# 17.1 DESIGN OF TEMPORARY BRIDGES FOR PERMIT VEHICLES

## 17.1.1 GENERAL

Pursuant to STP 17.1, this memo describes the minimum design permit vehicle used to satisfy the Strength II limit state for temporary bridges. Using this design permit vehicle for temporary bridges allows engineers to tailor the design for operational needs of the route.

## 17.1.2 DESIGN PERMIT VEHICLE

The design permit vehicle consists of a class of permit trucks varying from 5 to 15 axles that are used in load ratings. The axle configurations for this vehicle class have been reproduced from the Caltrans Structure Maintenance & Investigations *Bridge Load Rating Manual* in Figure 17.1.2-1. The trucks of the design permit vehicle are used to envelope the force effects from permit truck traffic permitted on the route.
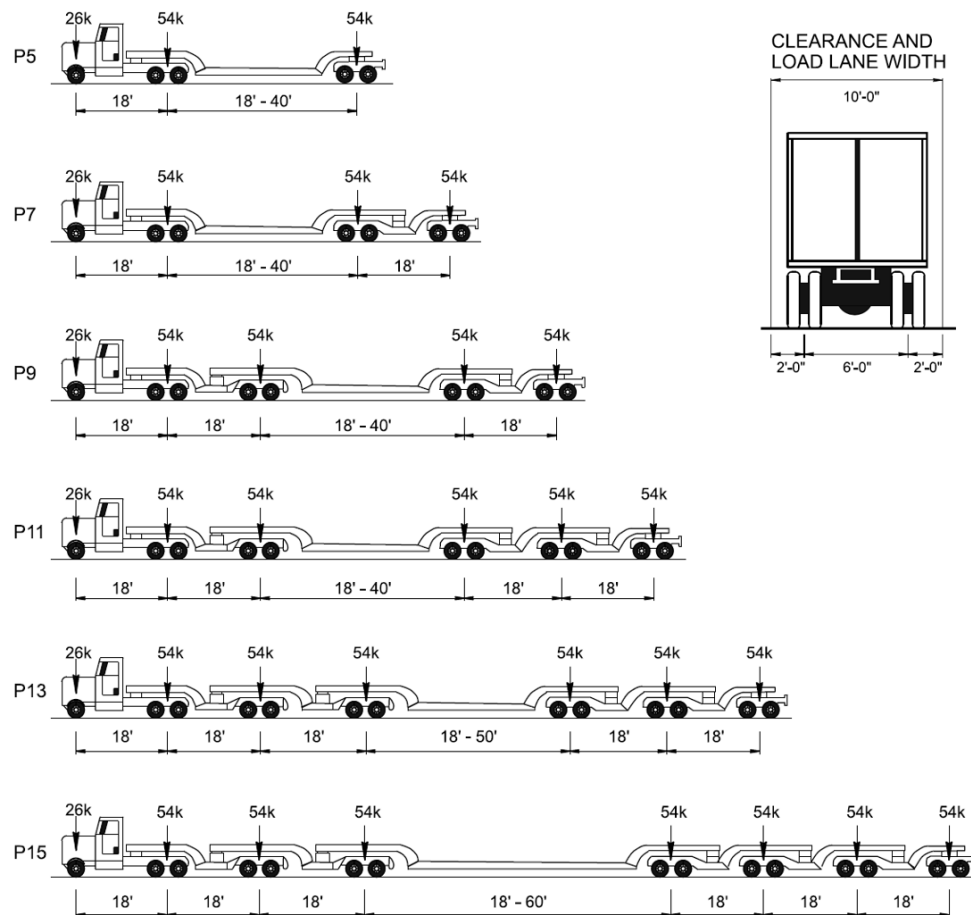


**Figure 17.1.2-1 California Permit Trucks and Axle Configurations**

## 17.1.2.1 Permit Rating

The permit trucks are evaluated on existing bridges to produce a set of load rating factors. Each permit truck is assigned a color code based on the value of the rating factor, as shown in Table 17.1.2.1-1. The combined set of color codes is known as a permit rating, with each position representing the load rating factor of a particular truck configuration, as shown in Table 17.1.2.1-2.

**Table 17.1.2.1-1 Permit Color Codes**

| Permit Color Coding | Rating Factor, RF, Range | Axle Reduction Factor, $\alpha$ |
|---|---|---|
| P (purple) | RF ≥ 1.00 | 1.00 |
| G (green) | 0.87 ≤ RF < 1.00 | 0.87 |
| O (orange) | 0.67 ≤ RF < 0.87 | 0.67 |
| X (no color) | RF < 0.67 | 0.00 |

**Table 17.1.2.1-2 Permit Rating**

| Color Code Position | 1st | 2nd | 3rd | 4th | 5th | 6th |
|---|---|---|---|---|---|---|
| Permit Truck Configuration | P5 | P7 | P9 | P11 | P13 | P15 |
| # of Axles | 5 | 7 | 9 | 11 | 13 | 15 |

The axle weights of the design permit vehicle trucks are calculated by applying the axle reduction factors, $\alpha$, obtained from the existing bridge permit rating to the axle weights of the corresponding truck configurations.

Instead of evaluating the entire class of permit trucks, conservatively, the force effects from the permit truck configuration with the greatest number of axles assigned a P, G, or O color code can be used along with the largest axle reduction factor of all the trucks from the permit rating.
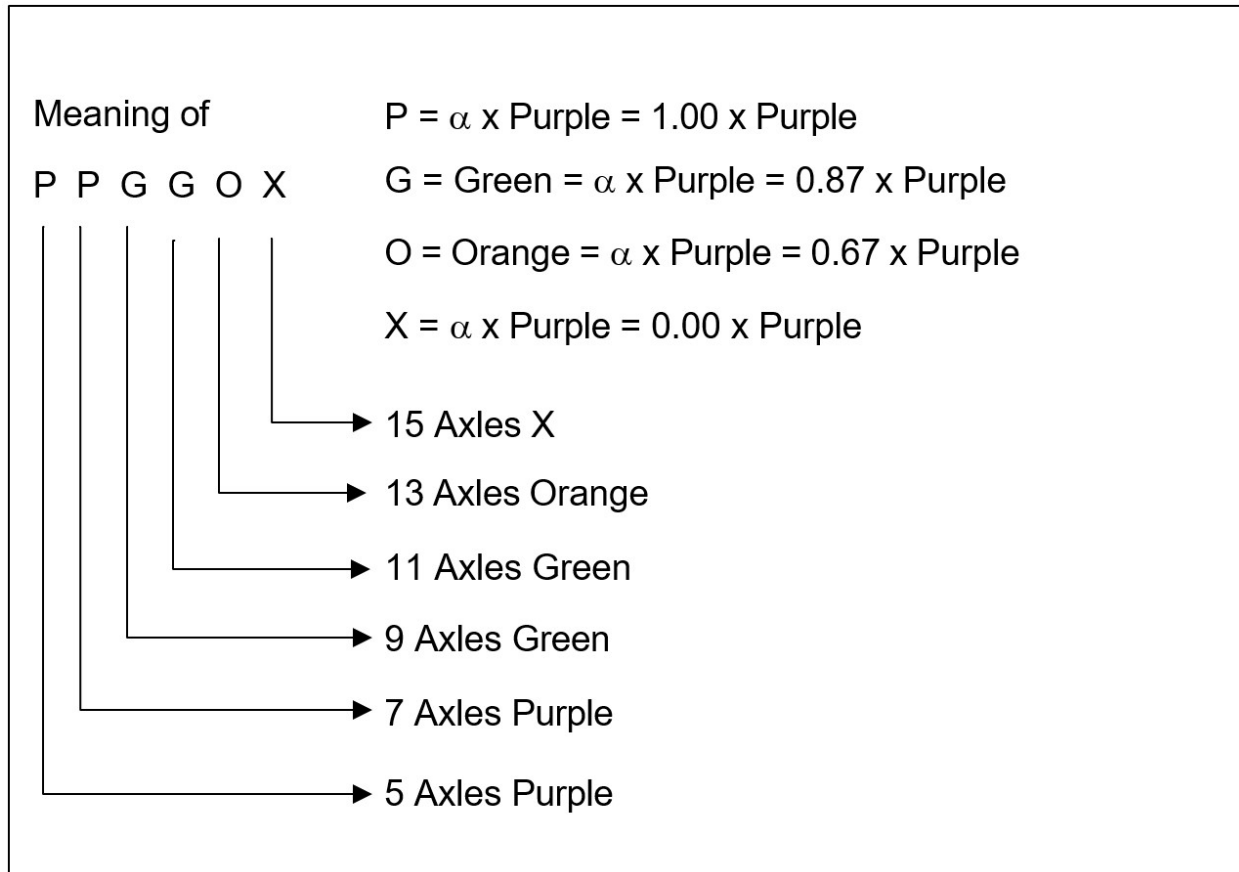
## 17.1.2.2 Example

**Given:**

Permit Rating:  PPGGOX

Meaning of

P  P  G  G  O  X

$P = \alpha \times Purple = 1.00 \times Purple$

$G = Green = \alpha \times Purple = 0.87 \times Purple$

$O = Orange = \alpha \times Purple = 0.67 \times Purple$

$X = \alpha \times Purple = 0.00 \times Purple$

→ 15 Axles X

→ 13 Axles Orange

→ 11 Axles Green

→ 9 Axles Green

→ 7 Axles Purple

→ 5 Axles Purple

**Figure 17.1.2.2-1 Permit Rating**

**Calculate:**

Axle weights for the permit trucks of the design permit vehicle

**1<sup>st</sup> Position:  P**PGGOX

Color Code:  P

Axle Reduction Factor, $\alpha$ = 1.00

Permit Truck Configuration:  P5

Front Axle Weight = $\alpha$ x front axle weight = 1.00 x 26 k = 26.0 k

Rear Axle Weight = $\alpha$ x rear axle weight = 1.00 x 54 k = 54.0 k

**2$^{nd}$ Position:** P**P**GGOX

Color Code:  P

Axle Reduction Factor, $\alpha$ = 1.00

Permit Truck Configuration:  P7

Front Axle Weight = $\alpha$ x front axle weight = 1.00 x 26 k = 26.0 k

Rear Axle Weight = $\alpha$ x rear axle weight = 1.00 x 54 k = 54.0 k

**3$^{rd}$ Position:** PP**G**GOX

Color Code:  G

Axle Reduction Factor, $\alpha$ = 0.87

Permit Truck Configuration:  P9

Front Axle Weight = $\alpha$ x front axle weight = 0.87 x 26 k = 22.6 k

Rear Axle Weight = $\alpha$ x rear axle weight = 0.87 x 54 k = 47.0 k

**4$^{th}$ Position:** PPG**G**OX

Color Code:  G

Axle Reduction Factor, $\alpha$ = 0.87

Permit Truck Configuration:  P11

Front Axle Weight = $\alpha$ x front axle weight = 0.87 x 26 k = 22.6 k

Rear Axle Weight = $\alpha$ x rear axle weight = 0.87 x 54 k = 47.0 k

**5$^{th}$ Position:** PPGG**O**X

Color Code:  O

Axle Reduction Factor, $\alpha$ = 0.67

Permit Truck Configuration:  P13

Front Axle Weight = $\alpha$ x front axle weight = 0.67 x 26 k = 17.4 k

Rear Axle Weight = $\alpha$ x rear axle weight = 0.67 x 54 k = 36.2 k

**6$^{th}$ Position:**  PPGGO**X**

Color Code:  X

Axle Reduction Factor, $\alpha$ = 0.00

Permit Truck Configuration:  P15

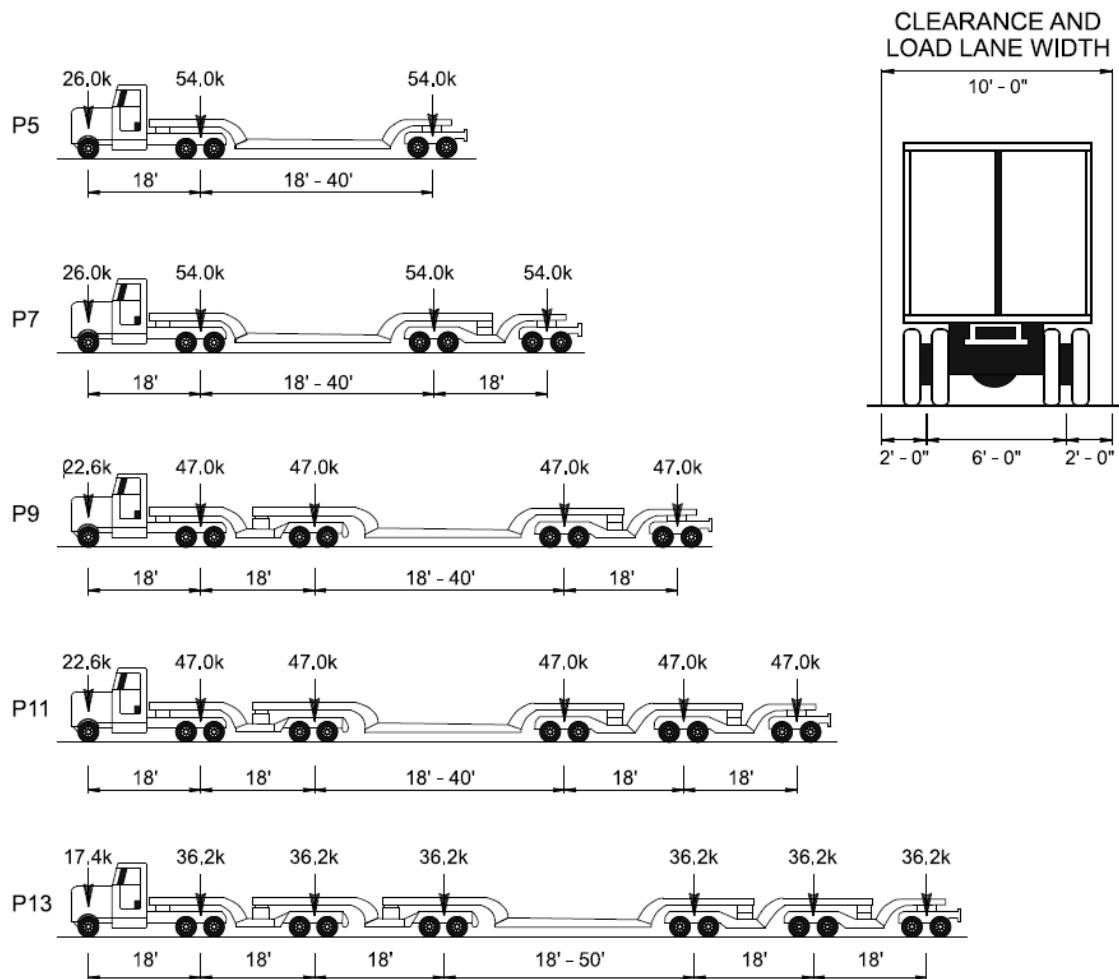The route need not consider design for the P15 truck



**Figure 17.1.2.2-2 Trucks Comprising the Design Permit Vehicle**

Figure 17.1.2.2-2 shows the resulting axle weight configurations of the trucks comprising the design permit vehicle. The force effects on the temporary bridge are determined for each truck, and when evaluating each individual permit truck, axles that do not contribute to the extreme force effect under consideration shall be neglected. The bridge is designed to satisfy the Strength II limit state using the overall demands enveloped by the trucks.

Conservatively, the force effects can be enveloped by the truck configuration with the most axles assigned a color code, which is the P13 permit truck. In this example, the P15 permit truck has an X designation and need not be considered. The axle weights should be multiplied by the largest axle reduction factor from the permit rating, $\alpha$ = 1.0 (obtained from the P5 and P7 trucks), producing the resulting truck axle weights:

Front Axle Weight = $\alpha$ x front axle weight = 1.00 x 26 k = 26.0 k

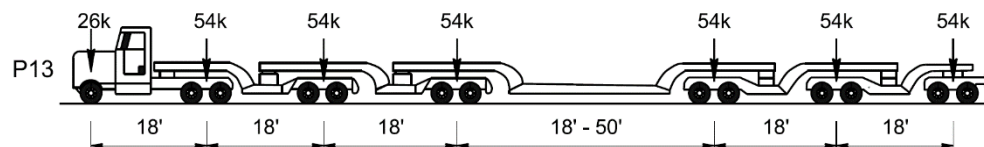Rear Axle Weight = $\alpha$ x rear axle weight = 1.00 x 54 k = 54.0 k



**Figure 17.1.2.2-3 P13 Permit Trucks**

Figure 17.1.2.2-3 shows a single P13 truck that can be evaluated instead of the permit trucks in Figure 17.1.2.2-2.

## 17.1.3 REFERENCES

1.      Caltrans (2022). *Structure Maintenance and Investigations Bridge Load Rating Manual*, 2nd Edition, California Department of Transportation, Sacramento, CA.