

## Center Beam to Frac Sand Railcar Conversion

In these post-recession years, center beam railcars are equipment in surplus. With reduced demand for the dimensional lumber center beams were designed to carry, many car owners are faced with an underutilized, outdated fleet of center beams with few options going forward. Many center beams are held in long term storage, or even sold for scrap value. In the interest of reducing long term cost and capital losses to railcar owners, mechanical engineering students at Michigan Tech developed a proof of concept to **convert center beams to another use with a realistic investment of time and resources**. Students outlined steps required to convert a center beam railcar into a flatcar specifically tailored to carry seven pods of frac sand for the growing Midwestern oil and natural gas industry (Figure 1).



**Figure 1. Model center beam car (right) and converted frac sand car with pods (left)**

The conversion requires the removal of the center beam and modification of the center sill underneath the deck to mitigate the structural strengths lost in the removal. Students used computer aided drafting and finite element analysis software to build and test a full scale flatcar with an augmented center sill. Two W section beams welded to the center sill running the length of the car make up for load capacity lost when the center beam is removed. An unmodified center beam railcar has an average light weight of 62,400 lb, and a converted flatcar weighs roughly 10,000 pounds more without bulkheads. A modified center sill can support over 2 million pounds of compressive load before buckling, well exceeding AAR regulations. A 3D representation of one end of the car's modified center sill and of the complete sill are shown in Figure 2 (left and right, respectively). The sill was manufactured in 1/4 scale and tested in a laboratory for bending (Figure 3).

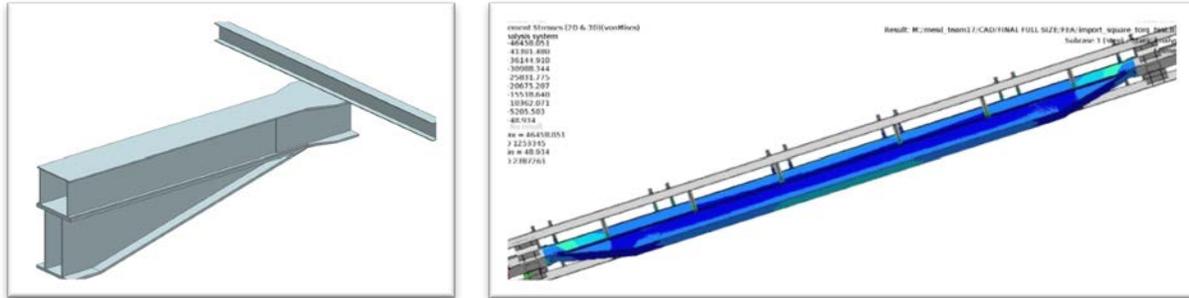


Figure 2. 3D representations of center sill



Figure 3. 1/4 scale prototype testing

Students planned their conversion package around the transport of frac sand, but any variation of flatcar could be made following the same design process. The cost of a frac sand conversion is estimated at \$16,793.98 (Figure 4). This number can be compared to the cost of a new flatcar, a minimum of \$80,000. A significant portion of the frac sand conversion cost is associated with 28 specially manufactured pod anchors, therefore it stands to reason that converting a car to a different use, perhaps to carry logs, may have equal or lesser cost, making conversion of center beam cars an attractive alternative to both long term storage *and* new car purchase.

Process	Component	Length Needed (ft)	Weight per Length (lb/ft)	Material Weight (lb)	Material Cost, Negative for Scrap (\$)	Shop Hours to Complete (hrs)	Shop Rate (\$/hr)	Labor Cost (\$)	Total (\$)
Materials Added	W Section Beam (Fishbelly)	140	93	13,020	1529.85	25	55	1,375	2,904.85
	Pod Support Beams	140	12	1,680	197.40	30	55	1,650	1,847.40
	Brake Components Repositioning	-	-	-	2200.00	27	55	1,485	3,685.00
	Pod Anchor	-	-	-	6440.00	15	55	825	7,265.00
Materials Removed	Center Beam	73	140	10,200	-1198.50	17	55	935	-263.50
	Bulkhead (2)	-	-	3,800	-446.50	5	55	275	-171.50
<b>Total (\$)</b>									<b>15,267.25</b>
<b>10% Contingency</b>									<b>1,526.73</b>
<b>Net Cost (\$)</b>									<b>16,793.98</b>

Figure 4: Estimated unit cost