Project Name: REBUS STUDIO SHPK

Design #:

Date:

4 | SUBGRADE

Evaluation of Annual-equivalent Subgrade Strength according to Seasonal Relative Damage.

Subgrade Description:

Modulus-CBR Correlation $M_R = 17.6\ (CBR)^{0.64}$

Table 1 - Seasonal Subgrade Strength

Subgrade Strength	CBR [%]	M_R [MPa]	Duration [months]	Relative Damage
Minimum:	4.0	42.7	6.0	0.1878
Maximum:	8.0	66.6	6.0	0.0671

Where:

Relative Damage for Minimum Subgrade Strength: $u_f^{min} = 1.18 \times 10^8\ (M_{R\ (psi)}^{min})^{-2.32}$

Relative Damage for Maximum Subgrade Strength: $u_f^{max} = 1.18 \times 10^8\ (M_{R\ (psi)}^{max})^{-2.32}$

Average Relative Damage: $u_{avg} =$ 0.1275

Annual-equivalent Subgrade Resilient Modulus: $M_R = \left[\frac{u_f^{avg}}{(1.18 \times 10^8)}\right]^{-1/2.32}$ = 50.5 MPa

Annual-equivalent Subgrade CBR: CBR = 5.2 %

Road Designer

Project Name: REBUS STUDIO SHPK

Design #:

Date:

5 | TRAFFIC

The number of 18-kip (W_{18}) Equivalent Single Axle Loads (ESAL's) applications is used to define the number of the equivalent traffics based on standard truck axle loads (AASHTO 1993).

Road Design Life: 15.0 [years]

Tire Pressure: 550 [kPa]

Input W_{18}: 41,169

Project Name: REBUS STUDIO SHPK

Design #:

Date:

6 | UNREINFORCED PAVEMENT

6.1 Pavement Configuration

Table 6.1- Unreinforced Pavement Configuration

Layer		Poisson's Ratio	Modulus	Thickness	Cost
No.	Description		[MPa]	[mm]	[$/m^2]
1	Asphalt Concere	0.40	3,000.0	30	
2	Asphalt Concere Binder	0.40	2,800.0	50	
3	High-quality Granular Base	0.35	550.0	150	
4	Crushed Stone	0.30	155.0	400	
5	Subgrade:	0.45	50.5	Semi-inf.	-

6.2 Equivalent HMA Modulus

No. of Asphalt Layers: 2

$E_{ACeq}^{(un)}$ = 2,874 MPa

6.3 Fatigue Failure Criteria

Examination of the Fatigue Failure Criteria according to the horizontal tensile strain at the bottom of the Asphalt layer (ε_t) and the elastic modulus of the Asphalt. One commonly accepted criterion developed by Finn et al. (1977) is:

$$\log W_{18}^{Fatigue} = 15.947 - 3.29 \log (\varepsilon_t/10^{-6}) - 0.854 \log (E_{AC}/10^3)$$

Where:

E_{AC} = elastic modulus of the Asphalt [psi]

ε_t = horizontal tensile strain at the bottom of the Asphalt layer

Input Strain according to Layered Elastic Model: **ε_t = 2.670E-04**

$W_{18}^{Fatigue}$ = number of W_{18} cycles to Fatigue Failure (10% cracking of wheelpath area)

$W_{18}^{Fatigue}$ = 530,000

6.4 Rutting Failure Criteria

Examination of the Rutting Failure Criteria according to the vertical compressive strain (ε_v) at the top of the subgrade layer:

$$W_{18}^{Rutting} = 1.077 \times 10^{18} (10^{-6}/\varepsilon_C)^{4.4843}$$

Where:

ε_C = vertical compressive strain at the top of the subgrade layer

Input Strain according to Layered Elastic Model: **ε_C = 2.720E-04**

$W_{18}^{Rutting}$ = number of W_{18} cycles to 12.5mm Rutting Failure

$W_{18}^{Rutting}$ = 13,030,000

6.5 Deflection Failure Criteria

Examination of the Surface Deflection Failure Criteria according to AASHO Road Test (Highway Research Board, 1962b):

$$\log W_{18}^{Deflection} = 11.06 - 3.25 \log (D_0 \times 10^3)$$

Where:

D_0 = Surface Deflection [in.]

Input Deflection according to Layered Elastic Model: **D_0 = 1.614E-02 in. = 4.100E-01 mm**

$W_{18}^{Deflection}$ = number of W_{18} cycles to Deflection Failure (2.5 terminal servisiability)

$W_{18}^{Deflection}$ = 13,620,000

6.6 Unreinforced Pavement Performance

Design Pavement Performance according to minimum W_{18} Failure Criteria:

W_{18}^{UN} = Min ($W_{18}^{Fatigue}$, $W_{18}^{Rutting}$, $W_{18}^{Deflection}$) = 530,000

6.7 Unreinforced Design Examination

Design W_{18}		Predicted W_{18}	
(design performance)		(required)	
530,000	≥	41,169	***OK !***