Übung zur Vorlesung

Spezielle Kapitel des Schiffsentwurf

RoPax und Pax

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Übung 10

1. Welche Leckrechnungsvorschrift gilt für Passagierschiffe die heutzutage gebaut werden? Welche Regel ist hier ganz besonders zu beachten?

2. Welche Besonderheit gilt für neue Passagierschiffe bzgl. der Teil-Unterteilungsgrade ggü. Frachtschiffen?

3. Welche Besonderheit gilt für neue Passagierschiffe bzgl. des Required Index ggü. Frachtschiffen? Was hat sich hier mit dem 01.01.2020 geändert?

4. Was muss bei RoPax-Schiffen in Europa besonders berücksichtigt werden?

5. Wie groß ist die anzunehmende Eindringtiefe für Leckfälle von Passagierschiffen gemäß aktueller Vorschrift und was für ein Unterteilungselement leitet sich daraus sinnvoller Weise ab?

6. Welche Leckrechnung gilt für Passagierschiffe, die vor 2009 gebaut worden sind?

7. Wie groß ist die anzunehmende Eindringtiefe für Leckfälle von älteren Passagierschiffen und was für ein Unterteilungselement leitet sich daraus sinnvoller Weise ab?

8. Was ist die Folge, wenn eine Abteilung nicht über das in der zuvor gestellten Frage erwähnte Unterteilungselement verfügt?

9. Wie lang dürfen Hauptbrandabschnitte (Main-Fire-Zone/MFZ) maximal sein und durch welches strukturelle Element werden diese unterteilt?

10. Welcher Regel müssen alle nach dem 1. Juli 2010 gebauten Fahrgastsschiffe entsprechen, die eine Länge nach der Begriffsbestimmung in Regel II-1/2.5 von 120 m oder mehr oder drei oder mehr senkrechte Hauptbrandabschnitte haben?

11. Was ist die Margin Line und für welche Schiffe ist sie von Bedeutung?

12. Erläutern Sie ein typisches Antriebskonzept für ein Passagierschiff.

13. Markieren Sie in dem angehängten GA-Plan des Kreuzfahrtschiffes das Freiborddeck, die Hauptbrandschotte und die wasserdichten Querschotte.


15. Welche Intaktkriterien sind für Passagierschiffe einzuhalten?
9 Where the required factor of subdivision is 0.5 or less, the combined length of any two adjacent compartments shall not exceed the floodable length.

Regulation 8

Stability of passenger ships in damaged condition*

(Subject to the provisions of regulation 8-1, paragraphs 2.3.1 to 2.3.4, 2.4, 5 and 6.2 apply to passenger ships constructed on or after 29 April 1990. Paragraphs 7.2, 7.3 and 7.4 apply to all passenger ships)

1.1 Sufficient intact stability shall be provided in all service conditions so as to enable the ship to withstand the final stage of flooding of any one main compartment which is required to be within the floodable length.

1.2 Where two adjacent main compartments are separated by a bulkhead which is stepped under the conditions of regulation 7.5.1 the intact stability shall be adequate to withstand the flooding of those two adjacent main compartments.

1.3 Where the required factor of subdivision is 0.5 or less but more than 0.33 intact stability shall be adequate to withstand the flooding of any two adjacent main compartments.

1.4 Where the required factor of subdivision is 0.33 or less the intact stability shall be adequate to withstand the flooding of any three adjacent main compartments.

2.1 The requirements of paragraph 1 shall be determined by calculations which are in accordance with paragraphs 3, 4 and 6 and which take into consideration the proportions and design characteristics of the ship and the arrangement and configuration of the damaged compartments. In making these calculations the ship is to be assumed in the worst anticipated service condition as regards stability.

2.2 Where it is proposed to fit decks, inner skins or longitudinal bulkheads of sufficient tightness to seriously restrict the flow of water, the Administration shall be satisfied that proper consideration is given to such restrictions in the calculations.

* Refer to MSC/Circ.541 (as may be revised): Guidance notes on the integrity of flooding boundaries above the bulkhead deck of passenger ships for proper application of regulations II-1/8 and 20, paragraph 1, of SOLAS 1974, as amended.
2.3 The stability required in the final condition after damage, and after equalization where provided, shall be determined as follows:

2.3.1 The positive residual righting lever curve shall have a minimum range of $15^\circ$ beyond the angle of equilibrium. This range may be reduced to a minimum of $10^\circ$, in the case where the area under the righting lever curve is that specified in paragraph 2.3.2, increased by the ratio:

\[
\frac{15}{\text{range}}
\]

where the range is expressed in degrees.

2.3.2 The area under the righting lever curve shall be at least 0.015 metre-radians, measured from the angle of equilibrium to the lesser of:

.1 the angle at which progressive flooding occurs;
.
.2 $22^\circ$ (measured from the upright) in the case of one-compartment flooding, or $27^\circ$ (measured from the upright) in the case of the simultaneous flooding of two or more adjacent compartments.

2.3.3 A residual righting lever is to be obtained within the range of positive stability, taking into account the greatest of the following heeling moments:

.1 the crowding of all passengers towards one side;
.
.2 the launching of all fully loaded davit-launched survival craft on one side;
.
.3 due to wind pressure;

as calculated by the formula:

\[
GZ \text{ (in metres)} = \frac{\text{heeling moment}}{\text{displacement}} + 0.04
\]

However, in no case is this righting lever to be less than 0.1 m.

2.3.4 For the purpose of calculating the heeling moments in paragraph 2.3.3, the following assumptions shall be made:

.1 Moments due to crowding of passengers:

.1.1 four persons per square metre;
.
.1.2 a mass of 75 kg for each passenger;
.
.1.3 passengers shall be distributed on available deck areas towards one side of the ship on the decks where muster stations are located and in such a way that they produce the most adverse heeling moment.
Moments due to launching of all fully loaded davit-launched survival craft on one side:

2.1 all lifeboats and rescue boats fitted on the side to which the ship has heeled after having sustained damage shall be assumed to be swung out fully loaded and ready for lowering;

2.2 for lifeboats which are arranged to be launched fully loaded from the stowed position, the maximum heeling moment during launching shall be taken;

2.3 a fully loaded davit-launched liferaft attached to each davit on the side to which the ship has heeled after having sustained damage shall be assumed to be swung out ready for lowering;

2.4 persons not in the life-saving appliances which are swung out shall not provide either additional heeling or righting moment;

2.5 life-saving appliances on the side of the ship opposite to the side to which the ship has heeled shall be assumed to be in a stowed position.

Moments due to wind pressure:

3.1 a wind pressure of 120 N/m² to be applied;

3.2 the area applicable shall be the projected lateral area of the ship above the waterline corresponding to the intact condition;

3.3 the moment arm shall be the vertical distance from a point at one half of the mean draught corresponding to the intact condition to the centre of gravity of the lateral area.

In intermediate stages of flooding, the maximum righting lever shall be at least 0.05 m and the range of positive righting levers shall be at least 7°.

In all cases, only one breach in the hull and only one free surface need be assumed.

For the purpose of making damage stability calculations the volume and surface permeabilities shall be in general as follows:

<table>
<thead>
<tr>
<th>Spaces</th>
<th>Permeability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriated to cargo, coal or stores</td>
<td>60</td>
</tr>
<tr>
<td>Occupied by accommodation</td>
<td>95</td>
</tr>
<tr>
<td>Occupied by machinery</td>
<td>85</td>
</tr>
<tr>
<td>Intended for liquids</td>
<td>0 or 95*</td>
</tr>
</tbody>
</table>

Higher surface permeabilities are to be assumed in respect of spaces which, in the vicinity of the damage waterplane, contain no substantial quantity of...
accommodation or machinery and spaces which are not generally occupied by any substantial quantity of cargo or stores.

**4** Assumed extent of damage shall be as follows:

.1 longitudinal extent: 3 m plus 3% of the length of the ship, or 11 m, whichever is the less. Where the required factor of subdivision is 0.33 or less the assumed longitudinal extent of damage shall be increased as necessary so as to include any two consecutive main transverse watertight bulkheads;

.2 transverse extent (measured inboard from the ship’s side, at right angles to the centreline at the level of the deepest subdivision load line): a distance of one fifth of the breadth of the ship, as defined in regulation 2; and

.3 vertical extent: from the base line upwards without limit;

.4 if any damage of lesser extent than that indicated in paragraphs 4.1, 4.2 and 4.3 would result in a more severe condition regarding heel or loss of metacentric height, such damage shall be assumed in the calculations.

**5** Unsymmetrical flooding is to be kept to a minimum consistent with efficient arrangements. Where it is necessary to correct large angles of heel, the means adopted shall, where practicable, be self-acting, but in any case where controls to cross-flooding fittings are provided they shall be operable from above the bulkhead deck. These fittings together with their controls shall be acceptable to the Administration. The maximum angle of heel after flooding but before equalization shall not exceed 15°. Where cross-flooding fittings are required the time for equalization shall not exceed 15 min. Suitable information concerning the use of cross-flooding fittings shall be supplied to the master of the ship.*

**6** The final conditions of the ship after damage and, in the case of unsymmetrical flooding, after equalization measures have been taken shall be as follows:

.1 in the case of symmetrical flooding there shall be a positive residual metacentric height of at least 50 mm as calculated by the constant displacement method;

.2 in the case of unsymmetrical flooding, the angle of heel for one-compartment flooding shall not exceed 7°. For the simultaneous flooding of two or more adjacent compartments, a heel of 12° may be permitted by the Administration;

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* Refer to the Recommendation on a standard method for establishing compliance with the requirements for cross-flooding arrangements in passenger ships adopted by the Organization by resolution A.266(VIII).
Chapter II-1: Construction – structure, stability, installations
Regulation 8

3 in no case shall the margin line be submerged in the final stage of flooding. If it is considered that the margin line may become submerged during an intermediate stage of flooding, the Administration may require such investigations and arrangements as it considers necessary for the safety of the ship.

7.1 The master of the ship shall be supplied with the data necessary to maintain sufficient intact stability under service conditions to enable the ship to withstand the critical damage. In the case of ships requiring cross-flooding the master of the ship shall be informed of the conditions of stability on which the calculations of heel are based and be warned that excessive heeling might result should the ship sustain damage when in a less favourable condition.

7.2 The data referred to in paragraph 7.1 to enable the master to maintain sufficient intact stability shall include information which indicates the maximum permissible height of the ship's centre of gravity above keel (KG), or alternatively the minimum permissible metacentric height (GM), for a range of draughts or displacements sufficient to include all service conditions. The information shall show the influence of various trims taking into account the operational limits.

7.3 Each ship shall have scales of draughts marked clearly at the bow and stern. In the case where the draught marks are not located where they are easily readable, or operational constraints for a particular trade make it difficult to read the draught marks, then the ship shall also be fitted with a reliable draught indicating system by which the bow and stern draughts can be determined.

7.4 On completion of loading of the ship and prior to its departure, the master shall determine the ship’s trim and stability and also ascertain and record that the ship is in compliance with stability criteria in the relevant regulations. The determination of the ship’s stability shall always be made by calculation. The Administration may accept the use of an electronic loading and stability computer or equivalent means for this purpose.

8.1 No relaxation from the requirements for damage stability may be considered by the Administration unless it is shown that the intact metacentric height in any service condition necessary to meet these requirements is excessive for the service intended.

8.2 Relaxations from the requirements for damage stability shall be permitted only in exceptional cases and subject to the condition that the Administration is to be satisfied that the proportions, arrangements and other characteristics of the ship are the most favourable to stability after damage which can practically and reasonably be adopted in the particular circumstances.
Regulation 8-1

Stability of ro–ro passenger ships in damaged condition*

Ro–ro passenger ships constructed before 1 July 1997 shall comply with regulation 8, as amended by resolution MSC.12(56), not later than the date of the first periodical survey after the date of compliance prescribed below, according to the value of $A/A_{\text{max}}$ as defined in the annex of the Calculation Procedure to assess the survivability characteristics of existing ro–ro passenger ships when using a simplified method based upon resolution A.265(VIII), developed by the Maritime Safety Committee at its fifty-ninth session in June 1991 (MSC/Circ.574).†

<table>
<thead>
<tr>
<th>Value of $A/A_{\text{max}}$</th>
<th>Date of compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 85%</td>
<td>1 October 1998</td>
</tr>
<tr>
<td>85% or more but less than 90%</td>
<td>1 October 2000</td>
</tr>
<tr>
<td>90% or more but less than 95%</td>
<td>1 October 2002</td>
</tr>
<tr>
<td>95% or more but less than 97.5%</td>
<td>1 October 2004</td>
</tr>
<tr>
<td>97.5% or more</td>
<td>1 October 2005</td>
</tr>
</tbody>
</table>

Regulation 8-2

Special requirements for ro–ro passenger ships carrying 400 persons or more

Notwithstanding the provisions of regulations 8 and 8-1:

.1 Ro–ro passenger ships certified to carry 400 persons or more constructed on or after 1 July 1997 shall comply with the provisions of paragraph 2.3 of regulation 8, assuming the damage applied anywhere within the ship’s length $L$; and

.2 Ro–ro passenger ships certified to carry 400 persons or more constructed before 1 July 1997 shall comply with the requirements of subparagraph .1 not later than the date of the first periodical survey after the date of compliance prescribed in subparagraph .2.1, .2.2 or .2.3 which occurs the latest:

<table>
<thead>
<tr>
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</tr>
<tr>
<td>95% or more but less than 97.5%</td>
<td>1 October 2004</td>
</tr>
<tr>
<td>97.5% or more</td>
<td>1 October 2010</td>
</tr>
</tbody>
</table>

* For the application of specific stability requirements to ro–ro passenger ships, refer to resolution 14 of the 1995 SOLAS Conference and resolution MSC.141(76), Revised model test method under resolution 14 of the 1995 SOLAS Conference.

† Refer to MSC/Circ.649, Interpretations of provisions of resolution MSC.26(60) and MSC/Circ.574.
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Regulation 8-3

Special requirements for passenger ships, other than ro–ro passenger ships, carrying 400 persons or more

Notwithstanding the provisions of regulation 8, passenger ships, other than ro–ro passenger ships, certified to carry 400 persons or more constructed on or after 1 July 2002 shall comply with the provisions of paragraphs 2.3 and 2.4 of regulation 8, assuming the damage applied anywhere within the ship’s length \( L \).

Regulation 9

Ballasting of passenger ships

1 Water ballast should not in general be carried in tanks intended for oil fuel. In ships in which it is not practicable to avoid putting water in oil fuel tanks, oily-water separating equipment to the satisfaction of the Administration shall be fitted, or other alternative means, such as discharge to shore facilities, acceptable to the Administration shall be provided for disposing of the oily-water ballast.

2 The provisions of this regulation are without prejudice to the provisions of the International Convention for the Prevention of Pollution from Ships in force.

Regulation 10

Peak and machinery space bulkheads, shaft tunnels, etc., in passenger ships\(^*\)

1 A forepeak or collision bulkhead shall be fitted which shall be watertight up to the bulkhead deck. This bulkhead shall be located at a

\(^*\) Refer to MSC/Circ.855, Interpretation of the position of the forward perpendicular for the purpose of SOLAS regulation II-1/10.
3  **Breadth of the ship** is the extreme width from outside of frame to outside of frame at or below the deepest subdivision load line.

4  **Draught** is the vertical distance from the moulded base line amidships to the subdivision load line in question.

5  **Bulkhead deck** is the uppermost deck up to which the transverse watertight bulkheads are carried.

6  **Margin line** is a line drawn at least 76 mm below the upper surface of the bulkhead deck at side.

7  **Permeability of a space** is the percentage of that space which can be occupied by water. The volume of a space which extends above the margin line shall be measured only to the height of that line.

8  **Machinery space** is to be taken as extending from the moulded base line to the margin line and between the extreme main transverse watertight bulkheads, bounding the spaces containing the main and auxiliary propulsion machinery, boilers serving the needs of propulsion, and all permanent coal bunkers. In the case of unusual arrangements, the Administration may define the limits of the machinery spaces.

9  **Passenger spaces** are those spaces which are provided for the accommodation and use of passengers, excluding baggage, store, provision and mail rooms. For the purposes of regulations 5 and 6, spaces provided below the margin line for the accommodation and use of the crew shall be regarded as passenger spaces.

10  In all cases volumes and areas shall be calculated to moulded lines.

11  **Weathertight** means that in any sea conditions water will not penetrate into the ship.


13  **Ro–ro passenger ship** means a passenger ship with ro–ro cargo spaces* or special category spaces as defined in regulation II-2/3.

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**Regulation 3**  
**Definitions relating to parts C, D and E**

For the purpose of parts C, D and E, unless expressly provided otherwise:

1  **Steering gear control system** is the equipment by which orders are transmitted from the navigation bridge to the steering gear power units.

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* This relates to the chapter II-2 in force before 1 July 2002. The equivalent term in the amended chapter II-2 is “ro–ro spaces”.

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Part B
Subdivision and stability*

(Part B applies to passenger ships and to cargo ships, as indicated in the regulations)

Regulation 4
Floodable length in passenger ships

1 The floodable length at any point of the length of a ship shall be determined by a method of calculation which takes into consideration the form, draught and other characteristics of the ship in question.

2 In a ship with a continuous bulkhead deck, the floodable length at a given point is the maximum portion of the length of the ship, having its centre at the point in question, which can be flooded under the definite assumptions set forth in regulation 5 without the ship being submerged beyond the margin line.

3.1 In the case of a ship not having a continuous bulkhead deck, the floodable length at any point may be determined to an assumed continuous margin line which at no point is less than 76 mm below the top of the deck (at side) to which the bulkheads concerned and the shell are carried watertight.

3.2 Where a portion of an assumed margin line is appreciably below the deck to which bulkheads are carried, the Administration may permit a limited relaxation in the watertightness of those portions of the bulkheads which are above the margin line and immediately under the higher deck.

Regulation 5
Permeability in passenger ships

1.1 The definite assumptions referred to in regulation 4 relate to the permeability of the spaces below the margin line.

1.2 In determining the floodable length, a uniform average permeability

* Instead of the requirements in this part, the Regulations on subdivision and stability of passenger ships as an equivalent to part B of chapter II of the International Convention for the Safety of Life at Sea, 1960, adopted by the Organization by resolution A.265(VIII), may be used, if applied in their entirety.
CHAPTER 3 - SPECIAL CRITERIA FOR CERTAIN TYPES OF SHIPS

3.1 Passenger ships

Passenger ships shall comply with the requirements of 2.2 and 2.3.

3.1.1 In addition, the angle of heel on account of crowding of passengers to one side as defined below shall not exceed $10^\circ$.

3.1.1.1 A minimum weight of $75 \text{ kg}$ shall be assumed for each passenger except that this value may be increased subject to the approval of the Administration. In addition, the mass and distribution of the luggage shall be approved by the Administration.

3.1.1.2 The height of the centre of gravity for passengers shall be assumed equal to:

- 1 m above deck level for passengers standing upright. Account may be taken, if necessary, of camber and sheer of deck; and
- 0.3 m above the seat in respect of seated passengers.

3.1.1.3 Passengers and luggage shall be considered to be in the spaces normally at their disposal, when assessing compliance with the criteria given in 2.2.1 to 2.2.4.

3.1.1.4 Passengers without luggage shall be considered as distributed to produce the most unfavourable combination of passenger heeling moment and/or initial metacentric height, which may be obtained in practice, when assessing compliance with the criteria given in 3.1.1 and 3.1.2, respectively. In this connection, a value higher than four persons per square metre is not necessary.

3.1.2 In addition, the angle of heel on account of turning shall not exceed $10^\circ$ when calculated using the following formula:

$$ M_R = 0.200 \times \frac{\nu_0}{L_{wl}} \times \Delta \times (KG - \frac{d}{2}) $$

where:

- $M_R$ = heeling moment (kNm)
- $\nu_0$ = service speed (m/s)
- $L_{wl}$ = length of ship at waterline (m)
- $\Delta$ = displacement (t)
- $d$ = mean draught (m)
- $KG$ = height of centre of gravity above baseline (m).