I Jornadas Técnicas de Diseño y Arquitectura Naval,
Colegio de Ingenieros Navales del Ecuador, Guayaquil, Abril 2007

ESTIMACION DEL MOMENTO FLECTOR DINAMICO PARA UN TANQUERO DE 3800 DWT

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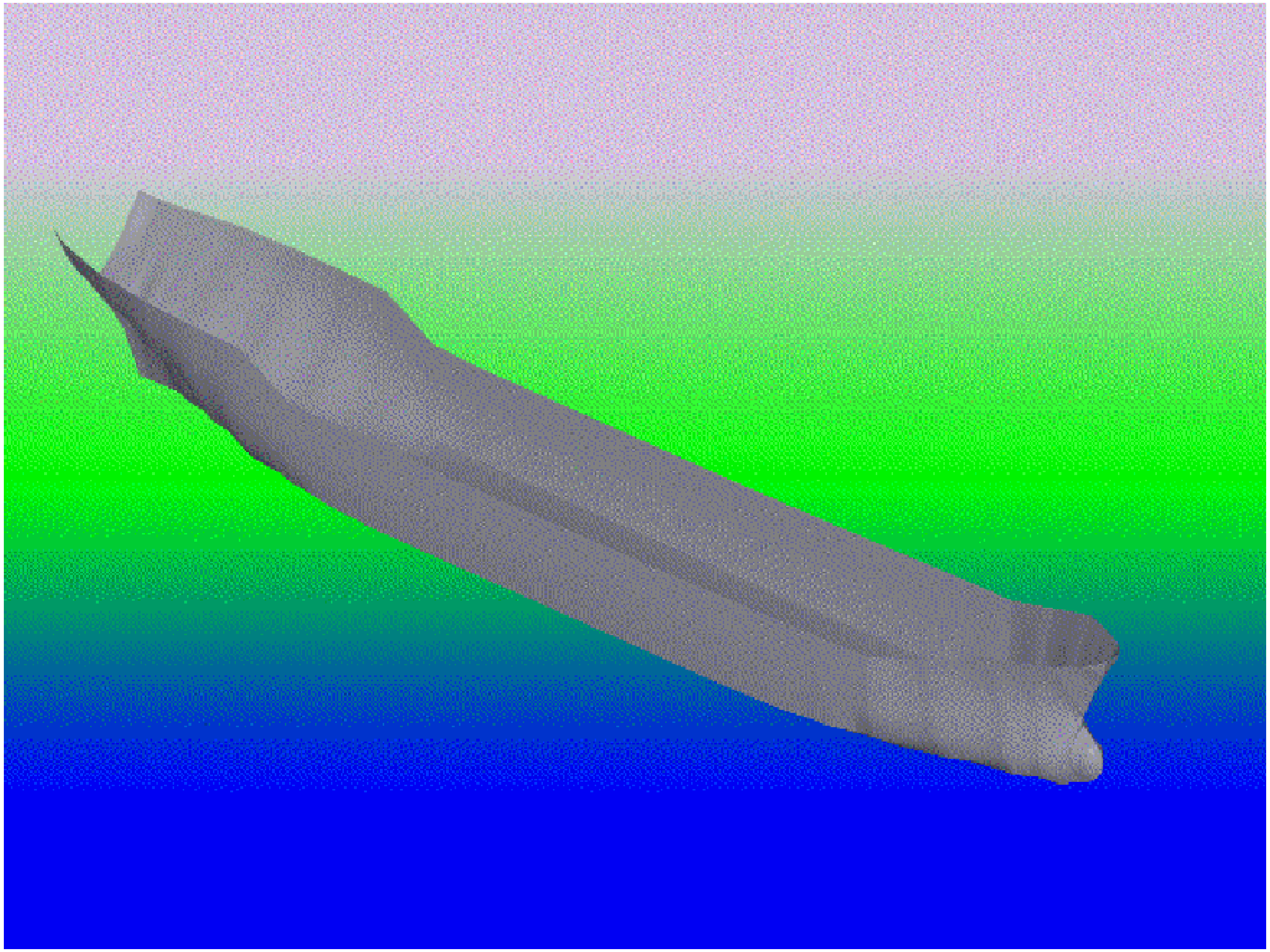
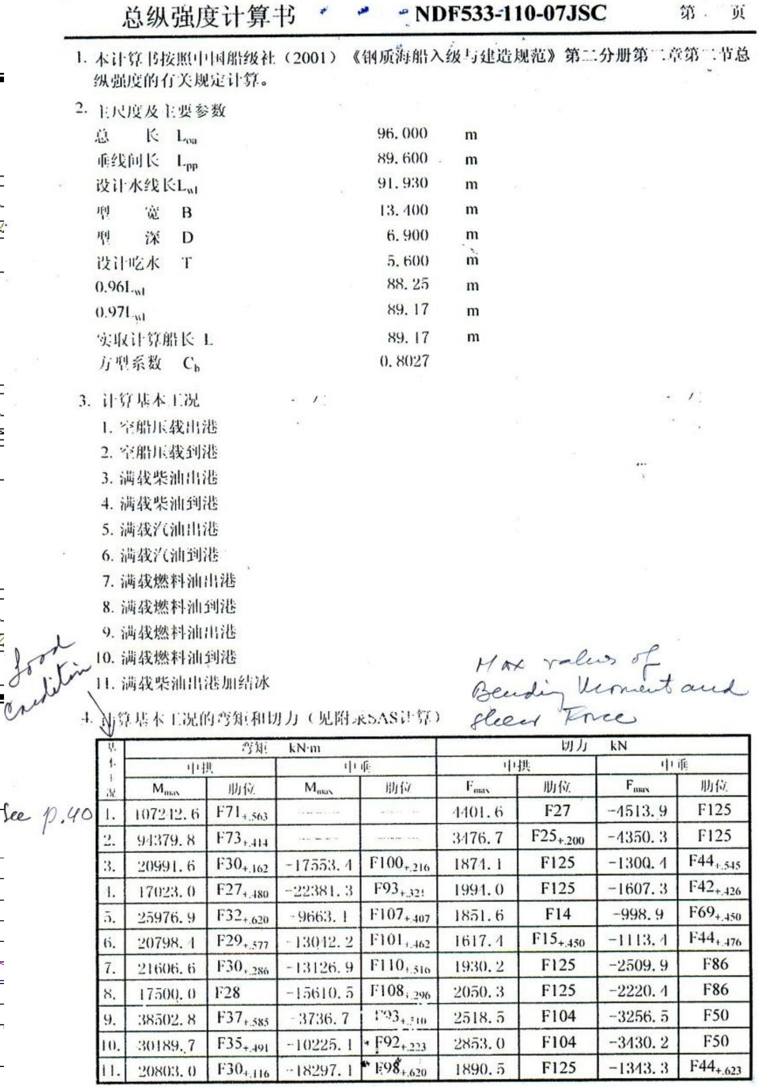
Descripción de la Embarcación



Condiciones de Carga



总纵强度计算书 NDF533-110-07JSC 第 页

1. 本计算书按照中国船级社（2001）《钢质海船入级与建造规范》第二分册第二章第二节总纵强度的有关规定计算。

2. 主尺度及主要参数

总　长 L_{oa}	96.000	m
垂线间长 L_{pp}	89.600	m
设计水线长 L_{wl}	91.930	m
型　宽 B	13.400	m
型　深 D	6.900	m
设计吃水 T	5.600	m
$0.96L_{wl}$	88.25	m
$0.97L_{wl}$	89.17	m
实取计算船长 L	89.17	m
方型系数 C_b	0.8027	

3. 计算基本工况
   1. 空船压载出港
   2. 空船压载到港
   3. 满载柴油出港
   4. 满载柴油到港
   5. 满载汽油出港
   6. 满载汽油到港
   7. 满载燃料油出港
   8. 满载燃料油到港
   9. 满载燃料油出港
   10. 满载燃料油到港
   11. 满载柴油出港加结冰

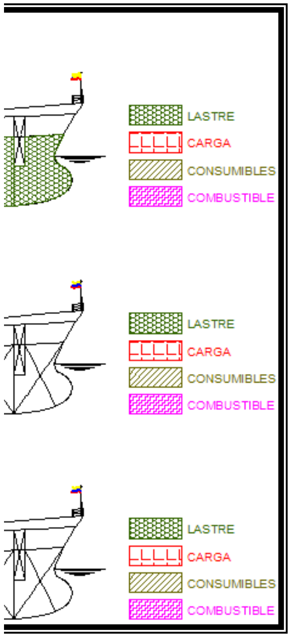
Load Condition

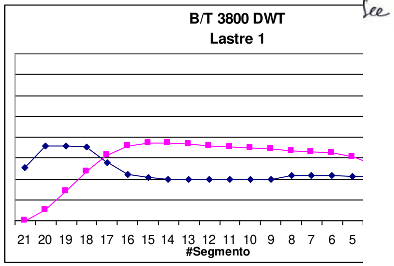
4. 计算基本工况的弯矩和切力（见附录SAS计算）

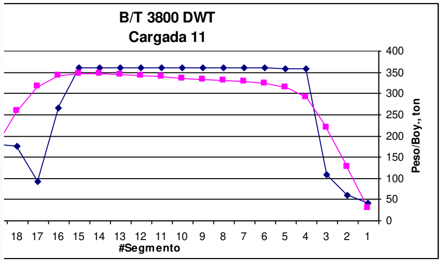
Max values of Bending Moment and Shear Force

See p.40

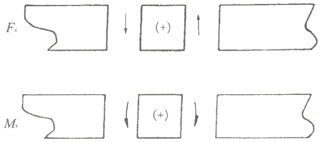
基本工况	弯矩 kN·m				切力 kN			
	中拱		中垂		中拱		中垂	
	M_{max}	肋位	M_{max}	肋位	F_{max}	肋位	F_{max}	肋位
1.	107242.6	F71$_{+.563}$	------	------	4401.6	F27	-4513.9	F125
2.	94379.8	F73$_{+.414}$	------	------	3476.7	F25$_{+.200}$	-4350.3	F125
3.	20991.6	F30$_{+.162}$	-17553.4	F100$_{+.216}$	1874.1	F125	-1300.4	F44$_{+.545}$
4.	17023.0	F27$_{+.480}$	-22381.3	F93$_{+.321}$	1994.0	F125	-1607.3	F42$_{+.426}$
5.	25976.9	F32$_{+.620}$	-9663.1	F107$_{+.407}$	1851.6	F14	-998.9	F69$_{+.450}$
6.	20798.4	F29$_{+.577}$	-13042.2	F101$_{+.462}$	1617.4	F15$_{+.450}$	-1113.4	F44$_{+.476}$
7.	21606.6	F30$_{+.286}$	-13126.9	F110$_{+.516}$	1930.2	F125	-2509.9	F86
8.	17500.0	F28	-15610.5	F108$_{+.296}$	2050.3	F125	-2220.4	F86
9.	38502.8	F37$_{+.585}$	-3736.7	F93$_{+.510}$	2518.5	F104	-3256.5	F50
10.	30189.7	F35$_{+.491}$	-10225.1	F92$_{+.223}$	2853.0	F104	-3430.2	F50
11.	20803.0	F30$_{+.116}$	-18297.1	F98$_{+.620}$	1890.5	F125	-1343.3	F44$_{+.623}$

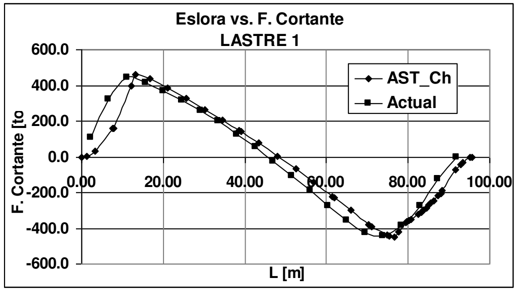


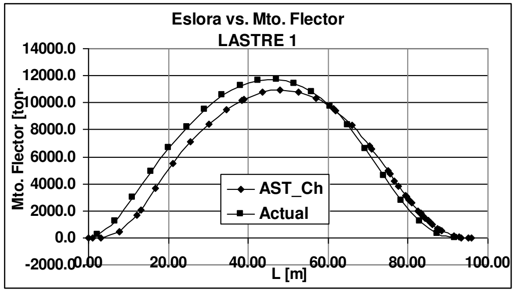


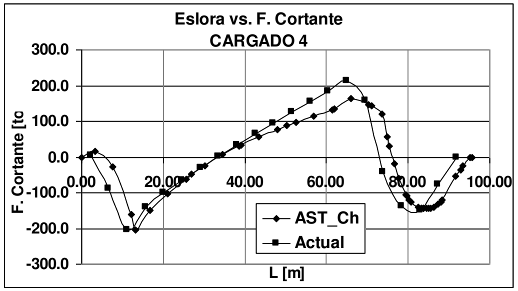


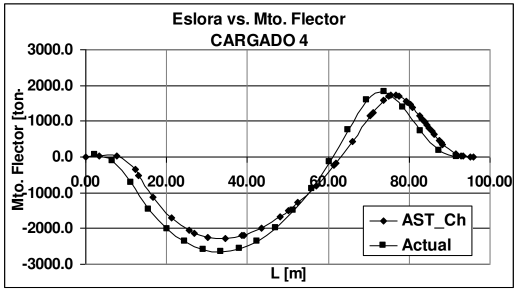
Aguas Tranquilas (AST_Ch vs Actual, SHCP)

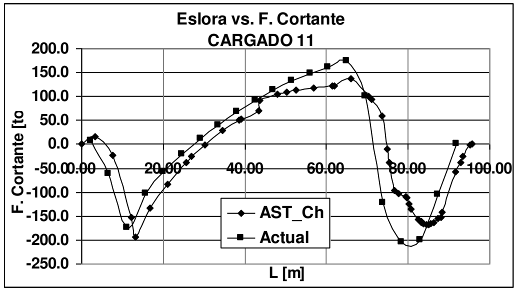


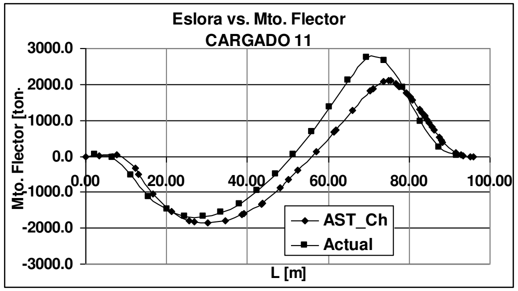




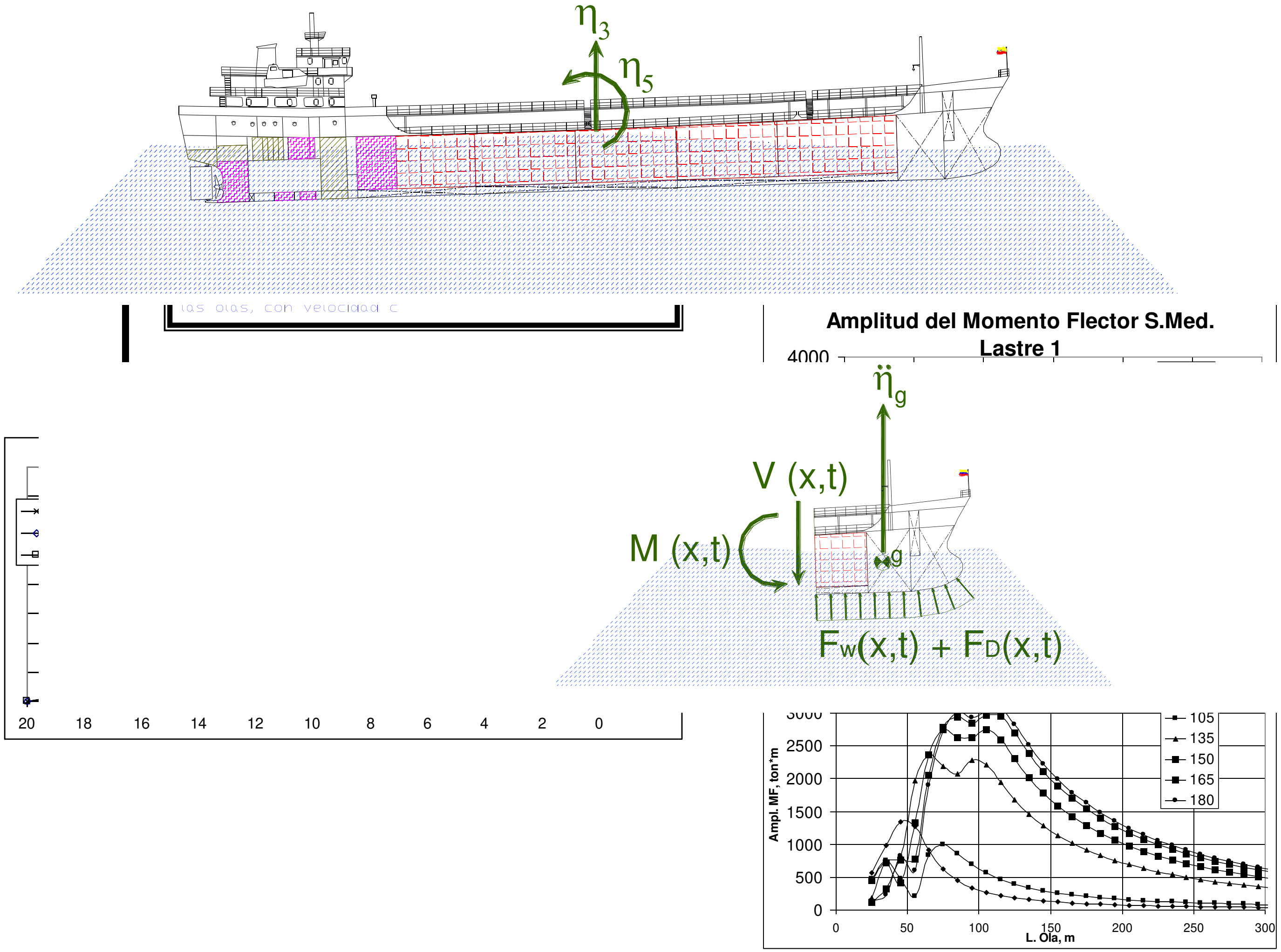




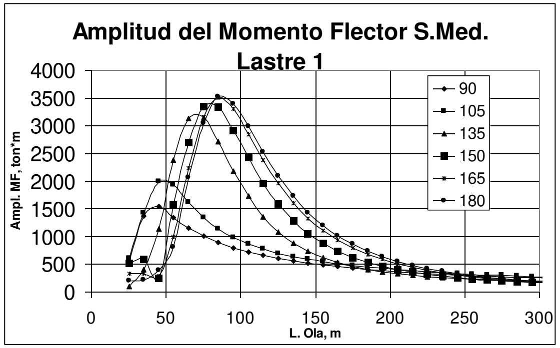


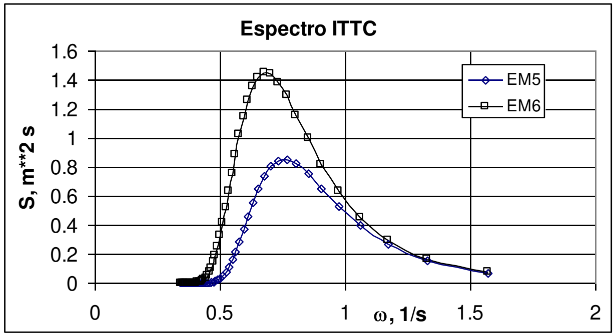


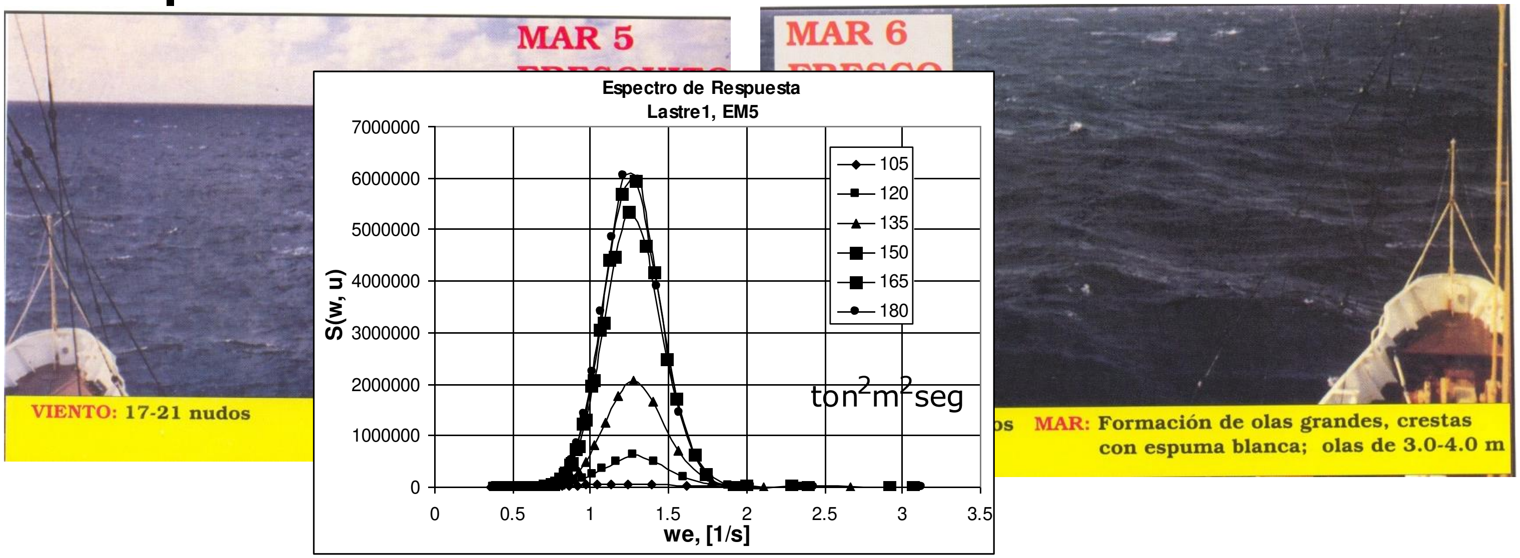
Olas Regulares (SCORES, 1972)



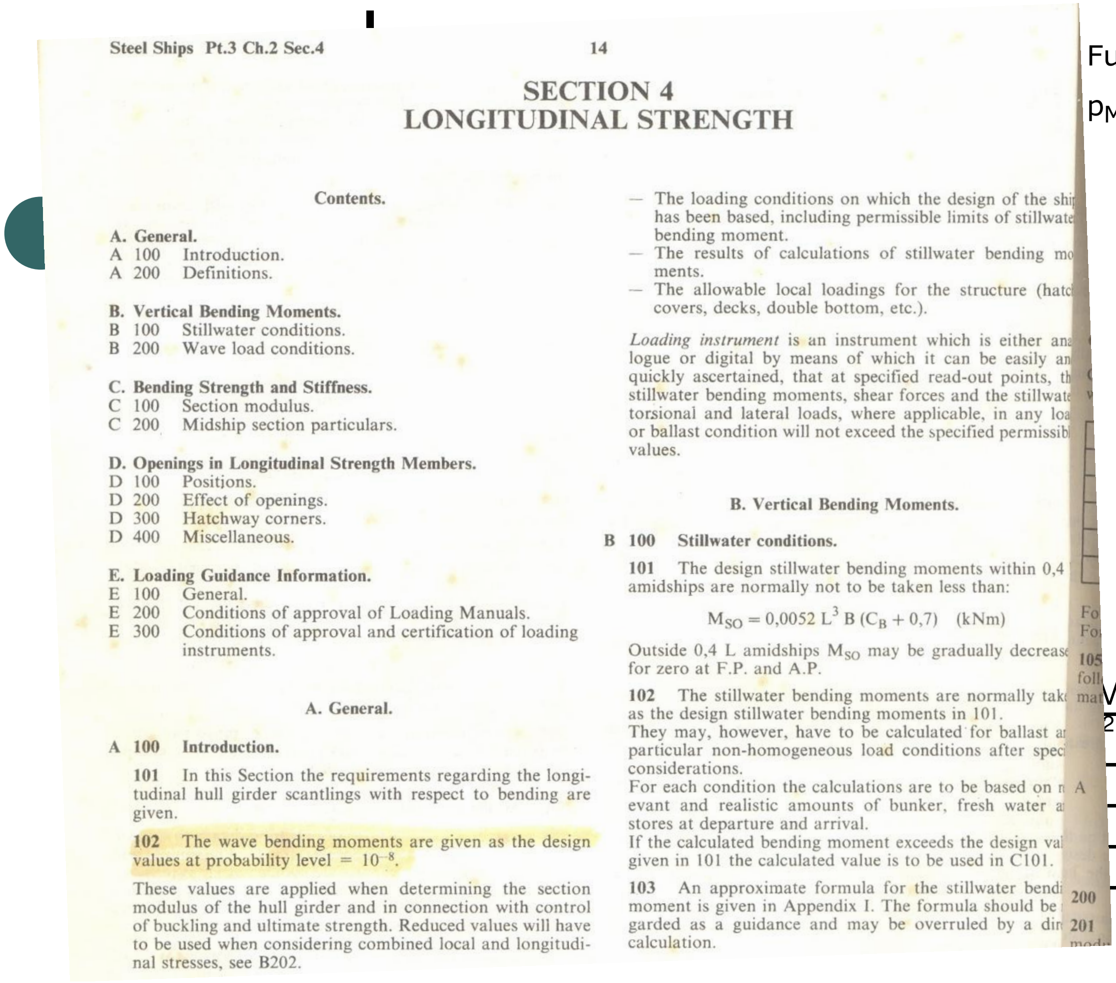
MF en Olas Irregulares







MF Dinàmico



SECTION 4

LONGITUDINAL STRENGTH

Contents.

A. General.
A 100 Introduction.
A 200 Definitions.

B. Vertical Bending Moments.
B 100 Stillwater conditions.
B 200 Wave load conditions.

C. Bending Strength and Stiffness.
C 100 Section modulus.
C 200 Midship section particulars.

D. Openings in Longitudinal Strength Members.
D 100 Positions.
D 200 Effect of openings.
D 300 Hatchway corners.
D 400 Miscellaneous.

E. Loading Guidance Information.
E 100 General.
E 200 Conditions of approval of Loading Manuals.
E 300 Conditions of approval and certification of loading instruments.

A. General.

A 100 Introduction.

101 In this Section the requirements regarding the longitudinal hull girder scantlings with respect to bending are given.

102 The wave bending moments are given as the design values at probability level = 10^{-8}.

These values are applied when determining the section modulus of the hull girder and in connection with control of buckling and ultimate strength. Reduced values will have to be used when considering combined local and longitudinal stresses, see B202.

- The loading conditions on which the design of the shi has been based, including permissible limits of stillwate bending moment.
- The results of calculations of stillwater bending mo ments.
- The allowable local loadings for the structure (hatc covers, decks, double bottom, etc.).

Loading instrument is an instrument which is either ana logue or digital by means of which it can be easily an quickly ascertained, that at specified read-out points, th stillwater bending moments, shear forces and the stillwate torsional and lateral loads, where applicable, in any loa or ballast condition will not exceed the specified permissib values.

B. Vertical Bending Moments.

B 100 Stillwater conditions.

101 The design stillwater bending moments within 0,4 amidships are normally not to be taken less than:

$$M_{SO} = 0{,}0052\ L^3\ B\ (C_B + 0{,}7) \quad (kNm)$$

Outside 0,4 L amidships M_{SO} may be gradually decrease for zero at F.P. and A.P.

102 The stillwater bending moments are normally tak as the design stillwater bending moments in 101.
They may, however, have to be calculated for ballast a particular non-homogeneous load conditions after spec considerations.
For each condition the calculations are to be based on r evant and realistic amounts of bunker, fresh water a stores at departure and arrival.
If the calculated bending moment exceeds the design va given in 101 the calculated value is to be used in C101.

103 An approximate formula for the stillwater bendi moment is given in Appendix I. The formula should be garded as a guidance and may be overruled by a dir calculation.

Función Densidad Prob. de Rayleigh :

$$p_{MF}(mf) = (mf / m_o)\exp(-mf^2 / 2m_o) \quad (5)$$

m_0 : El área bajo la curva del Espectro del MF

$$P\left[mf > mf_{diseño}\right] = \int_{mf_{diseño}}^{\infty} p_{MF}(mf)\,dmf =$$

$$= \exp\left[-mf_{diseño}{}^2 / 2m_0\right]$$

$$mf_{diseño} = \sqrt{-2m_0 \ln P_{MF}}$$

Mar 6

^{2}	$MF_{diseño}$, ton-m
	10269
	10417
	10444

MF Olas, Soc. Clasificación

DNV Part 3, Ch. 2, Sec. 4, B200:

$$M_{W0} = 0.11 C_W L^2 B (C_B + 0.7), \mathrm{kNm}\,(\mathrm{Arr})$$

$$M_{W0} = 0.19 C_W L^2 B C_B, \mathrm{kNm}\,(\mathrm{Que})$$

Lloyd's Part 3, Ch. 4, Sec. 5.2:

$$M_{W0} = -1.1 * 0.1(0.0412L + 4.0) * L^2 B (C_B + 0.7), \qquad \mathrm{kNm}\,(\mathrm{Arr})$$

$$M_{W0} = \frac{1.9 C_B}{(C_B + 0.7)} * 0.1(0.0412L + 4.0) * L^2 B (C_B + 0.7), \qquad \mathrm{kNm}\,(\mathrm{Que})$$

DNV

M_{WO}, Arrufo	124297.429	kN*m
M_{WO}, Quebr.	114617.72	kN*m

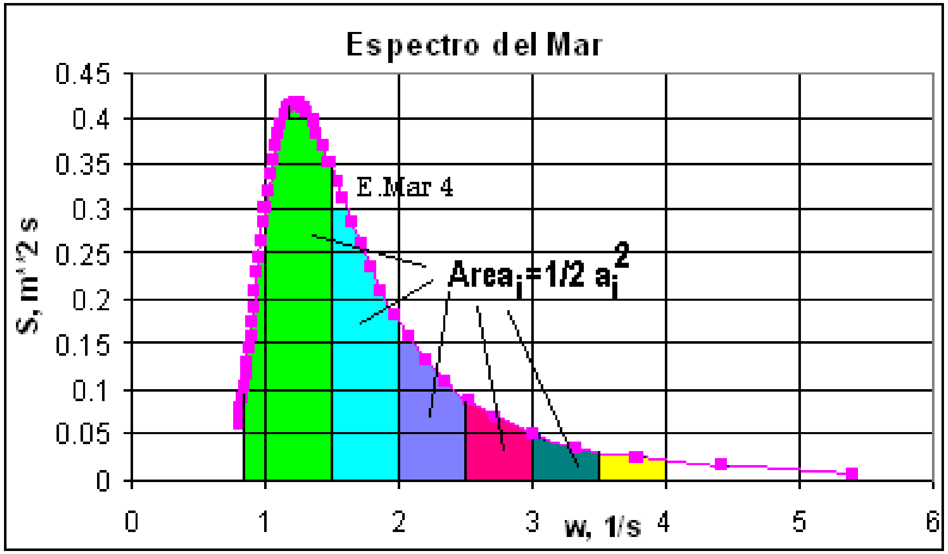
Lloyd's

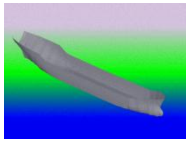
M_{WO}, Arrufo	-135060.67	kN*m
M_{WO}, Quebr.	124542.769	kN*m

Estado de Mar 6

	m_o, (ton m)^2	$MF_{diseño}$, ton-m
Lastre 1	2862077	10269
Cargada 4	2945698	10417
Cargada 11	2960485	10444

Visualización de resultados





Conclusiones y Recomendaciones

1. Cálculos del MFD implican manejar diferentes disciplinas: Hidrostática, Hidrodinàmica, Estructuras, Probabilidades...

2. Asunciones necesarias: Linealidad de la respuesta, Descripción del Estado de Mar, Ancho de banda angosto, Plazo Corto, …

Para un Estado de Mar 6:		
	Lloyd's:	13768 ton-m
	Cargada 11:	10444 ton-m

Debemos empezar a formar Bases de Datos con información real.

Muchas gracias …