APPENDIX 2

METHOD OF DETERMINING THE VERTICAL CENTRES OF GRAVITY AND VERTICAL MOMENTS OF WEIGHT OF VEHICLES/CARGO IN THE MAIN VEHICLE SPACES

1. The information in Section 1, relating to the vertical centres of gravity (vcgs) to be used for various categories of vehicles, was obtained from manufacturers and organisations associated with the vehicle-industry.

2. The information in Section 2 indicates the various optional methods of calculating the vertical moment of vehicles and other cargo units carried in the vehicle spaces. There are four options, each of which will be acceptable, ie:-

(a) Option 1 which requires that the weights and vcgs of individual groups of vehicles of each category on each discrete part of the deck be entered separately in the calculation;

(b) Options 2 and 3 which permit certain simplifying assumptions to be made; and

(c) Option 4 which allows all the weights on a deck to be aggregated and a common (and highest) vcg to be used for the cargo on that deck.

3. It will be noted that Option 1 is the more accurate method whilst the simplifying assumptions in Options 2, 3 and 4 will result in the production of vcg(s) and vertical moment which err on the side of safety.

SECTION 1

CATEGORIES OF VEHICULAR CARGO ON RO-RO PASSENGER FERRIES AND RESPECTIVE CENTRES OF GRAVITY ABOVE DECK

Category 1 <u>vcg above deck</u>

Laden freight (lorries, road tankers, articulated lorries, drops, vans of 750 kgs payload and above)	1.9 m

Category 2

Unladen freight (as above)	1.1 m

Category 3

Motor cars (saloons, pickups, caravans, dormobiles, minibuses and vans below 750 kgs payload)	0.7 m

Category 4

Coaches all types	1.5 m

Category 5

Special freight (eg low loaders carrying machinery, steel carriers, cattle carriers). The vertical centre of gravity for such units to be determined by the master or his loading officer. Where no information available, it is recommended that the vcg above deck is taken as being at half the maximum height of the unit carried.	'x' m

SECTION 2

ACCEPTABLE METHODS OF CALCULATING THE VERTICAL CENTRES OF GRAVITY AND VERTICAL MOMENTS OF VEHICULAR CARGO

Option 1

This Option uses the weights of each individual category of vehicles on each part of the deck acting at a vcg above the keel:

(H_1, H_2, H_3 .... H_n) + vcg of the individual category above the deck then:-

Total Vertical Moment (M_t) = $W_{c1}(H_1 + 1.9) + W_{c2}(H_1 + 1.1) + W_{c3}(H_1 + 0.7) + W_{c5}(H_1 + x) + W_{c1}(H_2 + 1.9) + W_{c2}(H_2 + 1.1) + \ldots\ldots\ldots\ldots + W_{c5}(H_n + x)$.

Option 2

Each Category of vehicle units is assumed distributed over the total cargo area A, acting at appropriate vcg's above the keel;

(H_a + vcg of the individual category above the deck) then:-

Total Vertical Moment (M_t) = $W_{c1}(H_a + 1.9) + W_{c2}(H_a + 1.1) + W_{c3}(H_a + 0.7) + W_{c4}(H_a + 1.5) + W_{c5}(H_a + x)$

Option 3

This option may be used when the height of the deck varies and/or the between deck height limits the categories of vehicles carried. The weight of

cargo on any part of the deck is assumed to be proportional to the fraction of the total area of the deck represented by that part.

The weight on each part is assumed to act at the highest vcg (G_1) G_2 .... G_n) of any category of vehicles which can be carried on that part.

Therefore the vcgs of cargo above the keel on the parts of the deck are: (H_1 + G_1), (H_2 + G_2), (H_3 + G_3), ... (H_n + G_n) respectively, then:-

Total Vertical Moment (M_T) = W/A [A_1(H_1 + G_1) + A_2(H_2 + G_2) + ... + A_n(H_n + G_n)]

Option 4

The total weight of cargo on the deck is assumed to act at the highest vcg of any of the categories of vehicles which can be carried. The vcg of cargo above the keel is therefore;
H_a + G then:-

Total Vertical Moment (M_T) = W(H_A + G).

Definitions

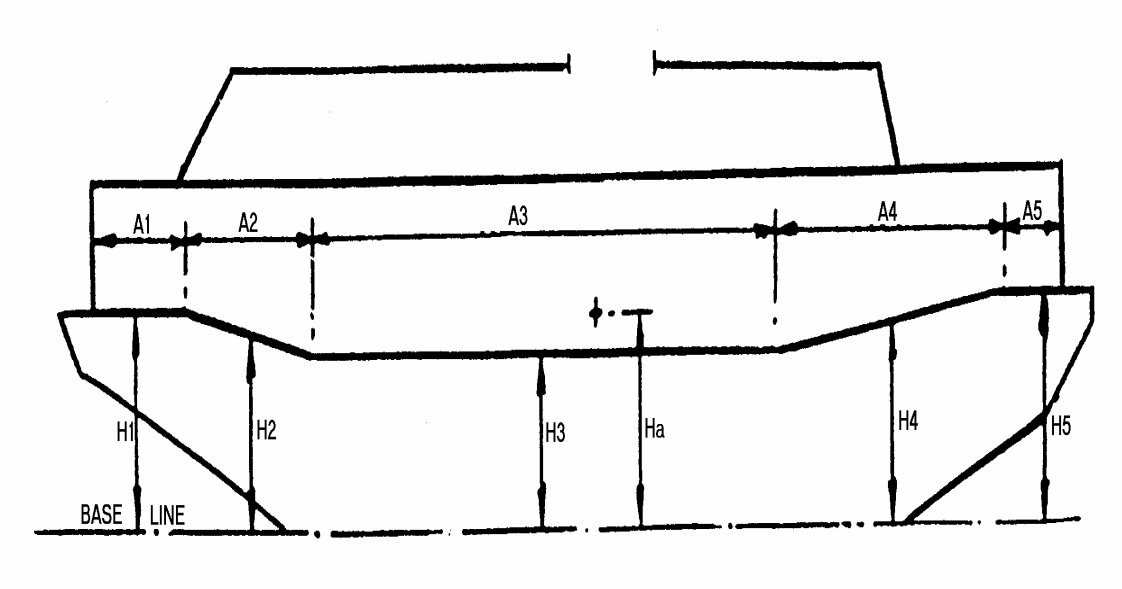

FIGURE APP.2

A = Total cargo area of deck.

A_1, A_2, A_3 .... A_n = Part cargo deck area, longitudinally and/or transversely determined.

H_1, H_2, H_3 .... H_n = Height of the centre of the part cargo deck area above base line.

H_a = mean height of deck above baseline as defined by:

$1/A\ [A_1 H_1 + A_2 H_2 + A_3 H_3 + \ldots + A_n H_n.]$

G = the greatest vcg value of any of the vehicle or cargo units which can be carried on deck.

$G_1, G_2, G_3 \ldots G_n$ = the greatest vcg of any of the vehicle or cargo units which can be carried on each area ($A_1, A_2, A_3 \ldots A_n$) of deck.

W = the total weight of vehicle units carried on deck.

$W_1, W_2, W_3 \ldots W_n$ = that portion of the total weight of vehicle units carried on individual areas ($A_1, A_2, A_3, \ldots A_n$) of deck and calculated as
W_1 = WA1/A, W2 = WA2/A, W3 = WA3/A, Wn = WAn/A.

W_{c1} = total weight of laden freight (excluding special freight).

W_{c2} = total weight of unladen freight (excluding special freight).

W_{c3} = total weight of motorcars.

W_{c4} = total weight of coaches.

W_{c5} = total weight of special freight.

and the vcg obtained from that shown in Section 1.