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The scope of the Marine Information Notice publication is to provide the Shipping Sector with information relevant to RINA, its organization, initiatives and services as well as to disseminate information of a general nature which in RINA view may be of interest. The information provided does not intend to be exhaustive and is given for reference only.

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SOLAS 2020: Stability requirements

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SOLAS 2020: stability requirements

Regulatory overview

The 2020 SOLAS amendments, adopted by Res. MSC.421(98), represent a revolution, concerning damage stability requirements for new ships. In fact, according to the new damage stability criteria:

- the required subdivision index R of passenger ships does not depend anymore on the ship's length, but just on the number of persons onboard, without the distinction between the number of persons for which lifeboats are provided (N_1) and those permitted to be carried in excess (N_2). The index R is constant for passenger ships with less than 400 persons onboard;
- $s_{intermediate}$ shall also be calculated for cargo ships fitted with cross-flooding devices and the time for equalization shall not exceed 10 minutes;
- s_{final} for ro-ro passenger ships is severer than other ship types (i.e. TGZ_{max}=20 and TRange=20°).

In line with SOLAS amendments and IMO Circular MSC-MEPC.5/Circ.8, new ships are defined as ships:

- for which the building contract signing date occurs on or after 1 January 2020; or
- only in the absence of a building contract, the keel of which is laid or which are at a similar stage of construction on or after 1 July 2020; or
- regardless of the building contract signing date or keel laying date, delivered on or after 1 January 2024, except in the case where the Administration has accepted that the delivery of the ships was delayed due to unforeseen circumstances beyond the control of the shipbuilder and the owner.
  The delivery date means the completion date (day, month and year) of the survey on which the certificate is based (i.e. the initial survey before the ship is put into service and certificate issued for the first time) as entered on the relevant statutory certificates.

The 2020 SOLAS amendments also require:

- new passenger ships not to sail with any watertight door continuously open; and
- a damage control drill - for crew members with damage control responsibilities - to take place at least every three months on all (i.e. new and existing) passenger ships.

Finally, other 2020 SOLAS amendments, adopted by Res. MSC.436(99), require passenger ships - of 120m in length and above or having at least 3 main vertical zones - constructed before 1 January 2014, to have - not later than the first renewal survey after 1 January 2025 - an onboard stability computer or a shore-based support for the purpose of providing operational information to the master for safe return to port after a flooding casualty.

Detailed description of new damage stability requirements in SOLAS Chapter II-1

Regulation 6 – Required subdivision index R:
In the case of passenger ships the following table, depending uniquely on the total number of persons on board, is to be applied. Quite remarkably, the required index does not take into account either the LSA numbers or the ship's length.

Persons on board	R
N < 400	R = 0.722
400 ≤ N ≤ 1350	R = N / 7580 + 0.66923
1350 < N ≤ 6000	R = 0.0369 × Ln (N + 89.048) + 0.579
N > 6000	R = 1 - (852.5 + 0.03875 × N) / (N + 5000)

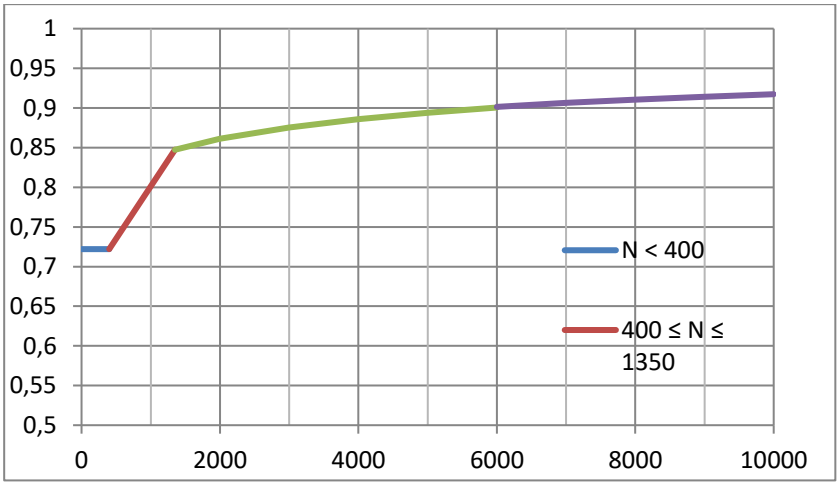

Fig. 1: Graphic plot of Required Subdivision Index for passenger ships

Regulation 7-2 – Calculation of the factor si:

- The survivability factor "$S_{intermediate,i}$" during intermediate flooding stages for both passenger and cargo ships equipped with cross flooding devices is to be assessed by means of the following formula. Moreover, the time for equalization shall not exceed 10 min.

$$S_{intermediate,i} = \left[\frac{GZ_{max}}{0.05}\frac{Range}{7}\right]^{\frac{1}{4}}$$

Where GZ_{max} is not to be taken as more than 0.05 m and Range as not more than 7°. $S_{intermediate,i} = 0$, if the intermediate heel angle exceeds 15º for passenger ships and 30° for cargo ships.
What above aims to harmonize a criterion previously applicable to passenger ships only.

- A new formulation for the survivability factor "$S_{final,i}$" relevant to the final stages of flooding is provided for ro-ro passenger ships. Such formula finds application only for those damage cases involving a ro-ro space.

$$S_{final,i} = K\left[\frac{GZ_{max}}{TGZ_{max}}\frac{Range}{TRange}\right]^{1/4}$$

  Where "target values" TGZ_{max} = 0.20 m, TRange = 20º. This novel criterion - together with the previously discussed new "required subdivision index" R – has the potential to impact significantly on the design of a modern ro-ro pax vessel.

- For the sake of completeness, a minor amendment involving the factor $s_{mom,i}$ "survivability factor subsequent to the application of heeling moments", applicable only to passenger ships, has been introduced:

$$S_{mom,i} = \frac{(GZ_{max} - 0.04)\ Displacement}{M_{heel}}$$

  Displacement is now intended as "intact displacement at the respective calculation draughts" (ds, dp or dl), instead of "intact displacement at the subdivision draught".

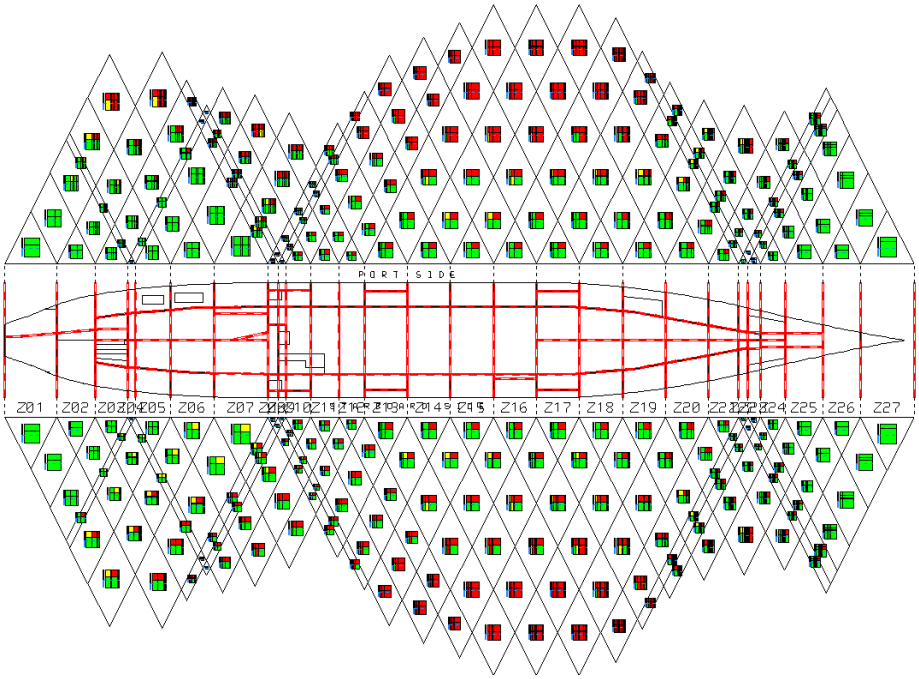

Fig. 2: Examples of survivability indexes computed for a ro-ro vessel taking into account multiple-zone damage at max. draught. Severity of damage reported on a "color-based" scale.

Regulation 8 – Special requirements concerning passenger ship stability & Regulation 9 – Double bottoms in passenger ships and cargo ships other than tankers:
The above considerations concerning Reg. 7-2 indirectly reflect on the "deterministic" checks prescribed by Regs. 8 & 9, where compliance is to be achieved by demonstrating that S_i, calculated in accordance with regulation 7-2, is not less than 1 or 0.9 (depending on the case).
In addition, a minimum vertical extent of 0.76 m measured from the keel line, is established for bottom damages.

Regulation 19-1 – Damage control drills for passenger ships:
- Reg. 19-1 is a new regulation, which applies to passenger ships constructed before, on or after 1st January 2020, in which periodical damage control drills are required.
- A damage control drill shall take place at least every three months. Only crew members with damage control responsibilities are deemed to attend every drill.
- The damage control drill scenarios shall vary each drill, simulating different damage conditions.
- At least one damage control drill each year shall include activation of the shore-based support, if provided in compliance with Reg. II-1/8-1.3, to conduct stability assessments for the simulated damage conditions.
- A record of each damage control drill shall be maintained.

Regulation 8-1 – System capabilities and operational information after a flooding casualty on passenger ships:
At the first renewal survey on or after 1 January 2025, passenger ships constructed before 1 January 2014 - of 120 m in length and above or having at least 3 main vertical zones - shall have an onboard stability computer or a shore-based support based on the IMO Guidelines on operational information for masters in case of flooding (MSC.1/Circ.1589).
MSC.1/Circ.1589, together with IACS UR L5, provides specific requirements applicable to such stability computers, in particular:
- At least two independent stability computers should be available at all times (either two onboard, or two through shore-based support, or one each). The onboard system should have an uninterruptible power supply (UPS) connected to both main and emergency switchboards.
- Stability computer software should use an accurate and detailed computer model of the entire hull, the pre-damage loading condition and the status of the watertight doors to calculate the residual damage stability following any flooding casualty. Moreover, details of the damage location(s) and extent(s) or the damaged compartments should be input manually and combined with data from electronic sensors such as draught gauges, tank level devices, watertight door indicators and flooding level sensors, when available. The system should be updated with the loading condition before the voyage commences and on a daily basis during navigation.
- The system should be capable of accounting for applied moments such as wind, lifeboat launching, cargo shifts and passenger relocation. Account for

the effect of wind by using the method in regulation II-1/7 2.4.1.2 should be the default, but manual input of “on-scene” wind speed/pressure should be allowed as well.

- The system should be capable of assessing the impact of open main watertight doors on stability.
- For ro-ro passenger ships There should be algorithms in the software for estimating the effect of water accumulation on deck (WOD). There shall be also the possibility for the crew to input manually the significant wave height of the ship navigation area.

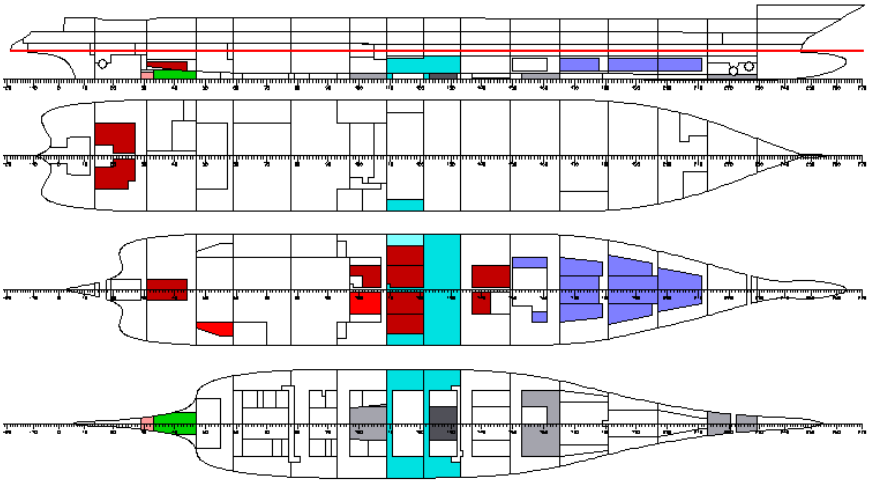

Fig. 3: Example of damage stability assessment based on an actual loading condition

How RINA can help

In order to comply with the above-mentioned 2020 SOLAS requirements, RINA is offering to clients the following services:

- appraisal of damage stability calculations and plans, based on a proven expertise achieved over the years, especially for ro-ro passenger ships and cruise vessels;
- approval and testing of on-board stability computer, when this is installed to comply with regulation II-1/8-1; and
- technical advisor, when the shore-based support option is chosen to comply with regulation II-1/8-1, based on the experience gained on such service already offered to a fleet of over 450 merchant ships.

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