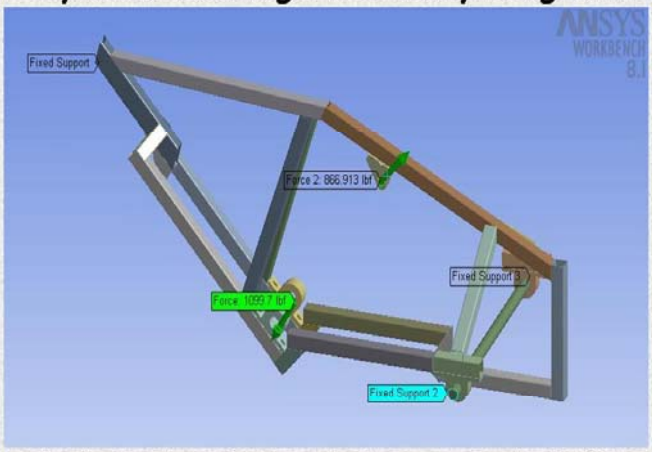
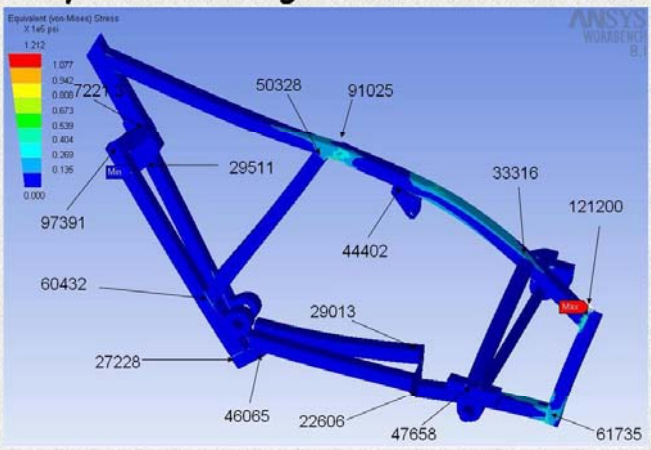
ANSYS® Finite Element Analysis

Dynamic Loading Free-Body Diagram



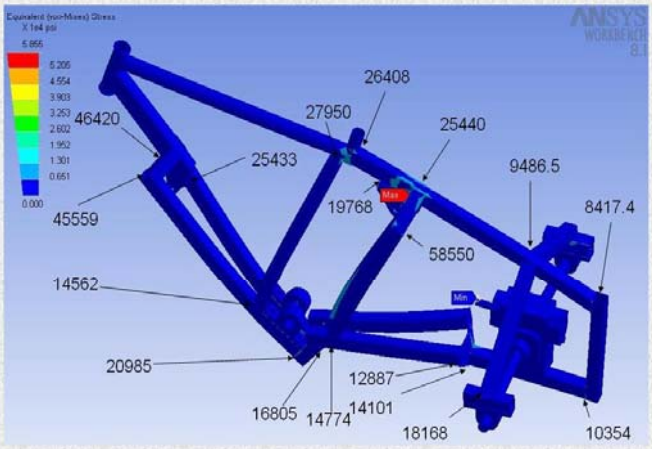
This diagram shows the dynamic loading scenario on the 1.25 " 16 gage steel tube frame that resulted in the highest stress levels in 90% of the frame. It includes 300 lbs of rider weight applied vertically on one pedal coupled with this entire force transmitted to the rear hydraulic cylinder simulating the front cylinder reaching the end of its stroke.

Dynamic Loading von Mises Stresses



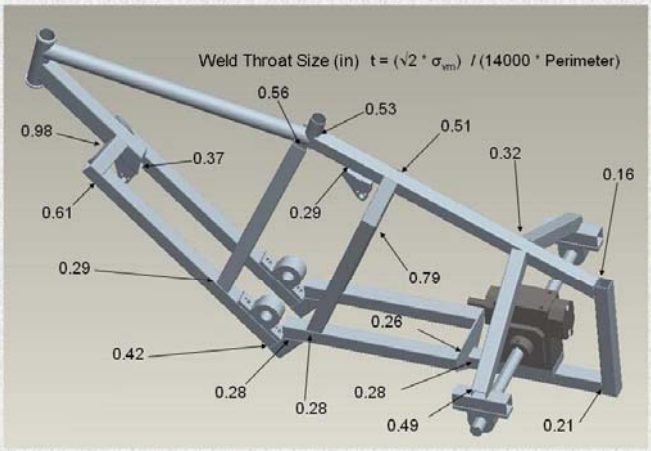
The first FEA analysis of the frame revealed quite a few problematic joints, with one existing at a stress state of over three times the yield strength of low carbon steel. The top support tubes were the most stressed, so it was decided to insert two more frame members and the gearbox into the model. The original design goal was to design the frame as to not require the gearbox to be a necessary structural frame member.

Dynamic Loading on Redesigned Frame



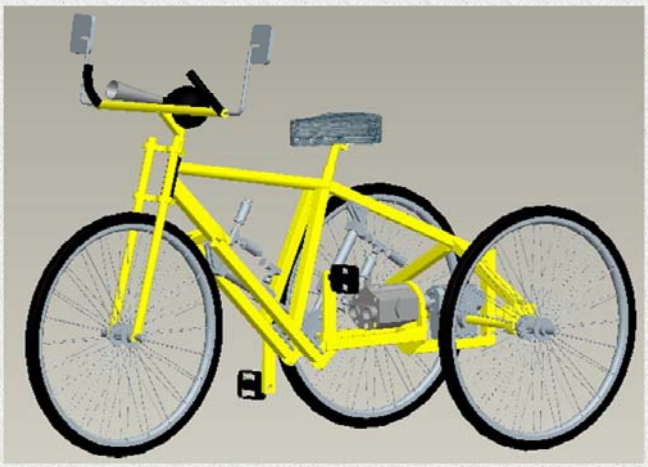
This figure shows the maximum von Mises stress state at each joint compiled from multiple loading scenarios. By adding two more frame members along with the gearbox to the model, the stress levels seen by the frame were greatly reduced. The three places that still exceeded the yield stress (approximately 40,000 psi) do not exceed this value by enough to warrant further frame redesign. Instead, these joints are excellent candidates to for the addition of gussets. Although the gearbox was added as a structural member, the stresses on it were minimal.

Weld Throat Calculations



Correctly sizing the welds is a critical step in the design process of a load bearing welded structure. To "just use what has worked in the past" without calculating the actual weld size is not a practice that should be performed by any competent design engineer. The above weld calculations include a factor of safety of 3 which explains why some of the sizes are quite large. With the addition of gussets where needed, the length of the weld bead at these joints will be increased thus making the required throat much smaller.

PRO/E ® Model of Bike



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