

Getting Simulation Done – Vierhout Improves Structural Steel Machine Frame using Mesh-free Simulation



Developing new factory lines and assembly machines is a very challenging task. These systems are incredibly complex and contain many different components and subsystems. When a company is in charge of developing a new machine, the engineers of today often turn to software solutions to handle all major development tasks using CAD (Computer Aided Design) and CAE (Computer Aided Engineering). The market offers a broad range of these software tools for various applications and physical effects to be considered and analyzed. When it comes to structural optimization and simulation of these complex machine assemblies, typically linear Finite Element Analysis (FEA) comes into play. While traditional FEA solutions offer precise results for a broad range of applications, significant effort and expertise is required to prepare the models for analysis, especially for geometry simplification and meshing.

Universal Corrugated B.V. (UC), part of the Minda Group and based in Almelo, the Netherlands, is a company offering automatic deposit systems for the corrugated cardboard and board industry. UC provides solutions for the dry end of corrugated cardboard plants, including complete systems for the manufacturing of endless corrugated cardboard and stacking systems down-stream of corrugated cardboard converting machines. When the engineers of Universal were tasked with analyzing and simulating one of their machines, they turned to Vierhout Engineering (VE), a professional independent engineering services provider based in Hengelo, the Netherlands, to support for the project.

The Universal Corrugated use case of SimSolid

When Universal Corrugated approached VE and requested an analysis and simulation of one of its machines, it soon became clear that new solutions were needed to enhance the development processes. Vierhout is very experienced with multiple 2D/3D CAD and CAE tools, including FEA simulation applications, however, due to the extreme complexity of the machine being analyzed, VE realized that traditional FEA might come to its limits



Industry

Engineering services, general machinery

Challenge

Simulation of large assemblies with different load cases and detailed framework to generate a complete, detailed 3D simulation model

Altair Solution

Altair SimSolid, meshless simulation of large assemblies, early phase designs with extremely fast turnarounds

Benefits

- Improve analysis efficiency
- Perform detailed analysis
- Visualize 3D solids
- Cost and time savings
- Speed-up decision-making in the design cycle

with this project. This forced the engineers to explore new methods and technologies that could provide a faster road to success. The solution they discovered was Altair SimSolid™, a structural analysis software developed specifically for upfront structural assessment. VE selected SimSolid as it eliminates geometry simplification and meshing, the two most time-consuming and expertise-intensive tasks done in traditional FEA.

Enabling complex simulations of large structural frames with SimSolid

With projects such as the one from UC, the VE engineers start with a basic check to see if the construction complies with the applicable norm. In the past, these analyses were carried out with traditional FEA software. While FEA tools offer precise results for a broad range of applications, they have some limitations when it comes to simulating very large and complex systems. In essence, these large systems have to be simplified and divided in order to carry out an analysis with a solid mesh. Engineers have to create a simplified FEA 3D model for each individual machine component or system. Not only is this time-consuming, the resulting data load often reaches the hardware limits of the computers on which CAE and CAD software is used. Additionally, if large structural frames come into play, they have to be analyzed with simplified beams and sheet elements, a very cumbersome, error-prone and time-consuming process. By leveraging SimSolid for these types of systems, all of the manual work was reduced to a minimum.

"The time saved by not having to simplify and clean-up geometry, as well as the meshless analysis, offers the opportunity to investigate more variants and load cases than with traditional FE tools in the past."

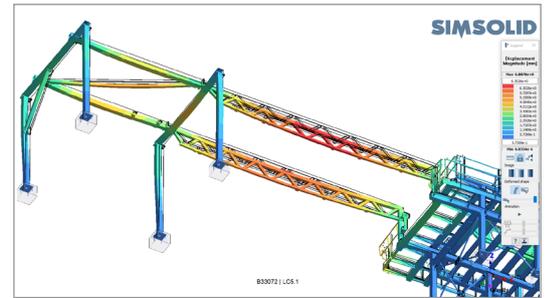
Evert Vierhout, Owner Vierhout Engineering

In this particular use case, VE had to analyze the structural steel machine frame in high detail. The frame had a mass of about 20 tons and was approximately 32 meters long. The focus was to perform analyses with different load cases and very detailed framework conditions of contacts and forces. In addition, a check had to be performed whether the custom frame would be strong and stable enough to comply with Euro Code requirements. A significant advantage of using SimSolid was that the complete 3D detailed model, a large assembly, was analyzed, including bolts and nuts with tightening torques and pre-tensions. Parts with contacts such as flange connections were analyzed geometrically, non-linearly, including friction and separation contacts. The results of these analyses were very detailed and clearly displayed in 3D with material stress, displacements, modal frequencies, and reaction forces on the foundations.

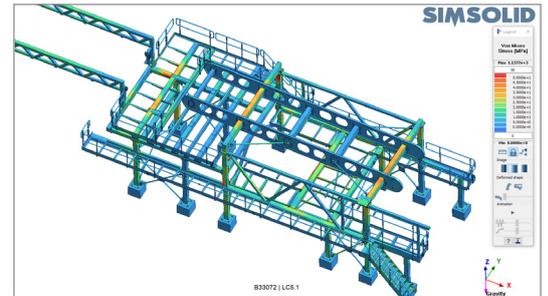
Based on this success, SimSolid is now being applied for all complex analyses and simulations at VE. The analyses are more detailed and can be fully executed on 3D solids. With SimSolid, the complex 3D CAD composition detail models (at production level) can be used, including all details such as major welding and bolt-nut connections. Due to the mesh-free simulation method of SimSolid, the meshing phase of the design process can be entirely eliminated. This allows more attention to many details and custom settings such as contacts, loads and pre-tensions, and offers more development time to investigate design variants.

Solutions ahead: Simulation paves the way

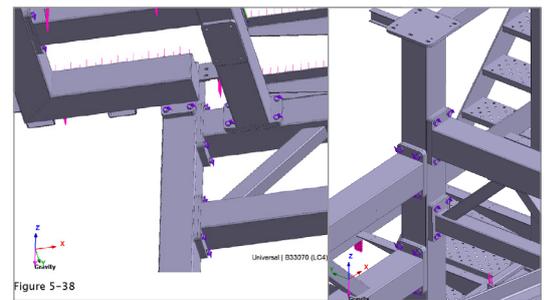
Through the efficient and detailed analysis, Vierhout Engineering sees a lot of potential in SimSolid and will continue using it in future customer 3D CAD export projects. "SimSolid goes further in efficiency and detail than traditional FEA systems, which is a big advantage. The time saved by not having to simplify and clean-up geometry, as well as the meshless analysis, offers the opportunity to investigate more variants and load cases than with traditional FE tools in the past," said Evert Vierhout, Owner Vierhout Engineering. "We are very happy with the results and look forward to supporting our customers using this efficient solution."



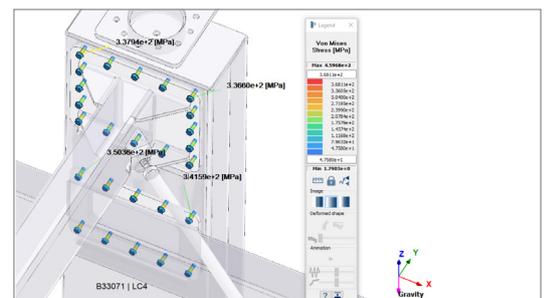
Displacements of the structural frame



Stresses in the structural frame



Several downloads and bolted connections with torque preloads at friction flanged & welded connections



Results of the Von Mises stresses at bolts with preloads