Trebuchet Force Analysis

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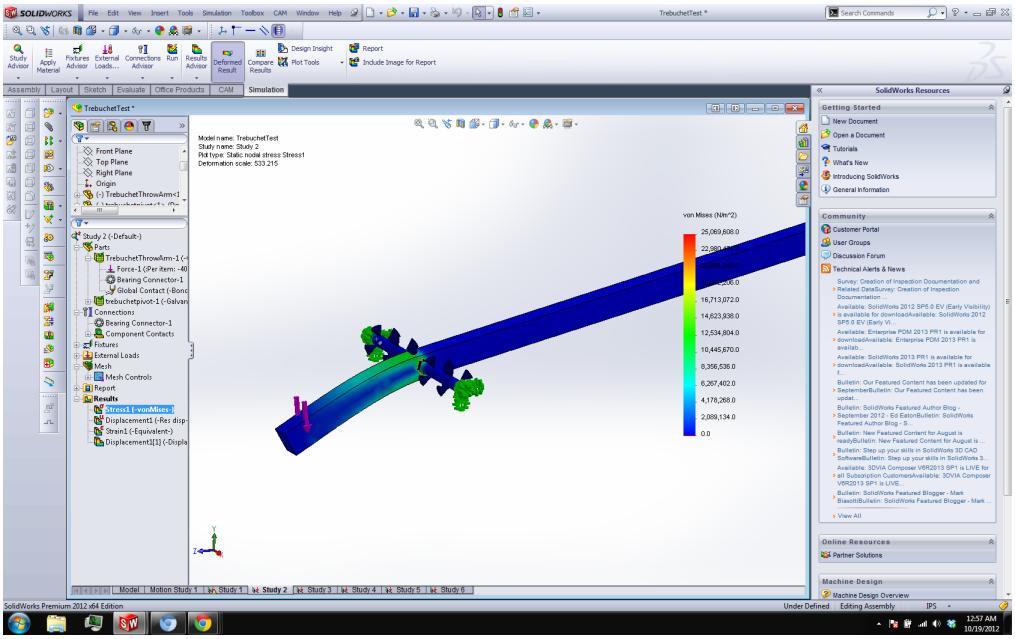
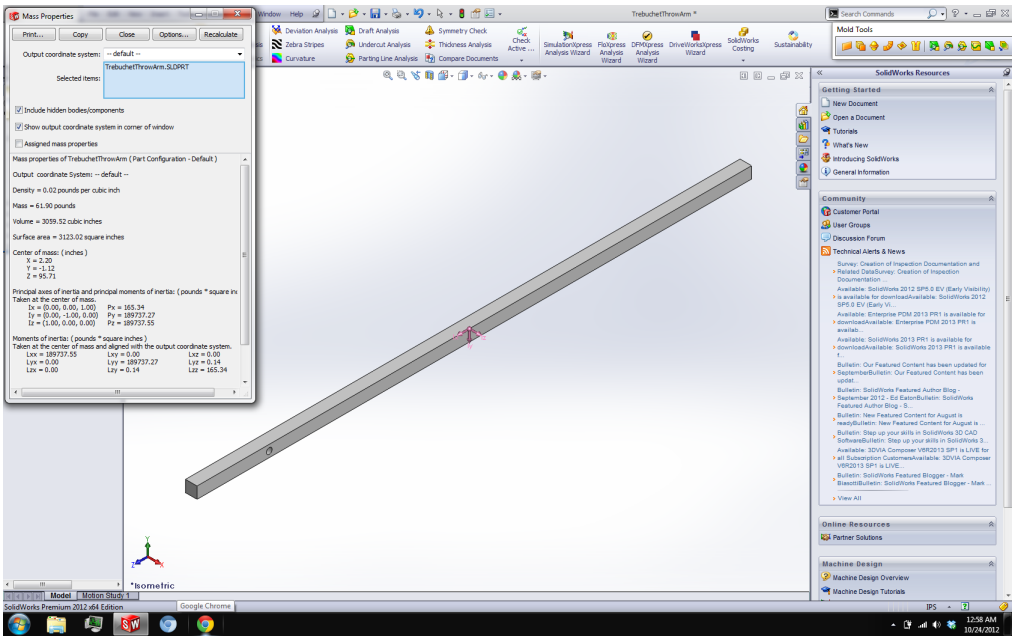
To determine feasibility of drilling out the trebuchet launch arm we consider first the structural feasibility of a larger pivot arm by applying force of 4000 newtons to a CAD model of the 16 foot throwing arm, at the location where our launch mass is attached to the throwing arm with our new 1.75" pivot hole modeled in place of the old .75" pivot hole.

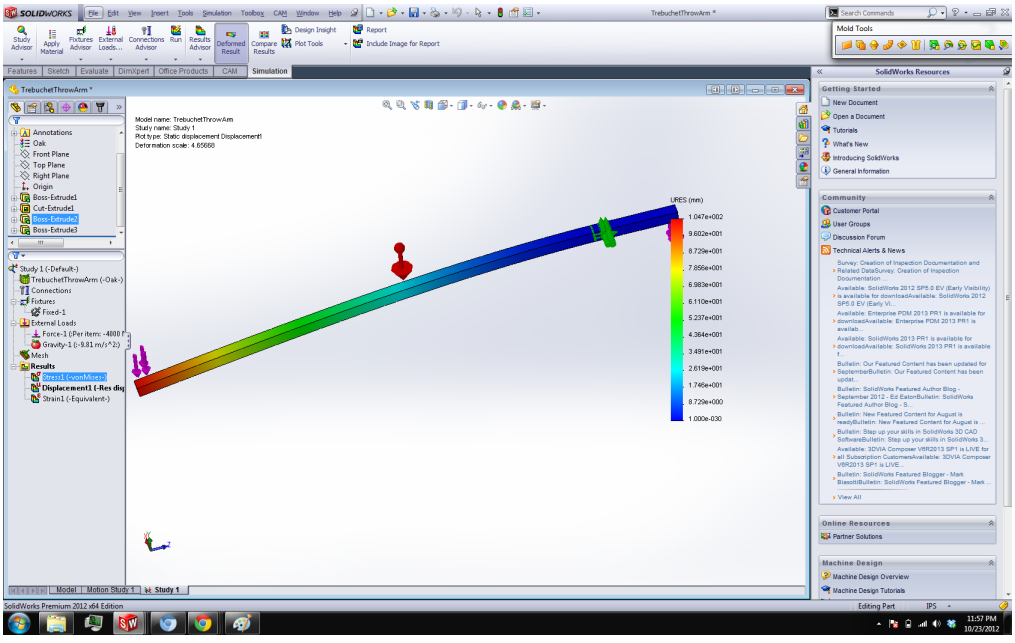


As a result of this large deflection we choose to support the new pivot hole with a large 4x4 brace and a smaller 2x4 brace on the bottom and a second smaller 2x4 brace on the top, bolted in place with 4 x 1/2" bolts. We choose the 6" of bracing on the bottom given the location and direction of the large displacement. This has shown to be sufficient support.

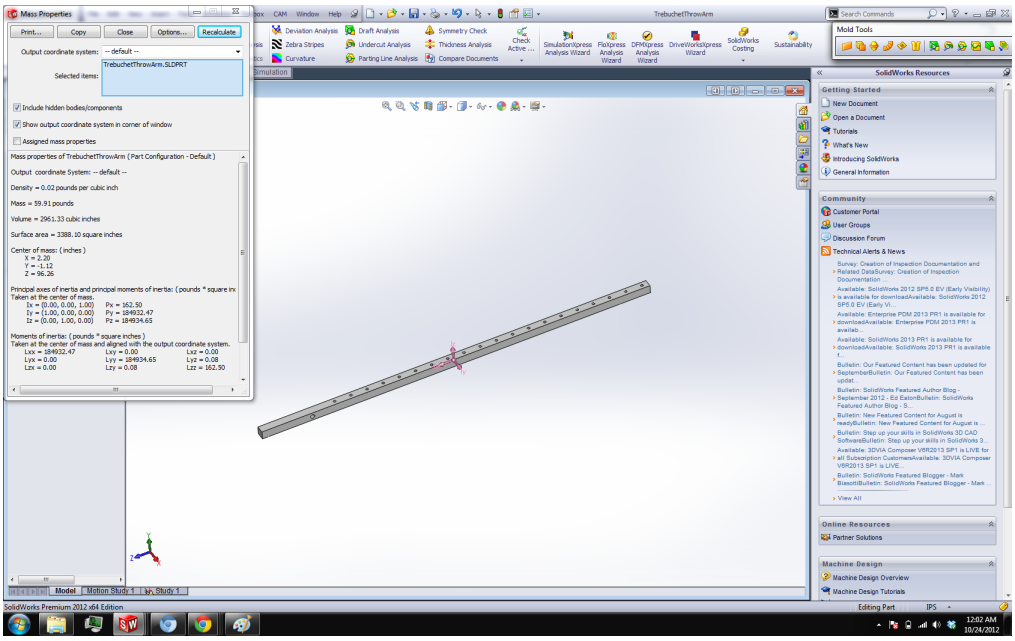
Due to the poor performance of the trebuchet last year, we consider reducing weight on the throwing side of the arm, i.e. the 12 foot section of 4x4 throwing arm between the launch basket and pivot arm. This is calculated by Solidworks to weigh roughly 60lb, and while this is probably inaccurate on density of material, since we choose to simulate pressure treated pine with the Solidworks "oak" material, by being consistent with material we can get an accurate idea of the effects which was sufficient in this model.

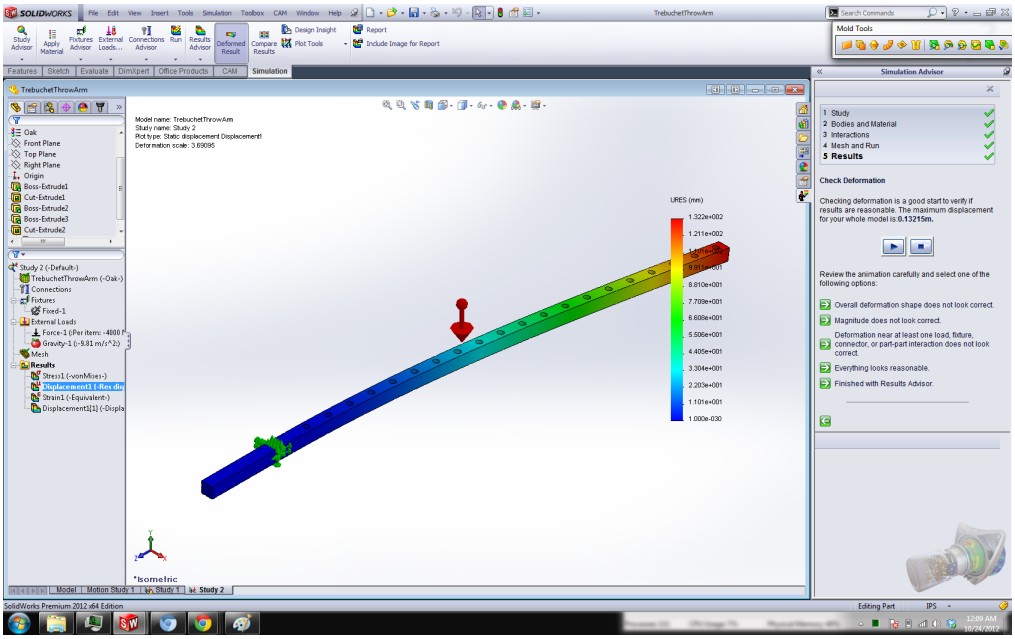
We start by modeling the arm with no lightening holes in the model for a baseline of deflection and mass that we can compare our later simulations to. With a fixed pivot and a force of 4000 newtons applied to the location our basket will be bolted to, and location of the launch mass on the throwing arm our initial mass is 61.9lb, with total deflection of 104cm.





We again calculate mass and displacement of the throwing arm with our lightening holes. Keeping in mind that we do not have perfect simulation parameters in place, we find a mass of 59.91lb and displacement of 133cm.





This is a 25% increase in deflection for a 3% reduction in mass of the arm. There is no significant reduction of system mass with this modification while adding a significant increase in deflection of a critical system component. The safety of operation for this throwing arm is critical, as we are using a 400 lb counterweight in a public demonstration. Due to the large increase in deflection and negligible decrease in mass, this is not a reasonable modification to make.