MULTI-HULL SHIPS: strength, structure mass

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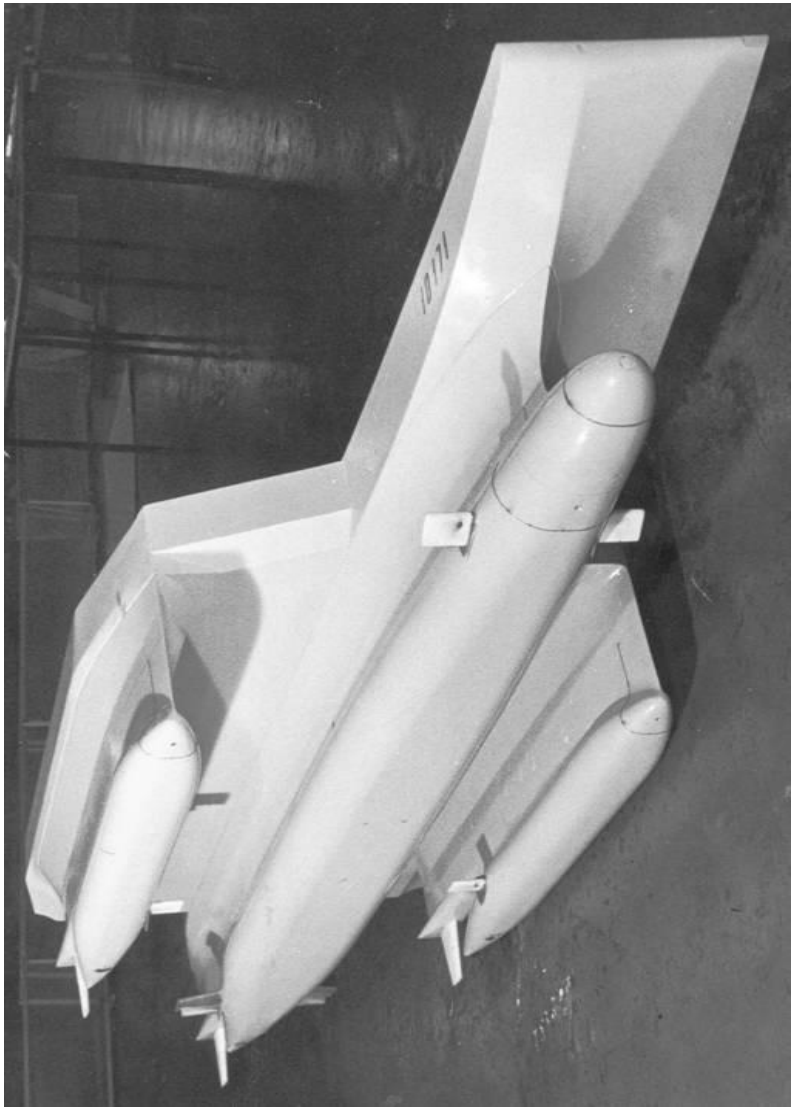
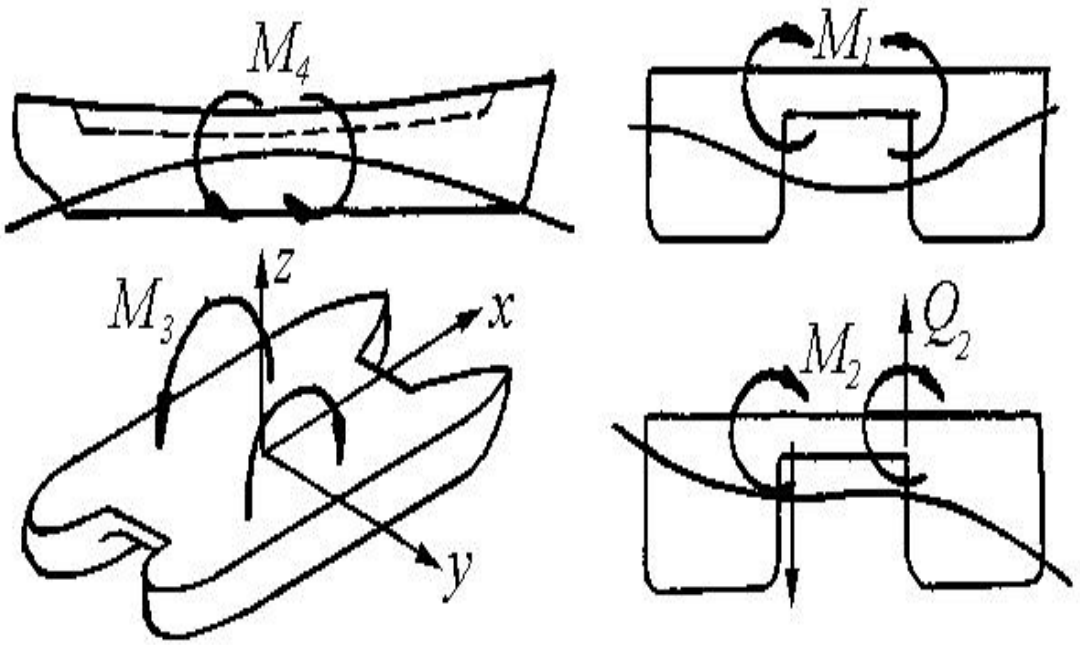
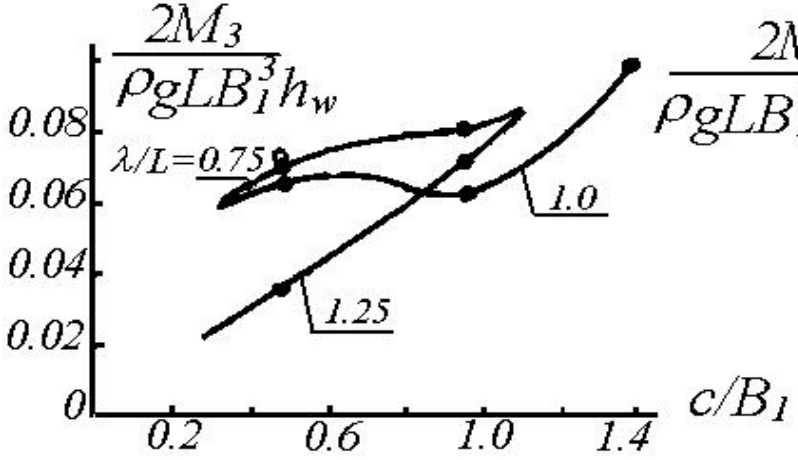


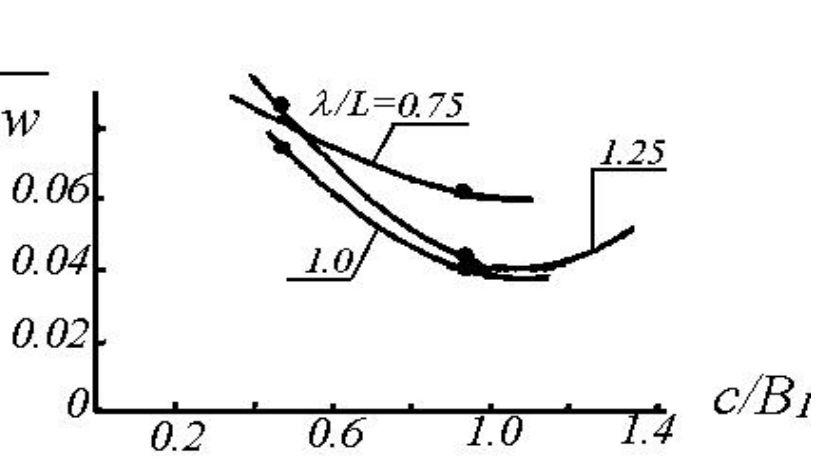
Simplified scheme for catamaran external loads [1].



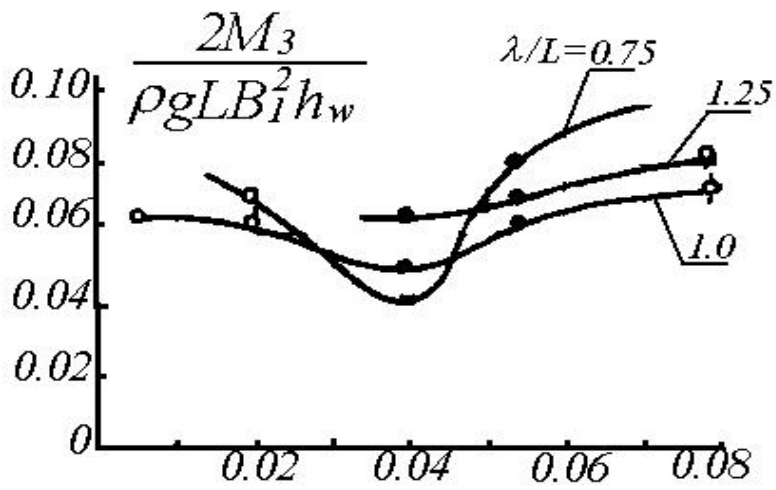
Some experimental data on clearance influence on external bending moments [1].



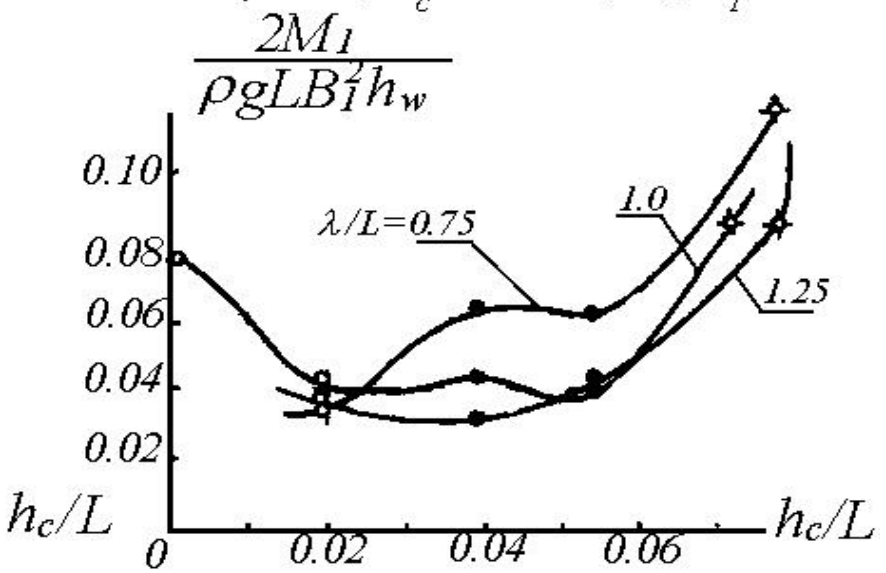
$\varphi=60°;\ h_c/L=0.055;\ z_0/B_1=0.54$



$\varphi=90°;\ h_c/L=0.055;\ z_0/B_1=0.54$



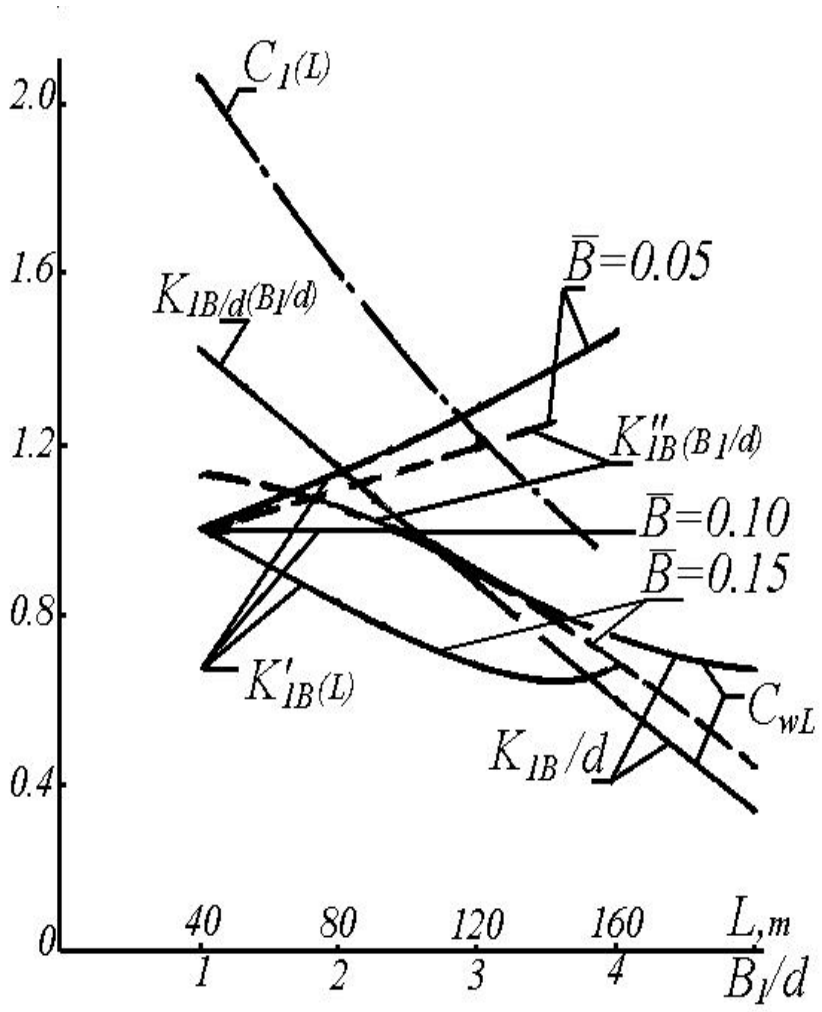
$\varphi=60°;\ c/B_1=0.95$



$\varphi=90°;\ c/B_1=0.95$

$M_1 = K_{1B/d} K'_{1B} K''_{1B} C_1 C_{WL}^{0.4} \rho g B_1 d L z_0$

An example of the data for approximate estimation of catamaran external loads [1]: symmetrical moment M_1.



$$M_1 = K_{1(B/d)} * K`_{1\underline{B}} * K``_{1\underline{B}} * C_1 * C_{WL}^{0.4} * \rho g B_1 d\, L\, z_0$$

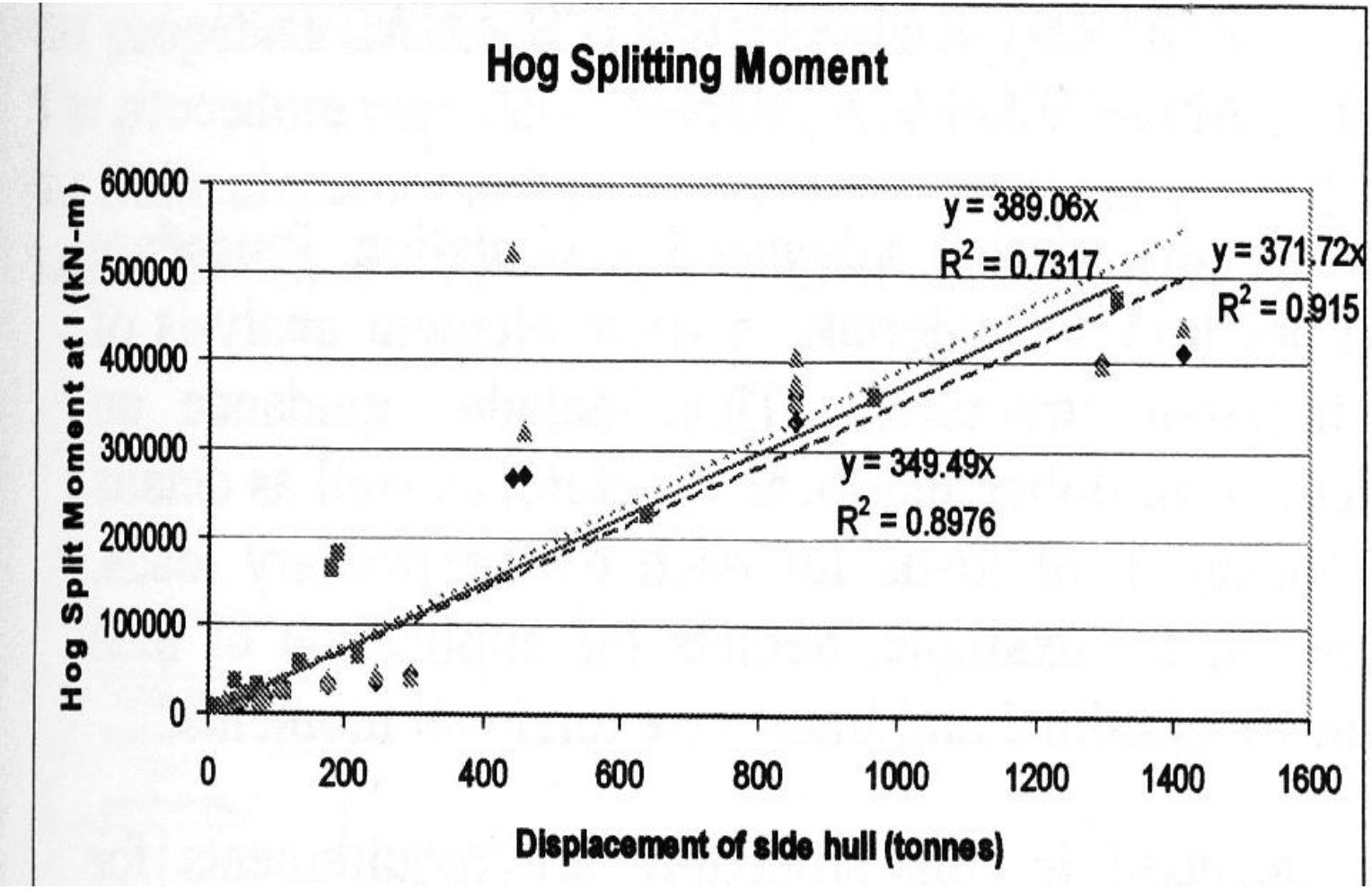
Here L, B, d – a hull dimensions;

C_{WL} – a hull water-plane area coefficient;

ρ – water density;

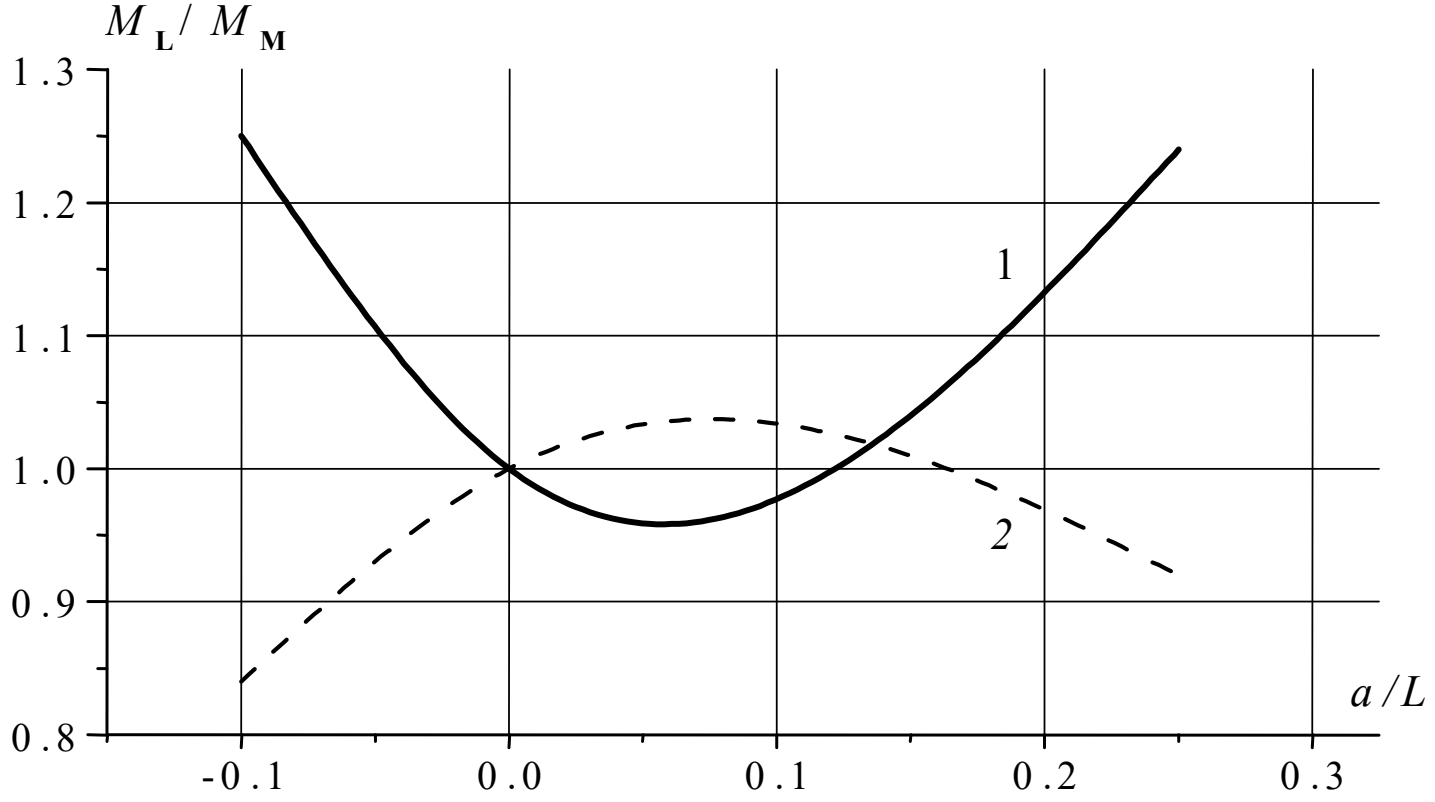
g – acceleration of free drop;

An example: transverse moment on outrigger ship, outriggers on middle [2]

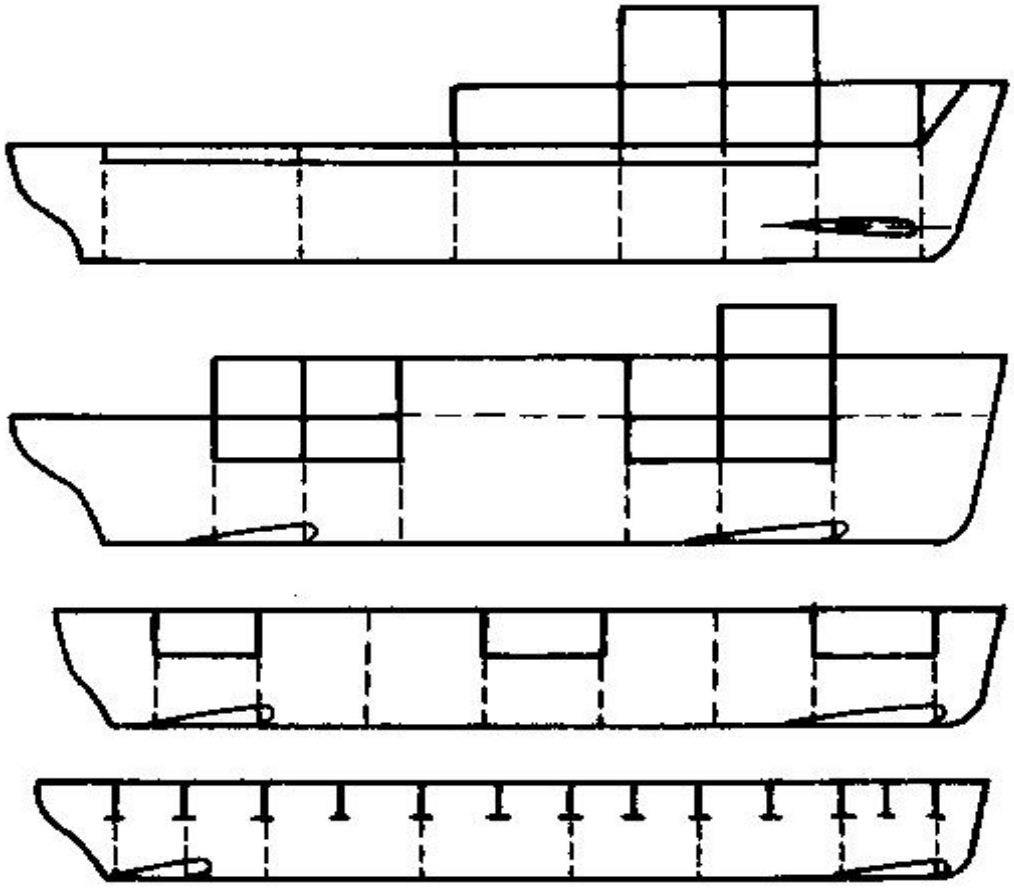


Effect of outriggers' position on longitudinal hogging (1) and sagging (2) bending moment, M_L, relative to that when outriggers at amidships, M_M , after [2];
here a = distance between midship stations of outriggers and main hull,

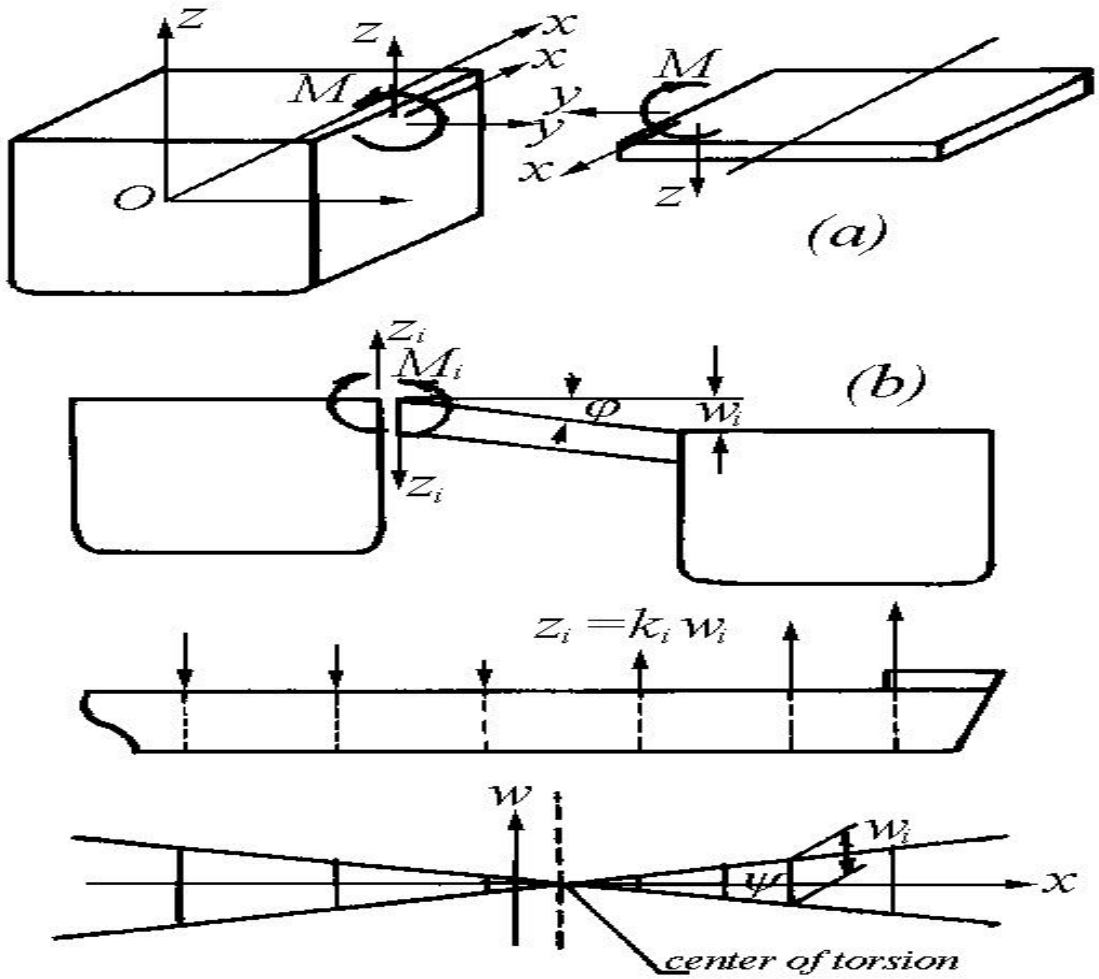
negative for outriggers shifted aft.



Some examples of applied types of a catamaran cross structure [1].

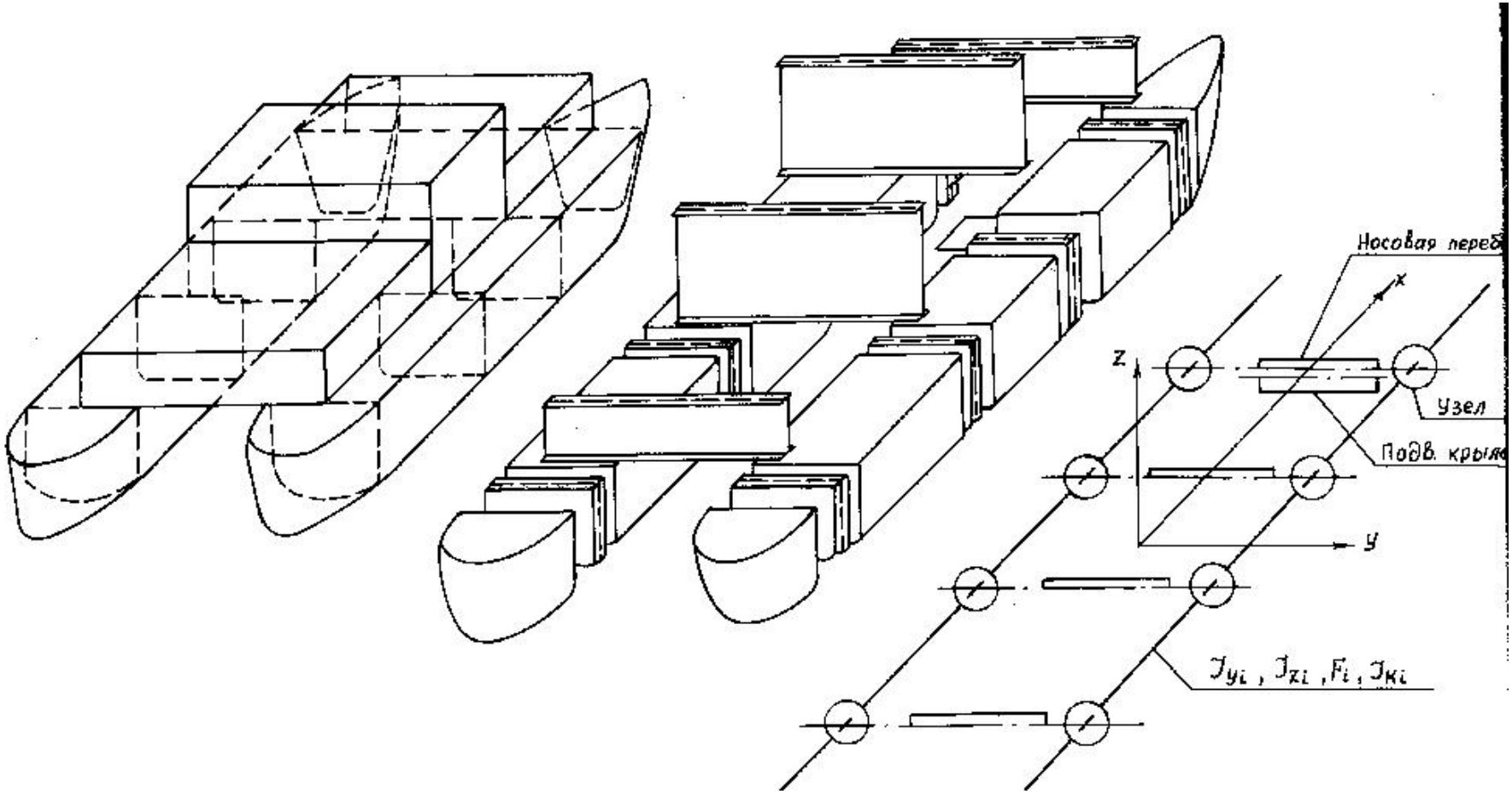


Schematics of structural response analysis in different solutions [1]:

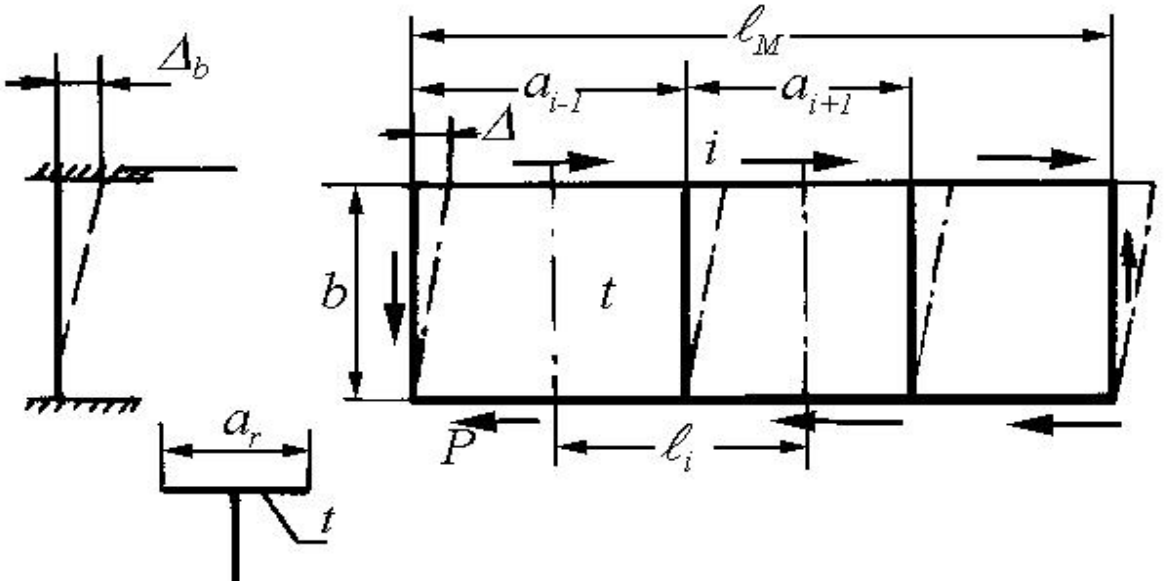


- **a) - after Galakhov & Volkova [1] for the structure in Slide 5, bottom;**
- **b) after Ferin & Belenky [1] for the structure in Slide 5, top.**

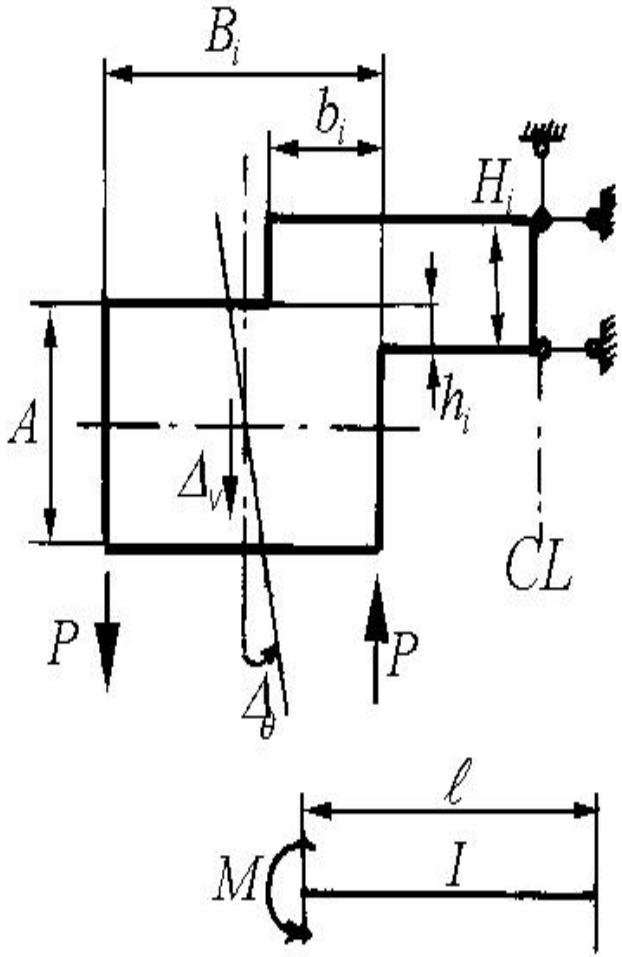
Stages of a catamaran structure idealization [1]



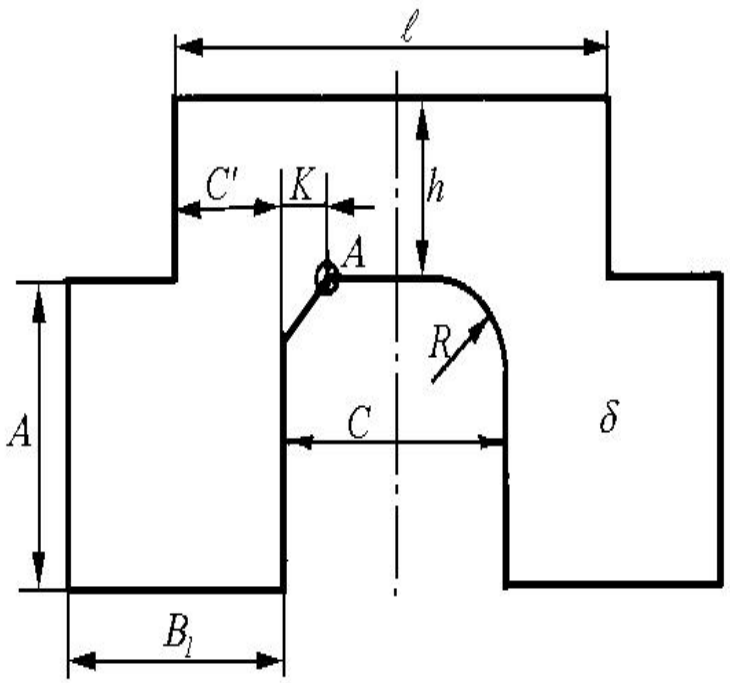
Idealization of deck plating by a beam simulating its shear loading [1]



Catamaran girder idealization [1].



Tested model of girder [1].

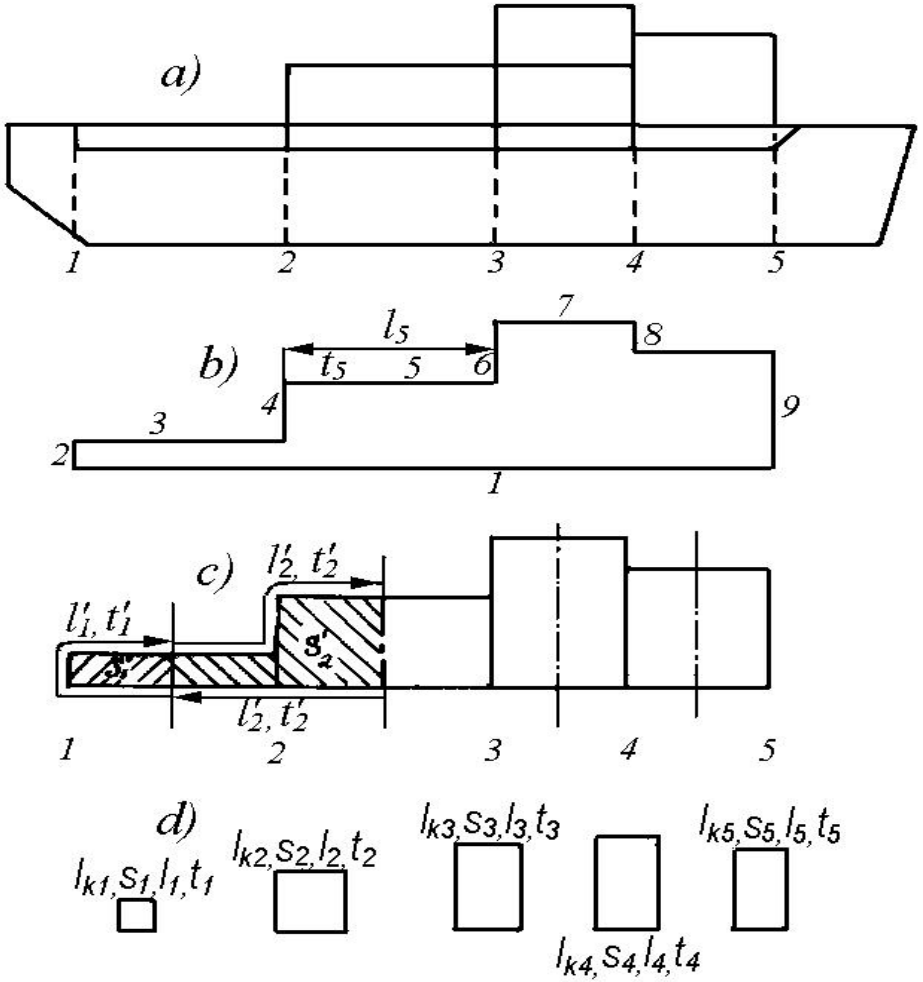


Idealization of torsional rigidity of the bridge [1]:

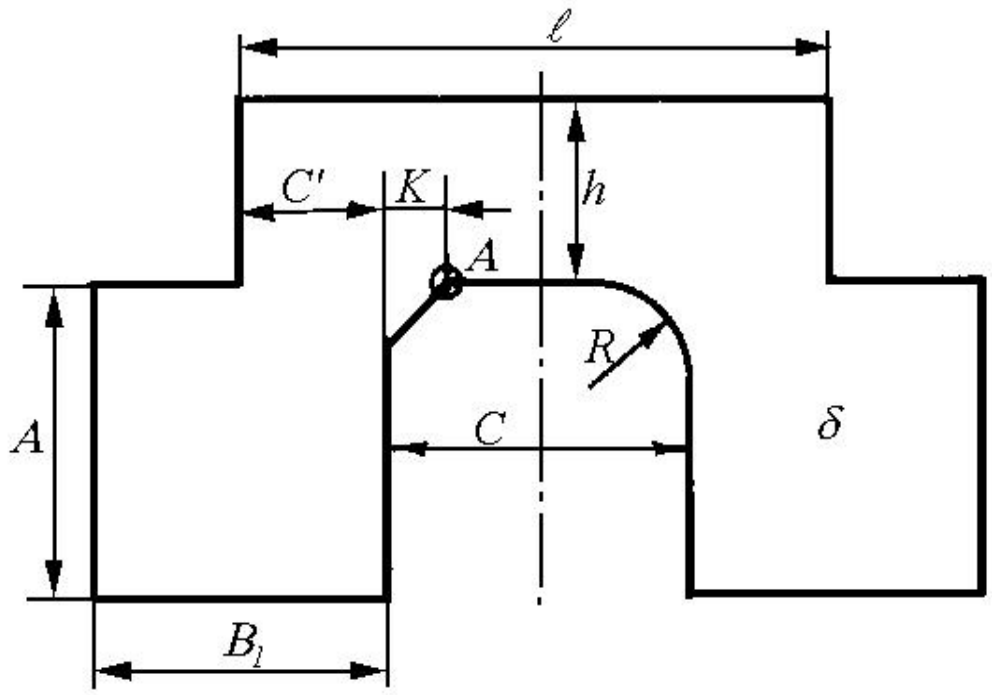
a – actual cross section,

b - contour of the bridge as a whole,

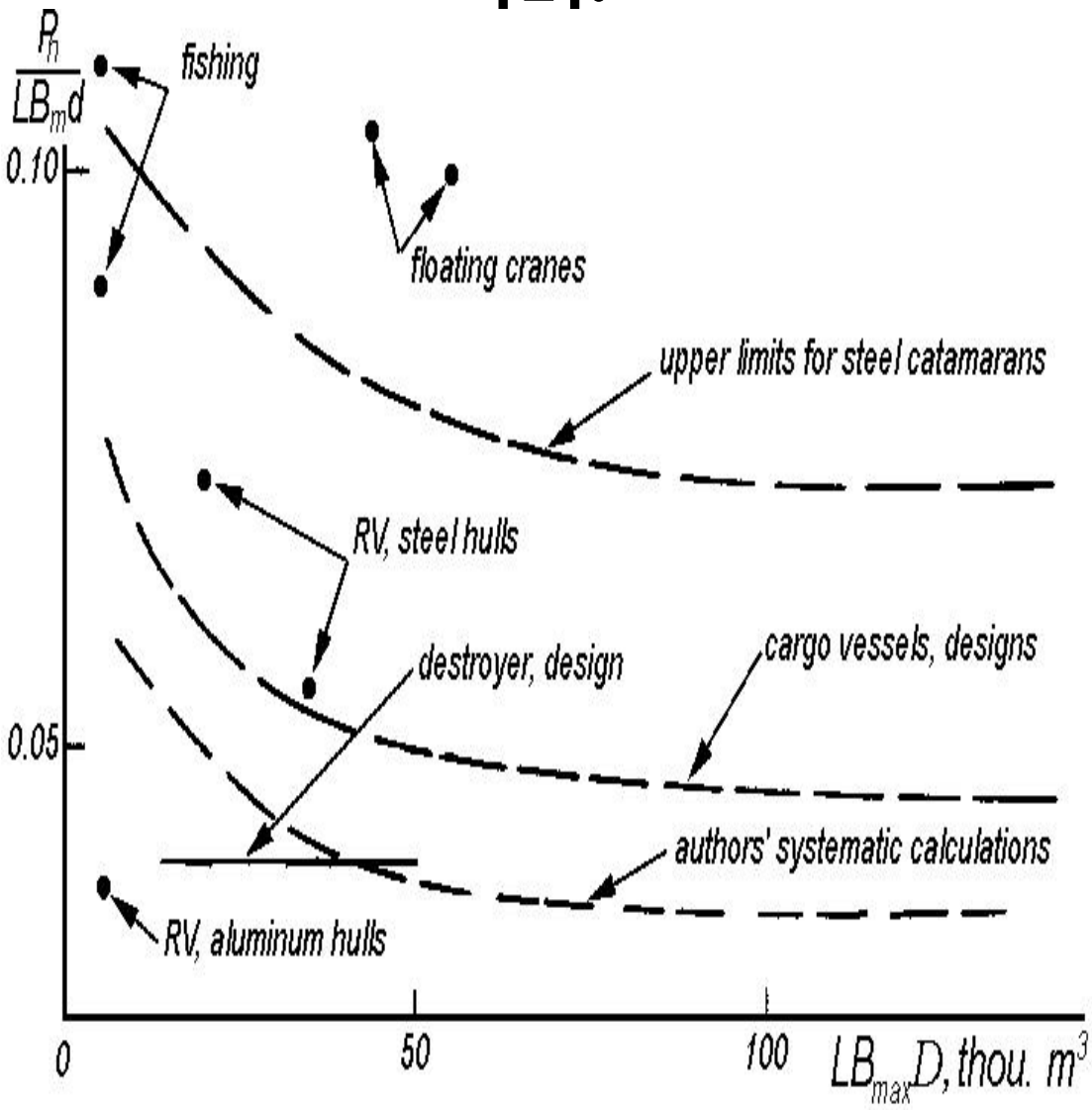
c, d - characteristics of torsional rigidity of individual girders



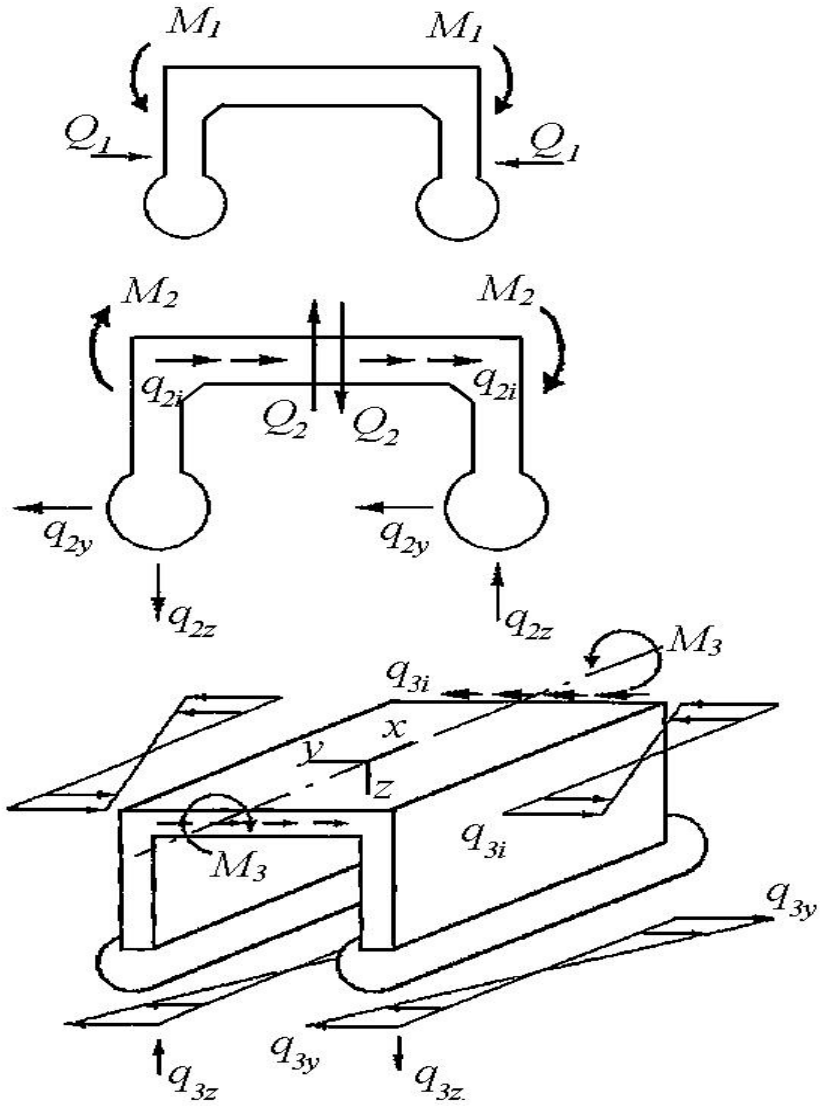
Bridge model for stress distribution study [1]



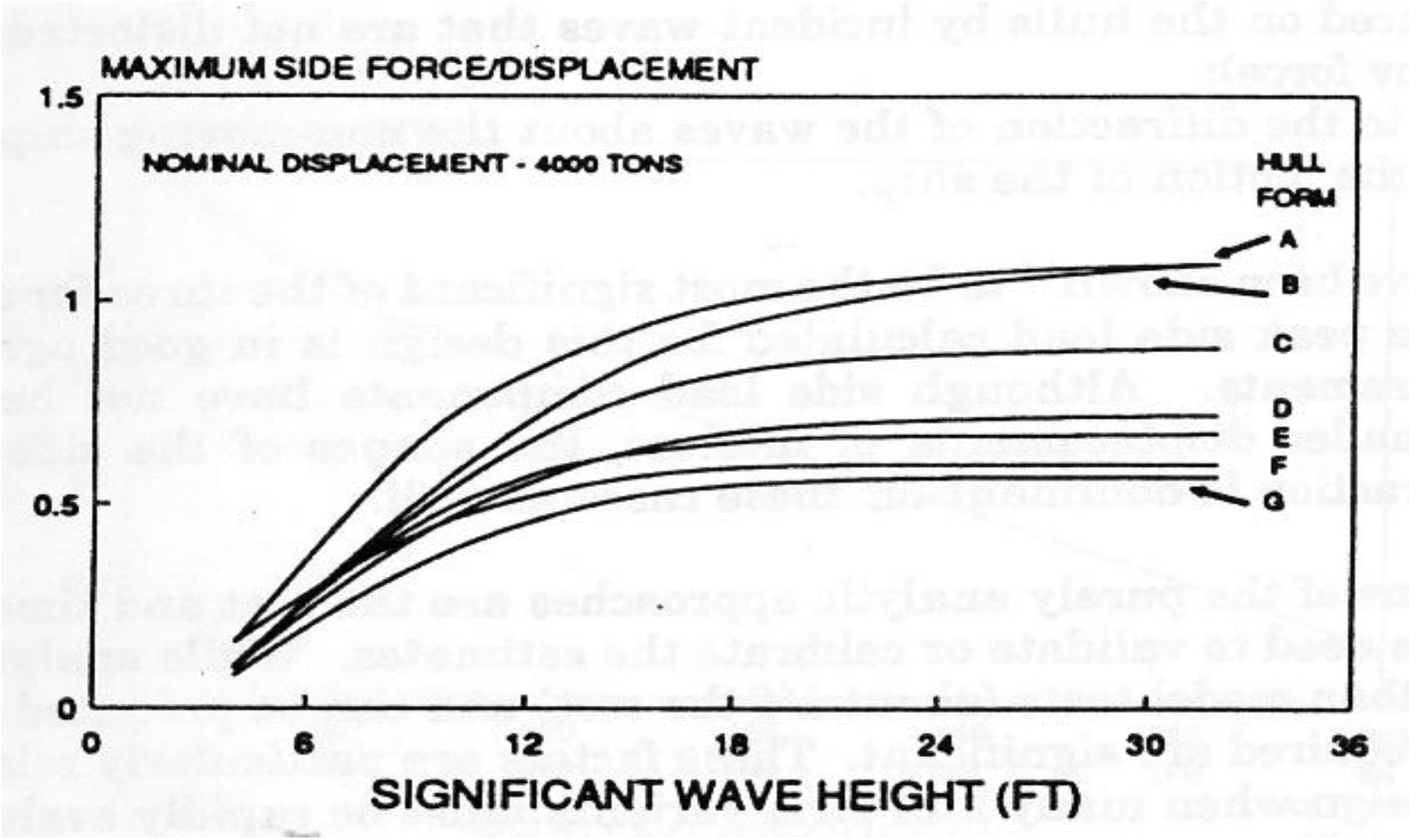
Generalized data on catamaran hull weight, [1].



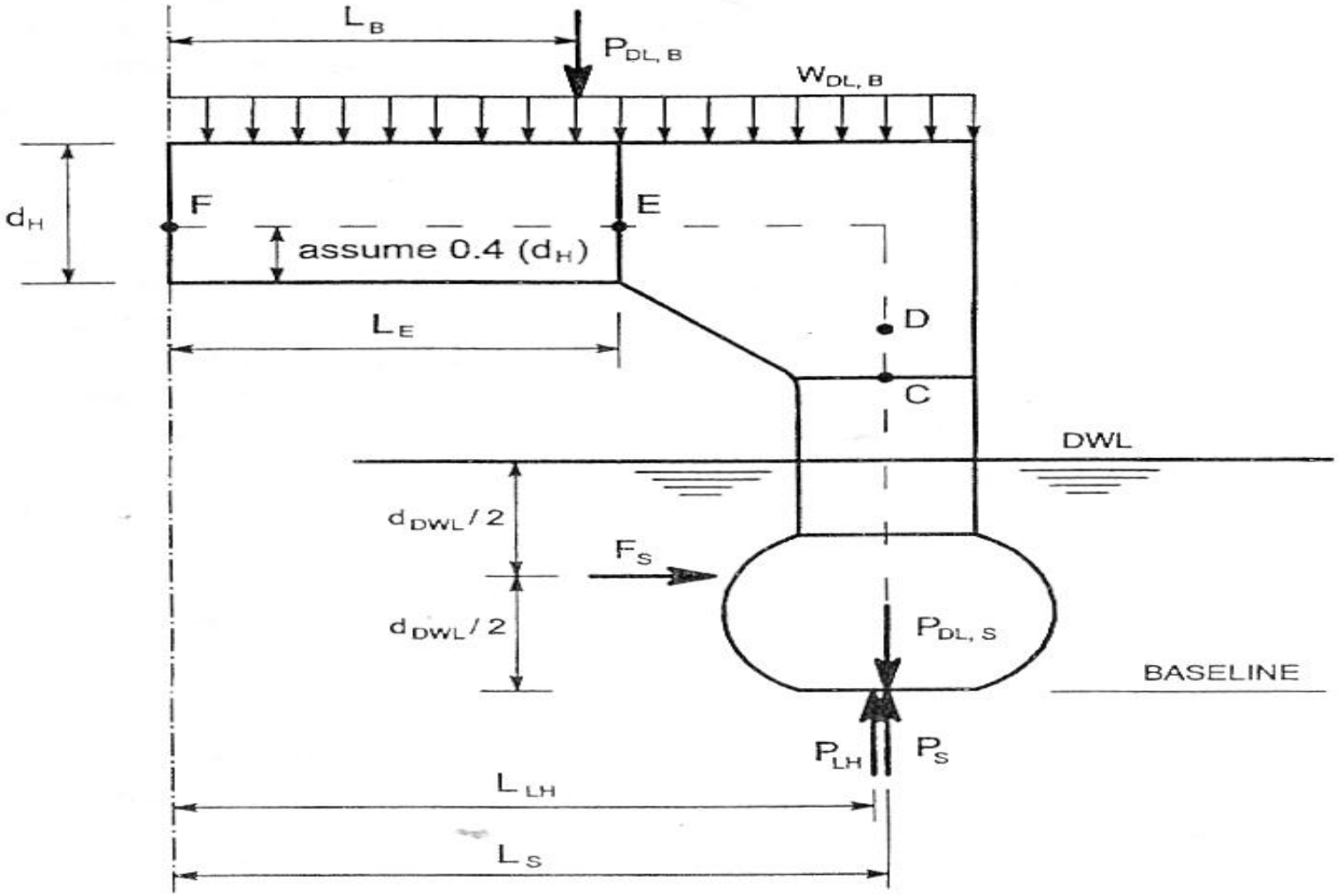
SWATH external loads [3].



Experimental data on side force at rest [3].



The scheme of side force F_S generation – the main external load for early stage of designing [2]

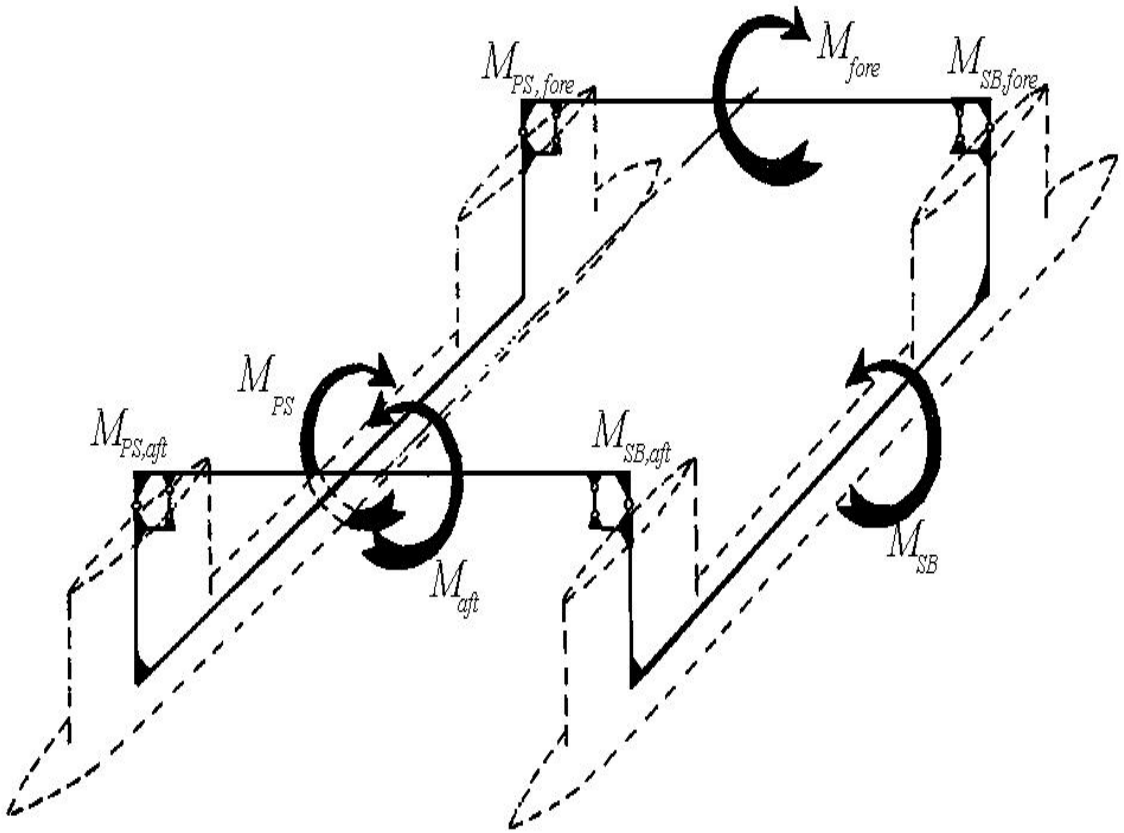


Today the relative vertical accelerations are recognized as the reason of the main part of transverse global loads of multi-hull ships with traditional hulls.

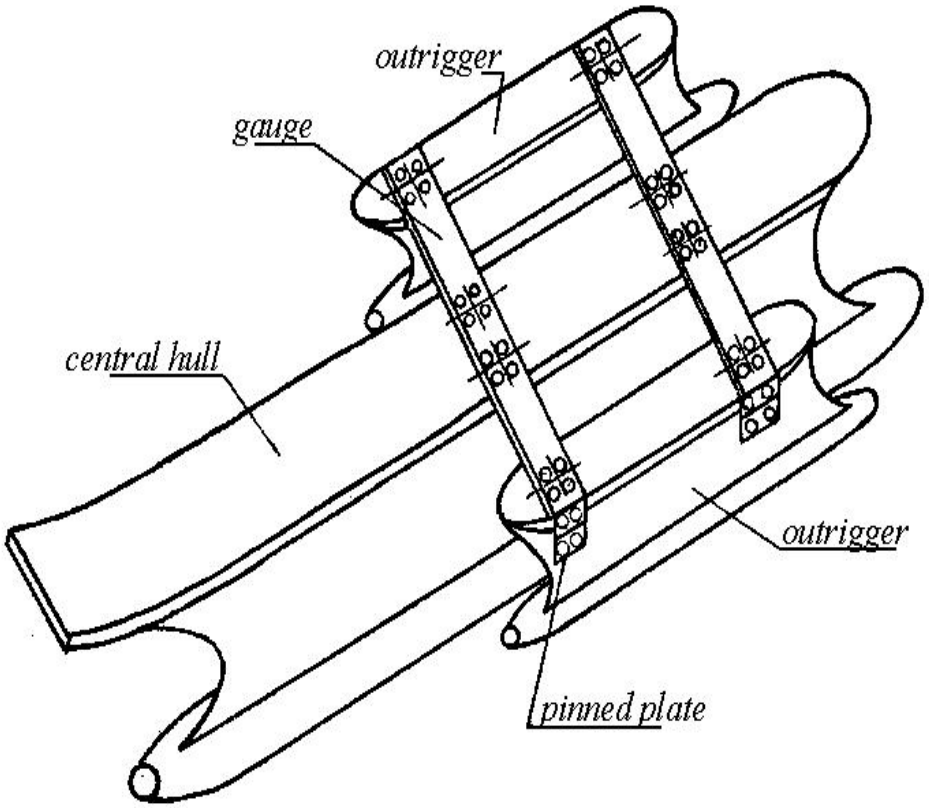
But the relative horizontal speeds are recognized as the reason of main part of transverse global loads of ships with small water-plane area.

For s semi-SWATH, two corresponded values of loads must be calculated and compared, and the bigger value can be used for estimation of such ships.

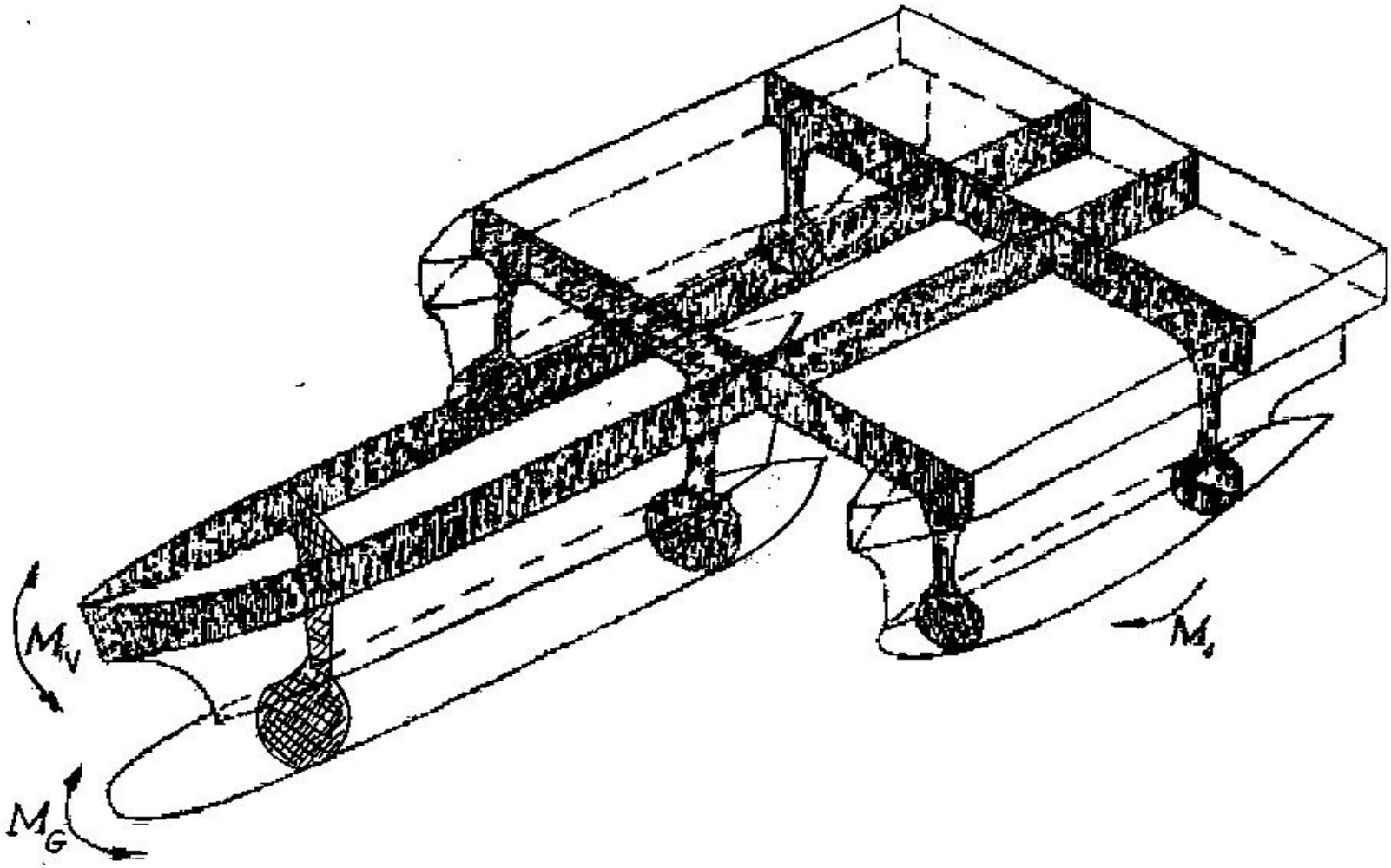
Measured loads on a SWATH model, [3].



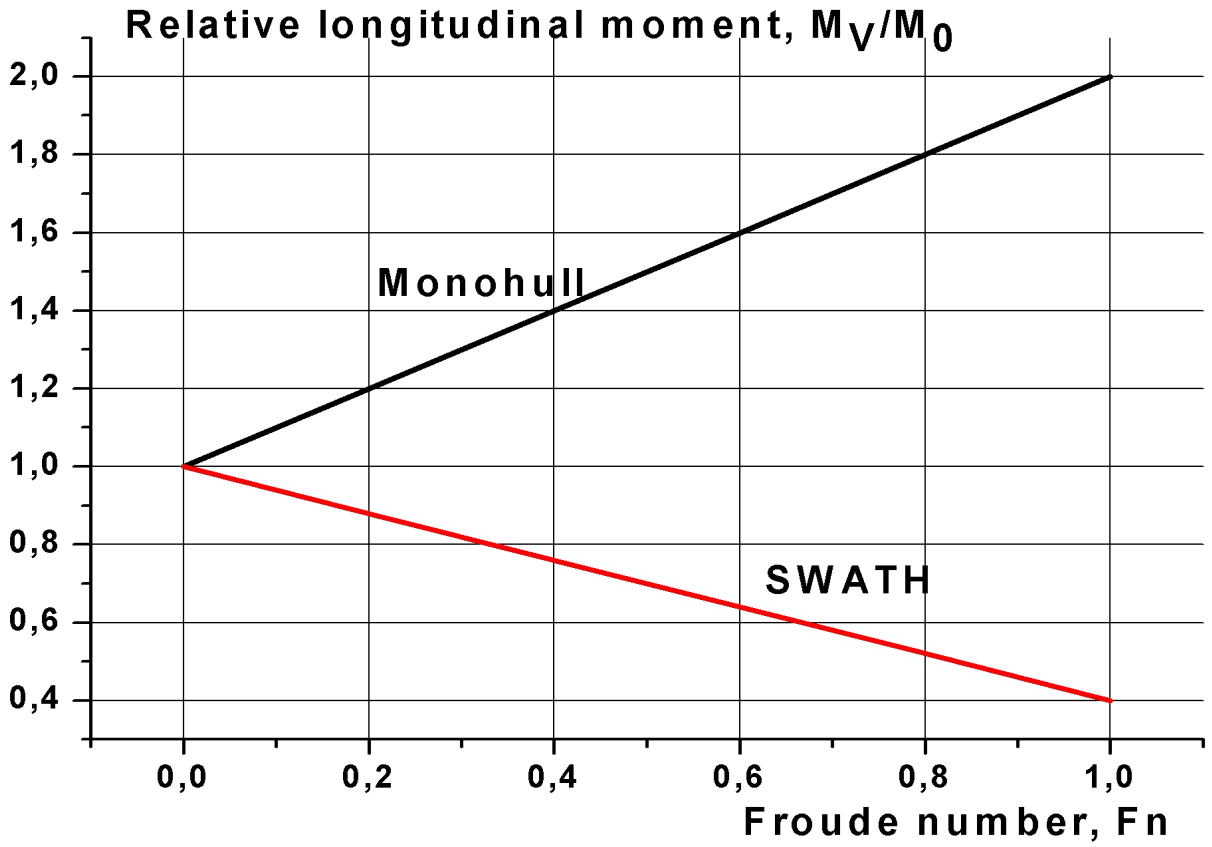
Tested outrigger SWA model, [3].



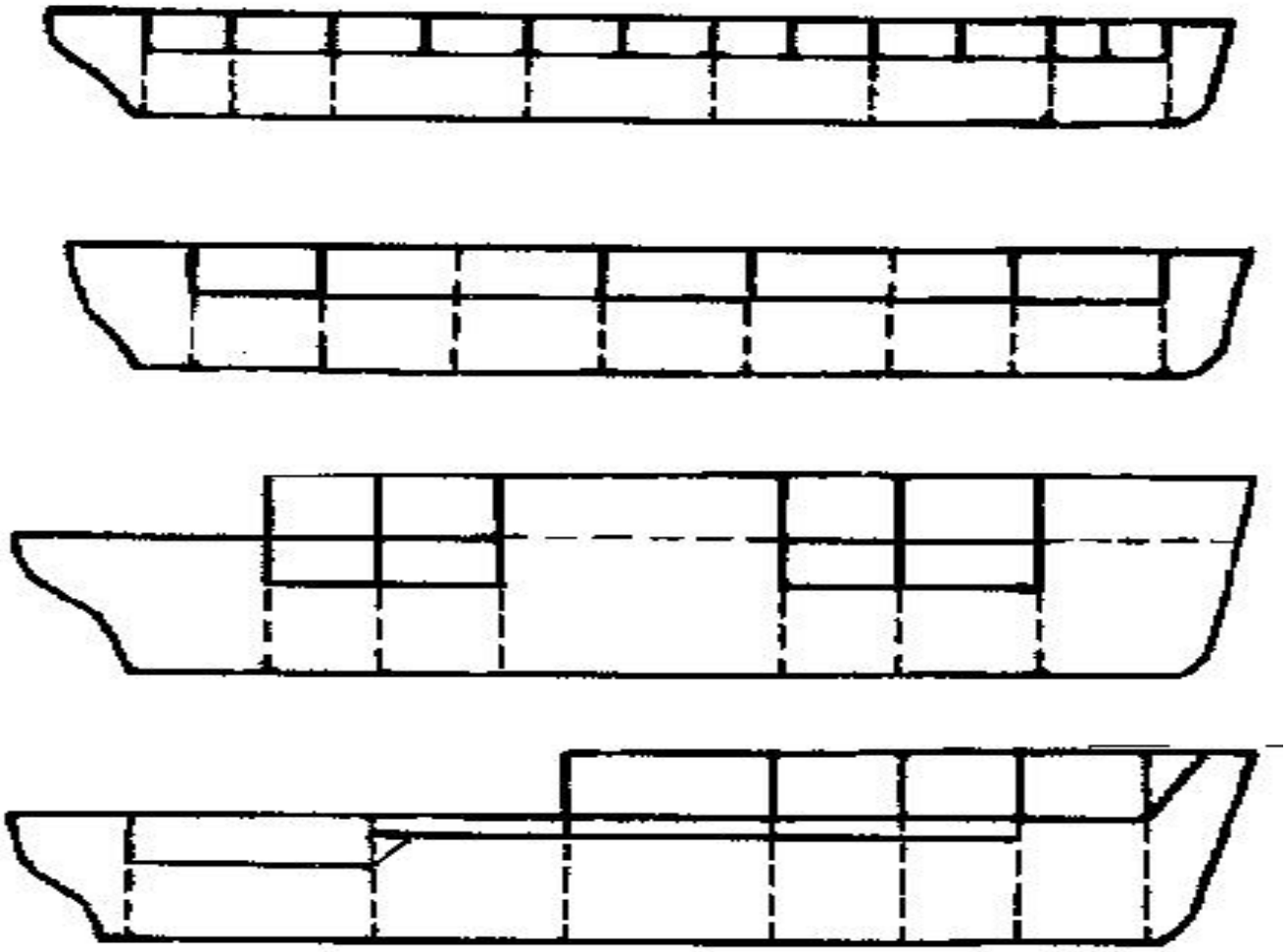
The main external loads and structure, a triple-hull SWA ship, [2].



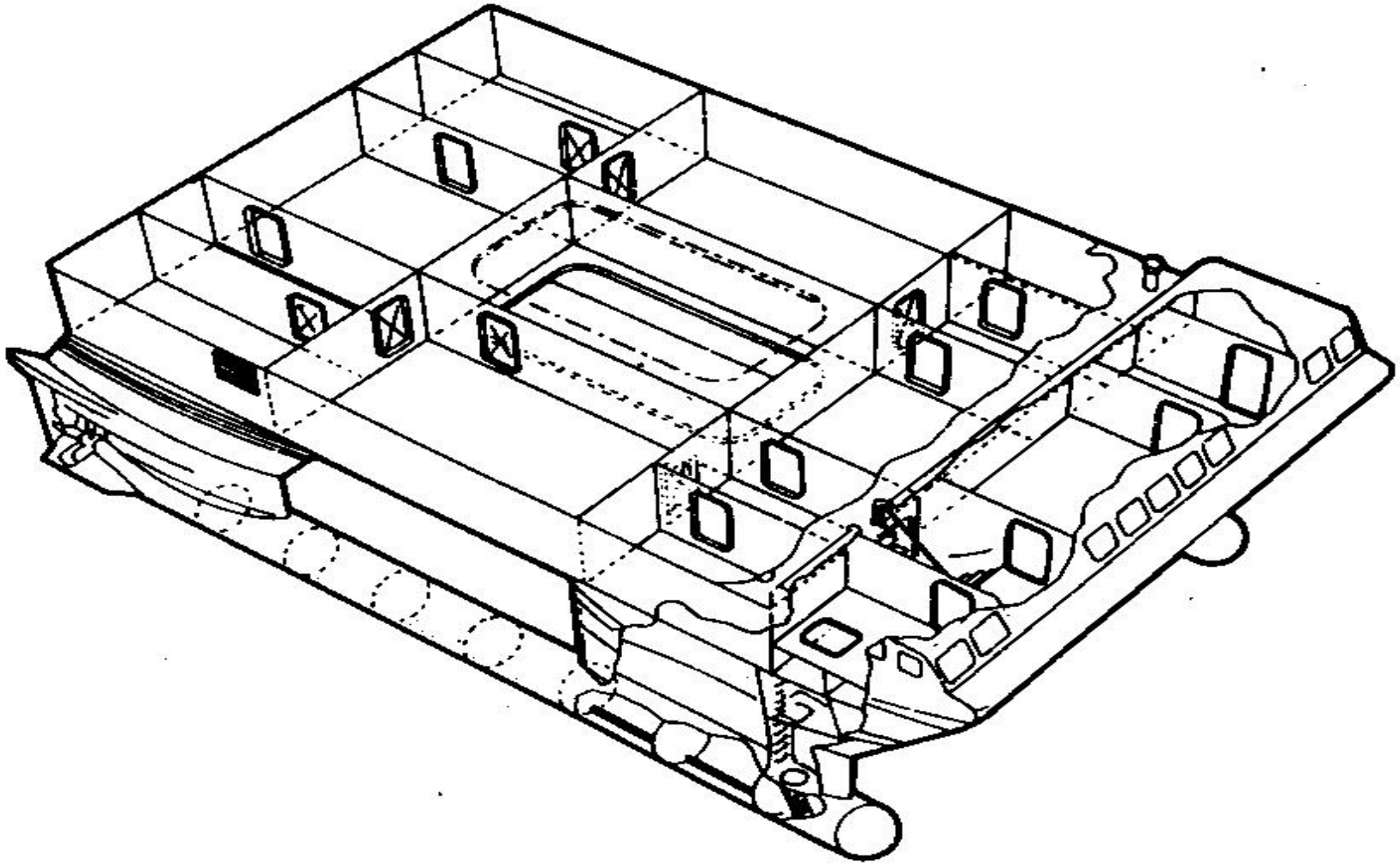
Longitudinal bending moment, [2].



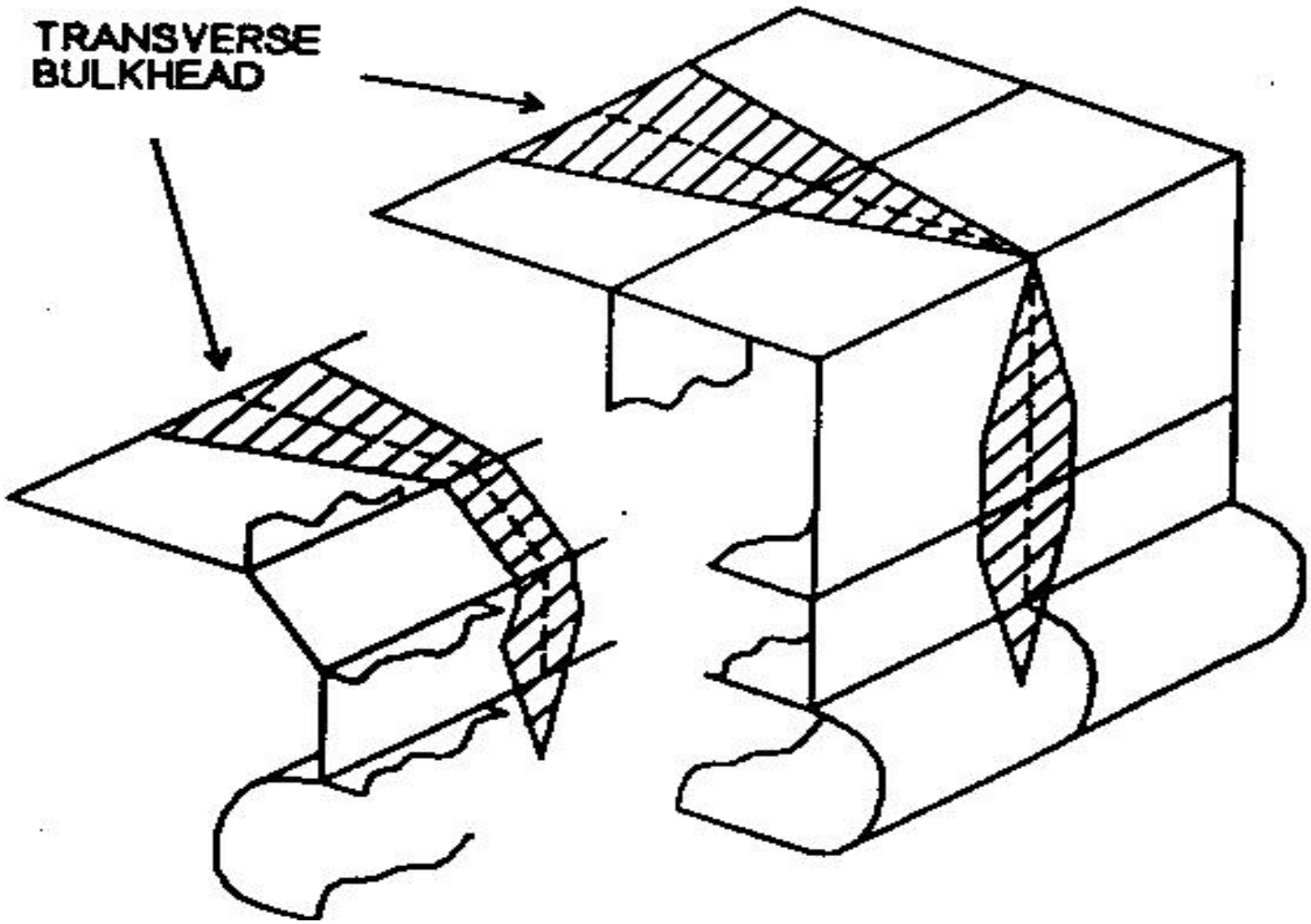
Options of platform structures: effective platform bulkheads must be supported by corresponded bulkheads in hulls, [3].



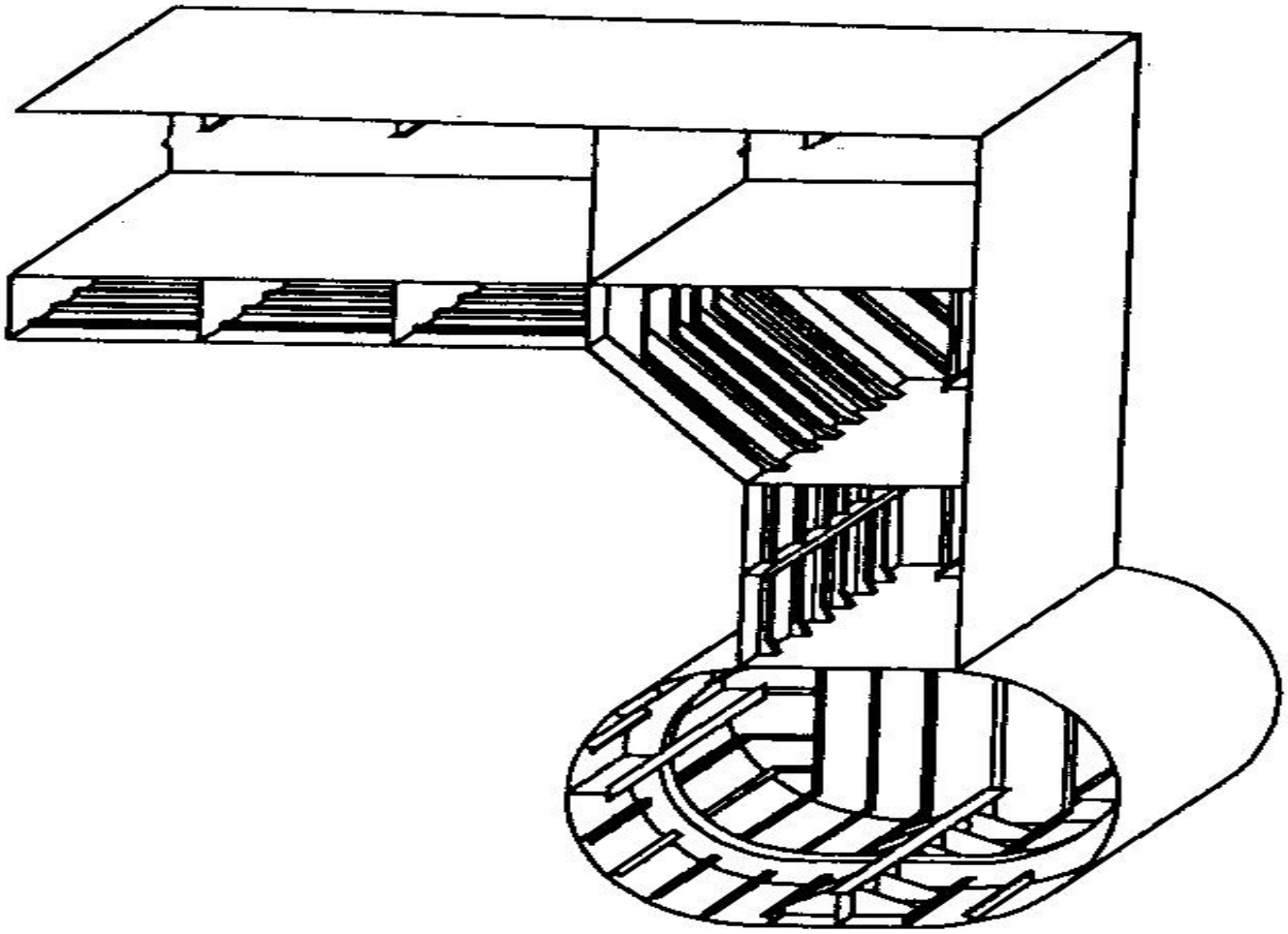
Structure of built trisec “Kaimalino”, [3], (not supported bulkheads in the platform)



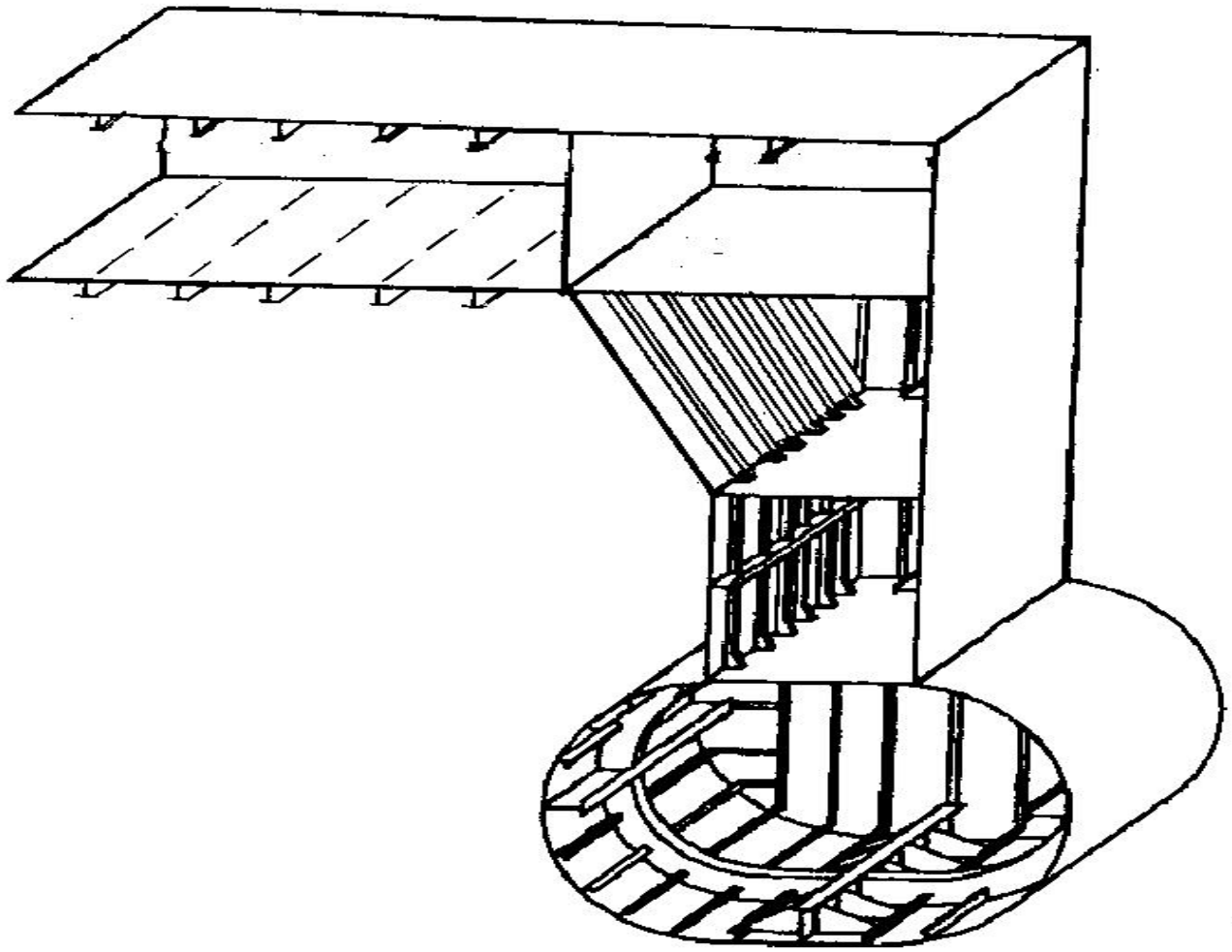
Effective band of transverse bulkheads of strut and platform, [3]



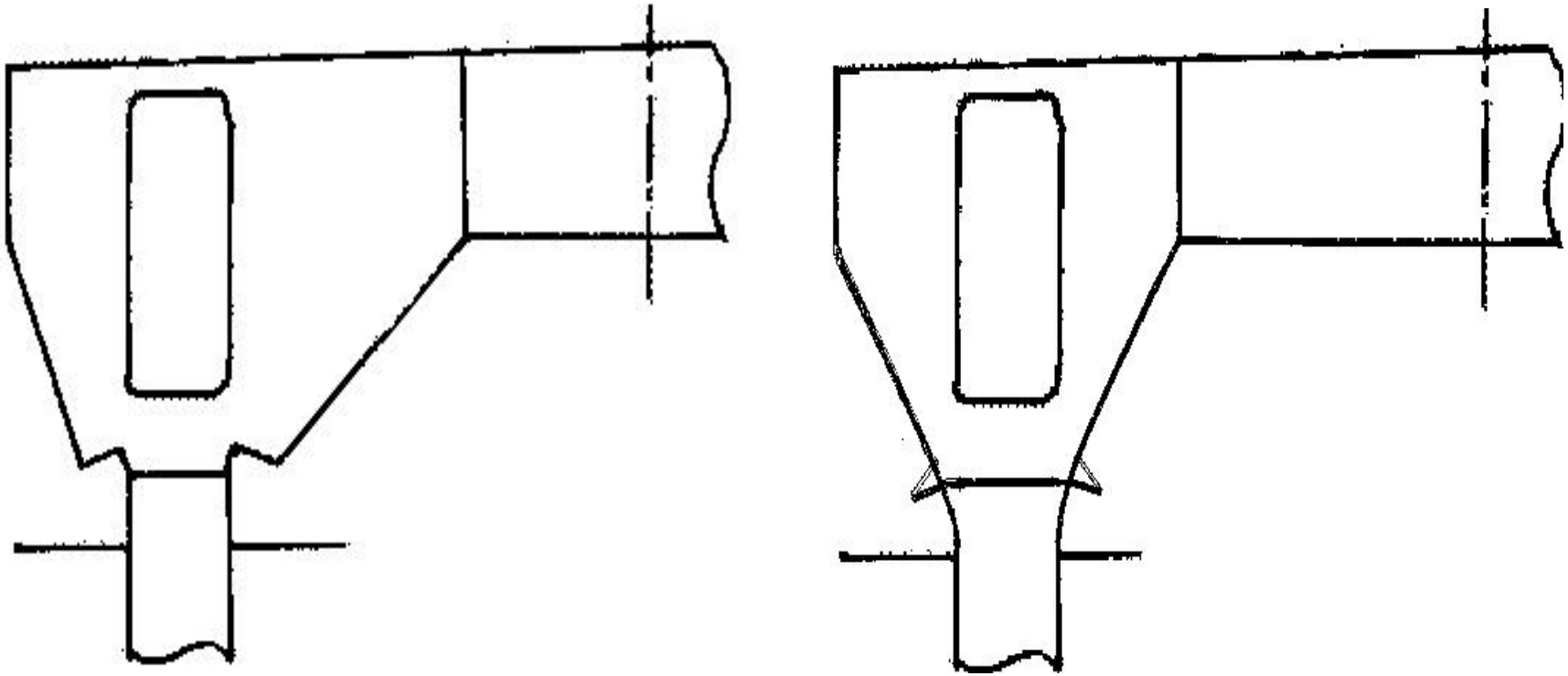
Usual cross structure of platform, [3] (with “second bottom” in the platform.



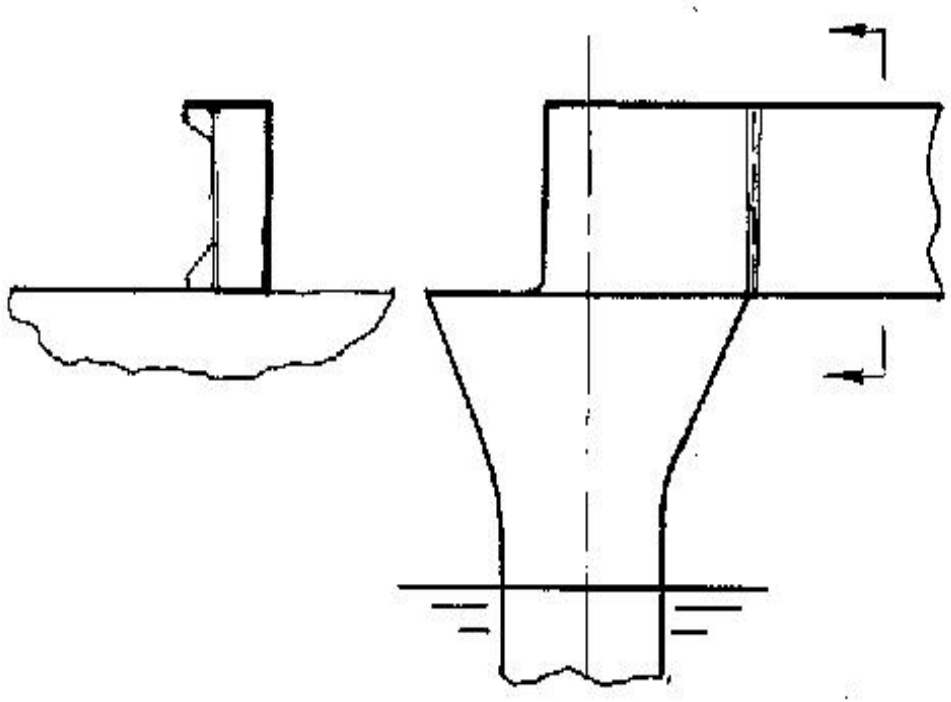
Developed structure of platform (without one plating), [3].



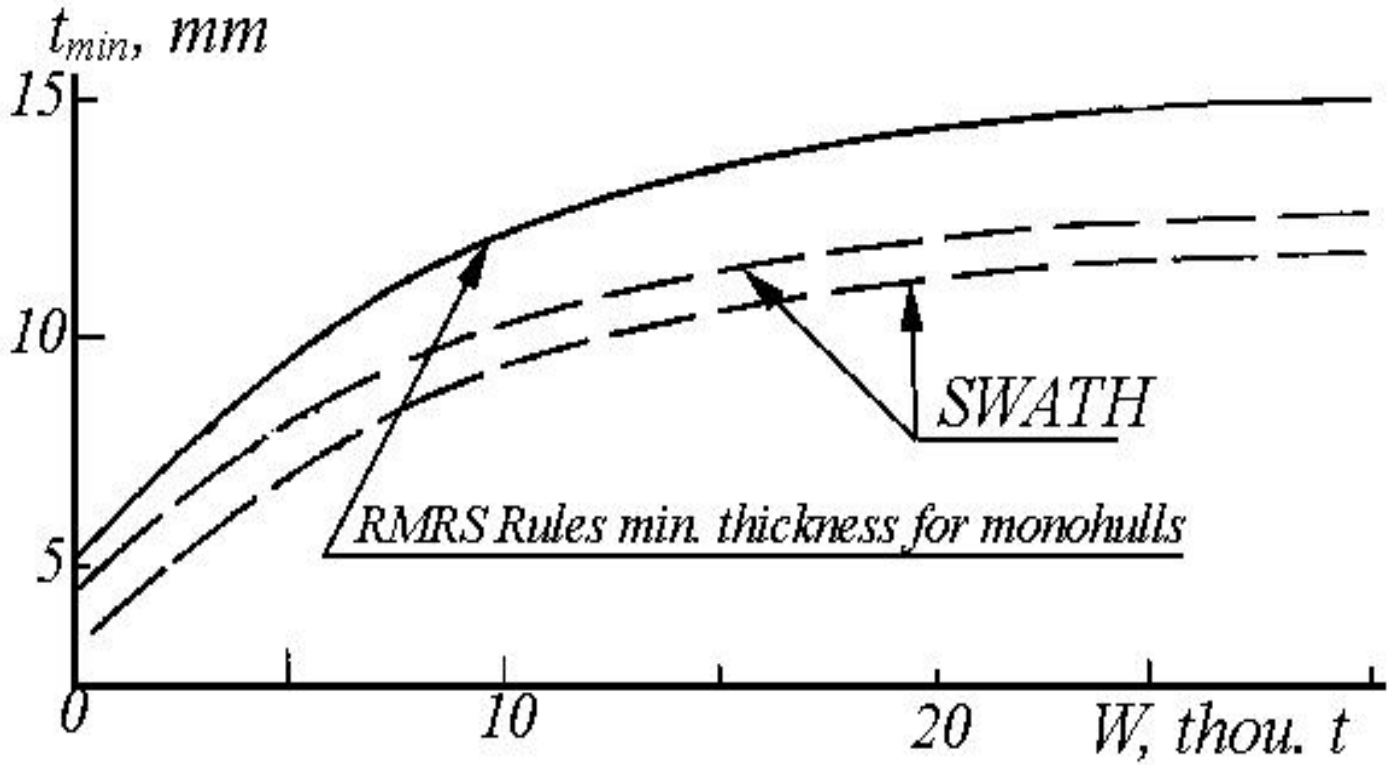
Bad (left) and better (right) bulkhead structure, [3].



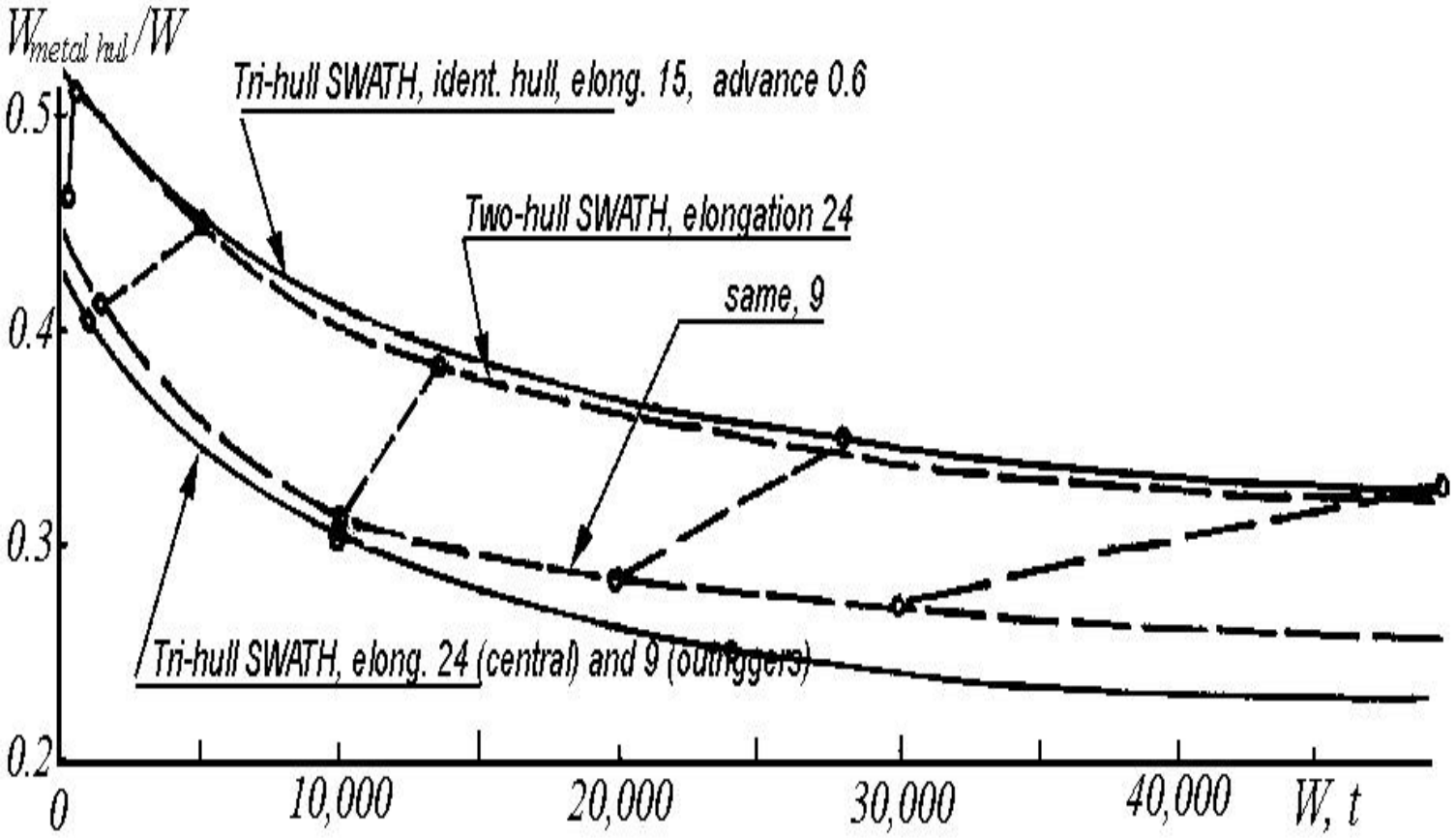
Small-sized SWA hull connection without “double-bottom” of platform: the transverse strength is ensured by bulkheads only, [3].



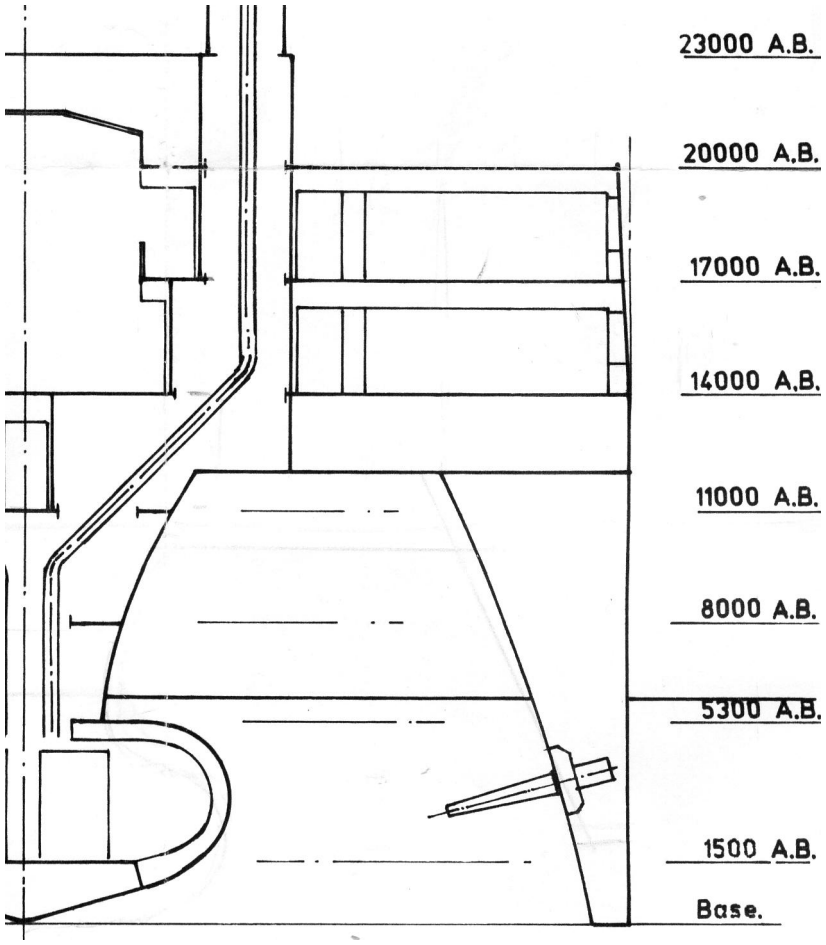
Minimal thickness of plating, [1].

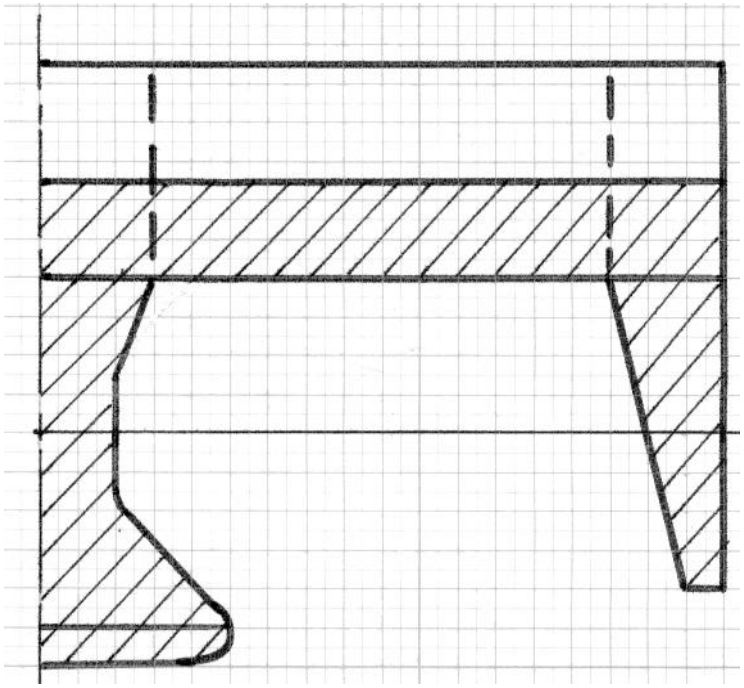


Approximate estimation of hull relative mass, [1].



Cross section comparison: left – initial option, full displacement 6,000 t; right – alternative option, 4,500 t, [2].





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2. Dubrovsky V., “Ships With Outriggers”, *2004, ISBN 0-9742019-0-1, Backbone Publishing Co., Fair Lawn,USA, 88 p*

3. Dubrovsky V., Matveev K., Sutulo S., “Small Water-plane Area Ships”, *Backbone Publishing Co., 2007, ISBN-13978-09742019-3-1, Hoboken, USA,256 p.*