Commercial vessels design concepts

1. Load of the commercial vessel

1.1. General concepts
1.2. Detailing of the vessel load
1.3. Vessel displacement empty, displacement stock
1.4. Deadweight of commercial vessel
1.5. Standard types of displacement
1.6. The factors of the vessel displacement utilization

2. Dependences of the masses individual pieces and groups of loads on the characteristics of vessel

2.1. General concepts
2.2. The load group «hull»
2.3. The load group «hull» particulary
2.4. The load groups: «ship devices» and «ship hull systems»
2.5. The load group «ship power plant»
2.6. The load groups: «electric power system, Intercommunication and control» and « radio navigation equipment»
2.7. The load groups: «spare parts», « supplies and equipment»
2.8. The load groups: «ballast» and « constant liquid cargo»
2.9. The load group «stock of displacement and stock for stability»
2.10. The load group «crew, food, water, supplies, consumables, liquid cargo»
2.11. The load group « cargo transported»
2.12. The load groups: «variables of liquid cargo», « liquid ballast», «cargoes, supplies, stocks additional»
2.13. The load group «supplies of fuel, engine oil and fresh water»

3. The equation of the load (mass balance) as a function of displacement. Determination of displacement for the vessel design

3.1. General concepts
3.2. Composing of the mass balance equation and it solution
3.3. Some forms of mass balance equations. The equation of the displacement utilization factor. Composing of the provisional table of the projected workload of the vessel
3.4. Effect of changing parameters and independent of the masses to the load. The derivative of the equation of the load as a function of displacement. Norman’s factor
3.5. Determination of the mass increments when changing the elements of the vessel load
3.6. Calculation of the Norman’s factor
3.7. The relationship between Norman's factor of the vessel load increment and cargo-displacement ratio

4. The concepts of vessel main dimensions determination. Load balance equation as a function of main dimensions and of block coefficient of hull shape completeness of vessel hull

4.1. Ways of defining of main dimensions of the vessel and of hull block coefficient of hull shape completeness at a known displacement
4.2. Load balance equation as a function of main dimensions and of hull block coefficient of hull shape completeness. Compilation and solution of load balance equation
4.3. Derivative form of load balance equation as a function of main dimensions of the vessel and of hull block coefficient of hull shape completeness

4.4. Calculation of the dependent mass of mechanisms and fuel on block coefficient of hull shape completeness and on main dimensions
4.5. Solution of load balance equation in derivative form in the options depending on the displacement of the vessel of hull block coefficient of hull shape completeness and on main dimensions
4.6. Refined definition of dimensions of the vessel, of hull block coefficient of hull shape completeness and displacement
4.7. Determination of the increment of the load when the vessel dimensions and hull shape vary, the coefficient of Norman for such increments
4.8. The accuracy of formulas, including small increments of variables in determining the load of the vessel

5. Vessel tonnage and capacity

5.1. Full theoretical capacity of the vessel
5.2. The equation of the volume (capacity). Determination of ratio of depth to draught
5.3. The increment factor of displacement volume at capacity vary
5.4. Equation of capacity of dry cargo vessel with a middle engine room
5.5. Capacity-deadweight ratio of vessel, stowage rate. Relationship of vessel capacity-deadweight ratio with relative depth (ratio of the vessel depth to draught)
5.6. Equation of capacity for the vessels with double sides and ships to transport wood, taking deck cargo
5.7. Capacity of dry cargo vessels with a stern and intermediate engine room. Leveling of trim at various loads of the vessel
5.8. Vessel capacity variations of the small increments of main dimensions
5.9. Capacity of tanker ships (liquid cargo). The location of ballast tanks on tankers. Leveling of trim of the vessel in ballast passage
5.10. Tonnage of the vessel, determined by International Rules measurement

6. Interdependences of vessel hull shape characteristics. Accounting of characteristics variations

6.1. Applicable methods of statistical data process. Statistical approximation of the data according to the method of minimum squared residuals. Deviation of the statistical data from their average values. Using Microsoft Office or software for statistical data processing
6.2. The relationship between the indexes of the completeness of vessel hull shape by Norman. Distribution along the length of the vessel area and average ordinate of immersed theoretical frames
6.3. Determination of the shape completeness of theoretical mid-ship frame (submerged part)
6.4. Determination of the longitudinal sharpening of vessel hull shape
6.5. Determination of the completeness index of cargo waterline (load line)
6.6. The interdependences besides the metacentre elevation, the vessel dimensions, block coefficient of hull shape and the shape completeness indexes
6.7. Formulas of Euler, Okunev and Norman for the determination of buoyancy center Z-direction above the keel
6.8. Dependence of the metacentric radius on vessel main dimensions, block coefficient of hull shape and the shape completeness indexes

7. Ensure the vessel's stability and smooth rolling in the design

7.1. Transverse metacentric height as index of the vessel's stability. Relative metacentric height
7.2. Effect of sea swell for ship pitching

7.3. The interdependence of own period of roll with its dimensions and metacentric height
7.4. Evaluation of smooth roll of a vessel for maximum acceleration
7.5. Recommendations for choice in the design of the ship of its values of metacentric height and the relative metacentric height (the ratio of metacentric height to the breadth of the vessel), characterizing the initial stability
7.6. Concepts of the vessel stability equation. The equation of stability as function of the relative metacentric height. Determination of the relative breadth of the vessel (the ratio of the vessel breadth to draught) and its relationship with other characteristics of the vessel design
7.7. The equation of the vessel stability in the derivative form. The change the position of metacentre height with change of vessel dimensions and indexes of hull shape completeness
7.8. Ensuring stability of the vessel at high angles of heel

8. Vessel buoyancy reserve and freeboard. Providing unsinkability at the vessel design

8.1. General concepts, determination of buoyancy reserve in the design of the vessel
8.2. Effect of freeboard on the seaworthiness of the vessel
8.3. Basic freeboard of the ship and standard deck sheer, the corresponding buoyancy reserve
8.4. Major amendments to the basic freeboard. Providing of the buoyancy reserve. Reduced and the excess freeboard
8.5. Freeboard in the bow of the vessel
8.6. Providing of the unsinkability at vessel design, the number and distribution of the transverse watertight bulkheads along the length of the vessel

9. Determining of propulsion for design of the ship

9.1. General concepts, bases for calculating the required capacity of ship propulsion
9.2. Determination of the capacity of power plant in accordance with Admiralty coefficient
9.3. Determination of the capacity of power plant by the double-component formulas, depending on the tonnage of the vessel and cruising speed
9.4. Functional dependence of towing capacity and the resistance on ship speed. Critical speed
9.5. Vessel cruising speed. Power reserve. The index of velocity (factor of the cruising speed use)
9.6. General geometric characteristics of the vessel hull shape. The theoretical drawing contours and shape of the vessel distribution along the length of the vessel submerged area of theoretical frames (section-area curve)
9.7. Determination of the wetted surface area of vessel hull. Distribution of theoretical waterlines on draft vessel
9.8. Effect of the length of vessel hull for propulsion. Determination of the relative length of vessel hull
9.9. Sharpening of vessel medium water line shape. Indexes of longitudinal sharpening of the vessel hull shape and vessel hull block coefficient
9.10. The location of the buoyancy center along the length of the vessel. The location of the theoretical maximum frame section along the length of the vessel. The indexes of the completeness of the vessel peaks
9.11. Sharpening of the vessel aft shape
9.12. Shape of the vessel fore

10. Theoretical drawing of vessel hull shape

10.1. General concepts and terms
10.2. Approximate methods of distribution of submerged areas of theoretical frames along the length of the vessel (section-area curve) and theoretical areas of waterlines on draught
10.3. Yakovlev way of theoretical drawing of vessel hull shape
10.4. Theoretical balance - frames, frames the largest cross-section
10.5. Affine drawing by the vessel-prototype shape
10.6. Interpolation method of hull shape theoretical drawing
10.7. The transformation of the theoretical drawing of the vessel - prototype based on the distribution of submerged areas of theoretical frames (section-area curve) along the length of the project ship
10.8. Drawings of shape of projected vessel hull by unite analytic equation. Parabolic method
10.9. Radial method of Pavlenko for drawing of developable on plane shape surface of vessel hull

11. General systematic approach for ship project optimization

11.1. Economical indexes and criteria of efficiency of the commercial vessel or another asset of marine company property complex
11.2. The determination of the characteristics and particulars of the cargo vessel by the example of ferries for Pacific transportations
11.3. The criterion functions for optimization of the characteristics and particulars for the commercial order commercial of commercial vessel, other asset or the marine company property complex, based on application of economic criteria and value index
11.4. The system approach for the criterion functions elaboration for project characteristics optimization of commercial vessel, real asset or structure of marine company property complex
11.5. The economic criteria for the commercial vessel characteristics and particulars optimization, based on expenses minimization
11.6. The optimality criteria of the commercial vessel project characteristics, based on an estimation of indexes of profitableness
11.7. The causes of target and data uncertainty resulting to economic multicriteriality
11.8. The investments efficiency generalized criteria based on value indexes
11.9. The recommendations concerning the criteria choice for project optimization and investments evaluation in the marine industrial activity
11.10. The methodological contradictions of economic criteria appropriate for the optimization of the commercial vessel characteristics and particulars
11.11. An estimation of investments efficiency by criterion of the marine resources contribution in structure of value of commercial vessel