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SUMMARIES

G.V. Boytsov, G.B. Kryzhevich. **Demands and approaches in updating requirements to overall strength of sea–river and river ships.** Pp. 5–16.

Authors describe serious disadvantages of calculation requirements to overall strength of sea–river and river ships, which contained in Rules of Russian River Register, published in 2002 and, mainly, kept in new edition of these Rules published in 2008. Authors note that main disadvantage of these requirements is that absolutely different in form and content results of determining additional bending moments at ship hull imposed by waves are given for similar wave conditions. Authors indicate disadvantages in prerequisites adopted in formulations of calculation algorithms for determining dynamic components of general bending moments for river ships imposed by slamming and wave vibrations. Authors propose possible solutions and specific algorithms to eliminate indicated disadvantages.
Key words: *bending moment, dynamic load, slamming, wave vibrations*

G.V. Egorov, N.V. Avtutov. **Perspectives of present sea–river fleet.** Pp. 17–28.

This article is natural and actual sequel of previous article of the author called "Sea–river ships. History and economic role". The article contains more detailed analysis of statistic data on fleet configuration, average age, damageability of hull components and equipment for Russian sea–river ships, risks of operation at sea and detection of further perspectives for present sea–river fleet.
Author was able to demonstrate that high average age of present sea–river fleet of 24–30 years, considerable change of operation conditions and associated with that increase of corrosive wear, as well as exhaust of fatigue life, lead to significant increase of risk associated with actual dangers for crew lives and large ecologic consequences, which already could not be blocked only through administrative measures introduced by fleet authorities, ports and classification societies. Therefore, main approaches to reduce risks in operation of sea–river ships is principal renovation of the fleet either through conversion of existing ships along with increase of their wear and fatigue life or development of new ships considering changed operation conditions combined with more strict administrative control measures for all factors that govern operational risks.
Key words: *sea–river ship, risk analysis, safety, reliability, deterioration, damage*

V.N. Tryaskin, Myint Khine. **Application of mathematical programming apparatus in solving problems of parametric designing the ship hull structures.** Pp. 29–40.

This article introduces a concept of parametric design of ship structures and proposes an effective approach to solve tasks of parametric design of ship structures using optimisation – search procedures of mathematical programming apparatus. Authors examine statement and solution of tasks related to designing frames of double board with optimisation of horizontal platform positions; task of designing bulkhead plating sheets using flexible plate model; task of designing longitudinal connections accounting requirement to overall strength. Tasks are solved using "Solution Search" and "Parameter Selection" tools of Microsoft Excel.
Key words: *mathematical programming, parametric design, ship structure*

A.A. Golovkin, A.B. Nesterov. **Determining parameters of ship movement and ice load during ramming as applied to arctic ice-going ships.** Pp. 41–52.

Development of oil and gas resources at arctic shelf and Russian North shore requires designing new types of ice-going ships. Task of determining interaction forces and movement parameters during stem impact against ice (ramming) could be actual for such ships. At that, case with impact against limited thickness ice, when vertical force value of interaction is restricted by ice bearing capacity, and case with impact against grounded hummock (stamukha), i.e. thick ice formation that touches sea bottom, which bending destruction is impossible, should be differentiated. Authors have formulated main assumptions for physical model that uses modified hydrodynamic model of ship impact against ice.
Algorithm and software for numerical calculations of ship movement parameters during stem impact against ice are developed. Approximate calculation ratio for determining vertical force of interaction with ice during impact against grounded hummock is proposed.
Key words: *arctic ship, ice load, interaction with ice, movement parameters*

G.V. Boytsov. **Estimation of effect of distances between wave shelter places for sea–river ships on their overall loading.** Pp. 53–64.

The article lists typical conditions of sea–river ship operation at sea that govern complex patterns of wave conditions imposing operational loads on their hulls. Author describes main of these conditions including long-term probabilistic distributions of sea wave intensity, prediction validity, duration of excess wave modes, their development and decay patterns. Author defines concretely the concept of storm and statistical parameters of storm description, which governs requirements to shelter ships at wave shelters. Author proposes ratios that determine reduction of probability of the excess waves due to usage of wave shelters. Author describes specific procedure for accounting effect of wave shelter on calculation conditions of extreme wave loading on ship hulls.
Key words: *sea wave, wave conditions, meteorological conditions , wave shelter*

V.M. Ryabov, I.A. Saraeva, N.V. Bournasheva, V.M. Grekov, O.YA. Timofeev, P.A. Lopashev. **Estimation of strength and service life of structural components of ship-borne rescue hyperbaric chamber.** Pp. 65–70.

Authors examine problems that appear in course of studying the stressed state, strength and service life of hyperbaric chamber set under their combined operation with each other and carrying ship decks. Authors determine system of requirements to stating the initial information regarding operation conditions and comprehensive calculation estimation of strength and service life of ship-born hyper-baric chamber structural components.
Key words: *stress condition, strength, resources, hyperbaric chamber, diving-bell*

G.V. Boytsov. **Some issues of calculating and regulating strength of structures under effect of wave and hydrostatic loads.** Pp. 71–78.

1. Author gives calculation ratios estimating effect of sea areas limited depths (shallow waters) on values of wave bending moments acting on ship hulls due to wind waves. Author provides practical recommendations regarding effect of this factor.
2. Author estimates effect of limits over allowable heights of operational waves on calculation wave bending moments of the sea–river ship hulls. Author provides recommendations on calculation predictions of this factor effect in course of stating the requirements to overall strength of this type of vessels.
3. Author examines effect of economical responsibility associated with providing structure strength on selection of safety factors for the overall strength. Author estimates role of this factor basing on experience obtained during regulating of ultimate hull strength and application of this experience to estimations of safety factor of ultimate strength for Saint-Petersburg flooding protection

(caisson gates). These estimation results are compared with solution of similar problem basing on Construction Rules and Regulations of Russian Federation for hydrotechnic facilities.

Key words: *ship hull, bending moment, overall strength, safety, reserve coefficient*

S.V. Sochinskiy, G.V. Boytsov. **Calculation of strength and stiffness of open-deck vessels under effect of torsion moments.** Pp. 79–88.

Authors propose methodology for calculating hull strength of ships with open deck under effect of torsion moments in accordance with Russian Register Rules & Regulations. This methodology is based on technical theory of constrained torsion of thin-walled multi-linked structures and uses software for calculating sectorial characteristics of the hull cross-sections and numerical integrations of constrained torsion differential equations through sweep method. At that, performed calculations include determining degree of constrain crook warp at ends and calculation of normal stresses at deck structures under constrained torsion, as well as estimations of parameters describing distortion of deck cutout contours.

Key words: *torsion, ship, open-deck vessel, thin-wall structure, hull cross section*

A.A. Rodionov, Go Tzun. **Mathematical simulation of failure process at board structure beam of the rammed ship.** Pp. 89–102.

Authors examine failure process of ship hull board structure under collision. Authors use simple beam models based on analytical methods and more accurate numerical models of the finite element method. Authors estimate components of the destruction energy related to bending and membrane deformations. Authors provide recommendations on application of calculation models of finite element method in problems associated with structure failure.

Key words: *rammed ship, destruction, ship structure, limit load, finite element method*

N.F. Butenko, I.F. Davydov, V.V. Kozlyakov, A.A. Soloviev. **Specific details of overall transverse strength calculations for ocean dry-cargo one-hold vessels.** Pp. 103–122.

The advent of one-hold ocean dry-cargo vessels called for the analysis of their stress-strained state taking into account interactions with hatch covers.

An approximate method of structural analysis under overall transverse bending of these vessels is justified. Results of the analysis for one of these vessels are in satisfactory agreement with benchmark results obtained by finite element method (FEM) both for plate representation (ISPA software) and rod representation (FEM-94 software).

Summation of stresses is found to be required in the base section of deck stringer and web frame elements in mid-hold area, also it is required to control the highly stressed state of buttresses at hatch-side coamings and ensure local strength of hatch cover fixing details.

Key words: *one-hold vessel, local strength, hatch cover, buttress*

V.I. Alferov, N.A. Steshenkova. **FEM and thermoplastic analysis of residual strains in vessel shell rings welded using automatic indirect one-pass MIG technique, (cross-hill).** Pp. 123–138.

This paper deals with analytical calculation of residual strains in butt joints of cylinder vessel shell rings thickness $s = 20$ mm) welded by “cross-hill” automatic indirect one-pass MIG method. The solution of thermoplastic problem by FEM provides reliable estimate of welding strain in cylinder and spherical shells of LNG carriers and other ship structures. The development and application of analytical methods for calculation of welding strains is important for improving manufacturing processes and elaboration of measures for reducing (compensation) of welding strains.

Key words: *welding, residual strain and stress, thermal field, spherical shell, cylindrical shell*

G.B. Kryzhevich, V.V. Ishkov. **Effect of fixed bow stabilizer foils on pitch, heave and overall bending of high-speed craft.** Pp. 139–154.

The use of fixed bow stabilizer foils on high-speed craft may reduce the amplitudes, velocities and accelerations of pitch, heave and roll as well as environmental loads critical to hull structure strength. Some data on the efficiency of such foils are available but presently these are not taken into account in calculation of design loads on ship structures. No studies on optimization of foil shapes and locations along the ship hull length have been done. Moreover, in spite of some publications on this subject no reliable mathematical models have yet been developed for estimation of hydrodynamic forces on stabilizer foils under motions of high-speed vessels. In an effort to fill the gap this paper describes a mathematical model for including the effect of fixed bow stabilizer foils with low aspect ratio on pitch and heave of a high-speed vessel. Reduction of heave and pitch amplitudes, bow heave accelerations as well as bending moment amplitudes at hull cross sections is estimated for a range of ship speeds, stabilizer foil shapes and dimensions.
Key words: *high-speed craft, external load, pitching, rolling, passive stabilizer*

A.M. Puzyrev, G.A. Tumashik. **Evaluation of stressed-strained state and bearing capacity of shells with shape defects.** Pp. 155–166.

The effect of as-built defects of various types on stressed state and bearing capacity of stiffened cylinder shells is investigated. The studies are based on finite element techniques implemented in the ANSYS software package.
The following types of defects have been considered:

- Plating deflection – local plating deviations from regular shape with respect to frames in the form of dents and bulges;
- Offsets in butt and longitudinal welds – misalignment of plate edges in way of butt and longitudinal welds on shell plating;
- Angularity of butt and longitudinal welds – local plating deviations from regular shape in the form of kinks in way of butt and longitudinal welds;
- Frame angle deviation – out- of- plane web deviation.

Also, some combinations of defects have been examined:

- Plating deflection + Frame angle deviation;
- Offset + Angularity of butt welds;
- Offset + Angularity of longitudinal welds.

These types of defects were modelled using a wide range of finite elements for evaluating the stressed state and bearing capacity of stiffened shells. The stressed state was calculated based on geometrically linear and non-linear assumptions; the bearing capacity was calculated based on geometrically and physically non-linear assumptions.
This paper describes the calculation models applied for the above-listed types of defects and combinations thereof, presents the calculation results and compares these with available analytical solutions.
Key words: *cylindrical shell, rib, bearing capacity, finite element technique, deflection, stressed state*

S.S. Novikov, A.G. Taubin. **Implications of the ice load local character for the strength of three-layer metal domes.** Pp. 167–172.

The paper proves the necessity of sonar dome ice strength calculations. It is shown that the ice load profile has a vivid peak-type character, and it is governed by the load value per unit length, load distribution height and contact patch length.
The stressed-strained state of a three-layer metal dome structure is analyzed. It is demonstrated that due account of ice load local character results in reduction of plating deflections by = 40 % as compared to the dome assumed to be under distributed load.
Key words: *ice strength, local ice load, metal dome*

P.A. Lopashev. **Method for automatic account of geometric shape defects for cylinder shells in FEM analysis of bearing capacity.** Pp. 173–180.

Submersible hulls are stiffened cylinder shells. Shape irregularities are mainly associated with manufacturing processes involving welding and bending jobs. State-of-the-art geometry control techniques have great capabilities in terms of accuracy and resolution. In this connection there is a requirement to process a large amount of measured data. The automatic method is using a geometric upgrade of already available finite-element model. Interpolation procedure is used for generation of a smooth function passing through discrete values of deviations. All nodes of FEM model are given deviations from the initial ideal geometric shape. The method is validated using FEM model of a cylinder compartment part. The comparison of calculations performed on the basis of the “ideal” and upgraded models indicates low discrepancy between results for the assumed deviations.
Key words: *shape irregularities, cylindrical shell, finite element technique*

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