ittc - news

DECEMBER 1998 No. 39

Contents

Message from the Chairman

The review of the Advisory Council Membership for about one-half of the member organizations has been carried out. Most of the member organizations are found to have satisfactorily accomplished their tasks in line with the objectives of the ITTC to maintain their membership of the Advisory Council. The technical committees seem to be very busy in drafting their final reports for the Full Conference of the 22nd ITTC to meet the submission deadline of March 31 of the coming year. In view of the importance of the reports of the technical committees, I sincerely wish them a successful completion of their reports. As the year end is quickly approaching, we find ourselves busy in wrapping up some unfinished tasks before the new year. I believe most of you will have more rewarding feelings than regrets for what you have accomplished in this year. I hope the global economy will be better in 1999 and the member organizations will have better opportunities in the expansion and enrichment of their business. I sincerely wish each of you a happy new year.

Choung Mook Lee, Chairman

22nd ITTC Executive Committee

Notes from the Secretary

The 22nd ITTC Proceedings, excluding the Quality Systems Manual, will be put on the ITTC web site by the end of May 1999. ITTC member organizations and the delegates to the 1999 Conference can download the Proceedings from the ITTC Homepage(http://www.kriso.re.kr/ITTC/) ; hard copies of the Proceedings can be collected at the conference. Those delegates who have trouble downloading the Proceedings should contact the Secretary so that hard copies can be mailed to them.

News from the Executive Committee

The second meeting of the 22nd ITTC Executive Committee was held in Washington, D.C., USA, on August 13, 1998. Selected items from the extensive agenda are presented below.

New ITTC Member Organization

An application from the Technical University of Malaysia, Johor Bahru, Malaysia was presented and approved. Prof. Mohd Zamani Ahmad represents the Marine Technology Laboratory, Universiti Teknologi Malaysia(MTL-UTM).

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Review of Advisory Council Membership

According to the Rules, 16 Advisory Council member organizations chosen for review during

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this conference period replied to the questionnaire. The replies of the questionnaire and the qualifications for remaining as an Advisory Council member were reviewed. The review report will be presented at the next meeting of the Advisory Council on March 16, 1999 in Japan.

Arrangement for the 22nd ITTC Meeting in 1999

The meeting is to be held at Seoul Hotel Lotte in Seoul and successively at the Shanghai Worldfield Convention Hotel in Shanghai. The special reduced prices for rooms in both hotels for the ITTC delegates will be offered.
The EC Secretary requested that a proposed list of delegates to be invited to the 1999 Conference be prepared by each Area Representative and submitted to the Secretary by January 31, 1999. The list should include:

- The delegate representing each member organization of ITTC,
- All members of present Technical Committees and Groups, Advisory Council and Executive Committee, and
- Other delegates including observers from shipbuilding and shipping industries, and young researchers.

Invitation for Hosting the 23rd ITTC in 2002

Applications for the 23rd ITTC from two organizations (INSEAN, Italy of Southern Europe Area and the University of Newcastle, UK of Central Europe Area) were presented.
A formal announcement for the selection will be made in March 1999.

ITTC Homepage on the Internet

The ITTC Homepage(web site : http://www.kriso.re.kr/ITTC/) shows the history of the ITTC, the Rules of the Organization, member organizations, newsletters (No.35-No.38), membership of Committees, and Symbols and Terminology.
The published list of the ITTC Proceedings, the Guidelines for Preparation of Technical Committee and Group Reports, and the standard format on the Catalogue of Facilities are newly added.
The EC Secretary will list the internet addresses of the member organizations on the ITTC Homepage. Those who want to have information on the facilities of individual organizations can directly enter the homepage of the respective organization using the internet address. The list of the internet addresses of the member organizations prepared by each Area Representative should be forwarded to the Secretary.

Other Matters

Each Area Representative who serves a second term should decide on a successor by means of a discussion with the member organizations of that Area. The representative must be appointed at least one-half year prior to the Full Conference.
Each Area Representative will contact the member organizations of the Area in order to update the list of the ITTC Member Organization.
Also, the Executive Committee members will prepare the list of proposed Technical Committees for the next Conference.

Date for Next Meeting

The next meeting of the Executive Committee will take place on Thursday, March 18, 1999 in Izu Kogen, Japan.

News from the Advisory Council

A meeting of the Advisory Council was held in Washington on 11 August 1998. The main item on the agenda was the discussion of the progress reports of the technical committees and groups. The work of all of the committees is generally progressing satisfactorily but it was emphasised again that the committees should ensure that they proofread all of the existing ITTC procedures and send copies to the Quality Systems Group by the end of December. It is intended that the first draft of the Quality Systems Manual should include all of the existing ITTC procedures and this is a high priority task during this conference period. The committees should also identify suitable benchmark data and test cases for inclusion in the Manual.

The Council will recommend to the Full Conference in September 1999 that the 1995 method of the American Institute of Aeronautics and Astronautics for uncertainty analysis should be adopted by the ITTC for towing tank experiments instead of the Guidelines on Uncertainty Analysis agreed by the ITTC in 1990 in Madrid.

It was agreed that Volumes 1 and 2 of the ITTC Proceedings should be put on the ITTC Web Site and members who have access to the Internet can then download the reports they want to read. Members will get the Proceedings more quickly and there will be a saving on the cost of mailing them; hard copies of the Proceedings can be collected at the Conference.

The chairpersons of all of the technical committees and groups have been reminded that they should send copies of their draft conclusions, recommended procedures, and recommendations for future work to Brian Bowden by the 1st February 1999. The drafts will be reviewed by the Advisory Council at its next meeting on the 16 and 17 March 1999.

News from the Technical Committees

Resistance Committee

The fourth meeting of the 22nd ITTC Resistance Committee was held at the University of Iowa, Iowa City, IA on 17-19 August just following the 22nd Symposium on Naval Hydrodynamics held in Washington D.C. The host was Prof. F. Stern. The fifth and final meeting of the Committee was held at the Escuela Técnica Superior de Ingenieros Navales, Madrid, Spain on 3-5 November, 1998. The host was Prof. L. Perez-Rojas.

The Committee has almost finalized its work and many sections of the final report are completed. A draft version of the conclusions and recommendations were also considered. The report will be finalized by e-mail communications between Committee members.

The Committee has submitted recommended procedures, guidelines, and example for experimental uncertainty assessment methodology and recommended benchmarks for CFD validation for Resistance and Propulsion to the Quality Systems Group for inclusion in the Quality Manual and adoption by the 22nd ITTC. The Committee has also submitted recommended procedures, guidelines, and example for computational uncertainty assessment methodology to the Quality Systems Group for interim inclusion in the Quality Manual and interim adoption by the 22nd ITTC with finalization postponed for the 23rd ITTC. The Committee is working closely with the Quality Systems Group in finalizing its contributions to the Quality Manual.

All members, through their Institutions, have contributed to the example of the experimental uncertainty assessment methodology for a towing-tank resistance test. A similar approach in which all members contribute is planned for the example for computational uncertainty assessment methodology.

The final report will summarize the aforementioned recommended procedures etc., along with discussions and literature reviews concerning the state of the art and the potential impact of new developments, resistance and flow physics, trends in EFD, trends in CFD, and relationship with other professional organizations.

Propulsion Committee

The fourth and last meeting of the 22nd ITTC Propulsion Committee was held in San Diego, California on November 11-13, 1998. All eight committee members attended the meeting. The 1998 SNAME Annual Meeting was also held in San Diego on November 11-14, 1998.

TASKS

Review the state-of-the-art and identify the need for research and development in the areas of propulsors, cavitation and powering performance. This task focuses on new developments in extrapolation methods, podded propulsors and new blade section propeller design methods. The number of references on new blade section design method shows that the method is more widely used. References on podded propulsors are starting to appear.

Review the ITTC recommended procedures, benchmark data, and test cases for validation and uncertainty analyses and update as required. Pass the information to the Quality Systems Group for Publication in 1999. The 22nd ITTC Quality Systems Group assigned eleven ITTC Recommended Procedures to the Committee for checking. The proofread and corrected procedures were discussed. Some of the procedures require only minor editing and can be considered to correspond with present day requirements. The Committee will recommend that three or four procedures will be re-written by the next Committee(s).

Identify the requirements for new procedures, benchmark data, validation, uncertainty analysis and stimulate the necessary research for their preparation. The Committee noted that the differences in the extrapolation methods used at various model basins can lead to difficulties in the comparison of predicted performances. The reasons for the rather low acceptance of the ITTC-1978 method were discussed in detail. The conclusion of the discussion will result in recommendations for future work for the next Committee(s).

Prepare an up-to-date bibliography of relevant technical papers and reports. The plan of the Committee is to have the database available at the 22nd ITTC Conference. The database includes the references of all the previous propeller/propulsor, cavitation, and powering performance committees. The bibliography contains about 8000 references. At the end of 1998 the Committee will contact the propulsion related specialist committees to get their references included in the database.

Review the development of design and analysis methods for propulsors with special emphasis on the modelling of the vortex wake. The Committee should consider repeating the 18th ITTC comparative exercise. The Committee organised a workshop of comparative calculations of RANS equation and unsteady panel method codes in Grenoble on April 5-6, 1998. The printed proceedings of the workshop are now available. A copy will be posted to each ITTC member organisation and to each participant of the Workshop.

Review research on the performance of propellers operating in various conditions such as for ships when turning, accelerating, decelerating, backing or operating in waves. Unsteady vortex lattice and RANSE codes form the best analysis tools for some of the operating conditions of this task

Review available LDV data for propulsors. Applications of Particle Image Velocimetry are included in this task. In the future this task can be included in Task 1.

Review the correlation of liquid quality with cavitation inception and the stability of cavitation patterns. The analysis of the questionnaire on this task was completed in October.

Drafts for all the tasks were presented and discussed at the meeting. All the drafts require condensing to keep the length of the report within the page limit.

Recommendations for future work were discussed at the meeting. Proposals for new tasks were presented at the meeting. The Committee found that the proposals for new tasks could not be finalised at the meeting and further discussion is still needed.

Dr. Stuart D. Jessup hosted the fourth meeting. Dr. Jessup is warmly thanked for the successful meeting in San Diego.

Loads and Responses Committee

The Loads and Responses Committee met in September at the Hague, The Netherlands, in conjunction with the PRADS '98 Symposium. All members of the Committee attended the meeting, with the exception of Dr. Allan Magee who is no longer employed at Bassin d'Essais des Carenes and will not be able to continue his participation in ITTC.

During the meeting, the progress of the committee's work was reviewed. Committee members had completed drafts of key sections of the report prior to the meeting, so that the meeting was very productive. As requested, the Committee reviewed sections of the Symbols and Terminology List. The Committee also reviewed the compilation of previously developed procedures from the Ocean Engineering and Seakeeping Committees. This compilation had been provided by the Quality Systems Group. Discussion focused on the difficulties associated with developing an adequate and consistent set of procedures from a collection of procedures developed over a period of years.

The next meeting of the Committee will be hosted by Dr. Deuk-Joon Yum at the Hyundai Maritime Research Institute in Ulsan, Korea during the second week in February, 1999.

Manoeuvring Committee

The fourth meeting of the 22nd ITTC Manoeuvring Committee was held at the Bassin d'Essais des Carenés, Val de Reuil, France on September 14-16, 1998. Five of the seven committee members were present. Dr. S. Cordier kindly hosted the meeting.

The progress report on the tasks was reviewed and the following structure was suggested for the report:

- General information
- Special groups
- Hydrodynamics forces
- Simulation of dynamics
- Scale effects, validation and full scale effects
- Ship operations and safety, IMO standards
- Model test procedures
- Benchmark study based on Esso Osaka

Committee on Unconventional Propulsors

The fourth meeting of this Specialist Committee was held on 28-30 September 1998 at the the Bassin d'Essais des Carénes in Paris, France. This meeting focussed on the review of the current draft of the Committee's report and on the completion of the remaining action items. During this meeting, the members toured both the Paris and Val de Reuil facilities of the Bassin d'Essais des Carénes. The Committee would like to express their appreciation for the efforts of our host, Mr. Christian Dugue.

The initial draft of the report consisted of the following sections : 1. Membership and Meeting, 2. Task Set From the 21st ITTC, 3. Introduction, 4. Model Scale and Full Scale Results of Various Extrapolation Methods for Unconventional Propulsors, 5. Description of Extrapolation Methods and Test Procedures, 6. Proposal for Suggested Guidelines for Extrapolation Methods and Appropriate Testing, i.e., Self-Propulsion, Open-Water, Resistance, etc., 7. Conclusions and Recommendations, and 8. References.
The resulting discussion was very spirited as the Committee reviewed current extrapolation methods and then attempted to develop general guidelines for the future. It has been very difficult to define general guidelines because an extensive review of the literature shows clearly that each unconventional propulsor and the corresponding organization appear to have different testing procedures and, hence, extrapolation methods. In addition, not only are details of the model tests generally not discussed precisely, but in many cases little or no full-scale data is available to validate extrapolation methodology.

The Committee then agreed on the General Technical Conclusions, Recommendations to the Conference and Recommendations for Future Work. These have been forwarded to the Advisory Council for review. A schedule has been established for the completion of the final report and appropriate action items established.

Both the Chair, Neil Bose, and Secretary, Mike Billet would like to note the hard work of every Committee member and their timely written contributions. The edited final report is significantly less in pages than the initial draft which is a tribute to the members efforts to document current work on Unconventional Propulsors.

Committees on Waterjets

The second meeting of the Specialist Committee was held at the University College London from June 16-18, 1998. We would like to thank Dr. Mehrad Zangeneh for hosting this meeting as well as the tour of Haslar to look at the experimental facility and the testing procedures used there.

At this meeting it was decided that the next step in the development of the "waterjet self-propulsion test" would be the performance of a series of standardization experiments. It will be proposed that these experiments be performed on a voluntary basis, by participating ITTC experimental facilities and other interested parties such as waterjet manufactures or universities.

The major goals of the standardization experiments are to obtain cross validation of the test techniques, correlation with numerical predictions, comparison of results between laboratories, and to perform a comprehensive measurement uncertainty analysis. The details of this proposed effort will be included as part of the Committee's final report.

The ITTC will team up with an effort funded by the Office of Naval Research through the Gulf Coast Region Maritime Technology Center. Three different types of experiments are proposed in order to investigate and validate the methods currently used to estimate the powering characteristics of a waterjet-propelled ship. The three experiments to be utilized in this study are the waterjet pump loop test, the waterjet/inlet water tunnel experiment, and the towing basin self-propulsion test. One or more of these studies will be performed by each participant, as appropriate.

The third and final meeting of the Specialist Committee was held at MARIN, Wageningen, The Netherlands on October 20 and 21 in order to coincide with the RINA Waterjets Conference. On the 21st, a joint meeting with representatives of several waterjet manufacturers was held. The Committee would very much like to thank Dr. Tom Van Terwisga for his efforts in organizing

the manufactures meeting, and MARIN for hosting this meeting, the tour of their facilities, as well as a dinner to promote the continuation of informal discussions. MARIN should be commended for its commitment to the goals and objectives of the ITTC demonstrated during this meeting.

Representatives from KaMeWa, Hamilton Jets, Vosper-Thorneycroft, Bird-Johnson, Lipps Jets, North American Waterjets, Band-Lavis, Marine Propulsors Company, and the United States Navy participated in an open discussion led by Dr. Terwisga. Topics such as the desirability on the manufactures part for the development of experimental tools, as well as their willingness to participate in a "standardization" process were discussed. The participants voiced an interest in the efforts of the ITTC, and KaMeWa felt an obligation to participate in some way, being an active member of the ITTC.

Committee on Cavitation Induced Pressure Fluctuations

Since the last meeting in April, the members of the Specialist Committee have worked on the assigned tasks for the final report according to the following topics:

- Introduction
- Review on computational methods
- Full scale measurements
- Model measurements
- Methods reducing excitation levels
- Round robin tests
- ISO 9000 Issues
- Outline of problems
- Recommendations for future work

The members had been assigned to write their specific chapter within a suggested target number of pages, including sketches and photographs, by the end of November. All reports shall be sent to the chairman and the secretary, who will integrate each chapter and develop a preliminary report, which will be thoroughly discussed during the next meeting. This last meeting will be held at CETENA in Italy in the middle of January 1999.

Committee on Computational Methods for Propeller Cavitation

The fourth and the final formal meeting of the Committee was held on November 4-6, 1998 at the Gdansk Model Basin (Ship Design and Research Center, CTO) of Poland. Mr. Zbigniew Karpinski, director of CTO, was the host, and Professor Jan A. Szantyr of the Institute of Fluid-Flow Machinery was the contact person of the meeting. All of seven members were present.

Minutes of the last Propulsion Committee meeting were reviewed in order to avoid possible overlap in the final report. It was agreed that our report should concentrate on the prediction methods of cavitation, while the Propulsion Committees report would cover the general numerical methods for non-cavitating propulsors. Prediction of cavity volume would be our task while prediction of fluctuating pressure forces using the predicted cavity volume would be the task of the Specialist Committee on Cavitation Induced Pressure Fluctuation.

Progress on the assigned tasks was reviewed and extensively discussed during the three-day meeting. A Preliminary Table of Contents for the Committee's final report was discussed, and would contain the following chapters:

- Introduction
- Description of Problems
- Questionnaire
- Lifting-Surface Methods
- Boundary Element/Panel Methods
- RANS, Euler, and Two-Phase Flow Methods
- General Technical Conclusions
- Guide for Selection of Methods
- Recommendations for Future Works

Members responsible for a chapter are assigned to update the already existing drafts and to prepare the final drafts by January 15, 1999. The Secretary and the Chairman will finalize the Report by the end of February. Drafts of General Conclusions and Recommendations for future work are discussed and will be prepared by the Secretary for review before the submission to the Advisory Council. A workshop for comparative computation of the cavitation performances for selective propellers is recommended as the future work of the next ITTC technical committee.

Committee on Trials and Monitoring

There have been two meetings of the Specialist Committee since the last progress report :

1. Yokohama, Japan, 11-16 May 1998 hosted by Ishikawajima-Harima Heavy Industries Co., Ltd.
2. Bethesda, Maryland, USA, 28-30 September 1998 hosted by the Carderock Division, Naval

Surface Warfare Center

In the first meeting, hosted by Mr. Ryosuke Fujino, the Committee reviewed and modified a presentation summarizing the committee's recommendations and progress. This presentation was shown to five members of the Japanese shipbuilding industry. An extremely informative exchange of ideas and concerns followed. As a result, language used with the committee's final report was modified to prevent any future misunderstanding and suggestions were incorporated which took into account the concerns of the shipbuilders, ship owners and the research and development community.

The second portion of this meeting dealt with the formatting of the committee's final report and the review of the progress of the committee's five tasks. The progress of each task was discussed and further research of modification based on the duscussion was assigned to the appropriate committee member.

The second meeting was hosted by Mr. Everett Woo. The Committee addressed comments dealing with the draft of the committee's final report that were forwarded by the Advisory Council from concerned parties in Japan, Italy and Russia. The comments were addressed and incorporated, as the committee members felt appropriate. A review of the draft of three tasks was completed and returned to the authors for modification. Final criteria were established for the conduct of speed/power (Task 1), maneuvering (Task 2) and seakeeping (Task 3) trials. Descriptions of trial conduct were agreed upon. Analysis of trial data was deferred to the next meeting. The format for the reporting of each individual type of sea trial will be further discussed in the next meeting.

The next committee meeting is tentatively schedule for Genoa, Italy on 12-15 January 1999.

Committee on Stability

Fourth meeting of the Committee
The Committee held its fourth meeting in Newfoundland in September/October. This was in conjunction with the 4th International Ship Stability Workshop, which was run by the Institute for Marine Dynamics. This series of workshops has adopted a style to encourage discussion rather than mini-papers, and has proved very successful.
The meeting was attended by all but one of the committee members, with the chairman of the Committee on the Safety of High-Speed Marine Vehicles in attendance.

Questionnaire
Results of the replies to the questionnaire sent to all member organisations have now been analysed and will form part of the committee report to the next conference. As one or two of the leading researchers in this field are not ITTC member organisations their input has also been solicited and will be included in the analysis.
Any member organisation which has not yet replied to the questionnaire, can still do so by accessing it on the web page at : http://www.amc.edu.au/staff/events/stab2000/ ittc.html. This will have to be returned by mid December to be included in the committee's report.

Benchmarking
Details of the two standard vessels (one for intact stability and one for damaged stability) and the relevant selected tests for benchmarking against have now been established. Once the procedures have been finalised they will be circulated to those member organisations who have indicated they have a capability in this area. This will include instructions to enable them to run their numerical model. Once all the results have been collated this will be used to validate the codes against model experiment results.

Guidelines for model tests
The standard guidelines for model testing of intact vessels, and of damaged vessels are now almost complete.

ITTC Symbols and Terminology appropriate to ship stability
A list of symbols and terminology has been developed along the lines of the existing ITTC standard symbols. However, as this does not always agree with those used by IMO and other bodies interested in the stability of ships, it is now being revised to try to reduce the differences between ITTC and IMO.

7th International Conference on the Stability of Ships and Ocean Vehicles
The above conference will be held in Launceston, Australia, in Jan/Feb 2000. Details of the conference can be found on the web at: http://www.amc.edu.au.

Committee on Environmental Modelling

The 3rd meeting of the Specialist Committee was held at the Delft University of Technology on

25-26 September 1998 with five out of seven members and a corresponding member, Dr. David Kriebel of the US Naval Academy, attending.
This meeting hosted by Prof. Jo Pinkster followed the PRADS '98 conference held in The Hague on 21-25 September.

Copies of selected abstracts from the following conferences were distributed at the meeting:

- 26th International Conference on Coastal Engineering
- 8th International Conference on Offshore and Polar Engineering
- 25th International Conference on Coastal Engineering

The Committee discussed the progress made on their work. The general status is that the work is progressing well albeit a little behind schedule. Nonetheless, the Committee aims to have an extensive report prepared in time.

The next meeting will be held at the Defence Evaluation and Research Agency, Haslar on 22-23 January 1999.

Committee on Deep Water Mooring

The Committee on Deep Water Mooring held its fourth meeting on October 20-25, 1998 at ICEPRONAV, Galati, Romania, hosted by Director Liviu Crudu. Six of the eight members were present. First drafts of some sections of the final report were presented and discussed related to the following subjects : moored vessels and the relative importance of environmental loads in deep water, extremely small scale physical models and involved scale effects, numerical models, interpretation and verification.
A number of recommendations to the ITTC were discussed, but not yet finalized. The Committee's questionnaire on deep water mooring has been distributed to member and non-member organizations and 22 responses have been received.

In deep water the current forces become the dominating environmental loads, contributing up to 80% of the total drift loads on a deep water floating production system. Therefore, precise metocean data on currents in deep water are absolutely necessary. Unfortunately, such data is still very difficult to obtain or even non-existent. The Committee has contacted the ITTC Committee on Environmental Modelling regarding this matter.

A one-day workshop on "Deep Water Mooring and Related Topics in Offshore Engineering" was held with the participation of researchers from the University of Galati and from ICEPRONAV together with the Committee members. Thirteen interesting papers were presented.

No further Committee meetings are planned, except for one or two editorial meetings between the secretary and chairman.

Committee on Safety of High Speed Marine Vehicles

The last meeting of the Specialist Committee before the conference itself was held in Athens on 24th and 25th November 1998. The host was the National Technical University of Athens, represented by Professor Grigoropoulos, and six members of the Committee were present.

Several sections of the Committee's report were presented and discussed, and final versions will be submitted to the Secretary early in the New Year for final assembly. General conclusions and recommendations were also discussed and will be submitted to the Advisory Council in due course.

It is clear that the report will venture into topics not normally covered by the ITTC and will seek to bridge the gap between tank tests and the requirements of safe operation. In order to achieve this, a number of safety criteria and rules-of-thumb have been collected and will be summarised in the report.

It has become apparent that little work is being made available in the open literature with regard to the specific topic of HSMV safety. there are some notable exceptions, however, and it is the hope of the Committee that it will be able to bring these to the notice of members.

Committee on Model Tests of High Speed Marine Vehicles

The fourth meeting of the Specialist Committee was held in Annapolis, MD. USA on 2nd/3rd November 1998, hosted by Mr. Zseleczky. Five of the eight committee members attended the meeting.

First of all the potential overlap of the work scope with other committees was reviewed. Chairman began the meeting with a review of

correspondence from other organizations. A liaison between the Committee and the ISSC Loads Committee has been established regarding loads on HSMVs. A copy of the draft committee report will be sent to all the committees with which a liaison has been established.

The Committee discussed the progress of the report and noted that the length would be a problem. It was suggested that the questionnaire summary in the first pages could be separated into an individual report. During the discussion it was also agreed that the reference section was too long and that references should be limited to those specifically mentioned in the text. A Table of Contents for the Committee's final report was discussed, containing the following paragraphs:

1. General
   1.1 Membership and Meetings
   1.2 Recommendations of the 21st ITTC
2. Introduction
3. Questionnaire on Model Tests of High Speed Marine Vehicles
4. Survey of Existing Test Techniques and Procedures
   4.1 General
   4.2 Resistance Tests
   4.3 Seakeeping Tests
   4.4 Propulsion Tests
   4.5 Manoeuvring Tests
   4.6 Structural Load
   4.7 Dynamic Instability Tests
5. Conclusions
6. Recommendation to the Conference on Methods and Procedures
7. Recommendation for Future Work
8. Acknowledgements
9. References

Progress on the assigned tasks was reviewed and extensively discussed during the meeting.

Concerning the model test procedures related to Resistance, an update copy of the text contained in the first draft report was distributed to committee members along with copies of notes on wetted surface, correlation, etc. In reviewing the recommendations a common pattern emerged. There is often a method for each test procedure that is agreed to be the "best" method. However, some of these methods are rarely used because of the excessive time and expense involved. The Committee agreed to list "best" methods first, followed by alternative approaches in order of desirability.

Concerning the model test procedures related to propulsion, it was noted that differences of opinion should be expected among committee members on details in each section. It was agreed that committee members could send comments to the author of each section regarding thoughts on individual matters after reviewing the text more thoroughly. A plan was made to update and circulate the report several times by e-mail before it is finalized.

Concerning the model test procedures related to the Dynamic Stability, it was suggested that the title should be changed to "Dynamic Instability". The conclusion of the discussion was that "Dynamic Instability" described the subject more accurately. When the subject of transverse stability was discussed, the suggestion was made to add "transverse stability in waves" to the seakeeping section. Other committees should be consulted to find out about their related work on dynamic instability.

About the review of test methods unique for different marine vehicles, contributions on Hybrid Ships, Surface Piercing Hydrofoil Ships, and WIG Ships were presented. The text provided summaries of model test programs, including model configurations, parameters measured and an overview of test results when possible.

At the end of the meeting a tentative outline of the final report was established as well as each committee member's contribution. The schedule allows time for one last cycle of the review process before making recommendations / conclusions and sending the final report to the Conference Secretary.

Symbols and Terminology Group

The full membership of the SaT Group met 13-17 May during the First International Conference on Maritime Terminology in Brussels, Belgium. The meeting included a paper presented to that conference by Dr. Schmiechen on the "History and Recent Developments of the ITTC Symbols and Terminology List". In preparation of this paper and the SaT Group Report, Dr. Schmiechen, Dr. Clarke and Dr. Johnson researched the history of the SaT Group and its predecessors, the Information Committee, the Presentation Committee and subgroups of other committees which recommended standards for presenting towing tank data. The 1999 Version of the ITTC SaT List will contain the names of all known former members of these committees.

A reduced SaT Group membership met during

the Symposium on Naval Hydrodynamics in August 1998 commemorating the 100th anniversary of the David Taylor Model Basin. We made contact with other ITTC committee members present at the Symposium. The SaT Group conferred with members of the Committee on Stability concerning suggested symbols changes and clarifications. It contacted the Loads and Responses Committee and IAHR representatives concerning changes and additions to Section 3.4 Environmental Mechanics. A number of symbols have been added to the list of multidirectional sea state parameters and a greatly expanded section 3.4.2 on Wind has been added. Suggestions from the ITTC Quality Systems Group concerning recommended procedures for ITTC member organization will be a likely task of the SaT Group for the next conference. The activity of the Quality Systems Group will encourage necessary feedback from Committees to the SaT Group. In addition, Dr. Schmiechen has brought the Secretary of ISO/TC/SC10 up to date on our progress towards a proposal to replace ISO Standard 7463.

The SaT Group is making slow progress on developing appropriate illustrative sketches to convey the relationships between various symbols and their terminology. At present, the entire SaT list must be downloaded in .pdf format. By the time of the 22nd ITTC the intent is to create a separate hypertext-linked document containing the first set of sketches and drawings. It now appears that the existing word processor format for the symbols list can be converted to XML which will support mathematical symbols including the Greek alphabet, superscripts and subscripts, so it will not be necessary to convert the existing SaT List to a Unicode- based terminological database. When the SaT List in word processor format is converted to XML it will contain links to subsets of the SaT list and sketches which can be downloaded only if desired.

Mathematics on the Web: MathML and MathType
(downloaded from http://www.mathtype.com/)

"Currently, there is no effective way of expressing standard mathematical notation in Web pages. Equations can be displayed as GIF images but printing is poor, pages can download slowly, and they don't adapt to the browser user's font choices."

"MathML is a proposed solution to the problem. It is based on XML (Extensible Markup Language), a proposed standard by the W3C (World Wide Web Consortium) as a successor to HTML (HyperText Markup Language), the language of the Web (http://www.w3.org/XML/). MathML can be used to express both the presentation of mathematics and its meaning (through high school level mathematics). MathML is human-readable but not designed to be written by humans but by software."

"MathType 4.0, its next major release, will be able to generate MathML for use in authoring Web pages with mathematics. It will do so via a new translator mechanism. Translators are defined using a simple language and may be customized from the end user. A MathML translator definition file will be supplied with MathType 4.0 that will produce MathML presentation tags. With support for XML/MathML by the major browser vendors and authoring tool suppliers, MathML will be a good mechanism for bringing mathematics to the Web."

XML will enable scientific organizations such as the ITTC, SNAME and so forth to publish scientific papers directly on the WWW without resorting to pdf formats which do not allow for easy cut and paste operations of anything other than ASCII text.

The 22nd ITTC Symbols and Terminology Group continues to seek comments and suggestions for additions and clarifications concerning the symbols and their definitions from anyone associated with towing tank testing.

Quality Systems Group

The third meeting of the QS Group took place in Washington D.C. on August 8th to 9th 1998.

The Quality Systems Group has assembled two Volumes of the "Quality Systems Manual".

Volume 1 : "ITTC Sample Quality Manual" which covers
- all formal items according to ISO 9000

Volume 2 : "ITTC Quality Manual" is planned to contain
- all decisions of the ITTC including all recommended procedures
- collections of benchmark tests (presented as list of references)
- recommended procedures dealing with instrumentation.

During the meeting the procedures were gone

through and it was decided to wait for the results of the proof reading by the committees to which the collected recommended procedures had been sent. The deadline is December 1998.

There was produced a draft of the contribution of the QSG to the ITTC proceedings which includes all the steps which have to be done for the implementation of a quality control system. However, as the contents of this contribution will, to a certain extent, depend on the decisions of the Advisory Council and also partly on the answers of the committees this paper can only be finished after the next meeting of the AC in March.

Also a presentation to the Advisory Council was prepared which was given by Dr. Strasser in the AC meeting on August 11th.

This presentation stated the following items:
The purpose of the ITTC Manual is :

1. To assist ITTC member organisations in producing their own quality systems manuals. The members could use the ITTC recommended procedures as a basis for producing their own procedures.
2. To produce a definitive version of the ITTC recommended procedures that could be easily accessed.

The review of the ITTC procedures and guidelines is a major task and it raised a number of important points:

1. There is a large considerable number of ITTC Procedures and the first draft of the manual will be large, exceeding 500 pages.

2. It is necessary to agree a formal process that should be followed when adopting the new ITTC procedures.

3. The Resistance Committee has recommended that the 1995 method of the American Institute of Aeronautics and Astronautics (AIAA) for Uncertainty Analysis should be adopted by the ITTC for towing tank measurements. If this were done the method would replace the Guidelines on Uncertainty Analysis adopted by the ITTC in 1990 in Madrid.

4. The International Standards Organisation (ISO) is presently preparing a new standard for quality control systems and the question arises as to whether the ITTC should wait until this becomes available before producing the "ITTC Sample Quality Manual". There also may be some impact on the numbering of the recommended procedures in the ITTC Quality Manual.

5. Should the ITTC set up a committee to deal with procedures concerning instrumentation? Many of the ITTC activities involve the use of measurement and test equipment and some of the procedures, such as the calibration of length measuring devices, are the same for a number of tests and each laboratory. It is also possible that suitable procedures have already been developed for other technical areas, such as aerodynamics, that could be adopted by the ITTC and possibly there is a need for an ITTC group to monitor the international standards for measuring equipment.

The Advisory Council stated that the principal task of the technical committees during the present conference period was to identify and proofread all of the existing ITTC procedures, benchmark data, and test cases for validation and uncertainty analyses. Each committee should pass this information to the Quality Systems Group (QSG) by the end of December 1998 so that the QSG can prepare the information for inclusion in the Quality Systems Manual. The Council realised it was possible that some of the existing procedures may now be technically unsound or outdated but it emphasised that the committees should still proofread them and send them to the QSG. If a committee considered that a procedure was no longer satisfactory it should inform the QSG of the reasons and put forward proposals for bringing the procedure up to date. It was the intention to publish all of the existing procedures in the first version of the manual; if a procedure was no longer satisfactory this would be pointed out in the manual and there would be a statement that the procedure was being revised.

The Advisory Council agreed with the process proposed by the QSG for adopting and modifying ITTC procedures. It also considered that on some occasions it might be necessary to adopt procedures on an interim basis and it asked the QSG to put forward a process for doing this and bringing them to the stage of full procedures. It was recognised that some of the existing procedures were inconsistent and it decided that when the first version of the Quality Systems Manual was available it would be necessary to prepare a plan defining the need for new procedures and revising existing ones.

It was noted that the new ISO standard for quality control systems would not be available until the year 2000 or later and the Council decided it was necessary to continue preparing the ITTC manual rather than waiting until the

new standard becomes available.

The Council agreed that the 1995 method of the American Institute of Aeronautics and Astronautics (AIAA) for Uncertainty Analysis should replace the Guidelines on Uncertainty Analysis adopted by the ITTC in 1990 in Madrid for towing tank experiments. The AIAA method will be published in the Quality Systems Manual and has already been put in the format of a recommended procedure.

With regard to whether it was necessary to set up a group to deal with instrumentation, the Council decided that this matter should be considered further at the next meeting of the Advisory Council.

The Advisory Council pointed out that it had already been agreed at earlier meetings that there was no intention, and in fact no possibility of setting up quality control standards for member organisations; it was the responsibility of each member organisation to prepare its own standard procedures and ensure that they conform with the requirements of the ISO. Furthermore, it had also been agreed that the ITTC procedures would be referred to as "recommended procedures and guidelines" and the term "standard procedures" would not be used in the manual. With regard to the time scales for adopting the manual, it was noted that it was the intention to bring together all existing procedures in the first version of the manual and then to ask future technical committees to review and revise them as necessary.

In all the procedures where the expression "standard procedure" had previously appeared, the QSG has since replaced that the expression with "recommended procedure".

Answers and some corrected proofs have been received so far by the Resistance, the Propulsion, Loads and Responses, Trials and Monitoring, and Ice Committees.

Ice Committee

The fourth meeting of the Ice Committee was held at the Iowa Institute of Hydraulic Research, University of Iowa from December 7-8, 1998. Members presented were K. Kato (IHI, Japan), S. Jones (IMD, Canada), G. Wilkman (MARC, Finland) and W. Nixon (IIHR, USA). Two members, K. Izumiyama (SRI, Japan) and K. Sazanov (KSRI, Russia) were absent.

In the meeting, the drafts prepared by members as well as the structure of the final report were discussed. The responsible members for each section are as follows:

1. General (Kato)

2. General Guideline of Testing Methods for Model Ice Properties
   - 2.1. Recommended Procedures measurement for Model Ice Properties (Kato)
     The measurement procedures for elastic modulus, flexural strength and specific weight are recommended in the final report.
   - 2.2 Floating Uniaxial Compressive Strength Test of Model Ice (Izumiyama)
     The round robin tests results done at IHI, SRI, NKK and IMD are to be summarized and if the tests could be done by the end of January, the MARC test results will be incorporated into the final report.
   - 2.3 Fracture Toughness of Model Ice (Nixon)
     This section will be a generic discussion on fracture toughness as a modeling parameter.
   - 2.4 Testing of Deformed Ice Properties (Wilkman)
     The results of the survey Mr. Wilkman collected are to be summarized. The report will note that there is growing interest in non-uniform ice, and that there is a need for recommended procedures. The report will be a good start line for recommending procedures for measuring the deformed ice properties.

3. Procedures for Model Tests in Deformed Ice (Wilkman)
   The results of the survey Mr. Wilkman collected are also to be summarized here. The Committee noted that there is growing interest in non-uniform ice, and that there is a need for recommended procedures for preparing ridges, pack ice, channels, and other types of deformed ice.

4. Test Methods for Offshore Structures in Ice (Jones)
   The results of the survey Dr. Jones collected are to be summarized. It was recognized that it would be difficult to make any recommendations at present. Thus the report is to be prepared in such a way that some important aspects for the model tests in this respect are summarized.

5. Updated Bibliography (Nixon)
   This will cover the time period from January 1, 1996 through December 31, 1998.

6. Ice Tank Facilities (Kato)
   All existing ice tanks with contact personal for each tank are tabulated.

7. Recommendations

   The paper describing the three recommended procedures for model ice properties mentioned above was presented at ATTC '98 Conference (Iowa City, USA) and CTC '98 (Sapporo, Japan). The Committee is eager to hear any comments on the recommended procedures before finalizing the report.
   The Committee also discussed on the ITTC Recommended Procedures drafted by the QSG. The Committee thinks that the draft represents a significant amount of work, and that is most impressive, especially given the short period of time in which it had to be undertaken. However, the Committee is reluctant to approve any publication of some sections. The Committee decided to send comments to the chairman of QSG and it was sent out immediately.
   Finalizing the report will be made by the e-mail communications. Thus no further meeting is planned.

News from the Member Organizations

Bulgarian Ship Hydrodynamics Centre

The web-site of BSHC is
Web-site : http://www.bshc.mt-link.bg

University of Tokyo, Japan

The name of the department has been changed as of April 1998.
The post code has become 7 digits in Japan.

Department of Environment and Ocean Engineering
School of Engineering
University of Tokyo
Hongo 7-3-1
Bunkyo, Tokyo 113-8656
Japan

Hyundai Maritime Research Institute, Korea

IMDC 2000
The 7th International Marine Design Conference (IMDC 2000) will be held over the period of 21 ~ 24 May 2000 at Hyundai Hotel, Kyongju, Korea with the support of the Society of Naval Architects of Korea.

The aim of the IMDC is to promote all aspects of marine design as an engineering discipline with particular emphasis on issues of synthesis. The topics covered by the conference are as follows:

- Design methods
- Design criteria
- Design of systems
- Design with computers
- Design for productions
- Design for safety, reliability, operation and maintenance
- Design education
- Other design related topics

About fifty papers will be presented with ample time for discussion around groups of related papers. Also, invited speakers will give a personal overview of the future of marine design. In addition to the technical program, social and accompanying persons programs will be organized.

For further information, please contact the secretariat:

IMDC 2000 Secretariat
Hyundai Maritime Research Institute
Hyundai Heavy Industries Co., Ltd.
1 Cheonha-dong, Dong-ku,
Ulsan, 682-792, KOREA

E-mail : imdc2000@hhi.co.kr
Fax : +82 (52) 230-3410
Web site : http://imdc2000.hhi.co.kr:8090

Ecole Centrale de Nantes, France

NSH7
The seventh International Conference on Numerical Ship Hydrodynamics will be held in Nantes between July 19-22, 1999. NSH7 will be organized by the Laboratory of Fluid Mechanics, Ecole Centrale de Nantes.

Topics are Free-surface flow (panel and field methods having applications to ship motions), viscous flow with applications to ship flows and wakes, Lifting-surface flows (viscous, inviscid

flows, applications to propeller flows), Floating bodies (wave-induced motions and loads), Hydrodynamics in ship and submarine design, Propulsor hydrodynamics and cavitation, Applications to advanced marine vehicles, Frontier problems in ship hydrodynamics.

Further detail will be available from

Prof. Jean Piquet, Chairman
Organizing Committee of NSH7
LMF/UMR6598, Ecole Centrale de Nantes
1 rue de la Noe, B.P.92101
44072 Nantes Cedex3, FRANCE

Tel : +33 2 40 37 16 33
Fax: +33 2 40 37 25 23
E-mail : Jean.Piquet@ec-nantes.fr
Web site : http://www.ec-nautes.fr/nsh7

St.-Petersburg State Marine Technical University

MEET '99

The International Symposium on Maritime Engineering: Education and Training will be held in St-Petersburg, Russia, between 21-24 June 1999.

MEET '99, associated with the Centenary of civil shipbuilding education in Russia, is planned as a Forum of educators involved in instruction and training of maritime engineers of all disciplines.

The goals of the Symposium are to discuss most urgent problems and perspectives of higher maritime engineering education worldwide, to establish and strengthen links between educational establishments in different countries, and to elaborate on new ways to improve qualification of maritime engineers in the forthcoming millenium.

The subjects of MEET '99 are:

- History of maritime engineering education in different countries,
- Particular features of curricula and educational programmes, modular structure of curricula,
- International accreditation and equivalence of diplomas,
- Linking educational process with industrial demand,
- New horizons of maritime engineering education: maritime system technologies, project management, maritime law education, maritime surveyors, etc.,
- New information and communication technologies in maritime engineering education: distant learning and world wide web, multimedia and virtual reality, CAD-CAM, software packages and learning tools.

Please Contact:

Prof. Kirill V. Rozhdestvensky
St. Petersburg State Marine Technical University
3 Lotsmanskaya, St. Petersburg, 190008, RUSSIA
Fax : +7 812 219 5227
E-mail : xmas@infopro.spb.su

University of Naples, Italy

IMAM 2000

The ninth congress of the International Maritime Association of Mediterranean will be held between 2-6 April 2000 in Naples, Italy. IMAM 2000 will be organized by University of Naples "Federico II"(chairman:Prof. P. Cssella).

The aim of the IMAM Conferences is to increase the efficiency, the economy and the safety of ships and marine structures through the exchange of knowledge and the promotion of discussions on relevant topics in the fields of naval architecture and of marine and offshore engineering.
It will provide an opportunity for the people involved in these fields to present and discuss theoretical and experimental research and to consider the practical application of the results of these research activities.
The Conference should be of interest to researchers, government departments, certifying authorities, designers, operators and owners.

The main topics for IMAM 2000 are as follows :

- Resistance and Hull Form Optimization
- Propulsion(Screw Propellers and Waterjets)
- Stability(Stability calculations, stability criteria, stability in ship operations)
- Seakeeping and Manoeuvrability
- Theoretical and Numerical Hydrodynamics
- Ship Strength and Materials
- Ocean Engineering and Technology
- High Speed Vehicles and Unconventional Vehicles
- Ship Design
- Marine Engineering and Ship Equipment
- Safety at Sea(including Training)
- Environmental and Ecological Problems
- Marine Transportation and Management
- Shipping Economics and Law
- Passenger and Cruise Ships

All Correspondence:
IMAM 2000 Secretariat
C/O Dipartimento Ingegneria Navale
Via Claudio 21
80125 Napoli, ITALY
Tel : +39 81 768 3307
Fax : +39 81 239 0380
E-mail : cassella@unina.it

Obituary

Mr. Alex Goodman, 74, died Oct. 27, 1998

Mr. Alex Goodman, 74, a research engineer who had received patents on devices for improving the stability of submarines and surface ships died of a heart ailment Oct. 20 at his home in Silver Spring, MD., USA.
Mr. Goodman was born in New York and graduated from City College of New York in 1953. He came to Washington and began working for the Department of the Navy at the David Taylor Model Basin. While there, he was co-inventor of the Planar Motion Mechanism, a widely used means of evaluating the stability, control and maneuvering of ships and submarines. He received two Superior Achievement Awards.
In 1961, he joined Hydronautics Inc. in Columbia, MD. He later became president of the company and continued in that position after it was acquired by Tracor Inc. He designed and supervised construction of the ship model testing basin in Laurel, USA. He was co-inventor of a high-speed water channel for testing hydrofoil and other ship models. He received U.S. and foreign patents for this invention.
He was author of more than 80 technical papers and reports, and he had lectured widely in the United States and abroad. He retired in 1996.
He is survived by his wife of 53 years, Paula Goodman of Silver Spring, three children, Joel Goodman of Saratoga Springs, N.Y., David Goodman of Silver Spring and Susan Goodman of Rockville; and five grandchildren.

Catalogue of Facilities

The catalogue of experimental facilities is included in this issue of *ittc-news*.

- Towing Tank(1996), Universiti Teknologie Malaysia
- Towing Tank(1996), Cavitation Tunnel(1996) and Circulating Water Channel(1993), Samsung Heavy Industries, Co., Ltd.

Organizations changing or extending their facilities, and organizations which have not responded so far, are kindly requested to send a description of their facilities in the standard format to the Executive Committee Secretariat.

Deadline of Next Newsletter

The deadline for submitting material to the June 1999 issue (No.40) is 15 May 1999.

Best wishes for merry Christmas and happy New Year from the Secritariat!

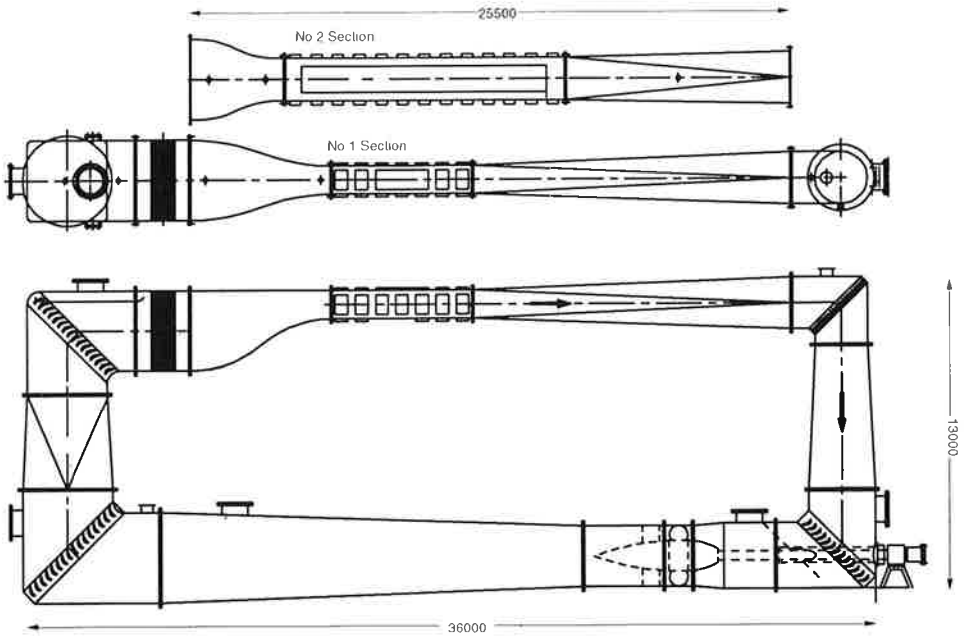
SAMSUNG SHIP MODEL BASIN (SSMB) **KOREA**

SAMSUNG HEAVY INDUSTRIES, CO., LTD.

103-6, MUNJI-DONG, YUSUNG-KU, TAEJON, KOREA TEL +82-42-865-4748

Web."http://www.shi.samsung.co.kr/sspri/ssmb" FAX +82-42-865-4380

CAVITATION TUNNEL (1996)



Description of facility :	Vertical, plan, closed recirculation
Drive system :	7-blades axial flow impeller
Power :	AC electric motor (2,600kW, 100 RPM)
Generated flow speed :	No.1 test section: 28 m/s (1.2m × 1.2m × 6m)
	No.2 test section: 12 m/s (3.0m × 1.4m × 12m)
Pressure of test section :	0.05~4.0 bar
Cavitation number :	$\sigma \geq 0.063$

Instrument :	5 kinds of propeller dynamometer
	6 kinds of force balancer
	3-D LDV system, PIV system, pulse laser system, acoustic measuring system
Capacity of dynamometers :	inclined type: maximum thrust 2.5kN
	normal type: maximum thrust 4kN
	contra-rotating type: maximum thrust 3kN × 2
	high capacity type: maximum thrust 6kN
Model size :	Propeller: 150~600mm diameter (normally 250mm)
	Ship: normally 8~10m length
Test performed :	Propeller test in uniform and non-uniform flow behind ship
	Force and pressure measurement on hull, propeller blade, wings and submersible body
	Flow velocity measurement and visualization
	Underwater noise measurement
	Performance tests for submersible body

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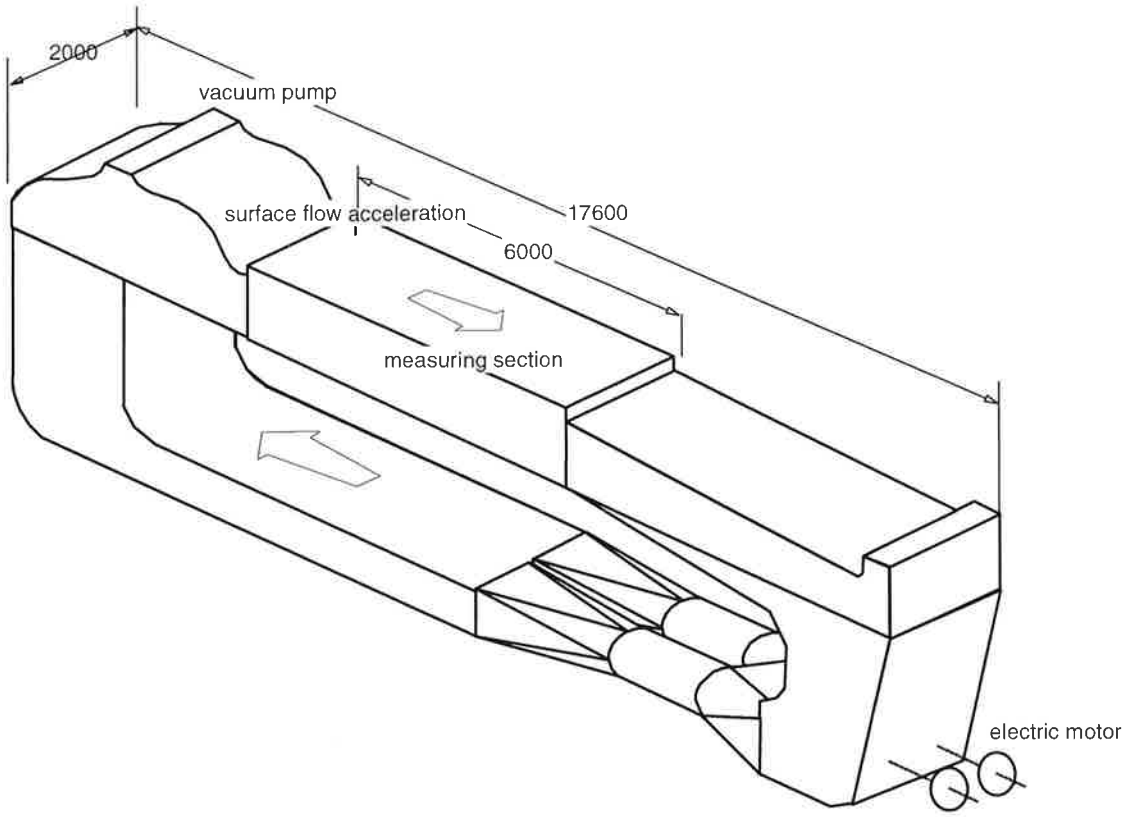
CIRCULATING WATER CHANNEL (1993)



Description of facility :	Vertical circulating type by double impellers
Size of measuring section :	6m(L) × 2m(B) × 1.2m(D)
Drive system :	4 blades axial flow impeller × 2
Generated flow speed :	Maximum 3 m/s in measuring section
Motor power :	37kW, 1750rpm × 2

Instrument :	Real time multi-tasking system for data acquisitions
Model Size :	Ship length 1~2m
Test performed :	Resistance and self-propulsion test
	Propeller open water test
	3-D flow measurement
	Pressure measurement
	Flow visualization and image processing

SAMSUNG SHIP MODEL BASIN (SSMB) **KOREA**
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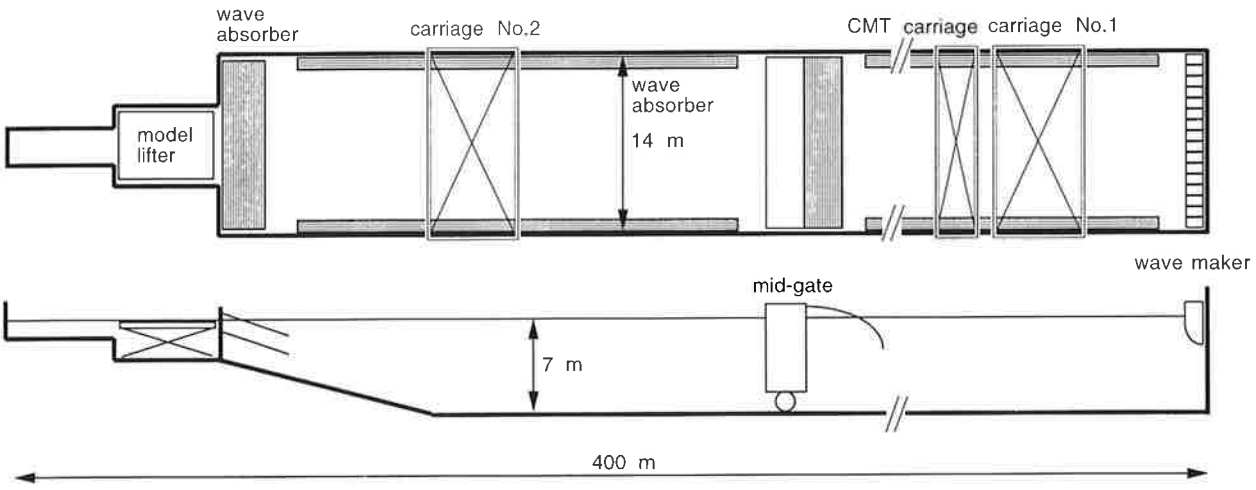
TOWING TANK (1996)



Description of carriages :	2 carriages, Digital PID control
Drive system and power :	Linear induction motor driven Carriage No.1: 180kW × 4+13.5kW × 2 Carriage No.2: 43kW × 4
Maximum carriage speed :	18 m/s for carriage No.1 (maximum acceleration 2 m/s^2) 5 m/s for carriage No.2 (maximum acceleration 1 m/s^2)
Other capabilities :	Mid-gate for 2 simultaneous experiments Facility for circular motion test
Wave generating capability :	Regular, long-crested and short-crested irregular wave Wave length 0.5~15m, maximum wave height 0.5m
Wave maker :	0.35m × 40 segments plunger type, digital PID control
Wave absorber :	2 layered panel with honeycomb and square pipes Side beach with square pipes
Wave measurement :	Capacitance and servo type probes
Instrument :	Real time multi-tasking system for data acquisitions and monitoring, 64 channels
Model size :	Ship length 2~9.6 m
Test performed :	Resistance and self-propulsion, Propeller open water tests 3-D wake surveys, Wave pattern analysis Wave induced motions and loads Maneuvering test by circular motion test and PMM

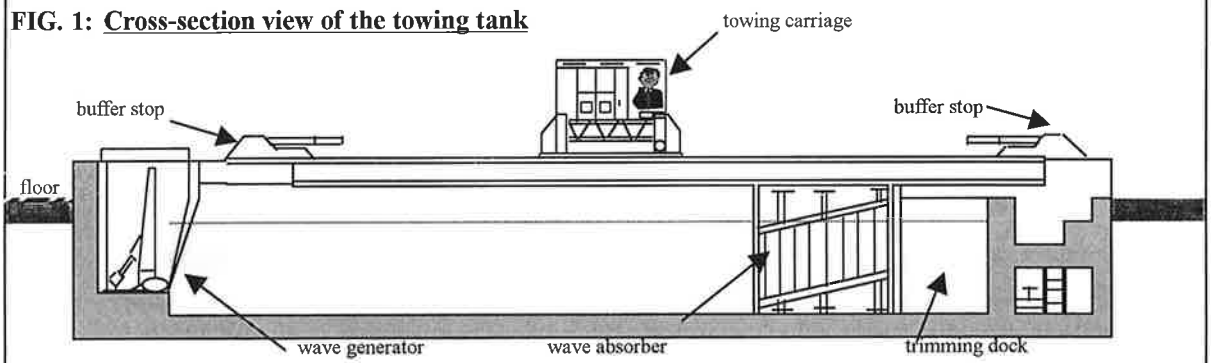
MARINE TECHNOLOGY LABORATORY
FACULTY of MECHANICAL ENGINEERING

UNIVERSITI TEKNOLOGI MALAYSIA
LOCKED BAG 791
80990 JOHOR BAHRU
JOHOR
MALAYSIA.

MALAYSIA

IDENTIFICATION OF TOWING TANK: No. 1 (September 1996)

FIG. 1: Cross-section view of the towing tank



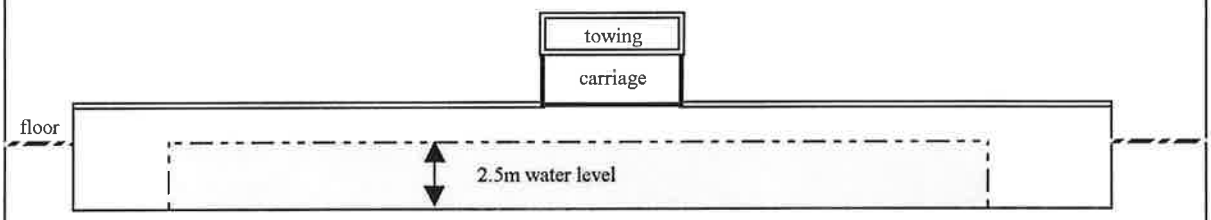


FIG. 2: Front elevation view of the towing tank

TOWING TANK DESCRIPTION: length = 120m, breadth = 4m, water depth = 2.5m.
DESCRIPTIN OF CARRIAGE: 1 unit, manned, motor driven
TYPE OF DRIVE SYSTEM AND TOTAL POWER: 4-quadrannt thyristor, DC motor, 44kW
MAXIMUM CARRIAGE SPEED: 5 m/s
OTHER CAPABILITIES: fixed with variable water depth test frame, fixed with working & observation platform, vertical and horizontal planar motion mechanism, 6-component force measurement system.

WAVE GENERATION CAPABILITY: (a) regular [T=0.5 - 2.5s, H_{max}=0.44m, steepness= 1/10, Accuracy = 0-10%FSR(wave height) & +/-2% (period)] (b) Irregular [$H_{1/3}$=0.25 at T=1.7s, Accuracy = +/-5% FSR($H_{1/3}$) & +/-5%FSR (spectral density)
WAVE MAKER TYPE AND EXTENT: hydraulic, dry-back, 4m width
WAVE ABSORBER TYPE: 14 rows of expanded steel mesh, 7m long, removable middle portion for model access
WAVE MEASUREMENT: resistance type wave probe.

INSTRUMENTATION: MARIN's Basin Management System (BMS) data aquisition and analysing system, 40 channels (expandable to 100), 250 samples per second.
MODEL SIZE RANGE: 2.5 - 4.5m
TEST PERFORMED: resistance test, self propulsion test; seakeeping (hydrodynamic coefficient) test, wave load test, wake measurement test.

PUBLISHED DESCRIPTION: (none)