Chapter 7, Appendix

List of Figures

FIGURE 1: 980H PARKING BRAKE SYSTEM

This is the brake system for a wheel loader where the parking brake in disengaged. The green line shows the standard braking system of most vehicles. The red line demonstrates the additional brake system put on wheel loaders.

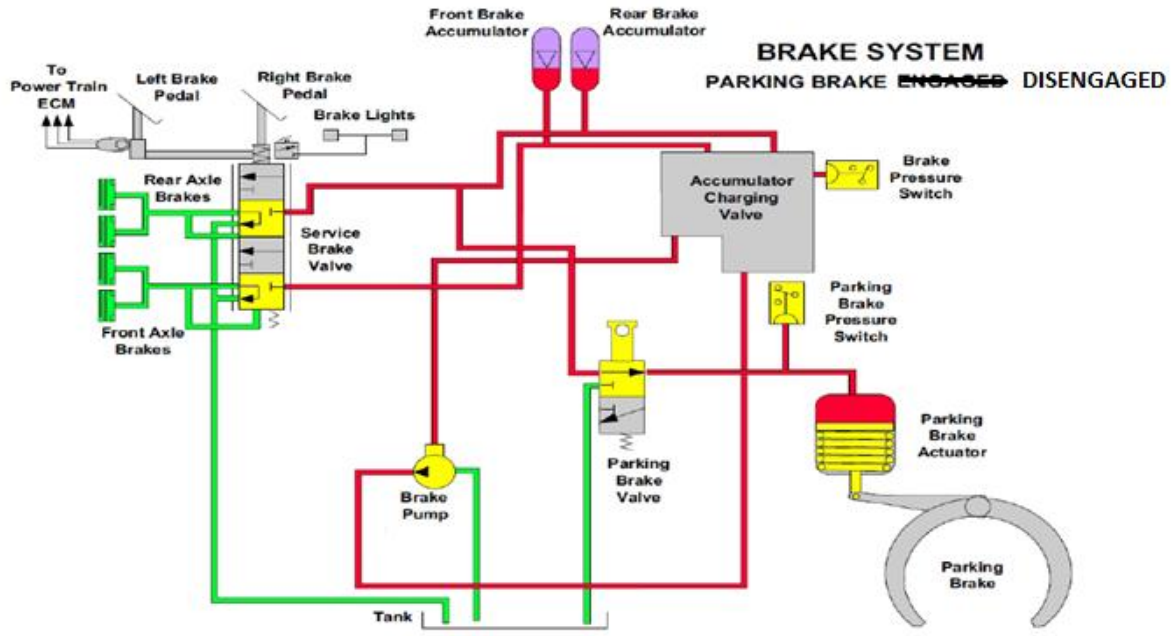

FIGURE 2A: HOOK STRESS ANALYSIS

In Figure 2B, we performed a stress analysis to our final tow hook design. In our analysis, we inputted the impact load and live load onto our structure. At the location where you see the max equivalent stress is where we positioned our impact load. The reason behind this is because for our structure, once the towing vehicle starts tugging on the tow hook, the tow pin would be moved in the back position of our tow hook. The tow pin would cause the resistance that is the impact load. The second load or the live load is placed in the little hole on the top of our design.

This is where we designated to have the 157kN to be applied because that is the force given to us to allow the vehicle to be towed away.

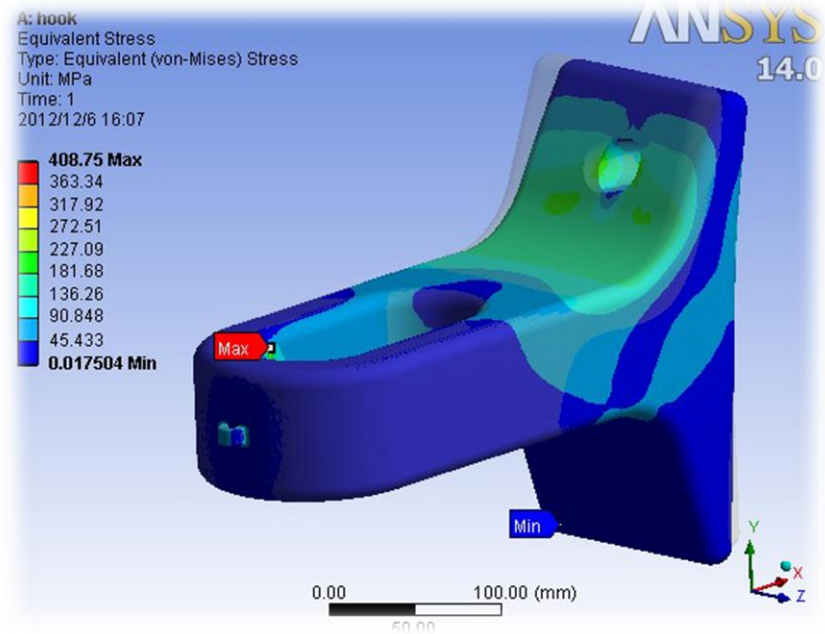

FIGURE 2B: HOOK STRAIN ANALYSIS

In Figure 3, the application software already inferred the total strain in accordance to the load that we have already applied to the specific locations. We are using this analysis to prove the relationship between stress and strain and to identify the certain elastic and plastic deformation that could occur with the specific material we have chosen.

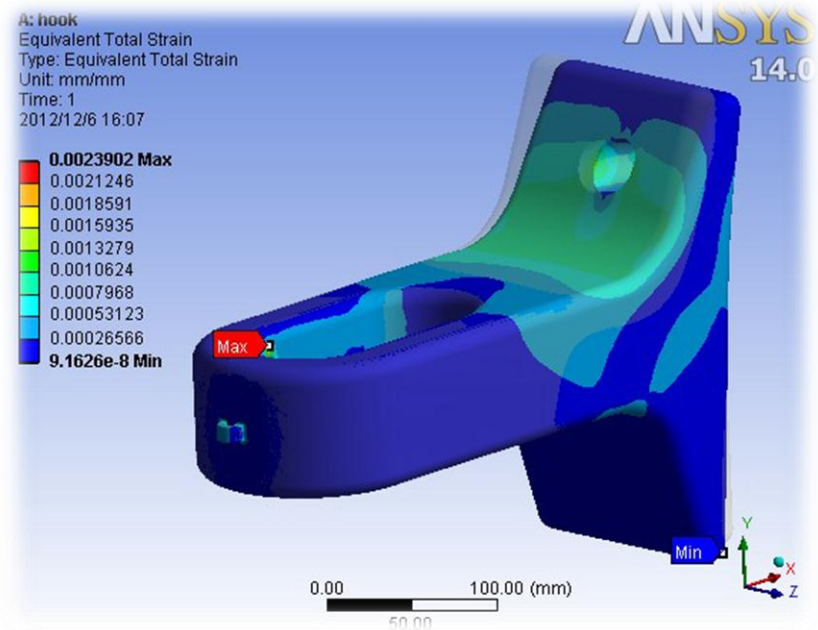

FIGURE 3: TOW HOOK POINTS OF CONTACT, ANALYSIS

This figure shows the force analysis performed on the hook to determine which locations of the hook were most impacted and how much force was used

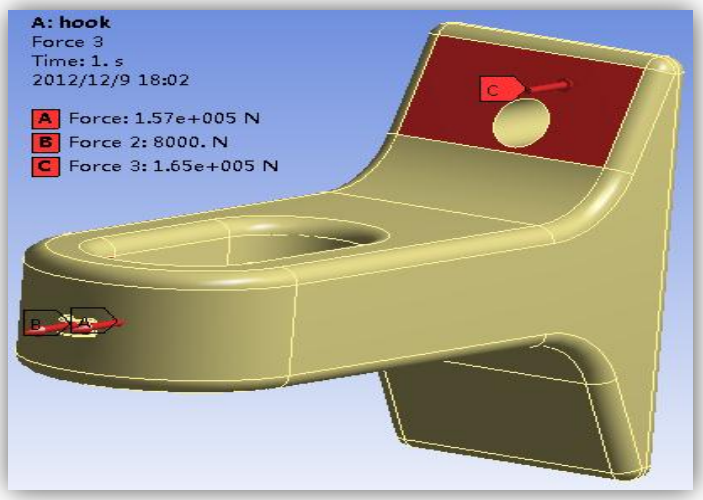

FIGURE 4: 980H HYDRAULIC SYSTEM

The following figure shows the hydraulic system in the 980H Wheel Loader. This was used to determine at which points in the system we could modify the braking system.

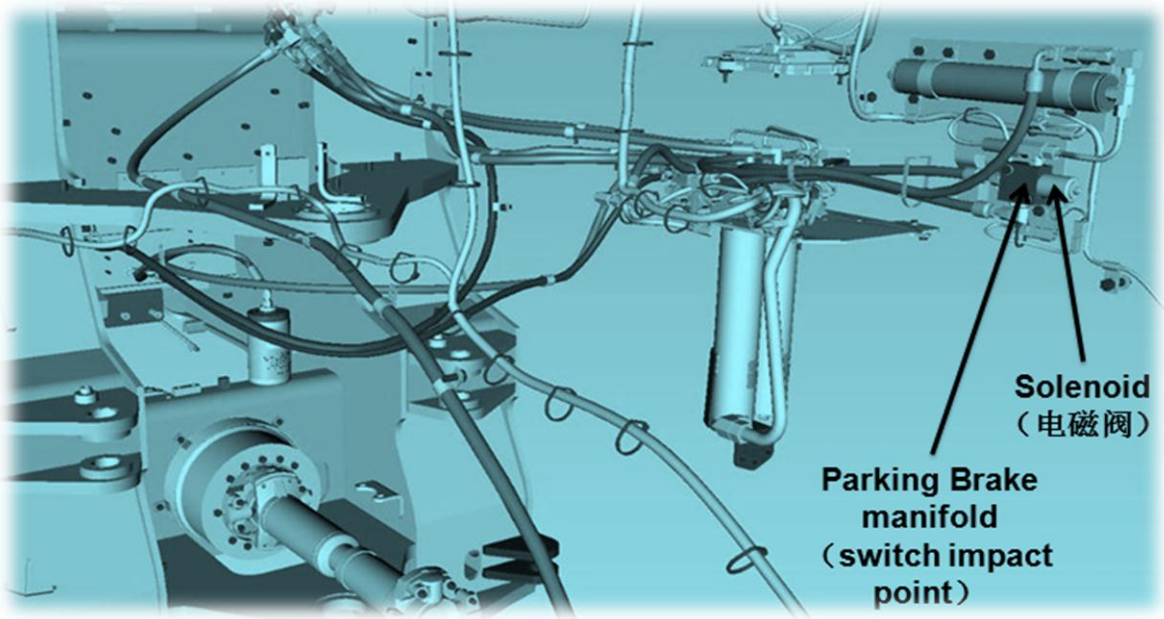

FIGURE 5: LEVER ANALYSU

The figure below represents the lever analysis performed ANSYS.

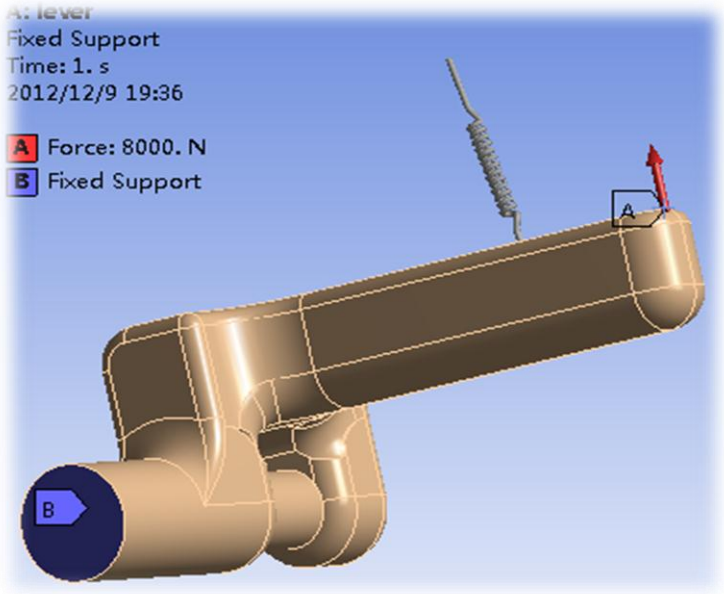

FIGURE 6: LEVER STRAIN ANALYSIS

In Figure 7, from the reported strain, we could then calculate the necessary deformation that can occur with our material.

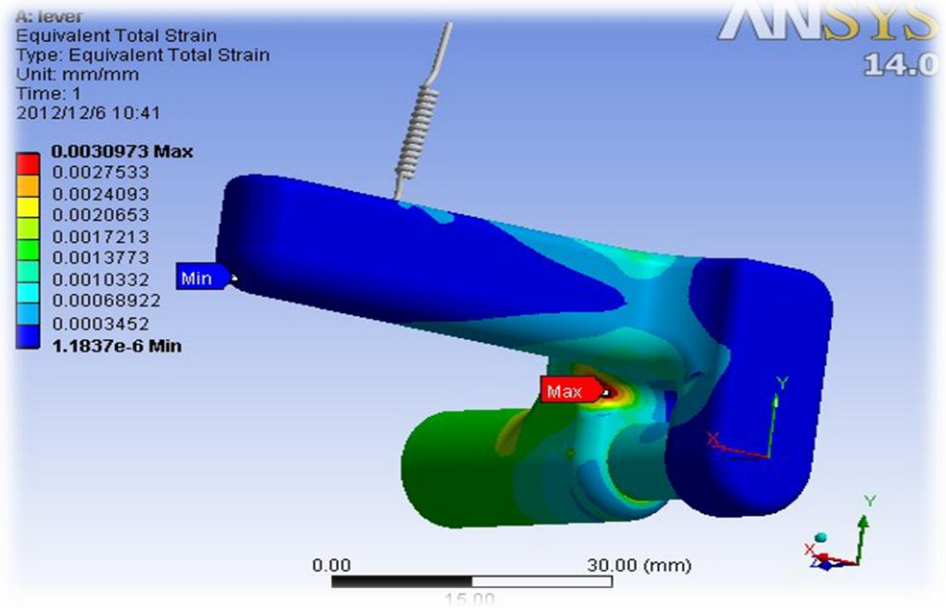

FIGURE 7: LEVER STRESS ANALYSIS

In Figure 7, we first had some complications on applying the remainder 8kN load. We had first applied it on the location where the cable lifts our lever system, but the software gave us a number that was far greater than what our material could withstand. To adjust to this, we figured that the load is not actually applied to the exact location where the cable touches the lever, but it occurs at where our pulley lever contacts the parking brake lever.

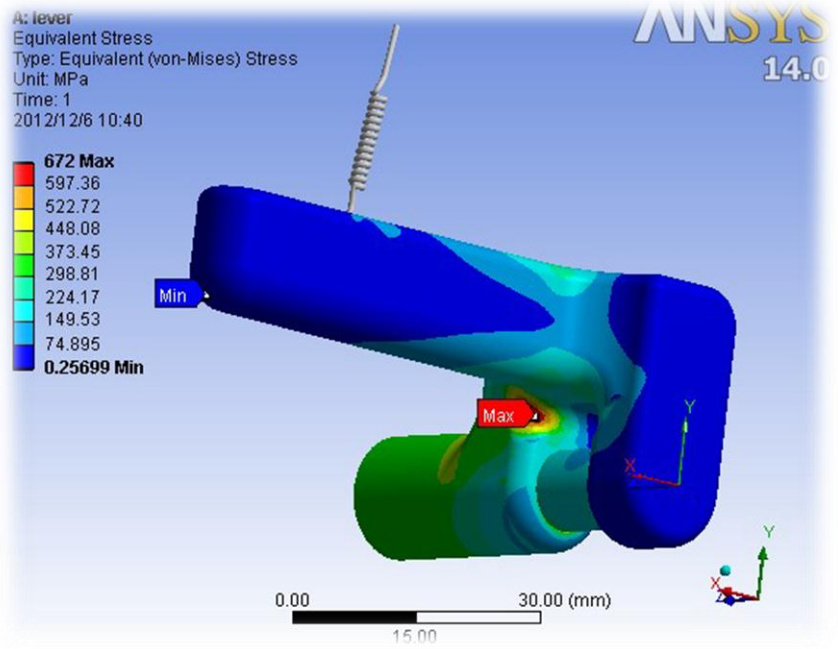

FIGURE 8: DIFFERENT HOOK OPTIONS

Figure 8 below shows different hook options used to grab on to the disabled vehicle

FIGURE 9: GRAPH OF MATERIAL ANALYSIS

We used the CES Edupack to analyze different materials for the tow hook. The graph below shows the results we got on our analysis

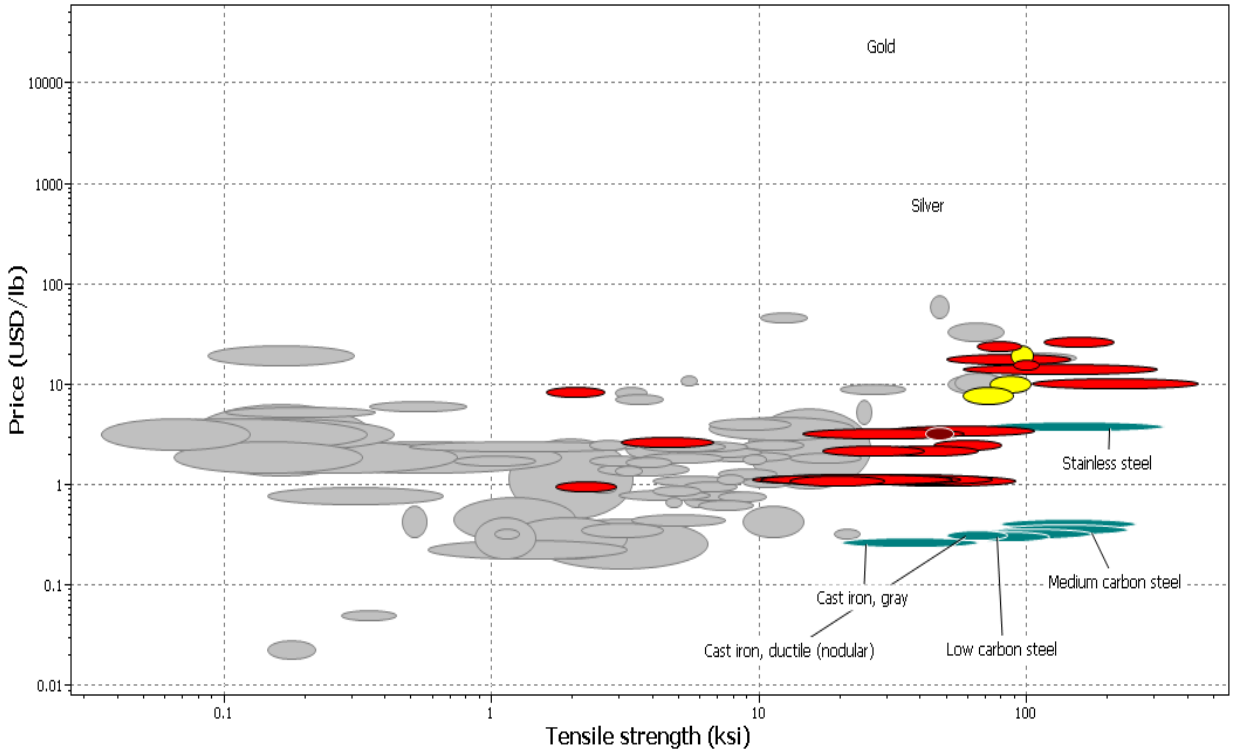

FIGURE 10: PULLEY CABLE SELECTION

Figure 11 below shows the concept of the transfer mechanism design used in the design

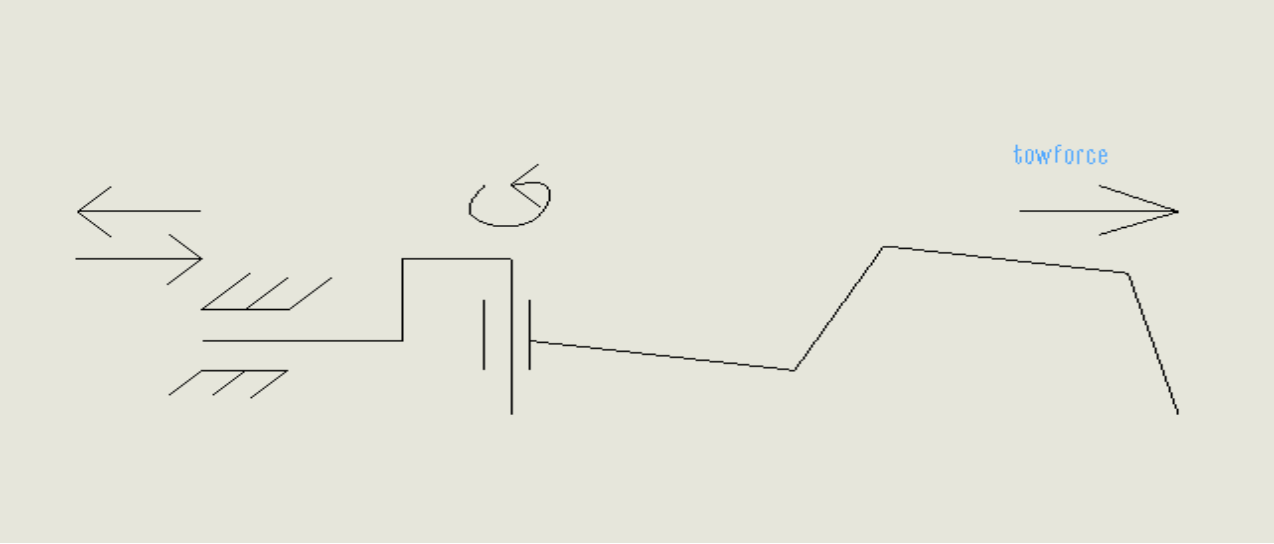

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TABLE 3.1: PULLEY CABLE SELECTION

The table below shows the values selected for the steel cable of the pulley

钢丝绳规格表
Specification Table of

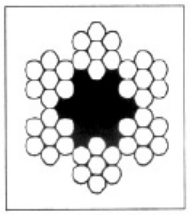
6×7	公称直径 Nominal Diameter of rope mm	外层单丝直径 Diameter of outer wire mm	标准横截面积 Calcultaed sectional area mm2	最小破断拉力 Breaking Load		概数单位重量 (参考值) Approximate rope mass per meter (公斤/米)
				镀锌 Galvanized	无镀锌 Bright	
				G 种 Grade G	A 种 Grade A	
				KN	KN	
 Section of the steel	6	0.65	14.4	19	21.4	0.134
	8	0.87	25.5	33.8	38.1	0.237
	9	0.98	32.3	42.8	48.2	0.300
	10	1.09	39.9	52.8	59.5	0.371
	12	1.31	57.5	76	85.6	0.534
	14	1.53	78.2	103	117	0.727

Table 3.2: Typical Factor of Safety Values

Table 3.2 shows the typical factor of safety values that we used to base our design calculations on.

Design Factor, N			
Manner of Loading	Ductile Materials		Brittle Materials
	Sy basis	Su basis	Su basis
Static	2	---	6
Repeated	---	8	10
Impact	---	12	15

Table 3.3: Material Pricing

The table below shows sample price information for the materials we considered for the tow hook.

Metal	**Price**			**Density**		
cast iron ductile (nodular)	0.295	0.324	usd/lb	440	453	lb/ft^3
cast iron gray	0.258	0.284	usd/lb	440	453	lb/ft^3
low carbon steel	0.303	0.334	usd/lb	487	493	lb/ft^3
low alloy steel	0.406	0.446	usd/lb	487	493	lb/ft^3