Onboard Load Sensor for Freight Railcar Service

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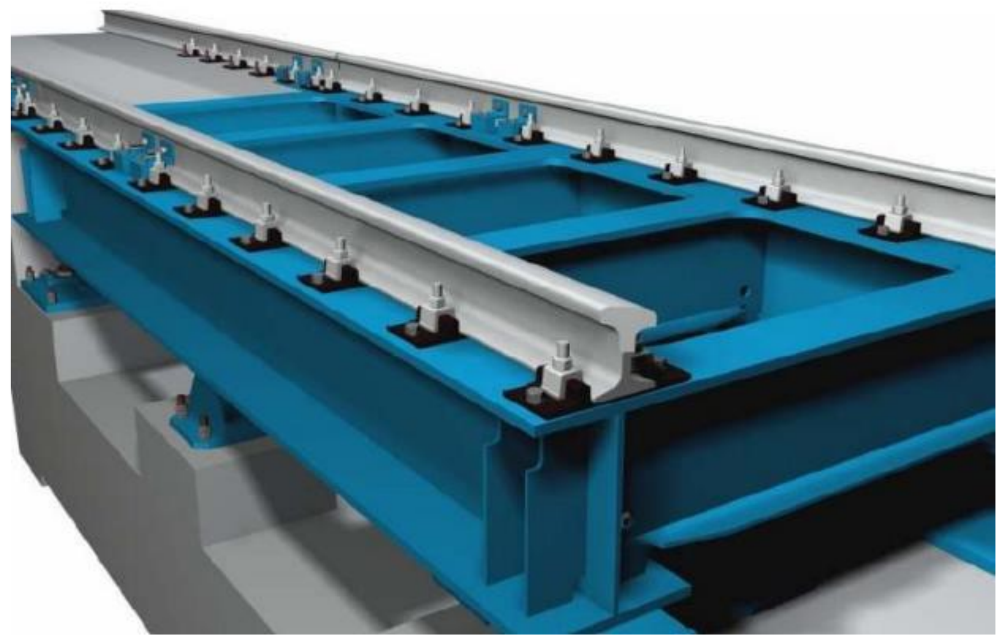
Abstract

In the United States, it is estimated that 40% of freight is transported by rail, with rail networks covering approximately 140,000 route miles. A freight railcar's load is measured by weigh bridges. These weigh bridges are found close to train stations, meaning the load of a freight railcar cannot be constantly monitored. Companies take advantage of this by intentionally overloading freight railcars to make more money ultimately disregarding the safety protocols that are set. At the same time, an underloaded railcar can lead to loss in profit. Hence, it is crucial that freight railcars have an onboard sensor that could monitor the weight constantly. The University Transportation Center for Railway Safety (UTCRS) has been working on developing a reliable sensor that can track both dynamic and static loads. This sensor would be an onboard system located at the bearing adapter; at this location the load sensor can be used to monitor any bearing that may be receiving more load than others. This implies imbalance, which could lead to bearing failure. The development and implementation of a load sensor for the railcar industry can prevent mistakes, accidents, and potentially save lives by helping ensure that safety standards are being upheld.

Introduction

Today, railcar loads are measured using weighing stations similar to those used for commercial vehicles and semi-trucks. Systems, such as weigh bridges like the one in **Figure 1**, measure the total weight of the hauled goods and railcar combined. However, the current system does not have the capability to continuously monitor the load or distribution of weight within the railcar. The weight of the load is transferred from the carriage, to the bearings, to the wheel axles, to the rail. This becomes an integral factor in shipping goods as overloading cars can lead to costly damage by means of derailment and damage to the environment.

Figure 1: Weigh bridge



Purpose

The onboard load sensor would have the capability to measure a load of a railcar in real-time by adding the load applied to each bearing adapter within that railcar. That allows any load imbalance within the railcar to be identified. Being notified of an imbalance of a wheel in real-time would prolong the life of equipment and parts as they would be able to be properly serviced instead of constantly misused. Knowing the exact weight can help the Association of American Railroads (AAR) and the Department of Transportation (DOT) to monitor and keep them from ex-

Testing Methodology

Testing was conducted using the UTCRS single dynamic bearing test rig (**Figure 2**) with an AAR class K bearing and a bearing-adapter assembly. Full load on an AAR Class K bearing is 34,400 lbs., simulating a fully loaded railcar. A 17% load (5,850 lbs.) represents an unloaded (empty) railcar. A strain-gauge-based sensor was developed to be inserted in the middle of a bearing-adapter as shown in **Figures 3** and **4**.

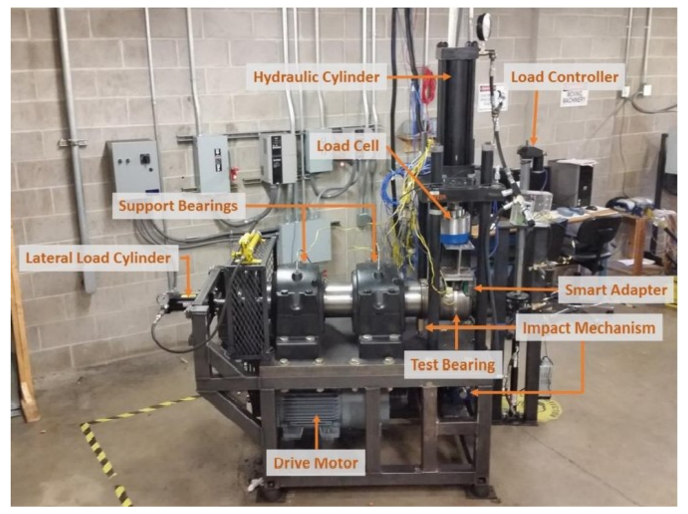
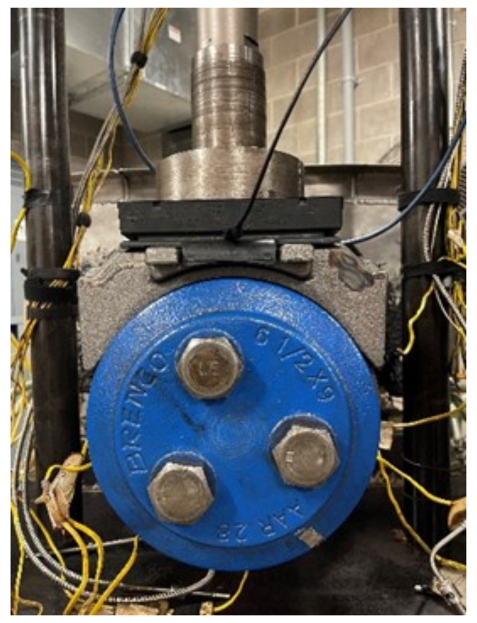


Figure 2: Single dynamic bearing test rig

Figure 3: Load sensor insert

Figure 4: Mounted load sensor



Acknowledgement

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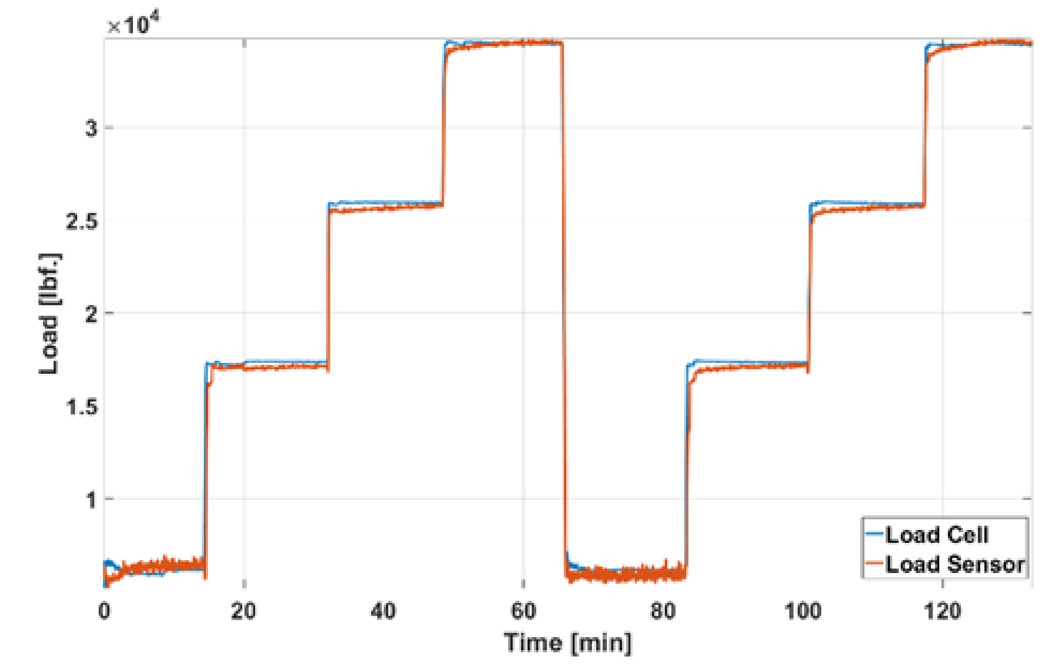
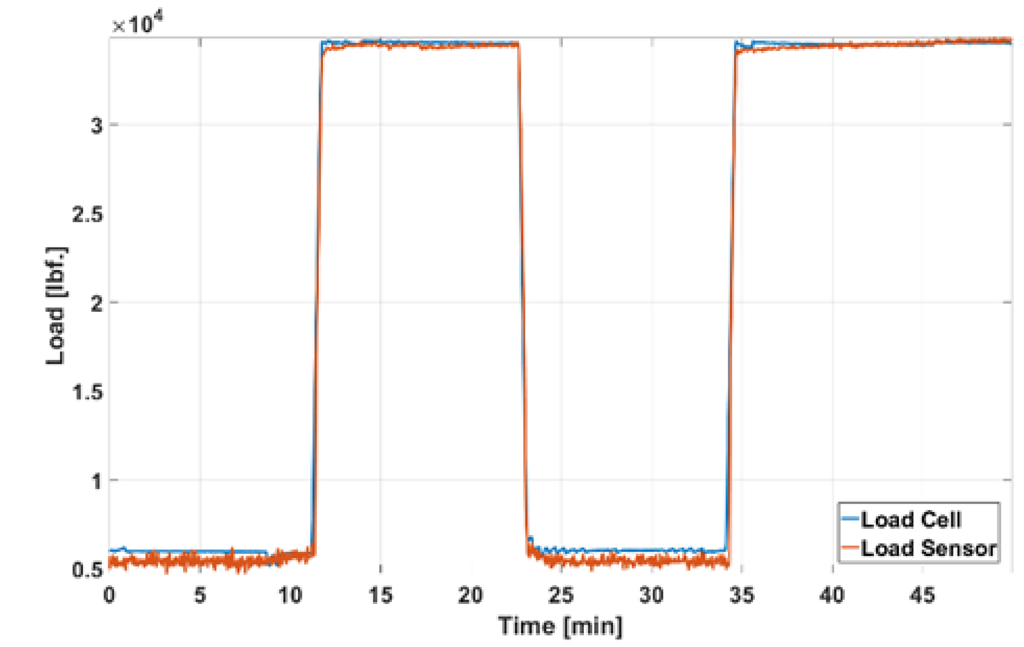
Results

For the results acquired, the load cell and the calibrated load sensor were tested and compared. **Figure 5** shows the four-step response measuring at 17%, 50%, 75%, and 100% of the standard full load of a railcar. **Figure 6** shows the two-step response from unloaded (17%) to fully loaded conditions (100%).



Top: Figure 5; Bottom: Figure 6



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