Design and Fabrication of Split Hopkinson Pressure Bar Apparatus to Investigate High Strain Rate Mechanical Behavior of Low Carbon Steel

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This work consists of designing and fabricating of compression split Hopkinson pressure bar (SHPB) apparatus to investigate the high strain rate stress-strain behavior of low carbon steel at strain rates of 217.686 s^{-1}, 283.728 s^{-1}, and 356.692 s^{-1}. High strain rate mechanical behavior at the aforementioned regime has never been studied in Sri Lanka; notably with SHPB apparatus. High strain rate behavior of materials is essential in designing mechanical components to be used in high loading impact components such as sports equipment, automotive applications and ballistic applications. General mechanical behavior analogies used for quasi static regime such as universal tensile testing machine are inaccurate and inadequate in dealing with high strain rate related studies.

A test bench, loading device, an incident bar, a transmission bar, bar holders, a momentum trap, and standard specimens were fabricated. Two data acquisition and recording systems were used for collecting data from the incident bar and the transmission bar with a maximum sampling rate of 428571 Hz. The data acquisition and recording system components were strain gauges, a Wheatstone bridge circuit, an amplifier, a microcontroller, a power supply, a USB hub, and a USB to micro-B cable and computer. Software codes were developed to collect the data and process the experimental data and determine the corresponding flow curves. In further work on this area, it was recognized to use much more accurate strain gauges suitable for the high strain rate applications so that the data will be more accurate and efficient.

Keywords: SHPB (Split Hopkinson Pressure Bar)