Drop Impact of a Ball

For this exercise, you will model the drop impact phenomenon of a ball striking a composite plate as an explicit dynamics problem. This will take place on the "surface" of Jupiter, so adjust any necessary units accordingly. (Disregard the effect of Jupiter's atmosphere on the composite laminate.)

The ball is a rigid 3D shell with 100 mm diameter and mass 2 kg. It strikes the plate at a speed of 10 $m \cdot s^{-1}$.

The composite plate consists of three layers of a quasi-isotropic laminate alternating kevlar fibers in an epoxy matrix of configuration [0°, 90°, 0°]. It measures 500 mm × 500 mm and is simply supported on all four edges. Each layer is 0.25 mm thick.

You will document your simulations in an 8–10 page report (with figures) containing sections:

- Problem description (model, grid, etc.—you should examine and report beam profiles and any necessary modifications you've made)
- Numerical values (element parameters, boundary conditions, etc.)
- Computational times (CPU time to solve)
- Observations of numerical behavior (boundary conditions, mesh behavior, etc.)
- Discussion of the results (deformation, perceived safety, etc.)—is the laminate qualified?

Include the following plots in your report, with data from each case as appropriate:

- Kinetic and strain energy plots
- Contour plot of von Mises stress at select time steps.

The report should be formatted with 1.5 line spacing, 1 inch margins on all sides, and set in 11 point serif font. All figures and tables (if any) should be numbered and have labels and captions.

Resources

Composites Modeling–Analysis Procedures and Techniques.

Abaqus example problem 1.1.14, Damage and failure of a laminated composite plate.

Abaqus example problems manual.