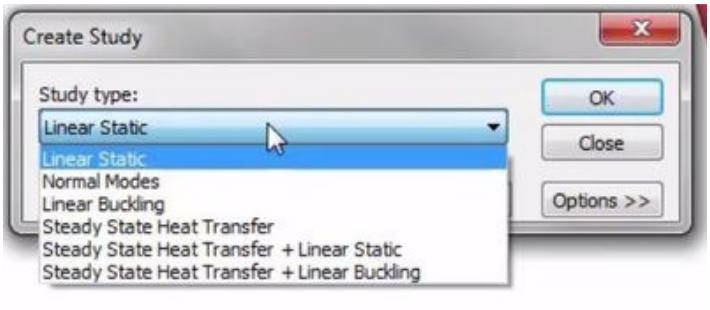
Simulation & Optimization in Solid Edge

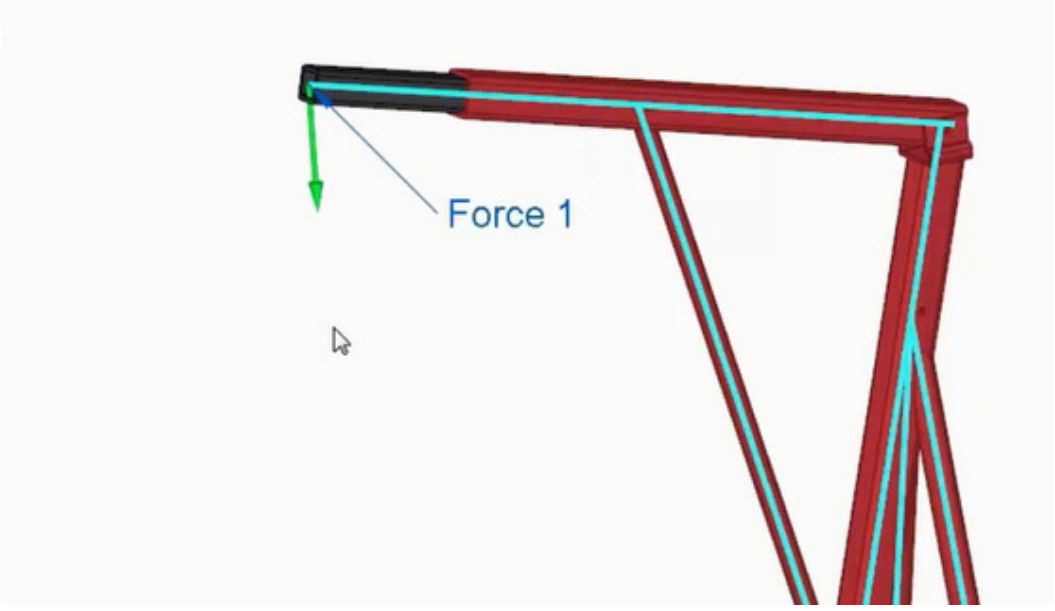
This Tech Tip looks at the different types of simulation analysis in Solid Edge.

Solid Edge's embedded simulation solution, Solid Edge Simulation, allows design engineers to ensure that designs are appropriate for their purpose - strong enough, but not over built. Solid Edge Simulation offers several different types of simulation analyses, including linear static, thermal, vibration (or modal), and buckling, as well as combinations of multiple study types.

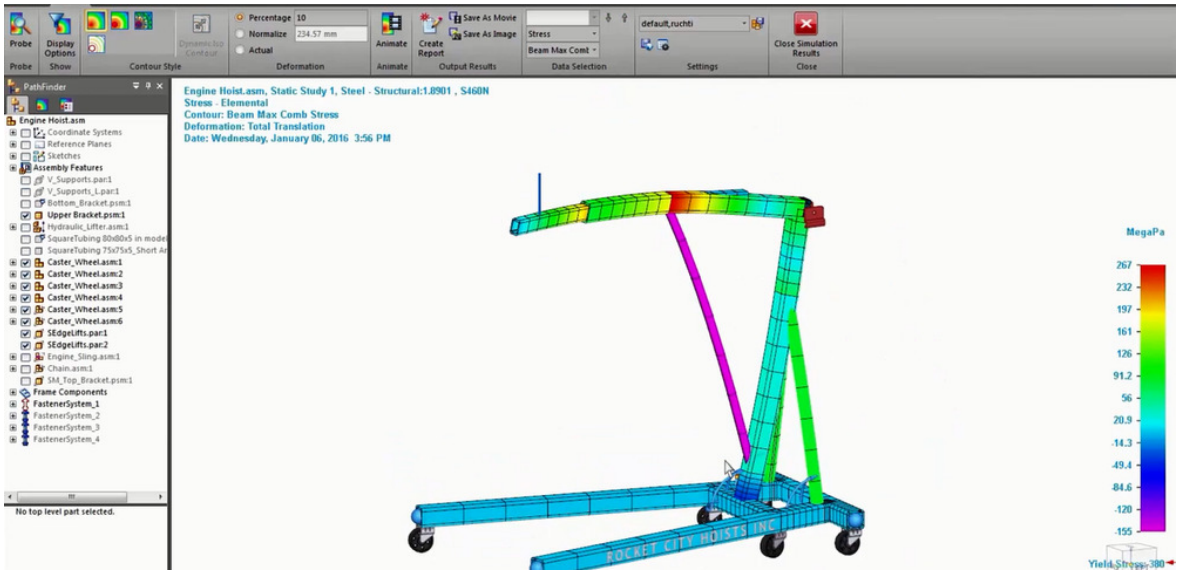


The first type of study we'll review is a subtype of linear static for analysing beams and frames. Beam analysis is a great tool inside of Solid Edge Simulation for users who design frame structures. Using beam analysis, you can quickly validate the strength of parts and assemblies, focusing solely on frame elements, eliminating the time and resource required to analyse complex shapes and features. Beam analysis checks to see if assemblies are overbuilt, based on the amount of stress exerted on them, and potentially causing manufacturing to spend more money than necessary on stock materials. Solid Edge Simulation's simple interface, completely integrated within Solid Edge, means creating simulation studies are a breeze.

When creating analyses in Solid Edge, there is a consistent and intuitive workflow followed. Define the geometry that makes up the study, set the appropriate loads that the part or assembly will be seeing and set constraints to simulate proper reactions from the elements making up the study. This allows you to create real life scenarios to test on your 3D parts.



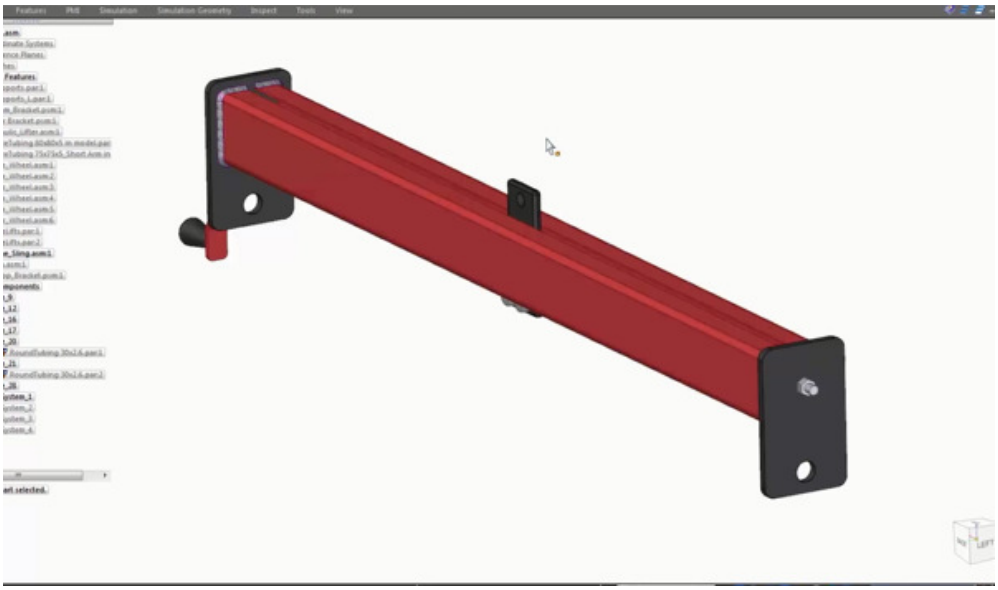
Once the study is set up, running a beam analysis is fast and efficient, as Solid Edge Simulation doesn't need to worry about the exact frame geometry to solve for the reaction forces on its members.



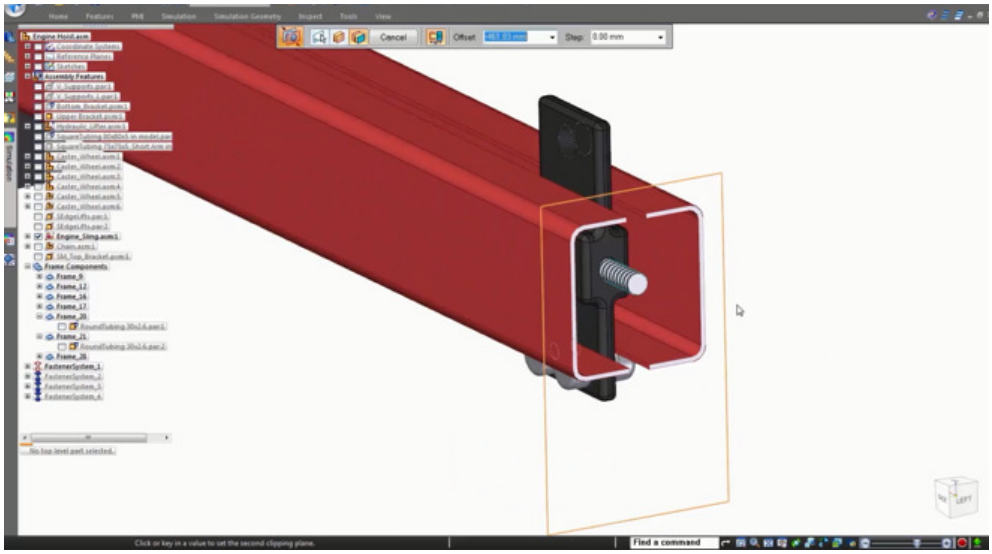
Once solved, Solid Edge provides an easy to understand readout of the results. If changes need to be made, Solid Edge allows you to edit the model quickly and easily, and then simply rerun the existing simulation study to review results of the change.

In addition to supporting multiple study types, Solid Edge can leverage several mesh types including surface meshing, solid meshing, or both to optimize speed and accuracy when simulating parts and assemblies.

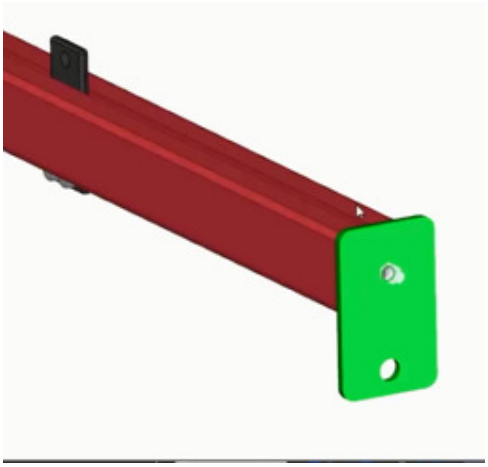
Take, for example a leveller, made up of a threaded bolt running through an adjustment bracket (used to control the balance of the engine being held).



Imagine that you have a requirement that the bolt can't bend more than 1mm, because the adjustment bracket wouldn't work properly.

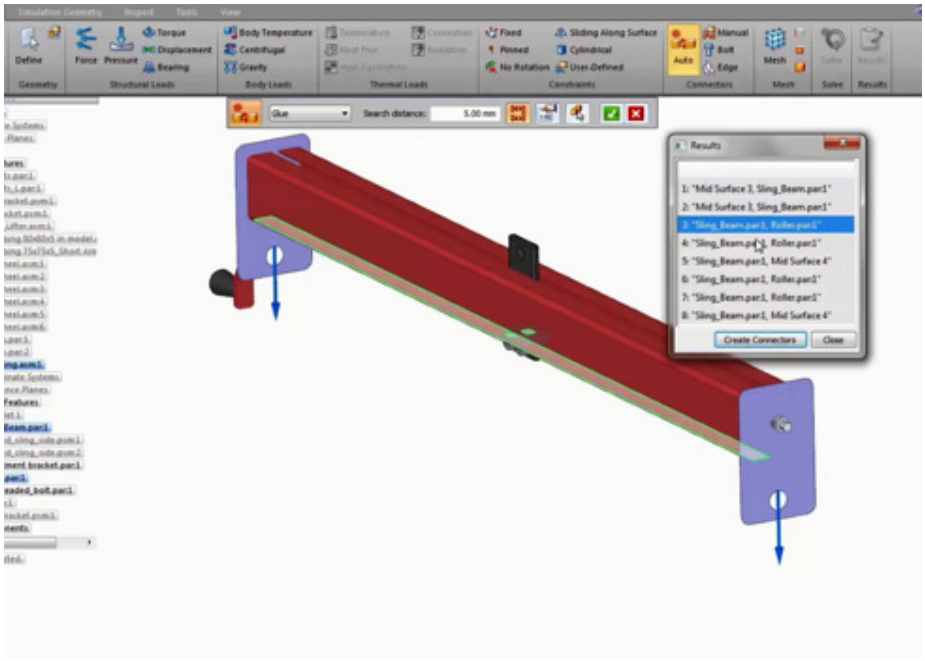


To optimize the simulation analysis, you can represent sheet metal end caps as surfaces, a much more lightweight representation for the study. Mixing surface and general body meshes is a great way to simulate sheet metal bodies along with formed parts.

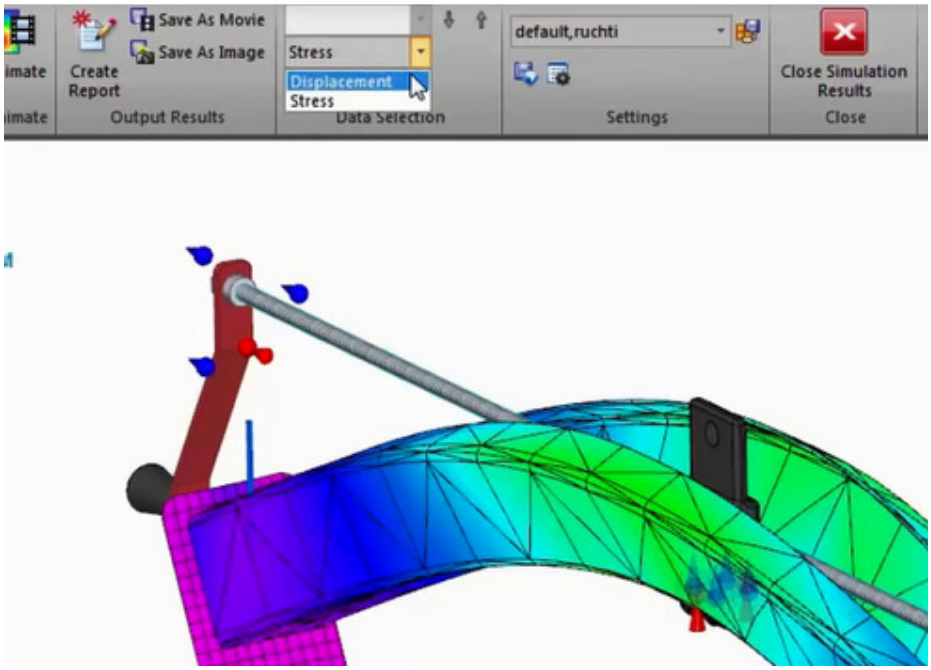


With the end caps defined, you can then set up the study. No matter the type of study being run, common steps are used to set them up. You have geometry, loads, and constraints—just like in beam analysis—but in the assembly study you need to define how the parts connect together (this was done automatically in the beam analysis based on the proximity of the beams to one another).

Solid Edge Simulation provides great connection creation tools such as options for bolted, edge, and manual definitions. However, one of the best time-saving options is the “Auto Connection” command, which allows you to quickly create all connectors automatically.

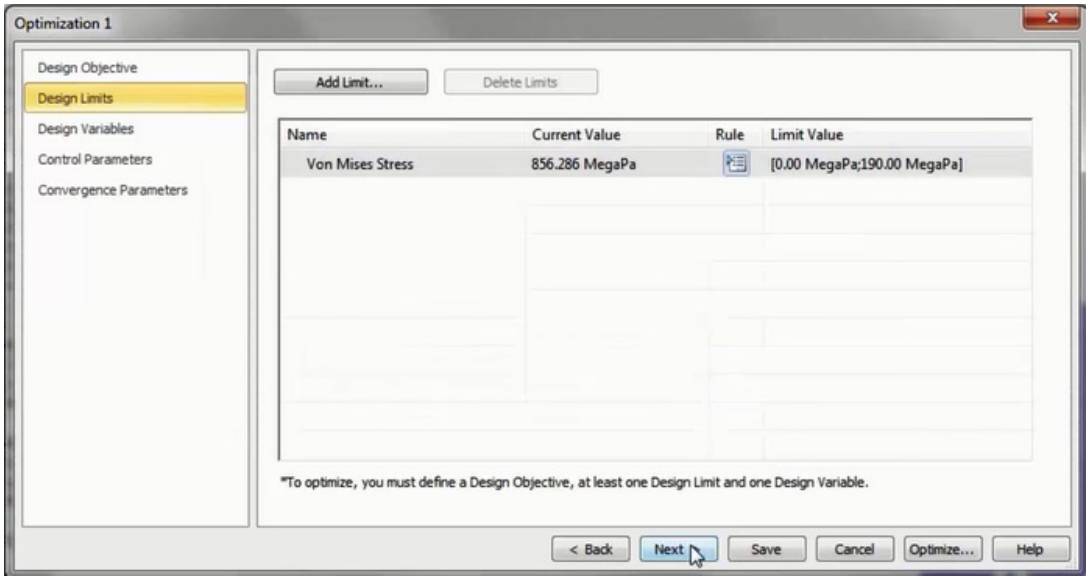


Once everything is set up, you can mesh and solve the study. Solid Edge gives users complete control over the mesh settings for both solid and surface meshes. You can easily change your view of results, for example, from stress distribution to displacement, using a dropdown.

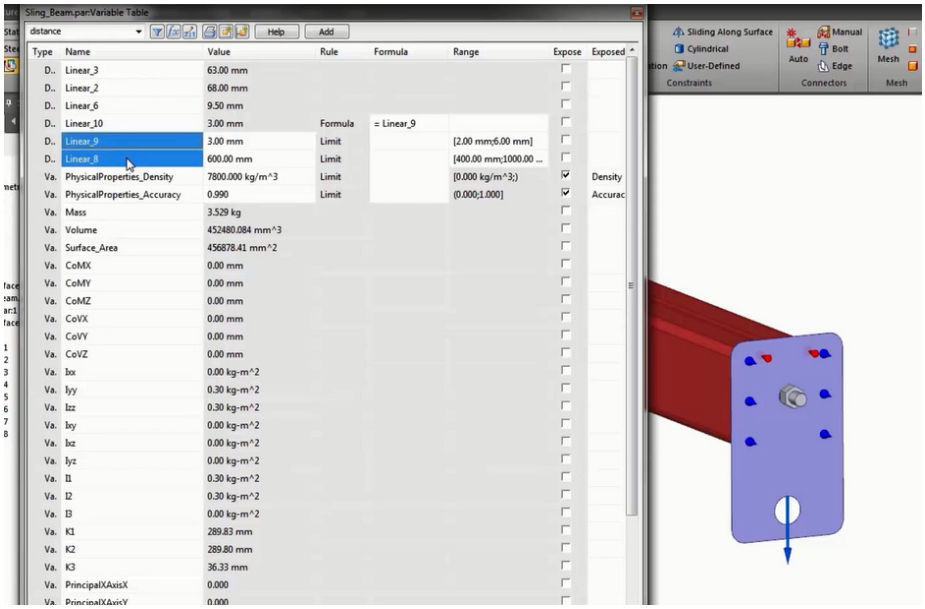


If you don't get your desired results the first time—such as, if our beam from the previous example has a displacement of more than 1mm—Solid Edge synchronous technology allows for easy changes to your design depending on your end goals. However, rather than manually making time-consuming changes to try to dial in the appropriate results, Solid Edge provides a great tool to automate and optimize your design – Simulation Optimization.

Simulation Optimization is a wizard-based tool that allows users to define objectives of simulation studies and customize how their parts can change in order to converge on the most optimized version. Simply set your objective, in this case, a maximum displacement of 1mm.



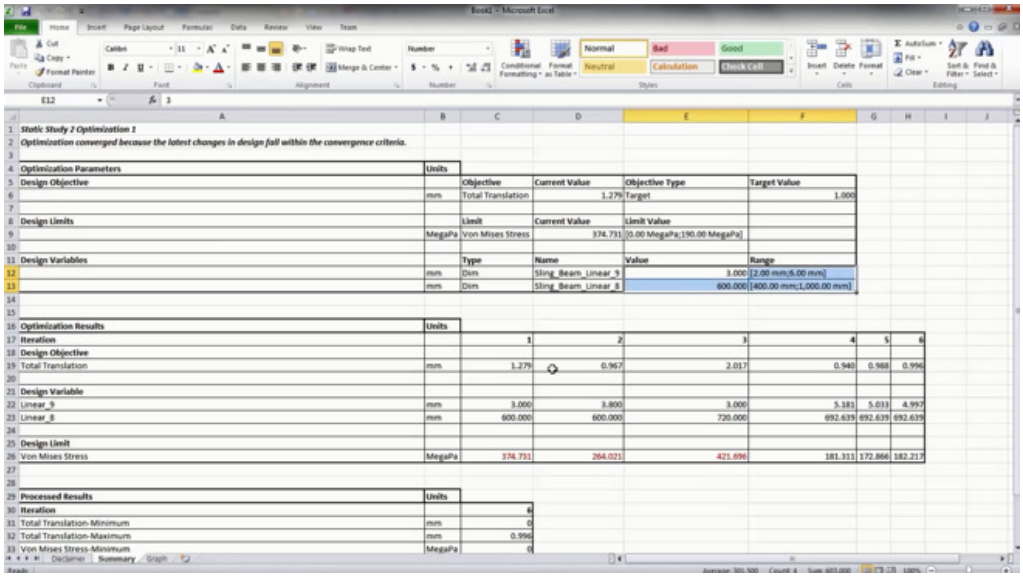
Next, define limits of the parts, such as stresses that they cannot exceed, and define what changes you want Solid Edge to make, such as thicknesses and lengths of components.



The remainder of the options define what is considered “solved” on the study.

The optimization iterates, taking the values of each subsequent study to make closer approximations to what the most optimized condition will be—in much less time than it would take to run each of these studies independently. In the end, Solid Edge provides you with a comprehensive summary of all of the studies and their associated values.

The optimization summary is produced in Microsoft Excel, allowing you to easily customize the output if desired.



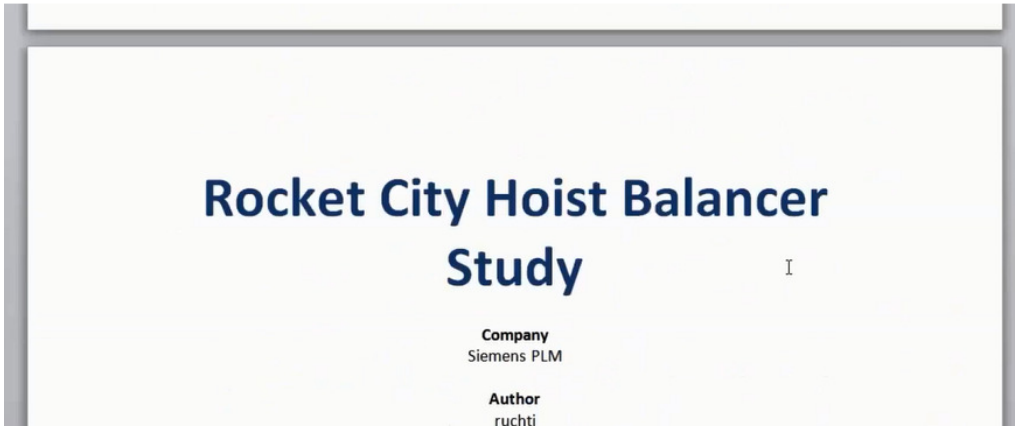
Static Study 2 Optimization 1
Optimization converged because the latest changes in design fall within the convergence criteria.

Optimization Parameters	Units				
Design Objective		Objective	Current Value	Objective Type	Target Value
	mm	Total Translation	1.279	Target	1.000
Design Limits		Limit	Current Value	Limit Value	
	MegaPa	Von Mises Stress	374.731	[0.00 MegaPa;190.00 MegaPa]	
Design Variables		Type	Name	Value	Range
	mm	Dim	Sling_Beam_Linear_9	3.000	[2.00 mm;6.00 mm]
	mm	Dim	Sling_Beam_Linear_8	600.000	[400.00 mm;1,000.00 mm]

Optimization Results	Units						
Iteration		1	2	3	4	5	6
Design Objective							
Total Translation	mm	1.279	0.967	2.017	0.940	0.988	0.996
Design Variable							
Linear_9	mm	3.000	3.800	3.000	5.181	5.033	4.997
Linear_8	mm	600.000	600.000	720.000	692.639	692.639	692.639
Design Limit							
Von Mises Stress	MegaPa	374.731	264.021	421.696	181.311	172.866	182.217

Processed Results	Units	
Iteration		6
Total Translation-Minimum	mm	0
Total Translation-Maximum	mm	0.996
Von Mises Stress-Minimum	MegaPa	0

Once optimized, you can save and output results, including animations, for use in design reviews, marketing materials, and more. Generating study reports from Solid Edge Simulation is easy; Solid Edge automates the creation of screen captures of study results and other pertinent information, with multiple options for output formatting.



As you can see, Solid Edge Simulation is perfect for design engineers—from making sure your designs are appropriate for their purpose, providing a simple and intuitive method for setting up studies, to a full optimization capability that automates solving multiple variables with minimal designer input. Oh, and rest easy knowing this is all done leveraging Femap and Nastran, industry leading Simulation technology.