

# ANSYS - Semi-monocoque shell - Step 9

## Problem Specification

1. Start-up and preliminary set-up
2. Specify element type and constants
3. Specify material properties
4. Specify geometry
5. Mesh geometry
6. Specify boundary conditions
7. Solve!
8. Postprocess the results
9. **Validate the results**

## Step 9: Validate the results

We checked in the previous step that the BC's have been applied correctly and the deflection looks plausible.

### Comparison With Plate Theory

An FEA analyst displays his mettle by going head-to-head with theory. The theoretical solution for a clamped plate subjected to pressure is presented by Timoshenko and Woinowsky-Krieger, page 202. This solution can be modified to account for the presence of stiffeners using the parallel axis theorem. This calculation and the resulting stress and displacement values have been generously provided by Prof. Alan Zehnder and are summarized in [this pdf document](#). Do take the time to review [this document](#).

The head-to-head comparison of the analytical values with the FEA values from [Step 8](#) at the center of the structure is presented in the following table.

| Entity | Location | FEA     | Theory  |
|--------|----------|---------|---------|
| $w$    |          | 3.8 mm  | 3.6 mm  |
| $xx$   | Bottom   | -56 MPa | -50 MPa |
| $xx$   | Top      | 312 MPa | 350 MPa |
| $yy$   | Bottom   | -28 MPa | -20 MPa |
| $yy$   | Top      | 38 MPa  | 105 MPa |

The deflection at the center is about 8% larger than the theoretical value due to shear deformation in the FEA model that is not accounted for in the analytical result. Correlation of stresses in the center is reasonably good. It might improve if solution for anisotropic plate were used. Also, the stiffeners are not at the centerline of the model, while maximum stresses in theory are calculated at the center.

The head-to-head comparison of the *edge* stresses is given in the following table.

| Entity | Location | FEA      | Theory   |
|--------|----------|----------|----------|
| $xx$   | Bottom   | 116 MPa  | 100 MPa  |
| $xx$   | Top      | -653 MPa | -704 MPa |
| $yy$   | Bottom   | 77 MPa   | 78 MPa   |
| $yy$   | Top      | -300 MPa | -403 MPa |

There is good correlation of the edge stress on the bottom of facesheet but the edge stress at the top of the stiffeners is overestimated by the theory. This is possibly due to the stiffeners not being at the centerline of the model while the maximum stresses in theory are calculated at the center.

Back to [Problem Specification](#)

[See and rate the complete Learning Module](#)

[Go to all ANSYS Learning Modules](#)