Structure Design and Impact Safety Analysis of Mini Baja

朱孝文、梁卓中

E-mail: 345428@mail.dyu.edu.tw

ABSTRACT

Mini Baja is an international collegiate design competition sponsored by the Society of Automotive Engineers (SAE). The Mini Baja is a special kind of four-wheeled vehicle used for recreational and exploration purpose. It is designed for off road usage and for endurance of a rough terrain. This thesis was aim to develop the design of a frame which is safe, ergonomic and has the lower possible weight. At first, a Mini Baja which is a rugged, single seat, off road recreational vehicle, is designed and build according 2010 Baja SAE Rules. And then the crash simulations are performed by using the LS-DYNA3D finite element code. The simulated models obtained here have potential for evaluating vehicle crash safety and guiding the development of safety technologies. In order to verify the adaptability of the ECE R94 and ECE R32 in a frontal-impact and rear-impact test, the dynamic response and injury of occupants and vehicle crashes are analyzed. Moreover, with regard to rear-impact safety, Mini Baja is assessed to pass the technical inspection according to the review of the test result and rules. Based on the outcome of the research, it is hoped that the result is able to be taken as a reference to the future design of Mini Baja.

Keywords : SAE Mini Baja、LS-DYNA3D、ECE R94、ECE R32

Table of Contents

REFERENCES

[1] 2010 Baja SAE Rules [2] http://projects.fit.edu/minibaja/2008MEDIA/Mini-Baja_TD_PS.jpg [3] http://www.baja.mtu.edu/media/stout/2005/007.jpg [4] http://www.pgo.com.tw/BUGGY%20500.shtml [5] http://www.auto-online.com.tw/news/78-15402 [6] Brent Zollinger,Robert H.Todd, " Rethinking the Design Paradigm: A Customer-Focused Approach to Designing a Mini-Baja Vehicle ", SAE Paper No.2000-01-2651(2000) [7] Thomas J. Labus and Paul Wasielewski, " An Off-Road Competition Hydraulic Vehicle ", SAE Paper No.2002-01-1450 NCFP 102-21.4(2002) [8] Hashemi , Jonathan Hastie, " Mini Baja Vehicle Design Optimization ",(2005) [9] Allan Burke , Jose Carlos Miranda, " Mini baja Frame Design using Topological Optimization and Impact Testing ", SAE Paper No.2006-01-0952,(2006) [10] KerryT.Wilcoxon, " Occupant Restraint Design for Commercial Go-Karts ",SAE Paper No 1999-01-1294,(1999) [11] Abhijit Duraphe, Ajit D. Kelkar , David Klett, " Non-linear Structural Analysis of An Allterrainvehicle Using ANSYS ",(1999) [12] Romulo Rossi Pinto Filho, Jean Carlos Campos Rezende, Marcus de Freitas Leal, Jose Antonio Ferreira Borges, " Automotive Frame Optimization ", SAE Paper No.2003-01-3702,(2003) [13] Curtis Calwell, John Dejan, William Lo, Robert McKinlay, " University of Windsor SAE Mini-Baja Design Report ", SAE Paper No. Vehicle #38,(2005) [14] Anthony Taylor Owens, Marc Daniel Jarmulowicz ,Peter Jones, " Structural Considerations of a Baja SAE Frame ",SAE paper No.2006-01-3626,(2006) [15] Mark Gilbert, Jeremy Goodman, " University of Tennessee at Chattanooga 2006 Mini Baja Design Report ", SAE Paper No. Vehicle #134,(2006) [16] Tyler Forbes, Jeff LaPierre, Luke Leahy, Ben Mies, " Worcester Polytechnic Institute SAE Baja Design Report ",(2007) [17] Juniper Filanc-Bowen, Kyle Krause, Frank Spiteri, Bradley Vinton, " Bronco Racing Design Report ", SAE Paper No. Vehicle #025,(2008) [18] Matthew Beenen, Jon Wilson , Ned Lincoln, " Union College SAE Baja Vehicle Design Report ", SAE Paper No. Vehicle #83,(2009) [19] Brendan Behrens, Kyle Droessler, " UW-Platteville 2009 Mini Baja Team Design Report ", SAE Paper No. Vehicle #22,(2009) [20] Eric Halfmann, " Lamar University 2010 Baja Design Report ", SAE Paper No. Vehicle #099,(2010) [21] 李春穎、顏健軒， " 輕量化兩輪電動車車架設計 "， 第十五屆車輛工程學術研討會，(2010) [22] Abdullatif K. Zaouk, Nabin E. Bedewi, Cing-Dao Kan, and Dhafer Marzougui, " Validation of A Non-Linear Finite Element Vehicle Model Using Multiple Impact Data ", NCAC paper,(1996) [23] Dhafer Marzougui, Cing-Dao Kan, and Nabih E. Bedewi, " DEVELOPMENT AND VALIDATION OF AN NCAP SIMULATION USING LS-DYNA3D " FHWA/NHTSA National Crash Analysis CenterThe George Washington University, Ashburn,(1997) [24] 吳建勳， " 車輛側陝撞擊事故中人體之損傷分析 "， 大葉大學機械工程學系碩士班畢業論文，(2003) [25] 陳海樹、賴征海， " LS-DYNA在汽車碰撞模擬過程中的應用 "， 沈陽大學學報第18卷第四期，(2006) [26] 黃興閎、許永明、陳偉霖， " 台車模擬碰撞與實車碰撞之特性比對 "， 車輛研究測詴中心，(2008) [27] 黃信裕、施尚融、李易昌， " 二維台車模擬碰撞技術 "， 第十四屆車輛工程學術研討會，(2009) [28] 楊沛霖、吳建勳、謝寶賢， " 輕型電動車正陝碰撞分析與改良設計研究 "， 中國汽車安全技術國際研討會，(2009) [29] 施尚融、黃秀棓、詹英敏， " 前陝全寬碰撞與偏置碰撞測詴之比較 "， 第十五屆車輛工程學術研討會，(2010) [30] 林源富、吳建勳， " 車輛後碰撞分析探討 "， 第三十屆全國力學會議，(2006) [31] 陳宥霖， " 防後撞頸部損傷之座椅設計 "， 大葉大學機械工程學系碩士班畢業論文，(2009) [32] Dhruv Vikram Patel, " STUDY OF REAR IMPACT IN LIGHT TRUCKS AND POTENTIAL INJURIES TO THE OCCUPANTS ", Bachelors of Engineering, Mumbai University,(2003) [33] LS-DYNA THEORETICAL MANUAL,V971,(2007) [34] http://live.unece.org/index.php?id=986,歐洲汽車前撞測詴程序,UN/ECE R94 [35] http://live.unece.org/index.php?id=986,歐洲汽車後撞測詴程序,UN/ECE R32 [36] 游家華， " 單人座小型賽車(Go-Kart)車架之結構分析與設計 "， 大葉大學機械工程學系碩士班畢業論文，(2004) [37] 林智群， " 車輛碰撞之動態反應分析 "， 大葉大學機械工程學系碩士班畢業論文，(2003) [38] Justin Larsen, Joshem Gibson, Stephen Prax, " ME4000 2006-2007 Mini Baja ",Department of Mechanical Engineering University of Utah,(2007) [39] 美國道路交通安全管理局 http://www.nhtsa.dot.gov/ [40] Vijay, Manvinder, " ME320S ", http://www.freewebs.com/manvinder/baja.pdf [41] 黃秀棓， " 車輛動態安全法規 "， 車輛研究測詴中心，(2008) [42] VPG (Virtual Proving Ground)3.0, http://www.eta.com/index.php/software/vpg [43] 馮德安， " 車輛撞擊曲線之研究 "， 大葉大學機械工程學系碩士班畢業論文，(2007)