DAFTAR PUSTAKA

Adi, Prasetyo dan Amiadji. 2013. “Analisa Penerapan Bulbous Bow pada Kapal Katamaram untuk Meningkatkan Efisiensi Pemakaian Bahan Bakar”. ITS.F-15. Surabaya

Adji, Suryo W. 2009. “Resistance & Propulsion Modul 1: Introduction to Ship Resistance”. Surabaya

Aprianto, Agung. 2019. Studi Tahanan Kapal Semi Displacement. Makassar: Departement Teknik Perkapalan Universitas Hasanuddin.

Baso, S., Ardianti, A., Rosmani, A. Ade Anggriani. (2021). An Extended Validation of Free CFD Application to Ship Resistance Prediction for Using In Preliminary Design Stage. Journal of Engineering Science and Technology, 16(3), 2544-2561.

https://id.wikipedia.org/wiki/Kapal_tunda Diakses pada tanggal 9 Juni

Harvald. A, 1998. “Tahanan dan Propulsi Kapal”. Surabaya: Airlangga University Press

Peraturan Menteri Perhubungan Republik Indonesia Nomor PM. 48 tahun 2018 Tentang Angkutan Laut.

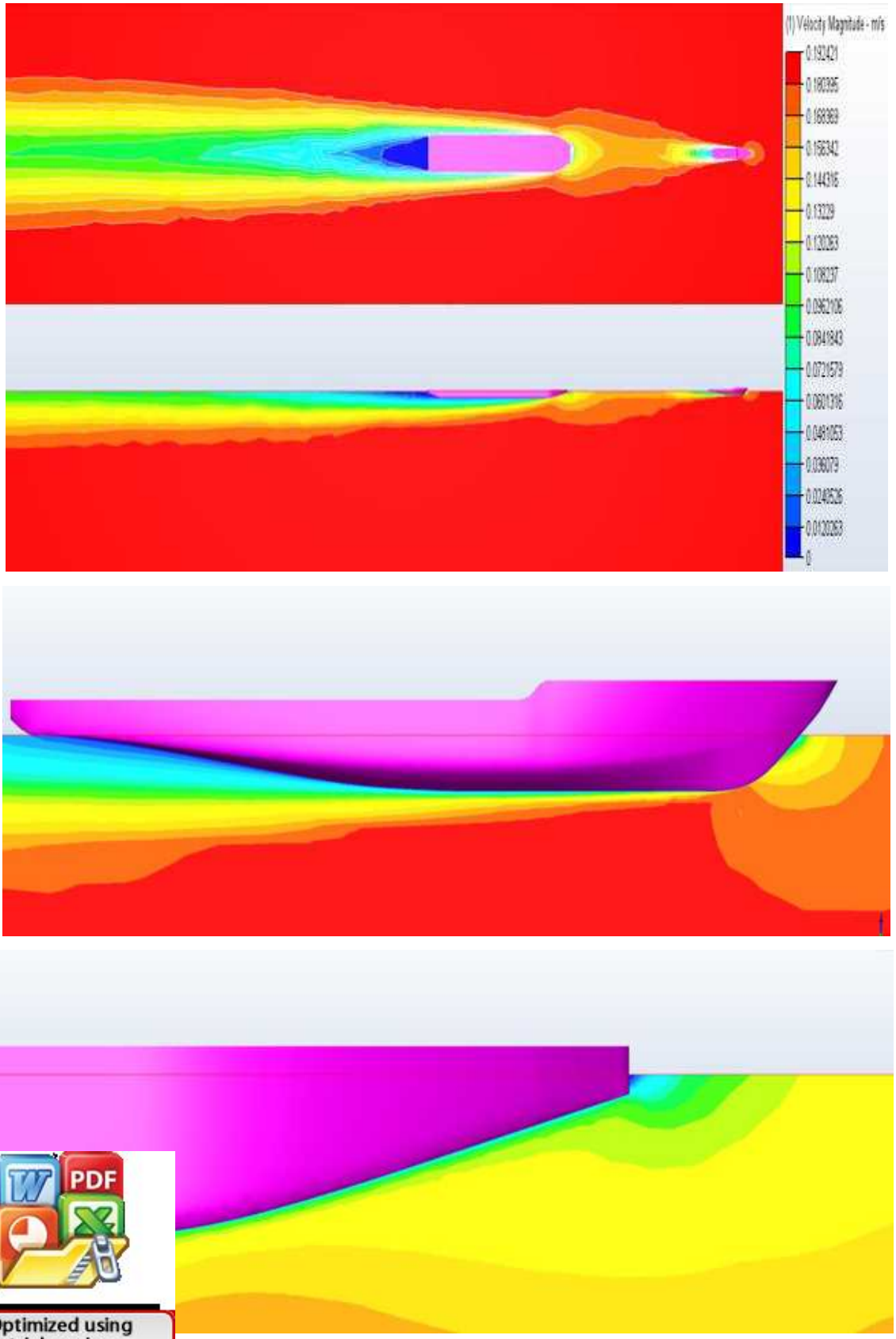
Rasidi, Ahmad A. 2019. “Komparasi Tahanan Kapal Menggunakan Bulbous Bow dan Tanpa Bulbous Bow berdasarkan Analisis CFD (Computational Fluid Dynamic)”. Unhas. Makassar

Sardjadi, Djoko. 2003. Mekanika Fluida. Bandung.

Sv. Harvald. 1992. “Tahanan dan Propulsi Kapal”. Airlangga. Surabaya Autodesk CFD. (2015, 28 Desember). Autodesk Knowladge Networks. Diperoleh 10 April 2018, dari https://knowledge.autodesk.com/support/cfd/learn explore/caas/CloudHelp/cloudhelp/2014/ENU/SimCFD/files/GUID-46AC3A14 5C6E-485D-95BA-E174F1BC1A47-htm.html

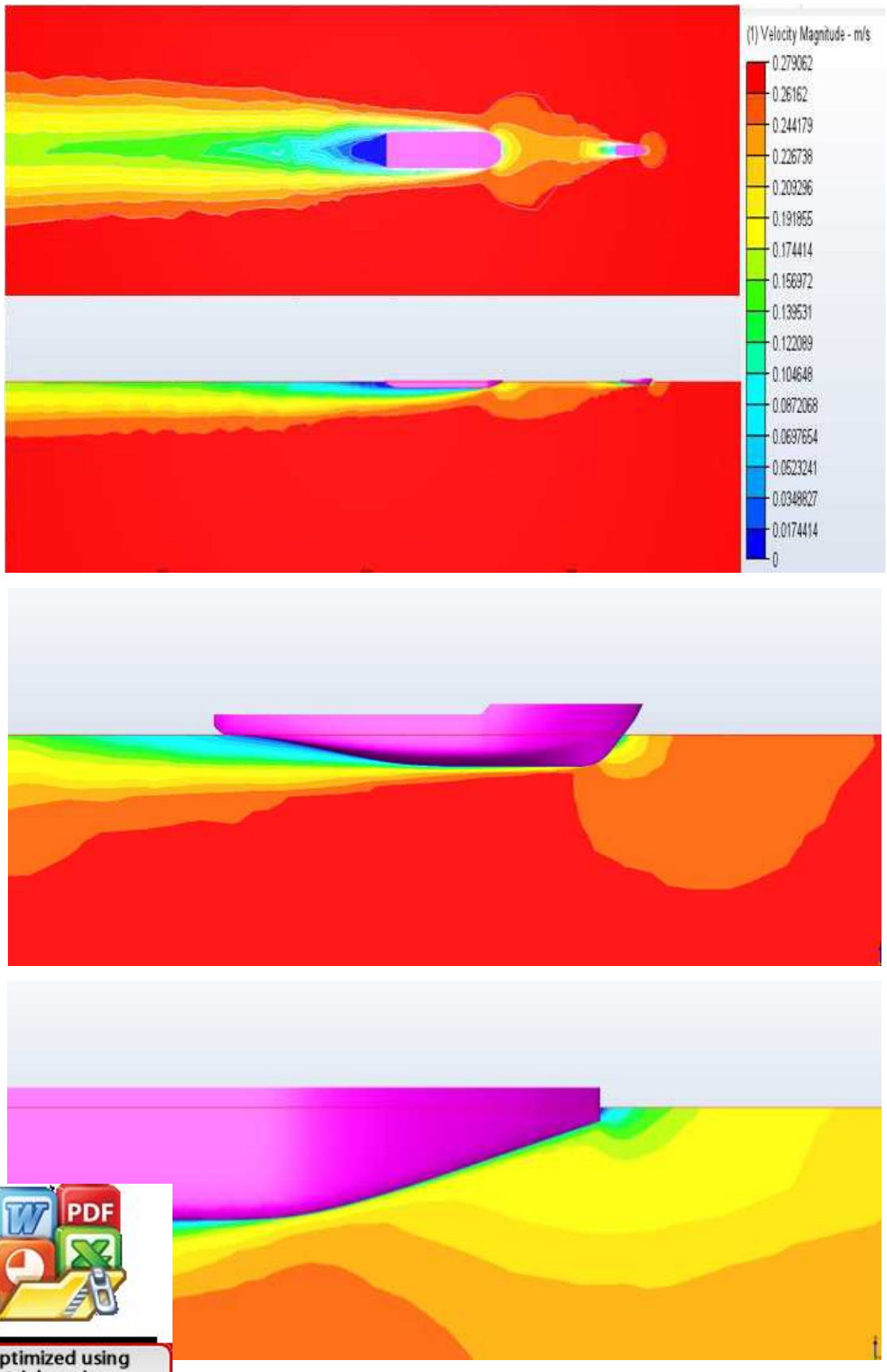
Lampiran 1. Visualisasi Velocity Magnitude pada setiap kecepatan

- Kecepatan 3 knot
  - **1 L**



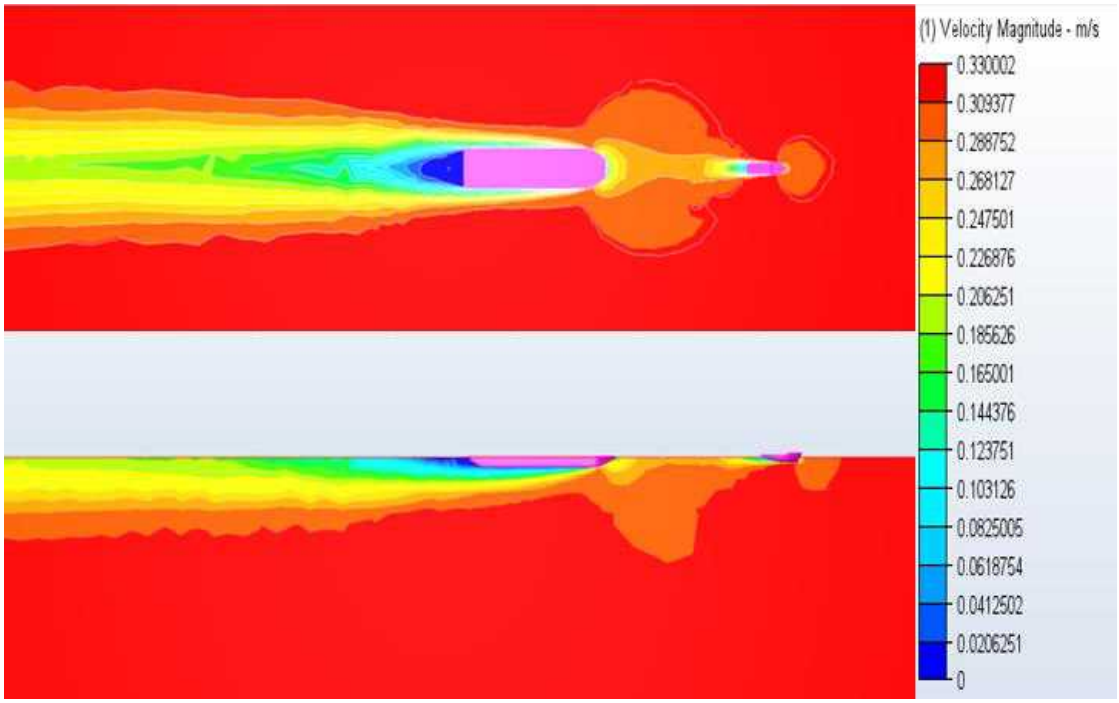
Visualisasi velocity magnitude **1 L**

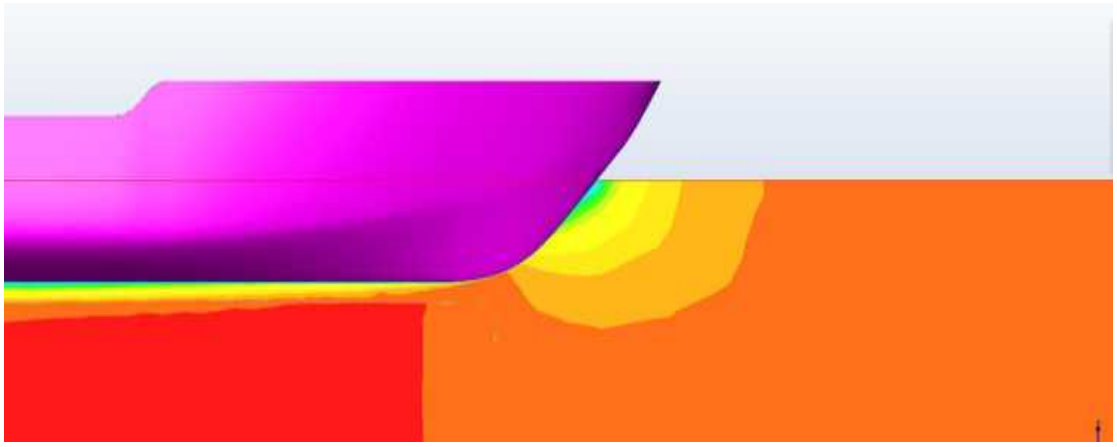
- Kecepatan 4 knot
  - **1 L**

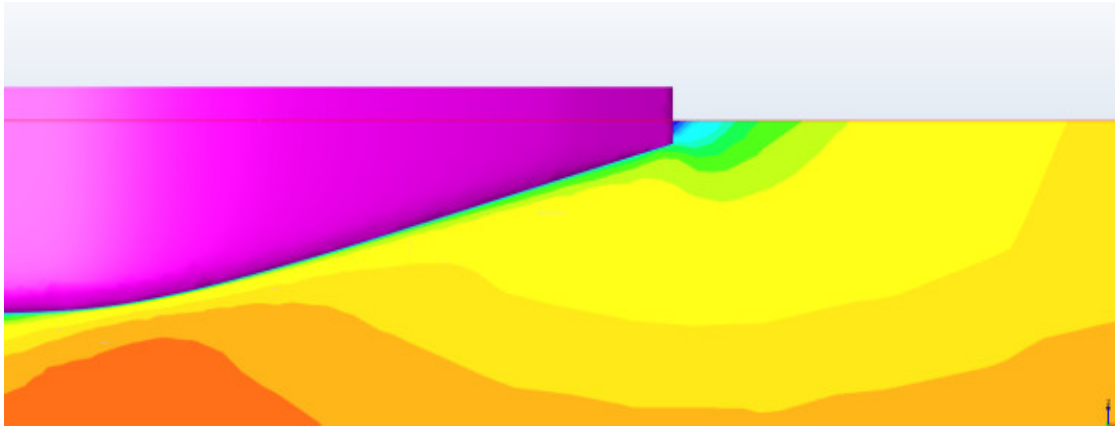


Visualisasi velocity magnitude **1 L**

- Kecepatan 5 knot
  - **1 L**



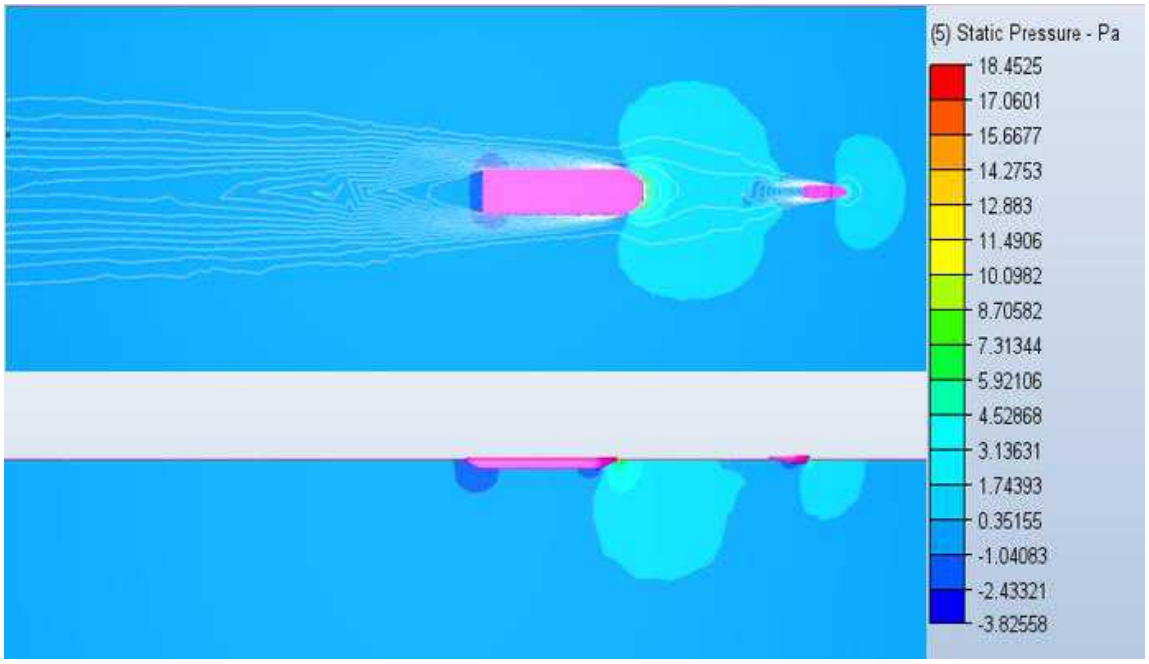


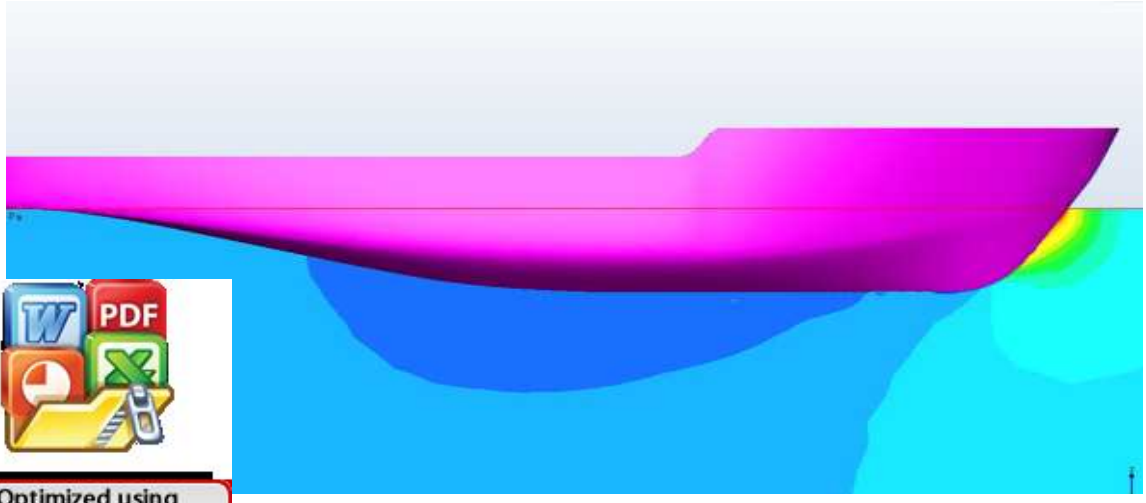


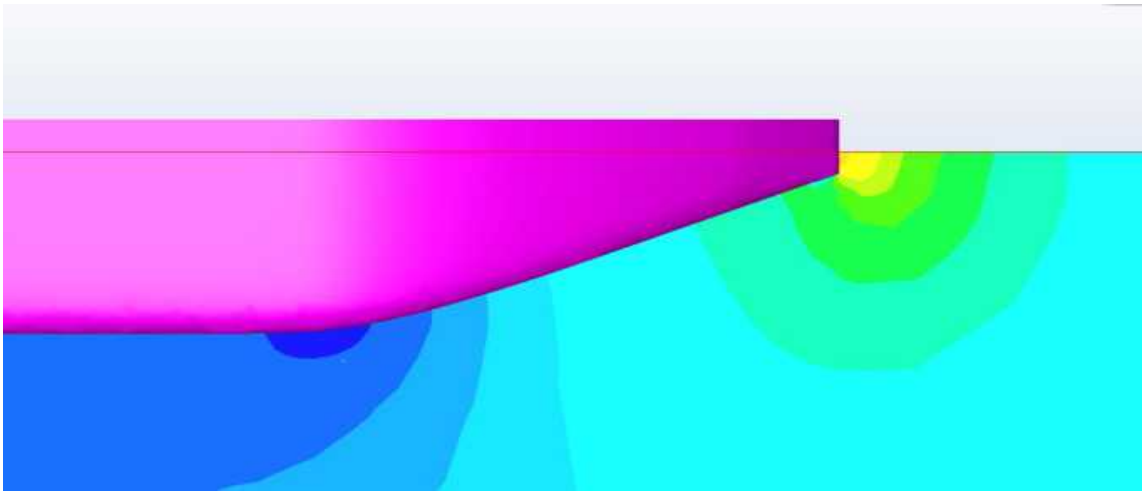
Visualisasi velocity magnitude **1 L**

Lampiran 2. Visualisasi Static Pressure pada setiap kecepatan

- Kecepatan 3 knot
  - **1 L**

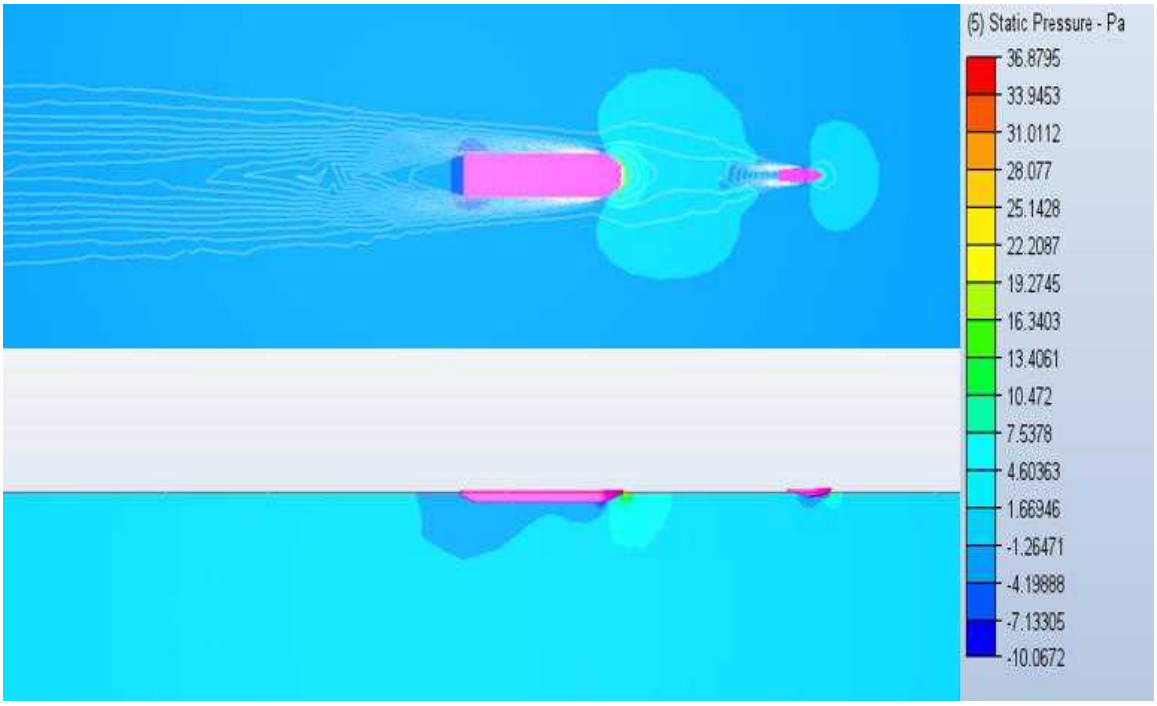


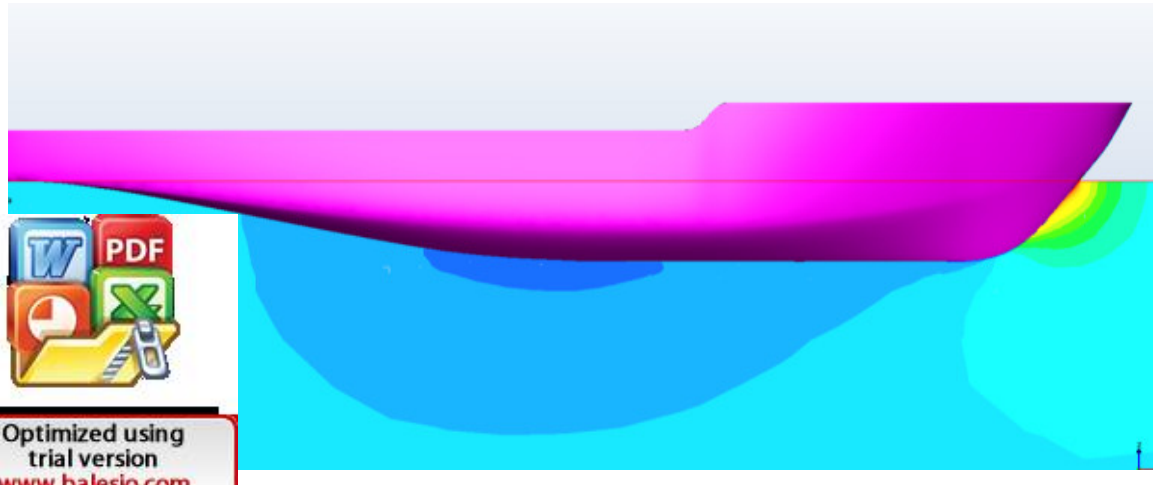


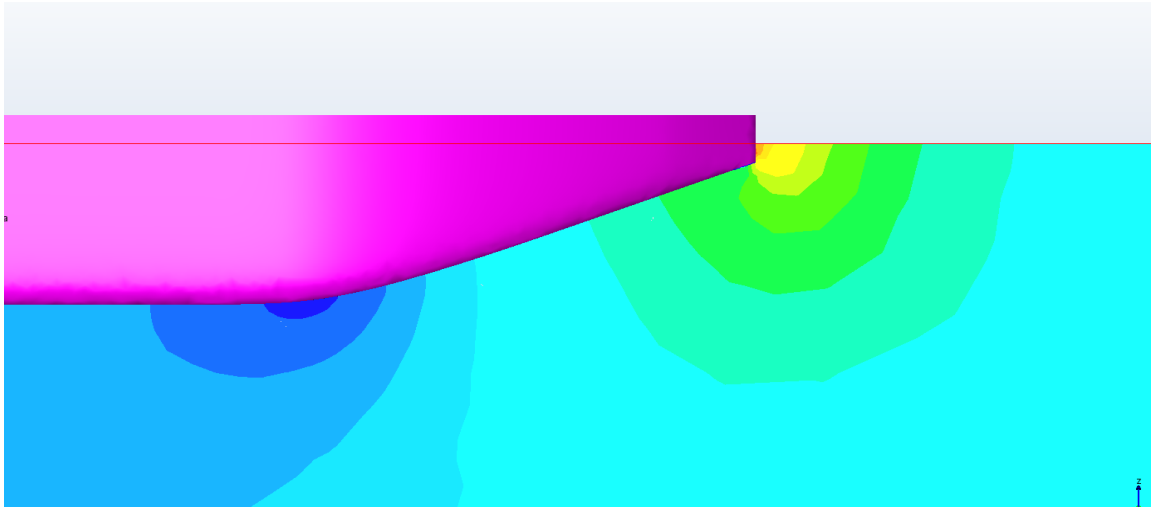


Static Pressure **1 L**

- Kecepatan 4 knot
  - **1 L**

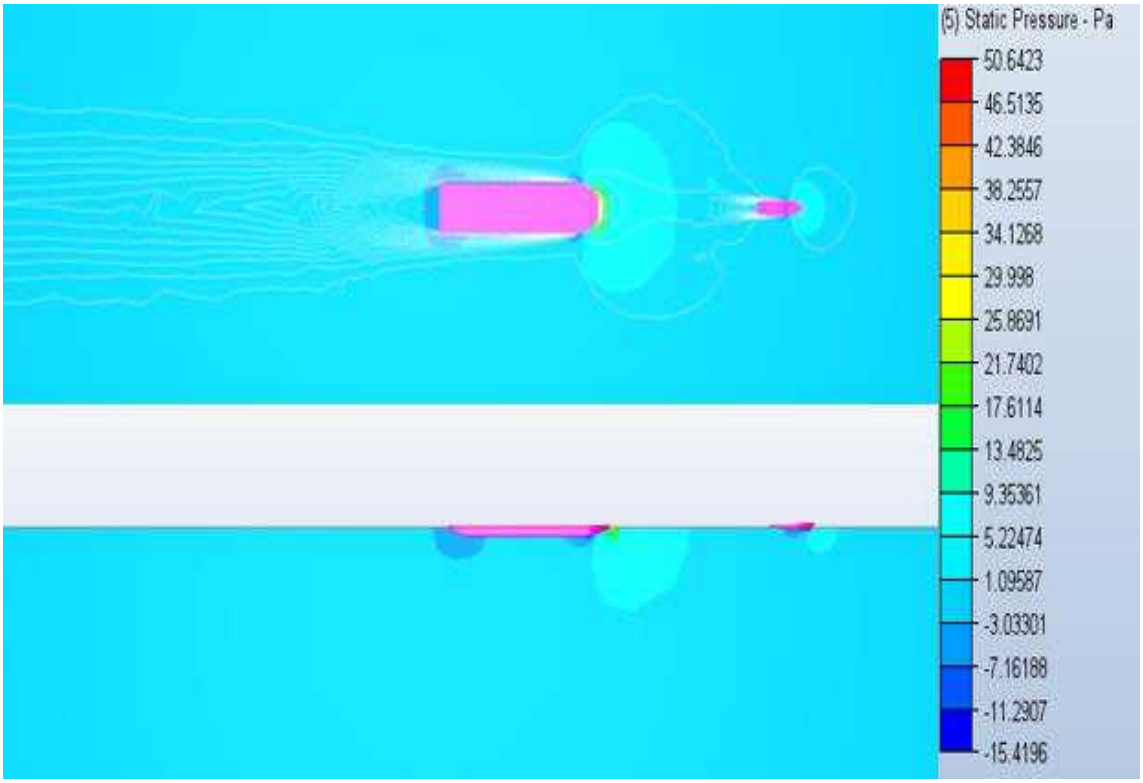


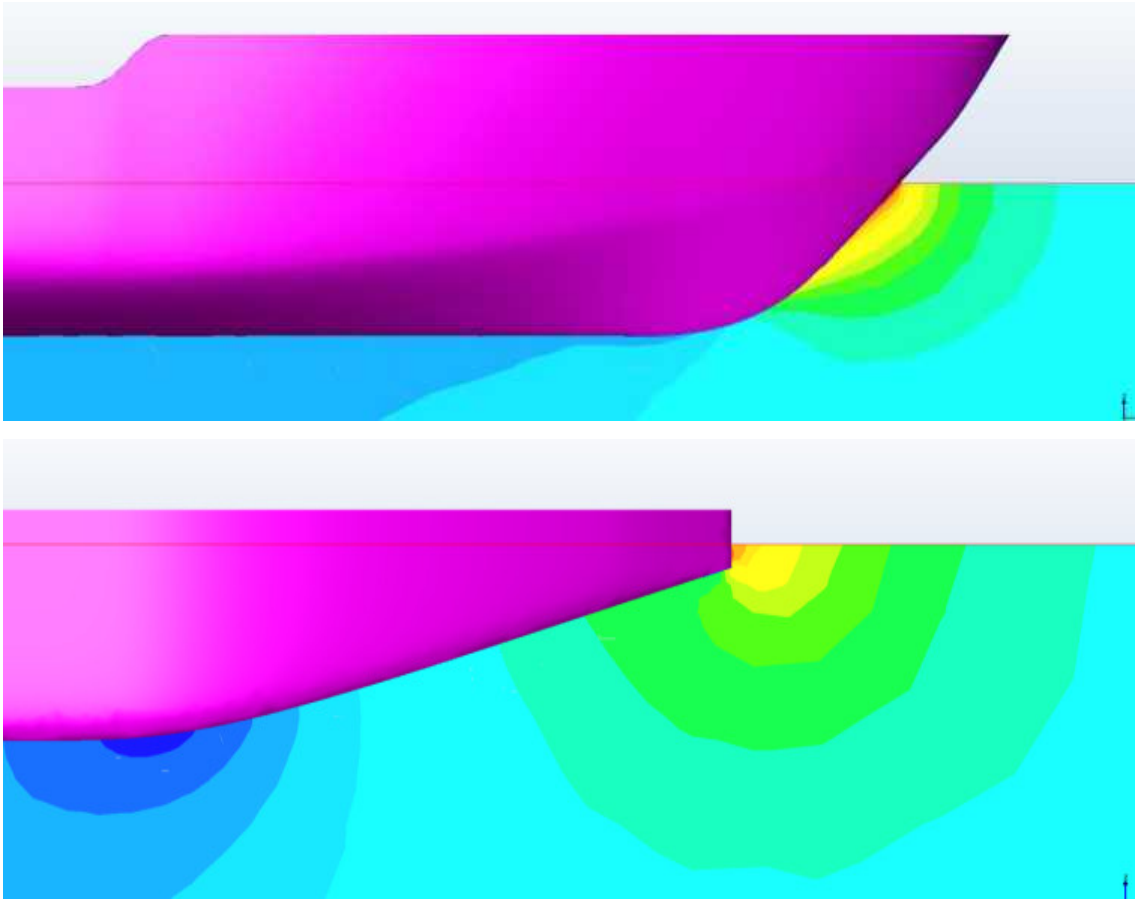




Static pressure **1 L** tampak atas kecepatam 4 knot

- Kecepatan 5 knot
  - **1 L**

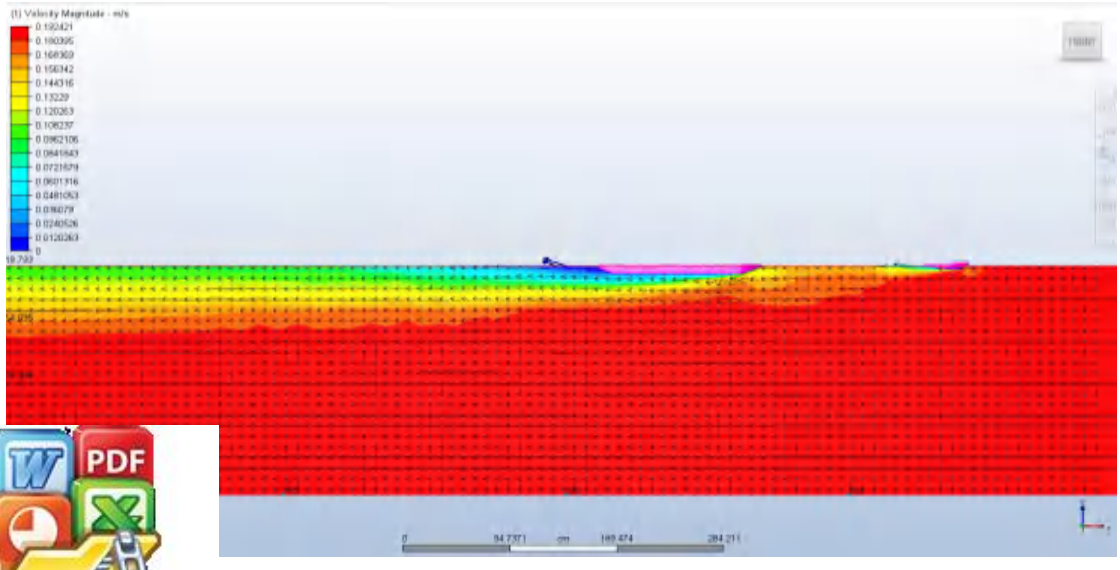


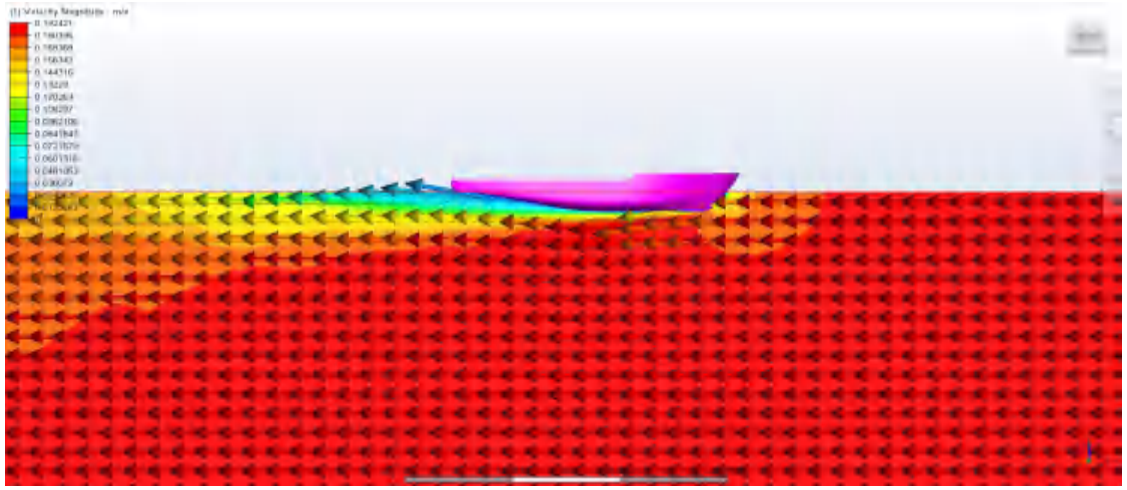


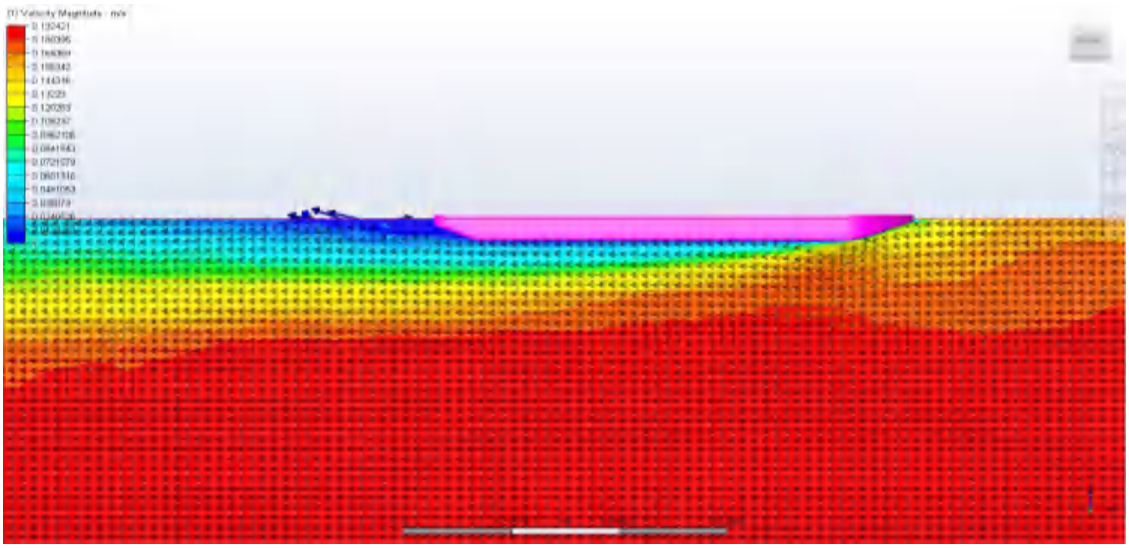
Static pressure **1 L** pada tongkang kecepatan 5 knot

Lampiran 3. Visualisasi velocity vector pada setiap kecepatan

- Kecepatan 3 knot
  - **1 L**

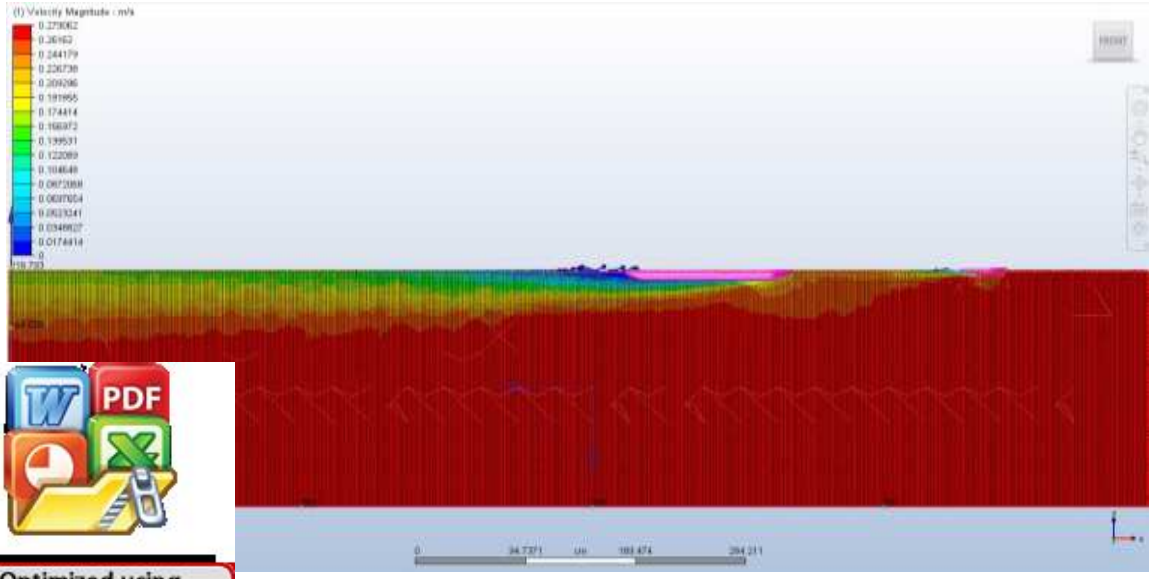


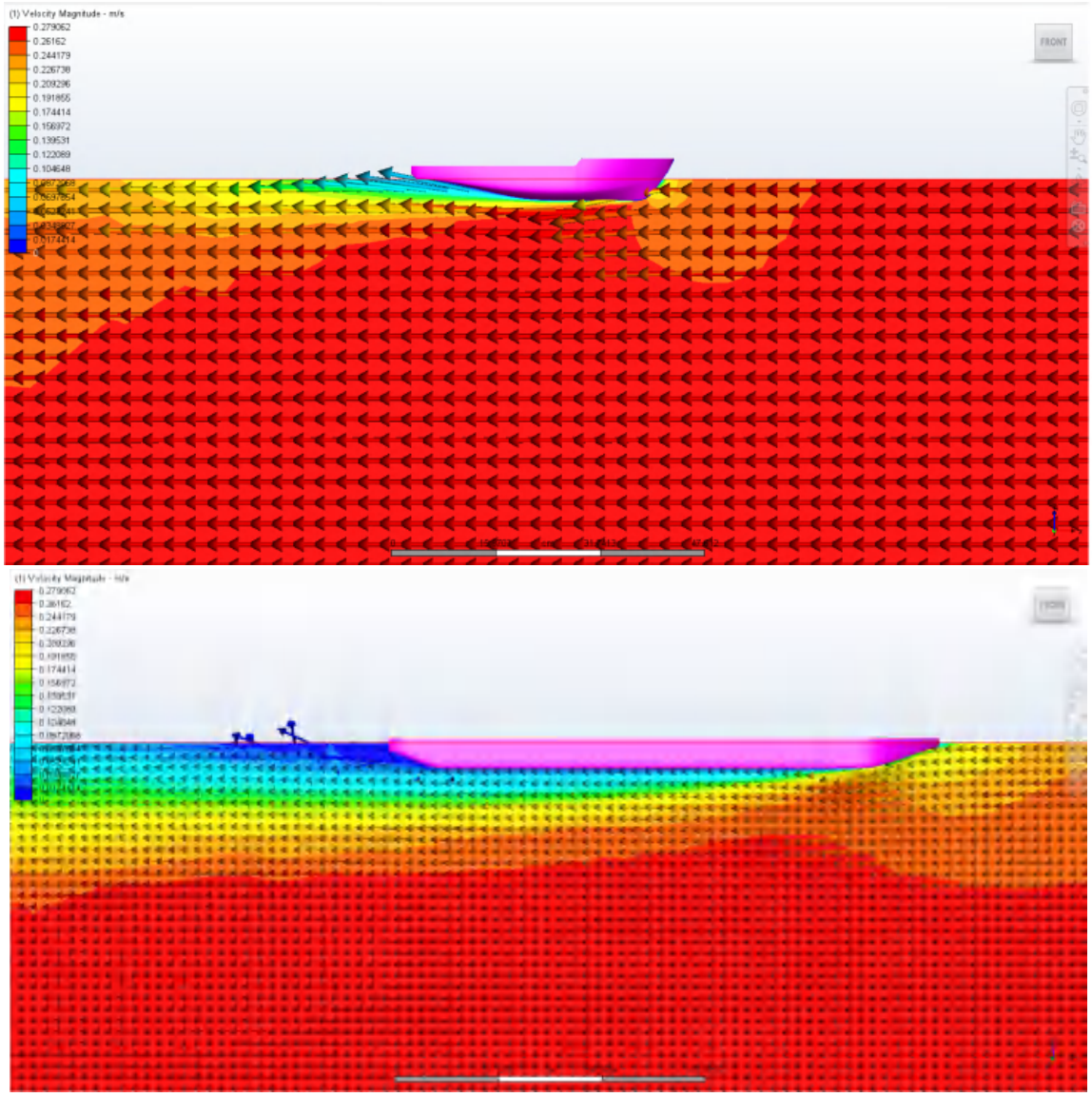




Velocity vector **1 L**

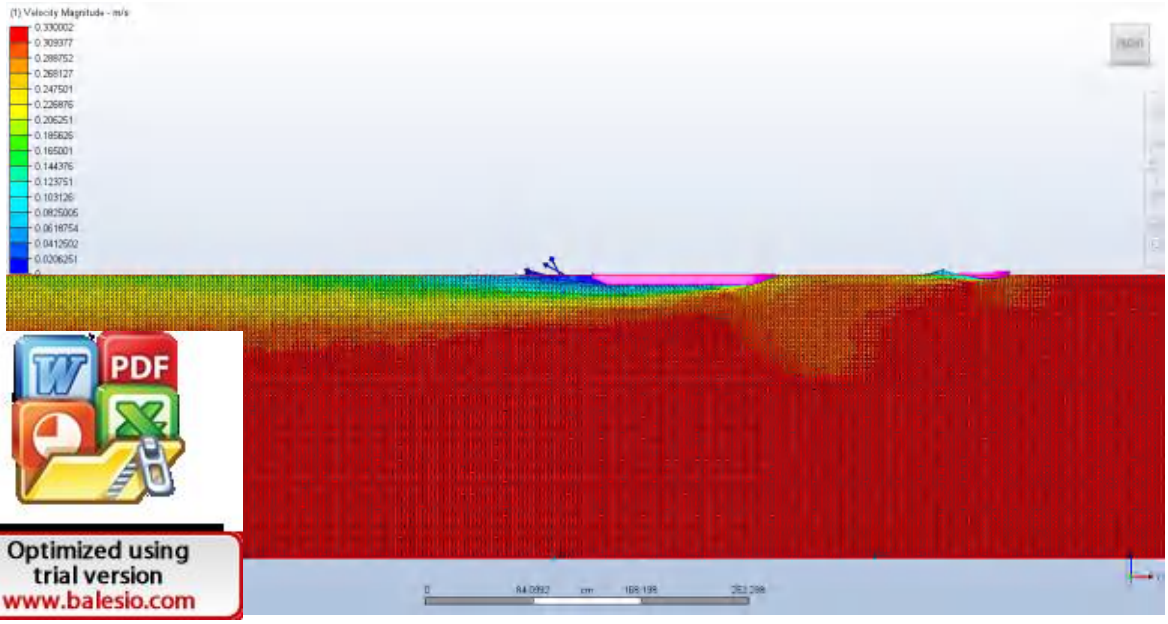
- Kecepatan 4 knot
  - **1 L**

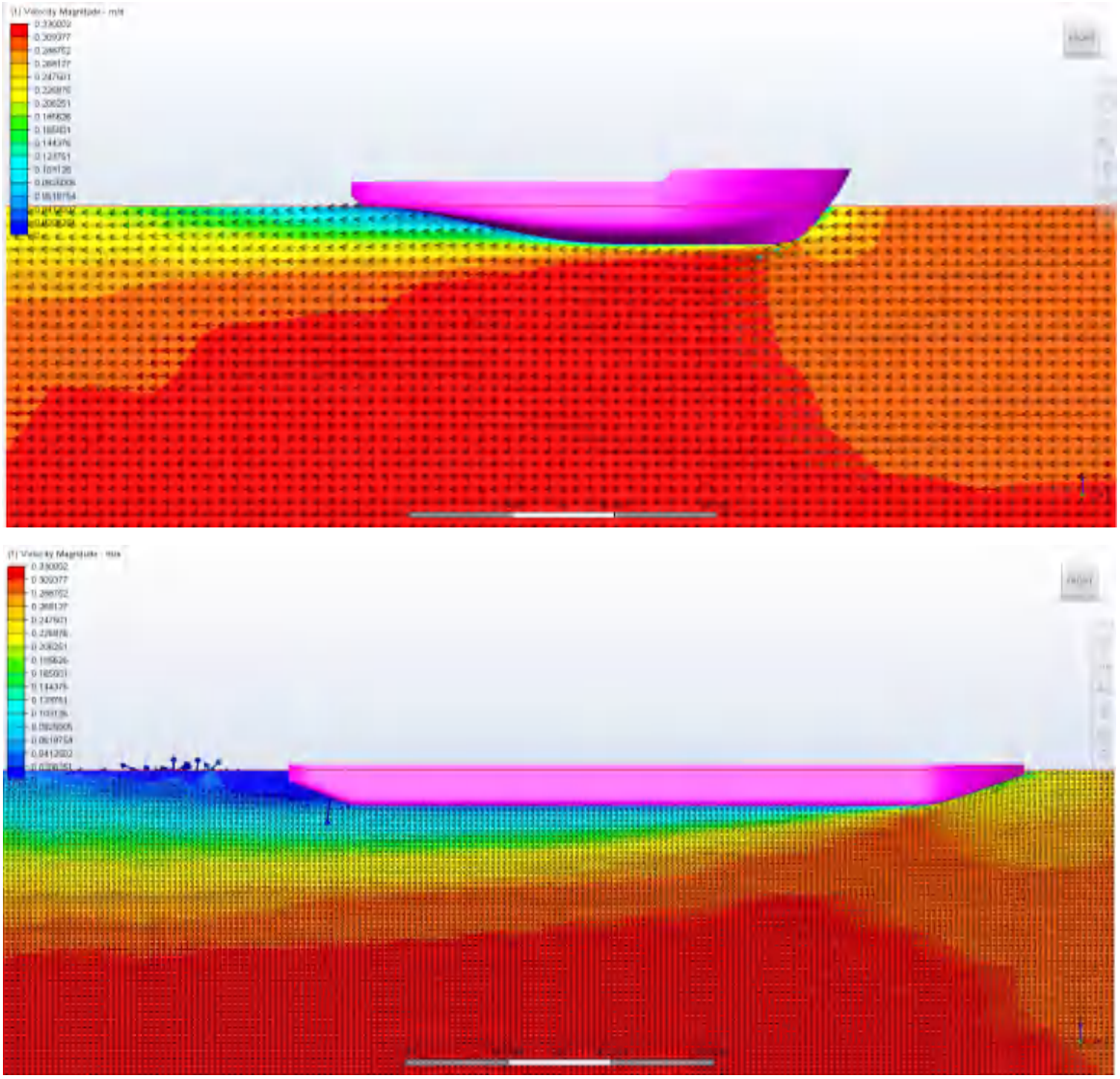




Velocity vektor **1 L** kecepatan 4 knot

- Kecepatan 5 knot
  - **1 L**





Velocity vektor **1 L** kecepatan 5 knot

Lampiran 4. Data statistik jumlah elemen mesh

- Kecepatan 3 knot

No	Material	Model Size	
		Nodes	Element
1	Fluid	380812	1415222
2	Solid (model)	913901	4801417
	Total	1294713	6216639

➢ Kecepatan 4 knot

No	Material	Model Size	
		Nodes	Element
1	Fluid	380812	1415222
2	Solid (model)	913901	4801417
	Total	1294713	6216639

➢ Kecepatan 5 knot

No	Material	Model Size	
		Nodes	Element
1	Fluid	381967	1420700
2	Solid (model)	914441	4803489
	Total	1296408	6224189

Lampiran 5. Penentuan nilai kecepatan model kapal (V_m)

Berdasarkan persamaan 2.20 dimana $\frac{vm}{\sqrt{g.Lm}} = \frac{vs}{\sqrt{g.Ls}}$ maka dalam menentukan kecepatan model kapal sebagai berikut.

➢ Kecepatan 3 knot

$Fn_s = \frac{vs}{\sqrt{g.Ls}}$

$= \frac{1.543}{\sqrt{9.81\ x\ 100.584}}$

$= 0.049$

$Fn_m = 0.049$

$= \frac{vm}{\sqrt{g.Lm}}$

0.049 $= \frac{vm}{\sqrt{9.81\ x\ 1.437}}$

Vm = **0.184** m/s

- Kecepatan 4 knot

$Fn_s = \frac{vs}{\sqrt{g.Ls}}$

$= \frac{2.057}{\sqrt{9.81\ x\ 100.584}}$

= 0.065

$Fn_s = Fn_m$ = 0.065

Maka, $Fn_s = \frac{vm}{\sqrt{g.Lm}}$

0.065 $= \frac{vm}{\sqrt{9.81\ x\ 1.437}}$

Vm = **0.253** m/s

- Kecepatan 5 knot

$Fn_s = \frac{vs}{\sqrt{g.Ls}}$

$= \frac{2.572}{\sqrt{9.81\ x\ 100.584}}$

= 0.0818 = 0.082

$Fn_s = Fn_m$ = 0.082

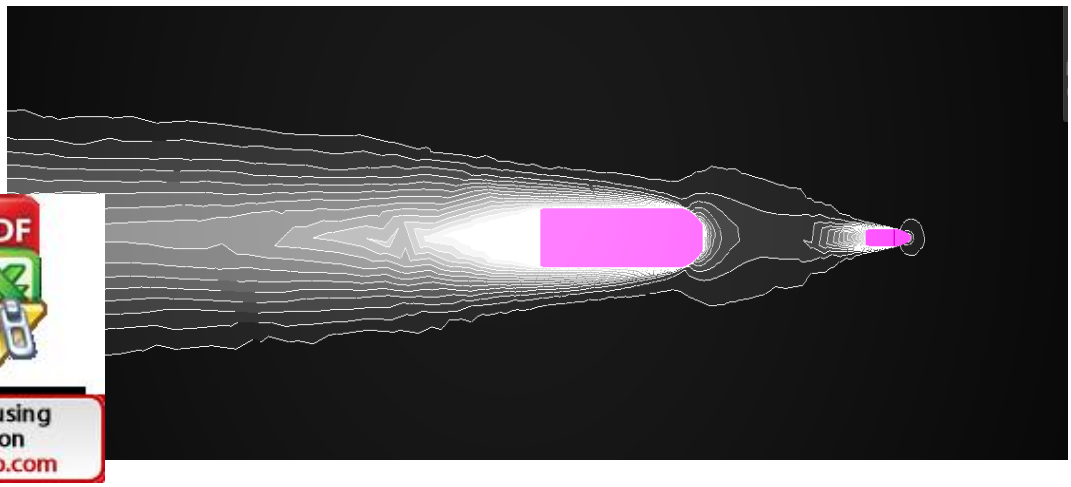
Maka, $Fn_s = \frac{vm}{\sqrt{g.Lm}}$

0.082 $= \frac{vm}{\sqrt{9.81\ x\ 1.437}}$

Vm = **0.307** m/s

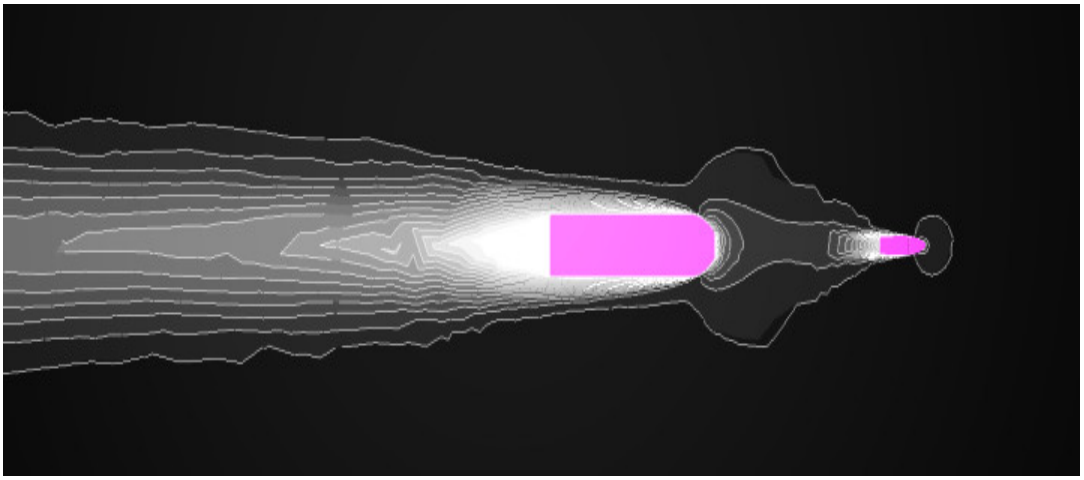
Lampiran 6. Visualisasi Pola Aliran pada setiap kecepatan

- Kecepatan 3 knot
  - **1 L**



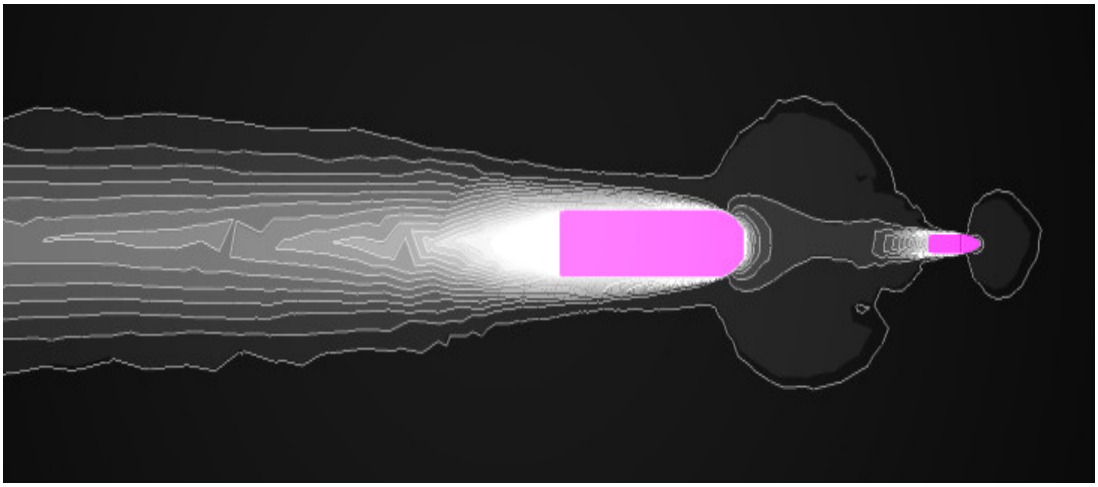
➢ Kecepatan 4 knot

- **1 L**



➢ Kecepatan 5 knot

- **1 L**



Lampiran 7. Persentase Kenaikan Tahanan Model Kapal Tandem

- Model kapal Tugboat

No.	Kecepatan (knot)	Tahanan Barge (N)	Presentase Kenaikan Tahanan
1	0.18	0.01698	0%
2	0.26	0.03149	46.078%
3	0.31	0.04141	23.956%

- Model kapal Tongkang

No.	Kecepatan (knot)	Tahanan Barge (N)	Presentase Kenaikan Tahanan
1	0.18	0.15079	0%
2	0.26	0.30153	49.992%
3	0.31	0.4172	27.725%

- Model Kapal Tandem

No.	Kecepatan (knot)	Tahanan Tandem (N)	Presentase Kenaikan Tahanan
1	0.18	0.16775	0%
2	0.26	0.33302	49.628%
3	0.31	0.45861	27.385%

Lampiran 8. Persentase Kenaikan Tahanan Kapal Tandem

- Kapal Tugboat

No.	Kecepatan (knot)	Tahanan Tugboat (KN)	Presentase Kenaikan Tahanan
3	0.01698	0%
4	0.03149	46.178%
5	0.04141	23.081%

➢ Kapal Barge

No.	Kecepatan (knot)	Tahanan Barge (KN)	Presentase Kenaikan Tahanan
1	3	51.45	0%
2	4	103.243	50.166%
3	5	143.031	27.818%

➢ Kapal Tandem

No.	Kecepatan (knot)	Tahanan Barge (KN)	Presentase Kenaikan Tahanan
1	3	57.53825	0%
2	4	114.22586	49.628%
3	5	157.30323	27.385%