

Flexible Pavement Design Example Page 1	402-1 July 2025
	Reference Section 402

Given:

- Number of Lanes: 4 (2 per direction)
- Functional Classification: Principal Arterial (Rural)
- 2018 Traffic: 15,800 ADT
- 2038 Traffic: 22,450 ADT
- 24 hour truck %: 18%
- Design Period: 20 years
- Open to Traffic: 2019
- Subgrade CBR: 5 (from Subgrade Analysis)

Problem: Solve for the Structural Number and determine an acceptable flexible buildup

Solution:

Step 1 - Determine the 18 Kip Equivalent Single Axle Loading (ESAL)

Since the project is expected to open to traffic in 2019, the ESAL projection should be for 2019 to 2039. Calculate the mid-year (2029) ADT, rounded to the nearest ten:

$$2029 \text{ ADT} = 15,800 + (22,450 - 15,800)(11/20)$$

$$2029 \text{ ADT} = 19,460$$

Directional distribution, D = 50% (Figure 202-1)
Lane factor = 95% (Figure 202-1)
B:C ratio = 5:1 (Figure 202-1)
ESAL conversion factor for B trucks = 1.06 (Figure 202-1)
ESAL conversion factor for C trucks = 0.33 (Figure 202-1)

Using the equations given in Section 202.2:

$$\text{ESAL's from B trucks} = 19,460(0.18)(0.50)(0.95)(5/6)(1.06) = 1470$$

$$\text{ESAL's from C trucks} = 19,460(0.18)(0.50)(0.95)(1/6)(0.33) = 92$$

$$\text{Total daily ESAL's} = 1470 + 92 = 1562 \text{ ESAL/day}$$

$$\text{Design period ESAL's} = 1562 \text{ ESAL/day} * 365.25 \text{ days/yr.} * 20 \text{ years} = 11,410,410$$

use 11.4×10^6 ESAL

Step 2 - Determine the subgrade resilient modulus (M_r) using the formula given in Section 203.1.

$$M_r = 1200 * \text{CBR}$$

$$M_r = 1200 * 5$$

$$M_r = 6000 \text{ psi}$$

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Step 3 - Determine the design structural number (SN) using Figures 402-2 and 402-3. In Figure 402-2, solve for the match line number using the following information:

Reliability = 85% (Figure 201-1)

Overall Standard Deviation = 0.49 (Figure 201-1)

18-kip Single Axle Loads = 11.4×10^6 ESAL (Step 1)

Subgrade Resilient Modulus = 6,000 psi (Step 2)

The resulting match line number is then used in Figure 402-3, along with the design serviceability loss of 2.0 (Figure 201-1), to solve for the design structural number (SN).

Therefore: design structural number (SN) = 5.07

Step 4 - Design the typical section using the layer coefficients found in Figure 401-1. The structural number of each layer is determined by multiplying the thickness times the coefficient. The total structural number for the pavement buildup must equal or exceed the design structural number (SN) = 5.07 (Step 3).

Check the number of trucks in the opening day traffic.

2019 ADTT = $(15,800 + (22,450 - 15,800)(1/20)) \times 0.18$

2019 ADTT = 2900

Since the opening day truck traffic is greater than 1500, Item 442 Asphalt Concrete Surface Course, 12.5mm is required.

The following buildup is the recommended solution in accordance with the guidance in Section 406.

Material	Thickness	Coefficient	SN
442 AC Surface Course, 12.5mm, Type A (447)	1.5"	0.43	0.65
442 AC Intermediate Course, 12.5mm, Type A (446)	1.75"	0.43	0.75
302 Asphalt Concrete Base, PG64-22, (449)	8"	0.36	2.88
304 Aggregate Base	6"	0.14	0.84
Total SN =			5.12

Since the total SN equal to 5.12 of the proposed buildup is greater than the required SN of 5.07, the design is acceptable.