fake_vancleave

File Name: C:\Rao\MERRA_Runs\fake_vancleave.dgpx

Design Inputs

Design Life: 20 years
Design Type: FLEXIBLE

Base construction: May, 2021
Pavement construction: June, 2022
Traffic opening: September, 2022

Climate Data Sources (Lat/Lon) 30.5, -88.75

Design Structure

Layer type	Material Type	Thickness (in)
Flexible	Default asphalt concrete	2.0
Flexible	Default asphalt concrete	3.0
Flexible	Default asphalt concrete	6.0
NonStabilized	Crushed stone	12.0
Subgrade	A-7-6	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	13.3
Air voids (%)	7.0

Traffic

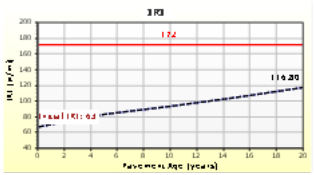
Age (year)	Heavy Trucks (cumulative)
2022 (initial)	3,000
2032 (10 years)	5,699,120
2042 (20 years)	12,646,300

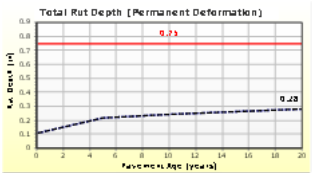
Design Outputs

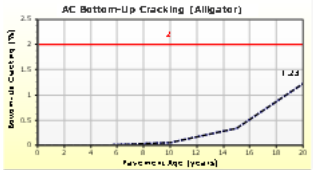
Distress Prediction Summary

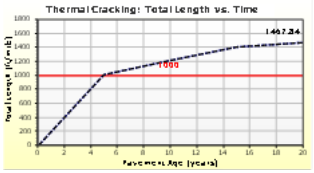
Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	172.00	116.82	50.00	95.52	Pass
Permanent deformation - total pavement (in)	0.75	0.28	50.00	100.00	Pass
AC bottom-up fatigue cracking (% lane area)	2.00	1.23	50.00	71.75	Pass
AC thermal cracking (ft/mile)	1000.00	1467.84	50.00	24.99	Fail
AC top-down fatigue cracking (ft/mile)	2000.00	0.00	50.00	100.00	Pass
Permanent deformation - AC only (in)	0.25	0.06	50.00	100.00	Pass

Distress Charts





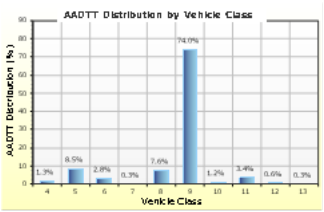


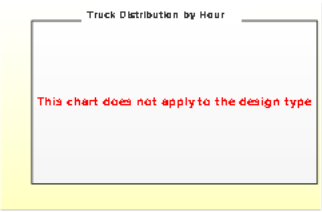


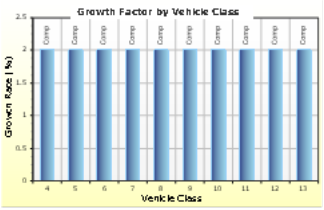
Traffic Inputs

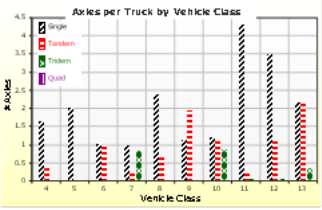
Graphical Representation of Traffic Inputs

Initial two-way AADTT:	3,000	Percent of trucks in design direction (%):	50.0
Number of lanes in design direction:	2	Percent of trucks in design lane (%):	95.0
		Operational speed (mph)	60.0









Traffic Volume Monthly Adjustment Factors

Tabular Representation of Traffic Inputs

Volume Monthly Adjustment Factors

Level 3: Default MAF

Month	Vehicle Class									
	4	5	6	7	8	9	10	11	12	13
January	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
February	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
March	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
April	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
May	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
June	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
July	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
August	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
September	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
October	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
November	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
December	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Distributions by Vehicle Class

Truck Distribution by Hour does not apply

Vehicle Class	AADTT Distribution (%) (Level 3)	Growth Factor	
		Rate (%)	Function
Class 4	1.3%	2%	Compound
Class 5	8.5%	2%	Compound
Class 6	2.8%	2%	Compound
Class 7	0.3%	2%	Compound
Class 8	7.6%	2%	Compound
Class 9	74%	2%	Compound
Class 10	1.2%	2%	Compound
Class 11	3.4%	2%	Compound
Class 12	0.6%	2%	Compound
Class 13	0.3%	2%	Compound

Axle Configuration

Traffic Wander	
Mean wheel location (in)	18.0
Traffic wander standard deviation (in)	10.0
Design lane width (ft)	12.0

Axle Configuration	
Average axle width (ft)	8.5
Dual tire spacing (in)	12.0
Tire pressure (psi)	120.0

Average Axle Spacing	
Tandem axle spacing (in)	51.6
Tridem axle spacing (in)	49.2
Quad axle spacing (in)	49.2

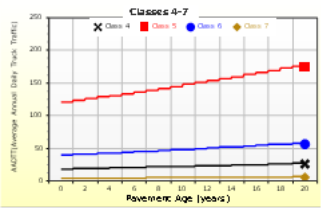
Wheelbase does not apply

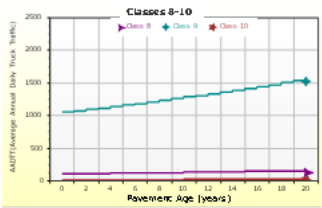
Number of Axles per Truck

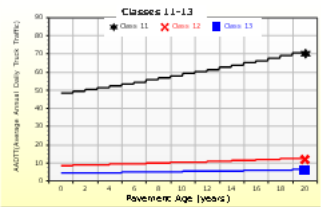
Vehicle Class	Single Axle	Tandem Axle	Tridem Axle	Quad Axle
Class 4	1.62	0.39	0	0
Class 5	2	0	0	0
Class 6	1.02	0.99	0	0
Class 7	1	0.26	0.83	0
Class 8	2.38	0.67	0	0
Class 9	1.13	1.93	0	0
Class 10	1.19	1.09	0.89	0
Class 11	4.29	0.26	0.06	0
Class 12	3.52	1.14	0.06	0
Class 13	2.15	2.13	0.35	0

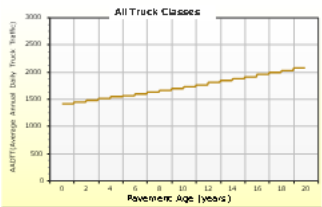
AADTT (Average Annual Daily Truck Traffic) Growth

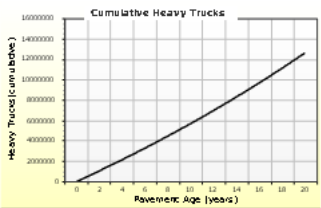
*** Traffic cap is not enforced**







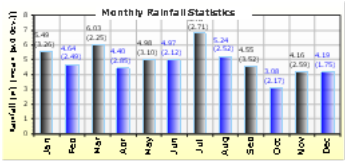




Climate Inputs

Climate Data Sources:

Climate Station Cities:	Location (lat lon elevation(ft))
US, MS	30.50000 -88.75000 43

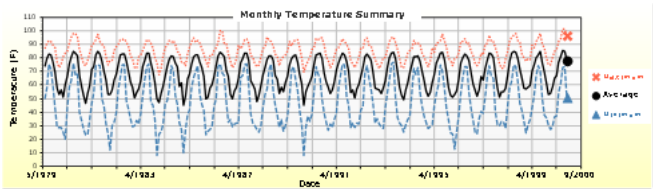


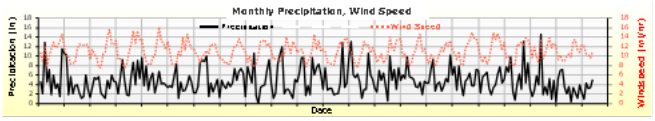
Annual Statistics:

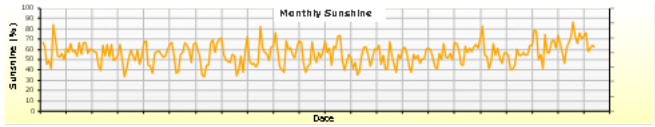
Mean annual air temperature (ºF)	68.49
Mean annual precipitation (in)	58.59
Freezing index (ºF - days)	6.61
Average annual number of freeze/thaw cycles:	10.92

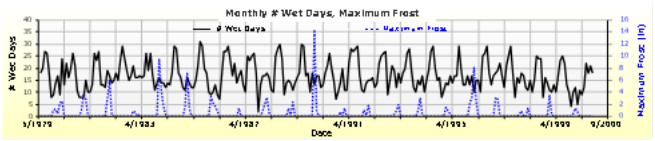
Water table depth (ft)	10.00

Monthly Climate Summary:

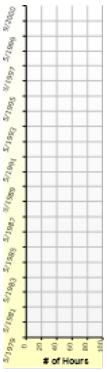
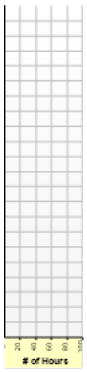
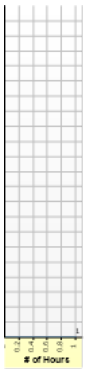
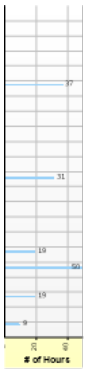
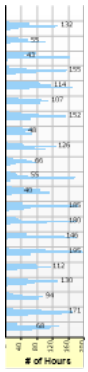
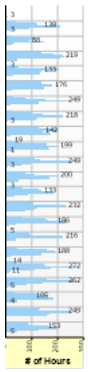


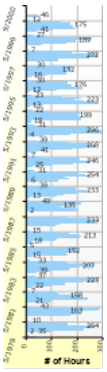
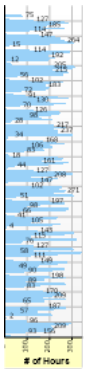
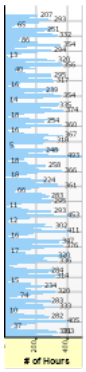
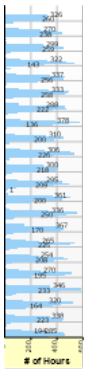
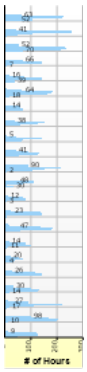
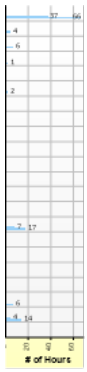
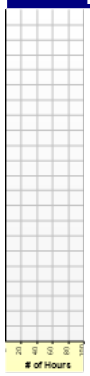
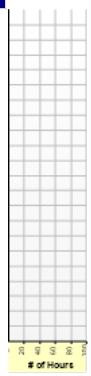






Hourly Air Temperature Distribution by Month:

< -13° F	-13° F to -4° F	-4° F to 5° F	5° F to 14° F	14° F to 23° F	23° F to 32° F	32° F to 41° F	41° F to 50° F
							

50° F to 59° F	59° F to 68° F	68° F to 77° F	77° F to 86° F	86° F to 95° F	95° F to 104° F	104° F to 113° F	> 113° F
							

Design Properties

HMA Design Properties

Use Multilayer Rutting Model	False
Using G* based model (not nationally calibrated)	False
Is NCHRP 1-37A HMA Rutting Model Coefficients	True
Endurance Limit	-
Use Reflective Cracking	True

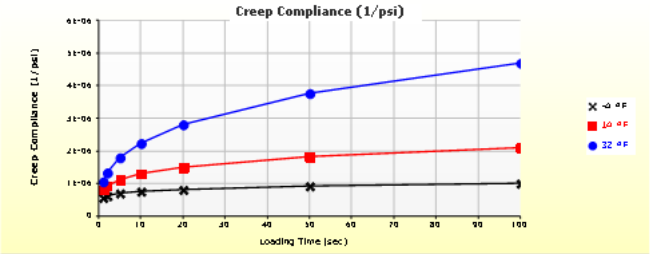
Structure - ICM Properties	
AC surface shortwave absorptivity	0.85

Layer Name	Layer Type	Interface Friction
Layer 1 Flexible : Default asphalt concrete	Flexible (1)	1.00
Layer 2 Flexible : Default asphalt concrete	Flexible (1)	1.00
Layer 3 Flexible : Default asphalt concrete	Flexible (1)	1.00
Layer 4 Non-stabilized Base : Crushed stone	Non-stabilized Base (4)	1.00
Layer 5 Subgrade : A-7-6	Subgrade (5)	-

Thermal Cracking

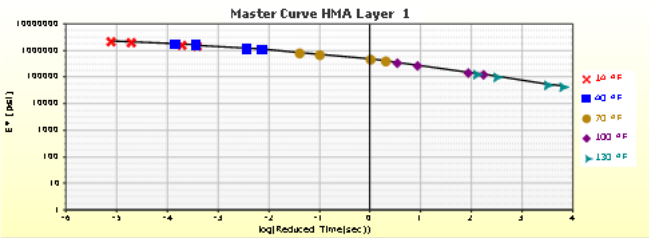
Thermal Contraction	
Is thermal contraction calculated?	True
Mix coefficient of thermal contraction (in/in/ºF)	-
Aggregate coefficient of thermal contraction (in/in/ºF)	5.0e-006
Voids in Mineral Aggregate (%)	20.3

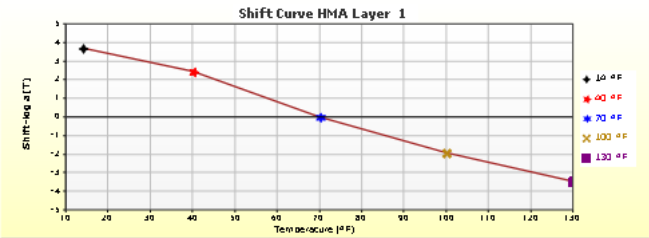
Indirect Tensile Strength (Input Level: 3)	
Test Temperature (ºF)	**Indirect Tensilte Strength (psi)**
14.0	322.23

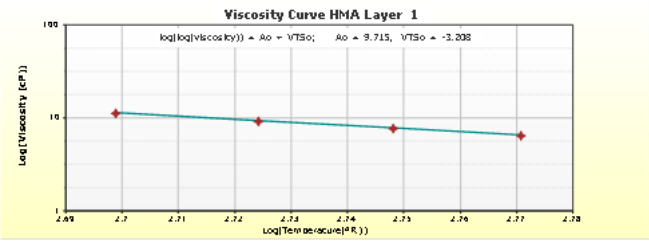


Creep Compliance (1/psi) (Input Level: 3)			
Loading time (sec)	**-4 ºF**	**14 ºF**	**32 ºF**
1	5.85e-007	8.21e-007	1.08e-006
2	6.35e-007	9.47e-007	1.35e-006
5	7.09e-007	1.14e-006	1.81e-006
10	7.71e-007	1.32e-006	2.26e-006
20	8.38e-007	1.52e-006	2.82e-006
50	9.35e-007	1.84e-006	3.77e-006
100	1.02e-006	2.12e-006	4.71e-006

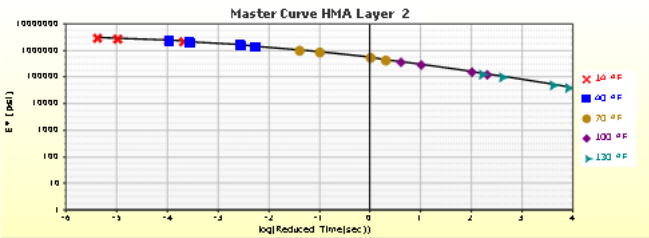
HMA Layer 1: Layer 1 Flexible : Default asphalt concrete

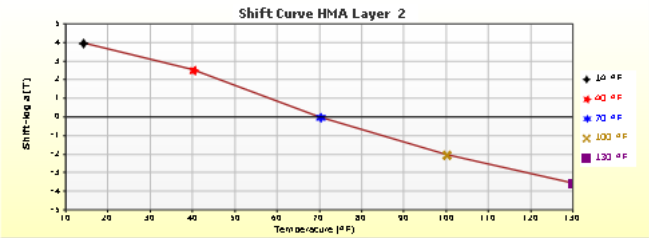


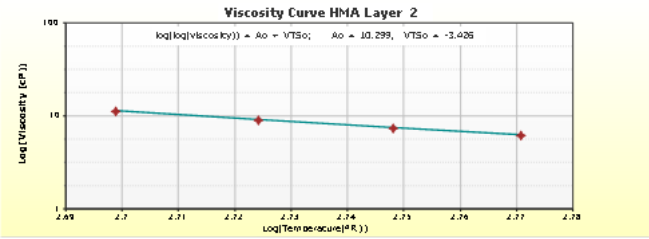




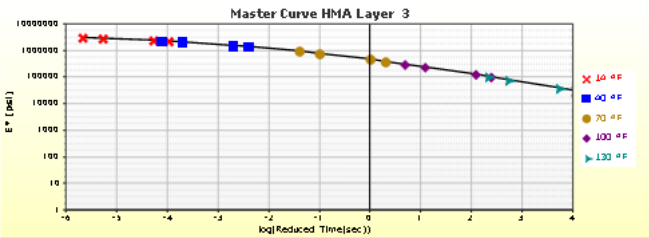
HMA Layer 2: Layer 2 Flexible : Default asphalt concrete

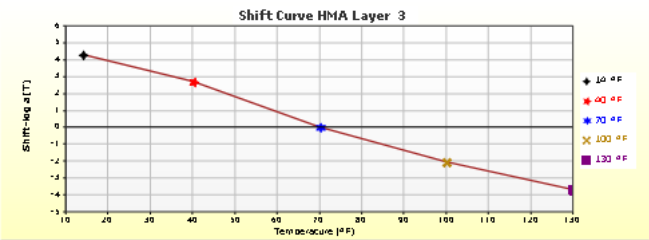


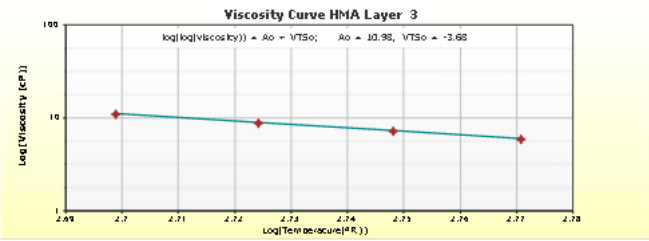




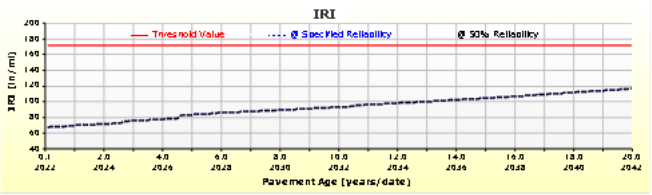
HMA Layer 3: Layer 3 Flexible : Default asphalt concrete

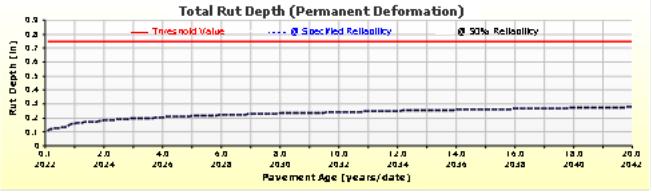


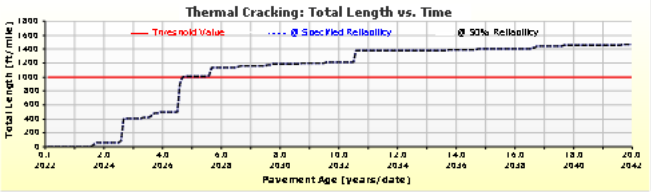


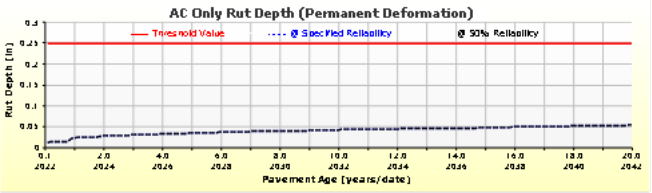


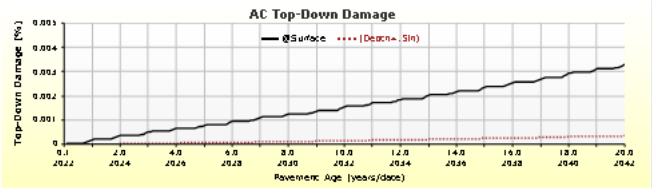
Analysis Output Charts

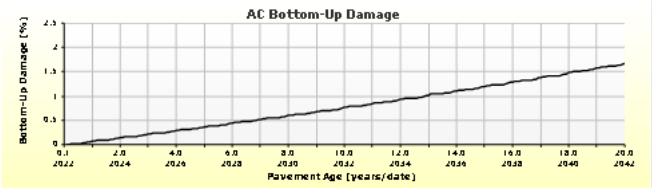


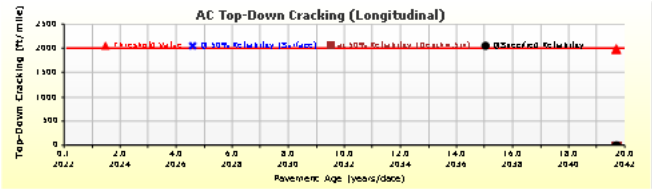


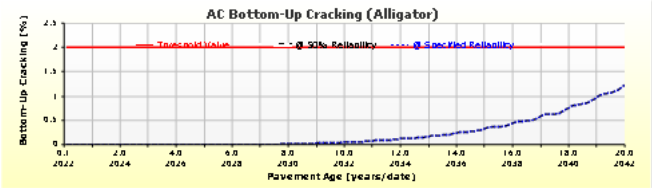


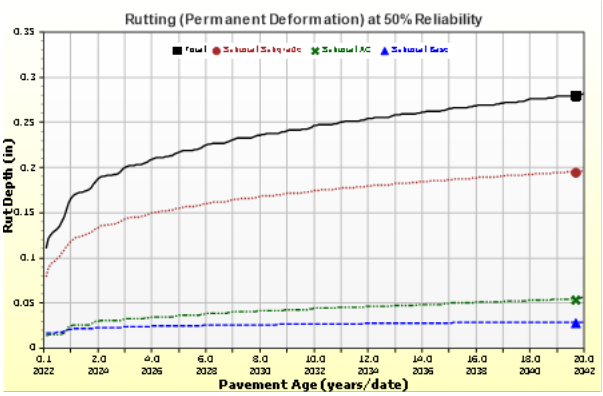


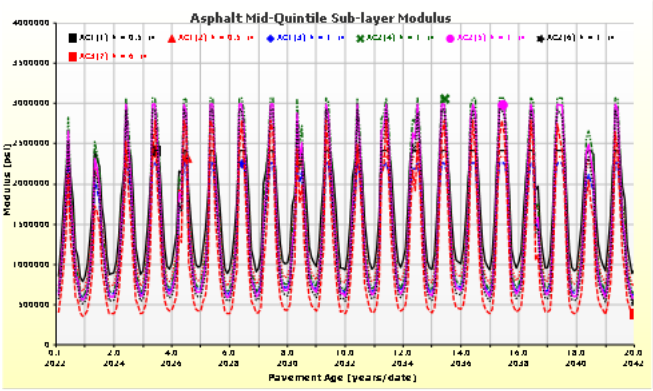

AC Top-Down Damage
@Surface
Top-Down Damage (%)
Pavement Age (years/date)

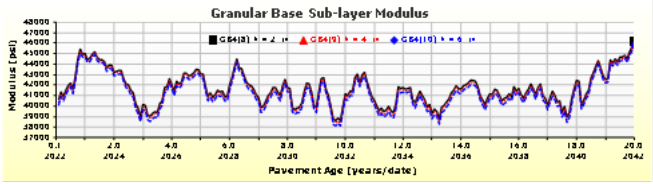

AC Bottom-Up Damage
Bottom-Up Damage (%)
Pavement Age (years/date)

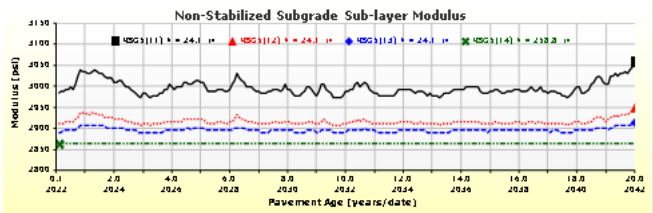

AC Top-Down Cracking (Longitudinal)
Top-Down Cracking (ft/mile)
Pavement Age (years/date)


AC Bottom-Up Cracking (Alligator)
@ 50% Reliability
Bottom-Up Cracking (%)
Pavement Age (years/date)


Rutting (Permanent Deformation) at 50% Reliability
Rut Depth (in)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.1
2022
2.0
2024
4.0
2026
6.0
2028
8.0
2030
10.0
2032
12.0
2034
14.0
2036
16.0
2038
18.0
2040
20.0
2042
Pavement Age (years/date)


Asphalt Mid-Quintile Sub-layer Modulus
Modulus [psi]
Pavement Age [years/date]


Granular Base Sub-layer Modulus
Modulus [psi]
Pavement Age [years/date]


Non-Stabilized Subgrade Sub-layer Modulus
Modulus [psi]
Pavement Age [years/date]

Layer Information

Layer 1 Flexible : Default asphalt concrete

Asphalt		
Thickness (in)	2.0	
Unit weight (pcf)	140.8	
Poisson's ratio	Is Calculated?	False
	Ratio	0.35
	Parameter A	-
	Parameter B	-

Asphalt Dynamic Modulus (Input Level: 3)

Gradation	Percent Passing
3/4-inch sieve	100
3/8-inch sieve	75
No.4 sieve	33.5
No.200 sieve	8

Asphalt Binder

Parameter	Value
Grade	Superpave Performance Grade
Binder Type	76-22
A	9.715
VTS	-3.208

General Info

Name	Value
Reference temperature (ºF)	70
Effective binder content (%)	13.3
Air voids (%)	7
Thermal conductivity (BTU/hr-ft-ºF)	0.67
Heat capacity (BTU/lb-ºF)	0.23

Identifiers

Field	Value
Display name/identifier	Default asphalt concrete
Description of object	
Author	
Date Created	10/30/2010 1:00:00 AM
Approver	
Date approved	10/30/2010 1:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 1	
User defined field 2	
User defined field 3	
Revision Number	0

Layer 2 Flexible : Default asphalt concrete

Asphalt		
Thickness (in)	3.0	
Unit weight (pcf)	143.4	
Poisson's ratio	Is Calculated?	False
	Ratio	0.35
	Parameter A	-
	Parameter B	-

Asphalt Dynamic Modulus (Input Level: 3)

Gradation	Percent Passing
3/4-inch sieve	89.4
3/8-inch sieve	55.5
No.4 sieve	33.1
No.200 sieve	5.8

Asphalt Binder

Parameter	Value
Grade	Superpave Performance Grade
Binder Type	70-22
A	10.299
VTS	-3.426

General Info

Name	Value
Reference temperature (ºF)	70
Effective binder content (%)	10
Air voids (%)	7
Thermal conductivity (BTU/hr-ft-ºF)	0.67
Heat capacity (BTU/lb-ºF)	0.23

Identifiers

Field	Value
Display name/identifier	Default asphalt concrete
Description of object	
Author	
Date Created	10/30/2010 1:00:00 AM
Approver	
Date approved	10/30/2010 1:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 1	
User defined field 2	
User defined field 3	
Revision Number	0

Layer 3 Flexible : Default asphalt concrete

Asphalt		
Thickness (in)	6.0	
Unit weight (pcf)	143.4	
Poisson's ratio	Is Calculated?	False
	Ratio	0.35
	Parameter A	-
	Parameter B	-

Asphalt Dynamic Modulus (Input Level: 3)

Gradation	Percent Passing
3/4-inch sieve	89.4
3/8-inch sieve	55.5
No.4 sieve	33.1
No.200 sieve	5.8

Asphalt Binder

Parameter	Value
Grade	Superpave Performance Grade
Binder Type	64-22
A	10.98
VTS	-3.68

General Info

Name	Value
Reference temperature (ºF)	70
Effective binder content (%)	10
Air voids (%)	7
Thermal conductivity (BTU/hr-ft-ºF)	0.67
Heat capacity (BTU/lb-ºF)	0.23

Identifiers

Field	Value
Display name/identifier	Default asphalt concrete
Description of object	
Author	
Date Created	10/30/2010 1:00:00 AM
Approver	
Date approved	10/30/2010 1:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 1	
User defined field 2	
User defined field 3	
Revision Number	0

Layer 4 Non-stabilized Base : Crushed stone

Unbound	
Layer thickness (in)	12.0
Poisson's ratio	0.35
Coefficient of lateral earth pressure (k0)	0.5

Modulus (Input Level: 3)

Analysis Type:	Modify input values by temperature/moisture
Method:	Resilient Modulus (psi)

Resilient Modulus (psi)
30000.0

Use Correction factor for NDT modulus?	-
NDT Correction Factor:	-

Identifiers

Field	Value
Display name/identifier	Crushed stone
Description of object	Default material
Author	AASHTO
Date Created	1/1/2011 12:00:00 AM
Approver	
Date approved	1/1/2011 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 1	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	6.0
Plasticity Index	3.0
Is layer compacted?	True

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	126.1
Saturated hydraulic conductivity (ft/hr)	False	1.526e-01
Specific gravity of solids	False	2.7
Water Content (%)	False	8.2

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	11.0479
bf	0.9651
cf	0.9010
hr	160.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	10.0
#100	
#80	
#60	
#50	
#40	
#30	
#20	
#16	
#10	
#8	
#4	20.0
3/8-in.	
1/2-in.	
3/4-in.	72.0
1-in.	
1 1/2-in.	85.0
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	95.0

Layer 5 Subgrade : A-7-6

Unbound	
Layer thickness (in)	Semi-infinite
Poisson's ratio	0.35
Coefficient of lateral earth pressure (k0)	0.5

Modulus (Input Level: 2)

Analysis Type:	Modify input values by temperature/moisture
Method:	Resilient Modulus (psi)

CBR	Resilient Modulus (psi)
3.0	5161

Use Correction factor for NDT modulus?	-
NDT Correction Factor:	-

Identifiers

Field	Value
Display name/identifier	A-7-6
Description of object	Default material
Author	AASHTO
Date Created	1/1/2011 12:00:00 AM
Approver	
Date approved	1/1/2011 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 1	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	51.0
Plasticity Index	30.0
Is layer compacted?	False

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	97.7
Saturated hydraulic conductivity (ft/hr)	False	8.946e-06
Specific gravity of solids	False	2.7
Water Content (%)	False	22.2

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	136.4179
bf	0.5183
cf	0.0324
hr	500.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	79.1
#100	
#80	84.9
#60	
#50	
#40	88.8
#30	
#20	
#16	
#10	93.0
#8	
#4	94.9
3/8-in.	96.9
1/2-in.	97.5
3/4-in.	98.3
1-in.	98.8
1 1/2-in.	99.3
2-in.	99.6
2 1/2-in.	
3-in.	
3 1/2-in.	99.9

Calibration Coefficients

AC Fatigue

$$N_f = 0.00432 * C * \beta_{f1} k_1 \left(\frac{1}{\varepsilon_1}\right)^{k_2\beta_{f2}} \left(\frac{1}{E}\right)^{k_3\beta_{f3}}$$

$$C = 10^M$$

$$M = 4.84\left(\frac{V_b}{V_a + V_b} - 0.69\right)$$

k1: 3.75	
k2: 2.87	
k3: 1.46	
Bf1: (5.014 * Pow(hac,-3.416)) * 1 + 0	
Bf2: 1.38	
Bf3: 0.88	

AC Rutting

$$\frac{\varepsilon_p}{\varepsilon_r} = k_z \beta_{r1} 10^{k_1 T^{k_2 \beta_{r2}} N^{k_3 \beta_{r3}}}$$

$$k_z = (C_1 + C_2 * depth) * 0.328196^{depth}$$

$$C_1 = -0.1039 * H_{ac}^2 + 2.4868 * H_{ac} - 17.342$$

$$C_2 = 0.0172 * H_{ac}^2 - 1.7331 * H_{ac} + 27.428$$

Where:

$H_{ac} = total\ AC\ thickness(in)$

$\varepsilon_p = plastic\ strain\left(^{in}/_{in}\right)$
$\varepsilon_r = resilient\ strain\left(^{in}/_{in}\right)$
$T = layer\ temperature(^{\circ}F)$
$N = number\ of\ load\ repetitions$

AC Rutting Standard Deviation	0.24 * Pow(RUT,0.8026) + 0.001	
AC Layer 1	K1:-2.45 K2:3.01 K3:0.22	Br1:0.4 Br2:0.52 Br3:1.36
AC Layer 2	K1:-2.45 K2:3.01 K3:0.22	Br1:0.4 Br2:0.52 Br3:1.36
AC Layer 3	K1:-2.45 K2:3.01 K3:0.22	Br1:0.4 Br2:0.52 Br3:1.36

Thermal Fracture

$$C_f = 400 * N\left(\frac{\log C / h_{ac}}{\sigma}\right)$$

$$\Delta C = (k * \beta t)^{n+1} * A * \Delta K^n$$

$$A = 10^{(4.389 - 2.52 * \log(E * \sigma_m * n))}$$

$C_f = observed\ amount\ of\ thermal\ cracking(ft/500ft)$
$k = refression\ coefficient\ determined\ through\ field\ calibration$
$N(\,) = standard\ normal\ distribution\ evaluated\ at(\,)$
$\sigma = standard\ deviation\ of\ the \log\ of\ the\ depth\ of\ cracks\ in\ the\ pavments$
$C = crack\ depth(in)$
$h_{ac} = thickness\ of\ asphalt\ layer(in)$
$\Delta C = Change\ in\ the\ crack\ depth\ due\ to\ a\ cooling\ cycle$
$\Delta K = Change\ in\ the\ stress\ intensity\ factor\ due\ to\ a\ cooling\ cycle$
$A, n = Fracture\ parameters\ for\ the\ asphalt\ mixture$
$E = mixture\ stiffness$
$\sigma_M = Undamaged\ mixture\ tensile\ strength$
$\beta_t = Calibration\ parameter$

Level 1 K: (0.13 * Pow(MAAT,2) - 11.68 * MAAT + 244.14) * 1 + 0	Level 1 Standard Deviation: 0.14 * THERMAL + 343
Level 2 K: (0.13 * Pow(MAAT,2) - 11.68 * MAAT + 244.14) * 1 + 0	Level 2 Standard Deviation: 0.20 * THERMAL + 343
Level 3 K: (0.13 * Pow(MAAT,2) - 11.68 * MAAT + 244.14) * 1 + 0	Level 3 Standard Deviation: 0.2386 * THERMAL + 343

CSM Fatigue

$$N_f = 10^{\left(\frac{k_1 \beta_{c1} \left(\frac{\sigma_s}{M_r}\right)}{k_2 \beta_{c2}}\right)}$$

$N_f = number\ of\ repetitions\ to\ fatigue\ cracking$
$\sigma_s = Tensile\ stress(psi)$
$M_r = modulus\ of\ rupture(psi)$

k1: 0.972	k2: 0.0825	Bc1: 1	Bc2:1

Unbound Layer Rutting

$$\delta_a(N) = \beta_{s_1} k_1 \varepsilon_v h \left(\frac{\varepsilon_0}{\varepsilon_r}\right) \left| e^{-\left(\frac{\rho}{N}\right)^{\beta}} \right|$$

$\delta_a = permanent\ deformation\ for\ the\ layer$
$N = number\ of\ repetitions$
$\varepsilon_v = average\ veritcal\ strain(in/in)$
$\varepsilon_0, \beta, \rho = material\ properties$
$\varepsilon_r = resilient\ strain(in/in)$

Base Rutting		Subgrade Rutting	
k1: 0.965	Bs1: 1	k1: 0.675	Bs1: 1
Standard Deviation (BASERUT) 0.1477 * Pow(BASERUT,0.6711) + 0.001		Standard Deviation (BASERUT) 0.1235 * Pow(SUBRUT,0.5012) + 0.001	

AC Cracking

AC Top Down Cracking

$$FC_{top} = \left(\frac{C_4}{1 + e^{(C_1 - C_2 * log_{10}(Damage))}}\right) * 10.56$$

c1: 7	c2: 3.5	c3: 0	c4: 1000

AC Bottom Up Cracking

$$FC = \left(\frac{6000}{1 + e^{\left(C_1 * C_1' + C_2 * C_2' log_{10}(D * 100)\right)}}\right) * \left(\frac{1}{60}\right)$$

$$C_2' = -2.40874 - 39.748 * (1 + h_{ac})^{-2.856}$$

$$C_1' = -2 * C_2'$$

c1: 1.31	c2: (0.867 + 0.2583 * hac) * 1 + 0	c3: 6000

Top down AC Cracking Standard Deviation	Bottom up AC Cracking Standard Deviation
200 + 2300/(1+exp(1.072-2.1654*LOG10(TOP+0.0001)))	1.13 + 13/(1+exp(7.57-15.5*LOG10(BOTTOM+0.0001)))

CSM Cracking

$$FC_{ctb} = C_1 + \frac{C_2}{1 + e^{C_3 - C_4 * log_{10}(Damage)}}$$

C1: 0	C2: 75	C3: 2	C4: 2

CSM Standard Deviation
CTB*1

IRI Flexible Pavements

C1 - Rutting
C2 - Fatigue Crack
C3 - Transverse Crack
C4 - Site Factors

C1: 40	C2: 0.4	C3: 0.008	C4: 0.015