

Remarks on Computer Aided Design (CAD) Project Reports

Web pages are written for readers with a fifth to eighth grade education. They contain many paragraphs that are only one or two sentence long. Engineering reports should not be written like web pages. The American Society of Mechanical Engineers (ASME) gives required "Author Guidelines" for communicating in a technical article.

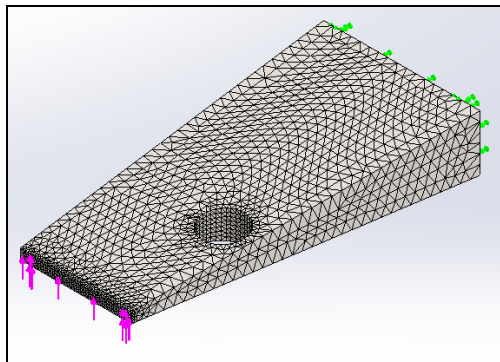
Your report is to contain your parts with drawings and dimensions sufficient to build the part. The existence of the part means that you have mastered the CAD tools needed to construct it. Thus, there is no need to describe the constructive solid geometry (CSG) steps used to build it. You should specify and justify which material was assigned to the part. Other important assumptions and justifications relate to how the part or assembly was supported and loaded in your simulations. Be sure to specify the units associated with a numerical quantity, and avoid mixing unit systems. If you must mix unit systems, then ASME requires both units be displayed with the secondary set in parentheses.

General styles continue to apply in technical writings: never start a sentence with a number, follow a comma with one space and a period with two spaces. Numerical values that are less than one should begin with a zero, not a period. Numbers greater than 999 should include commas after every third digit. Spelling errors are not accepted, and their deductions will be multiplied by the number of authors. All group members (authors) are expected to proof read their reports.

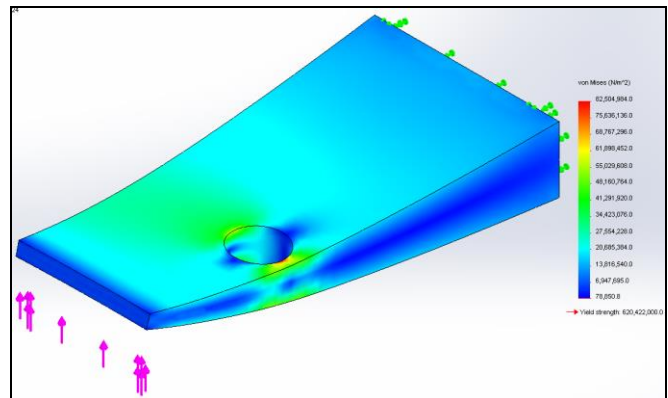
Most figures should have a black line edge frame. All figures with any non-white edge must have a black

line frame. (Windows Home →  →  Borders and Shading...)

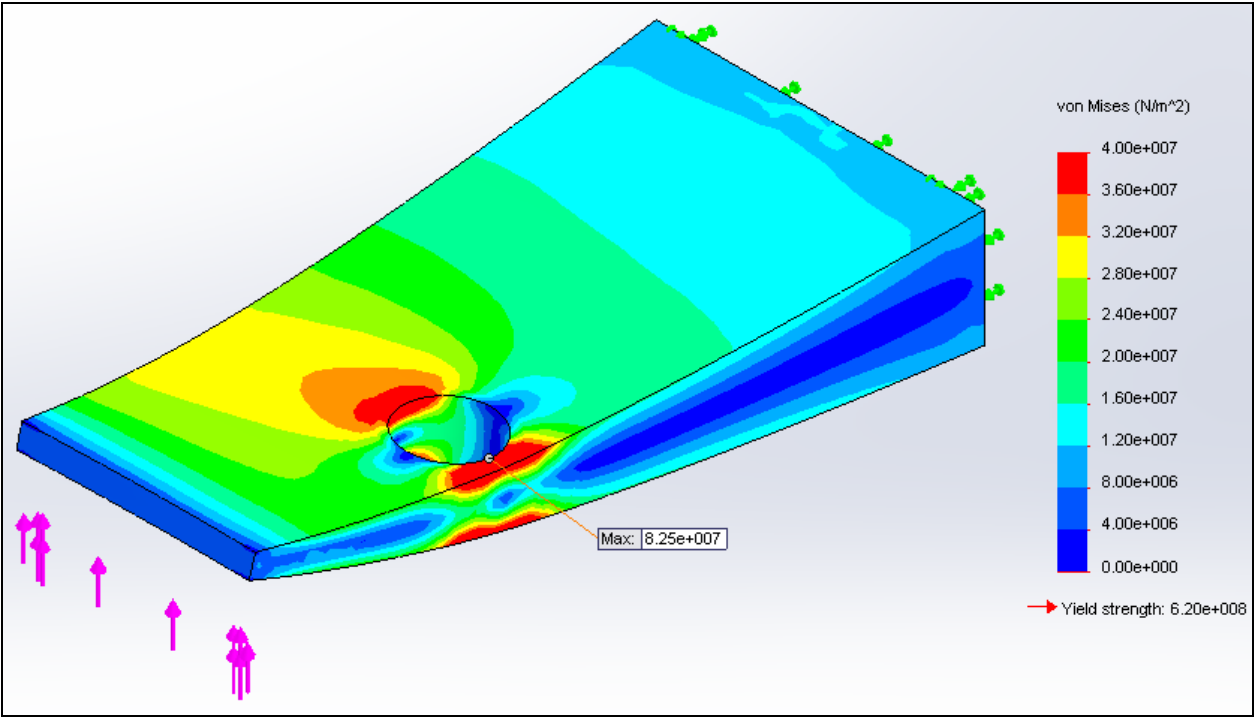
A simulation study gives results from analysis based on engineering *assumptions*. A simulation is NOT a test and should never be referred to as one. Simulation results should be presented with clear discrete contour displays (right click **Settings** → **Discrete**). Contours should not appear as blue blobs and should include related extreme values (e.g. right click **Chart Options** → **Options** → **Show max**). Contour scales should be chosen to give a good range of colors (**Chart Options** → **Options** → **Defined**) and a useful number of colors (**Chart Options** → **Color Options** → **Number**). Contour numerical scales should display a reasonable number of significant figures (**Chart Options** → **Format** → **Scientific**). Contour images should be captured against a white background (**Options** → **Document Properties** → **Color** → **Viewport background** → **Edit**) and must be bright to show up in color prints and/or on most projectors (**View** → **Lights** → **Properties** → **Ambient** → **Scroll**). Part edges, or pre-planned split lines, should be utilized to provide more detailed engineering data in the form of a graph taken from the contour data (right click **List selected** → **On selected entities** → **pick** → **update** → **graph**).



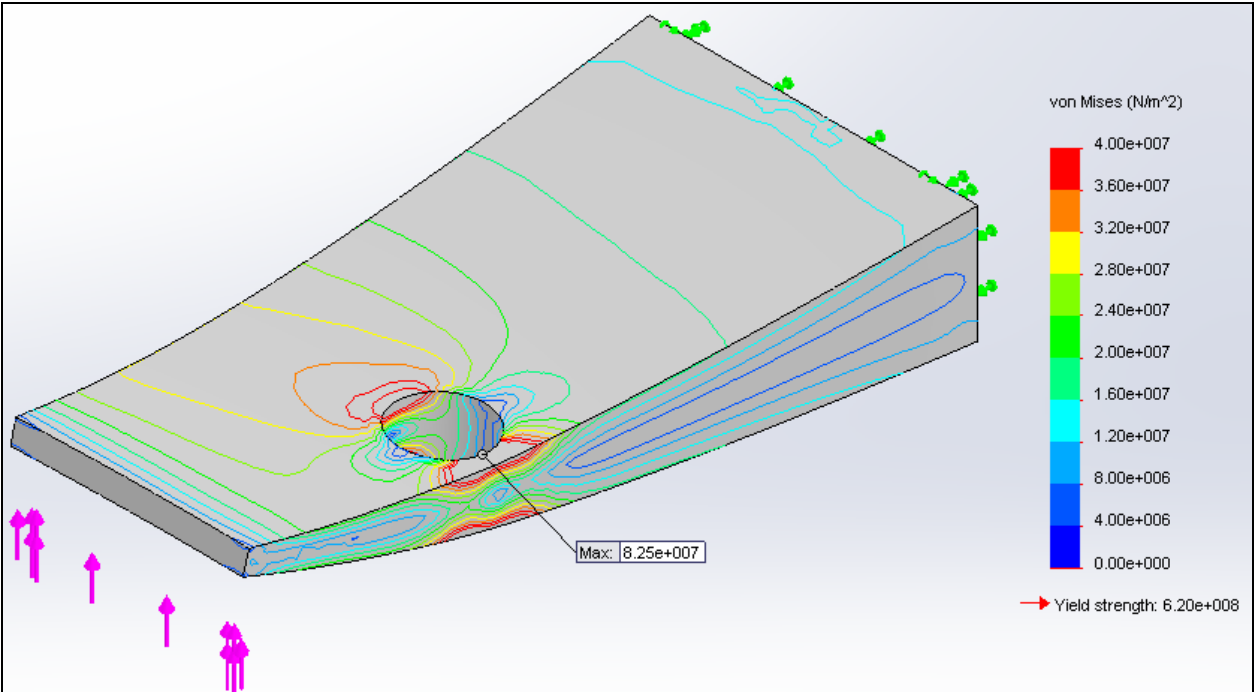
A Mesh Plot



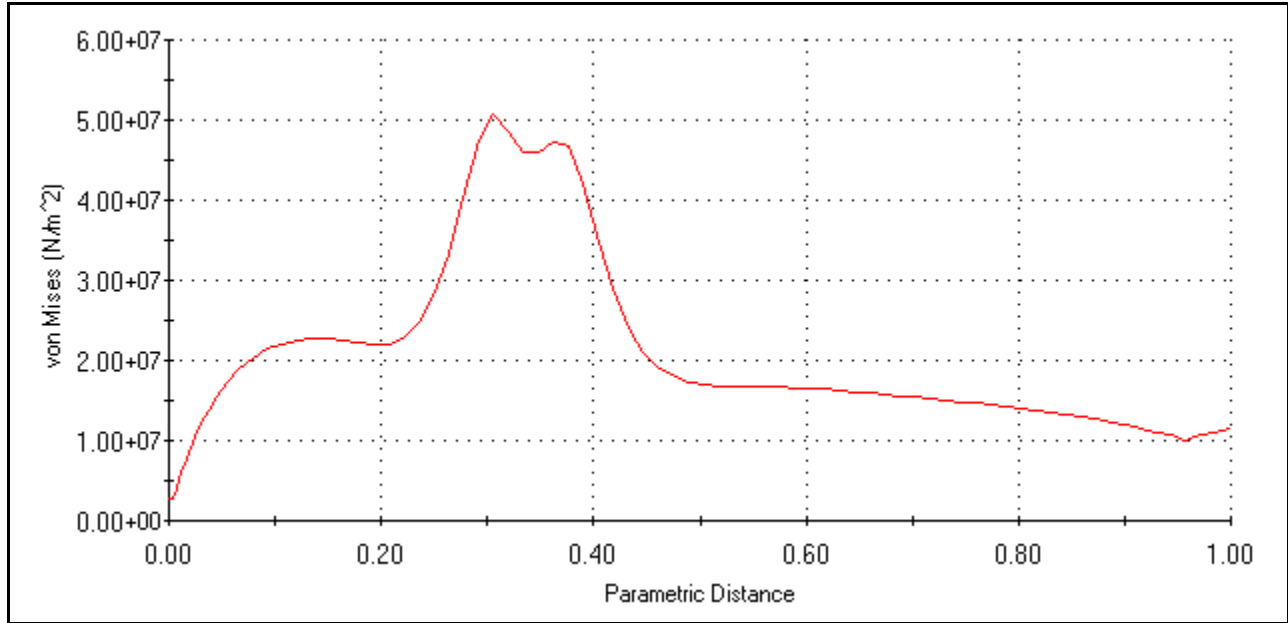
A Default Contour Plot (can not read numbers)



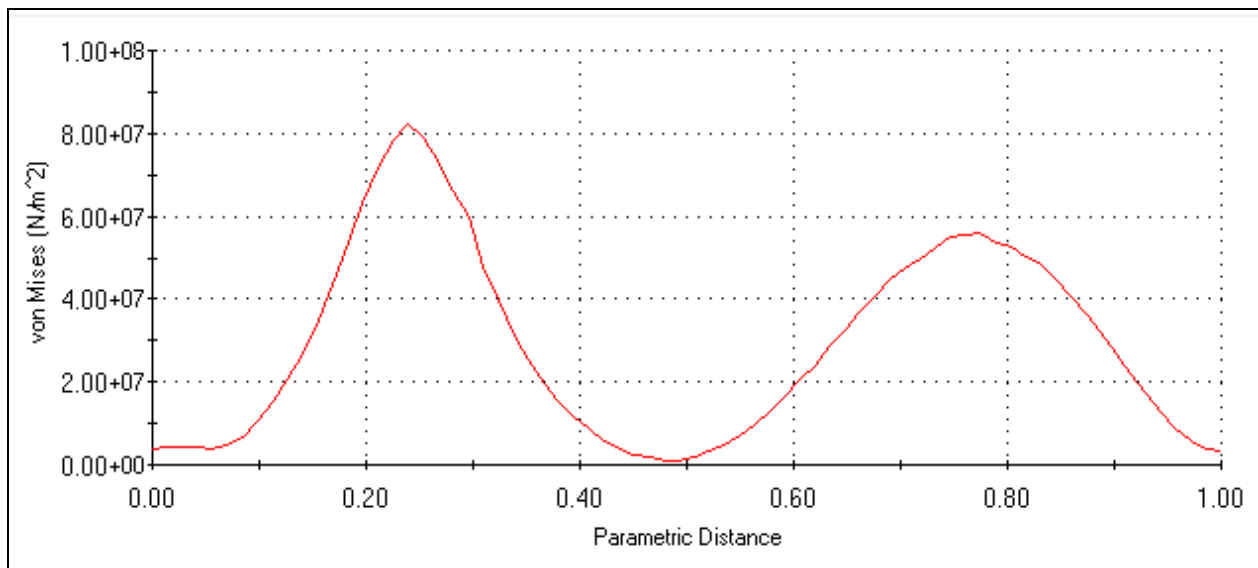
Controlled Discrete Contours



Contours as Lines Only



Contour Values along Top Right Edge

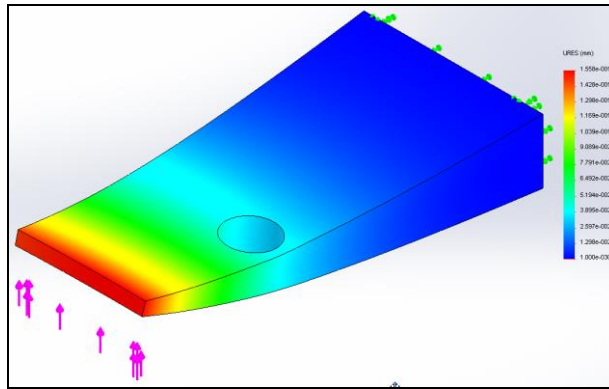


Contour Values around Top Circle

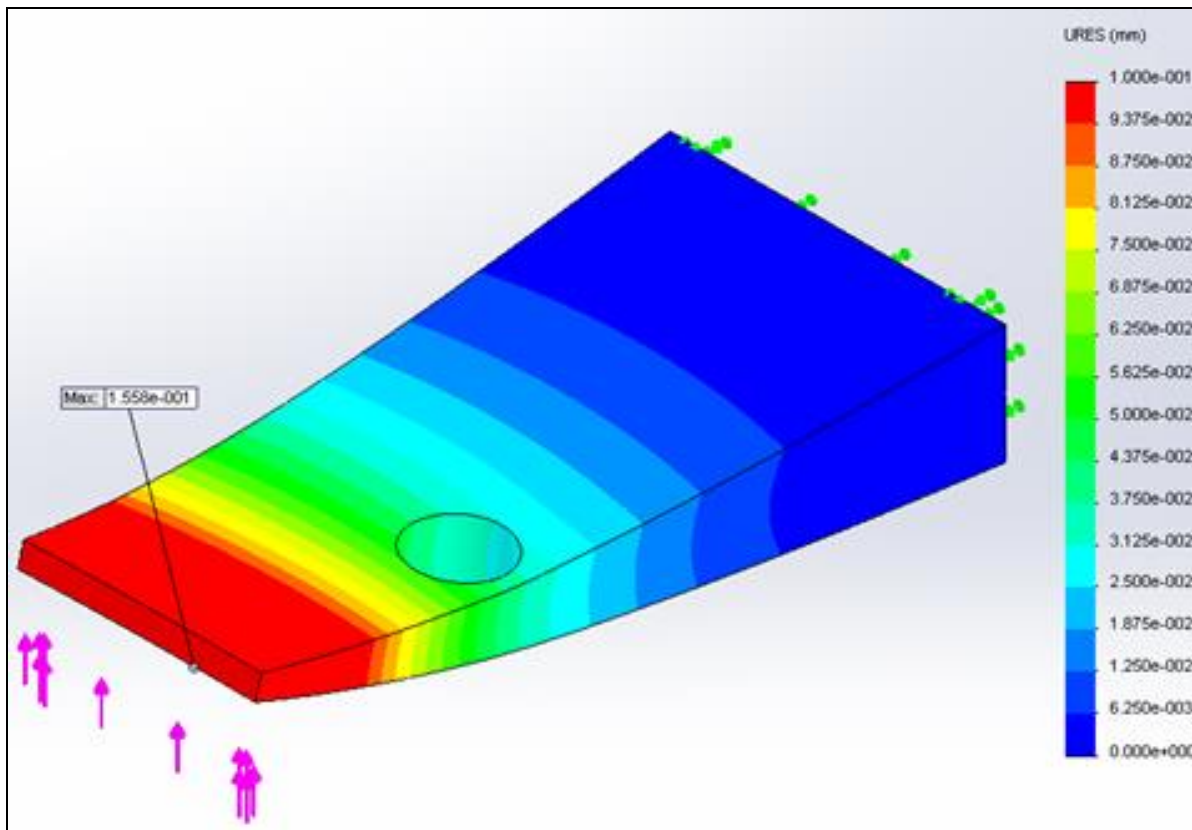
There are 18 stress components: $\sigma_{xx}, \sigma_{yy}, \sigma_{zz}, \tau_{xy}, \tau_{xz}, \tau_{yz}$ in Cartesian, or Cylindrical, or Spherical coordinate systems. There are several material Failure Criteria calculated: the three Principle Stresses (P1, P2, P3), the Triaxial stress (P1+P2+P3), the Maximum Shear Stress Intensity (P1-P3), and the distortional energy criterion (von Mises effective stress) which has the units of stress ($\sqrt{(P1 - P3)^2 + (P1 - P2)^2 + (P2 - P3)^2} / \sqrt{2}$). Each can be important in different regions in an application. Any failure criterion must be compared to the corresponding measured material limit, and the comparison needs to be cited in the report. For P1, von Mises, and the Intensity that property is the material yield stress.

The simulation software always computes about eleven stress measures. *All references to a stress must state which stress is used.* Those choices should be justified in the report. The default display is the von Mises effective stress which is compared to the material yield stress to predict failure of a ductile material. When an assembly contains more than one material then there should be a 'named stress' plot for each of the materials where the color bar is manually scaled relative to the material failure limit of the material that is the focus of that plot.

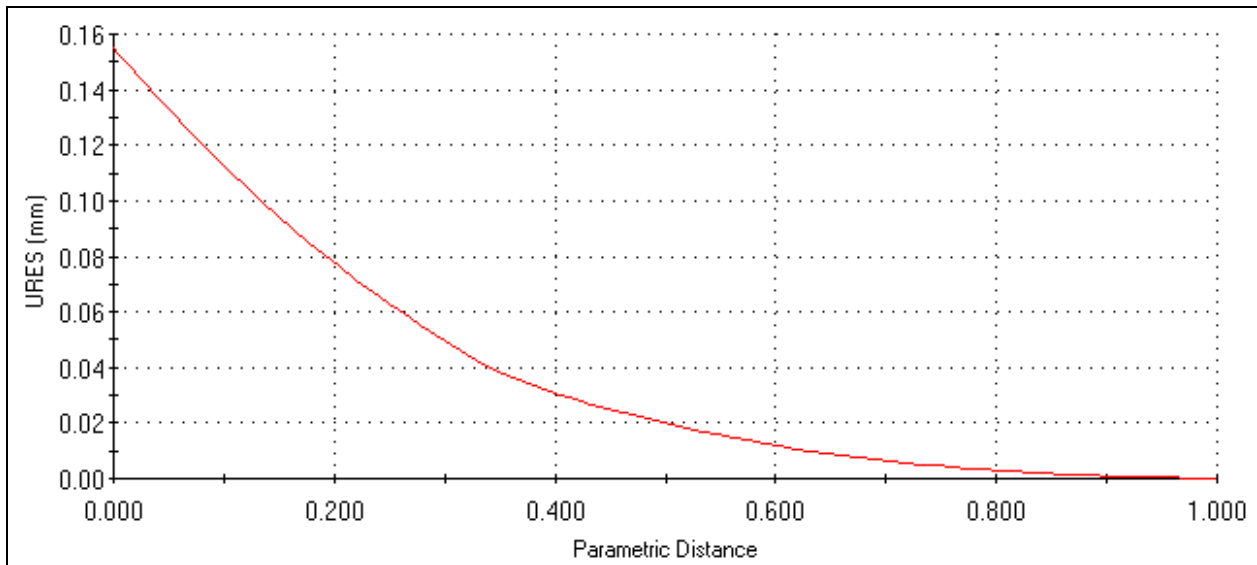
Some results are vector quantities and can be usefully displayed as arrows (right click **Edit Definition** → **Advanced features** → **Show as vector plots**). However, the lengths of the vectors need control (right click **Vector plot options** → **Options** → **scale**) and such plots can become cluttered and may need to be filtered by showing a reduced set of surface nodes (right click **Vector plot options** → **Options** → **Surface only** → %).



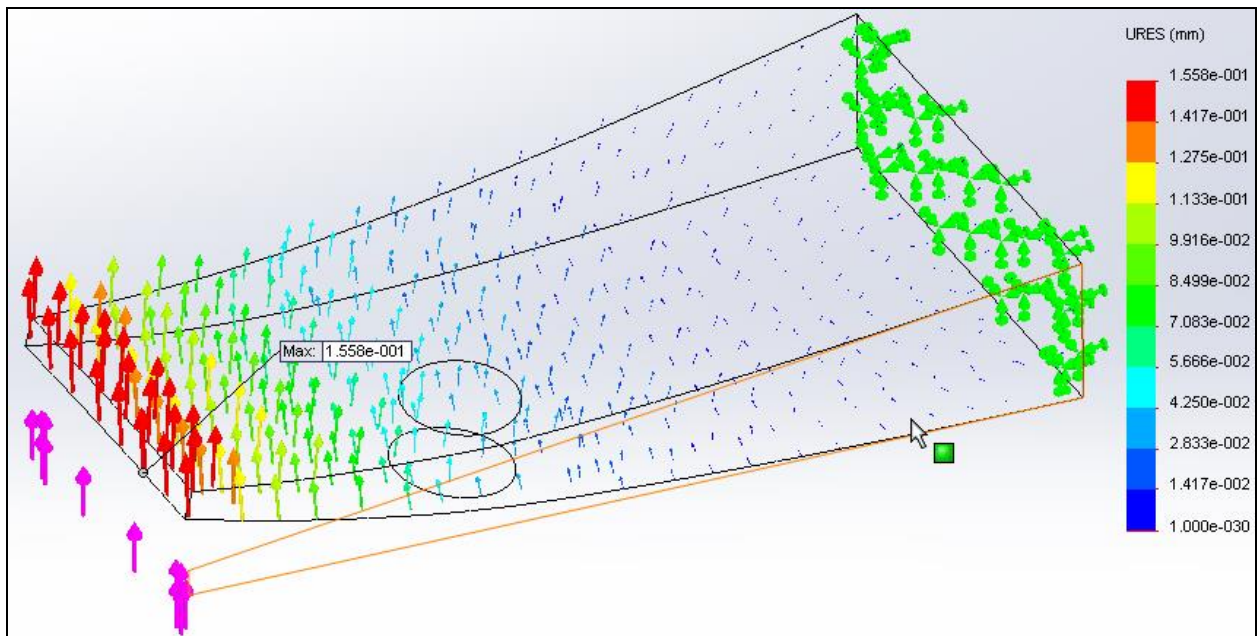
Default Magnitude of a Vector Quantity



Controlled Vector Magnitude Contours



Magnitude of the vector along Top Right Edge



(Surface) Vector Plots of a Vector Quantity

Deformed shapes are magnified by a controllable *Deformation scale* (right click **Edit definition** → **Deformed shape** → **choice**) which is shown in the caption. Some deformed shape contour plots can be enhanced by including a partial transparent image of the undeformed part (right click **Settings** → **Deformed plot options** → **Superimpose** → **Transparency**). For insight and video presentations it can be useful to animate the deformations (right click **Animate**).

Where an essential boundary condition is applied (known displacement or known temperature), then a simulation program will calculate a corresponding reaction (e.g. **Results** → **List result force** → **select region**). Those reactions are important as they are equal and opposite to the actual total applied load (source). They can also be used to validate or invalidate important assumptions. For example, if a floor is assumed to support four table legs but one of the reactions is tension (floor pulls on table) then the modeling assumption was wrong.

When working with assemblies always define at least one exploded view in the model. Use both exploded and un-exploded views to show simulation results. It is usually helpful to assign each major part in an assembly a different color. The peak simulation stress results often occur at part contact regions and would otherwise not be visible in an unexploded view.
