Direct Crane Hook Load Measurement System- Manitowoc Cranes

Overview
Manitowoc Cranes uses a length sensor, angle sensor, and pressure sensor to calculate hook load and derive total moment on the crane for their GRT8100 telescoping rough terrain crane. An onboard computer receives sensor outputs, calculates the moments, and displays the results on the Load Moment Indicator (LMI) so that the operator can prevent tipping the crane and exceeding structural limits. Because the calibration for the current LMI system is lengthy, costly, and indirect, the design team was tasked to create a more direct and reliable way of measuring hook load.

Objectives
The design team's primary goal was to design a more direct and reliable way to measure hook load. The team also strived to reduce calibration time, the cost of implementation, and cost of calibration of the LMI system.

Approach
- The design team researched relevant patents, measurement systems, and competing crane technology in order to investigate existing solutions.
- The team visited the Manitowoc Crane site in Shady Grove, PA to gather costumer needs, define metrics, and learn more about the GRT8100 crane.
- All possible solutions were evaluated through quantitative decision matrices to find the cheapest and most direct measurement system. Using a load pin to measure cable tension and calculate hook load proved to be the best solution.
- SolidWorks models of the modified crane nose were created. These modifications were necessary to adjust for the replacement of the single dead pin through the preliminary sheaves with a set of two load pins.
- A circuit was designed to take the voltage output of the load pins and send it to the onboard computer so that hook load can be displayed on the LMI.
- The team tested the circuit and verified the design with a 300lb load cell and LCD screen.
- A 3-D printed mock up of the modified crane nose was also printed and assembled to show the modification needed to use the two load pin design.

Outcomes
- If Manitowoc implements this solution on the GRT8100 cranes they will save $86,970.00 a year.
- Calibration time for the LMI system will be reduced.
- Measurement through the load pin is more direct than the current measurement method through the three sensors.