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NVIC 10-86
5 Aug 1986

NAVIGATION AND VESSEL INSPECTION CIRCULAR NO. 10-86
Electronic Version for Distribution Via the World Wide Web

Subj: Equivalence to Minimum Bow Height Requirements for Load Line Assignment

1. PURPOSE. The purpose of this Navigation and Vessel Inspection Circular (NVIC) is to clarify bow height penalty reduction calculations and procedures and to delegate the review of the calculations for all vessel types to all classification societies recognized by the Coast Guard for the purpose of assigning load lines.

   This NVIC will provide an equivalent standard to the minimum bow height requirements in the load line regulations (46 CFR 42.20-70 (Regulation 39 of the International Convention on Load Lines, 1966 (ICLL66))). Provision for such an equivalency is cited as "special consideration" in 46 CPR 42.20-70(c). Regulations 46 CFR 42.07-35 and 42.07.40 permit recognized classification societies to review load line calculations on behalf of the Commandant (G-MTH-5). This NVIC reflects current Coast Guard policy and allows recognized classification societies to review bow height equivalency calculations.

2. DIRECTIVE AFFECTED. NVIC 15-82 is canceled.

3. BACKGROUND. Minimum freeboard requirements were originally based upon having a certain percentage of hull volume above the load line to provide sufficient intact reserve buoyancy to make the vessel seaworthy in heavy weather. Calculation of hull volume at that time was difficult to perform due to lack of electronic calculating aids. Therefore, when an international agreement concerning freeboards was achieved at the International Convention on Load Lines, 1930, certain assumptions were made which provided for freeboard determination based upon linear deviation from the geometry of a standard vessel. The same freeboard derivation methods were used again in ICLL66.

   A tabular freeboard is obtained from tables based on the length of the vessel. Corrections (both additive and subtractive) are then made to the tabular freeboard for various vessel particulars such as height and length of superstructure, block coefficient, length-to-depth ratio, and the sheer of the vessel. This corrected tabular freeboard is known as the geometric freeboard (Figure 1).

   The minimum bow height requirement is to ensure that a vessel’s bow configuration develops sufficient longitudinal righting energy (or trim resisting moment) to recover from a bow immersion in a seaway. It was introduced at ICLL66 after the previous requirement for forecastles on tankers was eliminated. However, the minimum bow height requirement was developed without considering the actual amount of resisting moment provided by a standardized bow configuration. Some current vessel designs are quite different from those conventional vessels used to develop the international load line requirements. A new vessel could be deficient in bow height according to the present regulations, but might have a bow configuration which develops a righting moment equivalent to that which would be developed by the standard bow geometry.

4. DISCUSSION. Vessels which do not meet the minimum bow height requirements are given a bow height penalty (Figure 1). Enclosure (1) discusses requirements for calculating a reduced bow height penalty. The calculations are based upon providing an equivalent bow volume to that of a standard vessel so that sufficient longitudinal righting energy is developed. Enclosure (2) provides a sample calculation to illustrate the method.

5. ACTION.

a. The owner or owner's agent of a vessel which cannot meet the minimum bow height requirements of 46 CFR 42.20-70 may request special consideration from a recognized load line assigning and issuing authority to allow the vessel to meet the reduced penalty discussed in this NVIC. The owner or owner's agent must prove to the assigning authority that the vessel has a bow configuration which yields a righting moment equivalent to that developed by the standard bow geometry.

b. The request for penalty reduction should include the calculations based upon the principles in Enclosure (1) and, if not already submitted for the preliminary freeboard calculations, a lines plan and general arrangement plan.

c. The load line assigning and issuing authority will advise the vessel owner or owner's agent of the results of the review.

d. The Commandant (G-MTH-5) will provide oversight as discussed in NVIC 10-85

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Chief, Office of Marine Safety,
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End: (1) Bow Height Penalty Reduction Calculations
(2) Sample Calculation

Non-standard Distribution:

C:e Baltimore (45); Alameda (40); Port Arthur, Honolulu, Puget Sound (35); Miami, Mobile, Long Beach (25); Norfolk, Jacksonville, Portland OR (20); Boston, Portland ME, Charleston, Anchorage, Galveston (15); Cleveland (12); Cincinnati, Louisville, Memphis, Nashville, Paducah, Pittsburgh, St. Louis, Savannah, San Juan, Tampa, Buffalo, Chicago, Detroit, Duluth, Milwaukee, San Diego, Juneau, Valdez (10); Providence, Huntington, Wilmington, Corpus Christi, Toledo (5).

C:m New Orleans (140); New York (70); Philadelphia (35); Houston (25); St. Ignace (5); Sturgeon Bay (4).

D:l CG Liaison Officer MILSEALIFTCOMD M-65 STRAT MOB, CG Liaison Officer JUSMAGPHIL (1).

Bow height penalty reduction calculations

1. The reduced bow height penalty (E_r) is developed in terms of the actual longitudinal volumetric moment and the required volumetric moment defined by a standard bow configuration. The difference between the required moment and the actual moment, when divided by the moment of the bow planform area yields the reduced bow height penalty.

2. The reduced bow height penalty is expressed as follows:

$$E_r = \frac{(V_R \times r_R) - (V_A \times r_A)}{(A_{BP} \times r_{BP})}$$

where:

E_r - reduced bow height penalty

V_R - the required volume

V_A - the actual volume

A_{BP} - bow planform area

r_R, r_A, r_{BP} = appropriate moment arms referenced to some longitudinal reference of the centroid of V_R, V_A or A_{BP} as appropriate.

3. Definitions:

a. The zero sheer level is a line parallel to the design waterline passing through a point on the freeboard deck at amidships.

b. The zero sheer waterplane is a plane parallel to the design waterplane passing through a point on the freeboard deck at amidships.

c. The bow planform area (A_{BP}) is the area of the zero sheer waterplane bounded by the shell of the ship and lying forward of a point fifteen percent (15%) of the length (L) aft of the forward perpendicular (FP). This area is shown by the crosshatched area labeled "A_{BP}" in figure 1(b).

d. The required volume (V_R) is the volume that extends, in a wall-sided fashion, from the bow planform area on the zero sheer waterplane to the upper edge of the minimum bow profile. This upper edge is a parabolic curve (as defined in 46 CFR Table 42.20-56(b)(1)) starting at the zero sheer level 0.15L aft of the FP and drawn to the minimum bow height required at the PP.

e. The actual volume (V_A) is the volume of weathertight structures which extend above the zero sheer level between the FP and a point 0.15L aft of the FP within the bow planform area.

f. The reduced bow height penalty (E_r) is the result of the formula in paragraph 2. It cannot be greater than the difference between the required bow height in 46 CFR 42.20-70 and the geometric freeboard.

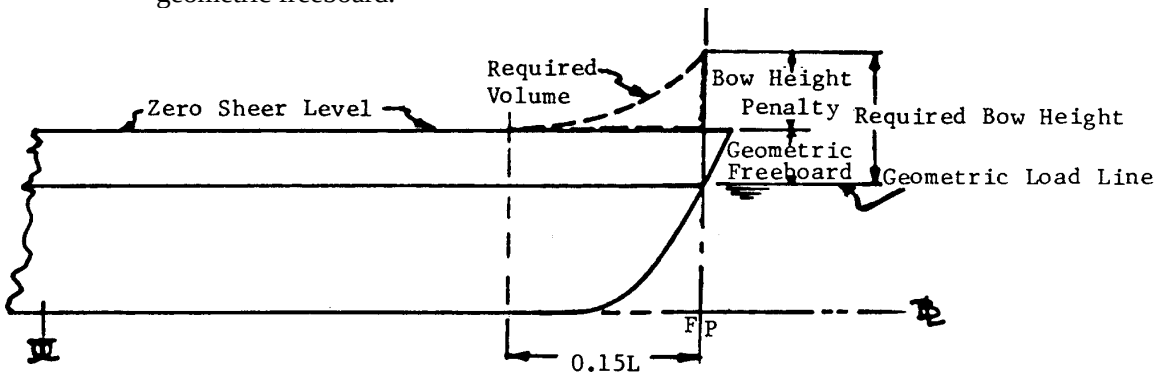


Figure 1(a)

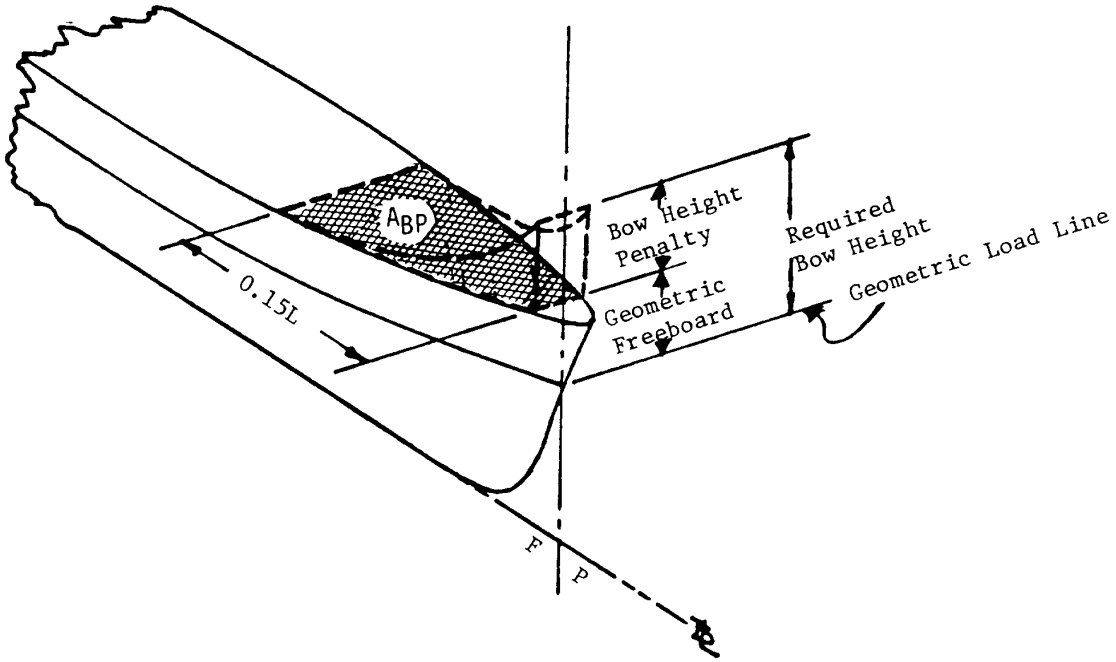


Figure 1(b)

g. The following terms are defined as in 46 CFR 42.13-5: length, perpendicular, amidships, freeboard deck, superstructure, and weathertight.

4. NOTES:

a. The reduced bow height penalty cannot be negative. In other words, no freeboard credit (reduction) will be granted for bow configurations which generate a resisting moment in excess of that required.

b. Cutouts and recesses in the bow region, above and below the zero sheer waterplane, should be treated as negative volumes and areas. For example, a bow ramp (not covered by watertight doors) will increase the value of Er by both increasing the required amount (with a negative moment) and by decreasing the bow planform area.

c. To be considered effective in contributing to the actual volume, superstructures and trunks must comply with the following:

(1) enclosed bulkheads must be of efficient construction;

(2) any access openings within 15%L of the PP must be fitted with doors complying with the requirements of 46 CFR 42.15-01; and

(3) all other openings in the sides or ends of the superstructure must be fitted with efficient weathertight closures.

d. These calculations should be conducted assuming the vessel has zero trim. Application of a trim other than the “design trim” in order to meet the requirements will not be allowed.

e. Actual volume may be assumed for camber within the bow planform area.

Example Calculation

The application of the reduced bow height penalty is illustrated with a barge with a rectangular bow planform shape and no sheer or superstructure forward (see Figure 2). For such a flush deck barge, there is no buoyancy above the zero sheer level as there would be in a conventional vessel configuration with sheer and a forecastle. Direct application of the bow height requirements in 42 CFR 42.20-70 would yield a bow height penalty Smin. However, using the method shown in enclosure (1), the reduced bow height penalty E_r:

$V_R = (1/3)(0.15L)(2W)(S_{min}) = (0.l)(L)(W)(S_{min})$

$r_R = (0.35L) + (0.75)(0.15L) = 0.4625L$

$V_A = 0.0$

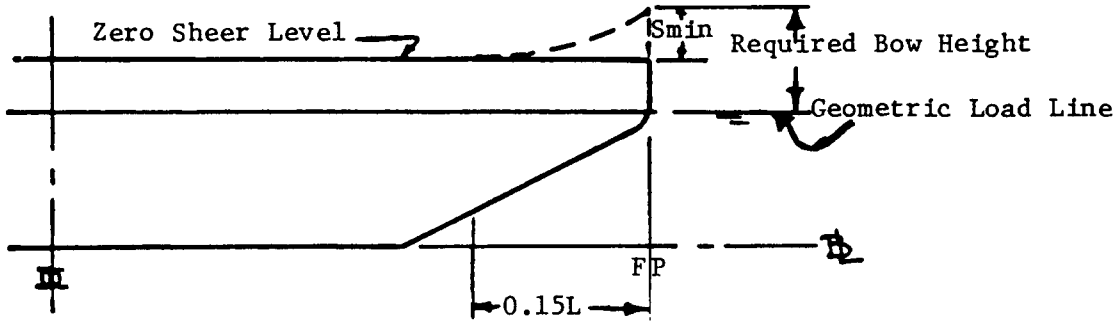
$A_{BP} = (0.15L)(2W) = (0.3)(L)(W)$

$r_{BP} = (0.35L) + (l/2)(0.15L) = 0.425L$

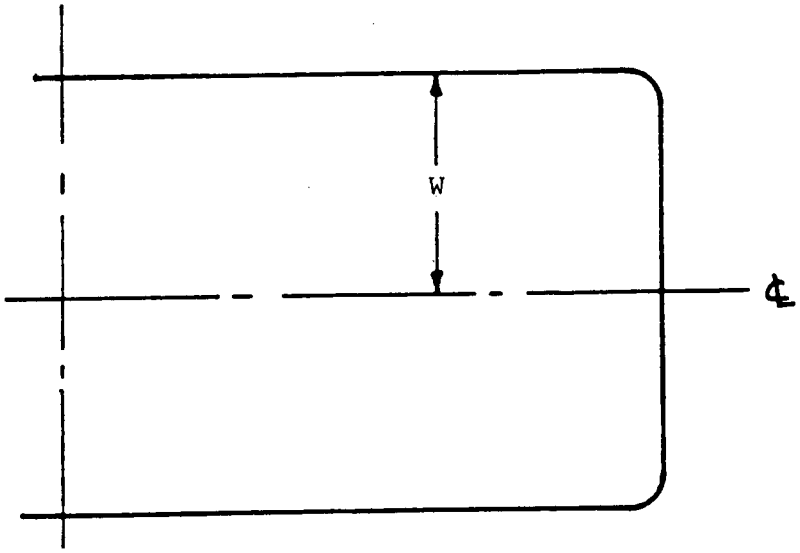
and E_r is

$$E_r = \frac{\left\{\left[(0.1)(L)(W)\left(S_{\min}\right)\right]\left[0.4625L\right]\right\} - 0.0}{\left[(0.3)(L)(W)\right](0.425L)} = 0.363S_{\min}$$

Thus the penalty has been reduced from Smin to 0.363 S_{min}.



Profile View



Plan View

Figure 2