

# The Proceedings of The Ninth (1999) International OFFSHORE AND POLAR ENGINEERING CONFERENCE

**Brest, France, May 30–June 4, 1999**

**VOLUMES I, II, III, IV, 1999**

---

Copyright © 1999 by International Society of Offshore and Polar Engineers,  
Golden, Colorado, USA. All Rights Reserved.

[www.isopec.org](http://www.isopec.org); [meetings@isopec.org](mailto:meetings@isopec.org)

For set of 4 volumes; 3,060 pp.

ISBN 1-880653-39-7: ISSN 1098-6189 (Set)

Indexed by Engineering Index, Compendex and Others

[www.isopec.org](http://www.isopec.org): [orders@isopec.org](mailto:orders@isopec.org)

**International Society of Offshore and Polar Engineers (ISOPE)**  
**P.O. Box 189, Cupertino, California 95015-0189 USA**



**International Society of  
Offshore and Polar Engineers**

# The Proceedings of The Ninth (1999) International OFFSHORE AND POLAR ENGINEERING CONFERENCE

Brest, France, May 30–June 4, 1999

VOLUME I, 1999

---

Technology Review, Mobile Offshore Base (MOB), Very Large Floating Structures (VLFS), Ocean Energy and Resources, Offshore Systems and Design, FPSO, TLP and SPAR,  
Remote Sensing, Environment and Database, Geotechnical Engineering and Environment

## How to Use This Table of Contents

Scroll down or use the bookmarks in the left-side frame to move to a new location in this index. Click on a **blue paper title** you like to view.

To return to this index after viewing a paper, click on PREVIOUS MENU bookmark in the left-side frame.

This CD-ROM is created from the PDF files. The hard-copy originals in the proceedings are scanned and saved as PDF files. View quality of the text and graphics, the searchability and the ease of readability depend largely on the quality and/or consistency of the originals.

Copyright © 1999 by International Society of Offshore and Polar Engineers,  
Golden, Colorado, USA. All Rights Reserved.

[www.isopec.org](http://www.isopec.org); [meetings@isopec.org](mailto:meetings@isopec.org)

For set of 4 volumes; 3,060 pp.

ISBN 1-880653-39-7: ISSN 1098-6189 (Set)

Indexed by Engineering Index, Compendex and Others

[www.isopec.org](http://www.isopec.org); [orders@isopec.org](mailto:orders@isopec.org)

edited by:

Jin S. Chung, Colorado School of Mines, USA  
Tomatsu Matsui, Osaka University, Japan  
Wataru Koterayama, Kyushu University, Japan

presented at:

The Ninth (1999) International Offshore and Polar Engineering Conference held in Brest, France,  
May 30–June 4, 1999

organized by:

International Society of Offshore and Polar Engineers

sponsored by:

International Society of Offshore and Polar Engineers (ISOPE)  
with cooperating societies and associations

The publisher and the editors of its publications assume no responsibility for the statements or opinions expressed in papers or presentations by the contributors to this conference or proceedings.

**International Society of Offshore and Polar Engineers (ISOPE)**  
**P.O. Box 189, Cupertino, California 95015–0189 USA**

## CONTENTS

### OFFSHORE RESOURCE & TECHNOLOGY

#### TECHNOLOGY REVIEW

#### **Mega Float: Achievements to Date and Ongoing Plan of Research**

*Kiyoshi Inoue* ..... 1

#### **Mobile Offshore Base: Research Spin-Offs**

*Robert Zueck, Paul Palo and Robert Taylor and Gene Remmers* ..... 10

#### **Research on Hydroelastic Responses of VLFS: Recent Progress and Future Work**

*Masashi Kashiwagi*..... 17

### MOBILE OFFSHORE BASE (MOB) AND VERY LARGE FLOATING STRUCTURES (VLFS)

#### **Fast Hydrodynamic Analysis of Large Offshore Structures**

*Tom Korsmeyer, Tom Klemas, Jacob White and Joel Phillips* ..... 27

#### **Principal Design Concept for 1000-m Class Floating Experimental Model**

*Shigeto Shibuta, Masaharu Kado, Hiroshi Negayama and Chiaki Sato* ..... 35

<b>Elastic Response Reduction of Large Floating Structures by Tuning Wet Mode Shapes</b> <i>Masashi Inoue, Yasuo Tanaka and Takuji Hamamoto</i> .....	43
<b>Development of Visual Simulation Technique for Elastic Behavior of a Mega-Float Using Computer Graphics</b> <i>Tetsuro Ikebuchi, Nobuo Nagamatsu and Takayuki Taketomi</i> .....	51
<b>Prediction of Marine Environmental Change by Installation of Mega-Float in a Bay</b> <i>Hiroyuki Nakagawa and Hideyuki Omori, Akio Hikai and Yusaku Kyojuka</i> .....	57
<b>A Study on Compressional Wave Field in Seawater Caused by Vibrated Floating Body</b> <i>Y. Higo, D. Ishihara, K. Kokubun and H. Ando</i> .....	65
<b>A Coordinated DP Control Methodology for the MOB</b> <i>K. Hedrick, A. Girard and B. Kaku</i> .....	70
<b>Experimental Study on Dynamic Positioning Control for Semi-Submersible Platform</b> <i>Tadahiro Hyakudome, Masahiko Nakamura, Hiroyuki Kajiwara, and Wataru Koterayama</i> .....	76
<b>Optimum Allocation for Multiple Thrusters</b> <i>William C. Webster and João Sousa</i> .....	83
<b>Analytical Performance Study of Suction Piles in Sand</b> <i>S. Bang and Y. Cho</i> .....	90
<b>A Consideration on Dispersion Relation of Hydroelastic Wave and Dynamic Response of VLFS in Regular Waves</b> <i>T. Tsubogo and H. Okada</i> .....	94
<b>OCEAN ENERGY AND RESOURCES</b>	
<b>Motion Analysis of a Towed Collector for Manganese Nodule Mining in Ocean Test</b> <i>Hironori Yasukawa, Kunihiro Ikegami and Tohru Minami</i> .....	100
<b>Axial-Stress Control of Pipe String for Mining Manganese Nodules in Deep Sea by Using Multi-Stepped Pipe</b> <i>Gang Cui, Kazuo Aso and Hitoshi Doki</i> .....	108
<b>Determination of Safe Parameters of Mining Deposits on Shelf Applying Hydraulic Mining with Holes</b> <i>Yuriy N. Niskovskiy and Elena V. Niskovskaya and Anatoliy M. Vasianovitch</i> .....	116
<b>The Main Principles and Parameters of the Project of Marine Dressing Complex for the Industrial Development of the Continental Shelf Deposits</b> <i>Anatoly V. Zhukov and Vladimir T. Lutsenko</i> .....	119
<b>Experiments on the Characteristics of Darrieus Turbine for the Tidal Power Generation</b> <i>M. Shiono, K. Suzuki and S. Kiho</i> .....	123
<b>Wave Energy Prospects</b> <i>N. W. Bellamy</i> .....	129
<b>Installation of the New Pendolor for the 2<sup>nd</sup> Stage Sea Test</b> <i>Tomiji Watabe, Hirotaka Yokouchi, Hideo Kondo, Masaru Inoya and Mamoru Kudo</i> .....	133

<b>Performance Studies on a Scaled Model of Backward Bent Ducted Buoy (BBDB) Type Wave Energy Converter in Regular and Random Waves</b> <i>Ardhendu G. Pathak, V. Anantha Subramanian and Yoshio Masuda</i> .....	139
<b>Development of Backward Bent Duct Buoy (BBDB)</b> <i>Yoshio Masuda, Toshiari Kuboki, M. Ravindrum, A.G. Pathak, V. Jayashankar and Xianguang Liang</i> .....	142
<b>Research on Fundamental Performance of Multi-Floats Type Wave Energy Conversion System</b> <i>T. Saito, K. Hadano, N. Murakami and T. Ozaki</i> .....	150
<b>A Study of a Wave and Wind Energy Hybrid Conversion System _ Part 2: Output Characteristics of the Double Type Wave Energy Converter</b> <i>Taichi Matsuoka, Kenichiro Ohmata, Tomichika Mizutani and Noboru Kojima</i> .....	156
<b>Guide Vanes Effect of Wells Turbine for Wave Power Generator</b> <i>M. Suzuki and C. Arakawa</i> .....	162
<b>The Effect of Rotor Blade Shape on the Performance of the Wells Turbine</b> <i>M. Webster and L.M.C. Gato</i> .....	169
<b>Reinforced Rubber Membranes for the Clam Wave Energy Converter</b> <i>L.J. Duckers</i> .....	174
<b>Study on an Impulse Turbine for Wave Energy Conversion</b> <i>T. Setoguchi, M. Takao, Y. Kinoue, K. Kaneko, S. Santhakumar and M. Inoue</i> .....	180
<b>A 3D Boundary Element Code for the Analysis of OWC Wave-Power Plants</b> <i>A. Brito-Melo, A.J.N.A. Sarmiento, A.H. Clément and G. Delhommeau</i> .....	188
<b>Structural-Aerodynamic Coupling for Wells Turbine Blades</b> <i>R. Curran, J.A.P. de Visser and A. Rothwell, and S.G. Sterling</i> .....	196
<b>Turbine Modelling and Analysis Using Data Obtained from the Islay Wave-Power Plant</b> <i>R.G. Alcorn, W.C. Beattie and R. Douglas</i> .....	204

## OFFSHORE SYSTEMS AND DESIGN

<b>Upgrading of a Semi-Submersible Platform to a Dynamically Positioned Drilling Unit to Operate in 2500-m Water Depth</b> <i>Carlos Alberto Bardanachvili, Aldemir Bonfim dos Santos, Alexandro Voronoff, Robert Paschoalin, Luciano de Almeida Campos and Andréa Sampaio Pitta</i> .....	210
<b>Design Analysis of Offshore Stabbing Guide</b> <i>Chul H. Jo, B.K. Woo and Sung G. Hong</i> .....	218
<b>Characteristics Study of Hydrocyclone Used for Separating Polymer-Flood Produced-Water</b> <i>Zunce Wang, Lixin Zhao, Feng Li, Jie He, and Lei Chen</i> .....	226
<b>Smart Technology Applications in Offshore Structural Systems: Status and Needs</b> <i>Hari B. Kanegaonkar</i> .....	231

<b>Systematic Design for Offshore Oilfield Development</b> <i>Celso Kazuyuki Morooka and Yadira Diaz Galeano</i> .....	237
<b>Stirling Machine Technology for Subsea Intervention</b> <i>G.T. Reader and I.J. Potter</i> .....	244
<b>FPSO, TLP AND SPAR</b>	
<b>Linear and Non-Linear Wave Loads on FPSOs</b> <i>F. Blandeau, M. François, Š. Malenica and X.B. Chen</i> .....	252
<b>Influence of the Wave-Current Interaction on Drift Loads in FPSO</b> <i>M.R. Martins, H.L. Brinati, J.A.P. Aranha and A.J.P. Leite</i> .....	259
<b>FPSO-Turret System Stability and Wave Heading</b> <i>André Jacques de Paiva Leite, Alexandre Nicolaos Simos, Eduardo Aoun Tannuri and Celso Pupo Pesce</i> .....	265
<b>Environmental Design Criteria for a TLP in Cyclonic Conditions</b> <i>S.A. Higgins and J.B. Hinwood</i> .....	273
<b>Noise and Vibration: Computational Analysis Applied to Offshore Platforms and FPSOs</b> <i>Marcelo Fernandes Mendes, Marcus Alves da Silva França, Ernani Luis Sztajnbok and Wallace Moreira Bessa</i> .....	279
<b>Wavelet Ridge Analysis of Nonlinear Dynamic Spar Responses</b> <i>David C. Weggel, Donald A. Jordan, Jose M. Roesset and Richard W. Miksad</i> .....	285
<b>Coupled Time-Domain Analysis of the Response of a Spar and Its Mooring System</b> <i>X.H. Chen and J. Zhang and W. Ma</i> .....	293
<b>Hull/Mooring Coupled Dynamic Analysis of a Truss Spar in Time-Domain</b> <i>M.H. Kim, Z. Ran and W. Zheng, S. Bhat and Pierre Beynet</i> .....	301
<b>Dynamic Motion of TLP with Wave-Large Body and Wave-Small Body Interactions</b> <i>Hsien Hua Lee, Wen-Sheng Wang and Pei-Wen Wang</i> .....	309
<b>Nonlinear and Non-Gaussian Effects on TLP Tether Responses</b> <i>J. Zou, E.W. Huang and C.H. Kim</i> .....	315
<b>Surge Motion of Tension Leg Platform with Underwater Net Systems</b> <i>Hsien Hua Lee and Pei-Wen Wang</i> .....	325
<b>Active/Passive Control of Heave Motion for TLP Type Offshore Platform</b> <i>Rosane M. Alves and Ronaldo C. Batista</i> .....	332
<b>Integrated Vessel Motion and Mooring Analysis Applied in Hybrid Model Testing</b> <i>Harald Ormberg, Carl Trygve Stansberg, Rune Yttervik, and Gudmund Kleiven</i> .....	339
<b>Experiments and Analysis with Fully Coupled Mini-TLP/Barge System</b> <i>P. Teigen and J.M. Niedzwecki</i> .....	347
<b>An Experimental Study on Roll Damping for Tanker-Based FPSO</b> <i>I.K. Park, H.S. Shin, K.S. Ham and J.W. Cho</i> .....	355

<b>Comparative Study of Numerical Simulation and the Experimental Results for a Parallely Connected FPSO and LNG in Waves</b> <i>Yoshiyuki Inoue and Islam, M.R.</i> .....	360
---	-----

<b>Yawing of Turret Moored Vessels: Experimental Methods</b> <i>D.T. Brown and F. Liu</i> .....	368
--	-----

## REMOTE SENSING AND ENVIRONMENT

<b>Deep-Sea Environment and Impact Experiment to It</b> <i>T. Yamazaki, and Y. Kajitani</i> .....	374
--	-----

<b>Investigating the Effect of Seasonal Plant Growth and Development in 3-Dimensional Atmospheric Simulations</b> <i>E. Tsvetsinskaya, L.O. Mearns, and W.E. Easterling</i> .....	382
--	-----

<b>Formation of Oil Drops Discharged Underwater</b> <i>Museok Song, Shunji Homma, and Keyyong Hong</i> .....	390
---	-----

<b>Development of a Database Characterising Waste Released from Drilling Operations</b> <i>L.J. Carles, I.G. Bryden and M.B. Oyeneyin</i> .....	397
--	-----

<b>Digital Image Investigation on the Short Term Fate of Offshore Discharges of Produced Water</b> <i>Bao-Shi Shiau and Chi-Jou Hong</i> .....	402
---	-----

<b>On the Stimulation of the Tidal Exchange of an Enclosed Coastal Sea</b> <i>Yusaku Kyojuka and Tadaaki Shima</i> .....	406
---	-----

<b>Information-Analytical System on the Black Sea Environmental Conditions</b> <i>Alexander S. Tsvetsinsky, Valentin S. Tuzhilkin, Nicolay N. Mikhailov</i> .....	413
--	-----

<b>Environmental Atlas of the White Sea</b> <i>Vladimir Lukanin, Lars-Henrik Larsen and Alexei Bambulyak</i> .....	418
---	-----

<b>On Slowly-Drifting Sea Ice with a Corrugated Underside</b> <i>Jan Erik Weber and Jens Debernard</i> .....	426
---	-----

<b>Applications of Satellite Data for Coast Monitoring</b> <i>Antony K. Liu, Sunny Y. Wu, Gregory H. Leonard, Ming-Kuang Hsu</i> .....	434
---	-----

<b>A Volterra Model for the Study of Wave-Current Interaction as Described by the Action Balance Equation</b> <i>Jordi Inglada and René Garello</i> .....	441
--	-----

## GEOTECHNICAL ENGINEERING

### SOIL PROPERTIES

<b>Investigation on the Moisture Retention Characteristics of Lowland Expansive Soils</b> <i>Taghi Ebadi and Maria Elektorowicz</i> .....	447
--	-----

<b>Determining and Monitoring Presence of Contaminants in Ocean Environment</b> <i>Abidin Kaya</i> .....	451
---	-----

<b>The Effect of Shear Bands within Backfill on the Development of Passive Thrust Against Retaining Walls</b>	
<i>Hemanta Hazarika, Juichi Nakazawa, Hiroshi Matsuzawa, and Dawit Negussey</i> .....	457
<b>Numerical Analysis of Seawater Intrusion in Coastal Area</b>	
<i>T.B. Ahn, B.W. Shin</i> .....	464
<b>Determination of Critical Slip Surface Using Finite Element Method</b>	
<i>T.B. Ahn</i> .....	472
<b>SOIL AND ROCK MECHANICS</b>	
<b>Shear Strength Characteristics of Undisturbed and Disturbed Marine Clays in Japan</b>	
<i>Mitsuhiko Mukaitani, Emi Ichinose, Ryuichi Yatabe and Norio Yagi</i> .....	480
<b>Thermo-Viscoplastic Modeling of Temperature Dependent Behavior of Clays</b>	
<i>Nobuharu Abe</i> .....	485
<b>Behavior of Earth and Water Pressures and Deformation in Freezing Soft Clay Ground</b>	
<i>Satoshi Fukui, Tomio Tamano, Satoshi Ono, and Tamotsu Matsui</i> .....	492
<b>SOIL CONSOLIDATION</b>	
<b>Modified Consolidation Test Apparatus</b>	
<i>Ahmet Tuncan, Mustafa Tuncan and Yucel Guney</i> .....	498
<b>The Analysis of Constant Rate of Consolidation Test</b>	
<i>Robert Y.P. Chin and D.Y. Sheu</i> .....	502
<b>Technical Problems in the One-Dimensional Consolidation of Cohesive Soils under Varying Temperature</b>	
<i>Masayoshi Shimizu</i> .....	510
<b>A Neural Network Expert System Developed for Predicting the Ground Settlement and the Damage Assessment of Adjacent Structures Due to Tunnel Excavation</b>	
<i>C.Y. Kim, G.J. Bae, S.W. Hong, H.K. Moon, and M.Y. Oh</i> .....	514
<b>SOIL DYNAMICS</b>	
<b>A Random-Walk Model for Pore Pressure Accumulation in Marine Soils</b>	
<i>B. Mutlu Sumer and Nian-Sheng Cheng</i> .....	521
<b>Dynamic Properties and State Parameter of Sand</b>	
<i>Yao-Chung Chen and Ting-Shing Liao</i> .....	529
<b>Degradation in Cyclic Shear Behavior and Soil Properties of Saturated Clays</b>	
<i>T. Matsui, Y. Nabeshima and M.A. El Mesmary</i> .....	536

## SOIL LIQUEFACTION

<b>Effect of Principal Stress Direction on Undrained Cyclic Shear Behaviour of Dense Sand</b> <i>Ken-ichi Sato and Nobuo Yoshida</i> .....	542
<b>Cyclic Loading Behaviour of Fine-Grained Calcareous Soils: Effect of Mean and Cyclic Stress Level</b> <i>X. Mao, M. Fahey and M.F. Randolph</i> .....	548
<b>Elasto-Plastic Behaviour of Sandy Seabed to Standing Wave Loading</b> <i>Ali Noorzad and H.B. Poorooshasb</i> .....	556
<b>Liquefaction Properties of Well Graded Coarse Fill Materials</b> <i>Yasuo Tanaka</i> .....	562
<b>Mine Burial Due to Wave-Induced Liquefaction and Other Processes</b> <i>H.G. Brandes</i> .....	568

## SOIL IMPROVEMENT

<b>Effects of Pre-Cyclic Loading on Strength Resistance and Liquefaction Induce Settlement of Reclaimed Soil</b> <i>L.K. Chien and Y.N. Oh</i> .....	575
<b>A Study on Discharge Capacity and Efficiency of Consolidation Drainage for Cross-Shaped Vertical Drain</b> <i>Yeon-Soo Jang, Young-Woo Kim and Soo-Sam Kim</i> .....	583
<b>Electrokinetic Strengthening of Soft Marine Clays</b> <i>K.Y. Lo, S. Micic, J.Q. Shang, Y.N. Lee and S.W. Lee</i> .....	590
<b>Vertical-Horizontal Loading of Skirted Foundations Compared with Vertical-Torsional Loading</b> <i>M. Fahey, P.G. Watson and T. Tremain</i> .....	596
<b>Feasibility of Waste Lime Used in Land Reclamation Projects in Korea</b> <i>Eun C. Shin, Young-In Oh, and Braja M. Das</i> .....	604
<b>A Case Study of System Grouting Using 'ENPASOL' &amp; 'SINNUS'</b> <i>B.S. Chun, Y.S. Chae, B.H. Chung, and H.S. Choi</i> .....	608
<b>Deep Penetrating Anchor: Subseabed Deepwater Anchor Concept for Floaters and Other Installations</b> <i>Jon Tore Lieng, Frode Hove, and Tor Inge Tjelta</i> .....	613
<b>Calibration of Analytical Solution Using Centrifuge Model Tests on Mooring Lines</b> <i>S. Bang, R.J. Taylor, and H. Han</i> .....	620
<b>Use of Pile as Anchor: Numerical and Physical Approach</b> <i>D. Levacher and S. Belkhir</i> .....	625

## DEEP FOUNDATION

<b>Innovative Temporary Foundation System for Jacket Installation and Leveling</b> <i>D. Green and P. Jeanjean</i> .....	631
<b>Deep Foundation for Offshore Structure: The Kwang-An Grand Bridge</b> <i>S.Z. Park, G.H. Jeong, Tamotsu Matsui, Masaya Hirai, and Seiji Suwa</i> .....	639
<b>Deformation and Settlement Analysis of Foundation in Seawalls Using DDA</b> <i>Y.N. Oh, L.K. Chien, and S. Chen</i> .....	646
<b>Seismic Behavior of a Caisson Type Quay Wall on a Pile Foundation</b> <i>Tomoya Takatani, Yoshi-hiko Maeno, and Hirosuke Kodama</i> .....	652
<b>The Cyclic Pullout Capacity of Suction Caisson Foundations</b> <i>Sherif El-Gharbawy and Roy Olson</i> .....	660
<b>Dynamic Response of a Caisson on Pile Foundation Due to Wave Attack</b> <i>Yoshi-hiko Maeno, Tomiya Takatani, Shigeo Takahashi and Ken-ichiro Shimosako</i> .....	668
<b>Limiting Aspect Ratio for Suction Caisson Installation in Clay</b> <i>A.R. House, M.F. Randolph and M.E. Borbas</i> .....	676

## PILE FOUNDATION

<b>Driving Fatigue Damage Estimation for Ursa TLP 96" OD Piles</b> <i>Rupert J. Hunt, Jack H-C Chan and Earl H. Doyle</i> .....	684
<b>Pile Short-Term Capacity in Clays</b> <i>U.A.A. Mirza</i> .....	693
<b>Analysis of Open-Ended Piles Subjected to Multiple Hammer Blows Using a Large-Strain Finite Element Procedure</b> <i>D.S. Liyanapathirana, A.J. Deeks and M.F. Randolph</i> .....	700
<b>Tension Pile Foundation Analyses for Offshore Structures: A Comparison</b> <i>V. Silvestri, F. Murias and C. Tabib</i> .....	706
<b>Centrifuge and Numerical Modelling of Horizontally Loaded Suction Piles</b> <i>H.G.B. Allersma, A.A. Kirstein, R.B.J. Brinkgreve and T. Simon</i> .....	711
<b>A Study on Characteristics of Negative Skin Friction on Model Pile</b> <i>Kyu Hwan Lee, Min Bo Shim and Song Lee and Changtok Yi</i> .....	718
<b>Bearing Capacity of a Model Pile in Sand Under Different Loading Rates</b> <i>Abdullah I. Al-Mhaidib</i> .....	724

## SLOPE STABILITY

<b>Submarine Slope Failure in a Fluid Migration Environment Offshore Gabon</b> <i>F. Cayocca, P. Cochonat and J.-F. Bourillet, and P. Quéméneur</i> .....	731
<b>A Study on the Relationship Between Mechanical Properties and Microstructure of Ariake Clay</b> <i>Katsutada Onitsuka, Takehito Negami and Junan Shen</i> .....	739
<b>Heap Shape of Materials Dumped from Hopper Barges by Drum Centrifuge</b> <i>M. Miyake and T. Yanagihata</i> .....	745
<b>Sediment Concentration and Turbulent Boundary Layer of Wave-Induced Sheet Flow</b> <i>Tai-Wen Hsu and Hsien-Kuo Chang</i> .....	749

## ADDITIONAL PAPERS

<b>The Unstable Offloading of a FPSO</b> <i>S.H. Sphaier, S.H.S. Correa, and A.C. Fernandes</i> .....	756
<b>A Computational Study of Techniques for Reduction of Connection Forces in Large, Articulated, Semi-Submersible Ocean Structures</b> <i>Richard H. Messier, Eric Weybrant and Lawrence D. Thompson</i> .....	764
<b>Visualization of Simulations of Porous Media Flows in Oil Reservoirs Using Virtual Reality Techniques</b> <i>Carlos Luiz Nunes dos Santos, Luis Fernando Nunes Mello, Gerson Gomes Cunha and Luiz Landau</i> ..	771
<b>Offshore Engineering for Tidal Power</b> <i>Walt van Walsum</i> .....	777
<b>Particle Crushing and Undrained Shear Behaviour of Sand</b> <i>Masayuki Hyodo, Noritaka Aramaki, Yukio Nakata, Shogo Inoue, and Adrian F.L. Hyde</i> .....	785
<b>Research on Prediction Method for Time History Elastic Response of Very Large Floating Structure by Sea Shock Loads</b> <i>Koichi Masuda, Hisaaki Maeda, Hiroaki Takamura and Masatosi Bessho</i> .....	792
<b>The Effect of Soil Freezing and Thawing Behavior on Slope Stability</b> <i>Kuang-Jung Tsai, Huang-Yu Wang, Sheng-Chi Chen and Yu-Ming Sung</i> .....	800

# The Proceedings of The Ninth (1999) International OFFSHORE AND POLAR ENGINEERING CONFERENCE

Brest, France, May 30–June 4, 1999

VOLUME II, 1999

---

Offshore and Arctic Pipelines, Riser and Cable Mechanics, Fiber Rope Mooring,  
Underwater Vehicles and Robotics, Polar and Ice Engineering,  
Polar Environment, Atmospheric Icing

## How to Use This Table of Contents

Scroll down or use the bookmarks in the left-side frame to move to a new location in this index. Click on a **blue paper title** you like to view.

To return to this index after viewing a paper, click on PREVIOUS MENU bookmark in the left-side frame.

This CD-ROM is created from the PDF files. The hard-copy originals in the proceedings are scanned and saved as PDF files. View quality of the text and graphics, the searchability and the ease of readability depend largely on the quality and/or consistency of the originals.

Copyright © 1999 by International Society of Offshore and Polar Engineers,  
Golden, Colorado, USA. All Rights Reserved.

[www.isopec.org](http://www.isopec.org); [meetings@isopec.org](mailto:meetings@isopec.org)

For set of 4 volumes; 3,060 pp.

ISBN 1-880653-39-7: ISSN 1098-6189 (Set)

Indexed by Engineering Index, Compendex and Others

[www.isopec.org](http://www.isopec.org): [orders@isopec.org](mailto:orders@isopec.org)

edited by:

Jin S. Chung, Colorado School of Mines, USA

Robert MW Frederking, National Research Council Canada, Canada

Hiroshi Saeki, Hokkaido University, Japan

Hermann Moshagen, Statoil, Norway

Jose M Roesset, Offshore Technology Research Center, USA

presented at:

The Ninth (1999) International Offshore and Polar Engineering Conference held in Brest, France,  
May 30–June 4, 1999

organized by:

International Society of Offshore and Polar Engineers

sponsored by:

International Society of Offshore and Polar Engineers (ISOPE)  
with cooperating societies and associations

The publisher and the editors of its publications assume no responsibility for the statements or opinions expressed in papers or presentations by the contributors to this conference or proceedings.

**International Society of Offshore and Polar Engineers (ISOPE)**  
**P.O. Box 189, Cupertino, California 95015–0189 USA**

## CONTENTS

### PIPELINES

<b>Hotpipe Project: Design Guideline for High Temperature/High Pressure Pipelines</b> <i>Kim J. Mørk, Leif Collberg, Erik Levold and Roberto Bruschi</i> .....	1
<b>Hotpipe Project: Use of Analytical Models/Formulas in Prediction of Lateral Buckling and Interacting Buckles</b> <i>Maurizio Spinazzè, Luigino Vitali and Richard Verley</i> .....	9
<b>Hotpipe Project: Capacity of Pipes Subject to Internal Pressure, Axial Force and Bending Moment</b> <i>Luigino Vitali, Roberto Bruschi, Kim J. Mørk, Erik Levold and Richard Verley</i> .....	22
<b>Hotpipe Project: Snaking of Submarine Pipelines Resting on Flat Sea Bottom Using Finite Element Method</b> <i>Enrico Torselleti, Luigino Vitali, Erik Levold</i> .....	34
<b>Hotpipe Project: A Study of the Selection of Remedial Measures to Tackle/Control the Development of Excessive Bending</b> <i>Maurizio Spinazzè, Enrico Torselleti, Erik Levold</i> .....	46
<b>Controlled Lateral Buckling of Large Diameter Pipeline by Snaked Lay</b> <i>Rob Preston, Frank Drennan and Colin Cameron</i> .....	58
<b>Critical Aspects of Shell ETAP HP/HT Pipe-in-Pipe Pipeline Design and Construction</b> <i>B.S. Sahota, P. Ragupathy and R. Wilkins</i> .....	64
<b>Local Buckling and Plastic Collapse of Corroded Pipes with Yield Anisotropy</b> <i>Yong Bai, Søren Hauch and Jens C. Jensen</i> .....	74

<b>Influence of Variable Foundation and Cover Response on Vertical Buckling of Pipelines</b> <i>E.A. Maschner and L.A. Wood</i> .....	82
<b>Multi-Bundle Pipeline Installation Technique Applied to Yong-Jong Island</b> <i>Chul H. Jo</i> .....	89
<b>New Concept of Export Line for Deepwater Fields</b> <i>Jean-Luc Legras and Didier Traube</i> .....	96
<b>Oil Transport Alternatives from the Caspian Sea</b> <i>Deniz Güneş and Ove T. Gudmestad</i> .....	99
<b>Complex Assessment of Natural Conditions for Offshore Pipeline Route Optimization</b> <i>Sergey Alekseev, Alexander Dobrotvorsky, Alexey Serebryakov and Elena Stavrova</i> .....	106
<b>Introduction to the Update of DNV'96, DNV OS F101; Submarine Pipeline Systems</b> <i>Leif Collberg</i> .....	112
<b>Introduction and Background to DNV RP-F101 "Corroded Pipelines"</b> <i>O.H. Bjørnøy, B. Fu, G. Sigurdsson, E.H. Cramer and D. Ritchie</i> .....	117
<b>Modern Line Pipe Steels Designed for Sophisticated Subsea Projects for Sweet and Sour Gas</b> <i>A. Streisselberger, P. Flüß and J. Bauer, C.J. Bennett</i> .....	125
<b>A Finite-Element Model for In-Situ Behavior of Offshore Pipelines on Uneven Seabed and Its Application to On-Bottom Stability</b> <i>Bjørn A. Ose, Yong Bai, Per R. Nystrøm and Per A. Damsleth</i> .....	132
<b>Hot Tapping on the Norwegian Continental Shelf</b> <i>Ståle Størkersen and Thomas Sunde</i> .....	141
<b>Nonlinear Vibrations of a Pipeline Under the Action of Pressure Waves in Fluid</b> <i>M.A. Ilgamov and R.L. Lukmanov</i> .....	145
<b>Stress Analysis of Damaged Submarine Pipeline Using Finite Element Method</b> <i>B. Pal and V.Y. Salpekar</i> .....	153
<b>Fishing Gear Interaction on HP/HT Pipe-in-Pipe Systems</b> <i>T. Sriskandarajah, P. Ragupathy, G. Anurudran and R. Wilkins</i> .....	160
<b>Effect of Initial Imperfections on the Lateral Buckling of Subsea Pipelines</b> <i>T. Sriskandarajah, S. Dong, S. Sribalachandran and R. Wilkins</i> .....	168
<b>Simulations of Ratcheting of HP/HT Flowlines</b> <i>Yong Bai, June Y. Nielsen and Per Damsleth</i> .....	176
<b>An Elasto-Plastic Model for Pipe-Soil Interaction of Unburied Pipelines</b> <i>J. Zhang, M.F. Randolph and D.P. Stewart</i> .....	185
<b>Reflection Induced by Large Pipe on an Erodible Bed</b> <i>C. Dulou, M. Belzons and V. Rey</i> .....	193

<b>Fatigue Due to Vortex-Induced Crossflow Oscillations in Free Spanning Pipelines Supported on Elastic Soil Bed</b>	
<i>S. Kapuria, V.Y. Salpekar and S. Sengupta</i> .....	197
<b>Numerical Flow Visualization of Vortex Shedding Flow Over a Circular Cylinder Near a Plane Boundary</b>	
<i>C. Lei, L. Cheng and K. Kavanagh</i> .....	204
<b>Numerical Simulation of Pipeline Local Scour with Lee-Wake Effects</b>	
<i>Fangjun Li and Liang Cheng</i> .....	212
<b>Floatation of Buried Pipeline Under Cyclic Loading of Water Pressure</b>	
<i>S. Maeno, W. Magda and H. Nago</i> .....	217

## RISER AND CABLE MECHANICS

<b>Non-Linear Bending Behaviour of Offshore Flexible Pipes</b>	
<i>E. Kebabze and I. Kraincanic</i> .....	226
<b>Alternative Configurations for Steel Catenary Risers for Turret-Moored FPSOs</b>	
<i>Breno P. Jacob, Marta C.T. Reyes, Beatriz S.L.P. de Lima, Ana L.F.L. Torres, Marcio M. Mourelle and Renato C.M. Silva</i> .....	234
<b>Design of Deepwater Metallic Risers</b>	
<i>Finn Kirkemo, Kim J. Mørk and Nils Sødahl and Bernt Leira</i> .....	240
<b>Torsional Buckling of Vertical Risers</b>	
<i>G.M. Katsaounis and V.J. Papazoglou</i> .....	248
<b>Analytical and Closed Form Solutions for Deep Water Riser-Like Eigenvalue Problem</b>	
<i>C.P. Pesce, A.L.C. Fajarra, A.N. Simos and E.A. Tannuri</i> .....	255
<b>3-D Responses of Vertical Pipe Bottom Pin-Joined to a Horizontal Pipe to Ship Motion and Thrust on Pipe - Part I: MSE and FEM Modeling</b>	
<i>Jin S. Chung and B. Cheng</i> .....	265
<b>Implementation of Elastoplastic Material Laws in Dynamic Riser Analysis with Applications to Reeled Pipes</b>	
<i>Daniel Averbuch, Jean-Michel Heurtier and Vu-Hieu Nguyen</i> .....	272
<b>Active Control of Longitudinal Vibration and Axial Stress Caused in Pipe String for Mining Manganese Nodules in Deep Sea</b>	
<i>Yoshikazu Kobayashi, Goro Obinata and Kazuo Aso</i> .....	278
<b>Influence of Transported Fluid on Behavior of an Extensible Flexible Riser/Pipe</b>	
<i>Somchai Chuchepsakul, Tseng Huang and Tinnakorn Monprapussorn</i> .....	286
<b>3-D Numerical Analysis of a Long Slender Marine Structure Under Combined Axial and Lateral Excitations</b>	
<i>Han-il Park, Dong-ho Jung and Chun-jun Piao</i> .....	294
<b>Dynamic Analysis of Deep Seawater Risers</b>	
<i>Koji Otsuka, Akiyoshi Bando and Yoshiho Ikeda</i> .....	302

<b>Parametric Analysis of Steel Catenary Risers Under Extreme Loads</b> <i>C.A. Martins, C.A.N. Harada, A.B. Costa, and R.M.C. Silva</i> .....	309
<b>Parametric Analysis of Steel Catenary Risers: Fatigue Behavior Near the Touchdown Point</b> <i>C.A. Martins, A.B. Costa and C.A.N. Harada and R.M.C. Silva</i> .....	314
<b>Investigation into Three Mooring Line - Seabed Interaction Models for Frequency-Domain Mooring Line Dynamic Analysis</b> <i>Shukai Wu</i> .....	320
<b>Moored System Damping Evaluation Using Maximum Entropy Spectral Analysis</b> <i>Celso Velasco Raposo and Tiago A. Piedras Lopes</i> .....	326
<b>Comparison of Numerical Methods for Predicting the Dynamic Behavior of Mooring Lines</b> <i>I.K. Chatjigeorgiou and S.A. Mavrakos</i> .....	332
<b>Modeling the Pay-Out and Reel-In of Cable</b> <i>Robert F. Zueck</i> .....	340
<b>Surging Motions of a Towed Undersea Cable Plow</b> <i>James J. Burgess</i> .....	345

## FIBER ROPE MOORING

<b>The Design of Deepwater Moorings Using Fibre Rope Tethers</b> <i>R.W.P. Stonor, J.C. Trickey and T. Versavel</i> .....	352
<b>Polyester Rope Mooring Design Considerations</b> <i>K.H. Lo, H. Xü and L.A. Skogsberg</i> .....	358
<b>Third Order Model for the Polyester Mooring Cables Dynamics</b> <i>Antonio C. Fernandes, Ronaldo R. Rossi and Gustavo A.V. Castro</i> .....	364
<b>Testing of Large Cables for Mooring Line Applications</b> <i>P. Davies, R. Baizeau, F. Grosjean and M. François</i> .....	369
<b>Testing of a Large-Diameter Polyester Rope Offshore West Africa</b> <i>L. Foulhoux, S. Pennec, G. Damy and P. Davies</i> .....	377
<b>Experience and Developments in Fibre Rope Mooring Certification</b> <i>M. François</i> .....	385

## UNDERWATER VEHICLES AND ROBOTICS

<b>10,000-Meter Class Deep Sea ROV "KAIKO" and Underwater Operations</b> <i>Toshinobu Mikagawa, Tsutomu Fukui and "KAIKO" Operation Team</i> .....	388
<b>Sea Trials of the Deep Scientific System VICTOR 6000</b> <i>Marc Nokin</i> .....	395
<b>A Four Quadrant Finite Dimensional Thruster Model</b> <i>R. Bachmayer, L.L. Whitcomb, and M.A. Grosenbaugh</i> .....	399

<b>Optimization of Diesel Powered Underwater Vehicles</b> <i>I.J. Potter, G.T. Reader and J.G. Hawley</i> .....	407
<b>Boundary Layer Relaminarization in Swimming Fish</b> <i>A.H. Techet and M.S. Triantafyllou</i> .....	415
<b>Experimental Study of a Self-Propelled Two-Joint Dolphin Robot</b> <i>M. Nakashima, K. Tokuo, K. Kaminaga and K. Ono</i> .....	419
<b>Diagnosis and Fault Tolerance for ROV</b> <i>B. Deuker and M. Perrier</i> .....	425
<b>In-Situ Oceanic Turbulence Measurements Using a Mobile AUV Platform</b> <i>Manhar R. Dhanak and Ken Holappa</i> .....	431
<b>Visual and Acoustic Terrain Based Navigation</b> <i>M. Sistiaga, J. Opderbecke, M.J. Aldon and V. Rigaud</i> .....	435
<b>Successive Learning Track-Keeping Control (SLTC) Algorithm for Seafloor Vehicle</b> <i>T. Qi and Jin S. Chung</i> .....	441
<b>From SIRENE to SWIMMER - Supervised Unmanned Vehicles: Operational Feedback from Science to Industry</b> <i>V. Rigaud and SIRENE Team, Y. Chardard and SWIMMER Team</i> .....	447
<b>Underwater Operation for Complex Deep Seafloor Observatory Using Demission Submarine Cable</b> <i>K. Kawaguchi, R. Iwase and H. Momma</i> .....	452
<b>Autonomous Underwater Vehicle for Inspection of Submarine Cables</b> <i>Junichi Kojima, Yoichi Kato and Kenichi Asakawa</i> .....	458
<b>Mission Planning and Navigation for an AUV</b> <i>Claude Barrouil and Jérôme Lemaire</i> .....	463
<b>Developments in the AUV Field and Description of REDERMOR</b> <i>Frédéric Devie, Jérôme Lemaire, Gilles Mailfert and Norbert Toumelin</i> .....	469
<b>Dynamics and Control of a Towed Vehicle in Transient Mode</b> <i>Wataru Koterayama, Masahiko Nakamura and Takashi Yokobiki</i> .....	476
<b>POLAR AND ICE ENGINEERING</b>	
<b>Study on Ice Loads Acting on Marine Structures: Interim Report of JOIA Project</b> <i>Kazuyuki Kato, Kazuhiko Kamesaki, Satoshi Akagawa, Takahiro Takeuchi, Tetsuro Kawasaki, Naoki Nakazawa and Akira Kurokawa</i> .....	483
<b>Field Ice Indentation Tests: 6m-wide (Maximum) with Servo-Controlled Power System and 2D Pressure Measurement System</b> <i>Satoshi Akagawa, Muneo Kawamura, Takahiro Takeuchi, Hisao Matsushita, Masafumi Sakai and Takashi Terashima</i> .....	491

<b>Medium-Scale Field Ice Indentation Test (MSFIT): Results of Winter 1998 Tests</b> <i>Naoki Nakazawa, Satoshi Akagawa, Muneo Kawamura, Masafumi Sakai, Hisao Matsushita, Takashi Terashima, Takahiro Takeuchi, Hiroshi Saeki, and Ken-ichi Hirayama</i> .....	498
<b>Contact Ratio in Ice/Structure Interaction Based on Statistical Generation of Ice Failure Surface</b> <i>Takahiro Takeuchi, Mikio Sasaki, Satoshi Akagawa and Muneo Kawamura, Masafumi Sakai, Yasuhiro Hamana, Akira Kurokawa, and Hiroshi Saeki</i> .....	505
<b>Experimental Study on Ice Sheet Strain Area According to Indentation Velocity in Field Indentation Tests</b> <i>Masafumi Sakai, Kyo-ichi Narita and Yasuhiro Hamana, Takahiro Takeuchi, and Hiroshi Saeki</i> .....	512
<b>Experimental Study for First Year Ridge Load</b> <i>Kazuhiko Kamesaki and Yutaka Yamauchi</i> .....	518
<b>Medium Scale Field Indentation Tests: Strength Characteristics of the Ice Sheet (First-Year Sea Ice)</b> <i>Hisao Matsushita, Toru Takawaki, Toichiro Tuboi, Takahiro Takeuchi, Masafumi Sakai, Takashi Terashima and Hiroshi Saeki</i> .....	523
<b>A Lattice Model of Ice Failure</b> <i>Mohamed Sayed and Gary W. Timco</i> .....	528
<b>Use of Mathematical Modeling of Ice Regime for Simulating Ice Load on Sakhalin Offshore Structure</b> <i>Alexander T. Bekker and Igor Appel</i> .....	535
<b>Ice Pressure Distributions from First-Year Sea Ice Features Interacting with the Molikpaq in the Beaufort Sea</b> <i>R. Frederking, G.W. Timco, and B. Wright</i> .....	541
<b>Experimental Study on Adfreeze Bond Strength Between Ice and Pile Structures</b> <i>Takashi Terashima, Takaharu Kawai, Atsumi Furuya, Kyo-ichi Narita, and Norihiro Usami and Hiroshi Saeki</i> .....	549
<b>Mathematical Model for Offshore Platform Structural Vibration by Sea Ice</b> <i>Wei-Liang Jin, Hai-Bo Li and Zhi-Gang Song</i> .....	553
<b>The Analysis of Ice Loads on "Molikpaq" for Sakhalin Offshore Conditions</b> <i>Alexander T. Bekker, Olga A. Komarova, Tatyana E. Uvarova, and Alexander N. Chetyrbotsky</i> .....	559
<b>Internal Structure of Hummocks</b> <i>Stepan V. Zemluk, Vladimir N. Astafiev, Genadiy A. Surkov and Anatoliy M. Polomoshnov</i> .....	566
<b>Meteorological Conditions and Icing in a Low Stratus Cloud</b> <i>W. Fuchs, and Klaus-Peter Schickel</i> .....	569
<b>Analysis of Atmospheric Icing Events Observed at the Mount Valin Test Site During the 1995-96 Season</b> <i>J. Druetz, P. McComber and M. Farzaneh</i> .....	574

<b>Increased Lift Losses of Airfoils Protected with Anti-Icing Fluids and Submitted to Dynamic Dilution</b>	
<i>Gilles Bouchard and Martin Bourbonnais</i> .....	581
<b>Innovative Airborne Inventory and Inspection Technology for Electric Power Line Condition Assessments in Remote Areas and Cold Climates</b>	
<i>Mark Ostendorp</i> .....	588
<b>Predicting Extreme Loads on a Power Line from Freezing Rainstorms</b>	
<i>M.L. Lu, P. Oliver, N. Popplewell and A.H. Shah</i> .....	594
<b>Estimation of Transmission Line Icing at Different Sites Using a Neural Network</b>	
<i>P. McComber, J. Druetz, J. De Lafontaine and A. Paradis, and J.N. Laflamme</i> .....	599
<b>Analysis and Interpretation of Icing Rate Meter and Load Cell Measurements on the Mt. Bélair Icing Site</b>	
<i>Konstantin Savadjiev, Masoud Farzaneh, Jacques Druetz, Pierre McComber and Alain Paradis</i> .....	607
<b>DC Flashover of Artificial Ice-Covered Insulators at Low Atmospheric Pressure</b>	
<i>M. Farzaneh, Y. Li, S.M. Fikke and H. Mercure</i> .....	612
<b>Morphogenetic Modelling of Wet Ice Accretions on Transmission Lines as a Result of Freezing Rain</b>	
<i>Krzysztof Szilder, Edward P. Lozowski, and Masoud Farzaneh</i> .....	616
<b>Overview of a New Operational Ice Model</b>	
<i>Mohamed Sayed and Tom Carrieres</i> .....	622
<b>Field Observation on Wave-Ice Interactions in the Okhotsk Sea</b>	
<i>Mayumi Dozaki, Tetsuya Hayakawa, and Shigeki Sakai</i> .....	628
<b>Ice Formation and Hydrodynamics of the Weddell Sea: a Modelling Approach</b>	
<i>B. Petit and A. Norro</i> .....	636
<b>Hummocking of Ice in the Okhotsk Sea</b>	
<i>Lev P. Yakunin and Anton K. Skorupsky</i> .....	643
<b>Transport Corridor East-West as New Stage of Asia-Pacific Economic Cooperation</b>	
<i>Igor L. Belchuk</i> .....	645
<b>LC-130H Parking Curves for Operating from Skiways</b>	
<i>Joseph L. Barthelemy</i> .....	647
<b>USCGC HEALY (WAGB-20): A Modern Platform to Support Polar Research</b>	
<i>George Dupree, Jonathan Berkson, Stephen Osmer, Chuck Klingler and Robert Pond</i> .....	654
<b>Adapting the Canadian Ice Regime System to Operational Ice Navigation</b>	
<i>R. Frederking</i> .....	659
<b>A Consideration on Ship Performance in Broken Ice Sea</b>	
<i>Kazuo Nozawa</i> .....	665

## ADDITIONAL PAPERS

<b>Design Considerations in the Use of Pipe-In-Pipe Systems for Hp/Ht Subsea Pipelines</b> <i>T. Sriskandarajah, G. Anurudran, P. Ragupathy and R. Wilkins</i> .....	672
<b>Design Considerations of High-Temperature Pipelines</b> <i>Wim Guijt</i> .....	683
<b>The Heat Build-Up and Mechanical Property Characteristics of Polyester and Aramid Rope</b> <i>Neil Casey, Steve Banfield and Ulrik Bindingsbo</i> .....	690
<b>Full-Scale Dynamic Measurements of a Shallow-Water Oceanographic Surface Mooring</b> <i>Mark A. Grosenbaugh and Jason I. Gobat</i> .....	699

# The Proceedings of The Ninth (1999) International OFFSHORE AND POLAR ENGINEERING CONFERENCE

Brest, France, May 30–June 4, 1999

VOLUME III, 1999

---

**Metocean, Ocean Waves, Internal Waves and Remote Sensing, Breaking Waves, Numerical Wave Tank, Hydrodynamic Forces, Dynamics Of Floating Structures, Vortex Shedding and Flow-Induced Vibrations, Coastal Engineering**

## How to Use This Table of Contents

Scroll down or use the bookmarks in the left-side frame to move to a new location in this index. Click on a **blue paper title** you like to view.

To return to this index after viewing a paper, click on PREVIOUS MENU bookmark in the left-side frame.

This CD-ROM is created from the PDF files. The hard-copy originals in the proceedings are scanned and saved as PDF files. View quality of the text and graphics, the searchability and the ease of readability depend largely on the quality and/or consistency of the originals.

Copyright © 1999 by International Society of Offshore and Polar Engineers,  
Golden, Colorado, USA. All Rights Reserved.

[www.isopec.org](http://www.isopec.org); [meetings@isopec.org](mailto:meetings@isopec.org)

For set of 4 volumes; 3,060 pp.

ISBN 1-880653-39-7: ISSN 1098-6189 (Set)

Indexed by Engineering Index, Compendex and Others

[www.isopec.org](http://www.isopec.org): [orders@isopec.org](mailto:orders@isopec.org)

edited by:

Jin S. Chung, Colorado School of Mines, USA  
Michel Olagnon, Ifremer, France  
Cheung H. Kim, Texas A & M University, USA  
Alberto Francescutto, University of Trieste, Italy

presented at:

The Ninth (1999) International Offshore and Polar Engineering Conference held in Brest, France,  
May 30–June 4, 1999

organized by:

International Society of Offshore and Polar Engineers

sponsored by:

International Society of Offshore and Polar Engineers (ISOPE)  
with cooperating societies and associations

The publisher and the editors of its publications assume no responsibility for the statements or opinions expressed in papers or presentations by the contributors to this conference or proceedings.

**International Society of Offshore and Polar Engineers (ISOPE)**  
**P.O. Box 189, Cupertino, California 95015–0189 USA**

## CONTENTS

### PLENARY PRESENTATION

<b>Viscous Forces on Offshore Structures and Their Effects on the Motion of Floating Bodies</b> <i>John R. Chaplin and Yoshiho Ikeda</i> .....	1
<b>Variability and Trends in the Wave Climate of the North Atlantic: A Review</b> <i>D.J.T. Carter</i> .....	12
<b>Recent Advances in Wave Measurement Technology</b> <i>Harald E. Krogstad and Stephen F. Barstow</i> .....	19

### METOCEAN

<b>Statistics for Velocities of Random Waves</b> <i>Krzysztof Podgórski, Igor Rychlik and Eva Sjö</i> .....	27
<b>Comparison of Time-Frequency Representations of Random Wave Elevation Data</b> <i>YongJune Shin, Edward J. Powers and Eun-jik Yi</i> .....	34
<b>Experimental Study on the Dependence of Wave Statistics Upon Wave Dimensionality</b> <i>John Z. Yim, Jaw-Guei Lin, C.R. Chou and W.P. Huang</i> .....	41
<b>The Typhoon Waves in Shantou Coastal Areas: Hindcasted Typhoon Waves and Their Characteristics</b> <i>Shaoying Li, Jinghan Zhang, Shengan Wang and Jianping Shen</i> .....	47
<b>How Big Are the Big Waves?</b> <i>Krzysztof Podgórski, Igor Rychlik, Jesper Rydén and Eva Sjö</i> .....	53

<b>Experimental Study on the Distributions of Wave Phases</b> <i>Jaw-Guei Lin, Ching-Yun Yueh and John Z. Yim</i> .....	61
<b>Joint Distribution of Wave Height and Wave Crest Velocity from Reconstructed Data</b> <i>Per A. Brodtkorb, Dag Myrhaug and Håvard Rue</i> .....	66
<b>Time Domain Model Representations of Standard Wind Gust Spectra</b> <i>Karl E. Kaasen</i> .....	74
<b>Directional Distributions in Ocean Wave Spectra</b> <i>Harald E. Krogstad and Stephen F. Barstow</i> .....	79
<b>Comparative Evaluation of Directional Wave Analysis Techniques Applied to Field Measurements</b> <i>Michel Benoit and Gérard Goasguen</i> .....	87
<b>Extreme Water Level from Joint Distributions of Tide, Surge and Crests: a Case Study</b> <i>M. Olagnon, R. Nerzic and M. Prevosto</i> .....	95
<b>Models of the Probability Distribution of Extreme Wave Crest Elevation</b> <i>E.G. Pitt, J. Daruvala, J.B. Bole and D.B. Driver</i> .....	101
<b>Statistics of Heavy Weather Actual Ocean Wave Data in North Sea and Japan Sea with Reference to Abnormal Waves</b> <i>H. Tomita and H. Sawada</i> .....	109
<b>Long-Term Comparison of ERS, TOPEX and POSEIDON Altimeter Wind and Wave Measurements</b> <i>P. Queffelec</i> .....	114
<b>Duration Characteristics of Storm and Calm Weather Periods Over the North Western Siberian Shelf</b> <i>Vladimir N. Kryjov</i> .....	121
<b>A Steady-State Shallow-Water Spectral Wave Model Based on Unstructured Spatial Meshing</b> <i>Frédéric Marcos and Michel Benoit</i> .....	126
<b>Sensitivity Analysis on the Transfer of the Offshore Wave Conditions to a Coastal Location</b> <i>Mauro Sclavo and Luigi Cavaleri</i> .....	132
<b>WaMoS II: A Radar Based Wave and Current Monitoring System</b> <i>K. Reichert, K. Hessner, J.C. Nieto Borge and J. Dittmer</i> .....	139
<b>Sea State Measurements in the Ross Sea Based on Ship Motions</b> <i>R. Tedeschi</i> .....	144
<b>CANDHIS Database of <i>in situ</i> Sea States Measurements on the French Coastal Zone</b> <i>Joël L'Her, Gérard Goasguen and Michel Rogard</i> .....	148
<b>North Atlantic Wave Climate Variability and the North Atlantic Oscillation Index</b> <i>P.D. Cotton and P.G. Challenor</i> .....	153
<b>Eurowaves: a User-Friendly Approach to the Evaluation of Nearshore Wave Conditions</b> <i>Luigi Cavaleri, Gerassimos A. Athanassoulis and Steve Barstow</i> .....	158

<b>Climate Changes of Wind Waves in the North Atlantic Over the Last Several Decades</b> <i>Sergey K. Gulev and Lutz Hasse</i> .....	164
---	-----

<b>A Numerical Study of High Wave Probability for Some Severe Wave Conditions</b> <i>Jianbo Hua and Philip Ekman</i> .....	168
---	-----

## INTERNAL WAVES

<b>Nonlinear Internal Waves in the South China Sea</b> <i>Ming-Kuang Hsu and Antony K. Liu</i> .....	175
---	-----

<b>Baroclinic Tides at a North-West European Margin: Analytical Modelling Compared to In Situ Data</b> <i>Katell Guizien, Mark Inall, Eric Barthélemy and Toby Sherwin</i> .....	181
---	-----

<b>Generation of Upstream Internal Waves on the Pycnocline by a Horizontally Moving Body</b> <i>Hsien P. Pao and Timothy W. Kao</i> .....	187
--	-----

<b>Non-Linear Resonance Between Short and Long Waves</b> <i>H. Michallet and F. Dias</i> .....	193
---	-----

<b>Internal Wave Signature Detection and Characterization from SAR Images</b> <i>Josep A. Ródenas and René Garello</i> .....	199
---	-----

## BREAKING WAVES

<b>Experimental Study of Breaking Wave Flow Field Past a Submerged Hydrofoil by LDV</b> <i>Paolo De Blasi, Fabio Di Felice, Francesco Lalli and Giovanni Paolo Romano</i> .....	207
--	-----

<b>Spatial Distribution of Breaking Waves: An Airborne Measurement Technique</b> <i>Paul A. Hwang, Edward J. Walsh, William B. Krabill, Wayne Wright and Robert N. Swift</i> .....	213
---	-----

<b>Internal Solitary Waves Shoaling and Breaking on Uniform Slopes</b> <i>H. Michallet and G.N. Ivey</i> .....	217
---	-----

<b>Experimental Investigation of Fluid-Particle Oscillating Flows</b> <i>G.P. Romano, F. Lalli, P. Monti and A. Papili</i> .....	223
---	-----

<b>Two-Phase Flow Structure in Breaking Waves</b> <i>Y. Yüksel, T. Bostan, E. Çevik, Y. Çelikoglu and M. Günal</i> .....	231
---	-----

## OCEAN WAVES

<b>Deep Water Three-Dimensional Waves</b> <i>R.-Q. Lin and M.-Y. Su</i> .....	236
--	-----

<b>Continuous Change of Wave Direction in Dual-Face Wave Generator</b> <i>T. Hiraishi, K. Hirayama, H. Maruyama, T. Takayama and N. Hosotani</i> .....	241
---	-----

<b>Effect of Surface Tension on Wave Characteristics Past a Porous Barrier</b> <i>T. Sahoo, A.T. Chan and A.T. Chwang</i> .....	247
--	-----

<b>A Finite Element Procedure for 3D Incompressible Free-Surface Flow</b>	
<i>Tong Chen and Allen T. Chwang</i> .....	253

<b>On the Irregular Eigenvalues in Wave Radiation Solutions Using Dual Boundary Element Method</b>	
<i>J.T. Chen, I.L. Chen and M.T. Liang</i> .....	260

## NUMERICAL WAVE TANKS

<b>Benchmark Test Cases for Numerical Wave Absorption: 1st Workshop of ISOPE Numerical Wave Tank Group, Montréal, May 1998</b>	
<i>A.H. Clément</i> .....	266

<b>Simulation of a Self-Adaptively Controlled OWC in a Nonlinear Numerical Wave Tank</b>	
<i>G. Chatry, A.H. Clément and A.J.N.A. Sarmiento</i> .....	290

<b>A Numerical Approach to Three-Dimensional Diffraction Problem in Non-Linear Waves</b>	
<i>Hong G. Sung and Hang S. Choi</i> .....	297

<b>Computation of Shoaling and Breaking Waves in Nearshore Areas by the Coupling of BEM and VOF Methods</b>	
<i>Stéphan Guignard, Stéphan T. Grilli, Richard Marcer and Vincent Rey</i> .....	304

<b>A Numerical Model of Wave Setup Associated with Monochromatic Waves</b>	
<i>Guohai Dong, Zhili Zou and Nicholas Dodd</i> .....	310

<b>Method of Verification for Numerical Wave Tank Force</b>	
<i>C.H. Kim, Z.M. Wang, A. Sebastian and S.Y. Boo</i> .....	317

<b>Estimation of Wave Drift Force by Numerical Wave Tank</b>	
<i>Katsuji Tanizawa, Makiko Minami and Shigeru Naito</i> .....	323

<b>A Computation on Wave Damping Effects for a 3-D Body Under Regular Waves and Currents</b>	
<i>Tzung-hang Lee</i> .....	331

<b>Fully Non-Linear Diffraction of Regular Waves by a Multi-Column Structure</b>	
<i>Pierre Ferrant</i> .....	337

<b>Chimera RANS Simulation of Ship and Fender Coupling for Berthing Operations</b>	
<i>Hamn-Ching Chen, Tuanjie Liu, Erick T. Huang and Duane A. Davis</i> .....	345

<b>Wave-Induced Response in a Rigid Porous Bed</b>	
<i>Ching-Jer Huang and Hsing-Han Chang</i> .....	355

<b>Three-Dimensional Model of Waves Passing Submerged Porous Structures</b>	
<i>Jaw-Fang Lee and Po-I Chen</i> .....	363

<b>Numerical Simulation of Nonlinear Transient Waves and Its Validation by Laboratory Data</b>	
<i>Günther F. Clauss and Ulrich Steinhagen</i> .....	368

<b>Cross-Validation Methods for Wave Tank Measurements</b>	
<i>M. Le Boulluec, S. Maisondieu and Y. Stassen</i> .....	376

<b>New VOF Method for Simulation of Non-Linear Wave Effects</b>	
<i>S. Guignard, V. Rey and R. Marcer</i> .....	382
<b>Vortex Generation in Water Waves Propagating Over a Submerged Rectangular Dike</b>	
<i>C.M. Dong and C.J. Huang</i> .....	388
<b>Evaluation of Performance of New Wave-Making Basin</b>	
<i>Shigeru Naito, Munehiko Minoura, Kenta Tanaka and Haruaki Sakashita</i> , .....	396
<b>Uncertainty Assessment in Wave Elevation Measurement</b>	
<i>A. Olivieri and R. Penna</i> .....	404
<b>Fully Nonlinear Multi-Directional Waves by a 3D Viscous Numerical Wave Tank</b>	
<i>M.H. Kim, J.C. Park, S.Y. Hong and A. Tavassoli</i> .....	412
<b>2D Nonlinear Diffraction Around Free Surface Piercing Body in a Viscous Numerical Wave Tank</b>	
<i>L. Gentaz, B. Alessandrini and G. Delhommeau</i> .....	420
<b>HYDRODYNAMIC FORCES</b>	
<b>Resistance in Unsteady Flow: Search for an In-Line Force Model</b>	
<i>T. Sarpkaya</i> .....	427
<b>Maximum Wave Loads on a Caisson Structure for the Sakhalin Offshore</b>	
<i>A.M. Cornett, M.H. Davies, J.S. Readshaw and H. Wells</i> .....	433
<b>Wave Pressure on a Large Cylinder in a Wave-Current Coexisting Field</b>	
<i>S.S. Hsiao, W.K. Weng and M.C. Lin</i> .....	441
<b>Wave Forces on Large Cylinders on Slope in Directional Sea</b>	
<i>Norimi Mizutani, Yukikazu Yoshida, Takeshi Sanada, Naoto Kawashima and Koichiro Iwata</i> .....	446
<b>Time-Domain Solution of Freely Floating Cylinders in a Viscous Fluid</b>	
<i>R.W. Yeung and S.-W. Liao</i> .....	454
<b>Offshore Concrete Structures: Force Distribution in Massive Intersections of Structural Members</b>	
<i>Jean-Luc Parat, Patrick Le Tallec and Marina Vidrescu</i> .....	463
<b>Wave-Current Forces on Rectangular Cylinder at Low KC Numbers</b>	
<i>V. Vengatesan, K.S. Varyani and N.D.P. Barltrop</i> .....	469
<b>Hydrodynamic Forces on Three-Dimensional Bodies in a Restricted Waterway</b>	
<i>S.Y. Liou and D.T. Su</i> .....	478
<b>Aspect of the Normalization of Hydrodynamic Coefficients in Morison Equation</b>	
<i>Yu-cheng Li</i> .....	485
<b>Numerical Estimation of Hydrodynamic Heave Damping of a Vertical Cylinder with Appendages</b>	
<i>L. Tao, L. Cheng and K. Thiagarajan</i> .....	490

**Towards Convective Cell Free Surface Modelling of a SPAR Buoy**  
*A.M. Wright and S.R. Turnock*..... 496

**Analysis of Second Order Steady Hydrodynamic Forces on Floating Bodies in Regular Waves by Finite Element Method**  
*Santhosh Sathyapal, S.K. Bhattacharyya and C.P. Vendhan*..... 504

## DYNAMICS OF FLOATING STRUCTURES

**An Experimental Study of the Nonlinear Dynamics of Floating Cranes**  
*G.F. Clauss and M. Vannahme*..... 511

**Nonlinear Air-Gap System Identification from Model Tests**  
*Carl Trygve Stansberg*..... 519

**On the Mathematical Modelling of Roll Motion of a Ship with a List**  
*Fabrizio D'Este and Giorgio Contento*..... 527

**Large Amplitude Nonlinear Dynamics of the Mobile Offshore Base (MOB) at Transit Draft in a Random Seaway**  
*S. Vishnubhotla, J. Falzarano and A. Vakakis*..... 531

**A Study on Numerical Simulation Methods to Reproduce Long-Period Ship Motions**  
*Satoru Shiraishi, Masayoshi Kubo, Shigeki Sakakibara and Kenji Sasa*..... 536

**Ship Roll Motion with Water Inside Compartments Due to Damage**  
*Roby Kambisseri and Yoshiho Ikeda*..... 544

**Characteristics of Harbor Oscillation and Ship Motion Induced by Long Period Waves**  
*Keisuke Murakami, A. Yoshida and I. Irie*..... 552

**Wind-Induced Dynamic Response of Offshore Platform Structures**  
*Jing-Jong Jang and Chiou-Shui Lee*..... 558

**Response Statistics of a Moored Semisubmersible Platform in Multidirectional Waves: A Model Test Study**  
*Carl Trygve Stansberg*..... 566

**A Study on Time Domain Analysis of Moored Ship Motion Considering Harbor Oscillations**  
*Masayoshi Kubo and Shigeki Sakakibara*..... 574

**Analysis on the Fender Deformation by Moored Ship Motions Due to Wave Actions at Ocean Facing Port**  
*Satoru Shiraishi, Koichi Nagamatsu and Toshiaki Umihara*..... 582

**The Fractal Character of Chaotic Motion of a Structure with Nonlinear Mooring**  
*Dale G. Karr, Patrick J. Murphy and Daniel Fuchs*..... 590

**Primary Resonance Response of a Controlled Ocean System**  
*P.E. King and S.C.S. Yim*..... 596

**Average Wave Drift Force Determination for the Ships and Offshore Structures: Testing and Computation**  
*I.K. Boroday, M.N. Bogdanov and G.V. Vilensky*..... 601

<b>A Dynamical System Approach to the Sloshing: Experimental and Theoretical Analysis</b> <i>G. Sciortino and M. La Rocca</i> .....	607
<b>The Use of the Finite Element Method in the Simulation of Liquid Sloshing</b> <i>D.C. Webb and K. Kormi</i> .....	615
<b>The Effect of Steady Flow Potential on the Ship Motions in Waves</b> <i>Ming-Chung Fang and Pei-Yawn Liao</i> .....	621
<b>A Method to Analyse Seakeeping Model Measurements in Time Domain</b> <i>K. Garne and J. Hua</i> .....	629
<b>A Study on Motions in Waves and Performance of Wave Energy Absorption of an Autonomous Biogeochemical Monitoring Platform</b> <i>Tetsuro Ikebuchi, Naoyuki Takatsu and Wataru Koterayama</i> .....	635
<b>Improving the Accuracy of Free-Surface Recognition and Conservation of Mass for the Volume of Fluid Method</b> <i>Fumihiko Yamada and Kiyoshi Takikawa</i> .....	643
<b>Non-Linear Diffraction Around Heeled Ship Sections</b> <i>R.H.M. Huijsmans, J. Westhuis and A. Ballast</i> .....	651
<b>Non-Linear Time Domain Analysis of Complex Marine Operations</b> <i>C. Berhault, M.A. Bohéas and G. Morin</i> .....	658

## VORTEX SHEDDING AND FLOW-INDUCED VIBRATIONS

<b>Determination of Instantaneous Frequency of Vortex Bursts</b> <i>Jon Hinwood and Richard Aarons</i> .....	665
<b>Vortex Shedding Around Two Circular Cylinders of Different Diameters</b> <i>X. Wang and L. Cheng</i> .....	671
<b>Modal Decomposition of Measured Vortex Induced Response of Drilling Risers</b> <i>Christopher Hoen and Geir Moe</i> .....	679
<b>Effect of Internal Flow on Vortex-Induced Vibration of Riser</b> <i>Namseeg Hong and Taiknyung Huh</i> .....	688
<b>Parametrical Analysis of a Rectangular Cylinder with Splitter Plate Using Numerical Simulation</b> <i>C.L.R. Siqueira, J.R. Meneghini and F. Saltara</i> .....	694
<b>Avoidance Criteria for Wind-Induced Vortex Shedding Vibrations</b> <i>Kurt Sjursen</i> .....	699

## COASTAL ENGINEERING

<b>The Effects of Impulsive Wave Loads on the Dynamic Response of Vertical Breakwaters</b> <i>E. Benassai, M. Calabrese and G. Sorgenti degli Uberti</i> .....	706
<b>Analysis of Horizontal Forces Acting on Vertical Walls of Perforated Breakwater</b> <i>E.H. Tabet-Aoul, J.-M. Rousset and M. B�elorgey</i> .....	712
<b>Wave Force on a Vertical Wall in Directional Seas</b> <i>T. Hiraishi</i> .....	718
<b>Effect of Detached Breakwater on Wave Directionality: Example of BDZ Harbour</b> <i>Wei-Po Huang, John Z. Yim and Jaw-Guei Lin</i> .....	724
<b>Performance of a Floating Breakwater by the Use of Wave Slamming Loss</b> <i>Takayuki Nakamura, Tohru Kohno and Minoru Uemura</i> .....	730
<b>Experimental Study on Deformation and Hydraulic Function of Rubble Mound Breakwater</b> <i>Susumu Araki, Yoshiyasu Fujiwara and Ichiro Deguchi</i> .....	735
<b>Reflection of Water Waves by Sloping Porous Structures</b> <i>A.T. Chan, T. Sahoo and A.T. Chwang</i> .....	743
<b>Numerical and Experimental Study of Submerged Flexible Nets: Applications to Fish Farms</b> <i>F. Le Bris and D. Marichal</i> .....	749
<b>Wave Damping Due to Porous Seabed Effect</b> <i>Zhao-Chen Sun and Zhi-Hai Zhu</i> .....	756
<b>A Boundary Layer Correction Approach on Dynamic Response of Soft Poroelastic Bed to Nonlinear Water Waves</b> <i>P.C. Hsieh, L.H. Huang and T.W. Wang</i> .....	762
<b>Characteristics of the Turbulent Boundary Layer Along Sand-Ripples Under Regular Waves</b> <i>Tetsuya Kakinoki, Kiyoshi Takikawa and Fumihiko Yamada</i> .....	767
<b>The Threshold of Sand Motion Under Random Waves</b> <i>R. Gentile, L. Rebaudengo Land� and G. Scarsi</i> .....	775
<b>Performance of Silt Protector in Three Dimensional Flow</b> <i>Akio Yasui, Ichiro Deguchi and Masanobu Ono</i> .....	781
<b>Extended Boussinesq Equations Model for Wave Propagation on Currents</b> <i>M. Mohiuddin, H. Togashi and Y. Hirayama</i> .....	787
<b>Linear and Nonlinear Transfer Functions in the Prediction of Unidirectional Irregular Waves from Pressure Measurements</b> <i>Eustorgio Meza and Jun Zhang</i> .....	794
<b>DRBEM Analysis on Wave-Induced Harbor Oscillation</b> <i>M.C. Lin, S.S. Hsiao, C.L. Ting and P.H. Lin</i> .....	800
<b>Oscillation Problems in �esme Marina</b> <i>�. Yerli, A. �nal, R. Koh, M. Furukawa and Y. Y�ksel</i> .....	806

# The Proceedings of The Ninth (1999) International OFFSHORE AND POLAR ENGINEERING CONFERENCE

Brest, France, May 30–June 4, 1999

VOLUME IV, 1999

---

**Tubular Structures, Materials, Fatigue and Welding, Composite Materials and Smart Structures, Reliability, Risk and Safety, Mechanics and Analysis, Collision, Impact and Damage, Earthquake Engineering, Advanced Ships and Naval Systems, Underwater Acoustics**

## How to Use This Table of Contents

Scroll down or use the bookmarks in the left-side frame to move to a new location in this index. Click on a **blue paper title** you like to view.

To return to this index after viewing a paper, click on PREVIOUS MENU bookmark in the left-side frame.

This CD-ROM is created from the PDF files. The hard-copy originals in the proceedings are scanned and saved as PDF files. View quality of the text and graphics, the searchability and the ease of readability depend largely on the quality and/or consistency of the originals.

Copyright © 1999 by International Society of Offshore and Polar Engineers,  
Golden, Colorado, USA. All Rights Reserved.

[www.isopec.org](http://www.isopec.org); [meetings@isopec.org](mailto:meetings@isopec.org)

For set of 4 volumes; 3,060 pp.

ISBN 1-880653-39-7: ISSN 1098-6189 (Set)

Indexed by Engineering Index, Compendex and Others

[www.isopec.org](http://www.isopec.org): [orders@isopec.org](mailto:orders@isopec.org)

edited by:

Paul Grundy, Monash University, Australia  
Jay Koo, Exxon Research and Engineering Company, USA  
Ivar Langen, Høgskolen i Stavanger, Norway  
Yukio Ueda, Kinki University, Japan

presented at:

The Ninth (1999) International Offshore and Polar Engineering Conference held in Brest, France,  
May 30–June 4, 1999

organized by:

International Society of Offshore and Polar Engineers

sponsored by:

International Society of Offshore and Polar Engineers (ISOPE)  
with cooperating societies and associations

The publisher and the editors of its publications assume no responsibility for the statements or opinions expressed in papers or presentations by the contributors to this conference or proceedings.

**International Society of Offshore and Polar Engineers (ISOPE)**  
**P.O. Box 189, Cupertino, California 95015–0189 USA**

## CONTENTS

### TUBULAR STRUCTURES

<b>Strength Prediction of Axially Loaded Overlap Tubular K-Joints</b> <i>F. Gazzola, M.M.K. Lee and E.M. Dexter</i> .....	1
<b>Strength Sensitivities of Overlap Tubular K-Joints Under Axial Loading</b> <i>F. Gazzola, M.M.K. Lee and E.M. Dexter</i> .....	10
<b>The Static Strength of Ring-Stiffened Tubular Joints</b> <i>Silke Willibald, Stefan Herion and Ram S. Puthli</i> .....	18
<b>Pullout Strength of Concrete Plugs in Tubular Piles</b> <i>R. Al-Mahaidi, P. Grundy and W. Bean</i> .....	24
<b>The Use of Grout for the Repair and Strengthening of Steel Tubular Members</b> <i>C. D'Mello and L.F. Boswell</i> .....	30
<b>Experimental Study of Through Plate, Transverse Plate, and Stiffened Plate-to-RHS Member Connections</b> <i>N. Kostaski, J.A. Packer and J.J. Cao</i> .....	38
<b>Experimental Study of Bolted Flange-Plate Connections for Square Hollow Section Tension Members</b> <i>Silke Willibald, Jeffrey A. Packer and Ram S. Puthli</i> .....	46
<b>Load-Deformation Relationships for Gusset-Plate to CHS Tube Joints Under Compression Loads</b> <i>M. Ariyoshi and Y. Makino</i> .....	54

<b>Experimental and Finite Element Investigations on the Static Collapse of a Plane Tubular Framework Structure</b>	
<i>T.H. Hyde, H. Ou and S.B. Leen</i> .....	63
<b>Tests on the Effective Column Lengths of Web Members in a CHS Lattice Girder</b>	
<i>Y. Furukawa, K. Adachi, Y. Makino and Y. Kurobane</i> .....	71
<b>Residual Fatigue Life Predictions Under Mixed Mode Loads in Offshore Structures</b>	
<i>Xiaobo Yu and Andras Abel</i> .....	78
<b>SCF Equations for Fatigue Design of Multiplanar Tubular XT-Joints</b>	
<i>S.P. Chiew, C.K. Soh and N.W. Wu</i> .....	82
<b>Fracture from Fatigue Cracks Installed at Weld Toes of Plate to Plate T-Joints</b>	
<i>T. Iwashita, K. Azuma, Y. Makino and Y. Kurobane</i> .....	90
<b>Fatigue Behaviour of Nailed Tubular Connections</b>	
<i>N. Koteski, J.A. Packer and A.M. van Wingerde</i> .....	97
<b>Application of Finite Element Analysis in Shakedown Analysis of CHS Joints</b>	
<i>K. Dale, X.-L. Zhao and P. Grundy</i> .....	104
<b>MATERIALS, FATIGUE and WELDING</b>	
<b>Fatigue Strength of Coated Steel Plate in Seawater</b>	
<i>Yasushi Kumakura, Masahiro Takanashi, Akio Fuji, Masaki Kitagawa, Masao Ojima and Yuki Kobayashi</i> .....	108
<b>X-Ray Stress Determination in a Dual Phase Stainless Steel Using Orientation Distribution Function</b>	
<i>Shouichi Ejiri, Jun Hayashi, Toshihiko Sasaki, Hirofumi Inoue and Yukio Hirose</i> .....	115
<b>Measurement of Residual Stress Introduced by Grinding in Dual Phase Stainless Steel by the Method of the X-Ray Stress Measurement</b>	
<i>Hajime Hirose and Toshihiko Sasaki</i> .....	121
<b>Random Fatigue Crack Propagation in Offshore Structural Steel A131 Under Ice Loading at 292K</b>	
<i>M.L. Duan and Z.J. Gao</i> .....	127
<b>Development of Residual Stresses in High Strength Low Alloy Steel</b>	
<i>L. Volden, Ø. Gundersen and G. Rørvik</i> .....	134
<b>Study of FEM Simulation of Cyclic Plastic Behavior of Face-Centered Cubic Crystal (F.C.C.) Crystalline Materials (3rd Report)</b>	
<i>Naoki Osawa, Yasumitsu Tomita and Kiyoshi Hashimoto</i> .....	140
<b>A Study on the Antifouling Technique Through Seawater Electrolysis on Structural Surface</b>	
<i>Y. Huang, M. Iwata, M. Usami and K. Ueda</i> .....	146
<b>The Hole Profile and Tool Wear of BTA Deep Hole Drilling for SUS 316 Marine Part Material</b>	
<i>Sung-Bo Sim and Chi-Ok Kim</i> .....	154

<b>Coarse Grain Measures and Limit of Application to Worked Surface on X-Ray Stress Measurement for TiAl Intermetallic Compound</b>	
<i>Tokimasa Goto, Toshihiko Sasaki and Yukio Hirose</i> .....	162
<b>X-Ray Stress Measurement of Sintered Fe-Cr/TiN Composites</b>	
<i>Shigeki Takago, Toshihiko Sasaki and Yukio Hirose</i> .....	169
<b>Application of Neural Network to Control Penetration in Arc Welding</b>	
<i>Y. Suga, T. Shimamura, T. Fujio and K. Ogawa</i> .....	175
<b>Study on Approximate Method to Analyze Thermo-Flow Field During Line-Heating Process</b>	
<i>Yasumitsu Tomita, Naoki Osawa, Kiyoshi Hashimoto and Nobutaka Shinkai</i> .....	181
<b>Modelling of Residual Stresses in Weld Simulated Restrained C-Mn Steel Specimens</b>	
<i>Ø. Gundersen, Z. Zhang, L. Volden, G. Rørvik and O.M. Akselsen</i> .....	187
<b>Local Thermal Effect on the Growth Rate of Fatigue Crack</b>	
<i>Chung-Hung Lin, Jer-Wei Sheu and Dong-Ming Lee</i> .....	195
<b>Precipitate Effects on CGHAZ Toughness of Underwater Weld on Pipeline Steels</b>	
<i>Guorong Wang and Yonghua Shi</i> .....	199
<b>A Process Combining Shielding and Gas Cleaning in Wet Underwater Welding</b>	
<i>Sven Scheuch, Matthias Creutz and Dieter Mewes</i> .....	207
<b>The Classification of Metal Weld Deposits in Terms of the Amount of Oxygen</b>	
<i>Tomasz Wegrzyn</i> .....	212
<b>Effect of Mechanical Work on Joint Properties of SUS304 Stainless Steel Friction Weld Joint</b>	
<i>T. Sawai, K. Ogawa, H. Yamaguchi, R. Tsujino and Y. Suga</i> .....	217
<b>Relationship Between FRW and AE for Real-Time Quality Evaluation of Engine Valve Production and the Creep Life Prediction</b>	
<i>Sae Kyoo Oh, Seon Jin Kim and Hyung Dong Park</i> .....	222
<b>Influence of Welding Condition on Strength of Aluminum Alloy to Copper Friction Welded Joints</b>	
<i>H. Ochi, K. Ogawa, Y. Yamamoto, K. Fujii and Y. Suga</i> .....	231
<b>COMPOSITE MATERIALS AND SMART STRUCTURES</b>	
<b>Composite Structures Health Monitoring</b>	
<i>Melek Yalcintas</i> .....	236
<b>A New Concept for Smart Composite Pressure Vessels</b>	
<i>R.H. Knapp and I.N. Robertson</i> .....	244
<b>The Use of Composites in the Rehabilitation of Concrete Structures</b>	
<i>M.A. Unal, J.O. Jirsa, H.G. Wheat and D.W. Fowler</i> .....	249
<b>On the Transitions of Secant Modulus of GFRP Laminates for Ship Structure During Fatigue Test</b>	
<i>Sadayoshi Chiaki and Akio Sakurai</i> .....	253

<b>Prestressing Losses in Lightweight Concrete Members</b> <i>Yupu Song and Yankun Zhang</i> .....	259
<b>Measurement of Stress Intensity Factor for Orthotropic CFRP Material by the Method of Caustics</b> <i>Masayuki Shozu</i> .....	264
<b>Influence of Moisture and Low Temperature on Notched Izod Impact Toughness in a Pultruded Reinforced Composite</b> <i>K.G. Kellogg, A.R. Kallmeyer, R.B. Chinnam and P.K. Dutta</i> .....	270

## MECHANICS AND ANALYSIS

<b>Sensitivity Analysis of the SMFM Technique for Measuring the Thickness of a Conducting Plate</b> <i>S.H.H. Sadeghi and A.H. Salemi</i> .....	276
<b>Ultimate Compressive Strength Prediction of Stiffened Panels by Counterpropagation Neural Networks (CPN)</b> <i>Dong Wei and Shengkun Zhang</i> .....	280
<b>Geometric and Material Nonlinear Analysis of Offshore Framed Structures</b> <i>Adilson C. Benjamin, Sérgio M.S. Freitas, Breno P. Jacob and Nelson F.F. Ebecken</i> .....	286
<b>Equivalent Stiffness Parameters of Truss-Core Sandwich Panel</b> <i>Tat Seng Lok, Qianhua Cheng and Leonard Heng</i> .....	292
<b>Fundamental Study on Damping Matrix by Fluid Viscosity for Vibration Analysis of Floating Structures</b> <i>Toshihiko Funaki and Shigehiro Hayashi</i> .....	299
<b>Fundamental Study on the Optimization Method for Vibration Level: Development of the Optimization Method for Vibration in a Superstructure</b> <i>Toshihiko Funaki, Shigehiro Hayashi, Kenneth Sunil Mukherjee and Naruyoshi Izumi</i> .....	307
<b>Beam-Like Ship Vibration Analysis in Consideration of Fluid-Structure Interaction</b> <i>Choong-Yul Son, Seok Lee and Young-Bok Kim</i> .....	315
<b>Hydroelastic Analysis of Ship Hulls with Large Deck Openings</b> <i>Wei Ye and Jun Zhang</i> .....	320

## RELIABILITY, RISK AND SAFETY

<b>ISO Standard Pipeline Transportation Systems: Reliability-Based Limit State Methods</b> <i>Torbjørn Sotberg, Kim J. Mørk and Serghios Barbas</i> .....	325
<b>Optimal Design-Phase Inspection and Replacement Planning of Pipelines Subjected to CO<sub>2</sub> Corrosion</b> <i>Svein G. Hellevik and Ivar Langen</i> .....	331
<b>Reliability-Based Assessment of Offshore Structures at Cold Phase Considering the Effect of Inspection</b> <i>Ruxin Song and Peng Zheng</i> .....	339

<b>Assessment of Pipeline Suitability for Service</b> <i>R. Bea, B. Farkas, C. Smith, J. Rosenmoller, V. Valdes and O. Valle</i> .....	347
<b>Assessment of Biases and Uncertainties in Design and Requalification Parameters for Offshore Platforms</b> <i>A. Soriano, R. Ramos, E. Heredia and R. Bea</i> .....	355
<b>Probabilistic Description of the Response of Offshore Structures to Wave Loading Via Random Sampling Technique</b> <i>G. Najafian, R. Burrows and R.G. Tickell</i> .....	362
<b>Coastal Revetment Risk Assessment: A Case Study in UK</b> <i>A.T. Williams, A. Ergin and C.E. Balas</i> .....	369
<b>Uncertainties in Weather Forecasting, a Risk to Offshore Operations</b> <i>Ove T. Gudmestad and Per Erik Bjerke</i> .....	375
<b>Risk Management of Through-Thickness Cracks in Offshore Fixed Structures</b> <i>J.V. Sharp and A. Stacey</i> .....	381
<b>Uncertainties in the Response of Offshore Structures to Explosion Loading</b> <i>R.B. Corr and V.H.Y. Tam</i> .....	391
<b>Designing Gas Detection Systems for Offshore Installations Using CFD Models</b> <i>Márcia S. Araújo, Wagner Salomão, Marcelo F. Mendes and Wyler Mansur</i> .....	396
<b>Fire Numerical Simulations in Engineering Design of Offshore Platforms</b> <i>L. Dufrêne, G. Morin, J.M. Bureau and J.C. Naudin</i> .....	401
<b>10 Years of Computational Fire Simulation at Offshore Installations: Results, Benefits and New Developments</b> <i>Márcia S. Araújo, Sérgio H. Rodriguez, Marcelo F. Mendes and Wyler Mansur</i> .....	408
<b>Deformation and Failure of Corrugated Firewalls Under Blast Loading</b> <i>Luke A. Louca, Roland Martland and David Campbell</i> .....	415
<b>A Strategy for Assessment of Non-Stationary Free Spans</b> <i>Kim J. Mørk, Olav Fyrileiv, Hroar Nes and Lars Sortland</i> .....	421
<b>COLLISION, IMPACT AND DAMAGE</b>	
<b>Occurrence of Breaking on Vertical Breakwaters</b> <i>M. Calabrese</i> .....	429
<b>Numerical Prediction of Slamming Loads Acting on Catamaran Sections</b> <i>Rama M. Gatiganti, Kamlesh S. Varyani and Miroslaw Gerigk</i> .....	434
<b>Slamming of Elastic Structures on the Water Surface: A Shock Spectral Approach</b> <i>A. Carcaterra, E. Ciappi, A. Iafrati and E.F. Campana</i> .....	440
<b>Experimental Study on the Collision Strength of VLCC Side Structures</b> <i>Tak K. Lee, Jae D. Kim, Tae B. Chun and Byung C. Shin</i> .....	450

<b>The Double-Skid Launching, a New Concept for Launching Free-Fall Lifeboats</b> <i>Makoto Arai and Kazushige Okazaki</i> .....	456
<b>Impact Load of a Supply Vessel</b> <i>Ge Wang and Hideomi Ohtsubo</i> .....	463
<b>Non-Linear Analysis and Redundancy Approach for Analysing Offshore Steel Structures During Ship Impact</b> <i>Wan Mahmood Wan Ab. Majid and Mohamad bin Embong</i> .....	472
<b>Dynamic Characteristics of New Material Protective Device for Ship Collision</b> <i>Kuniaki Shoji, Tokiko Takabayashi, Shigeo Mita and Chisato Nonomura</i> .....	476
<b>Damage Analysis of Super Large Floating Structure in Airplane Collision</b> <i>Osamu Muragishi, Takumi Kawasaki, Takao Yoshikawa, Kazuo Kada, Takuya Fujita and Akira Kohsaka</i> .....	482
<b>A Numerical Simulation Method of Dynamic Response for Marine Structures Under an Explosive Load</b> <i>T. Shibue, E. Nakayama, H. Manabe, T. Asano and A. Yamaguchi</i> .....	490

#### EARTHQUAKE ENGINEERING

<b>Proposal of Tsunami Fission Criteria and Splitted Tsunami Pressure Formulae Based on Non-Distorted Model Tests</b> <i>Masaaki Ikeno, Masafumi Matsuyama and Hiroyoshi Tanaka</i> .....	496
<b>Spectral Analysis of Offshore Structures Under Combined Wave and Earthquake Loadings</b> <i>H. Karadeniz</i> .....	504
<b>Instability of Gravity Type Quay Wall During Earthquake with Regard to Dynamic Interaction with Backfill Ground</b> <i>Kinya Miura, Eiji Kohama, Kiyotaka Inoue, Natsuhiko Ohtsuka, Takahiko Sasajima, Tadashi Hayashi and Nozomu Yoshida</i> .....	512
<b>Seismic Performance and Ultimate Load-Carrying Capacity of an Open Piled Marginal Wharf</b> <i>H. Yokota, S. Kawasaki, H. El-Bakry, R. Sugawara, N. Takehana and N. Kawabata</i> .....	520
<b>Seismic Response Effects on Large Offshore Platform</b> <i>Kenji Kawano, Katta Venkataramana and Tutomu Hashimoto</i> .....	528

#### ADVANCED SHIPS AND NAVAL SYSTEMS

<b>LDV Cross-Flow Survey on a Series 60 Double Model at Incidence</b> <i>F. Di Felice and S. Mauro</i> .....	536
<b>Availability Analysis of High Speed Crafts: A Way to Improve Competitiveness</b> <i>C. Vivalda and S. Capizzi</i> .....	544
<b>A New Approach to Select SWATH Hull Shapes for Minimum Total Resistance at Preliminary Design Stages</b> <i>Protásio Dutra Martins Filho and Marcos Santoni</i> .....	549

<b>Development of a Rapid Pile Splicer for the Navy Modular Elevated Causeway System</b> <i>Sheng S. Lin</i> .....	554
<b>Seabasing Naval Operations: The Challenges Ahead</b> <i>Shujie Chang</i> .....	558
<b>Magnetorheological Fluid Based Torque Transmission Clutches</b> <i>Melek Yalcintas</i> .....	563
<b>Building of Ships and Floating Structures on Horizontal Berth and Their Launching by Tipping Table Principle</b> <i>Ivo Senjanovic</i> .....	570
<b>US High Speed Coastal Cargo Transportation and Agile Port Developments</b> <i>Robert Latorre</i> .....	578

## UNDERWATER ACOUSTICS

<b>Sampling and Measuring of Hydrothermal Fluids with the Hydro Bottom Station (HBS)</b> <i>Andrea Koschinsky, Peter Halbach, Thomas Kuhn and Sylvia Sander</i> .....	583
<b>Multiscale Discriminant Analysis for Texture Classification of High Resolution Sonar Images</b> <i>Christophe Collet, Jean-Marie Burel and Eric Borderie</i> .....	590
<b>Conceptual Design of an Autonomous Biogeochemical Monitoring Platform</b> <i>M. Kusakabe, N. Takatsu, T. Kimoto and H. Mikasa</i> .....	596
<b>A New Approach for Long-Term Seafloor Monitoring and Data Recovery</b> <i>H. Momma, K. Kawaguchi and R. Iwase</i> .....	603
<b>POSIDONIA: Acoustic Positioning System</b> <i>Frédéric Rybicki, Jean François Denis and Jean-Paul Peyronnet</i> .....	611
<b>Generator of Plane Shock Waves</b> <i>Serge Sibony</i> .....	616
<b>First Results of a 3D Very High Resolution Seismic Survey Near the Present Rhone Delta</b> <i>Bruno Marsset and Tania Marsset</i> .....	623
<b>Optical Communication System for Expendable Fiber Optics ROV "UROV7K" System</b> <i>Takashi Murashima, Taro Aoki, Hidehiko Nakajoh, Satoshi Tsukioka and Yoshihisa Asao</i> .....	628
<b>IMBAT3000: A New Deep Towed Fish System for the Offshore Oil Industry</b> <i>Dominique Brechet and Jean-Paul Peyronnet</i> .....	635
<b>Automatic Selection of Soundings Toward a Dynamic Method for Nautical Chart Generalisation</b> <i>Thierry Huet</i> .....	642

**ADDITIONAL PAPERS**

**A Study of Some Problems Relating to the Stress Calculation of Ring-Stiffened Cylindrical Shells**

*Z.B. Li, X.T. Wang and G.Q. Dong*..... 646

**Free Vibration Analysis and Optimization of Sandwich Plate with Aluminum Honeycomb Core**

*C.Y. Son, H.J. Lim and I.T. Kim*..... 650

**An Experimental Study on the Vibration Characteristics of FRP Sandwich Structure**

*C.Y. Son, C.K. Jeong and I.T. Kim*..... 657

PROC-99.CON . 99.3.28- 4.4