Soda Can Crush

Overview

In this simulation a soda can is crushed by another object to illustrate how Explicit dynamics analysis can be used for impact problems. Explicit dynamics captures the dynamic effect of impact and plasticity of the material.

Goals

- To understand the time integration and time step size limit in Explicit Analysis. The Explicit Dynamic solver uses a central difference time integration scheme (often referred to as the Leapfrog method). To ensure stability and accuracy of the solution, the size of the timestep used in Explicit time integration is limited by the CFL (Courant-Friedrichs-Lewy) condition. This condition implies that the timestep be limited such that a disturbance (stress wave) cannot travel farther than the smallest characteristic element dimension in the mesh, in a single timestep.
  Thus, the timestep criteria for solution stability is

$$\Delta t \leq f * \frac{h}{c}$$

  Where
  Δt is the time increment
  f is the stability timestep factor (= 0.9 by default)
  h is the characteristic dimension of an element
  c is the local material soundspeed in an element

Modeling Steps

1. Create an Explicit Dynamics Analysis in ANSYS.
2. Define a material model for Soda can, Water and Steel Punch and Die.
3. Import the Soda Can Model.

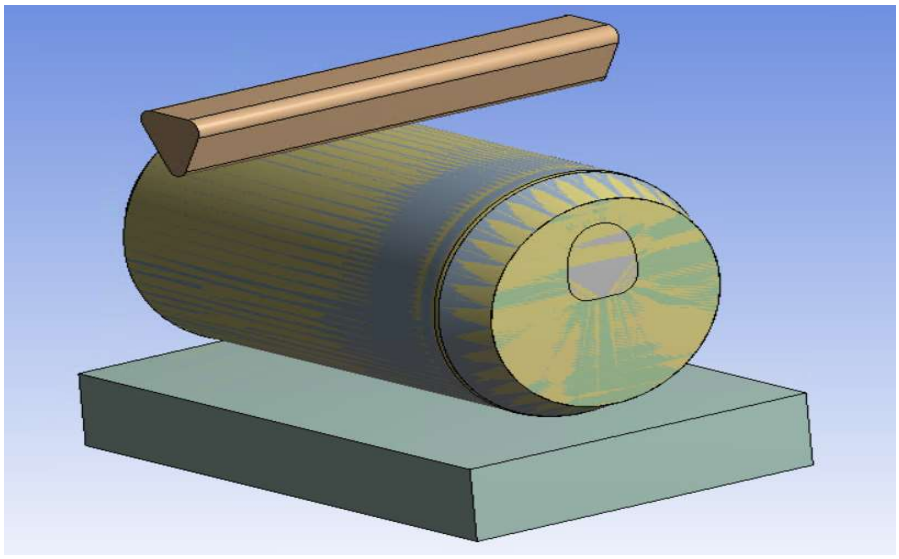

Figure 1. Soada can and Punch geometry

4. Assign the material to geometries. The Die and Punch are modeled as rigid behavior. For the Soda water define reference frame Eulerian.
5. Mesh the geometry. Since Soda can is modeled as surface body, it will be meshed with shell mesh while solid mesh is created for all other bodies.
6. Define the interaction between different bodies. Set the interaction type to "Frictionless"
7. Define the analysis settings and assign boundary conditions. The Die geometry is fixed. The displacement is applied to punch body in two steps. 6e-2 m is applied in first step till the time 5e-4 s and then punch body retracted back to the distance 3e-2m at 6e-4s.

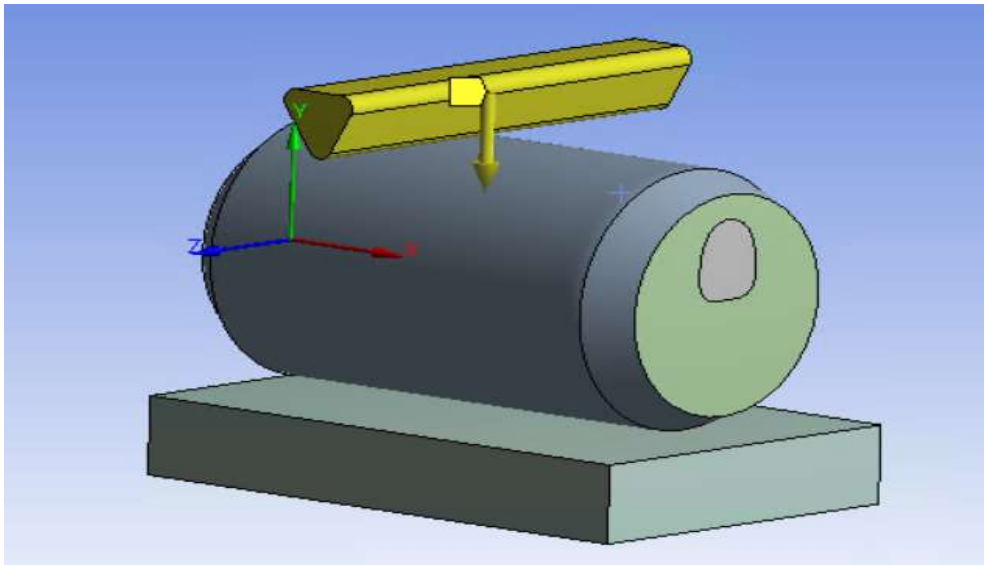

Figure 2. Boundary conditions

8. Run the simulation and check the results.

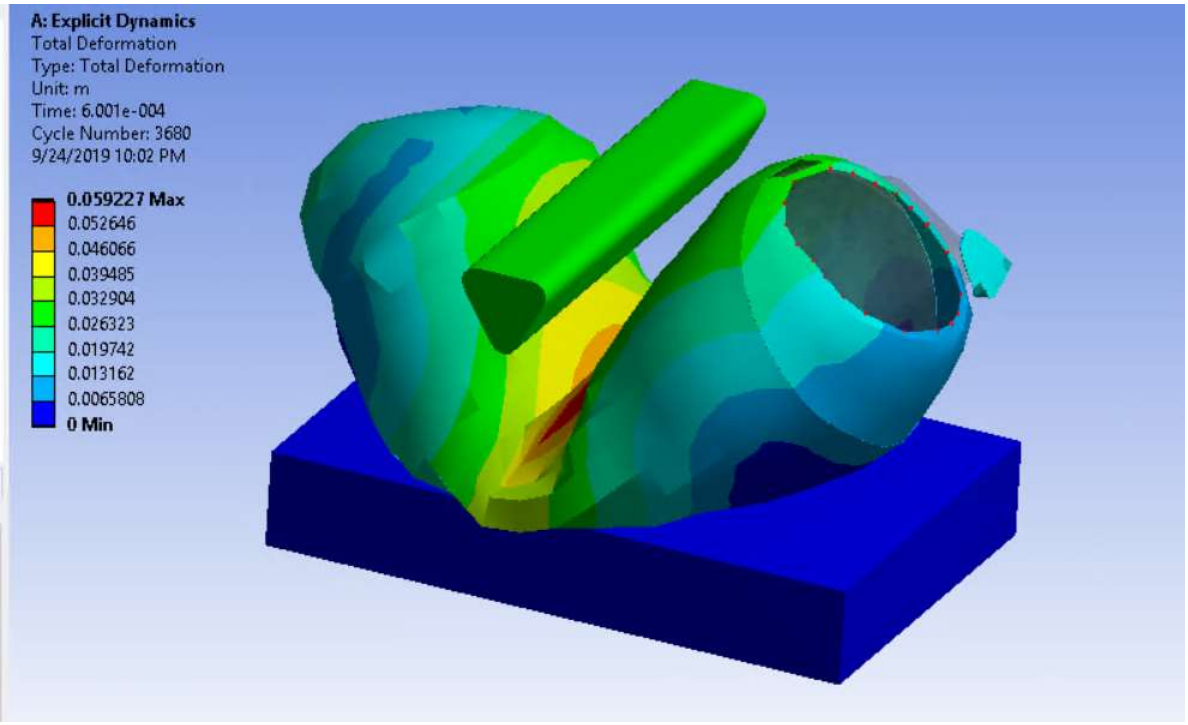

Figure 3. Deformation

Summary

This simulation uses explicit dynamics to simulate the Soda can crashing. Explicit dynamics is suitable for this type of simulation because it involves high dynamic effects of the impact.