CASE STUDY:

Advanced Finite Element Analysis

Date: *September 2021*

PAMI's Capabilities:

PAMI supports machinery manufacturers with

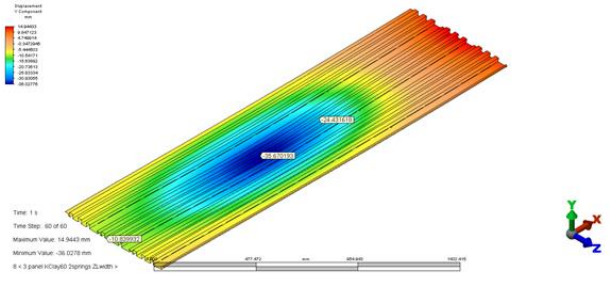
- *Failure Mode and Effects Analysis.*
- *Proven test set-ups and analysis methodologies.*
- *Convenient locations at our facilities at Portage La Prairie, Manitoba, and Humboldt, Saskatchewan.*
- *Assistance with prototype design to accelerate development and to-market timelines.*
- *Computer modelling and analysis to save time and cost when developing prototypes.*
- *Design insights based on decades of engineering experience.*

The finite element method has become a widely trusted approach for conducting virtual structural analysis. Through continuing advancements, finite element analysis (FEA) software is now available in many forms, including many simple but robust analysis plug-ins that have been integrated into computer-aided drafting (CAD) and 3D modeling packages. However, many industrial-use applications demand higher-level features and functionality than those available through FEA-integrated CAD packages.

For many years, PAMI has been involved in advanced FEA projects, such as fatigue life predictions and investigations into plastic deformation and the resulting post-yield behaviour. While simulations are a valuable tool during the engineering process, PAMI's extensive testing history provides an added dimension when physical validation is also a requirement. A validated and trusted simulation can be used to model various scenarios well before a final design has been completed, allowing for many iterations and options to be assessed early in the design process. The knowledge gained from modelling these scenarios enables focus on only the most feasible outcomes for physical testing and greatly increases confidence throughout the decision-making process.

Client's Challenge 1: Fatigue

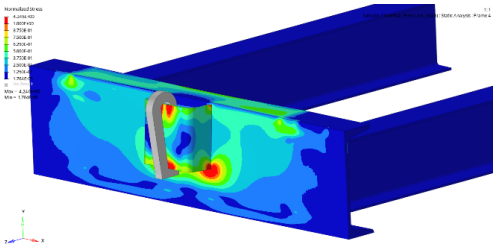
Fatigue from repeated loading is one of the most common failure modes of in-service machinery across many industries. To understand the service life of a portable track-roadway system, the deformation and strain of components supported by compressible soil was simulated while under load from several vehicle drivetrain configurations and weights.

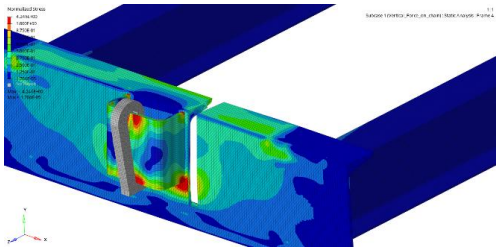


To support FEA model development, actual strain measurements were recorded in multiple locations during multiple passes of a heavy vehicle. Fatigue calculations based on the FEA results were then used to understand and predict component life in the track-roadway system.

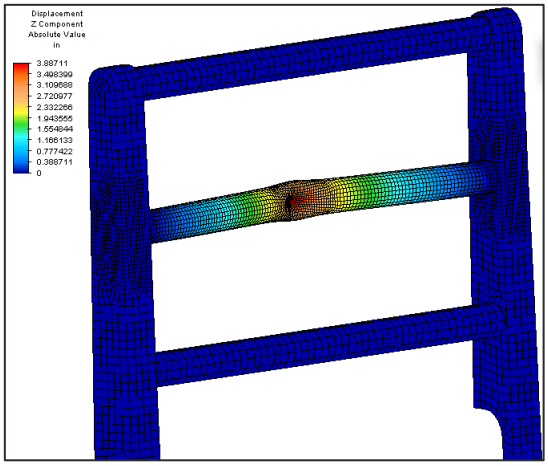
Client's Challenge 2: Plasticity and Post-Yield Behaviour

Many scenarios in industry require an accounting of non-linear effects, such as material plasticity and large deformations. In an investigation to support an OEM manufacturer, these non-linear effects were included and helped to improve the match between prediction and physical testing. Additionally, advanced mesh control aided in predicting accurate through-thickness stress results.





PAMI has a long history of conducting physical testing to support product research and development. At the center of our mechanical testing capabilities is our MTS FlexTest® System. In the work pictured below, highly non-linear FEA that accounted for permanent deformation was validated with physical testing; displacement results agreed within 1.0%.



Value Created:

PAMI's 45+ years of practical experience in operating and designing both agricultural and non-agricultural machinery provides our clients a unique perspective when it comes to simulation. PAMI's experience ensures models and simulations are

- practical and have real-world applications,
- aligned with local, national, and international standards,
- able to add value throughout all phases of the product development cycle, and
- tailored to achieve a shorter timeframe from concept to market with a far lower risk of warranty issues after the final product has been released to customers.