# Numerical studies on the fracture behavior of steel plates of varying thickness under high-velocity impact

**†Nikesh Kumar Ojha[1], *Ravindra K. Saxena[1]**

[1]Department of Mechanical Engineering, Sant Longowal Institute of Engineering and Technology, Longowal-148106, Sangrur, Punjab, India

*Presenting author: rksaxena04@yahoo.com

†Corresponding author: nikeshkumarojha@gmail.com

## Abstract

Analysis of impact is an important factor that is considered in the designing of components for application at different velocities in the field of science and technology. Projectiles having blunt shapes are generally used to study the fracture behavior of target plates during high velocity impact. Identification of the location for the initiation of fracture in a flat target plate assists the designer to design the parts for improved performance. The designer can provide the strengthening factors at such locations to delay the initiation of fracture. Further, the fracture path facilitates the decision about the dimensions of the component at such weaker locations. In the present work, the fracture behavior of a mild steel target plate with thickness in the range of 1~6 mm is studied at 400 m/s impact velocity. The fracture behavior of these plates is analyzed for the varying weight of the projectile viz. 52.5 gm and 197 gm. The finite element analysis is performed using MSc Marc Mentat™. The fracture phenomenon is incorporated using the external FORTRAN subroutine. The fracture phenomenon is analyzed using the damage variable proposed in literature. The damage variable is a function of equivalent plastic strain and triaxiality. These variables are used to investigate and analyze the fracture behavior in a flat target plate. The fracture behavior is found to be different for different target plate thicknesses. Further, the weight of the projectile also influences the fracture behavior of the target plate with different thicknesses. It is observed that at lower plate thickness with 52.5 gm projectile, the fracture initiates at the bottom of the plate and progresses to the top. At higher values of plate thickness, the fracture initiates at the midplane and leads towards the top and later towards the bottom when impacted with a 52.5 gm projectile. It is again observed that the fracture initiates at the top of the plate and progresses towards the bottom of the plate with 197 gm projectile at lower plate thicknesses. The fracture initiates at the midplane and progresses towards the top and bottom of the plate with 197 gm projectile when the plate thickness increases beyond 2 mm.

**Keywords**: Finite element analysis; High-velocity impact; Damage; Continuum damage mechanics; Triaxiality; MSc Marc; Steel.