PART
3

CHAPTER 2 Hull Structures and Arrangements

APPENDIX 1 Calculation of Shear Stresses for Vessels Having Longitudinal Bulkheads

1 Methods of Calculation

The nominal total shear stress f_s in the side shell or longitudinal bulkhead plating is related to the shear flow N at that point, by the following equation:

f_s = N/t, kN/cm^2 (tf/cm^2, Ltf/in^2)

N = shear flow, kN/cm (tf/cm, Ltf/in.)

t = thickness of the plating, cm (in.)

3 Calculation of the Shear Flow Around Closed Sections

The shear flow of a closed and prismatic structure is expressed by the following equation.

N = $(Fm/I)+N_i$, kN/cm (tf/cm, Ltf/in.)

F = total shear force at the section under consideration, in kN(tf, Ltf)

m = first moment about the neutral axis of the section, in cm^3(in^3), of the area of the longitudinal material between the zero shear level and the vertical level, at which the shear stress is being calculated

m = $\int_o^p Zt \quad ds + \sum_{i=o}^{n} a_i z_i$ cm^3(in^3)

I = moment of inertia of the section, in cm^4(in^4)

N_i = constant shear flow around the cell regarded as an integration constant of unknown value arising from substituting the statically indeterminate structure by statically determinate one, in kN/cm (tf/cm, Ltf/in)

Z = distance from section neutral axis to a point in the girth, positive downward, in cm(in.)

a = equivalent sectional area of the stiffener or girder attached to the deck, shell and bulkhead plating, in cm^2(in^2)

s = length along girth and longitudinal bulkhead, in cm (in.)

5 Calculation of m

To calculate the value of m requires the knowledge or assumption of a zero shear point in the closed cell. As an example, in the case of a simplified tanker section, the deck point at the centerline is a known point of zero shear in the absence of the centerline girder. An arbitrary point may be chosen in the wing tank cell. Superposition of the constant N_i to the shear flow resulting from the assumption of zero shear point will yield to the correct shear flow around the wing cell.

7 Determination of N_i

N_i is determined by using Bredt's torsion formula, making use of the assumption that there is no twist in the cell section, i.e., the twist moment resulting from the shear flow around a closed cell should equal zero,