CHAPTER 8

IMPLEMENTATION OF STABILITY ASSESSMENT

8.1 The proposed criteria

The results of the calculation are shown again, for ship A to E imposing righting work done of each ship on, in figures (8.1) to (8.5). The author considers that capsizing is a dynamic process and is not determined by the stability moment, but by the work necessary to incline the vessel.

Investigation of ship-A to E, one will be able to see that all ships able to witbstand sea loads up to sea state 5 but with a considerable heeling angle of approximately 50 degree. At sea state 4, all ship heel at roughly 35 degrees. In view of the risks of vessel's functioning, the author would like to propose "permitted angle" of 50 degrees to be limited for fishing vessel. By means of this criteria only ship B and C can not be operated up to sea state 5 while all of the remains can be. It should be noted here that ship-B was turned over during the violent strom at that beginning of this year. The vessel has been repaired and now in operation in the Gulf.

The author has tried to transform the relation of dynamical stability work done into a simple equation by using vessels'parameter abtained from chapter 6 but no satisfactory relation is obtained. There seems to have a

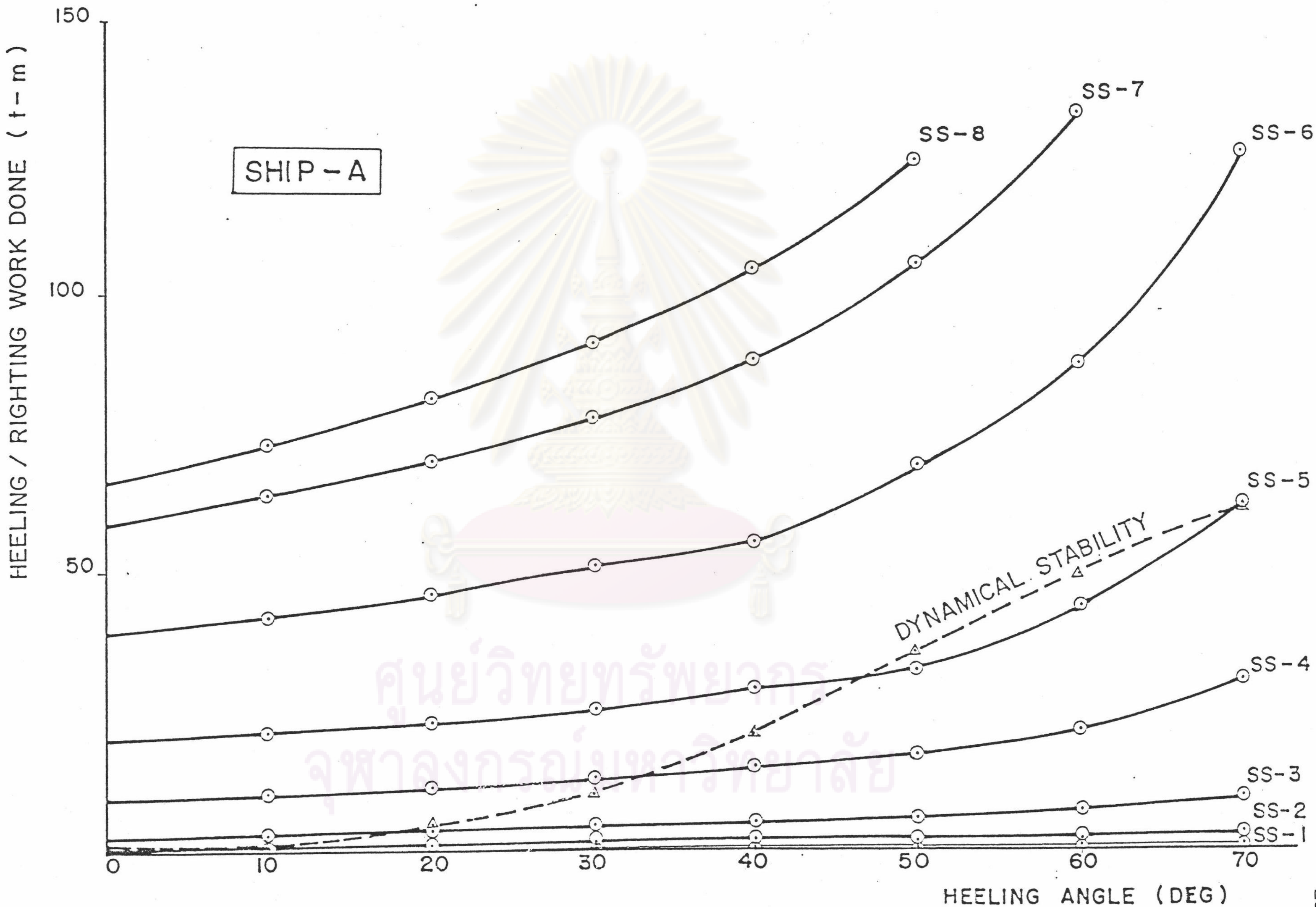

Fig. (8.1) Superimpose of heeling/righting work done of ship - A

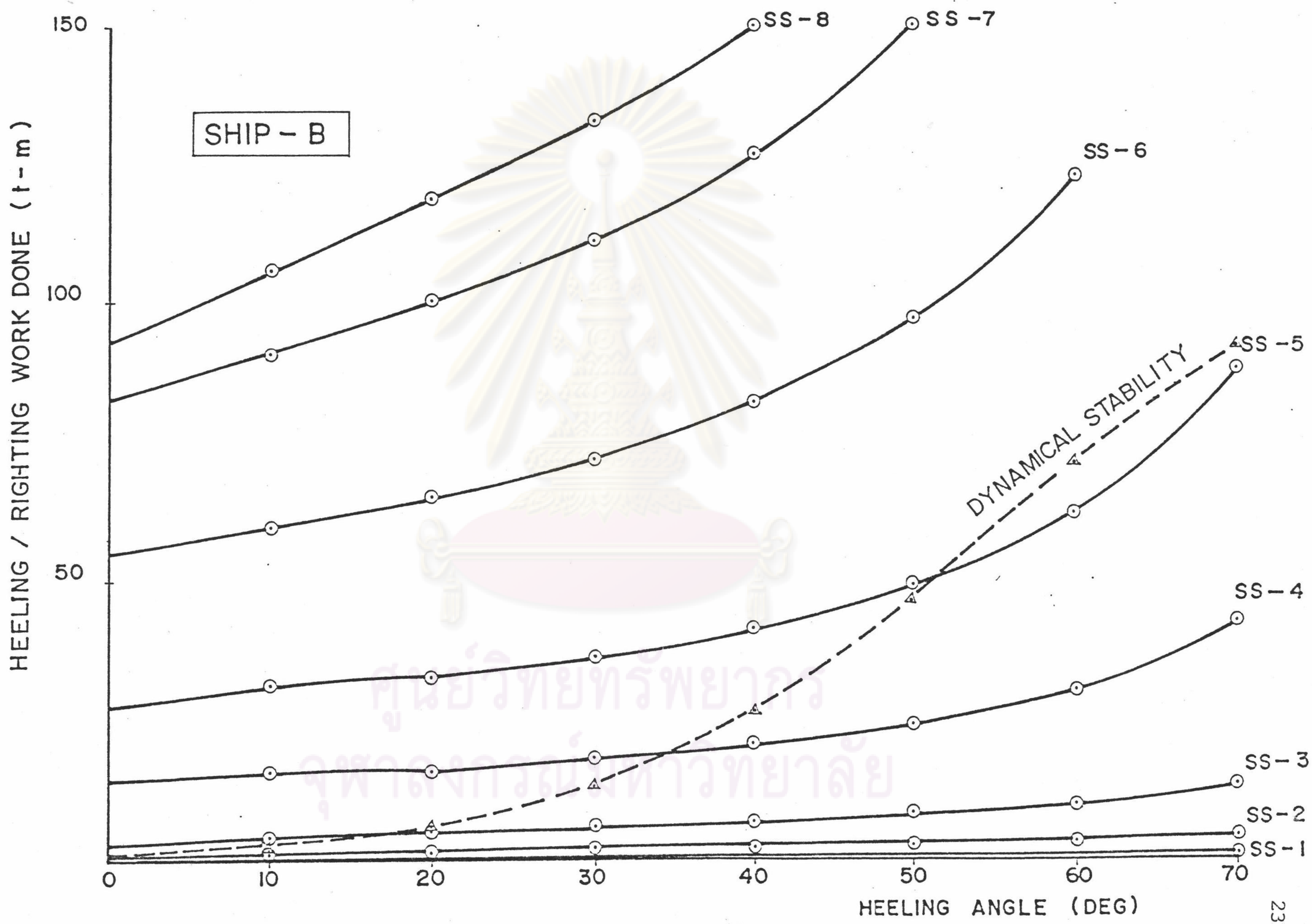

Fig (8.2) Superimpose of heeling/righting work done of ship - B

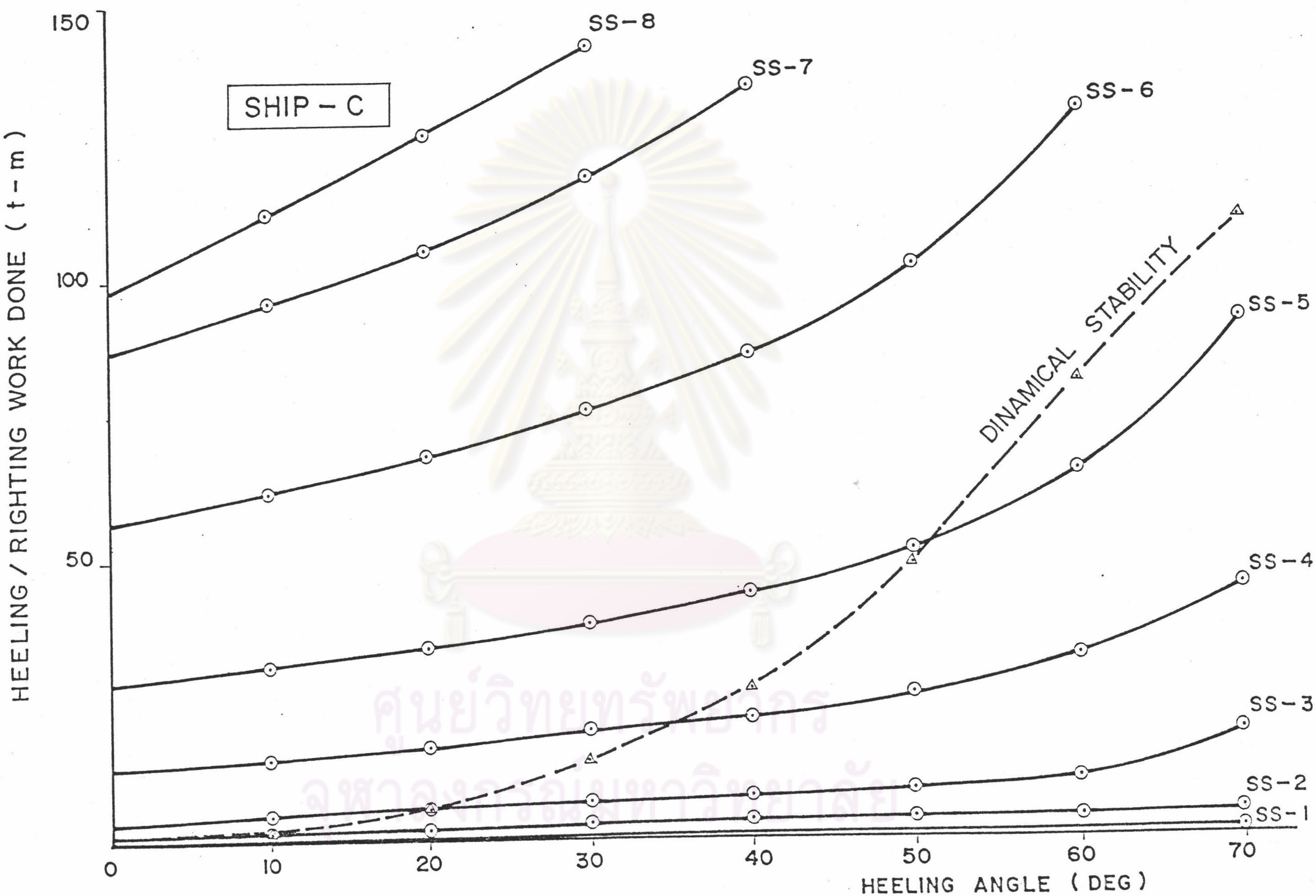

Fig. (8.3) Superimpose of heeling/righting work done of ship - C

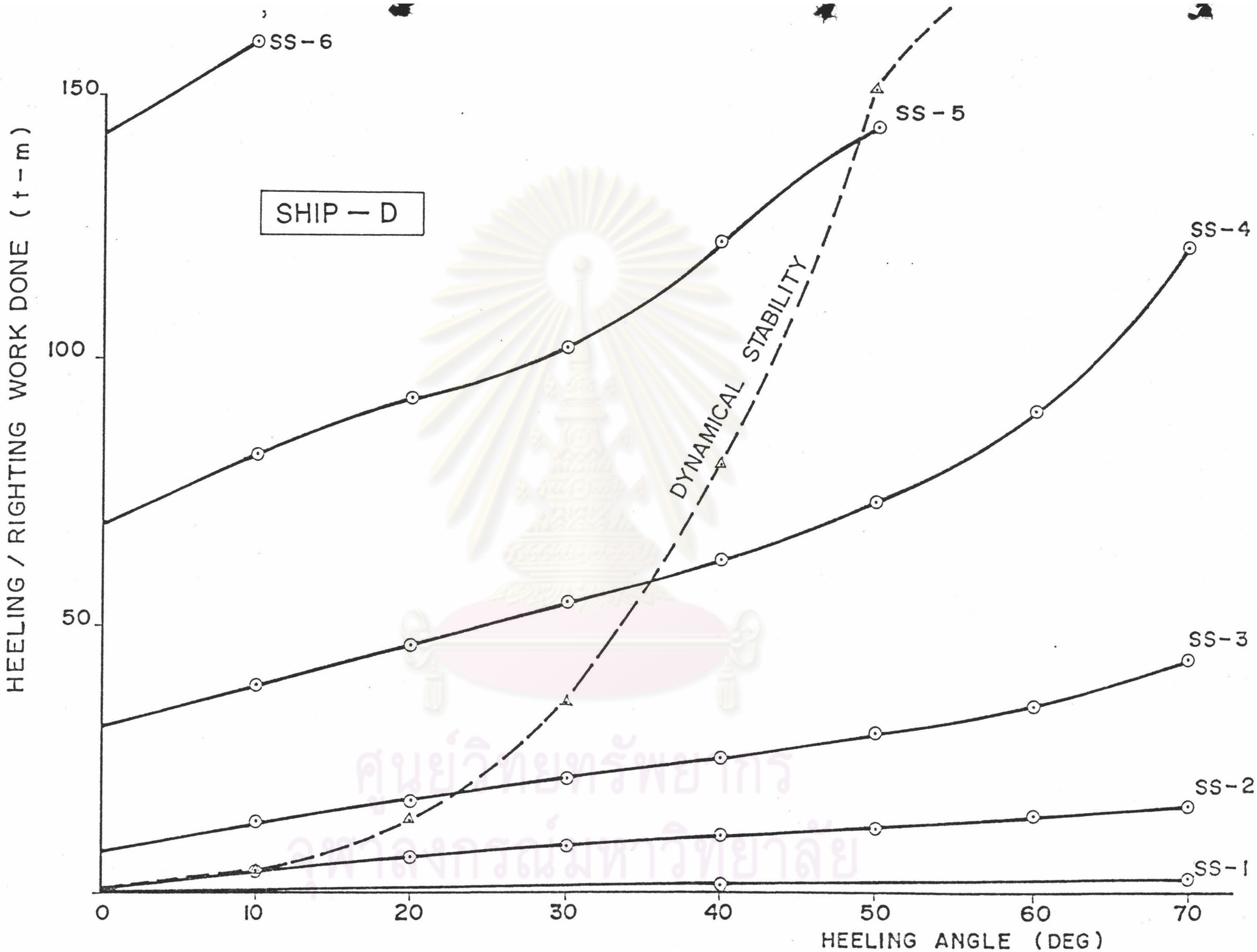

Fig. (8.4) Superimpose of heeling/righting work done of ship - D

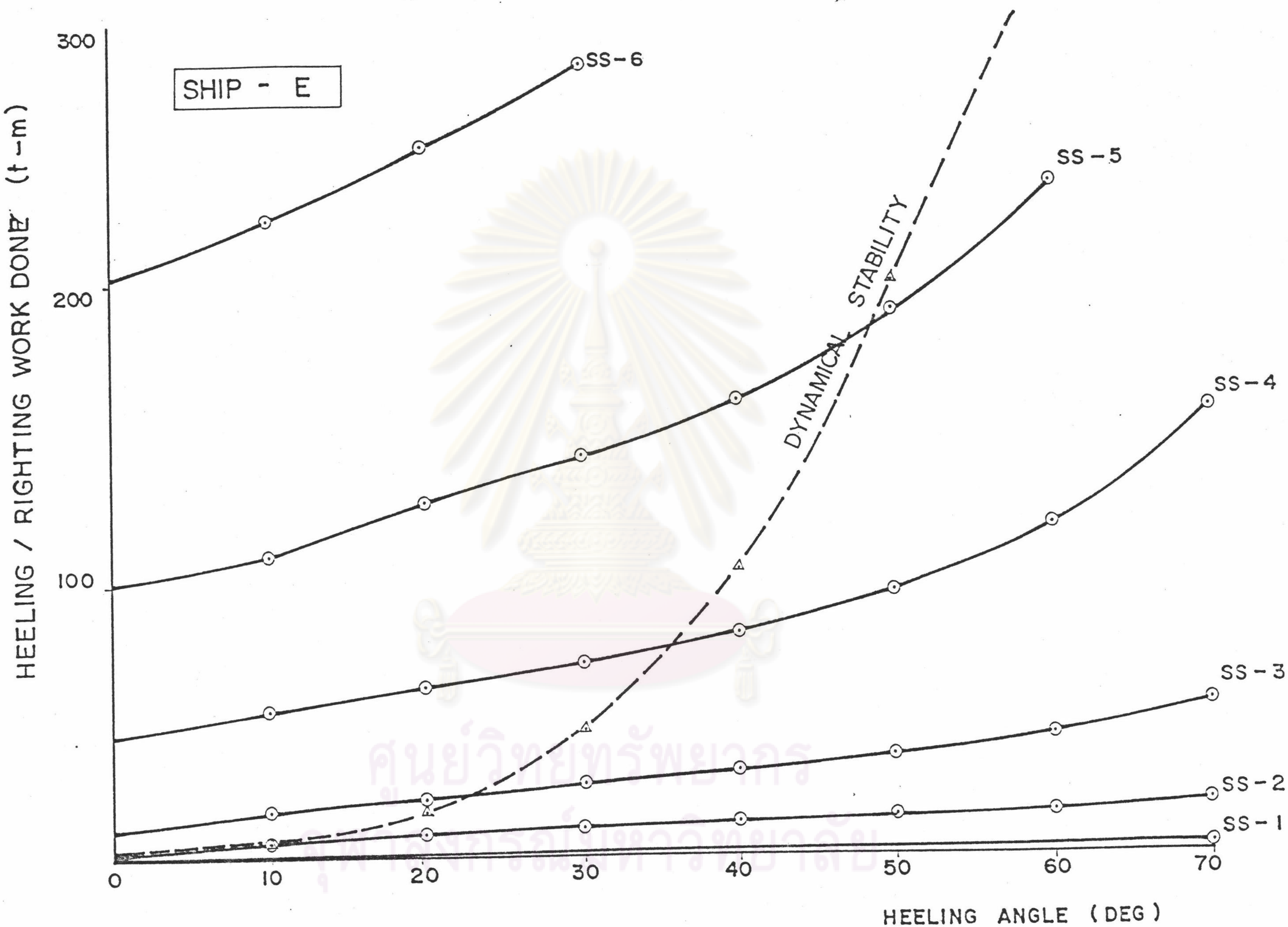

Fig (8.5) Superimpose of heeling/righting work done of ship - E simple criteria exists as far as area under the curves are concerned.

Consider at the angle of 50 degrees, as far as the vassel's functioning is concerned. By choosing sea states 4 and 5 as examples to consider, one will be able to determine the ratio of heeling to righting work done without difficulty. Let the ratio of heeling to righting work done be called " Coefficient of work done", ie.

<u>Coefficients of work done</u> (at 50 deg.)

	SS-4	SS-5
Ship A	0.486	0.914
Ship B	0.522	1.065
Ship C	0.542	1.063
Ship D	0.487	0.906
Ship E	0.462	0.943

One will easily notice that for coefficient of work done greater than 1.0, the vessel is assumed to be unsafe since the heeling work done is greater than the righting work done. Ship B and C, therefore, are unsafe at all to be operated in sea states 5.

By contrast, all vessels are safe at sea states 4. If 20 percents of reserved work done is included for the sake of safety, the author would like to propose that :-

"Up to a required angle of heeling, the coefficient of work done should be less than 0.80"

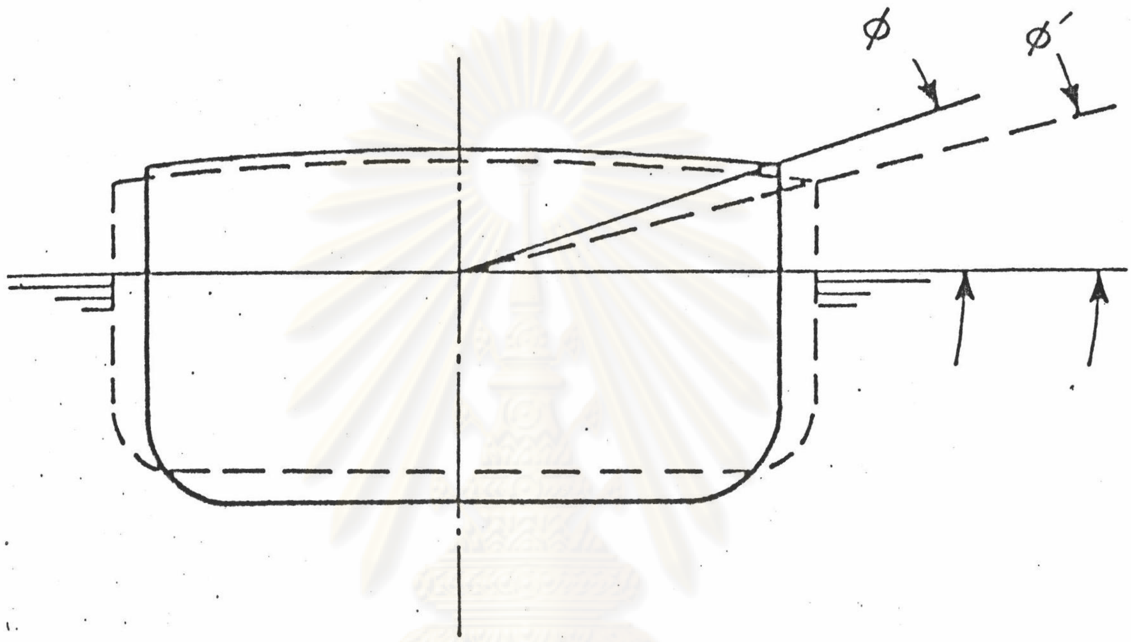

Fig. (8.6) Breadth variation with constant midship section area

8.2 Related consideration with regard to fishing vessel design

a) Breadth variation and ship's characteristics

Normal practice for a ship designer, when determining the main dimensions and coefficients, is to keep to a sequence, ie. after the length, the block coefficient (C_B) and the ship breadth in relation to the draught.

The equation :

$$\Delta = L \times B \times T \times C_B \times \rho$$

establishes the value of the product(B x T). That is, when varying breadth at the design stage, draught and depth are generally varied in inverse ratio to the breadth Fig.(8.6). If breadth is increased in such a way that the midship section area, taken up to the deck, remain constant, the following effects will present :-

1) Increased resistance and power requirements [52].

2) Hull steel weight will be increased due to increasing in thickness of bottom and deck plating.

   (1) and (2) yield higher initial costs of the vessel.

3) Smaller draught restricts smaller propeller dimensions. This, in turn, means that lower

propulsive efficiency will be obtained.

4) Greater initial stability :
KM becomes greater, KG smaller. In detail KM = KB + BM. When increasing the breadth, KB will be smaller in relation to the draught. BM increasses with the second moment of area of the waterplane, ie. with the cube of the breadth. This increase in BM has a considerably greater effect than the decrease in KB. The initial stability GM is, thus, increased for two reasons : Upward shifting of metacentre (M) and downward shifting of centre of gravity (G)-in relation to the keel.

5) On the inclined stability, the righting arm curve of the wide ship, besides having steeper initial slope (resulting from the great metacentric height) usually has longer range. See Fig. (8.7). Its maximum value is reached earlier due to earlier deck edge immersion.

6) Smaller draught. This is convenient where draught restriction exist.

Readers should be aware that, apart from technically limited possibilities, there are also operational limited possibilities as well.

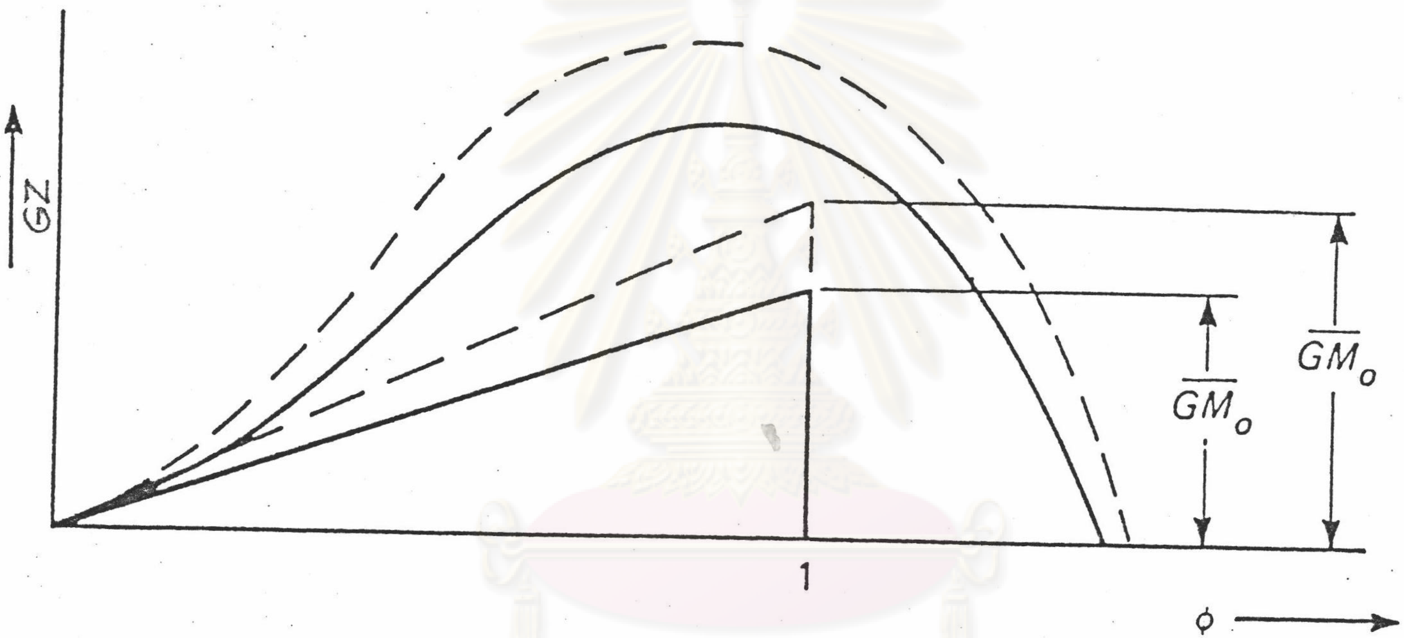

Fig. (8.7) Effect of change in breadth on curve of righting arm.

b) Fixing the breadth

Where the breadth of the vessel can be chosen arbitrarily, its size depends on the stability. In such case, the breadth can be made as large as the stability demands. It should be noted that the length-breadth ratio (L/B) is less significant for the stability requirement than the breadth-draught ratio (B/T).

When choosing the breadth required for the stability, a distinction should be made between stability which is conductive to good seakeeping quality and stability which is required to cope with special loading conditions:

a) Good seakeeping quality :-
   1) Small amplitudes of roll
   2) Small rolling accelerations

b) Special loading conditions :-
   1) Damaged condition
   2) People crowded at one side of deck
   3) Lateral tow-rope pull
   4) Grain cargoes
   etc.

In the past, it was beleived that low metacentric height (GM) of a vessel meant that the inclining moment in waves was also small [23]. Today, it is known that a more critical condition occurs in a stern sea, especially when ship and wave speed are nearly the same. In such a case, the transverse moment of inertia of the waterplane can be considerably reduced when the wave creast in amidships and the vessel may capsize, even in the absence of previous violent motions.

c) Increasing the area below the righting arm curve by increasing the reserve buoyancy

1) Increasing depths and fewer deck houses.

This usually makes the vessel lighter and cheaper.Generally speaking,living quarters in deckhouses are preferred, almost exclusively, to living quarters in the hull,since standard-dised furniture and facilities can better be accommodated in the former [34].

It should be noted that fewer deckhouse resulting in lower wind heeling moments.

2) Inclusion of superstructure and hatchways in the stability calculation.

Fishing vessels are under 100 m.in Length, have an aft deckhouse, improving both sea-keeping and stability in the inclined position.

If full-width superstructures are used, water can enter at a smaller angle of inclination than deckhouses, and have a greater effect on stability. Most regulations do not regard deckhouse as buoyancy units. Actually, the calculation can be made either with or without full-width superstructure. The same procedure can be applied to watertight hatches, if sufficient level of stability can not be proved without them.

3) Increasing the outward flare of framing above the constructed waterline.

At angle of flare of up to 40 degrees at the bow is acceptable for fishing vessels [5; 6; 33].

d) Criticism of the freeboard regulations :-

Criticism of the freeboard regulations is levelled at the following aspects :

1) For small ships, the dependence of the freeboard on ship size results in smaller freeboards not only in absolute, but also in relative terms. Seen in relation to ship's size, however, the small ship is normally subjected to higher waves than the large ship. If the freeboard is considered as given protection against flooding, the smaller ship should surely have relatively greater freeboard than the large ship.

According to the regulation of 1966, the basis freeboard for Type B ships (Fig.8.8) ranges from less than 1% of the ship's length for small vessels up to around 1.5 % for large ships. The critics demanded freeboards of between 1 and 2% of the length for the whole length range.

Advocates of the current freeboard regulation argue that :

a) Small vessels are engaged in coastal water and have more chance of dodging bad weather [63;74].

b) The superstructures of small vessels are less exposed than those of large vessels to the danger of destruction by violent seas since sea washing on board causes a more firceful braking effect to a small than to a large ship. Furthermore, the speeds of smaller vessels are usually lower than those of large ships [44; 48].

c) The preferential treatment given to the small ship (with respect to freeboard) is valued as a kind of "social measure".

2) In the freeboard regulations, the freeboard is made to be dependent on many factors

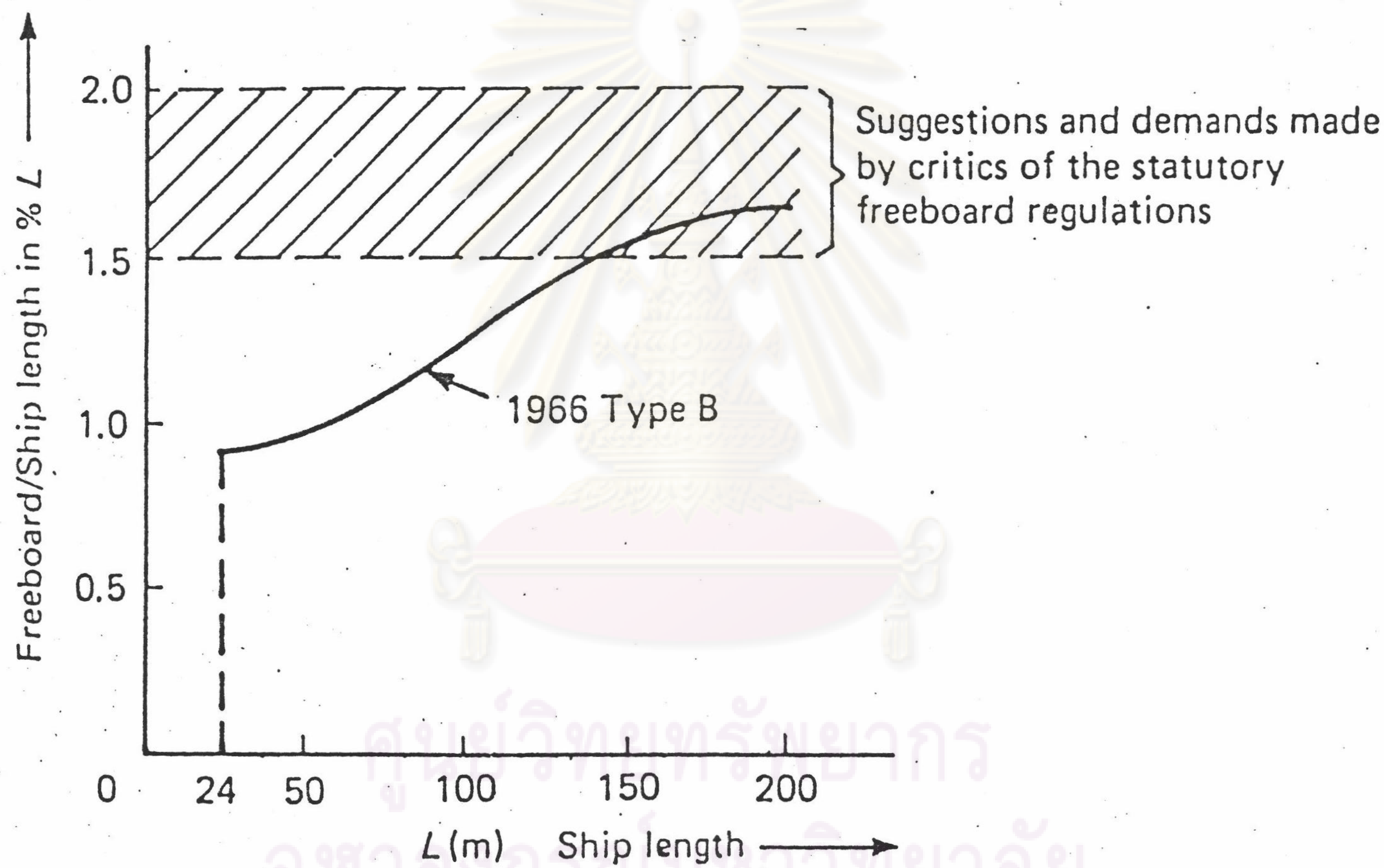

Fig. (8.8) Table freeboard type B.

such as type, size and arrangement of super-superstructure and sheer [57]. The physical relationships between the data entered into the calculation and their effects on ship safety are not as clear as they appear in the calculation.

3) The reserve buoyancy for larger thankers stipulated in the new freeboard regulation has received universal approval, although technically it should not be a part of the freeboard regulation. Moreover, there are other types of ships (e.g. fishing boats) which appear to be in considerably greater danger than tankers.

4) In many areas, the freeboard regulations seem insufficient (particularly for small full-scantling vessels).

5) A link with stability regulations seems more sensible than the link with flooding regulations which was introduced for super-tankers, since when there is a lack of stability due to heeling,the freeboard on one side can be diminished considerably.

Unlike the previous regulations, the final draft of the current freeboard regulations attempts not to impair in any way the competitive position of any ship type.

One positive aspect of the latest freeboard regulations in considered to be the new "minimum bow height". Despite the shortcomings mentioned, the existing freeboard regulations undoubtedly represent a way of preventing gross mistakes.

8.3 Reccommended further studies

a) Loss of righting lever on a wave crest

This is one aspect of the influence of external forces which has been considered over the past few years and internationally has been studied in particular regard to fishing vessels. At present, the study is not yet completed. Some work gives reasonable estimates of the stability loss in a following sea provided it is used within the limits specified as part of its definition.

Some countries consider that they have taken this loss into account in the national standards by specifying a minimum value for GZ (max.) at for example 0.3 m., of which all or part may be lost in a following sea condition.

Accepting the possibility that a large proportion of transverse stability might be lost in a following sea conditions, it must then be considered whether such a state can operate concurrently with other adverse influences such as beam wind. The probability of such coincidence is highly speculative and the indications are that a criteria which provided for all such influences could not be met by a high proportion of vessel. Furthermore, so far as following seas are concerned there appear to be many indications that the basic danger lies in the broaching action which may follow the poising of a vessel on a wave crest rather than the loss of stability itself.

b) Forces excerted by fishing gear or methods

The data available is insufficient to allow any recommendations to be made but one or two of their general conclusions are relevant :-

(i) Quick release mechanisms, dependent upon the method of fishing would be advantageous [21; 67].

(ii) At present, the forces exerted by fishing gear are generally less than those due to the maximum external forces of wind and sea and since these two systems of forces are not likely to act at the same time [49] a vessel with adequate stability to meet the natural forces will be able to withstand the forces due to fishing gear. This present relationship might however be disturbed as certain fishing methods show a tendency to increase the weight of nets and height of the hauling points and some future reconsideration might be necessary.

c) Influence of freeboard and superstructures on the stability of fishing vessels

In this topic, the stability should be calculated for selected draughts or freeboards. The adverse influence of water trapped on deck assuming various bulward heights should be studied in detail. Extension of superstructure should have affect the variation in the values of the righting lever.

Experimental studies of low-speed operation in head or following seas have shown that the stability of small vessels such as tugs and fishing vessels could be greatly reduced by water accumulating on deck [2; 41]. When the encounter frequency is high enough, the build-up of water could cause a large and essentially static angle of heel to result. At present, analytical solutions to this problem are untenable since analysis must include the influence of deck clutter, bulwark height, freeing port area, etc. Much additional research is needed in this area if small vessel stability is to be adequately assessed.

8.4 Conclusion

Any hope to control the hazards inherent in the fishing profession is realistic only if three factors are duly considered :-

a) The environment in which the fisherman operates.

b) The tools of the fisherman's trade, that is the vessel itself, the configuration and condition of the hull, the mechanical and electrical systems, and the system directly involved in fishing and handling of the catch.

c) The fisherman himself - his knowledge and competence in dealing with the environment and handling the hardware, as well as his motivations and attitudes.

One will realise that marine environment is extremely harsh. Anybody familiar with it has learned to respect it.

The author believe that all of the above described factors are in need of continued attention and refinement. However human error has played the major role in fishing vessel accidents and has contributed to over 80 percent of the casualties. These errors stem from a lack of knowledge of vessel operations unrelated to the business of bussiness of catching fish, and include a general lack of understanding of the various forces acting upon the vessel and their impact on vessel stability.

Today's fisherman is faced with escalating operating costs-particularly stiff competition and in, many cases, a limited fishing season. Thus, it should not come as a surprise that the fisherman, when faced with a tradeoff between financial gain and possible hazards associated with a " slight " overload which he may well feel he can handle - will decide in favour of catching more or staying out too long. Obviously, the danger of the fisherman making the wrong decision will be the greater the less he understands about stability and the possible consequences to his vessel of exceeding certain limits.

The ultimate criterion for the hull design of a ship is its performance in a seaway. As Lucius Annaeus Seneca, a Roman writer living during the first century, said,

" A ship is said to be good, not when she is painted with extravagant colouring, nor when the bow is silver or gold, nor when the bulwarks are carved in ivory; but when she is stable and firm, tight in the seams to exclude water, strong to withstand the assault of the sea, obedient to the helm, swift, and not sensitive to the wind. "