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LAMPIRAN

Lampiran 1. Perhitungan spektrum gelombang JONSWAP

Lokasi : Medan

Gravity Acceleration [m/s^2]	Mean wave period [s]	Angular Frequency (ω)	Signifiacnt Height of Waves [m]	Peak Frequency (ωp)	S(ω) [mm^2/s]
9.81	5.694	1.10	1.453	0.161	0.062
9.81	5.451	1.15	1.453	0.161	0.075
9.81	5.331	1.18	1.453	0.161	0.081
9.81	5.228	1.20	1.453	0.161	0.085
9.81	5.187	1.21	1.453	0.161	0.086
9.81	5.011	1.25	1.453	0.161	0.091
9.81	4.909	1.28	1.453	0.161	0.093
9.81	4.795	1.31	1.453	0.161	0.094
9.81	4.66	1.35	1.453	0.161	0.094
9.81	4.356	1.44	1.453	0.161	0.088
9.81	4.198	1.50	1.453	0.161	0.082
9.81	4.035	1.56	1.453	0.161	0.075
9.81	3.959	1.59	1.453	0.161	0.072
9.81	3.794	1.66	1.453	0.161	0.064
9.81	3.791	1.66	1.453	0.161	0.064
9.81	3.548	1.77	1.453	0.161	0.051
9.81	3.491	1.80	1.453	0.161	0.049
9.81	3.37	1.86	1.453	0.161	0.043
9.81	3.29	1.91	1.453	0.161	0.039
9.81	3.161	1.99	1.453	0.161	0.033
9.81	3.099	2.03	1.453	0.161	0.031
9.81	2.996	2.10	1.453	0.161	0.027
9.81	2.914	2.16	1.453	0.161	0.024
9.81	2.857	2.20	1.453	0.161	0.022
9.81	2.776	2.26	1.453	0.161	0.019
9.81	2.748	2.29	1.453	0.161	0.018
9.81	2.679	2.35	1.453	0.161	0.016
9.81	2.677	2.35	1.453	0.161	0.016

Gravity Acceleration [m/s^2]	Mean wave period [s]	Angular Frequency (ω)	Signifiacnt Height of Waves [m]	Peak Frequency (ωp)	S(ω) [mm²/s]
9.81	2.634	2.39	1.453	0.161	0.015
9.81	2.585	2.43	1.453	0.161	0.014
9.81	2.481	2.53	1.453	0.161	0.012
9.81	2.512	2.50	1.453	0.161	0.012
9.81	2.467	2.55	1.453	0.161	0.011
9.81	2.424	2.59	1.453	0.161	0.010
9.81	2.424	2.59	1.453	0.161	0.010
9.81	2.359	2.66	1.453	0.161	0.009
9.81	2.251	2.79	1.453	0.161	0.007
9.81	2.25	2.79	1.453	0.161	0.007
9.81	2.246	2.80	1.453	0.161	0.007
9.81	2.181	2.88	1.453	0.161	0.006
9.81	2.125	2.96	1.453	0.161	0.006
9.81	1.961	3.20	1.453	0.161	0.004

Lampiran 2. Perhitungan *Response Amplitude Operator* (RAO)

Kapal *Double Hull Tanker* Tipe T3

ω [rad/s]	σ [N/mm²]	Hs [m]	RAO [(N/mm²)/m]
1.10	10.45	1.45	7.19
1.15	20.89	1.45	14.38
1.18	31.34	1.45	21.57
1.20	41.78	1.45	28.76
1.21	52.23	1.45	35.94
1.25	62.67	1.45	43.13
1.28	73.12	1.45	50.32
1.31	83.56	1.45	57.51
1.35	94.01	1.45	64.70
1.44	104.46	1.45	71.89
1.50	114.90	1.45	79.08
1.56	125.35	1.45	86.27

ω [rad/s]	σ [N/mm²]	Hs [m]	RAO [(N/mm²)/m]
1.59	135.79	1.45	93.46
1.66	146.24	1.45	100.64
1.66	156.67	1.45	107.82
1.77	167.00	1.45	114.93
1.80	177.32	1.45	122.04
1.86	187.19	1.45	128.83
1.91	195.96	1.45	134.86
1.99	203.70	1.45	140.19
2.03	209.97	1.45	144.50
2.10	215.48	1.45	148.30
2.16	223.98	1.45	154.15
2.20	227.86	1.45	156.82
2.26	232.72	1.45	160.16
2.29	238.17	1.45	163.91
2.35	241.89	1.45	166.48
2.35	247.38	1.45	170.26
2.39	251.77	1.45	173.27
2.43	254.72	1.45	175.31
2.53	258.21	1.45	177.71
2.50	263.46	1.45	181.32
2.55	269.57	1.45	185.52
2.59	275.32	1.45	189.48
2.59	281.84	1.45	193.97
2.66	281.73	1.45	193.90
2.79	284.18	1.45	195.58
2.79	284.81	1.45	196.02
2.80	284.81	1.45	196.02

Lampiran 2. Perhitungan *Response Amplitude Operator* (RAO)

Kapal *Double Hull Tanker* Tipe T4

ω [rad/s]	σ [N/mm²]	Hs [m]	RAO [(N/mm²)/m]
1.10	8.19	1.45	5.64
1.15	16.38	1.45	11.28

ω [rad/s]	σ [N/mm²]	Hs [m]	RAO [(N/mm²)/m]
1.18	24.57	1.45	16.91
1.20	32.77	1.45	22.55
1.21	40.96	1.45	28.19
1.25	49.15	1.45	33.83
1.28	57.34	1.45	39.46
1.31	65.53	1.45	45.10
1.35	73.72	1.45	50.74
1.44	81.91	1.45	56.38
1.50	90.11	1.45	62.01
1.56	98.30	1.45	67.65
1.59	106.49	1.45	73.29
1.66	114.68	1.45	78.93
1.66	122.87	1.45	84.56
1.77	131.06	1.45	90.20
1.80	139.25	1.45	95.84
1.86	147.45	1.45	101.48
1.91	155.64	1.45	107.11
1.99	163.83	1.45	112.75
2.03	172.02	1.45	118.39
2.10	180.21	1.45	124.03
2.16	188.40	1.45	129.66
2.20	196.59	1.45	135.30
2.26	204.79	1.45	140.94
2.29	212.98	1.45	146.58
2.35	221.17	1.45	152.21
2.35	229.36	1.45	157.85
2.39	235.45	1.45	162.04
2.43	237.57	1.45	163.51
2.53	239.99	1.45	165.17
2.50	242.55	1.45	166.93
2.55	245.08	1.45	168.67
2.59	247.56	1.45	170.38
2.59	250.01	1.45	172.06
2.66	252.39	1.45	173.70

ω [rad/s]	σ [N/mm²]	Hs [m]	RAO [(N/mm²)/m]
2.79	254.87	1.45	175.41
2.79	257.85	1.45	177.46
2.80	260.31	1.45	179.15

Lampiran 3. Perhitungan *Stress Response Spectra*

Kapal *Double Hull Tanker Tipe* T3

ω [rad/s]	RAO [(N/mm²)/m]	S(ω) [mm²/s]	Sr(ω) [mm²/s]
1.10	7.19	0.06	3.20
1.15	14.38	0.08	15.53
1.18	21.57	0.08	37.56
1.20	28.76	0.08	70.22
1.21	35.94	0.09	111.62
1.25	43.13	0.09	169.84
1.28	50.32	0.09	235.51
1.31	57.51	0.09	310.57
1.35	64.70	0.09	391.66
1.44	71.89	0.09	452.98
1.50	79.08	0.08	514.08
1.56	86.27	0.08	560.81
1.59	93.46	0.07	627.50
1.66	100.64	0.06	646.07
1.66	107.82	0.06	739.80
1.77	114.93	0.05	678.65
1.80	122.04	0.05	722.95
1.86	128.83	0.04	708.39
1.91	134.86	0.04	708.55
1.99	140.19	0.03	653.89
2.03	144.50	0.03	641.04
2.10	148.30	0.03	586.64
2.16	154.15	0.02	563.21
2.20	156.82	0.02	535.19
2.26	160.16	0.02	492.08
2.29	163.91	0.02	492.74

ω [rad/s]	RAO [(N/mm²)/m]	S(ω) [mm²/s]	Sr(ω) [mm²/s]
2.35	166.48	0.02	453.66
2.35	170.26	0.02	472.89
2.39	173.27	0.02	455.28
2.43	175.31	0.01	427.89
2.53	177.71	0.01	364.02
2.50	181.32	0.01	401.35
2.55	185.52	0.01	386.48
2.59	189.48	0.01	371.50
2.59	193.97	0.01	389.30
2.66	193.90	0.01	342.53
2.79	195.58	0.01	279.29
2.79	196.02	0.01	279.94
2.80	196.02	0.01	277.58

Lampiran 3. Perhitungan *Stress Response Spectra*

Kapal *Double Hull Tanker Tipe* T4

ω [rad/s]	RAO [(N/mm²)/m]	S(ω) [mm²/s]	Sr(ω) [mm²/s]
1.10	5.64	0.06	1.97
1.15	11.28	0.08	9.55
1.18	16.91	0.08	23.10
1.20	22.55	0.08	43.19
1.21	28.19	0.09	68.64
1.25	33.83	0.09	104.45
1.28	39.46	0.09	144.84
1.31	45.10	0.09	191.00
1.35	50.74	0.09	240.86
1.44	56.38	0.09	278.57
1.50	62.01	0.08	316.15
1.56	67.65	0.08	344.89
1.59	73.29	0.07	385.90
1.66	78.93	0.06	397.33
1.66	84.56	0.06	455.04
1.77	90.20	0.05	418.02

ω [rad/s]	RAO [(N/mm²)/m]	S(ω) [mm²/s]	Sr(ω) [mm²/s]
1.80	95.84	0.05	445.88
1.86	101.48	0.04	439.51
1.91	107.11	0.04	446.97
1.99	112.75	0.03	422.98
2.03	118.39	0.03	430.28
2.10	124.03	0.03	410.31
2.16	129.66	0.02	398.50
2.20	135.30	0.02	398.38
2.26	140.94	0.02	381.04
2.29	146.58	0.02	394.03
2.35	152.21	0.02	379.25
2.35	157.85	0.02	406.50
2.39	162.04	0.02	398.17
2.43	163.51	0.01	372.21
2.53	165.17	0.01	314.47
2.50	166.93	0.01	340.19
2.55	168.67	0.01	319.45
2.59	170.38	0.01	300.36
2.59	172.06	0.01	306.33
2.66	173.70	0.01	274.88
2.79	175.41	0.01	224.65
2.79	177.46	0.01	229.45
2.80	179.15	0.01	231.88

Lampiran 4. Perhitungan *Zero Moment*

Kapal *Double Hull Tanker* Tipe T3

ω [rad/s]	Sr(ω) [mm²/s]	Faktor Simpson	Sr(ω) x FS
0.00	0	1	0
0.10	0	4	0
0.20	0	2	0
0.30	0	4	0
0.40	0	2	0

ω [rad/s]	Sr(ω) [mm²/s]	Faktor Simpson	Sr(ω) x FS
0.50	0	4	0
0.60	0	2	0
0.70	0	4	0
0.80	0	2	0
0.90	0	4	0
1.00	0	2	0
1.10	3.20	4	12.81
1.20	15.53	2	31.06
1.30	169.84	4	679.35
1.40	391.66	2	783.32
1.50	514.08	4	2056.33
1.60	560.81	2	1121.62
1.70	646.07	4	2584.29
1.80	722.95	2	1445.90
1.90	708.55	4	2834.20
2.00	653.89	2	1307.79
2.10	586.64	4	2346.54
2.20	563.21	2	1126.41
2.30	492.08	4	1968.32
2.40	453.66	2	907.31
2.50	364.02	4	1456.07
2.60	342.53	2	685.05
2.70	279.29	4	1117.16
2.80	277.58	1	277.58
Σ			22741.13
LUASAN			758.04

Lampiran 4. Perhitungan *Zero Moment*

Kapal *Double Hull Tanker* Tipe T4

ω [rad/s]	Sr(ω) [mm²/s]	Faktor Simpson	Sr(ω) x FS
0.00	0	1	0
0.10	0	4	0
0.20	0	2	0

ω [rad/s]	Sr(ω) [mm²/s]	Faktor Simpson	Sr(ω) x FS
0.30	0	4	0
0.40	0	2	0
0.50	0	4	0
0.60	0	2	0
0.70	0	4	0
0.80	0	2	0
0.90	0	4	0
1.00	0	2	0
1.10	1.97	4	7.88
1.20	9.55	2	19.10
1.30	104.45	4	417.79
1.40	240.86	2	481.73
1.50	316.15	4	1264.61
1.60	344.89	2	689.77
1.70	397.33	4	1589.33
1.80	445.88	2	891.75
1.90	446.97	4	1787.88
2.00	422.98	2	845.97
2.10	410.31	4	1641.23
2.20	398.50	2	797.00
2.30	381.04	4	1524.17
2.40	379.25	2	758.51
2.50	340.19	4	1360.75
2.60	274.88	2	549.77
2.70	229.45	4	917.79
2.80	231.88	1	231.88
Σ			15776.90
LUASAN			525.90

Lampiran 5. Perhitungan *Second Moment*

Kapal *Double Hull Tanker* Tipe T3

ω [rad/s]	Sr(ω) [mm²/s]	Sr(ω) x ω²	Faktor Simpson	Sr(ω) x ω² x FS
0.00	0	0.00	1	0.00
0.10	0	0.00	4	0

ω [rad/s]	Sr(ω) [mm²/s]	Sr(ω) x ω²	Faktor Simpson	Sr(ω) x ω² x FS
0.20	0	0.00	2	0
0.30	0	0.00	4	0
0.40	0	0.00	2	0
0.50	0	0.00	4	0
0.60	0	0.00	2	0
0.70	0	0.00	4	0
0.80	0	0.00	2	0
0.90	0	0.00	4	0
1.00	0	0.00	2	0
1.10	3.20	3.90	4	15.60
1.20	15.53	22.36	2	44.73
1.30	169.84	287.02	4	1148.10
1.40	391.66	767.65	2	1535.30
1.50	514.08	1156.68	4	4626.73
1.60	560.81	1435.68	2	2871.36
1.70	646.07	1867.15	4	7468.60
1.80	722.95	2342.36	2	4684.72
1.90	708.55	2557.87	4	10231.46
2.00	653.89	2615.58	2	5231.16
2.10	586.64	2587.07	4	10348.26
2.20	563.21	2725.92	2	5451.84
2.30	492.08	2603.10	4	10412.42
2.40	453.66	2613.06	2	5226.13
2.50	364.02	2275.10	4	9100.41
2.60	342.53	2315.48	2	4630.96
2.70	279.29	2036.03	4	8144.13
2.80	277.58	2176.25	1	2176.25
∑				93348.16
LUASAN				3111.61

Lampiran 5. Perhitungan *Second Moment*

Kapal *Double Hull Tanker* Tipe T4

ω [rad/s]	Sr(ω) [mm²/s]	Sr(ω) x ω²	Faktor Simpson	Sr(ω) x ω² x FS
0.00	0	0.00	1	0.00

ω [rad/s]	Sr(ω) [mm²/s]	Sr(ω) x ω²	Faktor Simpson	Sr(ω) x ω² x FS
0.10	0	0.00	4	0
0.20	0	0.00	2	0
0.30	0	0.00	4	0
0.40	0	0.00	2	0
0.50	0	0.00	4	0
0.60	0	0.00	2	0
0.70	0	0.00	4	0
0.80	0	0.00	2	0
0.90	0	0.00	4	0
1.00	0	0.00	2	0
1.10	1.97	2.40	4	9.59
1.20	9.55	13.75	2	27.51
1.30	104.45	176.52	4	706.06
1.40	240.86	472.09	2	944.18
1.50	316.15	711.34	4	2845.37
1.60	344.89	882.91	2	1765.82
1.70	397.33	1148.29	4	4593.16
1.80	445.88	1444.64	2	2889.27
1.90	446.97	1613.56	4	6454.26
2.00	422.98	1691.93	2	3383.87
2.10	410.31	1809.46	4	7237.82
2.20	398.50	1928.74	2	3857.48
2.30	381.04	2015.71	4	8062.84
2.40	379.25	2184.50	2	4369.00
2.50	340.19	2126.17	4	8504.69
2.60	274.88	1858.21	2	3716.43
2.70	229.45	1672.68	4	6690.71
2.80	231.88	1817.96	1	1817.96
Σ				159227.05
LUASAN				5307.57