UNIVERSITY OF CALIFORNIA, SAN DIEGO

Residual Strength and Grout Repair of Dented Offshore Tubular Bracing

A thesis submitted in partial satisfaction of the requirements for the degree of Master of Science in Engineering Sciences (Structural Engineering)

by

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1993

ABSTRACT OF THE THESIS

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Thirteen steel tubular braces of various diameter to thickness (D/t) ratio were tested to examine the effect of dent damage on their residual strength and to assess the effectiveness of internal grout and grouted steel clamp repair techniques. The braces were subjected to either direct axial loading or combined axial and bending loads through an applied load with an end eccentricity of 20% of the specimen diameter. The thirteen specimens were tested in five series, including: the testing of non-damaged specimens subjected to combined loads; dent damaged specimens subjected to direct axial or combined loads; internal grout repaired damaged specimens subjected to combined loads; and a grouted steel clamp repaired specimen subjected to combined loads. These tests allowed a direct evaluation by a comparison of the test results. The direct axial tests showed a pronounced loss of ultimate strength. The strength was further reduced for specimens subjected to the combined loading. The degradation of ultimate strength occurred due to a rapid growth of the dent, leading to a plastic hinging in the dented section. Both repair techniques reinstated each specimen's ultimate strength to the original non-damaged ultimate strength by arresting dent growth. Modification of existing damage strength equations and development of new ones were found to reasonably assess the residual strength. Nonlinear finite element analysis also showed promising results in predicting specimen behavior.

ACKNOWLEDGEMENTS

Financial support for this study was provided by the National Science Foundation under Grant MSS 91-57959 PYI, Dr. Ken Chong cognizant NSF program official, in addition to Chevron Oil Field Research Company, Dr. T.M. Hsu program official, Unocal 76 Corporation, Dr. William Lamport program official, and California State Lands Commission under Contract No. C 9160, Martin Eskijian program official. This work is also a result of research sponsored in part by NOAA, National Sea Grant College Program, Department of California Sea Grant College, and in part by California State Resources Agency. The U.S. Government is authorized to reproduce and distribute this document for governmental purposes.

I gratefully acknowledge the support of Professor James Ricles for his unfailing guidance throughout this research. I am also most grateful to Melissa Cabrera, Arlene Schauer, and Paul Mihalic, who assisted in various phases of the experiments, and especially Bill Bruin without whose contributions, this project could not have been completed.