Case Study 1

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This case study is about an aluminum bike frame subjected to a load of one hundred and 50 newtons or fifteen point three kilograms at point D and a rider with a load of six hundred and eighty six point seven newtons or seventy kilograms at point C both directed directly down. In this report I am tasked with finding the deformation of the bike frame from the applied loads and determine if the deformation is within acceptable limits. Secondly, to find the total stress in the bike frame and to determine if the bike frame is yielding. Third, to find the maximum weight of the rider that can be sustained by the bike frame. Fourth, to investigate if AZ231 magnesium alloy is a viable alternative to aluminum.

Assumptions made during this analysis are gravity acts in the -y direction of the model, the only forces acting on the frame are the rider and second force, and the way the pipes are attached to one another via bolts or welds will not fail before the pipes do.

First, in the engineering data section I input the modulus of elasticity, poisons ratio, and yield strength of both materials into custom materials. Second, I modeled the bike frame in DesignModeler using a text file with the points with units of millimeters. I then connected the points shown in the problem drawing. after that, I created a tube cross section with outer diameter of twenty millimeters and inner diameter of eighteen millimeters and applied it to the bike frame. For the first frame analysis I chose the aluminum and for the second I chose the magnesium alloy. I then created a mesh ten percent the size of my smallest dimension that turned out to be five millimeters. After analyzing the frame I found the maximum deformation due to a seventy kilogram rider to be twenty thousandths of a millimeter (Figure 1) which is an acceptable amount of deformation. I found that the maximum stress on the bike frame was three point one three megapascals (Figure 2), since the yield strength of aluminum is thirty-five megapascals, the bike frame does not yield. I then found the maximum rider weight by first adjusting the force of the rider to ninety-seven hundred newtons or nine hundred and eighty eight point nine kilograms to give me a maximum stress of thirty-four point one seven megapascals (Figure 3). I proceeded to rerun the calculations with the standard seventy kilogram rider with the magnesium alloy and found the maximum deformation and stress to also be in acceptable levels (Figure 4,Figure 5), meaning the magnesium alloy is an acceptable alternative to aluminum. I calculated the safety factor to be eleven.

In conclusion, The aluminum and magnesium bike frame does not fail the tests when a seventy kilogram rider is on it making this bike safe for use by customers.

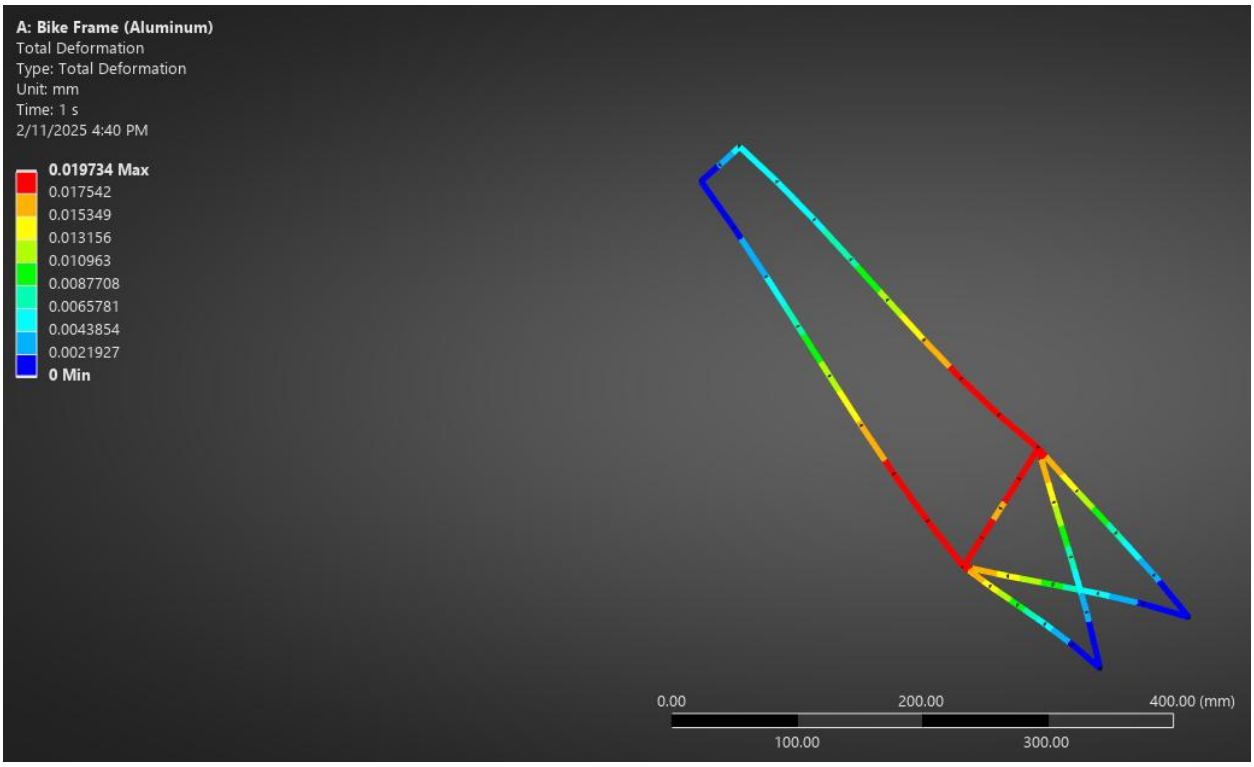

Figure 1: Total deformation in aluminum bike frame

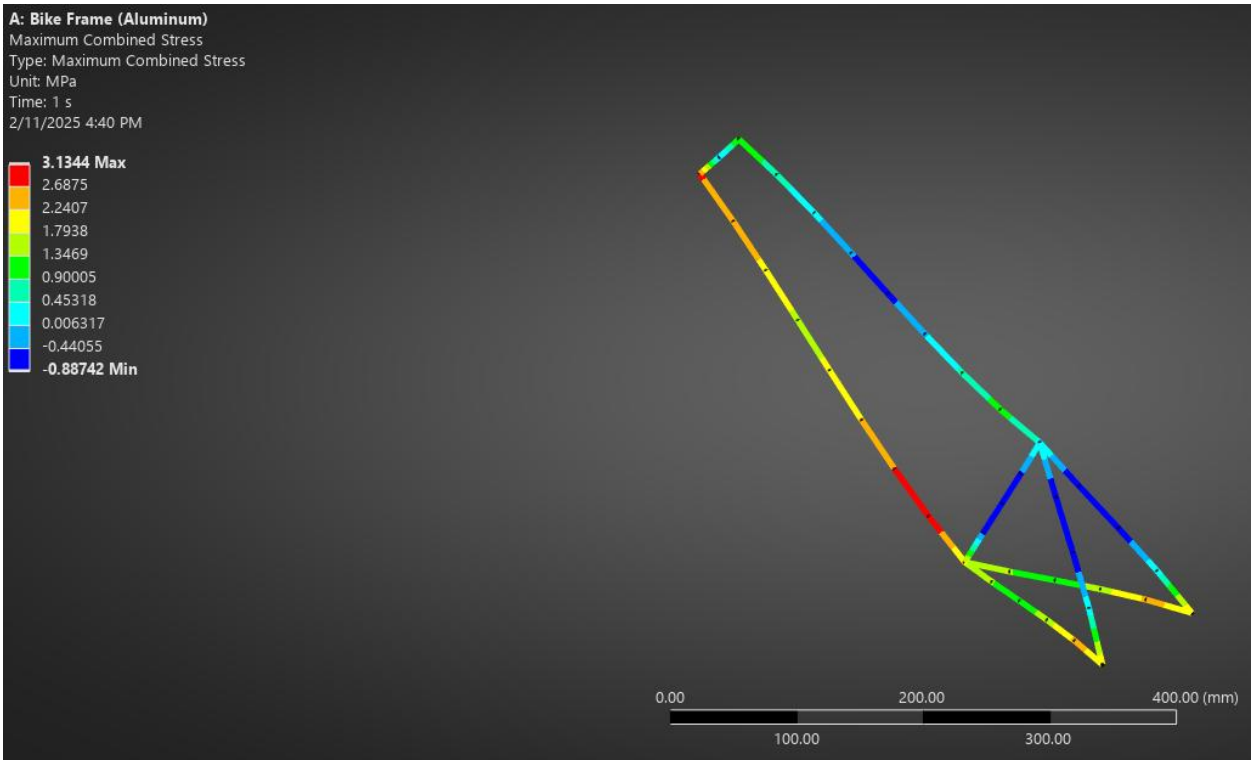

Figure 2: Maximum stress in aluminum bike frame

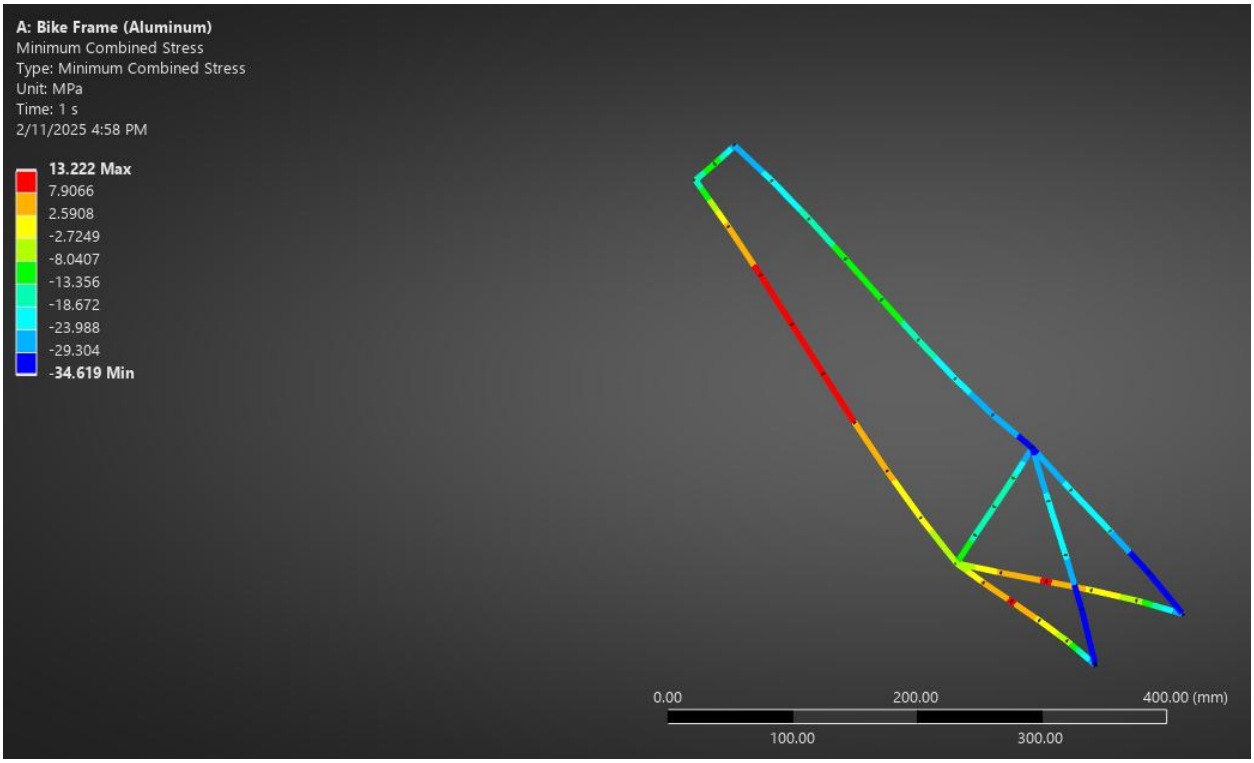

Figure 3: Maximum stress due to max weight in aluminum bike frame

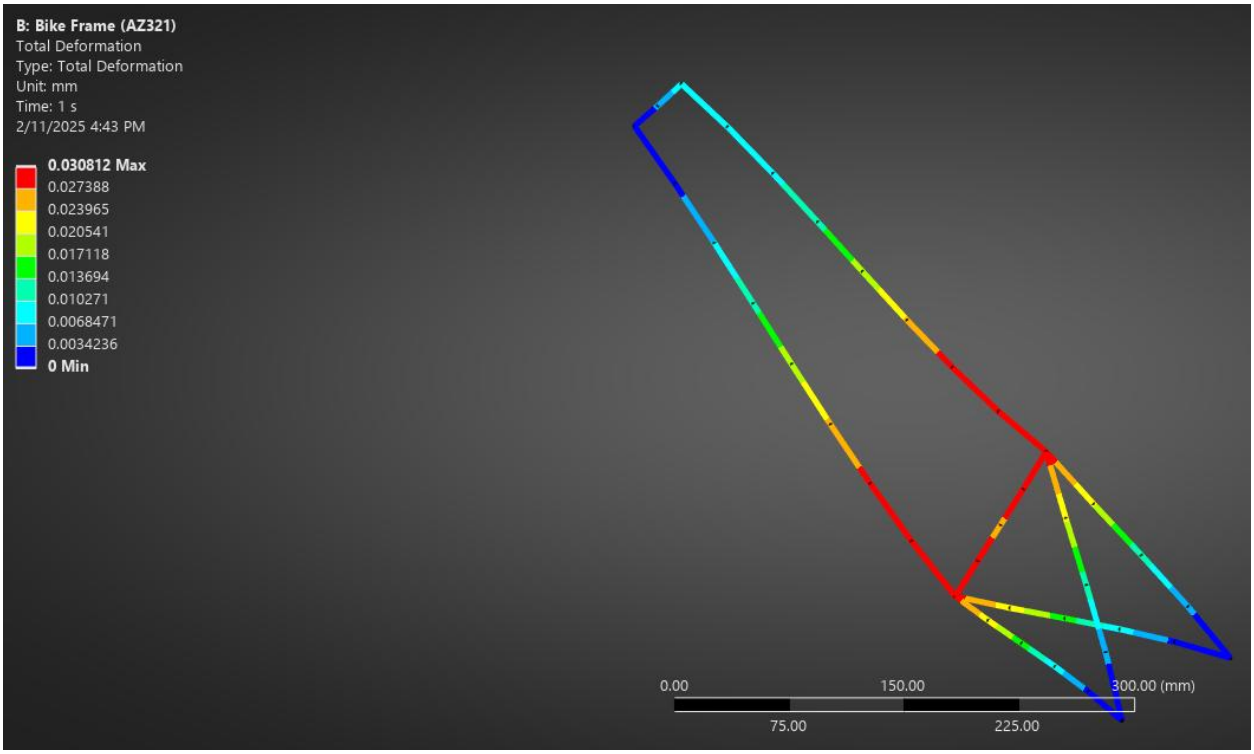

Figure 4: Total deformation in magnesium bike frame

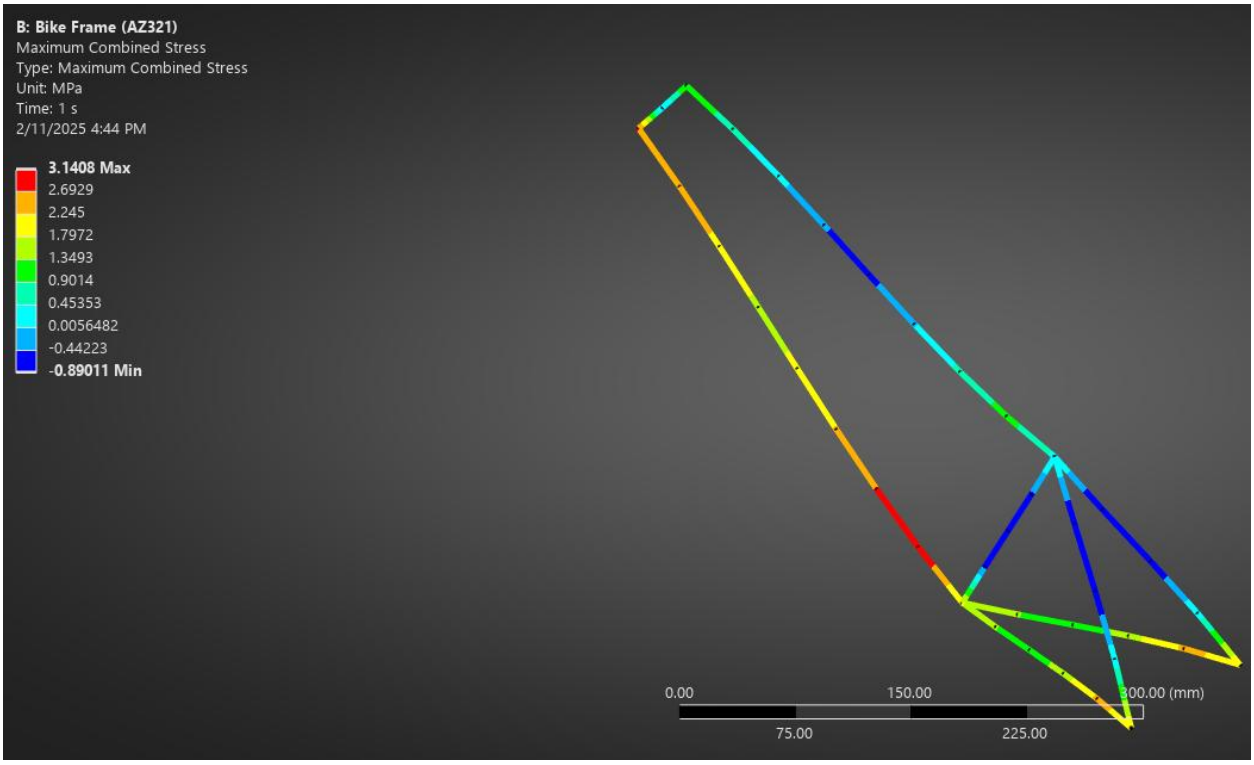

Figure 5: Maximum stress in magnesium bike frame