

SESSION ON INFORMATION AND PRESENTATION

Chairman: R. Adm. P. O'Dogherty

Information Committee Memberships: M. W. C. Oosterveld (Chairman) - G. K. Knight (Secretary) - B. Johnson - T. Koyama - S. Marsich - E. P. Nikolaev - N. H. Norrbin - M. Pérez Sobrino - M. Schmiechen

Discussion of the Report and the Draft Recommendations of the Information Committee. (Cf Proceedings, Volume 1, p. 27-73.)

Note: Within the framework of the Committee a multi-lingual translation of the Overall Index of Titles of the ITTC Dictionary of Ship Hydrodynamics (RINA Maritime Technology Monograph No. 6, 1978) was prepared for the Conference, at which opportunity the six separate parts of Index Volume 1 were distributed to the Delegates. Copies of Index Volume 2 have been enclosed to the present Volume 2 of the Proceedings at its original distribution to each Member Organization. Additional copies of the Index volumes may be obtained from CETENA and from University of Tokyo respectively. (Cf Proceedings, Volume 1, p. 35.)

I. DISCUSSIONS

V. FERDINANDE - University of Ghent, Ghent, Belgium

REMARKS CONCERNING ORIENTATION OF COORDINATE SYSTEMS AND THE PROPOSED RESTRUCTURING OF THE ITTC STANDARD SYMBOLS

Formerly, the I.T.T.C. and the I.S.S.C. imposed to choose a z-axis directed downwards. Some authors of text-books and lecture notes on naval architecture imitated consequently, but others didn't. In ocean engineering and wave

theory, the z-axis commonly has always been directed upwards. Of course, the choice is of no fundamental importance, but somewhat annoying yet when lecturing ship theory, wave mechanics and behaviour of offshore structures in waves to the same students.

Hence, some questions might be asked here. Is it compatible to choose the z-axis positive upwards for exciting forces, and positive downwards for seakeeping problems, as proposed at the bottom of p. 33? What is the choice pro-

posed for hydrostatic problems on p. 54 after all?

Further, the list of symbols invites some questions (misprints or intentional modifications?).

p. 41: F for frequency, instead of f? (Look however at the bottom of p. 45.)

L_w for wave length, instead of L_W ?

p. 42: R_{aW} for mean resistance increase in waves, instead of R_{AW} ?

S for relative motion, instead of s?

p. 43: The definition of T_{-1} , T_{-10} as given in the list ($Z_{\pi(m_{-1}/m_a)}$) is not clear to me. I think a good general definition of a "characteristic period" is $T_j = 2\pi (m_0/m_j)^{1/j}$, ($j = -n, \dots, -2, -1, 1, 2, \dots, n$).

Also the symbols related to "Apparent wave amplitude" on p. 44 and p. 45 seem rather confusing.

These remarks above should not be considered as an act of criticizing the Committee's work. It indeed is a heavy but necessary task to conciliate all currently used symbols, and the efforts of this Committee should be praised and encouraged.

S. A. HARVALD - Technical University of Denmark, Lyngby, Denmark

REMARKS REGARDING SYMBOLS

1. P. 41 and p. 45: L_w , Wave length.
The symbol L_w has been changed to L_w . It is difficult to see the reason for this change when the symbol ζ_w (wave height) is retained. A misprint?

2. P. 47: Q_R , Rudder torque.
Is the meaning of "shaft" the rudder stock?

3. P. 48: ΔC_F , Roughness allowance.
The parenthesis "(Obsolescent, see C_A)" on p. 15 in the B.S.R.A. memorandum ought to be left out.

4. P. 49: J, Advance coefficient.
A " J_Q , Advance coefficient of propeller determined from torque identity" ought to be added (compare K_T and K_Q , w_T and w_Q).

5. P. 49: η_R , Relative rotative efficiency.
Perhaps the symbols η_{RT} and η_{RQ} ought to be added.

6. P. 53: AG_T and AG_V , Transverse and Vertical distance.
A could be the assumed centre of gravity as well as the actual centre of gravity. A is used as symbol for many things and therefore G_1 ought here to be used instead of A.

7. P. 54: l, Longitudinal trimming arm.
The letter l is a controversial one as most typewriters do not distinguish between 1 and l.

8. P. 54: Δ , Displacement force.
For many years Δ has been the displacement mass (compare $\Delta = S + M + E + D_w$) and ought still be the mass: $\Delta = \rho \nabla$. In the dynamic cases the buoyancy may be expressed by $\rho g \nabla$. m is mass in general. N.B. misprint in the proposal: $\nabla = \nabla / \rho g$.

9. P. 54 and p. 55: QQF , QQB and QQG , Longitudinal mean Centre of flotation of buoyancy and of gravity.
The old symbols LCF , LCB and LCG are easier to remember than the QQ -symbols and ought therefore to be retained.

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DEFINITION OF ROLL, PITCH, AND YAW

Introduction

The roll, pitch, and yaw motions of a ship are defined to be the rotations of the vessel about its longitudinal, transverse and vertical axis. This definition is adequate for ships, since the roll and pitch angles are small. For an offshore structure undergoing up-ending, or a submersible, or any object which can undergo large rotations in more than one direction this definition is inadequate.

There are many possible definitions of roll, pitch and yaw. The most obvious definitions are to define them as sequential rotations about either space or body axes in some specified order. From a mathematical point of view it does not matter what definition is used, providing it is explicit, and allows any orientation to be specified by a (generally unique) set of angles called roll, pitch and yaw.

From a practical point of view, however, it is convenient if the roll, pitch and yaw can be described as angles between the body and some suitable reference. For floating bodies, the most obvious reference is the water surface itself.

This note argues that defining roll, pitch and yaw as successive rotations about body axes, taken in the order yaw first, pitch second, and roll last results in such convenient definitions.

Axis Systems

Let OXYZ be a set of axes fixed in space with the Z axis vertically upwards (or downwards), and the Y and X axes in the water surface. Let

Oxyz be a set of axes fixed in the body which are co-incident with OXYZ when the body is in the position that is to be described as zero roll, pitch and yaw.

Now rotate the body through a yaw angle ψ about the Oz axis. The x and y axes remain in the water surface, and the yaw angle can be measured as the angle between the X and x axes.

Next rotate the body through a pitch angle ϕ . This rotates the x axis out of the water surface. The pitch angle can be measured as the angle between the x axis and the water surface. The yaw angle can no longer be measured directly as the angle between the X and x axes. The yaw can be measured as the angle between the X axis and the projection of the x axis into the water surface. Since the pitch rotation was about the y axis, this axis remains in the water surface.

Finally, roll the body through an angle θ about the x axis. Since this rotation is about the x axis, the position of the x axis is not changed, and therefore pitch and yaw can be measured as before. The roll angle can be measured as the angle between the y axis and the water surface, measured in the Oyz plane.

Conclusions

If the roll, pitch and yaw of a body are defined to be the angles or rotation, about body axes, required to move the body from its un-rotated position to its current position, when applied successively in the order: yaw, pitch, roll, then they can be conveniently be interpreted as angles of the body axes to the water surface, as follows:

- a) Roll ($-180^\circ < \theta \leq 180^\circ$) is the angle between the y axis and the water surface, measured in the Oyz plane. If the z axis has a component downwards (upwards, if Z is downwards)

then the obtuse angle should be measured.

- b) Pitch ($-90^\circ \leq \phi \leq 90^\circ$) is the angle between the x axis and the water surface. It is positive if the x axis has a component downwards (upwards, if Z is downwards).
- c) Yaw ($-180^\circ < \psi \leq 180^\circ$) is the angle between the X axis and the projection of the x axis onto the water surface.

Notes

- 1) Exactly the same orientation of the body can be obtained by applying exactly the same roll, pitch and yaw rotations, in the order roll, pitch, yaw; providing the rotations are taken about space axes rather than body axes.
- 2) Using this definition the depth of submersion of any point on the body is independent of yaw.

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REMARKS ON THE SYMBOL FOR DISPLACEMENT

I have read the Committee's Report with considerable interest and would like to commend the proposals generally. I have only some brief remarks to make on a number of the symbols.

In the first place, on the use of the well known Greek letter Δ . In the present symbol list it is defined as 'displacement mass' and in S.I. the units are, of course, in tonnes.

The Committee now proposes to use this same symbol Δ for 'displacement force' (the upward buoyancy force) which in S.I. will be measured in Newtons - a different order of magnitude altogether.

For example, for a 10,000 tonne ship, Δ as a force would have a numerical value of the order of 100,000,000 Newtons or 100,000 Kilonewtons. I am not too sure about such a dramatic change in the scale of units for the same well known symbol Δ already in such common use.

By the way, I fully appreciate the point made by the Committee about coping with the non-Archimedes case where weight and displacement force are not equal which has given rise to the proposed change.

In the light of the above, however, I think it might be worthwhile trying to find another symbol for upward buoyancy force. I would suggest a variation on the letter B e.g.: B_F or F_B or perhaps some other symbol altogether.

In this way we would be able to use Δ for Ship Mass and thus preserve the order of magnitude of its measurement which has been in use for a very long time. This goes back way beyond the introduction of the S.I. System when Δ was measured in either English or metric tons. As it transpired, of course, the metric ton is the same as the S.I. tonne.

The symbol m should be retained as mass in general rather than ship mass.

I would stress here that I have in mind particularly the feelings of practitioners (shipbuilders, shipowners and ship designers in general) who might be averse to the proposed change.

I would add, by the way, that the symbol W , ship weight, is not affected by all this. W is a force and would be measured in Newtons as is the upward buoyancy force.

A brief comment now on the definitions of some of the symbols on p. 54.

Item 14, ∇ , displacement volume. Defining this

as $\Delta/\rho g$ seems a very roundabout way of going about it. I think it is really self-explanatory and does not need a definition. The dimensions L^3 should suffice.

I think much the same can be said about Item 12, mass, m.

On p. 31 a proposal is made to separate the symbol lists for Seakeeping and Manoeuvring. This takes me back - this is just the way they were arranged in the first ITTC list published in 1965.

It was later suggested that they had so much in common they should be combined and this was done in later editions.

Finally I would like to congratulate the Committee on the good work they have done.

J. V. WEHAUSEN - University of California, Berkeley, USA

REMARKS ON BIBLIOGRAPHIES

A conscious decision appears to have been made in preparing the Proceedings of the 17th ITTC to eliminate all page references in Bibliographies. Author(s), title, journal abbreviation, years and volume number are given, but not first and last pages (or number of pages if it be a report). The rationale is undoubtedly that anyone who has the volume in hand can easily find the article in question, or if he has the report in hand he can see for himself the number of pages.

The key words here are "in hand". If a periodical or report is not in an easily accessible library, one usually orders a copy from another library, either directly or through a librarian. In such cases it is usually necessary to specify exactly the article in question; this

requires first and last pages, and possibly plates also.

In addition, such information informs the prospective reader as to his financial commitment in ordering a copy. Is the article 15 or 50 pages, the report 25 or 125 pages.

I also have another comment on bibliography. In each report the referred items are listed in order of occurrence in the report. This makes the bibliography almost useless later on. On the other hand if the order is alphabetical by first author, and then by year if there are several papers by the same author, the bibliography has an independent usefulness, in fact a usefulness quite independent of the report itself or even of its quality.

These may seem like pedantic and even picayune points, but I suggest that in the Proceedings for the 18th ITTC full references be given and that they be ordered alphabetically.

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REMARKS CONCERNING THE PROPOSED RESTRUCTURING OF THE SYMBOLS

I like to congratulate the Information Committee for the progress achieved in completing the List of ITTC-Standard Symbols and in translating the index of the Dictionary of Ship Hydrodynamics.

From the point of view of a user of the List of Standard Symbols a brief comment on the proposed revision of the List as given in Appendix 6 seems to be necessary. The Information Committee decided to combine all the Symbols listed by the High-Speed Marine Vehicle Committee under the headline "Semi-Displacement Vessels" with those of conventional ships.

This decision is not practical and will complicate the use of the revised List of Standard Symbols for two reasons. To describe the geometric characteristics of Semi-Displacement Round Bilge Hulls and to address all aspects of interest in the field of resistance and propulsion in the semi-displacement mode the HSMV-Committee listed more than 100 additional symbols. They are also applicable to all the other vessels which can reach speeds between hump speed and planing speed. If all these symbols are mixed with those of conventional ships, it will become a very time consuming procedure to find out the required symbol of the respective type of vessel. The user of symbols for conventional ships will be confused by the great num-

ber of symbols which are required for Semi-Displacement Hulls and vice versa. The second reason to compile the symbols of Semi-Displacement Hulls separately and arrange them subsequently to those of Planing Hulls is given by the fact, that many symbols which are used for both hull types are listed either at Planing Hulls or at Semi-Displacement Hulls. If the proposal of Appendix 6 will not be changed, then it becomes necessary looking for symbols of Planing Hulls to check in addition the very extensive List for Semi-Displacement Vessel and conventional ships. This will prevent the use of the revised List of Standard Symbols for high-speed vessels definitely.

II. REPLY BY THE INFORMATION COMMITTEE

1. Individual Symbols

The Committee wishes to thank *Professors Ferdinande and Harvald* for their careful reading of the proposed symbols list. They caught several typographical errors and have requested useful clarifications for several ambiguous symbols. The known typographical errors and corrections are

<u>Page</u>	<u>Correction</u>
41, 45	Change "L _w " to "L _w "
53	Change "δ" to "Δ"
54	Add to the definition of \overline{CZ} "or $\overline{GM} \sin \phi + MS$ "
54	Change definition of \bar{v} to " $\Delta/\rho g$ "
54, 55	Change "QQ" to the midships symbol.

The comment by Professor Harvald on Δ used for displacement force is covered in the response to Dr. Lackenby. Comments 2, 3, 4 and 5 are referred to the appropriate Committee.

The Committee respects the insight provided by *Dr. Lackenby*, who prepared the present List of Standard Symbols. He correctly points out, that the symbol Δ is sofar defined as displacement mass measured in the SI units kg or tonne, the latter being identical with the metric ton. Surprisingly the concept is not mentioned in the ITTC Dictionary on Ship Hydrodynamics. So the following remarks may be offered here:

As long as no explicit distinction was made between (displacement) mass and force the unit was uniformly kg or ton for both. Later, when the distinction was made, the different units were distinguished as kg mass and kg force, finally as kg and kp or ton and Mp, respectively. The numerical values of the two quantities remained the same sofar, and this may be one reason for the fact that no separate symbol was introduced for the displacement force, although this force is the only quantity of interest in hydrostatics. This situation in turn was the reason for the proposal of the Committee to re-interpret the concept of displacement and its symbol.

However, the Committee agrees with the discussants that in view of the traditional and long standing usage of the term "displacement" and the symbol Δ by ship builders, owners, etc. its proposal is much too radical. In general the term "displacement" refers to the quantity of water displaced, measured in units of mass, rather than its mass or force, which are of interest to engineers. This is in accordance with European standards concerning the term "weight", which engineers would like to use as a term for a force, while in view of common usage in the general, the commercial domain in particular, it is standardized as referring to mass or rather quantity of matter measured in units of mass. Non-engineers are simply not interested in the mass, i.e. the inertia of a body, and the force it exerts in a gravitational field. Both these aspects are rather annoying to the general public, being interested in quantities of goods only.

Using B to represent bouyant force would not be advisable since it already represents the beam which is used in many hydrostatic equations and is the symbol for the center of buoyancy.

2. Structure of the List of Standard Symbols

The Committee agrees with *Mr. Müller-Graf* of the High-Speed Marine Vehicle Committee that Semi-Displacement ships should remain a separate category under Special Vehicles. This involves a renumbering of sections 2.2 and 4.2 on page 56.

It is felt that other changes in the proposed new structure may be necessary, as soon as the work is actually carried out.

3. Coordinate Systems

The Information Committee is aware of the unsatisfactory state of affairs concerning the orientation of reference axes, addressed by

Prof. Ferdinande. As a matter of fact this situation was the reason for the Committee to try and resolve the problem. The result of this work are the statements in the Report to the effect that the choice of the coordinates is in any case a matter of convenience and that it is certainly outside the competence of the Committee to suggest the use of only one system. The only thing the Committee can ask for is that the origin and the orientation of the axes used should be explicitly stated in each individual case.

The problem of large yaw, pitch, and roll angles addressed by *Mr. Brendling* has apparently not been treated explicitly by the former Presentation Committee, neither in the List of Standard Symbols nor in the Dictionary of Ship Hydrodynamics. The reason for this omission may be that the interpretation *Mr. Brendling* is proposing in accordance with textbooks on this matter was tacitly implied by the Presentation Committee, as it certainly is by the present Information Committee. These angles are sometimes called Euler angles, sometimes Cardan angles.

It may be of interest in this context that another description in terms of only one angle may offer advantages. This description in terms of so-called Euler or Klein-Cayley parameters avoids the problems of singularities at extreme conditions and leads to particularly simple kinematic equations.

4. References and Bibliographies

The points raised by *Prof. Wehausen* are very pertinent and his suggestions are fully endorsed by the Committee. The nearly uniform omission of page numbers from the references in the Committee Reports is quite apparently a major fault, the reason of which will have to be traced. Concerning the ordering of references the Committee agrees with *Prof. Wehausen*

that the alphabetic order is in general the most efficient, not only in using but also in setting up bibliographies. Consequently the Committee will set forth more explicit and rigorous standards for references in its proposed guidelines for Committee Reports.
