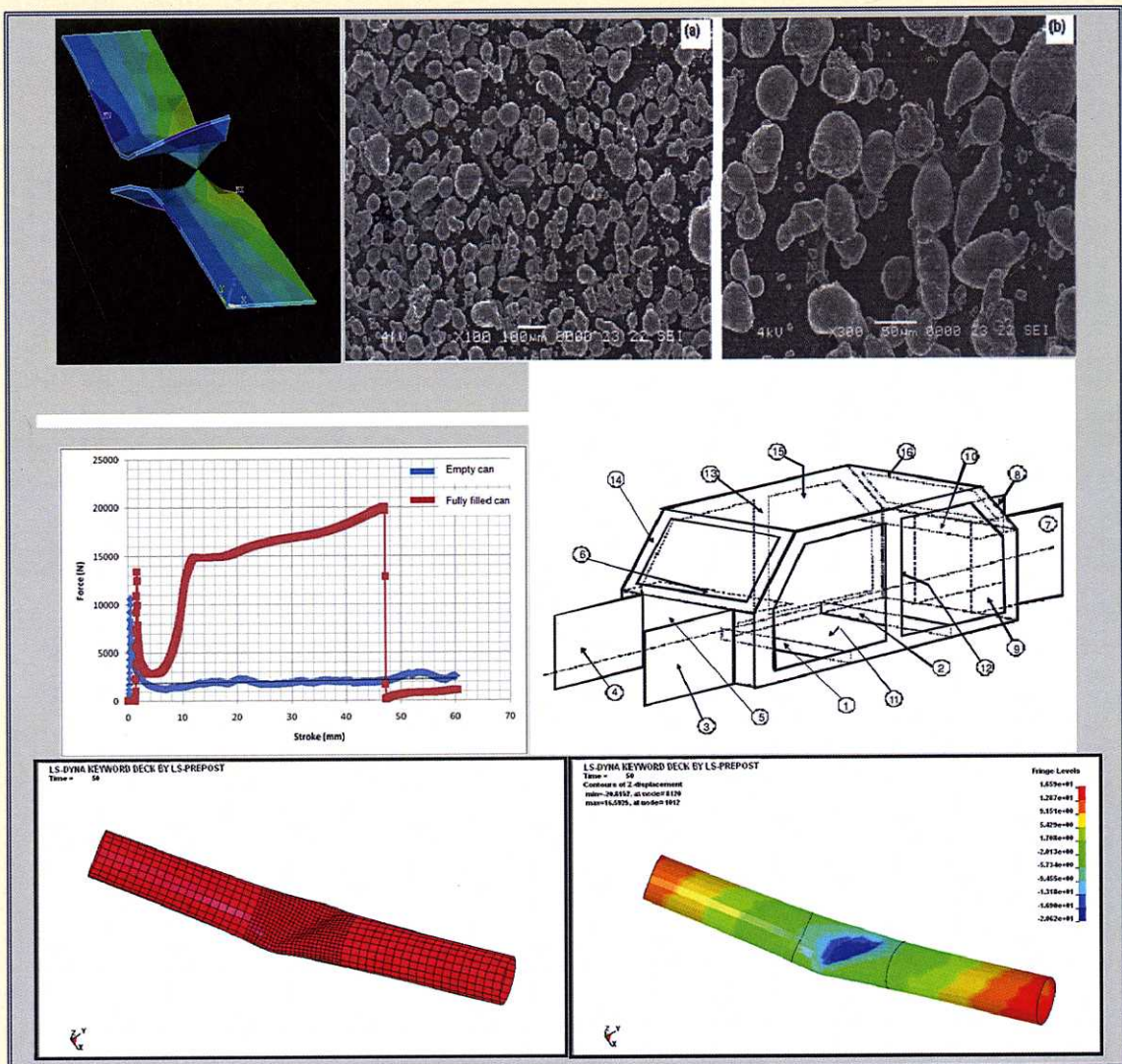


# ADVANCED TOPICS IN MECHANICAL BEHAVIOR OF MATERIALS



Edited by

**Meftah Hrairi**



IIUM PRESS

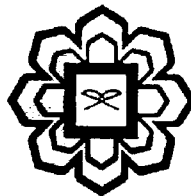
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

ADVANCED TOPICS IN MECHANICAL BEHAVIOR OF MATERIALS

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Edited by

Meftah Hrairi



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# Contents

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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>	

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

### **Section 3 Design and Manufacturing**

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

*Meftah Hrairi*

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

#### **Section 4 Liquid Sloshing**

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

# 35

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## LIQUID SLOSHING

*Qasim H. Shah, Hasan M. Abid, Adib B. Rosli*

### 1. INTRODUCTION

Liquid cargo half filled in a moving road tank usually experiences slosh in large or small amplitude depending on the maneuvers and road surface conditions. Large amplitude sloshing can be induced when a vehicle undergoes braking or accelerating, cornering or lane change maneuvers. Liquid cargo road containers are often partially filled because the axle loads are subject to regulatory limits but the weight densities of the liquid products transported vary from one case to another. For the tanks employed in fuel delivery, the partial fill situation may occur on route.

### 2. DIRECTION DYNAMICS OF HEAVY VEHICLES

The instability of road vehicles, in most cases, occurs when the vehicles are performing maneuvers, such as braking, cornering, lane-change, and braking-in-turn. Roll instability is known to be the most dangerous instability mode that results in relatively large number of rollover related accidents. Heavy-duty vehicles generally tend to be unstable when subjected to a lateral acceleration over 0.3g [1]. Road vehicles may roll over when the overturning moment exceeds the maximum restoring moment [2]. The overturning moment is yielded by the centrifugal force arising from the directional maneuver, while the restoring moment is generated by the lateral transfer of vertical load on tires. For articulated heavy vehicles, the roll instability originates from the trailer axles that experience large magnitudes of lateral load shift. The roll instability can be evaluated from the point of view of relative instability or absolute instability [3]. A relative instability does not imply the actual occurrence of a tip- or roll-over, but relates to the onset of a probable instability, while an absolute instability refers to the absolute rollover.