Marine Technology and
Management Group
Project

SCREENING METHODOLOGIES FOR USE IN OFFSHORE PLATFORM ASSESSMENT AND REQUALIFICATION: PHASE IV

Professor Robert G. Bea

Graduate Student Researcher James D. Stear

Graduate Student Researcher Zhaohui Jin

Post-Doctoral Researcher Tao Xu

Department of Civil and Environmental Engineering

University of California at Berkeley

January 29-30, 1998

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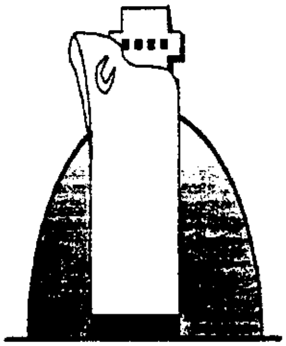
MEETING AGENDA

Wednesday:

1:00 PM	Introduction and project review - *Bob Bea*
1:30	ULSLEA Enhancements (foundations, earthquakes, input/output) - *Jim Stear*
2:30	Marine Pile Foundations - *Zhaohui Jin*
3:30	Break
3:45	Tubular Joint Uncertainties and Biases - *Tao Xu*
4:30	Discussion
5:00 PM	Conclude

Thursday:

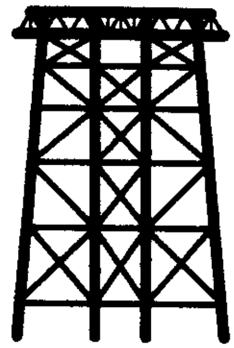
8:00 AM	Review issues from previous day - *Bob Bea*
8:30	ULSLEA Professional - *Jun Ying*
9:00	Expanding the Simplified Analysis Concept: TOPCAT, SADWS - *Jim Stear, Bob Bea*
10:00	Phase IV Spring Work Plan - *Bob Bea, Jim Stear, Zhaohui Jin*
10:30	Discussion, sponsors' directions
11:00 AM	Adjourn



1997 - 1998

MARINE TECHNOLOGY & MANAGEMENT GROUP

INDUSTRY & GOVERNMENT AGENCIES SPONSORED RESEARCH PROJECTS SUMMARIES



Professor Robert Bea
College of Engineering
Tel: (510) 642-0967
Fax: (510) 643-8919
e-mail: rgbea@euler.berkeley.edu

Professor Karlene Roberts
Haas School of Business
Tel: (510) 642-5221
Fax: (510) 631-0150
e-mail: karlene@haas.berkeley.edu

215 McLaughlin Hall
UNIVERSITY OF CALIFORNIA
Berkeley, CA 94720-1712

Goal: Develop engineering and management technology that will help improve the QUALITY (safety, serviceability, durability, compatibility - economy) of marine systems

QUALITY

RESEARCH AREAS

Human & Organization Factors
Ships & Floating Systems
Platforms & Pipelines

Human and Organization Factors	Researcher	Goals and Objectives
Management of Rapidly Developing Crises: A Multi-Community Study	Bob Bea, Karlene Roberts	Develop a real-time system to assist in arresting rapidly developing sequences of events that can lead to catastrophic accidents.
Human & organization factors in diving operations	Shawn Cullen	Promote dive safety through identification, analysis, and management of human and organization factors in diving operations.
Human & organization error risk reduction assessment instrument - SMAS	Brant Pickrell	Develop, code, and verify a computer program for use in assessing the risks of human and organization errors in operations of offshore platforms and marine terminals.
Safety Management Assessment System - SMAS (R. G. Bea, Profs. Brady Williamson and Karlene Roberts)	Derek Hee	Develop a two-level assessment instrument to help qualified assessors evaluate human and organization performance in operations of offshore platforms and marine terminals.
Human & organization factors in quality of offshore platforms (R. G. Bea, Atkins, Ramboll, and MSL Engineering)	Rich Lawson	Develop a computer program to facilitate analyses of human and organizational factors in the life-cycle quality performance of offshore platforms.
Safety Management Assessments in Ship Operations: Human and Organizational Factors	Paul Szwed	Develop an instrument and computer program to help perform ship operations Safety Management Assessments (ISM, International Safety Management, Code) with a focus on Human and Organizational Factors.
Human and Organizational Factors in Emergency Medicine	Karlene Roberts	Develop and implement research in seven medical units, ranging from paramedic units in fire departments to adult and child critical care units. This research tests a model of risk mitigation.
Center for Risk Mitigation - CRM	Bob Bea, Karlene Roberts, Admiral Tom Mercer	Organize a research center that will provide a forum for research, development, application, education, and information exchange among diverse industries to improve the safety of high technology systems with a key focus on the human and organizational aspects of such systems.

Ships, Platforms, Pipelines	Researcher	Goals and Objectives
Ship Structural Integrity Information System - SSIIS III	Henry Reeve	Develop and verify one component of a comprehensive ship quality information system that addresses the structural aspects of ships over their life.
Design and construction of long-life marine composite structures	Paul Miller	Develop and test panels of marine composites subjected to repeated loadings in submerged conditions. Develop and verify an analytical procedure to allow the evaluation of the long-term performance characteristics of marine composite panels.
Optimal strategies for the inspections of ships and offshore platforms for fatigue and corrosion damage (R. G. Bea, Martec, Inc.)	Tao Xu	Develop procedures and strategies to optimize the inspection and repair of ship and offshore platform structures. The inspection strategies will address predictable damage (e.g. fatigue of critical structural details) and unpredictable damage (e.g. due to accidents and errors).
Ultimate Limit State Limit Equilibrium Analyses of template-type offshore platforms - ULSLEA Phase 4	Jim Stear, Zhaohui Jin, Pending Assignment	Continue development and verification of a simplified procedure to characterize the ultimate limit state loadings and capacities of offshore platforms and their reliabilities for extreme condition storms and earthquakes.
Analyses of the nonlinear performance of platforms and caissons subjected to hurricanes	John Kareolis, James Wiseman	Continue study of the performance characteristics of platform and caisson systems when the storm loadings force the structures to their ultimate limit states.
Performance of pile foundations subjected to earthquake excitations (Profs. Seed, Bray, Pestana)	Philip Meymand, Thomas Lok, Chris Hunt	Develop and verify analytical models to assess the performance characteristics of groups of piles supporting structures subjected to intense earthquake excitations. Perform shaking tests on model pile groups to provide test data to verify the analytical models.
Pipeline Integrity and Maintenance Information System - PIMPIS	Boytond Farkis	Develop and verify an inspection and maintenance decision support system for submarine pipelines using a knowledge-based approach. PIMPIS will provide a means of embedding expert knowledge to help select options for pipeline inspections and maintenance.
Platform, pipeline, and floating systems design and requalification criteria for the Bay of Campeche and offshore Tampico - Tuxpan	Tao Xu, Zhaohui-Jin, Pending Assignment	Develop and verify a general platform and pipeline design and reassessment - requalification system tailored to the unique environmental, operational, and economic characteristics of PEMEX operations in the Bay of Campeche.
Pipeline design criteria for second trunkline North West Shelf Australia	Bob Bea	Develop risk based deformation - strain stability criteria for a 48-inch diameter gas pipeline offshore North West Shelf Australia
ISO earthquake guidelines for design and reassessment of offshore platforms	Bob Bea	Continue development of reliability based platform earthquake design and reassessment guidelines for the International Standards Organization.
Reliability based earthquake LRFD design guidelines for offshore Indonesia	Bob Bea	Develop platform load and resistance factor design guielines for offshore Indonesia
Decommissioning and re-use of offshore platforms	James Wiseman, Brian Collins	Develop a general process for the assessment and evaluation of alternative procedures for the decommissioning of offshore platforms . Assist in conduct of MMS / CSLC workshop on decommissioning.

Current Publications

1996 - 1997:

Human and Organization Errors in Reliability of Offshore Structures, Transactions of the American Society of Mechanical Engineers, Vol. 119, Feb. 1997 (R. G. Bea).

Evaluation of Storm Loadings on and Capacities of Offshore Platforms, Journal of waterway. Port, Coastal, and Ocean Engineering, American Society of Civil Engineers, Vol. 123, No. 2, March/April 1997 (R. G. Bea, M. M. Mortazavi, and K. J. Lock).

Capacities of Template-Type Platforms in the Gulf of Mexico During Hurricane Andrew, Journal of Offshore Mechanics and Arctic Engineering, American Society of Mechanical Engineers, Vol. 119, Feb. 1997 (R. G. Bea, K. J. Lock and P. L. Young).

ULSLEA: A Limit Equilibrium Procedure to Determine the Ultimate Limit State Loading Capacities of Template Type Platforms, Journal of Offshore Mechanics and Arctic Engineering, American Society of Mechanical Engineers, Vol. 118, Nov. 1996 (R. G. Bea, M. M. Mortazavi).

Load Shedding of Fatigue Fracture in Ship Structures, Journal of Marine Structures, Vol 10, Elsevier, 1997 (R. G. Bea, T. Xu).

Assessing the Risks and Conutermeasures for Human and Organizational Error, Transactions, American Society of Naval Architects and Marine Engineers, 1996 (R. G. Bea, Lt. D. Boniface).

Human and Organization Factors: Engineering Operating Safety Into Offshore Structures, Reliability Engineering and System Safety, Vol 52, Elsevier Science Limited, 1997.

Fatigue of Ship Critical Structural Details, Journal of Offshore Mechanics and Arctic Engineering, American Society of Mechanical Engineers, May 1997 (R. G. Bea, T. Xu).

In-Service Inspection Programs for Marine Structures, Proceedings 16th International Conference on Offshore Mechanics and Arctic Engineering, American Society of Mechanical Engineers, Yokohama, Japan, 1997 (R. G. Bea, T. Xu).

Managing Rapidly Developing Crises: Real-Time Prevention of Marine System Accidents, Proceedings 16th International Conference on Offshore Mechanics and Arctic Engineering, American Society of Mechanical Engineers, Yokohama, Japan, 1997 (R. G. Bea, K. Roberts).

Reliability Based Load and Resistance Factor Design Guidelines for Offshore Platforms to Resist Earthquakes, Proceedings 16th International Conference on Offshore Mechanics and Arctic Engineering, American Society of Mechanical Engineers, Yokohama, Japan, 1997 (R. G. Bea, M. J. K. Craig).

Comparative Analysis of the Capacities of Gulf of Mexico Steel Template-Type Platforms Subjected to Hurricane Forces, Proceedings 16th International Conference on Offshore Mechanics and Arctic Engineering, American Society of Mechanical Engineers, Yokohama, Japan, 1997 (R. G. Bea, J. Stear).

Background for the Proposed International Standards Organization Reliability Based Seismic Design Guidelines for Offshore Platforms, Earthquake Criteria Workshop Proceedings, 16th International Conference on Offshore Mechanics and Arctic Engineering, American Society of Mechanical Engineers, Yokohama, Japan, 1997.

Reassessment and Requalification of Two Gulf of Mexico Platforms, Proceedings 7th International Conference on Offshore and Polar Engineering, Honolulu, Hawaii, May 1997 (R. G. Bea, A. Sturm and T. Miller).

Reliability Based Design & Requalification Criteria for Longitudinally Corroded Pipelines, Proceedings 7th International Conference on Offshore and Polar Engineering, Honolulu, Hawaii, May 1997 (Y. Bai, T. Xu, and R. G. Bea).

Offshore Single Point Mooring Systems for Import of Hazardous Liquid Cargoes Offshore Southern California, Proceedings 7th International Conference on Offshore and Polar Engineering, Honolulu, Hawaii, May 1997 (R. G. Bea, A. Salancy)

Experimental Validation of the Ultimate Limit State Limit Equilibrium Analysis (ULSLEA) with Results from Frame Tests, Proceedings 7th International Conference on Offshore and Polar Engineering, Honolulu, Hawaii, May 1997 (R. G. Bea, M. Mortazavi).

Experience with Fast Rack Risk Assessment Used to Compare Alternative Platforms, Proceedings of the International Conference on Safety and Reliability, European Safety and Reliability Association, Lisbon, Portugal, June 1997 (R. G. Bea, A. Brandtzaeg).

Human and Organizational Factor Considerations in the Structure Design Process for Offshore Platforms, Proceedings of the International Workshop on Human Factors in Offshore Operations, U. S. Minerals Management Service, New Orleans, Louisiana, Dec. 1996 (R. G. Bea).

Accident and Near-Miss Assessments and Reporting, Human and Organizational Factor Considerations in the Structure Design Process for Offshore Platforms, Proceedings of the International Workshop on Human Factors in Offshore Operations, U. S. Minerals Management Service, New Orleans, Louisiana, Dec. 1996 (R. G. Bea).

Real-Time Prevention of Platform Drilling Blowouts: Managing Rapidly Developing Crises, Human and Organizational Factor Considerations in the Structure Design Process for Offshore Platforms, Proceedings of the International Workshop on Human Factors in Offshore Operations, U. S. Minerals Management Service, New Orleans, Louisiana, Dec. 1996 (R. G. Bea).

A Safety Management Assessment System (SMAS) for Offshore Platforms, Human and Organizational Factor Considerations in the Structure Design Process for Offshore Platforms, Proceedings of the International Workshop on Human Factors in Offshore Operations, U. S. Minerals Management Service, New Orleans, Louisiana, Dec. 1996 (R. G. Bea).

Human and Organization Factors in Safety of Offshore Platforms, Proceedings of the International Workshop on Human Factors in Offshore Operations, U. S. Minerals Management Service, New Orleans, Louisiana, Dec. 1996 (R. G. Bea).

A Decision Analysis Framework for Assessing Human and Organizational Error in the Marine Industries, Proceedings of the Symposium on Human and Organizational Error in Marine Structures, Ship Structure Committee - Society of Naval Architects and Marine Engineers, Arlington, Virginia, November 1996 (R. G. Bea, Lt. D. Boniface).

Consideration of Human and Organization Factors in Development of Design, Construction, and Maintenance Guidelines for Ship Structures, Proceedings of the Symposium on Human and Organizational Error in Marine Structures, Ship Structure Committee - Society of Naval Architects and Marine Engineers, Arlington, Virginia, November 1996 (R. G. Bea).

High Reliability Tanker Loading & Discharge Operations: Chevron Long Wharf, Richmond, California, Proceedings of the Symposium on Human and Organizational Error in Marine Structures, Ship Structure Committee - Society of Naval Architects and Marine Engineers, Arlington, Virginia, November 1996.

Ship Structural Integrity Information System Phase II, Ship Structure Committee SSC 388, Washington, DC, 1996, NTIS #PB96 167564 (R. G. Bea, M. Dry, R. Schulte-Strathaus).

Risk Based Oceanographic Criteria for Design and Requalification of Platforms in the Bay of Campeche, Report to Petroleos Mexicanos and Instituto Mexicano del Petroleo, March 1997 (R. G. Bea).

Structural Reliability of the Monopod Platform, Report to Unocal Corporation, December 1997 (R. G. Bea, J. Ying).

ULSLEA: Parametric Studies of the Effects of Local Damage and Repairs on Global Lateral Load Capacity of a Typical Offshore Platform, Report to U. S. Minerals Management Service and Joint Industry Project Sponsors, Dec. 1996 (R. G. Bea, T. Aviguerto).

Marine Infrastructure Rejuvenation Engineering: Fatigue and Fracture of Critical Structural Details (CSD), Marine Technology and Management Group Report, University of California at Berkeley, Jan. 1997 (R. G. Bea, T. Xu).

Ship Maintenance Project: Program Summary and Rational Basis for Corrosion Limits on Tankers, Ship Structure Committee SSC 395, Washington, DC, NTIS #PB97-142822.

Ship Maintenance Project: Study of Fatigue of Proposed Critical Structural Details in Double Hull Tankers, Ship Structure Committee SSC 395, Washington, DC, NTIS #PB97-142830.

Ship Maintenance Project: Repair Management System for Critical Structural Details in Ships, Ship Structure Committee SSC 395, Washington, DC, NTIS #PB97-142848.

Ship Maintenance Project: Fatigue Classification of Critical Structural Details in Tankers, Ship Structure Committee SSC 395, Washington, DC, NTIS #PB97-142855.

Ship Maintenance Project, Fitness for Purpose Evaluation of Critical Structural Details in Tankers, Ship Structure Committee SSC 395, Washington, DC, NTIS #PB97-142863.

Assessment of Human and Organizational Factors in Operations of Marine Terminals and Offshore Platforms, Marine Technology Management Group Report, University of California at Berkeley, May 1997 (R. G. Bea, Lt. B. Pickrell).

Ship Structural Integrity Information System: Phase III - SSIIS IIII, Marine Technology and Managment Group Report, University of California at Berkeely, May 1997 (R. G. Bea, H. P. Reeve).

Life Cycle Reliability & Risk Characteristics of Minimum Structures, Proceedings of the Offshore Technology Conference, Houston, Texas, OTC 8361, May 1997 (R. G. Bea, M. Craig and T. Miller).

Ultimate Limit State Capacity Analyses of Two Gulf of Mexico Platforms, Proceedings of the Offshore Technology Conference, Houston, Texas, OTC 8418, May 1997 (R. G. Bea, J. Stear).

Conceptual Approaches to the Risk Mitigation Challenge: An Engineer's Perspectives, Proceedings of the First Annual Conference of the Center for Risk Mitigation, University of California at Berkeley, June 1997 (R. G. Bea).

A Safety Management Assessment System: SMAS, Proceedings of the First Annual conference of the Center for Risk Mitigation, University of California at Berkeley, June 1997 (R. G. Bea, D. Hee).

Crisis Management and the Near Miss, Surveyor, American Bureau of Shipping, Sept. 1996.

Evaluation of the West Cameron 5452 #6 and #7 Well Caisson Capacity Characteristics, Report to Chevron (Operator), & Partners (Unocal, CNG Production Co., & Phillips), Ocean Engineering Services, Department of Civil and & Environmental Engineering, University of California at Berkeley, May 1997 (R. G. Bea).

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1995 - 1996:

"Human and organization Factors in Design, Construction and Operation of Offshore Platforms," Jl. of Society of Petroleum Engineers, SPE 30899, Sept. 1995 (R. G. Bea, K. Roberts).

"Risk-Management System for Infrastructure-Condition Assessment," Jl. of Infrastructure Systems, ASCE, Vol. 1, No. 4, Dec. 1996 (R. G. Bea, S. T. Staneff, C. W. Ibbs).

"Nonlinear Performance of Offshore Platforms in Extreme Storm Waves," J. of Waterway, Port, Coastal, and Ocean Engineering, ASCE, Vol. 122, No. 2, March/April, 1996.

"Learning How Organizations Mitigate Risk," J. Of Contingencies and Crisis Management, Vol. 4, No. 2 June, 1996, pp 83-92 (T. Mannarelli, K. Roberts, R. G. Bea).

"Reassessment and Requalification of Infrastructure: An Application to Offshore Structures," Jl. Of Infrastructure Systems, ASCE, Vol. 2, No. 2, June 1996.

"A Repair Management System for Fatigue Cracks in Ships," Transactions, The Societyof Naval Architects and Marine Engineers, Vol. 103, 1995 (R. G. Bea, K. T. Ma).

"Simulation Model for Development of Siting Strategies for Mobile Offshore Drilling Units," Proc. Of the 6th Int. Offshore and Polar Eng. Conf., Los Angeles, CA, May 1996 (R. G. Bea, J. Ying).

"Fatigue of Cracked Ship Critical Structural Details: Cracked S-N Curves and Load Shedding," Proc. Of the 6th Int. Offshore and Polar Eng. Conf., Los Angeles, CA, May 1996 (R. G. Bea, T. Xu).

"A Simplified Structural Reliability Analysis Procedure for Use in Assessments and Requalifications of Template-Type Offshore Platforms," Proc. Of the 6th Int. Offshore and Polar Eng. Conf., Los Angeles, CA, May 1996 (R. G. Bea, M. Mortazavi).

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"Life-Cycle Reliability Characteristics of Minimum Structures," Proceedings of the 15th Int. Conf. On Offshore Mechanics and Arctic Engineering, OMAE Paper No. 96-1205, ASME, June 1996 (R. G. Bea, A. Brandtzaeg, M. J. K. Craig).

"A. Reliability Based Screening Procedure for Platrform Assessments and Requalifications," Proceedings of the 15th Int. Conf. On Offshore Mechanics and Arctic Engineering, OMAE Paper No. 96 1421, ASME, June 1996 (R. G. Bea, M. Mortazavi).

"The Ship Structural Maintenance Projects: 1990-1995," Vol. 1, Fatigue Damage Evaluation, Ship Structure Committee, SSC-386, Washington, D. C. (R. G. Bea,E. H. Cramer, R. Schulte-Strathus).

"The Ship Structural Maintenance Projects: 1990-1995," Vol. 2, Corrosiion Damage Evaluation, Ship Structure Committee, SSC 386, Washington, D. C. (R. G. Bea, R. Mayoss).

"The Ship Structural Maintenance Projects: 1990-1995," Vol. 3, Repairs and Maintenance, Ship Structure Committee, SSC-386, Washington, D. C. (R. G. Bea, K. A. Gallion).

"The Ship Structural Maintenance Projects: 1990-1995," Vol. 4, Durability Considerations, Ship Structure Committee, SSC-386, Washington, D. C. (R. G. Bea,K. T. Ma, R. S. Holzman, and L. Demsetz

Development and Verification of a Computer Simulation Model for Evaluation of Siting Strategies for Mobile Drilling Uinits in Hurricanes, Phase Ii Report to U. S. Minerals Management Service, Marine Technology and Management Group Project, Dept. Of Naval Architecture & Pffshore Eng., Univ. Of California at Berkeley, August 1995 (R. G. Bea, J. Ying).

Ship Structural Integrity Information System - SSIIS, Phase II Report to Ship Structure Committee, Dept. Of Naval Architecture & Offshore Eng., Univ. Of California at Berkeley, Oct. 1995 (R. G. Bea, M. Dry, R. Schulte Strathaus).

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Reduction of Tanker Oil and Chemical Spills: Development of Accident and Near-Miss Databases, Sea Grant Project Report R/OE28, Marine Technology & Management Group, Haas School of Business and College of Engineering, University of California at berkeley, Nov. 1995 (R. G. Bea, E. Mason, K. Roberts)

Screening Methodologies for Use in Platform Assessments and Requalifications, Report to Joint Industry - Government Project, Marine Technology & Management Group, Dept. Of Civil Eng., University of California at Berkeley, Nov. 1995 (R. G. Bea, M. Mortazavi).

Requalifcation of SS209B and SS209B-AUX (ULSLEA) Analysis, Final Report to Unocal Corp., Marine Technology & Management Group, Dept. Of Civil Eng., University of California at Berkeley, Nov. 1995 (R. G. Bea, A. Sturm).

Reliability Based Comparison of Standard and Minimum Fixed Gulf of Mexico Platforms, Reort to Unocal Corp, Marine Technology & Management Group, Dept. Of Naval Architercture & Offshore Eng., and Dept. Of Civl Eng., University of California at Berkeley, Dec., 1995 (R. G. Bea, A. Brandtzaeg).

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Comparison of Two Screening Methodologies for Steel Template-Type Platforms: Ultimate Limit State Limit Equilibrium Analysis (ULSLEA) and Simplified Ultimate Strength Analysis (SUS), Report toJoint Industry Project Sponsors, Marine Technology & Management group, Department of Civil and Environmental Eng.,University of California at Berkeley, June 1996 (R. G. Bea, J. Stear).

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ULSLEA Ultimate Limit State Limit Equilibrium Analysis Manual of Operation, Report to Joint Industry Project, Marine Technology and Management Group, Department of Civil and Environmental Engineering, University of California at Berkleey, June 1996 (R. G. Bea, J. Stear, M Mortazavi).

"Quantitative & Qualitative Risk Analyses - The Safety of Offshore Platforms," Proceedings of the Offshore Technology Conference, OTC 8037, Society of Petroleum Engineers, Houston, Texas, May 1996 (R. G. Bea).

"Probability Based Earthquake Load & Resistrance Factor Design Criteria for Offshore Platforms," Proceedings of the Offshore Technology Conference, OTC 8106, Society of Petroleum Engineers, Houston, Texas, May 1996 (R. G. Bea)

"Evaluation of the Reliability of a Conventional Platform Sited in South Pass Block 47 of the Mississippi River Delta," Proceedings of the Offshore Technology Conference, OTC 8305, Society of Petroleum Engineers, Houston, Texas, May 1996 (R. G. Bea).

"Human and organization Factors in the Safety of Offshore Structures," Risk and Reliability in Marine Technology, C. G. Soares Editor, Balkema Publishers, Rotterdam, The Netherlands, 1996 (R. G. Bea).

"Verification of a Second Generation Simplified Method to Evaluate Storm Loadings on and Capacities of Steel, Template-Type Platforms," Proceedings of the Offshore & Arctic Operations Symposium, American Society of Mechanical Engineers Petroleum Division, Energy & Environmental Expo 95, Houston, Texas, January 1995 (R. G. Bea, M. Mortazavi, K. J. Loch, and P. L. Young).

"Development & Verification of a Simplified Method to Evaluate Storm Loadings on and Capacities of Steel, Template-Type Platforms," Proceedings of the Offshore & Arctic Operations Symposium, American Society of Mechanical Engineers Petroleum Division, Energy & Environmental Expo 95, Houston, Texas, January 1995 (R. G. Bea).

"Probability Based Earthquake Load & Resistance Factor Design Criteria for Offshore Platforms," Proceedings of the International Workshop on Wind and Earthquake Engineering for Coastal and Offshore Facilities, University of California at Berkeley, January 1995 (R. G. Bea).

"Simplified Earthquake Floor Response Spectra for Equipment on Offshore Platforms," Proceedings of the International Workshop on Wind and Earthquake Engineering for Coastal and Offshore Facilities, University of California at Berkeley, January 1995 (R. G. Bea, C. Bowen).

"Men, Ships, and the Sea," Proceedings of the Marine Safety Council, U. S. Coast Guard, Washington, D. C. , May-June 1995 (R. G. Bea).

"Management of Human and Organizational Error Throughout a Ship's Life Cycle," Proceedings of the Institute of Marine Engineers, Symposium on Management and Operation of Ships, London, U. K. , May 1995 (W. H. Moore, R. G. Bea).

"Simplified Evaluation of the Capacities of Template-Type Offshore Platforms," Proceedings of the 5th International Offshore and Polar Engineering Conference, The Hague, The Netherlands, ISOPE Paper No. 95-JSC-214, June 1995 (R. G. Bea, M. Mortazavi).

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"A Methodology for Assessing and Managing Fire and Life Safety for Offshore Production Platforms," Proceedings of the 5th International Offshore and Polar Engineering Conference, The Hague, The Netherlands, ISOPE Paper No. 95-JSC-215, June 1995 (W. E. Gale, W. H. Moore, R. G. Bea, and Prof. R. B. Williamson).

"Fatigue Life Estimation for Repaired Ship Critical Structural Details," Proceedings of the 14th International Offshore Mechanics and Arctic Engineering Conference, OMAE Paper No. 95-731M, Copenhagen, Denmark, June 1995 (K. Ma, R. G. Bea).

"Organization Factors in the Quality and Reliability of Marine Systems," Proceedings of the 14th International Offshore Mechanics and Arctic Engineering Conference, OMAE Paper No. 95-1354, Copenhagen, Denmark, June 1995 (R. G. Bea, K. Roberts).

"Quality, Reliability, Human and Organization Factors in Design of Marine Structures," Proceedings of the 14th International Offshore Mechanics and Arctic Engineering Conference, OMAE Paper No. 95-1355, Copenhagen, Denmark, June 1995 (R. G. Bea).

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"Human Factors in Operationial Reliability of Offshore Production Platforms: The Fire and Life Safety Assessment Index Methodology (FLAIM), Proceedings of the Offshore Mechanics and Arctic Engineering Conference, American Society of Mechanical Engineers, Copenhagen, Denmark, June 1995 (W. E. Gale, W. H. Moore, R. G. Bea, R. B. Williamson).

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"Human and Organization Factors (HOF) in Design, Construction, and Operation of Offshore Platforms," Proceedings of the Offshore Technology Conference, OTC 7738, Houston, Texas, May 1995 (R. G. Bea, K. Roberts.

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SCREENING METHODOLOGIES FOR USE IN OFFSHORE PLATFORM ASSESSMENT AND REQUALIFICATION

Project Objective:

Further develop and verify simplified quantitative screening methodologies for Level 2 platform assessments so these methodologies may be used in practice

Phase I: June 1993 to May 1995

Phase II: June 1995 to May 1996

Phase III: June 1996 to May 1997

Phase IV: June 1997 to December 1998

PHASE IV PROJECT SPONSORS

ARCO Exploration and Production Technology

Exxon Production Research Company

Mobil Technology Company

Shell Deepwater Development Company

Unocal Corporation

US Minerals Management Service

IMP / Brown & Root

New Sponsor:

Chevron Petroleum Technology Company

PHASE IV DELIVERABLES

#1:

Documentation of ULSLEA program enhancements, comparisons, developments, evaluations, and verifications

#2:

Updating of ULSLEA user and modeling guide; updating of ULSLEA software

#3:

Two meetings

ULSLEA PHASE I

- Aero and hydrodynamic loadings ✓
- Unbraced deck legs capacity ✓
- Jacket capacity (legs, braces, joints) ✓
- Foundation capacity ✓
- Deterministic ULS analysis ✓
- Probabilistic ULS analysis ✓
- Damaged and grout-repaired members ✓
- Verification case studies (5) ✓
- ULSLEA program documentation ✓
- Meetings (2) ✓

ULSLEA PHASE II

- Modeling enhancements ✓
- Code updating and enhancement ✓
- Preliminary design of braces ✓
- Jacket horizontal framing effects ✓
- Additional verifications (2) ✓
- Linear analysis comparisons ✓
- User - modeling guide ✓
- Reporting and documentation ✓
- Meetings (2) ✓

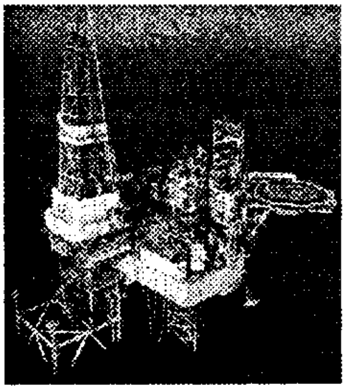
ULSLEA PHASE III

- Fatigue analysis algorithms ✓
- Earthquake analysis algorithms ✓
- Verifications of earthquake analysis (3)✓
- Earthquake deck spectra ✓
- Additional configurations ✓
- Platform strength and robustness studies ✓
- Code updating ✓
- Reporting and documentation✓
- Meetings (2) ✓

ULSLEA PHASE IV

- Platform Damage Studies (1 of 3) ✓
- Ductility-Level Earthquake Analysis
- Diagonal Loads on Platforms
- Additional Configurations (2) ✓
- Tubular Joint Uncertainties ✓
- Platform Foundations ✓
- Improved Input / Output
- Lifetime Reliability (Storms and Quakes)
- Wave Spatial Effects
- Shallow Water Kinematics
- Deck Elements
- Reporting and documentation
- Meetings (2)

ULSLEA Updating and Enhancements



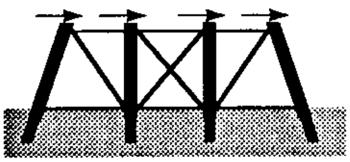
- Simple Modeling of Foundations
- Ductility-Level Earthquake Analysis
- Program Input / Output Enhancements

by James D. Stear

ULSLEA Foundation Model

Current Model:

- Foundation strength and stiffness is based only on piles
- Jacket weight assumed carried by mudline elements

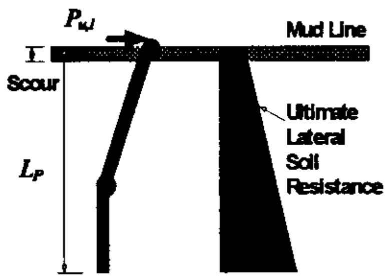


Proposed Changes:

- Include strength and stiffness formulations for conductors, mud mats and mudline braces
- Present "bounding" capacities and stiffnesses to user

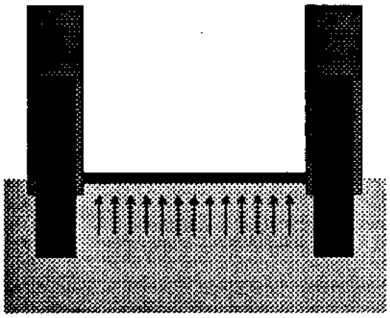
Conductors

- Model as piles
- Deduct for group effects
- No vertical strength or stiffness

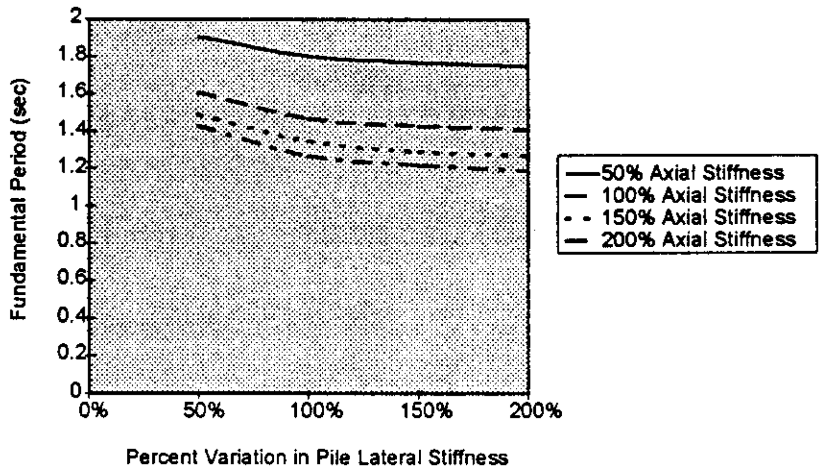


Mats and Braces

- Establish projected areas of resistance
- Capacity is based on weakest of brace or mat, leg or soil
- For upper-bound stiffness, consider jacket to be fixed at mudline



Bounding Stiffness



Modeling Pile Stiffnesses

Horizontal Pile-Head Springs (kips / in)

D	$12EI/L^3_{5D}$	$12EI/L^3_{10D}$	Penzien	Dobry	DRAIN
72"	1093	136	870	515	469
66"	1640	205	598	623	260
48"	1640	205	435	623	135

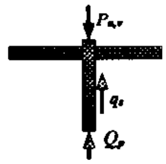
Vertical Pile-Head Springs (kips / in)

D	3EA/L	EA/L	Dobry	DRAIN
72"	10933	3644	2915	3150
66"	8541	2847	3787	4496
48"	7069	2356	3787	2825

Piles in Layered Soils

Axial:

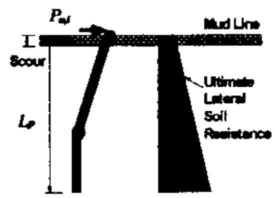
$$P_{u,v} = \int_0^L q_s(z)dz + Q_p$$



Lateral:

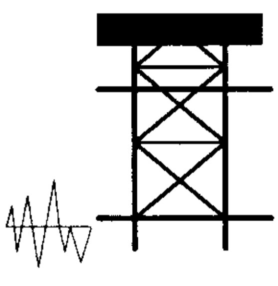
$$P_{u,l} = \int_0^{L_d} S_u(z)dz$$

$$P_{u,l} = \frac{2M_p}{L_d} + \frac{1}{L_d}\int_0^{L_d} S_u(z)dz$$



Earthquake Analysis: Overview

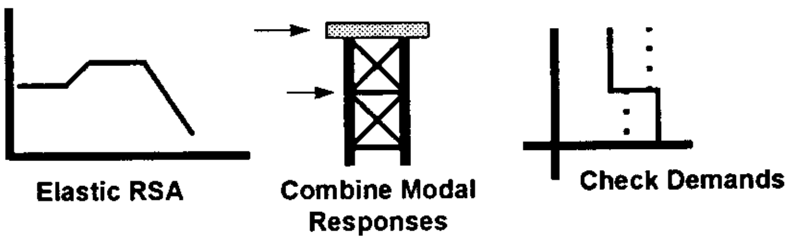
- Previous effort devoted to strength-level analysis
- Procedures developed for determination of vibration properties
- Current focus is on ductility-level analysis



Bounding DLE Demands

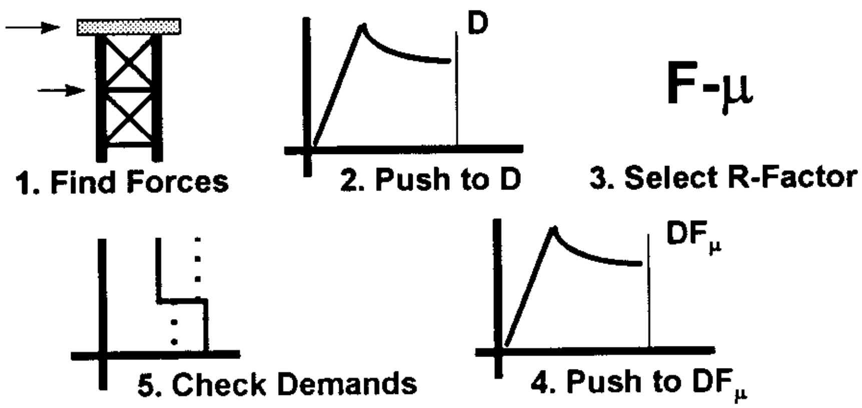
APPROACH 1: NEWMARK / HALL

- Perform elastic modal analysis
- Assume $D_{elastic} = D_{inelastic}$



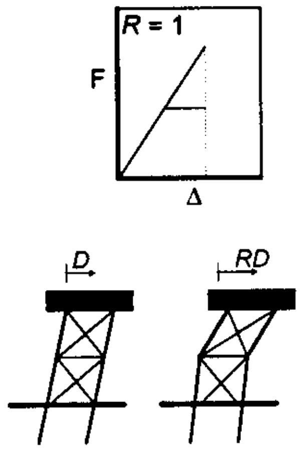
Bounding DLE Demands

APPROACH 2: SCALED PUSHOVER



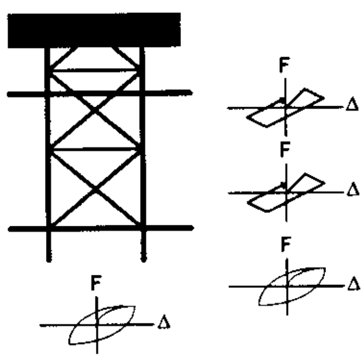
Response Factors

- Relate displacements of linear and nonlinear SDOF systems
- Previous comprehensive studies have examined EPP, bilinear, stiffness degrading systems

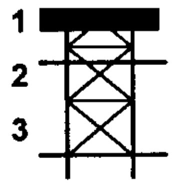


Response Factors

- Study will determine response factors for systems with stiffness and strength degrading behavior
- Statistical properties of factors will be identified



Example: Bounding



MKO (μ)

H	N-H	SP	T-H
1	0.74	0.4	0.44
2	1.84	2.93	1.4
3	1.34	0.72	0.89

Northridge-Newhall (μ)

H	N-H	SP	T-H
1	0.49	0.4	0.44
2	1.22	1.42	1.54
3	1.92	0.72	0.84

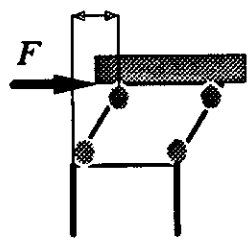
Northridge-Sylmar (μ)

H	N-H	SP	T-H
1	0.81	0.4	0.47
2	2	2.93	3.03
3	1.5	0.73	1.13

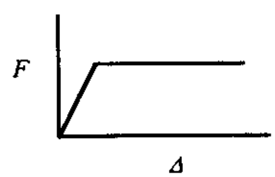
Component Capacities

Unbraced Jacket Sections:

$$\mu_{cr} = \frac{\phi_u}{\phi_y}$$



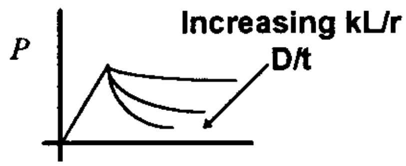
$$\Delta_u = \mu_{cr} \Delta_y$$



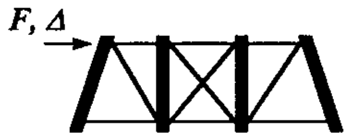
Component Capacities

Braces:

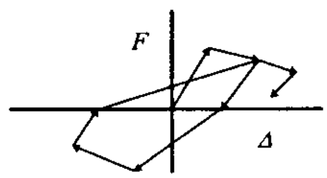
$$\mu_{cr} = \frac{\varepsilon_u}{\varepsilon_y}$$



Bay Behavior:

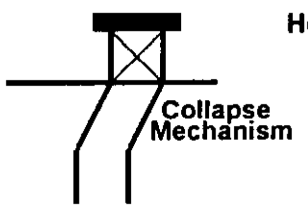


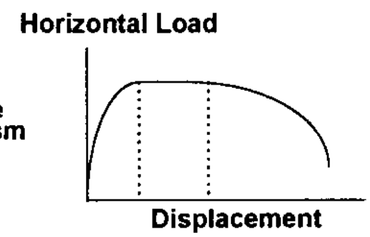
$$\Delta_u = \mu_{cr} \Delta_y$$



Component Capacities

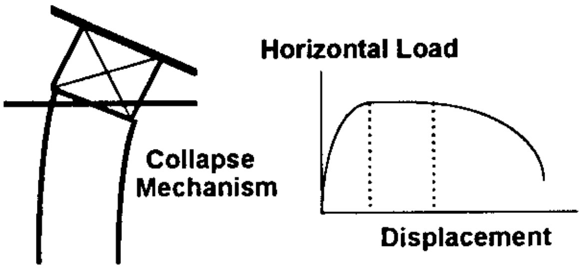
Pile Lateral Capacity:





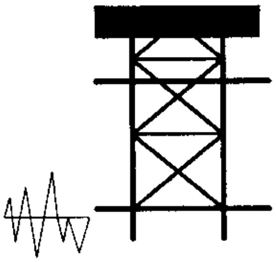
Component Capacities

Pile Axial Capacity:



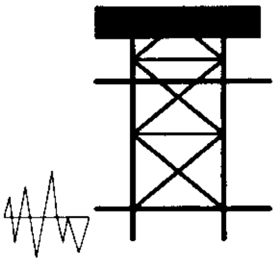
Reliability

- Principal source of uncertainty is in ground motion
- Uncertainty in R-Factor may be significant at large displacements



Verification:

- Models and results from 3-D TH ductility-level analyses of platforms are needed
- Sponsor input is requested



Program Enhancements: Revised Input

Interface Revision is 70 % Complete:

- Excel 4.0 macros removed
- New inputs for braces, joints and piles
- Special input screens for additional configurations
- Program is now a single file of 1MB
- Development done in Excel 7.0 for Windows 95

Program Enhancements: Improved Output

Tabular Output:

- Revised printing features, no more blank pages
- Pile capacities and loads, with self-weight added to load
- Mode shapes and periods
- Fatigue damage
- Shears at framing levels and bay capacities
- Brace capacities with and without local forces

Program Enhancements: Improved Output

Graphical Output:

- Mode shapes
- Fatigue criticality for main diagonals
- Correct titles for plots
- Base shear and overturning moment

INFORMATION REQUEST FOR DUCTILITY-LEVEL VERIFICATIONS

INTRODUCTION:

To assist in benchmarking the proposed simple ductility-level earthquake analysis approach, data from comprehensive ductility-level earthquake time-history analyses of jacket-type platforms is being requested from the sponsors.

TYPES OF PLATFORMS:

Initial focus will be on fairly simple structures, of which three are desired. These structures should have the following characteristics:

1. 4-legs, symmetric mass and stiffness on both end-on and broadside axes (to minimize torsion effects).
2. If piled through the legs, grouted pile-leg annuluses.
3. Sited in water depths from 50 ft to 600+ ft.
4. Platforms without conductors are preferred.
5. A variety of framing systems is preferred (single braced, X-braced, K-braced).

Later studies will consider larger, more redundant structures. Again, it is preferred that the structures be fairly symmetric, and have grouted pile-leg annuluses if piled through the legs.

INFORMATION NEEDED FOR EACH CASE:

Data is needed both on the model developed for the time-history analyses, and on the results obtained from the time-history analyses.

Model:

1. Structural drawings of platform.
2. Weight distribution of platform used in model. Lumped masses at horizontal framing levels.
3. Description of program used.
4. Description of how added mass was accounted for. Marine growth assumed?
5. Description of element used to represent tubular members, and sample cyclic hysteresis plots for several elements. How were member yield and post-yield behavior established?
6. Description of how foundation was modeled. Were mats and mudline braces accounted for? Were conductors accounted for? How were piles and conductors modeled? Pile-head load-deflection plots (for principal directions) for piles and conductors under cyclic loading. If equivalent pile-head springs were used, the stiffness, yield strengths, and post-yield cyclic behavior assigned to each spring on each principal direction.

7. Description of how deck was modeled. Rigid deck assumed?
8. What earthquake time-histories were used? What scaling was applied? How were motions applied to the model?
9. Local member loads.
10. What damping was used?
11. Soil profile at the site, including soil shear strengths, elastic modulus and poisson's ratio.
12. Description of how joints were modeled.

Analysis:

1. Principal vibration characteristics of model (periods, mode shapes).
2. Diagrams showing were yielding occurred, and how much. Envelopes for peak member stresses and strains.
3. Collapse criteria used (Critical strain on members exceeded? Instability in model?).
4. Deck deflection vs. base shear plots if static pushover analysis was performed, along with load pattern used and collapse mechanism identified.
5. Any simple or approximate dynamic analysis results (inelastic response spectrum approach, etc.).
6. Envelopes for peak global loads on the platform: base shear, overturning moment, shears at each horizontal framing level.

Any questions or comments should be forwarded to:

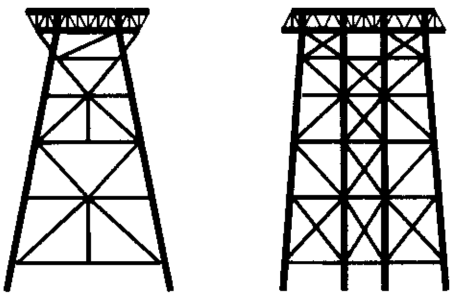
James Stear
Civil Engineering / Construction
215 McLaughlin Hall
Berkeley, CA 94720-1712

Phone: 510 526-2501

e-mail: stear@loke.berkeley.edu

Loading and Capacity Characteristics of Marine Pile Foundations

Correlation of Calculation Results with ULSLEA



Report to Joint Industry Project ponsors

by
Zhaohui Jin
and Professor R.G. Bea
Dept of Civil & Environmental Engineering
University of California at Berkeley

Some general conclusion from the current research in the field of pile response

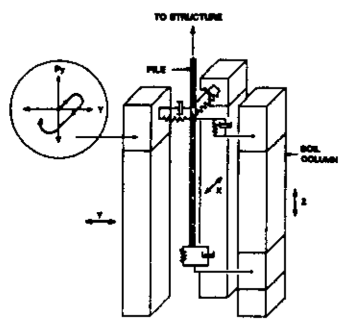
- Dynamic response depends primarily on external loading patterns and the inherent structure properties;
- Environmental loading are dynamic;
- Nonlinearity is a key concern in the analysis: at presence of soil, which are highly nonlinear, the pile foundation exhibits complicated coupling action between the soil and the steel piles;
- High strain rates increase strength and stiffness;
- Cyclic strains decrease strength and stiffness;
- Cyclic loading leads to accumulated displacements;
- Damping developed from pile foundation is important;

Analysis models used in the study

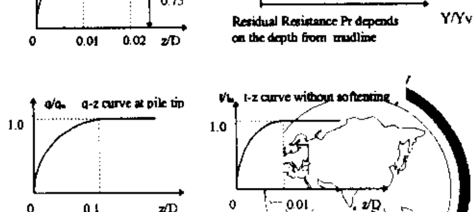
- SPASM: lateral Response
  - linear pile
  - non-linear, degrading, hysteretic soil supports
  - extended capacity to estimate the ultimate pile foundation resistance
- DRAIN3D: Both lateral and axial response
  - non-linear pile up to the ultimate state
  - non-linear, hysteretic, displacement-softening soil supports
- ULSLEA: both lateral and axial response
  - simplified estimation of the ultimate capacity

Basic Approaches in the simulation of the coupling of the pile and the near-field Soils

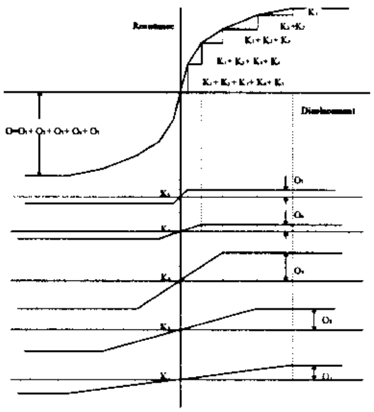
- Winkler pile foundation model



- Typical p-y curve, t-z curve and q-z curve



Soil profiles and computer-internal representation of the p-y,t-z and q-z springs



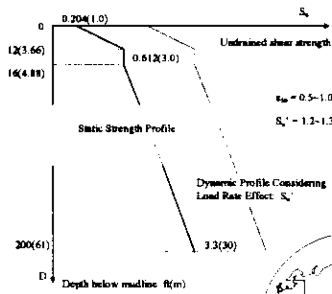
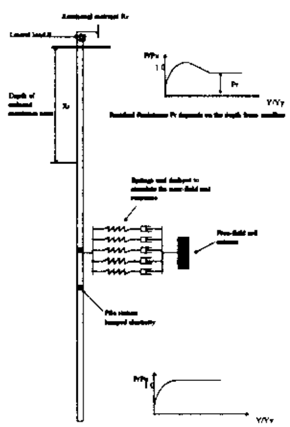
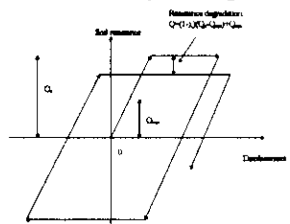


Illustration of the SPASM analytical model



Mechanism of cyclic degradation:



$$Q_2 = (1-\lambda)(Q_1 - Q_{min}) + Q_{min}$$

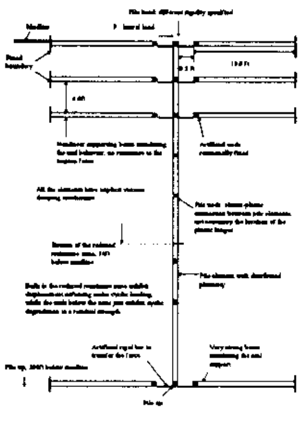
Residual soil resistance:

$$\frac{P}{P} = 0.75\ \frac{X}{X}$$

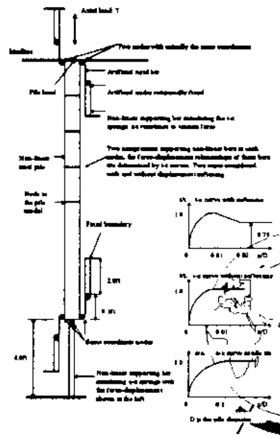
$$\frac{P}{P} = 0.75$$

Expression of Laterally and Axially Loaded Pile in DRAIN3D Program

- Equivalent truss frame simulating the lateral pile-soil response

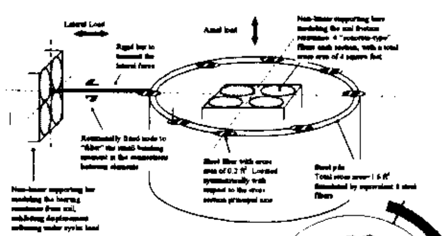


- Equivalent truss frame simulating the axial pile-soil response



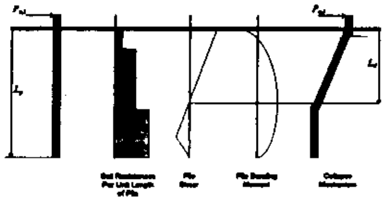
Details of the nodes in the discrete DRAIN3D models

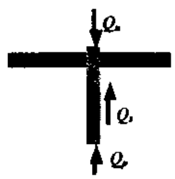
- Sections of the elements are divided into plastic fibers with the non-linear stress-strain relationships
- Artificial rigid bars are added to the soil elements with one end nodes rotationally fixed. This is intended to filter the unreasonable small bending moments at the connection nodes. These bending moments can induce the buckling of the soil elements, which is not true for the soils in field



Simplified ULSLEA Static Pile Ultimate Capacity Estimation

Illustration of the simplified approach: lateral and axial:





Lateral capacity calculation:

$$P = \int S(z)dz$$

$$P = \frac{2M}{L} + \frac{1}{L}\int S(z)zdz$$

Axial capacity calculation:

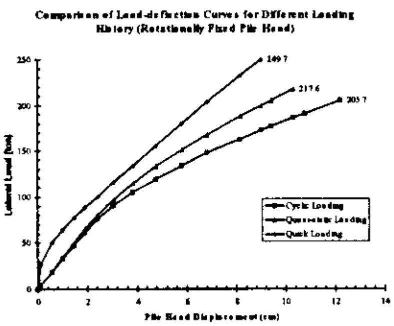
$$Q = Q + Q = qA + fA$$

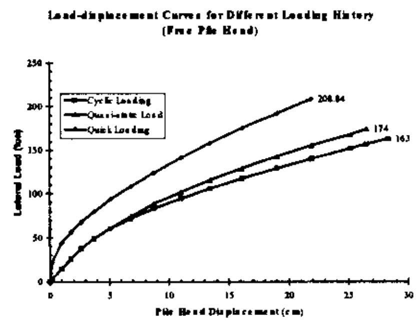
$$Q = \frac{q\pi D^2}{4} + (f\pi D - W)L$$

$$W = \gamma A + \gamma A = \frac{1}{4}[\gamma\pi(D^2 - D^2) + \lambda\pi D^2]$$

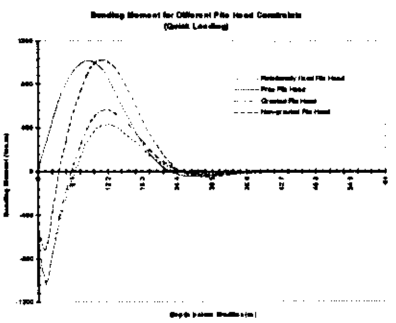
$$q = 9S \qquad f = kS$$

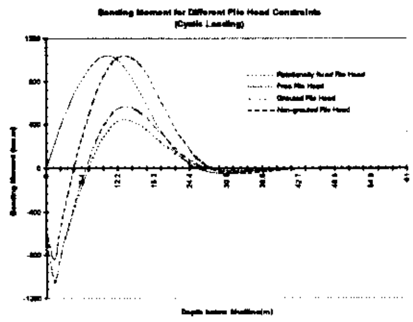
Results from SPASM: load-deflection relationship for the standard cases with best estimated soil characteristics: rotationally fixed and free pile heads





Results from SPASM: bending moments in the pile at the point when the first yielding occurs (fast load and cyclic load)

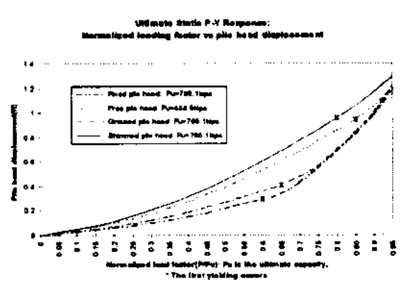




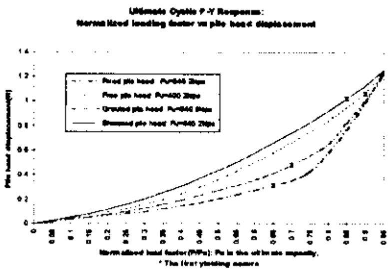
Analysis results of DRAIN3D Lateral Response Model

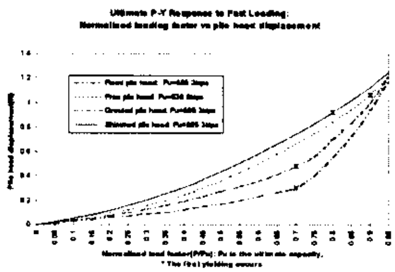
Results and Conclusions Obtained from the DRAIN3D Model:

- There are satisfactory agreements in the pile lateral response before the occurrence of the first yielding with the SPASM model. Pile performances, both in resistance to loading and pile head displacement are comparable.
- The prediction of the ultimate capacities are quite different from those of SPASM. For each case of loading pattern, the ultimate capacities of the pile-soil system tend to converge to one value for fixed, grouted and shimmed pile head. For the case of free pile head, the ultimate capacity is much lower than those with pile head restraint.
- Different loading patterns have different ultimathe capacities
- It seems that there is a maximum pile head displacement for this pile configuration. The pile is doomed to fail if the pile head displacement exceeds this maximum value for all cases

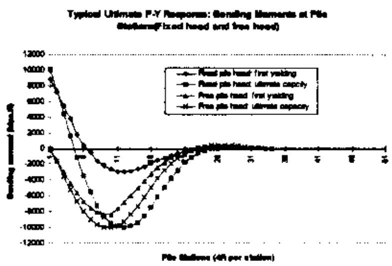


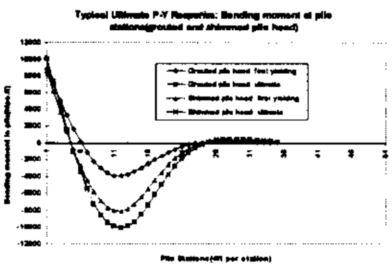
Analysis results of DRAIN3D Lateral Response Model(continued)





Typical Bending Moment Distribution along the Pile length for the First Yielding and Ultimate States





Comparison of the lateral capacities obtained by different models

Lateral capacities of a single pile (CALCULATED BY SPASM)						
	First Yielding Capacity (kips)			Ultimate Capacity(kips)		
Head Rigidity	Quasi-static	Quick	Cyclic	Quasi-static	Quick	Cyclic
Fixed Head	479	550	453	813	968	778
Free head	383	460	359	627	871	599
Grouted	525	618	496	867	1073	831
Non-grouted	630	740	599	1046	1400	1002

Lateral capacities of a single pile (CALCULATED BY DRAIN3D)						
	First Yielding Capacity (kips)			Ultimate Capacity(kips)		
Head Rigidity	Quasi-static	Quick	Cyclic	Quasi-static	Quick	Cyclic
Fixed Head	513	609	413	765	895	645
Free head	415	472	351	489	537	400
Grouted	480	645	453	765	895	641
Non-grouted	643	725	554	765	895	645

Static ultimate capacity of a single pile (CALCULATED BY ULSLEA)	
Fixed Head	Static ultimate Capacity(kips)
ULSLEA 3.0 (linearly increasing S_u)	793
ULSLEA phase IV(layered soils)	910

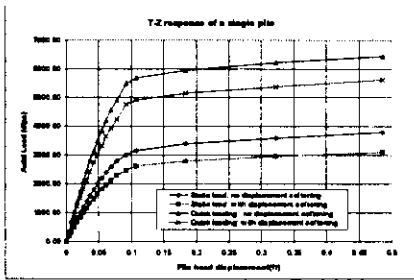
Comparison of the Axial Ultimate Capacities Obtained by Different Methods

There are satisfactory agreements between the different calculation methods:

Axial capacities of a single pile [illegible]		
	Axial ultimate Capacity(kips)	
Calculation Methods	Static	Quick
Drain3D without displacement softening	[illegible]	[illegible]
Drain3D with displacement softening	[illegible]	[illegible]
ULSLEA(layered soils)	[illegible]	[illegible]
API calculation method	[illegible]	[illegible]

- Drain3D model proved the axial response is quite sensitive to the load rate effect.
- ULSLEA model tends to capture the lower bound of the static ultimate capacity
- More efforts needed to figure out the cyclic load effects on the ultimate capacities

Axial load-pile head displacement history obtained by DRAIN3D:



Summary and Conclusions

- For lateral loaded pile, three failure modes exist: excessive pile head displacement; permanent damage to the pile; and ultimate collapse.
- For the pile configuration under study, pile rigidity is not an important factor influencing the ultimate capacity, all shimmed, grouted, and fixed pile heads have the similar lateral ultimate capacity. Free pile head is an exception.
- For the pile configuration under study, pile rigidity is an important factor influence the first yielding capacity, and the reserve strength of the pile. Stiff pile head is prune to suffer permanent damage but has large reserve strength. Flexible pile head is not easy to yield, but has little robustness.
- For the pile configuration under study, there exists a maximum later pile head displacement. The pile is doomed to fail if the pile head displacement exceeds this value.
- The cyclic degradation will cause 20-30% loss of static lateral capacities, both first yielding capacity and ultimate capacity.
- The loading rate effect will cause around 20% increase in lateral dynamic capacity with respect to the static capacity.

Summary and Conclusions (cntd)

- For the pile-soil system under study, the axial loading rate effect increases the dynamic capacity by 70-80% with respect to the static axial capacity.
- The end bearing capacity is not as important as the side friction for the axially loaded piles. For the pile configuration under study, the maximum pile head displacement is a little larger than 10% of the pile diameter.
- The displacement softening occurring during the axial loading process decreases the ultimate axial capacity by around 20%.
- For the case of lateral loading, ULSLEA can give a very good estimation of the ultimate capacities no matter the pile heads are fixed, shimmed or grouted.
- For the case of axial loading, ULSLEA capture the lower bound of the ultimate capacity, thus is conservative in practice.
- In practice, ULSLEA has good validity in predicting the ultimate capacities of the platforms' pile foundations.

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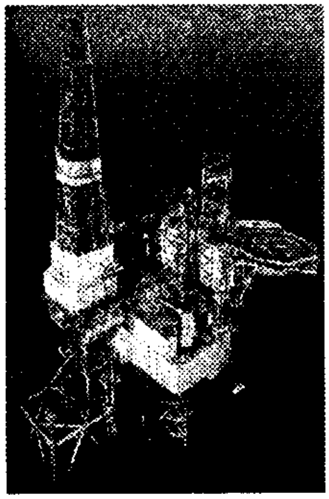
Screening Methodologies for Use in Platform Assessments & Requalification

REASSESSMENT OF TUBULAR JOINT CAPACITY

UNCERTAINTY AND RELIABILITY

By
Dr. Tao Xu
Marine Technology & Management Group
Dept. of Civil & Environmental Engineering
University of California at Berkeley
Berkeley, CA 94720

January, 1998



Uncertainty and Reliability

1 - Uncertainty

Natural (Type I) ⟶ irreducable

Model (Type II) ⟶ reducable

Human (Type III)

2 - Reliability and Uncertainty

Tubular Joint Capacity

- Failure Modes

- -Plastic failure of the chord,
- -Cracking and gross separation
- -Cracking of the brace
- -Local Buckling
- -Shear failure of the chord
- -Lamellar tearing

- Principal Factors

- - Chord outside diameter
- - Brace outside diameter
- - Chord wall thickness
- - Gap
- - Angle between chord & brace
- - Chord material yield stress

Development of Joint Capacity Equations

- Dimensional Analysis

(P_u) or $(M_u) = F(D, d, T, g, \theta, L, F_y, F_t)$

D - Chord outside diameter

d - Brace outside diameter

T - Chord wall thickness

g - Gap

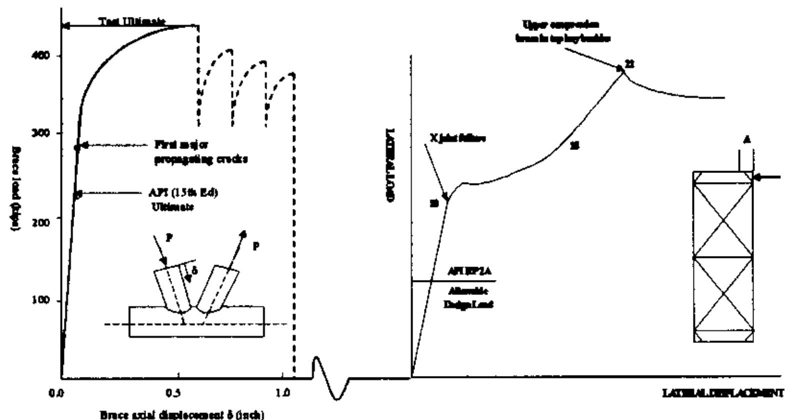
θ - angle between chord and brace

F_y - Chord material yield stress

F_t - Chord material tensile strength

- Calibration with Experimental Data

Uncertainty of Tubular Joint Capacity



Full Scale Test of Tubular Joint

Overall Load-Displacement Response in a Large Scale Frame Tests

Evaluation of Existing Guidelines

- **Data Screening and Validity**
  1 - Scale Effects : Small & Large ✓
  2 - Material Properties - Yield Stress
  3 - Chord/Brace Length and Boundary Conditions
  4 - Joint and Structural System
- **Multiplanar Joints**
  1 - AWS Code
  2 - API Code
- **Complex Joints**

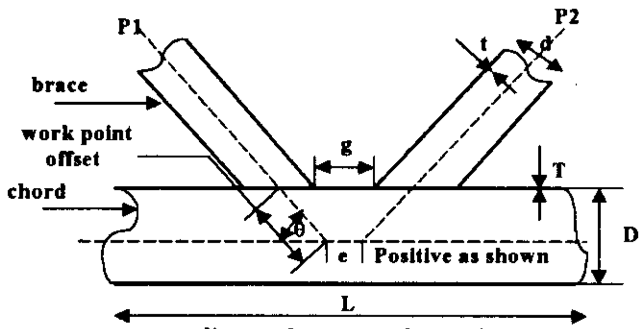
Development of Uncertainty Models

1 - Data Screening and Acceptability

2 - Database Development

- Yura/API Database
- HSE Database
- JISSP (Joint Industry Static Strength Project) Database
- Database for Multiplanar Joints
- Database for Cracked Joints
- Others

Uncertainty Analysis of Simple Joints



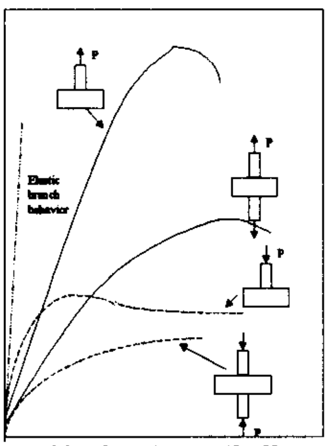
Database for Simple Joints

1 - Yura/API Database

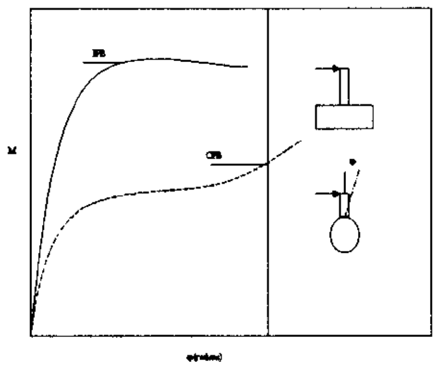
2 - HSE Database

3 - JISSP Database

Simple Joint Behavior

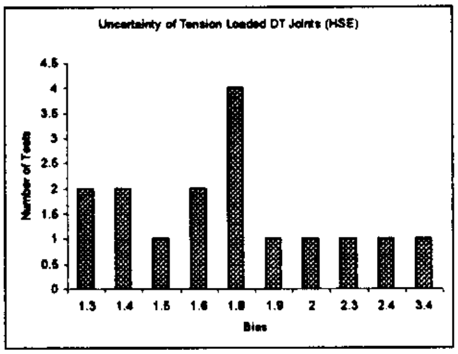


Load Deflection Behavior of Axially Loaded T and DT joints



Load-deflection Behavior of Tubular Joints subjected to Bending

Uncertainty Analysis of Simple Joints

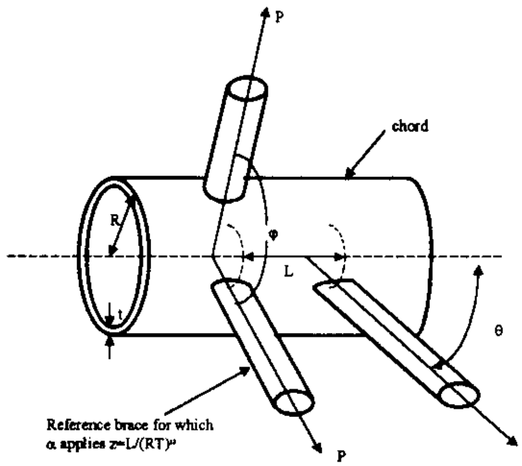


Uncertainty of Tension Loaded T, Y and DT Joints Based on HSE Database (Ultimate Strength Criteria)

Uncertainty of Simple Joints

		Yura Database		HSE Database		JISSP
Joint Type	Load Type	B	COV(%)	B	COV (%)	B
T & Y	Tension	1.41	42.7	2.71	14.1	-
X & DT	Tension			1.72	17.3	-
T & Y	Compression	1.07	7.1	1.236	19.8	2.025
X & DT	Compression			1.13	7.73	1.49
K & YT	Compression	1.31	26	1.32	20	-
All	In-Plane Bend	1.23	13.3	1.18	17.8	2.4
All	Out-Plane Bend	1.17	15.3	1.18	17.8	1.145

Uncertainty Analysis of Multiplanar Joints



Multiplanar Joint Database

Multiplanar Joint Database

Joint Type	Range of Parameters	Origin of Database	Test or FEA	Number of Data
KK	$60^0 \leq \varphi \leq 90^0$	*Paul et al (1992)*	*Test*	*18*
	$49.1^0 \leq \theta_c \leq 90^0$	*Makino et al (1984)*	*Test*	*19*
	$0.224 \leq \beta \leq 0.471$ $9 \leq \gamma \leq 40$	*Makino et al (1992)*	*Test*	*2*
	$0.82 \leq \xi_l \leq 16.85$ $0.037 \leq \xi_t \leq 0.524$	*Wilmshurst et al (1993)*	*FEA*	*40*
TT	$60.3^0 \leq \varphi \leq 120.4^0$	*Paul et al (1991)*	*Test*	*11*
	$0.222 \leq \beta \leq 0.732$	*Scola et al. (1989)*	*Test*	*7*
	$17.2 \leq \gamma \leq 18.3$ $0.037 \leq \xi_t \leq 0.732$			
XX	$\varphi = 90^0$	*Van der Vegte et al (1991,1993)*	*Test*	*12*
	$\beta = 0.602$ $\gamma = 20.32$ $\xi_l = 0.39$		*FEA*	*18*

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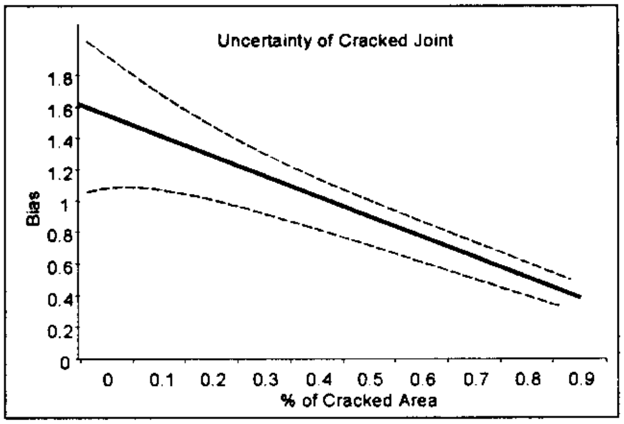
Uncertainty of Multiplanar Joints

Joint Type	Load	Design Code		B	COV
TT Joint	Axial	AWS	unmodified	1.214	0.17
			In-plane		
			Out-of-plane	1.719	0.15
			Both		
KK Joint	Axial	AWS	Unmodified	1.378	0.151
			In-plane	1.310	
			Out-of-plane	1.239	0.108
			Both	1.178	0.122
XX Joint	Axial	AWS	Unmodified	1.47	0.167
TT Joint	Axial	API	T Joint	1.594	0.188
KK Joint	Axial	API	K Joint	1.642	0.121
XX Joint	Axial	API	X Joint	2.07	0.27

Uncertainty of Complex Joints

Joint Type	Bias	COV
Overlapping Through Overlap	3.56	0.31
Grouted	1.27	0.30
Can Reforced T Joint X Joint	 1.1 1.2	 0.057 0.074
Cracked Joint	1.73	0.154

Uncertainty Analysis of Complex Joints



Uncertainty of Cracked Simple Joint Based on API RP 2A Intact Equations

Summary and Conclusions

1 - Development of the Database

2 - Evaluation of the Existing Codes

3 - Development of Uncertainty Models

Recommendations

- Joint and Structural System

- Fatigue of Tubular Joints - Uncertainty Model

- Risk Based Management of Joint System

  Inspection, Maintenance, Monitoring, and Repair Systsem √

Development of Stand-Alone Version of ULSLEA v4.0

Dr. J. Ying

Prof. R.G. Bea

University of California, Berkeley

Background

- Excel4.0 macros and Excel 5.0 Visual Basic
- Compatibility with new versions of Excel
- Spreadsheets data storage is inefficient
- Macros are limited in size, and not good for efficient computing
- Hard for maintenance and update

Objective and Scope

- A stand-alone version of ULSLEA
  - Input, output features of ULSLEA v3.0
  - Update the calculation procedure
  - MS Visual C++ & Visual Basic
  - Run on the Windows 95/NT

Deliverables and Schedule

- ULSLEA v4.0, a stand-alone program
- Document of the program structure and source code.
- February 1st to June 30th 1998.

Personnel and Budget

Category	Budget $
Personnel: Prof. Bea (20 hours) Dr. Ying (500 hours)	 $4,000 $25,000
Expenses and Supplies: VC++/VB Package Miscellaneous	 $500 $500
Total Direct Cost	$30,000
University Overhead	$15,000
Total Cost	$45,000

Proposal

Development of Stand-Alone Version of ULSLEA v4.0

Background:

During the past three years, as a result of the Joint Industry Project (JIP) "Screening Methodologies for Use in Platform Assessments and Requalifications," a computer program identified as ULSLEA (Ultimate Limit State Limit Equilibrium Analysis) has been developed and verified for use in performing rapid assessments of platform lateral loading capacity.

The ULSLEA program has shown much promise as a tool to help engineers in the following tasks:

- Quickly assess a platform's fitness for purpose with regards to environmental loads (both deterministically and probabilistically)
- Damage and repair studies, and preliminary design studies
- Checking the results of detailed non-linear analyses

The current version of the ULSLEA program, v3.0 beta, consists of two linked Microsoft Excel 5.0 workbooks. Intended solely as a prototype, the program makes use of the spreadsheet environment within Excel to store data and show tabular and graphical output. Program input is largely controlled by Excel 4.0 macros, while the actual strength, load and reliability calculation routines have been written in Visual Basic, the macro language for Excel 5.0. This arrangement, while functional, has the following drawbacks:

- The program is dependent on the user having a full version of Microsoft Excel 5.0 installed
- Macros (essentially subroutines) contained within the workbooks are limited in size, and not written for efficient updating
- There is no assurance of backwards compatibility as new versions of Excel are released.
- Data storage using Excel spreadsheets is very inefficient

Objective and Scope:

The objective of this project is to produce a stand-alone executable version of ULSLEA which possesses all of the current input, storage, calculation and output features of ULSLEA v3.0 beta, but is no longer dependent upon Microsoft Excel as an operating environment. The program development will be done in Microsoft Visual C++ and Visual Basic. The end result will be a standard MS application which is more versatile, faster, better graphic user interface(GUI), and better hardward resource management. This program will run on the Windows 95/NT operating system. To every extent possible, the final product will replicate the features and functionality of the existing ULSLEA Excel macros, and more, will introduce more powerful functions which are available from Microsoft applications.

Tasks:

The project is organized into four tasks:

1. Program design (input, calculation procedures, output)
2. Program coding (input, calculation procedures, output)
3. Installation procedures
4. Testing and verification

Deliverables:

As a result of the foregoing tasks, there will be two deliverables:

1. ULSLEA v4.0, a stand-alone executable program with all the features and capabilities of ULSLEA v3.0 beta.
2. A report documenting the program structure and source code.

Schedule:

The project will be initiated February 1st 1998, and conclude June 30th 1998. The estimated man-hours to be spent on each task are listed below:

1. Design: A. Input: 50 hours
   B. Output: 50 hours
   C. Algorizm: 50 hours
2. Coding: A. Input: 100 hours
   A. Output: 100 hours
   B. Algorizm: 50 hours
3. Testing: 60 hours
4. Document 40 hours

Total: **500 hours**

Task	Feb.	March	April	May	June
Design	---------------	-------x			
Coding		------	--------------	--------------x	
Install					-x
Testing & Document					-----------x

Personnel and Organization:

This project will be managed by Prof. R.G. Bea and conducted by Dr. Jun Ying, operating as an outside consultant in cooperation with the Marine Technology and Management Group (MTMG).

Budget:

The total cost associated with the project is estimated to be $30,000. The project will be initiated when commitments have been obtained by five sponsors, each contributing $6,000. The budget outlay is as follows:

Category	Budget $
Personnel: Prof. Bea (20 hours) Dr. Ying (500 hours)	 $4,000 $25,000
Expenses and Supplies: VC++/VB Package Miscellaneous	 $500 $500
Total Cost	$30,000

FROM ULSLEA TO TOPCAT: Template Offshore Platform Capacity Assessment Tools

"Limit Equilibrium" is now only one part of the current program... hence "TOPCAT"

Topics of Future Research / Program Enhancement:

1. Fatigue of horizontals
2. Fatigue reliability
3. Benchmarking of simplified fatigue method against more comprehensive analyses
4. Analysis of pile-only structures
5. Distributed loads and torsion
6. Wave loads on decks
7. Continued work on earthquakes

PHASE IV: PLAN FOR NEXT 11 MONTHS

Task /GSR	1998 1 … 6	1998 7 … 12
Damage Studies *New Student*	---------	----------------x
Earthquakes *Stear*	-------------------	--------x
Diagonal Loads *Jin*	---------x	
Improved In/Out *Stear, Jin*	----------------x	
Reliability *Jin*	----------------x	
Spatial Effects *Jin*	-------x	
Shallow Kinematics *Jin*	--------x	
Deck Elements *New Student*	--------------	----------------x
Updated Software	x	
Meetings	x x	