

# Pipe Lifting Device and I-Rod Fastener

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Special thanks to



## Objective

To design and manufacture a compact device capable of lifting a corroded pipe safely off of its support. To design and manufacture a device to permanently fasten an I-Rod pipe support on to an existing supporting beam.

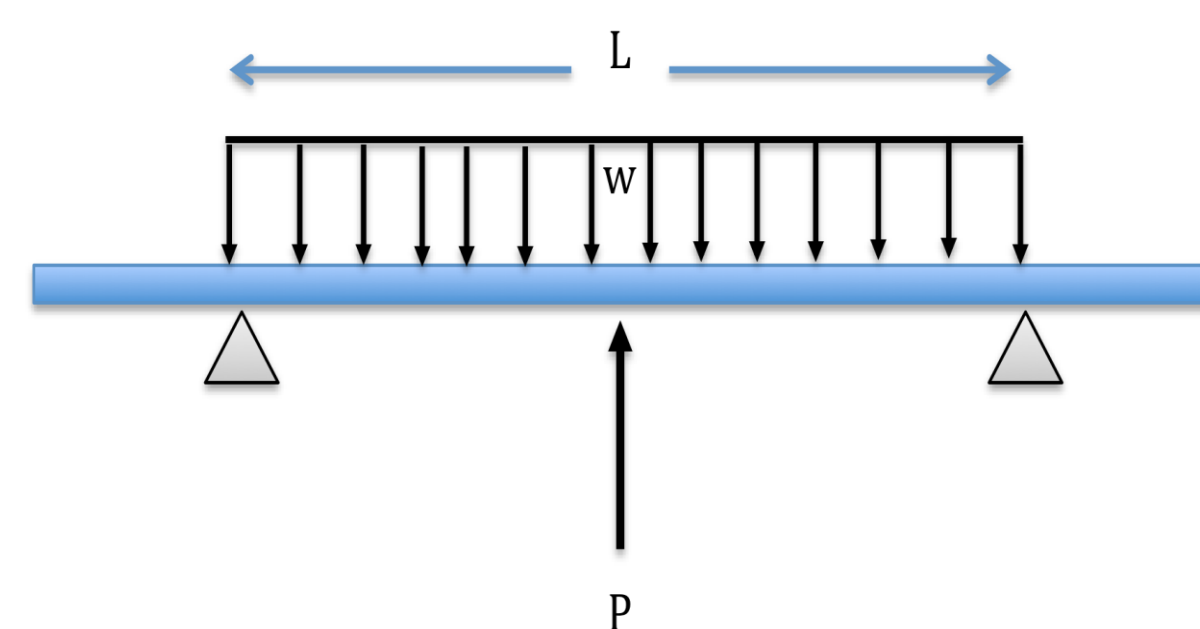
## Engineering Specifications

Lift Device	I-Rod Fastener
Pipe Size 2'-20"	Pipe Size 2'-20"
10 Years of Service	3-30' I-Rods long
6.2 Tons lift capacity	1" and 1.5" I-Rods in diameter
6' maximum lifting heights	W14x26; W12x26; W10x22 beam supports
50 lbs maximum device weight	ST3x8.625 and WT3x10 for structural supports
2 wireless operators	Galvanized steel or stainless steel
5 safety factor (to fail)	10 years in service
250 use per year frequency	

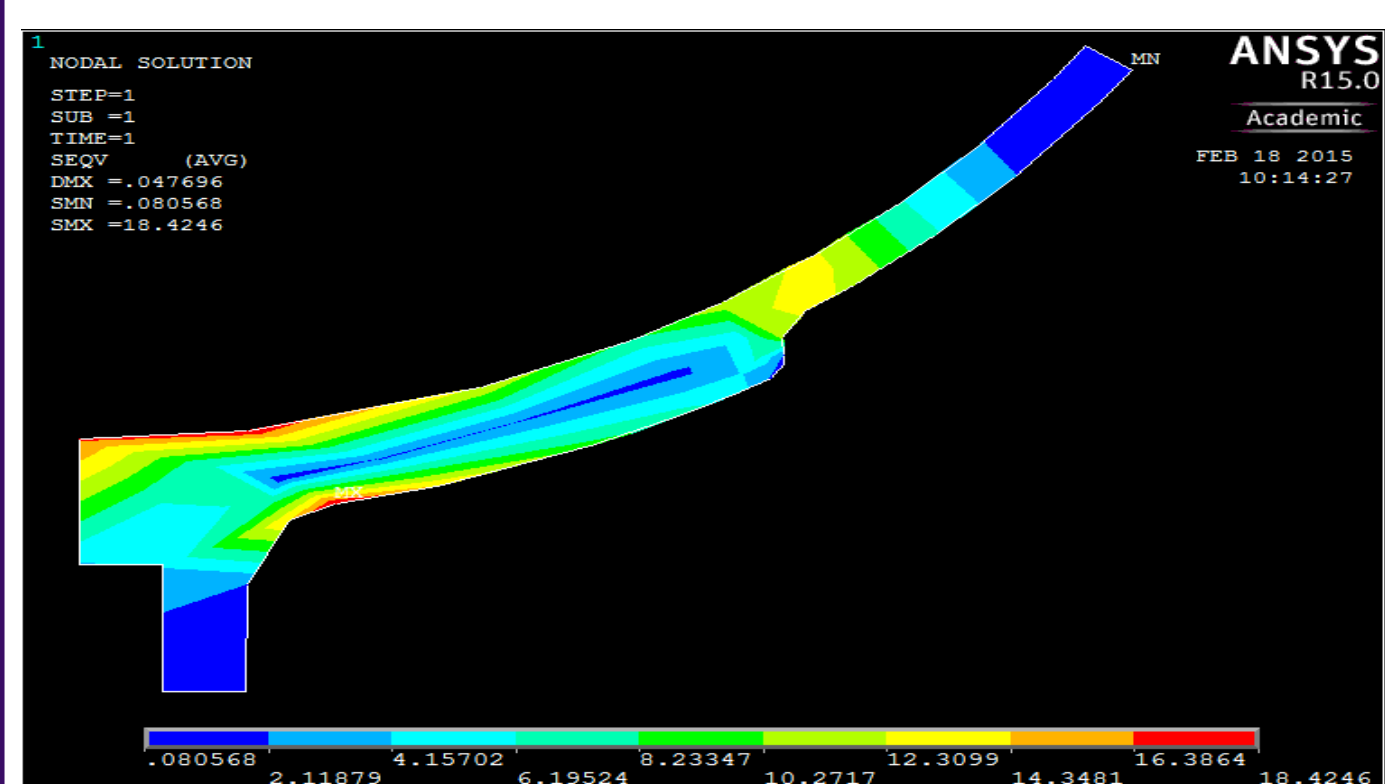
## Analysis

Force Required to Lift Pipe

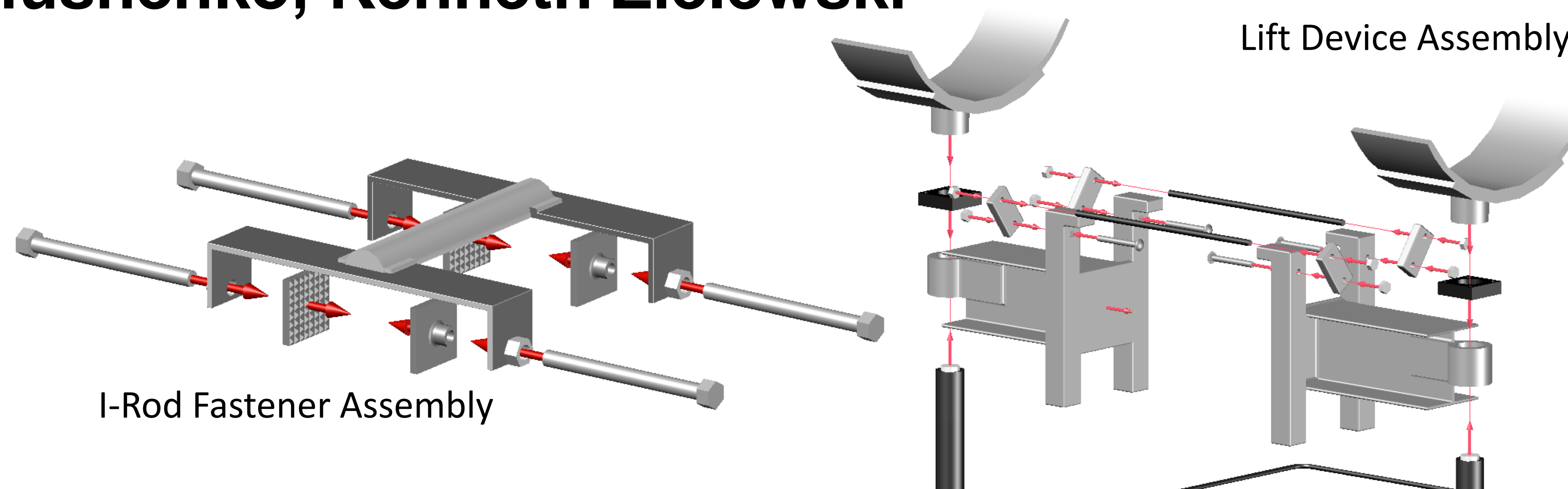
$$y = -\frac{Pl^3}{48EI} + \frac{5wl^4}{384EI}$$



Y = vertical deflection  
P = load  
L = length  
E = modulus of elasticity  
I = moment of inertia  
W = weight per unit length



Finite-element analysis of the pipe saddle shows that while lifting 6.15 tons, the maximum stress is 21 ksi, which provides a factor of safety of roughly 3.3 for the 70 ksi filler metal.



Lift Device Testing at Bengal Cranes

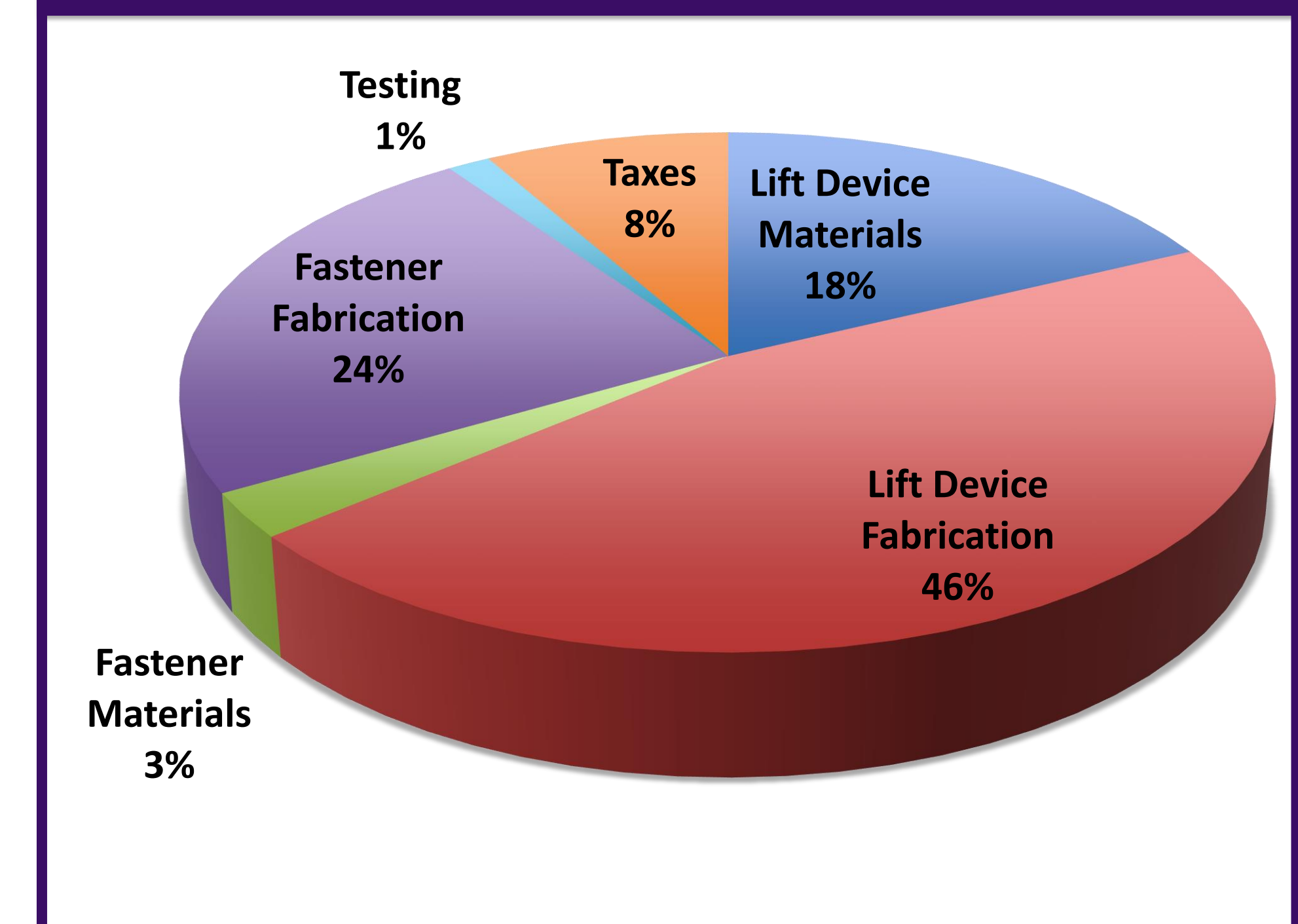


Lift Device Re-testing

## Safety

- Control Valves
- Pressure Gauge
- PPE
- Operating Instructions
- Warning Labels

## Budget Breakdown



## Milestones

PHASE I	PHASE II	PHASE III
<b>Ideation and Initial Design</b> September-2014 • Determine project scope • Determine design options October-2014 • Choose final design • Component breakdown • Component analysis November-2014 • Assembly drawings • Manufacturing drawings	<b>Material Purchasing and Assembly</b> December-2014 • Purchase material January-2015 • Final order for parts February-2015 • Manufacture device components • Complete device welding • Lifter protective coat	<b>Testing, Redesign and Delivery</b> March-2015 • Finalize testing plans • Complete lift device load testing at Bengal Cranes • I-Rod redesign April-2015 • Analyze test results • Repeat testing for lift device May-2015 • Project delivery to Dow

## Testing

- We partnered with Bengal Cranes & Rigging LLC to simulate the real world use
- The lifter was assembled onto a support by two personnel
- Pipe was placed on a beam and then lifted 6 inches by the pipe lifter
- Weights were incrementally added to the pipe between successive lifts, with the final lift totaling 8.7 tons
- On a separate testing rig, lifter was loaded to 9.2 tons without experiencing any noticeable damage or deflection

## Conclusion

Through physical testing and extensive analysis, the lift device has been proven to lift and withhold loads required by Dow. The lift was easily operable by two men, being assembled in less than five minutes. All components performed as expected. The I-rod fastener has been proven to withhold the expected forces seen between the I-rod and supported pipe through computational analysis.