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LAMPIRAN

Lampiran A

Tabel A 1

MODEL 1	T (°C)	ρ (kg/m ³)	V (m/s)	μ (Kg/m.s)	Luas Permukaan Benda (m ²)
	32	1.156	8	0.00001881	0.001513
		1.156	10	0.00001881	0.001513
		1.156	12	0.00001881	0.001513
		1.156	14	0.00001881	0.001513
		1.156	16	0.00001881	0.001513
		1.156	18	0.00001881	0.001513
		1.156	20	0.00001881	0.001513
MODEL 2	T (°C)	ρ (kg/m ³)	V (m/s)	μ (Kg/m.s)	Luas Permukaan Benda (m ²)
	32	1.156	8	0.00001881	0.001319
		1.156	10	0.00001881	0.001319
		1.156	12	0.00001881	0.001319
		1.156	14	0.00001881	0.001319
		1.156	16	0.00001881	0.001319
		1.156	18	0.00001881	0.001319
		1.156	20	0.00001881	0.001319
MODEL 3	T (°C)	ρ (kg/m ³)	V (m/s)	μ (Kg/m.s)	Luas Permukaan Benda (m ²)
	32	1.156	8	0.00001881	0.001260
		1.156	10	0.00001881	0.001260
		1.156	12	0.00001881	0.001260
		1.156	14	0.00001881	0.001260
		1.156	16	0.00001881	0.001260
		1.156	18	0.00001881	0.001260
		1.156	20	0.00001881	0.001260

Tabel A 2 Nilai gaya drag (F_D) blade terhadap perubahan sudut untuk pendekatan eksperimen

	V (m/s)	0	15	30	45	60	75	90
MODEL 1	8	0.06	0.11	0.15	0.19	0.26	0.3	0.26
	10	0.09	0.15	0.22	0.28	0.37	0.44	0.38
	12	0.12	0.2	0.3	0.37	0.47	0.56	0.48
	14	0.16	0.25	0.39	0.49	0.59	0.72	0.6
	16	0.2	0.3	0.5	0.62	0.75	0.89	0.77
	18	0.25	0.37	0.62	0.76	0.93	1.1	0.95
	20	0.3	0.46	0.74	0.91	1.13	1.35	1.15
MODEL 2	8	0.07	0.12	0.16	0.2	0.26	0.31	0.27
	10	0.1	0.17	0.23	0.29	0.37	0.44	0.39
	12	0.13	0.22	0.31	0.39	0.47	0.56	0.48
	14	0.17	0.28	0.40	0.51	0.6	0.73	0.6
	16	0.21	0.34	0.52	0.65	0.77	0.89	0.78
	18	0.26	0.43	0.63	0.79	0.94	1.1	0.95
	20	0.32	0.51	0.75	0.93	1.14	1.35	1.16
MODEL 3	8	0.06	0.11	0.15	0.19	0.26	0.3	0.27
	10	0.09	0.16	0.22	0.28	0.37	0.44	0.39
	12	0.12	0.21	0.3	0.38	0.48	0.56	0.48
	14	0.15	0.26	0.39	0.5	0.6	0.73	0.6
	16	0.19	0.32	0.51	0.64	0.77	0.9	0.78
	18	0.24	0.4	0.62	0.77	0.94	1.1	0.95
	20	0.29	0.48	0.74	0.92	1.14	1.35	1.16

Tabel A 3 Nilai gaya drag (F_D) blade terhadap perubahan sudut untuk pendekatan komputasi

	V (m/s)	0	15	30	45	60	75	90
MODEL 1	8	0.06	0.12	0.16	0.21	0.27	0.34	0.27
	10	0.10	0.16	0.24	0.32	0.40	0.48	0.41
	12	0.14	0.22	0.34	0.41	0.53	0.63	0.53
	14	0.18	0.29	0.44	0.54	0.68	0.80	0.66
	16	0.23	0.34	0.57	0.70	0.87	0.98	0.84
	18	0.28	0.42	0.72	0.88	1.06	1.20	1.05
	20	0.35	0.52	0.85	1.03	1.28	1.45	1.29
MODEL 2	8	0.07	0.13	0.18	0.23	0.27	0.34	0.28
	10	0.11	0.18	0.26	0.33	0.40	0.48	0.42
	12	0.15	0.24	0.35	0.44	0.54	0.64	0.53
	14	0.19	0.30	0.46	0.56	0.69	0.82	0.66
	16	0.24	0.39	0.60	0.73	0.88	0.99	0.85
	18	0.30	0.49	0.73	0.91	1.08	1.20	1.07
	20	0.36	0.57	0.85	1.06	1.29	1.46	1.30
MODEL 3	8	0.07	0.13	0.17	0.22	0.27	0.33	0.27
	10	0.10	0.17	0.25	0.32	0.41	0.49	0.41
	12	0.14	0.23	0.33	0.43	0.54	0.64	0.53
	14	0.17	0.30	0.44	0.56	0.69	0.82	0.66
	16	0.22	0.36	0.57	0.72	0.88	1.00	0.84
	18	0.27	0.45	0.71	0.88	1.07	1.21	1.05
	20	0.33	0.55	0.85	1.03	1.30	1.47	1.29

Tabel A 4 Perbandingan nilai koefisien *drag* pada sudut serang 0 derajat untuk pendekatan eksperimen dan simulasi

	V (m/s)	EKSPERIMEN		SIMULASI		SELISIH
		FD	CD	FD	CD	
MODEL 1	8	0.06	1.072	0.06	1.158	8%
	10	0.09	1.029	0.10	1.161	13%
	12	0.12	0.953	0.14	1.086	14%
	14	0.16	0.933	0.18	1.063	14%
	16	0.2	0.893	0.23	1.007	13%
	18	0.25	0.882	0.28	0.998	13%
	20	0.3	0.858	0.35	0.996	16%
MODEL 2	8	0.07	1.435	0.07	1.530	7%
	10	0.1	1.312	0.11	1.382	5%
	12	0.13	1.184	0.15	1.326	12%
	14	0.17	1.138	0.19	1.294	14%
	16	0.21	1.076	0.24	1.217	13%
	18	0.26	1.053	0.30	1.198	14%
	20	0.32	1.049	0.36	1.187	13%
MODEL 3	8	0.06	1.287	0.07	1.396	8%
	10	0.09	1.236	0.10	1.330	8%
	12	0.12	1.144	0.14	1.292	13%
	14	0.15	1.051	0.17	1.198	14%
	16	0.19	1.019	0.22	1.166	14%
	18	0.24	1.017	0.27	1.147	13%
	20	0.29	0.995	0.33	1.117	12%

Tabel A 5 Perbandingan nilai koefisien *drag* pada sudut serang 15 derajat untuk pendekatan eksperimen dan simulasi

	V (m/s)	EKSPERIMEN		SIMULASI		SELISIH
		FD	CD	FD	CD	
MODEL 1	8	0.11	1.213	0.12	1.371	13%
	10	0.15	1.058	0.16	1.164	10%
	12	0.2	0.980	0.22	1.097	12%
	14	0.25	0.900	0.29	1.029	14%
	16	0.3	0.827	0.34	0.944	14%
	18	0.37	0.806	0.42	0.921	14%
	20	0.46	0.811	0.52	0.914	13%
MODEL 2	8	0.12	1.435	0.13	1.579	10%
	10	0.17	1.301	0.18	1.416	9%
	12	0.22	1.170	0.24	1.259	8%
	14	0.28	1.094	0.30	1.189	9%
	16	0.34	1.017	0.39	1.168	15%
	18	0.43	1.016	0.49	1.160	14%
	20	0.51	0.976	0.57	1.095	12%
MODEL 3	8	0.11	1.359	0.13	1.556	15%
	10	0.16	1.265	0.17	1.377	9%
	12	0.21	1.153	0.23	1.260	9%
	14	0.26	1.049	0.30	1.197	14%
	16	0.32	0.988	0.36	1.125	14%
	18	0.4	0.976	0.45	1.110	14%
	20	0.48	0.949	0.55	1.085	14%

Tabel A 6 Perbandingan nilai koefisien *drag* pada sudut serang 30 derajat untuk pendekatan eksperimen dan simulasi

	V (m/s)	EKSPERIMEN		SIMULASI		SELISIH
		FD	CD	FD	CD	
MODEL 1	8	0.15	1.251	0.16	1.342	7%
	10	0.22	1.174	0.24	1.290	10%
	12	0.3	1.112	0.34	1.242	12%
	14	0.39	1.062	0.44	1.208	14%
	16	0.5	1.042	0.57	1.198	15%
	18	0.62	1.021	0.72	1.178	15%
	20	0.74	0.987	0.85	1.129	14%
MODEL 2	8	0.16	1.407	0.18	1.577	12%
	10	0.23	1.294	0.26	1.473	14%
	12	0.31	1.212	0.35	1.380	14%
	14	0.4	1.149	0.46	1.326	15%
	16	0.52	1.143	0.60	1.309	15%
	18	0.63	1.094	0.73	1.260	15%
	20	0.75	1.055	0.85	1.200	14%
MODEL 3	8	0.15	1.355	0.17	1.510	11%
	10	0.22	1.272	0.25	1.421	12%
	12	0.3	1.205	0.33	1.343	11%
	14	0.39	1.151	0.44	1.306	14%
	16	0.51	1.152	0.57	1.297	13%
	18	0.62	1.107	0.71	1.266	14%
	20	0.74	1.070	0.85	1.222	14%

Tabel A 7 Perbandingan nilai koefisien *drag* pada sudut serang 45 derajat untuk pendekatan eksperimen dan simulasi

	V (m/s)	EKSPERIMEN		SIMULASI		SELISIH
		FD	CD	FD	CD	
MODEL 1	8	0.19	1.348	0.21	1.523	13%
	10	0.28	1.271	0.32	1.433	13%
	12	0.37	1.167	0.41	1.296	11%
	14	0.49	1.135	0.54	1.248	10%
	16	0.62	1.100	0.70	1.248	14%
	18	0.76	1.065	0.88	1.228	15%
	20	0.91	1.033	1.03	1.165	13%
MODEL 2	8	0.2	1.458	0.23	1.660	14%
	10	0.29	1.353	0.33	1.533	13%
	12	0.39	1.264	0.44	1.415	12%
	14	0.51	1.214	0.56	1.339	10%
	16	0.65	1.185	0.73	1.337	13%
	18	0.79	1.138	0.91	1.305	15%
	20	0.93	1.085	1.06	1.232	14%
MODEL 3	8	0.19	1.434	0.22	1.632	14%
	10	0.28	1.352	0.32	1.524	13%
	12	0.38	1.274	0.43	1.438	13%
	14	0.5	1.232	0.56	1.368	11%
	16	0.64	1.207	0.72	1.354	12%
	18	0.77	1.148	0.88	1.316	15%
	20	0.92	1.111	1.03	1.249	12%

Tabel A 8 Perbandingan nilai koefisien *drag* pada sudut serang 60 derajat untuk pendekatan eksperimen dan simulasi

	V (m/s)	EKSPERIMEN		SIMULASI		SELISIH
		FD	CD	FD	CD	
MODEL 1	8	0.06	1.706	0.06	1.772	4%
	10	0.09	1.554	0.10	1.685	8%
	12	0.12	1.371	0.14	1.557	14%
	14	0.16	1.264	0.18	1.453	15%
	16	0.2	1.231	0.23	1.420	15%
	18	0.25	1.206	0.28	1.376	14%
	20	0.3	1.187	0.35	1.344	13%
MODEL 2	8	0.07	1.743	0.07	1.810	4%
	10	0.1	1.588	0.11	1.721	8%
	12	0.13	1.401	0.15	1.597	14%
	14	0.17	1.314	0.19	1.517	15%
	16	0.21	1.291	0.24	1.476	14%
	18	0.26	1.245	0.30	1.432	15%
	20	0.32	1.223	0.36	1.384	13%
MODEL 3	8	0.06	1.780	0.07	1.856	4%
	10	0.09	1.621	0.10	1.785	10%
	12	0.12	1.460	0.14	1.655	13%
	14	0.15	1.341	0.17	1.545	15%
	16	0.19	1.318	0.22	1.504	14%
	18	0.24	1.271	0.27	1.442	13%
	20	0.29	1.249	0.33	1.429	14%

Tabel A 9 Perbandingan nilai koefisien *drag* pada sudut serang 75 derajat untuk pendekatan eksperimen dan simulasi

	V (m/s)	EKSPERIMEN		SIMULASI		SELISIH
		FD	CD	FD	CD	
MODEL 1	8	0.06	1.955	0.06	2.193	12%
	10	0.09	1.835	0.10	2.008	9%
	12	0.12	1.622	0.14	1.835	13%
	14	0.16	1.532	0.18	1.694	11%
	16	0.2	1.450	0.23	1.599	10%
	18	0.25	1.416	0.28	1.551	10%
	20	0.3	1.408	0.35	1.513	8%
MODEL 2	8	0.07	2.038	0.07	2.213	9%
	10	0.1	1.852	0.11	2.026	9%
	12	0.13	1.637	0.15	1.884	15%
	14	0.17	1.567	0.19	1.757	12%
	16	0.21	1.463	0.24	1.627	11%
	18	0.26	1.429	0.30	1.564	9%
	20	0.32	1.420	0.36	1.537	8%
MODEL 3	8	0.06	2.009	0.07	2.224	11%
	10	0.09	1.886	0.10	2.120	12%
	12	0.12	1.667	0.14	1.901	14%
	14	0.15	1.597	0.17	1.787	12%
	16	0.19	1.507	0.22	1.674	11%
	18	0.24	1.455	0.27	1.604	10%
	20	0.29	1.447	0.33	1.580	9%

Tabel A 10 Perbandingan nilai koefisien *drag* pada sudut serang 90 derajat untuk pendekatan eksperimen dan simulasi

	V (m/s)	EKSPERIMEN		SIMULASI		SELISIH
		FD	CD	FD	CD	
MODEL 1	8	0.06	1.805	0.06	1.901	5%
	10	0.09	1.689	0.10	1.830	8%
	12	0.12	1.481	0.14	1.627	10%
	14	0.16	1.360	0.18	1.493	10%
	16	0.2	1.337	0.23	1.456	9%
	18	0.25	1.303	0.28	1.443	11%
	20	0.3	1.278	0.35	1.432	12%
MODEL 2	8	0.07	1.867	0.07	1.961	5%
	10	0.1	1.726	0.11	1.839	7%
	12	0.13	1.475	0.15	1.635	11%
	14	0.17	1.355	0.19	1.497	11%
	16	0.21	1.348	0.24	1.467	9%
	18	0.26	1.297	0.30	1.458	12%
	20	0.32	1.283	0.36	1.436	12%
MODEL 3	8	0.06	1.897	0.07	1.926	2%
	10	0.09	1.753	0.10	1.867	6%
	12	0.12	1.499	0.14	1.649	10%
	14	0.15	1.376	0.17	1.513	10%
	16	0.19	1.370	0.22	1.476	8%
	18	0.24	1.318	0.27	1.473	12%
	20	0.29	1.304	0.33	1.451	11%

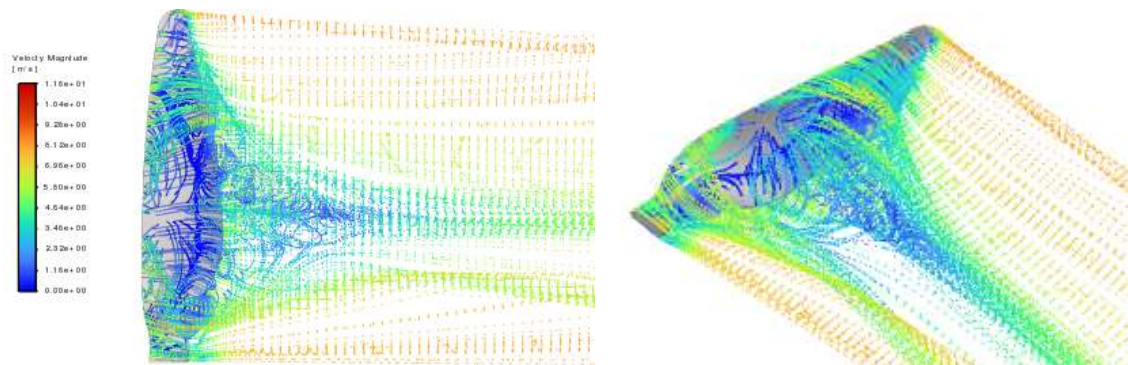
Tabel A 11 Sifat fisis Udara

Temp. $T, ^\circ\text{C}$	Density $\rho, \text{kg/m}^3$	Specific Heat c_p $\text{J/kg} \cdot ^\circ\text{K}$	Thermal Conductivity $k, \text{W/m} \cdot \text{K}$	Thermal Diffusivity $\alpha, \text{m}^2/\text{s}$	Dynamic Viscosity $\mu, \text{kg/m} \cdot \text{s}$	Kinematic Viscosity $\nu, \text{m}^2/\text{s}$	Prandtl Number Pr
-150	2.866	983	0.01171	4.158×10^{-6}	8.636×10^{-6}	3.013×10^{-6}	0.7246
-100	2.038	966	0.01582	8.036×10^{-6}	1.189×10^{-5}	5.837×10^{-6}	0.7263
-50	1.582	999	0.01979	1.252×10^{-5}	1.474×10^{-5}	9.319×10^{-6}	0.7440
-40	1.514	1002	0.02057	1.356×10^{-5}	1.527×10^{-5}	1.008×10^{-5}	0.7436
-30	1.451	1004	0.02134	1.465×10^{-5}	1.579×10^{-5}	1.087×10^{-5}	0.7425
-20	1.394	1005	0.02211	1.578×10^{-5}	1.630×10^{-5}	1.169×10^{-5}	0.7408
-10	1.341	1006	0.02288	1.696×10^{-5}	1.680×10^{-5}	1.252×10^{-5}	0.7387
0	1.292	1006	0.02364	1.818×10^{-5}	1.729×10^{-5}	1.338×10^{-5}	0.7362
5	1.269	1006	0.02401	1.880×10^{-5}	1.754×10^{-5}	1.382×10^{-5}	0.7350
10	1.246	1006	0.02439	1.944×10^{-5}	1.778×10^{-5}	1.426×10^{-5}	0.7336
15	1.225	1007	0.02476	2.009×10^{-5}	1.802×10^{-5}	1.470×10^{-5}	0.7323
20	1.204	1007	0.02514	2.074×10^{-5}	1.825×10^{-5}	1.516×10^{-5}	0.7309
25	1.184	1007	0.02551	2.141×10^{-5}	1.849×10^{-5}	1.562×10^{-5}	0.7296
30	1.164	1007	0.02588	2.208×10^{-5}	1.872×10^{-5}	1.608×10^{-5}	0.7282
35	1.145	1007	0.02625	2.277×10^{-5}	1.895×10^{-5}	1.655×10^{-5}	0.7268
40	1.127	1007	0.02662	2.346×10^{-5}	1.918×10^{-5}	1.702×10^{-5}	0.7255
45	1.109	1007	0.02699	2.416×10^{-5}	1.941×10^{-5}	1.750×10^{-5}	0.7241
50	1.092	1007	0.02735	2.487×10^{-5}	1.963×10^{-5}	1.798×10^{-5}	0.7228
60	1.059	1007	0.02808	2.632×10^{-5}	2.008×10^{-5}	1.896×10^{-5}	0.7202
70	1.028	1007	0.02881	2.780×10^{-5}	2.052×10^{-5}	1.995×10^{-5}	0.7177
80	0.9994	1008	0.02953	2.931×10^{-5}	2.096×10^{-5}	2.097×10^{-5}	0.7154
90	0.9718	1008	0.03024	3.086×10^{-5}	2.139×10^{-5}	2.201×10^{-5}	0.7132
100	0.9458	1009	0.03095	3.243×10^{-5}	2.181×10^{-5}	2.306×10^{-5}	0.7111
120	0.8977	1011	0.03235	3.565×10^{-5}	2.264×10^{-5}	2.522×10^{-5}	0.7073
140	0.8542	1013	0.03374	3.898×10^{-5}	2.345×10^{-5}	2.745×10^{-5}	0.7041
160	0.8148	1016	0.03511	4.241×10^{-5}	2.420×10^{-5}	2.975×10^{-5}	0.7014
180	0.7788	1019	0.03646	4.593×10^{-5}	2.504×10^{-5}	3.212×10^{-5}	0.6992
200	0.7459	1023	0.03779	4.954×10^{-5}	2.577×10^{-5}	3.455×10^{-5}	0.6974
250	0.6746	1033	0.04104	5.890×10^{-5}	2.760×10^{-5}	4.091×10^{-5}	0.6946
300	0.6158	1044	0.04418	6.871×10^{-5}	2.934×10^{-5}	4.765×10^{-5}	0.6935
350	0.5664	1056	0.04721	7.892×10^{-5}	3.101×10^{-5}	5.475×10^{-5}	0.6937
400	0.5243	1069	0.05015	8.951×10^{-5}	3.261×10^{-5}	6.219×10^{-5}	0.6948
450	0.4880	1081	0.05298	1.004×10^{-4}	3.415×10^{-5}	6.997×10^{-5}	0.6965
500	0.4565	1093	0.05572	1.117×10^{-4}	3.563×10^{-5}	7.806×10^{-5}	0.6986
600	0.4042	1115	0.06093	1.352×10^{-4}	3.846×10^{-5}	9.515×10^{-5}	0.7037
700	0.3627	1135	0.06581	1.598×10^{-4}	4.111×10^{-5}	1.133×10^{-4}	0.7092
800	0.3289	1153	0.07037	1.855×10^{-4}	4.362×10^{-5}	1.326×10^{-4}	0.7149
900	0.3008	1169	0.07465	2.122×10^{-4}	4.600×10^{-5}	1.529×10^{-4}	0.7206
1000	0.2772	1184	0.07868	2.398×10^{-4}	4.826×10^{-5}	1.741×10^{-4}	0.7260
1500	0.1990	1234	0.09599	3.908×10^{-4}	5.817×10^{-5}	2.922×10^{-4}	0.7478
2000	0.1553	1264	0.11113	5.664×10^{-4}	6.630×10^{-5}	4.270×10^{-4}	0.7539

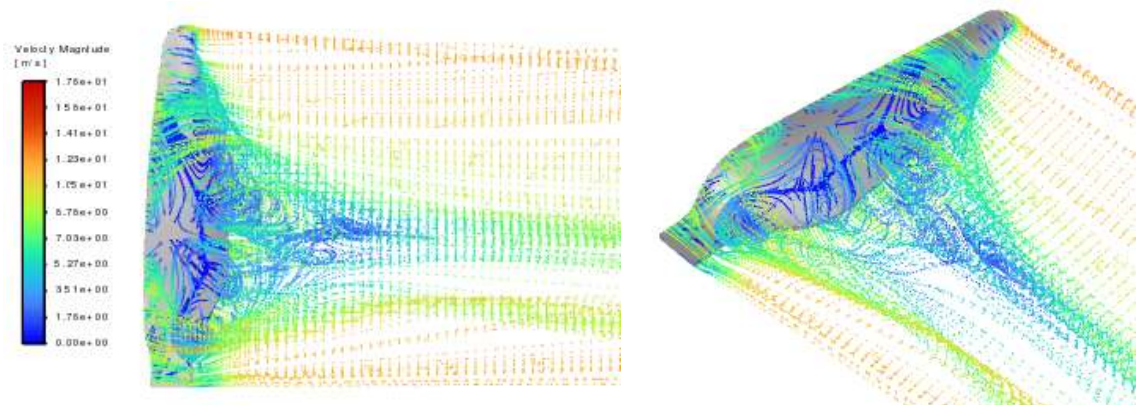
Note: For ideal gases, the properties c_p , k , μ , and Pr are independent of pressure. The properties ρ , ν , and α at a pressure P (in atm) other than 1 atm are determined by multiplying the values of ρ at the given temperature by P and by dividing ν and α by P .

Source: Data generated from the EES software developed by S. A. Klein and F. L. Alvarado. Original sources: Keenan, Chao, Keyes, Gas Tables, Wiley, 198; and Thermophysical Properties of Matter, Vol. 3: Thermal Conductivity, Y. S. Touloukian, P. E. Liley, S. C. Saxena, Vol. 11: Viscosity, Y. S. Touloukian, S. C. Saxena, and P. Hestermann, IFI/Plenum, NY, 1970, ISBN 0-306067020-8.

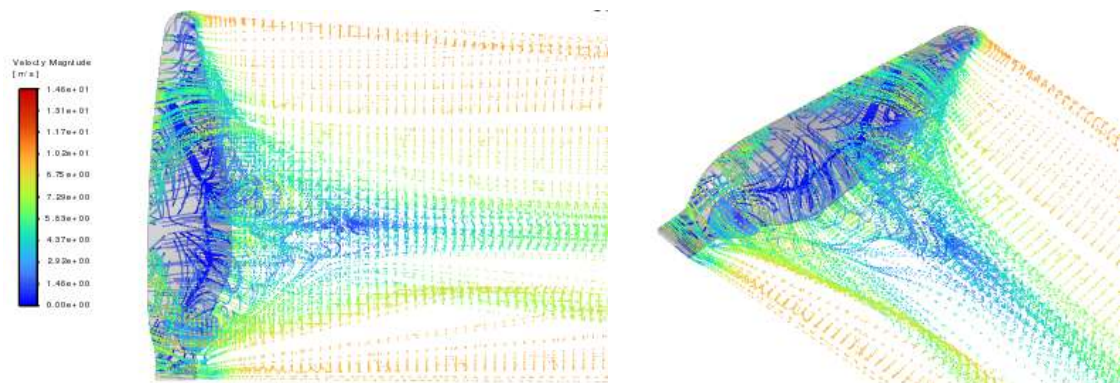
Karakteristik Aliran Pada Model 2



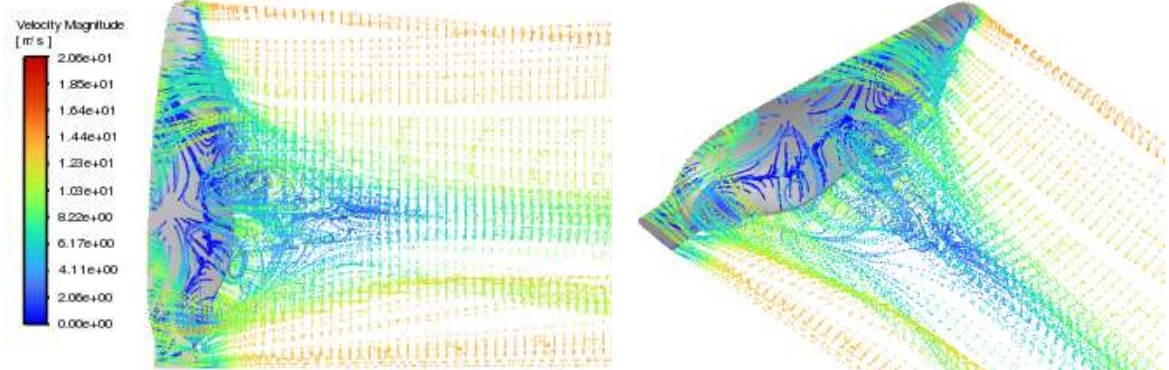
Gambar A 1 Kecepatan 8 m/s



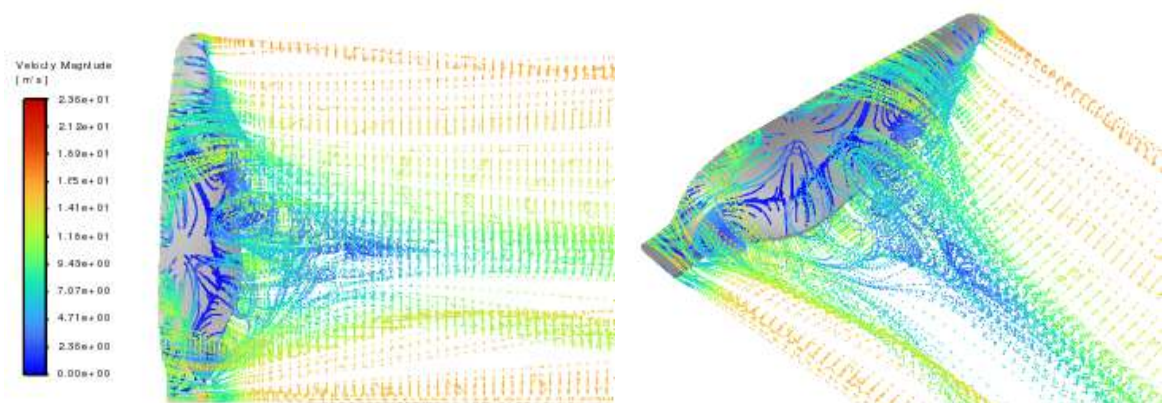
Gambar A 2 Kecepatan 10 m/s



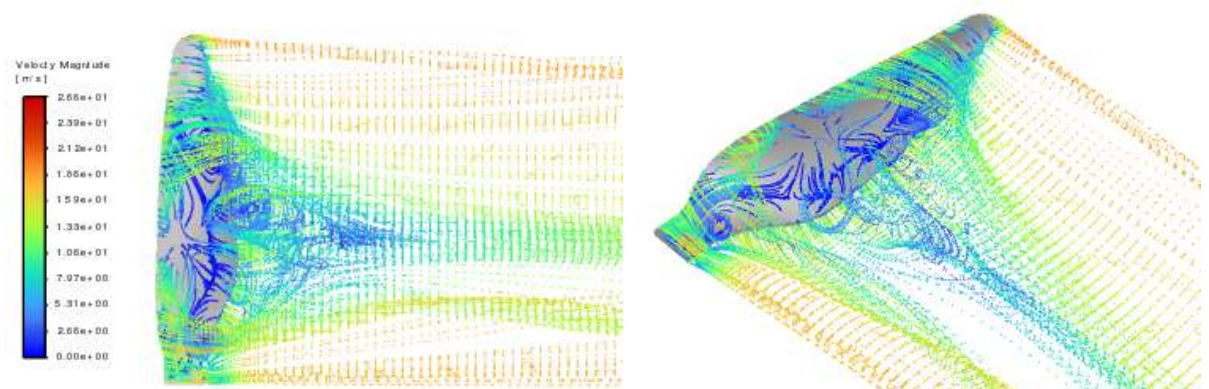
Gambar A 3 Kecepatan 12 m/s



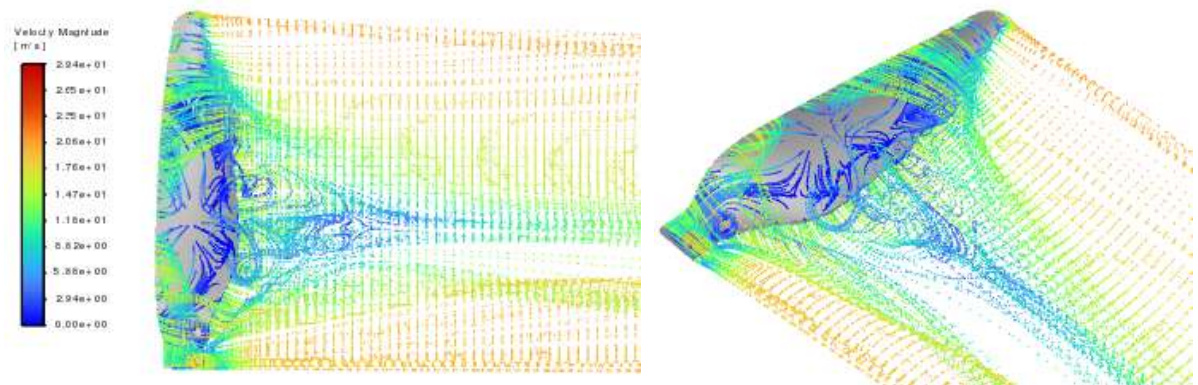
Gambar A 4 Kecepatan 14 m/s



Gambar A 5 Kecepatan 16 m/s

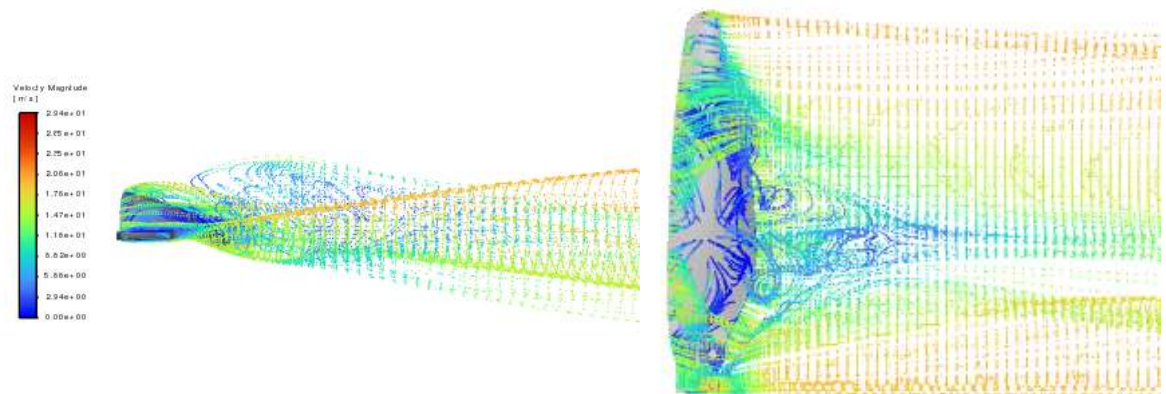


Gambar A 6 Kecepatan 18 m/s

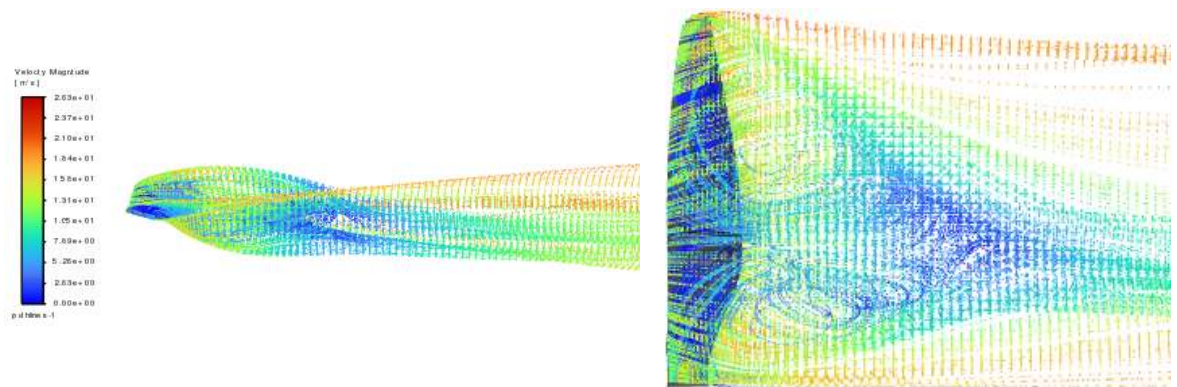


Gambar A 7 Kecepatan 20 m/s

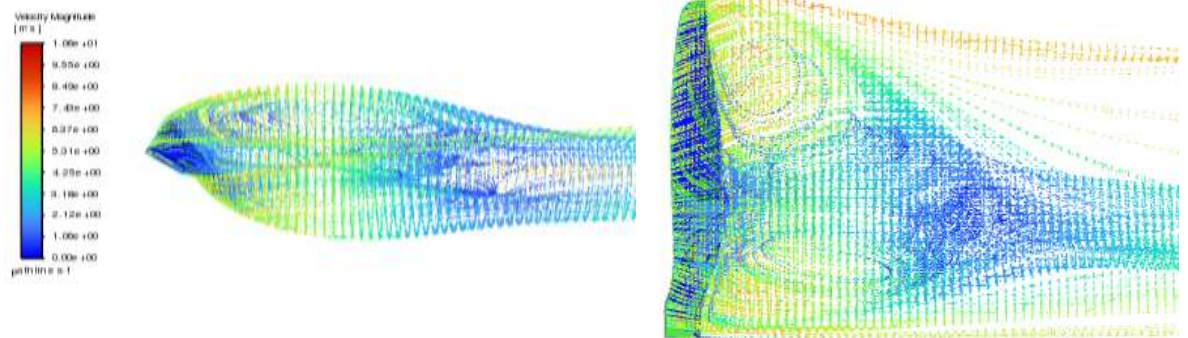
Karakteristik Aliran Pada Model 2 terhadap perubahan sudut serang



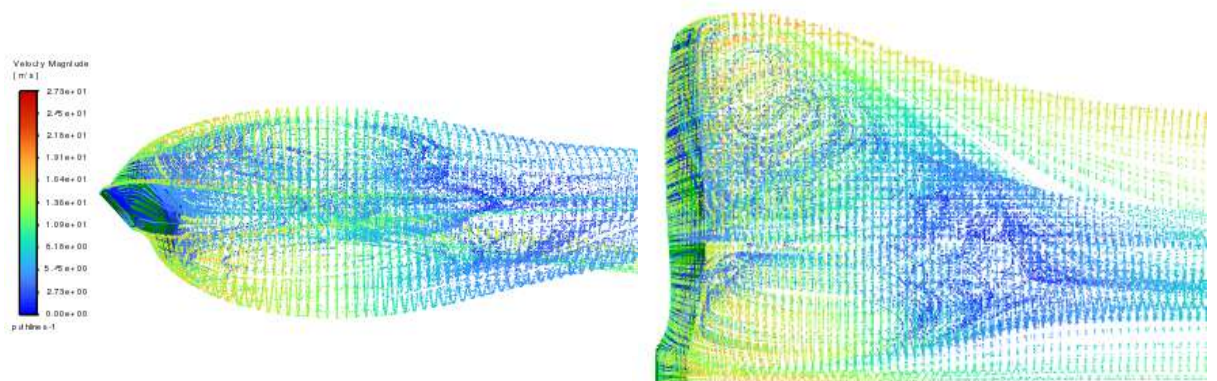
Gambar A 8 Sudut Serang 0 Derajat



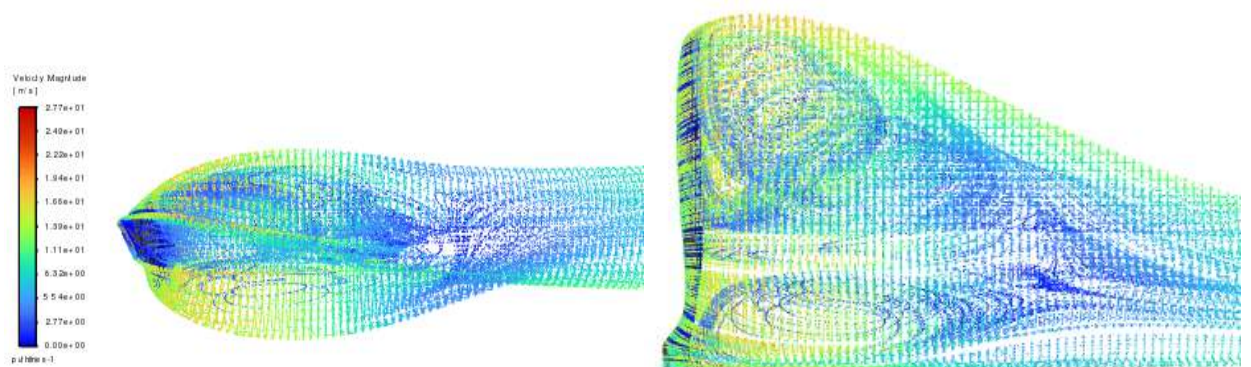
Gambar A 9 Sudut Serang 15 Derajat



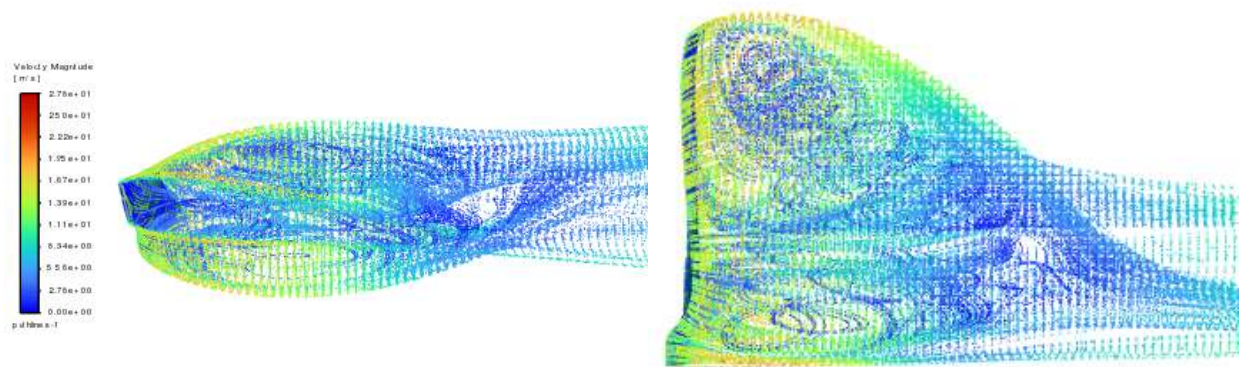
Gambar A 10 Sudut Serang 30 Derajat



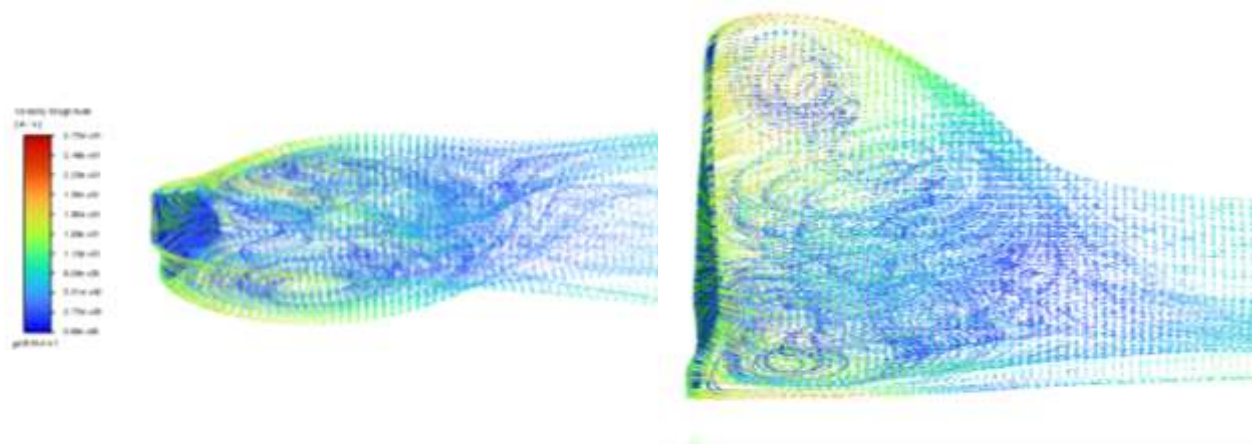
Gambar A 11 Sudut Serang 45 Derajat



Gambar A 12 Sudut Serang 60 Derajat

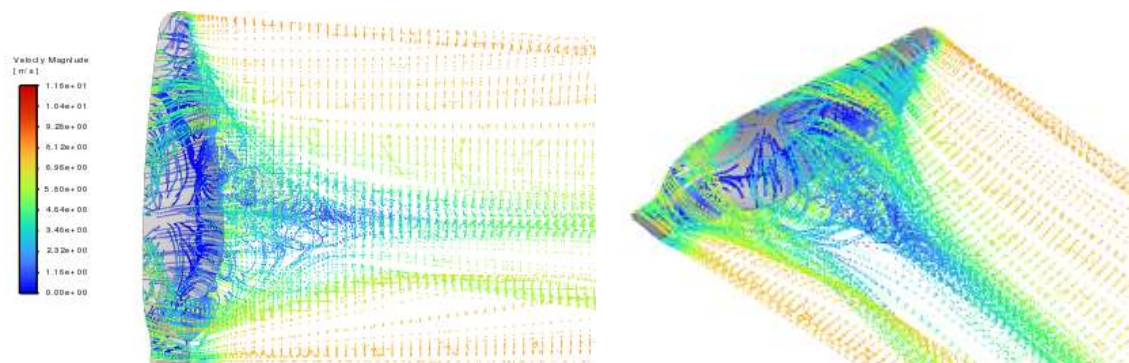


Gambar A 13 Sudut Serang 75 Derajat

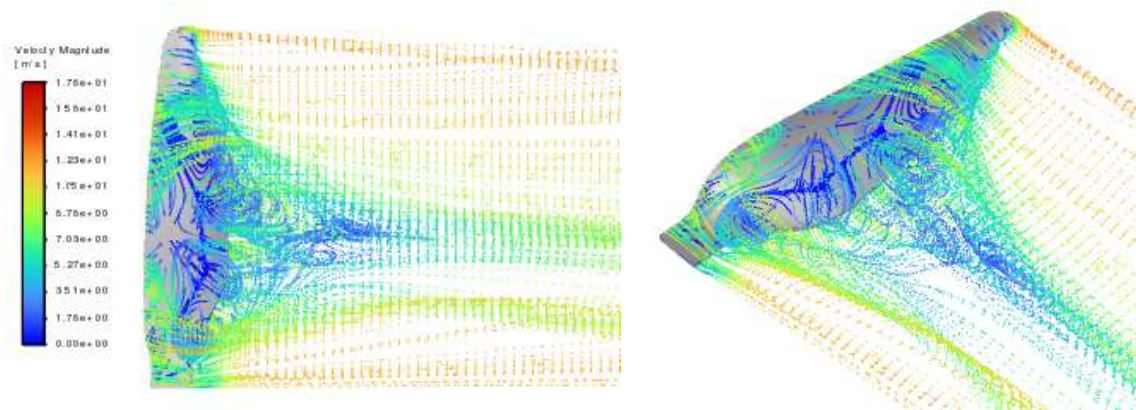


Gambar A 14 Sudut Serang 90 Derajat

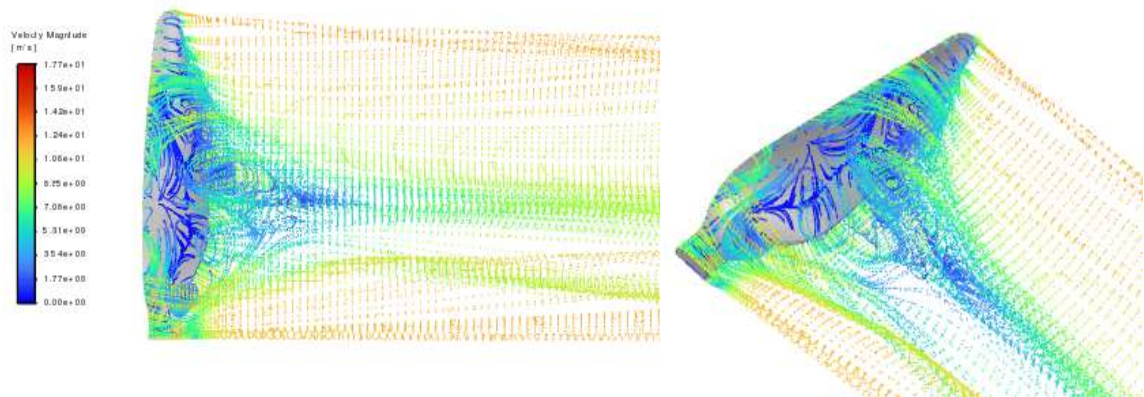
Karakteristik Aliran Pada Model 3



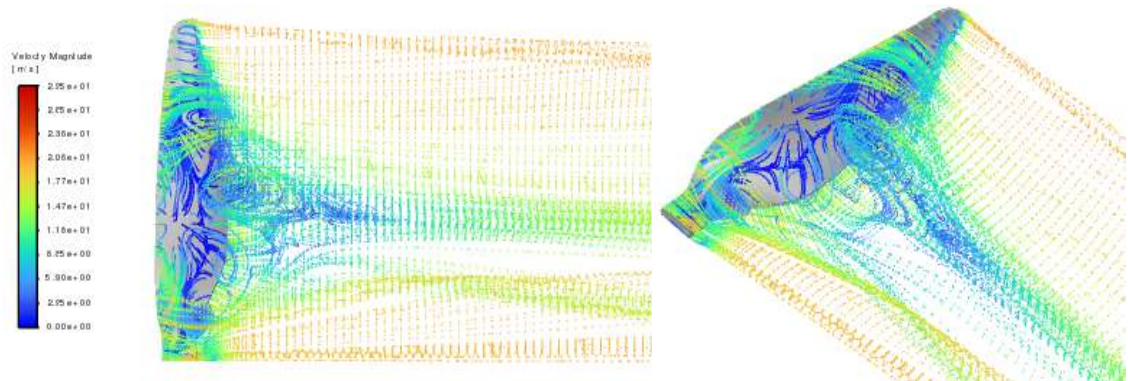
Gambar A 15 Kecepatan 8 m/s



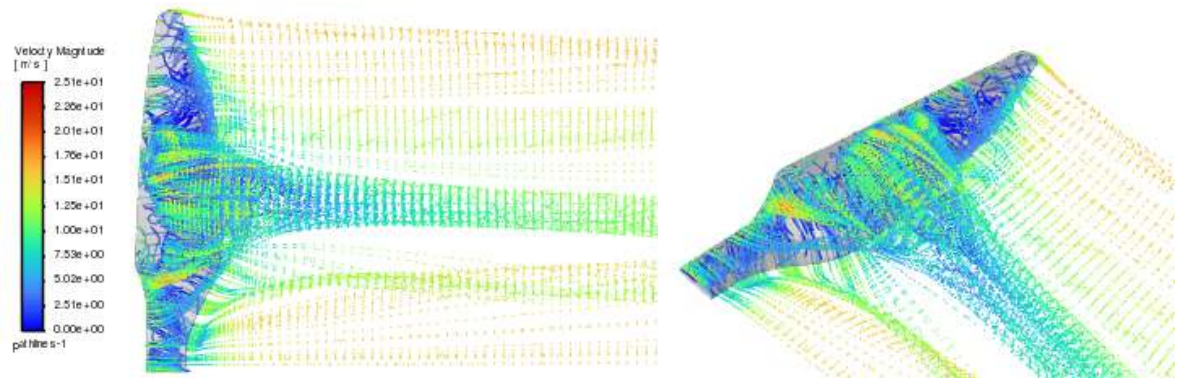
Gambar A 16 Kecepatan 10 m/s



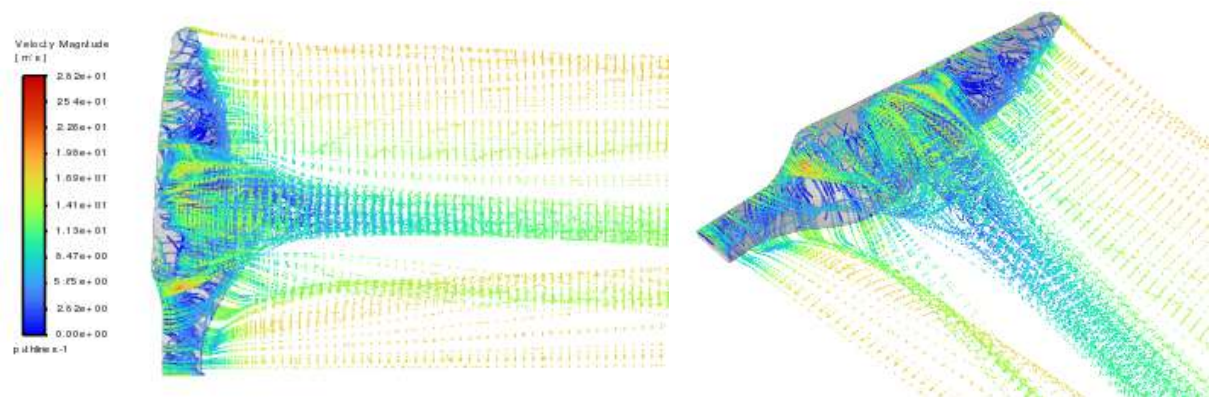
Gambar A 17 Kecepatan 12 m/s



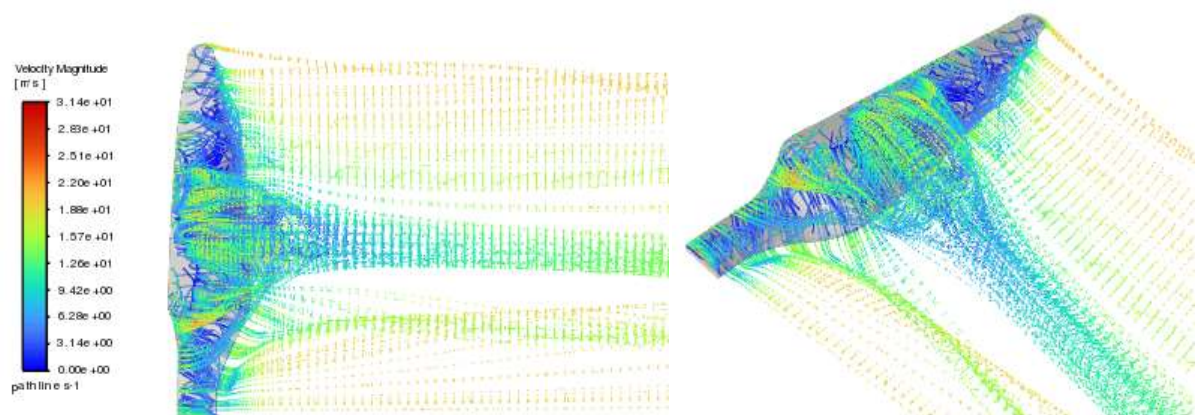
Gambar A 18 Kecepatan 14 m/s



Gambar A 19 Kecepatan 16 m/s

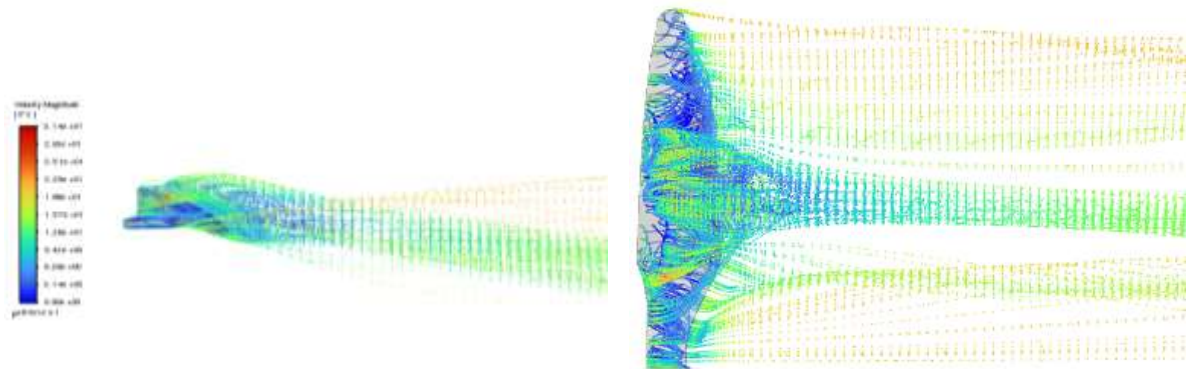


Gambar A 20 Kecepatan 18 m/s

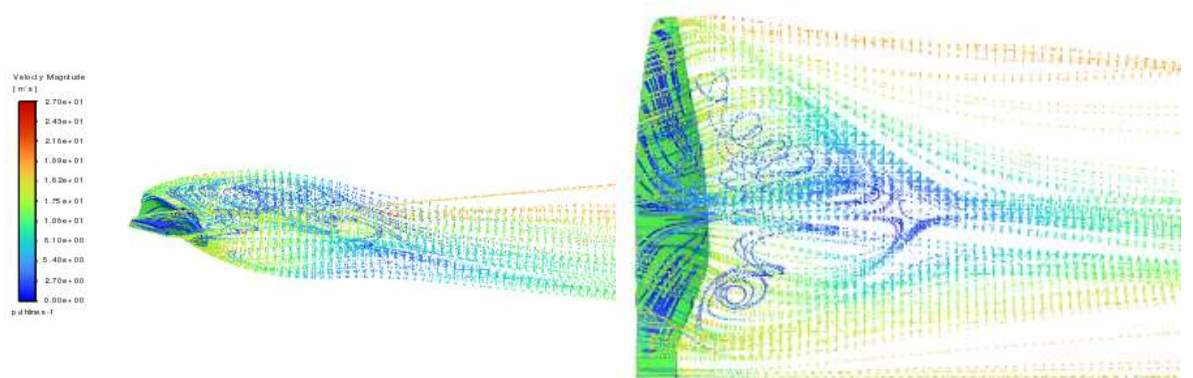


Gambar A 21 Kecepatan 20 m/s

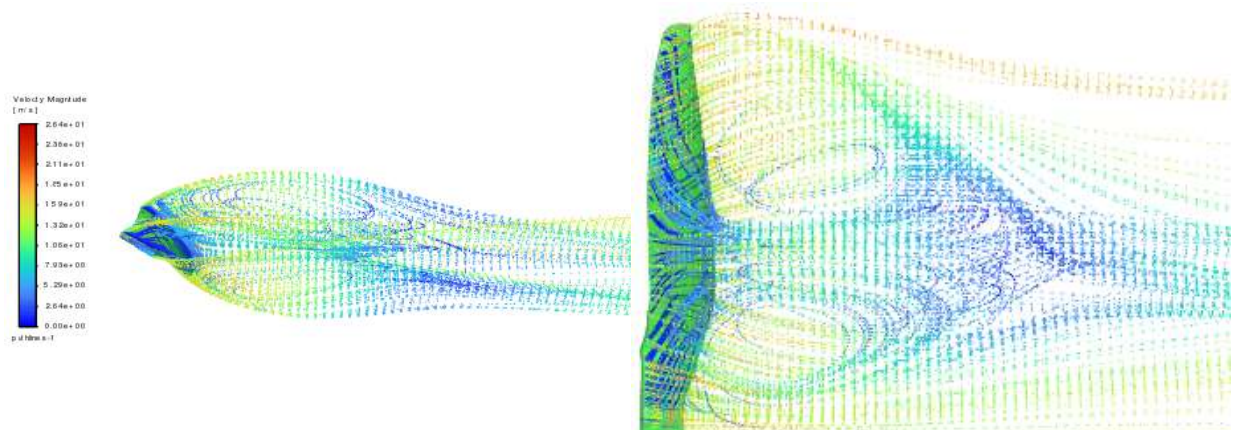
Karakteristik Aliran Pada Model 3 terhadap perubahan sudut serang



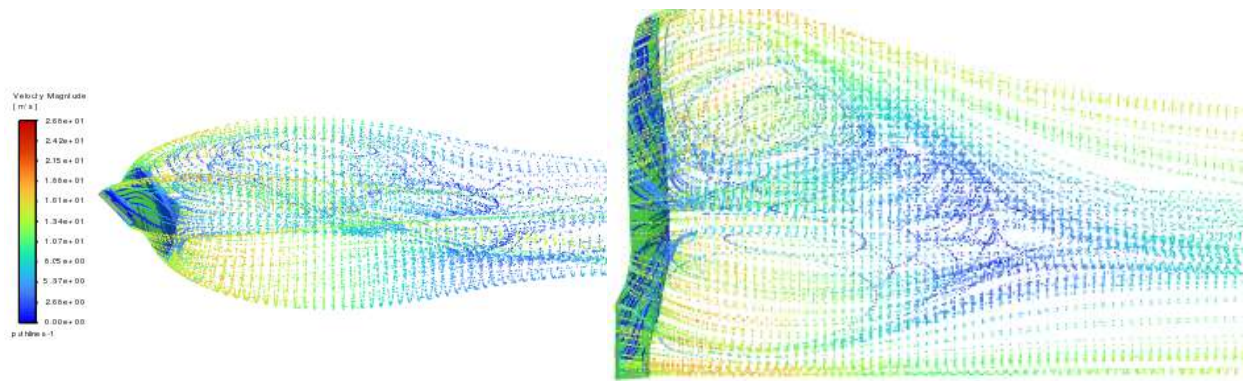
Gambar A 22 Sudut Serang 0 Derajat



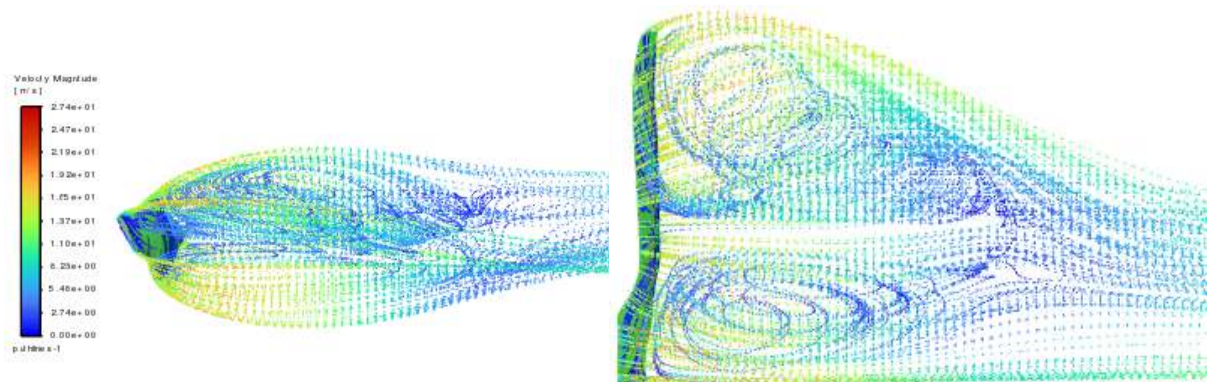
Gambar A 23 Sudut Serang 15 Derajat



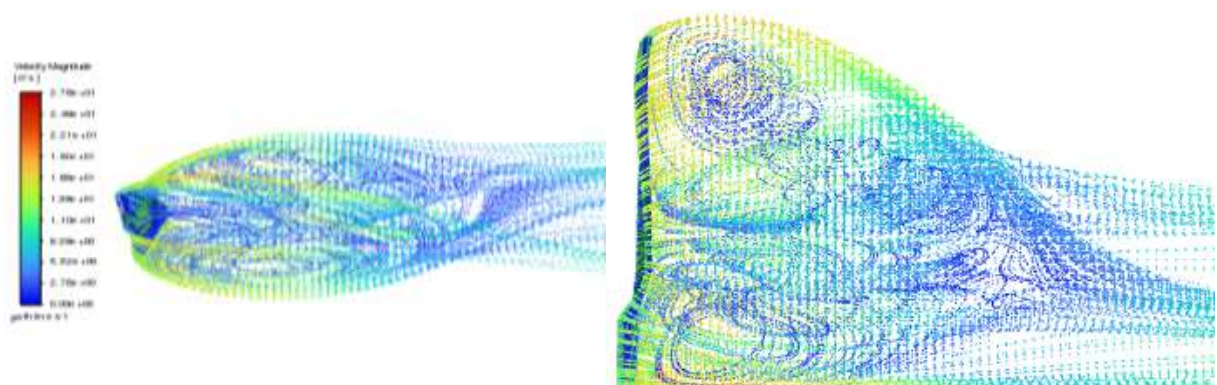
Gambar A 24 Sudut Serang 30 Derajat



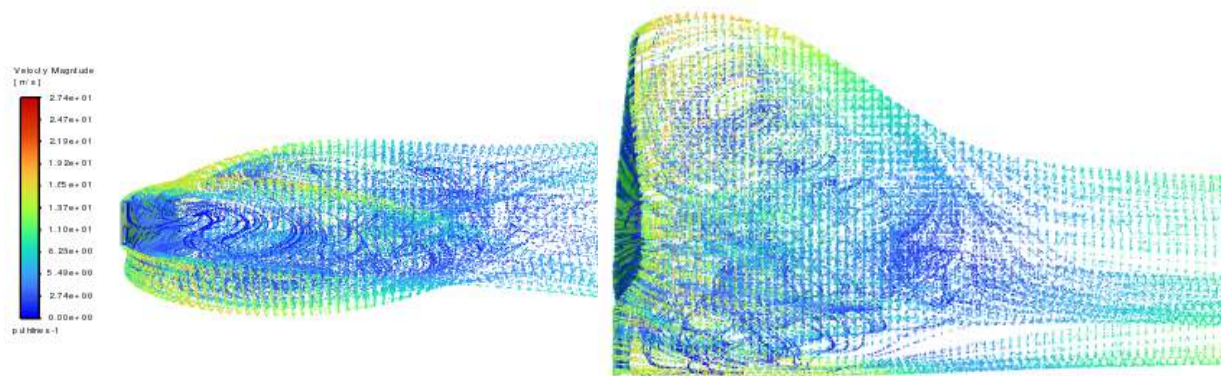
Gambar A 25 Sudut Serang 45 Derajat



Gambar A 26 Sudut Serang 60 Derajat



Gambar A 27 Sudut Serang 75 Derajat



Gambar A 28 Sudut Serang 90 Derajat

Lampiran B



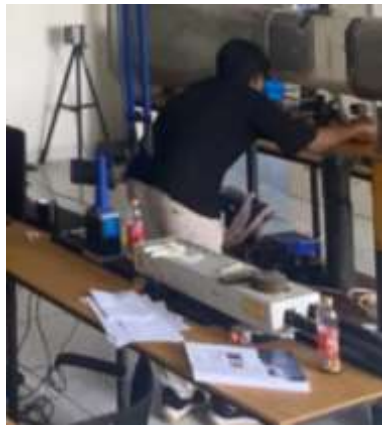
Gambar B 1 Model Spesimen 1



Gambar B 2 **Model Spesimen 2**



Gambar B 3 **Model Spesimen 3**



Gambar B 4 Proses Pengambilan Data