

08/17/2026

Wade Stevens
Fire Marshal
Plainfield Fire Territory
591 Moon Road
Plainfield, IN 46168

Mr. Stevens,

The purpose of this letter is to provide a design calculation verifying that the proposed 5" plain concrete pavement on 6-inch gravel layer roadway section is adequate for infrequent travel for a 75,000 lb design vehicle (Fire Truck). The design method used was the 1993 AASHTO pavement design manual. The attached package shows the design values and assumptions made. The proposed design exceeds the 2" minimum thickness calculated by this method as shown on the attached. Please note that less than 5" is not recommended for constructability purposes even though the design calculation suggests a 2" slab could support the fire truck. The calculations suggest that the concrete and gravel pavement section, if constructed according to generally accepted construction practices, will support the fire truck vehicle loading.

Sincerely,

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Assumptions Made: Design Vehicle: 75,000 lb

AASHTO Design Vehicle Equivalent: 3-Axles – Front Single Axle, Tandem rear Axles

Front gross axle weight rating of 21,000 lbs (28% total vehicle load)

Rear gross tandem axle weight rating of 27,000 lbs per rear axle each (72% of vehicle loading)

ESAL Calculation:

	$ESAL = \left(\frac{W}{18,000} \right)^4$
Calculation	
Front axle:	$\left(\frac{21,000}{18,000} \right)^4 = 1.86$
Each rear axle:	$\left(\frac{27,000}{18,000} \right)^4 = 5.06$
Two rear axles:	$2(5.06) = 10.13$
Total	$ESAL = 1.86 + 10.13 = 11.99$

ESALs = 12 per pass. Assume 1 pass per month for 25 years design life = 12 x 12 x 25 = 3600 total ESALs over the design life of the rigid pavement.

AASHTO 93 Design Method for Rigid Pavement:

Variable Assumptions:

1. Reliability (%) = 50 (Local)

Table 1. Suggested Levels of Reliability for Various Functional Classifications (from AASHTO, 1993^[1])

Functional Classification	Recommended Level of Reliability	
	Urban	Rural
Interstate and Other Freeways	85 - 99.9	80 - 99.9
Principal Arterials	80 - 99	75 - 95
Collectors	80 - 95	75 - 95
Local	50 - 80	50 - 80

Typical values of S_o used are 0.40 to 0.50 for flexible pavements and 0.35 to 0.40 for rigid pavements. 0.4 was used for this calculation.

2. Serviceability

- Initial Serviceability = 4.5 (typical for new pavement)
- Terminal Serviceability = 3 (Typical for pre-failed pavement)

3. Portland Cement Concrete Pavement (PCCP) Parameters:

- Elastic Modulus (E_c) in psi = 3,600,000 (typical value for 4,000 psi Portland Cement Concrete)
- Modulus of Rupture (S'_c) in psi = 700 (Typical value for 4000 psi concrete)

4. Other Design Parameters

- Drainage Factor = 1 (typical value for normal drainage)
- Load Transfer Coefficient (J) = 3.8 (typical factor for plain concrete with no dowel bars)
- Modulus of Subgrade Reaction (k) in pci = 200 (50-600 is typical where 50 is poor support and 200 is modest support) Assume modest for this example.

$$\log(W_{18}) = Z_R \times S_o + 7.35 \log(D + 1) - 0.06 + \frac{\log\left(\frac{\Delta PSI}{4.2 - 1.5}\right)}{1 + \frac{1.624 \times 10^7}{(D + 1)^{8.46}}} + (4.22 - 0.32 p_t) \log \left[\frac{S'_c \times C_d (D^{0.75} - 1.132)}{215.63 \times J \left[D^{0.75} - \frac{18.42}{(E_c/k)^{0.25}} \right]} \right]$$

Figure 1. AASHTO 93 Empirical Equation for Rigid Pavement Design

1993 AASHTO Empirical Equation for Rigid Pavements

Equation Solver

Variable Descriptions and Typical Values

Precautions

Type in data in the grey boxes and click the calculate button to see the output. To make additional calculations, change the desired input data and click the calculate button again. Click on the text descriptions of the input or output variables for more information.

INPUT

1. Loading

Total Design ESALs (W_{18}):

2. Reliability

Reliability Level in percent (R): ▾

Combined Standard Error (S_0):

3. Servicability

Initial Servicability Index (p_i):

Terminal Servicability Index (p_t):

4. Portland Cement Concrete Parameters

Elastic Modulus (E_c) in psi:

Modulus of Rupture (S'_c) in psi:

5. Other Design Parameters

Drainage Factor (C_d):

Load Transfer Coefficient (J):

Mod. of Subgrade Reaction (k) in pci:

OUTPUT

1. Calculation Parameters

Standard Normal Deviate (z_R):

ΔPSI :

Calculated Slab Thickness (inches):

2. Slab Thickness (to the nearest 1/2 inch)

Design Slab Thickness (inches):

Comments



Calculate

Figure 2. Rigid Pavement Calculator Results using the formula from Figure 1