CONTRIBUTION TO DISCUSSION OF SNAME PAPERS BY

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PAPER No. 5: THE SIMULATION OF SHIP MOTIONS AND CAPSIZING IN SEVERE SEAS
J O De Kat and J R Paulling

This paper is another useful contribution to ship stability. The authors are to congratulated on their attempt to integrate a large number of aspects of ship dynamics, so as to examine their effects on vessel capsizing. This study is, no doubt, motivated by the existence of valuable data acquired in the early nineteen-seventies, and that information has provided a useful guide for the theoretical work. The paper also highlights what must be a good PhD project and the systematic way in which the thesis work was performed.

Having studied the paper and discussed the approach and results, we have several points to raise with the authors.

Firstly, to what extent do they believe the results of the present study will provide a better judgment of the stability of ships than that given by the results of previous work? How effectively do they think the resulting simulation software can be used for other types of ships and for the practical assessment of ship stability at the design stage?

Secondly, beneath Equation (25) in the sensitivity analysis it is stated that "The location of the centre of gravity (KG) has an important bearing on the sensitivity behaviour; however, this variable has not been included in the analysis". In our own studies - see, for example, Ref **(SU-1)** - we have found KG to be the single most sensitive factor in ship stability analysis. For this reason we would welcome an explanation both of the decision not to include KG in the analysis, and of the contradictory action of discarding a parameter which is regarded as important.

Thirdly, we are unclear about the justification for using a combination of linear and non-linear derivation of coefficients. Typical examples of this include:-

a) On Page 5-4: "... diffraction forces are computed not by a convolution as in the case of radiation forces, but by superimposing the instantaneous values....". This can only be done in a linear sense.

b) On Page 5-3: Since the sine and cosine functions of large angles are non-linear functions, why does non-linearity have to be derived by a product of sines and cosines in the transformation matrices?

Fourthly, our experience has shown the importance of combining the effects of transverse stability and directional stability, see **(SU-2)**, and we should be glad of the authors' views on whether directional stability should be incorporated in their formulation at the expense of other less sensitive factors.

Finally, could the authors provide more evidence on the general applicability of their proposed equivalent wave system for use when a vessel is in short-crested random seaways?

STRATHCLYDE UNIVERSITY REFERENCES

1. Kuo, C, Vassalos, D, Alexander, J G and Barrie, D: **Incorporating Theoretical Advances in Usable Stability Criteria".** RINA Int. Conf. on the SAFESHIP Project, Ship Stability and Safety, London, June 1986.

2. Vassalos, D and Spyrou, K: **An Investigation into the Combined Effects of Transverse and Directional Stabilities on Vessel Safety.** Paper submitted to the 4th Int. Conf. on Stab. of Ships and Ocean Vehicles, Naples 1990.

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PAPER No. 6: INVESTIGATION INTO THE PHYSICS OF SHIP CAPSIZING BY COMBINED CAPTIVE AND FREE-RUNNING MODEL TESTS

S Grochowalski

In view the scarcity of experimental data, both model and fullscale, on ship capsizing, we are delighted to be able to examine the information provided in this paper. We believe that everyone interested in ship safety will, like ourselves, appreciate the usefulness of this further insight into the mechanisms of capsizing. The Canadian Coast Guard is to be commended for sponsoring such a project, and for making the knowledge gained so readily available.

We enjoyed studying the free-running model tests and, in particular, those involving the influence of bulwark submergence. That last is a situation in which theoretical formulations are difficult and these experiments have been most valuable. However, we have several difficulties in regard to the captive tests. It is not clear to us what their aims were, nor why such a series of experiments was carried out. Neither is it clear why theoretical checks were not done in parallel.
We understand that in these experiments the author was measuring hydrodynamic forces at the mean position of the model displaced at large angles but for relatively large waves most computer software would allow these forces to be computed for this situation. For the case of extreme waves, on the other hand, we believe that the "captive" forces would be quite different from the free-running forces. The logical way forward would surely be a combination of theory and a few selected experiments before making a decision on whether further experiments were necessary. We should be grateful for an explanation of the thinking behind this series of experiments. We should also appreciate the author's comments regarding how best to translate the knowledge gained into the practical design of a fishing vessel.

PAPER No. 7: DYNAMIC-RESPONSE-BASED INTACT AND RESIDUAL DAMAGE STABILITY CRITERIA FOR SEMISUBMERIBLE UNITS

G Stark, Y.S. Shin, J S Spencer

Having followed this project over the past few years, we welcome the opportunity to consider this latest paper but we should like to make certain observations, and to seek the authors' response on several issues.

a) Usage of Available Knowledge

As the authors will know, we have been involved in semisubmersible stability research for a number of years and have derived considerable benefit from earlier studies initiated by the SNAME MS-3 panel on the subject. This is reflected in our recent research programme (1985-87) sponsored by the UK Department of Energy, the offshore industry and the UK Science and Engineering Research Council. The principal aim of that programme was to develop a procedure for assessing semisubmersible stability that would incorporate the effects of a realistic environment and vessel dynamics whilst taking into account operational considerations - much along the lines of the work presented in the paper. The programme was completed in July 1987 and stability criteria were put forward for consideration by the UK Government and regulatory bodies. The research work and findings were described in **(SU-1)**.

Despite reference to some relevant publications, the present paper indicates that very little use has been made of the experience gained by other researchers on such aspects as extreme rotational motions of semisubmersible. Is there some reason for this decision?

b) Comparative Studies

We are surprised by the continued use of the "area ratio" as a method of comparing designs in different operating conditions. It should be noted that the "area ratio" concept, which shows the excess of restoring moment over excitation moments, provides only relative comparisons.

Furthermore, this is only valid when alternative designs are examined under the same design condition and would be meaningless for semisubmersibles operating under different environmental or operational conditions.

A more effective approach should be based on an absolute term such as the "net area" - which indicates the excess of restoration over excitation. Table 1 shows two conditions of the Aker H-3 design in intact and damaged conditions, and it is clear that more consistent values are provided by this approach. Perhaps the authors could give us reasons for their choice.

c) Effectiveness of the Proposed Criteria

Our earlier work, Ref. **(SU-1)**, has shown that the worst heading of a combined wind- plus-wave environment is normal to a diagonal axis. Dynamic responses are about such an axis instead of the traditional roll and pitch axes. It should be noted that at large angles such motions are not clearly defined, because the axis of rotation does not remain fixed. It is for this reason that there cannot be a clear definition of the downflooding distance when the semisubmersible is operating in an extreme environment.

Bearing these factors in mind, we should be grateful for clarification on the following points:

- What is meant by the authors' use of the term "dynamic response"?
- Around which axis has the response been calculated?
- What environmental heading is used in the calculations?
- What type of response has been adopted - linear, non-linear, or a combination of the two?

Lastly, could the authors explain why the capsize criteria contain a mixture of energies, some potential in nature and others time-dependent, and why is the effect of waves on the restoring curve omitted in these criteria? Finally, why is the very important response due to low frequency wave excitation omitted from the downflooding criteria? See Ref. **(SU-2).**

We very much regret that we shall not be present to discuss these points at length with the authors and those present at the Annual Meeting of SNAME, but we should greatly appreciate their response to the issues raised.

REFERENCES

SU-1. Vassalos, D, Kuo, C and Konstantopoulos, G: **An Effective Stability Assessment Procedure for Semisubmersibles Incorporating the Effect of Wind, Waves and Vessel Motion.** International Conference on "The Semisubmersible", City University, London. September 1987.

SU-2. Vassalos, D, **Experimental Verification of Stability Related Theoretical Concepts.** PRESS 7, Part A, Proeject MASS. June 1987.

TABLE 1

STABILITY ASSESSMENT OF AN AKER-H3 AT OPERATIONAL/SURVIVAL DRAUGHTS

		STATIC				QUASI-DYNAMIC	
		Intact		Damaged		Intact	Damaged
Draught (m)	KG (m)	Area Ratio	Net Area (m.rad.)	Area Ratio	Net Area (m.rad.)	Net Area (m.rad.)	Net Area (m.rad.)
21.3	16.28	2.35	0.13	2.95	0.02	0.19	0.08
18.3	16.3	1.6	0.14	4.63	0.08	0.18	0.17

NOTES:

a) Environment: quartering wind and waves
b) Wave height = 12.0m
c) Wind Speed: Intact: 36.0 m/s at 21.3 m draught
51.5 m/s at 18.3 m draught
Damaged: 25.8 m/s in both cases.