C C S 技术通告

Technical Information

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发：有关船东及航运公司、船厂、设计单位、产品制造商、总部有关处室、研发中心、规范与技术中心、武汉规范所、各审图中心、各分社、本社验船师

关于 IACS 发布建议案 No. 34 Rev.2“标准波浪数据”的技术通告

国际船级社协会（IACS）于2022年12月19日通过了建议案No.34（以下简称Rec 34）Rev.2“标准波浪数据”，该建议案Rev.1发布于1992年，距本次Rev.2更新已经超过20年。考虑气候变化的影响，IACS对波浪数据进行了更新，通过考虑船舶AIS位置信息，研究制定了用于无限航区船长>=90m船舶强度和疲劳评估的新波浪散布图，并给出了应用限制。

Rec 34为建议性要求，业界如有需要，请关注其后续规范应用情况。附件提供了 Rec 34 Rev.2的原文。

本通告在本社网站（www.ccs.org.cn）上发布，并由各分社转发所辖区域内的船东、船舶管理公司、船厂、船用产品厂。如有任何疑问，请与本社总部国际处（ia@ccs.org.cn）联系。

附件

No. 34 Standard Wave Data

(1992) (Rev.1 June 2000) (Corr.1 Nov 2001) (Rev.2 Dec 2022 Complete Revision)

1. This recommendation is intended for sea-going ships of length 90 m and greater operating in unrestricted service, excluding vessels that operate at a fixed location focusing on design wave loads for both strength and fatigue assessments.

2. The scatter diagram given in Table 1 describes the wave data of the North Atlantic as defined in Figure 1.

3. It is recommended to use a design lifetime of 25 years for strength and fatigue assessments.

4. The extreme design wave loads for the strength assessment are evaluated at a return period of 25 years.

5. The design wave loads at the probability level of 10^{-2} are selected for the fatigue assessment as the reference value to derive their long-term prediction distribution.

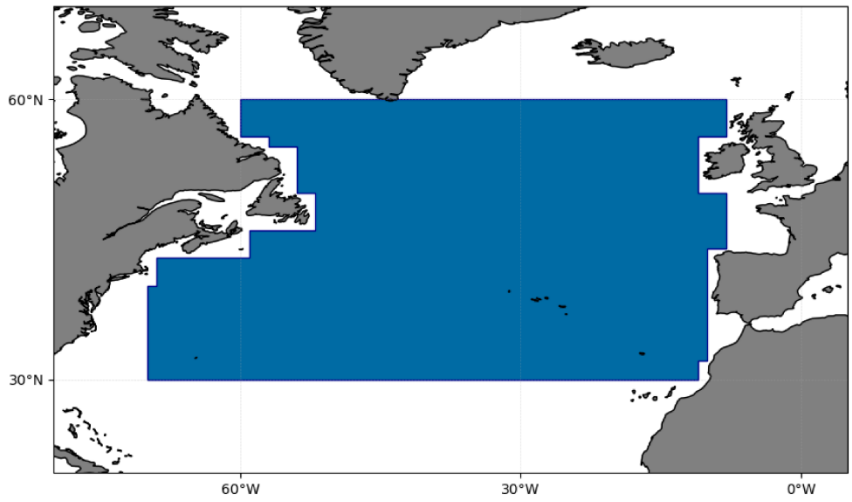

Figure 1: Definition of the extent of the North Atlantic

No. 34 (cont)

Table 1: Probability of sea-states in the North Atlantic described as occurrence per 100,000 observations.

Significant wave height, H_S (m)	Mean wave period, T_{0m1} (s)																Sum
	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5	
0.5	6.82	202.00	333.61	187.76	45.59	4.74	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	780.73
1.5	0.33	2028.35	12750.82	11693.39	7215.76	3006.80	846.07	160.77	20.63	1.79	0.10	0.00	0.00	0.00	0.00	0.00	37724.81
2.5	0.00	3.38	2805.81	8517.74	7835.85	5885.37	3608.30	1805.81	737.71	246.00	66.96	14.88	2.70	0.40	0.05	0.00	31530.96
3.5	0.00	0.00	23.06	2742.51	4666.81	4100.83	2936.41	1713.38	814.68	315.65	99.66	25.64	5.38	0.92	0.13	0.01	17445.07
4.5	0.00	0.00	0.00	82.06	1759.81	2069.19	1715.42	1151.29	625.51	275.12	97.96	28.24	6.59	1.24	0.19	0.02	7812.64
5.5	0.00	0.00	0.00	0.08	149.74	811.81	791.81	609.66	375.67	185.26	73.12	23.09	5.84	1.18	0.19	0.02	3027.47
6.5	0.00	0.00	0.00	0.00	1.02	147.59	305.37	271.71	190.23	104.79	45.42	15.49	4.16	0.88	0.15	0.02	1086.83
7.5	0.00	0.00	0.00	0.00	0.00	4.77	88.62	107.20	86.26	53.35	25.36	9.27	2.60	0.56	0.09	0.01	378.09
8.5	0.00	0.00	0.00	0.00	0.00	0.02	9.40	38.70	36.80	25.95	13.63	5.33	1.55	0.34	0.05	0.01	131.78
9.5	0.00	0.00	0.00	0.00	0.00	0.00	0.20	9.34	15.15	12.51	7.39	3.12	0.94	0.20	0.03	0.00	48.88
10.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	5.73	5.96	4.08	1.90	0.60	0.13	0.02	0.00	19.23
11.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.29	2.68	2.23	1.18	0.40	0.08	0.01	0.00	7.89
12.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	1.01	1.14	0.72	0.27	0.06	0.01	0.00	3.32
13.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.51	0.42	0.18	0.04	0.00	0.00	1.37
14.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.19	0.21	0.12	0.03	0.00	0.00	0.57
15.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.09	0.07	0.02	0.00	0.00	0.22
16.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.04	0.01	0.00	0.00	0.08
17.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.00	0.00	0.04
18.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.02
Sum	7.15	2233.73	15913.30	23223.54	21674.58	16031.12	10301.81	5868.69	2909.77	1230.31	437.79	129.62	31.47	6.11	0.92	0.09	100000.00

The H_s and T_{0m1} values are class midpoints. $T_{0m1} = 2\pi \frac{m_{-1}}{m_0}$, where m_n is the spectral moment of order n.

No. 34 (cont)

6. JONSWAP wave spectrum with γ=1.5 is recommended for the North Atlantic, described by the following expression:

$$S(\omega) = \alpha\, S_{PM}(\omega)\, \gamma^{\exp\left[-\frac{(\omega/\omega_p - 1)^2}{2\sigma^2}\right]}$$

Where:

$S_{PM}(\omega)$ is the Bretschneider or two-parameter Pierson-Moskowitz spectrum, expressed as follows:

$$S_{PM}(\omega) = \frac{5}{16} H_s^2 \left(\frac{2\pi}{T_p}\right)^4 \omega^{-5} \exp\left[-\frac{5}{4}\left(\frac{2\pi}{T_p}\right)^4 \omega^{-4}\right]$$

γ is the non-dimensional peak shape parameter, taken as 1.5

α is the normalizing factor, may be taken as $\frac{1}{5}\left(\frac{1}{0.1160+0.0594\sqrt{\gamma}+0.0246\,\gamma}\right)$

H_s is the significant wave height [m]

ω is the angular wave frequency [rad/s]

ω_p is the peak angular frequency [rad/s]

T_p is the peak wave period (s)

$$\sigma = \begin{cases} 0.07 \text{ for } \dfrac{\omega}{\omega_p} \le 1 \\ 0.09 \text{ for } \dfrac{\omega}{\omega_p} > 1 \end{cases}$$

The relationship between the mean wave period, T_{0m1} in the scatter diagram in Table 1 and the peak wave period T_p can be evaluated by the following equation:

$$T_{0m1} = (0.7757 + 0.0965\sqrt{\gamma} - 0.0144\,\gamma)T_p$$

7. It is recommended to use a wave directional spreading, defined as follows:

$$S_w(\omega, \theta) = S(\omega) * G(\theta)$$

Where:

$G(\theta)$ is the spreading function, given by the following equation:

$$G(\theta) = k\cos^n(\theta - \theta_0), -\frac{\pi}{2} \le (\theta - \theta_0) \le \frac{\pi}{2}$$

θ_0 is the mean wave direction

θ is the wave direction at which the spectrum is evaluated

n is the cosine spreading power, recommended value is 3

k is the normalisation factor, expressed as follows:

$$k = \frac{\Gamma(\frac{n}{2}+1)}{\sqrt{\pi}\Gamma(\frac{n}{2}+\frac{1}{2})}$$

Γ is the Gamma function. k = ¾ for n = 3

No. 34 (cont)

8. For evaluation of the design wave loads for strength assessment, it is recommended to use a speed of 5 knots. It is noted that it may be necessary to apply a higher speed when evaluating roll related responses for vessels with very low metacentric height and operating without reduced speed in stern quartering seas. Furthermore, 75% of the design speed is recommended for evaluation of design wave loads for fatigue assessment.

9. In long-term predictions, all wave headings (0-360 deg) can be assumed to have an equal probability of occurrence and at most 30 deg spacing between headings should be applied.

References

1. Technical Background for IACS Recommendation 34 (Rev.2 Dec 2022).

2. Technical Background Rule Reference for IACS Common Structural Rules for Bulk Carriers and Oil Tankers (01 Jan 2020).

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