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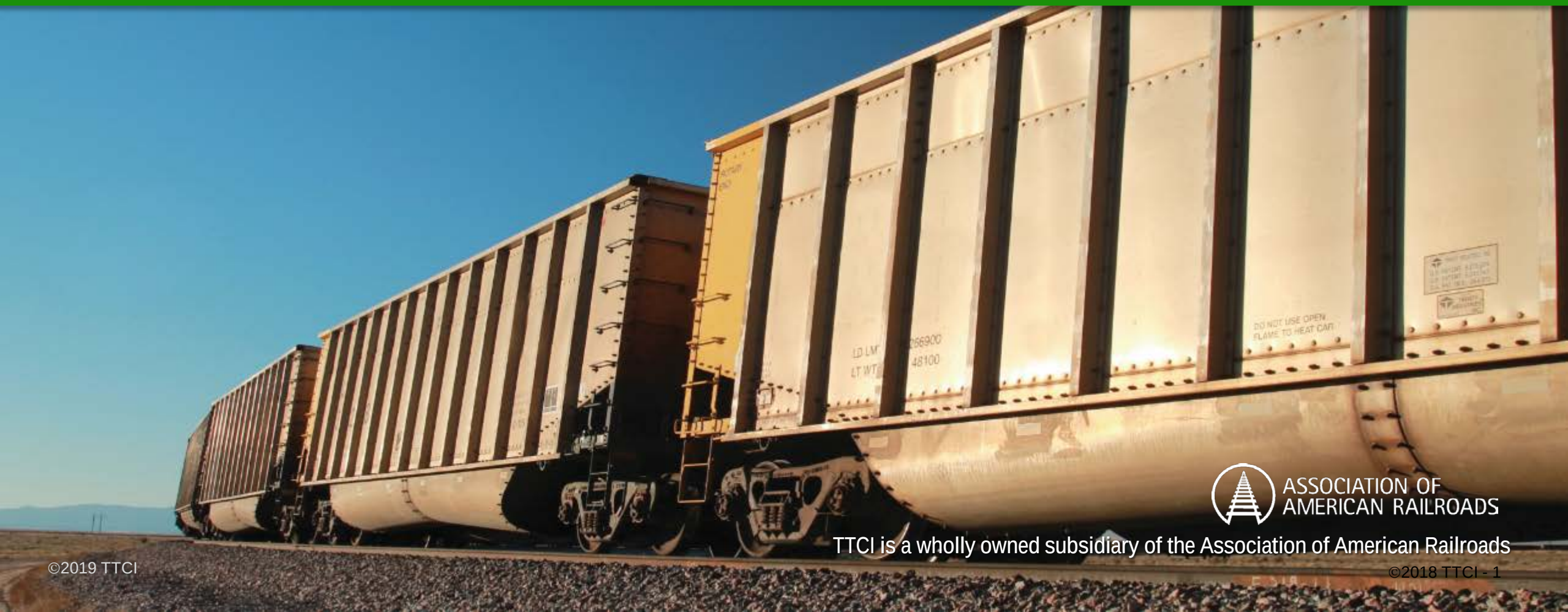

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Effect of Spring Deflection on Center of Gravity Height

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Principal Investigator II

Introduction

- **In 2017, AAR removed the allowance for spring deflection on center of gravity height calculations for loaded cars in the Closed Car Loading Guide.**
- **Shippers requested that this allowance be restored**
- **TTCI calculated load and deflection for a range of loads and spring groups to verify that newer spring groups would not create issues when using the old table.**

Table 3.4 Load weight versus spring deflection

Weight of Load (lb)	Spring Deflection (in.)
122,000–137,000	1.00
138,000–164,000	1.25
165,000–191,000	1.50
192,000–207,000	1.75

Background

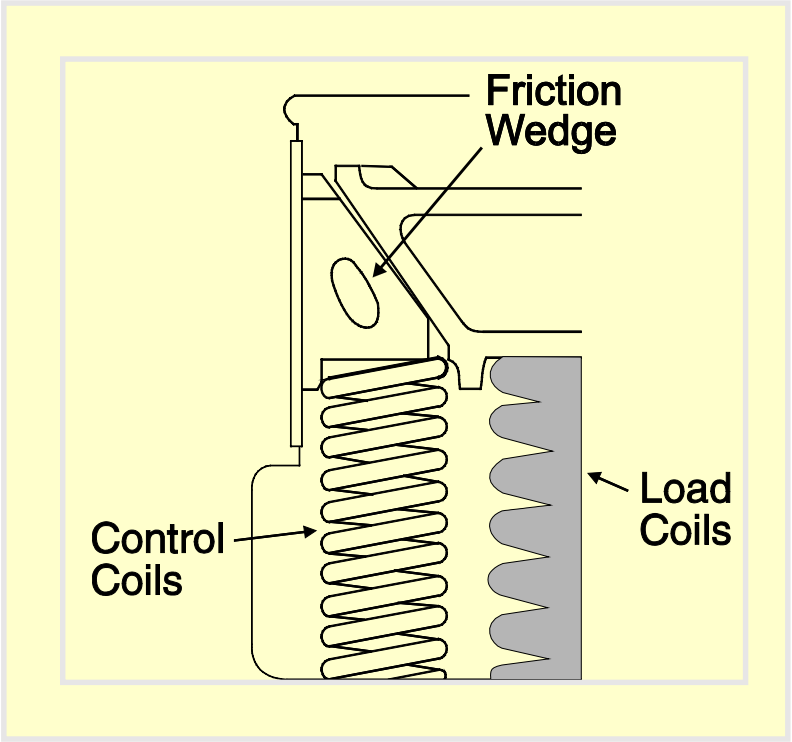
- **Truck suspension starts at the centerbowl.**
  - Keeps the truck centered as it steers around curves
- **Side bearings limit the roll between the carbody and truck bolster.**
- **Centerbowl and side bearings take up deflections required to negotiate spirals and track twist.**

Background

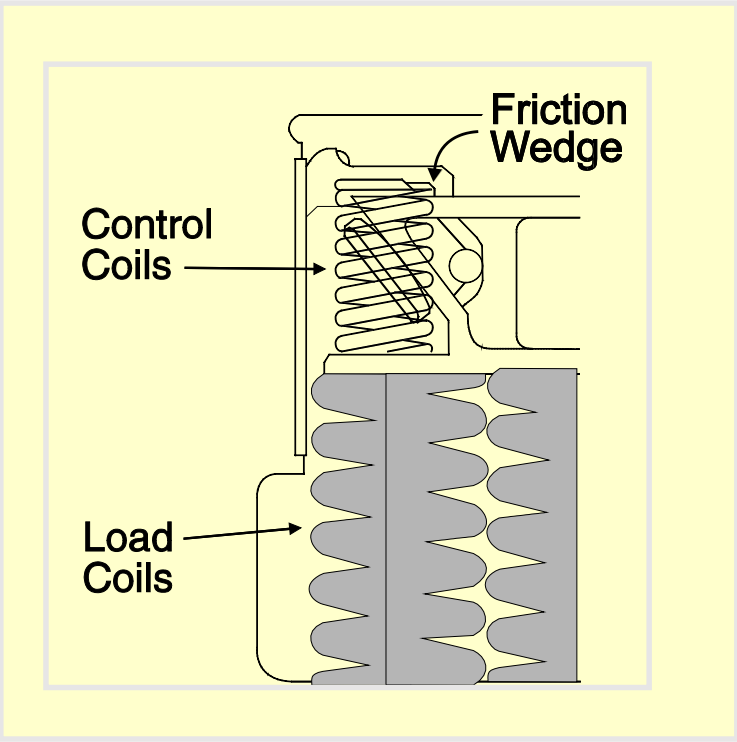
- **Coil springs provide the compliance in a freight car suspension.**
  - Provide isolation from track inputs
  - Equalize load on the wheels
- **Coupler height must remain within tolerance.**

Background

Friction wedges are used for damping.



Variable Damped Truck



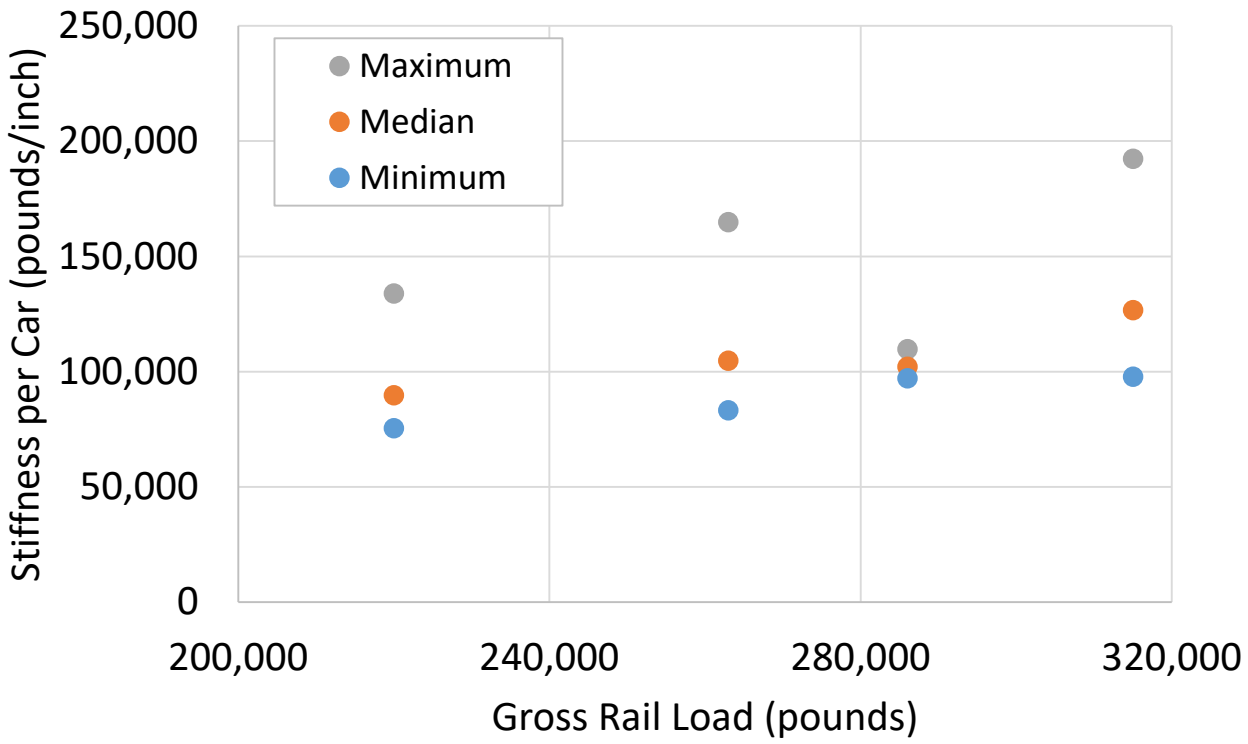
Constant Damped Truck

Scope

- **Examined of spring groups for 220,000-, 263,000-, 286,000-, 315,000-pound gross rail load (GRL) vehicles.**
- **Spring groups listed in AAR MSRP Section D, Trucks and Truck Details.**
  - S-340 Spring-Groups without Load Carrying Snubbers
  - S-341 Spring-Groups with Load Carrying Snubbers (Single Side Springs)
  - S-342 Spring-Groups with Load Carrying Snubbers (Double Side Springs)
  - S-343 Spring-Groups with Hydraulic Snubber
- **Spring Groups listed in AAR Field Manual Rule 46, Truck System Performance for Approved M-976 Truck Systems.**

Discussion of Results

- **For a given GRL, stiffness ranges widely due to D3 spring groups.**
- **Trucks designed for 286,000-pound GRL all have very similar stiffness.**
- **All but one use D5 springs, and the remaining one uses D7.**



This graph represents 59 different spring groups

Conclusion

- **The original weight-spring deflection table is conservative for most of the AAR spring groups analyzed.**

Data from Table 3.4		Calculated for each GRL Using Median Stiffness			
Weight of Load (lbs.)	Spring Deflection (in.)	220K Spring Deflection (in.)	263K Spring Deflection (in.)	286K Spring Deflection (in.)	315K Spring Deflection (in.)
122,000-137,000	1.00	1.44	1.24	1.27	1.02
138,000-164,000	1.25	1.68	1.44	1.48	1.19
165,000-191,000	1.50	1.98	1.7	1.74	1.41
192,000-207,000	1.75	2.22	1.91	1.95	1.58

- **More deflection than the table is conservative because the actual CG is lower than the calculated CG.**

Thank you!