

SIDANG TUGAS AKHIR

STUDI NUMERIK PENGARUH *JARAK TRANSISI* ANTARA *PRIMARY* DAN *SECONDARY* *SUPERHEATER* TERHADAP KARAKTERISTIK ALIRAN DAN PERPINDAHAN PANAS

(Studi Kasus pada *Boiler* PT. Indonesia Power, Perak, Surabaya)

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LATAR BELAKANG

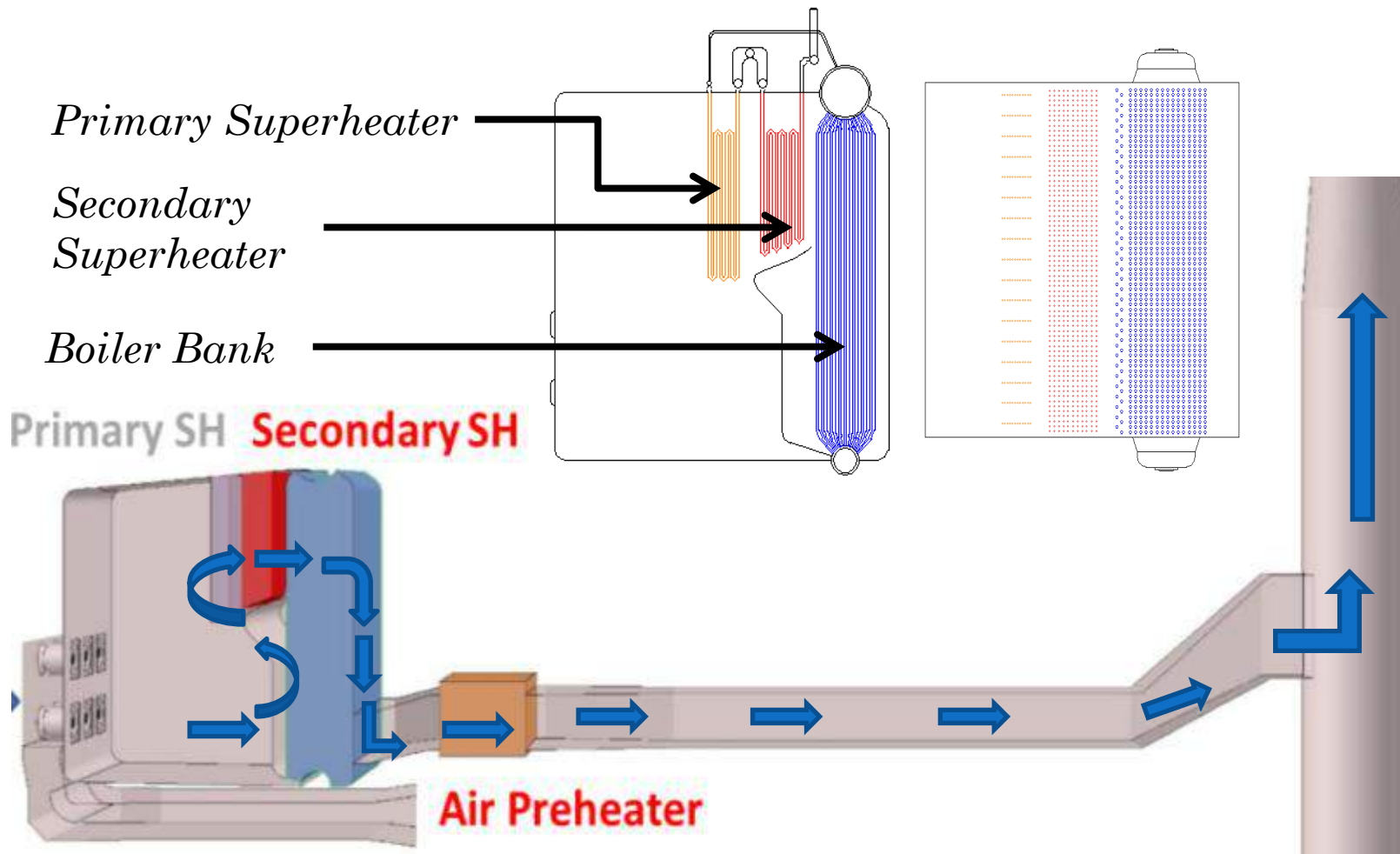
PT. Indonesia Power,
UP Perak,
Surabaya



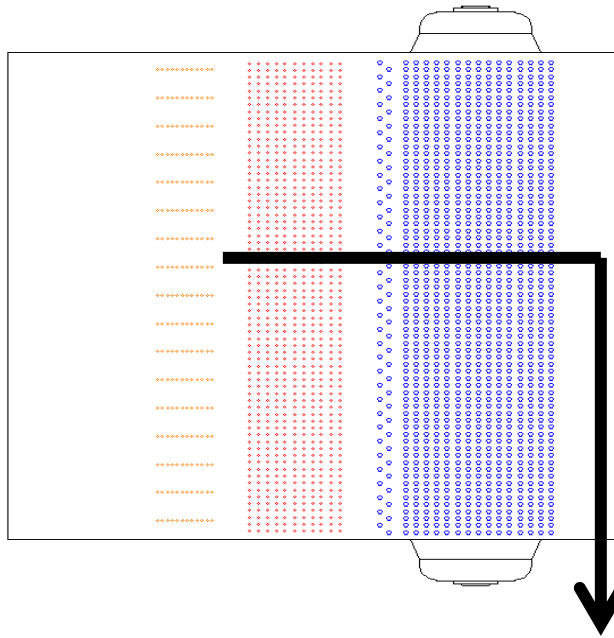
Boiler



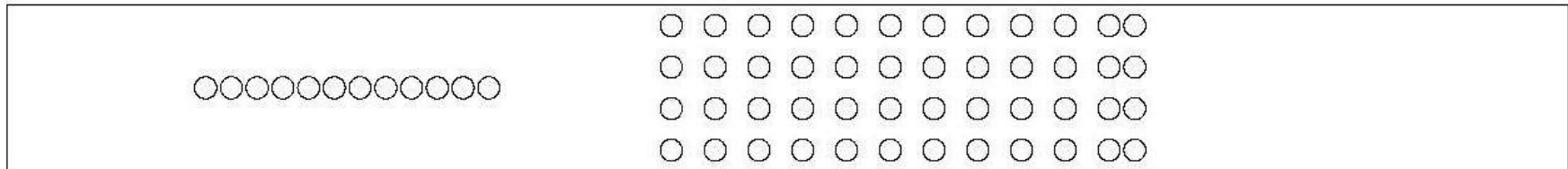
Boiler harus memiliki
efisiensi perpindahan
panas yang tinggi



RUMUSAN MASALAH



Karakteristik
Aliran dan
Perpindahan Panas

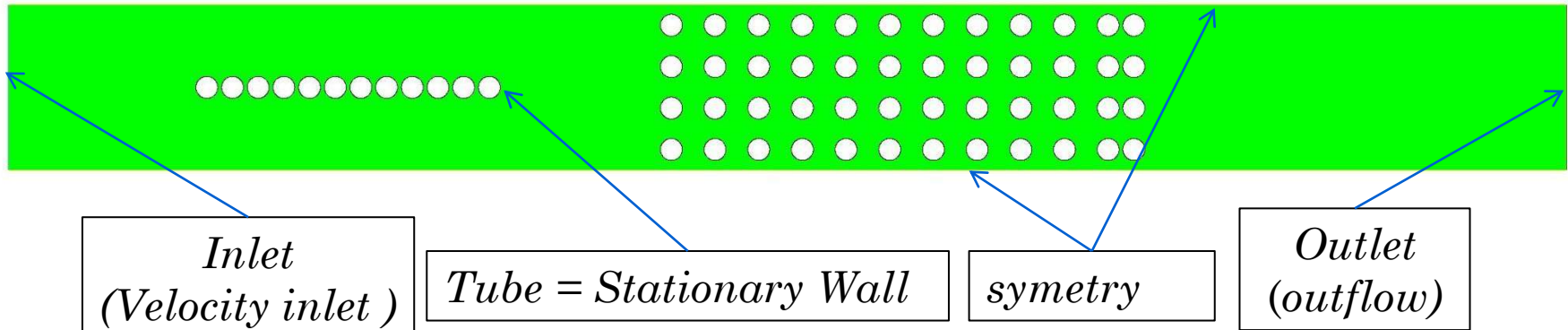


Variasi Jarak Transisi
(108 mm, 162 mm, 216 mm, 270 mm, 378 mm, dan 450 mm)

BATASAN MASALAH



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Inlet :

- *Udara Gas Ideal*
- *Steady Flow*
- *Uniform Flow*
- *Incompressible Flow*
- *1000 K*

Konveksi

Geometri = Gambit 2.4.6
Simulasi = Fluent 14

Tube Kolom ke-	Temperatur Superheater (K)	
	Primary	Secondary
1	579,00	626,00
2	584,45	640,55
3	589,91	655,09
4	595,36	669,64
5	600,82	684,18
6	606,27	698,73
7	611,73	713,27
8	617,18	727,82
9	622,64	742,36
10	628,09	756,91
11	633,55	771,45
12	639,00	786,00

Numerical Investigation of Convective Heat Transfer in Unsteady Flow Past Two Cylinders in Tandem Arrangements (Necati Mahir dkk, 2008)

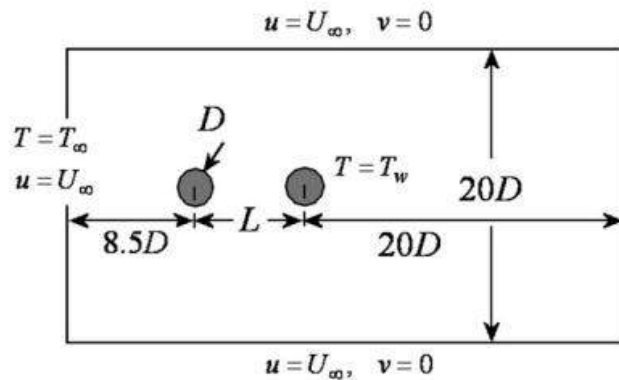


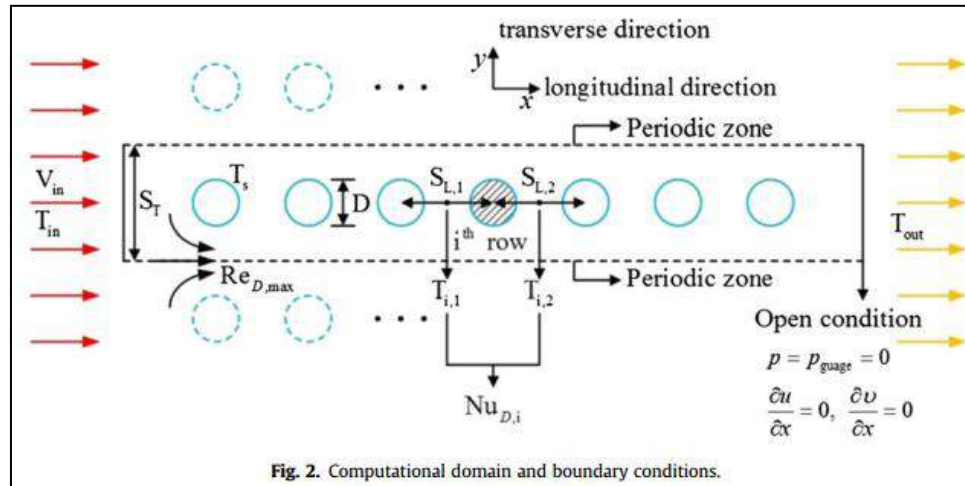
Fig. 1. Computational domain and two cylinder configuration.

The mean Nusselt numbers for the upstream and downstream cylinders as a function of Reynolds number and L/D ratio

Re	L/D	Nu_1	Nu_2
100	2	4.74	2.03
	3	4.804	2.293
	4	5.176 ± 0.006	4.02 ± 0.43
	5	5.180 ± 0.005	4.28 ± 0.40
	7	5.159 ± 0.003	4.21 ± 0.26
	10	5.174 ± 0.003	4.27 ± 0.18
200	2	6.460	2.88 ± 0.03
	3	6.56 ± 0.001	3.54 ± 0.11
	4	7.44 ± 0.046	6.15 ± 0.51
	5	7.43 ± 0.034	5.96 ± 0.47
	7	7.45 ± 0.029	5.83 ± 0.32
	10	7.46 ± 0.027	5.86 ± 0.26

Pada Re 100 dan 200, nilai Nu meningkat sampai pada jarak $L/D = 4$, dan nilai Nu relatif sama pada jarak L/D selanjutnya.

Uneven Longitudinal Pitch Effect on Tube Bank Heat Transfer in Cross Flow (Dongkyun Lee, 2012)



Semakin kecil nilai L/D ,
maka nilai Nu akan semakin
kecil. Begitu juga sebaliknya.

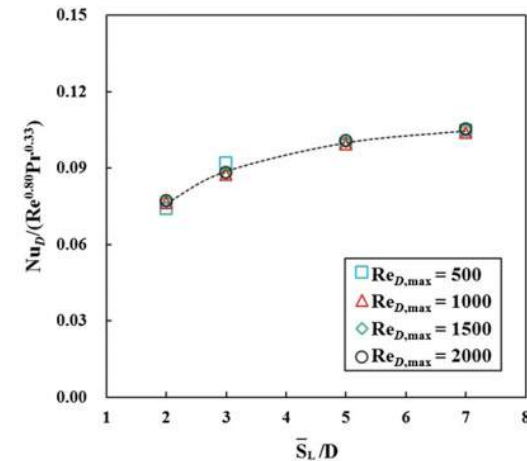
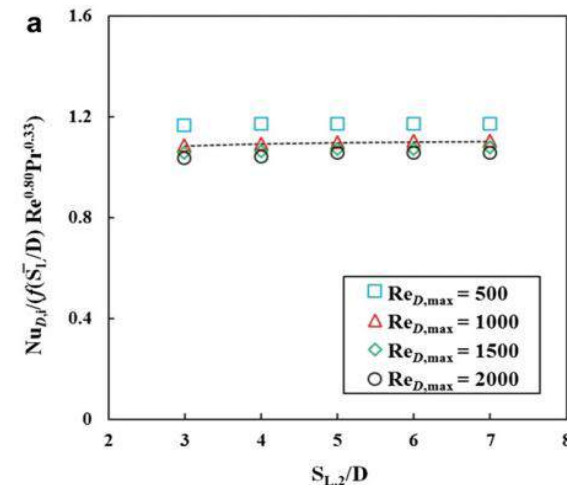


Fig. 5. Effect of longitudinal pitch distance on uniformly distributed tube bank.



Konsep Aliran

$$\dot{m} = \rho V A \quad \rightarrow \quad V_{max} = \frac{S_T}{S_T - D} V \quad \rightarrow \quad Re_{D,Max} = \frac{\rho V_{max} D}{\mu}$$

Konsep Perpindahan Panas

Grimisson

$$\bar{N}_{uD} = 1,13 C_1 Re_{D,max}^m P_r^{1/3}$$

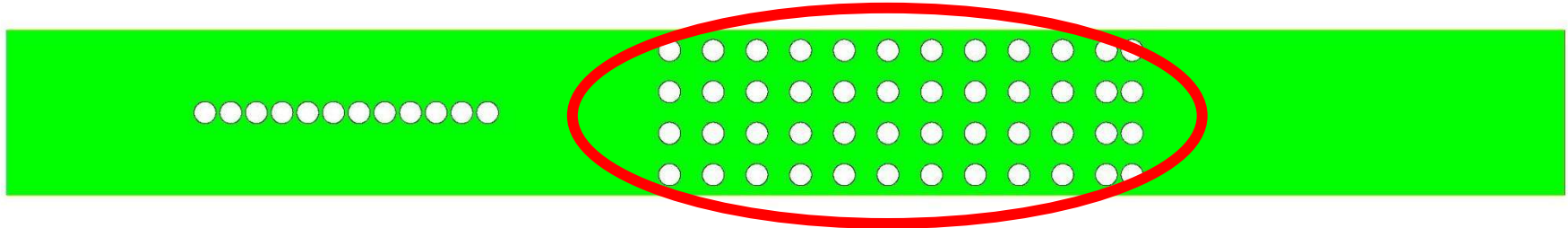
$$\left[\begin{array}{l} N_L \geq 10 \\ 2000 \leq Re_{D,max} \leq 40000 \\ P_r \geq 0,7 \end{array} \right]$$

Zukauskas

$$\bar{N}_{uD} = C Re_{D,max}^m P_r^{0,36} \left(\frac{P_r}{P_{rs}} \right)$$

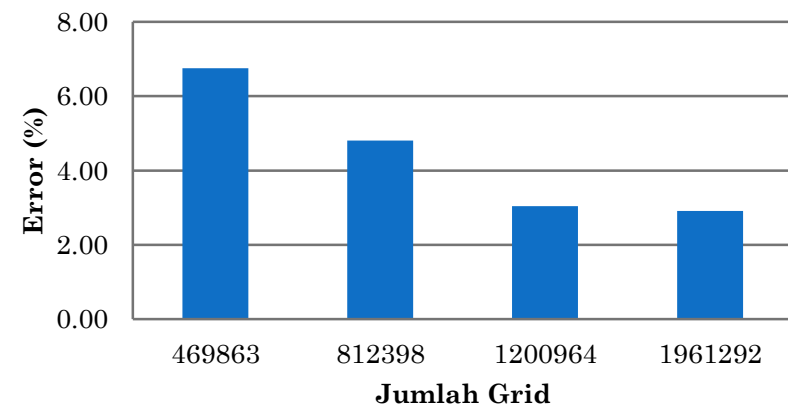
$$\left[\begin{array}{l} N_L \geq 20 \\ 1000 \leq Re_{D,max} \leq 2 \times 10^6 \\ 0,7 \leq P_r \leq 500 \end{array} \right]$$

PROSES VALIDASI



No	Jumlah Grid	Secondary Superheater		
		Nu Simulasi	Nu Perhitungan	Error (%)
1	469863	48,86	45,56	6,75
2	812398	47,86	45,56	4,81
3	1200964	44,22	45,56	3,04
4	1961292	44,27	45,56	2,91

Error Perbandingan Hasil Simulasi dan Perhitungan



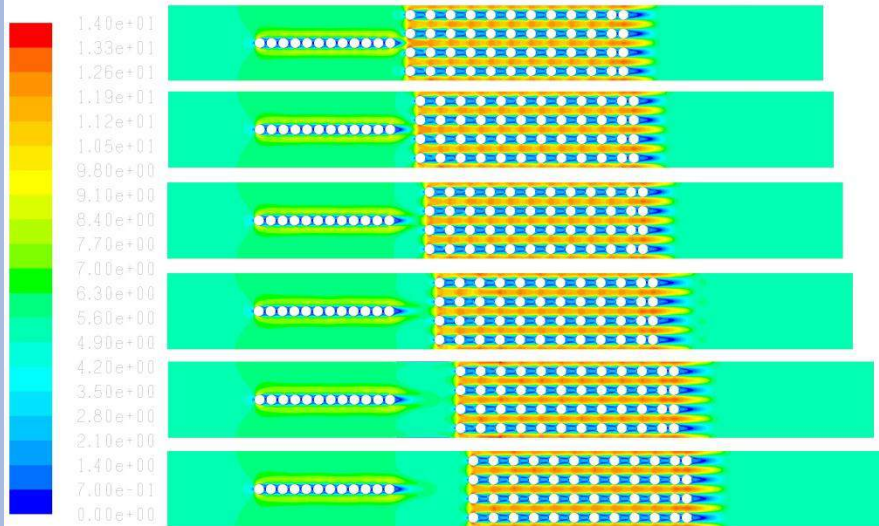
HASIL PENELITIAN



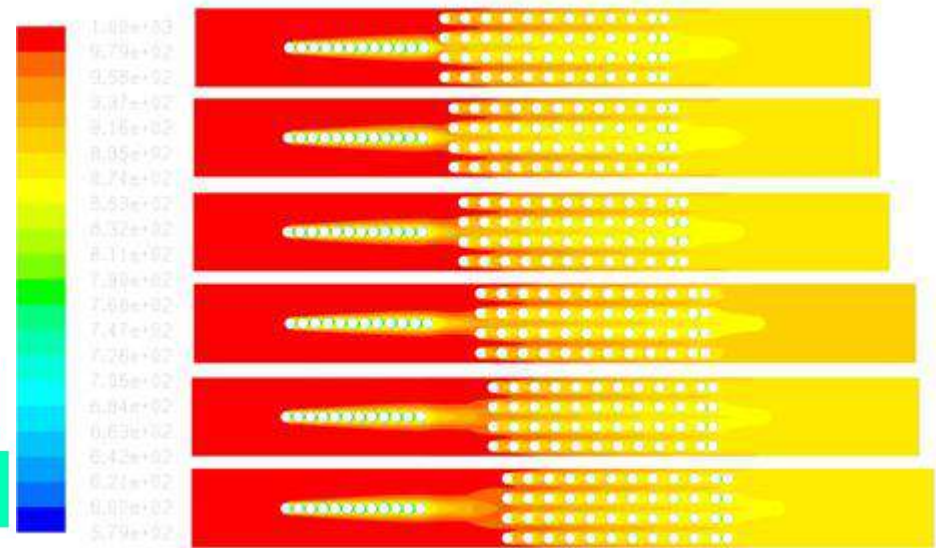
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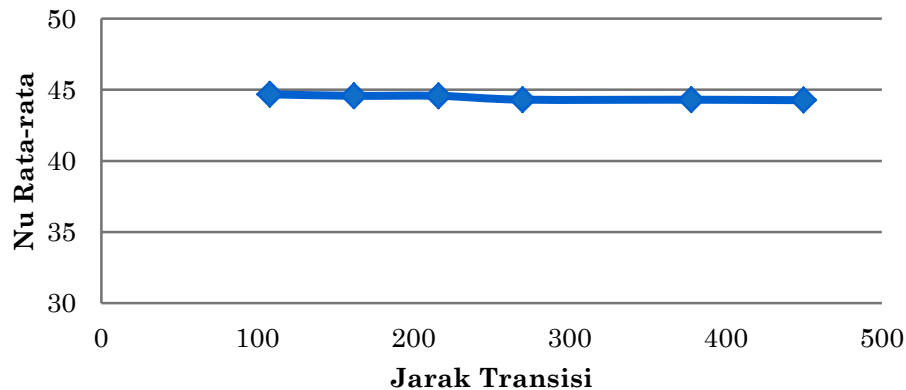
Kecepatan



Temperatur



Nusselt Number Rata-Rata Secondary Superheater

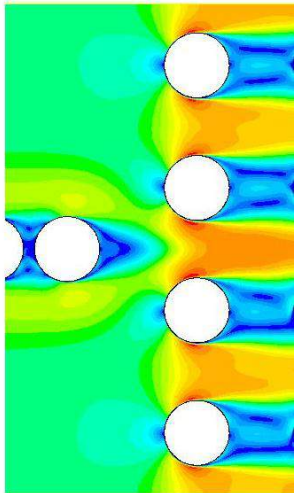


Jarak transisi (mm)	108	162	216	270	378	450
Peningkatan Nu (%)	0.9	0.7	0.69	0.09	0.07	0

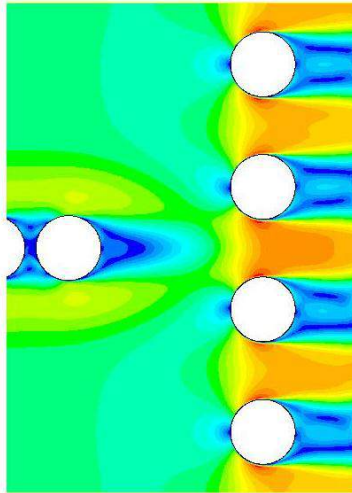
HASIL PENELITIAN



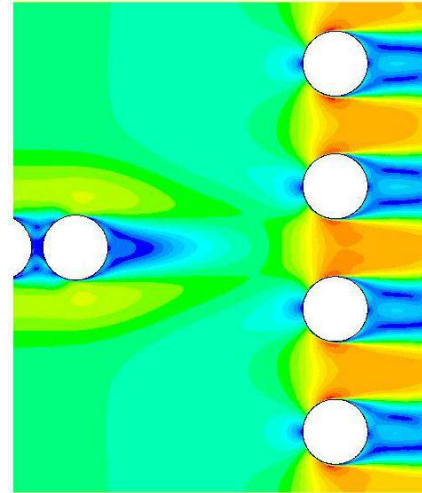
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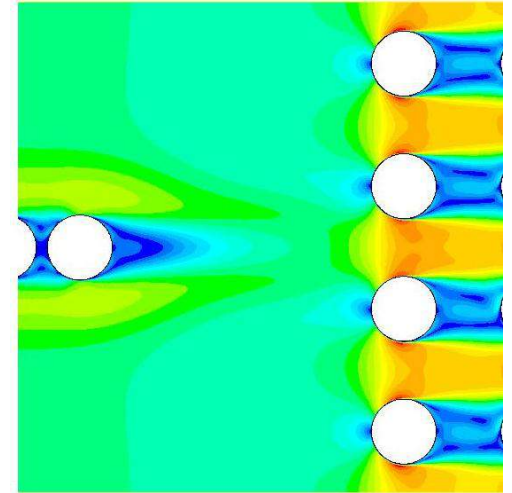
108 mm



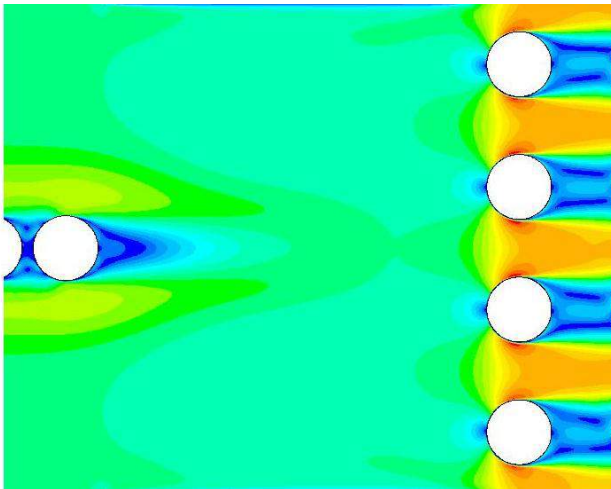
162 mm



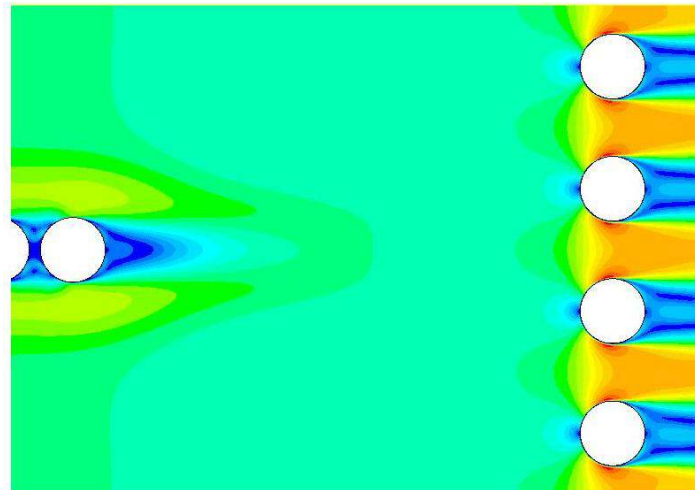
216 mm



270 mm



378 mm



450 mm

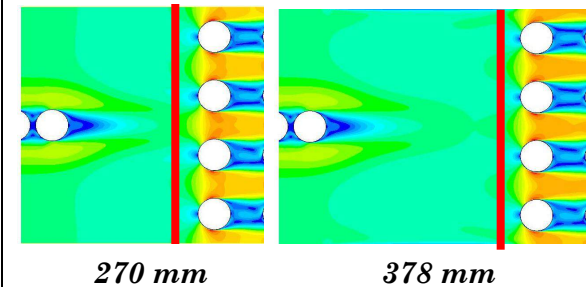
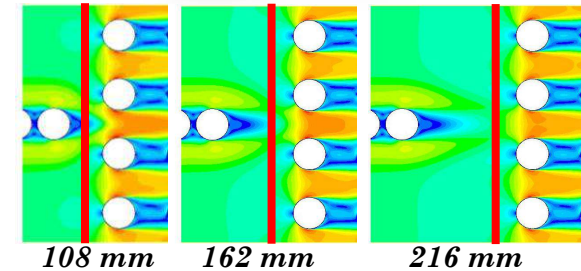
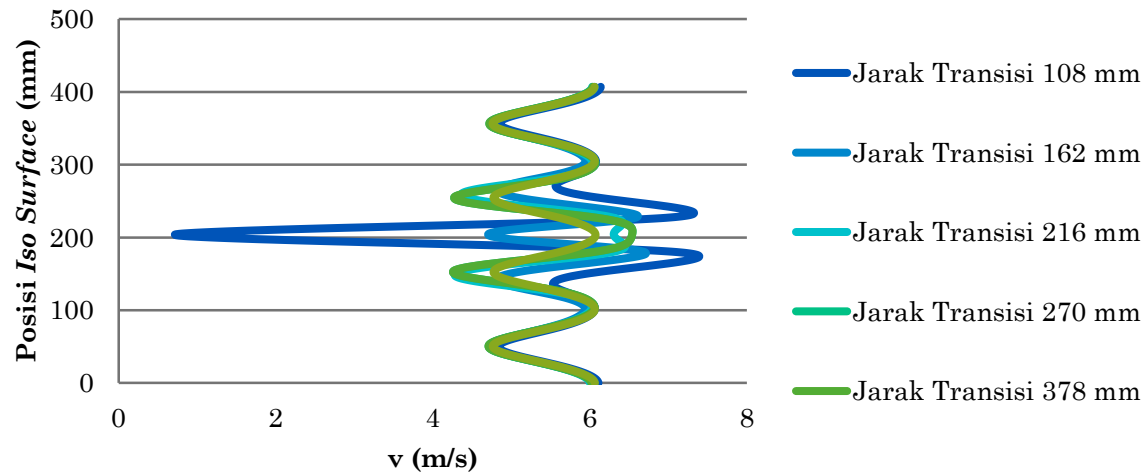
HASIL PENELITIAN



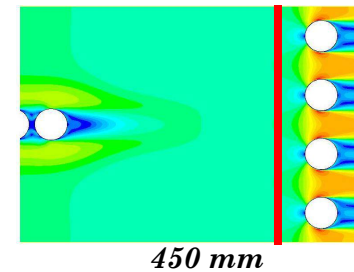
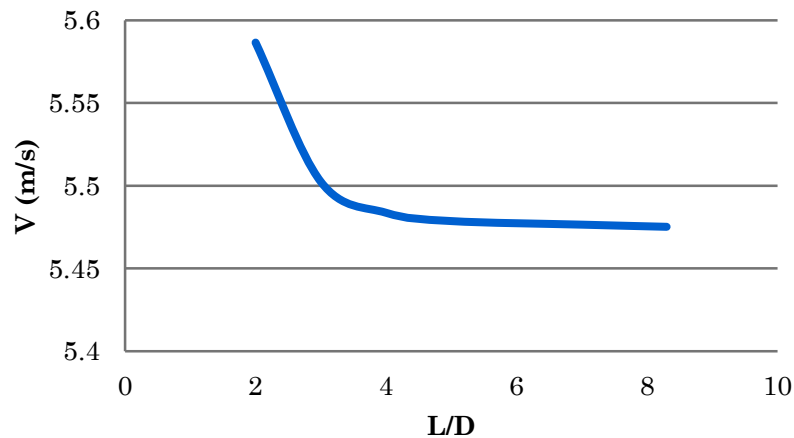
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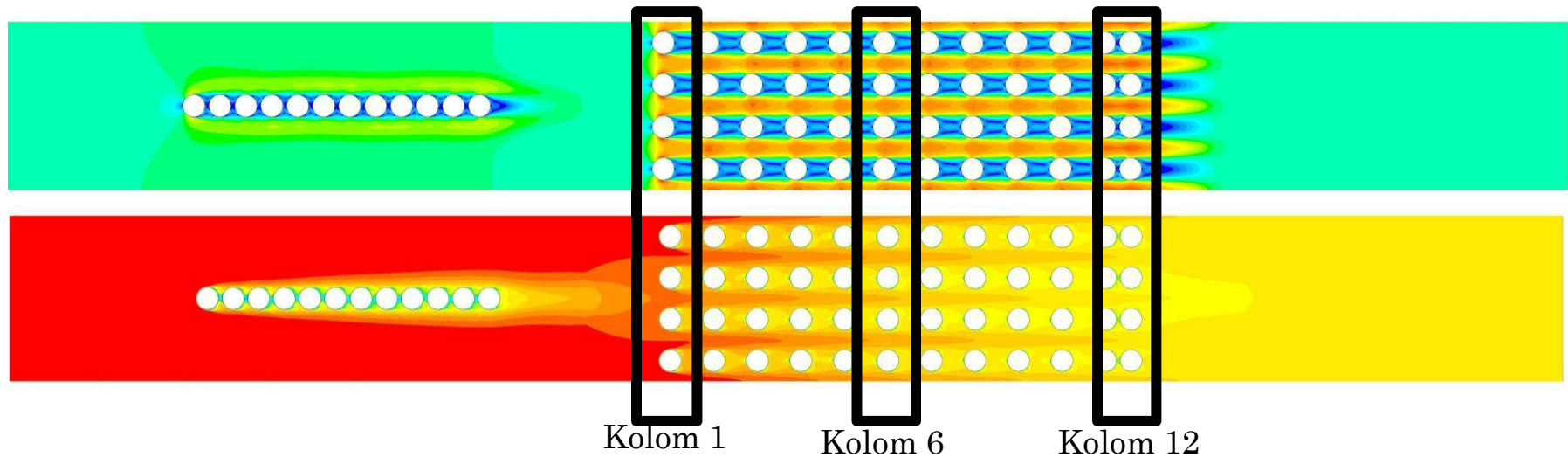
Perbandingan Kecepatan *Inlet* Secondary Superheater



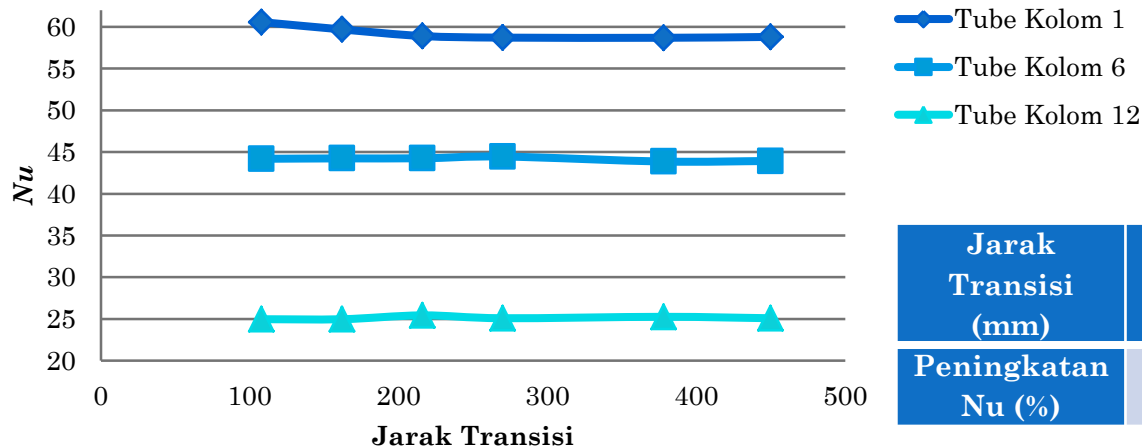
Kecepatan Rata-Rata *Inlet* Secondary Superheater



Jarak Transisi (mm)	108	162	216	270	378	450
Peningkatan Kecepatan (%)	2.03	0.50	0.15	0.06	0.02	0.00

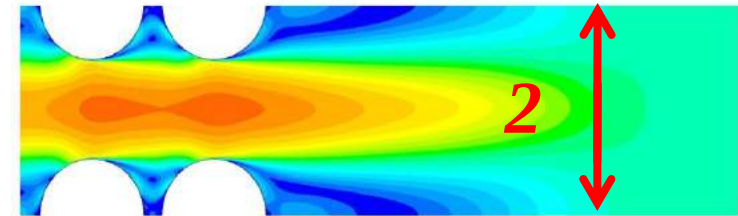
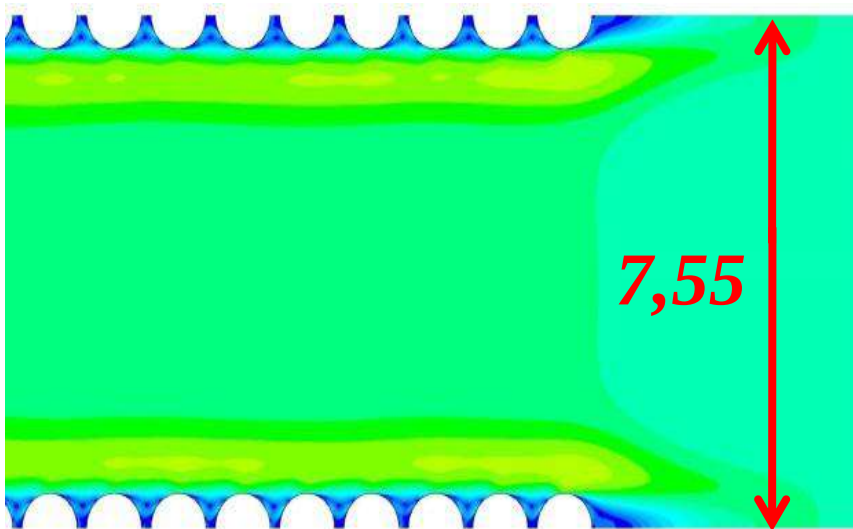


Nusselt Number Rata-Rata Secondary Superheater pada Kolom Pertama, Keenam, dan Keduabelas

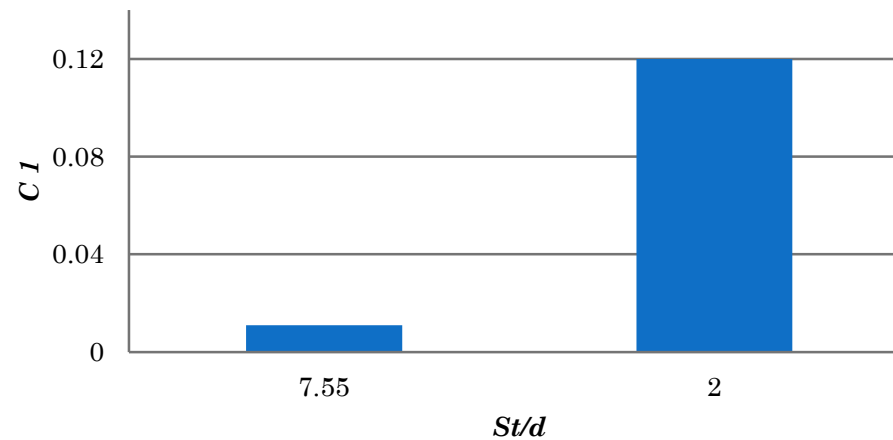


Jarak Transisi (mm)	108	162	216	270	378	450
Peningkatan Nu (%)	3,02	1,53	0,18	0,14	0,17	0,00

HASIL PENELITIAN

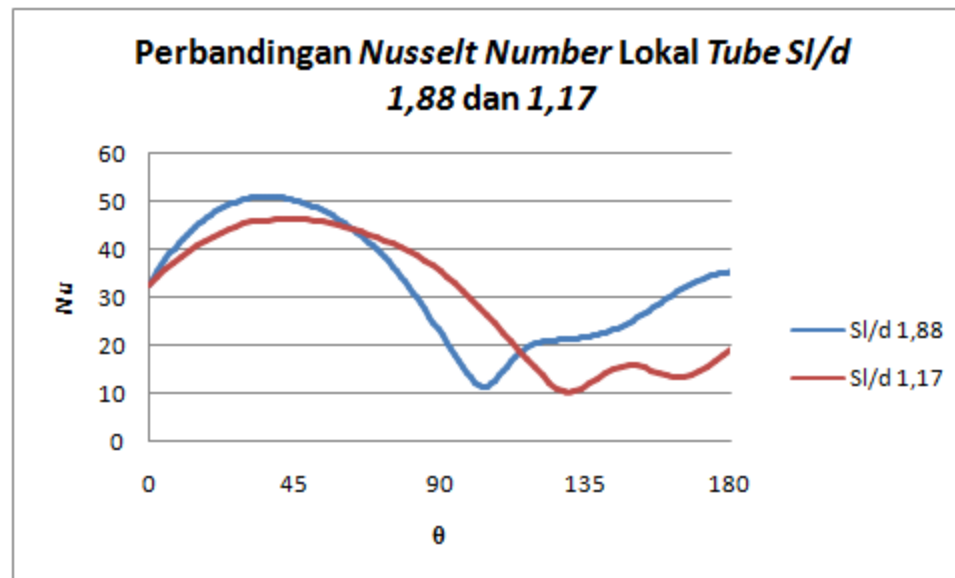
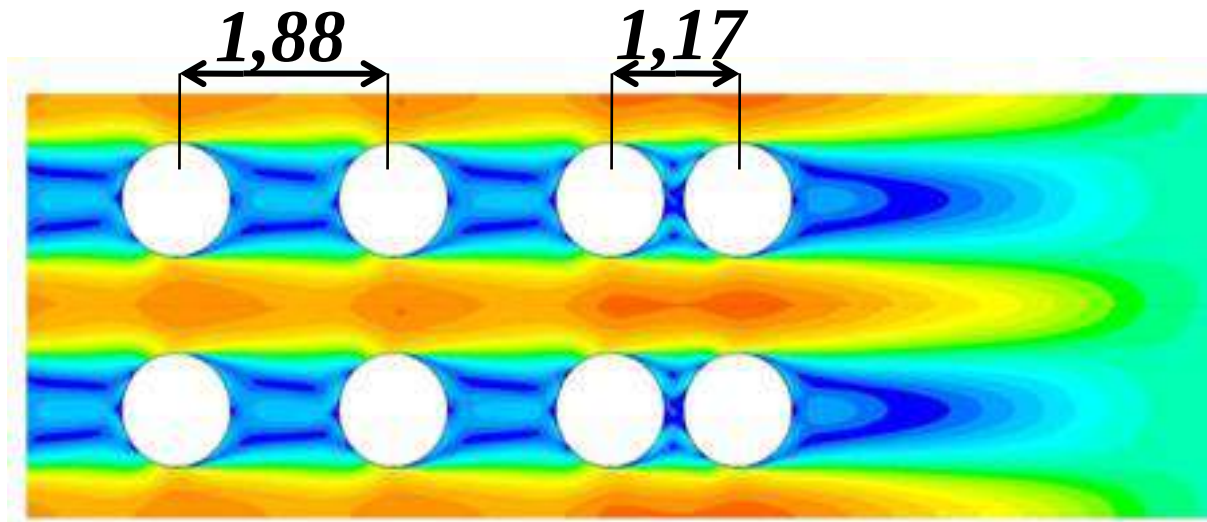


Perbandingan nilai C_1



$$\frac{\overline{Nu}}{Re_{D,max}^m Pr^{1/3}} = C_1$$

HASIL PENELITIAN



Peningkatan
Nilai Nu
sebesar
9,61 %

- Jarak transisi memiliki pengaruh yang sangat kecil terhadap peningkatan kualitas perpindahan panas pada *secondary superheater* secara *overall*.
- Aliran fluida akibat variasi jarak transisi hanya berpengaruh pada *tube* kolom pertama pada *secondary superheater*.
- Jarak transisi hanya berpengaruh pada *tube* kolom pertama terhadap kualitas perpindahan panas pada *secondary superheater*.
- Kualitas perpindahan panas pada $St/d = 2$ lebih tinggi daripada $St/d = 7,55$.
- Peningkatan nilai *Nusselt Number* rata-rata yang terjadi akibat perbedaan nilai Sl/d 1,88 dan Sl/d 1,17 adalah 9,61 %



TERIMA KASIH