Fabrication of Split Hopkinson Pressure Bar Apparatus to Study Uniaxial High Strain Rate Behavior of Aluminium

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There are many high strain rate related application in the world, including vehicle impact, blast welding, ballistic impact etc. Deformation mechanism of high strain rate applications differ from static applications, as a high strain rate application is solely due to stress wave propagation. These high strain rate data are required for safety and structural integrity assessment of structures subjected to dynamic loading. Engineering materials to be used in these applications should be selected irrespective of the deformation behavior witnessed in static uni-axial tensile test. Split Hopkinson Pressure Bar (SHPB) apparatus is used to study high strain rate behavior of different engineering materials (10^2 s^{-1} - 10^4 s^{-1}) under uni-axial loading applications. In this work, compression type SHPB apparatus was fabricated in-house, is consisted of incident bar, transmission bar with properly mounted strain gauges to measure strain under dynamic conditions. The incident bar was impacted using standard single mass pendulum. Incident bar and Transmission bar was made of mild steel and Aluminium was selected as the test sample. Dynamic stress - strain behavior under different strain rates were determined using standard experimental approach associated to SHPB apparatus, followed by classical numerical approach pertinent on uni-axial stress wave propagation theory. The results obtained through SHPB apparatus and theoretical calculations were compared and analyzed. Dynamic Compressive Yield Stress for Aluminium was calculated for different strain rates, and the strain rate sensitivity was clearly witnessed. The results between experimental and theoretical values agreed considerably and spare deviation from the theoretical calculations was identified due to friction of the contact surfaces and wave dispersion effects.

Keywords: Split hopkinson pressure bar, Stress wave propagation