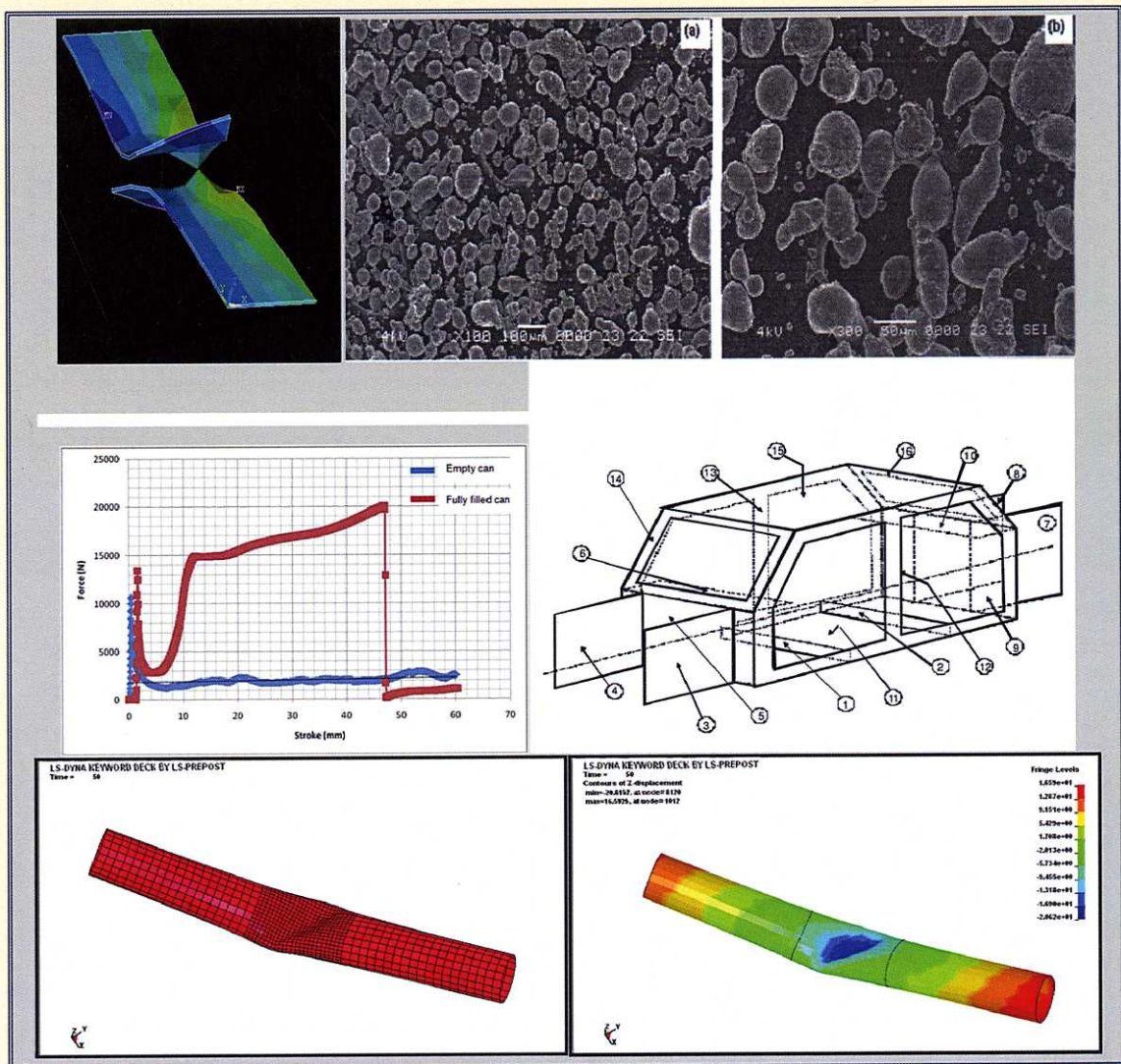


ADVANCED TOPICS IN MECHANICAL BEHAVIOR OF MATERIALS



Edited by

Meftah Hrairi



IIUM PRESS

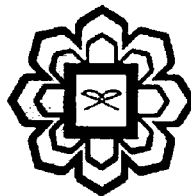
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

ADVANCED TOPICS IN MECHANICAL BEHAVIOR OF MATERIALS

ADVANCED TOPICS IN MECHANICAL BEHAVIOR OF MATERIALS

Edited by

Meftah Hrairi



IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011
©IIUM Press, IIUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

ISBN: 978- 967-418-174-1

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :

IIUM PRINTING SDN. BHD.

No. 1, Jalan Industri Batu Caves 1/3

Taman Perindustrian Batu Caves

Batu Caves Centre Point

68100 Batu Caves

Selangor Darul Ehsan

Contents

Preface.....	x
Acknowledgments	xii
Editor.....	xiv
Contributors	xvi

Section 1 Buckling

1	Cylindrical Shell Buckling Under Axial Compression Load	3
	<i>Qasim H. Shah, Hasan M. Abid, Abid B. Rosli</i>	
2	Experimental Setup of Empty and Water Filled Cylindrical Shell Buckling	8
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
3	Experimental Results of Empty and Water Filled Cylindrical Shell Buckling	13
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
4	Experimental Results of Empty and Water Filled Cylindrical Shell Buckling for 50mm Stroke	18
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
5	Experimental Results of Empty and Water Filled Cylindrical Shell Buckling for 60mm Stroke	24
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
6	Simulation Setup of Empty and Water Filled Cylindrical Shell Buckling	30
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
7	Simulation Results of Empty and Water Filled Cylindrical Shell Buckling	35
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
8	Experimental and Simulation Results of Cylindrical Shell Buckling	41
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
9	Buckling and Crush Analysis of Light Weight Structure	48
	<i>Kassim A. Abdullah and Wan Nur Hidayah Wan Sulaiman</i>	
10	Analysis of Lightweight Structural Tubes for Crashworthy Car Body	54
	<i>Kassim A. Abdullah and Zahra Roslan</i>	

Section 2 Impact

11	Pipe Whip Impact	61
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
12	Experimental Setup of Pipe Whip Impact	66
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	

13	Experimental Results of Pipe Whip Impact	71
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
14	Simulation Setup of Pipe Whip Impact	77
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
15	Simulation Results of Pipe Whip Impact at 55° Angle	82
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
16	Simulation Results of Pipe Whip Impact at 90° Angle	87
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
17	Failure Mechanism of PC Armor Plates with PMMA Sacrificial Layer Subjected to Impact	93
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
18	Damage of Polycarbonate Armor Plate Subjected to Impact	106
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
19	Finite Element to Predict Damage of a Polycarbonate Armor Plate Subjected to Impact	112
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
20	Energy Absorbing Capability of Materials Subjected to Impact Under Gravity Loading	120
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
21	Damage Assessment of Liquid Filled Container Subjected to Free Fall on Rigid Steel Plate	127
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
22	Numerical Analysis of Materials Energy Absorbing Capability Under Gravity Loading Impact ..	134
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
23	Numerical Assessment of Liquid Filled Container Subjected to Free Fall on Rigid Steel Plate	141
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	

Section 3 Design and Manufacturing

24	Overview of the Powder Metallurgy Process	151
	<i>Meftah Hrairi, Asmu'i Hussi, Fadzly Mohamad Ravi</i>	
25	Mechanical Properties of Sintered Aluminum Alloy Compacts	156
	<i>Meftah Hrairi, Fadzly Mohamad Ravi</i>	
26	Numerical Simulation of Green Compacts	161
	<i>Meftah Hrairi, Asmu'i Hussin</i>	
27	Experimental Studies of Dieless Forming	167
	<i>Meftah Hrairi, Saiful Mazwan Nawi</i>	
28	Study of Spot Welding Process	172
	<i>Meftah Hrairi, Fatimah Jamil</i>	
29	General Framework for Inverse Identification of Consecutive Parameters	177

Meftah Hrairi

30	Inverse Parameter Identification of Elastic and Inelastic Constitutive Material Models	183
	<i>Meftah Hrairi</i>	
31	Enhancing Magnetic Particle Testing of Automotive Parts	189
	<i>Meftah Hrairi, Salah Echrif</i>	
32	Design and Fabrication of the Testing Model of the Vehicle Structure Test System	196
	<i>Kassim A. Abdullah and Cheah Siew Loong</i>	
33	Design Analysis of Laminated Composite Ladder Chassis Frame of Light Truck	202
	<i>Kassim A. Abdullah and Mohd Zaimi bin Rosli</i>	
34	Design and Development of Driving System for Disabled Driver	208
	<i>Kassim A. Abdullah, J.S. Mohamed Ali, Mohd Azlan bin Habeeb Rahmathullah, Ruzael Amir Afendi b. Kaharuddin</i>	

Section 4 Liquid Sloshing

35	Liquid Sloshing	215
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
36	Experimental Study of Liquid Slosh Dynamics in a Half Filled Cylindrical Tank	220
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
37	Experimental Results of Liquid Slosh in a Cylindrical Tank with Different Fill Levels	226
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
38	Simulation Model of 3D Liquid Slosh in a Partially Filled Cylindrical Tank	233
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
39	Simulation Results of Liquid Slosh in a Partially Filled Cylindrical Tank	238
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
40	Numerical and Experimental Results of Liquid Slosh in a Partially Filled Cylindrical Tank	242
	<i>Qasim H. Shah, Hasan M. Abid, Adib B. Rosli</i>	
Index.....		247

SIMULATION SETUP OF PIPE WHIP IMPACT*Qasim H. Shah, Hasan M. Abid, Adib B. Rosli***1. INTRODUCTION**

The safety of pipe whip is related issue for nuclear power and chemical plants, where pipes are often used to transport fluids at high pressure and high temperature. Simulation analysis for empty pipe and liquid filled pipe are conducted in this study. The model was made of simple pipe whip system which enables the missile pipe to hit the target pipe at an angle of 90° and also 55° oblique impact. The simulation setup is done by LS-DYNA which is an developed by the Livermore Software Technology Corporation (LSTC). It is a highly nonlinear transient dynamic finite element analysis using explicit time integration.

2. LS-DYNA SIMULATION

The setup of the simulation process is presented by the following figures which show the program applications cards, figures of the simualtions are provided.

2.1 Material Properties

To simulate the pipe whip impact, we had chosen the Johnson Cook material model for copper [1]. All the values for each command are shown in Figure 1. The keyword input for materials properties as follow:

1. MID – Material Identification
2. RO – Mass density
3. G – Shear modulus
4. E – Young’s Modulus (shells element only)
5. PR – Poisson’s Ratio (shells element only)