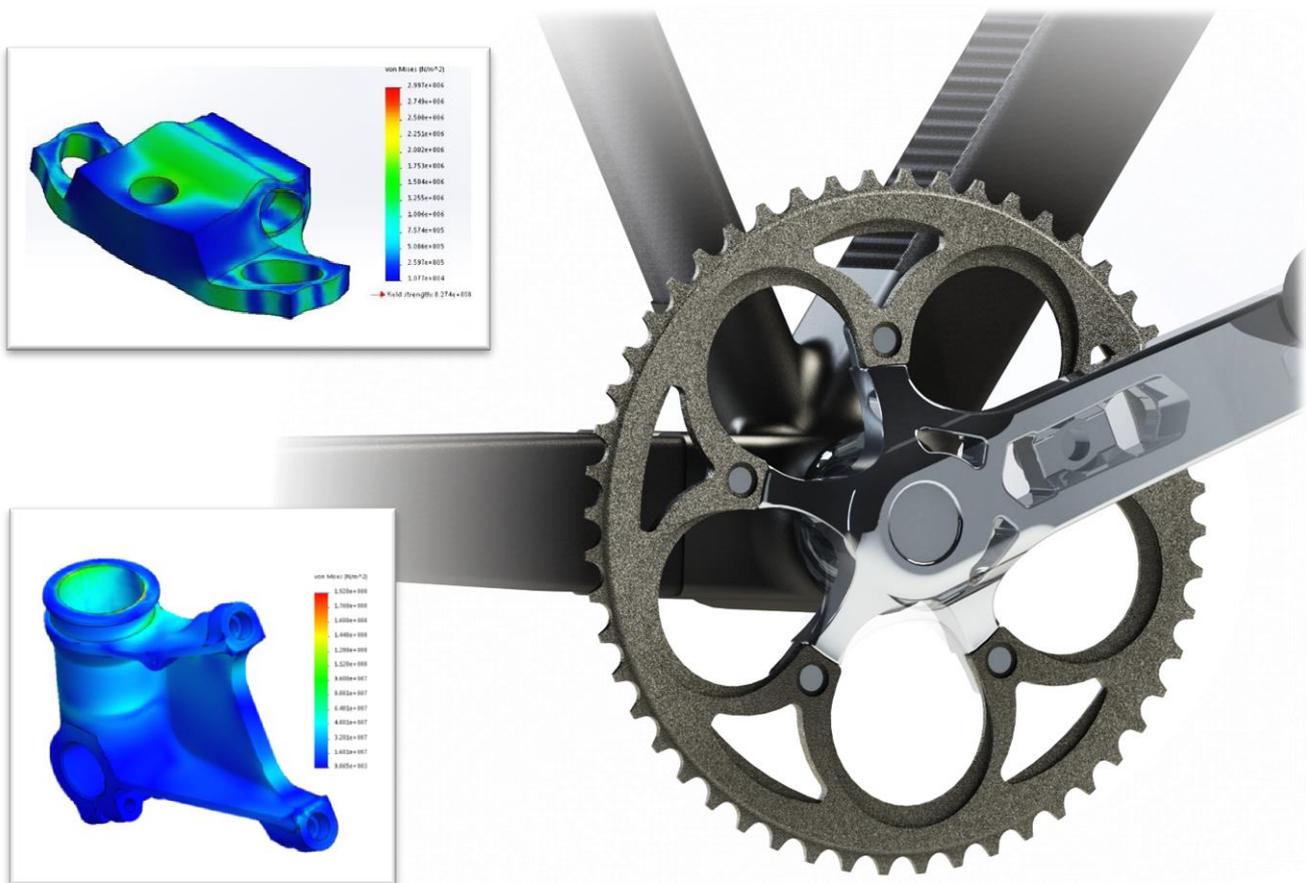


TruForm SOLIDWORKS

Extending SOLIDWORKS Simulation to Provide Design Insights, Reducing Mass and Improving Performance

White Paper



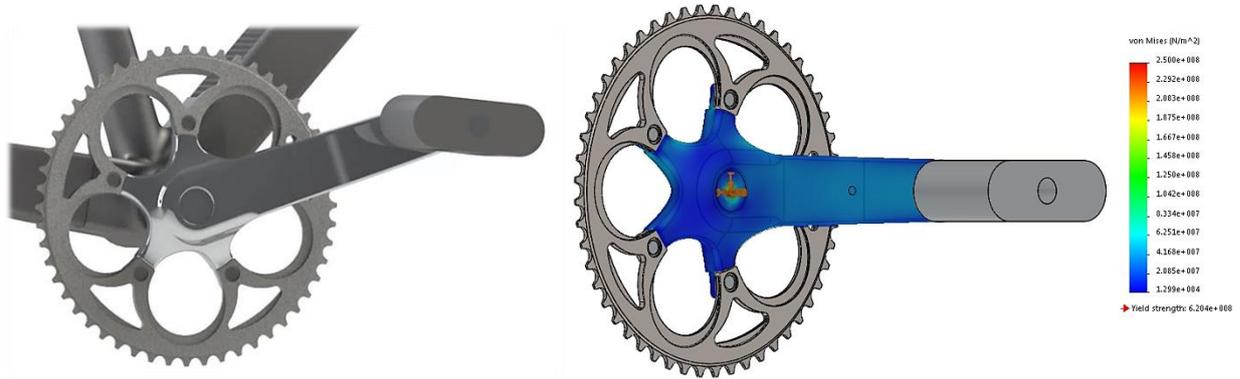
SUMMARY

SOLIDWORKS Simulation enables you to accurately and cost-effectively simulate how a design will behave in response to given load cases. Within the familiar SOLIDWORKS environment, TruForm SW then guides design engineers to develop the lightest, most cost effective structure, reducing the time spent developing and hence minimising the time to market.

TruForm Premium Features:

- Multiple Sim Study Optimisation
- Automated Sketch Tool

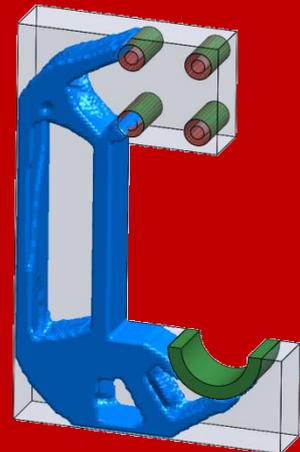
Case Study – Optimising an Existing Bicycle Crank Design



In order to demonstrate the capabilities of TruForm, a typical bicycle crank loading case was selected. The design started as a typical bicycle crank and pedal arm. The chain and axle were represented by constraints. The load applied by a cyclist was represented by a 1000N load at the pedal with example results at one position shown.

How TruForm SW Works

Topology optimisation is the mathematical study that leads to the optimisation of material within a design space based on defined loads and constraint sets. Working within SOLIDWORKS, TruForm SW allows a user to utilise the powerful topology optimisation method through a simple interface. This ultimately allows for the development of the most efficient and effective design. Saving mass, cost and time without compromise on performance.



Upon confirmation of the loading through SOLIDWORKS simulation studies, an optimisation was carried out in TruForm SW. The crank set was selected as the designable component with the exception of the pedal, spindle and chain wheel. The load and constraint set defined earlier were selected as the simulation study. The target mass was left at the TruForm default, being 30% of the original design space mass. The outcome was then imported as a graphics body.





The TruForm results were then used to modify and improve the part. Sketch and extrude cut features were used to remove sections of the existing part which were not being utilised.

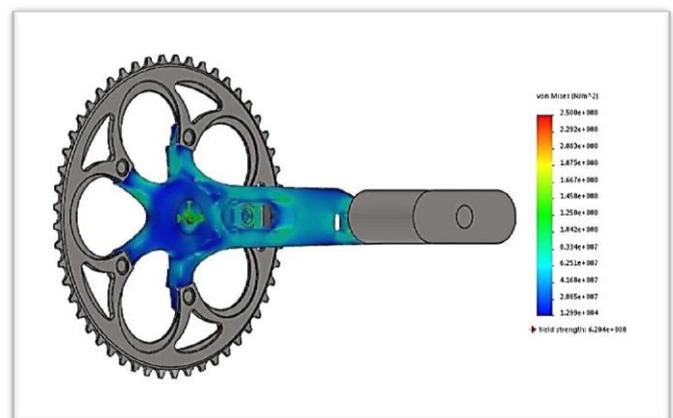
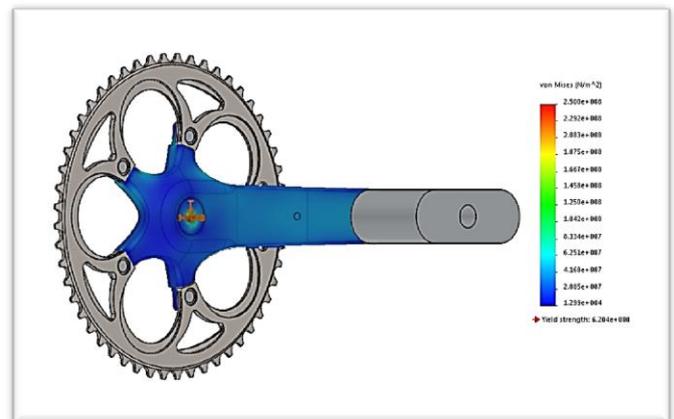
To conclude, the design was refined with features such as chamfering and filleting, and a 24% reduction in weight was achieved.

STRESS ANALYSIS

In order to validate the optimized design, a comparison is made using stress plots from SOLIDWORKS Simulation.

After the topology optimisation has been applied, changes to stress distributions through the crank are noted. With the stress scale upper limit being set to the Steel yield stress of 250MPa, on the original design it is conveyed that the material is not being properly utilised with an average value of approximately 60MPa.

After the applied changes however, the new average value is approximately 150MPa, still within a reasonable limit of the yield stress, but a much more effective and intelligent design. Showing a largely uniform stress distribution confirms an efficient use of material.



Case Study Examples

TruForm SW enables seamless topology optimisation within SOLIDWORKS for various applications including automotive, aerospace and motorsport giving a typical part mass saving of 30% and up to 50%. The wing mount assembly and jet engine bracket are both designs developed through the guidance of TruForm optimisation results, delivering weight, time and cost savings.



Using TruForm SW

Since TruForm is integrated into the SOLIDWORKS environment, it is simply an extension of the Simulation process. Optimisation can take part at the user's preferred stage. This can be an optimisation as a final part of the design, or the 'Right First Time' approach can be taken on a given design space. TruForm SW can also be used to resolve design strength and stiffness issues through the ongoing development of a part.



BENEFITS OF USING TRUFORM SW

- Mass reduction within a design can:
 - Reduce - maintenance, production and running costs.
 - Improve - efficiency, effective use of material and environmental friendliness.
- Minimise time to market.
- Enable the development of creative and revolutionary designs.
- Topology results can be imported as a solid body which can be used in simulations.

TRUFORM SW FEATURES

- User interface – Simple and easy to use
- Design Region Selection – Allows selection of part(s) which will be optimised
- Simulation Study Selection – Selection of defined load and constraint set
- Target Mass – Sets a target mass for the optimisation process
- Optimisation refinement – Define optimisation detail
- Results – Import results as a graphics body or as a solid body

TruForm SW Premium

ABSTRACT

Creating robust, lightweight and innovative designs becomes easier with TruForm Premium, which allows the consideration of **multiple Simulation Studies** within the same optimisation. Additionally, the user can then carry out the analysis interpreting each simulation study to be of equal importance or based upon the defined load magnitudes.

Furthermore, to improve and accelerate the user experience a sketch instrument is now available, enabling the automated creation of a sketch data based upon section cutting through the native TruForm Premium results. The created sketch can then be used to define the kept material or define the material to be removed from the given part.

Stiffness Test Case Study

An optimisation was carried out on the hook example shown opposite. The STL was imported into the working environment as a graphic body.

Previously, the user would have to manually create a sketch or multiple sketches and then use the SOLIDWORKS features to modify the part. However the user can now utilize the optimisation results in conjunction with the sketch tool to create the sketch highlighted below. The final part had a 66% reduction in mass.



Features

Optimisation Tool

- Simulation Study Weighting:
 - Based upon load magnitudes
 - Equal importance
- Target Mass Definition:
 - Percentage
 - Absolute

Sketch Tool

- Create a single or multiple sketches
- Import TruForm Premium results
- Projected Profile or Section Sketch
- Sketch profile of material to keep or discard

