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California's Load Rating and Permitting Program

Kevin I. Keady

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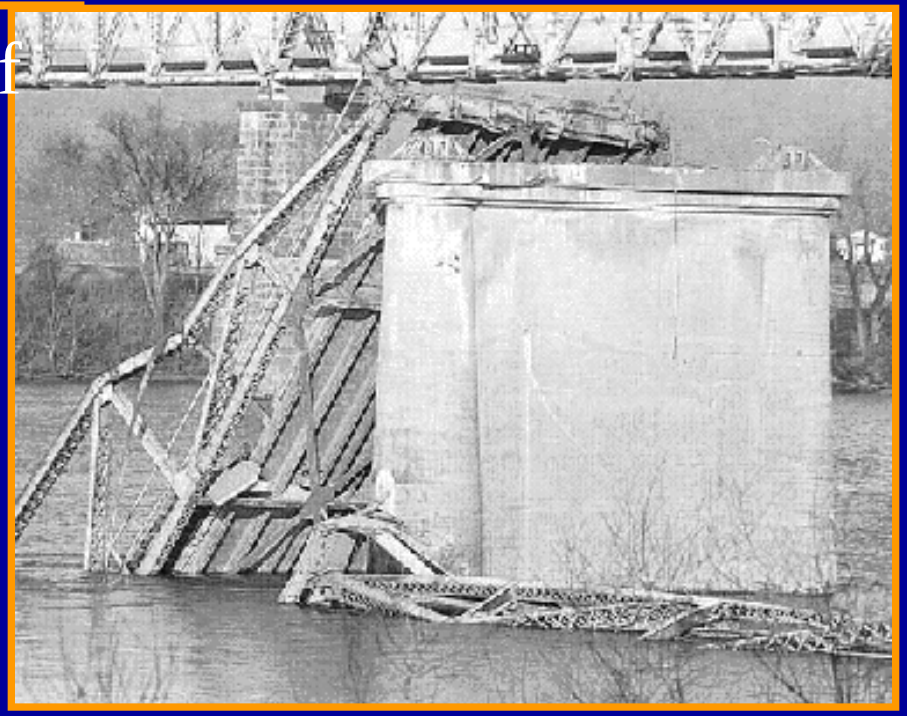
What this Presentation Covers

- Why do we load rate bridges?
- Load rating in California
- California's legal vehicles
- California's permit vehicles
- California's permitting process

Why do we load rate bridges?

Safety

The Silver Bridge Collapse



The Dec. 15, 1967, collapse of the Silver Bridge at Point Pleasant, Ohio killed 46 people.

The failure of the 39 year old eye bar suspension bridge across the Ohio River prompted US Congress to pass **National Bridge Inspection Standards (NBIS)** in 1968.

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Why do we load rate bridges?

Safety

Why do we load rate bridges?

Funding

Load ratings are used to help determine federal bridge replacement and rehabilitation funding levels to the states.

On a national level bridge load ratings reported to the NBI weigh heavily in the determination of the Sufficiency Rating (up to 55%).

Why do we load rate bridges?

Permit Routing

Permit vehicles are any vehicle that exceeds the size or weight limitations of the California Vehicle Code (CVC).

California issued over 158,000 permits last year alone. The CVC grants Caltrans the authority to issue permits and define the permit program. Load ratings are one of the primary resources used to route permits.

Why do we load rate bridges?

Emergency Response

Bridge Models and rating results are very valuable during Emergencies:

- Fire,
- Earthquake,
- Flood,
- Accidents,
- Man made disasters

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Why do we load rate bridges?

Emergency Response: Fires

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Why do we load rate bridges?

Emergency Response: Scour

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Why do we load rate bridges?

Man Made Disasters

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Why do we load rate bridges?

Construction Support

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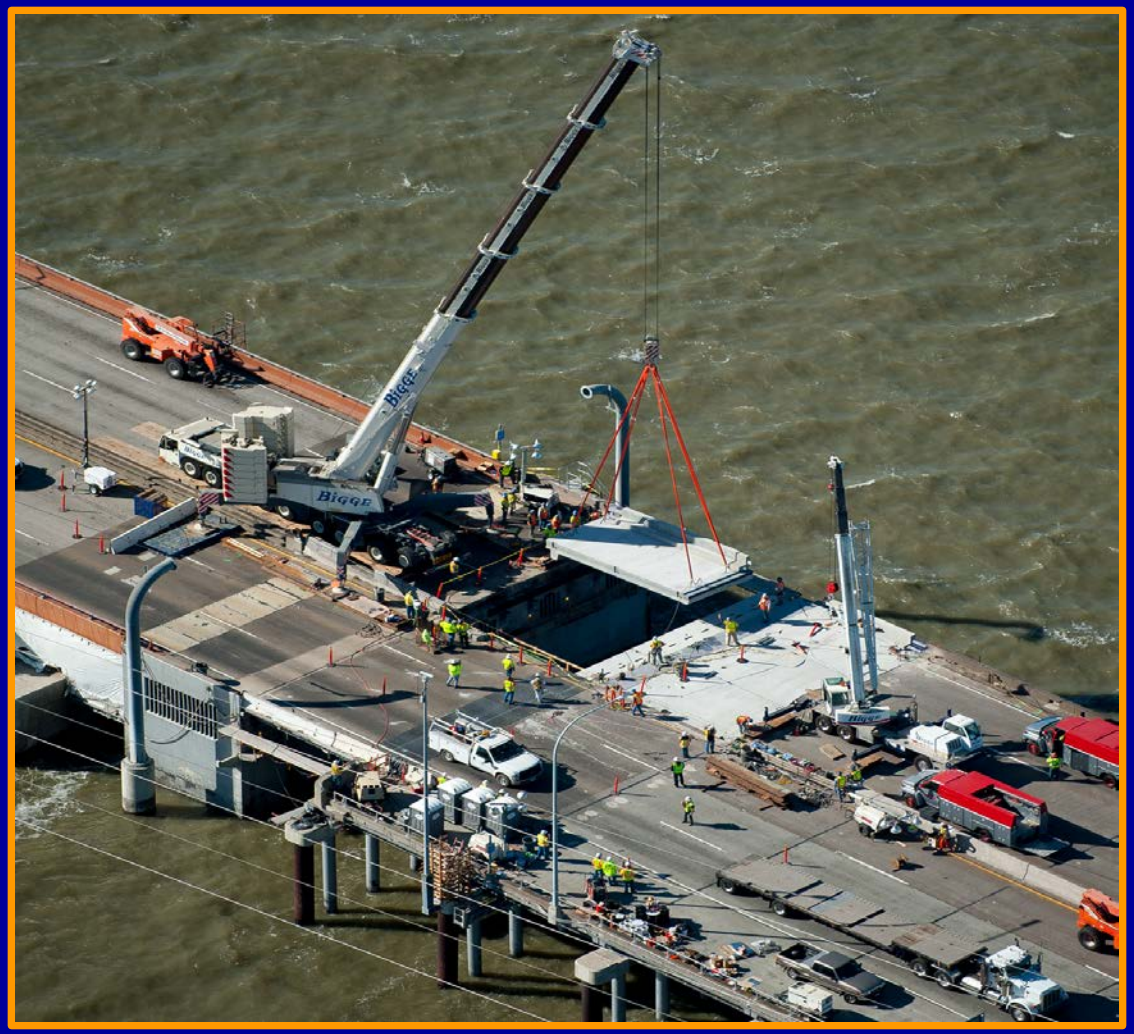
Why do we load rate bridges?

Construction Support



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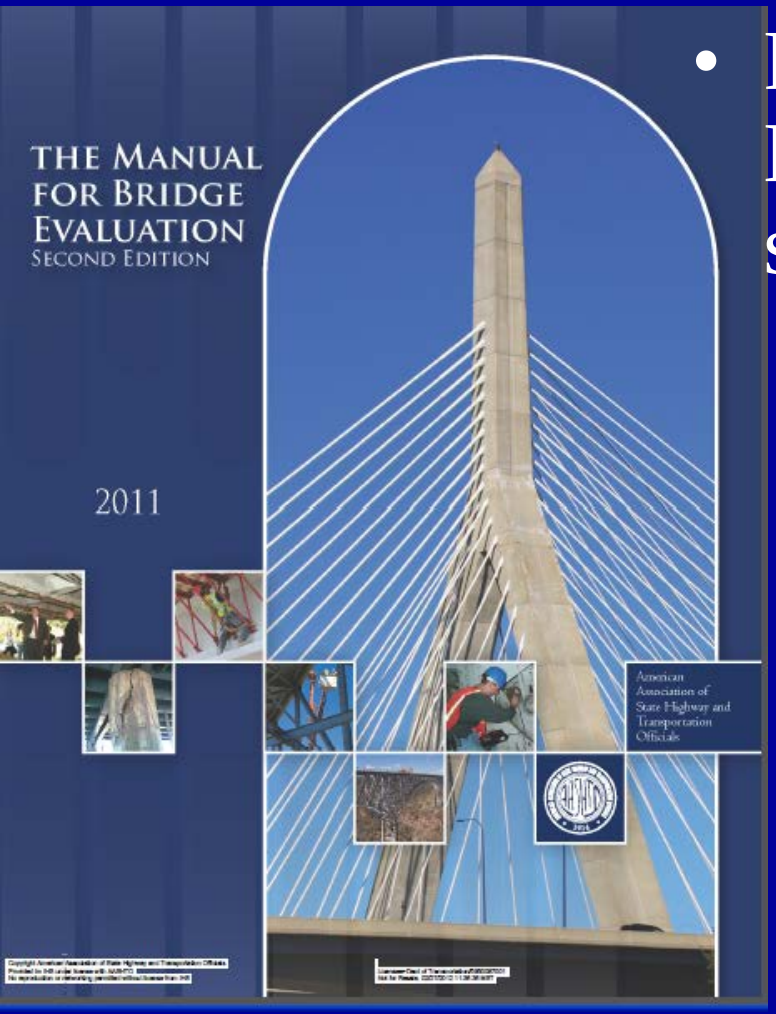
Why? Safety, Protect Infrastructure and Enforcement!

Los Angeles I-710

Bridge Load Rating in California

Load Rating Levels



- Per Manual for Bridge Evaluation, the following ratings should be established:
  - *Inventory Rating*
  - *Operating Rating*
  - *Legal Load Rating*
  - *Permit Rating*

Load Rating in CA

- 2008 FHWA Program Review Findings:
  - (E) ratings had not been maintained.
  - (E) Rating summary sheets not stamped by PE
  - Software was no longer available
  - Ratings did not include shear calcs

Load Rating in CA

- 2011, CA signed a PCA with FHWA.
- 11,300 bridges req'd new calculations
- Initially, LFR was the preferred rating spec in CA.
- AASHTOWare BrR developed concurrently

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Load Rating in CA

- Analytical shear capacities were reducing existing bridge ratings and restricting trucking routes.
- CA switched to the new LRFR code
- Probable vs specified material properties
- Initiated research contracts
- T-18 agenda items for MBE implementation
- AASHTOWare BrR beta testing

Load Rating in CA

- LRFR is the preferred rating spec in CA regardless of code used for original design.
- In addition to Inv/Op ratings, we also calculate rating factors for the Type 3, Type 3S-2, and Type 3-3 legal trucks and the CA family of permit trucks.
- As of fall 2014, CA includes SHV ratings.

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Load Rating Summary Sheet

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Load Rating Summary Sheet

Bridge Number: 20 0085L
Facility Carried: ROUTE 101 SB
Location: 04-SON-101-34.55-HLBG
City: HEALDSBURG

Bridge Name: SOUTH HEALDSBURG UC
Structural Element Rated: Continuous 3 span bridge with RCT beam girders (6)

Rating Summary

DESIGN LOADING	Rating Factor	Posting U.S. Tons	Critical Location: Structure	Control Element	Load Action	Location
Inventory:	0.88		Span 1-3	Girder	Moment (Strength)	0.4pt of Span 3,Exterior Girder (G1)
Operating:	1.13		Span 1-3	Girder	Moment (Strength)	0.4pt of Span 3,Exterior Girder (G1)
LEGAL RATING						
Type 3 (25T):	1.69	Legal	Span 1-3	Girder	Moment (Strength)	0.4pt of Span 3,Exterior Girder (G1)
Type 3S2 (36T):	1.85	Legal	Span 1-3	Girder	Moment (Strength)	0.4pt of Span 3,Exterior Girder (G1)
Type 3-3 (40T):	2.02	Legal	Span 1-3	Girder	Shear (Strength)	0.1pt of Span 2, Interior Girder (G5)
PERMIT RATING		Permit Rating				
5 Axle Annual :	0.93	G	Span 1-3	Girder	Shear (Strength)	0.1pt of Span 2, Interior Girder (G5)
5 Axle Truck :	1.52	P	Span 1-3	Girder	Shear (Strength)	0.1pt of Span 2, Interior Girder (G5)
7 Axle Truck :	1.42	P	Span 1-3	Girder	Shear (Strength)	0.1pt of Span 2, Interior Girder (G5)
9 Axle Truck :	1.39	P	Span 1-3	Girder	Shear (Strength)	0.1pt of Span 2, Interior Girder (G5)
11 Axle Truck:	1.39	P	Span 1-3	Girder	Shear (Strength)	0.1pt of Span 2, Interior Girder (G5)
13 Axle Truck:	1.39	P	Span 1-3	Girder	Shear (Strength)	0.1pt of Span 2, Interior Girder (G5)
15 Axle Truck:	1.39	P	Span 1-3	Girder	Shear (Strength)	0.1pt of Span 2, Interior Girder (G5)
15 Axle Dual :	1.06	P	Span 1-3	Girder	Shear (Strength)	0.1pt of Span 2, Interior Girder (G5)

RELEVANT LOAD RATING INFORMATION

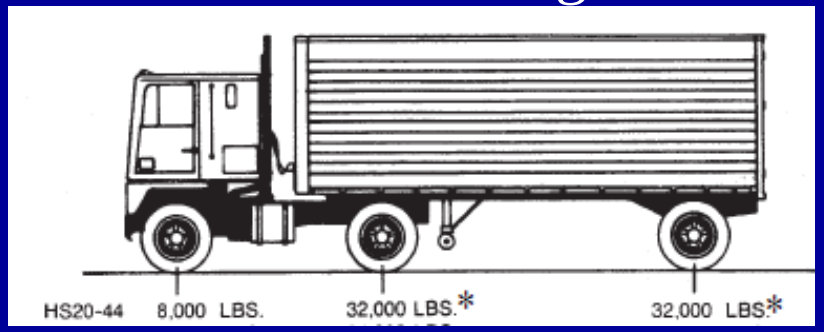
NOTES:

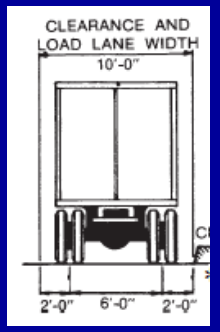
This load rating is based on the existing bridge geometry and roadway configuration. Modification to the structure (such as bridge rail modification or widening) may require a new load rating.

Bridge Load Rating in California

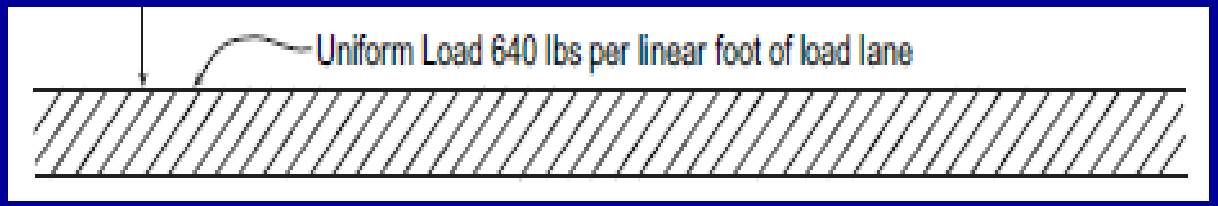
Design/Rating Vehicles

- HL93 Loading
  - Consists of
    - HS20 Truck Loading





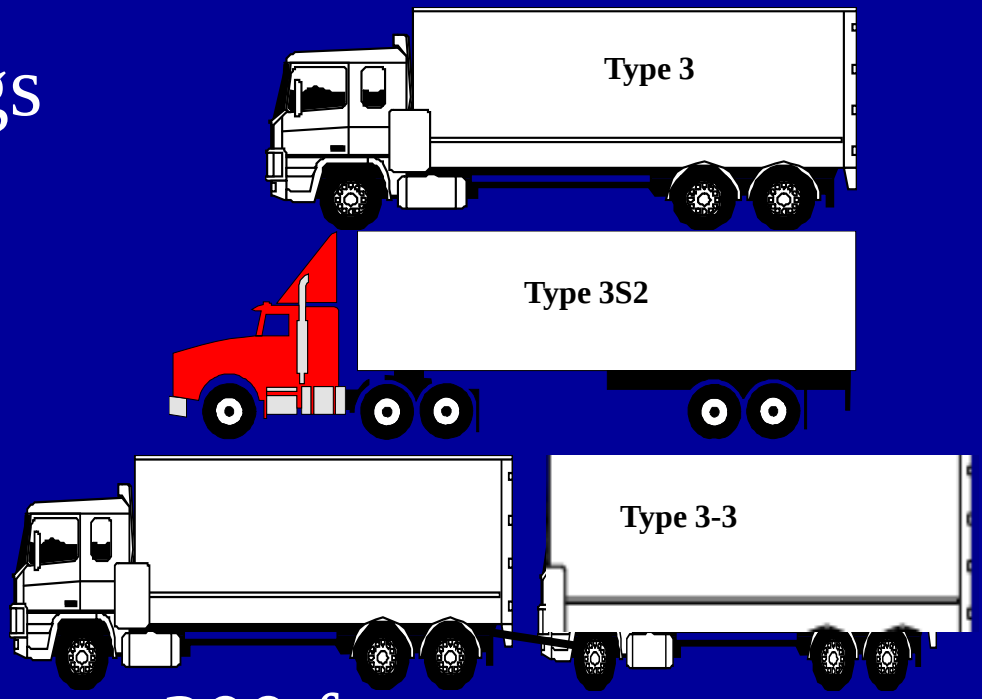
    - **Plus**, 640 lbs/ft uniform loading



Bridge Load Rating in California

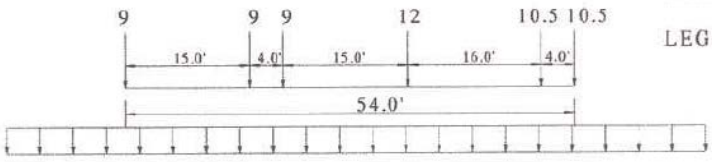
Legal Rating Vehicles

- Legal Loadings



- For bridge Spans >200 ft

75% of Type 3-3 PLUS 200 lbs/ft uniform load



INDICATED CONCENTRATIONS ARE AXLE LOADS IN kips (75% OF TYPE 3-3)

LEGAL LANE WEIGHT/ft. = 0.2 klf

Typical Type-3 Legal Vehicles

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Typical 3S-2 Tractor Semi-Trailer

Type 3-3 Truck and Trailer Combination

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Specialized Hauling Vehicles – SHV's

Our new "Legal" trucks ???

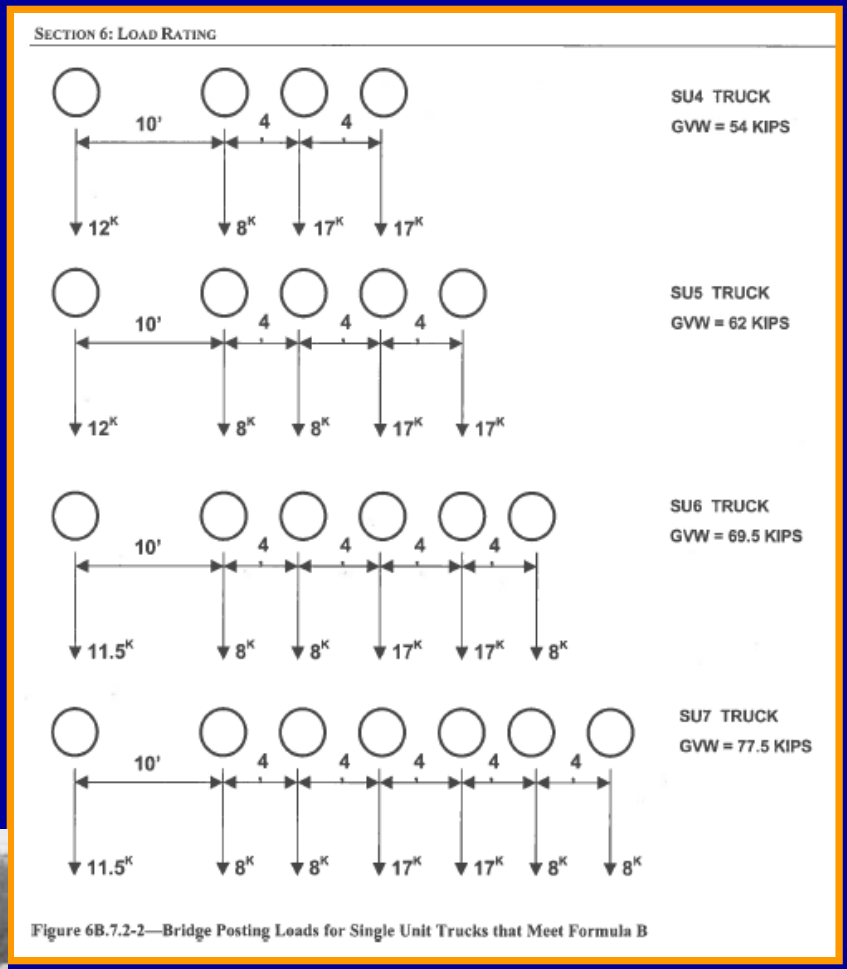
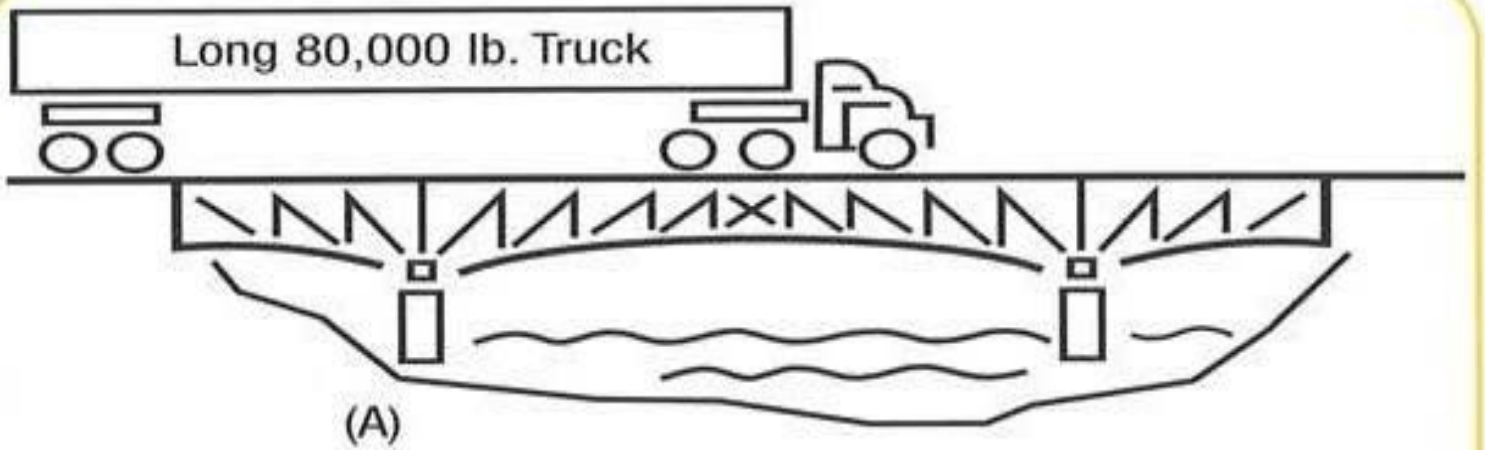


Figure 6B.7.2-2—Bridge Posting Loads for Single Unit Trucks that Meet Formula B

SU7



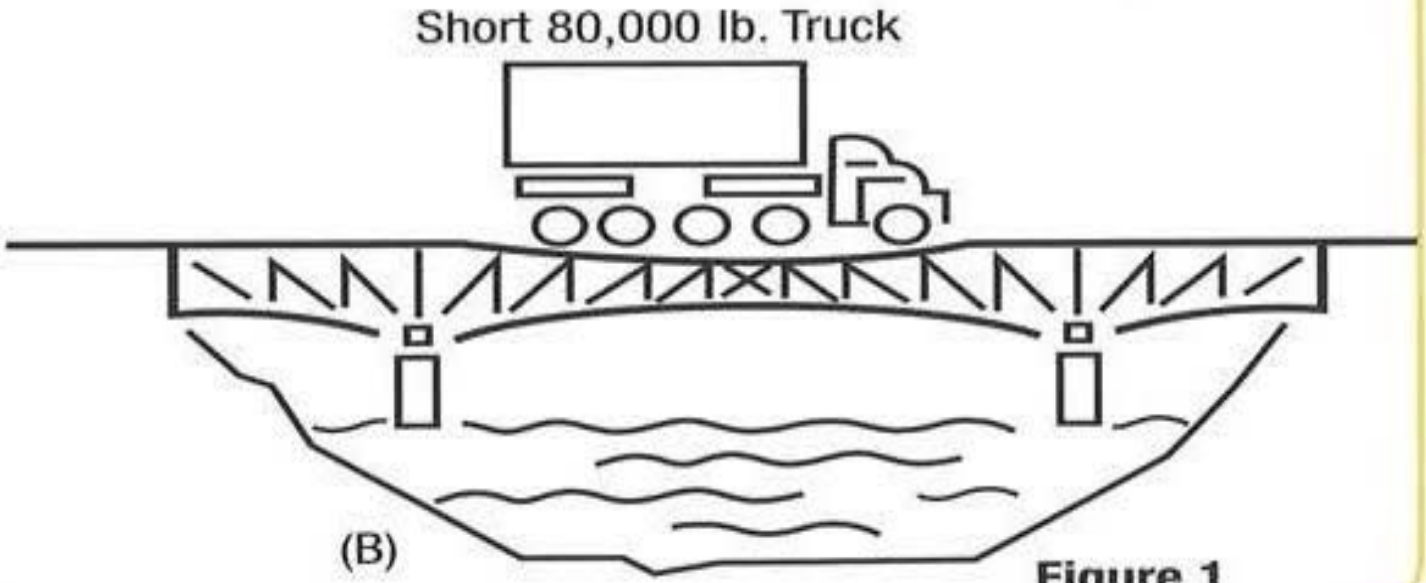


Figure 1

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CA Permit Vehicle Designation

- CA's permit vehicles were developed in mid 1970's
- Permit Design Vehicle
  - 13 axles - 48 kip per Tandem axle
- 5 Permit Rating Vehicle derived from design vehicle
  - 5,7,9,11 and 13 axles
- Letter Color designation used, P G, O, X
  - P = rating factor >1
  - G = rating factor 0.87 < 1
  - O = rating factor 0.67 < 0.87
  - X = no permit vehicles allowed

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Permit Vehicles

- Weight Limitations:
  - 24,000 lb. per single axle
  - 48,000 lb. per tandem axle
  - No gross weight limit
- Same vehicle used to design and load rate bridges
- CA does not issue permits for divisible loads

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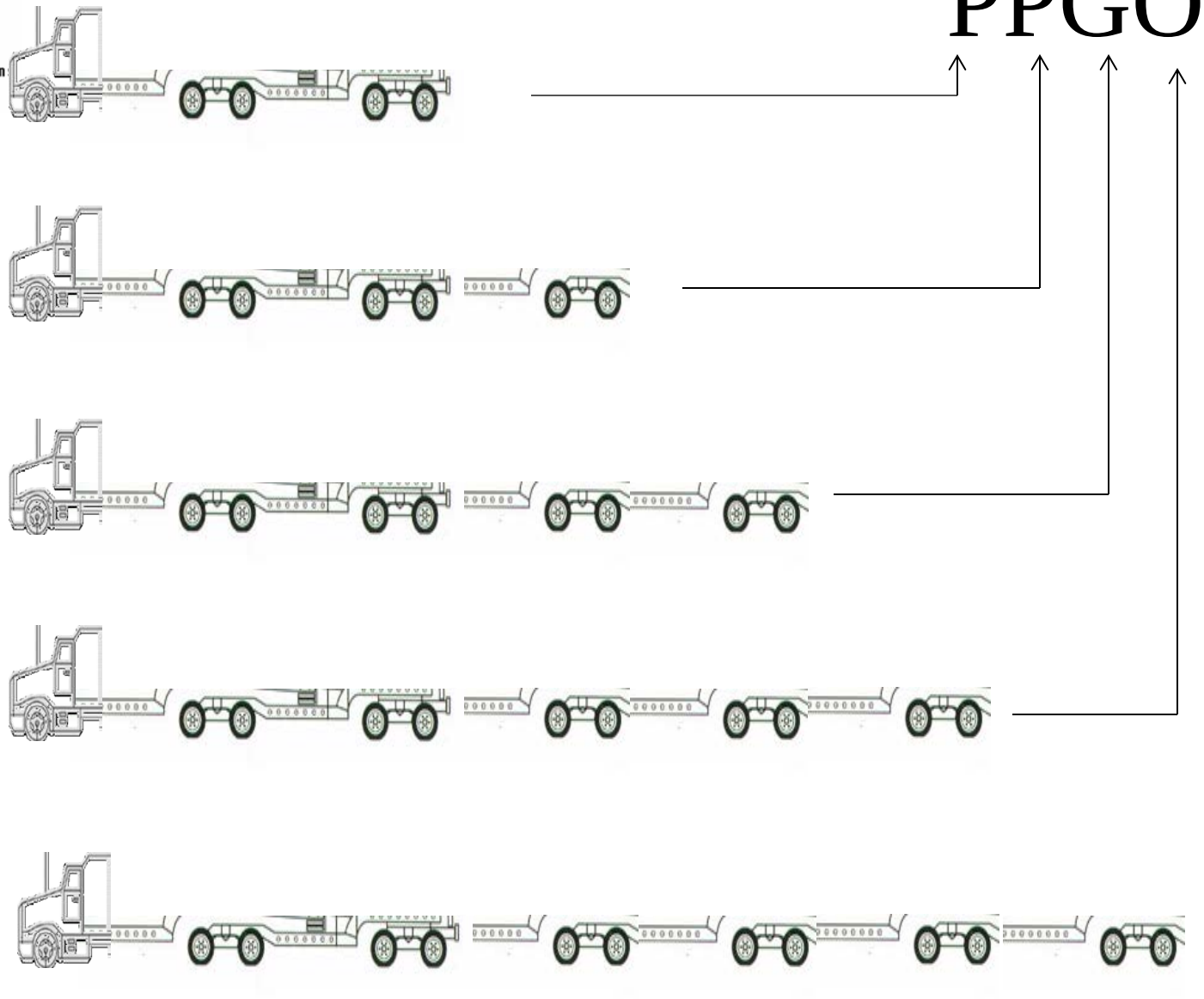
PPGOO



P = 100% permit weight, G = 87%, O=67%, X = no permit

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The California P15 Design Vehicle

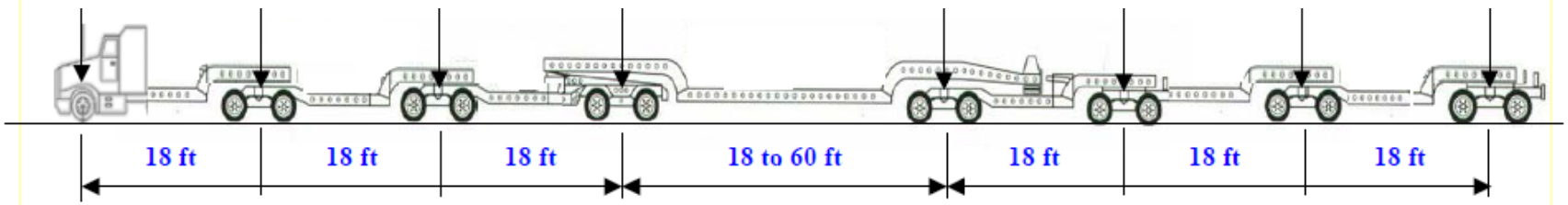

Figure 3.6.1.8.1-1 California P15 truck

Expecting the need for larger permit trucks in the future, Caltrans changed the permit truck configuration in 2008.

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ACTUAL PERMIT VEHICLES

Some of Typical Usage of Permit Trucks

5 Axle Permit Vehicles 120,000 lbs.

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Equivalent to 9 axle Permit Vehicle 250,000 lbs

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11 Axle Permit Vehicle

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Permit Routing

- How do Permit Vehicles get Routed
  - Every bridge has a permit designation, e.g. PPGOO
  - The 5 digit color designation is the first level screening tool which enables permit writers to quickly process applications.
  - Permit writers match the proposed vehicle to the permit ratings for all bridges on a proposed route when determining where the vehicle can travel.
  - For the above noted designation a 9 axle permit vehicle would only be allowed to cross the bridge if the axles were less than 87% of maximum.

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The Permit Process

- Calculated ratings from SM&I as well as “Assigned by Design” and “Field Evaluation” values are used to route permit trucks.
- The Permit Office assumes ALL rating factors (RF) are based on the 5 design vehicles and 48kip split tandem axle configuration regardless of analysis method.

  An approximate 15% “Bonus” is applied for 8 tire axles due to reduction in deck demand.

  A 10% additional bonus is applied for 10’ wide axles due to improved live load distribution.

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Example Permit Application

DESCRIPTION OF THE LOAD OR EQUIPMENT AND MODEL NO. ☒ HAUL ☐ DRIVE ☐ TOW ☐ SC Holiday Conditions

Dam Gates

DIMENSIONS OF LOAD

29'L 9'W 8'H VAR# 22999

DESCRIPTION OF HAULING EQUIPMENT:

3 Axle Truck, 2 Axle Jeep, 2 Axle Trailer, 2 Axle Booster

VEHICLE WIDTH: 8'6"	SEMI-TRAILER LENGTH:	KINGPIN TO LAST AXLE: 50'9"	COMB VEHICLE LENGTH: 105'

AXLE NUMBER	1	2	3	4	5	6	7	8	9
NUMBER OF TIRES PER AXLE	2	4	4	4	4	4	4	4	4
DISTANCE BETWEEN AXLES		17'9"	4'6"	12'4"	4'6"	34'11"	4'6"	14'2"	4'6"
WIDTH OF AXLES AT TIRE SIDEWALL	8'4"	8'2"	8'2"	8'2"	8'2"	8'2"	8'2"	8'2"	8'2"
MAXIMUM ALLOWABLE WEIGHT	20000	46725		46725		46725		46725	

NOT TO EXCEED THE LOADED DIMENSIONS SHOWN BELOW OR AXLE WEIGHTS SHOWN ABOVE

LOADED HEIGHT:	LOADED WIDTH:	LOADED OVERALL LENGTH:	LOADED OVERHANG:	WEIGHT CLASS:
14'	9'	105'	0	Purple

ORIGIN:

OR/CA I-5

DESTINATION:

Folsom Dam, 1070 Folsom Lake Crossing, Folsom, CA

AUTHORIZED STATE HIGHWAYS - CITY AND/OR COUNTY PERMITS MAY BE REQUIRED WHENEVER THE * IS SHOWN IN THE STATE ROUTE.

For office use only

* From OR LINE 5 - 5S - 80E - to MADISON AVE exit (MADISON AVE S/B OFF RAMP exit number 96) *

APPENDIX 20
WEIGHT CHART (PLATE 25-5)

*PURPLE AND BONUS OVERLOADS**

MAXIMUM PERMIT WEIGHT ON TANDEM AXLES = 60,000 POUNDS

Example: 8' - 0" Distance Between First and Last Axle in Feet

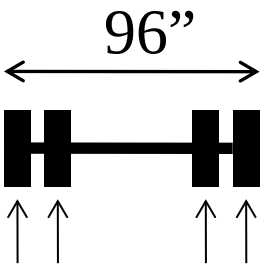
50,400	4 tires, 8' - 0" Wide
57,960	8 tires, 8' - 0" Wide
63,000	8 tires, 10' - 0" Wide

Purple Load = 1.5 x 700 (L + 40)
Purple Load (+ 15%) = 1.15 x 1.5 x 700 (L + 40)
Purple Load (+ 25%) = 1.25 x 1.5 x 700 (L + 40)

FT. \ IN.	0	1	2	3	4	5	6	7	8	9	10	11
2	28,000 32,000 35,000	28,000 32,000 35,000	28,000 32,000 35,000	28,000 32,000 35,000	28,000 32,000 35,000	28,000 32,000 35,000	28,000 32,000 35,000	28,000 32,000 35,000	28,000 32,000 35,000	28,000 32,000 35,000	28,000 32,000 35,000	28,000 32,000 35,000
3	28,000 32,200 35,000	28,000 32,200 35,000	28,000 32,200 35,000	28,000 32,200 35,000	28,000 32,200 35,000	28,000 32,200 35,000	45,675 52,526 57,094	45,763 52,627 57,203	45,850 52,728 57,313	45,938 52,828 57,422	46,025 52,929 57,531	46,113 53,029 57,641
4	46,200 53,130 57,750	46,288 53,231 57,859	46,375 53,331 57,969	46,463 53,432 58,078	46,550 53,533 58,188	46,638 53,633 58,297	46,725 53,734 58,406	46,813 53,834 58,516	46,900 53,935 58,625	46,988 54,036 58,734	47,075 54,136 58,844	47,163 54,237 58,953
5	47,250 54,338 59,063	47,338 54,438 59,172	47,425 54,539 59,281	47,513 54,639 59,391	47,600 54,740 59,500	47,688 54,841 59,609	47,775 54,941 59,719	47,863 55,042 59,828	47,950 55,143 59,938	48,038 55,243 60,047	48,125 55,344 60,156	48,213 55,444 60,266
6	48,300 55,545 60,375	48,388 55,646 60,484	48,475 55,746 60,594	48,563 55,847 60,703	48,650 55,948 60,813	48,738 56,048 60,922	48,825 56,149 61,031	48,913 56,249 61,141	49,000 56,350 61,250	49,088 56,451 61,359	49,175 56,551 61,469	49,263 56,652 61,578
7	49,350 56,753	49,438 56,853	49,525 56,954	49,613 57,054	49,700 57,155	49,788 57,256	49,875 57,356	49,963 57,457	50,050 57,558	50,138 57,658	50,225 57,759	50,313 57,859

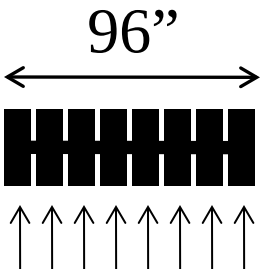
Permit “Bonusing”

Standard Purple Load



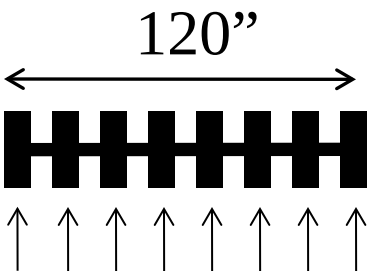
Tandem axles x 4 tires = 48kips

15% Bonused Purple Load



Tandem axles x 8 tires = 54kips

25% Bonused Purple Load



Tandem axles x 8 tires = 60kips

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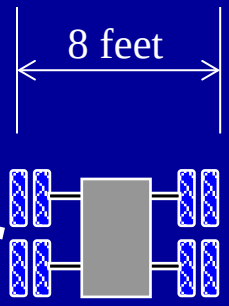
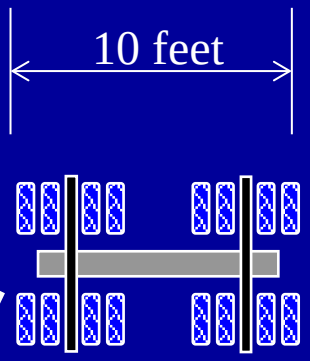


Up to 48 kip allowed

Standard Tandem



Up to 60 kip allowed (wider)

Bonused or "Trunnion" Axle

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Bonused “Trunnion Axles” at work!

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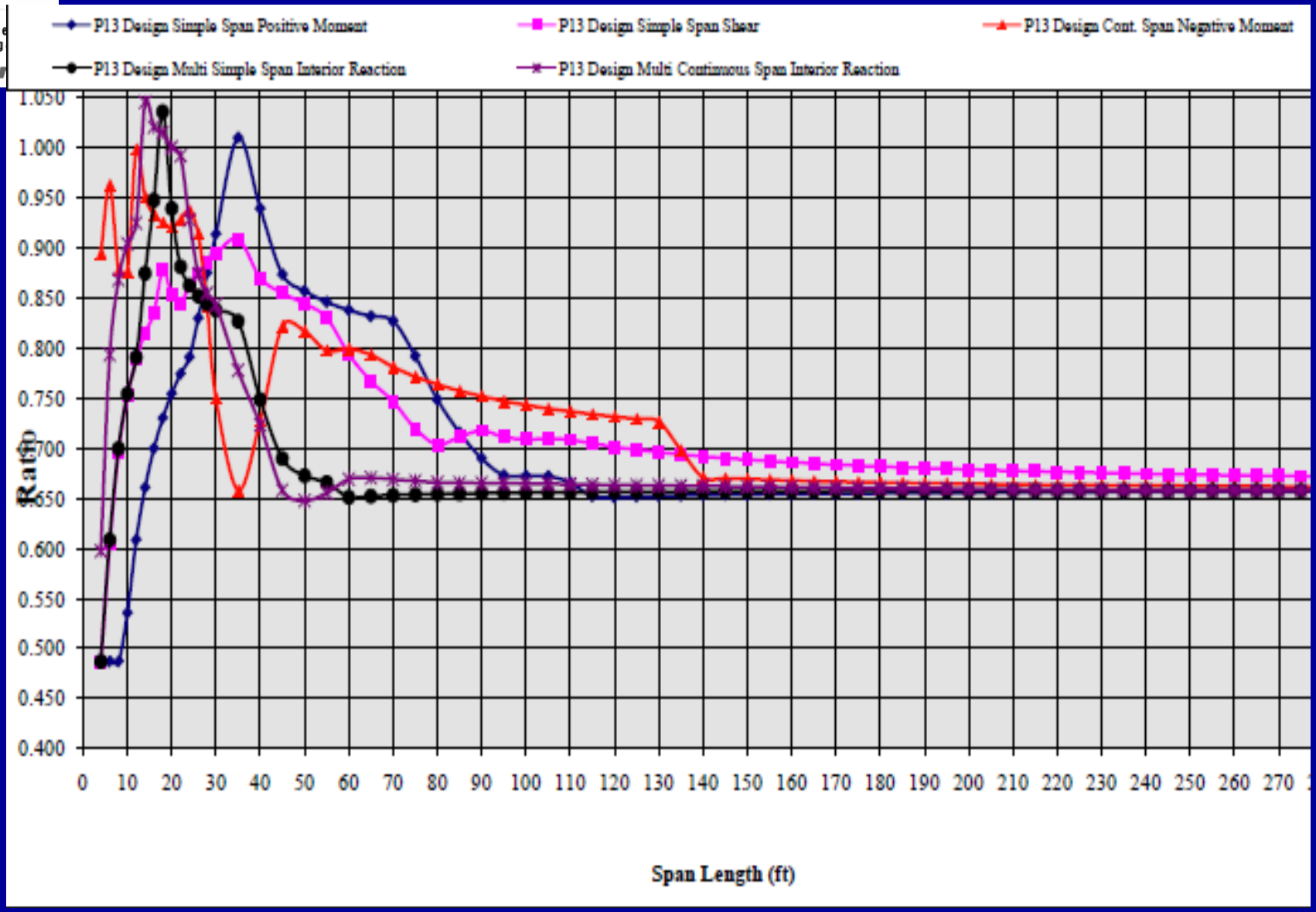
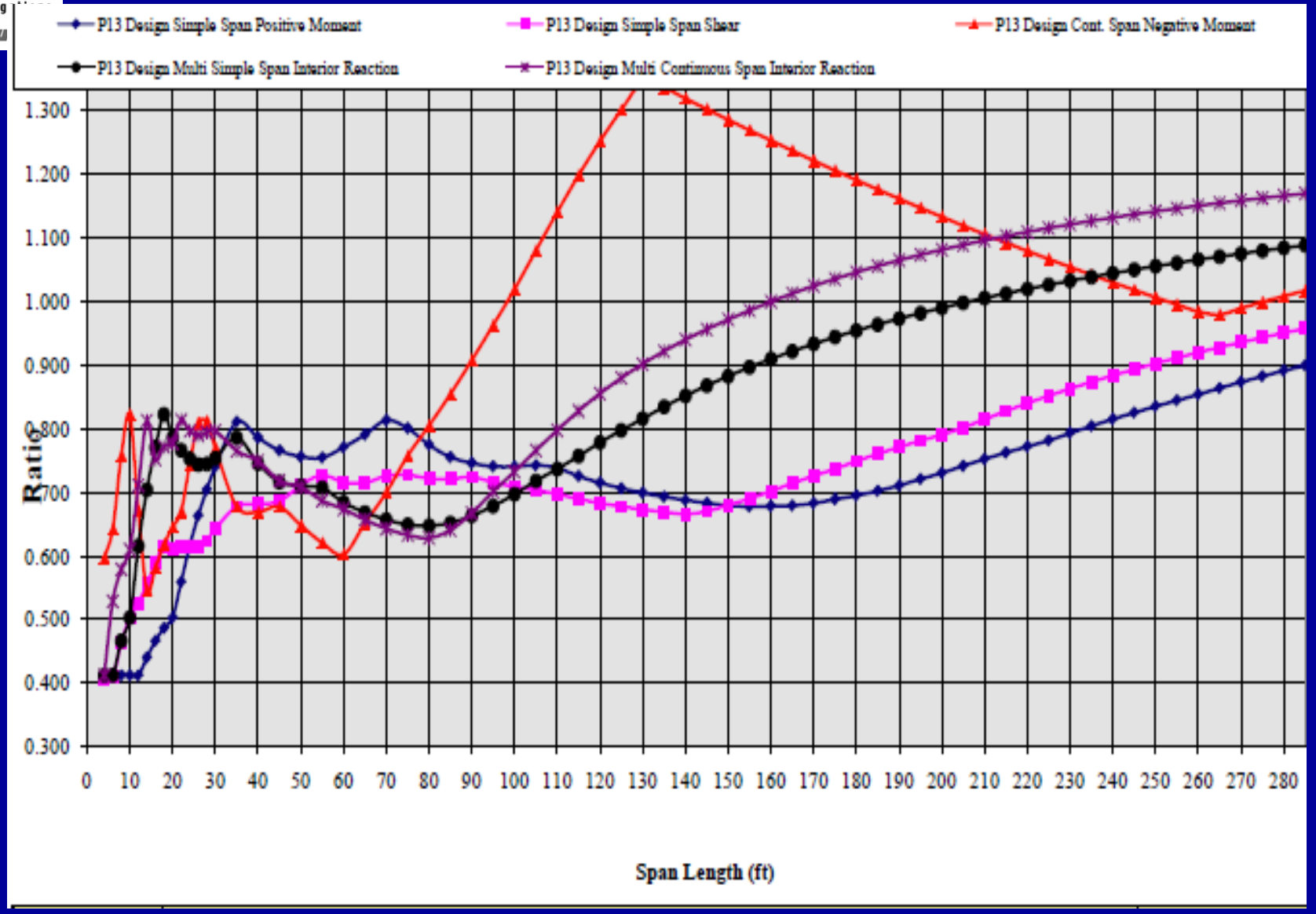
Variance or “Super load”

- Combinations > 135’ in length
- Combinations with 13 or more axles
- Vehicles with >9 axles and a “bridge” > 40’
- Double wide vehicles (13’ – 20’ +)
- Permit rating or weight chart is exceeded
- Specific structures req’d for review by SM&I


P13 Design Simple Span Positive Moment
P13 Design Simple Span Shear
P13 Design Cont. Span Negative Moment
P13 Design Multi Simple Span Interior Reaction
P13 Design Multi Continuous Span Interior Reaction
Ratio
1.050
1.000
0.950
0.900
0.850
0.800
0.750
0.700
0.650
0.600
0.550
0.500
0.450
0.400
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270
Span Length (ft)


P13 Design Simple Span Positive Moment
P13 Design Simple Span Shear
P13 Design Cont. Span Negative Moment
P13 Design Multi Simple Span Interior Reaction
P13 Design Multi Continuous Span Interior Reaction
1.300
1.200
1.100
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
Ratio
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280
Span Length (ft)

SM&I's variance process

- Review all bridges on the route and verify that the vehicle demands don't exceed bridge ratings.
- If demands are exceeded, dig a little deeper.
- Is controlling load action relevant to the span lengths and structure types?
- Speed restriction/truck location/CHP escort
- Can you detour via ramp?
- Special analysis may be required.

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Variance Examples - Endeavour

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Variance Examples - The Rock

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Questions? Thank You!

San Onofre Nuclear Generators move, 2011
Largest in CA history at 1.6 million pounds

Contact Information

Kevin I. Keady
Office of Structural Analysis and Design
Structure Maintenance and Investigations
Division of Maintenance
kevin.keady@dot.ca.gov
(916) 227-2446