Design of Flexible and Rigid Pavements

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Foster and Ahlvin Influence Chart for Vertical Stresses

\[
\frac{\sigma_z}{p} \times 100\%
\]

\[
\frac{z}{a}
\]

Numbers on Curves Indicate \( r/a \)
Foster and Ahlvin Influence Chart for Vertical Deflections

Numbers on Curves Indicate $r/a$

$$w = \frac{qa}{E} \frac{1}{F}$$
Types of Axle Loads

- **Single axle load**: wheels with distance more than 1 m apart
- **Tandem axle load**: two or more consecutive axles between 1 m to 2.44 m spacing

**Problem**: Compute the ESAL of this truck on a flexible pavement with SN=4 and terminal PSI $p_t = 2.5$.

**Solution:**

ESAL load = $0.10 + 0.89 + 0.89$

= 1.88 ESAL per truck
Problem: Compute the ESAL of this truck on a rigid pavement with $D=9$ in. and terminal PSI $p_t = 2.5$.

Solution:
ESAL load = 0.08 + 1.49 + 1.49
= 3.06 ESAL per truck

Types of Axle Loads

- **Single axle load**: wheels with distance more than 1 m apart
- **Tandem axle load**: two or more consecutive axles between 1 m to 2.44 m spacing
UK Road Note 29

Step 3: Determining Thickness of Sub-base Layer

Minimum CBR value for sub-base 20 per cent (see para 29)

Below CBR 2 per cent add 150mm to thickness indicated for CBR 2 per cent (see para 27)

Minimum CBR value for sub-base 30 per cent (see para 29)

Minimum thickness 150 mm on soils of CBR less than 30 per cent (see para 30)

Minimum thickness 80 mm on soils of CBR less than 20 per cent (see para 30)
UK Road Note 29 Step 4: Rolled Asphalt Roadbase: Minimum Thickness of Surfacing and Roadbase

For details of surfacing materials see:

Table 4

Col 4

Col 3

Col 2

Col 1

Thickness of layer (mm)

Rolled asphalt roadbase

Surfacing: basecourse + wearing course

Cumulative number of standard axles (x 10^6)
UK Road Note 29 Dense Macadam Roadbase: Minimum Thickness of Surfacing and Roadbase

For details of surfacing materials see:

Table 4
Col 4

Table 4
Col 3

Table 4
Col 2

Table 4
Col 1

Thickness of layer (mm)

Cumulative number of standard axles ($10^6$)

Surfacing:
basecourse + wearing course

Dense macadam roadbase
UK Road Note 29 Lean Concrete, Soil-Cement and Cement-Bounded Granular Roadbase: Minimum Thickness of Surfacing & Roadbase

For details of surfacing materials see:

Table 4  Table 4  Table 4  Table 4
Col 4    Col 3    Col 2    Col 1

Lean concrete

Cement bound granular (see para 34)

Soil cement (see para 34)

Roadbase

Surfacing

*For traffic over 11 million standard axles, materials in excess of 100 mm may be bituminous roadbase material to form a composite roadbase, see para 35 and Table 4.
UK Road Note 29 Wet-Mix and Dry-Bound Macadam Roadbase: Minimum Thickness of Surfacing and Roadbase

For details of surfacing materials see:

| Table 4 | Table 4 | Table 4 | Table 4 |
| Col. 4  | Col. 3  | Col. 2  | Col. 1  |

Wet-mix and dry bound macadam roadbases

Surfacing

*For traffic over 11 million standard axles material in excess of 100 mm. may be bituminous roadbase material to form a composite roadbase see para. 35 and Table 4
AAHSTO Flexible Pavement Nomograph

Example:

\[ W_{18} = 5 \times 10^6 \]
\[ R = 95\% \]
\[ S_0 = 0.35 \]
\[ M_R = 5000 \text{ psi} \]
\[ \Delta PSI = 1.9 \]

Solution: SN = 5.0
UK Road Note 29: Thickness of Reinforced and Unreinforced Concrete Slabs

On very stable subgrades (CBR 15 per cent or more) reduce slab thickness by 25 mm
On weak subgrades (CBR 2 per cent or less) increase slab thickness by 25 mm

Alternative design for unreinforced concrete for use where construction traffic is likely to be heavy:
see para. 51

Normal subgrades (CBR between 2 and 15 per cent.)
UK Road Note 29: Weight of Reinforcement Fabric and Area of Steel per Unit Width of Pavement
UK Road Note 29: Joint Spacing for Jointed Reinforced Concrete Pavement

![Diagram showing joint spacing and weight of reinforcement relationship.](Image)
Estimating $k_{\infty}$ assuming semi-infinite subgrade depth
Correction of $k_\infty$ to account for presence of rigid foundation near surface

Example:

- $M_R = 4,000$ lb/in.$^2$
- $D_{SG} = 5$ ft
- $k_\infty = 230$ lb/in.$^3$

Solution: $k = 300$ lb/in.$^3$
Estimating Relative Damage $u$ using slab thickness and composite $k$ value
Correction of $k$ Value due to Loss of Support
H. Determine Slab Thickness

Use nomograph (p. 68-69) to determine required slab thickness

Example:
- $k = 72$ pci
- $E_c = 5 \times 10^6$ psi
- $S'_c = 650$ psi
- $J = 3.2$
- $C_d = 1.0$
- $s_0 = 0.29$
- $R = 95\%$ ($Z_R = -1.645$)
- $\Delta P_S I = 4.2 - 2.5 = 1.7$
- $W_{18} = 5.1 \times 10^6$ (18-kip ESAL)
- Solution: $D = 10.0$ inches (nearest half-inch, from segment 2)
AAHSTO Rigid Pavement Nomograph - II

Note: Application of reliability in this chart requires the use of mean values for all the input variables.