

Survey of Taper-Worn Brake Shoes in Revenue Service Interim Report

by Fred Carlson

Summary

A survey of taper-worn brake shoes that is being conducted by the Transportation Technology Center Inc. in cooperation with the Central Air Brake Club of Chicago is revealing trends that ultimately could lead to financial savings in the railway industry. Taper worn brake shoes reach condemning thickness of 3/8 inch at the top or bottom, leaving substantial amounts of brake shoe material unused. The intent of the survey is to quantify the financial impact of taper-worn brake shoes, which cost the industry \$11.2 million per year, and to identify any trends in component design, such as truck manufacturer, truck capacity, brake beam design, and rigging design, which may be affecting the degree of taper wear. The survey began in late spring of 1999, and while some of the data is not yet sufficient to draw firm conclusions, some interesting trends are becoming evident. There appear to be significant differences in the degree of tapered wear when comparing the following:

- Age of brake systems
- Body-mounted brake rigging (rod through, rod under and hook-and-eye)
- Dead lever connection on car body versus truck bolster
- Truck manufacturer

The performance differences are not as pronounced when comparisons are made of brake beam manufacturer and truck capacity.

The survey to date also has shown that:

- Out of a total sample size of 1,278 brake shoes, 15.3 percent of brake shoes wore evenly, while 83.8 percent had significantly more wear on the top of the brake shoe than on the bottom. Only 1 percent of the brake shoes were worn more on the bottom than on the top.
- Rod through rigging had 9.3 percent even brake shoe wear, while rod under had 28.3 percent even wear and hook and eye had 28.4 percent even wear.
- When the dead lever is connected to the car body, 26.3 percent of the brake shoes wore evenly. When the dead lever was connected to the truck bolster, 6.6 percent wore evenly.
- When two truck manufacturers were compared, one had 31.4 percent even brake shoe wear, while the other had 14.6 percent.

This survey will continue in order to obtain a larger sample for detailed statistical analysis.

Suggested Distribution:

- Maintenance of Way
- Planning & Analysis
- Track Maintenance
- Safety



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INTRODUCTION

The data used in the TTCI tapered wear brake shoe study was gathered in cooperation with the Central Air Brake Club of Chicago. The intent of the survey is to identify the size of the problem, its cost to the industry, and to identify trends that may point to problem areas that may then be addressed. A large sample of brake shoes from a number of locations on a wide variety of car types was made possible through the Central Air Brake Club. The data collection consisted of observing brake shoe wear from outside the truck, and matching the degree of taper wear to a drawing on a chart. Also noted was truck capacity, truck type, brake rigging type, brake beam manufacturer (if possible), car type, and brake shoe location. Each drawing was number coded, and the number of “hits” under each number code was totaled. The data was then broken down into various categories, such as truck capacity and brake rigging type.

BODY-MOUNTED RIGGING TYPES

The types and sample sizes of body-mounted rigging examined were bottom rod through (589 shoes),

bottom rod under (113 shoes), and hook-and-eye (176 shoes). As can be seen in Exhibit 1, the results for hook-and-eye and bottom rod under are virtually identical, and both show more even brake shoe wear than rod through rigging. While the sample size of the rod under and hook-and-eye rigging types is small, the data seems to suggest that rod through rigging, a very commonly used rigging, causes somewhat higher tapered shoe wear. However, more data on rod under and hook-and-eye types will be collected over the next year.

RIGGING AGE COMPARISON

When the data was sorted by decade, the results tend to show that even new cars exhibit taper shoe wear, again with more wear at the top of the shoe. The rigging on cars built in 1960 through 1989 shows little difference, and as a group shows more severe taper wear than the newer cars (Exhibit 2). This indicates that the geometry of the unit guide is not favorable, and that wear in the brake beam end extensions is a factor in allowing the beams to droop after some years in service. It also tends to show that after some degree of wear in the end extensions occurs, the degree of taper shoe wear stabilizes.

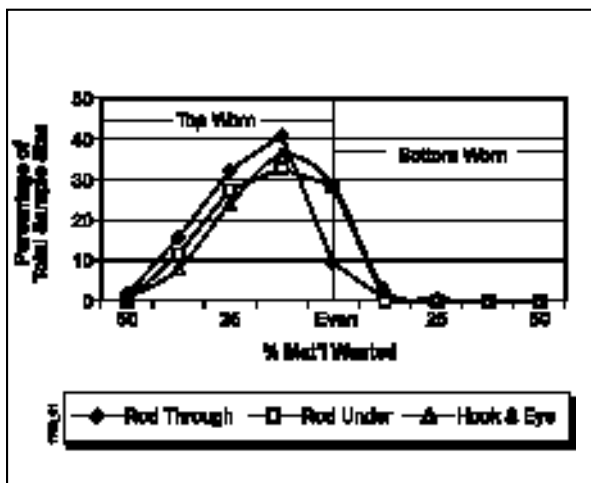


Exhibit 1. Comparison of Body-Mounted Rigging Types

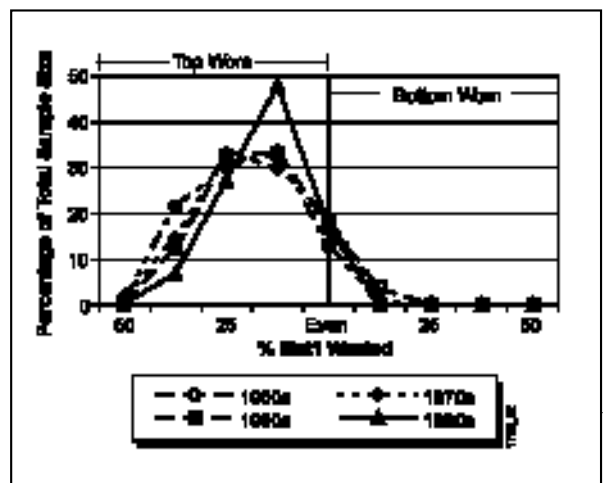


Exhibit 2. Age Comparison of Rigging

DEAD LEVER CONNECTION

It has been common knowledge that connecting the dead lever to the car body isolates the brake rigging from the effects of truck swivel. However, this study also suggests that taper brake shoe wear is reduced when the dead lever is connected to the car body (Exhibit 3). There were 339 car body connections and 763 truck bolster connections in the survey.

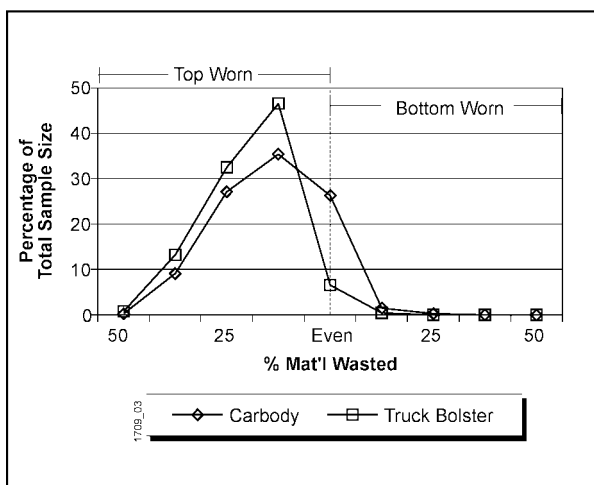


Exhibit 3. Comparison of Dead Lever Connections

TRUCK MANUFACTURER

Among all the truck types in the survey, there was one design from each of two manufacturers with reasonably large sample sizes of 233 and 191 shoes so as to allow a comparison, as shown in Exhibit 4. This comparison showed a surprising difference in tapered brake shoe wear. More samples are needed to determine whether this is a statistically significant observation.

were 354 and 211 shoes. Also, when it was possible to determine the manufacturer of the beam, it was virtually impossible to determine the capacity and vintage of the beam from outside the truck. Therefore any conclusions here should be tempered with caution. More data is needed, and this data will be collected over the coming year.

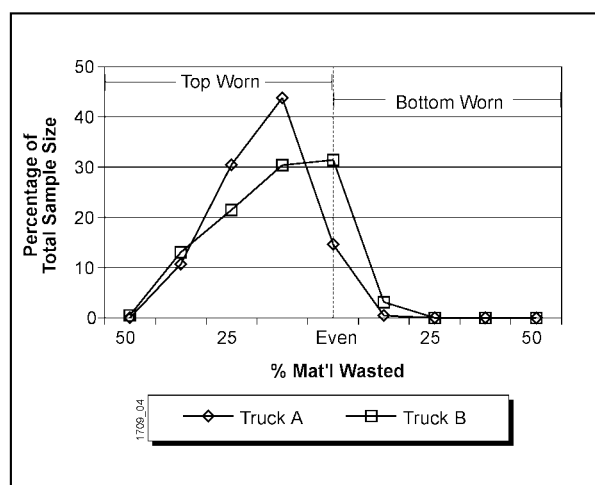


Exhibit 4. Comparison of Truck Manufacturers

BRAKE BEAM MANUFACTURER

Comparison of three brands of brake beam showed that there is little difference between manufacturers, as Exhibit 5 shows. However, the sample size for beam C was only 38 shoes, while the other two sample sizes

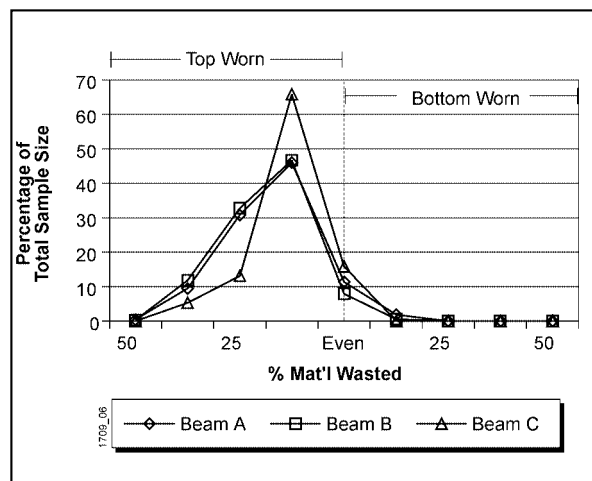


Exhibit 5. Comparison of Brake Beam Manufacturers



TRUCK CAPACITY

Trucks capacities of 70-ton (305 shoes), 100-ton (939 shoes), 110-ton (166 shoes), and 125-ton (35 shoes) were compared, and there was little difference between them (Exhibit 6). While 110-ton seems to have an advantage, the small sample size of that truck and the 125-ton truck preclude drawing any firm conclusions. More data on the less common truck sizes is needed.

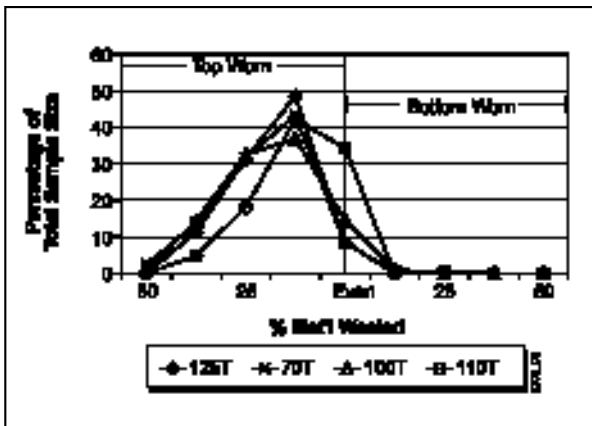


Exhibit 6. Comparison of Truck Capacities

CONCLUSION

This study is still preliminary in that some of the sample sizes are not large enough to be statistically valid. However, the trends that are beginning to develop make the continuation of this study worthwhile. Exhibit 7 shows a compilation of all factors examined to date, with percentages of even brake shoe wear and percentages of any degree of tapered shoe wear. Sample sizes are also included.

Tapered brake shoe wear, with the top of the shoe wearing out first, is typical in the railway industry. The cost in wasted brake shoe material is about \$11.2 million per year. Savings could be attained by:

- Making informed design decisions when cars are built.
- Tightening and improving the AAR standards governing brake beam to side frame interface.
- Looking for new and better methods of applying the brake shoe to the wheel that would allow the brake shoe to find its own correct alignment.

Note: Please contact Fred Carlson at (719) 584-0718 with questions or comments about this document.

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Exhibit 7. Compilation of All Factors Examined to Date

Taper-Wear Factor	Sample Size	Type of Wear	
		% Top Worn	%Worn Even
Rod Through	589	90.2	9.3
Rod Under	113	71.7	28.3
Hook-and-Eye	176	68.2	28.4
125-ton Trucks	35	91.4	8.6
110-ton Trucks	166	84.5	14.5
100-ton Trucks	939	65.1	34.3
70-ton Trucks	305	91.1	8.2
Truck Brand A	233	65.4	31.4
Truck Brand B	191	85.0	14.6
Dead Lever – Truck bolster	763	93.0	6.6
Dead Lever – Car body	339	72.0	26.3
Brake Beam A	211	86.7	11.4
Brake Beam B	354	91.5	7.9
Brake Beam C	38	84.2	15.8

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