# BIBLIOGRAPHY FOR SHIP VIBRATION PREDICTION METHODS AND EVALUATION OF INFLUENCE OF HULL STIFFNESS VARIATION ON VIBRATORY RESPONSE

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SR-214

1 0 MAR 1975

The Ship Structure Committee recently sponsored a hull-flexibility criteria study that produced an extensive bibliography. As a result, it was decided that a listing should be published separately.

Results of the original project have appeared in SSC-249 entitled, "Ship Vibration Prediction Methods And Evaluation of Influence of Hull Stiffness Variation On Vibratory Response" by R.G. Kline and J.C. Daidola.

Your comments and suggestions for additional research topics or problem areas will be most welcome.

Of the Beaking

Rear Admiral, U. S. Coast Guard Chairman, Ship Structure Committee SSC-250

Final Report

on

Project SR-214, "Hull Flexibility Criteria Study"

#### BIBLIOGRAPHY FOR

SHIP-VIBRATION PREDICTION METHODS AND EVALUATION OF INFLUENCE OF HULL-STIFFNESS VARIATION ON VIBRATORY RESPONSE

bу

R. G. Kline, U. S. Steel Corporation

and

J. C. Daidola, M. Rosenblatt & Son, Inc.

under

Department of the Navy Naval Ship Engineering Center Contract No. N00024-73-C-5206

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U. S. Coast Guard Headquarters Washington, D. C. 1974

# INTRODUCTION

The bibliography presented here was prepared in the course of performing the "Hull Flexibility Criteria Study" (SR-214) whose results appear in the report entitled "Ship-Vibration Prediction Methods and Evaluation of Influence of Hull-Stiffness Variation on Vibratory Response." The reason for publishing the bibliography separately is that it is believed it may be of assistance to locate references in a variety of topics relative to ship vibration not addressed to in Project SR-214. This is not to imply that the bibliography is complete or exhaustive.

The bibliography is subdivided as follows:

- 1. Related Books
- II. Hull-Vibration Prediction Procedures
- III. Propulsion-System-Vibration Prediction Procedures
- IV. Wave; Slam-and Propeller-Excited Hull Vibrations
- V. Limitations of Acceptable Vibrations
- VI. Miscellaneous

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The SHIP STRUCTURE COMMITTEE is constituted to prosecute a research program to improve the hull structures of ships by an extension of knowledge pertaining to design, materials and methods of fabrication.

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#### CODE OF ABBREVIATIONS FOR BIBLIOGRAPHY

ASCE American Society of Civil Engineers

ASME American Society of Mechanical Engineers

BSRA British Ship Research Association

DNV Det Norske Veritas

DTMB David Taylor Model Basin

IHI Ishikawajima-Harima Heavy Industries

Co. Ltd.

IME Institute of Marine Engineers

INA Institute of Naval Architects

ISSC International Ship Structures Congress

JSNA Journal of the Society of Naval Architects

JSNAJ Journal of the Society of Naval Architects

of Japan.

JSR Journal of Ship Research

LNEC Laboratorio National de Engenharia Civil

MHI Mitsubishi Heavy Industries

NACA National Advisory Committee for Aeronautics

NECIES North East Coast Institute of Engineers

and Shipbuilders

NSRDC Naval Ship Research and Development Center

RINA Royal Institution of Naval Architects

SNAME Society of Naval Architects & Marine

Engineers

SSC Ship Structure Committee

TINA Transactions of the Institute of Naval

Architects

#### 1. RELATED BOOKS

- Bibliography on Forces Exerted by Waves on Vertical Surfaces.

  BSRA Report B. 147. Wallsend Northumberland:
  British Ship Research Association.
- Bibliography on Propeller-Induced Vibration. BSRA Report B. 145.

  Wallsend Northumberland: British Ship Research
  Association.
- Bibliography on Ship Slamming and Water Impact. T & R Bulletin No. 2-16. New York: SNAME, 1967.
- CLOUGH, R.W. and PENZIEN, J. <u>Structural Dynamics</u>. New York: McGraw-Hill, in preparation
- COMSTOCK, J.P. ed. <u>Principles of Naval Architecture</u>. New York: SNAME, 1968.
- D'ARCANGELO, A.M. A Guide to Sound Ship Structures. Cambridge, Md.: Cornell Maritime Press, 1964
- DEN HARTOG, J. P. Mechanical Vibrations. New York: McGraw-Hill, 1956.
- DET NORSKE VERITAS. Rules for the Classification of Steel Ships, 1968 ed.
- LLOYD'S REGISTER OF SHIPPING. Rules and Regulations for the Construction and Classification of Steel Ships, 1972 ed.
- MEIROVITCH, L. Analytical Methods in Vibrations. New York: Macmillan, 1967.
- MYKLESTAD, N.O. Vibration Analysis. New York: Macmillan, 1967.
- RAYLEIGH, JOHN WILLIAM STRUTT, 5th Baron of. Theory of Sound. Vol. 1.
- SCANLON, R.H., and ROSENBAUM, R. <u>Aircraft Vibration and Flutter</u>. New York: Macmillan, 1951.
- THIEN WAH ed. A Guide for the Analysis of Ship Structure. Washington: Dept. of Commerce, 1962.
- THOMPSON, W.T. <u>Vibration Theory and Applications.</u> Elizabeth, N.J. Prentice-Hall 1965
- TIMOSHENKO, S. <u>Vibration Problems in Engineering</u>. New York: Van Nostrand, 1937.
- TODD, F.H. Ship Hull Vibration. London: Edward Arnold Ltd., 1961

- WIEGEL, E. Earthquake Engineering. New York: Prentice-Hall, 1970.
- YOSHIKI, M., KUMAI, T., and KANAZAWA, T. Recent Studies on Ship Vibration in Japan. 60th Anniversary Series, Vol. 10. Tokyo: Society of Naval Architects of Japan, 1965.
- ZIENKIEWICZ, O.C. The Finite-Element Method in Structural and Continuum Mechanics. London: McGraw-Hill, 1967.

#### II. HULL-VIBRATION PREDICTION PROCEDURES

# A. Calculation of Vibratory Response

- ADAMS, Emily J. "The Steady-State Response of a Ship Hull to a Simple Harmonic Driving Force Computed by a Digital Process." DTMB Report 715. May 1950.
- ADAMS and WELCH. DTMB Report 582. July, 1947.
- AERTSSEN, G. and DeLEMBRE. "Calculation and Measurement of the Vertical and Horizontal Vibration Frequencies of a Large Ore Carrier" Trans. NECLES. Vol. 86.
- ANDERSSON, G. and NORRARD, K. "A Method for the Calculation of Vertical Vibration with Several Nodes and Some Other Aspects of Ship Vibration." Trans. RINA, 1969.
- BISHOP, R.E.D. and JOHNSON, D.C. <u>Vibration Analysis Tables</u>. Cambridge Univ. Press, 1956.
- BURRILL, L.C. "Ship Vibration: Simple Methods of Estimating Critical Frequencies." Trans. NECIES. Vol. 51. 1935.
- CHANG, Pin-Yu, and MICHELSEN, Finn C. "A Vibration Analysis of Grillage Beams." JSR March, 1969.
- CONN, R.B. "Automatic Analysis of Ship-Hull Vibration Data." SNAME Spring Meeting 1967.
- CSUPOR, D. ''Methods for Calculating the Free Vibrations of a Ship's Hull,'' DTMB Translation 288. May, 1959. Original Paper: Translations Schiffbautechnische Gesellschaft 1956.
- CUTHILL, E.H. and HENDERSON, F.H. "Description and Usage of GRBC1 General Bending Response Code 1." DTMB Report 1925.

  October 1964.
- DIEUDONNE, J. "Vibration in Ships." INA Vol. 101, 1959.
- FRANCIS, J.J. and PALADINO, A.R. "Analytical and Experimental Evaluation of DD692 Class Hull Vibration." SNAME, LS-NE. May, 1966.
- GREENSPON. "Theoretical Developments in the Vibration of Hulls." JSR. April 1963.
- HENDERSON, F.M. ''Description and Usage of General Bending Response Code 2 (GBRC 2).'' DTMB, Applied Mathematics Laboratory Technical Note AML-59-66, August 1966.

- KUMAI, T. "Some Consideration on the Coupled Vibration of Hull and Bottom." Rep. Vibration Committee, <u>JSNAJ</u> V-8-2. 1964.
- . "On the Estimation of Natural Frequencies of Vertical Vibration of Ships." Zosen Kiokai. June, 1967.
- \_\_\_\_\_\_, "Vibration of a Mammoth Tanker with Special Consideration to Athwartship Flexibility." JSNA West Japan.
  No. 33. 1967.
- . "Vibration of a Mammoth Tanker-II Added Virtual Mass of Water." Structural Committee Report 61-11-1/2. 1967.
- LEIBOWITZ, RALPH C. "Natural Modes and Frequencies of Vertical Vibration of a Beam with an Attached Sprung Mass." DTMB Report 1215. September 1958.
- LEIBOWITZ, R.C. and KENNARD, E. H. "Theory of Freely Vibrating Nonuniform Beams, Including Methods of Solution and Application to Ships." DTMB Report 1317. May, 1961.
- McGOLDRICK, R. T. et al. "Recent Developments in the Theory of Ship Vibration." Rev. ed. DTMB Report 739. October, 1953.
- McGOLDRICK, R.T. "Comparison Between Theoretically and Experimentally Determined Natural Frequencies and Modes of Vibration of Ships." DTMB Report 906. August 1954.
- McGOLDRICK, R.T. and Russo, V.L. "Hull Vibration Investigation on S.S. Gopher Mariner." Trans. SNAME, Vol. 63, 1955.
- McGOLDRICK, R.T. "A Vibration Manual for Engineers." 2nd ed. DTMB Report R-189. December 1957.
- , "Ship Vibration." DTMB Report 1451. December, 1960.
- MATHEWSON, ALICE W. "Calculation of the Normal Vertical Flexural Modes of Hull Vibration by the Digital Process." DTMB Report 706. February 1950.
- MATSUMATO, K. "On the Non-Beam Vibration of Huge Vessels." JSNAJ Vol. 125 (In Japanese). June 1969.
- MATSUURA, YOSHIKAZU, "Transverse Vibration of Free-free Bars of Uniform Cross Section Taking into Account the Effect of Shear." JSNA Kansai, Vol. 94. 1959.
- \_\_\_\_\_, "An Analysis of Vertical Vibration of Cargo Ships." <u>JSNAJ</u> Vol. 108. 1960. December 1960.

- MATSUURA, Y., et al. "Study on the Coupled Torsional and Flexural Vibration of Ships with Large Hatch Openings 2nd Report Coupled Torsional and Flexural Vibration of a Uniform Bar with Open Cross Section." JSNA Kansai, No. 127. 1968.
- . "Study on the Coupled Torsional and Flexural Vibration of Ships with Large Hatch Openings 5th Report Coupled Torsional and Flexural Vibration of a Bar with Open Cross Section in Water." JSNA Kansai No. 132. 1969.
- MILLER, N.S. and KUO, C. "Main Hull Vibration of Ships." ISCC Report 1961.
- MYKLESTAD, N.O. "New Method of Calculating Natural Modes of Coupled Bending-Torsion Vibration of Beams." Trans. ASME, Vol. 67, No. 1, January 1945.
- . "Numerical Analysis of Forced Vibrations of Beams." <u>Journal</u> of Applied Mechanics. Vol. 20, No. 1. Trans. ASME, March 1953.
- NEKI, I. "Matrix Method of Vibrational Analysis of Framed Structures and its Application." IHI Engineering Review.
- NOWACKI, HORST. "Ship Vibrations." University of Michigan Publication No. 045. May, 1970.
- OHTAKA, K., KOMAI, T. USHIJIMA, M. "On the Horizontal and Torsional Vibration of Ships." Selected Papers from JSNAJ. Vol. 5. 1970.
- OHTAKA, K., HIBINO, F. and OHJI, M. "A Study of Vertical Vibration of Ships." 1st Report. JSNAJ Vol. 116. December 1964.
- OHTAKA, K., et al. "A study of Vertical Vibration of Ships." 2nd Report. JSNAJ Vol. 119. June 1966.
- OHTAKA, K. and KAGAWA, K. "Higher Mode Vibration of Tankers." <u>Structural Committee Report</u> 59-32-2/2 1966.
- OHTAKA, K., KUMAI, T. and USHIJIMA, M. "Study on the Coupled Torsional Horizontal Vibration of Ships." 1st Report.

  <u>JSNAJ</u> Vol. 121. June 1967.
- OHTAKA, K. and KAGAWA, K., .''A Study of Longitudinal Vibration of Ships.''
  lst Report. JSNAJ Vol. 123. June 1968.
- OHTAKA, K., et al., "Higher Mode Vertical Vibration of Giant Tanker."

  <u>JSNAJ</u> Vol. 125. June 1969.
- , "Vertical Vibration of Ships Coupled with Bottom Vibration."

  JSNAJ Vol. 126. December 1969.

- HINTERTHAN, W.B. and FONTAINE, W.R., "Prediction of Hull Vibration," Paper No. 8, Proceedings of the First Conference on Ship Vibration. Stevens Institute of Technology, Hoboken, N.J. 1965. DTMB Report 2002. August, 1965.
- HIROWATARI, TOMOYUKI, "On the Natural Frequencies of the Vertical Flexural Vibration of Ship." Part 3. <u>J\$NAJ</u> Vol. 97. June 1955.
- \_\_\_\_\_. "On the Natural Frequencies of the Flexural Vibration of Ship's Hull." Part 4. JSNAJ Vol. 102. December 1957.
- HIROWATARI, T. and MATSUMOTO, K. "Hull Vertical Vibration Treated as Box Beam." Vibration Committee Report V37-7. 1968.
- HYLARIDES. "Lowest Natural Frequencies of Structures with Rigid-Body Degrees of Freedom." JSR June 1968.
- HYLARIDES, Ir. S. "Finite-Element Technique in Ship-Vibration Analysis."

  International Shipbuilding Progress. Vol. 15, No. 169,
  September 1968.
- JUDD, P. H. "Longitudinal Strength and Vibration of Ships by Electronic Computer." NECIES. Vol. 77.
- KANAZAWA, TAKESHI. "On the Effects of Rotatory Inertia and Shear Force upon the Transverse Vibration of Bar." J\$NAJ. Vol. 75. June 1944.
- KLINE, R.G. and CLOUGH, R.W., "The Dynamic Response of Ships' Hulls as Influenced by Proportions, Arrangement, Loading, and Structural Stiffness." SNAME Spring Meeting 1967.
- KUMAI, T. "Estimation of Natural Frequencies of Torsional Vibration of Ships." JSNA West Japan, No. 11. 1956.
- "Vibration of Ships under Special Consideration to the Shearing Vibration." JSNAJ Vol. 99. June 1956.
- \_\_\_\_\_\_''On the Coupled Torsional-Horizontal Vibration of Ships.''
  JSNAJ Vol. 100. December 1956.
- \_\_\_\_\_ ''Response of the Higher Modes of the Hull Vibration of a Large Tanker.'' JSNAJ Vol. 103. June 1958.
- KUMAI, T., TOMITA, T. and ULHI, Y. "On the Mode Factor in the Calculation of Response of the Higher Mode of the Vibration of Ships." JSNA West Japan, No. 26. 1963.

- OHTAKA, K. et al. "On the Coupled Torsional-Horizontal Vibration of Ships." Mitsubishi Technical Bulletin. No. 54. 1967.
- OKUDA, KATSUMI and ARIMA, TAKASHI. "Strength and Frequency of Natural Vibration of Rectangular Thin Plates with Longitudinal and Lateral Stiffeners." JSNAJ Vol.58. 1936.
- PETTERSEN, J.W.E. "Vibration in the Afterbody of Ships." NECIES. Vol. 87.
- SCHADLOFSKY, E. "The Calculation and Measurement of Elastic Natural Frequencies of Ship Hulls." Shiffbautechnische Gesellschaft. Vol. 33, 1932. DTMB translation 7, June 1934.
- SHIMIZU, S. "Shear Vibration of Framed Structures." Structural Committee Report 67-36-1/1. 1968.
- SHIMIZU, S. and SATO, M. "Shear Vibration of Grillages." JSNA West Japan, No. 37. 1969.
- SHORT. "Theoretical Determination of Natural Modes of Deck Vibrations." SNAME LS-HR April 1965.
- SUEHIRO, KYOJI. "On the Damped Transversal Vibration of Prismatic Bars." Bull. Res. Inst. Earthq. Tokyo Imp. Univ. VI., 1929.
- SUETSUGU, ISSEI. "Stern Vibration on the Timoshenko Beam and on a Kind of Variable Section Beam." JSNA Kansai, Vol. 97. 1960
- SUETSUGU, Dr. I. and FUJII, K. "The Effects of Bottom Vibration on Hull Natural Frequencies." <u>International Shipbuilding Progress</u>. Vol. 10, No. 109. September 1963.
- SUETSUGU, I. and FUJII, K. "On the Bottom Vibration." JSNA Kansai, Vol. III. 1963.
- TERADA, TORAHIKO. "On the Vibration of a Bar Floating on a Liquid Surface." Proc. Tokyo Math. Phys. Soc. 1906.
- TODD, F.H. and MARWOOD, W.F. "Ship Vibration" Trans. NECIES. 1948
- TOMITA, TEKIJIRO. "Estimation of the Natural Frequency of the Hull." JSNAJ Vol. 86 1953.
- \_\_\_\_\_ "The Estimation of Principal Matural Frequencies of Hull." JSNAJ Vol. 107. 1960.
- TRAIL-NASH, R.W. and COLLAR, A.R. "The Effects of Shear Flexibility and Rotatory Inertia on the Bending Vibration of Beams." Quart. Journ. Mech. and Applied Math., Vol. VI, Part 2 1953.

- TSUNODA, REIJI, "The Estimation of Natural Vibration and its Allowable Exciting Force." JSNAJ Vol. 104. December 1958.
- UMEZAKI, K., et al "Vibration of Container Ship." JSNAJ Vol. 126.

  December 1969
- VEDELER, G. "Torsion of Ships." INA 1924.
- WATANABE, YOSHIHIRO. "On the Effect of Shear Deflection upon the Flexural Vibration of a Ship." JSNA Seibu, Japan, Vol. 11 1934.
- WILSON, E. L. and CLOUGH, R. W. "Dynamic Response by Step-by-Step Matrix Analysis," Proceedings Symposium on the Use of Computers in Civil Engineering, LNEC, Lisbon, Portugal 1963.
- YAMAKOSHI, M. and MAEDA, Y. "A Consideration on a Coupled Vibration of Horizontal and Torsional Vibration of Ships." JSNA West Japan, No. 26. 1968.
- YAMAKOSHI, M. and OHNUMA, S. ''On the Coupling of Hull Vibration and Bottom Vibration of Ships.'' JSNAJ Vol. 2. 1969.
- YOSHIKI, MASAO. "Simple Estimation of Natural Frequency of the Flexural Vibration of a Ship." <u>JSNAJ</u> Vol. 73. 1951.

#### 11. HULL-VIBRATION PREDICTION PROCEDURES

- B. Calculation of Quantitites Needed in the Equations of Motion
- AERTSSEN, G.and DeLEMBRE, IR. R., "A Survey of Vibrational Damping Factors Found from Slamming Experiements on Four Ships." NECIES 1970-1971, Vol. 87.
- CLOUGH, R.W. 'Matrix Analysis of Beams.' Proceedings ASCE vol. 84, No. EM 1. January 1958.
- DATTON, G.W. and LEIBOWITZ, R.C. "A Procedure for Determining the Virtual Mass J-Factors for the Flexural Modes of a Vibrating Beam." DTMB Report 1623. August, 1962.
- JOOSEN, W.P.A. and SPARENBERG, J.A. "On the Longitudinal Reduction Factor for the Added Mass of Vibrating Ships with Rectangular Cross-section." Netherland's Research Centers T.N.O., Report No. 40 S, 1961.
- KITO, FUMIKI, "On the Added Mass of Water in the Vibration of Plate."

  JSNAJ No. 266. 1944.
- KUMA!, T. "Damping Factors in the Higher Modes of Ship Vibration."

  JSNAJ Vol. 102, December 1957.
- . "Added Mass Moment of Inertia Induced by Torsional Vibration of Ships." <u>JSNAJ</u> Vol. 104, December 1958.
- . "On the Virtual Inertia Coefficients of the Vertical Vibration of Ships." <u>JSNAJ</u> Vol. 105. June 1959.
- \_\_\_\_\_. "Some Corrections on the Added Mass of Water in the Horizontal Vibration of Ships." <u>JSNAJ</u> Vol. 108, December 1960.
- . "Three-Dimensional Correction for the Added-Mass Moment of Inertia of Water in the Torsional Vibration of Ships." JSNAJ Vol. 108, December 1960.
- "On the Three-Dimensional Correction Factor for the Virtual Inertia Coefficient in the Vertical Vibration of Ships." JSNAJ Vol. 112. December 1962.
- . "On the Effects of Shear Deflection and Rotatory Inertia
  Upon the Damping of Ship Vibrations in the Higher Modes."

  JSNAJ Vol. 115. June 1964.
- . "On the Apparent Mass of Cargo Oil in Ship Vibration." JSNAJ Vol. 117. June 1965.

- KUMAI, T., "Estimation & Three-Dimensional Added Mass for Hull Vertical Vibration." JSNA West Japan, No. 32. 1966.
- Panels on the Hull Natural Frequencies." JSNA West Japan, No. 39. 1970.
- Exciting Hull Vibrations." JSNAJ Vol. 128 (In Japanese).

  December 1970.
- LANDWEBER, L., and MACAGNO, M.C. "Added Mass of Two-Dimensional Forms Oscillating in a Free Surface." JSR, November, 1957.
- . "Added Mass of a Three-Parameter Family of Two-Dimensional Forms Oscillating in a Free Surface." JSR Vol. 2, No. 4. March 1959.
- \_\_\_\_\_. "Added Masses of Two-Dimensional Forms by Conformal Mapping." JSR June 1967.
- LEIBOWITZ, R.C. and HARDER, R.L. "Mechanized Computation of Ship Parameters." DTMB Report 1841. June 1965.
- LEWIS, F.M. "The Inertia of the Water Surrounding a Vibrating Ship." Transactions SNAME. 1929.
- LEWIS, F.M. and AUSLAENDER, J. "Virtual Inertia of Propellers." JSR Vol. 3, No. 4. March 1960.
- MACAGNO. "A Comparison of Three Methods for Computing the Added Mass of Ship Sections." JSR December 1968.
- MATHEWSON, ALICE W. "Preparation of Data for Computation of Vertical Flexural Modes of Hull Vibration by Digital Process." DTMB Report 632. September 1949.
- MATSUMOTO, K. "Added Weight of Water of Non-Beam Vibration." Vibration Committee Report V53-7, 1970.
- "Application of Finite Element Method to Added Virtual Mass of Ship Hull Vibration." JSNAJ, Vol. 127. June 1970.
- MATSUURA, Y. et al. "Calculation of Added Virtual Mass and Added Virtual Mass Moment of Inertia of Ship Hull Vibration by the Finite Element Method." JSNAJ. Vol. 124. December 1968.
- MATSUURA, Y. and KAWAKAMI, H. "A Consideration on the Added Mass and Added Moment of Inertia of Water in the Coupled Torsional-Horizontal Vibration of Ships." Vibration Committee Report JSNAJ V42-9, 1969.

- OHTAKA, K. and KAGAWA, K. "Added Weight of Water of Giant Tanker." Structural Committee Report 73-32-2/2, 1969.
- TAYLOR, J. LOCKWOOD. "Some Hydrodynamic Inertia Coefficients."  $\underline{\text{Phil.}}$  Mag. 1930.
- TOWNSIN, R.L. "Virtual Mass Reduction Factors 'J' Values for Ship Vibration Calculations." RINA Publication 1971.
- WATANABE, YOSHIHIRO. "On the Apparent Moment of Inertia of Ship in Free Rolling."  $\underline{JSNAJ}$  Vol. 52, October 1933.
- WENDEL, K. "Hydrodynamic Masses and Hydrodynamic Moments of Inertia." DTMB Translation 260, July 1956. Original paper: Transactions Schiffbaut echnische Gesellschaft, 1950.
- YAMAKOSHI, M. "On the Centre of Added Mass of Water in the Coupled Torsional Horizontal Vibration." Unpublished, 1968.
- YOSHIKI, MASAO. et al. "A Contribution to the Virtual Mass of a Vibrating Ship."  $\underline{\sf JSNAJ}$  Vol. 84. 1952.

## III. PROPULSION-SYSTEM-VIBRATION PREDICTION PROCEDURES

# A. Calculation of Vibratory Response

- BROWN, T.W.F. "Vibration Problems from a Marine Engineering Point of View." Trans. NECIES Vol. 55. 1938-1939
- BUNYAN, J.W. "Practical Approach to Some Vibration and Machinery Problems in Ships." INA, U 97. 1955.
- CASHMAN, R.M. "Design of Marine Machinery Foundations." Trans. SNAME, Vol. 70. 1962.
- COUCHMAN, A.A.J. "Axial Shaft Vibration in Large Turbine-Powered Merchant Ships." Trans. IME, Vol. 77, 1965.
- DJODJO. "Frequency Calculation and Analysis of Discrete Torsional Systems." JSR December 1962,
- GENT, W. "Torsional-Axial Vibrations of a Ship's Propulsion System." Part II. Netherlands Ship Research Center, Report No. 132 M.
- JASPER, NORMAN H. ''A Design Approach to the Problem of Critical Whirling Speeds of Shaft-Disk Systems.'' DTMB Report 890.

  December 1954.
- KANE, J.R. and MC GOLDRICK, R.T. "Longitudinal Vibration of Marine Propulsion-Shafting Systems." Trans. SNAME, Vol. 57, 1949.
- KAWAKAMI, MASAO. "On the Vibration of Engine Bed." JSNA Seibu Vol. 12. 1956.
- LARSEN, O.C. "Computer Programme Specification NV 505: Whirling Frequencies of Shaft Systems." DNV. Report 67-14-M. 1967.
- LARSON, O.C. "Computer Programme Specification NV 524: Mass Forces and Mass Moments, Guide Pressure Analysis, Bedplate, Moment and Bearing Reactions in Diesel Engines."

  DNV. Report 67-25-M. 1967.
- LEWIS, F.M., "Vibration and Engine Balance in Diesel Ships." SNAME Vol. 35. 1927.
  - \_\_\_\_\_\_. "Propeller Vibration." Trans. SNAME Vol. 43. 1935.
- LINDEN, A.M. VAN DER "Torsional-Axial Vibrations of a Ship's Propulsion System," Part III Netherlands Ship Research Center, Report No. 137 M.

- MICHEL, R. "BuShips Design Data Sheet DDS 4301, Propulsion Shafting." Initial Issue December 1944, reissued May 1, 1957.
- PETTERSEN, J.W.E. et al. "Vibration in the Afterbody of Ships." NECIES Vol. 87.
- PORITSKY H. and ROBINSON, C.S.L. "Torsional Vibration in Geared-Turbine Propulsion Equipment." <u>Journal of Applied Mechanics</u>, Vol. 7, No. 3 Trans. ASME, September 1940.
- PHOHL, M.A. "General Method for Calculating Critical Speeds of Flexible Rotors." <u>Journal of Applied Mechanics</u>, Vol. 12. No. 3, Trans. ASME, 1945.
- RIGBY, C.P. "Longitudinal Vibration of Marine Propeller Shafting." Trans. IME, Vol. 60. 1948.
- ROBINSON, M. and SONKEY H. RIALL "A Method of Preventing Vibration of Marine Engines." Trans. INA Vol. 36. 1895.
- STODOLA, A. "Steam and Gas Turbines." Translation by L. C. Lowenstein, New York: McGraw-Hill.
- VEDELER, B. "On Marine Propeller Forces in Calm Water and Waves and the Strength of Propeller-Shaft Systems in Single-Screw Ships." DNV. Report 68-12-M. 1968.
- WILLEMS, N. and HOLZER, S.M. "Critical Speeds of Rotating Shaft Subjected to Axial Loading and Tangential Torsion." <u>Journal of Engineering for Industry</u>, Trans. ASME. Vol. 89, Series B, No. 2, May 1967.
- WULFF, E. "Computer Programme Specification NV 517: Holzer Tabulation of Axial Vibrations in Straight Shaft Systems." DNV. Report 66-27-M. 1966.
- ZALOUMIS, A. and ANTONIDES, G.P. "Recent Developments in Longitudinal Vibrations of Surface Ship Propulsion Systems." NSRDC Report 3358. September 1971.

# III PROPULSION-SYSTEM-VIBRATION PREDICTION PROCEDURES

- B. Calculation of Quantities Needed in the Equations of Motion
- AUSLAENDER, LEWIS "Virtual Inertia of Propellers." JSR March 1960. 37.
- BURRILL, L.C., ROBSON, W. "Virtual Mass and Moment of Inertia of Propellers." NECIES, Vol. 78.
- GRIM, O. "Elastic Support of the Propeller Shaft in the Stern Tube." Transactions, Schiffbautechnische Gesellschaft, 1960.
- NORRIE. "The Virtual Inertia of Propellers Under Load." JSR June 1965, 23.
- SUGAWARA, T., OCHI, S. and INOHARA, Y. "Consideration on Propeller Damping in Torsional Vibration of Recent Propulsion System." Selected Papers from JSNAJ. Vol. 6. 1970.

# IV. WAVE EXCITED, SLAM EXCITED AND PROPELLER EXCITED HULL VIBRATION.

- ADAMS, E.J. "The Steady-State Response of a Ship Hull to a Simple Harmonic Driving Force." Report 1317. 1961.
- AERTSSEN, G. "Hull Vibrations Excited by Waves." 60 Convengno Triestino di Tecnica Navale, Trieste Universitas. 1963.
- Basis of Whipping Records." Acta Techica Belgica, Transport.
- AKITA, Yoshio. "Effect of the Position of Engine to the Flexural Vibration of Ships with Damping." JSNAJ Vol. 86. 1953
- BELL, A. and TAYLOR, K. V. "Wave-Excited Hull Vibration Stresses Measurements on a 47,000 DWT Tanker." 1966, BSRA Report NS 115.
- BORG. "The Analysis of Ship Structures Subjected to Slamming Loads." JSR December 1960.
- BRESLIN, J.P. "A New Interpretation of the Free-Space Pressure Field Near a Ship Propeller." Stevens Institute of Technology Report No. 687. 1958.
- \_\_\_\_\_. "The Pressure Field Near a Ship Propeller." <u>JSR.</u> 1958.
- BRESLIN, J.P. and TSAKONAS, S. 'Marine Propeller Pressure Field Due to Loading and Thickness Effects.' Trans. SNAME. 1959.
- BRESLIN, J.P. "A Theory for the Vibratory Effects Produced by a Propeller on a Large Plate." JSR, December, 1959.
- Propeller-Induced Vibratory Effects." Fourth Symposium on Naval Hydrodynamics, 1962.
- BRESLIN, J.P. TSAKONAS, S. and JACOBS, W.R. "The Vibratory Force and Moment Produced by a Marine Propeller on a Long Rigid Strip." JSR, 1962.
- BRESLIN, J.P. and KOWALSKI. "Experimental Study of Propeller-Induced Vibratory Pressures on Simple Surfaces and Correlation with Theoretical Predictions." JSR, December, 1964.
- BRESLIN, J.P. "Review of Theoretical Prediction of Vibratory Pressures and Forces Generated by Ship Propellers." Stevens Institute of Technology, Davidson Laboratory Report prepared for the Second International Ship Structures Congress, Delft, The Netherlands. July 20-24, 1964.

- BRESLIN, J.P. and ENG, K.S. "A Method for Computing Propeller-Induced Vibratory Forces of Ships." First Conference on Ship Vibration, Hoboken. 1965.
- BRESLIN, J.P. "Vibratory Propeller, Appendage and Hull Forces and Moments." Stevens Institute of Technology, Davidson Laboratory Report to ITTC Propeller Comm. May 1969.
- BROWN, NEAL A. "Periodic Propeller Forces in Non-Uniform Flow." MIT, Department of Naval Architecture and Marine Engineering Report 64-7. June, 1964.
- "Theory and Experiment for Propeller Forces in Nonuniform Flow." First Conference on Ship Vibration, Hoboken. 1965.
- CHOPRA, A.K. "Earthquake Response of Appendages on Multi-Story Building." Proceedings of the Third World Conference on Earthquake Engineering, Auckland and Wellington, New Zealand. January, 1965.
- CHU and ABRAMSON. "Hydrodynamic Theories of Ship Slamming -- Review and Extension." JSR, March, 1961.
- CHUANG. "Experiments on Flat-Bottom Slamming." JSR, March, 1966.
- JSR, September 1967.
- "Considerations in the Structural Design of the New Generation of OCL Container Ships." The Naval Architect, April, 1971.
- DICKERSON, MARY "Induced Velocities Forward and Aft of a Propeller." DTMB Report 1310. March 1959.
- GOODMAN, R.A. 'Wave-Excited Main Hull Vibrations in Large Tankers and Bulk Carriers.' Trans. RINA, 1970.
- GREENBERG. "The Unsteady Loading on a Marine Propeller in a Non-uniform Flow." JSR, December 1964.
- GUNSTEREN, F.F. Van. "Springing; Wave-Induced Ship Vibrations." International Shipbuilding Progress.
- HADLER, J. and CHENG, H. "Analysis of Experimental Wake Data in Way of Propeller Plane of Single-Screw and Twin-Screw Ship Models." Trans. SNAME, 1964.
- HADLER, J. "Experimental Determination of Vibratory Propeller Forces at DTMB." Proceedings of the First Conference on Ship Vibration, Stevens Institute of Technology. 1965. Published as DTMB Report 2002. August 1965.

- HENRY, J.R. and BAILEY, F.C. "Slamming of Ships; A Critical Review of the Current State of Knowledge." SSC-208. 1970.
- HINTERTHAN, W. ''A Procedure for Calculating Propeller-Excited Vibratory Forces for Wake Surveys.'' NSRDC Report 2519, January, 1969.
- HUANG, R.T. and SIBUL, O.J. "Slamming Pressures on a Barge Model." SNAME T&R Report R-12.
- HUSE, E. "The Magnitude and Distribution of Propeller-Induced Surface Forces on a Single-Screw Ship Model." Norwegian Ship Model Experiment Tank Publication No. 100 December, 1968.
- . "Hull Vibration and Measurements of Propeller-Induced Pressure Fluctuations." International Shipbuilding Progress, Vol. 17, No. 187. March 1970.
- "Hydrodynamic Damper to Reduce Wave-Excited Vibration." The Naval Architect, April, 1971.
- JACOBS, W. R. and TSAKONAS, S. "Correlation of Vibratory Thrust and Torque Calculation with Experimental Values for the Netherlands Ship Model Basin Propellers." Stevens Institute of Technology, Davidson Laboratory, Part I and Part II, Research Report 1288. April 1968.
- JOHNSON. "The Effect of Air Compressibility in a First Approximation to the Ship Slamming Problem." JSR March 1968.
- JOHNSON, A.J. and CONN., R.B. "Propeller-Excited Vibration." International Marine and Shipping Conference, IME, 1969.
- KANAZAWA, TAKESHI and ISHII, MASAO. "On Rectangular Plate Under Lateral Impact. JSNAJ, Vol. 85. 1952.
- KEIL, H. ''Messung der Druckschwankungen on der Aussenhaut uber dem Propeller.'' Schiff und Hofen, heft 12, 17 Jahrgong, 1965.
- KERWIN, J. E. and LEOPOLD, R. "A Design Theory for Subcavitating Propellers." Trans. SNAME, 1964.
- KLINE, R.G., CLOUGH, R.W., and KAULIE, D. 'Propeller-Excited Ship Vibrations.' SNAME Publication.
- KUMAI, T. "On the Wave-Exciting Force and Response of Whipping of Ships." Publication of European Shipbuilding, Scandinavian Ship Technical Society.
- . "On the Transient Vibration of the Strut due to Axial Impact Load." JSNAJ, Vol. 83. February 1951.
- Frequency of Hull Vibration." JSNAJ, Vol. 101. June 1957.

- KUMAI, TOYOJI. "Damping Factors in the Higher Modes of Ship Vibrations." JSNAJ, Vol. 102. December 1957.
- KUMAI, TOYOJI, et al. "Measurement of Propeller Forces Exciting Hull Vibration by Use of a Self-Propelled Model." JSNA Seibu, Vol. 22. 1961.
- KUMAI, TOYOJI. "Some Aspect of the Propeller-Bearing Forces Exciting Hull Vibrations of a Single-Screw Ship." JSNA Seibu, Vol. 23. 1961.
- LABOUVIE, E.N. "Recent Findings and Empirical Data Obtained in the Field of Ship Vibrations (Einige Neuere Erkenntnjsse und Erfahrungen bei Schiffsvibrationen) Translated from Jahbuch Schiffbautechnische Gesellschaft, Vol. 47, February 1953.

  DTMB Translation 268. February 1958.
- LAMPLOUGH, T.A. "Some Aspects of Propeller-Excited Vibration." Lloyd's Register of Shipping, Publication No. 29.
- LEIBOWITZ, R.C. "A Method for Predicting Slamming Forces on and Response of a Ship Hull." DTMB Report 1691, September, 1963.
- LEIBOWITZ, R.C. and GREENSPON, J.E. "A Method for Predicting the Plate-Hull Girder Response of a Ship Incident to Slam." DTMB Report 1706. October, 1964.
- LEWIS, E.V., and WHEATON, J. "Study of Combined Wave and Springing Stresses of the 'Edward L. Ryerson'." SNAME Publication.
- LEWIS, F.M. and TACHMINDJI, A.J. "Propeller Forces Exciting Hull Vibration." SNAME, 1954.
- LEWIS, F.M. "Vibratory Hydrodynamic Forces on Struts Located Forward of a Propeller." MIT, Department of Naval Architecture and Marine Engineering. June 1960.
- \_\_\_\_\_\_\_ "Propeller-Vibration Forces." Trans. SNAME, 1963.
- \_\_\_\_\_. "Propeller-Vibration Forces in Single-Screw Ships." Trans. SNAME, 1969.
- LEWISON, G.R.G. "On the Reduction of Slamming Pressures." RINA.
- LEWISON and MACLEAN ''On the Cushioning of Water Impact by Entrapped Air.'' JSR June 1968.
- LOGAN, B.J. and GOODMAN, L.E. "Material and Interfacial Damping."

  Shock and Vibration Handbook, Edited by Harris and Crede.

  New York: McGraw-Hill, 1961.
- McGOLDRICK, "Buoyancy Effect on Natural Frequency of Vertical Modes of Hull Vibration." JSR, July 1957.

- MALHOTRA, A.K. and PENZIEN, J. "Response of Offshore Structures to Random-Wave Forces." Journal of the Structural Div., Proc. ASC. ST10, October 1970, pp.2155-2173.
- \_\_\_\_\_\_, "Nondeterministic Analysis of Offshore Structures."

  Journal of the Engineering Mechanics Div., Proc. ASC. EM6,
  Dec. 1970, pp. 985-1003.
- MILES, M. "On the Short-Term Distribution of the Peaks of Combined Low-Frequency and Springing Stresses." SNAME Publication.
- "The Theorectical Statistical Distribution of the Peaks of Combined Springing and Wave-Induced Stress Loads." Report LTR-SH-103, National Research Council of Canada. February 1970.
- MURDEY, D.C. "Pressures on the Bow Caused by Wave Impacts." The Naval Architect, April, 1972.
- NAKAMURA, ICHIRO and OSHIMA, HIYOSHI. "Some Examples of Stern Vibration of Tanker." JSNA Seibu, Vol. 21. 1961.
- NAKASE, DAIICHI, et al. "On the Effect of the Propeller Surface Force on Ship's Hull." Report 1, \_\_JSNAJ\_\_\_\_ Vol. 107. June 1960.
- NOLAN and HONSINGER "Wave-Induced Vibrations of Offshore Structures." SNAME, LS-GF, September 1962.
- NUMATA., "Comparative Slamming Characteristics of Two Ship Models." SY October 1967.
- OCHI, MICHEL K. "Extreme Behavior of a Ship in Rough Seas -- Slamming and Shipping of Green Water." Trans. SNAME 1964. pp. 143-202.
- OCHI and MOTTER ''Prediction of Extreme Values of Impact Pressure Associated with Ship Slamming.' JSR June 1969.
- OHTAKA, K., NAKANO, M. and ONAUE, M. "Hull Vertical Vibration Caused by the Unbalance of Diesel Engine." Technical Review of MHI. Ltd. Vol. 5, No. 5. 1968.
- PENZIEN, J. "Applications of Random Vibration Theory in Earthquake Engineering." <a href="Proceedings Joint U.S.-Japanese Seminar">Proceedings Joint U.S.-Japanese Seminar in Applied Stochastics</a>.
- PENZIEN, J. and LIU, S.C. "Nondeterministic Analysis of Nonlinear Structures Subjected to Earthquake Excitations." Vol. 1, Al-Santiago, Chile. Jan. 13-18, 1969, pp. 114-129.
- PENZIEN, J. and KAUL, M.K. "Response of Offshore Towers to Strong Motion Earthquakes." <u>Earthquake Engineering & Str. Dy.</u>, Vol. 1, No. 1, July-Sept. 1972.

- PENZIEN, J., KAUL, M.K., and BERGE, B. "Stochastic Response of Offshore Towers." to be published in <u>The Int. Journal of Computers and Structures</u>.
- POHL, K.H. "The Fluctuating Pressure Field in the Vicinity of a Ship's Propeller and the Periodic Forces Produced by It on Neighboring Plates." Schiffstechnik, 1959.
- REED, F.E. and BRADSHAW, R.T. "Ship Hull Vibrations 2 -- The Distribution of Exciting Forces Generated by Propellers."

  Conesco Report F-101-2. June 1960.
- REED, F.E. "Dynamic Vibration Absorbers and Auxiliary Mass Dampers."

  Shock and Vibration Handbook. Edited by Harris and Crede.

  New York: McGraw-Hill, 1961.
- "The Design of Ships to Avoid Propeller-Excited Vibrations."
  Transactions SNAME, 1971.
- SCHWANECKE, H. "Determination of Propeller-Excited Transverse Forces in the Bearings of the Screw Shaft on Full-Scale Ship and/or Model." Forschungszentrum Des Deutschen Schiffbaus, Report Nr. 21/1971. (in German).
- SELLARS, F.H. "Slamming Impact Pressure." MPR Associates Incorporated, June, 1971.
- SEZAWA, KATSUTADA and WATATABE, WATARU. "Damping Forces in Vibration of a Ship." JSNAJ, Vol. 59. June 1936.
- \_\_\_\_\_. "The Vibration Damping of a Ship in her Moving State." JSNAJ , Vol. 63. June 1938.
- SEZAWA, KATSUTADA. "Damping Resistances in Rolling, Pitching and Vibration of a Ship in her Motion-ahead." <u>JSNAJ</u>, Vol. 64. June 1939.
- a Ship on her Vibration." JSNAJ, Vol. 66. November 1940.
- SONTVEDT, T. "Propeller-Induced Excitation Forces, A Critical Examination of, Available at DNV." Publication No. 74, 1970.
- . "Theoretical Calculations of Hydrodynamic Loading on the Marine Propeller," Part I and II. DNV Reports 68-7-M and 68-14-M. 1968.
- SPINELLI, L. "Theoretical Research and Experiments in Slamming." Registro Italiano Navale.
- TRASBERG, M. "Impedance Concepts Applied to Mechanical Systems Excited by Random Oscillatory Forces." DTMB Report 1301.

  March 1959.

- STUNTZ, G.R. et al. "Series 60--The Effect of Variations in After-body Shape upon Resistance, Power, Wake Distribution and Propeller-Excited Vibratory Forces." Trans. SNAME, Vol. 68, 1960.
- SUETSUGU, ISSEI. "A Contribution to the Vibration at the Stern of Single-Screw Vessels." JSNAJ, Vol. 95. June 1954.
- . "On the Classification of the Vibration at the Stern of Single-Screw Vessels." JSNAJ, Vol. 103. June 1958
- TACHMINDJI, A.J. and McGOLDRICK, R.T. "Note on Propeller-Excited Hull Vibrations." JSR, 1959.
- TANIGUCHI. KANAME. "Pressure Variation of the Water Near a Propeller." JSNA Seibu, Vol. 16. 1958.
- . "Measurements of Propeller Vibratory Forces by Towing Self Propeller Model Ship." JSNA Seibu Vol. 12. 1956.
- TICK, "Submergence and Ship Slamming in Irregular Seas." JSR June 1958.
- TOMITA, TETSUJIRO. "Allowable Exciting Force or Moment of Diesel Marine Engine." JSNAJ, Vol. 108. December 1960.
- TSAKONA, BRESLIN and JACOBS. "The Vibratory Force and Moment Produced by a Marine Propeller on a Long Rigid Strip." JSR March, 1962.
- TSAKONAS, S., BRESLIN, J.P. and JEN, N. "Pressure Field Around a Marine Propeller Operating in a Wake." JSR, April, 1963.
- TSAKONAS, S. "Propeller Vibratory Thrust and Torque in Unsteady Three-Dimensional Flows." First Conference on Ship Vibration, Hoboken, 1965.
- TSAKONAS, S., BRESLIN, J. and MILLER, M. "Correlation and Application of an Unsteady Flow Theory for Propeller Forces." Trans. SNAME, 1967.
- TSAKONAS, S. and JACOBS, W.R. "Propeller Loading Distribution." Stevens Institute of Technology, Davidson Laboratory Report 1319. August 1968.
- VEDELER, B. "Correlation of Propeller-Induced Forces and Vibrations in the Afterbody of a 200.000 t.d.w. Tanker." DNV Report 60-2-0. 1970.
- VERHAGEN. "The Impact of a Flat Plate on a Water Surface." JSR December 1967,

- VORUS, W.S. "An Integrated Approach to the Determination of Propeller-Generated Vibratory Forces Acting on a Ship Hull." University of Michigan, Dept. of N.A., Report No. 072.
- VRIES, de GERHARD. "Safeguards Against Flutter of Airplanes."
  NACA TM 1423. National Advisory Committee for Aeronautics.
- WATANABE, YOSHIHIRO, and SUHARA, JIRO, "Study on the Impact of Beam." JSNAJ , Vol. 74, 1952.
- WATANABE, YOSHIHIRO et al. "Experimental Studies on the Impact Pressure and Transient Bending Stress of the Plate Produced by Clean Breach." JSNA Seibu, Vol. 18. 1959.
- WATANABE, YOSHIHIRO, "On the Causes of the Stern Vibration of a Ship." JSNAJ , Vol. 83. 1951.
- WERELDSMA, R. and MERCIER, R.H. "Measurements of Propeller-induced Vibratory Stern Pressure." Stevens Institute of Technology, Davidson Laboratory Report 1321. September 1968.
- 'Wind-Induced Vibration of Cylindrical Structures," <u>Journal of the Engineering Mechanics Division</u>, <u>Proceedings of ASCE</u>, Vol. 83, No. EMI. January, 1957.
- YAMAMOTO, Y. and ARITA, M. "Damping Forces in Ship Vibration." JSNAJ, Vol. 118. December 1965.

# V. LIMITATIONS OF ACCEPTABLE VIBRATION

- AERTSSEN, G. "Longitudinal Strength of Ships." <u>International Shipbuilding Progress</u>. September 1970.
- ASHLEY, C., "Equal Annoyance Contours for the Effect of Sinusoidal Vibration on Man." The Shock and Vibration Bulletin 41, Part 2, December 1970.
- BALDWIN, W.M. and EVANS, E.B. Part 1: "The Fundamental Factors Influencing the Behavior of Welded Structures under Conditions of Multiaxial Stress and Variations of Temperature." Part II: "The Effect of Subcritical Heat Treatment on the Transition Temperature of a Low-Carbon Ship Plate Steel." SSC-64. November, 1953.
- BAYSINGER, R.F., RIEPPEL, P.J. and VOLDRICH, C.B. "Evaluation of Improved Materials and Methods of Fabrication for Welded Steel Ships." SSC-45. December, 1951.
- BUCHMAN, E. "Criteria for Human Reaction to Environmental Vibration on Naval Ships." DTMB Report 1635. June 1962.
- COERMANN, R.R., et al. "The Passive Dynamic Mechanical Properties of the Human Thorax-Abdomen System and the Whole Body System." Aerospace Medicine 31, 6, p. 443. 1960.
- DIEUDONNE, J. "The IRCN Notes on the Appraisal of Human Reaction to Vibration." <u>ISSC Proceedings</u>, Vol. II, Committee 9, p. 395. 1967.
- DUNHAM. "Fatigue Testing of Large-Scale Models of Submarine Structural Details." SNAME LS-NE Oct. 1964. MT July 1965.
- GOLDMAN, D.E. and VON GIERKE, H.E. "The Effects of Shock and Vibration on Man." Naval Medical Research Institute U.S. Lecture and Review Series No. 60-3. 1960.
- . "Effects of Shock and Vibration on Man." Shock and Vibration Handbook. Edited by Harris and Crede. New York.
- "Guide for the Evaluation of Human Exposure to Whole Body Vibration."
  Document ISO/TC108/WG7--N.36 Revised 1970.
- HAGEN and HAMMER "Shipboard Noise and Vibration from a Habitability Viewpoint." SNAME LS-CH November, 1966. MT Jan. 1969.
- HARDRATH, HERBERT F. and WHALEY, RICHARD E. "Fatigue-Crack Propagation and Residual Static Strength of Built-up Structures." NACA TN 4012.

  National Advisory Committee for Aeronautics. May 1957.

- HOLLISTER, S.C., GARCIA, J., and CUYKENDALL, T.R. "Fatigue Tests of Ship Welds." SSC-14. February, 1948.
- HOTTA, T. et al. "Further Investigation of Estimation on Low-Cycle Fatigue Strength of Steels." <u>JSNAJ</u>, Vol. 124. in Japanese. December 1968.
- . "Further Investigation on Estimation of Low-Cycle Fatigue Strength of Steels." JSNAJ, Vol. 128. December 1970.
- HYLER, W.S. et al. "Fatigue Behavior of Aircraft Structural Beams." NACA TN 4137. National Advisory Committee for Aeronautics. January 1958.
- ITAGAK!, H. and SHINOZUKI, M. "Reliability of Single and Multi-Member Structure Subjected to Fluctuating Load." Selected Papers from JSNAJ, Vol. 8. 1971.
- JACKLIN, H.M. and LIDELL, G. "Riding Comfort Analysis." Eng. Bull No. 3, Purdue University, 1933.
- JACKLIN, H.M. "Human Reactions to Vibrations." <u>SAE Journal</u> No. 39, p. 401. 1936.
- JANSEN, J.H. "A Proposal for Standardized Measurements and Annoyance Rating of Simultaneous Noise and Vibration in Ships." Netherlands Ship Research Center. TNO Report No. 1208. 1969.
- JOHNSON, A.J. "On the Amplitudes of Ship's Hulls." Trans. Inst. Engineers & Shipbuilders in Scotland. 1962.
- KANAZAWA, T. "A Proposal for the Vibration Limits of Ships." University of Tokyo, SR-6101. 1961.
- KANAZAWA, TAKESHI and MINAMI, KENICHI "On the Equip-Sensation Curve to Horizontal Vibration." Tech. Rep. Univ. Tokyo, Japan, SR-6102. 1961.
- KAWAKAMI, M. "On the Impact Strength of Ships Due to Shipping Green Seas - Towing Ex. of a Ship Model in Regular Waves." Selected Papers from JSNAJ, Vol. 8, 1971.
- KUMAI, TOYOJI "Some Measurements of Acceleration of Hull Vibration and Human Sensitivity to Vibration." JSNA Seibu Vol. 14. 1957.
- LEYBOLD, HERBERT A., HARDRATH, HERBERT F., and MOORE, ROBERT L. "An Investigation of the Effects of Atmospheric Corrosion on the Fatigue Life of Aluminum Alloys." NACA TN 4331. National Advisory Committee for Aeronautics. September 1958.

- MILES, J.W. ''On Structural Fatigue Under Random Loading.' J. Aero Sci., Vol. 21. 1954. pp. 753-762.
- MINAMI, Y. et al. "Low-Cycle Random Fatigue of Steel." <u>JSNAJ</u>, Vol. 128 in Japanese. December 1970.
- MORI, M. et al. "On the Torsional Strength of a Ship with Wide and Long Hatch Openings." JSNAJ, Vol. 124. December 1968.
- . "Application of the Program Fatigue Tests on the Members of Ship Structure." JSNAJ, Vol. June 1965.
- NIBBERING, J.J. "Permissible Stresses and their Limitations." SSC-206. 1970.
- PETTERSEN, J.W.E. "Vibration in the Afterbody of Ships." NECIES, Vol. 87.
- POSTLETHWAITE, F. "Human Susceptibility to Vibration." Engineering No. 157, 1944. p. 61.
- "Proposal of the Limit of Vibration of a Ship." JSNAJ, No. 362. 1959.
- RICHARD, J.E. "Summary of Existing Information on the Human Reaction to Vibration." BSRA Rep. No. 28, 1949.
- SUHARA, JIRO. "On the Stiffening Effect of the Parallel Bar-Stiffener Against the Free and Forced Vibrations of Plane Plates." JSNAJ, Vol. 78. 1947.
- VASTA and PALERMO "An Engineering Approach to Low-Cycle Fatigue of Ship Structures." TR 1965.
- YAO, J.T.P., and MUNSE, W.H. "Low-Cycle Fatigue Behavior of Axially Loaded Specimens of Mild Steel." SSC-151. June, 1953.

## VI. MISCELLANEOUS

- BELL, A. "The Influence of Ship's Length on Vertical Wave Bending Moment."BSRA Report NS 138.
- BOURCEAU, G. and VOLEY, G.C. "Forced-Vibration Resonators and Free Vibration of the Hull." <u>International Shipbuilding</u>
  Progress. July and August 1971.
- BUCHMAN, ERICH. "Vibration Measurements on Vessel 86-1 During Acceptance Trials." Report 1297. February 1959.
- BUDIANSKY, BERNARD and FRALICH, ROBERT, W. "Effects of Panel Flexibility on Natural Vibration Frequencies of Box Beams." NACA TN 3070., March 1954.
- "Calculation of Natural Frequency and Vector Sum by Torsional Vibration, Holzer Method." Technical University of Norway, Report No. IF/M3. In Norwegian.
- CARMICHAEL, T.E. "Investigation into the Vibration of Ship's Plating." BSRA Rep. 278; 279; 305; 306.
- CHIOCCO, M.J., and NUMATA, E. 'Midship Wave Bending Moments in a Model of the Cargo Ship 'Wolverine State' Running at Oblique Headings in Regular Waves.'' SSC-201.
- CLEARY, W. et al. "The Results and Significance of the Strength Studies on the Great Lakes Bulk Ore Carrier 'Edward L. Ryerson'." SNAME Publication.
- COLEMAN, THOMAS L. et al. "An Evaluation of Effects of Flexibility on Wing Strains in Rough Air for a Large Swept-Wing Airplane by Means of Experimentally Determined Frequency-Response Functions with an Assessment of Random-Process Techniques Employed." NACA TN 4291. July,1958.
- CRAGIN, J.Q. "Ship Response Instrumentation Aboard the Container Vessel S.S. Boston: Results from Two Operational Seasons in North Atlantic Service." SSC-214.
- CRAWFORD, L., and RUBY, W.J. "Model Tests on Hull-Deck-Mouse Interaction." SSC-67.
- DALZELL, J.F. "An Investigation of Midship Bending Moments Experienced in Extreme Regular Waves by Models of the Mariner Type Ship and Three Variants." SSC-155.
- . "An Investigation of Midship Bending Moments

  Experienced in Extreme Regular Waves by Models of a Tanker and a Destroyer." SSC-156.

- . "Summary of Investigation of Midship Bending

  Moments Experienced by Models in Extreme Regular Waves."

  SSC-157.
- "Design of Marine Machinery Foundation." SNAME LS-NE January 1962.
- DIEUDONNE, J. "Vibration Miscellaneous Discussions." <u>Proceedings</u>
  Third. ISSC. Oslo. 1967.
- EFTRING, N. "Vibration Measurements on Three Tankers." Publication Swedish Ship Research Foundation.
- EGELAND, O. and JOHANSSON, P.I. "User's manual NV 461, Thin-Shell Vibration." First draft. Det norske Veritas, Oslo. To be published in 1971.
- EVANS, J.H. "Review of Past Structural Studies Related to the Ship and Ship Components and for Determining Loads and Strains on Ships at Sea." SSC-62.
- "Experimental Study on Vibration Prevention of Hull and Main Engine."
  Published by Committee SR-94, Report No. 60-1, 1966; Report
  No. 71-1, 1967.
- FAIN, R.A. et al. "Ship Response Instrumentation Aboard the Container Vessel 'S.S. Boston: Results from the 1st Operational Season in North Atlantic Service." SSC-212.
- "Fourth International Ship Structures Congress, Tokyo," 1969. (a)
  Wave Loads, Hydrodynamics, Report of Committee 2: (b) Sea
  Loads -- Full Scale, Report of Committee 3.
- FRALICH, ROBERT, W. and HEDGEPETH, JOHN, M. "Flutter Analysis of Rectangular Wings of Very Low Aspect Ratio." NACA TN 4245. June 1958.
- FRITCH, D.J. "Preliminary Analysis of Bending-Moment Data from Ships at Sea." SSC-153.
- FUJITA, SUMIO and OTAKA, KATSUO ''On the Vibration of the Double Bottom in Motor Ship.'' JSNA Seibu. Vol. 23. 1961.
- GOODRICH, G.J. "The Preduction of the Long-Term Distribution of Ship Bending Moments from Model Tests." Trans. RINA, Vol. 82.
- GRIM, O. and SCHENZLE, P. "The Influence of Ship Speed on Torsional Moment, Lateral Bending Moment and Laternal Shear Force in Oblique Waves." Forschungszentrum Des Deutschen Schiffbaus, Report No. 7/1969. In German.

- HART, H.H. "Hull Vibrations of the Cargo Liner Koudekert." International Shipbuilding Progress.
- HIROWATARI, T. and MATSUMOTO, K. "Fore-and-Aft Vibration of Superstructure Loaded at Aftership." Selected Papers from JSNAJ, Vol. 2.
- HIROWATARI, T. "Magnification Factors in the Higher Modes of Ship Vibrations." JSNAJ Vol. 113. June 1963
- HOFFMAN, D. and LEWIS, E.V. "Analysis and Interpretation of Full-Scale Data on Midship Bending Stresses of Dry Cargo Ships." SSC-196.
- HOFFMAN, D. "Analysis of Ship Structural Loading in a Seaway." SNAME. Publication, 1971.
- . "Wave-Induced Bending Moments on Great Lakes Ore Carriers." SNAME Publication.
- HYLARIDES. "Lowest Natural Frequencies of Structures with Rigid-Body Degrees of Freedom." JSR. June, 1968.
- IRWIN, L.K. and CAMPBELL, W.R. "Tensile Tests of Large Specimens Representing the Inter-section of a Bottom Longitudinal with a Transverse Bulkhead in Welded Tankers." SSC-68.
- JAN, H.Y. "Feasibility of Measuring Strains Corresponding to Bending Moments with Several Inflection Paints." SNAME T&R Report R-5.
- JOHNSON, A.J. and AYLING, P.W. ''On the Vibration Amplitudes of Ship's Hulls.'' Trans. Inst. Engrs. & Shipbuilders in Scotland. 1962.
- JOHNSON, A.J. and AYLING, P.W. "Some Observations on Local Vibration." Trans. Inst. Engrs. & Shipbuilders in Scotland.
- KANAZAWA, TAKESHI. "On Same Problems Concerning the Local Vibration of Ship." JSNAJ Vol. 86. 1953.
- KAPLAN, P. "Development of Mathematical Models for Describing Ship Structural Response in Waves." SSC-193.
- KAPLAN, P. et al. "An Investigation of the Utility of Computer Simulation to Predict Ship Structural Response in Waves." SSC-197.
- KAWAKAMI, MASUO. "On the Vibration of the Transverse Section of the Ship." 3rd Report. JSNA Seibu. Vol. 21. 1961.

- KAWAKAMI, MASAO. "On the Vibration of the Transverse Section of the Ship." 1st Report. JSNA Seibu. Vol. 19. 1960.
- KITO, FUMIKI "On Vibration of Thin Cylindrical Shell Immersed in Water and Subjected to an Action of Static and Impulsive Pressure." Part 1, Theoretical Consideration. JSNAJ Vol. 101. 1960.
- . "On Vibration of a Rectangular Tank Filled with Water." JSNAJ Vol. 106. 1960.
- \_\_\_\_\_. "On Vibration of a Rectangular Tank Filled with Water."

  JSNAJ Vol. 109. June 1961
- KMIECIK, M. "What About the Ship Vibration Limitation?" Ship Research Institute of Norway, Report M93.
- KORVIN-KROUKOVSKY, B.V., Prof. "Theory of Seakeeping." SNAME 1961.
- KROHN, A. "Strain Measurements on a Container Ship During a Round Trip Europe-Australia." Forschungszentrum Des Deuischen Schiffbaus. In German.
- KUMAI, TOYOJI "Some Notes on the Local Vibrations of Ships." Rep. Res. Inst. Applied Mech. Kyushu Univ. Vol. 12. 1950.
- JSNA Seibu. Vol. 7. 1953.
- . "Some Notes on the Local Vibrations of Ships." <u>International</u>
  Shipbuilding Progress. 1956. pp. 588-590.
- \_\_\_\_\_. "Vibrations, Miscellaneous Discussions." <u>Proceedings</u>
  Third ISSC. Oslo. 1967.
- KUO, C. "Review on Ship Vibration Problems -- Chairman's Contribution." Submitted to Third International Ship Structures Congress, Oslo. 1967.
- LITTLE, R. and FOLEY, J. "Observations on Great Lakes Bulk Carrier Strength Standards." SNAME Publication.
- LITTLETON RESEARCH AND ENGINEERING CORP. August 1970. "Propeller Stress Measurements and Hull-Vibration Measurements on S.S. Michigan, Final Repo-t, Part II, Analysis of Test Data, Display of Final Results, Discussion and Conclusions."

- MC GOLDRICK, R.T. "Determination of Hull Critical Frequencies on the Ore Carrier S.S. E.J. Kulas by Means of a Vibration Generator." DTMB Report 762. June, 1951.
- Determined Natural Frequencies and Modes of Vibration of Ships." DTMB. 1954.
- MC GOLDRICK, R.T. and RUSSO, V. 'Hull Vibration Investigation on S.S. Gopher Mariner.' SNAME. 1955.
- MANIAR, N.M. "Investigation of Bending Moments Within the Midship Half Length of a Mariner Model in Extreme Waves." SSC-163.
- MANIAR, N.M. and NUMATA, E 'Bending-Moment Distribution in a Mariner Cargo Ship Model in Regular and Irregular Waves of Extreme Steepness.' SSC-190.
- MATHEWS, S.T. "The Great Lakes Load Lines Main Hull -- 1968 Strength Standard." SNAME Publication.
- "Main Hull Girder Loads on a Great Lakes Bulk Carrier."

  SNAME Spring Meeting. 1967.
- MEREGA, F. "The Behaviour of Ships in Confused Sea." Publication of Registro Italiano Navale.
- . "The Wave Bending-Moment Distribution Along the Hull." Registro Italiano Navale.
- MICHAILIDIS, M. and NUMATA, E. "Bending-Moment Experiments in Waves on Some Great Lakes Bulk Carrier Models." SNAME Publication.
- MILES, J. and THOMSON, W.T. "Statistical Concepts in Vibration."
  Shock and Vibration Handbook. Edited by Harris and Crede
  New York: McGraw-Hill, 1961.
- MINSON, A.R. "Some Notes on Vibration Problems." Lloyd's Register of Shipping, Publication No. 36.
- NOZAKI, M., et al. "Transmission of the Vibrational Waves in Periodical Structure." **JSNAJ.**, Vol. 125. In Japanese. June 1969.
- NUMATA, E. and YONKERS, W.F. 'Midship Wave Bending Moments in a Model of the Mariner-Class Cargo Ship "California Bear' Running at Oblique Headings in Regular Wares." SSC-202.
- "Observing and Forecasting Ocean Waves." Hydrograph Office Publication No. 603-1955.

- OCHI. "Performance of Two Hull Forms (U and V) in Irregular Waves." October, 1967.
- OGILVIE, T.F. "Theory of Ship Vibrations I." Lecture notes, Department of Naval Architecture and Marine Engineering, The University of Michigan. Winter Term, 1968.
- OKABE, TOSHIMASA et al. "Some Measurements of Natural Frequencies on Diesel Cargo Ship." Rep. No. 1, <u>JSNA Seibu.</u> Japan Vol. 6. 1953.
- Diesel Cargo Ship." Rep. No. 1, JSNA Seibu Vol. 7. 1953.
- \_\_\_\_\_\_. "On the Vibration Measurement on Super Tanker."

  JSNA Seibu. Vol. 11. 1956
- ORMONDROYD, J. et al. "Dynamics of a Ship's Structure." Final Report on Project M670-4. University of Michigan, Ann Arbor. June, 1951.
- PLOEG, J. "Wave Climate Study; Great Lakes & Gulf of St. Lawrence." SNAME T&R Bulletin 2-17.
- RAMSAY, J.W. "Aspects of the Vibration Induced by Twin Propellers." TINA. Vol. 98. 1956.
- SADLER, H.C. and LINDBLAD, A. "Stresses on Vessels of the Great Lakes due to Waves of Varying Lengths and Heights." SNAME 1922.
- "Seaway Stresses Observed Aboard the Great Lakes Bulk Ore Carrier 'Edward L. Ryerson'." SNAME T&R Bulletin 2-18.
- SEZAWA, KATSUTADA ''The Effect of Difference in the Position of Engine Room on Ship Vibrations.'' JSNAJ Vol. 57. June 1935
- SEZAWA, KATSUTADA and KANAI, KIYOSHI "The Effect of Stiffness of Engine Beds on Ship Vibrations." JSNAJ, Vol. 64. December 1938
- SHIMIZU, S. et al. "On the Dynamical Stress Distribution of Stiffened Plate at Vibration and On the Effectiveness of Stiffened Plate." JSNAJ. Vol. 124. In Japanese. December 1968.
- SMITH "Bending, Buckling and Vibration of Orthotrapic Plate-Beam Structures." JSR December, 1968.
- Stevens Institute of Technology <u>Proceedings of the First Conference</u>
  On Ship Vibration. Hoboken, New Jersey. <u>January</u>, 1965.
- SUETSUGA, I. "The Effects of the Bottom Vibration on the Hull Natural Frequencies." <u>International Shipbuilding Progress</u>, Vol. 10. Sept. 1973.

- SUHARA, T. 'Vibration Experiments on Box Beams.' Ship Structure Committee Report. JANA Seibu. 32-12-1/1, 33-12-1/1 and 34/12/1/1.
- TOMITA, TETSUJIRO "The Effect of Shallow Water Upon the Natural Frequencies of Hull." JSNAJ Vol. 107. June 1960.
- "Torsional Rigidity of Box Beams Having Multiple Cut-Outs." JSR. Vol. 1, No. 4. March, 1958.
- VEDELER, G. A Naval Architects Reflections on some Research Problems with Ship Steel." SSC-140.
- WALTERS, I.J. and BAILEY, F. C. "Results from Full-Scale Measurements of Midship Bending Stresses on Three Dry Cargo Ships."
- WATANABE, Y. "On the Possible Causes of Stern Vibration." JSNA West Japan, Vol. 10. 1960.
- YAGLE. "Long-Term Strain Measurements on a Great Lakes Ore Carrier." SNAME LS-GL. October 1963.
- YAMAMOTO. YOSHIYUKI. "On the Vibration of the Double Bottoms. JSNAJ, Vol. 83. February 1951.
- YAMANOUCHI, Y. "On the Considerations of the Statistical Analysis of Ship Response in Waves." Selected Papers from JSNAJ Vol. 3. 1969.
- YOSHIKI, MASAO et al. "On the Effect of Variation of the Position of Engine to the Flexural Vibration of Ships." JSNAJ Vol. 78. October 1947.

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- SSC-241, Thermoelastic Model Studies of Cryogenic Tanker Structures by H. Becker and A. Colao. 1973. AD 771217.
- SSC-242, Fast Fracture Resistance and Crack Arrest in Structural Steels by G. T. Hahn, R. G. Hoagland, M. F. Kanninen, A. R. Rosenfield and R. Sejnoha. 1973. AD 775018.
- SSC-243, Structural Analysis of SL-7 Containership Under Combined Loading of Vertical, Lateral and Torsional Moments Using Finite Element Techniques by A. M. Elbatouti, D. Liu and H. R. Jan. 1974. AD A002620
- SSC-244, Fracture-Control Guidelines for Welded Steel Ship Hulls by S. T. Rolfe, D. M. Rhea, and B. O. Kuzmanovic. 1974. AD A004553
- SSC-245, A Guide for Inspection of High-Strength Steel Weldments by The Weld Flaw Evaluation Committee. (To be published).
- SSC-246, Theoretical Estimates of Wave Loads on the SL-7 Containership in Regular and Irregular Seas by P. Kaplan, T. P. Sargent and J. Cilmi. 1974. AD A00 4554
- SSC-247, Flame Straightening Quenched-And-Tempered Steels in Ship Construction by R. L. Rothman. 1974. AD A 002621
- SSC-248, Fracture Toughness Characterization of Shipbuilding Steels by J. R. Hawthorne and F. J. Loss. 1975.
- SSC-249, Ship Vibration Prediction Methods and Evaluation of Influence of Hull Stiffness Variation on Vibratory Response by R. G. Kline and J. C. Daidola. 1975.

#### SL-7 PUBLICATIONS TO DATE

- SL-7-1, (SSC-238) Design and Installation of a Ship Response Instrumentation System Aboard the SL-7 Class Containership S.S. SEA-LAND McLEAN by R. A. Fain. 1973. AD 780090.
- SL-7-2, (SSC-239) Wave Loads in a Model of the SL-7 Containership Running at Oblique Headings in Regular Waves by J. F. Dalzell and M. J. Chiocco. 1973. AD 780065.
- SL-7-3, (SSC-243) Structural Analysis of SL-7 Containership Under Combined Loadings of Vertical, Lateral and Torsional Moments Using Finite Element Techniques by A. M. Elbatouti, D. Liu and H. Y. Jan. 1974.
- SL-7-4, (SSC-246) Theoretical Estimates of Wave Loads on the SL-7 Containership in Regular and Irregular Seas by P. Kaplan, T. P. Sargent and J. Cilmi. 1974.