

## DAFTAR PUSTAKA

- ABS. (2004). Guide for Building and Classing: Floating Production Installations. Houston, Texas USA: American Bureau of Shipping.
- ABS. (2021). Nonlinear Finite Element Analysis and Offshore Structures. *Houston, Texas USA: American Bureau of Shipping.*
- Alie, M. (2018). Investigation of Ship Hull Girder Strength with Grounding Damage. *Makara Journal of Technology.*
- Alie, M. (2019). Progressive Collapse Analysis of the Local Elements and Ultimate Strength of a Ro-Ro Ship. *International Journal of Technology.*
- Alie M. dan Yusuf R (2020) Pendekatan Sederhana Analisis Prediksi Umur Kapal deepublish
- Alie, M. Z. M., Ramadhan, M. I., & Suci, I. M. (2021). Aplikasi Multiple Point Constrained (MPC) pada Penampang Kapal. deepublish.
- Aryawan, W. D., Nugroho, A. S., & Roesyanto. (2020). Structural integrity analysis of FPSO hull structure under collision load. *International Journal of Marine Engineering*, 18(2), 112-123.
- Bachman. (1991). Ship Hydrodynamics. National Academy.
- Bannantine, J. A. et al. (1990). Fundamentals of Metal Fatigue Analysis. 1-271.
- Chakrabarti, S. K. (2005). Handbook of Offshore Engineering (2-volume set) vol I. Elsevier United States.
- DNV GL. (2017a). Hull Girder Strength. In Rules for Classification: Ships (p. Pt.3 Ch.5).
- DNV GL. (2017b). Loads. In Rules for Classification: Ships (p. Pt.3 Ch.4). Norway.



Oil spill science and technology. Elsevier.

Awaka, J., Zhang, W., & Kujala, P. (2017). An analysis of ship escort operations in ice conditions. *Safety Science*, 95, 198-209.


J., & Ny, J. (2009). Crushing resistance of web girders in ship

- collision and grounding. *Marine Structures*, 22(1), 315-329.
- IACS. (2014). *Common Structural Rules for Bulk Carriers and Oil Tanker*
- M, Shama. (2013). *Buckling of Ship Structure*. Springer.
- Mulyati. (2014). *Mekanika Bahan, Tegangan dan Regangan* Mech. Eng. 1-20 .
- OF, H., & J.K, P. (2010). *Ship Structural Analysis and Design*. The Society of Naval Architecture and Marine Engineering-SNAME. New Jersey.
- Paik, J. (2007). Ultimate limit state performance of oil tanker structures designed by IACS common structural rules. *Journal Thin-Walled Structures*.
- Paik, J. K. et al. (1998). Residual Strength Assessment of Ship after Collision and Grounding. *Journal Marine Technology*, 35:38-54.
- Paik, J. ., B.J, K., & J.K, S. (2008). Methods for Ultimate Limit State Assessment of Ship and Ship-Shapped Offshore Structures: Part III hull girders. *Journal Ocean Engineering*.
- Shadan, N., Yenduri, A., & Murali, K. (2019). Numerical simulation of ship-ship collision using non-linear finite element analysis. *Ocean Engineering*, 173, 123-136.
- UKOOA. (2002). *Oil and Gas for Britain Energy Now and for the Future*
- Vektor, R.R.H. 2014. *Buku Ajar (Edisi:2014) Mekanika Rekayasa 2*. Politeknik Negeri Ambon.
- Zainuri, A. M. (2008). *Kekuatan Bahan* Yogyakarta: 1–19.



## LAMPIRAN

Lampiran 1. Tabel perhitungan kekuatan batas FPSO menggunakan metode NLFEA kondisi *sagging* dan *hogging* model 1

<i>Hogging</i>				<i>Sagging</i>			
<i>Moment</i>	<i>Rotation</i>	<i>Curvature</i>		<i>Moment</i>	<i>Rotation</i>	<i>Curvature</i>	
0	0	0	0	0	0	0	0
6.67E+11	7.08E-06	1.42E-09	1.42E-09	-6.67E+11	-7.08E-06	-1.42E-09	-1.42E-03
1.33E+12	1.42E-05	2.83E-09	2.83E-03	-1.33E+12	-1.42E-05	-2.83E-09	-2.83E-03
2.00E+12	2.12E-05	4.25E-09	4.25E-09	-2.00E+12	-2.12E-05	-4.25E-09	-4.25E-03
2.67E+12	2.83E-05	5.66E-05	5.66E-09	-2.67E+12	-2.83E-05	-5.66E-09	-5.66E-03
3.33E+12	3.54E-05	7.08E-09	7.08E-03	-3.33E+12	-3.54E-05	-7.08E-09	-7.08E-03
4.00E+12	4.25E-05	8.49E-09	8.49E-03	-4.00E+12	-4.25E+12	-8.49E-09	-8.49E-03
4.67E+12	4.95E-05	9.91E-09	9.91E-09	-4.67E+12	-4.95E-05	-9.91E-09	-9.91E-03
5.33E+12	5.66E-05	1.13E-08	1.13E-08	-5.33E+12	-5.66E-05	-1.13E-08	-1.13E-02
6.00E+12	6.37E-05	1.27E-08	1.27E-02	-6.00E+12	6.37E-05	-1.27E-08	-1.27E-02
6.67E+12	7.08E-05	1.42E-08	1.42E-02	-6.67E+12	-708E-05	-1.42E-08	-1.42E-02
7.33E+12	7.78E+12	1.56E-08	1.56E-02	-7.33E+12	-7.78E-05	-1.56E-08	-1.56E-02
8.00E+12	8.49E-05	1.70E-08	1.70E-02	-8.00E+12	-8.49E-05	-1.70E-08	-1.70E-02
8.67E+12	9.20E-05	1.84E-08	1.84E-02	-8.67E+12	-9.20E-05	-1.84E-08	-1.84E-02
9.33E+12	9.91E-05	1.98E-08	1.98E-02	-9.33E+12	-9.91E-05	-1.98E-08	-1.98E-02
1.00E+13	1.06E-04	2.12E-08	2.12E-02	-1.00E+13	-1.06E-04	2.12E-08	-2.12E-02
1.07E+13	1.13E-04	2.26E-08	2.26E-02	-1.07E+13	-1.13E-04	-2.26E-08	-2.26E-02
1.13E+13	1.20E-04	2.41E-08	2.41E-02	-1.13E+13	-1.20E-04	-2.41E-08	-2.41E-02
1.20E+13	1.27E-04	2.55E-08	2.55E-02	-1.20E+13	-1.27E-04	-2.55E-08	-2.55E-02
1.27E+13	1.34E-04	2.69E-08	2.69E-02	-1.27E+13	-1.34E-04	2.69E-08	-2.69E-02
1.33E+13	1.42E-04	2.83E-08	2.83E-02	-1.33E+13	-1.42E-04	-2.83E-08	-2.83E-02
1.40E+13	1.49E-04	2.97E-08	2.97E-02	-1.40E+13	-1.49E-04	-2.97E-08	-2.97E-02
1.47E+13	1.56E-04	3.11E-08	3.11E-02	-1.47E+13	-1.56E-04	-3.11E-08	-3.11E-02
1.		3.25E-08	3.25E-02	-1.53E+13	-1.63E-04	-3.25E-08	-3.25E-02
1.		3.40E-08	3.40E-02	-1.60E+13	-1.70E-04	-3.40E-08	-3.40E-02
1.		3.54E-08	3.54E-02	-1.67E+13	-1.77E-04	-3.54E-08	-3.54E-02
1.		3.68E-08	3.68E-02	-1.73E+13	-1.84E-04	-3.68E-08	-368E-02

1.80E+13	1.91E-04	3.82E-08	3.82E-02	-1.80E+13	-1.91E-04	-3.82E-08	-3.82E-02
1.87E+13	1.98E-04	3.96E-08	3.96E-02	-1.87E+13	-1.98E-04	-3.96E-08	-3.96E-02
1.93E+13	2.05E-04	4.10E-08	4.10E-02	-1.93E+13	-2.05E-04	-4.10E-08	-4.10E-02
2.00E+13	2.12E-04	4.25E-08	4.25E-02	-2.00E+13	-2.12E-04	-4.25E-08	-4.25E-02
2.07E+13	2.19E-04	4.39E-08	4.39E-02	-2.07E+13	-2.19E-04	-4.39E-08	-4.39E-02
2.13E+13	2.26E-04	4.53E-08	4.53E-02	-2.13E+13	-2.26E-04	-4.53E-08	-4.53E-02
2.20E+13	2.33E-04	4.67E-08	4.67E-02	-2.20E+13	-2.33E-04	-4.67E-08	-4.67E-02
2.27E+13	2.41E-04	4.81E-08	4.81E-02	-2.27E+13	-2.41E-04	-4.81E-08	-4.81E-02
2.33E+13	2.48E-04	4.95E-08	4.95E-02	-2.33E+13	-2.48E-04	-4.95E-08	-4.95E-02
2.40E+13	2.55E-04	5.09E-08	5.09E-02	-2.40E+13	-2.55E-04	-5.09E-08	-5.09E-02
2.47E+13	2.62E-04	5.24E-08	5.24E-02	-2.47E+13	-2.62E-04	-5.24E-08	-5.24E-02
2.55E+13	2.71E-04	5.42E-08	5.42E-02	-2.53E+13	-2.69E-04	-5.38E-08	-5.38E-02
2.63E+13	2.79E-04	5.57E-08	5.57E-02	-2.60E+13	-2.76E-04	-5.52E-08	-5.52E-02
2.69E+13	2.86E-04	5.72E-08	5.72E-02	-2.67E+13	-2.83E-04	-5.66E-08	-5.66E-02
2.76E+13	2.93E-04	5.86E-08	5.86E-02	-2.73E+13	-2.90E-04	-5.80E-08	-5.80E-02
2.83E+13	3.00E-04	6.00E-08	6.00E-02	-2.80E+13	-2.97E-04	-5.94E-08	-5.94E-02
2.89E+13	3.07E-04	6.14E-08	6.14E-02	-2.87E+13	-3.04E-04	-6.08E-08	-6.08E-02
2.96E+13	3.14E-04	6.28E-08	6.28E-02	-2.93E+13	-3.11E-04	-6.23E-08	-6.23E-02
3.03E+13	3.21E-04	6.42E-08	6.42E-02	-3.00E+13	-3.18E-04	-6.37E-08	-6.37E-02
3.09E+13	3.28E-04	6.57E-08	6.57E-02	-3.07E+13	-3.25E-04	-6.51E-08	-6.51E-02
3.16E+13	3.35E-04	6.71E-08	6.71E-02	-3.13E+13	-3.33E-04	-6.65E-08	-6.65E-02
3.23E+13	3.42E-04	6.85E-08	6.85E-02	-3.20E+13	-3.40E-04	-6.79E-08	-6.79E-02
3.29E+13	3.49E-04	6.99E-08	6.99E-02	-3.27E+13	-3.47E-04	-6.93E-08	-6.93E-02
3.36E+13	3.57E-04	7.13E-08	7.13E-02	-3.33E+13	-3.54E-04	-7.08E-08	-7.08E-02
3.43E+13	3.64E-04	7.27E-08	7.27E-02	-3.40E+13	-3.61E-04	-7.22E-08	-7.22E-02
3.49E+13	3.71E-04	7.41E-08	7.41E-02	-3.47E+13	-3.68E-04	-7.36E-08	-7.36E-02
3.56E+13	3.78E-04	7.56E-08	7.56E-02	-3.53E+13	-3.75E-04	-7.50E-08	-7.50E-02
3.63E+13	3.85E-04	7.70E-08	7.70E-02	-3.60E+13	-3.82E-04	-7.64E-08	-7.64E-02
3.69E+13	3.92E-04	7.84E-08	7.84E-02	-3.67E+13	-3.89E-04	-7.78E-08	-7.78E-02
3.76E+13	3.99E-04	7.98E-08	7.98E-02	-3.73E+13	-3.96E-04	-7.92E-08	-7.92E-02
3.82E+13	4.06E-04	8.12E-08	8.12E-02	-3.80E+13	-4.03E-04	-8.07E-08	-8.07E-02
3.89E+13	4.13E-04	8.26E-08	8.26E-02	-3.87E+13	-4.10E-04	-8.21E-08	-8.21E-02
3.95E+13	4.20E-04	8.41E-08	8.41E-02	-3.93E+13	-4.17E-04	-8.35E-08	-8.35E-02




4.03E+13	4.27E-04	8.55E-08	8.55E-02	-4.00E+13	-4.25E-04	-8.49E-08	-8.49E-02
4.09E+13	4.34E-04	8.69E-08	8.69E-02	-4.07E+13	-4.32E-04	-8.63E-08	-8.63E-02
4.16E+13	4.41E-04	8.83E-08	8.83E-02	-4.13E+13	-4.39E-04	-8.77E-08	-8.77E-02
4.23E+13	4.49E-04	8.97E-08	8.97E-02	-4.20E+13	-4.46E-04	-8.91E-08	-8.91E-02
4.29E+13	4.56E-04	9.11E-08	9.11E-02	-4.27E+13	-4.53E-04	-9.06E-08	-9.06E-02
4.36E+13	4.63E-04	9.25E-08	9.25E-02	-4.33E+13	-4.60E-04	-9.20E-08	-9.20E-02
4.43E+13	4.70E-04	9.40E-08	9.40E-02	-4.40E+13	-4.67E-04	-9.34E-08	-9.34E-02
4.49E+13	4.77E-04	9.54E-08	9.54E-02	-4.47E+13	-4.74E-04	-9.48E-08	-9.48E-02
4.56E+13	4.84E-04	9.68E-08	9.68E-02	-4.53E+13	-4.81E-04	-9.62E-08	-9.62E-02
4.63E+13	4.91E-04	9.82E-08	9.82E-02	-4.60E+13	-4.88E-04	-9.76E-08	-9.76E-02
4.69E+13	4.98E-04	9.96E-08	9.96E-02	-4.67E+13	-4.95E-04	-9.91E-08	-9.91E-02
4.76E+13	5.05E-04	1.01E-07	1.01E-01	-4.73E+13	-5.02E-04	-1.00E-07	-1.00E-01
4.83E+13	5.12E-04	1.02E-07	1.02E-01	-4.80E+13	-5.09E-04	-1.02E-07	-1.02E-01
4.89E+13	5.19E-04	1.04E-07	1.04E-01	-4.87E+13	-5.17E-04	-1.03E-07	-1.03E-01
4.96E+13	5.27E-04	1.05E-07	1.05E-01	-4.93E+13	-5.24E-04	-1.05E-07	-1.05E-01
5.02E+13	5.34E-04	1.07E-07	1.07E-01	-5.00E+13	-5.31E-04	-1.06E-07	-1.06E-01
5.09E+13	5.41E-04	1.08E-07	1.08E-01	-5.06E+13	-5.38E-04	-1.08E-07	-1.08E-01
5.16E+13	5.48E-04	1.10E-07	1.10E-01	-5.13E+13	-5.45E-04	-1.09E-07	-1.09E-01
5.22E+13	5.55E-04	1.11E-07	1.11E-01	-5.20E+13	-5.52E-04	-1.10E-07	-1.10E-01
5.29E+13	5.62E-04	1.12E-07	1.12E-01	-5.26E+13	-5.59E-04	-1.12E-07	-1.12E-01
5.36E+13	5.69E-04	1.14E-07	1.14E-01	-5.33E+13	-5.66E-04	-1.13E-07	-1.13E-01
5.42E+13	5.76E-04	1.15E-07	1.15E-01	-5.39E+13	-5.73E-04	-1.15E-07	-1.15E-01
5.48E+13	5.84E-04	1.17E-07	1.17E-01	-5.46E+13	-5.81E-04	-1.16E-07	-1.16E-01
5.54E+13	5.91E-04	1.18E-07	1.18E-01	-5.52E+13	-5.88E-04	-1.18E-07	-1.18E-01
5.60E+13	5.99E-04	1.20E-07	1.20E-01	-5.58E+13	-5.96E-04	-1.19E-07	-1.19E-01
5.64E+13	6.08E-04	1.22E-07	1.22E-01	-5.63E+13	-6.05E-04	-1.21E-07	-1.21E-01
5.68E+13	6.17E-04	1.23E-07	1.23E-01	-5.66E+13	-6.13E-04	-1.23E-07	-1.23E-01
5.71E+13	6.28E-04	1.26E-07	1.26E-01	-5.69E+13	-6.22E-04	-1.24E-07	-1.24E-01
5.74E+13	6.39E-04	1.28E-07	1.28E-01	-5.72E+13	-6.32E-04	-1.26E-07	-1.26E-01
5.		1.29E-07	1.29E-01	-5.74E+13	-6.38E-04	-1.28E-07	-1.28E-01
5.		1.30E-07	1.30E-01	-5.76E+13	-6.47E-04	-1.29E-07	-1.29E-01
5.		1.30E-07	1.30E-01	-5.77E+13	-6.52E-04	-1.30E-07	-1.30E-01
5.		1.30E-07	1.30E-01	-5.78E+13	-6.57E-04	-1.31E-07	-1.31E-01



5.76E+13	6.50E-04	1.30E-07	1.30E-01	-5.78E+13	-6.58E-04	-1.32E-07	-1.32E-01
5.76E+13	6.50E-04	1.30E-07	1.30E-01	-5.83E+13	-6.73E-04	-1.35E-07	-1.35E-01
5.76E+13	6.51E-04	1.30E-07	1.30E-01	-5.80E+13	-6.71E-04	-1.34E-07	-1.34E-01
5.77E+13	6.52E-04	1.30E-07	1.30E-01	-5.80E+13	-6.71E-04	-1.34E-07	-1.34E-01
5.77E+13	6.54E-04	1.31E-07	1.31E-01				
5.77E+13	6.54E-04	1.31E-07	1.31E-01				
5.77E+13	6.54E-04	1.31E-07	1.31E-01				
5.77E+13	6.54E-04	1.31E-07	1.31E-01				
5.77E+13	6.54E-04	1.31E-07	1.31E-01				



Lampiran 2. Tabel perhitungan kekuatan batas FPSO menggunakan metode NLFEA kondisi *sagging* dan *hogging* model 2

<i>Hogging</i>				<i>Sagging</i>			
<i>Moment</i>	<i>Rotation</i>	<i>Curvature</i>		<i>Moment</i>	<i>Rotation</i>	<i>Curvature</i>	
0	0	0	0	0	0	0	0
9.09E+11	1.01E-05	2.03E-09	2.03E-03	-1E+12	-1.11E-05	-2.23E-09	-2.23E-03
1.82E+12	2.03E-05	4.05E-09	4.05E-03	-2E+12	-2.23E-05	-4.46E-09	-4.46E-03
2.73E+12	3.04E-05	6.08E-09	6.08E-03	-3E+12	-3.34E-05	-6.69E-09	-6.69E-03
3.64E+12	4.05E-05	8.11E-09	8.11E-03	-4E+12	-4.46E-05	-8.92E-09	-8.92E-03
4.55E+12	5.07E-05	1.01E-08	1.01E-02	-5E+12	-5.57E-05	-1.11E-08	-1.11E-02
5.45E+12	6.08E-05	1.22E-08	1.22E-02	-6E+12	-6.69E-05	-1.34E-08	-1.34E-02
6.36E+12	7.09E-05	1.42E-08	1.42E-02	-7E+12	-7.80E-05	-1.56E-08	-1.56E-02
7.27E+12	8.11E-05	1.62E-08	1.62E-02	-8E+12	-8.92E-05	-1.78E-08	-1.78E-02
8.18E+12	9.12E-05	1.82E-08	1.82E-02	-9E+12	-1.00E-04	-2.01E-08	-2.01E-02
9.09E+12	1.01E-04	2.03E-08	2.03E-02	-1E+13	-1.11E-04	-2.23E-08	-2.23E-02
1E+13	1.11E-04	2.23E-08	2.23E-02	-1.1E+13	-1.23E-04	-2.45E-08	-2.45E-02
1.09E+13	1.22E-04	2.43E-08	2.43E-02	-1.2E+13	-1.34E-04	-2.67E-08	-2.67E-02
1.18E+13	1.32E-04	2.63E-08	2.63E-02	-1.3E+13	-1.45E-04	-2.90E-08	-2.90E-02
1.27E+13	1.42E-04	2.84E-08	2.84E-02	-1.4E+13	-1.56E-04	-3.12E-08	-3.12E-02
1.36E+13	1.52E-04	3.04E-08	3.04E-02	-1.5E+13	-1.67E-04	-3.34E-08	-3.34E-02
1.45E+13	1.62E-04	3.24E-08	3.24E-02	-1.6E+13	-1.78E-04	-3.57E-08	-3.57E-02
1.55E+13	1.72E-04	3.44E-08	3.44E-02	-1.7E+13	-1.89E-04	-3.79E-08	-3.79E-02
1.64E+13	1.82E-04	3.65E-08	3.65E-02	-1.8E+13	-2.01E-04	-4.01E-08	-4.01E-02
1.73E+13	1.93E-04	3.85E-08	3.85E-02	-1.9E+13	-2.12E-04	-4.23E-08	-4.23E-02
1.82E+13	2.03E-04	4.05E-08	4.05E-02	-2.0E+13	-2.23E-04	-4.46E-08	-4.46E-02
1.91E+13	2.13E-04	4.26E-08	4.26E-02	-2.1E+13	-2.34E-04	-4.68E-08	-4.68E-02
2E+13	2.23E-04	4.46E-08	4.46E-02	-2.2E+13	-2.45E-04	-4.90E-08	-4.90E-02
2.09E+13	2.33E-04	4.66E-08	4.66E-02	-2.3E+13	-2.56E-04	-5.13E-08	-5.13E-02
2.		4.86E-08	4.86E-02	-2.4E+13	-2.67E-04	-5.35E-08	-5.35E-02
2.		5.07E-08	5.07E-02	-2.5E+13	-2.79E-04	-5.57E-08	-5.57E-02
2.		5.32E-08	5.32E-02	-2.6E+13	-2.90E-04	-5.80E-08	-5.80E-02
2.		5.55E-08	5.55E-02	-2.7E+13	-3.01E-04	-6.02E-08	-6.02E-02

2.55E+13	2.88E-04	5.75E-08	5.75E-02	-2.8E+13	-3.12E-04	-6.24E-08	-6.24E-02
2.64E+13	2.98E-04	5.96E-08	5.96E-02	-2.9E+13	-3.23E-04	-6.46E-08	-6.46E-02
2.73E+13	3.08E-04	6.16E-08	6.16E-02	-3.0E+13	-3.34E-04	-6.69E-08	-6.69E-02
2.82E+13	3.18E-04	6.36E-08	6.36E-02	-3.1E+13	-3.45E-04	-6.91E-08	-6.91E-02
2.91E+13	3.28E-04	6.56E-08	6.56E-02	-3.2E+13	-3.57E-04	-7.13E-08	-7.13E-02
3.E+13	3.38E-04	6.77E-08	6.77E-02	-3.3E+13	-3.68E-04	-7.36E-08	-7.36E-02
3.09E+13	3.48E-04	6.97E-08	6.97E-02	-3.4E+13	-3.79E-04	-7.58E-08	-7.58E-02
3.18E+13	3.59E-04	7.17E-08	7.17E-02	-3.5E+13	-3.90E-04	-7.80E-08	-7.80E-02
3.27E+13	3.69E-04	7.37E-08	7.37E-02	-3.6E+13	-4.01E-04	-8.02E-08	-8.02E-02
3.36E+13	3.79E-04	7.58E-08	7.58E-02	-3.7E+13	-4.12E-04	-8.25E-08	-8.25E-02
3.45E+13	3.89E-04	7.78E-08	7.78E-02	-3.8E+13	-4.23E-04	-8.47E-08	-8.47E-02
3.55E+13	3.99E-04	7.98E-08	7.98E-02	-3.9E+13	-4.35E-04	-8.69E-08	-8.69E-02
3.64E+13	4.09E-04	8.19E-08	8.19E-02	-4.0E+13	-4.46E-04	-8.92E-08	-8.92E-02
3.73E+13	4.19E-04	8.39E-08	8.39E-02	-4.1E+13	-4.57E-04	-9.14E-08	-9.14E-02
3.82E+13	4.30E-04	8.59E-08	8.59E-02	-4.2E+13	-4.68E-04	-9.36E-08	-9.36E-02
3.91E+13	4.40E-04	8.79E-08	8.79E-02	-4.3E+13	-4.79E-04	-9.58E-08	-9.58E-02
4.E+13	4.50E-04	9.00E-08	9.00E-02	-4.4E+13	-4.90E-04	-9.81E-08	-9.81E-02
4.09E+13	4.60E-04	9.20E-08	9.20E-02	-4.5E+13	-5.02E-04	-1.00E-07	-1.00E-01
4.18E+13	4.70E-04	9.40E-08	9.40E-02	-4.6E+13	-5.13E-04	-1.03E-07	-1.03E-01
4.27E+13	4.80E-04	9.60E-08	9.60E-02	-4.7E+13	-5.24E-04	-1.05E-07	-1.05E-01
4.36E+13	4.90E-04	9.81E-08	9.81E-02	-4.8E+13	-5.35E-04	-1.07E-07	-1.07E-01
4.45E+13	5.00E-04	1.00E-07	1.00E-01	-4.9E+13	-5.46E-04	-1.09E-07	-1.09E-01
4.55E+13	5.11E-04	1.02E-07	1.02E-01	-5.0E+13	-5.57E-04	-1.11E-07	-1.11E-01
4.64E+13	5.21E-04	1.04E-07	1.04E-01	-5.1E+13	-5.69E-04	-1.14E-07	-1.14E-01
4.73E+13	5.31E-04	1.06E-07	1.06E-01	-5.2E+13	-5.80E-04	-1.16E-07	-1.16E-01
4.82E+13	5.41E-04	1.08E-07	1.08E-01	-5.3E+13	-5.93E-04	-1.19E-07	-1.19E-01
4.91E+13	5.51E-04	1.10E-07	1.10E-01	-5.4E+13	-6.06E-04	-1.21E-07	-1.21E-01
5.E+13	5.61E-04	1.12E-07	1.12E-01	-5.5E+13	-6.20E-04	-1.24E-07	-1.24E-01
5.09E+13	5.72E-04	1.14E-07	1.14E-01	-5.6E+13	-6.34E-04	-1.27E-07	-1.27E-01
5.18E+13	5.83E-04	1.16E-07	1.16E-01	-5.7E+13	-6.49E-04	-1.30E-07	-1.30E-01
5.27E+13	5.94E-04	1.19E-07	1.19E-01	-5.8E+13	-6.62E-04	-1.32E-07	-1.32E-01
5.36E+13	6.05E-04	1.21E-07	1.21E-01	-5.9E+13	-6.77E-04	-1.35E-07	-1.35E-01
5.45E+13	6.16E-04	1.23E-07	1.23E-01	-6.0E+13	-6.95E-04	-1.39E-07	-1.39E-01






5.55E+13	6.32E-04	1.26E-07	1.26E-01	-6.1E+13	-7.01E-04	-1.40E-07	-1.40E-01
5.64E+13	6.36E-04	1.27E-07	1.27E-01	-6.2E+13	-7.12E-04	-1.42E-07	-1.42E-01
5.73E+13	6.54E-04	1.31E-07	1.31E-01	-6.3E+13	-7.31E-04	-1.46E-07	-1.46E-01
5.82E+13	6.61E-04	1.32E-07	1.32E-01	-6.4E+13	-7.46E-04	-1.49E-07	-1.49E-01
5.91E+13	6.62E-04	1.32E-07	1.32E-01	-6.5E+13	-7.49E-04	-1.50E-07	-1.50E-01
				-6.6E+13	-7.50E-04	-1.50E-07	-1.50E-01
				-6.7E+13	-7.50E-04	-1.50E-07	-1.50E-01



Lampiran 3. Tabel perhitungan kekuatan batas FPSO menggunakan metode NLFEA kondisi *sagging* dan *hogging* model 3

<i>Hogging</i>				<i>Sagging</i>			
<i>Moment</i>	<i>Rotation</i>	<i>Curvature</i>		<i>Moment</i>	<i>Rotation</i>	<i>Curvature</i>	
0	0	0	0	0	0	0	0
1.67E+12	1.96E-05	3.92E-09	2.62E-03	-1.00E+12	-1.18E-05	-2.35E-09	-1.57E-03
3.33E+12	3.92E-05	7.85E-09	5.23E-03	-2.00E+12	-2.35E-05	-4.71E-09	-3.14E-03
5.00E+12	5.89E-05	1.18E-08	7.85E-03	-3.00E+12	-3.53E-05	-7.06E-09	-4.71E-03
6.67E+12	7.85E-05	1.57E-08	1.05E-02	-4.00E+12	-4.71E-05	-9.42E-09	-6.28E-03
8.33E+12	9.81E-05	1.96E-08	1.31E-02	-5.00E+12	-5.89E-05	-1.18E-08	-7.85E-03
1.00E+13	1.18E-04	2.35E-08	1.57E-02	-6.00E+12	-7.06E-05	-1.41E-08	-9.42E-03
1.17E+13	1.37E-04	2.75E-08	1.83E-02	-7.00E+12	-8.24E-05	-1.65E-08	-1.10E-02
1.33E+13	1.57E-04	3.14E-08	2.09E-02	-8.00E+12	-9.42E-05	-1.88E-08	-1.26E-02
1.50E+13	1.77E-04	3.53E-08	2.35E-02	-9.00E+12	-1.06E-04	-2.12E-08	-1.41E-02
1.67E+13	1.96E-04	3.92E-08	2.62E-02	-1.00E+13	-1.18E-04	-2.35E-08	-1.57E-02
1.83E+13	2.16E-04	4.32E-08	2.88E-02	-1.10E+13	-1.30E-04	-2.59E-08	-1.73E-02
2.E+13	2.35E-04	4.71E-08	3.14E-02	-1.20E+13	-1.41E-04	-2.83E-08	-1.88E-02
2.21E+13	2.60E-04	5.21E-08	3.47E-02	-1.30E+13	-1.53E-04	-3.06E-08	-2.04E-02
2.40E+13	2.82E-04	5.65E-08	3.77E-02	-1.40E+13	-1.65E-04	-3.30E-08	-2.20E-02
2.57E+13	3.02E-04	6.04E-08	4.03E-02	-1.50E+13	-1.77E-04	-3.53E-08	-2.35E-02
2.73E+13	3.22E-04	6.43E-08	4.29E-02	-1.60E+13	-1.88E-04	-3.77E-08	-2.51E-02
2.90E+13	3.41E-04	6.83E-08	4.55E-02	-1.70E+13	-2.00E-04	-4.00E-08	-2.67E-02
3.07E+13	3.61E-04	7.22E-08	4.81E-02	-1.80E+13	-2.12E-04	-4.24E-08	-2.83E-02
3.23E+13	3.81E-04	7.61E-08	5.07E-02	-1.90E+13	-2.24E-04	-4.47E-08	-2.98E-02
3.40E+13	4.00E-04	8.00E-08	5.34E-02	-2.00E+13	-2.35E-04	-4.71E-08	-3.14E-02
3.57E+13	4.20E-04	8.40E-08	5.60E-02	-2.10E+13	-2.47E-04	-4.95E-08	-3.30E-02
3.73E+13	4.39E-04	8.79E-08	5.86E-02	-2.20E+13	-2.59E-04	-5.18E-08	-3.45E-02
3.90E+13	4.59E-04	9.18E-08	6.12E-02	-2.30E+13	-2.71E-04	-5.42E-08	-3.61E-02
4.		.157E-08	6.38E-02	-2.40E+13	-2.83E-04	-5.65E-08	-3.77E-02
4.		.197E-08	6.64E-02	-2.50E+13	-2.94E-04	-5.89E-08	-3.92E-02
4.		.104E-07	6.91E-02	-2.60E+13	-3.06E-04	-6.12E-08	-4.08E-02
4.		.108E-07	7.17E-02	-2.70E+13	-3.18E-04	-6.36E-08	-4.24E-02

4.73E+13	5.58E-04	1.12E-07	7.44E-02	-2.80E+13	-3.30E-04	-6.59E-08	-4.40E-02
4.80E+13	5.67E-04	1.13E-07	7.57E-02	-2.90E+13	-3.41E-04	-6.83E-08	-4.55E-02
4.91E+13	5.86E-04	1.17E-07	7.82E-02	-3.00E+13	-3.53E-04	-7.06E-08	-4.71E-02
5.02E+13	6.11E-04	1.22E-07	8.14E-02	-3.10E+13	-3.65E-04	-7.30E-08	-4.87E-02
5.06E+13	6.22E-04	1.24E-07	8.29E-02	-3.20E+13	-3.77E-04	-7.54E-08	-5.02E-02
5.11E+13	6.33E-04	1.27E-07	8.44E-02	-3.30E+13	-3.89E-04	-7.77E-08	-5.18E-02
5.14E+13	6.42E-04	1.28E-07	8.56E-02	-3.40E+13	-4.00E-04	-8.01E-08	-5.34E-02
5.12E+13	6.40E-04	1.28E-07	8.54E-02	-3.50E+13	-4.12E-04	-8.24E-08	-5.49E-02
				-3.60E+13	-4.24E-04	-8.48E-08	-5.65E-02
				-3.70E+13	-4.36E-04	-8.71E-08	-5.81E-02
				-3.80E+13	-4.47E-04	-8.95E-08	-5.97E-02
				-3.90E+13	-4.59E-04	-9.18E-08	-6.12E-02
				-4.00E+13	-4.71E-04	-9.42E-08	-6.28E-02
				-4.10E+13	-4.83E-04	-9.66E-08	-6.44E-02
				-4.20E+13	-4.95E-04	-9.89E-08	-6.59E-02
				-4.30E+13	-5.06E-04	-1.01E-07	-6.75E-02
				-4.40E+13	-5.18E-04	-1.04E-07	-6.91E-02
				-4.50E+13	-5.30E-04	-1.06E-07	-7.07E-02
				-4.60E+13	-5.42E-04	-1.08E-07	-7.22E-02
				-4.69E+13	-5.54E-04	-1.11E-07	-7.38E-02
				-4.79E+13	-5.66E-04	-1.13E-07	-7.55E-02
				-4.87E+13	-5.80E-04	-1.16E-07	-7.73E-02
				-4.93E+13	-5.93E-04	-1.19E-07	-7.91E-02
				-5.01E+13	-6.11E-04	-1.22E-07	-8.15E-02
				-5.08E+13	-6.27E-04	-1.25E-07	-8.36E-02
				-5.12E+13	-6.40E-04	-1.28E-07	-8.53E-02
				-5.18E+13	-6.57E-04	-1.31E-07	-8.76E-02
				-5.22E+13	-6.71E-04	-1.34E-07	-8.94E-02
				-5.26E+13	-6.91E-04	-1.38E-07	-9.21E-02
				-5.30E+13	-7.08E-04	-1.42E-07	-9.43E-02
				-5.32E+13	-7.24E-04	-1.45E-07	-9.66E-02
				-5.34E+13	-7.35E-04	-1.47E-07	-9.80E-02
				-5.35E+13	-7.52E-04	-1.50E-07	-1.00E-01



				-5.35E+13	-7.53E-04	-1.51E-07	-1.00E-01
				-5.34E+13	-7.54E-04	-1.51E-07	-1.00E-01
				-5.34E+13	-7.54E-04	-1.51E-07	-1.00E-01


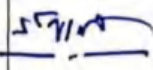

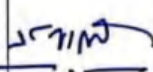

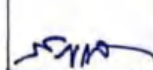

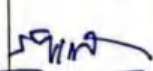

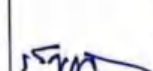



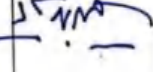


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
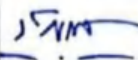

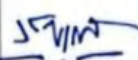

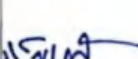

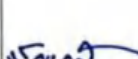


## Lampiran 4. Kartu kontrol asistensi skripsi

LEMBAR ASISTENSI SKRIPSI

Nama : ANDI HAMBIL WIKRI AL FARISI  
 NIM : D001201055  
 Judul Skripsi : Pengaruh korosi Peta kapal FPSO Terhadap kelautan  
 Membujur  
 Peminatan : Ocean Structure Analysis Research Laboratory (OSAREL)  
 Pembimbing : Prof. Muhammad Zubair Muis Alie, ST., MT., Ph.D

NO.	Hari/Tanggal/ Bulan/Tahun	Deskripsi	Paraf Mahasiswa	Paraf Pembimbing
1.	14/3/2024	Asistensi Skripsi dan Power Point		
2.	9/12/2024	Pemberian Judul dan Pengambilan data kapal terkait Skripsi		
3.	12/03/2024	Asistensi Skripsi Sekaligus PPT Presentasi Seminar Proposal		
4.	25/03/2024	Revisi Laporan dan Power Point Sekaligus Pengurusan laporan skripsi dan surat		
5.	22/04/2024	Asistensi materai autocad menurut aturan Bkl dan UES		
6.	17/05/2024	Lanjut gambar meter 2 untuk pengurusan alat alat korosi		
7.	20/05/2024	Asistensi terkait runtuhan model awal di mesh 300 dung 350.		


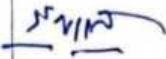
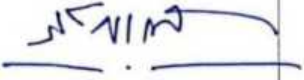


8.	21/05/2024	Asistensi Model yang diakibatkan korosi pada kapak FPSU		
9.	22/05/2024	- Memperbaiki hasil running model I - Mengolah data hasil dari running di excel		
10.	27/05/2024	- Memperbaiki hasil running model I (Sagging condition) - Mengolah data hasil running di excel		
11.	28/05/2024	- Running untuk model I (Sagging condition) dengan menggunakan variasi mesh yang berbeda - Mengolah data hasil running di excel (Sagging condition) dan mengamati bentuk perubahan grafik untuk kondisi Sagging.		
12.	29/05/2024	- Running model I (kondisi sagging) dengan modified mesh yang bervariasi - Revisi Babs I		



13.	3/06/2024	<ul style="list-style-type: none"> <li>- Running model I</li> <li>- Perbaiki grafik dari hasil olah di excel (Hogging Condition)</li> </ul>	<i>Mia</i>	<u>15/11/24</u>
14.	4/06/2024	<ul style="list-style-type: none"> <li>- Running model I (Hogging Condition)</li> <li>- Lanjut olah data di excel hasil running dari model I (Hogging Condition)</li> </ul>	<i>Mia</i>	<u>15/11/24</u>
15.	5/06/2024	<ul style="list-style-type: none"> <li>- Running model I</li> <li>- Input ketebalan model II</li> <li>- Asistensi terkait hasil running model I (Grafik)</li> </ul>	<i>Mia</i>	<u>15/11/24</u>
16.	6/06/2024	<ul style="list-style-type: none"> <li>- komparasi model I baik itu kondisi sagging dan hogging</li> <li>- Perlihatkan hasil dari komparasi</li> <li>- Input ketebalan plate model II</li> <li>- Modifikasi nilai mesh pada saat running model II</li> <li>- Ganti/modifikasi nilai mesh model II (Sagging condition)</li> </ul>	<i>Mia</i>	<u>15/11/24</u>



17.	11/06/2024	<ul style="list-style-type: none"><li>- Running model II (Sagging condition)</li><li>- Olah data di excel terkait hasil dari runnigan model II (Sagging condition)</li></ul>		
18.	4 Juli 2024	Acc!		
		Prof. Zubair		

