



Fatigue Crack Growth Research

MARINE RESEARCH REVIEWS

The aim of this series of short reviews, begun in 1993, is to disseminate the results of research programmes that were administered by the Marine Technology Directorate (MTD) beyond the immediate circle of the researchers and their sponsors to a wider readership in the offshore and marine industries.

The activities of MTD Ltd are now being carried out under the banner of a new company, CMPT, The Centre for Marine and Petroleum Technology Ltd. CMPT acknowledges the support of the Offshore Safety Division of the Health and Safety Executive in the production of these six reviews of research that has some implications for the safety and lifetime integrity of offshore structures. HSE was one of the contributors to each of the projects or programmes covered. Neither the Executive, the Division nor CMPT assume any liability for the reviews nor do they necessarily reflect the views or the policy of the Executive or the Division.

Six reviews have already been published, five of them with funding from the Oil and Gas Projects and Supplies Office (OSO) of the Department of Trade and Industry.

About the Offshore Safety Division

The responsibilities for regulating health and safety offshore were unified in a single body - the Health and Safety Executive - as a result of the recommendations of the Lord Cullen enquiry into the Piper Alpha disaster. A new Offshore Safety Division was set up as a result.

Research has played an important part in ensuring safety in the North Sea and will continue to do so. A major aim is to undertake an integrated programme of projects which address both the strategic or generic investigation of offshore hazards and the related short term needs, for example to support safety case assessment. A risk-based research strategy has been developed by HSE with input from the Division's Research Strategy Board to provide a means of prioritising research effort and helping to ensure that value for money is obtained.

About CMPT

CMPT is a new organisation set up to integrate research, innovation and technology for the upstream petroleum and marine industry. It will build on the capability and services of both the Marine Technology Directorate (MTD) and the Petroleum Science and Technology Institute (PSTI), each with its track record of meeting industry needs. CMPT's objective is to be the primary focal point and resource centre upon which its members rely for the provision of expertise and the facilitation of technology to enhance business performance.

Publications like Marine Research Reviews play their part in CMPT's technology transfer, delivering new technology from CMPT research programmes into use.

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Contents

	Page
Acknowledgements	2
Summary	3
Introduction	3
Experimental work	4
Fatigue crack growth software	9
High-strength steels	12
Conclusions	15
Programme sponsors	16

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1983-85	Cohesive programme of research and development into the fatigue of offshore structures
1985-87	Fatigue of offshore structures Managed Programme
1987-89	Fatigue crack growth Managed Programme
1990-92	Corrosion fatigue fracture mechanics of high-strength steels directed programme

The full list of sponsors appears on the final page of this review.

Members of MTD may consult the full research reports in the MTD Library. A full account of the later phases of the research has been published in *Fatigue Crack Growth in Offshore Structures*, edited by W D Dover, S Dharmavasan, F P Brennan and K J Marsh, EMAS, 1995, ISBN 0 947817 78 6. Anyone interested in further details of the work should contact the programme manager:

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Note

The Offshore Safety Division of the Health and Safety Executive has supported publication of this report to encourage dissemination of the results of research that has received public funding. This support does not imply automatic endorsement by the HSE of any of the technologies described.

Summary

This report is based on more than ten years of research into fatigue crack growth in offshore structures, which has made a positive contribution to structural safety and improved service life. It begins with an overview of experimental work into the variable amplitude corrosion fatigue of T, Y and K joints fabricated from Grade 50D Steel, and the influence of biological fouling on fatigue crack growth. Next, it details the work that was required to incorporate the findings of these tests into a commercial software package to predict fatigue crack growth. The later part of the report is given over to research on high-strength steels, for example X85, subjected to cathodic protection.

Introduction

The extraction of North Sea oil and gas has largely been achieved with fixed-jacket drilling and production platforms. This type of platform is supported by a welded tubular steel frame which continually experiences wind and wave loading, and is therefore vulnerable to fatigue.

From 1983 to 1992 four MTD research programmes on fatigue crack growth in offshore steel structures were completed. The earlier programmes (1983 - 85 and 1985 - 87) provided a basic understanding of how fracture mechanics modelling could predict the total and remaining life of conventional tubular welded connections and of several novel connections in air and in corrosive environments. The 1987 - 89 programme of research concentrated on three areas: the development of software for stress prediction and fatigue crack growth analysis; fatigue relevant to repairs; and fatigue relevant to new lower cost designs. The final programme (1990 - 1992) investigated the corrosion fatigue behaviour of some high-strength steels. This report concentrates on fatigue crack growth and on work on high-strength steels.