

Drilling into the Heart of Direct Modeling

Direct modeling enhances engineering analysis throughput at a hydraulic drilling rig manufacturer.

By Thomas Ronge, Mechanical Engineering Lead, Schramm, Inc., West Chester, U.S.A.

In the drilling industry, remote locations and operating downtime expenses typically exceed \$1,000 per hour. At Schramm, Inc., a manufacturer and global supplier of hydraulic drilling equipment, all components are analyzed during the design process to ensure product reliability and an adequate safety factor. To reach the company's goal of deploying exceptionally reliable equipment to the field, Schramm has standardized on Simulation Driven Product Development to design its products. However, the development process hit a bottleneck at the stage when engineers prepared models for simulation — an issue that Schramm needed to address.

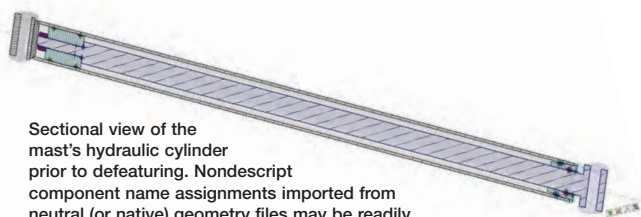
The century-old Pennsylvania company focuses on hydraulic drills for land-based applications. All Schramm drilling equipment is track- or truck-mounted. The organization supplies companies in the mining, energy, geothermal and water sectors worldwide. Over 75 percent of Schramm revenues come from export sales, with global reach including major market positions in China, Chile, Brazil, Australia, Russia and South Africa.

To support its product development process, Schramm adopted ANSYS Mechanical software in early 2010 to replace legacy mechanical analysis tools that had been in use for the past several years. The engineers who perform mechanical analysis there also have in-depth expertise in CAD. The CAD systems available today have their own unique strengths and weaknesses — but they historically have been missing the ability to defeature and repair an assembly in an expedient manner. Feature-based CAD user interfaces often don't provide the needed level of flexibility.

The starting point for most analysis work at Schramm is a geometry assembly supplied in native CAD or neutral file (IGES, STEP) formats. These models typically contain a significant amount of detail that is not relevant for the analysis and, therefore, must be simplified. Such simplification and cleanup work in traditional CAD systems can be highly time consuming. To improve return on investment from software and hardware assets, the



Schramm TXD Rotadrill with mast deployed via extension of its hydraulic cylinder. This equipment is a heavy-hoist, deep-hole, trailer-mounted top-head drive drill rig.

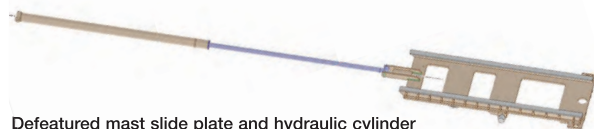


Sectional view of the mast's hydraulic cylinder prior to defeaturing. Nondescript component name assignments imported from neutral (or native) geometry files may be readily changed in ANSYS SpaceClaim Direct Modeler for easier tracking and referencing in ANSYS Workbench.

engineering team at Schramm identified model preparation as a key bottleneck. The company decided to expedite the work through a new software application; after researching various alternatives, they chose the ANSYS SpaceClaim Direct Modeler tool, which complemented ANSYS Mechanical. Upon introducing direct modeling, the staff quickly realized that a new paradigm for model preparation had arrived.

ANSYS SpaceClaim Direct Modeler software is equipped with a suite of CAD and neutral file translators that are highly robust, providing a geometry model that is easy to work with and defeature. Schramm engineers can quickly identify any technical issues that may exist after import using Repair Tab tools, such as *Stitch*, *Missing Faces* and *Gaps* commands. High-quality geometry models prepared in ANSYS SpaceClaim Direct Modeler reduce complications — such as poor mesh quality — downstream in the analysis process.

A traditional goal for those performing engineering simulation is to remove nonessential features in the



Defeatured mast slide plate and hydraulic cylinder subassemblies in ANSYS SpaceClaim Direct Modeler. The cylinder assembly has been reduced from 13 to two parts (barrel and rod) using CAE model preparation tools. Preparation of the entire assembly took approximately one hour. ANSYS SpaceClaim Direct Modeler has dedicated repair and prepare tools that expedite this process.

geometry to facilitate faster and more robust meshing. The Schramm team has found that ANSYS SpaceClaim Direct Modeler enables quick cleanup and defeaturing operations, as the tool works directly with geometry and does not have to take feature dependencies into account. Cleanup work can be done in a few hours, compared with a time frame of several days using a traditional CAD package. Engineers at Schramm strive to spend as much productive time as possible post-processing

and interpreting results (not repairing and defeaturing geometry models) and maintaining throughput on the eight-core cluster available for analysis runs. Spending less time on model setup is a huge benefit.

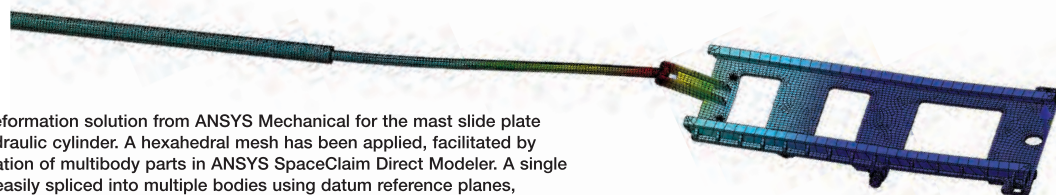
Another strength of ANSYS SpaceClaim Direct Modeler is the ability to drag and drop components in the structure tree to create or customize multibody parts at will and on the fly. Hexahedral meshes generally are preferred for accuracy reasons. Through proper definition of the multibody parts in ANSYS SpaceClaim Direct Modeler, the team at Schramm employs sweeping tools in the ANSYS Meshing platform that allow hex-dominant meshes to be used on complicated geometries. In many cases, it is obvious that a boundary should occur at a location where the geometry undergoes a step change, such as where a cylinder is attached to the face of a larger body. Decomposing the geometry is done using datum planes to splice the component into multiple parts.



Mast slide plate imported into ANSYS Workbench as a multibody part, which takes advantage of shared topology. The slide plate comprises dozens of individual solids. While these solids may be easily grouped in ANSYS SpaceClaim Direct Modeler to form a single solid, not doing so allows for unique material properties to be assigned to each individual solid.

Performing this work in the geometry phase mitigates the need to assign meshing controls in ANSYS Meshing and reduces the overall time for model setup. Shared topology may (or may not) be imposed when importing the geometry into the ANSYS Workbench platform. This means that, at the import stage, the user controls whether or not a common nodal imprint is applied at the shared boundary between adjacent parts. Generally, the shared topology option is desired, but in some cases there is value in applying different meshes to different adjacent parts.

The significant impact of Schramm's introducing direct modeling as a model preparation tool was larger than expected. For example, one engineer previously performing two to three projects per month is now regularly performing four to five during the same time frame. The larger and more complex the model, the more significant the time savings. Schramm can now reap a number of benefits from higher engineering analysis throughput, including reduced time to market and more reliable equipment.



Total deformation solution from ANSYS Mechanical for the mast slide plate and hydraulic cylinder. A hexahedral mesh has been applied, facilitated by the creation of multibody parts in ANSYS SpaceClaim Direct Modeler. A single part is easily spliced into multiple bodies using datum reference planes, enabling hexahedral mesh sweeping operations in ANSYS Workbench.