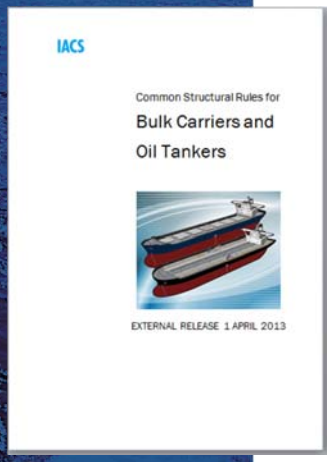
IACS

IMO GBS and IACS Harmonised Common Structural Rules



Safer and Cleaner Shipping

TSCF Shipbuilder Meeting

24 – 25 October 2013

Philippe Baumans,
IACS Project Management Team
BV Director of Development Department

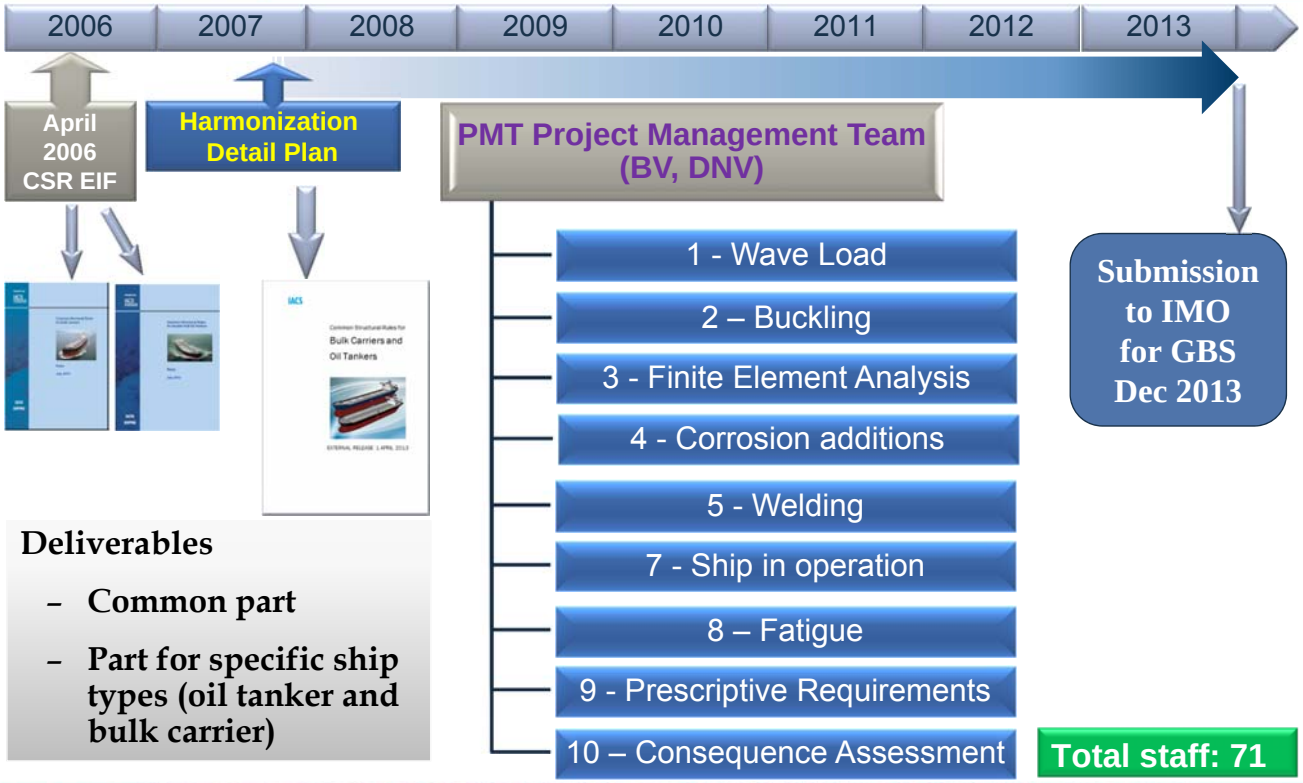
IACS

IMO GBS AND IACS HARMONISED CSR

Safer and Cleaner Shipping

CONTENT

Introduction: Harmonisation of CSR



Description of GBS

Safer and Cleaner Shipping

- Origin
- Standards
- GBS Tiers
  - Tier I : Goals
  - Tier II : Main functional Requirements

Goal Based Standard: The origin

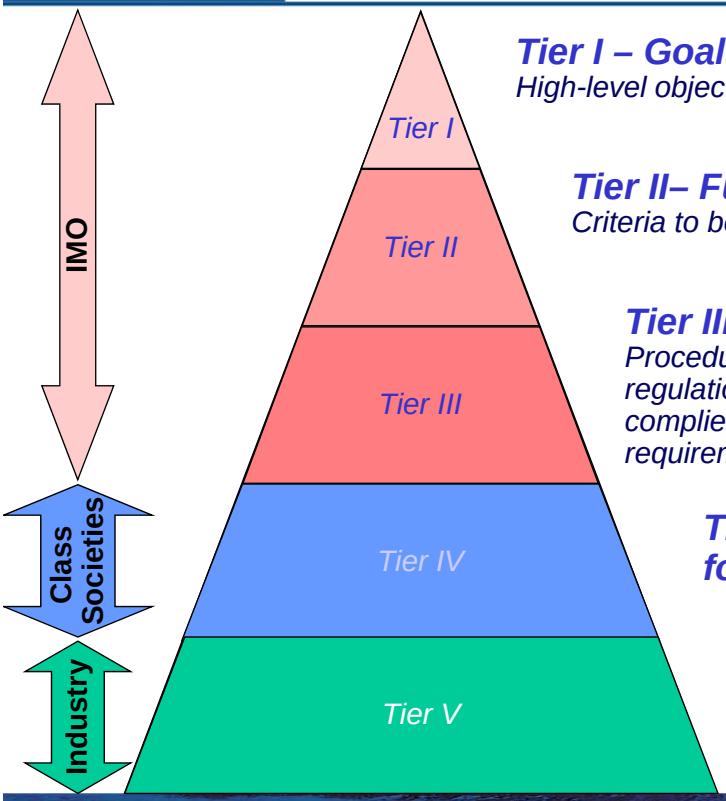
IMO Working Groups and Correspondence Group

4 important documents:

May 2010

- ***Amendments to SOLAS Chapter II-1 making the GBS standards for bulk carriers and oil tankers mandatory [Adopted IMO Res. MSC 290 (87)]***
- ***International Goal-Based Ship Construction Standards for Bulk Carriers and Oil Tankers [Adopted IMO Res. MSC 287 (87)]***
- ***Guidelines for Verification of Conformity with Goal-Based Ship Construction Standards for Bulk Carriers and Oil Tankers [Adopted IMO Res. MSC 296(87)]***
- ***Guidelines for the Information to be included in a Ship Construction File (SCF) [Approved MSC.1/Circ.1343]***

The Goal Based Standards : "The Rule for Rules"



Tier I – Goals
High-level objectives to be met

Tier II– Functional requirements
Criteria to be satisfied in order to conform to the goals

Tier III– Verification of conformity
Procedures for verifying that the rules and regulations for ship design and construction complies with the goals and functional requirements

Tier IV– Rules and Regulations for ship design and construction

Tier V –Industry practices and standards

GBS Standards: Tier I - Goals

The Tier I goals are as defined in SOLAS regulation II-1/3-10:

"Ships shall be designed and constructed for a **specified design life** to be safe and environmentally friendly, when properly operated and maintained under the specified operating and environmental conditions, in intact and specified damage conditions, throughout their life."

- **Safe and Environmentally friendly**
- **Environmentally friendly**
- **Safety**
- **Specified operating and environmental conditions**
- **Specified design life**

GBS Standards: Tier II
15 main functional requirements

- *DESIGN*
  - Design life
  - Environmental conditions
  - Structural strength
  - Fatigue life
  - Residual strength
  - Protection against corrosion
  - Structural redundancy
  - Watertight and weathertight integrity
  - Human element considerations
  - Design transparency
- *CONSTRUCTION*
  - Construction quality procedures
  - Survey during construction
- *IN-SERVICE CONSIDERATIONS*
  - Survey and maintenance
  - Structural accessibility
- *RECYCLING CONSIDERATIONS*
  - Recycling

GBS Standards: Tier II
Functional Requirements : Guidance

Example of functional requirement

5 Residual strength

5.1 Statement of intent

Confirm that the rules provide a reasonable level of residual strength after damage (e.g., collision, grounding and flooding).

5.2 Information and documentation requirements

5.2.1 Description of how ships designed to the rules with intact structure at net scantlings have sufficient ultimate strength to sustain flooding as defined in relevant IMO instruments.

5.2.2 Justification that ships designed to the rules have adequate residual strength to survive a casualty event. Include the following:

.1 Description of the methodology used to assess residual strength.

.2 Description of the flooding scenarios and the corresponding structural damage. Explanation of the relationship of the flooding scenarios with IMO instruments.

.3 Description of the environmental conditions and period of exposure representative of the sea states expected for collision and grounding scenarios, and justification why they are appropriate.

.4 Description of the acceptance criteria for residual strength of the ship in damaged condition, and justification if different from ultimate strength.

.5 Where it is determined that the rules inherently provide adequate residual strength, justification should be provided that demonstrates through analysis of a range of representative ship designs and loading conditions.

5.2.3 Description of how the residual strength assessment procedure has been validated with experimental and/or casualty history data.

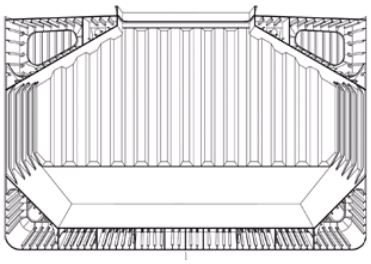
5.3 Evaluation criteria

5.3.1 Can a ship designed to the rules sustain flooding as defined in relevant IMO instruments and survive with intact structure at net scantlings?

5.3.2 Does a ship designed to the rules have sufficient residual strength to survive a more significant casualty event (e.g., flooding with structural damage due to collision or grounding) under environmental conditions consistent with the likelihood of occurrence? Are the

Summary of SOLAS Amendments
II-1 Reg. 3-10 (GBS)

- **Application: Oil tankers & Bulk carriers of 150 m in length and above**
- **Goals: Safe and environmentally friendly Ship design**
- **Structural Requirements : Goals shall be achieved through Structural Requirements of ROs (Class) conforming to GBS Functional Requirements**



- **Ship Construction File (SCF): Information on how the functional requirements have been applied in the ship design and construction to be kept on board**

Enter into force on 1 Jan 2012, and apply to ships:

1. building contract on or after 1 July 2016 or
2. keel lay on or after 1 July 2017 or
3. delivery on or after 1 July 2020.

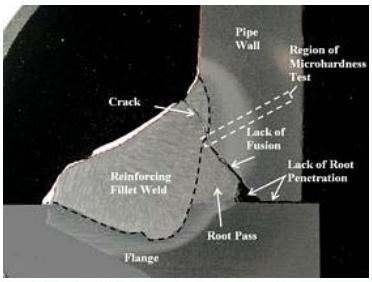
Application of GBS in CSR-H

Safer and Cleaner Shipping

- Items covered in CSR for Oil Tanker
- Gap Analysis
- New items not covered in CSR – OT

Items covered in CSR-OT

- Wave scatter diagram: North Atlantic



- Design ship life : 25 years
  - Long term period for the wave loads
  - Corrosion model
  - Design fatigue life

Gap analysis

Item	Fully covered in CSR	Partially covered in CSR	Not covered in CSR
DESIGN			
II.1 Design life	✓		
II.2 Environmental conditions	✓		
II.3 Structural strength	✓		
II.4 Fatigue life	✓		
II.5 Residual strength		✓	
II.6 Protection against corrosion	✓		
II.6.1 Coating life	✓		
II.6.2 Corrosion addition	✓		
II.7 Structural redundancy		✓	
II.8 Watertight and weathertight integrity	✓		
II.9 Human element considerations		✓	
II.10 Design transparency		✓	

Item	Fully covered in CSR	Partially covered in CSR	Not covered in CSR
CONSTRUCTION			
II.11 Construction quality procedures	✓		
II.12 Survey	✓		
IN-SERVICE CONSIDERATIONS			
II.13 Survey and Maintenance		✓	
II.14 Structural accessibility			✓
RECYCLING CONSIDERATIONS			
II.15 Recycling			✓

New items introduced in CSR-H

Residual strength after collision or grounding

- Introduced in a new section (Pt 1, Ch 5, Sec 3)

Structural redundancy

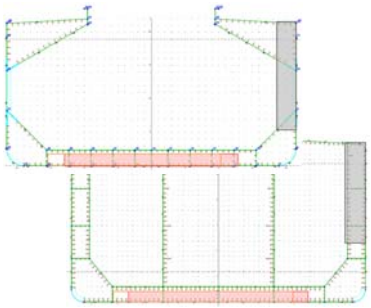
- Technical background is under development
- Conclusion: Ship structure, i.e. stiffened panels with scantlings in accordance with CSR have inherent redundancy and do not need reinforcement for this purpose

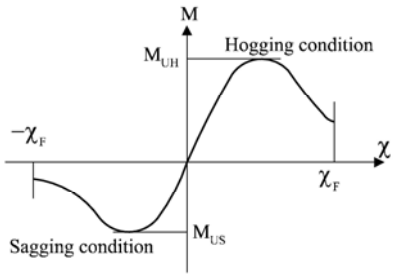
Fatigue Vibration due to whipping / springing

- Implicitly covered for a very large part of ships as it is included in the experience from operation
- Technical background Report is under development

Hull Girder Residual Strength

- Hull Girder Strength Assessment under damaged conditions due to collision and grounding



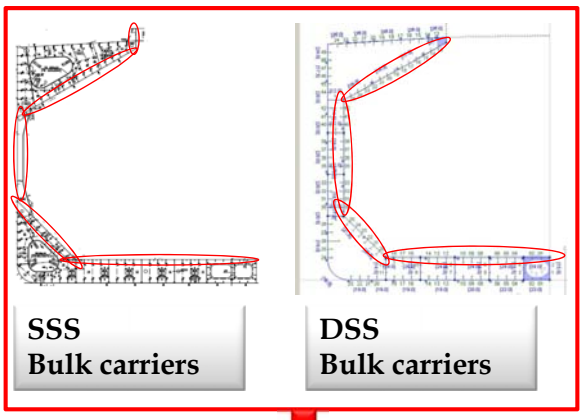


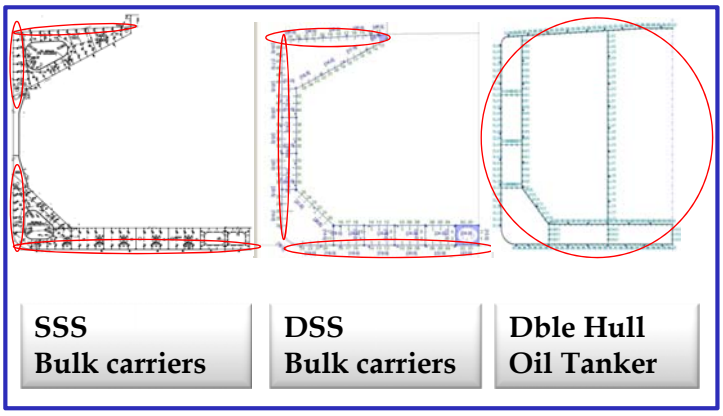
Structural redundancy

- GBS Guidelines:
  - *Does a ship designed to the rules have sufficient structural redundancy to survive localized damage to a stiffening member?*
- "Localized damage" is understood as:
  - local permanent deformation,
  - cracking or
  - weld failure
    that might result from accidental damage within the cargo hold.
- "Stiffening member" is understood as a stiffener attached to a structural plating panel

Structural redundancy – Concerned structural elements

Two categories:





Elements already covered in CSR-BC. Methodology agreed in IMO documents

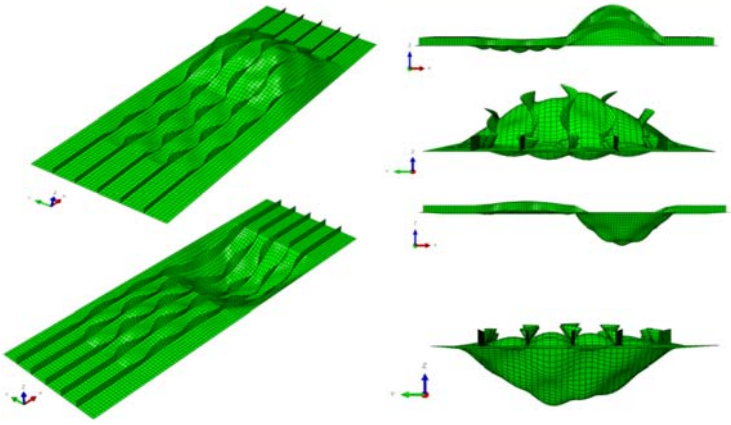
Structural redundancy criterion

$$\eta_D = \frac{\sigma_D}{U_D} \le 1 \qquad \Rightarrow \Rightarrow \Rightarrow \qquad \gamma = \frac{U_D/U_I}{\sigma_D/\sigma_I} \cdot \frac{1}{\eta_I} \ge 1$$

- U_D / U_I : Ultimate capacity ratio
- σ_D/σ_I : Working stress ratio
- η_I : Usage factor

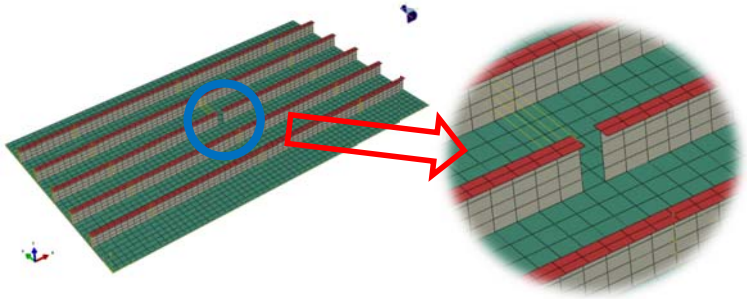
I: Intact stage
D: Damage stage

Localised damages



Permanent deformation

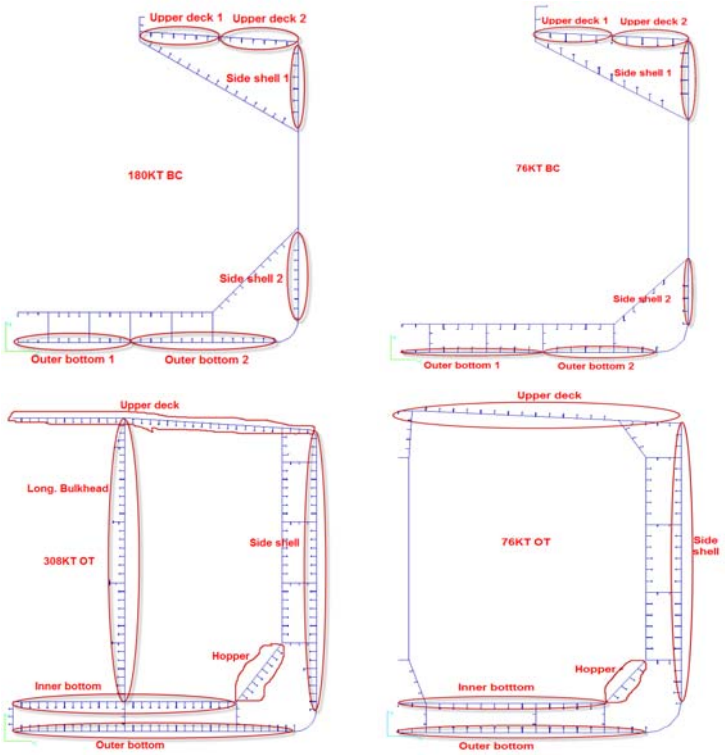
Overall initial stiffener deflection for a plate and stiffener induced imperfection



Web crack at stiffener end

Numerical studies

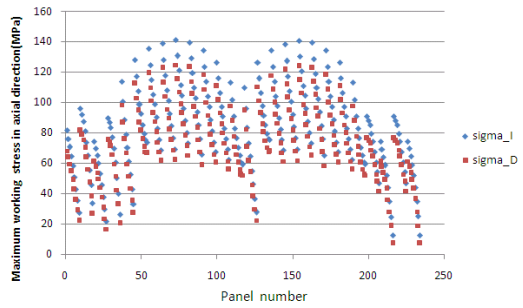
Ship Type	Ship Size
Bulk Carrier	180 kT
	76 kT
	115 kT
Oil Tanker	308 kT
	76 kT
	51 kT



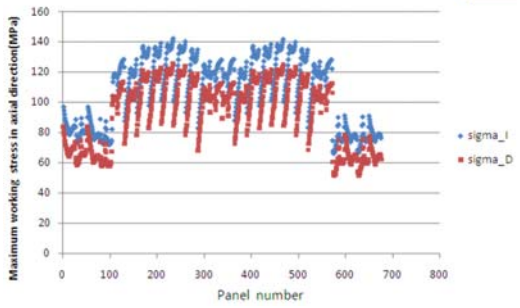
Structural redundancy Example of results

308 KT VLCC

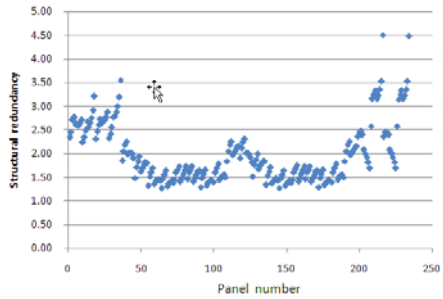
Hopper



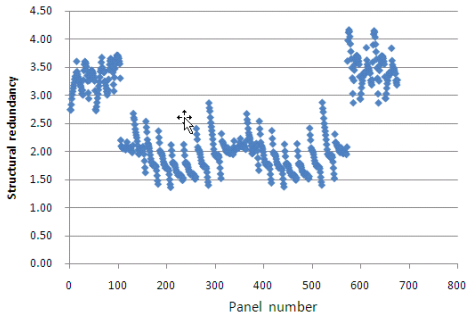
Inner bottom



$\gamma = \frac{U_D/U_I}{\sigma_D/\sigma_I} \cdot \frac{1}{\eta_I} > 1.0$ Hopper

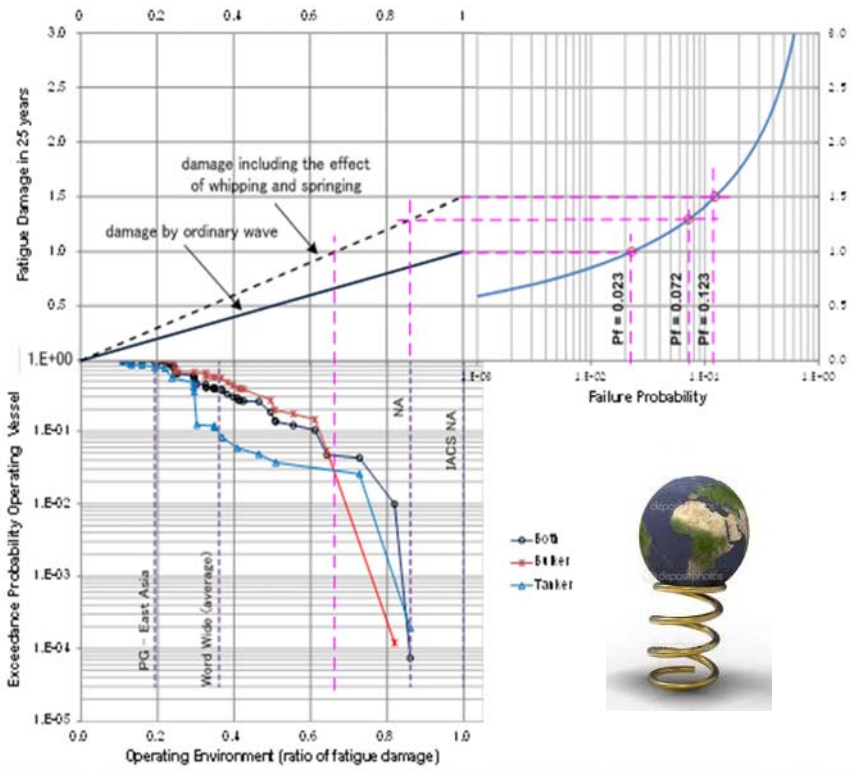


$\gamma = \frac{U_D/U_I}{\sigma_D/\sigma_I} \cdot \frac{1}{\eta_I} > 1.0$ Inner bottom



Fatigue due to whipping and springing

- Statistic on operating routes of existing bulk carriers and oil tankers
- 3.7% of oil tankers may be affected by the effect of whipping and springing
- Failure probability of ships which may be affected by whipping and springing: 2.3 and 7.2 % among population trading in North Atlantic
- 0.27% of oil tankers face risk of fatigue damage due to whipping and springing (0.27% = 3.7%*7.2%)
- CSRH fatigue sufficient safety margin against the effect of whipping and springing



Main GBS issues not directly covered in CSR-H

- Survey
- Human elements
- Ship construction file
- Recycling

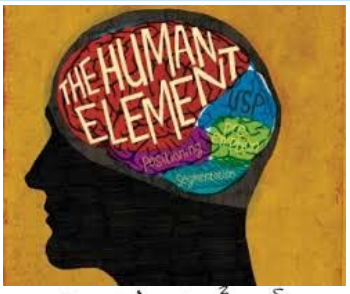
Safer and Cleaner Shipping

Main GBS issues not directly covered Survey

- Survey for new construction and in-service operations
  - Not introduced in CSR-H text but references made to UR Z for:
    - General concept of surveys during construction and while in-service.
    - Construction and fabrication fit-up, welding and non-destructive testing.
    - Areas subject to special attention.
    - Tank strength and leak testing

Main GBS issues not directly covered
Human Elements

- Addressed in newly developed IACS Guidelines
- IACS guidelines will include some Industry best practices
- CSR-H introduce and reference some human element considerations :
  - International Labour Organization (ILO) implemented by National Administrations or the Society on their behalf.
  - Lighting and ventilation arrangement considerations from the relevant requirements of International Conventions such as SOLAS and MLC 2006 Reg 3.1.
  - Noise consideration from the relevant requirements of SOLAS ChII-1, Reg. 3-12 and the mandatory document "The Code on Noise Levels On-board Ships" adopted at MSC.337(91).
  - Vibration consideration from the relevant statutory requirements such as MLC 2006 Reg 3.1.
  - Ship structure access.



Main GBS issues not directly covered
Ship Construction File

Aim: to facilitate safe operation, maintenance, survey, repair and emergency measures.

1. to be provided upon delivery of new bulk carriers and oil tankers contracted on or after *1 July 2016*.
2. to be kept on board the ship and/or
3. to be kept ashore (i.e. Archive Centers)
4. to be updated as appropriate throughout the ship's life

Examples of information to be included in SCF

Information stored on board ship

- General arrangement, midship section, key construction plans, loading manual, coating technical file
- Documents to be developed especially to meet the requirements of SCF Guidelines (SCF-specific) such as:
  - note on design life on midship section
  - construction quality standard
  - list of materials used for hull structure

Information stored on shore archive

- Yard plans, lines plan, fatigue life calculation

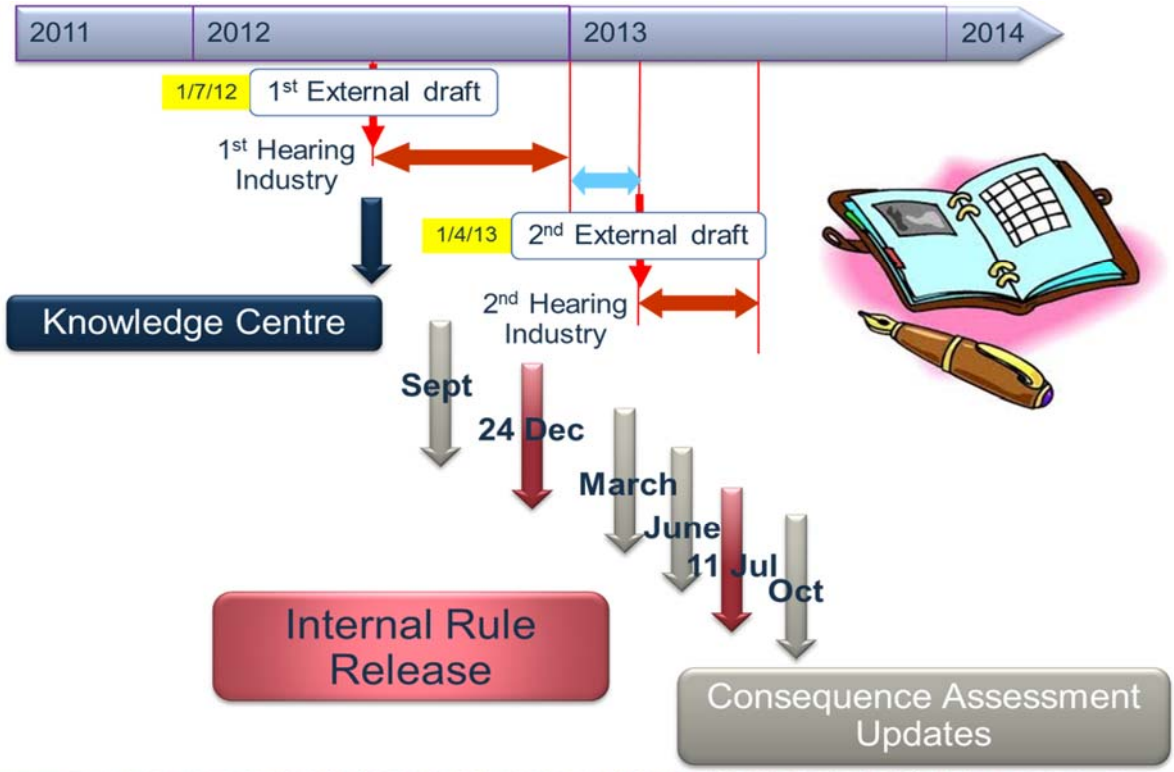
Main GBS issues not directly covered
Recycling

- **Recycling requires lists of materials used in the construction of the ship and later during any in-service modifications be maintained for future ship recycling purposes.**
- **The compilation and maintenance of the list of materials is included in the Ship Construction File.**
- **These lists are covered in IACS UR Z23 "Hull survey for new construction" and the UR Z10 series, respectively.**
- **Detailed recycling-related requirements are not included in CSR-H.**
- **List of materials to be assembled and maintained for future recycling:**
  - **Shipyards or Owners directly responsible for.**
  - **Class Societies will check for the existence of the SCF as indicated in the UR Z23 and UR Z10 series.**

Consequence Assessment and Schedule

Safer and Cleaner Shipping

Harmonised CSR - Time Schedule



Consequence assessment ships

Bulk carriers

Oil tankers

ID	Type	Lpp	B	Tsc	D	Dwt
BC-1	Capesize 1	285	46	18	25	180200
BC-2	Capesize 2	284	45	18	25	180000
BC-3	Capesize 3	293	50	18	25	205000
BC-4	Baby Cape 1	240	43	15	21	114500
BC-5	Baby Cape 2	248	43	15	20	115000
BC-6	Panamax 1	225	32	14	20	82000
BC-7	Panamax 2	223	32	15	20	81000
BC-8	Handymax 1	183	32	13	18	53000
BC-9	Handymax 2	185	32	13	18	57000
BC-10	Handymax 3	185	32	14	18	48000

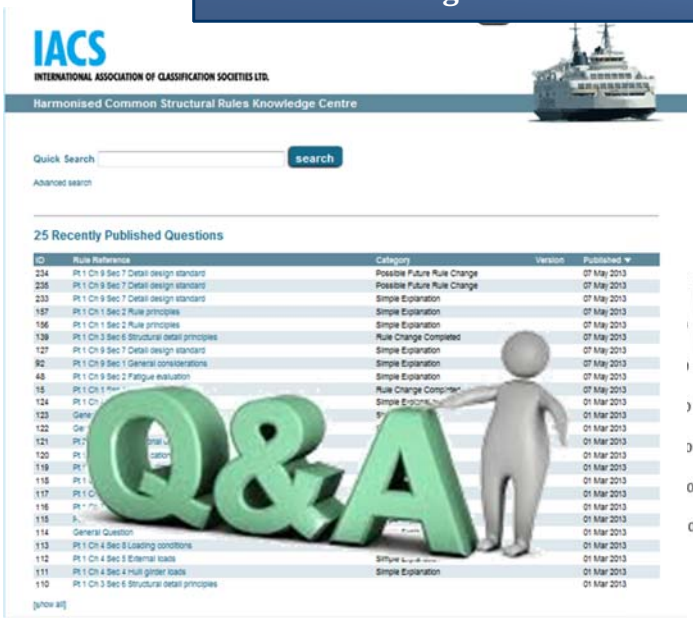
ID	Type	Lpp	B	Tsc	D	Dwt
OT-1	VLCC 1	319	60	23	30	318000
OT-2	VLCC 2	324	60	21	29	330000
OT-3	Suezmax1	264	48	17	24	158000
OT-4	Suezmax2	264	50	17	23	163000
OT-5	Aframax 1	240	42	15	22	97000
OT-6	Aframax 2	240	44	15	21	103000
OT-7	Aframax 3	234	42	15	21	105000
OT-8	Panamax1	220	32	15	21	76000
OT-9	Panamax2	219	32	15	21	74000
OT-10	Handymax1	176	32	13	18	51000

CA updates at each Rule Release

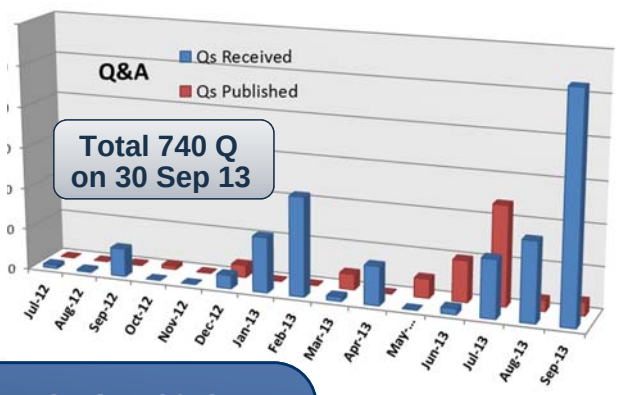
CA Report version available on IACS web site

IACS Knowledge Centre

IACS knowledge centre address: http://www.iacs-csrkc.org.uk



- Accessible by anyone
- Comments and questions received from Industry
- Answers provided by IACS groups (HPTs, PMTs, Hull panel, etc)



2nd Hearing period ended on 31 Aug 2013

Harmonised CSR - Time Schedule

2011 | 2012 | 2013 | 2014 ?☆

2012-07-01 1st External draft

1st Hearing Industry

2013-04-01 2nd External draft

2nd Hearing Industry

2013-11-01 Final draft

Technical Committee Review

2013-12-18 Final CSRH

IACS Council Adoption

Submission IMO 2013-12-31

External review period

Technical Committee review

IACS adoption

Entry into force (T.B.D.)

IMO Submission Packages

IACS Common Package, 1st Part

Other IACS documents (UR, PR, UI, etc.)

IACS Common Package, 2nd Part

CSR-H documents

Individual Packages

ABS

BV

CCS

...

RS

IACS Common Package, 1st Part and Individual Packages.

Goal based standard timetable agreed at MSC 87

1 Jan 2012	GBS SOLAS amendments enter into force and Standards take effect
31 Dec 2013	Deadline for receipt of initial verification requests at IMO
2014	MSC reviews progress made in GBS implementation
Jan 2016	Secretariat prepares documentation on all audits conducted for MSC 96 for final decision on conformity
May 2016	MSC 96 takes final decisions on conformity with GBS for all rules submitted
1 July 2016	GBS SOLAS amendments (II-1/3-10) become applicable

Thank you for your attention!