Review of Analysis of Motorcycle Helmets

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Abstract – Each year nearly nine hundred persons die in head Injuries and over fifty thousand persons are severely injured due to non wearing of helmets. In this Paper a review of different work to conceptually design a motorcycle helmet for improved thermal comfort, visibility, safety with adjustable interior form considering rider's ergonomics with new material named Fiberglass reinforced plastic (FRP) etc has been studied. For analysis The simulation software 'ANSYS and HYPERMESH' are used to analyze the helmet. The maximum force of 30 kN is applied on the helmet to study the model in static and dynamic conditions. The simulation has been carried out for the static condition for the parameters like total deformation, strain energy, von-Mises stress for different cases.

Index Terms – Helmet, Deformation, Strain energy, Equivalent elastic strain, Fiberglass reinforced plastic.

1. INTRODUCTION

It is very difficult to the middle class people to afford the luxury cars for daily needs. Hence the two wheeler motor cycles are very necessary for them. Due to this, the use of motor cycle is increasing steadily in India. In India most of the accidents includes the two wheelers, hence the safety of the motor cycle rider is most essential requirement. One of the effective countermeasures to prevent head injuries in motorcycle crashes is the use of a protective helmet. The beneficial effects of helmets in direct impact are well documented and helmets have been found to decrease the risk of head and brain injury by 70 to 88% and facial injury to the upper and mid-face by 65%.

It is very difficult to wear helmets in the countries like India due to the discomfort they caused in tropical climatic conditions. According to the Indian motor vehicle act, the wearing of motor cycle helmet is mandatory while riding. Due to the discomfort caused by the present day helmets, people use to wear open face helmet which doesn't give more protection to the head and the face of the rider when compared to full face helmets. Hence there is an essential requirement of motor cycle helmet with good thermal comfort, visibility, safety and adjustable interior head form. The proper ventilation is an important criterion for the safety and the comfort of the rider. As the rider exposed to the high speed stream of air, there should be proper heat transfer and air flow. A good helmet makes riding a motorcycle more fun, due to the comfort factor. It cuts down on wind noise on ears, windblast on face and eyes, and deflects bugs and other objects flying through the air. It even contributes to comfort from changing weather conditions and reduces rider fatigue.

2. LITERATURE REVIEW

V. C. Sathish Gandhi, R. Kumaravelan, S. Ramesh, M. Venkatesan, M. Ponraj. International Journal of Mechanical, Aerospace, Industrial and Mechatronics Engineering Vol:8 No:1, 2014. Analysis of Motor Cycle Helmet under Static and Dynamic Loading [2]. The Design and analysis of helmet has been carried out in 'ANSYS' for static and dynamic conditions. The study has been made for different cases. The results from the various cases show that chin (retention system) side of the helmet has undergone less strain energy and deformation. In this case the rider meet an accident, the head injury is very serious. So, special attention is needed in chin side of the helmet to reduce serious injuries for the rider.

P. Viswanadha Raju, Vinod Banthia , Abdul Nassar. Design of Streamlined Motorcycle Helmet with Enhanced Head Protection [3]. Fluid flow analyses were carried out to study the flow behavior inside a helmet and modifications were proposed to improve the flow within the helmet to improve comfort of the rider. Impact analysis was done to check if the modified helmet meets the BIS impact absorption test specification.

N.J.Mills, S.Wilkes, S.Derler, A.Flisch. International journal of impact engineering 36(2009) 913-925. FEA of oblique impact tests on a motorcycle helmet [4]. The peak head rotational acceleration, when motorcyclists fall obliquely to the road, was estimated by FEA to be the order of 15krad s-2 for typical-velocity impacts at the side of the helmet; this level would probably cause rotational head injury.

S. K. Mithun1, S. Umesh2, Ramjan Pathan3 1-M. Sc. [Engg.] Student, 2-Asst. Professor, 3- Asst. Professor, Automotive & Aeronautical Engineering Department, M. S. Ramaiah School of Advanced Studies, Bangalore – 58. Conceptual design of motor cycle helmet to meet the requirement of thermal comfort, ergonomics and safety [5]. In this project work an attempt has been made to conceptually design a motorcycle helmet for improved thermal comfort, visibility, safety with adjustable interior form considering rider's ergonomics. Initially, GEMBA study has been carried out on existing helmets to understand the design requirements, ergonomics and thermal comfort. Based on the user survey, QFD and PDS were

generated and the product specifications were obtained to meet the requirement. Concept sketches were generated incorporating features like adjustable head form, air vents and exhaust fans for thermal comfort. Detailed design for the selected helmet concept and geometric model for the same has been created incorporating all the features as per the concept. A full scale working model of the helmet is built with all features, tested and demonstrated for its functionality.

Praveen K. Pinnoji and Puneet Mahajan, Indian Institute of Technology Delhi, New Delhi-110016. Two Wheeler Helmets with Ventilation and Metal Foam [6]. Defence Science Journal, Vol. 58, No. 2, March 2008, pp. 304-311 2008, DESIDOC. Three different two wheeler helmets were studied to investigate their dynamic performance. First is helmet with ABS shell, second is helmet with metal foam, and third is helmet with single groove in the liner foam for providing ventilation. Front and side impact analyses were carried out at 10 m/s velocity by using LS-DYNATM. Forces on the helmet and on the head due to impact were studied with function of time. Pressure and stresses in the brain were investigated and found not to change significantly due to the presence of groove in the liner foam, which was provided to improve the ventilation in helmets. The dynamic performance of a helmet with outer shell as metal foam was examined and compared with ABS material.

Tamilmaniraj.V1, Santhosham.M2 1 Department of Mechanical Engineering, Kingston Engineering College, (India) 2 Associate Professor, Department of Mechanical Engineering, Kingston Engineering College, (India. International Journal of Science, Technology & Management. Volume No.04, Issue No. 04, April 2015 ISSN (online): 2394-1537. Prediction of mechanical properties of a motorcycle helmet [7]. As on defining the term safety in helmet we need to improve the strength through material and provide a closed surface with less ventilation. It is desired for safety on crash but asthma patient cannot wear the closed helmet for long time so to overcome that a helmet is designing with SOLID WORKS surface model and analysis is carried out in Ansys and CFD fluent 14.5 workbench. Starting from engineering analysis, a model for engineering optimization is developed. Then, we use the survey data collected from the class to develop a microeconomics (demand) model to predict the sales when our products hit the market. At the meantime, we also conduct a deep literature survey to address how we couple customers' demand with our design and manufacturing processes so that our cost estimation model is refined.

Asiminei AG1, Van der Perre G2, Verpoest I3, Goffin J1. 1Division of Neurosurgery and Neuroanatomy, KU Leuven. 2Division of Biomechanics and Engineering Design, KU Leuven. 3Department of Metallurgy and Materials Engineering, KU Leuven. A transient finite element study reveals the importance of the bycicle helmet material properties on head protection during an impact [8]. This paper is focused on understanding the mechanism that gives the bicycle helmet the role of protecting the head during an impact. The finite element method is used here as a first step in the helmet optimisation and improvement process. The relation between different helmet mechanical parameters and the risk of head injury during the impact is described using MSC Marc Mentat finite element software. The reduction in resulting head linear acceleration by more than 80% and in resulting stress by more than 65% prove the protective effect of all materials studied with an indication of superior behaviour for the anisotropic foam.

Keith Norris and Stephen Tiernan Department of Mechanical Engineering, Institute of Technology Tallaght, Dublin, Ireland. An analysis of the performance of foams used in hurling helmets [9]. This paper covers the testing and modelling of energy absorbing materials to ascertain the optimum thickness, and density of foam within the helmet. Static tests are carried out on a compression test machine to obtain stress/strain properties. The foams are tested on a purpose built drop test rig; the displacement, impact force, velocity and acceleration are measured using LabView and a high speed camera with TEMA analysis software to gain a greater understanding of the impact mechanics of each material. The foams are modelled, both statically and dynamically, using finite element analysis. The static model uses theANSYS implicit solver, while the dynamic model uses ANSYS/LS-DYNA to create and validate an appropriate foam material model. The displacement, velocity, and energy results from the finite element model and the test results are analysed and compared so that the optimum density and thickness of foam can be obtained.

Jingshu Wu,1 Ph.D., P.E., Charles Fleming,1 Claudia Covell2 1 – NCSA, 2- Enforcement of NHTSA. Analysis of Helmet Impact Velocity Experimental Data and Statistical Tolerance Design Performing Organization Code NHTSA/NVS-421 [10]. Helmet impact velocity experimental data is analyzed and various factors that influence the impact velocity are studied. One of the main goals of this report is to verify whether a tolerance of +/- 3 percent of mean velocity is feasible and will allow at least 95 percent of impacts to fall within the proposed impact velocity range. Statistical methods are applied to the design of impact velocity tolerances. Calibration procedures and data variances from several laboratories are also incorporated into this analysis.

The objective of this analysis is to evaluate proposed drop velocity ranges for FMVSS No. 218 motorcycle helmet impacts onto the flat and hemispherical anvil in support of NHTSA's response to comments received for the October 1, 2008, FMVSS No. 218 Notice of Proposed Rulemaking (NPRM). The impact attenuation test is specified in FMVSS No. 218 Sections S5.1 and S7.1. The nominal target velocity onto the hemispherical anvil is 5.2 meter/second and the nominal target velocity onto the flat anvil is 6.0 meter/second.

The NPRM proposed the impact velocity ranges of 4.8 to 5.6 meter/second, and 5.6 to 6.0 meter/second, respectively; however, many commenters proposed alternate tolerances. The most common suggestion was to limit the tolerance to +/- 3 percent of nominal target velocity, which would suggest a velocity range of (97% nominal to 103% nominal), or 5.04 to 5.36 meter/second on the hemispherical anvil, and 5.82 to 6.18 meter/second onto the flat anvil, respectively.

3. CONCLUSION

As per ISI standards the motorcycle helmet is being designed through UNIGRAPHICS software. The optimized design not deviating from the ISI standards is implemented. The analysis of the helmet is taken through the Ansys and Hypermesh software.Therefore the designed helmet can withstand high impact, Drag, Velocities also and can safeguard the human beings during driving of motorcycles.

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