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L A M P I R A N

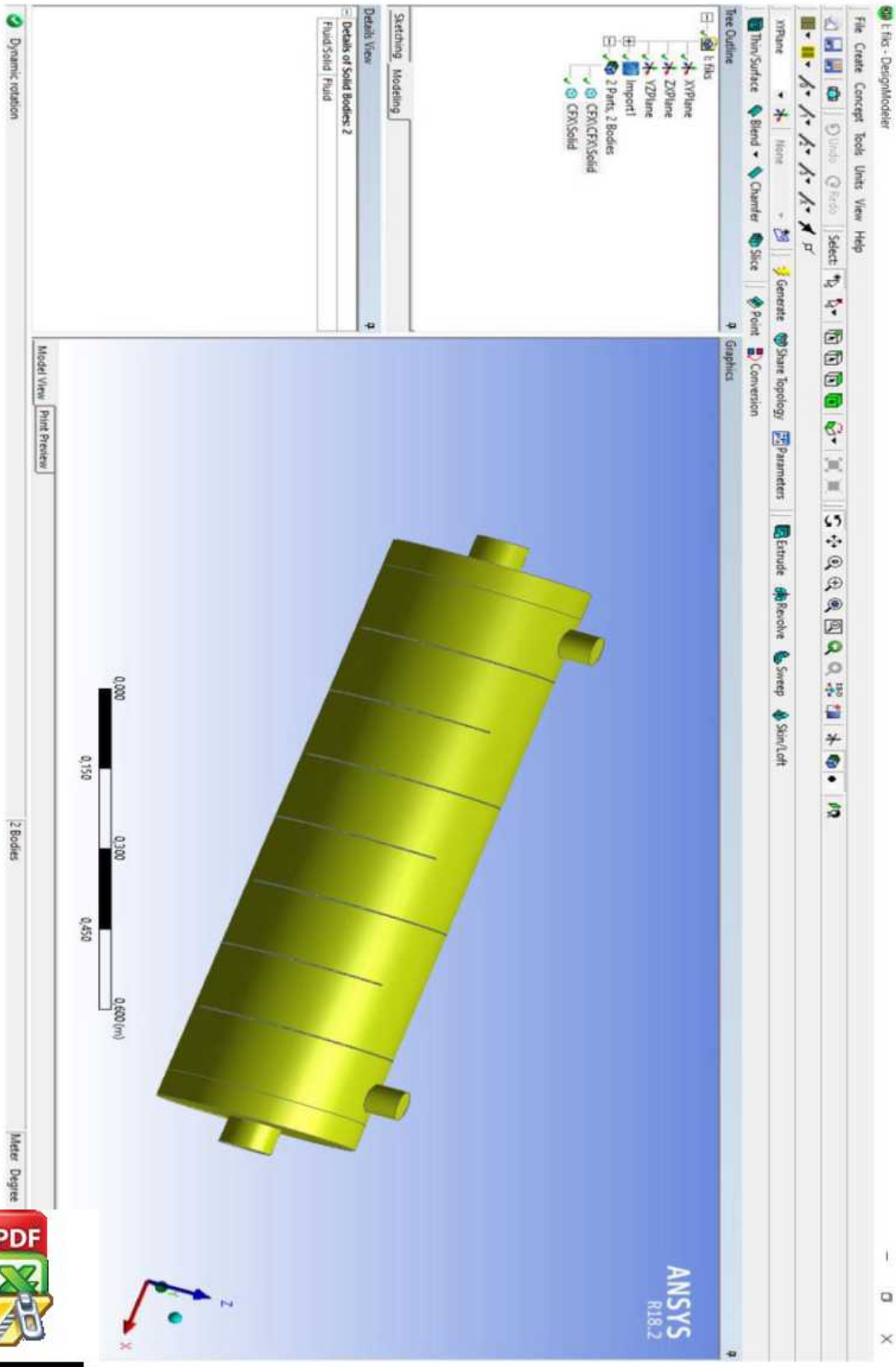
Lampiran 1. Data *Auxiliary Engine*

DAIHATSU

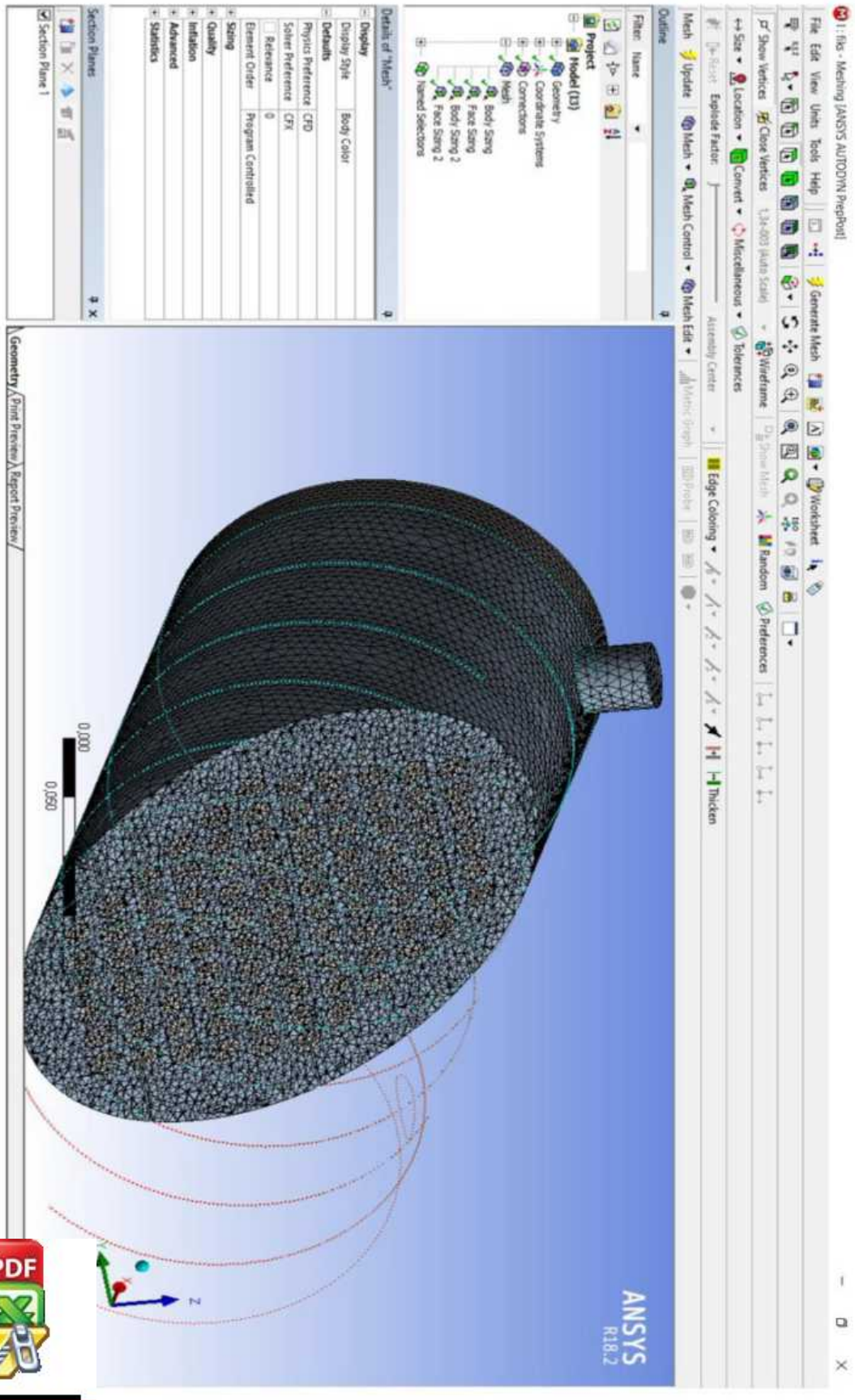
ENGINE ADJUSTMENT STANDARDS Operating Specifications	TYPE DL-19	SECTION 3 SHEET 2

Item				Design Value	Alarm Setting [Emergency stop Setting]	Remarks
Pressure MPa (kg/cm^2)	Intake air					According to turbocharger specifications
	Starting air			1.47 ~ 2.94 (15 ~ 30)	1.47 (15)	
	Fuel oil			0.2 ~ 0.29 (2.0 ~ 3.0) *[0.49 ~ 0.59 (5.0 ~ 6.0)]		Static pressure of tank head should be considered.
	Lubricating oil			0.29 ~ 0.39 (3.0 ~ 4.0)	0.16 (1.6) [0.12 (1.2)]	
	Rocker arm lubricating oil			0.06 ~ 0.12 (0.6 ~ 1.2)	0.03 (0.3)	
	Cooling water	Jacket		0.25 ~ 0.34 (2.5 ~ 3.5)		Tank head and external piping conditions should be considered.
		Cooler				
	Nozzle coolant pressure			0.1 ~ 0.29 (1.0 ~ 3.0)		Specified for operation with heavy fuel oil.
Temperature (°C)	Intake air	Engine inlet		40 ~ 50		Setting: 45°C (at 100% load)
	Exhaust gas	Cylinder outlet			480	According to turbocharger specifications
		Turbocharger inlet			580	
		Turbocharger outlet			480	
	Fuel oil	Engine inlet		65 sec. RW No.1 (14 cst)	80 sec. RW No.1 (18 cst)	Viscosities are for heavy fuel oil.
	Lubricating oil	Engine inlet		40 ~ 60	65	
		Engine outlet (inlet of LO cooler)		70		
	Cooling water	Jacket line (fresh water)	Engine inlet	70		In case of inlet control system
			Engine outlet	75	85 (90)	In case of outlet control system
			Valve seal cooling water outlet	80		
		Cooler line (sea water)	Engine inlet	24 ~ 32		

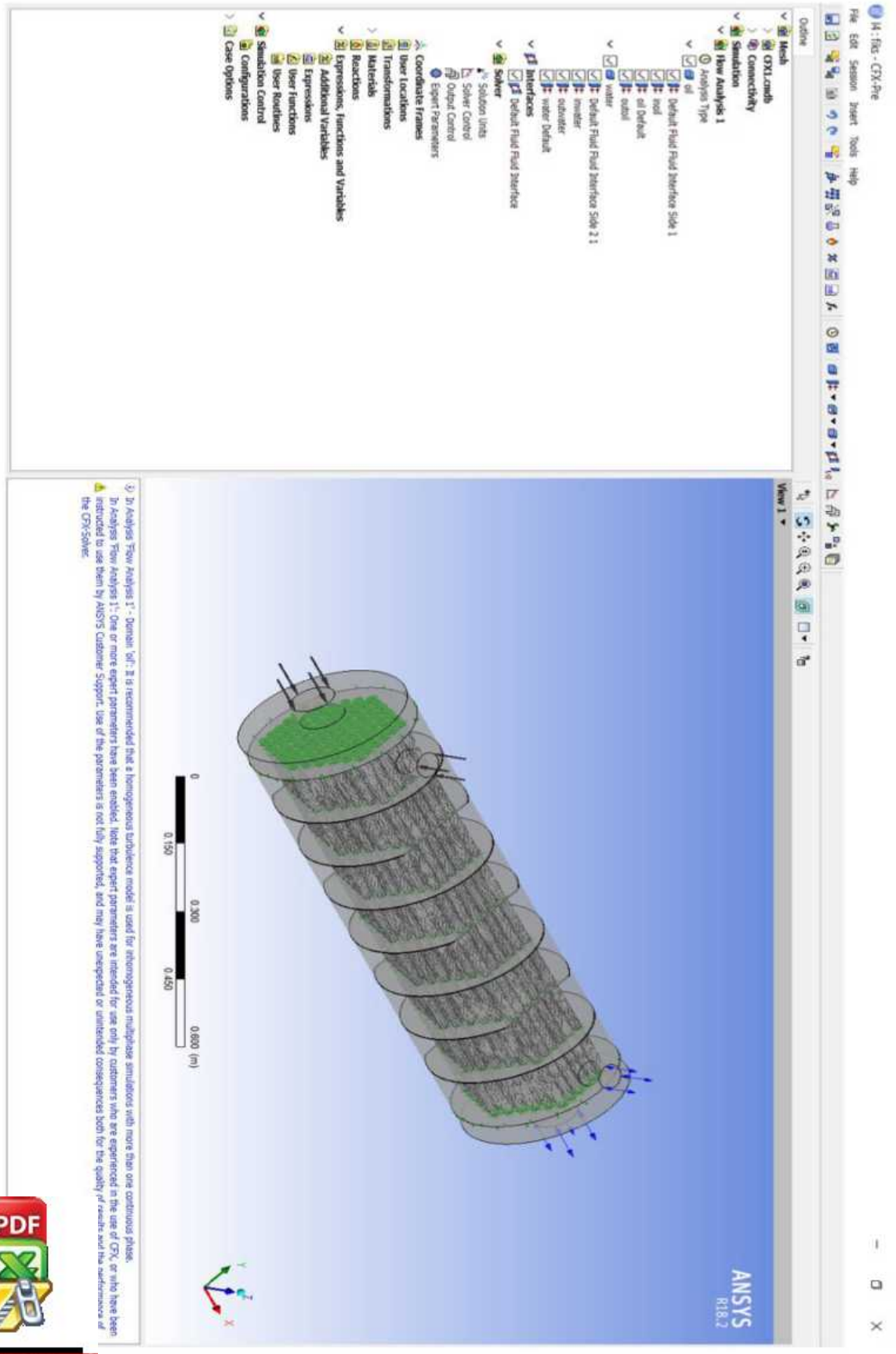
Lampiran 2. Tahap Modeling *Shell and Tube*



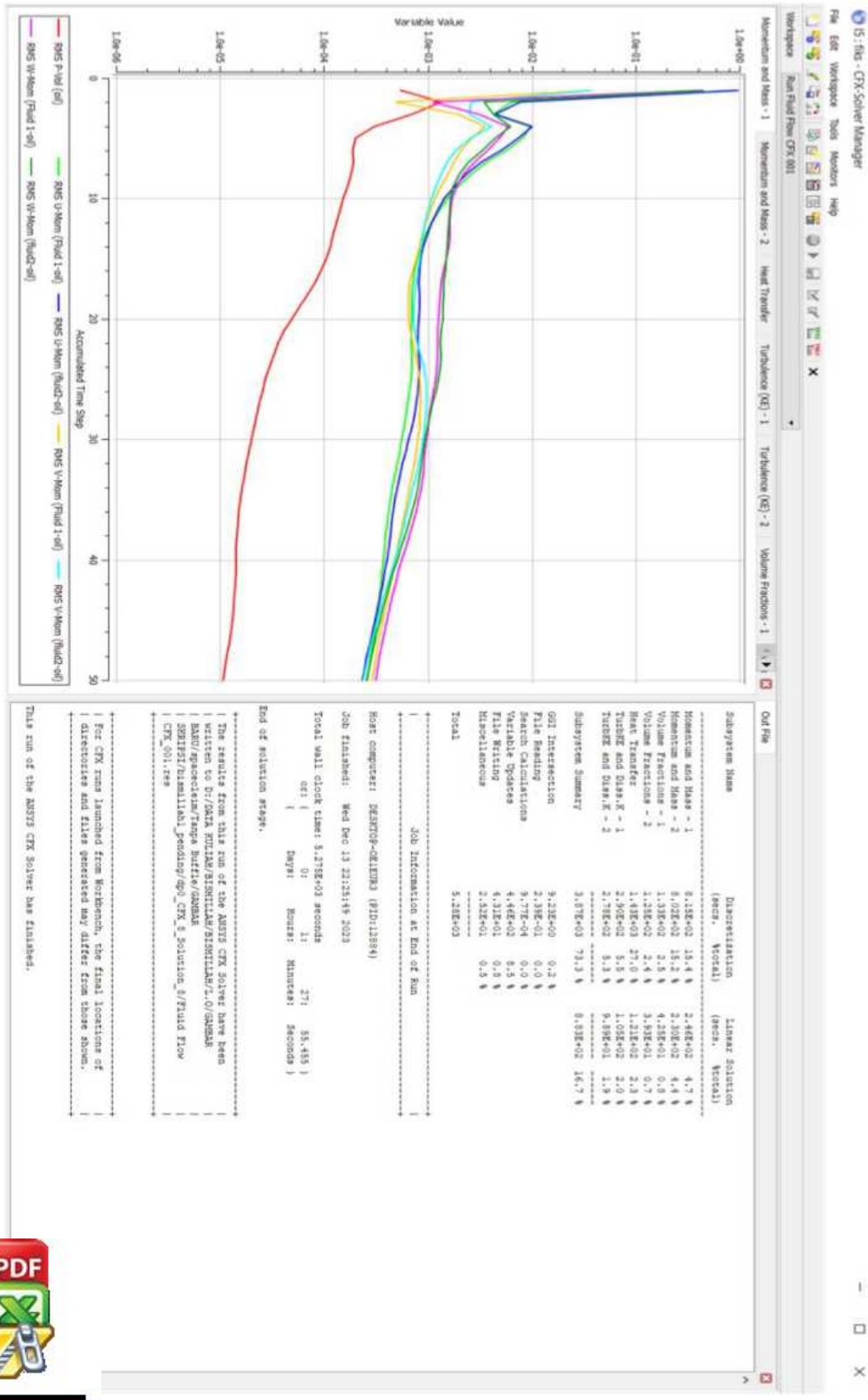
Lampiran 3. Tahap *Meshing*



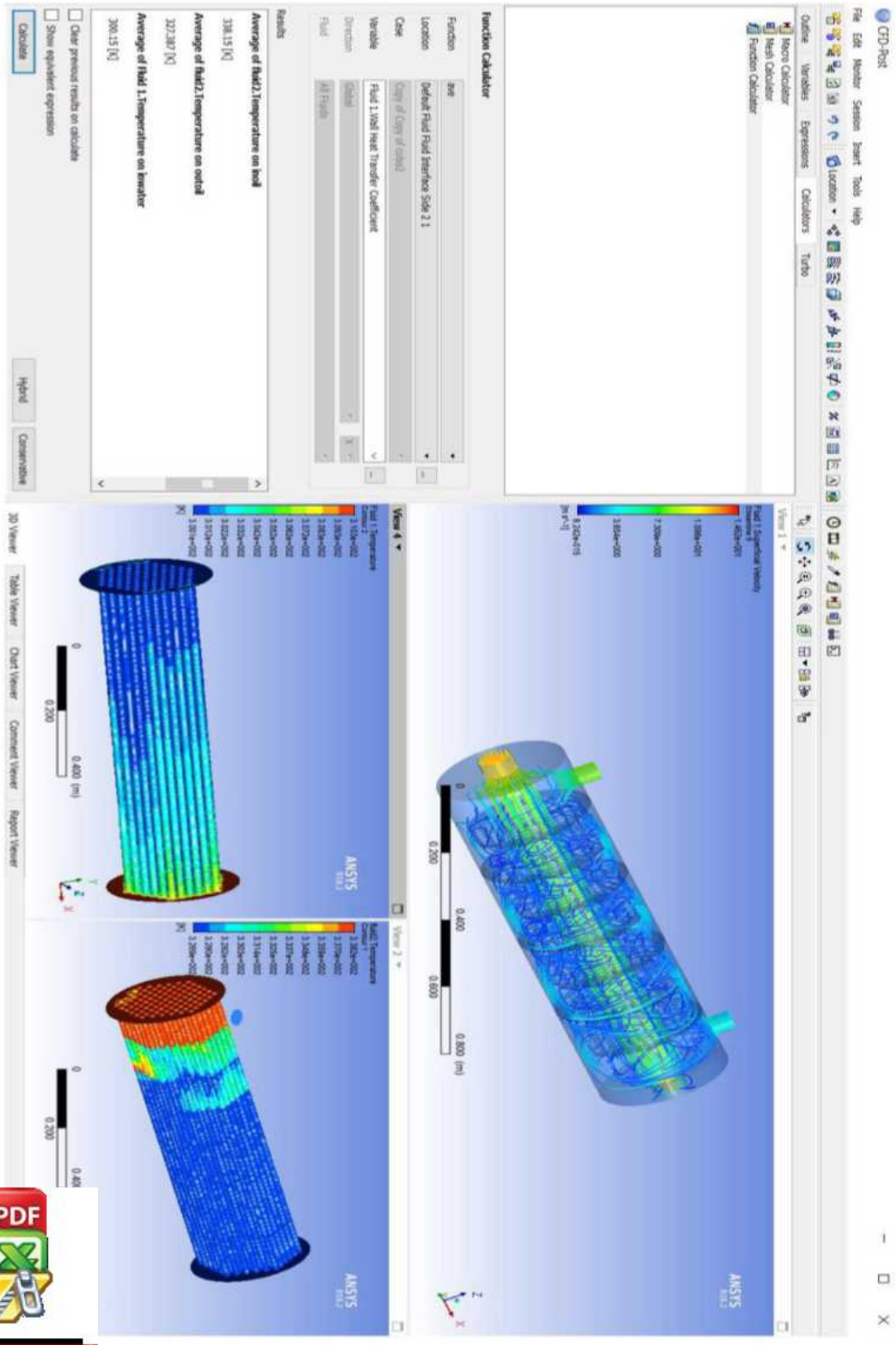
Lampiran 4. Tahap *Setup*



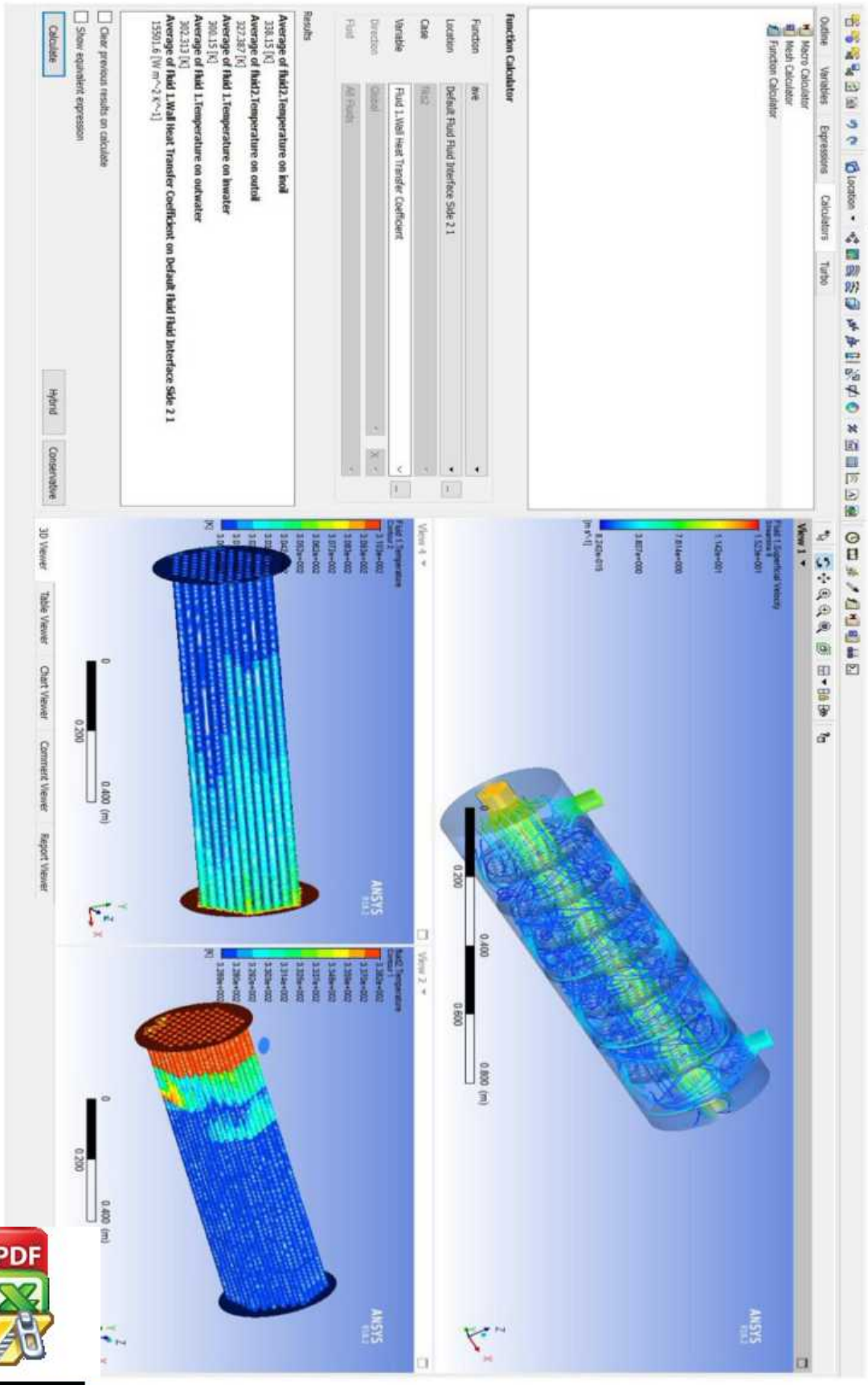
Lampiran 5. Tahap *Solution*



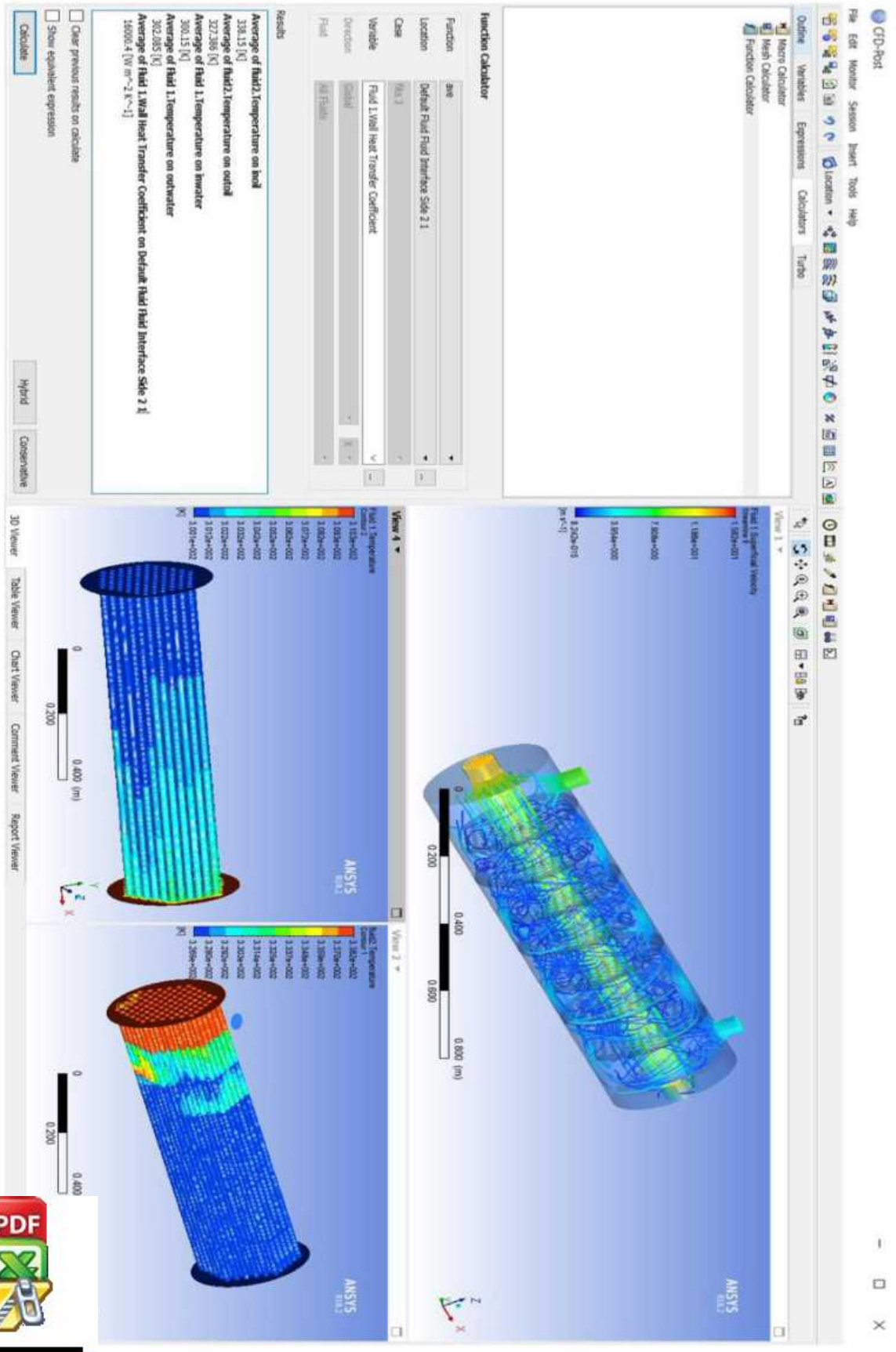
Lampiran 6. *Result* Pada Tekanan 2,2 Bar



Lampiran 7. *Result* Pada Teknan 2,3 bar



Lampiran 8. *Result* Pada Tekanan 2,4 bar



Lampiran 9. *Properties of Engine Oil*

Table A-4 | Properties of saturated liquids† (*Continued*).

T, °C	ρ kg/m³	c_p kJ/kg·°C	ν, m²/s	k W/m·°C	α, m²/s	Pr	β, K⁻¹
			Glycerin, $C_3H_5(OH)_3$				
0	1,276.03	2.261	0.00831	0.282	0.983×10^{-7}	84.7×10^{3}	
10	1,270.11	2.319	0.00300	0.284	0.965	31.0	
20	1,264.02	2.386	0.00118	0.286	0.947	12.5	0.50×10^{-3}
30	1,258.09	2.445	0.00050	0.286	0.929	5.38	
40	1,252.01	2.512	0.00022	0.286	0.914	2.45	
50	1,244.96	2.583	0.00015	0.287	0.893	1.63	
			Ethylene glycol, $C_2H_4(OH)_2$				
0	1,130.75	2.294	7.53×10^{-6}	0.242	0.934×10^{-7}	615	
20	1,116.65	2.382	19.18	0.249	0.939	204	0.65×10^{-3}
40	1,101.43	2.474	8.69	0.256	0.939	93	
60	1,087.66	2.562	4.75	0.260	0.932	51	
80	1,077.56	2.650	2.98	0.261	0.921	32.4	
100	1,058.50	2.742	2.03	0.263	0.908	22.4	
			Engine oil (unused)				
0	899.12	1.796	0.00428	0.147	0.911×10^{-7}	47,100	
20	888.23	1.880	0.00090	0.145	0.872	10,400	0.70×10^{-3}
40	876.05	1.964	0.00024	0.144	0.834	2,870	
60	864.04	2.047	0.839×10^{-4}	0.140	0.800	1,050	
80	852.02	2.131	0.375	0.138	0.769	490	
100	840.01	2.219	0.203	0.137	0.738	276	
120	828.96	2.307	0.124	0.135	0.710	175	
140	816.94	2.395	0.080	0.133	0.686	116	
160	805.89	2.483	0.056	0.132	0.663	84	
			Mercury, Hg				
0	13,628.22	0.1403	0.124×10^{-6}	8.20	42.99×10^{-7}	0.0288	
20	13,579.04	0.1394	0.114	8.69	46.06	0.0249	1.82×10^{-4}
50	13,505.84	0.1386	0.104	9.40	50.22	0.0207	
100	13,384.58	0.1373	0.0928	10.51	57.16	0.0162	
150	13,264.28	0.1365	0.0853	11.49	63.54	0.0134	
200	13,144.94	0.1570	0.0802	12.34	69.08	0.0116	
250	13,025.60	0.1357	0.0765	13.07	74.06	0.0103	
315.5	12,847	0.134	0.0673	14.02	81.5	0.0083	

Lampiran 10. *Properties of Water*

APPENDIX A Tables

Table A-9 | Properties of water (saturated liquid).†

Note: $\mathrm{Gr}_x \mathrm{Pr} = \left(\frac{g\beta\rho^2 c_p}{\mu k}\right) x^3 \Delta T$

°F	°C	c_p kJ/kg · °C	ρ kg/m³	μ kg/m · s	k W/m · °C	Pr	$\frac{g\beta\rho^2 c_p}{\mu k}$ 1/m³ · °C
32	0	4.225	999.8	1.79×10^{-3}	0.566	13.25	
40	4.44	4.208	999.8	1.55	0.575	11.35	1.91×10^{9}
50	10	4.195	999.2	1.31	0.585	9.40	6.34×10^{9}
60	15.56	4.186	998.6	1.12	0.595	7.88	1.08×10^{10}
70	21.11	4.179	997.4	9.8×10^{-4}	0.604	6.78	1.46×10^{10}
80	26.67	4.179	995.8	8.6	0.614	5.85	1.91×10^{10}
90	32.22	4.174	994.9	7.65	0.623	5.12	2.48×10^{10}
100	37.78	4.174	993.0	6.82	0.630	4.53	3.3×10^{10}
110	43.33	4.174	990.6	6.16	0.637	4.04	4.19×10^{10}
120	48.89	4.174	988.8	5.62	0.644	3.64	4.89×10^{10}
130	54.44	4.179	985.7	5.13	0.649	3.30	5.66×10^{10}
140	60	4.179	983.3	4.71	0.654	3.01	6.48×10^{10}
150	65.55	4.183	980.3	4.3	0.659	2.73	7.62×10^{10}
160	71.11	4.186	977.3	4.01	0.665	2.53	8.84×10^{10}
170	76.67	4.191	973.7	3.72	0.668	2.33	9.85×10^{10}
180	82.22	4.195	970.2	3.47	0.673	2.16	1.09×10^{11}
190	87.78	4.199	966.7	3.27	0.675	2.03	
200	93.33	4.204	963.2	3.06	0.678	1.90	
220	104.4	4.216	955.1	2.67	0.684	1.66	
240	115.6	4.229	946.7	2.44	0.685	1.51	
260	126.7	4.250	937.2	2.19	0.685	1.36	
280	137.8	4.271	928.1	1.98	0.685	1.24	
300	148.9	4.296	918.0	1.86	0.684	1.17	
350	176.7	4.371	890.4	1.57	0.677	1.02	
400	204.4	4.467	859.4	1.36	0.665	1.00	
450	232.2	4.585	825.7	1.20	0.646	0.85	
500	260	4.731	785.2	1.07	0.616	0.83	
550	287.7	5.024	735.5	9.51×10^{-5}			
	315.6	5.703	678.7	8.68			