Case Study 2

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This case study is about a trailer made from thin-walled rectangular sections and subjected to a weight of 2 18,200kg rolls of steel. I am tasked with finding if the trailer yields due to the weight, and If it does, to modify the allowed parameters until the trailer does not yield.

Assumptions made during this analysis are gravity acts in the -y direction of the model, the only forces acting on the trailer are the 2 steel rolls, and the way the trailer is attached to one another via bolts or welds will not fail before the thin-walled rectangular sections do. I also assumed that both sides of the trailer will receive the same forces from the supports and the steel rolls. This allows me to only model one of the two trailer side supports and halving the weight of both steel rolls due to assuming equal force distribution on both sides I can make this a much easier 2D problem.

In FEA, I first started by modeling the 5 points needed in a .txt file, then importing the .txt file into DesignModeler as a point coordinate file. I then made the rectangular thin-walled cross section and applied it to the model. I then imported the geometry into FEA and assigned the material as structural steel. I set the model to 10% of the smallest element which came out to 0.12m. after applying the supports and the weight in the correct locations I solved for the maximum combined stress and total deformation.

As shown in (Figure 1) the maximum combined stress is less than the yield strength of structural steel is 250MPa and the deformation in (Figure 2) is acceptable. However, the stress of the dynamic load in (Figure 3) exceeds the yield strength of structural steel.

For the trailer to be safe from yielding, the support material must be changed. I decided to increase the thickness of the wall material from 6.4mm to 12.8mm and rerun the simulation. The stress from static loading in (Figure 5) shows the trailer to be safe from yielding and in (Figure 6) the deformation is acceptable. After reanalyzing the stress from dynamic loading in (Figure 7) the stress is now below the yielding point of structural steel with a safety factor of 1.48. The deformation in (Figure 8) is also acceptable.

In conclusion, the default rectangular cross section was not sufficient to support the weight of the 2 steel rolls. So, by increasing the wall thickness by 2 the stress in the static simulation was decreased by 1.82 times, and the stress In the dynamic simulation was also decreased by 1.82 times.

Figure 1: Trailer Static Stress Contour Plot

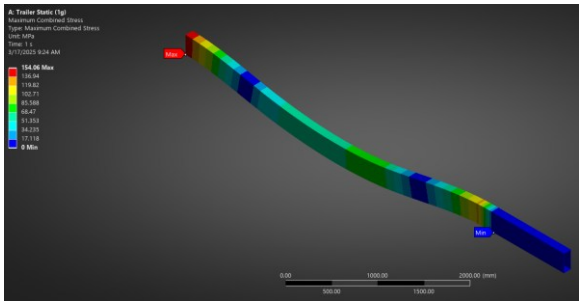

Figure 2: Trailer Static Deformation Contour Plot

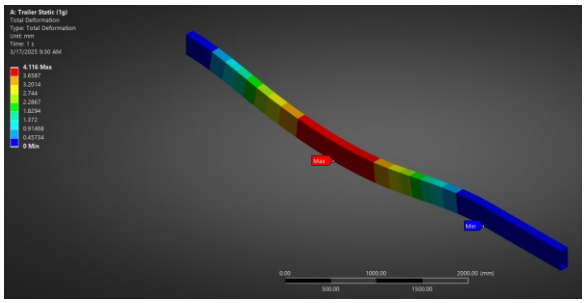

Figure 3: Trailer Dynamic Stress Contour Plot

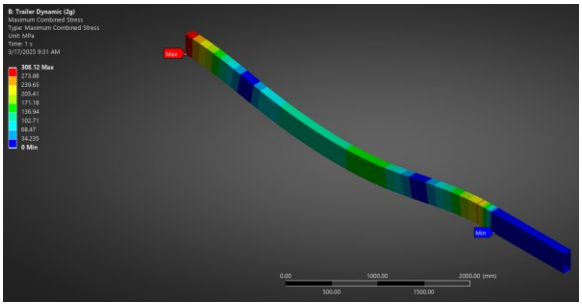

Figure 4: Trailer Dynamic Deformation Contour Plot

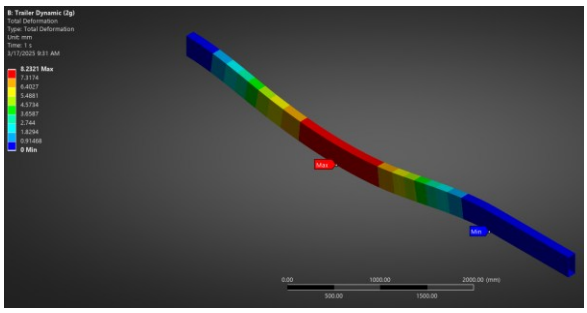

Figure 5: Updated Trailer Static Stress Contour Plot

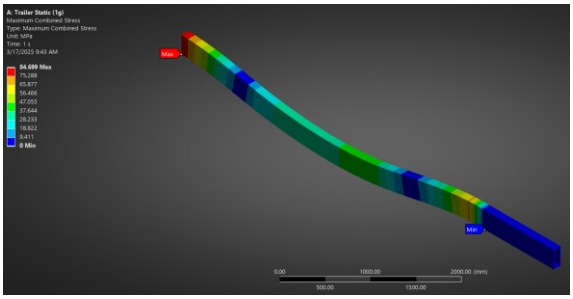

Figure 6: Updated Trailer Static Deformation Contour Plot

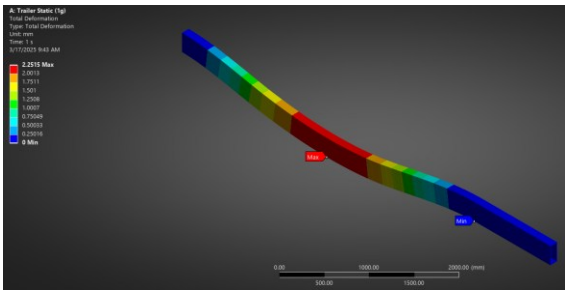

Figure 7: Updated Trailer Dynamic Stress Contour Plot

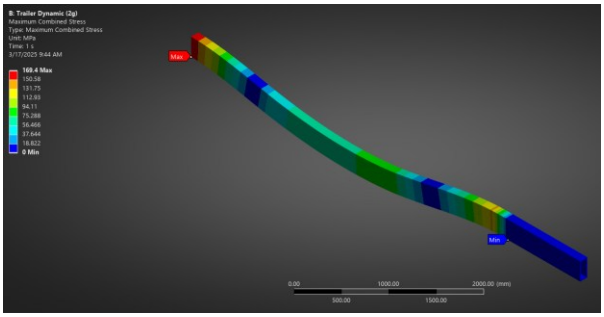

Figure 8: Updated Trailer Dynamic Deformation Contour Plot