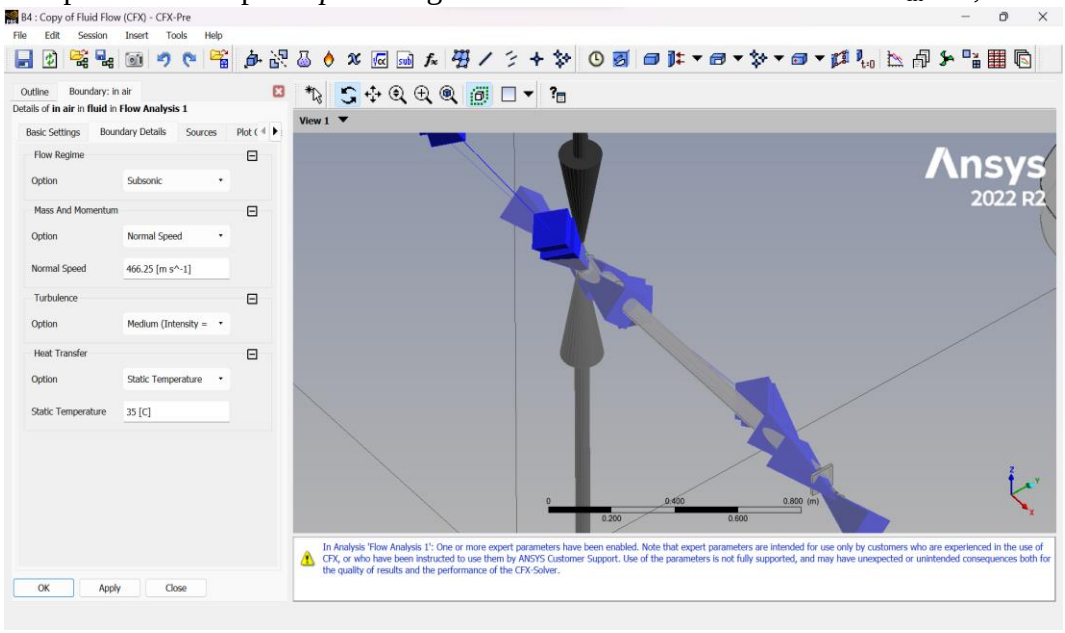
Lampiran 16 Tahap *Geometry* Tabung Vorteks Desain Alternatif Variasi P_{in} = 3,5 Bar



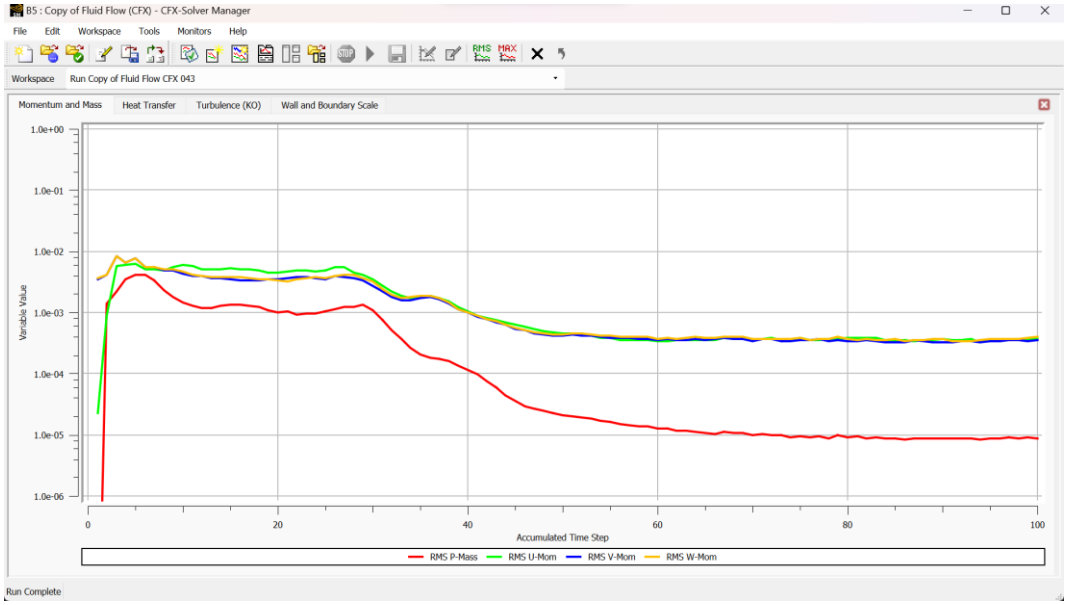
Lampiran 17 Tahap *Meshing* Tabung Vorteks Desain Alternatif Variasi P_{in} = 3,5 Bar

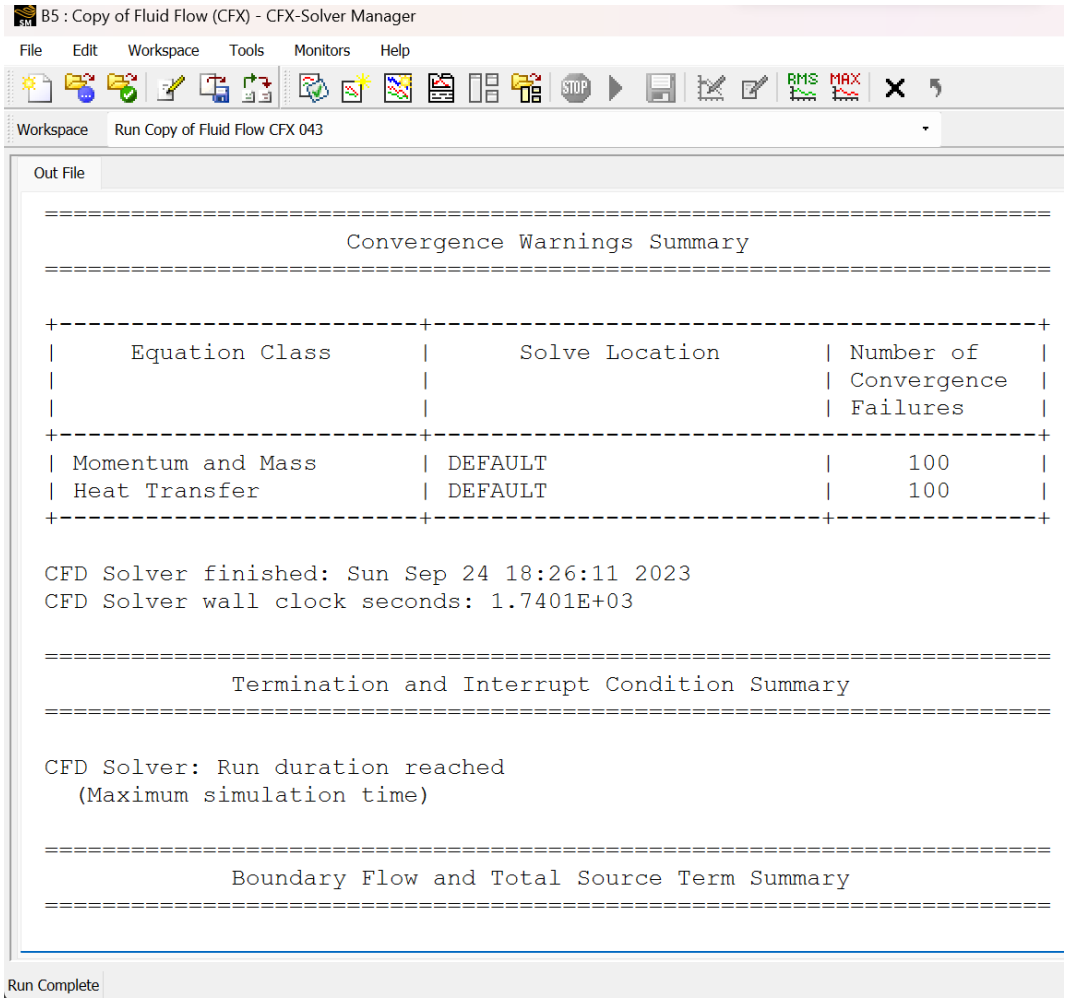


Lampiran 18 Tahap *Setup* Tabung Vorteks Desain Alternatif Variasi P_{in} = 3,5 Bar



Lampiran 19 Tahap *Solution* Tabung Vorteks Desain Alternatif Variasi P_{in} = 3,5 Bar





B5 : Copy of Fluid Flow (CFX) - CFX-Solver Manager

File Edit Workspace Tools Monitors Help

Workspace Run Copy of Fluid Flow CFX 043

Out File

```
+--------------------------------------------------------------------+
|                     Average Scale Information                      |
+--------------------------------------------------------------------+

Domain Name : fluid
    Global Length                                      = 4.6676E+00
    Minimum Extent                                     = 2.5000E+00
    Maximum Extent                                     = 1.8440E+01
    Density                                            = 1.1850E+00
    Dynamic Viscosity                                  = 1.8310E-05
    Velocity                                           = 7.7327E+01
    Advection Time                                     = 6.0362E-02
    RMS Courant Number                                 = 4.4084E+05
    Maximum Courant Number                             = 1.0270E+07
    Reynolds Number                                    = 2.3359E+07
    Thermal Conductivity                               = 2.6100E-02
    Specific Heat Capacity at Constant Pressure        = 1.0044E+03
    Prandtl Number                                     = 7.0462E-01
    Temperature Range                                  = 2.3770E+01
```

B5 : Copy of Fluid Flow (CFX) - CFX-Solver Manager

File Edit Workspace Tools Monitors Help

Workspace Run Copy of Fluid Flow CFX 043

Out File

```
Domain Name : solid
    Global Length                                      = 9.4738E-01
    Minimum Extent                                     = 2.4921E+00
    Maximum Extent                                     = 1.5549E+01
    Density                                            = 2.7020E+03
    Thermal Conductivity                               = 2.3700E+02
    Specific Heat Capacity at Constant Pressure        = 9.0300E+02
    Thermal Diffusivity                                = 9.7135E-05
    Average Diffusion Timescale                        = 9.2400E+03
    Minimum Diffusion Timescale                        = 6.3937E+04
    Maximum Diffusion Timescale                        = 2.4890E+06
    Temperature Range                                  = 1.0081E-01
```

B5 : Copy of Fluid Flow (CFX) - CFX-Solver Manager

File Edit Workspace Tools Monitors Help

Workspace Run Copy of Fluid Flow CFX 043

Out File

```
+--------------------------------------------------------------------+
|                    Variable Range Information                      |
+--------------------------------------------------------------------+

Domain Name : fluid
+--------------------------------------------------------------------+
|      Variable Name                          |    min     |    max    |
+--------------------------------------------------------------------+
| Density                                     |  1.19E+00  |  1.19E+00 |
| Specific Heat Capacity at Constant Pressure|  1.00E+03  |  1.00E+03 |
| Dynamic Viscosity                           |  1.83E-05  |  1.83E-05 |
| Thermal Conductivity                        |  2.61E-02  |  2.61E-02 |
| Static Entropy                              | -3.85E+01  |  4.15E+01 |
| Velocity u                                  | -4.35E+02  |  3.05E+02 |
| Velocity v                                  | -4.79E+02  |  6.42E+02 |
| Velocity w                                  | -8.42E+02  |  8.42E+02 |
| Pressure                                    |  8.31E+04  |  6.90E+05 |
| Turbulence Kinetic Energy                   |  1.06E-15  |  2.70E+03 |
| Turbulence Eddy Frequency                   |  2.44E-01  |  3.50E+06 |
| Eddy Viscosity                              |  1.58E-19  |  7.54E-02 |
| Temperature                                 |  2.87E+02  |  3.11E+02 |
| Static Enthalpy                             | -1.13E+04  |  1.26E+04 |
| Wall Scale                                  |  1.57E-07  |  4.38E-01 |
| Wall Distance                               |  6.70E-07  |  9.13E-01 |
+--------------------------------------------------------------------+
```

B5 : Copy of Fluid Flow (CFX) - CFX-Solver Manager

File Edit Workspace Tools Monitors Help

Workspace Run Copy of Fluid Flow CFX 043

Out File

```
Domain Name : solid
+--------------------------------------------------------------------+
|      Variable Name                          |    min     |    max    |
+--------------------------------------------------------------------+
| Density                                     |  2.70E+03  |  2.70E+03 |
| Specific Heat Capacity at Constant Pressure|  9.03E+02  |  9.03E+02 |
| Thermal Conductivity                        |  2.37E+02  |  2.37E+02 |
| Static Entropy                              |  2.98E+01  |  3.01E+01 |
| Temperature                                 |  3.08E+02  |  3.08E+02 |
| Static Enthalpy                             |  9.03E+03  |  9.12E+03 |
+--------------------------------------------------------------------+
```

B5 : Copy of Fluid Flow (CFX) - CFX-Solver Manager

File Edit Workspace Tools Monitors Help

Workspace Run Copy of Fluid Flow CFX 043

Out File

```
+--------------------------------------------------------------------+
|            Host Memory Information (Mbytes): Solver                |
+--------------------------+-------+-------------+-------------+-------+
|           Host           | Npart |   System    |    Peak     |   %   |
+--------------------------+-------+-------------+-------------+-------+
| MAIZHY                   |     2 |     6005.99 |     1451.64 | 24.17 |
+--------------------------+-------+-------------+-------------+-------+

+--------------------------------------------------------------------+
|              CPU Time Requirements of Solver - Total               |
+--------------------------------------------------------------------+

Subsystem Name                  Discretization       Linear Solution
                               (secs.   %total)     (secs.   %total)
-------------------------------------------------------------------------
Wall Scale                    8.64E+00   0.2 %     4.35E+00   0.1 %
Momentum and Mass             1.09E+03  31.1 %     2.60E+02   7.4 %
Heat Transfer                 4.85E+02  13.8 %     1.28E+02   3.7 %
TurbKE and TurbFreq           4.33E+02  12.3 %     1.60E+02   4.6 %
                              --------  -------    --------   ------
Subsystem Summary             2.02E+03  57.5 %     5.53E+02  15.8 %

GGI Intersection              3.90E-02   0.0 %
File Reading                  5.19E+00   0.1 %
Search Calculations           6.09E-03   0.0 %
Variable Updates              5.77E+02  16.4 %
```

B5 : Copy of Fluid Flow (CFX) - CFX-Solver Manager

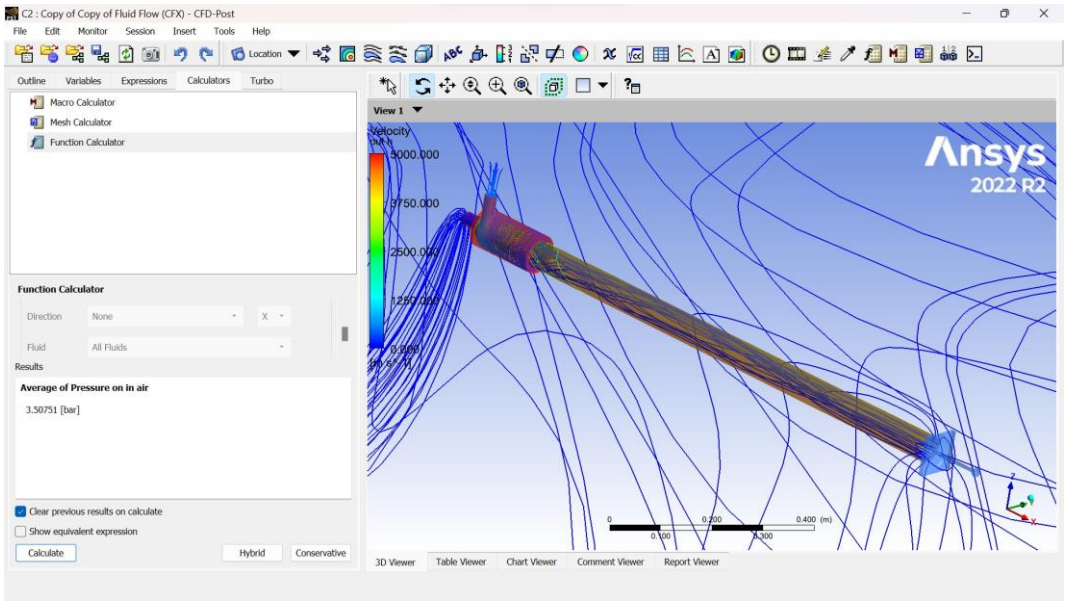
File Edit Workspace Tools Monitors Help

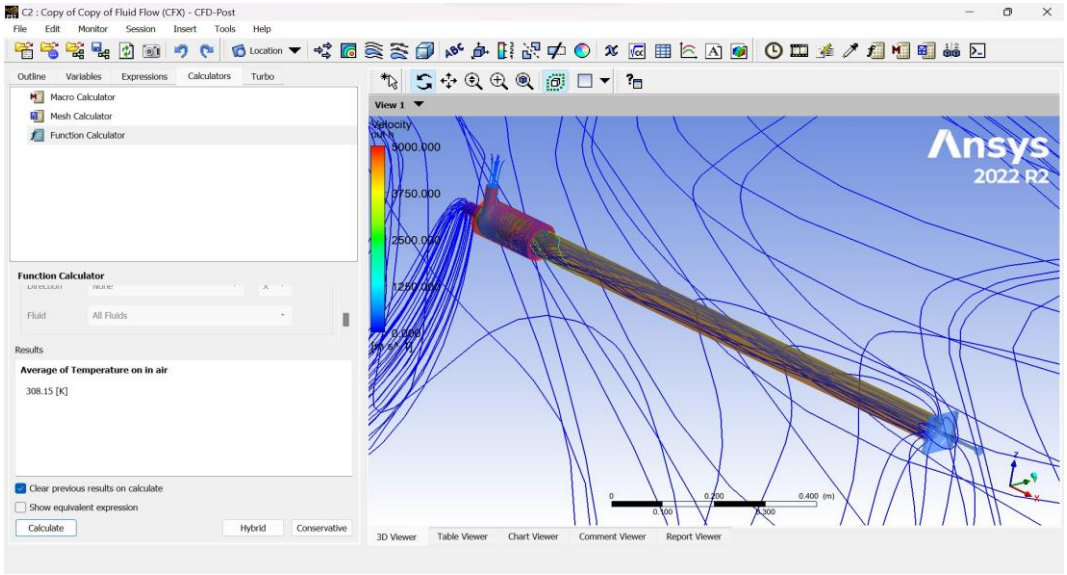
Workspace Run Copy of Fluid Flow CFX 043

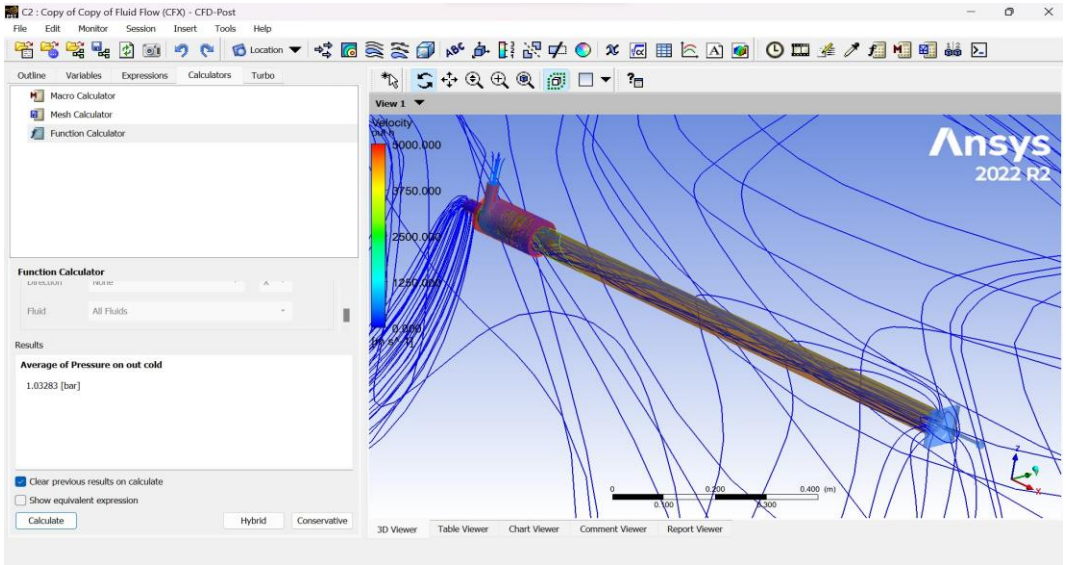
Out File

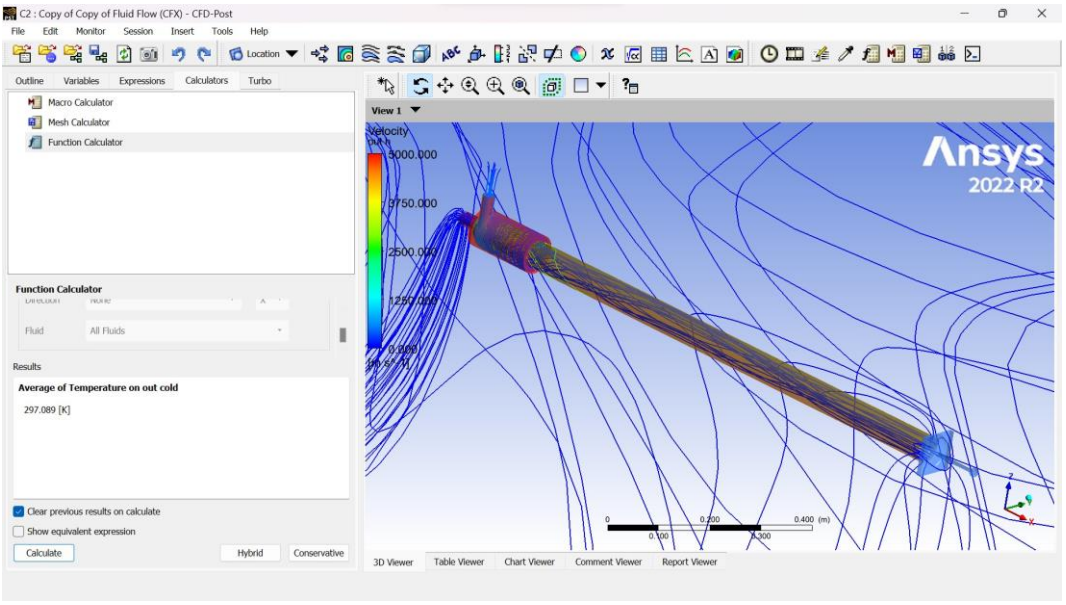
```
File Writing                  3.20E+02    9.1 %
Miscellaneous                 3.63E+01    1.0 %
                              --------
Total                         3.51E+03

+--------------------------------------------------------------------+
|                   Job Information at End of Run                    |
+--------------------------------------------------------------------+

Job finished:   Sun Sep 24 18:26:19 2023

Total wall clock time: 1.754E+03 seconds
            or: (          0:         0:        29:    13.895 )
                (       Days:     Hours:   Minutes:   Seconds )


 --> Final synchronization point reached by all partitions.
End of solution stage.
```

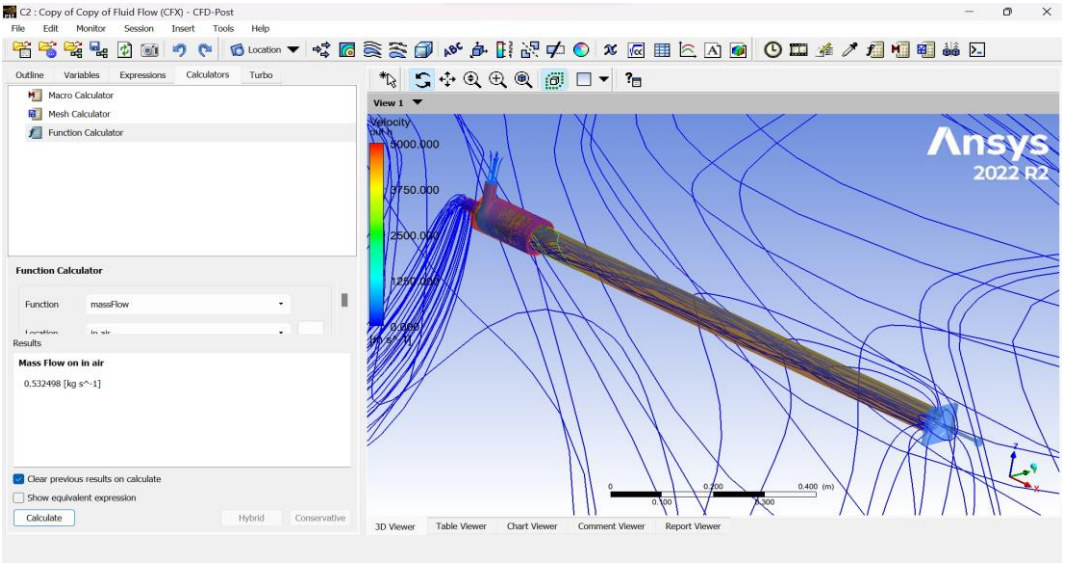
Lampiran 20 Tahap *Result* Tabung Vorteks Desain Alternatif Variasi P_{in} = 3,5 Bar

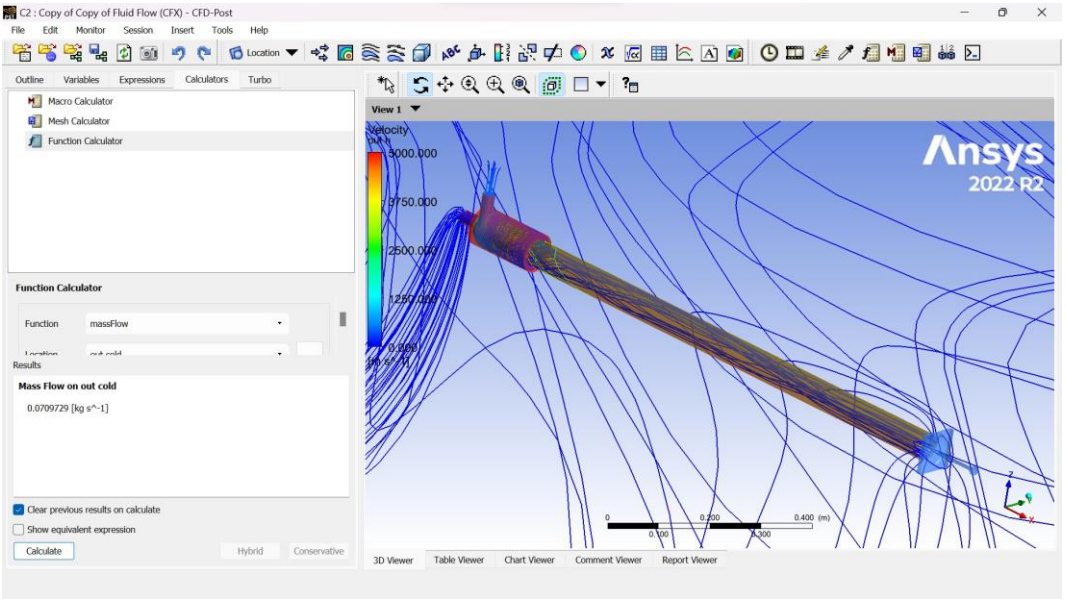




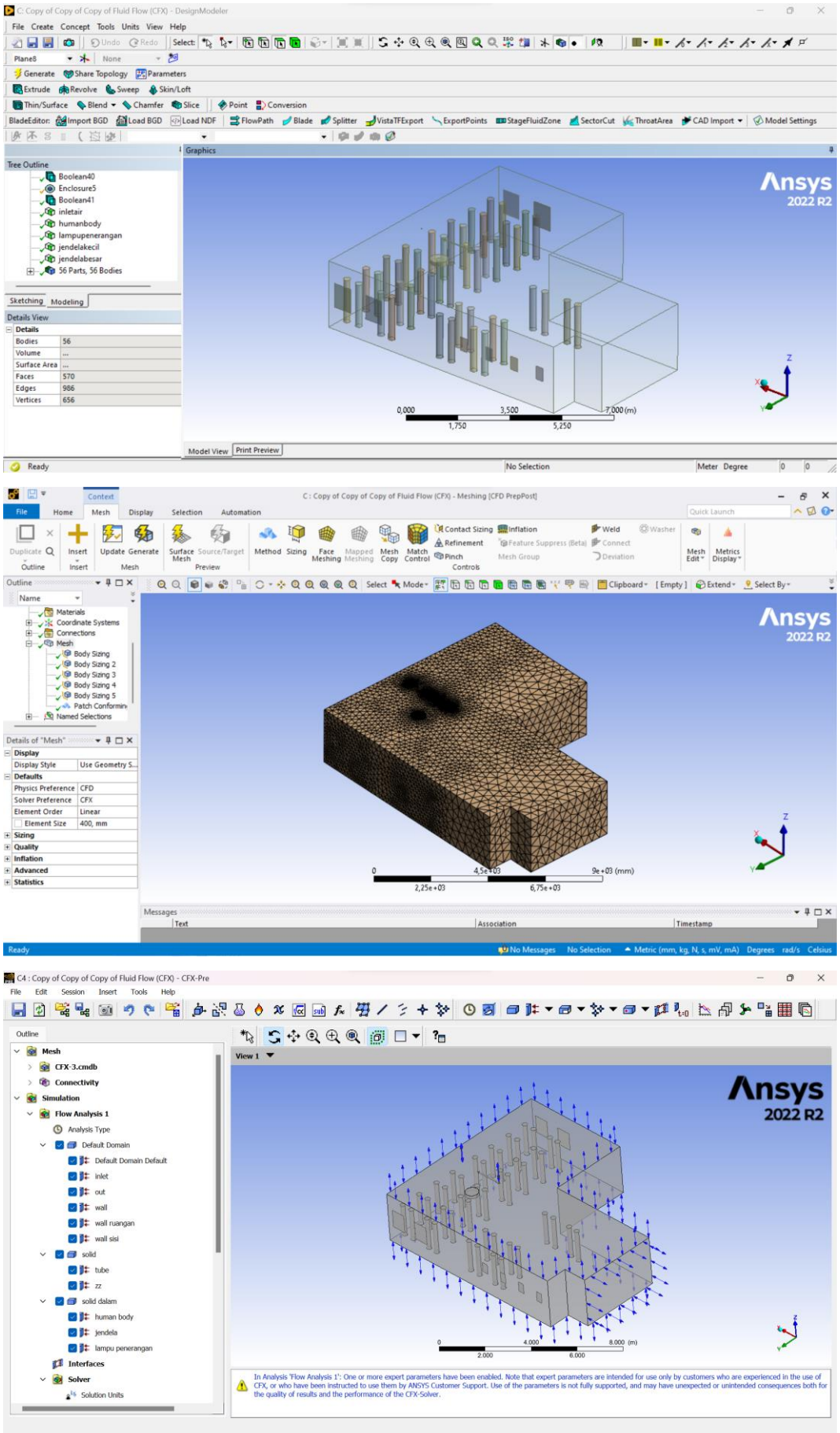


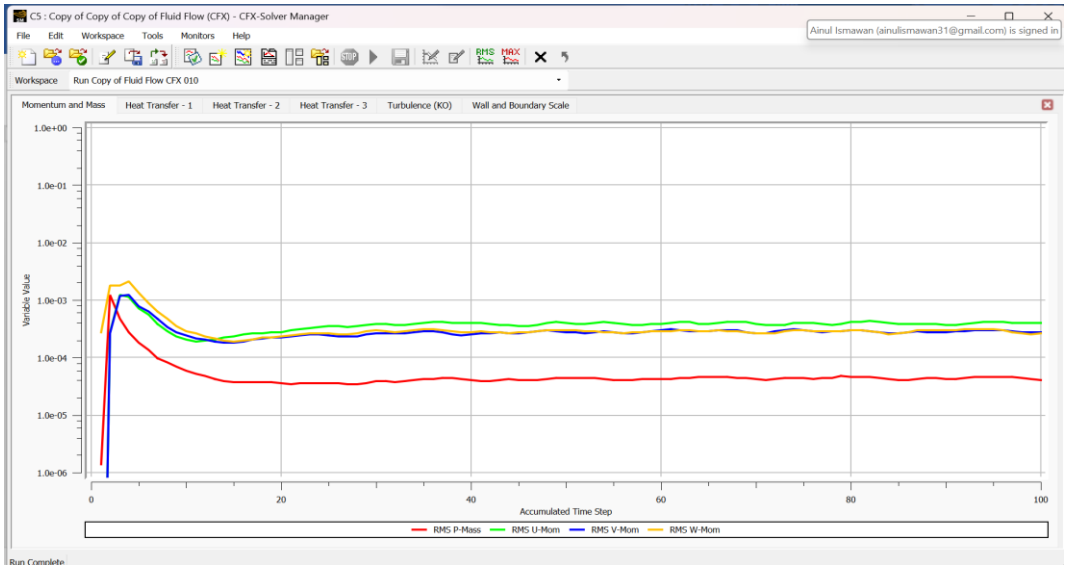

C2 : Copy of Copy of Fluid Flow (CFX) - CFD-Post
File Edit Monitor Session Insert Tools Help
Outline Variables Expressions Calculators Turbo
Macro Calculator
Mesh Calculator
Function Calculator
Function Calculator
Fluid All Fluids
Results
Average of Temperature on out cold
297.089 [K]
Clear previous results on calculate
Show equivalent expression
Calculate Hybrid Conservative
View 1
Velocity
3000.000
3750.000
2500.000
1250.000
0.000
Ansys
2022 R2
3D Viewer Table Viewer Chart Viewer Comment Viewer Report Viewer

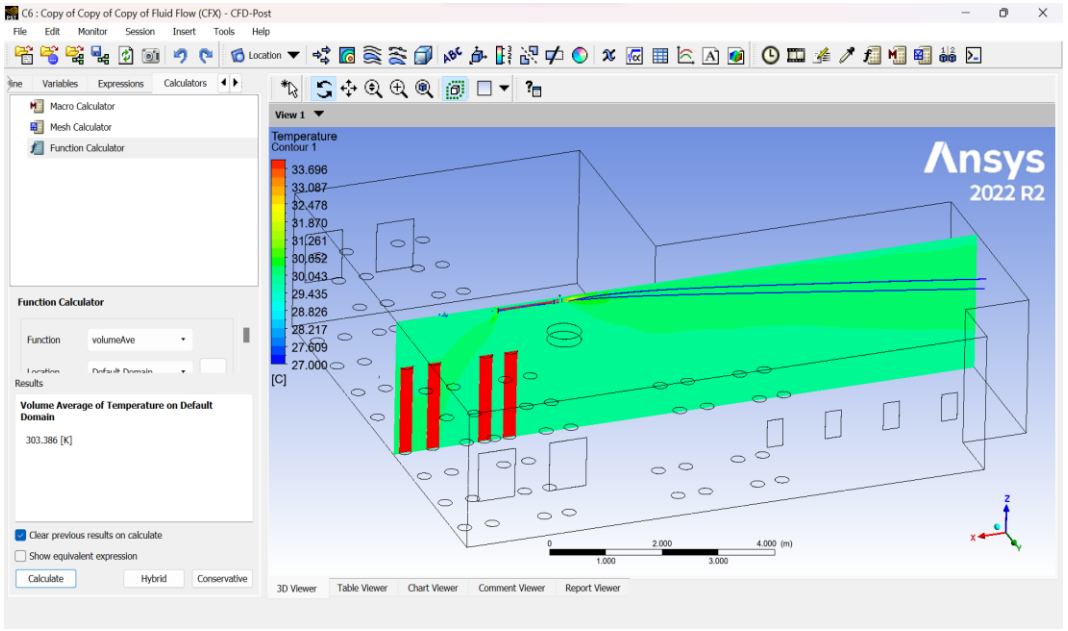

C2 : Copy of Copy of Fluid Flow (CFX) - CFD-Post
File Edit Monitor Session Insert Tools Help
Outline Variables Expressions Calculators Turbo
Macro Calculator
Mesh Calculator
Function Calculator
Function Calculator
Function massFlow
Results
Mass Flow on in air
0.532498 [kg s^-1]
Clear previous results on calculate
Show equivalent expression
Calculate Hybrid Conservative
View 1
Velocity
3000.000
3750.000
2500.000
1250.000
0.000
Ansys
2022 R2
3D Viewer Table Viewer Chart Viewer Comment Viewer Report Viewer


C2 : Copy of Copy of Fluid Flow (CFX) - CFD-Post
File Edit Monitor Session Insert Tools Help
Outline Variables Expressions Calculators Turbo
Macro Calculator
Mesh Calculator
Function Calculator
Function Calculator
Function massFlow
Results
Mass Flow on out cold
0.0709729 [kg s^-1]
Clear previous results on calculate
Show equivalent expression
Calculate Hybrid Conservative
View 1
Velocity
3000.000
3750.000
2500.000
1250.000
0.000
Ansys
2022 R2
3D Viewer Table Viewer Chart Viewer Comment Viewer Report Viewer

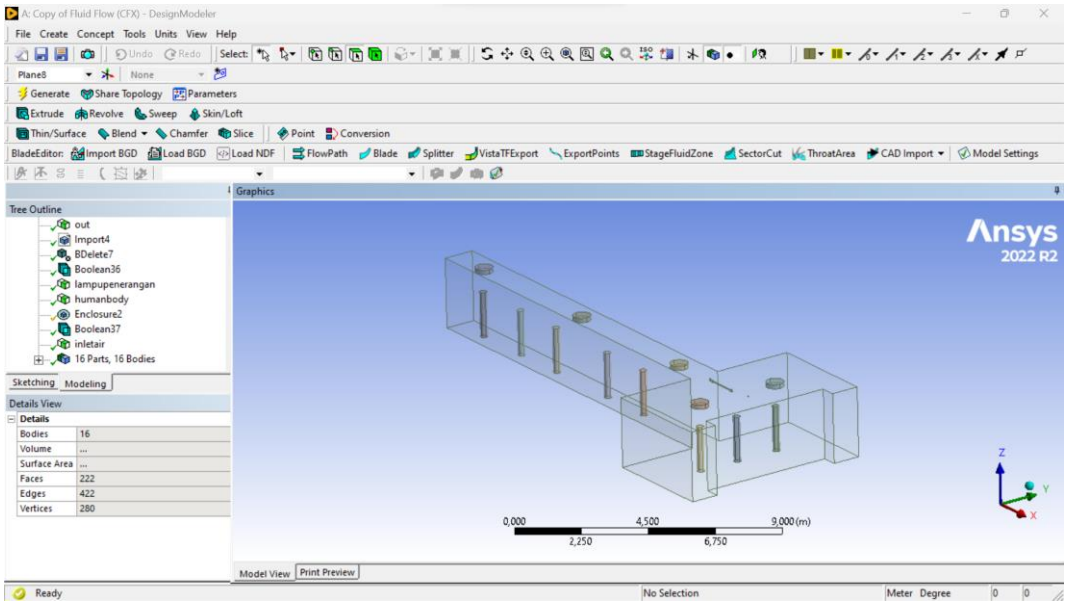
Lampiran 21 Tahap Simulasi *CFD* Zona 1

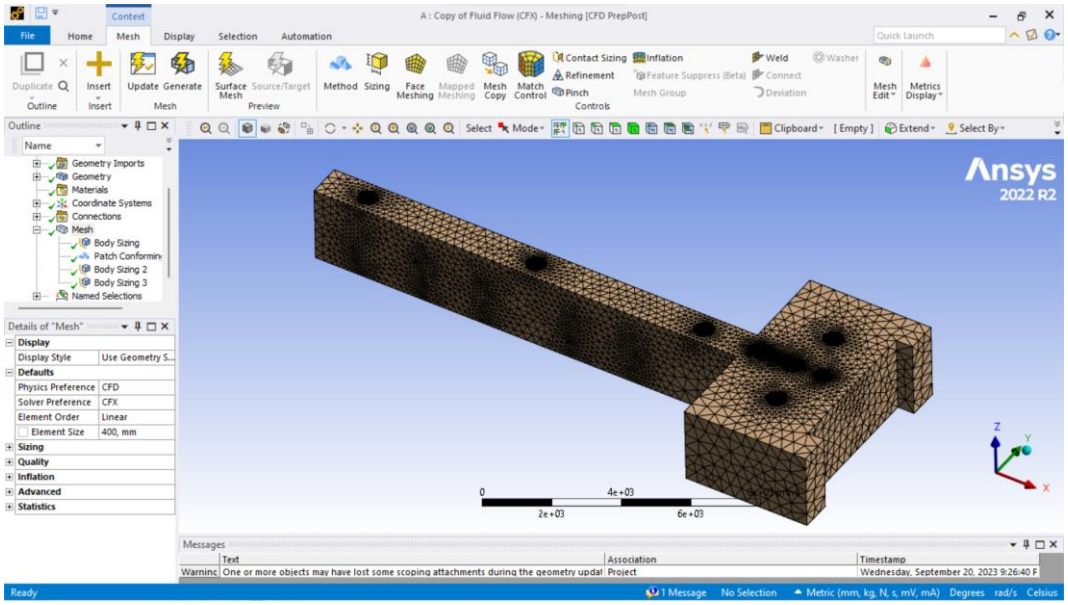


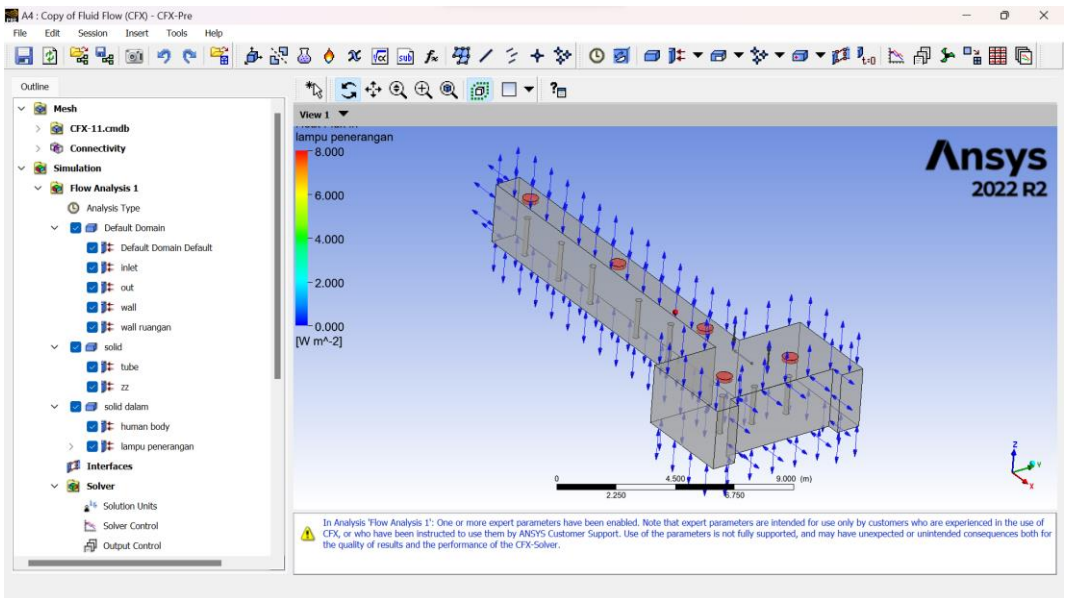

C5 : Copy of Copy of Copy of Fluid Flow (CFX) - CFX-Solver Manager
File Edit Workspace Tools Monitors Help
Ainul Ismawan (ainulismawan31@gmail.com) is signed in
Workspace Run Copy of Fluid Flow CFX 010
Momentum and Mass Heat Transfer - 1 Heat Transfer - 2 Heat Transfer - 3 Turbulence (KO) Wall and Boundary Scale
Variable Value
Accumulated Time Step
RMS P-Mass RMS U-Mom RMS V-Mom RMS W-Mom
Run Complete

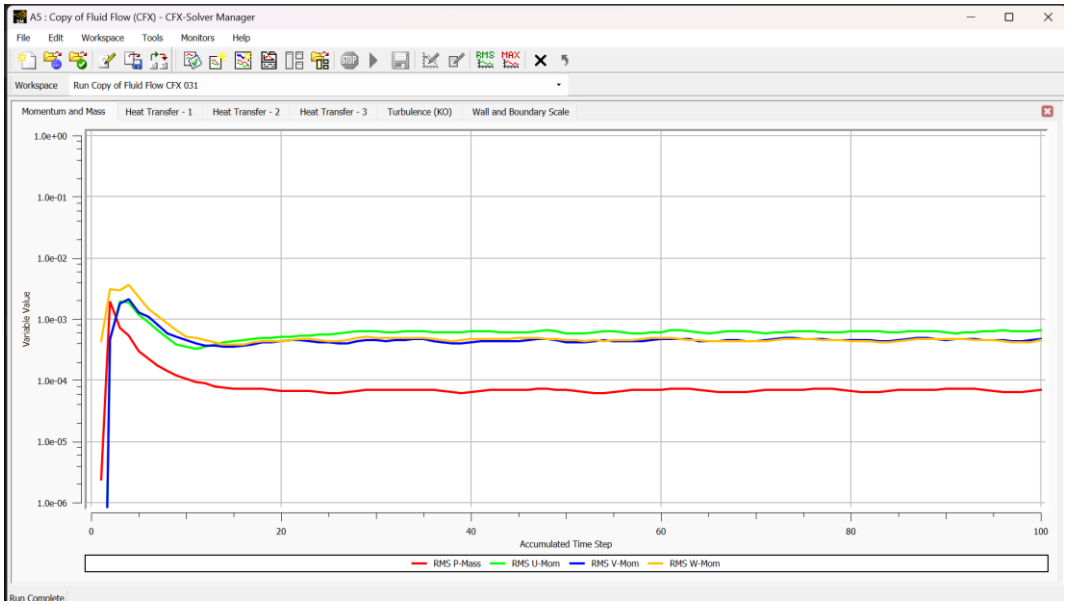

C6 : Copy of Copy of Copy of Fluid Flow (CFX) - CFD-Post
File Edit Monitor Session Insert Tools Help
Variables Expressions Calculators
Macro Calculator
Mesh Calculator
Function Calculator
Function Calculator
Function volumeAve
Results
Volume Average of Temperature on Default Domain
303.386 [K]
Clear previous results on calculate
Show equivalent expression
Calculate Hybrid Conservative
View 1
Temperature
Contour 1
33.696
33.087
32.478
31.870
31.261
30.652
30.043
29.435
28.826
28.217
27.609
27.000
[C]
Ansys
2022 R2
3D Viewer Table Viewer Chart Viewer Comment Viewer Report Viewer

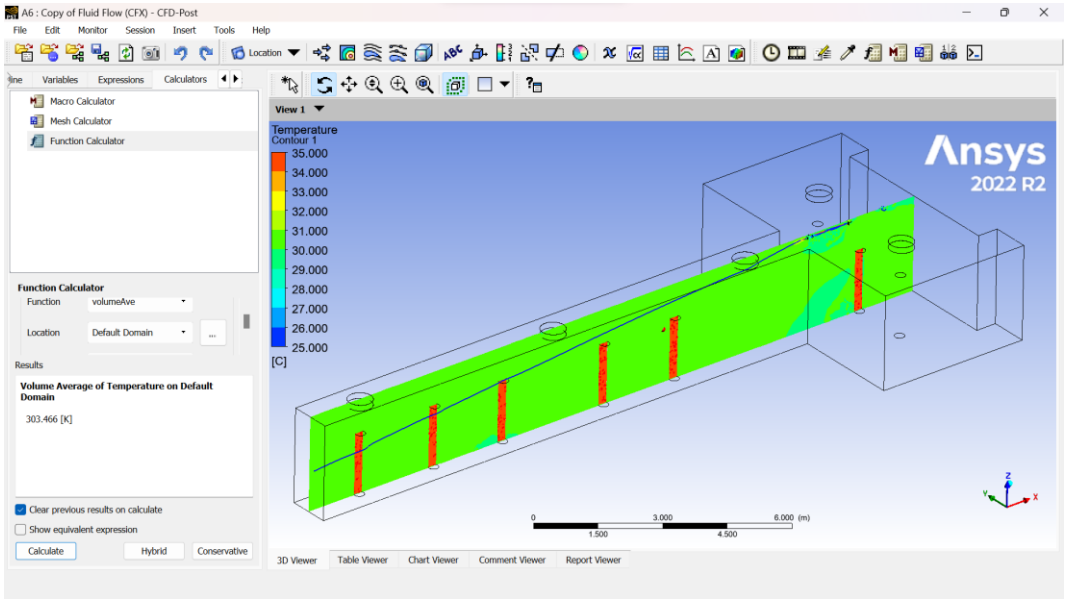
Lampiran 22 Tahap Simulasi *CFD* Zona 2



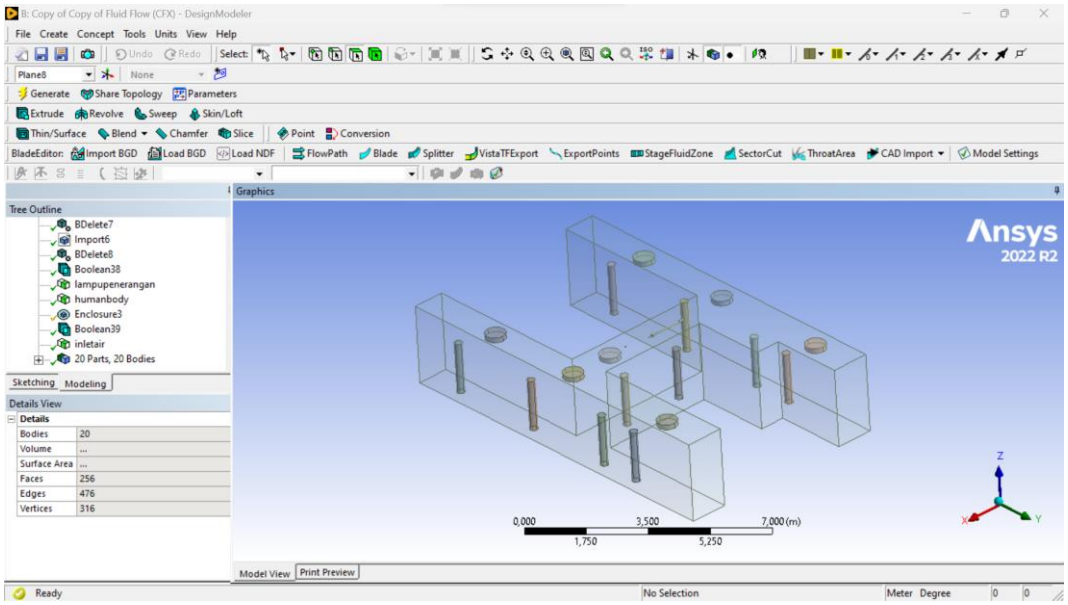


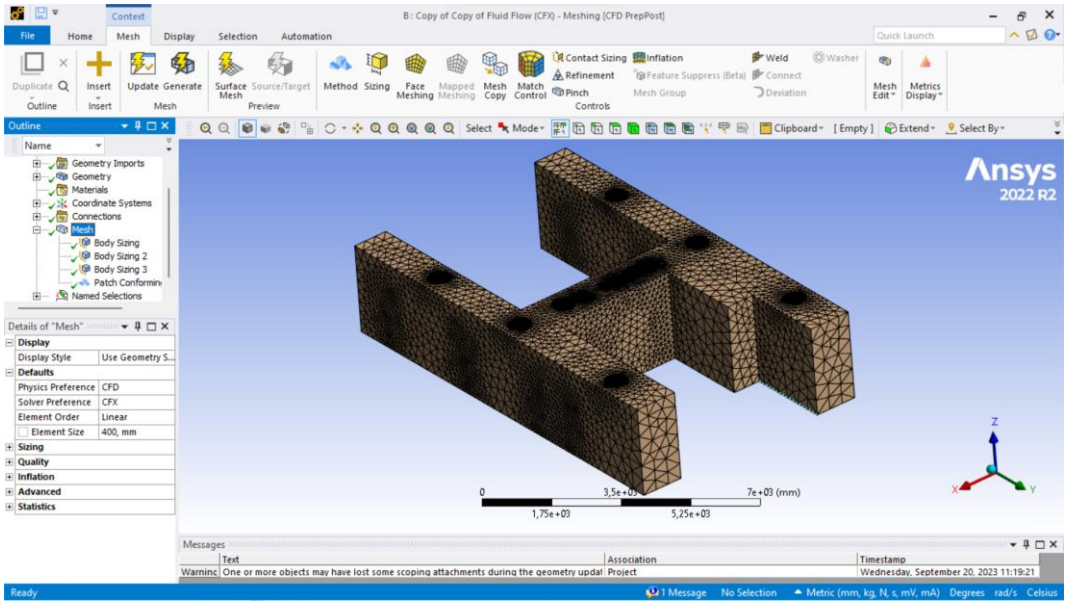


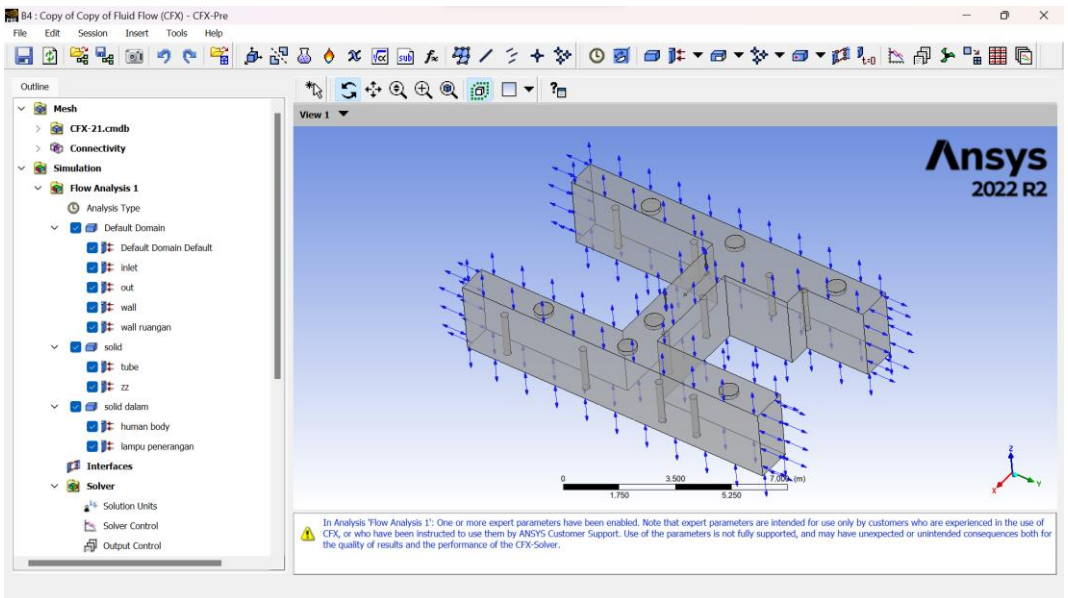

A5 : Copy of Fluid Flow (CFX) - CFX-Solver Manager
File Edit Workspace Tools Monitors Help
Workspace Run Copy of Fluid Flow CFX 031
Momentum and Mass Heat Transfer - 1 Heat Transfer - 2 Heat Transfer - 3 Turbulence (KO) Wall and Boundary Scale
1.0e+00
1.0e-01
1.0e-02
1.0e-03
1.0e-04
1.0e-05
1.0e-06
Variable Value
0 20 40 60 80 100
Accumulated Time Step
RMS P-Mass RMS U-Mom RMS V-Mom RMS W-Mom
Run Complete

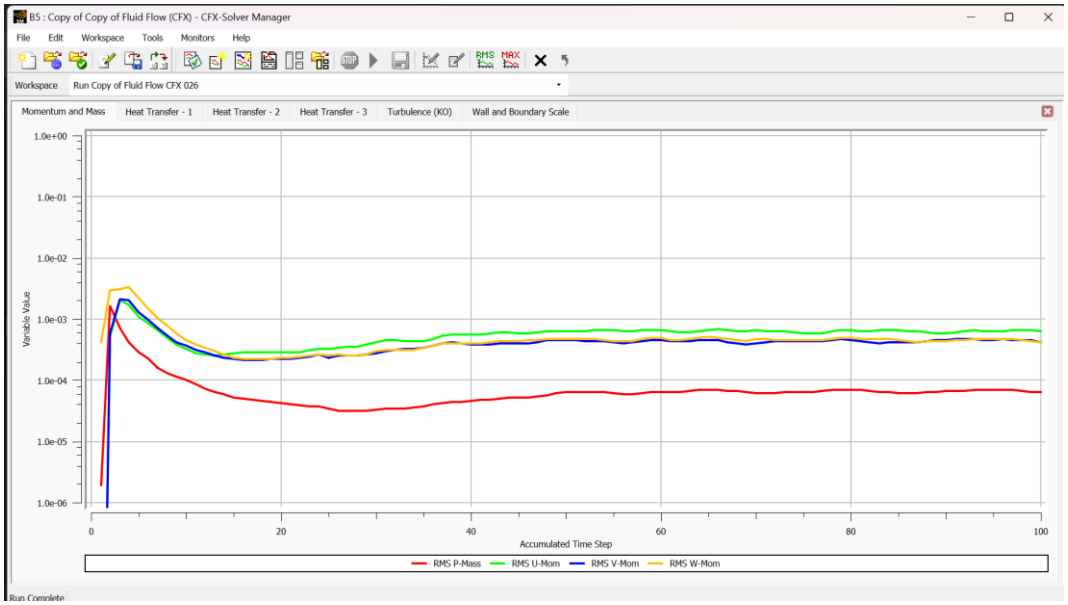

A6 : Copy of Fluid Flow (CFX) - CFD-Post
File Edit Monitor Session Insert Tools Help
Location
Variables Expressions Calculators
Macro Calculator
Mesh Calculator
Function Calculator
Function Calculator
Function volumeAve
Location Default Domain
Results
Volume Average of Temperature on Default Domain
303.466 [K]
Clear previous results on calculate
Show equivalent expression
Calculate Hybrid Conservative
View 1
Temperature
Contour 1
35.000
34.000
33.000
32.000
31.000
30.000
29.000
28.000
27.000
26.000
25.000
[C]
Ansys
2022 R2
0 1.500 3.000 4.500 6.000 (m)
3D Viewer Table Viewer Chart Viewer Comment Viewer Report Viewer

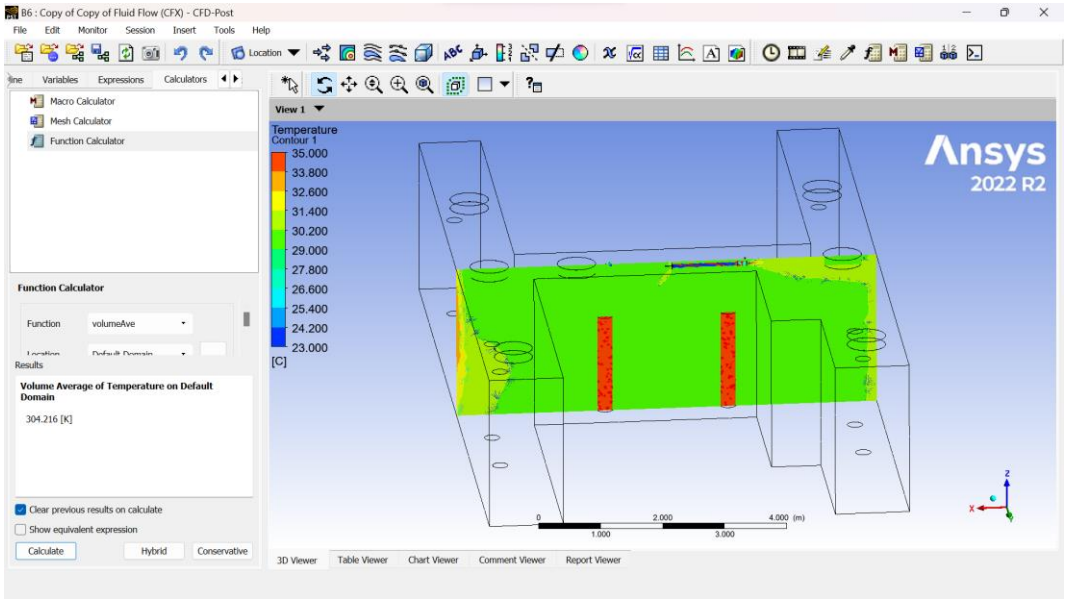
Lampiran 23 Tahap Simulasi *CFD* Zona 3








B5 : Copy of Copy of Fluid Flow (CFX) - CFX-Solver Manager
File Edit Workspace Tools Monitors Help
Workspace Run Copy of Fluid Flow CFX 026
Momentum and Mass Heat Transfer - 1 Heat Transfer - 2 Heat Transfer - 3 Turbulence (KO) Wall and Boundary Scale
Variable Value
Accumulated Time Step
RMS P-Mass RMS U-Mom RMS V-Mom RMS W-Mom
Run Complete


B6 : Copy of Copy of Fluid Flow (CFX) - CFD-Post
File Edit Monitor Session Insert Tools Help
Variables Expressions Calculators
Macro Calculator
Mesh Calculator
Function Calculator
Function Calculator
Function volumeAve
Results
Volume Average of Temperature on Default Domain
304.216 [K]
Clear previous results on calculate
Show equivalent expression
Calculate Hybrid Conservative
View 1
Temperature
Conlour 1
35.000
33.800
32.600
31.400
30.200
29.000
27.800
26.600
25.400
24.200
23.000
[C]
Ansys
2022 R2
3D Viewer Table Viewer Chart Viewer Comment Viewer Report Viewer

Lampiran 24 Tabel Perubahan Suhu Terhadap Waktu Pada Zona 1

Timestep	**Waktu (s)**	**Suhu (°C)**
0	0	35
1	15	34.997
2	30	34.67
3	45	33.92
4	60	33.332
5	75	32.448
6	90	31.763
7	105	31.485
8	120	31.263
9	135	31.076
10	150	30.949
11	165	30.874
12	180	30.828
13	195	30.795
14	210	30.766
15	225	30.74
16	240	30.716
17	255	30.694
18	270	30.674
19	285	30.656
20	300	30.64
21	315	30.625
22	330	30.611
23	345	30.596
24	360	30.583
25	375	30.57
26	390	30.559
27	405	30.548
28	420	30.537
29	435	30.526
30	450	30.516
31	465	30.507
32	480	30.5
33	495	30.493
34	510	30.487
35	525	30.482
36	540	30.474
37	555	30.464
38	570	30.455
39	585	30.445

40	600	30.435
41	615	30.426
42	630	30.417
43	645	30.409
44	660	30.404
45	675	30.4
46	690	30.397
47	705	30.395
48	720	30.392
49	735	30.388
50	750	30.382
51	765	30.376
52	780	30.37
53	795	30.363
54	810	30.356
55	825	30.349
56	840	30.343
57	855	30.338
58	870	30.334
59	885	30.333
60	900	30.332
61	915	30.332
62	930	30.331
63	945	30.328
64	960	30.325
65	975	30.321
66	990	30.316
67	1005	30.311
68	1020	30.306
69	1035	30.3
70	1050	30.295
71	1065	30.291
72	1080	30.289
73	1095	30.288
74	1110	30.288
75	1125	30.288
76	1140	30.289
77	1155	30.288
78	1170	30.286
79	1185	30.283
80	1200	30.279
81	1215	30.276
82	1230	30.272

83	1245	30.268
84	1260	30.264
85	1275	30.261
86	1290	30.259
87	1305	30.258
88	1320	30.258
89	1335	30.259
90	1350	30.26
91	1365	30.26
92	1380	30.258
93	1395	30.254
94	1410	30.251
95	1425	30.249
96	1440	30.248
97	1455	30.245
98	1470	30.242
99	1485	30.238
100	1500	30.236

Lampiran 25 Tabel Perubahan Suhu Terhadap Waktu Pada Zona 2

Timestep	**Waktu (s)**	**Suhu (^oC)**
0	0	35
1	15	34.9
2	30	34.748
3	45	33.765
4	60	33.134
5	75	32.516
6	90	32.027
7	105	31.613
8	120	31.298
9	135	31.154
10	150	31.026
11	165	30.912
12	180	30.847
13	195	30.808
14	210	30.778
15	225	30.747
16	240	30.715
17	255	30.684
18	270	30.654
19	285	30.629
20	300	30.607
21	315	30.59
22	330	30.575
23	345	30.562
24	360	30.547
25	375	30.529
26	390	30.513
27	405	30.499
28	420	30.489
29	435	30.483
30	450	30.476
31	465	30.469
32	480	30.463
33	495	30.458
34	510	30.456
35	525	30.454
36	540	30.448
37	555	30.436
38	570	30.425
39	585	30.416

40	600	30.409
41	615	30.403
42	630	30.397
43	645	30.391
44	660	30.385
45	675	30.38
46	690	30.379
47	705	30.381
48	720	30.384
49	735	30.382
50	750	30.375
51	765	30.367
52	780	30.361
53	795	30.357
54	810	30.354
55	825	30.352
56	840	30.349
57	855	30.345
58	870	30.343
59	885	30.343
60	900	30.347
61	915	30.353
62	930	30.357
63	945	30.354
64	960	30.347
65	975	30.34
66	990	30.334
67	1005	30.331
68	1020	30.33
69	1035	30.329
70	1050	30.328
71	1065	30.326
72	1080	30.324
73	1095	30.325
74	1110	30.33
75	1125	30.337
76	1140	30.342
77	1155	30.341
78	1170	30.336
79	1185	30.33
80	1200	30.324
81	1215	30.32
82	1230	30.319

83	1245	30.319
84	1260	30.32
85	1275	30.319
86	1290	30.317
87	1305	30.318
88	1320	30.321
89	1335	30.328
90	1350	30.335
91	1365	30.338
92	1380	30.336
93	1395	30.33
94	1410	30.323
95	1425	30.318
96	1440	30.316
97	1455	30.316
98	1470	30.317
99	1485	30.317
100	1500	30.316

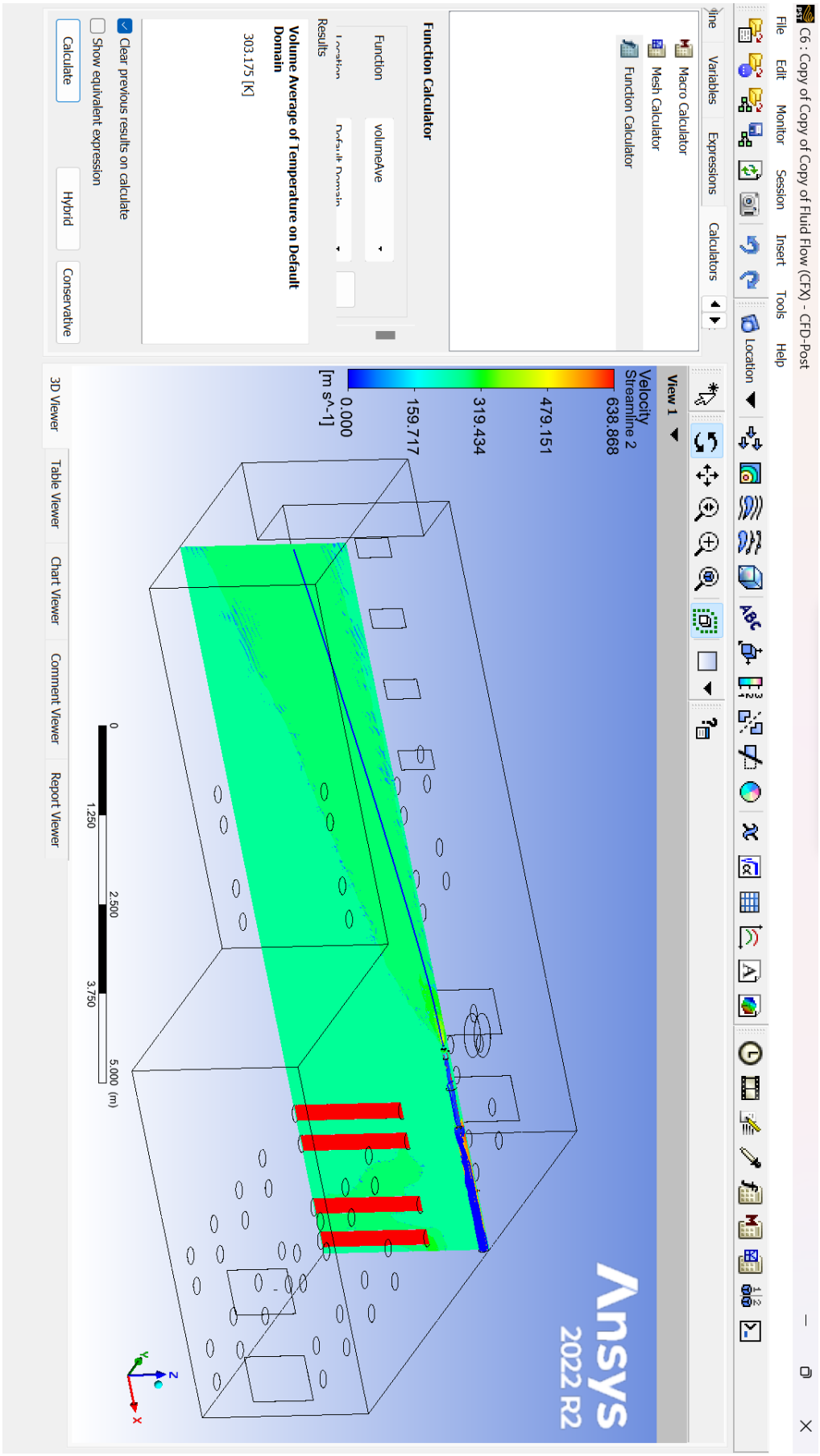
Lampiran 26 Tabel Perubahan Suhu Terhadap Waktu Pada Zona 3

Timestep	**Waktu (s)**	**Suhu (°C)**
0	0	35
1	15	35.001
2	30	34.859
3	45	33.723
4	60	33.125
5	75	32.566
6	90	32.01
7	105	31.688
8	120	31.537
9	135	31.408
10	150	31.289
11	165	31.206
12	180	31.146
13	195	31.086
14	210	31.031
15	225	31.003
16	240	30.989
17	255	30.982
18	270	30.977
19	285	30.973
20	300	30.971
21	315	30.97
22	330	30.969
23	345	30.97
24	360	30.971
25	375	30.974
26	390	30.976
27	405	30.976
28	420	30.976
29	435	30.977
30	450	30.979
31	465	30.982
32	480	30.985
33	495	30.989
34	510	30.993
35	525	30.996
36	540	30.997
37	555	30.997
38	570	30.996
39	585	30.995

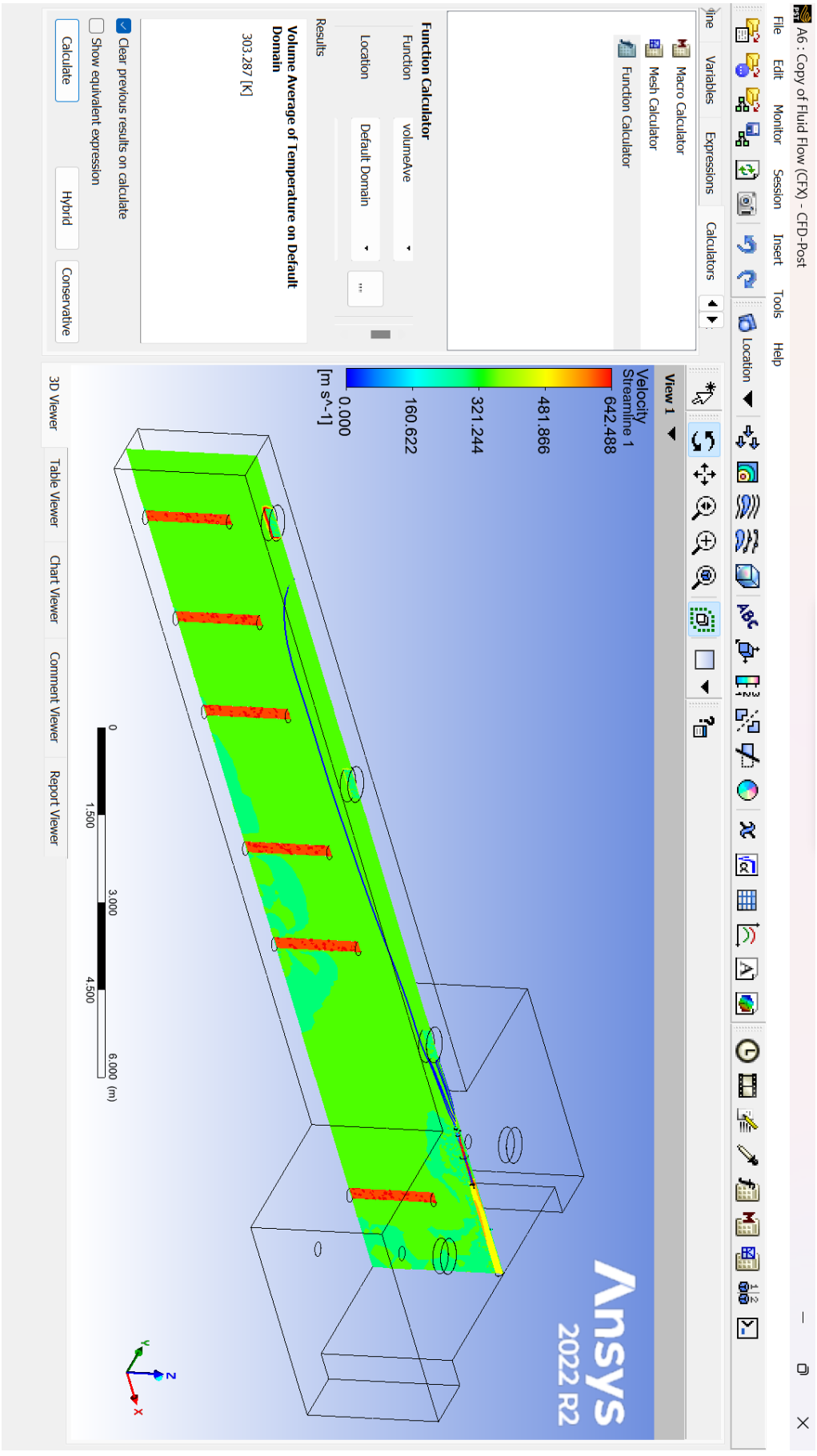
40	600	30.994
41	615	30.993
42	630	30.994
43	645	30.996
44	660	31.001
45	675	31.006
46	690	31.012
47	705	31.018
48	720	31.023
49	735	31.025
50	750	31.024
51	765	31.022
52	780	31.02
53	795	31.017
54	810	31.015
55	825	31.014
56	840	31.015
57	855	31.019
58	870	31.023
59	885	31.029
60	900	31.036
61	915	31.043
62	930	31.048
63	945	31.05
64	960	31.051
65	975	31.05
66	990	31.048
67	1005	31.045
68	1020	31.041
69	1035	31.038
70	1050	31.038
71	1065	31.039
72	1080	31.042
73	1095	31.046
74	1110	31.051
75	1125	31.057
76	1140	31.062
77	1155	31.067
78	1170	31.069
79	1185	31.068
80	1200	31.067
81	1215	31.063
82	1230	31.059

83	1245	31.056
84	1260	31.054
85	1275	31.054
86	1290	31.054
87	1305	31.056
88	1320	31.06
89	1335	31.065
90	1350	31.07
91	1365	31.074
92	1380	31.078
93	1395	31.079
94	1410	31.078
95	1425	31.076
96	1440	31.072
97	1455	31.069
98	1470	31.067
99	1485	31.066
100	1500	31.066

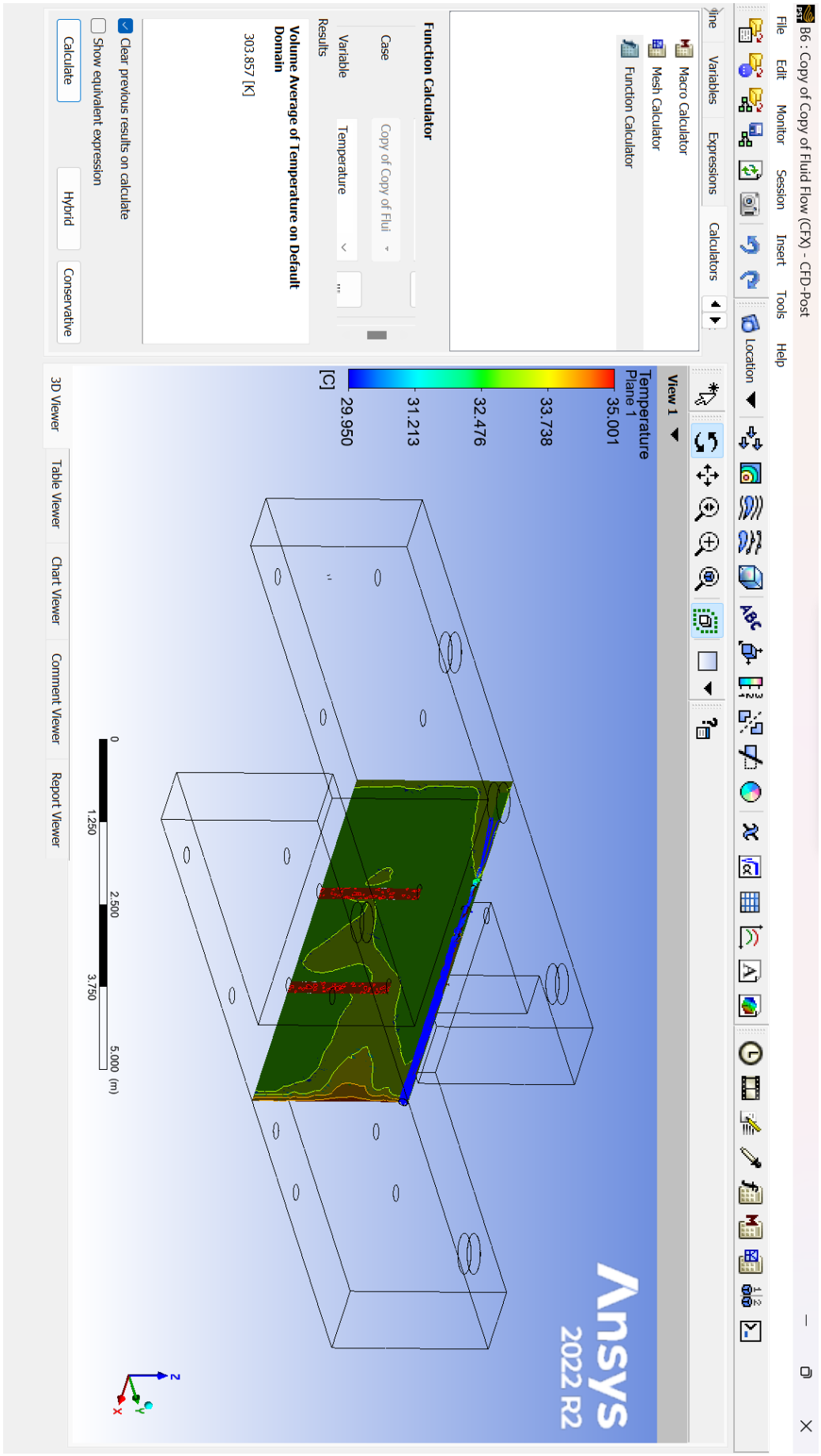
Lampiran 27 *Result* Penambahan Pipa Buang Pada Zona 1



Lampiran 28 *Result* Penambahan Pipa Buang Pada Zona 2



Lampiran 29 *Result* Penambahan Pipa Buang Pada Zona 3



Lampiran 30 Tabel Suhu Terhadap Waktu dengan Penambahan Pipa Buang Zona 1

Timestep	**Waktu (s)**	**Suhu (°C)**
0	0	35
1	15	34.96
2	30	34.57
3	45	33.968
4	60	33.646
5	75	33.063
6	90	32.098
7	105	31.446
8	120	31.208
9	135	30.9
10	150	30.784
11	165	30.702
12	180	30.637
13	195	30.58
14	210	30.538
15	225	30.504
16	240	30.474
17	255	30.447
18	270	30.426
19	285	30.404
20	300	30.38
21	315	30.356
22	330	30.334
23	345	30.315
24	360	30.296
25	375	30.279
26	390	30.264
27	405	30.15
28	420	30.238
29	435	30.228
30	450	30.22
31	465	30.209
32	480	30.198
33	495	30.187
34	510	30.177
35	525	30.166
36	540	30.155
37	555	30.144
38	570	30.133

39	585	30.123
40	600	30.116
41	615	30.11
42	630	30.105
43	645	30.101
44	660	30.098
45	675	30.094
46	690	30.088
47	705	30.081
48	720	30.076
49	735	30.071
50	750	30.066
51	765	30.06
52	780	30.056
53	795	30.053
54	810	30.051
55	825	30.051
56	840	30.052
57	855	30.052
58	870	30.054
59	885	30.052
60	900	30.048
61	915	30.044
62	930	30.042
63	945	30.04
64	960	30.038
65	975	30.035
66	990	30.033
67	1005	30.032
68	1020	30.032
69	1035	30.032
70	1050	30.034
71	1065	30.036
72	1080	30.038
73	1095	30.038
74	1110	30.035
75	1125	30.034
76	1140	30.032
77	1155	30.031
78	1170	30.03
79	1185	30.028
80	1200	30.027
81	1215	30.026

82	1230	30.025
83	1245	30.025
84	1260	30.026
85	1275	30.028
86	1290	30.031
87	1305	30.034
88	1320	30.034
89	1335	30.032
90	1350	30.031
91	1365	30.03
92	1380	30.027
93	1395	30.025
94	1410	30.024
95	1425	30.023
96	1440	30.022
97	1455	30.022
98	1470	30.023
99	1485	30.024
100	1500	30.025

Lampiran 31 Tabel Suhu Terhadap Waktu dengan Penambahan Pipa Buang Zona 2

Timestep	**Waktu (s)**	**Suhu (°C)**
0	0	35
1	15	34.927
2	30	34.838
3	45	33.775
4	60	33.212
5	75	32.605
6	90	31.953
7	105	31.541
8	120	31.208
9	135	30.9
10	150	30.653
11	165	30.472
12	180	30.332
13	195	30.232
14	210	30.168
15	225	30.131
16	240	30.113
17	255	30.108
18	270	30.109
19	285	30.104
20	300	30.094
21	315	30.088
22	330	30.088
23	345	30.093
24	360	30.098
25	375	30.104
26	390	30.107
27	405	30.112
28	420	30.118
29	435	30.123
30	450	30.124
31	465	30.121
32	480	30.117
33	495	30.114
34	510	30.112
35	525	30.112
36	540	30.115
37	555	30.119
38	570	30.12

39	585	30.12
40	600	30.12
41	615	30.122
42	630	30.128
43	645	30.133
44	660	30.131
45	675	30.126
46	690	30.121
47	705	30.117
48	720	30.115
49	735	30.115
50	750	30.117
51	765	30.118
52	780	30.119
53	795	30.12
54	810	30.122
55	825	30.125
56	840	30.131
57	855	30.135
58	870	30.134
59	885	30.128
60	900	30.122
61	915	30.118
62	930	30.116
63	945	30.116
64	960	30.118
65	975	30.121
66	990	30.122
67	1005	30.121
68	1020	30.122
69	1035	30.125
70	1050	30.13
71	1065	30.136
72	1080	30.135
73	1095	30.13
74	1110	30.125
75	1125	30.121
76	1140	30.119
77	1155	30.118
78	1170	30.12
79	1185	30.122
80	1200	30.122
81	1215	30.122

82	1230	30.123
83	1245	30.124
84	1260	30.129
85	1275	30.135
86	1290	30.132
87	1305	30.134
88	1320	30.128
89	1335	30.123
90	1350	30.12
91	1365	30.119
92	1380	30.12
93	1395	30.122
94	1410	30.123
95	1425	30.123
96	1440	30.123
97	1455	30.124
98	1470	30.127
99	1485	30.132
100	1500	30.137

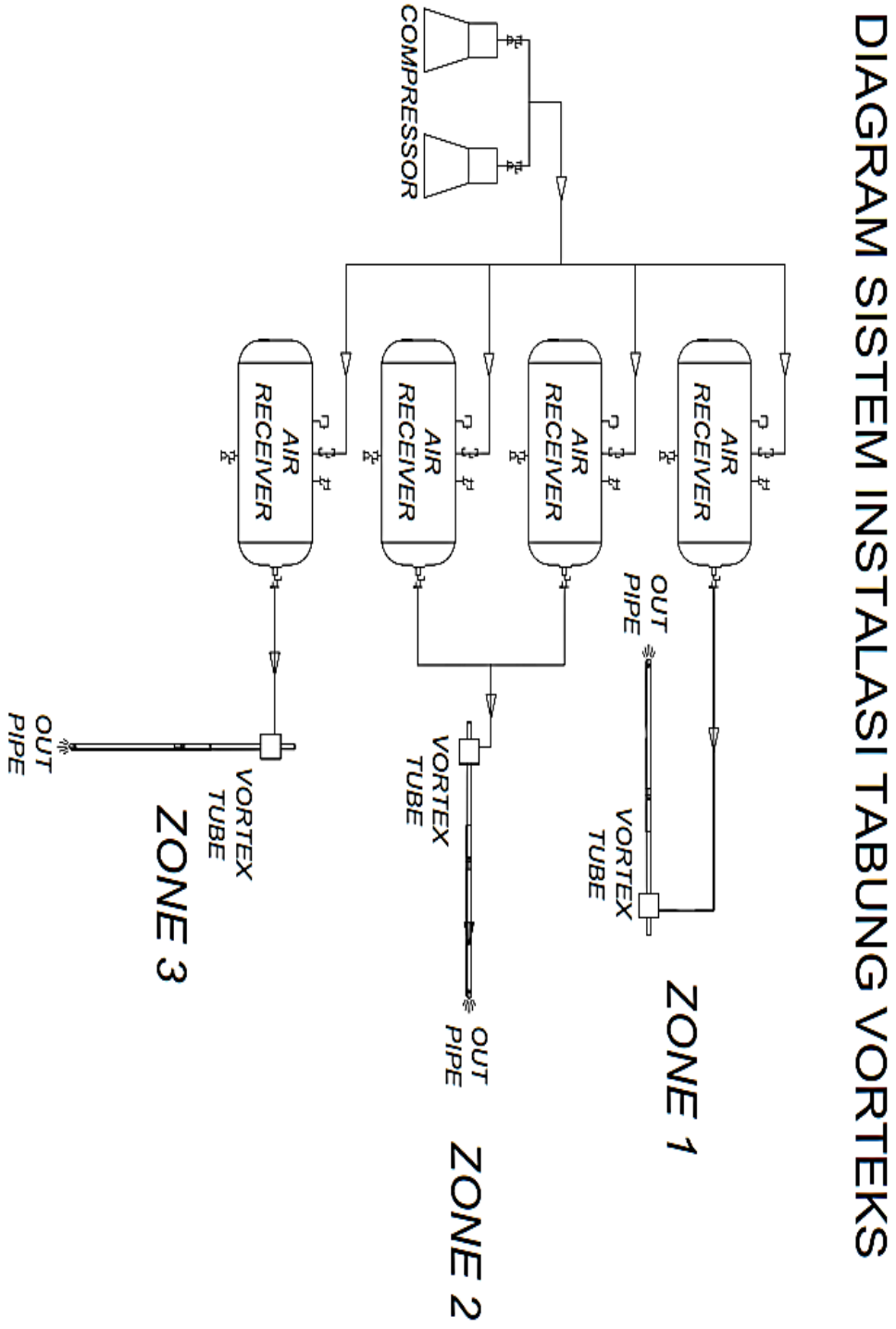
Lampiran 32 Tabel Suhu Terhadap Waktu dengan Penambahan Pipa Buang Zona 3

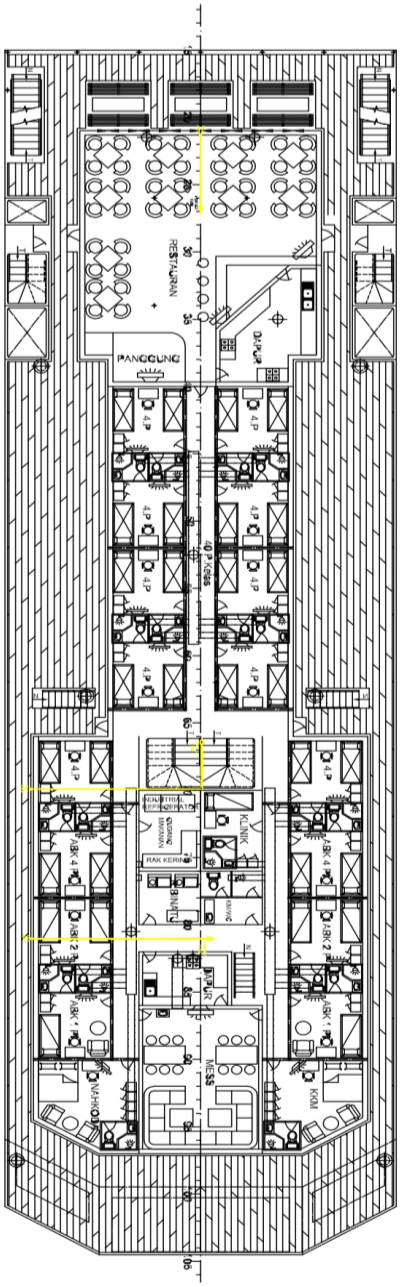
Timestep	**Waktu (s)**	**Suhu (°C)**
0	0	35
1	15	34.925
2	30	34.583
3	45	33.866
4	60	33.289
5	75	32.602
6	90	32.102
7	105	31.883
8	120	31.726
9	135	31.559
10	150	31.385
11	165	31.257
12	180	31.195
13	195	31.169
14	210	31.157
15	225	31.142
16	240	31.126
17	255	31.104
18	270	31.081
19	285	31.06
20	300	31.044
21	315	31.03
22	330	31.019
23	345	31.007
24	360	30.993
25	375	30.98
26	390	30.969
27	405	30.961
28	420	30.953
29	435	30.944
30	450	30.937
31	465	30.931
32	480	30.927
33	495	30.924
34	510	30.92
35	525	30.914
36	540	30.909
37	555	30.903
38	570	30.898

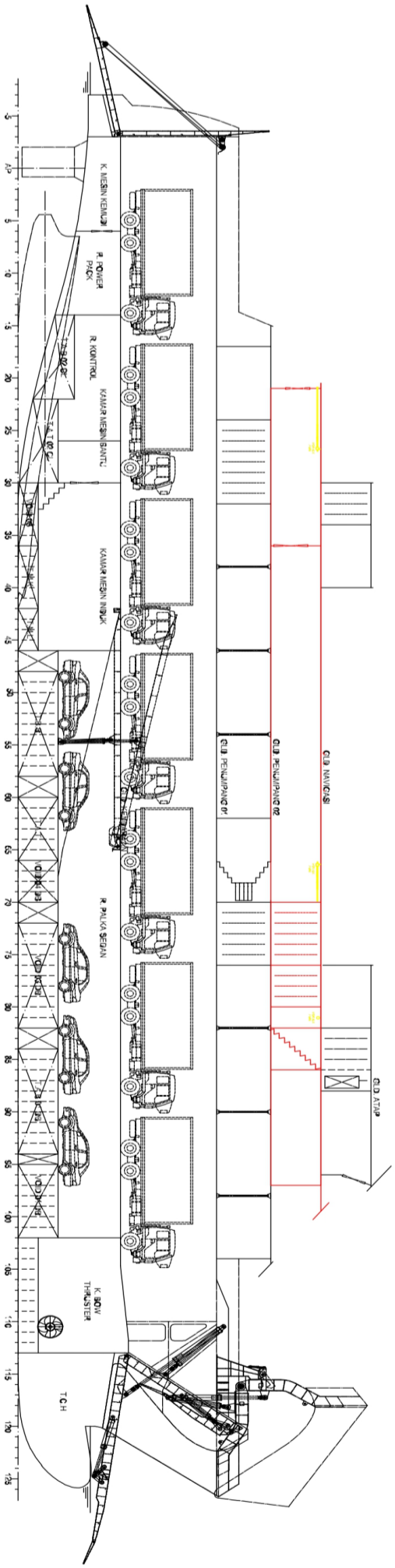
39	585	30.893
40	600	30.887
41	615	30.882
42	630	30.878
43	645	30.875
44	660	30.873
45	675	30.871
46	690	30.868
47	705	30.864
48	720	30.859
49	735	30.855
50	750	30.85
51	765	30.844
52	780	30.839
53	795	30.833
54	810	30.828
55	825	30.826
56	840	30.825
57	855	30.825
58	870	30.824
59	885	30.822
60	900	30.82
61	915	30.816
62	930	30.812
63	945	30.807
64	960	30.803
65	975	30.798
66	990	30.794
67	1005	30.789
68	1020	30.784
69	1035	30.781
70	1050	30.78
71	1065	30.781
72	1080	30.781
73	1095	30.781
74	1110	30.779
75	1125	30.776
76	1140	30.772
77	1155	30.768
78	1170	30.764
79	1185	30.761
80	1200	30.756
81	1215	30.75

82	1230	30.744
83	1245	30.74
84	1260	30.739
85	1275	30.74
86	1290	30.741
87	1305	30.742
88	1320	30.742
89	1335	30.741
90	1350	30.739
91	1365	30.735
92	1380	30.732
93	1395	30.729
94	1410	30.724
95	1425	30.719
96	1440	30.713
97	1455	30.708
98	1470	30.706
99	1485	30.706
100	1500	30.707

Lampiran 33 Sistem Instalasi Tabung Vorteks dengan Penambahan Pipa Buang




GELADAK PENUMPANG 02
RESTORAN
PANGGUNG
DAPUR
KLINIK
RAK KERIS
MESS
KOM
WASHROOM
TOILET


K. MESIN KEMUDI
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Hal : Penugasan Bimbingan Tugas Akhir

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Dengan hormat,
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Nama : Muhammad Ainul Ismawan
Stambuk : D091191063
Program Studi : Teknik Sistem Perkapalan

Dengan judul Tugas Akhir:
Analisis Penggunaan Tabung Vorteks Untuk Pengkondisian Udara Pada Kamar Mesin Menggunakan Metode Computational Fluid Dynamics (CFD)

Dosen Pembimbing **:**
1. Andi Husni Sitepu, S.T., M.T.
2. Muhammad Iqbal Nikmatullah, S.T., M.T.

Dapat dibuatkan Surat Penugasan Bimbingan Tugas Akhir
Demikian penyampaian kami, atas perhatian dan kerjasamanya diucapkan terima kasih.

G o w a, 21 Juni 2023
Ketua Departemen Teknik Sistem Perkapalan

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SURAT PENUGASAN

No. 13315/UN4.7.1/TD.06/2023

Dari : Dekan Fakultas Teknik Universitas Hasanuddin

Kepada :
1. **Andi Husni Sitepu, S.T., M.T.** — **Pemb. I**
2. **Muhammad Iqbal Nikmatullah, S.T., M.T.** — **Pemb. II**

Isi :

1. Bahwa berdasarkan peraturan Akademik Universitas Hasanuddin Tahun 2018 Pasal 16 (SK. Rektor Unhas nomor : 2784/UN4.1/KEP/2018), dengan ini menugaskan Saudara sebagai PEMBIMBING MAHASISWA, maka dengan ini kami menugaskan untuk membimbing penulisan Skripsi/Tugas Akhir mahasiswa Teknik Sistem Perkapalan Fakultas Teknik Universitas Hasanuddin di bawah ini :

   Nama : **Muhammad Ainul Ismawan**
   No. Stambuk : **D091191063**

   Judul Skripsi/Tugas Akhir :
   Analisis Penggunaan Tabung Vorteks Untuk Pengkondisian Udara Pada Kamar Mesin Menggunakan Metode Computational Fluid Dynamics (CFD)

2. Surat penugasan pembimbing ini mulai berlaku sejak tanggal ditetapkannya dan berakhir sampai selesainya penulisan Skripsi/Tugas Akhir Mahasiswa tersebut.

3. Agar surat penugasan ini dilaksanakan sebaik - baiknya dengan penuh rasa tanggung jawab.

Ditetapkan di Gowa,
Pada tanggal, 21 Juni 2023
a.n Dekan,
Wakil Dekan Bidang Akademik dan Kemahasiswaan,

Dr. Amil Ahmad Ilham, S.T., M.IT.
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Tembusan :
1. Dekan FT-UH.
2. Ketua Departemen Teknik Sistem Perkapalan FT-UH.
3. Mahasiswa yang bersangkutan

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Terhadap Mahasiswa

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Stambuk	:	D091191063
Judul	:	***Potensi Penggunaan Tabung Vorteks Untuk Pengkondisian Udara Pada Ruang Akomodasi Kapal Ferry Ro-Ro 2000 GT Menggunakan Computational Fluid Dynamics (CFD)***
Hari/Tanggal	:	Kamis, 16 November 2023
Waktu	:	10.00-12.00 wita
Tempat	:	Ruang Sidang Teknik Sistem Perkapalan
Keputusan Sidang / Catatan	:	lulus dgn Nilai A (87)

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No.	Susunan Panitia	N a m a	Tanda Tangan
1	Ketua/Anggota	Andi Husni Sitepu, S.T., M.T.	1.....
2	Sekretaris/Anggota	Muhammad Iqbal Nikmatullah, S.T., M.T.	2.....
3	Anggota	M. Rusydi Alwi, S.T., M.T.	3.....
4	Anggota	Surya Hariyanto, S.T., M.T.	4.....

Gowa , 2023

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