

Chapter **17**

Design of Rigid Highway Pavements

Portland Concrete Association Method (PCA)

| Soil Type | $k(\text{pci})$ |
|-----------------------|-----------------|
| Plastic clays | 50–100 |
| Silts and silty clays | 100–200 |
| Sands, clayey gravels | 200–300 |
| Gravels | 300+ |
| CTB or ATB | 400+ |

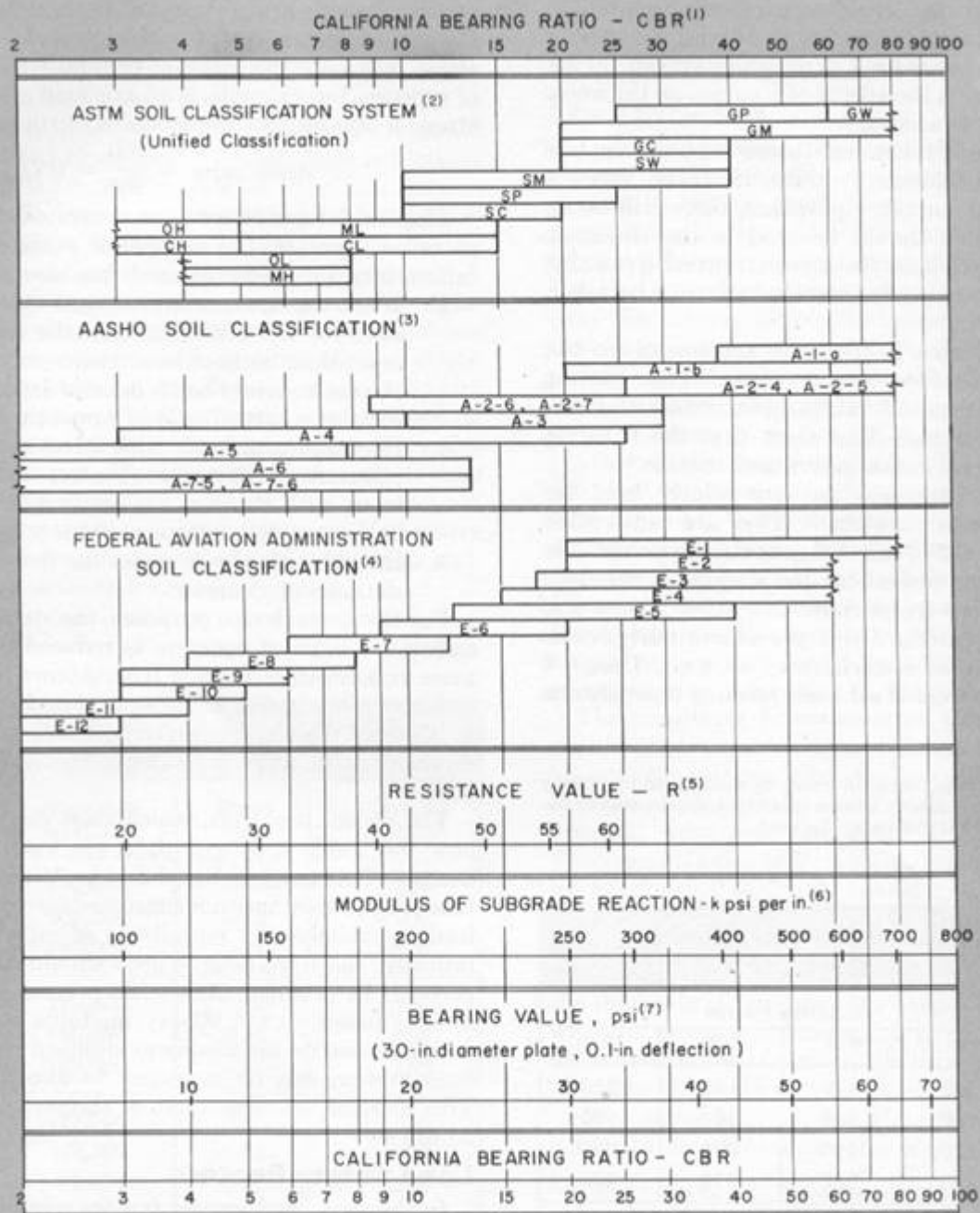


Fig. 3. Approximate interrelationships of soil classifications and bearing values.

Table 3. Stress Ratios and Allowable Load Repetitions

| Stress* ratio | Allowable repetition | Stress ratio | Allowable repetition |
|------------------|-------------------------|-----------------|-------------------------|
| 0.51** | 400,000 | 0.69 | 2,500 |
| 0.52 | 300,000 | 0.70 | 2,000 |
| 0.53 | 240,000 | 0.71 | 1,500 |
| 0.54 | 180,000 | 0.72 | 1,100 |
| 0.55 | 130,000 | 0.73 | 850 |
| 0.56 | 100,000 | 0.74 | 650 |
| 0.57 | 75,000 | 0.75 | 490 |
| 0.58 | 57,000 | 0.76 | 360 |
| 0.59 | 42,000 | 0.77 | 270 |
| 0.60 | 32,000 | 0.78 | 210 |
| 0.61 | 24,000 | 0.79 | 160 |
| 0.62 | 18,000 | 0.80 | 120 |
| 0.63 | 14,000 | 0.81 | 90 |
| 0.64 | 11,000 | 0.82 | 70 |
| 0.65 | 8,000 | 0.83 | 50 |
| 0.66 | 6,000 | 0.84 | 40 |
| 0.67 | 4,500 | 0.85 | 30 |
| 0.68 | 3,500 | | |

*Load stress divided by modulus of rupture.

**Unlimited repetitions for stress ratios of 0.50 or less.

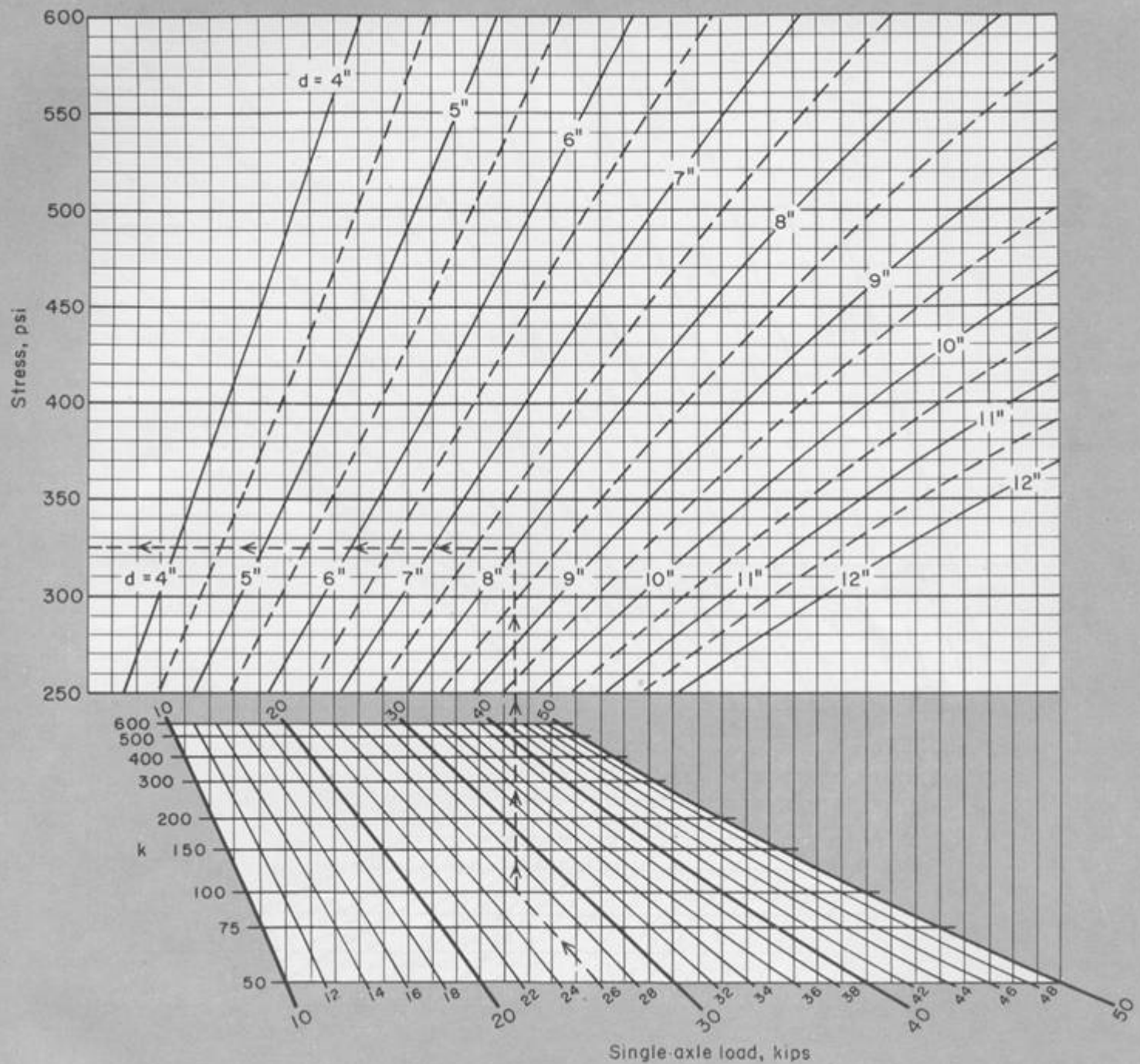


Fig. 6. Design chart for single-axle loads for Case I (based on Ref. 8, Influence Chart 6).

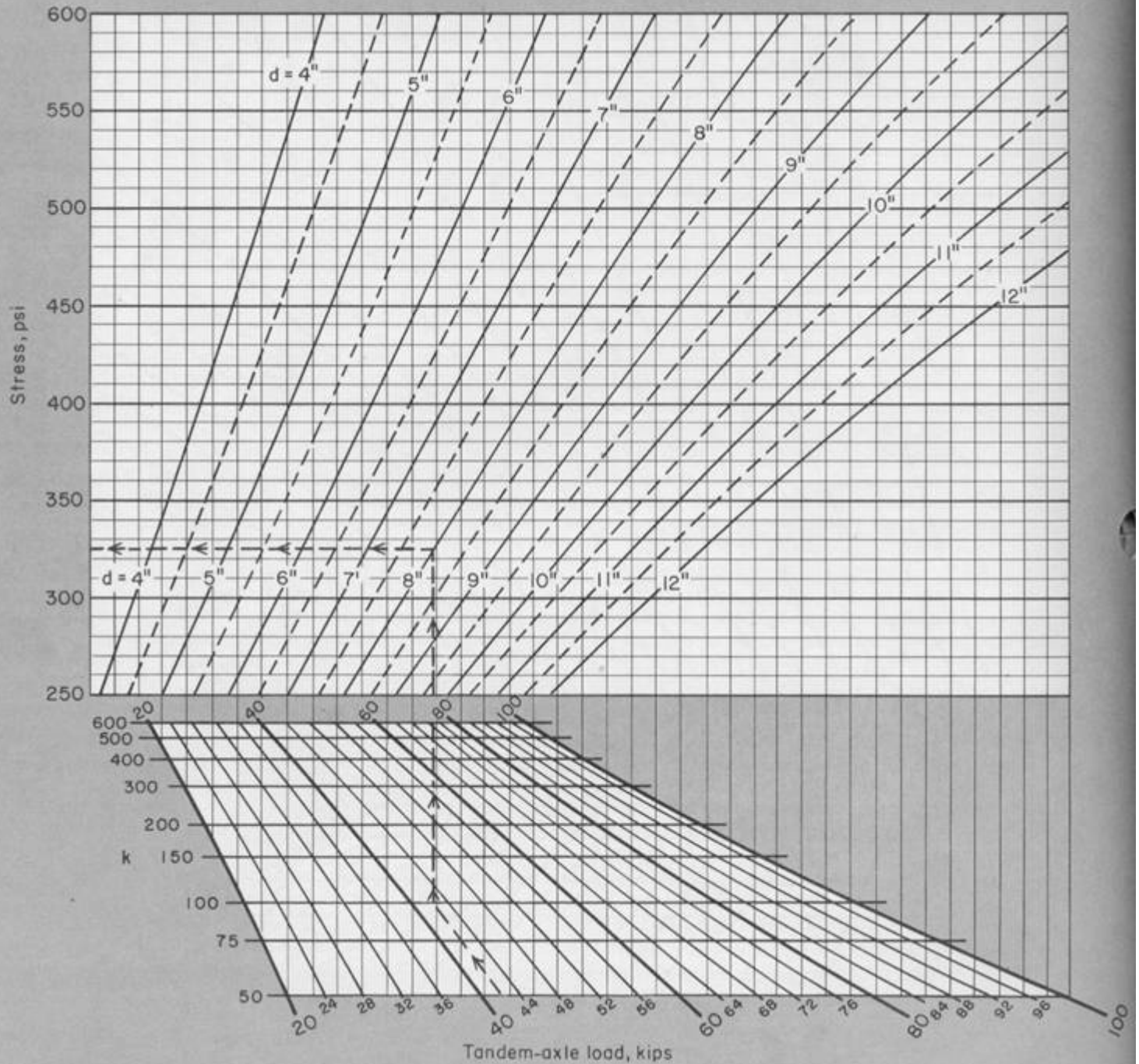


Fig. 7. Design chart for tandem-axle loads for Case I (based on Ref. 8, Influence Chart 6).

TABLE 17.2. Truck Axle Distribution

| Weight Group (in pounds) | No. Axles per 100 Trucks on the Road | |
|-----------------------------|--------------------------------------|--------------|
| | Single Axles | Tandem Axles |
| 14 | 8.0 | |
| 16 | 7.3 | |
| 18 | 6.1 | |
| 20 | 5.4 | |
| 22 | 3.2 | 5.2 |
| 24 | | 7.6 |
| 26 | | 8.4 |
| 28 | | 9.0 |
| 30 | | 11.2 |
| 32 | | 9.4 |
| 34 | | 1.8 |
| 36 | | 1.4 |
| 38 | | 0.9 |
| 40 | | 1.0 |
| 42 | | 0.1 |
| 44 | | 0.1 |
| 46 | | 0.1 |

Table 4. Yearly Rates of Traffic Growth and Corresponding Projection Factors (40-year design life)

| Yearly rate of traffic growth, percent | Projection factor at 20th year* | Average annual projection factor over 40-year period* |
|--|---------------------------------|---|
| 1 | 1.2 | 1.2 |
| 1½ | 1.3 | 1.3 |
| 2 | 1.5 | 1.5 |
| 2½ | 1.6 | 1.7 |
| 3 | 1.8 | 1.9 |
| 3½ | 2.0 | 2.2 |
| 4 | 2.2 | 2.5 |
| 4½ | 2.4 | 2.8 |
| 5 | 2.7 | 3.2 |
| 5½ | 2.9 | 3.6 |
| 6 | 3.2 | 4.1 |

*Based on compound interest table for $(1 + R)^n$ where R = yearly rate and n = number of years.

TABLE 17.4. Summary of Computations for Design of Concrete Pavement

(Modulus of Rupture = 650 psi)

F.S.

$t = 7 \text{ in.}, k = 150 \text{ pci}$

| ① | ② | ① × 1.2 | <i>Figures Tables</i> Stress (psi) | <i>= Stress / MR</i> Stress Ratio | Allow. Rep. | Percent Used |
|-----|--------|---------|--|---|----------------|-----------------|
| 45T | 876 | 54.0T | 435 | 0.67 | 4,500 | 19 |
| 43T | 876 | 51.6T | 415 | 0.64 | 11,000 | 8 |
| 41T | 876 | 49.2T | 410 | 0.63 | 14,000 | 6 |
| 39T | 8,760 | 46.8T | 390 | 0.60 | 32,000 | 27 |
| 37T | 7,884 | 44.4T | 375 | 0.58 | 57,000 | 14 |
| 35T | 12,250 | 42.0T | 350 | 0.54 | 180,000 | 7 |
| 33T | 15,800 | 39.6T | 325 | 0.50 | Unlimited | |
| 31T | 82,400 | 37.2T | 310 | 0.48 | Unlimited | |
| 21S | 28,100 | 25.2S | 350 | 0.54 | 180,000 | 15 |
| 19S | 47,400 | 22.8S | 325 | 0.50 | Unlimited | |
| 17S | 53,500 | 20.4S | 290 | 0.45 | Unlimited | |

Total fatigue used = 96%

^a (Number axles per 100 trucks) × (0.60) × (365) × (40).

