

THE PROTECTIVE PERFORMANCE OF DIFFERENT TYPES OF MOTORCYCLE HELMETS IN TERMS OF HIC AND BRIC

N. Q. Radzuan¹, M H. A. Hassan¹ [0000-0002-6681-1784], M. N. Omar¹, and K. A. Abu
Kassim²

¹ Faculty of Mechanical and Automotive Engineering Technology, Universiti Malaysia Pahang,
26600 Pekan, Pahang, Malaysia

² Malaysian Institute of Road Safety Research,
43000, Kajang, Malaysia

mhasnun@ump.edu.my

Abstract. This research evaluates the protective performance of full-face, open-face, and half-coverage motorcycle helmets by taking the head injury criterion (HIC) and brain injury criterion (BrIC) as performance indicators. A pendulum test rig was developed to produce a 5.58 ± 0.29 m/s impact speed. The researchers gave a head impact with or without a helmet to an anthropomorphic test device (ATD) head and neck called Hybrid III at its frontal, rear, and side areas. The Hybrid III had an installed Shimmer 200g IMU sensor in its skull. The raw data output was linear and rotational velocities recorded using ConsensysPro software version 1.6.0. The linear velocity data is then processed by MATLAB® 2016b software because its raw data is uncalibrated. Calibrated linear and rotational velocities were then used to calculate HIC and BrIC. The research can determine no definite best helmet type through the crash impact experiment; as a result it shows the inconsistency of HIC score among three different types of helmets at each impact location. Furthermore, the research found that the helmet type did not provide significant protection towards rotational impact. It is worth mentioning that side impact may cause the highest injury severity due to rotational motion.

Keywords: Motorcycle helmet; pendulum test rig, head impact; head injury criterion; brain injury criterion.

1 Introduction

Traumatic brain injury (TBI) can be categorised into primary or secondary brain injury and open or closed brain injury. It might also depend on its severity degree. The three categories of injury severity are mild, moderate, and severe. Open brain injury includes a penetrating object towards the skull resulting in an open wound and breakage. Meanwhile, closed brain injury occurs when the head is not broken or cracked, but the fragile brain tissue is damaged due to being shaken or rotated. Some examples of TBI include concussions, contusions, brain haemorrhages, intracranial hematomas, coup-