AE3212-II SVV Structures Assignment Description of Validation Data

A finite element model has been created using ABAQUS CAE based on the data for the Boeing 737 in the Aircraft Allocation & Data document. First, the choices that were made in the set-up of this model are explained in this document. Second, the files that are provided for validation purposes are clarified.

Model set-up

Geometry

The geometry is the same as that of the as detailed in the structures assignment, however one simplification has been made. The stiffeners of the aileron have been smeared out over the skin, in order to simplify its modelling.

Loading

The aerodynamic load on the aileron has been replaced by a constant distributed load *q* of *5.54 kN/m*, as shown in figure 5 of the structures assignment. This load is perpendicular to the chord line of the aileron.

The load is applied at 11 discrete x-locations. These locations have been modelled as nodes, which are connected using so-called Multi Point Constraints (MPC) to the node set on the aileron. More information on this can be found in the file *B737.inp* provided to you.

The load in actuator 2 is applied in a similar fashion. That means, that it is applied to a node, which is connected to a specific node set using an MPC.

The model considers three loadcases named *Bending*, *Jam_Bent* and *Jam_Straight*. These load cases respectively model:

1. the bending of the aileron without any other loads applied
2. the bent aileron subjected to the load case with the jammed actuator and aerodynamic load
3. the unbent aileron, subjected to the load case with the jammed actuator and aerodynamic load.

Boundary conditions

Hinges I, II and III have been modelled as nodes, which are connected to the aileron using MPCs. The boundary conditions are applied in the same way as they are described in the structures assignment:

- Hinge 1 is fixed in z-direction and displaced in y-direction by a predefined amount, d_1.
- Hinge 2 is fixed in x-, y- and z- direction.
- Hinges 3 is fixed in z-direction and displaced in y-direction by a predefined amount, d_3.

N.B.: The validation data uses the coordinate system of the aileron as main reference coordinate system.

Results

The figures given show screenshots from the simulation results viewed in Abaqus CAE.

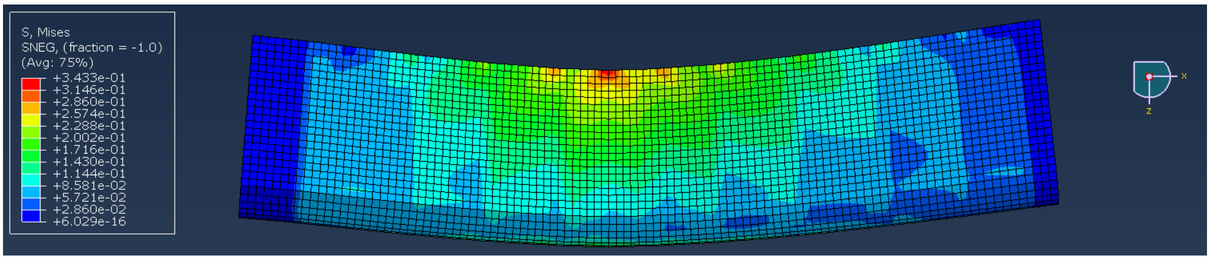

Figure 1: Output shown Von Mises stress, aileron seen from above, *bending* load case

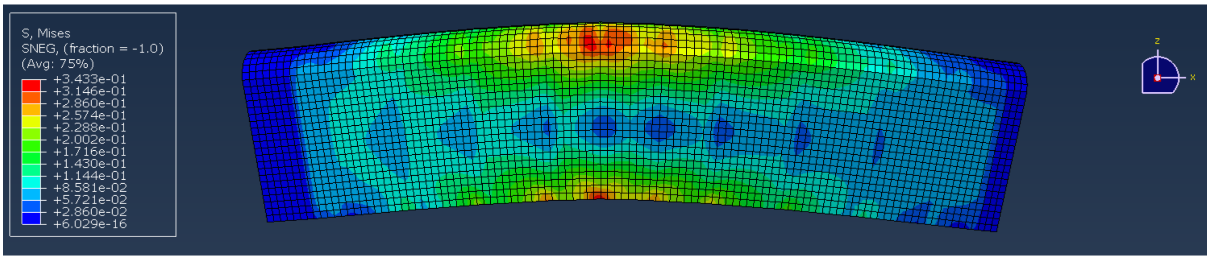

Figure 2: Output shown Von Mises stress, aileron seen from below, *bending* load case

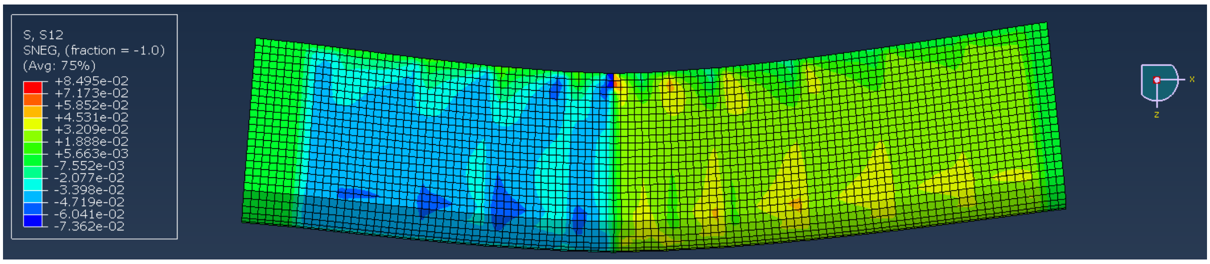

Figure 3: Output shown S12, aileron seen from above, *bending* load case

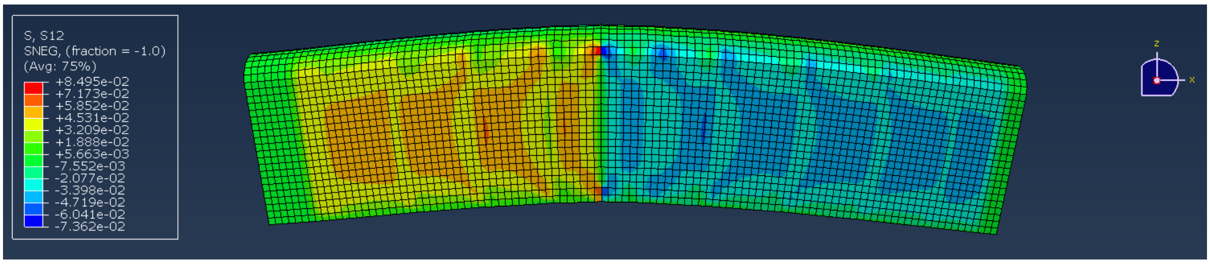

Figure 4: Output shown S12, aileron seen from below, *bending* load case

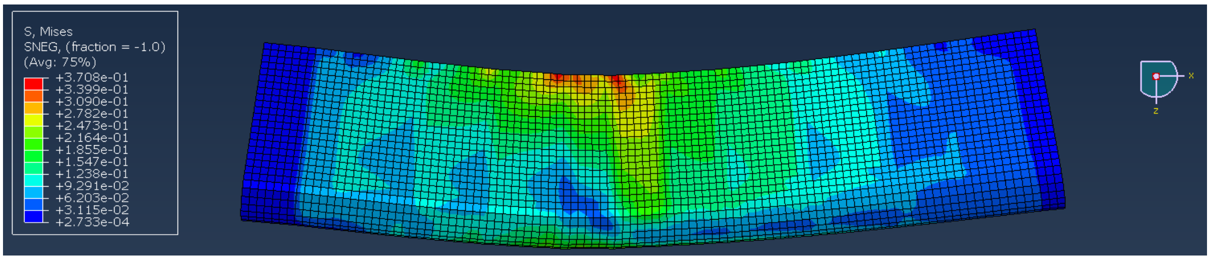

Figure 5: Output shown Von Mises stress, aileron seen from above, *jam* load case

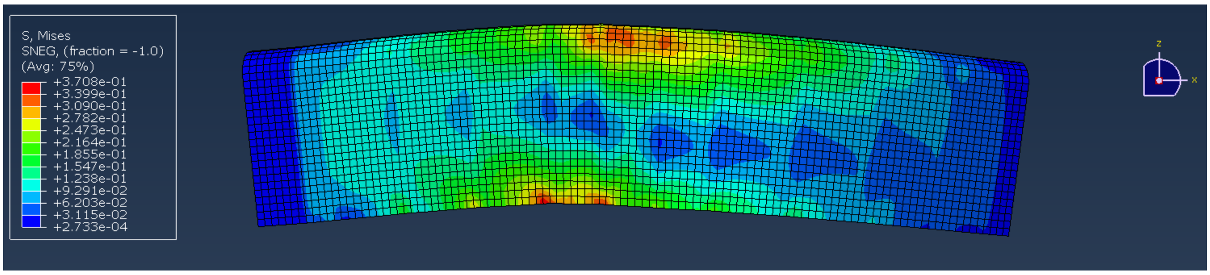

Figure 6: Output shown Von Mises stress, aileron seen from below, *jam* load case

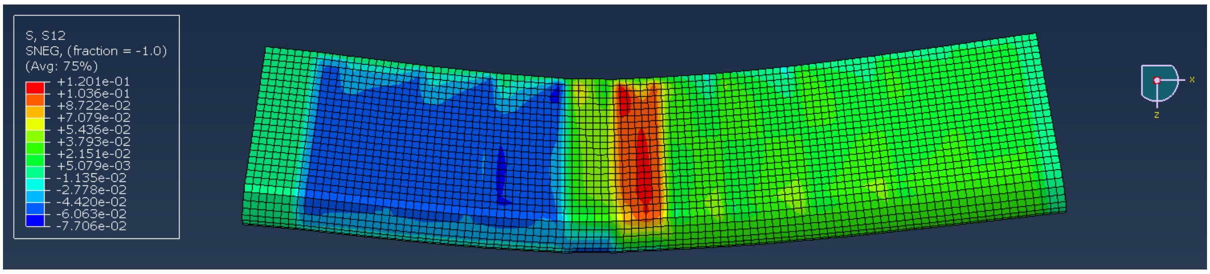

Figure 7: Output shown S12, aileron seen from above, *jam* load case

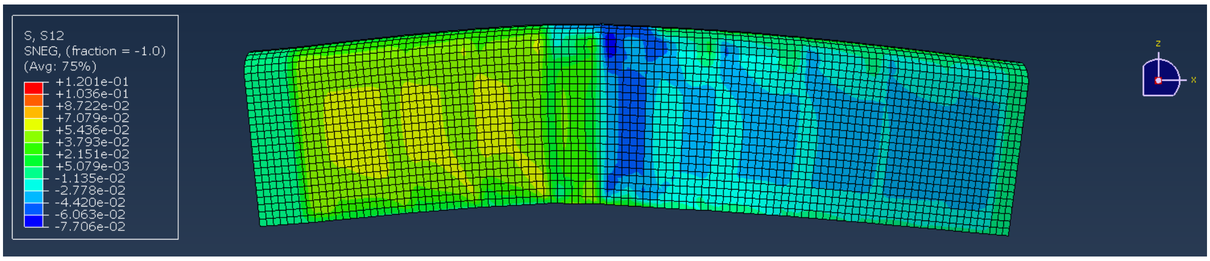

Figure 8: Output shown S12, aileron seen from below, *jam* load case

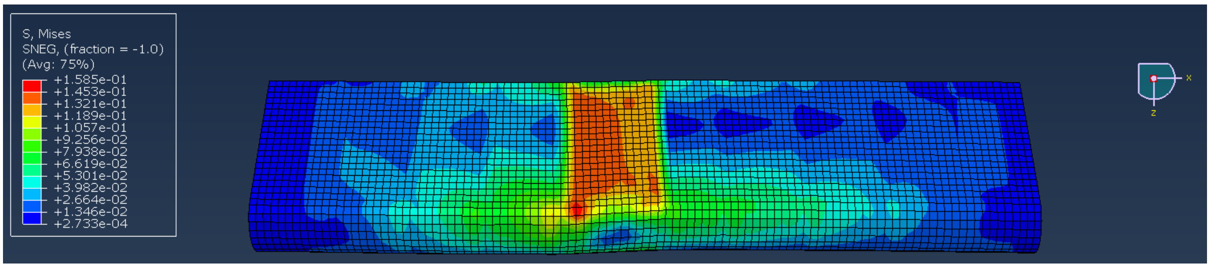

Figure 9: Output shown Von Mises stress, aileron seen from above, *unbent* load case

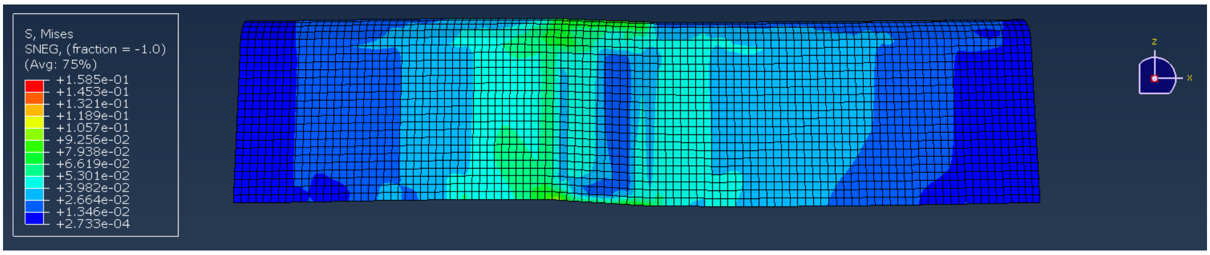

Figure 10: Output shown Von Mises stress, aileron seen from below, *unbent* load case

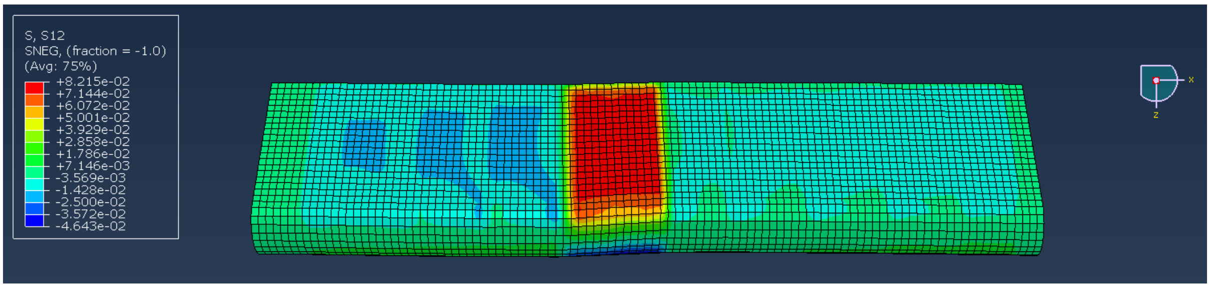

Figure 11: Output shown S12, aileron seen from above, *unbent* load case

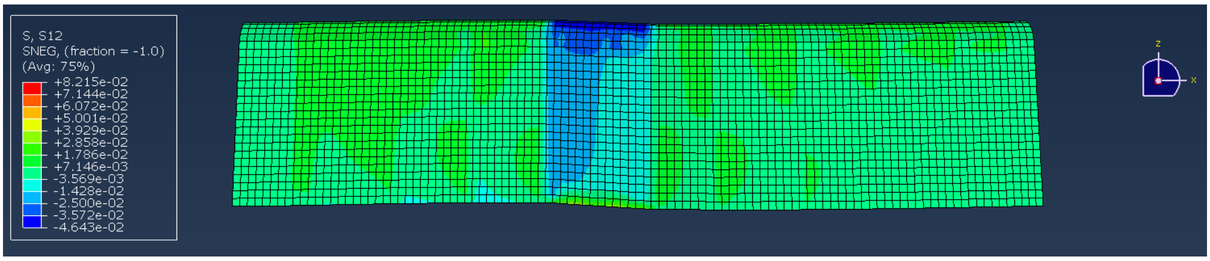

Figure 12: Output shown S12, aileron seen from below, *unbent* load case

Data provided for validation

You are provided with the following files:

- B737.inp, this is the input file that was used to run the finite element analysis.
- B737.rpt, this is a report file, including relevant output data: Von Mises stress, S12, nodal displacement and reaction forces.

Important:

a. Before comparing to your results please average the inside & outside von Mises stress to get the mean von Mises stress. The same applies to S12.
b. Smart sorting of the data in the RPT-file using the X, Y and Z-coordinates facilitates data collection for tables & graphs.