

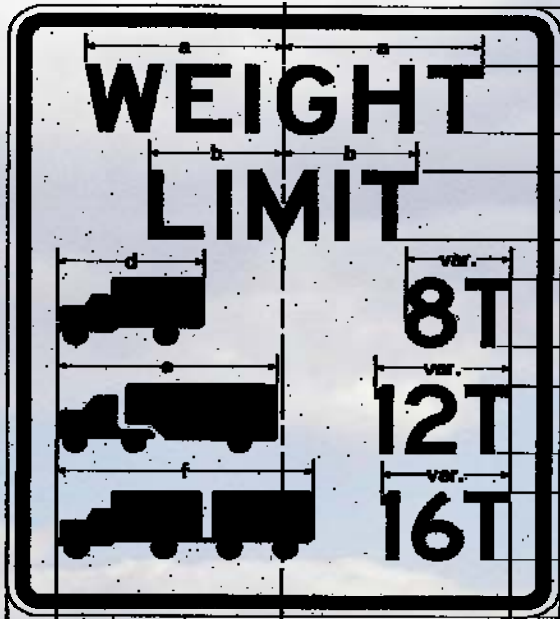
2008 Bridge Load Rating Class 101



Workshop Agenda

- I. Introductions
- II. Load Rating Basics
- III. General Equations
- IV. Load Rating Procedure
- V. Incorporating Member Distress
- VI. Posting, SHV's and Permitting
- VII. Load Rating Example #1
 - Simple Span Non-composite Steel

Bridge Posting



R12-5



R12-1A



Permit Sign

Maximum Load on Bridge

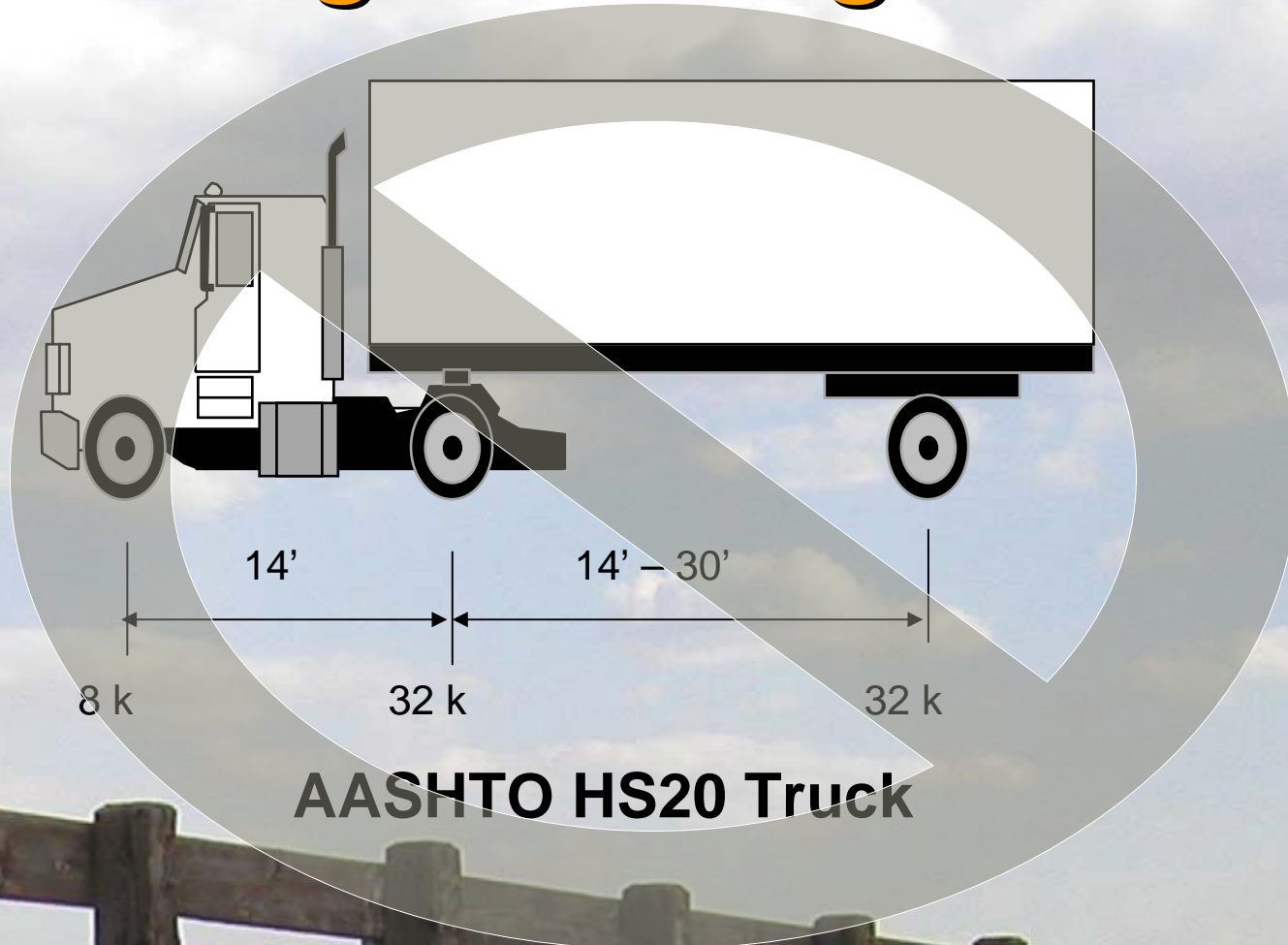
Posting Load Restrictions

- **The posted limit is the total weight on the respective truck which will produce max allowable load effect.**
- **Different than maximum capacity of bridge (Proof Load). The bridge should not fall down or have excessive deflections.**
 - **Safety Factor 1.3**
 - **Conservative modeling assumptions**
 - **Ductility**
 - **Inelastic behavior**

Posting Load

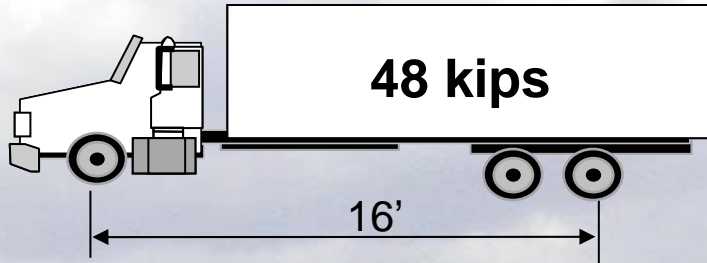


Design/Rating Load

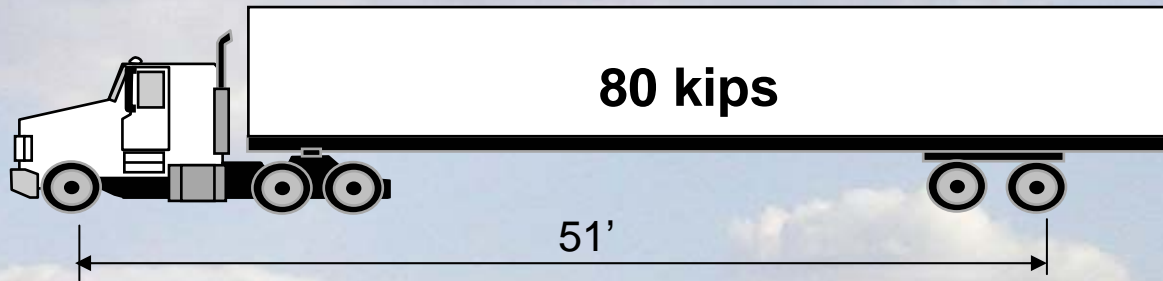


Posting Load

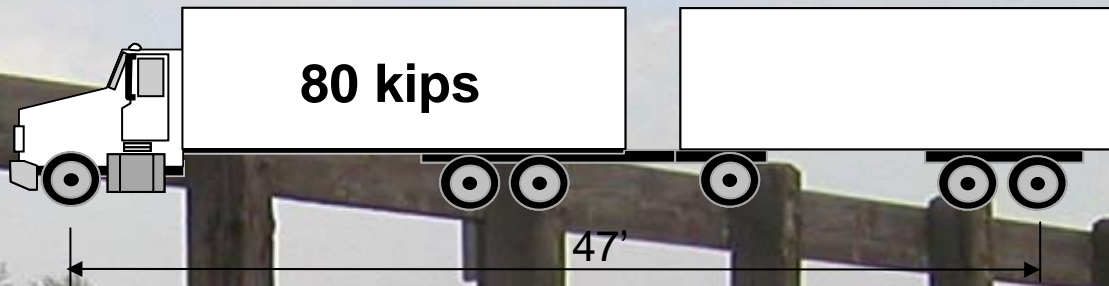
- Three trucks used to represent all the combinations of legal loads



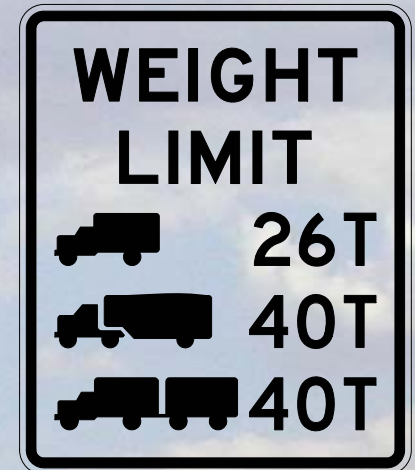
Type M3



Type M3S2-40



Type M3S3



R12-5, 30" X 36"
High Intensity background sheeting

Posting Load Calculation

$$RF = \frac{C - A_1 D}{A_2 (L + I)}$$

RF = Rating factor for live load capacity

C = Capacity of the member

D = Dead load on member

L = Live load on member

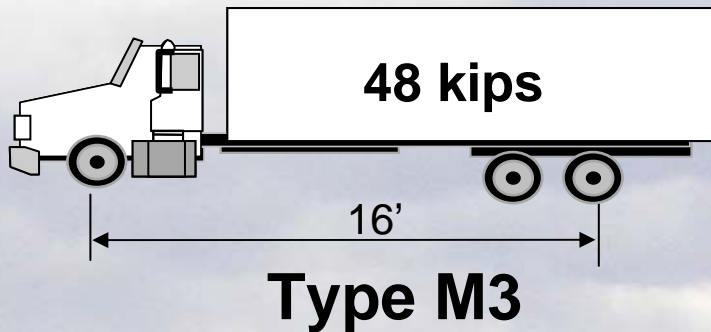
I = Impact Factor

A_1 = Factor for dead load

A_2 = Factor for live load

Use the same equation and values used to conduct the load rating. Substitute the posting trucks for the HS20 live load. Multiply the result by the weight of the truck to get the maximum allowable weight for that particular truck classification.

Simple Posting Example



R12-5, 30" X 36"
High Intensity background sheeting

$$RF = \frac{C - A_1 D}{A_2 (L + I)}$$

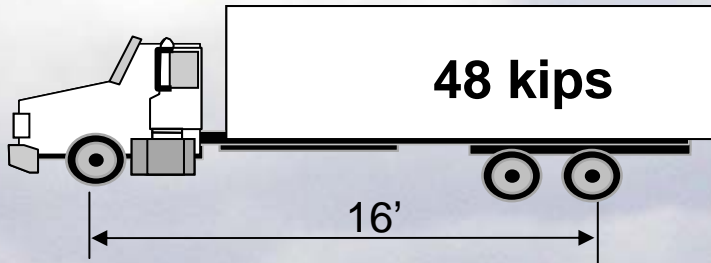
$$0.5 = \frac{100 - 50}{100 \text{ (Type 3)}}$$

$$0.5 \times 24 = 12 \text{ tons}$$

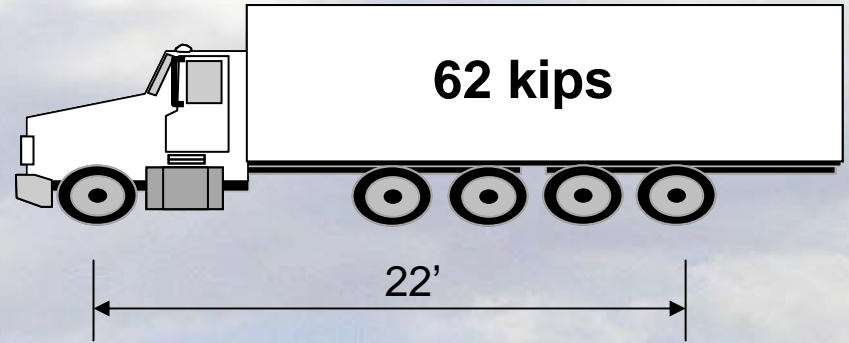
SHV's

- **Specialized Hauling Vehicles are single trucks with typically liftable axles that produce significantly higher stresses than posting trucks.**
- **NCHRP Project 12-63**

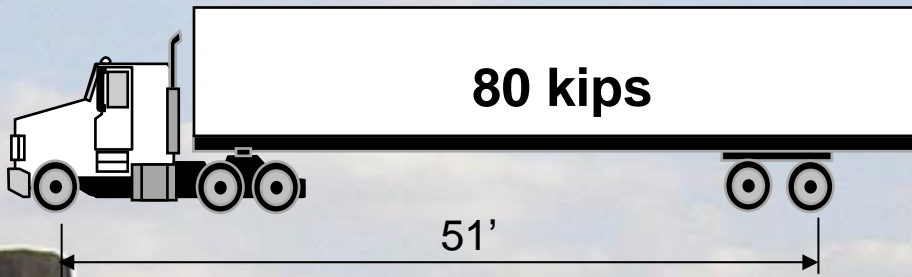
SHV's



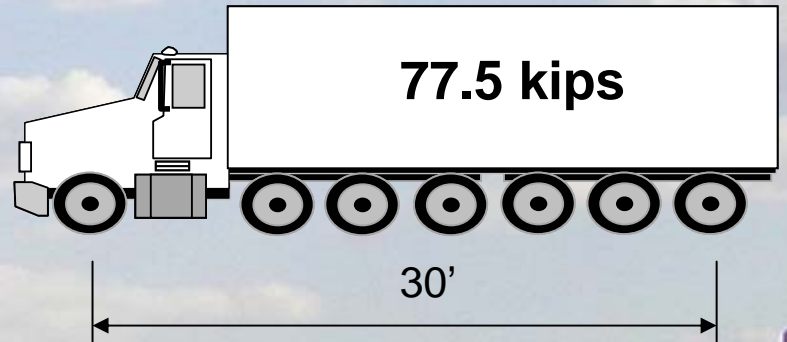
Type M3



SU5



Type M3S2-40



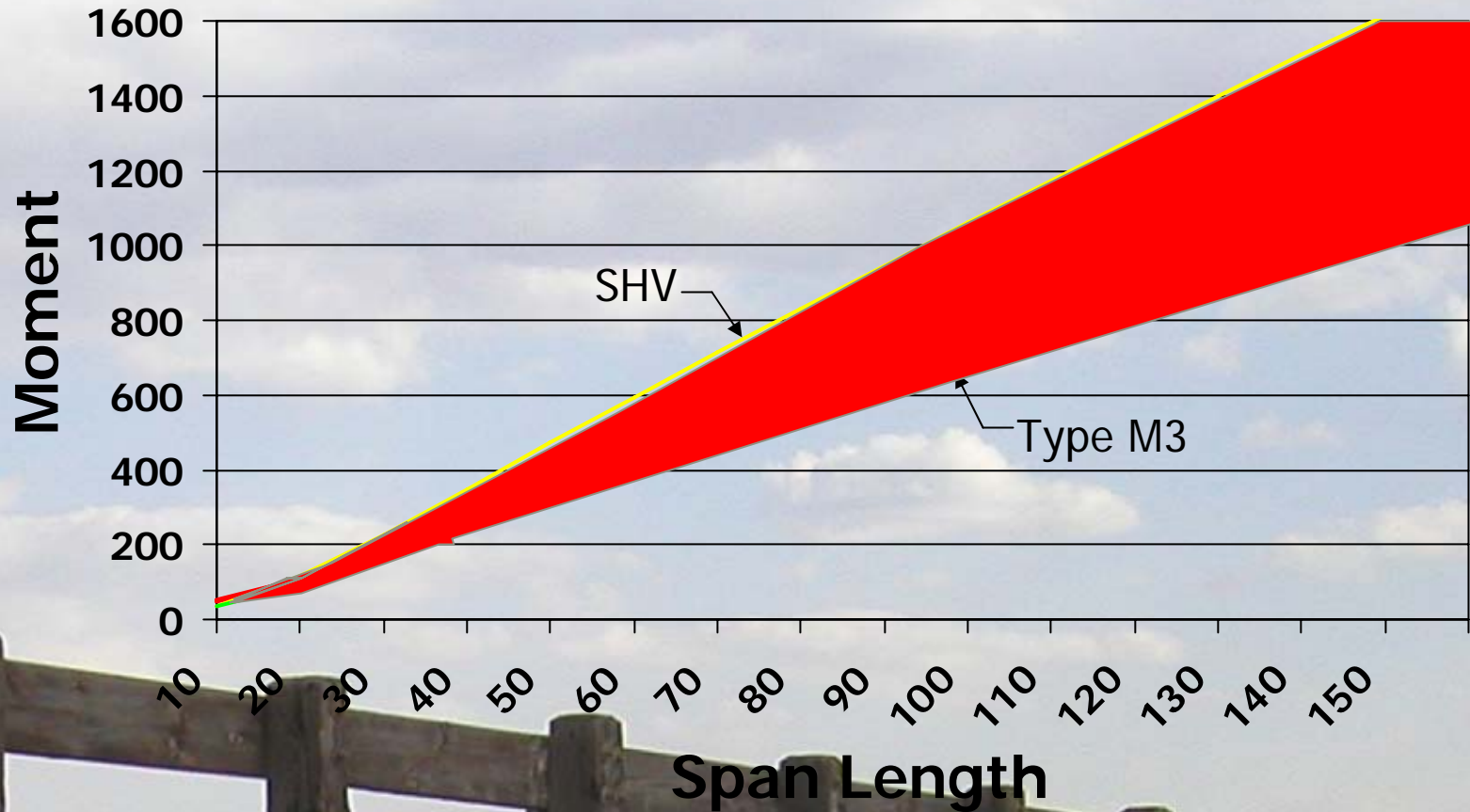
SU7

SHV's

- **These are legal and are becoming more commonplace on all roads.**



SHV vs HS20 vs Type 3

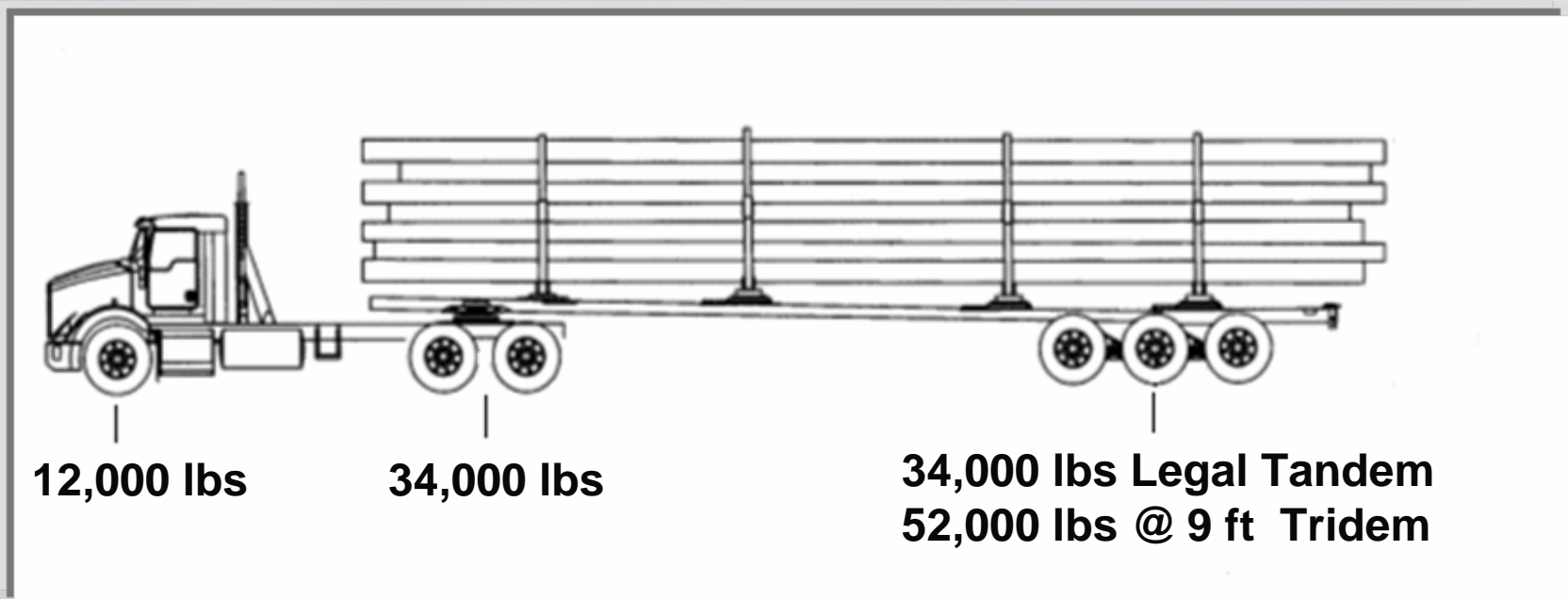


SHV's

- **Currently not posting for these vehicles.**
- **Will be a requirement in new “Manual for Condition Evaluation and Load and Resistance Factor Rating of Highway Bridges” (LRFR)**
- **MnDOT just started running analysis on TH bridges**
- **Highly suggested to do SHV analysis on any new ratings and post for these trucks now**

Timber Haulers Truck

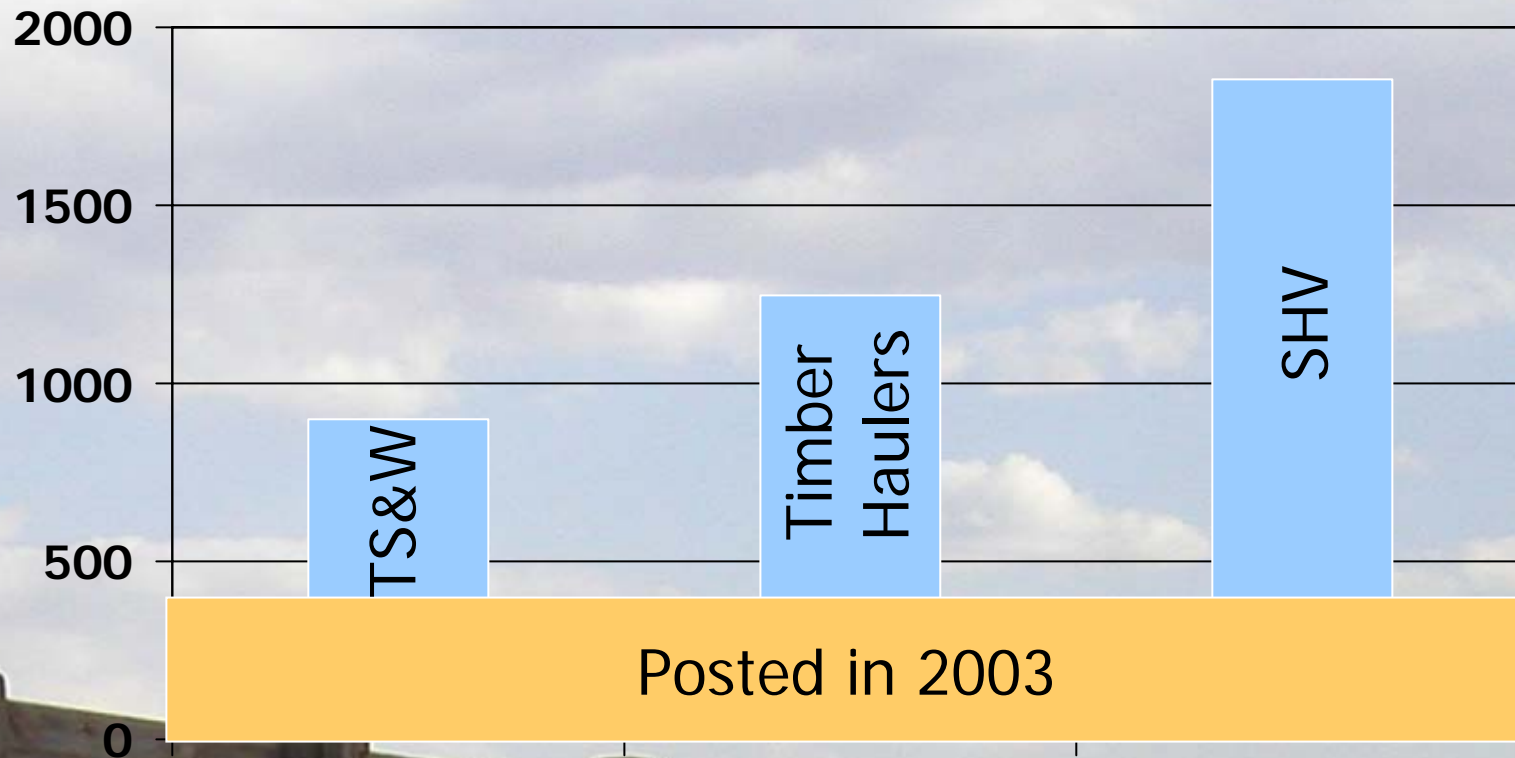
- **First haul of raw timber forest products**
- **Unregulated permitted truck**
- **County bridges should already be posted**



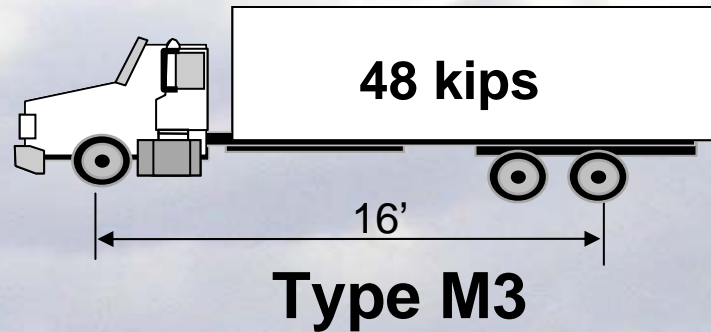
Timber Haulers Truck



Minnesota Postings (Est)

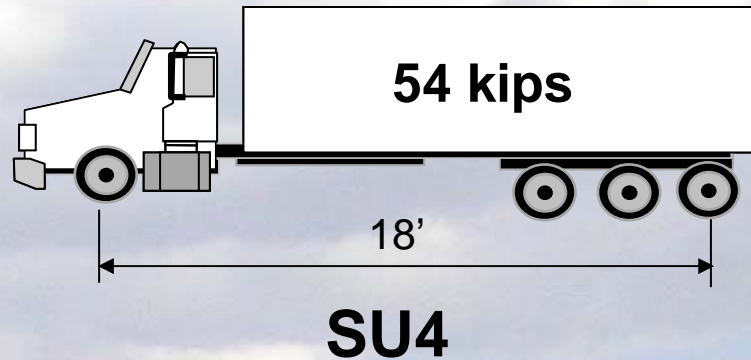


Type M3 Posting (24 tons)



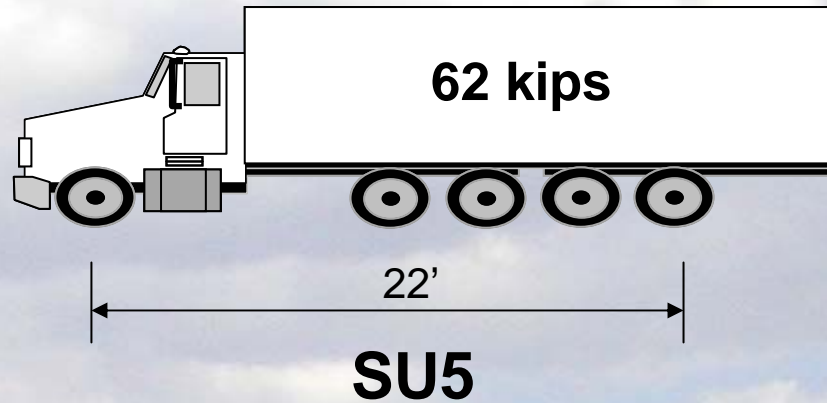
- $RF < 0.125$ close bridge (3 tons)
- $0.125 < RF < 1.1$ post at calculated tonnage
- $RF > 1.1$ no posting needed for Type 3 refer to SU4

SHV SU4 Posting (27 tons)



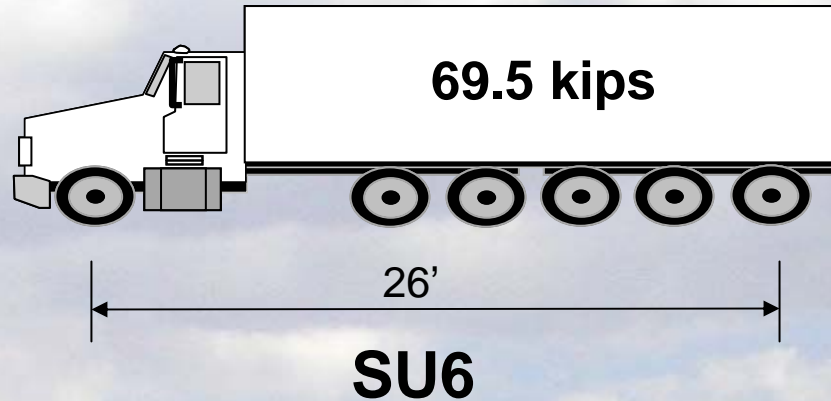
- $0.89 < RF < 1.1$ post at calculated tonnage
- $RF > 1.1$ no posting needed for SU4 refer to SU5

SHV SU5 Posting (31 tons)



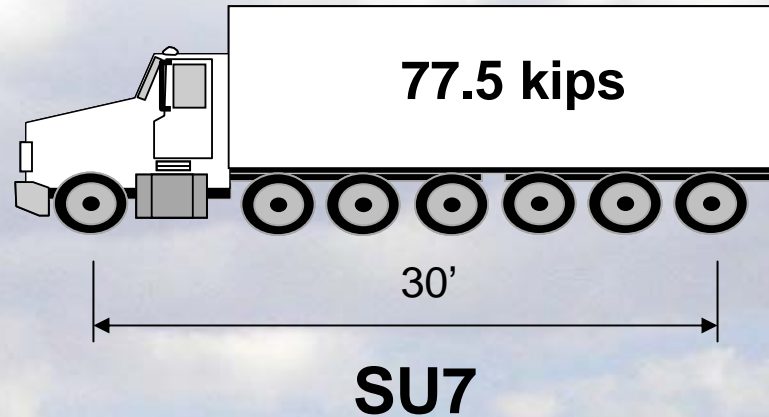
- $0.87 < RF < 1.1$ post at calculated tonnage
- $RF > 1.1$ no posting needed for SU5 refer to SU6

SHV SU6 Posting (34.75 tons)



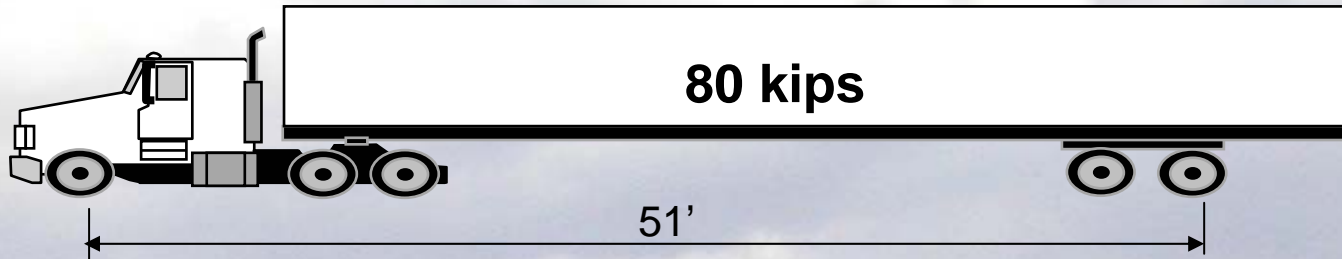
- $0.89 < RF < 1.1$ post at calculated tonnage
- $RF > 1.1$ no posting needed for SU6 refer to SU7

SHV SU7 Posting (38.75 tons)

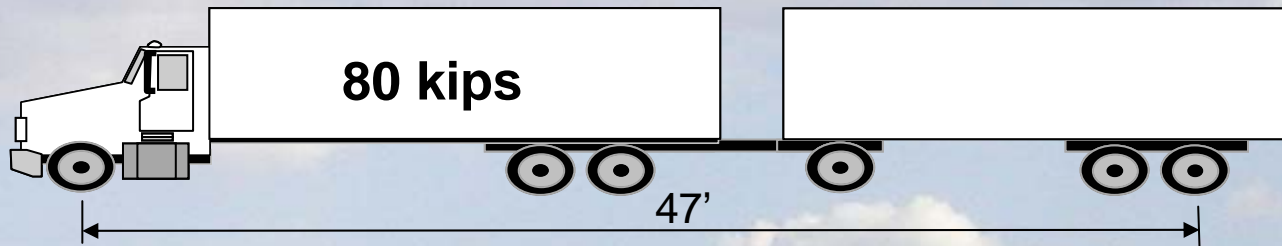


- $0.89 < RF < 1.025$ post at calculated tonnage
- $1.025 < RF < 1.13$ post at 40 tons
- $RF > 1.13$ no posting needed for SU7 refer to combination truck trailers

Truck M3S2, M3S3 (40 tons)



Type M3S2-40



Type M3S3

- RF < 0.35 post using lowest single truck posting with sign R12-1



Truck M3S2, M3S3 (40 tons)

- $0.35 < RF < 1.00$ post at indicated tonnage
- $1.00 < RF < 1.12$ post at 40 tons
- $1.12 < RF < 1.23$ post with the 45 T (Permit Weight Limit) sign unless single truck requires posting then use 40 tons for these two trucks (Timber Haulers truck)
- $1.23 < RF$ no posting required

Posting Tidbits

- Typically round down to even integers
- The M3S2 and M3S3 semis post at same tonnage
- If as an owner you do not have SHV or Timber Haulers truck, you are not required by code to post for those vehicles.
- Do posting analysis for any bridge that has operating rating less than HS28
- Use Type M3, SHV's, M3S2 and M3S3 for all 9 and 10 ton routes. If lower axle weight road then ratio down posting truck.
- If posting from engineer judgment the HS operating rating = posting for single truck = $0.625 \times$ posting for semi.

Approximate Weights of Various Trucks

- **School bus – 35 k**
- **Articulating city Bus – over legal – 70 k**
- **Fire Truck – wide variety – 62 k (3 axles)**
- **Small Tractor – 12 k (95 hp)**
- **Large Tractor – 41 k (350 hp)**
- **Concrete Truck – up to 77 k**
- **Single Truck full of gravel – up to 77 k**

Permitting

$$RF = \frac{C - A_1 D}{A_2 (L + I)}$$

RF = Rating factor for live load capacity

C = Capacity of the member

D = Dead load on member

L = Live load on member

I = Impact Factor

A_1 = Factor for dead load

A_2 = Factor for live load

Use the same equation and values used to conduct the load rating. Substitute the permit truck for the live load. If the $RF > 1$ then the truck can pass without restriction.

Permitting

- **If $RF < 1.0$ for permit truck**
 - Can ask truck to be the only vehicle on bridge. Can use the single lane distribution factor, Beam Spacing/7 rather than Beam Spacing/5.5
 - Can ask truck to limit speed to 5mph and not use brake. This reduces impact to 5% in calculations.
 - Apply both restrictions
 - **JUST BECAUSE THE TRUCK WENT OVER THE BRIDGE LAST WEEK AND NOTHING HAPPENED DOES NOT MEAN AS AN ENGINEER YOU CAN IGNORE CALCULATIONS. HIGH STRESS LOADINGS SIGNIFICANTLY REDUCE THE LIFE OF STRUCTURE AND REDUCE THE FUTURE SAFETY FACTORS.**

Permitting



Robbins Motor Transportation (445,000 lbs, 225')