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LAMPIRAN

Lampiran A

Tabel A. 1 Perrubahan kecepatan *upstream*

No	U (m/s)
1	10
2	12
3	14
4	16
5	18
6	20
7	22

Tabel A. 2 Perubahan sudut defleksi *rudder*

No	Sudut defleksi *rudder* (δ)
1	0^o
2	5^o
3	10^o
4	15^o
5	20^o
6	25^o
7	30^o
8	35^o
9	40^o
10	45^o

Tabel A. 3 Luas proyeksi *stabilizer* dan *rudder* untuk tiap perubahan sudut defleksi

Sudut defleksi *rudder* (δ)	A (m^2)
0^o	0.000806
5^o	0.001189
10^o	0.001573
15^o	0.001953
20^o	0.002325
25^o	0.002686
30^o	0.003034
35^o	0.003365
40^o	0.003676
45^o	0.003967

Tabel A. 4 Rentang karakteristik vertikal stabilizer dan *rudder* untuk tiap perubahan sudut defleksi

δ	b (m)
0º	0,006
5º	0,010
10º	0,013
15º	0,017
20º	0,020
25º	0,024
30º	0,027
35º	0,030
40º	0,033
45º	0,035

Tabel A. 5 Kecepatan *upstream* (U) dan bilangan Reynolds (Re) untuk tiap perubahan sudut defleksi *rudder*

δ	U (m/s)						
	10	**12**	**14**	**16**	**18**	**20**	**22**
	Bilangan Reynolds						
0º	3687	4425	5162	5900	6637	7375	8112
5º	5956	7147	8338	9529	10720	11912	13103
10º	8193	9832	11471	13109	14748	16387	18025
15º	10382	12459	14535	16612	18688	20765	22841
20º	12506	15008	17509	20010	22512	25013	27514
25º	14634	17561	20487	23414	26341	29268	32194
30º	16591	19910	23228	26546	29865	33183	36501
35º	18330	21996	25662	29328	32994	36660	40326
40º	20039	24047	28055	32063	36071	40078	44086
45º	21610	25932	30254	34576	38898	43220	47542

Tabel A. 6 Nilai gaya *drag* (F_D) pendekatan eksperimental untuk tiap tingkat perubahan sudut defleksi *rudder* pada 7 tingkat kecepatan

U (m/s)	**F_D**									
	(δ)									
	0º	**5º**	**10º**	**15º**	**20º**	**25º**	**30º**	**35º**	**40º**	**45º**
10	0.030	0.048	0.070	0.095	0.120	0.150	0.180	0.204	0.230	0.250
12	0.040	0.064	0.093	0.127	0.163	0.205	0.247	0.283	0.320	0.350
14	0.050	0.080	0.120	0.162	0.210	0.270	0.320	0.370	0.420	0.460
16	0.062	0.100	0.150	0.200	0.260	0.340	0.400	0.460	0.520	0.580
18	0.075	0.120	0.180	0.240	0.310	0.410	0.490	0.560	0.640	0.720
20	0.087	0.140	0.210	0.280	0.360	0.480	0.570	0.660	0.770	0.860
22	0.100	0.160	0.240	0.330	0.420	0.550	0.660	0.780	0.900	1.010

Tabel A. 7 Nilai gaya *side* (F_S) pendekatan eksperimental untuk tiap tingkat perubahan sudut defleksi *rudder* pada 7 tingkat kecepatan

U (m/s)	**F_S**									
	(δ)									
	0º	**5º**	**10º**	**15º**	**20º**	**25º**	**30º**	**35º**	**40º**	**45º**
10	0.000	0.030	0.080	0.130	0.196	0.240	0.260	0.300	0.320	0.340
12	0.000	0.050	0.120	0.200	0.290	0.360	0.390	0.440	0.480	0.500
14	0.000	0.080	0.170	0.280	0.400	0.500	0.540	0.620	0.670	0.710
16	0.000	0.110	0.230	0.380	0.550	0.680	0.740	0.840	0.900	0.970
18	0.000	0.150	0.310	0.500	0.710	0.900	0.980	1.100	1.180	1.260
20	0.000	0.200	0.400	0.640	0.900	1.130	1.240	1.390	1.500	1.600
22	0.000	0.250	0.500	0.800	1.120	1.430	1.550	1.740	1.880	2.008

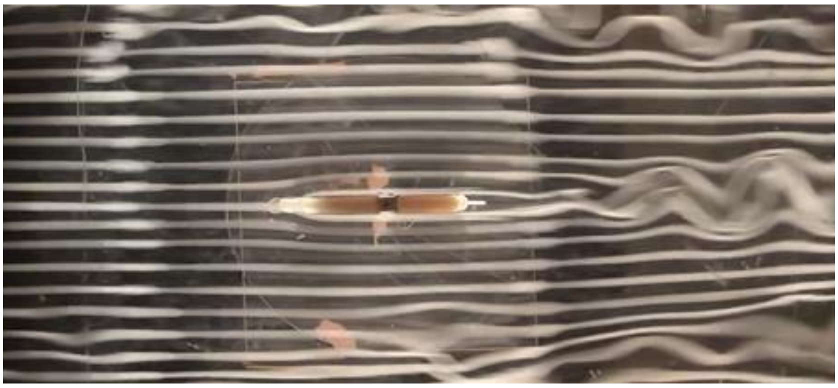
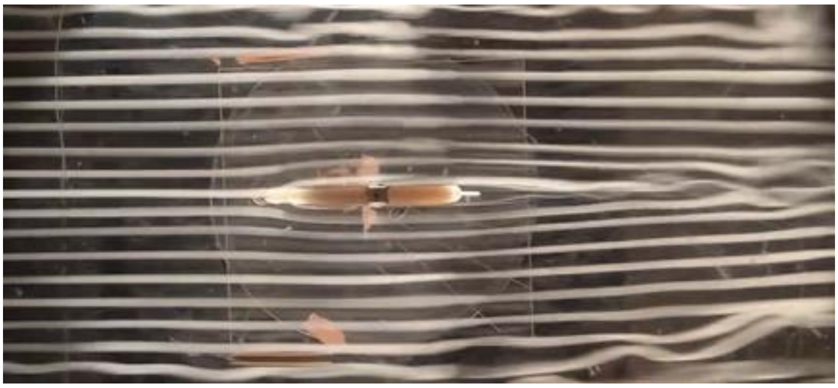
Tabel A. 8 Nilai koefisient *drag* (C_D) pendekatan eksperimental untuk tiap tingkat perubahan sudut defleksi *rudder* pada 7 tingkat kecepatan

U (m/s)	**Nilai koefisien *drag* (C_D) stabiliser dan *rudder***									
	δ									
	0	5	10	15	20	25	30	35	40	45
10	0,644	0,698	0,770	0,842	0,893	0,963	1,023	1,049	1,082	1,090
12	0,596	0,647	0,710	0,781	0,842	0,914	0,975	1,010	1,046	1,060
14	0,548	0,594	0,673	0,732	0,797	0,884	0,928	0,971	1,009	1,024
16	0,520	0,568	0,644	0,692	0,756	0,853	0,888	0,924	0,956	0,988
18	0,497	0,539	0,611	0,656	0,712	0,812	0,859	0,889	0,930	0,969
20	0,467	0,509	0,577	0,620	0,670	0,770	0,810	0,848	0,906	0,938
22	0,443	0,481	0,545	0,604	0,646	0,729	0,775	0,829	0,875	0,910

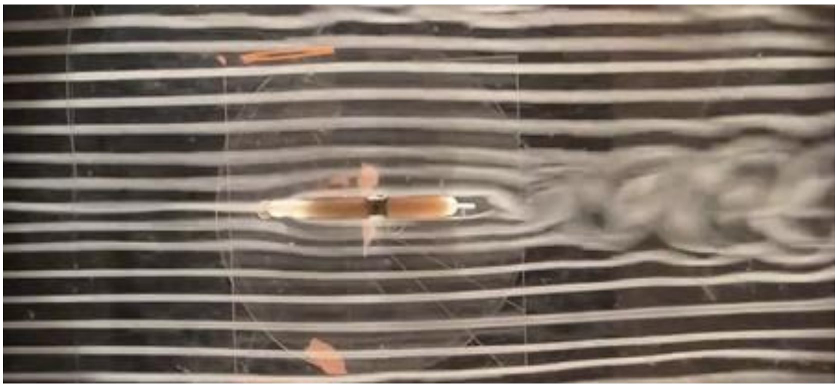
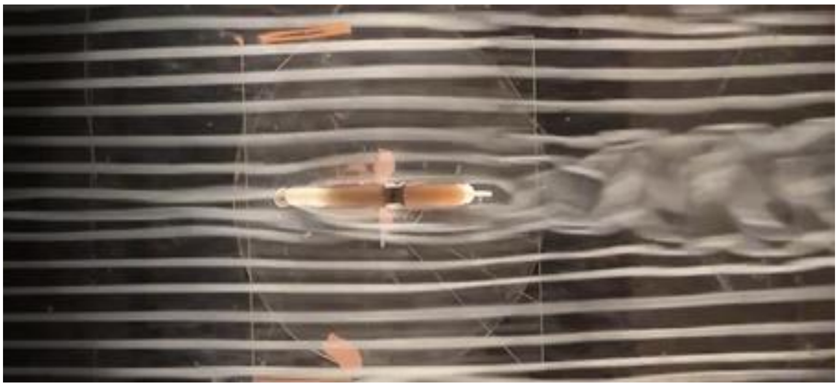
Tabel A. 9 Nilai koefisient *drag* (C_D) pendekatan eksperimental untuk tiap tingkat perubahan sudut defleksi *rudder* pada 7 tingkat kecepatan

U (m/s)	**Nilai koefisien *side* (C_S) stabiliser dan *rudder***									
	δ									
	0	5	10	15	20	25	30	35	40	45
10	0,000	0,437	0,880	1,152	1,458	1,541	1,478	1,542	1,506	1,483
12	0,000	0,505	0,917	1,230	1,499	1,605	1,539	1,571	1,569	1,514
14	0,000	0,594	0,954	1,266	1,519	1,637	1,566	1,626	1,609	1,580
16	0,000	0,625	0,988	1,315	1,599	1,705	1,643	1,687	1,655	1,653
18	0,000	0,674	1,052	1,367	1,631	1,783	1,719	1,746	1,714	1,696
20	0,000	0,728	1,100	1,417	1,674	1,813	1,762	1,787	1,765	1,744
22	0,000	0,752	1,136	1,464	1,722	1,897	1,820	1,848	1,828	1,809

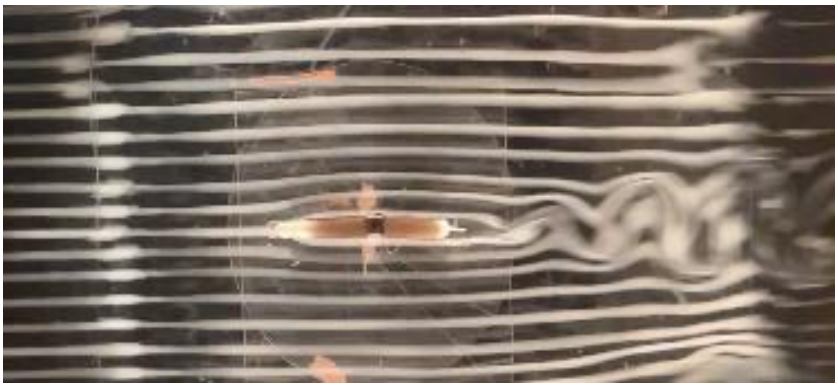
Tabel A. 10 Visualisasi aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 0°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	**Profil Aliran Sesaat**
12	
14	

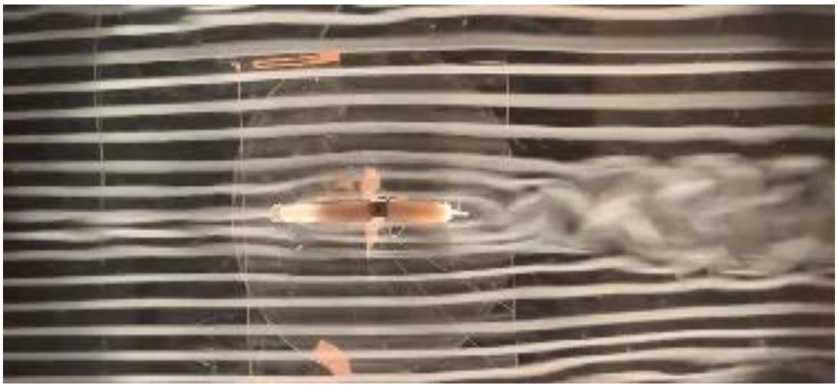
Lanjutan tabel A. 10 Visualisasi aliran melintasi *stabilizer* dan *rudder* untuk sudut ($\delta = 0^o$) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
18	
20	

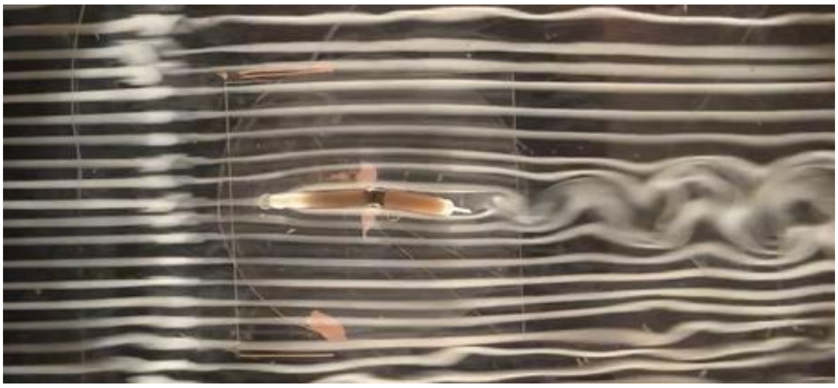
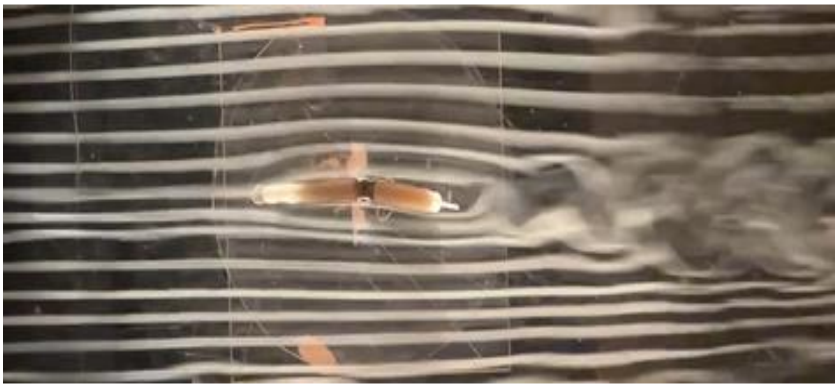
Tabel A. 11 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut ($\delta = 5^o$) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
12	

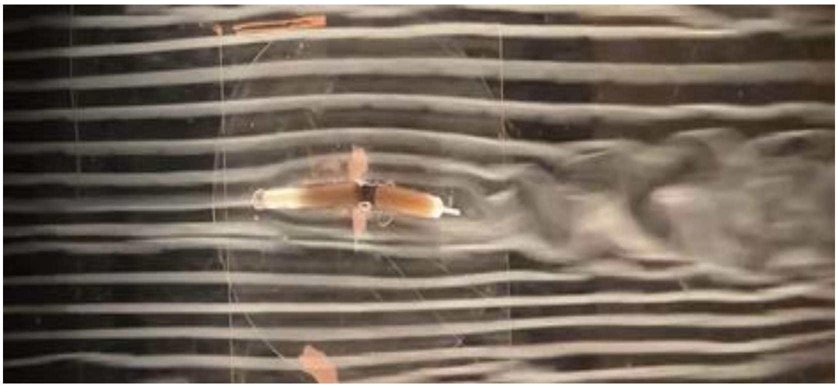
Lanjutan tabel A. 12 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut ($\delta = 5^o$) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
14	
18	
20	

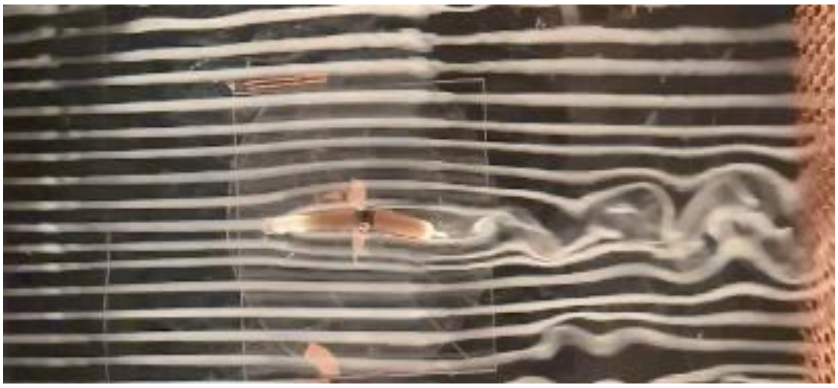
Tabel A. 12 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 10^o) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	**Profil Aliran Sesaat**
12	
14	
18	

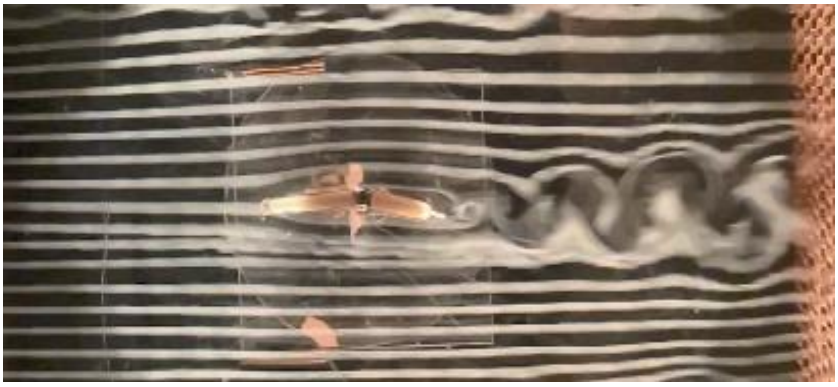
Lanjutan tabel A. 12 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 10^o) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
20	

Tabel A. 13 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 15^o) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
12	
14	

Lanjutan tabel A. 13 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 15°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	**Profil Aliran Sesaat**
18	
20	

Tabel A. 14 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 20°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	**Profil Aliran Sesaat**
12	

Lanjutan tabel A. 14 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut ($\delta = 20^o$) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
14	
18	
20	

Tabel A. 15 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 25^o) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
12	
14	
18	

Lanjutan tabel A. 15 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 25^o) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
20	

Tabel A. 16 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 30^o) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
12	
14	

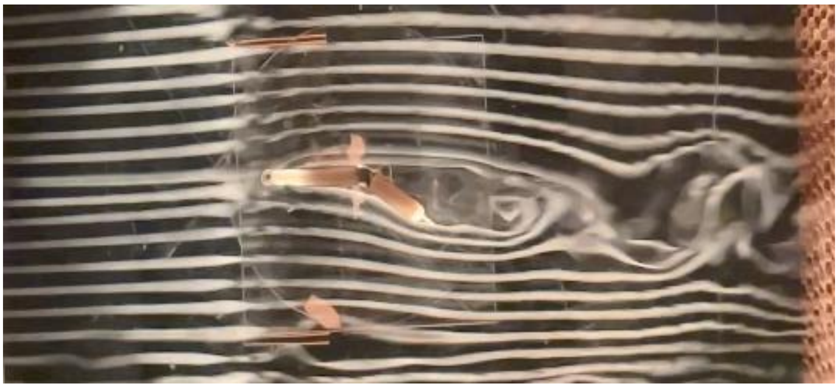
Tabel A. 16 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 30°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
18	
20	

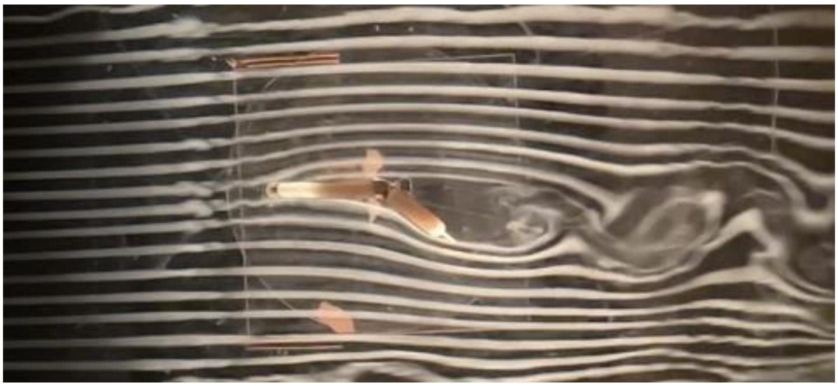
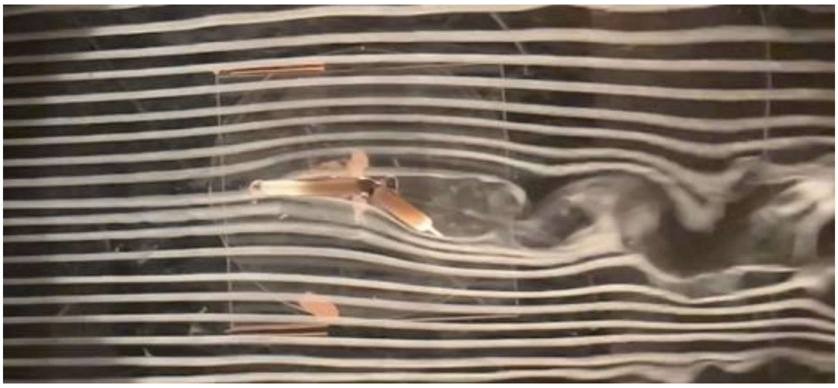
Tabel A. 17 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 35°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
12	

Lanjutan tabel A. 17 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut ($\delta = 35^o$) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
14	
18	
20	

Tabel A. 18 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 40°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
12	
14	
18	

Lanjutan tabel A. 18 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 40^o) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
20	

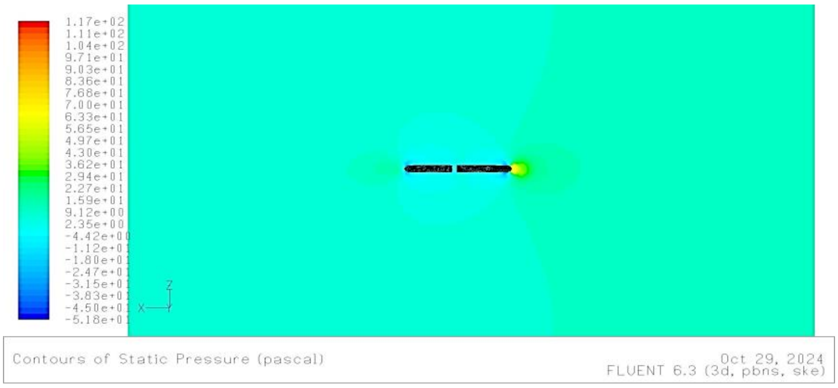
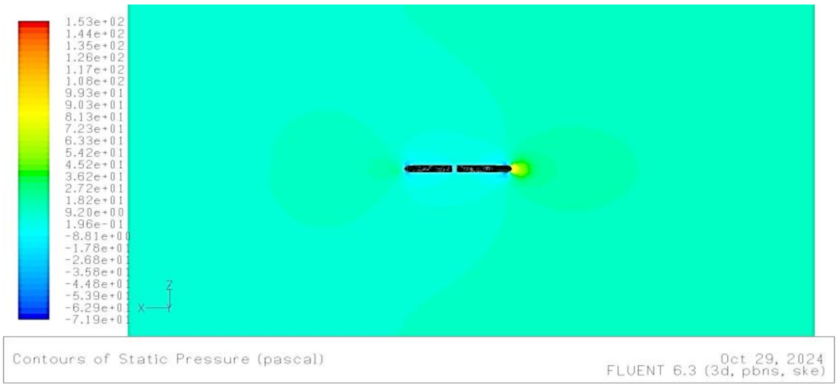
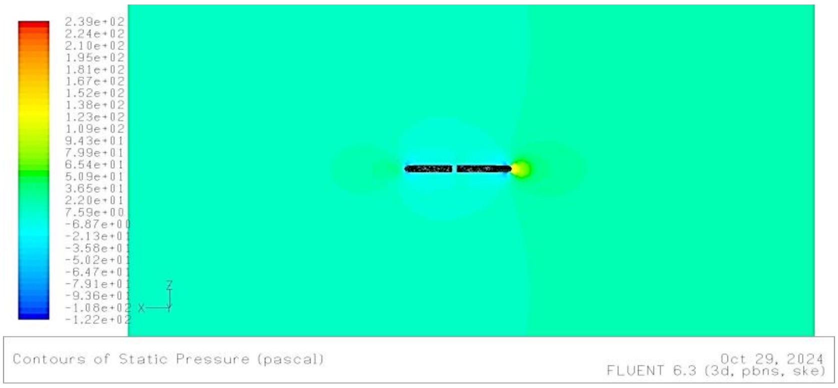
Tabel A. 19 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 45^o) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
12	
14	

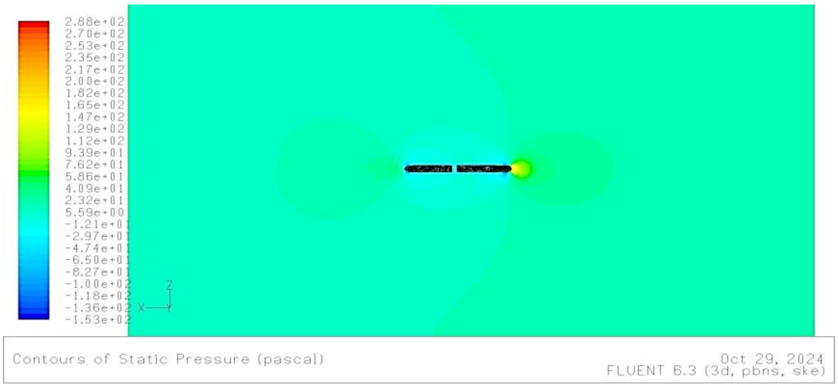
Lanjutan tabel A. 19 Karakteristik aliran melintasi *stabilizer* dan *rudder* untuk sudut (δ = 45^o) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Aliran Sesaat
18	
20	

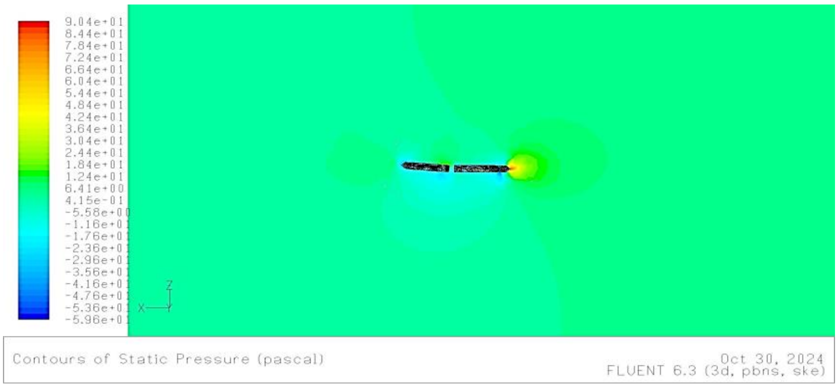
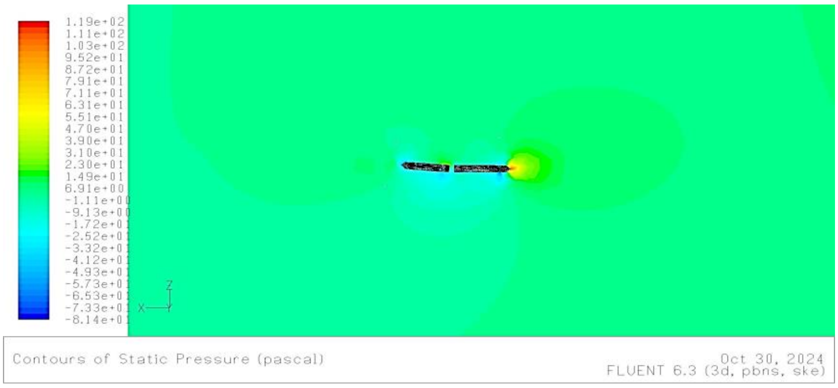
Tabel A. 20 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut ($\delta = 0^o$) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Kontur Tekanan
12	
14	
18	

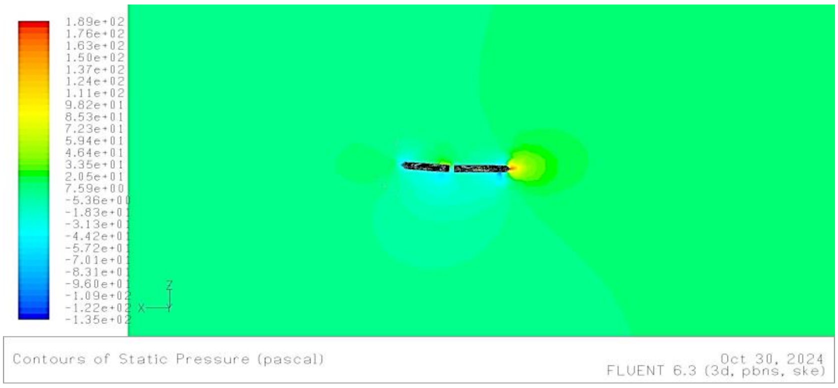
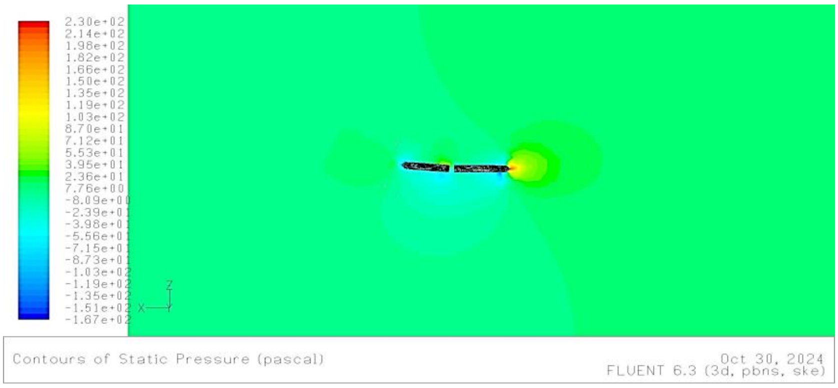
Lanjutan tabel A. 20 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut ($\delta = 0^o$) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	**Profil Kontur Tekanan**
20	

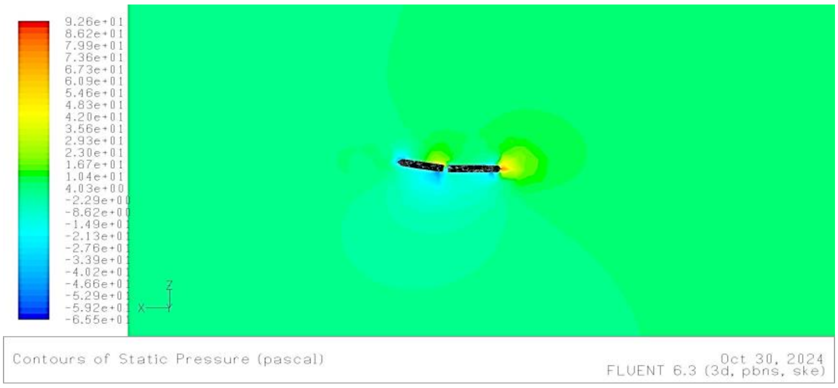
Tabel A. 21 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut ($\delta = 5^o$) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	**Profil Kontur Tekanan**
12	
14	

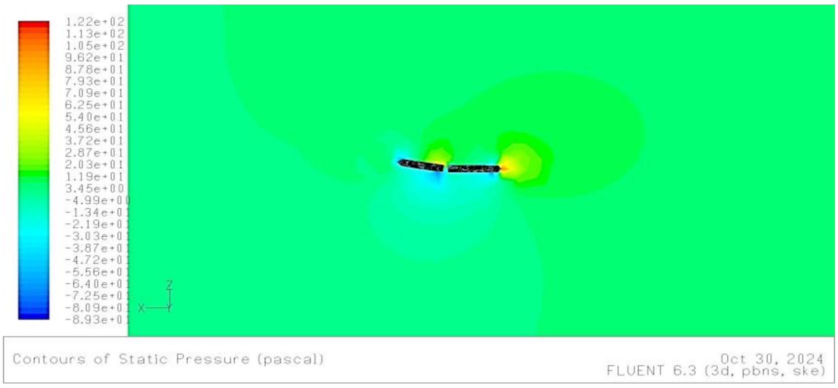
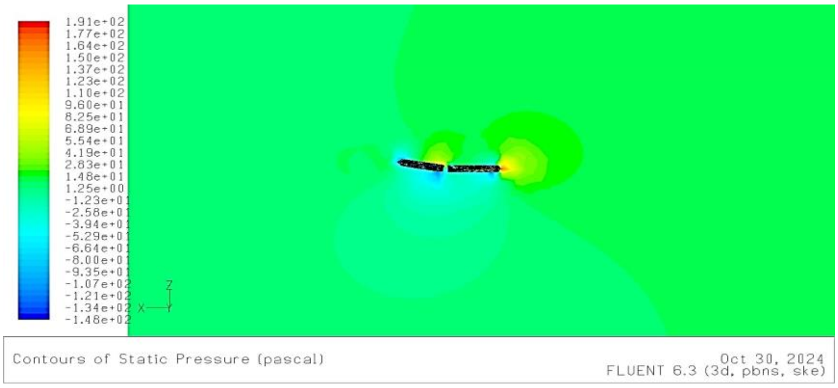
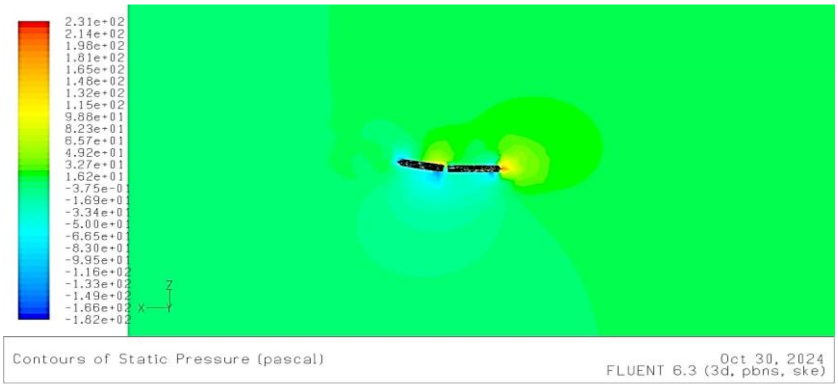
Lanjutan tabel A. 21 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut ($\delta = 5^o$) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Kontur Tekanan
18	
20	

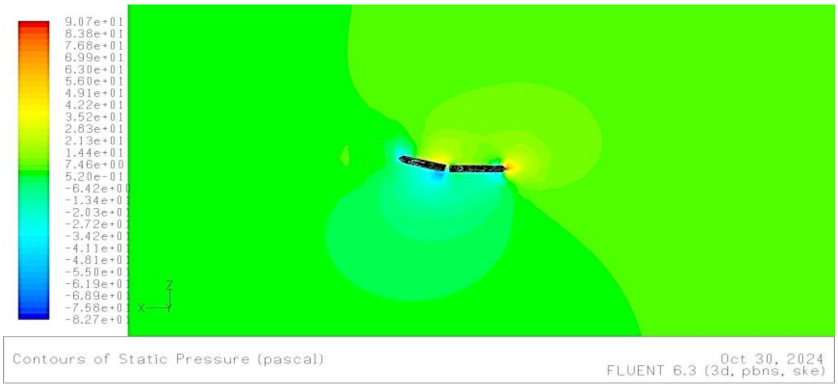
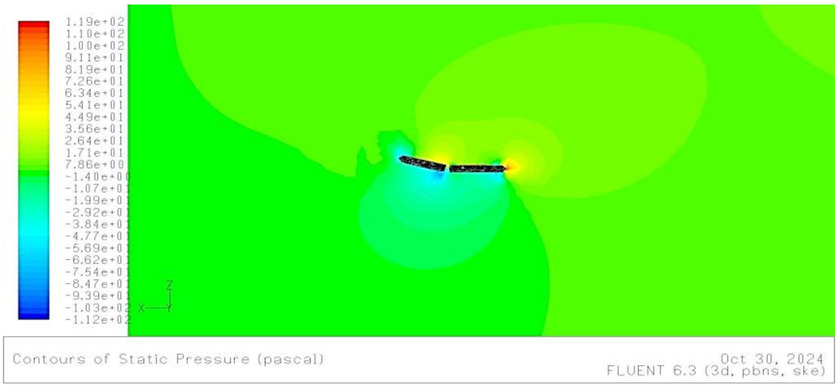
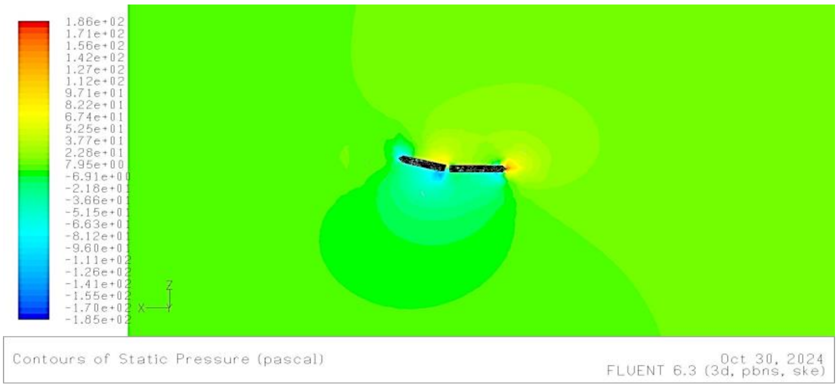
Tabel A. 22 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut ($\delta = 10^o$) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Kontur Tekanan
12	

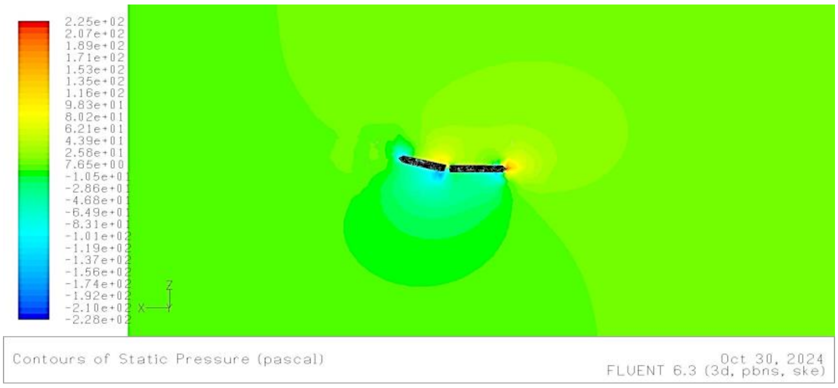
Lanjutan tabel A. 22 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut (δ = 10°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

<table>
<tr><th>U (m/s)</th><th>Profil Kontur Tekanan</th></tr>
<tr><td>14</td><td>
</td></tr>
<tr><td>18</td><td>
</td></tr>
<tr><td>20</td><td>
</td></tr>
</table>

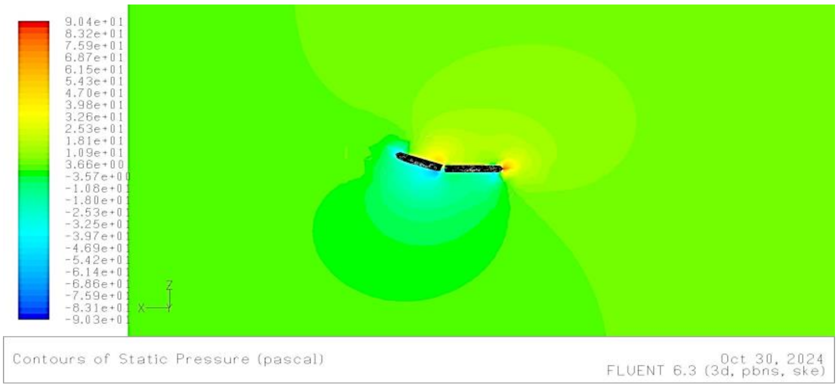
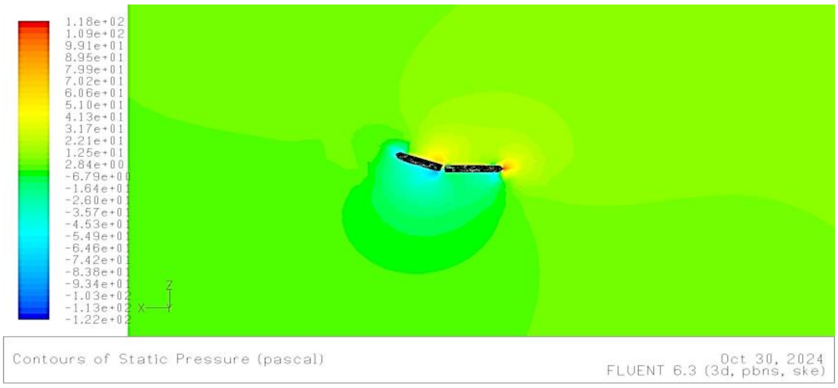
Tabel A. 23 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut (δ = 15°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Kontur Tekanan
12	
14	
18	

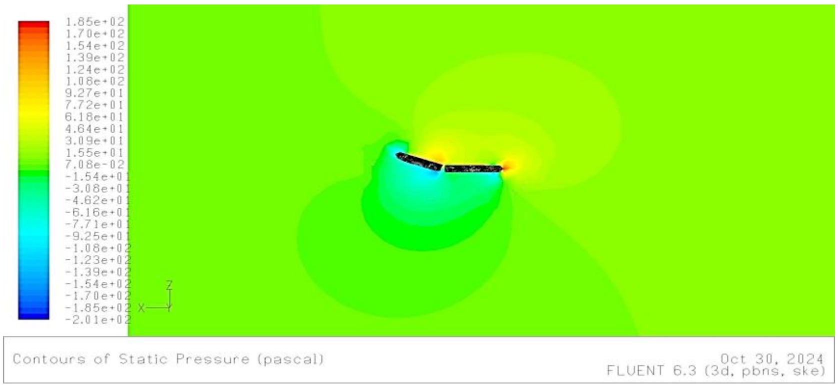
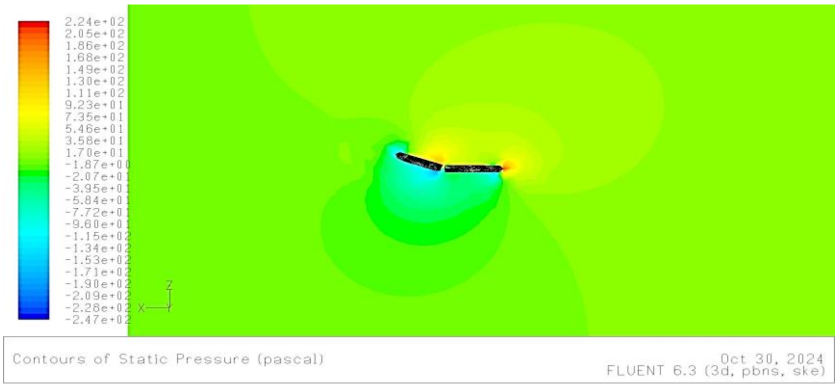
Lanjutan tabel A. 23 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut ($\delta = 15^o$) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	**Profil Kontur Tekanan**
20	

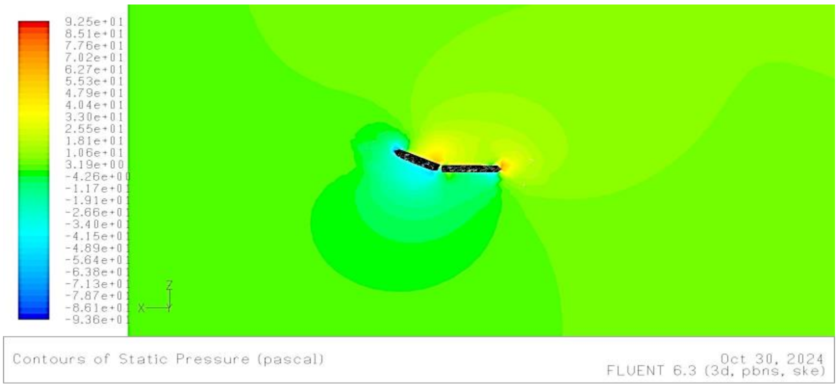
Tabel A. 24 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut ($\delta = 20^o$) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	**Profil Kontur Tekanan**
12	
14	

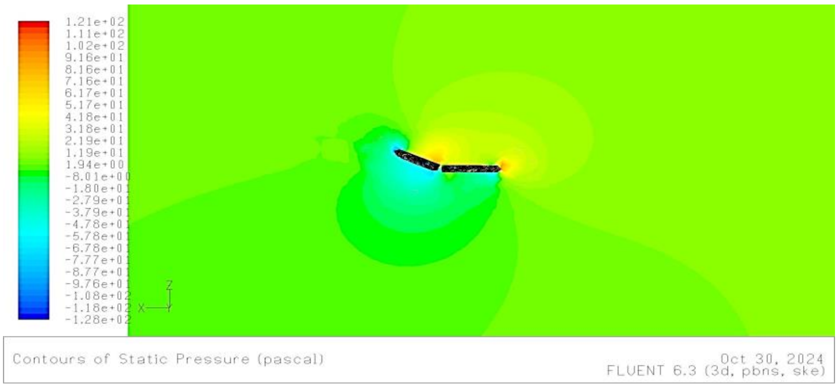
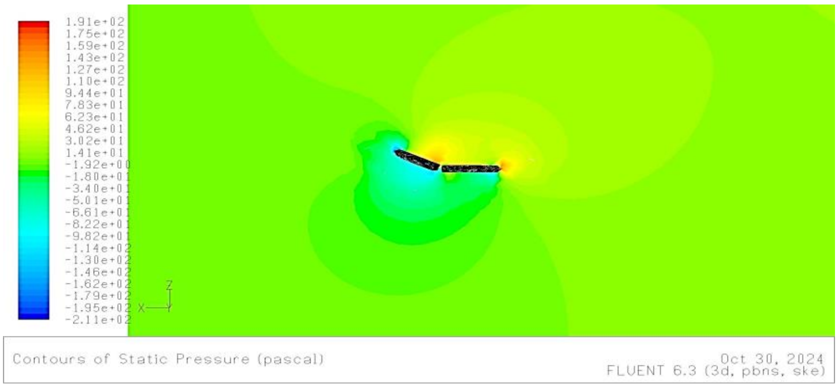
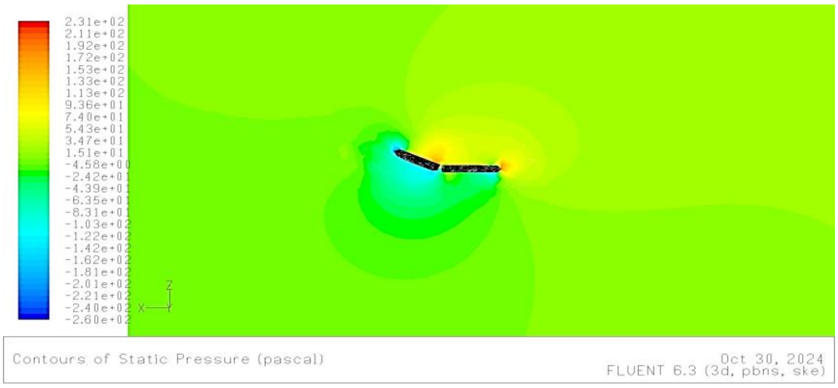
Lanjutan tabel A. 24 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut (δ = 20^{o}) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	**Profil Kontur Tekanan**
18	
20	

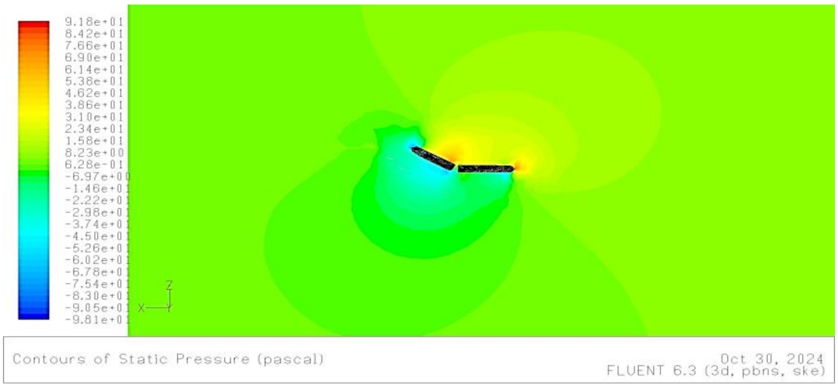
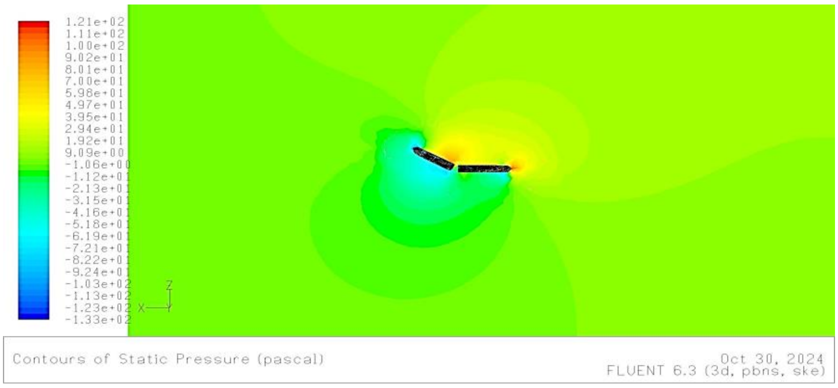
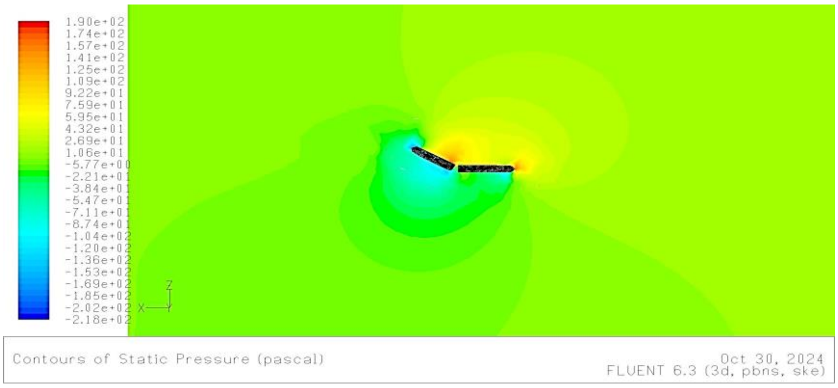
Tabel A. 25 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut (δ = 25^{o}) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	**Profil Kontur Tekanan**
12	

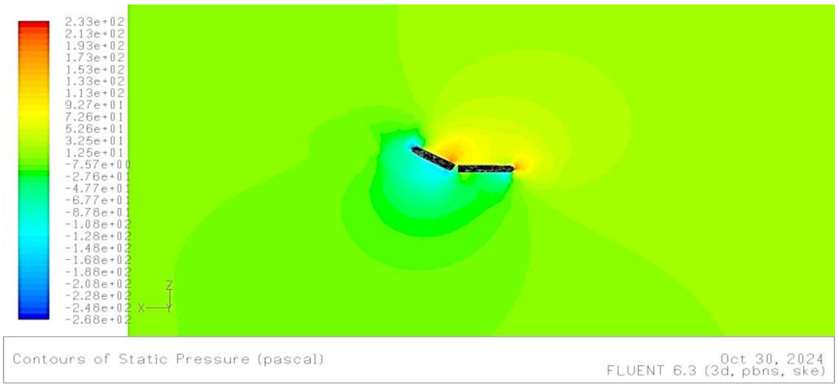
Lanjutan tabel A. 25 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut (δ = 25°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	**Profil Kontur Tekanan**
14	
18	
20	

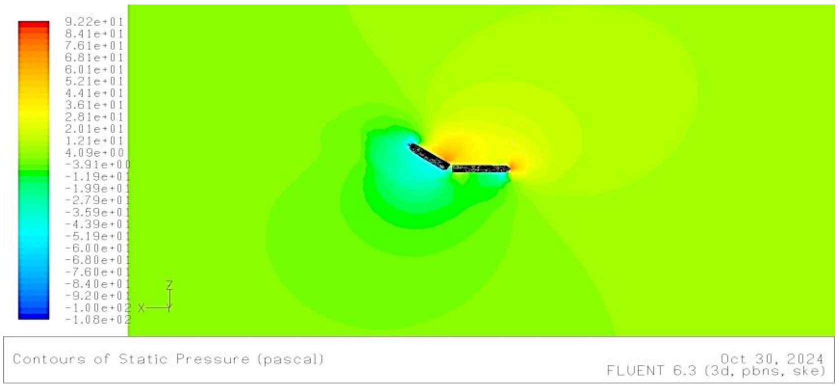
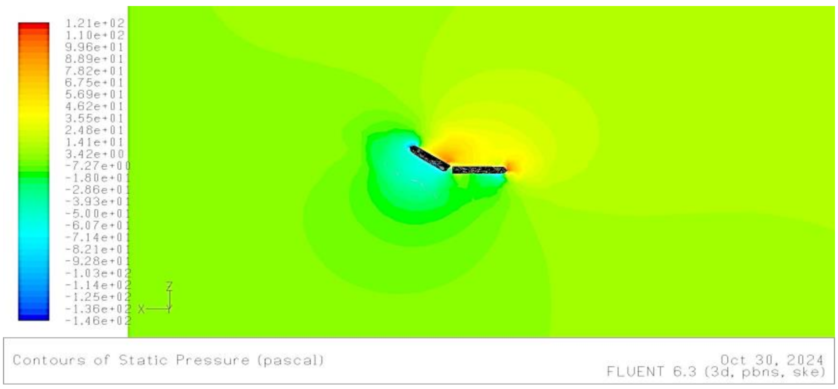
Tabel A. 26 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut (δ = 30°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Kontur Tekanan
12	
14	
18	

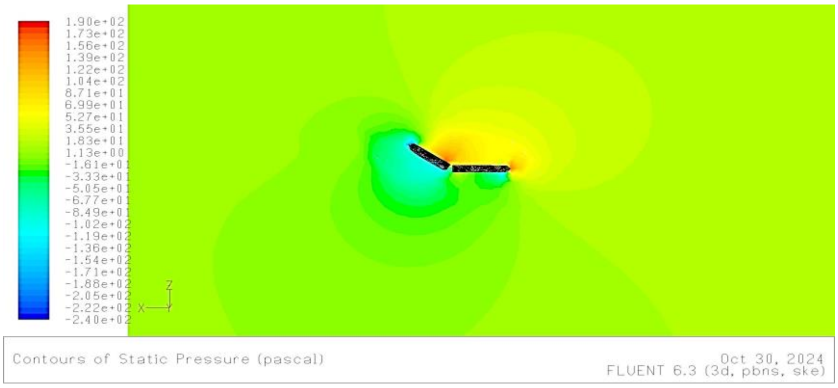
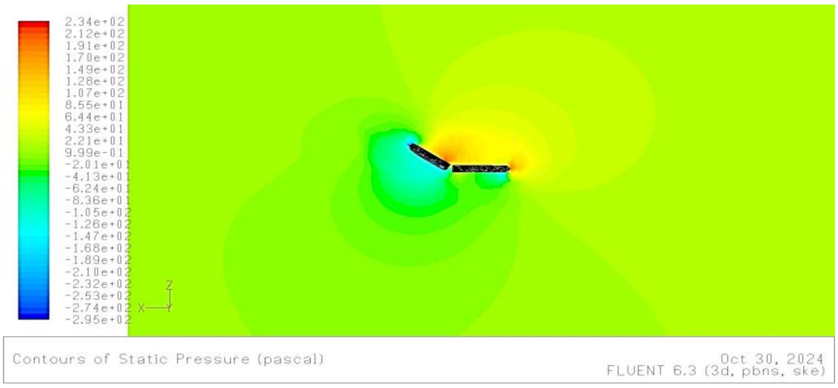
Lanjutan tabel A. 26 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut (δ = 30°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Kontur Tekanan
20	

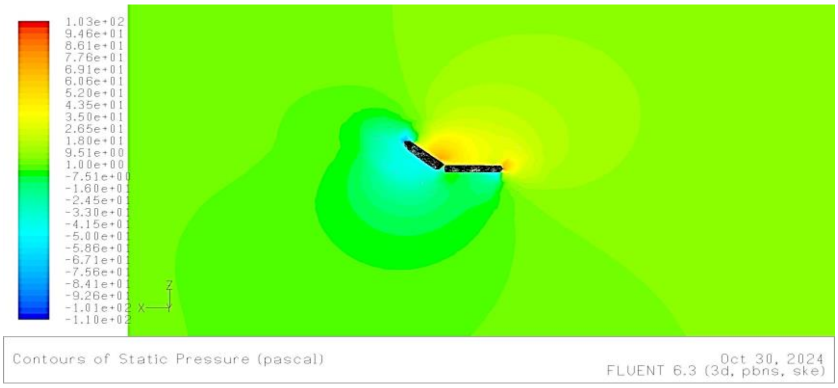
Tabel A. 27 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut (δ = 35°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Kontur Tekanan
12	
14	

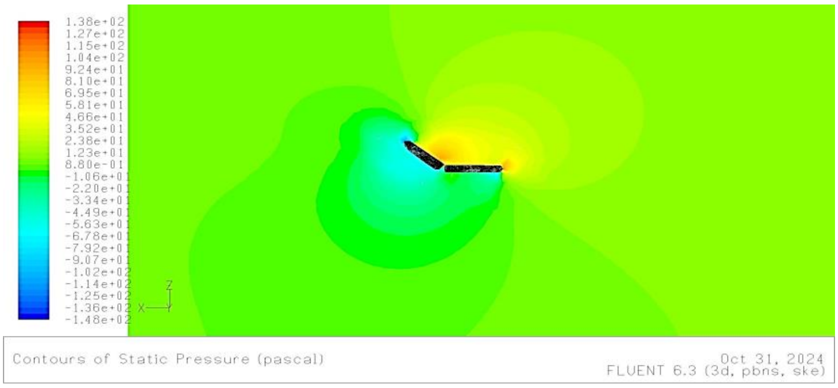
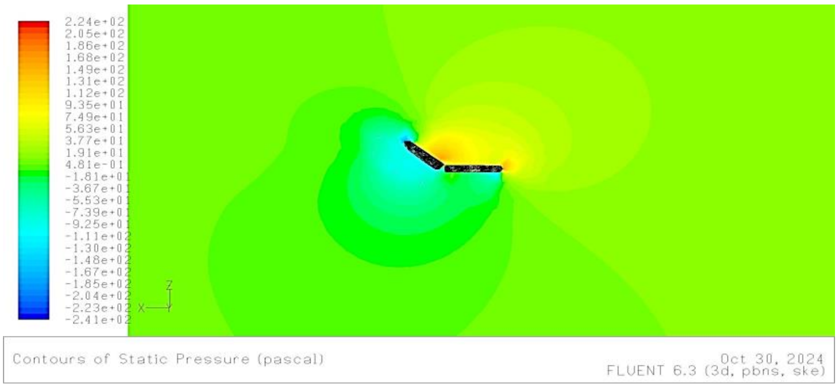
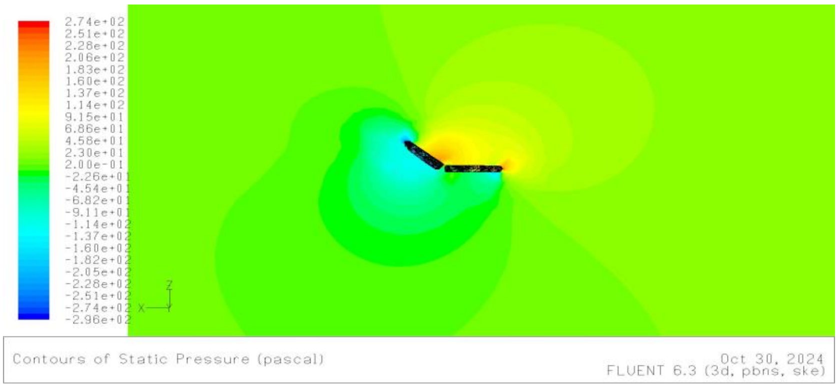
Lanjutan tabel A. 27 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut (δ = 35°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Kontur Tekanan
18	
20	

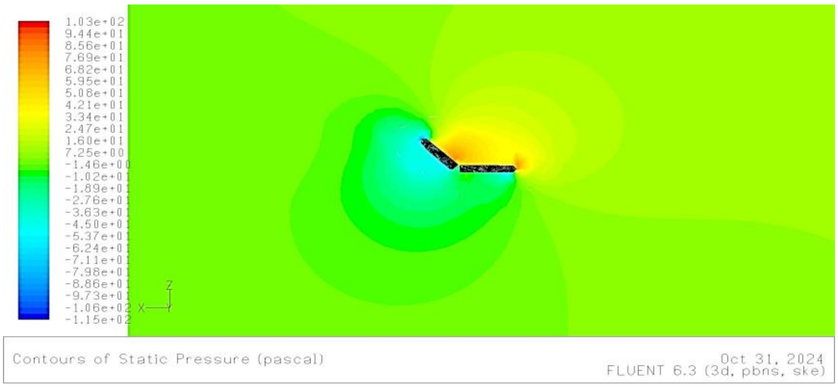
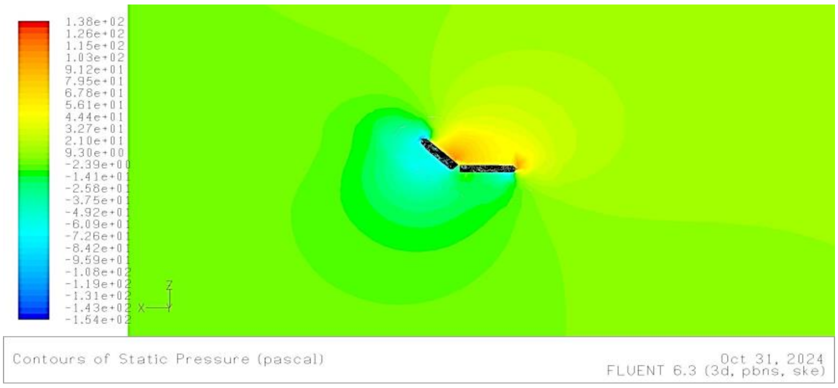
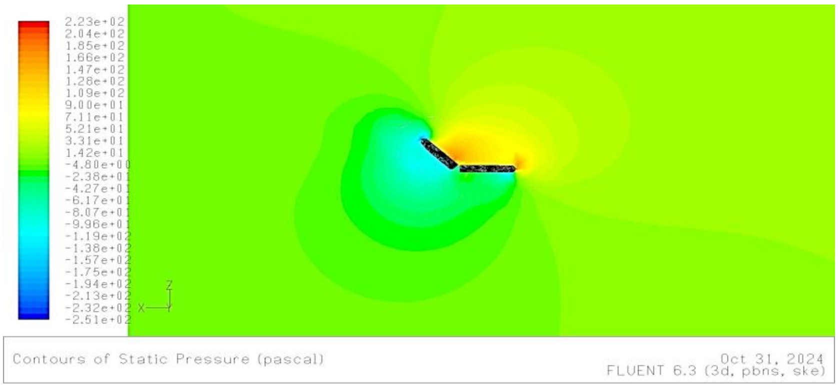
Tabel A. 28 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut (δ = 40°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Kontur Tekanan
12	

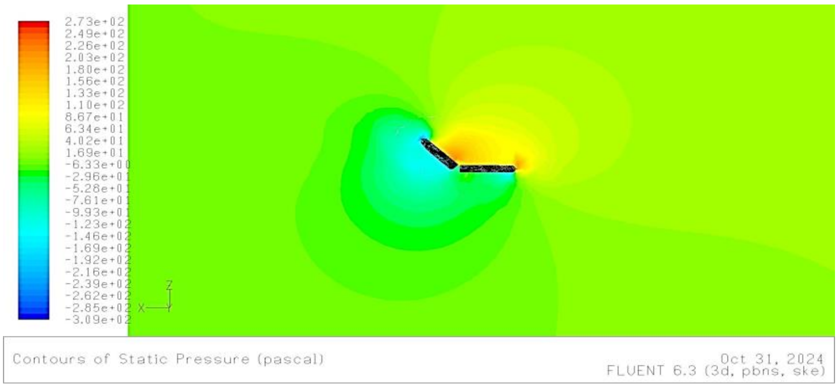
Lanjutan tabel A. 28 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut (δ = 40^o) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

U (m/s)	Profil Kontur Tekanan
14	
18	
20	

Tabel A. 29 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut (δ = 45°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

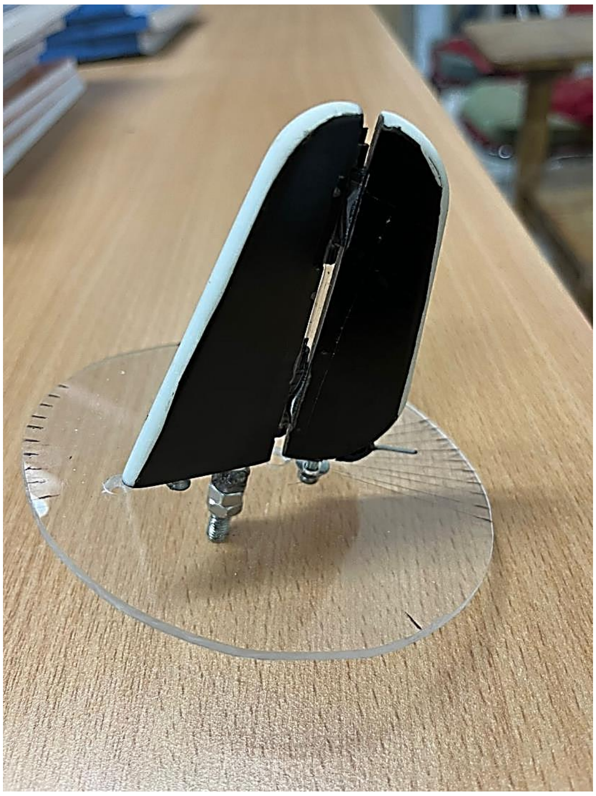
U (m/s)	**Profil Kontur Tekanan**
12	
14	
18	

Lanjutan tabel A. 29 Profil kontur tekanan pada *stabilizer* dan *rudder* untuk sudut (δ = 45°) dengan kecepatan U = 12 m/s, 14 m/s, 18 m/s, dan 20 m/s

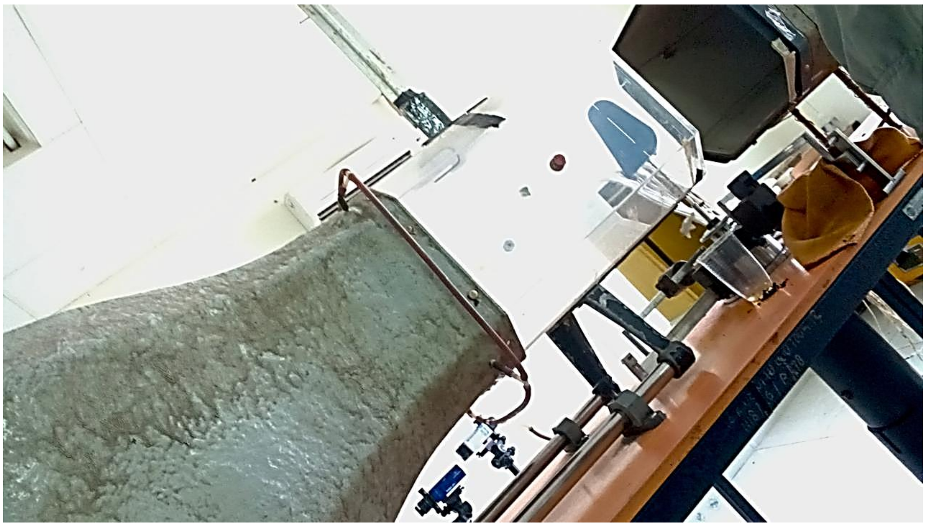
U (m/s)	Profil Kontur Tekanan
20	

Lampiran B

Gambar B. 1 Model spesimen pwngujian *wind tunnel*

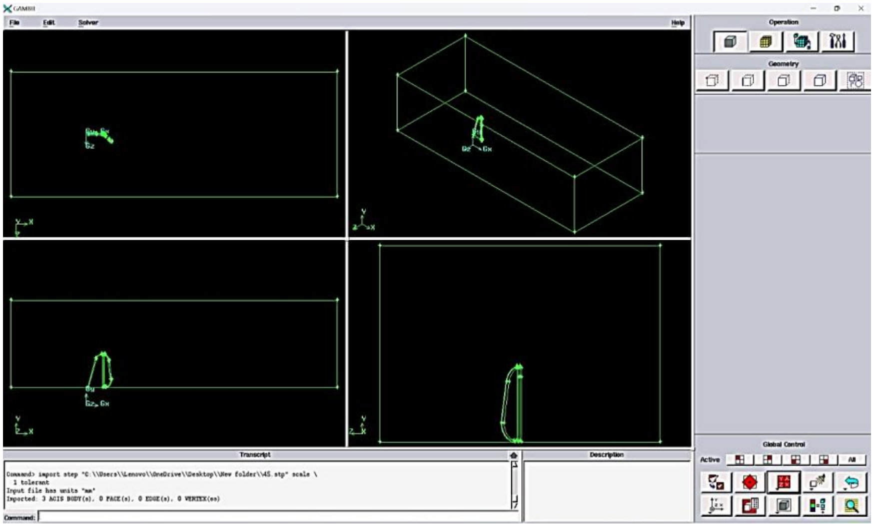


Gambar B. 2 Model spesimen pwngujian *smoke flow*



Gambar B. 3 Proses pengujian *wind tunnel*

Gambar B. 4 Proses pengujian *smoke flow*



Gambar B. 5 Proses pengujian CFD

Gambar B. 6 Proses presentasi artikel Conference; The 2 nd International Conference on Research in Engineering Science Technology (IC-REST) 2024