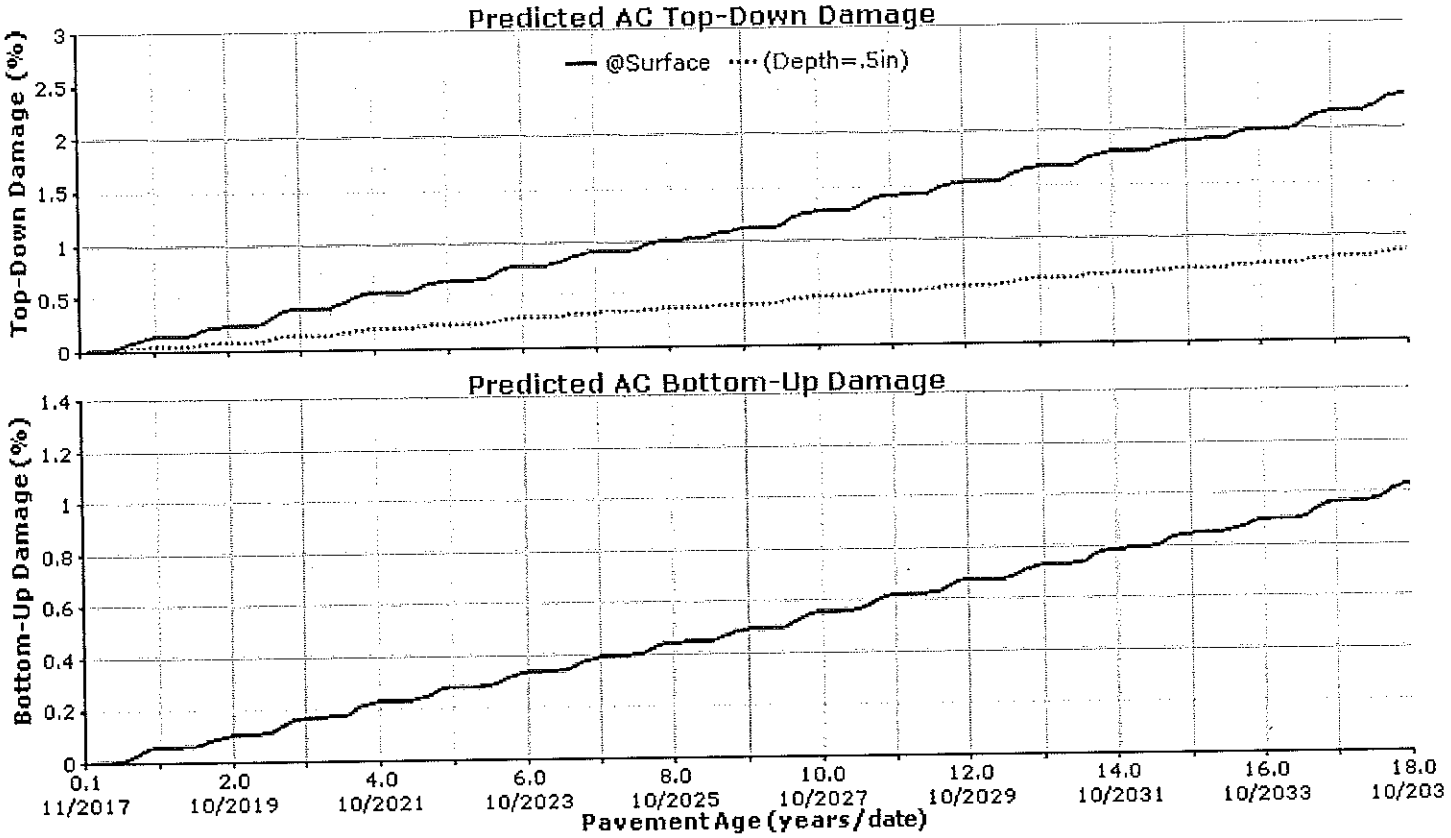

Predicted AC Top-Down Damage
@Surface
(Depth=.5in)
Top-Down Damage (%)
Predicted AC Bottom-Up Damage
Bottom-Up Damage (%)
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)

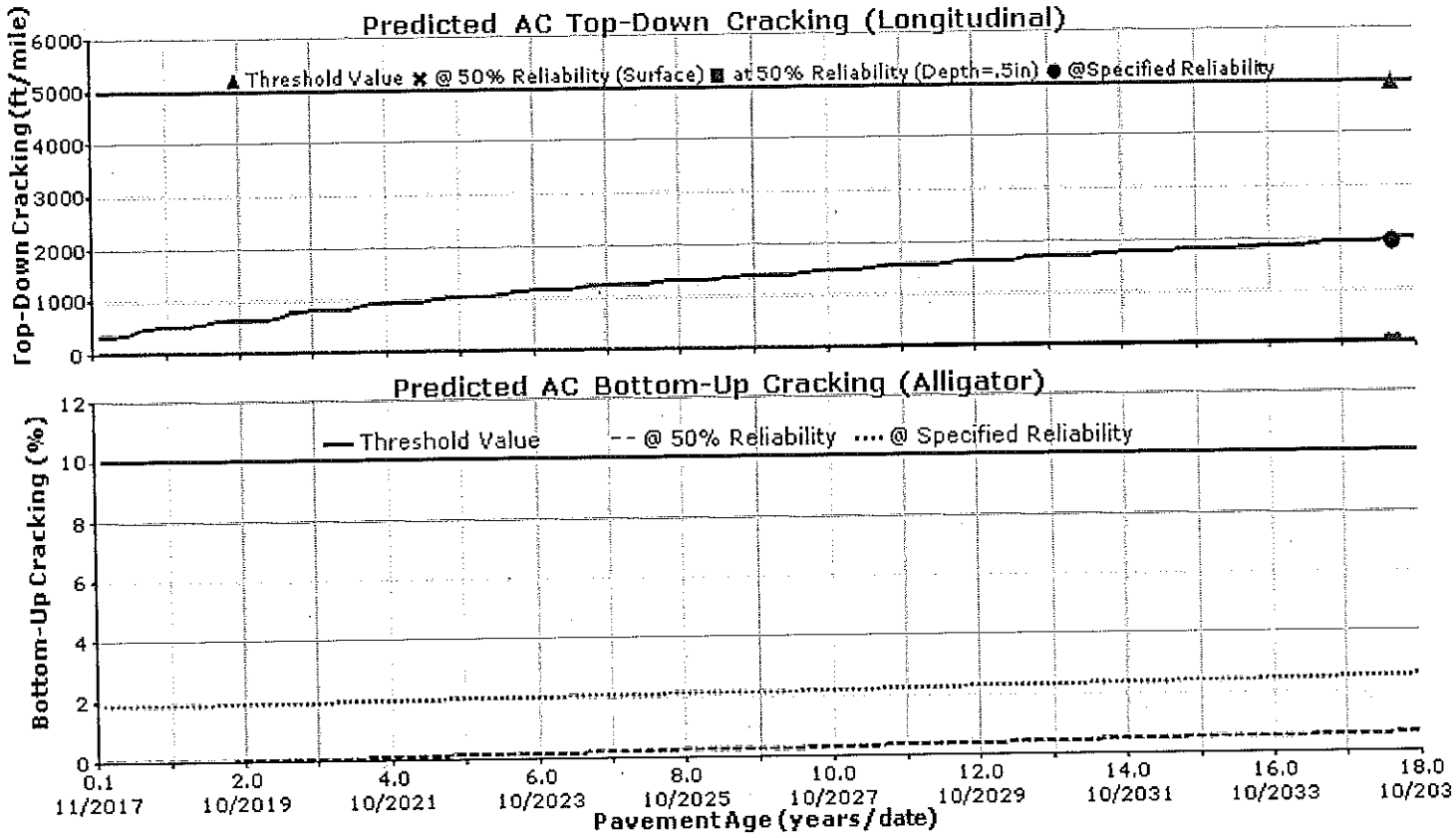

Predicted AC Top-Down Cracking (Longitudinal)
Threshold Value
@ 50% Reliability (Surface)
at 50% Reliability (Depth=.5in)
@Specified Reliability
Top-Down Cracking (ft/mile)
Predicted AC Bottom-Up Cracking (Alligator)
Threshold Value
@ 50% Reliability
@ Specified Reliability
Bottom-Up Cracking (%)
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)

EXHIBIT #63

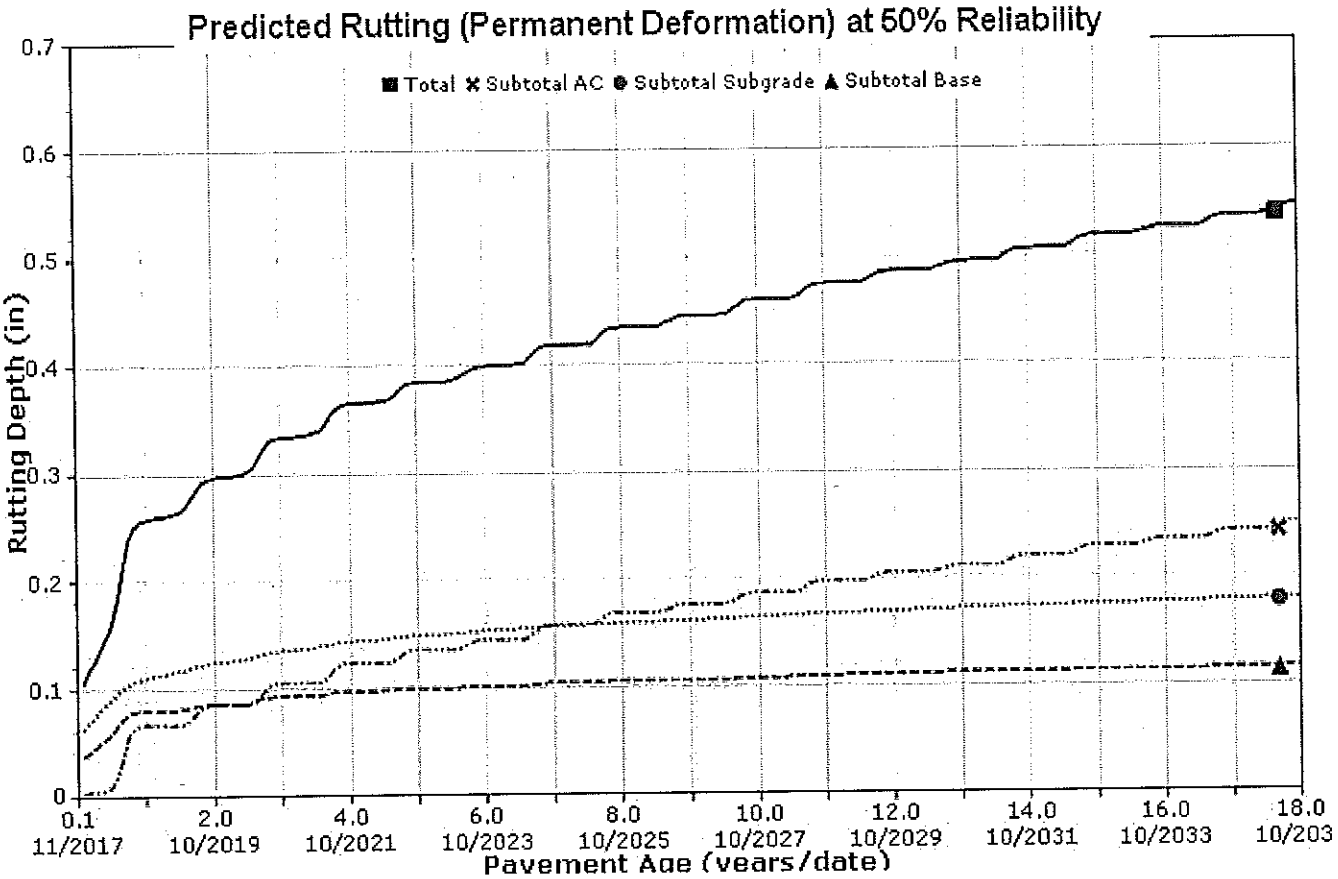
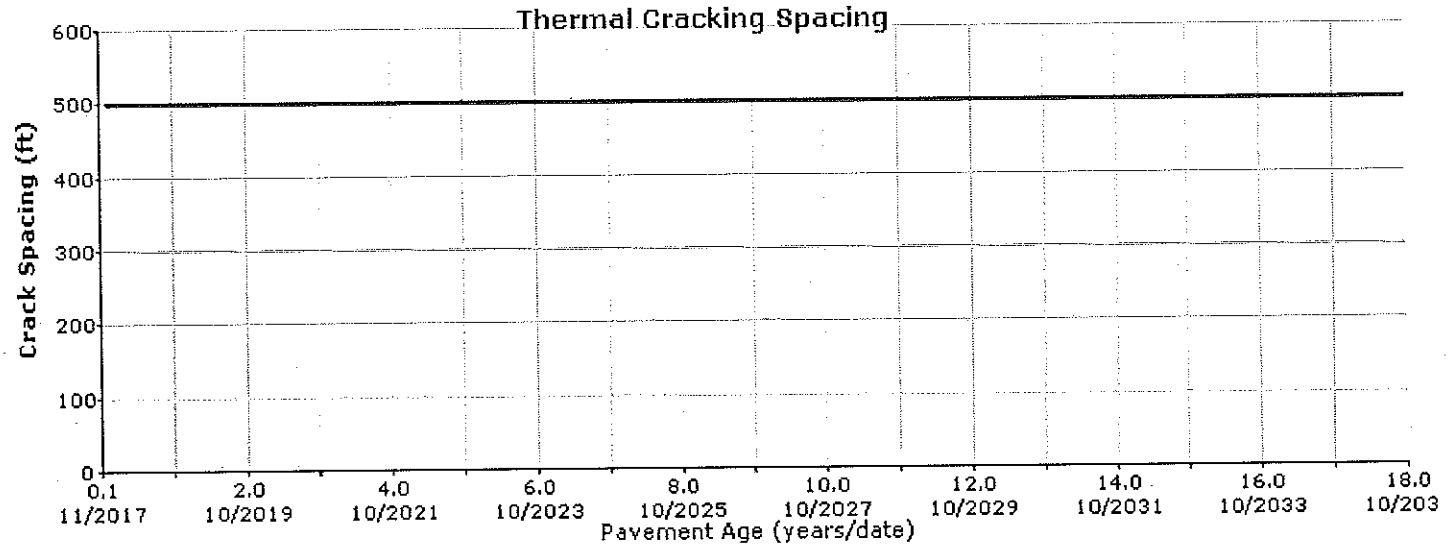

Predicted Rutting (Permanent Deformation) at 50% Reliability
Total Subtotal AC Subtotal Subgrade Subtotal Base
Rutting Depth (in)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)

EXHIBIT #64


Thermal Cracking Spacing
Crack Spacing (ft)
600
500
400
300
200
100
0
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)

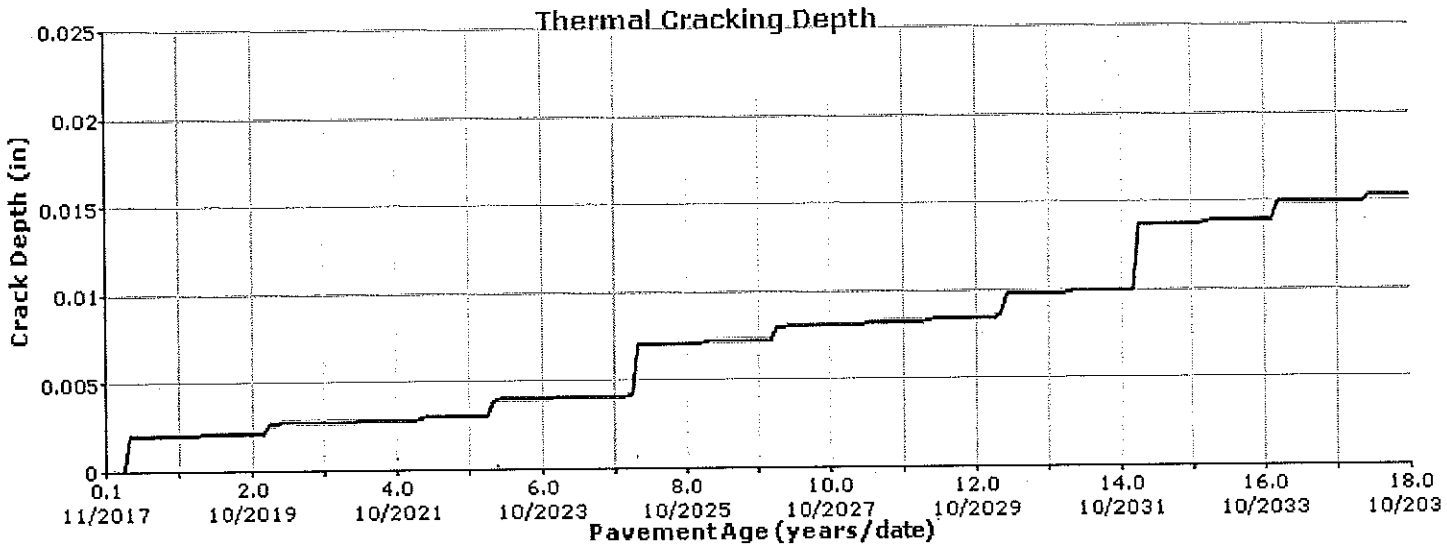
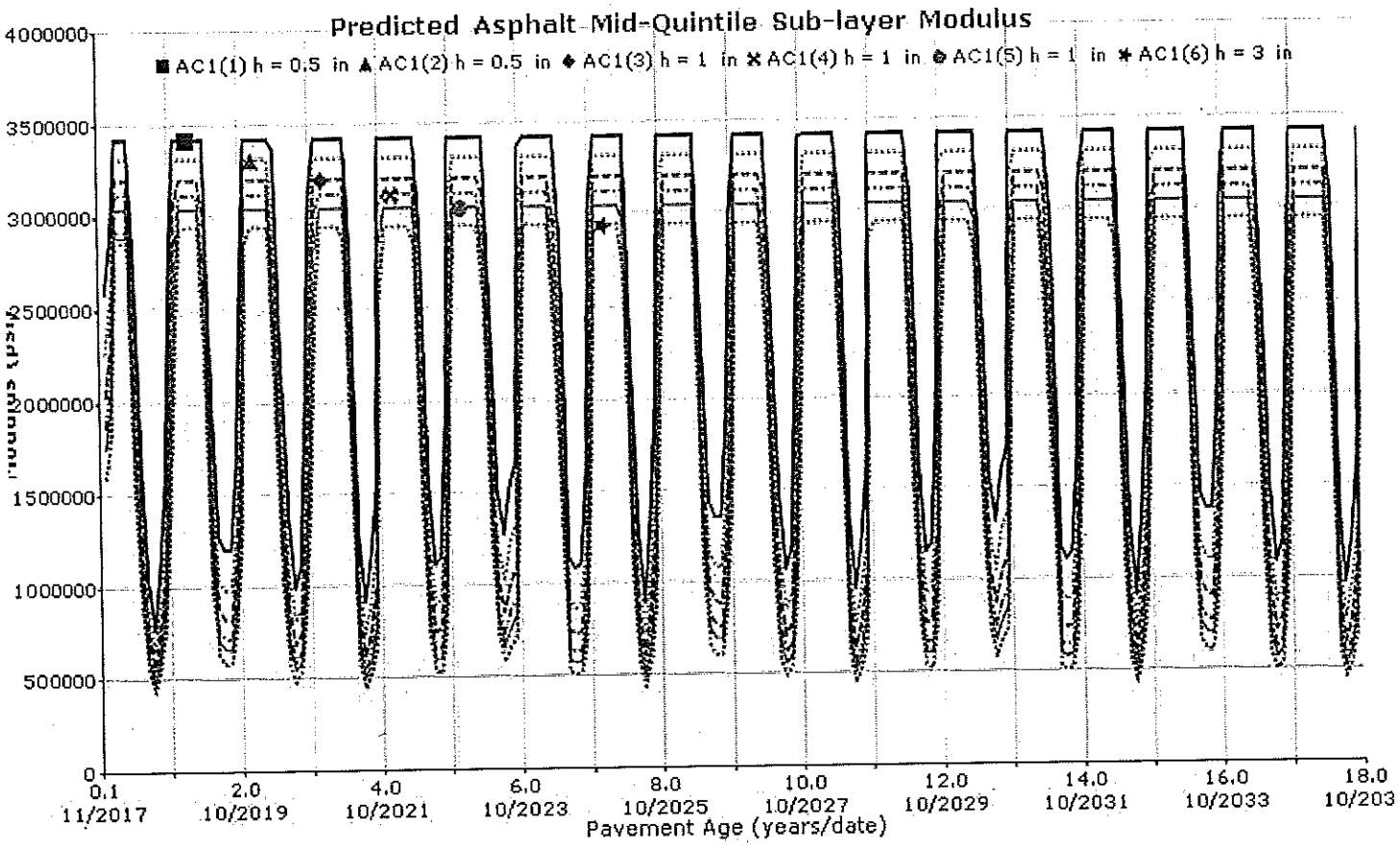

Thermal Cracking Depth
Crack Depth (in)
0.025
0.02
0.015
0.01
0.005
0
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)

EXHIBIT #65

27880001 Wauk Bypass Section#2 HMA 1-13-15

File Name: C:\ME Designs\12290401 IH43 10-29-14\27880001 Wauk Bypass Section#2 HMA 1-13-15.dgpx



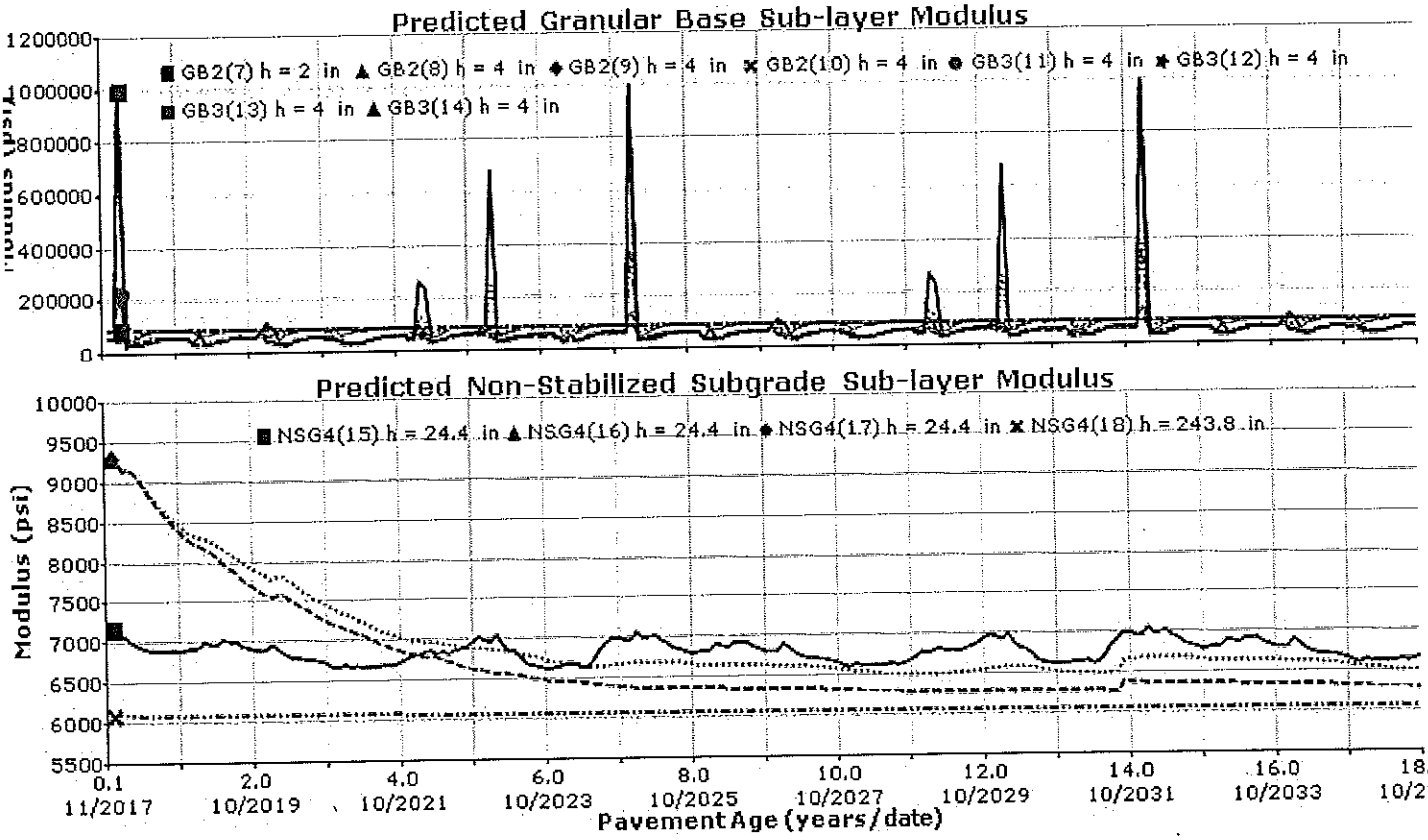


EXHIBIT #66

Layer Information

Layer 1 Flexible : Default asphalt concrete

Asphalt		
Thickness (in.)	7.0	
Unit weight (pcf)	145.0	
Poisson's ratio	Is Calculated?	False
	Ratio	0.30
	Parameter A	-
	Parameter B	-

Asphalt Dynamic Modulus (Input Level: 3)

Gradation	Percent Passing
3/4-inch sieve	95
3/8-inch sieve	90
No.4 sieve	60
No.200 sieve	5

Asphalt Binder

Parameter	Value
Grade	Superpave Performance Grade
Binder Type	64-28
A	10.312
VTS	-3.44

General Info

Name	Value
Reference temperature (°F)	70
Effective binder content (%)	9.2
Air voids (%)	7
Thermal conductivity (BTU/hr-ft-°F)	0.67
Heat capacity (BTU/lb-°F)	0.23

Identifiers

Field	Value
Display name/identifier	Default asphalt concrete
Description of object	
Author	
Date Created	1/13/2015 12:00:00 AM
Approver	
Date approved	1/13/2015 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

EXHIBIT #67

Layer 2 Non-stabilized Base : A-1-a

Unbound	
Layer thickness (in.)	14.0
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)
40000.0

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

Identifiers

Field	Value
Display name/identifier	A-1-a
Description of object	Default material
Author	AASHTO
Date Created	12/9/2014 12:00:00 AM
Approver	
Date approved	12/9/2014 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	True

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	128.1
Saturated hydraulic conductivity (ft/hr)	False	2.616e-02
Specific gravity of solids	False	2.7
Optimum gravimetric water content (%)	False	7.2

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	4.7511
bf	1.7494
cf	0.7630
hr	184.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	7.0
#100	
#80	
#60	
#50	
#40	18.0
#30	
#20	
#16	
#10	32.0
#8	
#4	44.0
3/8-in.	61.0
1/2-in.	
3/4-in.	82.0
1-in.	
1 1/2-in.	97.0
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	

EXHIBIT #68

Layer 3 Non-stabilized Base : A-1-a

Unbound	
Layer thickness (in.)	16.0
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)
42000.0

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

Identifiers

Field	Value
Display name/identifier	A-1-a
Description of object	Default material
Author	AASHTO
Date Created	12/9/2014 12:00:00 AM
Approver	
Date approved	12/9/2014 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	True

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	109.6
Saturated hydraulic conductivity (ft/hr)	False	8.267e+02
Specific gravity of solids	True	2.6
Optimum gravimetric water content (%)	True	16.6

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	9.2765
bf	3.7128
cf	2.9466
hr	160.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	5.0
#100	
#80	
#60	
#50	
#40	
#30	
#20	
#16	
#10	10.0
#8	
#4	
3/8-in.	
1/2-in.	30.0
3/4-in.	
1-in.	
1 1/2-in.	60.0
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	90.0

EXHIBIT #69

Layer 4 Subgrade : A-4

Unbound	
Layer thickness (in.)	Semi-infinite
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)
9450.0

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

Identifiers

Field	Value
Display name/identifier	A-4
Description of object	Default material
Author	AASHTO
Date Created	1/13/2015 12:00:00 AM
Approver	
Date approved	1/13/2015 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	False

	Is User Defined?	Value
Maximum dry unit weight (pcf)	True	116
Saturated hydraulic conductivity (ft/hr)	False	9.138e-06
Specific gravity of solids	True	2.65
Optimum gravimetric water content (%)	True	14

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	69.7987
bf	0.9890
cf	0.4694
hr	500.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	52.0
#100	
#80	
#60	
#50	
#40	65.0
#30	
#20	
#16	
#10	74.0
#8	
#4	85.0
3/8-in.	
1/2-in.	
3/4-in.	
1-in.	
1 1/2-in.	
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	

EXHIBIT #70

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: 0.007566
k2: 3.9492
k3: 1.281
Bf1: 1
Bf2: 1
Bf3: 1

AC Rutting

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

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

$$C_1 = -0.1039 * H_a^2 + 2.4868 * H_a - 17.342$$

$$C_2 = 0.0172 * H_a^2 - 1.7331 * H_a + 27.428$$

Where:

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

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

K1: -3.35412	K2: 1.5606	K3: 0.4791
Br2: 1	Br3: 1	Br1: 1

AC Rutting Standard Deviation

0.24*Pow(RUT,0.8026)+0.001

Thermal Fracture

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

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

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

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

Level 1 K: 1.5	Level 1 Standard Deviation: 0.1468 * THERMAL + 65.027
Level 2 K: 0.5	Level 2 Standard Deviation: 0.2841 *THERMAL + 55.462
Level 3 K: 1.5	Level 3 Standard Deviation: 0.3972 * THERMAL + 20.422

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: 1	k2: 1	Bc1: 1	Bc2:1

EXHIBIT #71

Subgrade Rutting

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

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

Granular		Fine	
k1: 2.03	Bs1: 1	k1: 1.35	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 Cracking Top Standard Deviation

200 + 2300/(1+exp(1.072-2.1654*LOG10 (TOP+0.0001)))

AC Bottom Up Cracking

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

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

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

c1: 1	c2: 1	c3: 6000

AC Cracking Bottom Standard Deviation

1.13+13/(1+exp(7.57-15.5*LOG10 (BOTTOM+0.0001)))

CSM Cracking

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

C1: 1	C2: 1	C3: 0	C4: 1000

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

EXHIBIT #72

27880001 Wauk Bypass Section#3 PCC 1-12-15

File Name: C:\ME Designs\12290401 IH43 10-29-14\27880001 Wauk Bypass Section#3 PCC 1-12-15.dgpx

Design Inputs

Design Life:	25 years	Existing construction:	-	Climate Data Sources (Lat/Lon)	42.761, -87.814
Design Type:	Jointed Plain Concrete Pavement (JPCP)	Pavement construction:	September, 2017		
		Traffic opening:	October, 2017		

Design Structure

Layer type	Material Type	Thickness (in.):
PCC	JPCP Default	8.0
NonStabilized	A-1-a	6.0
NonStabilized	A-1-a	16.0
Subgrade	A-4	Semi-infinite

Joint Design:

Joint spacing (ft)	15.0
Dowel diameter (in.)	1.25
Slab width (ft)	12.0

Traffic

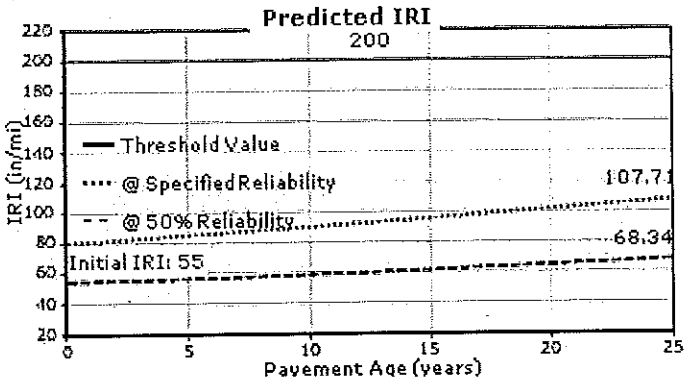
Age (year)	Heavy Trucks (cumulative)
2017 (initial)	1,084
2029 (12 years)	2,308,910
2042 (25 years)	4,856,170

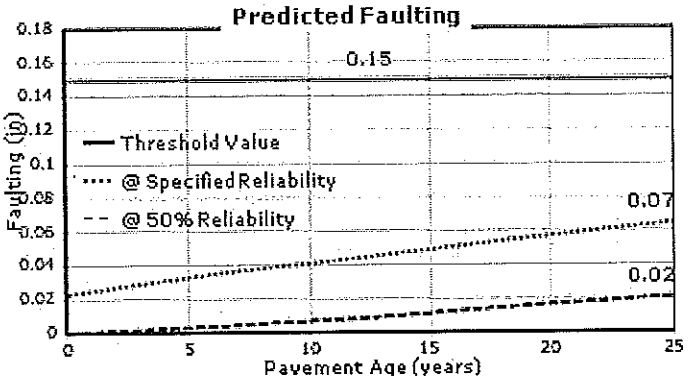
Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in./mile)	200.00	107.71	95.00	100.00	Pass
Mean joint faulting (in.)	0.15	0.07	95.00	100.00	Pass
JPCP transverse cracking (percent slabs)	15.00	6.57	95.00	99.99	Pass

Distress Charts





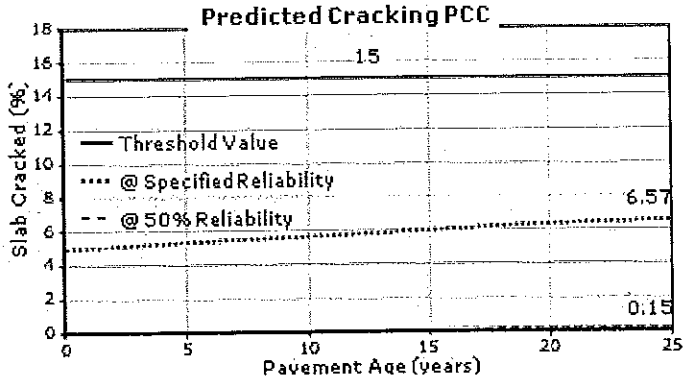
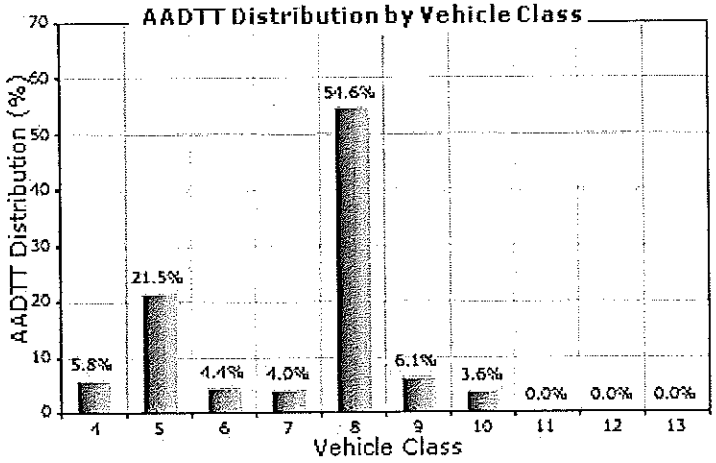


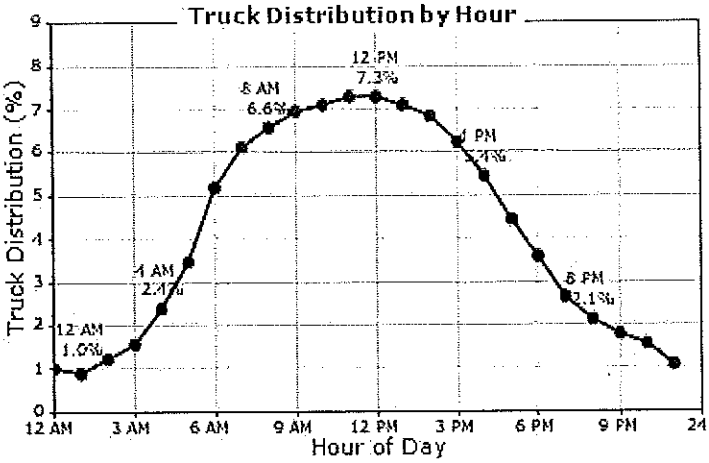
EXHIBIT #73

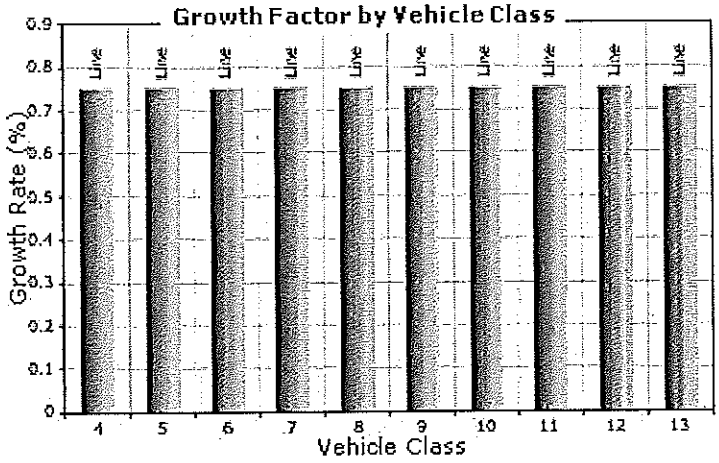
Traffic Inputs

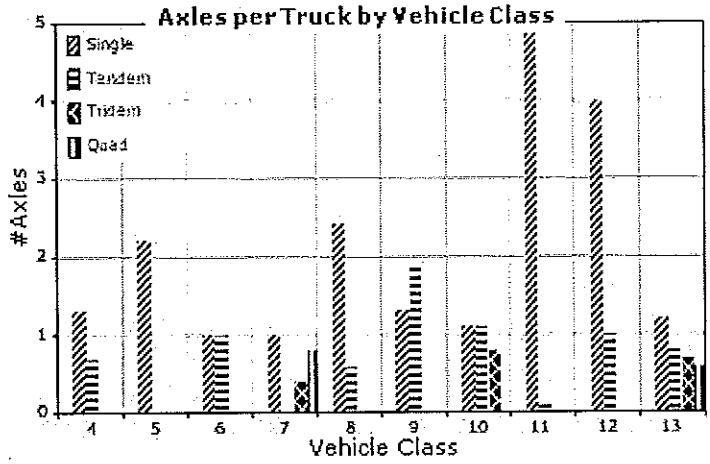
Graphical Representation of Traffic Inputs

Initial two-way AADTT:	1,084	Percent of trucks in design direction (%):	50.0
Number of lanes in design direction:	4	Percent of trucks in design lane (%):	90.0
		Operational speed (mph)	55.0









Traffic Volume Monthly Adjustment Factors

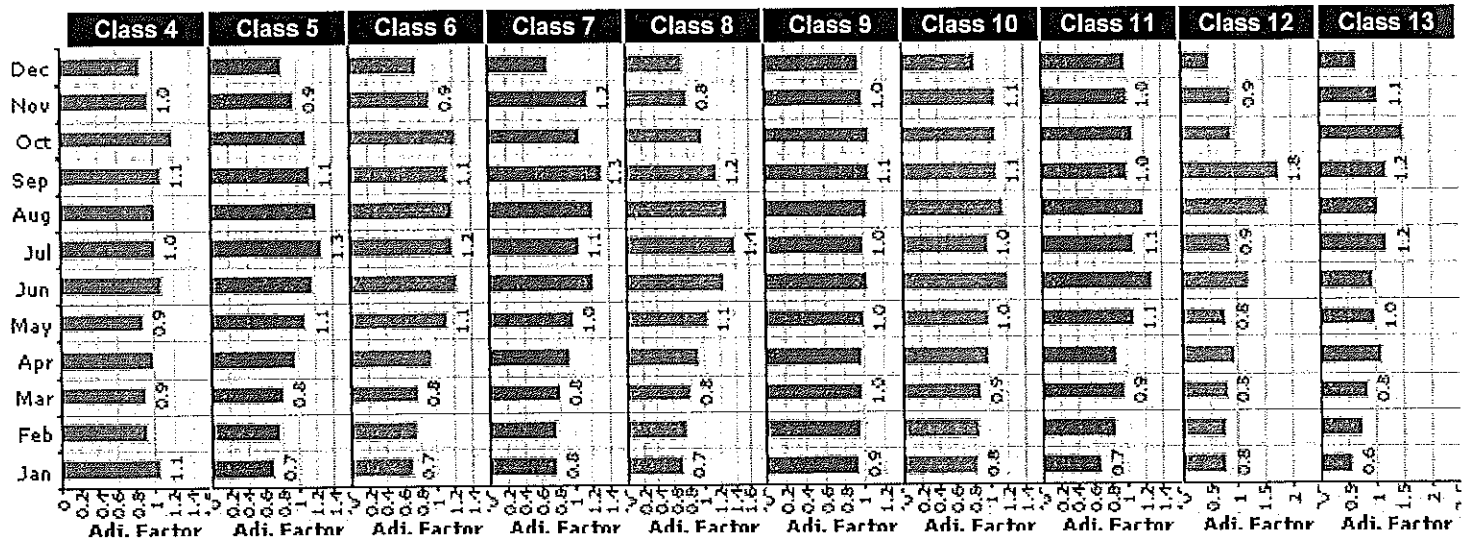


EXHIBIT #74

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	1.1	0.7	0.7	0.8	0.7	0.9	0.8	0.7	0.8	0.6
February	0.9	0.8	0.8	0.8	0.8	1.0	0.9	0.8	0.8	0.7
March	0.9	0.8	0.8	0.8	0.8	1.0	0.9	0.9	0.8	0.8
April	1.0	1.0	0.9	0.9	0.9	1.0	1.0	0.9	1.0	1.1
May	0.9	1.1	1.1	1.0	1.1	1.0	1.0	1.1	0.8	1.0
June	1.1	1.2	1.2	1.2	1.3	1.1	1.2	1.3	1.2	1.0
July	1.0	1.3	1.2	1.1	1.4	1.0	1.0	1.1	0.9	1.2
August	1.0	1.2	1.2	1.2	1.3	1.1	1.2	1.2	1.6	1.1
September	1.1	1.1	1.1	1.3	1.2	1.1	1.1	1.0	1.8	1.2
October	1.2	1.1	1.2	1.1	1.0	1.1	1.1	1.1	0.9	1.5
November	1.0	0.9	0.9	1.2	0.8	1.0	1.1	1.0	0.9	1.1
December	0.9	0.8	0.8	0.7	0.7	1.0	0.8	1.0	0.5	0.7

Distributions by Vehicle Class

Vehicle Class	AADTT Distribution (%) (Level 3)	Growth Factor	
		Rate (%)	Function
Class 4	5.8%	0.752%	Linear
Class 5	21.5%	0.752%	Linear
Class 6	4.4%	0.752%	Linear
Class 7	4%	0.752%	Linear
Class 8	54.6%	0.752%	Linear
Class 9	6.1%	0.752%	Linear
Class 10	3.6%	0.752%	Linear
Class 11	0%	0.752%	Linear
Class 12	0%	0.752%	Linear
Class 13	0%	0.752%	Linear

Truck Distribution by Hour

Hour	Distribution (%)	Hour	Distribution (%)
12 AM	1.02%	12 PM	7.3%
1 AM	0.93%	1 PM	7.09%
2 AM	1.25%	2 PM	6.82%
3 AM	1.58%	3 PM	6.23%
4 AM	2.39%	4 PM	5.44%
5 AM	3.46%	5 PM	4.44%
6 AM	5.19%	6 PM	3.58%
7 AM	6.12%	7 PM	2.67%
8 AM	6.59%	8 PM	2.14%
9 AM	6.93%	9 PM	1.79%
10 AM	7.09%	10 PM	1.56%
11 AM	7.3%	11 PM	1.09%
		Total	100%

Axle Configuration

Traffic Wander	
Mean wheel location (in.)	15
Traffic wander standard deviation (in.)	10
Design lane width (ft)	12

Axle Configuration	
Average axle width (ft)	8.5
Dual tire spacing (in.)	12
Tire pressure (psi)	120

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

Wheelbase				
Value Type	Axle Type	Short	Medium	Long
Average spacing of axles (ft)		12	15	18
Percent of Trucks (%)		17	22	61

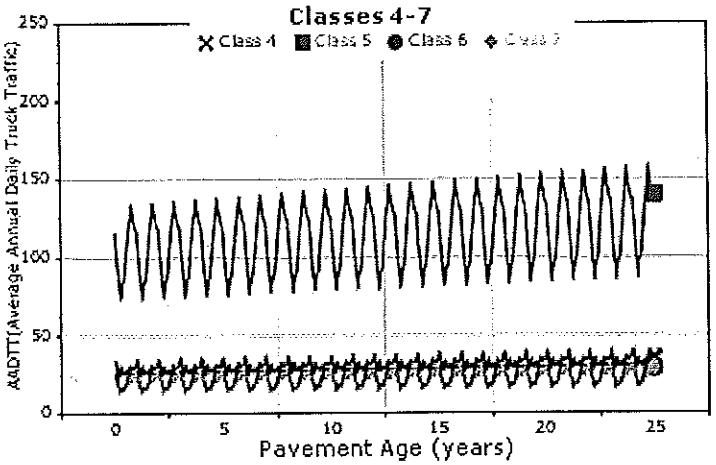
Number of Axles per Truck

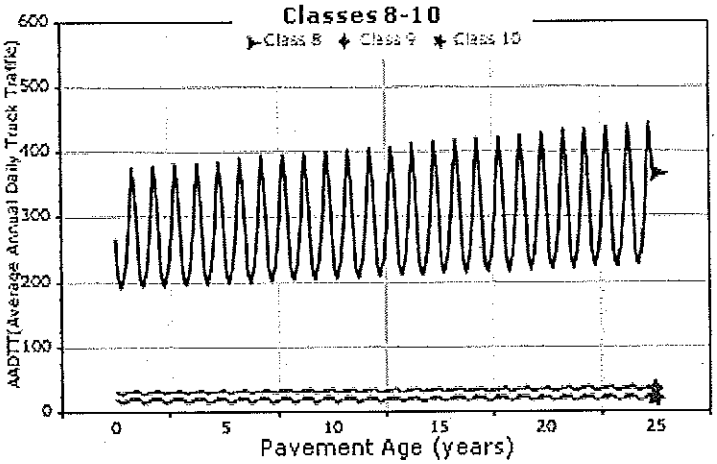
Vehicle Class	Single Axle	Tandem Axle	Tridem Axle	Quad Axle
Class 4	1.3	0.7	0	0
Class 5	2.2	0	0	0
Class 6	1	1	0	0
Class 7	1	0	0.4	0.8
Class 8	2.4	0.6	0	0
Class 9	1.3	1.9	0	0
Class 10	1.1	1.1	0.8	0
Class 11	4.9	0.1	0	0
Class 12	4	1	0	0
Class 13	1.2	0.8	0.7	0.6

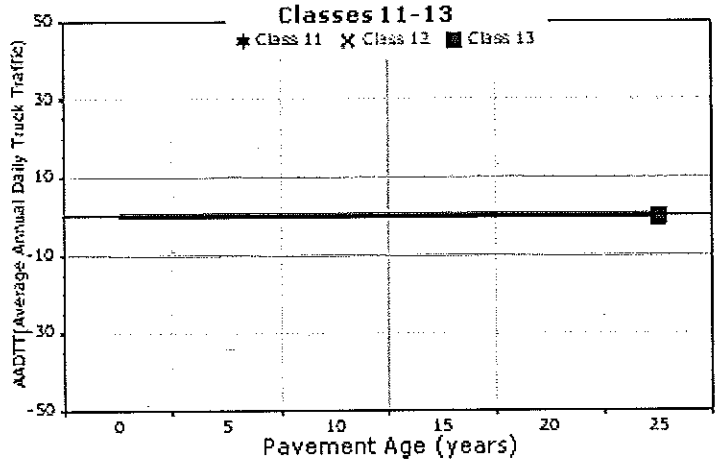
EXHIBIT #75

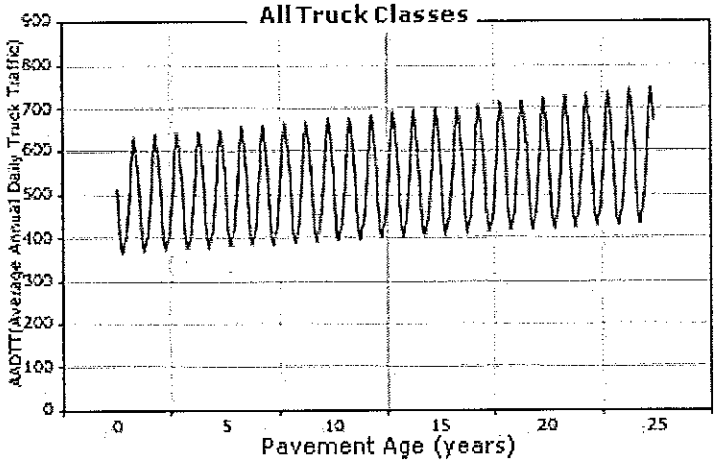
AADTT (Average Annual Daily Truck Traffic) Growth

* Traffic cap is not enforced









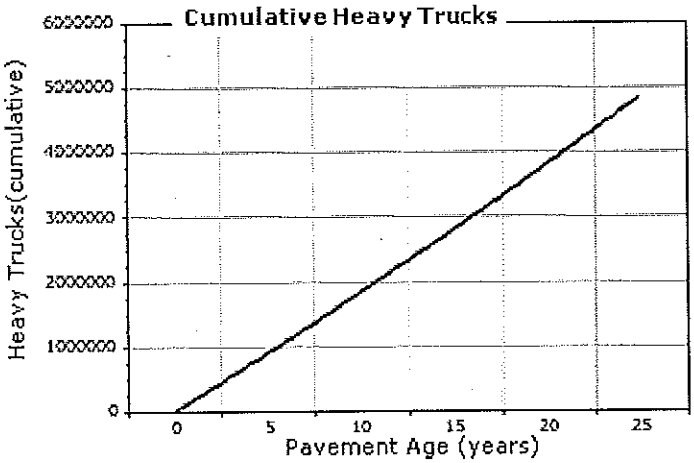
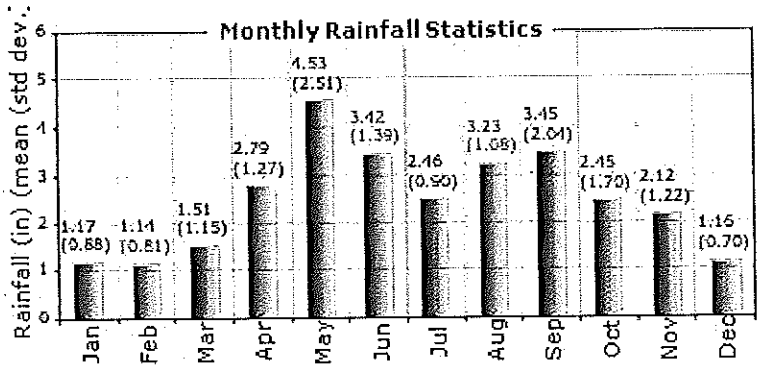


EXHIBIT #76

Climate Inputs

Climate Data Sources:

Climate Station Cities:	Location (lat lon elevation(ft))
RACINE, WI	42.76100 -87.81400 665

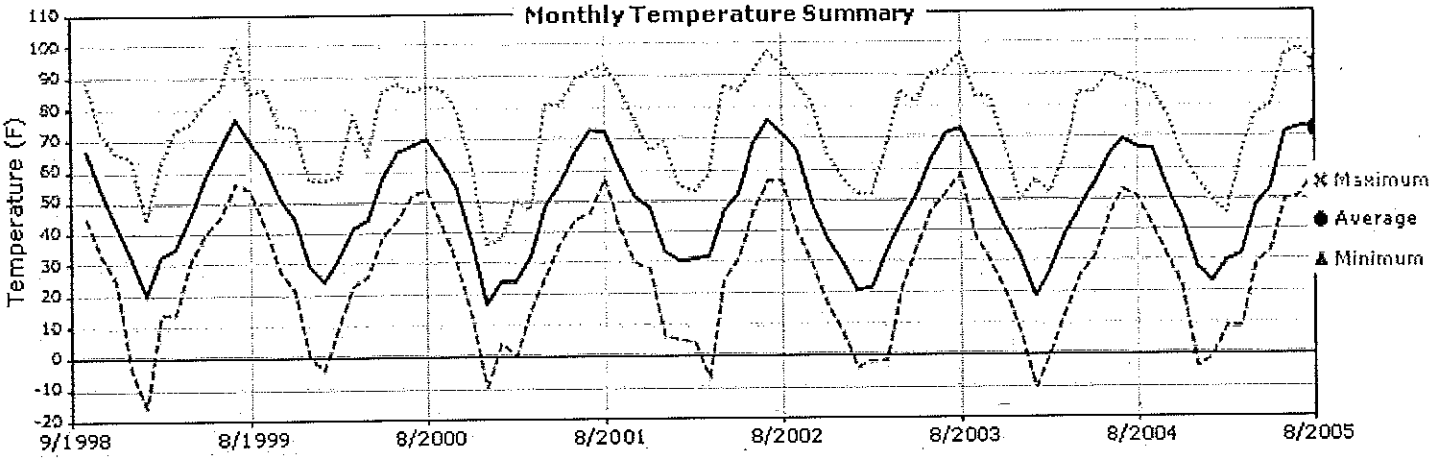


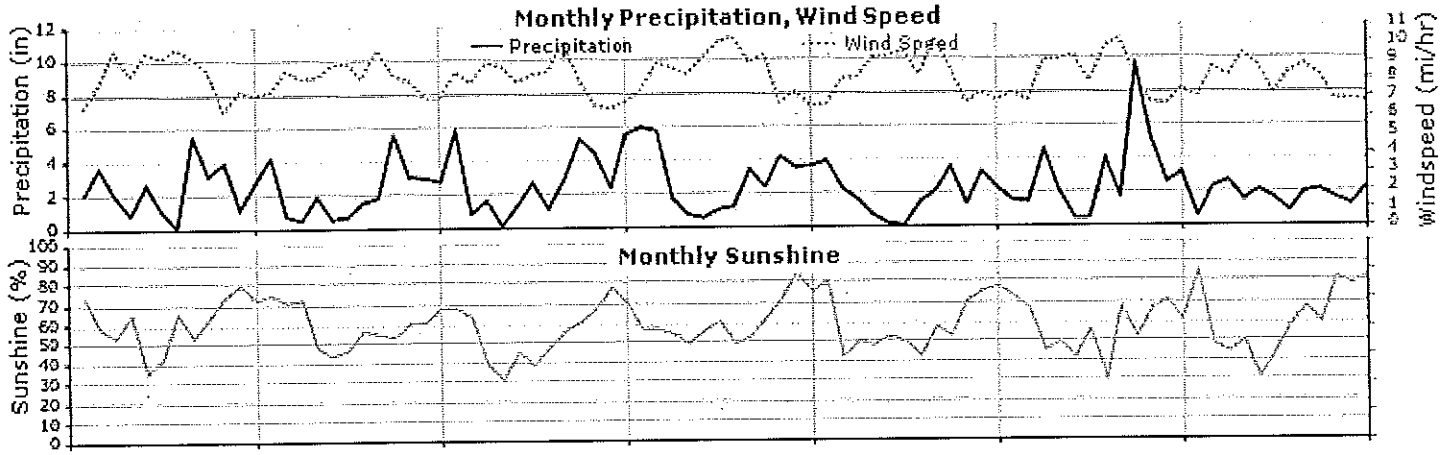
Annual Statistics:

Mean annual air temperature (°F)	48.60
Mean annual precipitation (in.)	29.44
Freezing index (°F - days)	786.30
Average annual number of freeze/thaw cycles:	55.83

Water table depth (ft)	10.00

Monthly Climate Summary:





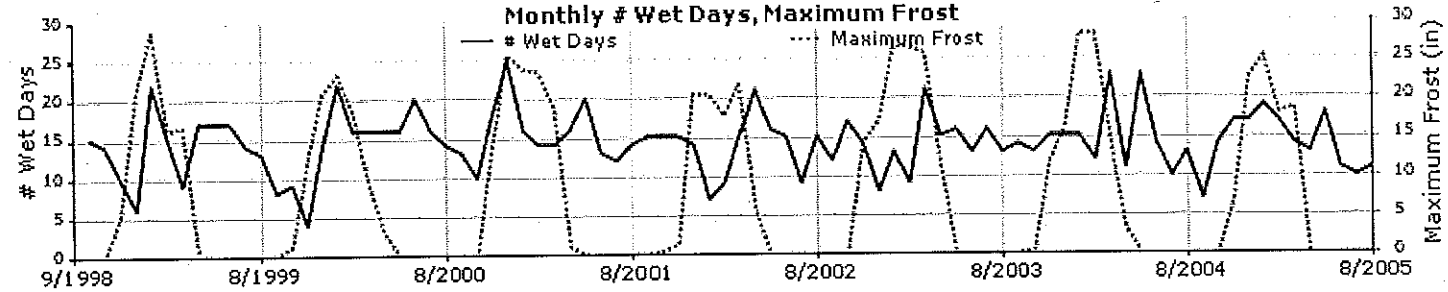
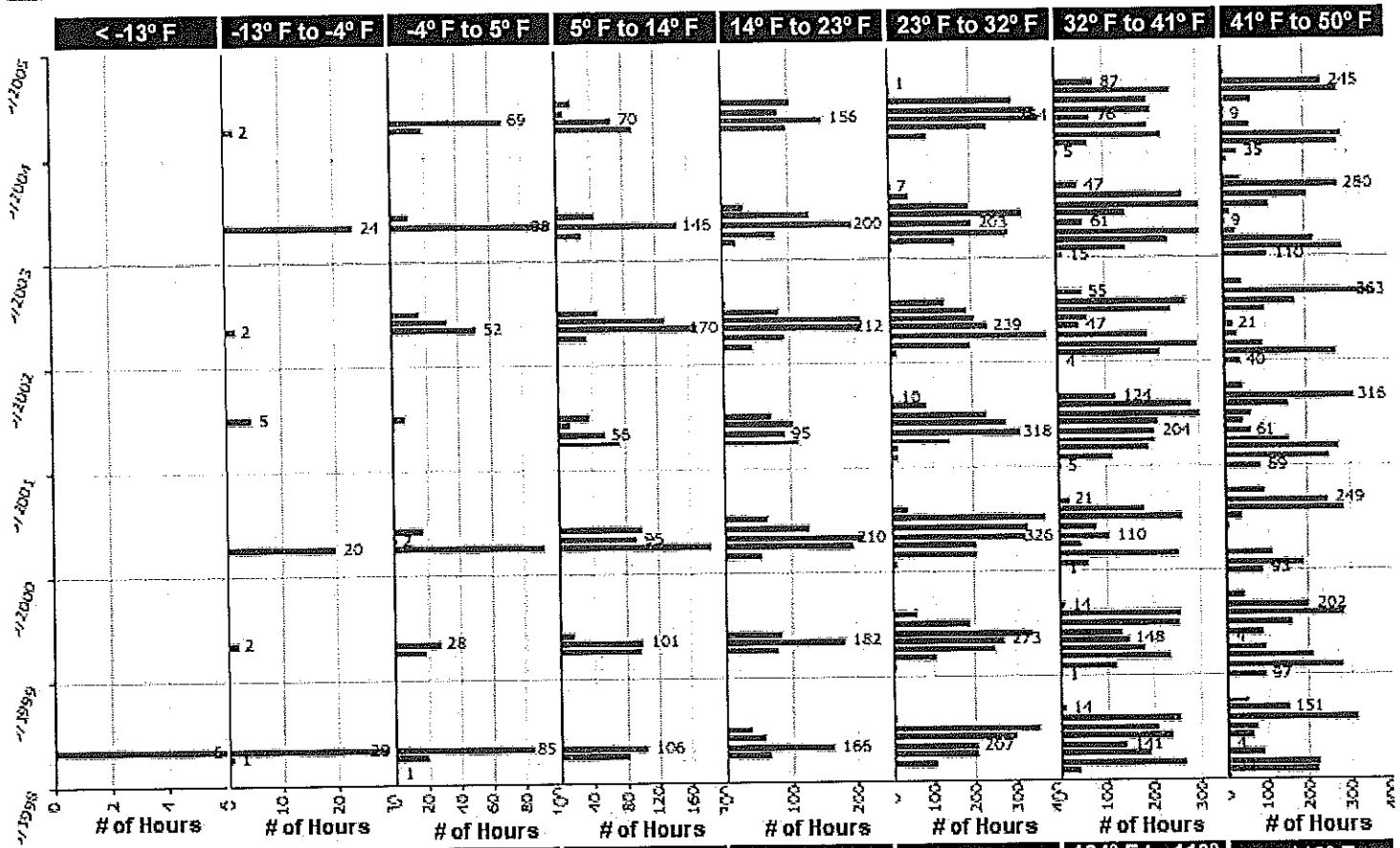


EXHIBIT #77

27880001 Wauk Bypass Section#3 PCC 1-12-15

File Name: C:\ME Designs\12290401 IH43 10-29-14\27880001 Wauk Bypass Section#3 PCC 1-12-15.dgpx

Hourly Air Temperature Distribution by Month:



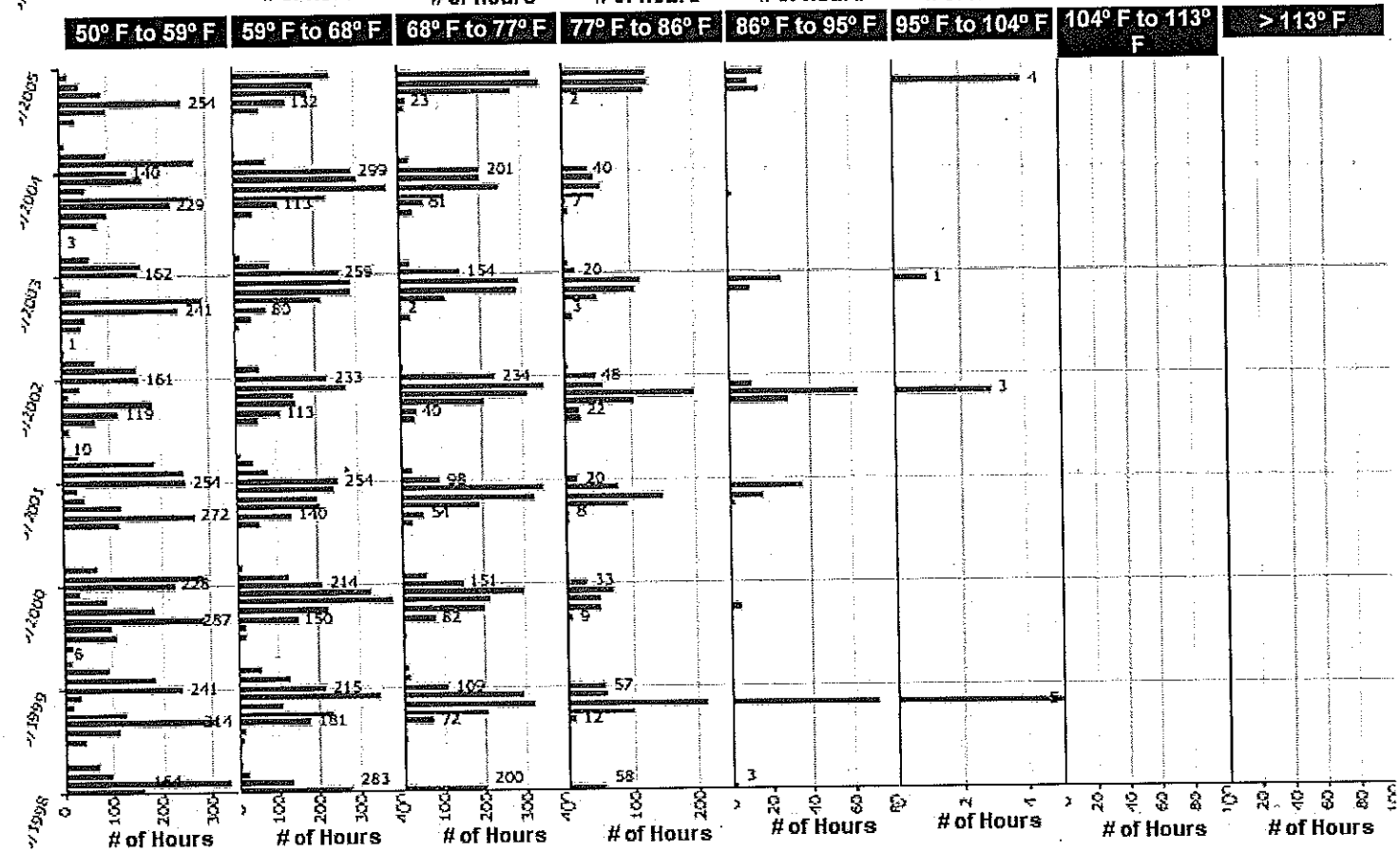


EXHIBIT #78

Design Properties

JPCP Design Properties

Structure - ICM Properties	
PCC surface shortwave absorptivity	0.85

Doweled Joints	
Is joint doweled ?	True
Dowel diameter (in.)	1.25
Dowel spacing (in.)	12.00

Tied Shoulders	
Tied shoulders	True
Load transfer efficiency (%)	50.00

PCC joint spacing (ft)	
Is joint spacing random ?	False
Joint spacing (ft)	15.00

Widened Slab	
Is slab widened ?	False
Slab width (ft)	12.00

PCC-Base Contact Friction	
PCC-Base full friction contact	True
Months until friction loss	240.00

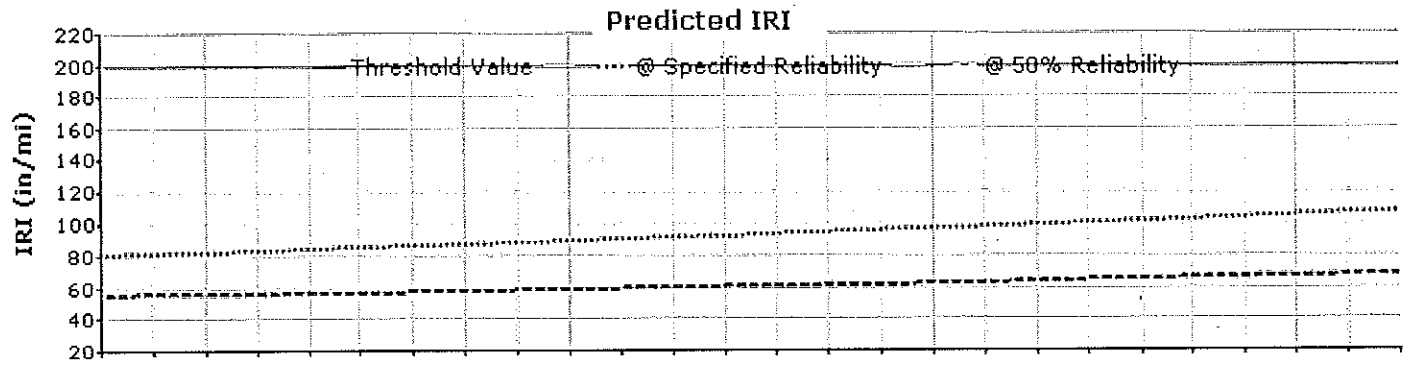
Sealant type	Preformed

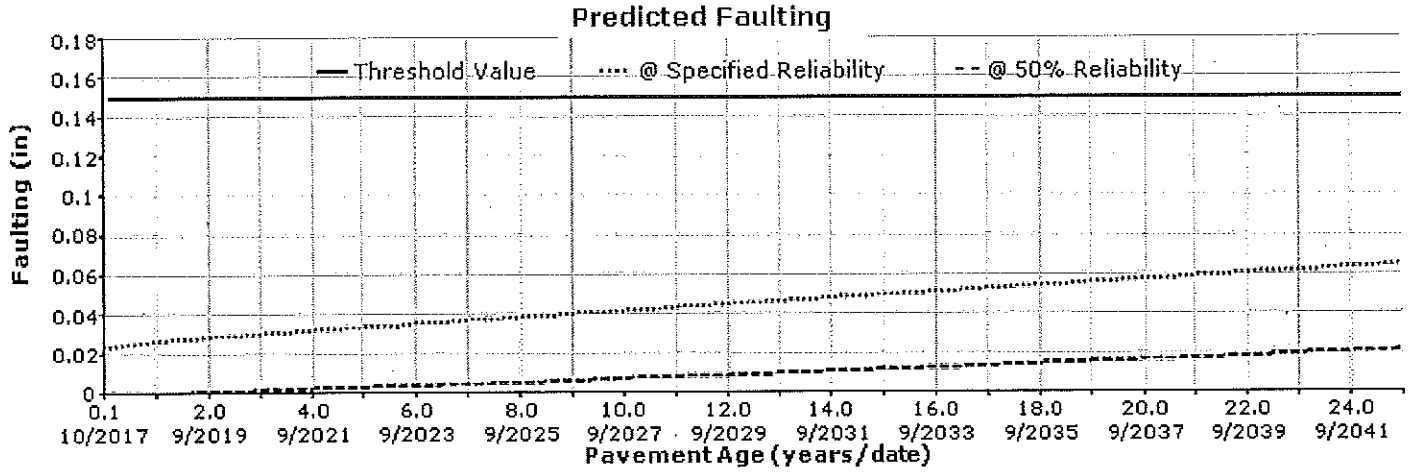
Erodibility index	3

Permanent curl/warp effective temperature difference (°F)	-10.00

EXHIBIT #79

Analysis Output Charts





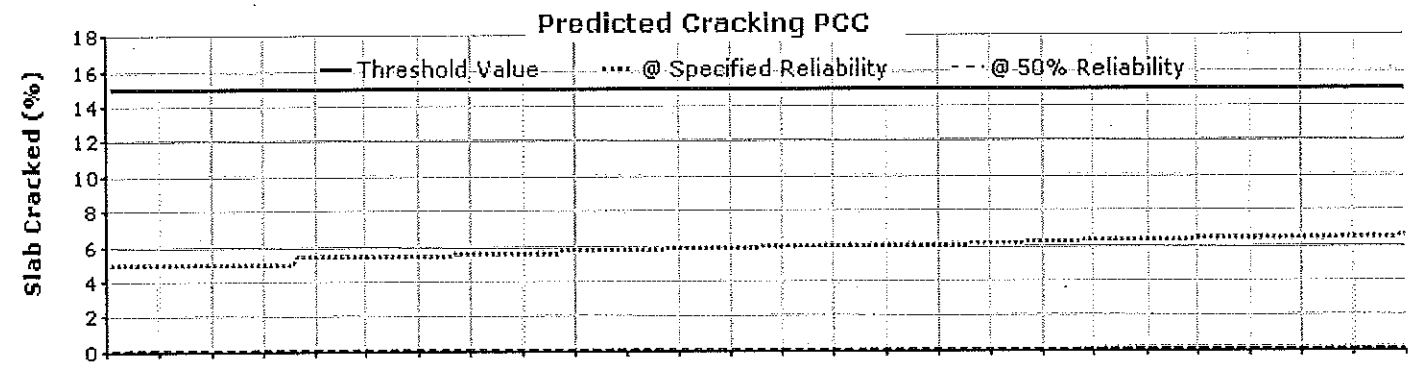
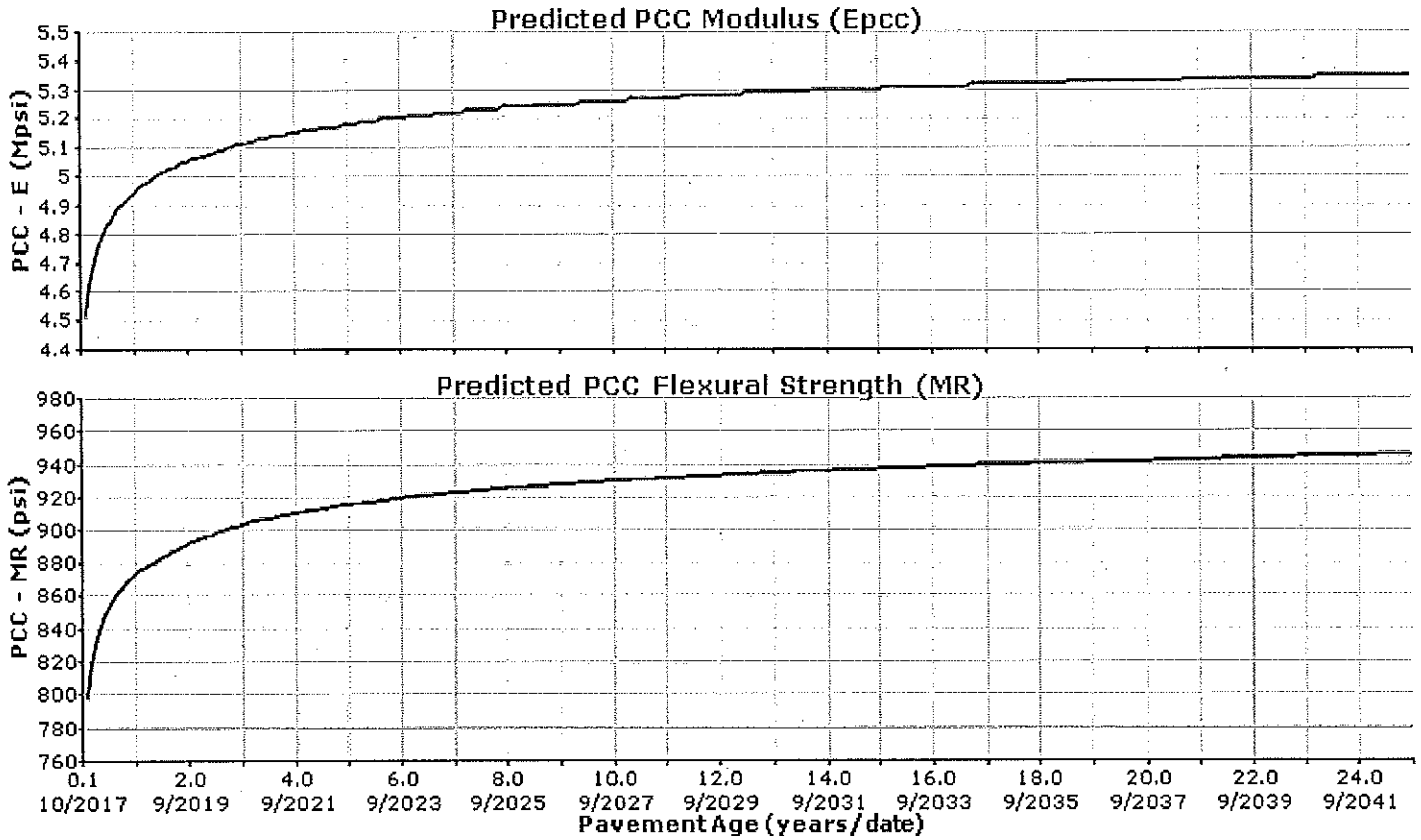


EXHIBIT #80


Predicted PCC Modulus (Epcc)
PCC - E (Mpsi)
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
4.4
Predicted PCC Flexural Strength (MR)
PCC - MR (psi)
980
960
940
920
900
880
860
840
820
800
780
760
0.1 10/2017
2.0 9/2019
4.0 9/2021
6.0 9/2023
8.0 9/2025
10.0 9/2027
12.0 9/2029
14.0 9/2031
16.0 9/2033
18.0 9/2035
20.0 9/2037
22.0 9/2039
24.0 9/2041
Pavement Age (years/date)

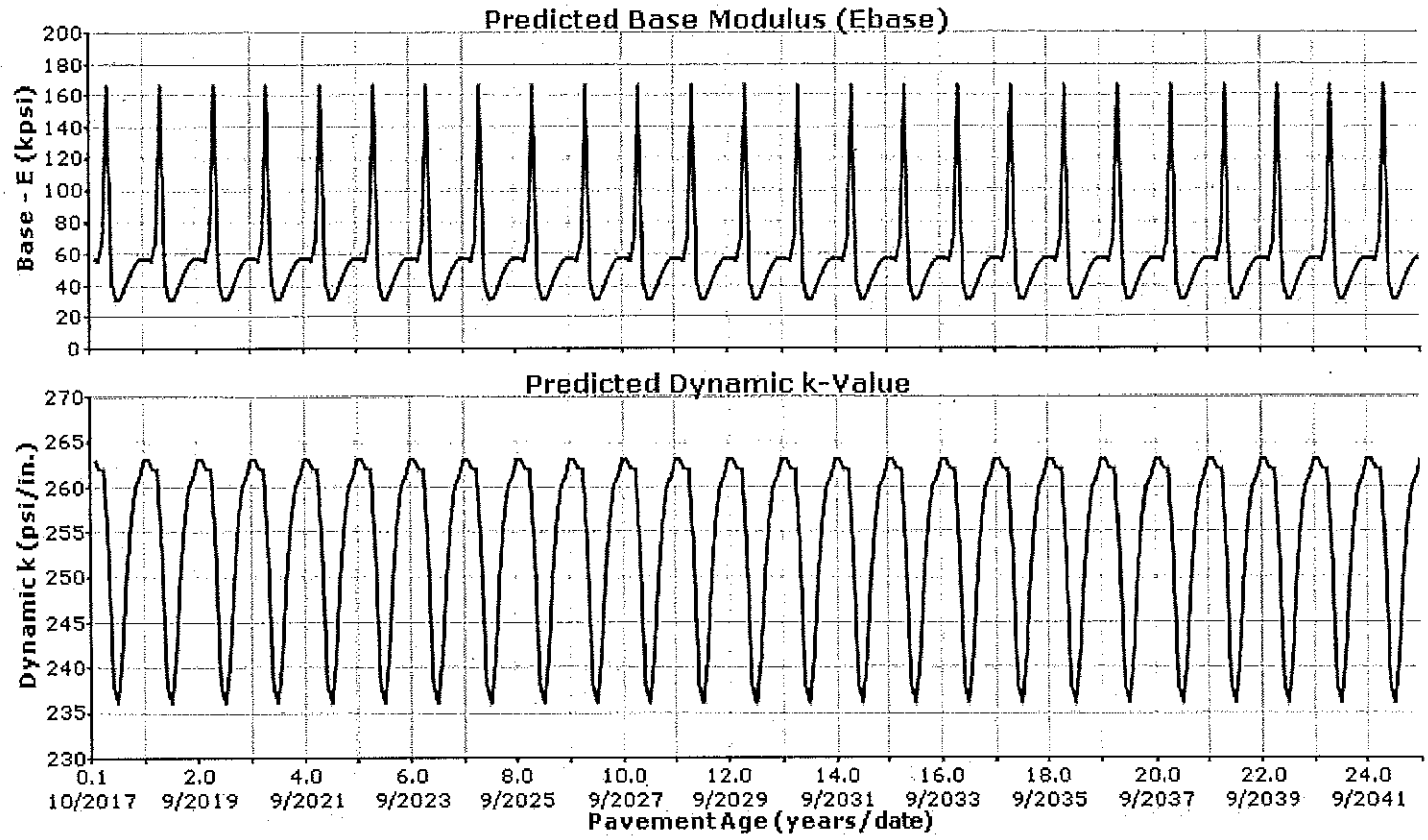
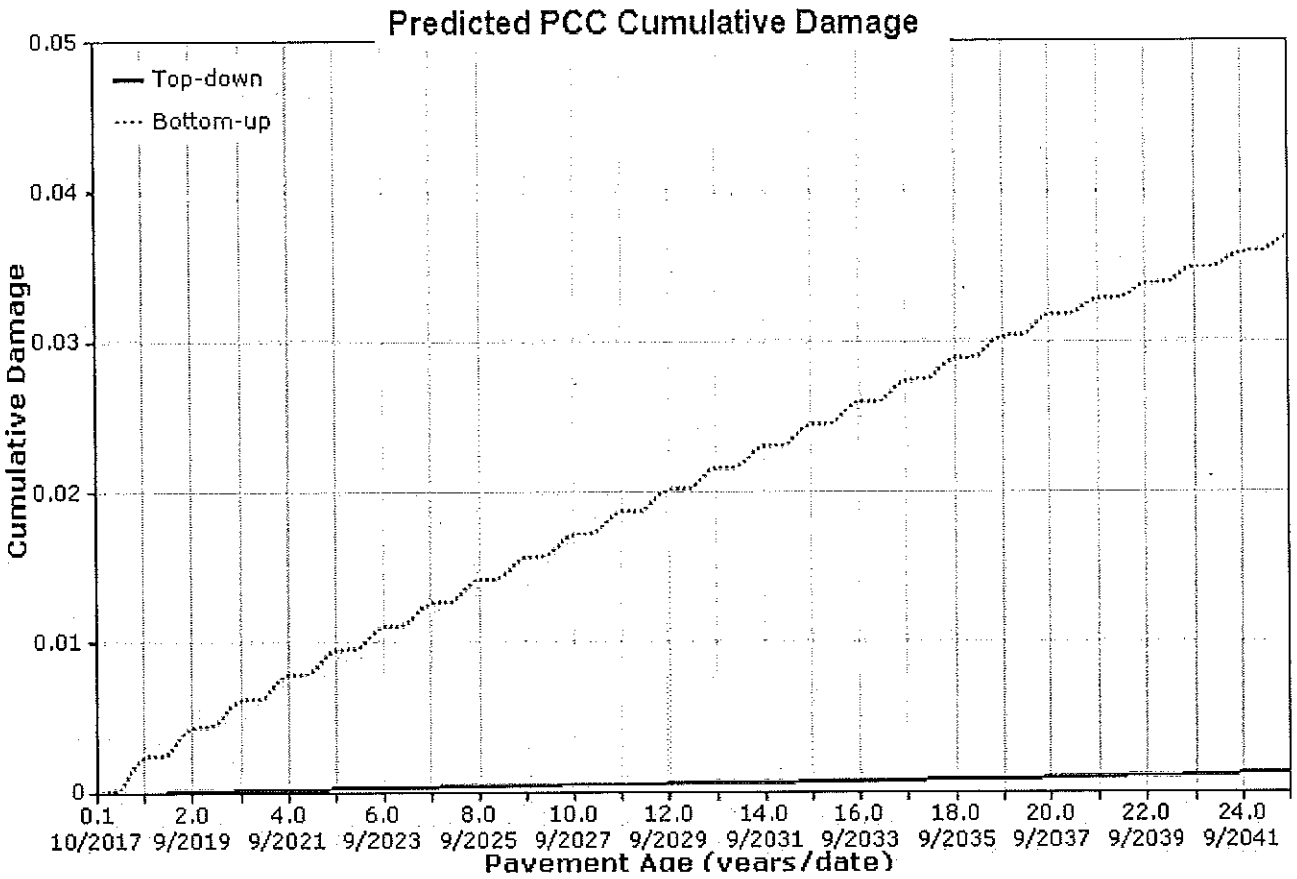

Predicted Base Modulus (Ebase)
Base - E (kpsi)
200
180
160
140
120
100
80
60
40
20
0
Predicted Dynamic k-Value
Dynamic k (psi/in.)
270
265
260
255
250
245
240
235
230
0.1 10/2017
2.0 9/2019
4.0 9/2021
6.0 9/2023
8.0 9/2025
10.0 9/2027
12.0 9/2029
14.0 9/2031
16.0 9/2033
18.0 9/2035
20.0 9/2037
22.0 9/2039
24.0 9/2041
Pavement Age (years/date)

EXHIBIT #81


Predicted PCC Cumulative Damage
Top-down
Bottom-up
Cumulative Damage
0.05
0.04
0.03
0.02
0.01
0
0.1 10/2017
2.0 9/2019
4.0 9/2021
6.0 9/2023
8.0 9/2025
10.0 9/2027
12.0 9/2029
14.0 9/2031
16.0 9/2033
18.0 9/2035
20.0 9/2037
22.0 9/2039
24.0 9/2041
Pavement Age (years/date)

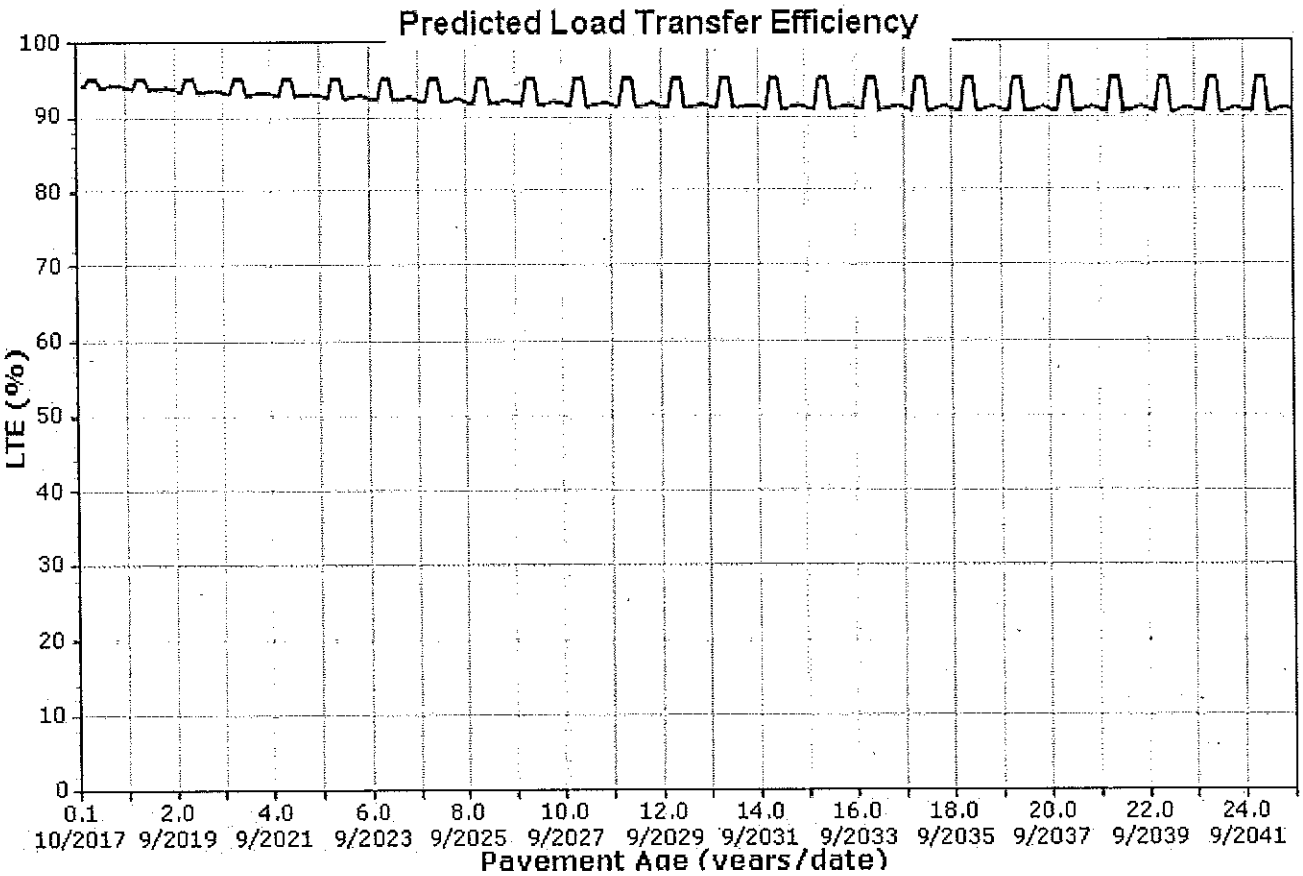

Predicted Load Transfer Efficiency
LTE (%)
100
90
80
70
60
50
40
30
20
10
0
0.1 10/2017
2.0 9/2019
4.0 9/2021
6.0 9/2023
8.0 9/2025
10.0 9/2027
12.0 9/2029
14.0 9/2031
16.0 9/2033
18.0 9/2035
20.0 9/2037
22.0 9/2039
24.0 9/2041
Pavement Age (years/date)

EXHIBIT #82

Layer Information

Layer 1 PCC : JPCP Default

PCC	
Thickness (in.)	8.0
Unit weight (pcf)	148.0
Poisson's ratio	0.2

Thermal	
PCC coefficient of thermal expansion (in./in./°F x 10^-6)	5.37
PCC thermal conductivity (BTU/hr-ft-°F)	1.25
PCC heat capacity (BTU/lb-°F)	0.28

Mix		
Cement type		Type II (2)
Cementitious material content (lb/yd^3)		780
Water to cement ratio		0.37
Aggregate type		Dolomite (2)
PCC zero-stress temperature (°F)	Calculated Internally?	True
	User Value	-
	Calculated Value	102.5
Ultimate shrinkage (microstrain)	Calculated Internally?	True
	User Value	-
	Calculated Value	600.7
Reversible shrinkage (%)		50
Time to develop 50% of ultimate shrinkage (days)		35
Curing method		Curing Compound

PCC strength and modulus (Input Level: 3)

28-Day PCC modulus of rupture (psi)	780.0
28-Day PCC elastic modulus (psi)	4413000.0

Identifiers

Field	Value
Display name/identifier	JPCP Default
Description of object	
Author	
Date Created	1/12/2015 12:00:00 AM
Approver	
Date approved	1/12/2015 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

EXHIBIT #83

Layer 2 Non-stabilized Base : A-1-a

Unbound	
Layer thickness (in.)	6.0
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)
40000.0

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

Identifiers

Field	Value
Display name/identifier	A-1-a
Description of object	Default material
Author	AASHTO
Date Created	1/12/2015 12:00:00 AM
Approver	
Date approved	12/9/2014 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	True

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	128.1
Saturated hydraulic conductivity (ft/hr)	False	2.616e-02
Specific gravity of solids	False	2.7
Optimum gravimetric water content (%)	False	7.2

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	4.7511
bf	1.7494
cf	0.7630
hr	184.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	7.0
#100	
#80	
#60	
#50	
#40	18.0
#30	
#20	
#16	
#10	32.0
#8	
#4	44.0
3/8-in.	61.0
1/2-in.	
3/4-in.	82.0
1-in.	
1 1/2-in.	97.0
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	

EXHIBIT #84

Layer 3 Non-stabilized Base : A-1-a

Unbound	
Layer thickness (in.)	16.0
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)
42000.0

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

Identifiers

Field	Value
Display name/identifier	A-1-a
Description of object	Default material
Author	AASHTO
Date Created	1/12/2015 12:00:00 AM
Approver	
Date approved	12/9/2014 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	True

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	109.6
Saturated hydraulic conductivity (ft/hr)	False	8.267e+02
Specific gravity of solids	True	2.6
Optimum gravimetric water content (%)	True	16.6

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	9.2765
bf	3.7128
cf	2.9466
hr	160.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	5.0
#100	
#80	
#60	
#50	
#40	
#30	
#20	
#16	
#10	10.0
#8	
#4	
3/8-in.	
1/2-in.	30.0
3/4-in.	
1-in.	
1 1/2-in.	60.0
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	90.0

EXHIBIT #85

Layer 4 Subgrade : A-4

Unbound	
Layer thickness (in.)	Semi-infinite
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)
15000.0

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

Identifiers

Field	Value
Display name/identifier	A-4
Description of object	Default material
Author	AASHTO
Date Created	1/12/2015 3:54:50 PM
Approver	
Date approved	12/9/2014 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	False

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	114
Saturated hydraulic conductivity (ft/hr)	False	1.205e-05
Specific gravity of solids	True	2.65
Optimum gravimetric water content (%)	True	14

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	69.7987
bf	0.9890
cf	0.4694
hr	500.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	52.0
#100	
#80	
#60	
#50	
#40	65.0
#30	
#20	
#16	
#10	74.0
#8	
#4	85.0
3/8-in.	
1/2-in.	
3/4-in.	
1-in.	
1 1/2-in.	
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	

EXHIBIT #86

Calibration Coefficients

PCC Faulting

$$C_{12} = C_1 + (C_2 * FR^{0.25})$$

$$C_{34} = C_3 + (C_4 * FR^{0.25})$$

$$FaultMax_0 = C_{12} * \delta_{curling} * \left[\log(1 + C_5 * 5.0^{EROD}) * \log\left(P_{200} * \frac{WetDays}{p_S}\right)\right]^{C_6}$$

$$FaultMax_i = FaultMax_0 + C_7 * \sum_{j=1}^{m} DE_j * \log(1 + C_5 * 5.0^{EROD})^{C_6}$$

$$\Delta Fault_i = C_{34} * (FaultMax_{i-1} - Fault_{i-1})^2 * DE_i$$

$$C_8 = DowelDeterioration$$

C1: 1.0184	C2: 0.91656	C3: 0.0021848	C4: 0.000883739
C5: 250	C6: 0.4	C7: 1.83312	C8: 400
PCC Reliability Faulting Standard Deviation			
Pow(0.0097*FAULT,0.5178)+0.014			

IRI-jpcp

C1 - Cracking	C1: 0.8203	C2: 0.4417
C2 - Spalling	C3: 1.4929	C4: 25.24
C3 - Faulting	**Reliability Standard Deviation**	
C4 - Site Factor	5.4	

PCC Cracking

$$\log(N) = C1 \cdot \left(\frac{MR}{\sigma}\right)^{C2}$$

$$CRK = \frac{100}{1 + C4\ FD^{C5}}$$

Fatigue Coefficients		Cracking Coefficients	
C1: 2	C2: 1.22	C4: 1	C5: -1.98
PCC Reliability Cracking Standard Deviation			
Pow(5.3116*CRACK,0.3903) + 2.99			

EXHIBIT #87

27880001 Wauk Bypass Section#3 HMA 1-13-15

File Name: C:\ME Designs\12290401 IH43 10-29-14\27880001 Wauk Bypass Section#3 HMA 1-13-15.dgpx

Design Inputs

Design Life: 18 years
Design Type: Flexible Pavement

Base construction: September, 2017
Pavement construction: October, 2017
Traffic opening: November, 2017

Climate Data Sources (Lat/Lon): 42.761, -87.814

Design Structure

Layer type	Material Type	Thickness (in.):
Flexible	Default asphalt concrete	5.5
NonStabilized	A-1-a	11.0
NonStabilized	A-1-a	16.0
Subgrade	A-4	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	9.2
Air voids (%)	7.0

Traffic

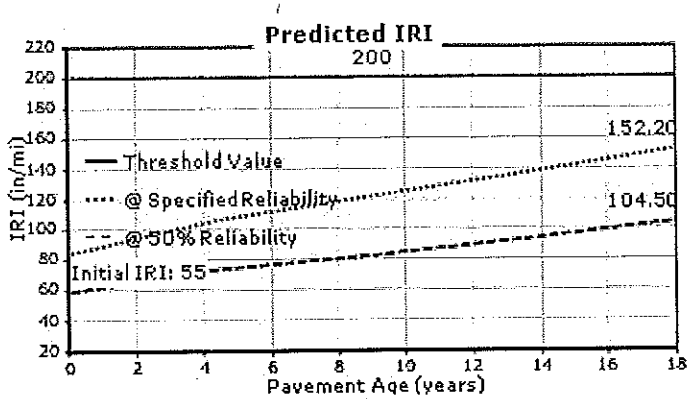
Age (year)	Heavy Trucks (cumulative)
2017 (initial)	826
2026 (9 years)	1,651,750
2035 (18 years)	3,412,040

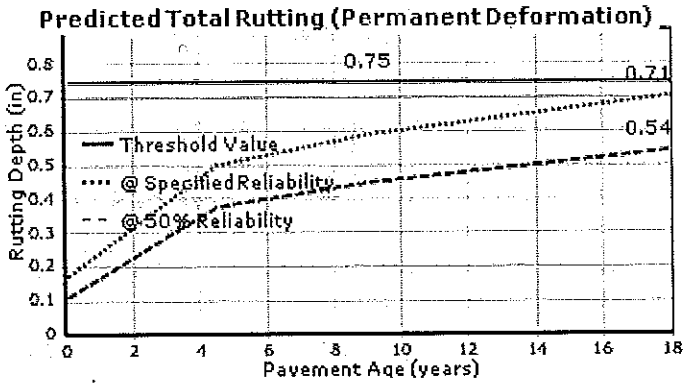
Design Outputs

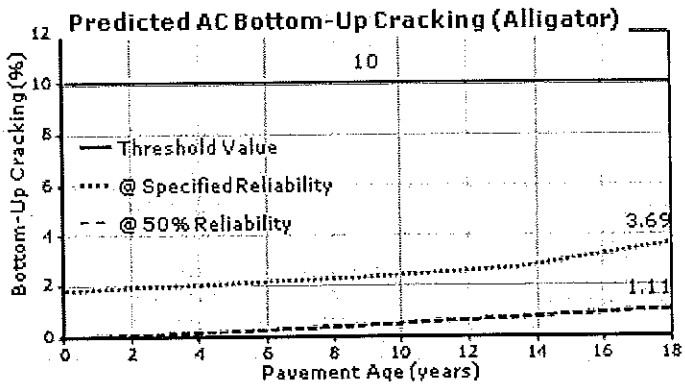
Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in./mile)	200.00	152.24	95.00	99.95	Pass
Permanent deformation - total pavement (in.)	0.75	0.71	95.00	98.14	Pass
AC bottom-up fatigue cracking (percent)	10.00	3.69	95.00	100.00	Pass
AC thermal cracking (ft/mile)	1500.00	35.03	95.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	5000.00	2045.94	95.00	100.00	Pass
Permanent deformation - AC only (in.)	0.40	0.34	95.00	99.33	Pass

Distress Charts







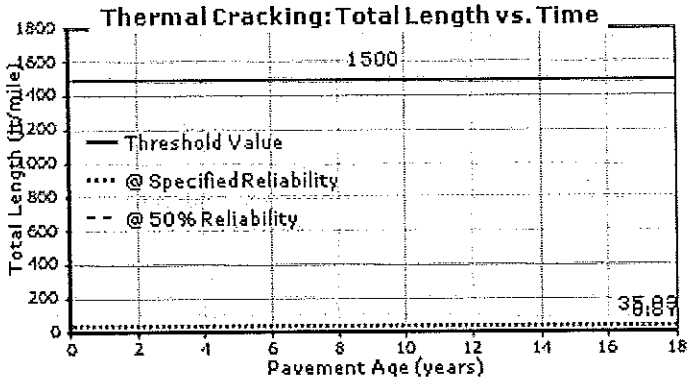
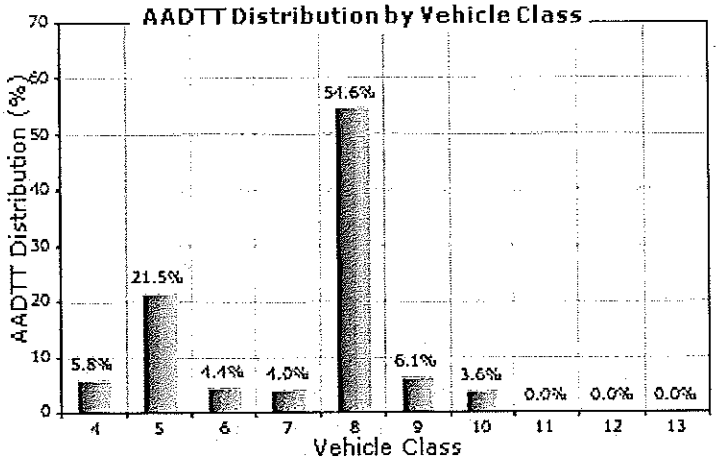


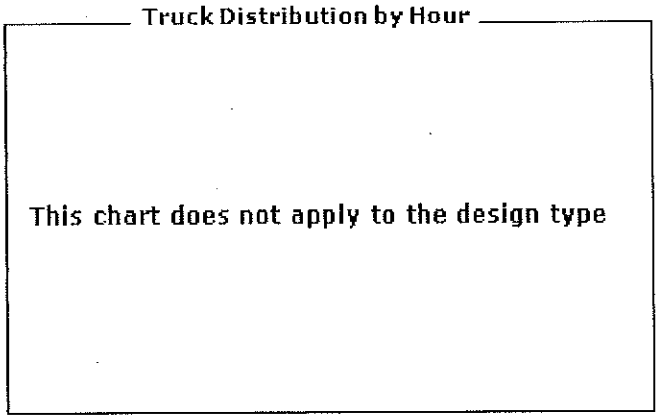
EXHIBIT #88

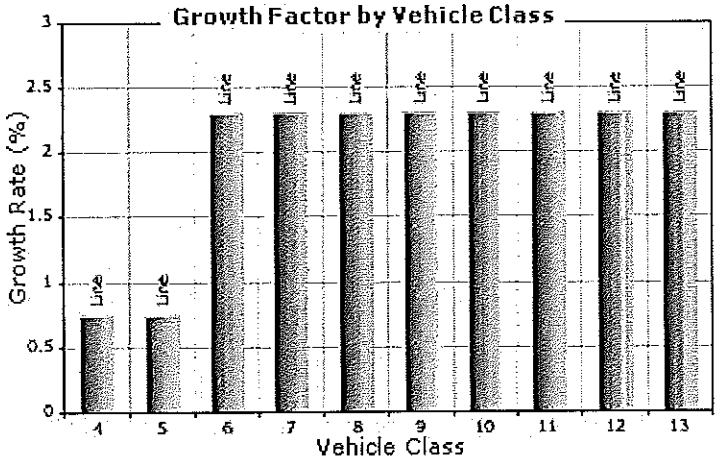
Traffic Inputs

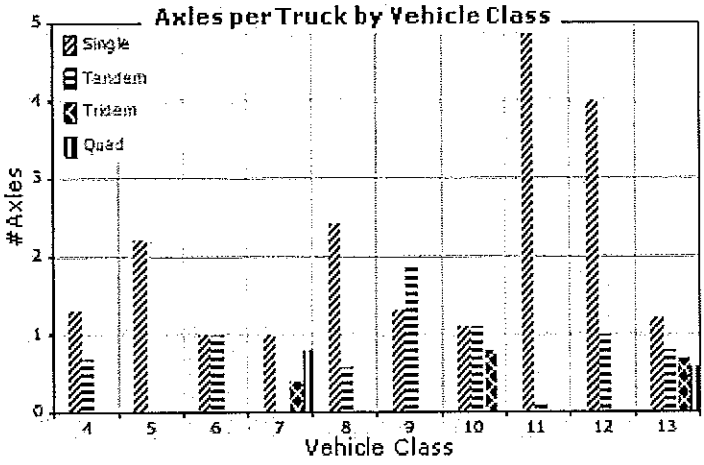
Graphical Representation of Traffic Inputs

Initial two-way AADTT:	826	Percent of trucks in design direction (%):	50.0
Number of lanes in design direction:	2	Percent of trucks in design lane (%):	100.0
		Operational speed (mph)	45.0









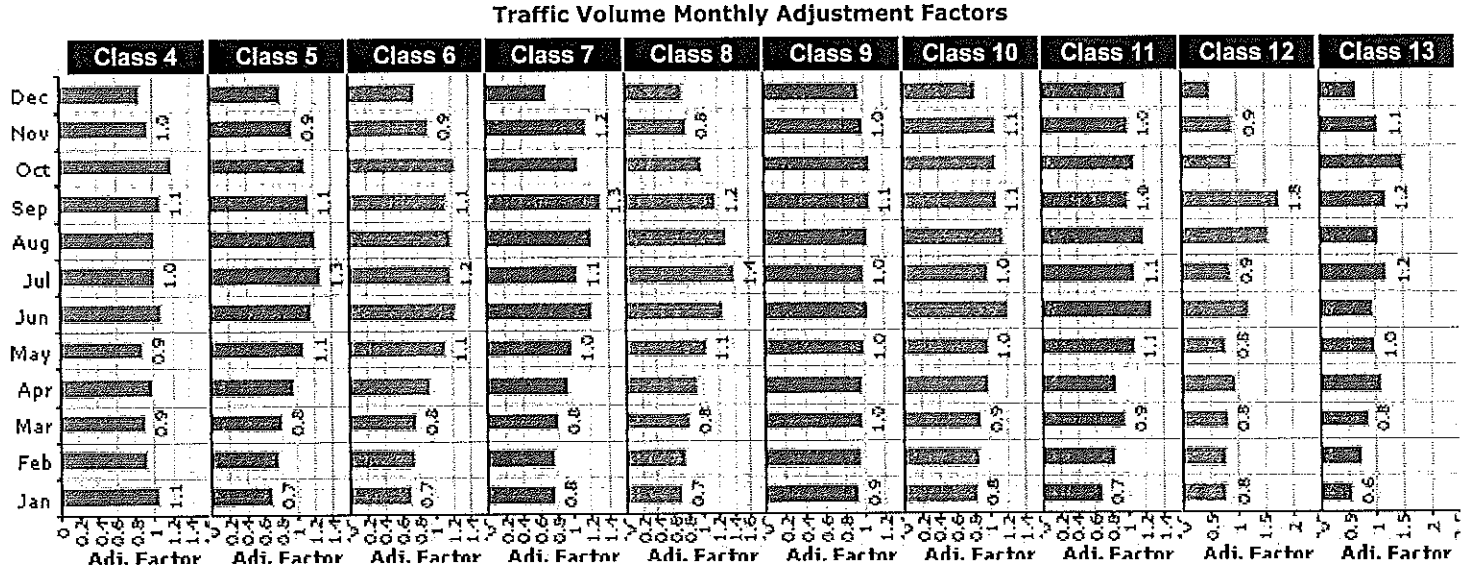


EXHIBIT #89

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	1.1	0.7	0.7	0.8	0.7	0.9	0.8	0.7	0.8	0.6
February	0.9	0.8	0.8	0.8	0.8	1.0	0.9	0.8	0.8	0.7
March	0.9	0.8	0.8	0.8	0.8	1.0	0.9	0.9	0.8	0.8
April	1.0	1.0	0.9	0.9	0.9	1.0	1.0	0.9	1.0	1.1
May	0.9	1.1	1.1	1.0	1.1	1.0	1.0	1.1	0.8	1.0
June	1.1	1.2	1.2	1.2	1.3	1.1	1.2	1.3	1.2	1.0
July	1.0	1.3	1.2	1.1	1.4	1.0	1.0	1.1	0.9	1.2
August	1.0	1.2	1.2	1.2	1.3	1.1	1.2	1.2	1.6	1.1
September	1.1	1.1	1.1	1.3	1.2	1.1	1.1	1.0	1.8	1.2
October	1.2	1.1	1.2	1.1	1.0	1.1	1.1	1.1	0.9	1.5
November	1.0	0.9	0.9	1.2	0.8	1.0	1.1	1.0	0.9	1.1
December	0.9	0.8	0.8	0.7	0.7	1.0	0.8	1.0	0.5	0.7

Distributions by Vehicle Class

Vehicle Class	AADTT Distribution (%) (Level 3)	Growth Factor	
		Rate (%)	Function
Class 4	5.8%	0.752%	Linear
Class 5	21.5%	0.752%	Linear
Class 6	4.4%	2.3%	Linear
Class 7	4%	2.3%	Linear
Class 8	54.6%	2.3%	Linear
Class 9	6.1%	2.3%	Linear
Class 10	3.6%	2.3%	Linear
Class 11	0%	2.3%	Linear
Class 12	0%	2.3%	Linear
Class 13	0%	2.3%	Linear

Truck Distribution by Hour

Hour	Distribution (%)	Hour	Distribution (%)
12 AM	1.02%	12 PM	7.3%
1 AM	0.93%	1 PM	7.09%
2 AM	1.25%	2 PM	6.82%
3 AM	1.58%	3 PM	6.23%
4 AM	2.39%	4 PM	5.44%
5 AM	3.46%	5 PM	4.44%
6 AM	5.19%	6 PM	3.58%
7 AM	6.12%	7 PM	2.67%
8 AM	6.59%	8 PM	2.14%
9 AM	6.93%	9 PM	1.79%
10 AM	7.09%	10 PM	1.56%
11 AM	7.3%	11 PM	1.09%
		Total	100%

Axle Configuration

Traffic Wander	
Mean wheel location (in.)	15
Traffic wander standard deviation (in.)	10
Design lane width (ft)	12

Axle Configuration	
Average axle width (ft)	8.5
Dual tire spacing (in.)	12
Tire pressure (psi)	120

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

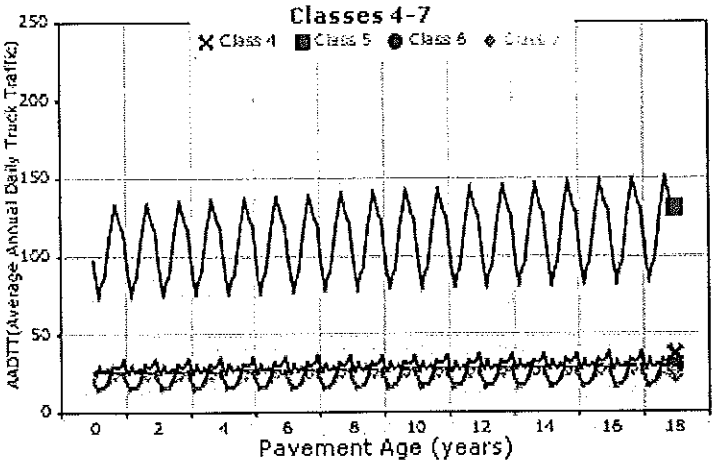
Number of Axles per Truck

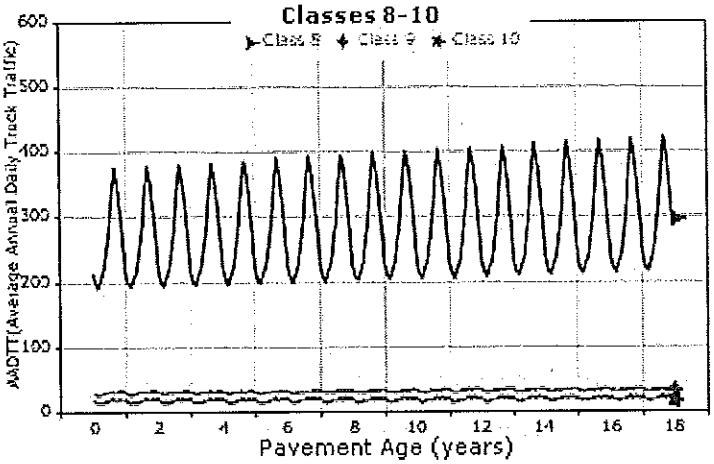
Vehicle Class	Single Axle	Tandem Axle	Tridem Axle	Quad Axle
Class 4	1.3	0.7	0	0
Class 5	2.2	0	0	0
Class 6	1	1	0	0
Class 7	1	0	0.4	0.8
Class 8	2.4	0.6	0	0
Class 9	1.3	1.9	0	0
Class 10	1.1	1.1	0.8	0
Class 11	4.9	0.1	0	0
Class 12	4	1	0	0
Class 13	1.2	0.8	0.7	0.6

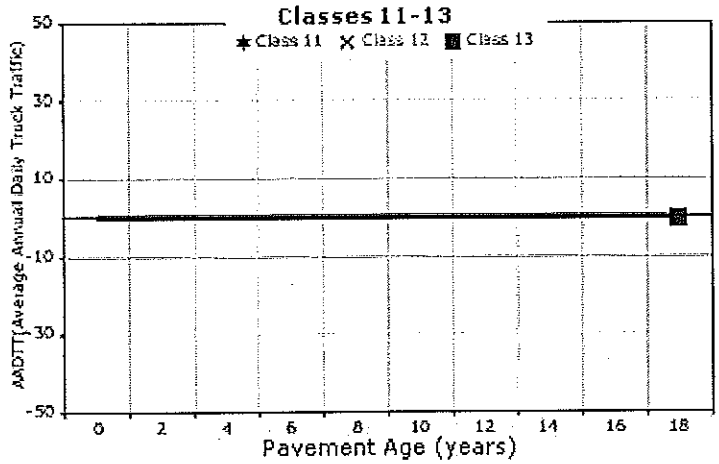
EXHIBIT #90

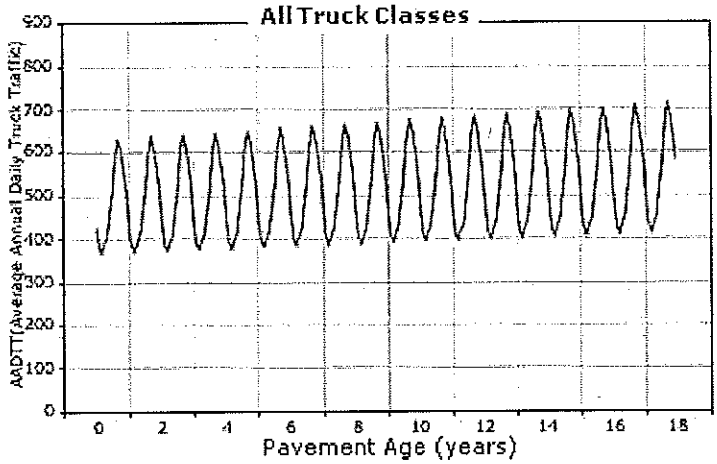
AADTT (Average Annual Daily Truck Traffic) Growth

* Traffic cap is not enforced









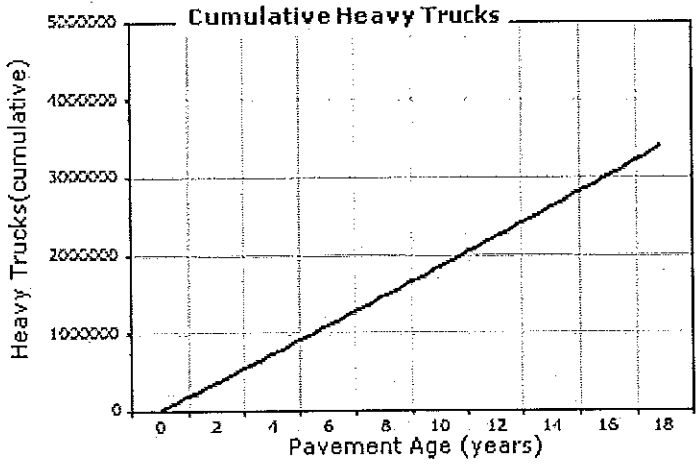
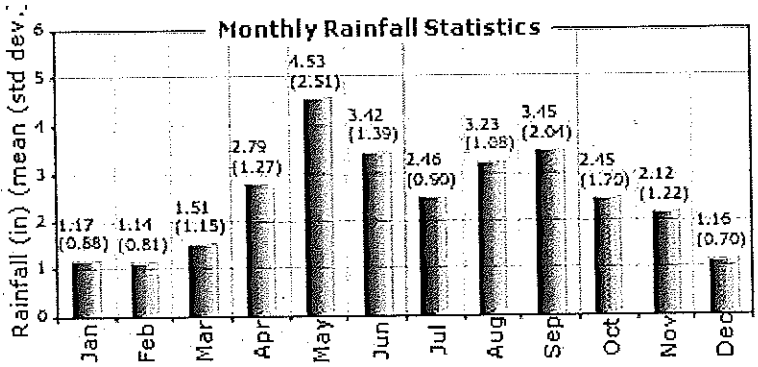


EXHIBIT #91

Climate Inputs

Climate Data Sources:

Climate Station Cities:	Location (lat lon elevation(ft))
RACINE, WI	42.76100 -87.81400 665

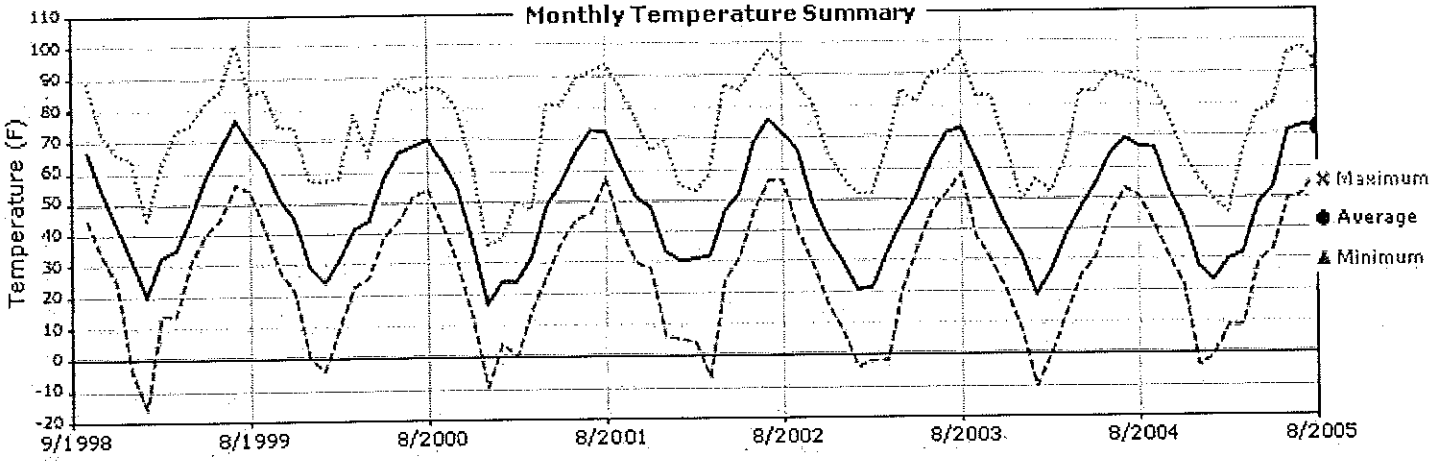


Annual Statistics:

Mean annual air temperature (°F)	48.60
Mean annual precipitation (in.)	29.44
Freezing index (°F - days)	786.30
Average annual number of freeze/thaw cycles:	55.83

Water table depth (ft)	10.00

Monthly Climate Summary:



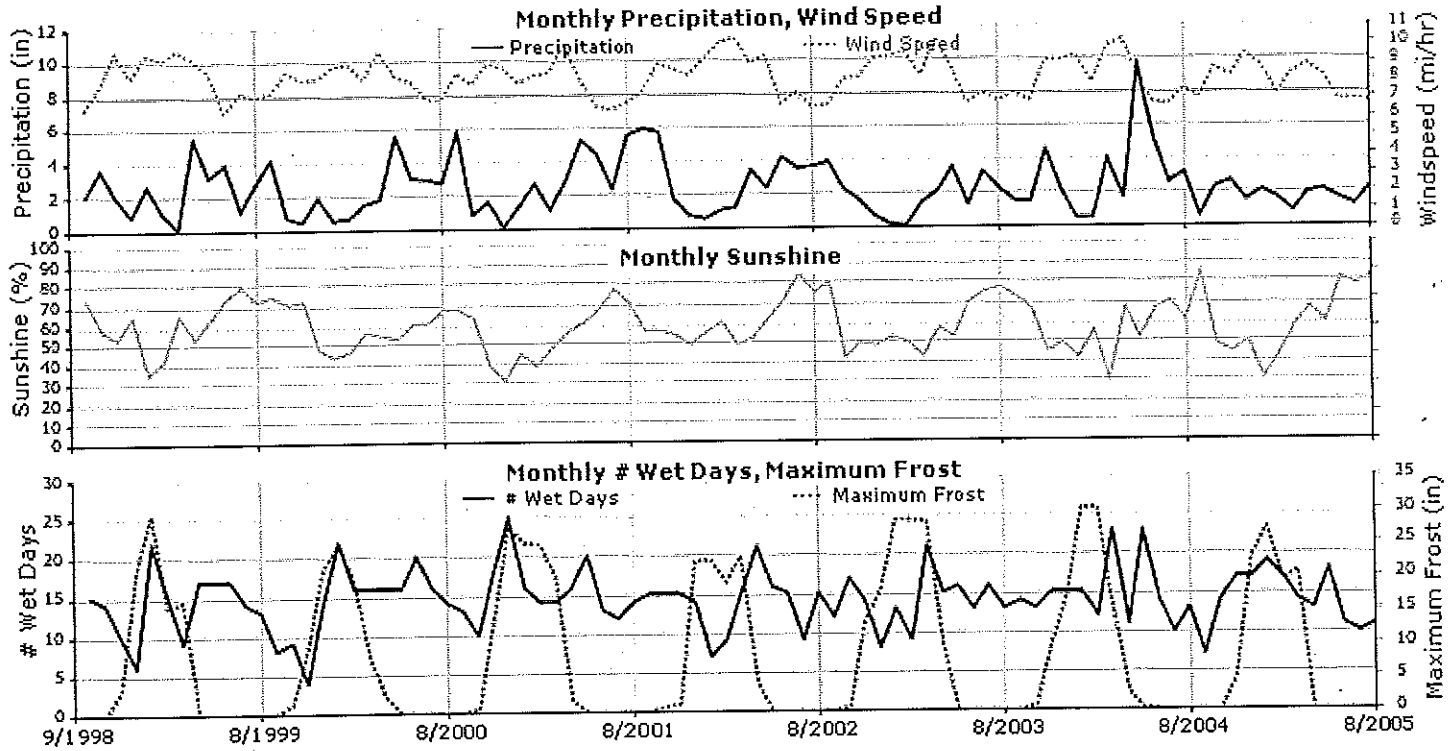
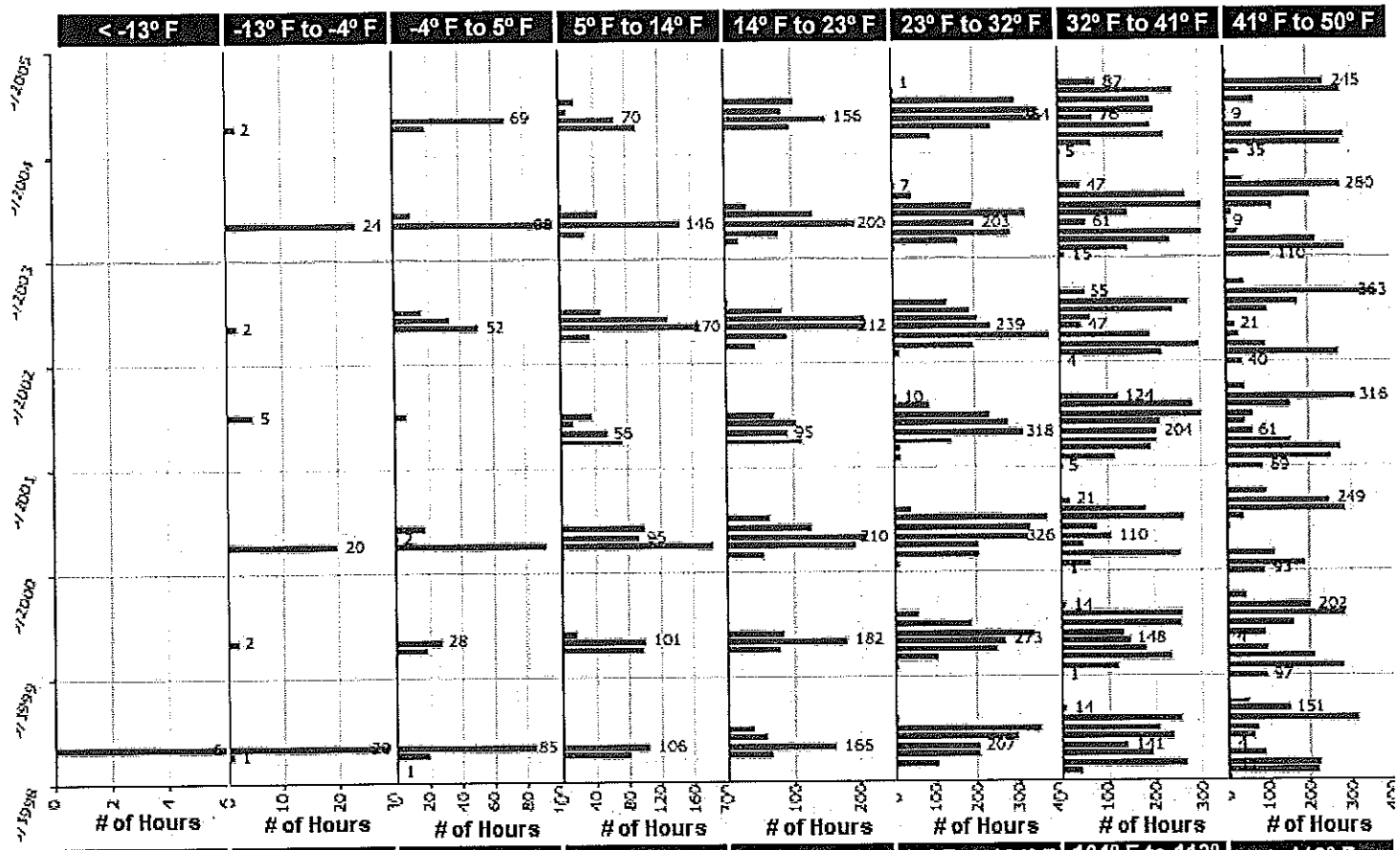


EXHIBIT #92

27880001 Wauk Bypass Section#3 HMA 1-13-15

File Name: C:\ME Designs\12290401 IH43 10-29-14\27880001 Wauk Bypass Section#3 HMA 1-13-15.dgpx

Hourly Air Temperature Distribution by Month:



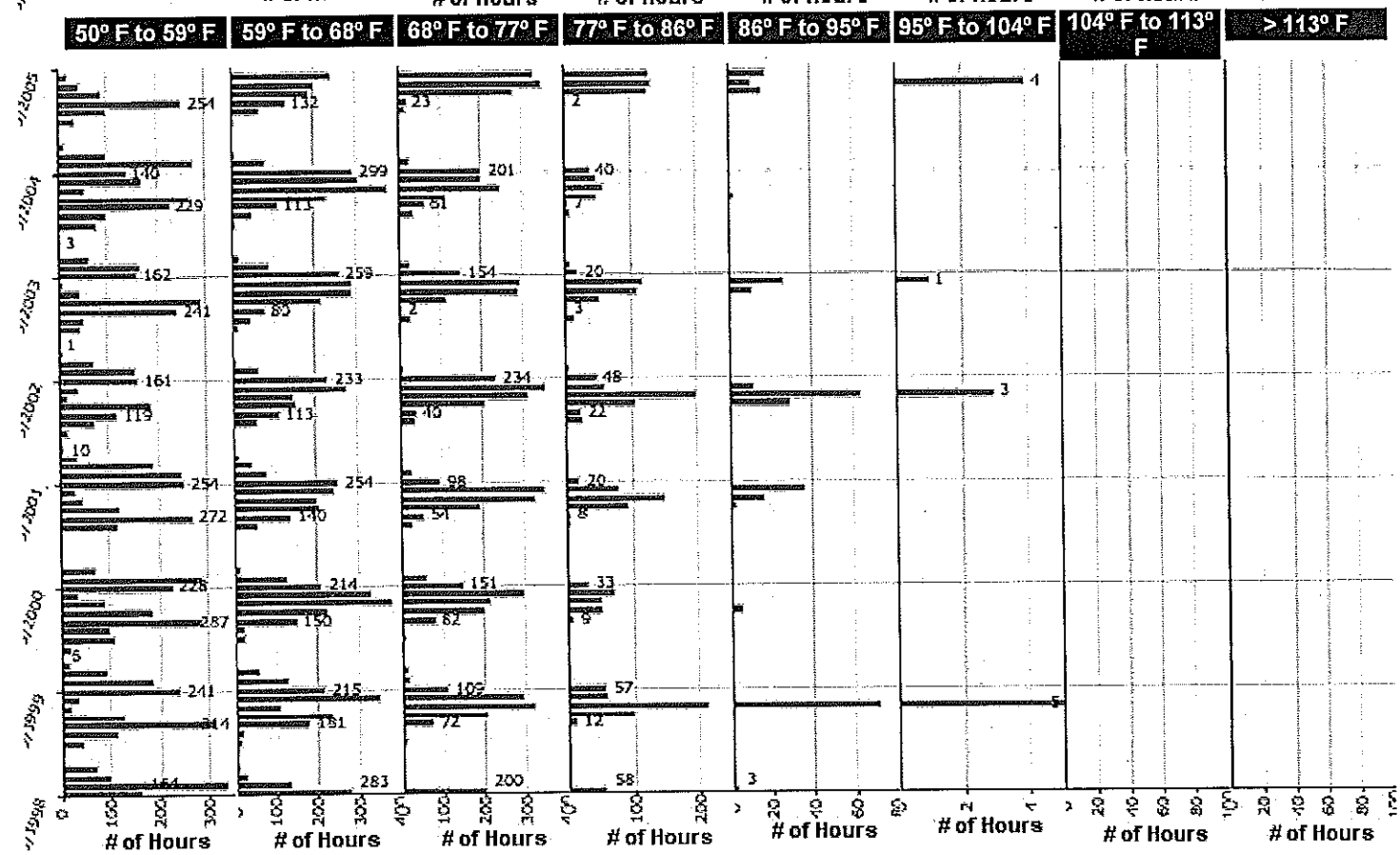


EXHIBIT #93

Design Properties

HMA Design Properties

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 Non-stabilized Base : A-1-a	Non-stabilized Base (4)	1.00
Layer 3 Non-stabilized Base : A-1-a	Non-stabilized Base (4)	1.00
Layer 4 Subgrade : A-4	Subgrade (5)	-

EXHIBIT #94

Thermal Cracking (Input Level: 3)

Indirect tensile strength at 14 °F (psi)	554.33

Thermal Contraction	
Is thermal contraction calculated?	True
Mix coefficient of thermal contraction (in./in./°F)	-
Aggregate coefficient of thermal contraction (in./in./°F)	5.0e-006
Voids in Mineral Aggregate (%)	16.2

	Creep Compliance (1/psi)		
Loading time (sec)	-4 °F	14 °F	32 °F
1	1.91e-007	3.42e-007	4.91e-007
2	2.14e-007	4.08e-007	6.57e-007
5	2.49e-007	5.16e-007	9.67e-007
10	2.79e-007	6.15e-007	1.30e-006
20	3.13e-007	7.34e-007	1.73e-006
50	3.63e-007	9.28e-007	2.55e-006
100	4.08e-007	1.11e-006	3.42e-006

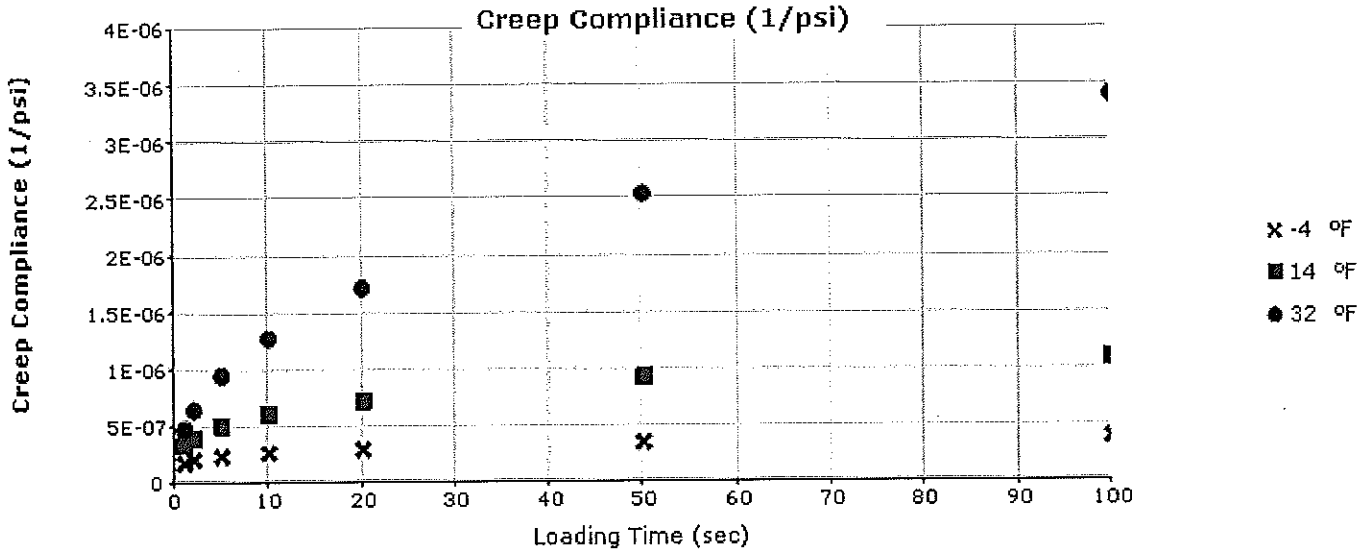
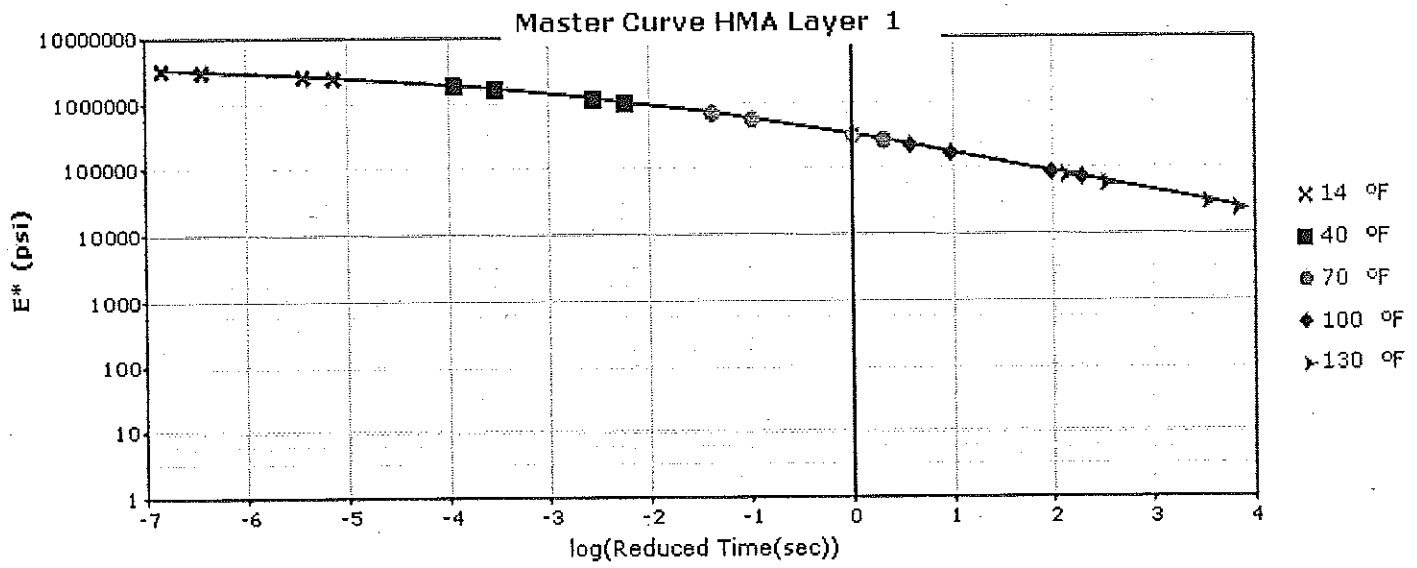
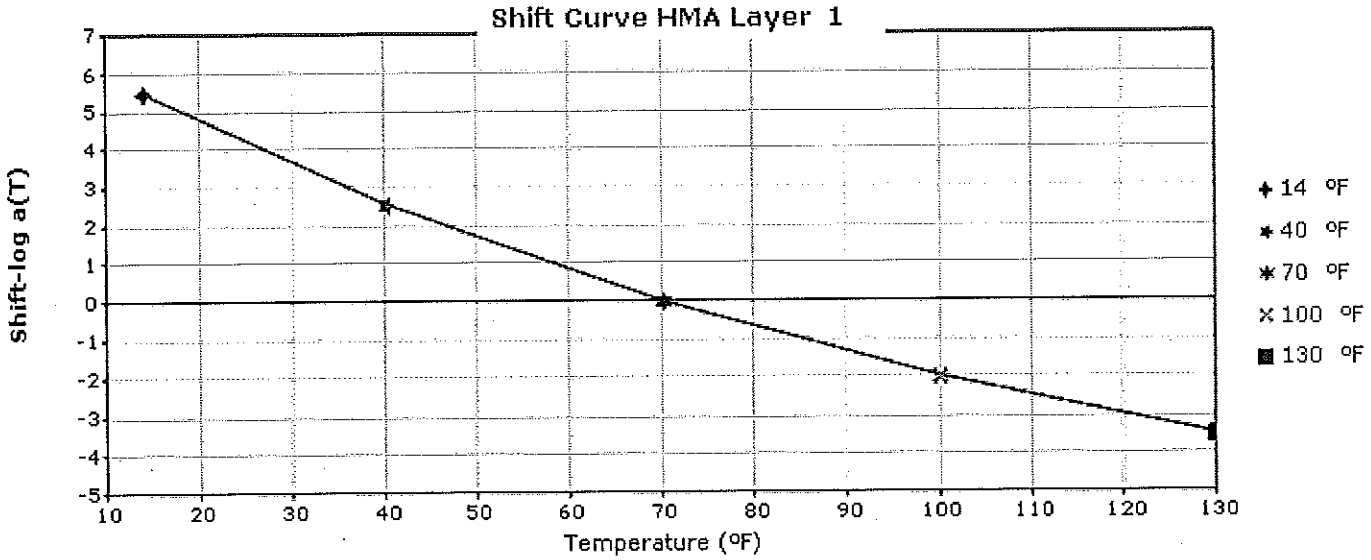


EXHIBIT #95

HMA Layer 1: Layer 1 Flexible : Default asphalt concrete





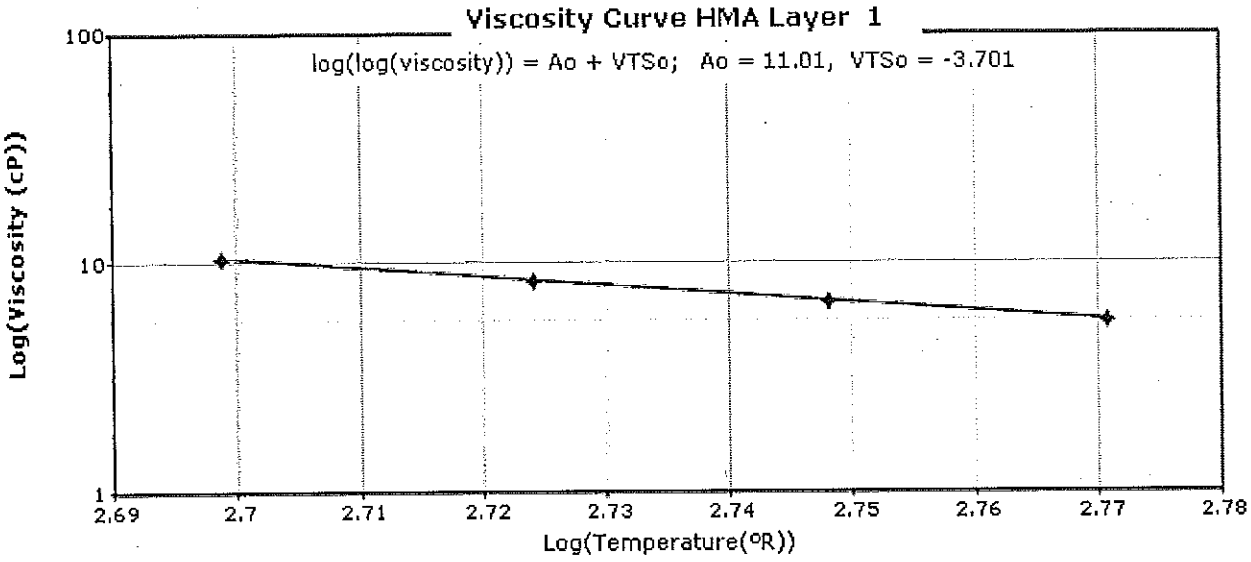
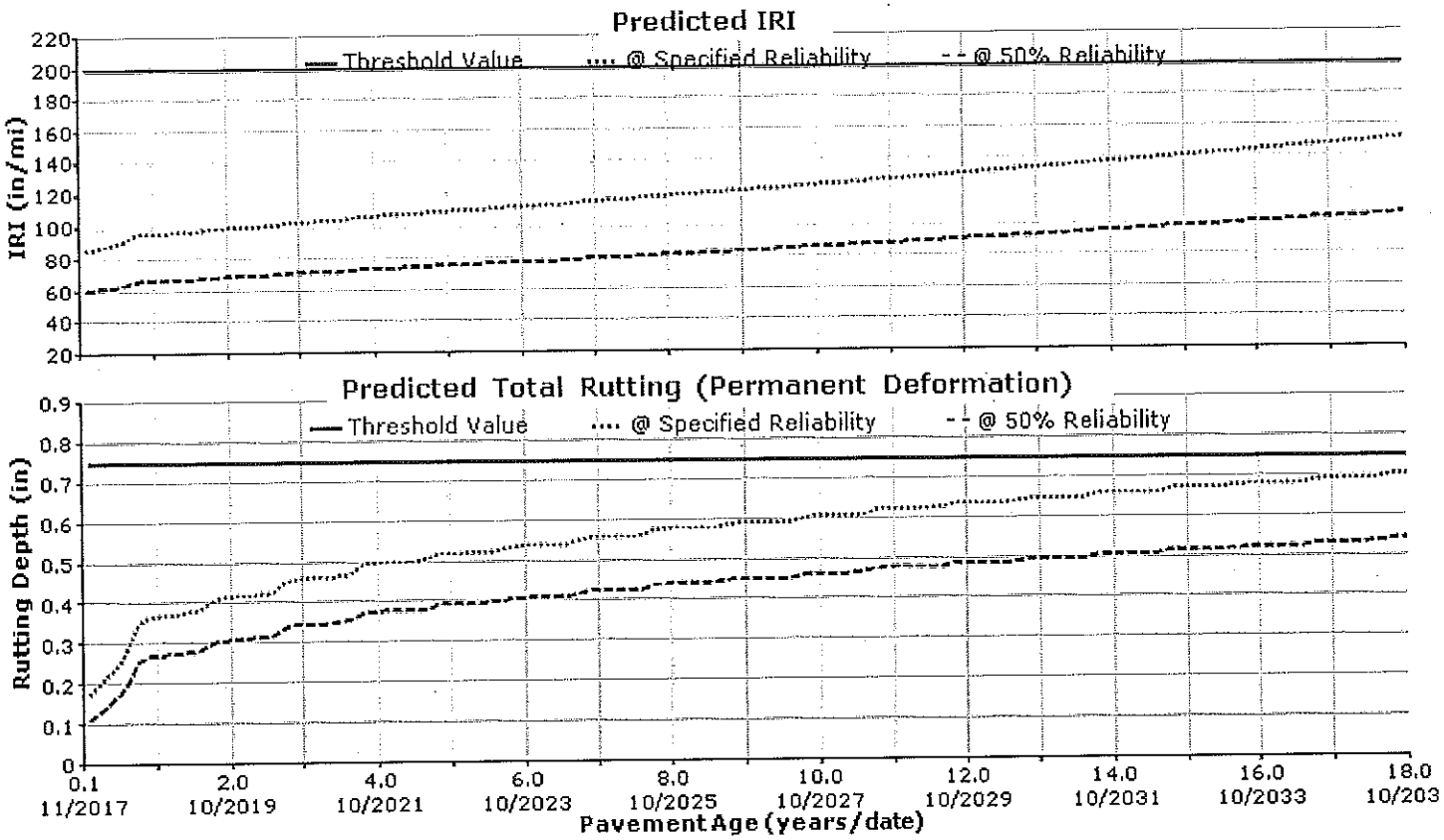
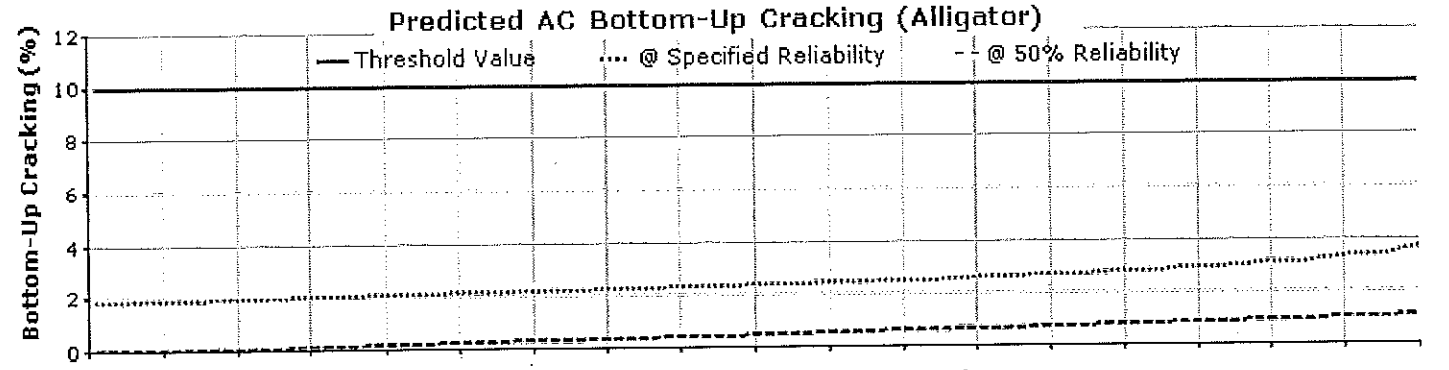


EXHIBIT #96

Analysis Output Charts





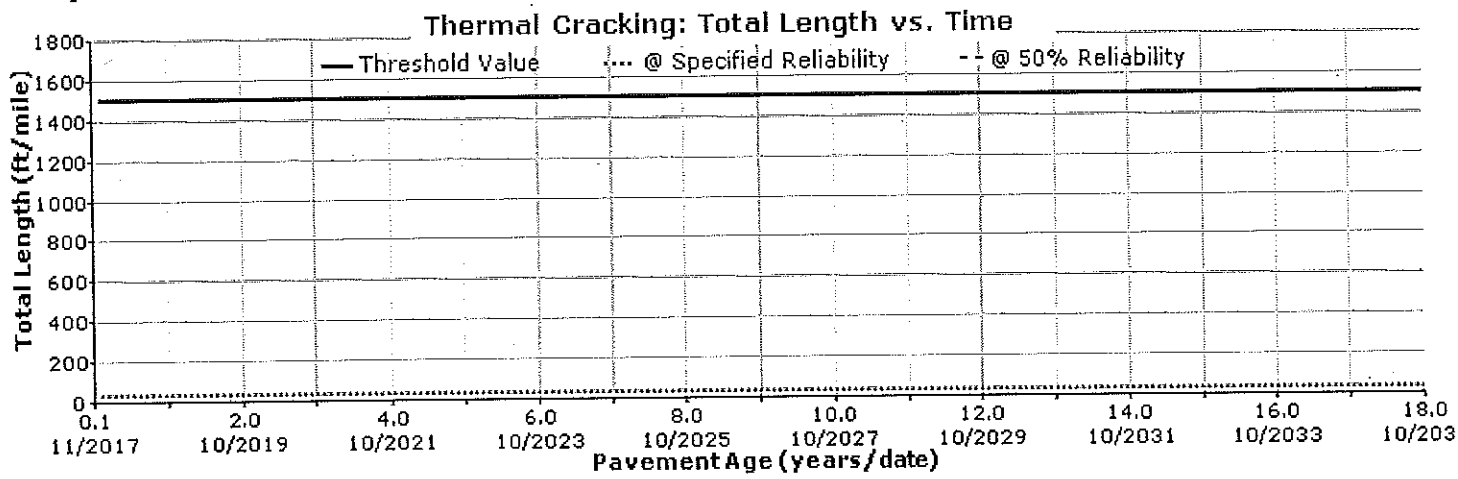
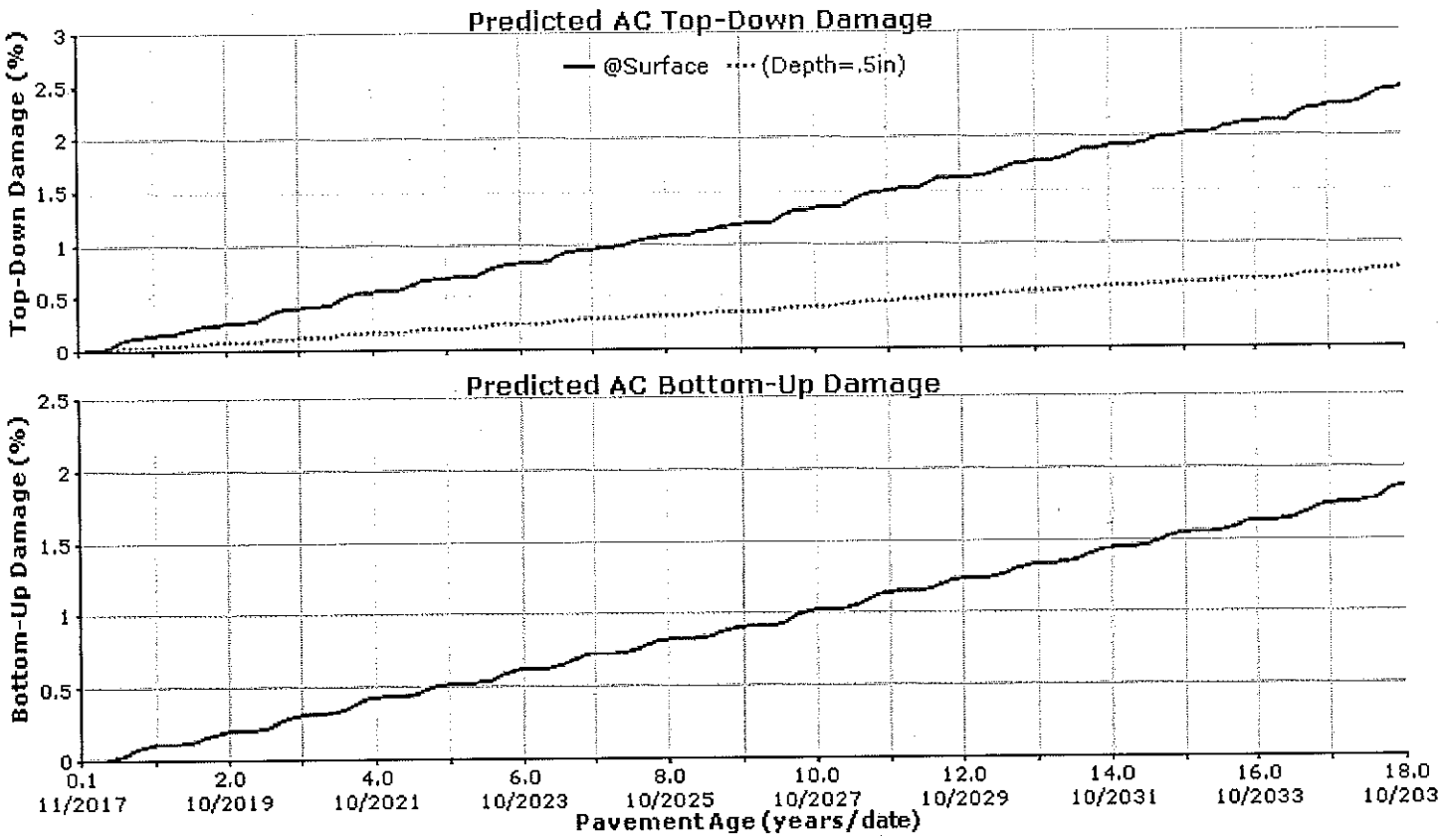


EXHIBIT #97

27880001 Wauk Bypass Section#3 HMA 1-13-15

File Name: C:\ME Designs\12290401 IH43 10-29-14\27880001 Wauk Bypass Section#3 HMA 1-13-15.dgpx



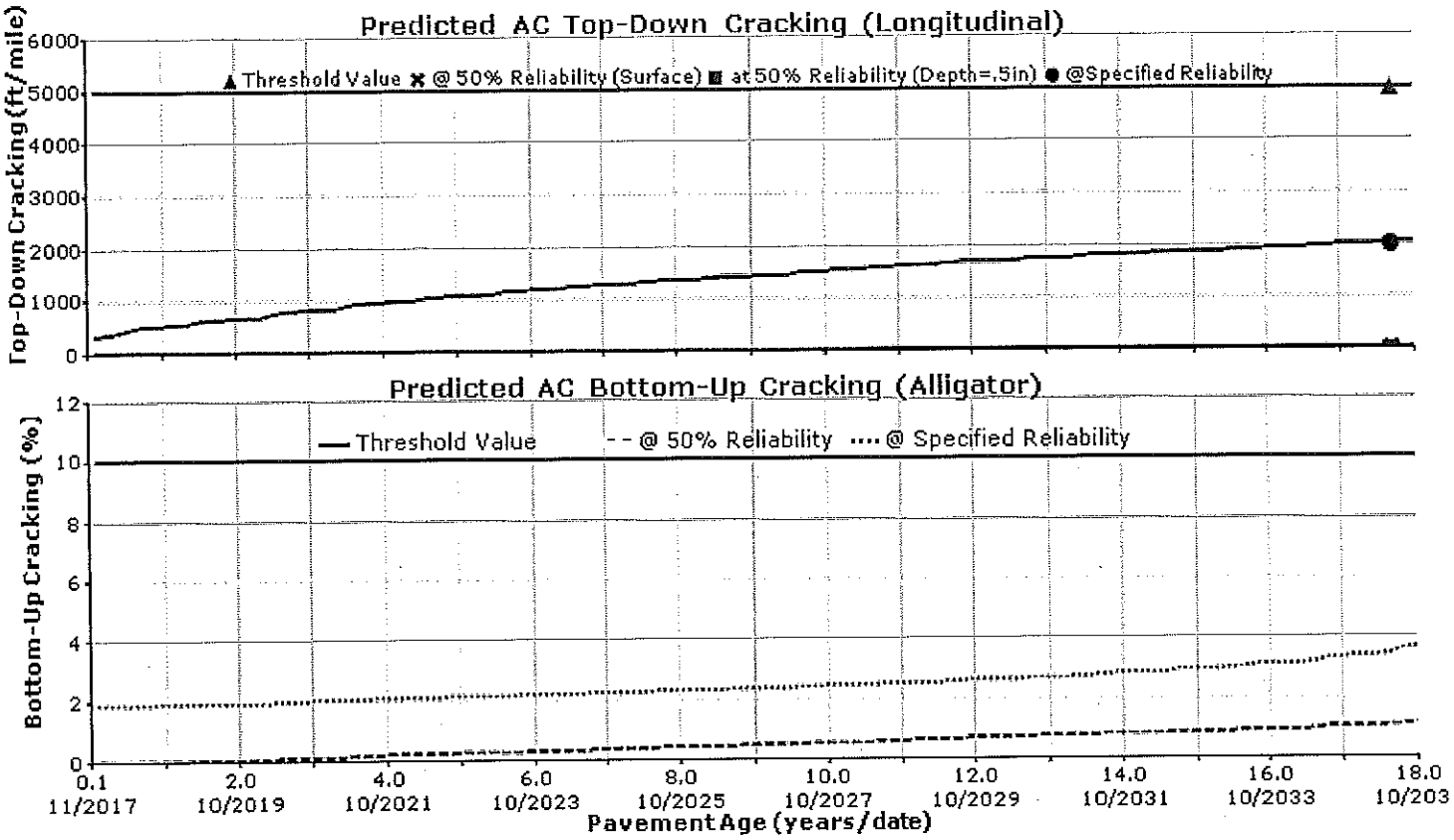


EXHIBIT #98

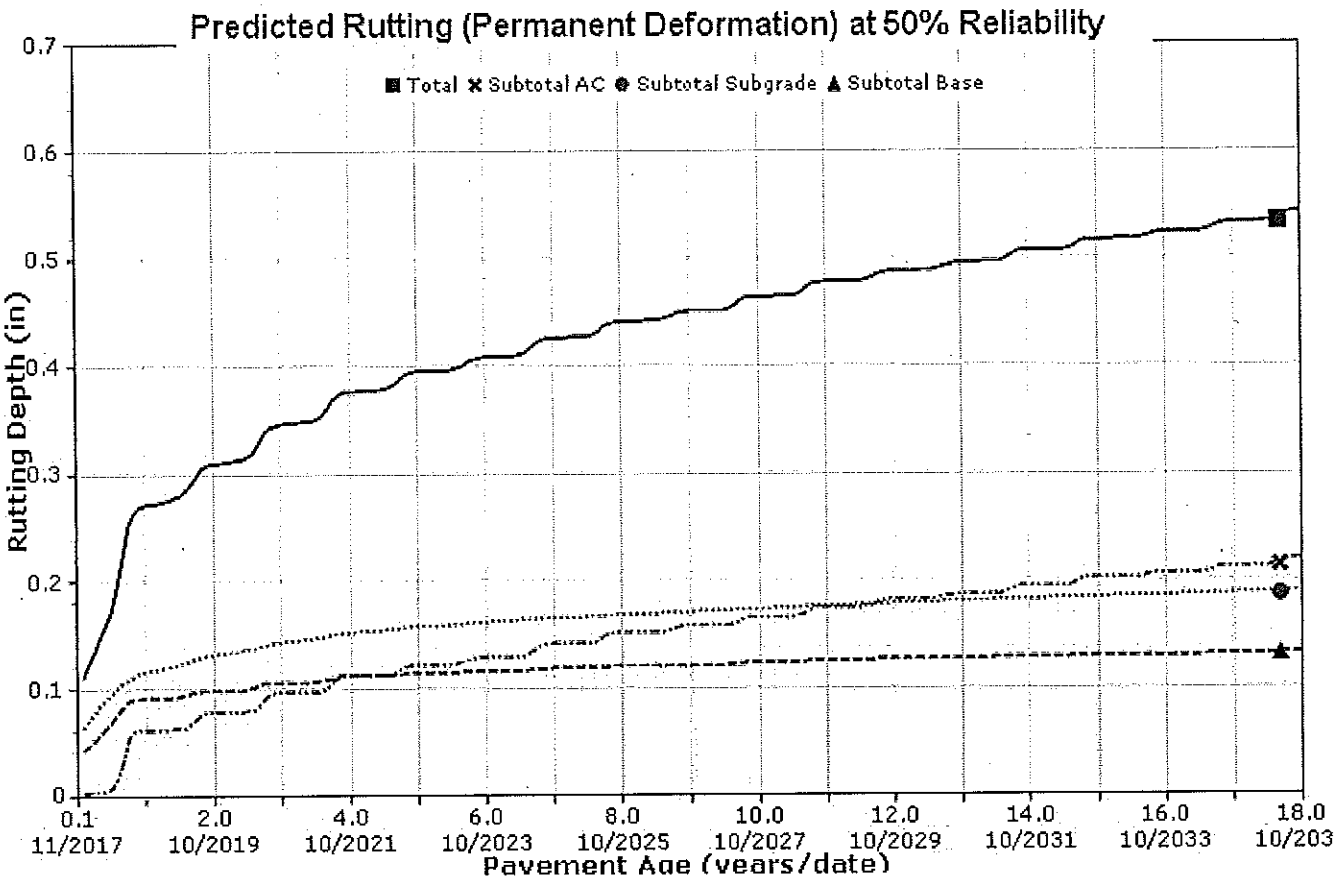
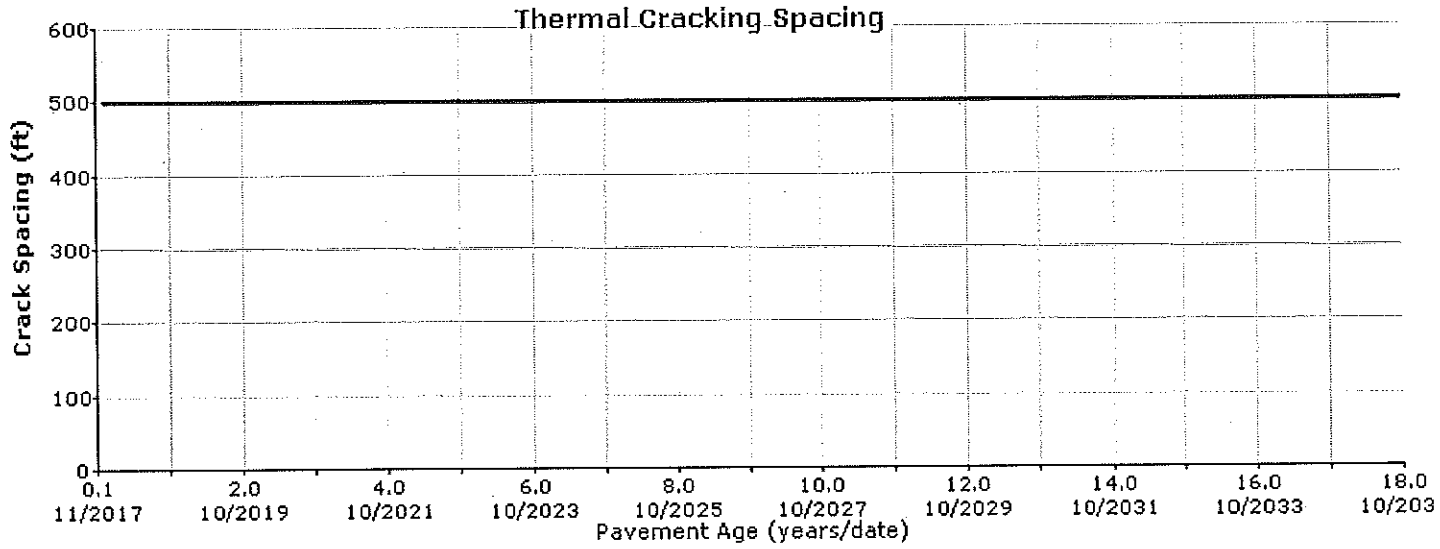

Predicted Rutting (Permanent Deformation) at 50% Reliability
Total
Subtotal AC
Subtotal Subgrade
Subtotal Base
Rutting Depth (in)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)

EXHIBIT #99


Thermal Cracking Spacing
Crack Spacing (ft)
600
500
400
300
200
100
0
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)

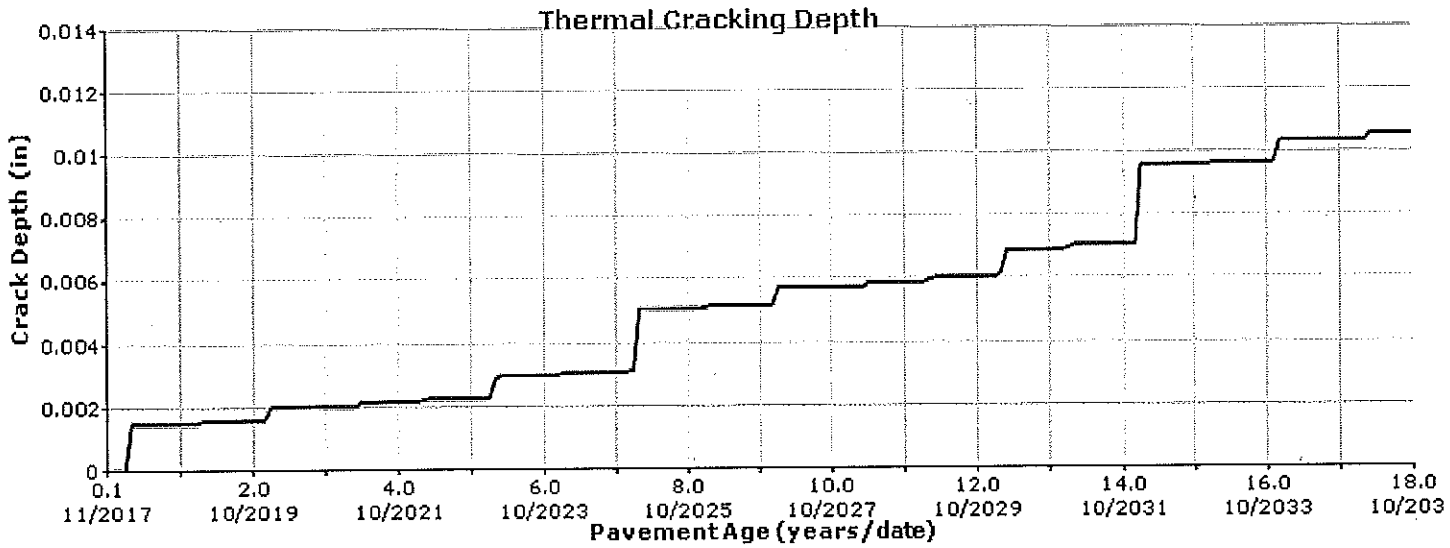
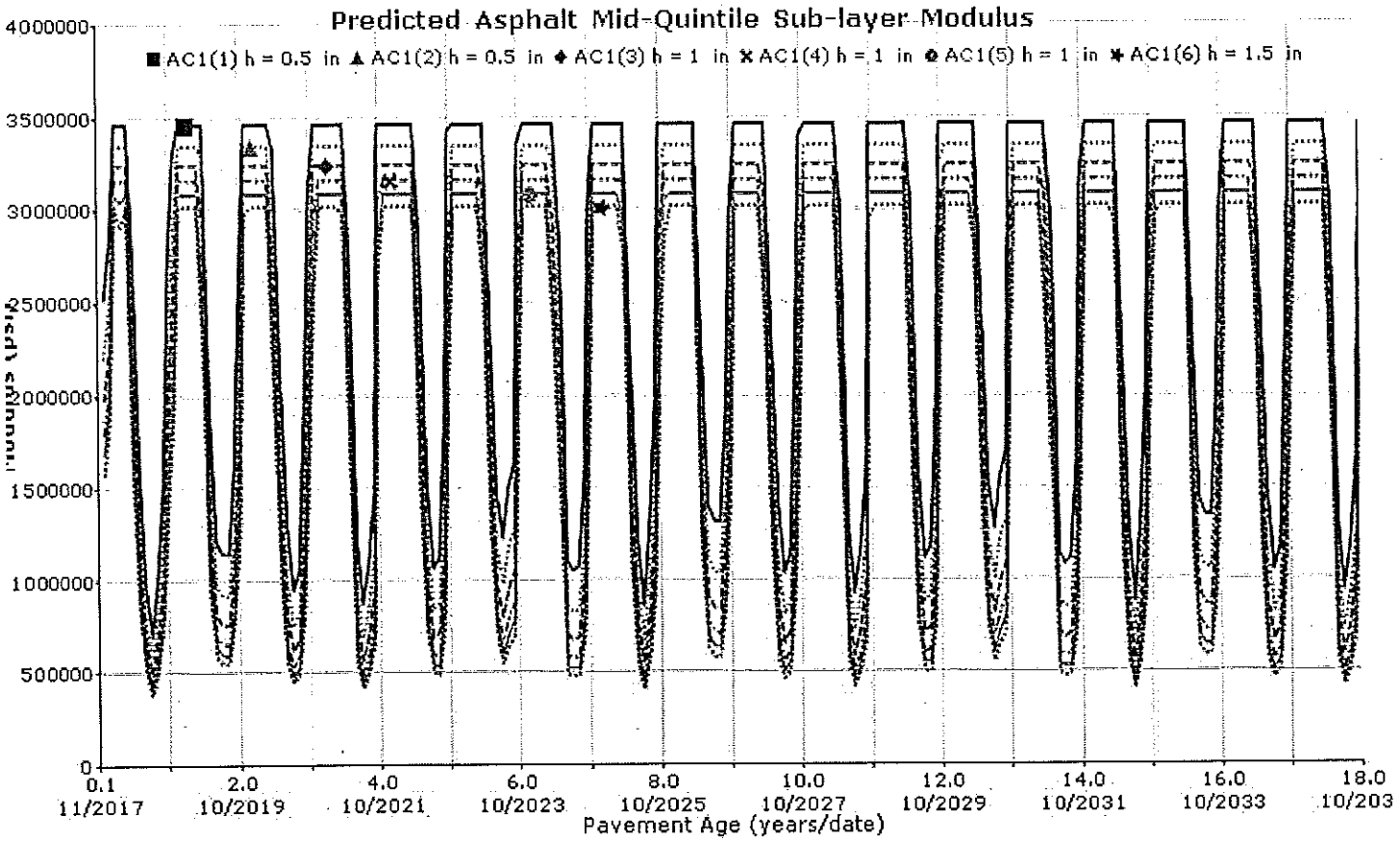

Thermal Cracking Depth
Crack Depth (in)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)

EXHIBIT #100


Predicted Asphalt Mid-Quintile Sub-layer Modulus
AC1(1) h = 0.5 in
AC1(2) h = 0.5 in
AC1(3) h = 1 in
AC1(4) h = 1 in
AC1(5) h = 1 in
AC1(6) h = 1.5 in
Resilient Modulus
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)

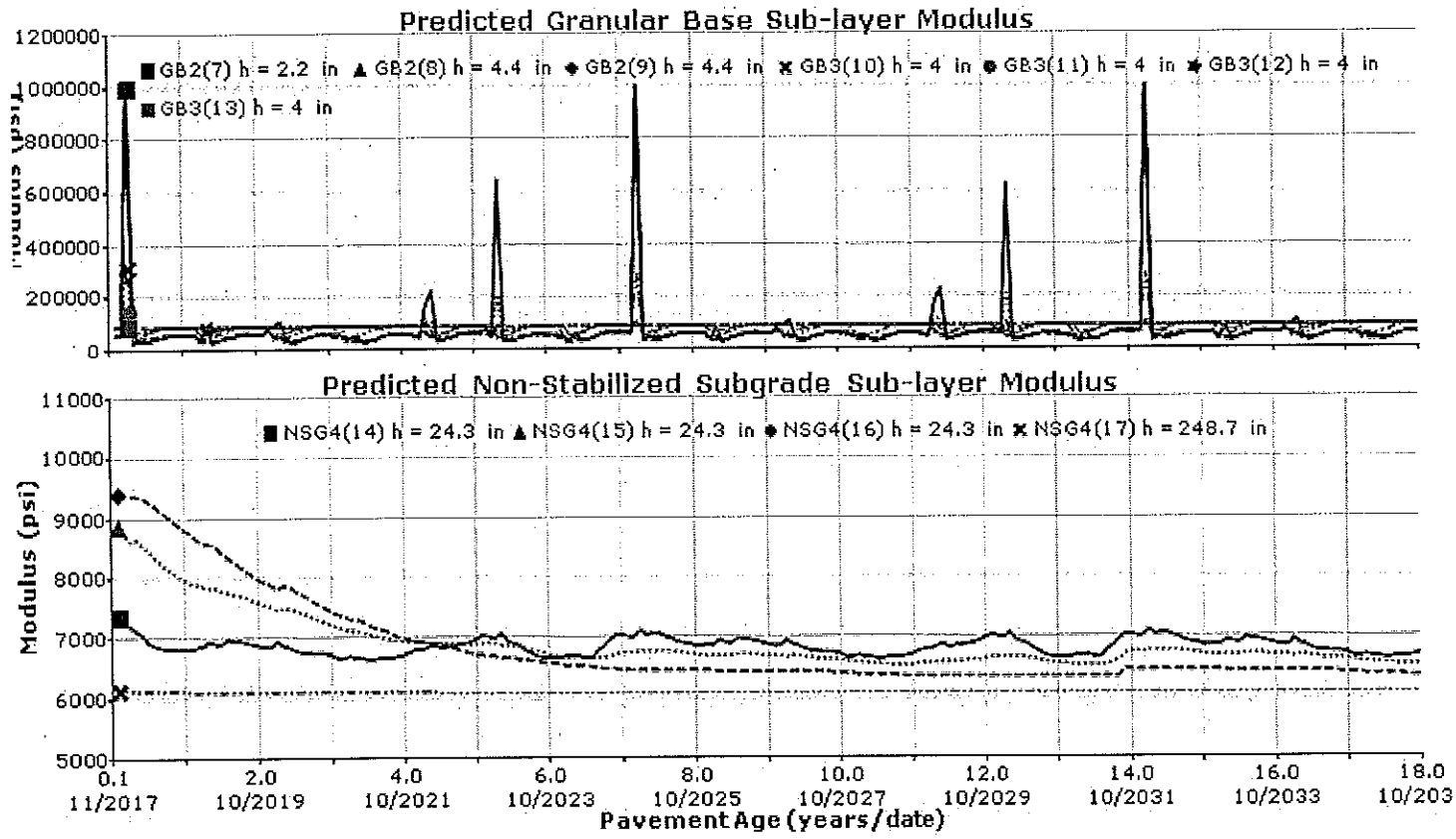

Predicted Granular Base Sub-layer Modulus
GB2(7) h = 2.2 in
GB2(8) h = 4.4 in
GB2(9) h = 4.4 in
GB3(10) h = 4 in
GB3(11) h = 4 in
GB3(12) h = 4 in
GB3(13) h = 4 in
Resilient Modulus
1200000
1000000
800000
600000
400000
200000
0
Predicted Non-Stabilized Subgrade Sub-layer Modulus
NSG4(14) h = 24.3 in
NSG4(15) h = 24.3 in
NSG4(16) h = 24.3 in
NSG4(17) h = 248.7 in
Modulus (psi)
11000
10000
9000
8000
7000
6000
5000
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)

EXHIBIT #101

Layer Information

Layer 1 Flexible : Default asphalt concrete

Asphalt		
Thickness (in.)	5.5	
Unit weight (pcf)	145.0	
Poisson's ratio	Is Calculated?	False
	Ratio	0.30
	Parameter A	-
	Parameter B	-

Asphalt Dynamic Modulus (Input Level: 3)

Gradation	Percent Passing
3/4-inch sieve	95
3/8-inch sieve	90
No.4 sieve	60
No.200 sieve	5

Asphalt Binder

Parameter	Value
Grade	Superpave Performance Grade
Binder Type	58-28
A	11.01
VTS	-3.701

General Info

Name	Value
Reference temperature (°F)	70
Effective binder content (%)	9.2
Air voids (%)	7
Thermal conductivity (BTU/hr-ft-°F)	0.67
Heat capacity (BTU/lb-°F)	0.23

Identifiers

Field	Value
Display name/identifier	Default asphalt concrete
Description of object	
Author	
Date Created	1/13/2015 12:00:00 AM
Approver	
Date approved	1/13/2015 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Layer 2 Non-stabilized Base : A-1-a

Unbound	
Layer thickness (in.)	11.0
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)
40000.0

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

Identifiers

Field	Value
Display name/identifier	A-1-a
Description of object	Default material
Author	AASHTO
Date Created	12/9/2014 12:00:00 AM
Approver	
Date approved	12/9/2014 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	True

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	128.1
Saturated hydraulic conductivity (ft/hr)	False	2.616e-02
Specific gravity of solids	False	2.7
Optimum gravimetric water content (%)	False	7.2

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	4.7511
bf	1.7494
cf	0.7630
hr	184.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	7.0
#100	
#80	
#60	
#50	
#40	18.0
#30	
#20	
#16	
#10	32.0
#8	
#4	44.0
3/8-in.	61.0
1/2-in.	
3/4-in.	82.0
1-in.	
1 1/2-in.	97.0
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	

Layer 3 Non-stabilized Base : A-1-a

Unbound	
Layer thickness (in.)	16.0
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)
42000.0

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

Identifiers

Field	Value
Display name/identifier	A-1-a
Description of object	Default material
Author	AASHTO
Date Created	12/9/2014 12:00:00 AM
Approver	
Date approved	12/9/2014 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	True

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	109.6
Saturated hydraulic conductivity (ft/hr)	False	8.267e+02
Specific gravity of solids	True	2.6
Optimum gravimetric water content (%)	True	16.6

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	9.2765
bf	3.7128
cf	2.9466
hr	160.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	5.0
#100	
#80	
#60	
#50	
#40	
#30	
#20	
#16	
#10	10.0
#8	
#4	
3/8-in.	
1/2-in.	30.0
3/4-in.	
1-in.	
1 1/2-in.	60.0
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	90.0

EXHIBIT #104

Layer 4 Subgrade : A-4

Unbound	
Layer thickness (in.)	Semi-infinite
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)
9450.0

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

Identifiers

Field	Value
Display name/identifier	A-4
Description of object	Default material
Author	AASHTO
Date Created	1/13/2015 12:00:00 AM
Approver	
Date approved	1/13/2015 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	False

	Is User Defined?	Value
Maximum dry unit weight (pcf)	True	116
Saturated hydraulic conductivity (ft/hr)	False	9.138e-06
Specific gravity of solids	True	2.65
Optimum gravimetric water content (%)	True	14

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	69.7987
bf	0.9890
cf	0.4694
hr	500.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	52.0
#100	
#80	
#60	
#50	
#40	65.0
#30	
#20	
#16	
#10	74.0
#8	
#4	85.0
3/8-in.	
1/2-in.	
3/4-in.	
1-in.	
1 1/2-in.	
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	

EXHIBIT #105

Calibration Coefficients

AC Fatigue

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

$$C = 10^M$$

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

k1: 0.007566
k2: 3.9492
k3: 1.281
Bf1: 1
Bf2: 1
Bf3: 1

AC Rutting

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

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

$$C_1 = -0.1039 * H_a^2 + 2.4868 * H_a - 17.342$$

$$C_2 = 0.0172 * H_a^2 - 1.7331 * H_a + 27.428$$

Where:

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

$\varepsilon_p = plastic\ strain\left(^{in}/_{in}\right)$

$\varepsilon_r = resilient\ strain\left(^{in}/_{in}\right)$

$T = layer\ temperature(^{\circ}F)$

$N = number\ of\ load\ repetitions$

K1: -3.35412	K2: 1.5606	K3: 0.4791
Br2: 1	Br3: 1	Br1: 1

AC Rutting Standard Deviation

0.24*Pow(RUT,0.8026)+0.001

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: 1.5	Level 1 Standard Deviation: 0.1468 * THERMAL + 65.027
Level 2 K: 0.5	Level 2 Standard Deviation: 0.2841 *THERMAL + 55.462
Level 3 K: 1.5	Level 3 Standard Deviation: 0.3972 * THERMAL + 20.422

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: 1	k2: 1	Bc1: 1	Bc2:1

EXHIBIT #106

Subgrade Rutting			
$\delta_a(N) = \beta_{s_1} k_1 \varepsilon_v h \left(\frac{\varepsilon_0}{\varepsilon_r}\right) \left\| e^{-\left(\frac{\rho}{N}\right)^{\beta}} \right\|$		$\delta_a = permanent\ deformation\ for\ the\ layer$ $N = number\ of\ repetitions$ $\varepsilon_v = average\ veritcal\ strain(in/in)$ $\varepsilon_0, \beta, \rho = material\ properties$ $\varepsilon_r = resilient\ strain(in/in)$	
Granular		**Fine**	
k1: 2.03	Bs1: 1	k1: 1.35	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				**AC Bottom Up Cracking**		
$FC_{top} = \left(\frac{C_4}{1 + e^{(C_1 - C_2 * log_{10}(Damage))}}\right) * 10.56$				$FC = \left(\frac{6000}{1 + e^{(C_1 * C_1' + C_2 * C_2' log_{10}(D * 100))}}\right) * \left(\frac{1}{60}\right)$ $C_2' = -2.40874 - 39.748 * (1 + h_{ac})^{-2.856}$ $C_1' = -2 * C_2'$		
c1: 7	c2: 3.5	c3: 0	c4: 1000	c1: 1	c2: 1	c3: 6000
AC Cracking Top Standard Deviation				**AC Cracking Bottom 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				IRI Flexible Pavements			
$FC_{ctb} = C_1 + \frac{C_2}{1 + e^{C_3 - C_4(Damage)}}$				C1 - Rutting C2 - Fatigue Crack		C3 - Transverse Crack C4 - Site Factors	
C1: 1	C2: 1	C3: 0	C4: 1000	C1: 40	C2: 0.4	C3: 0.008	C4: 0.015
CSM Standard Deviation							
CTB*1							

EXHIBIT #107

27880001 Wauk Bypass Section#4 PCC 1-12-15

File Name: C:\ME Designs\12290401 IH43 10-29-14\27880001 Wauk Bypass Section#4 PCC 1-12-15.dgpx

Design Inputs

Design Life:	25 years	Existing construction:	-	Climate Data Sources (Lat/Lon)	42.761, -87.814
Design Type:	Jointed Plain Concrete Pavement (JPCP)	Pavement construction:	September, 2017		
		Traffic opening:	October, 2017		

Design Structure

Layer type	Material Type	Thickness (in.):
PCC	JPCP Default	8.0
NonStabilized	A-1-a	6.0
NonStabilized	A-1-a	16.0
Subgrade	A-4	Semi-infinite

Joint Design:	
Joint spacing (ft)	15.0
Dowel diameter (in.)	1.25
Slab width (ft)	12.0

Traffic

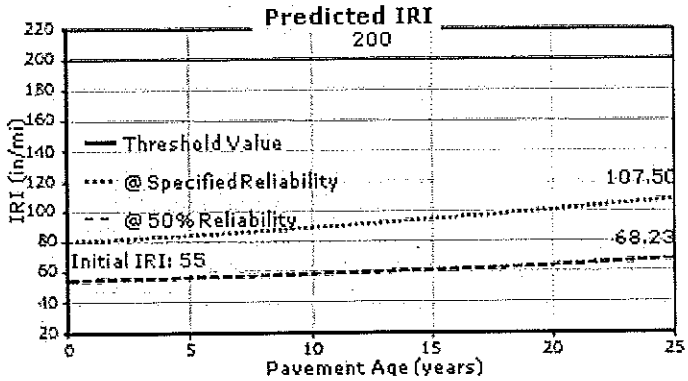
Age (year)	Heavy Trucks (cumulative)
2017 (initial)	826
2029 (12 years)	2,120,870
2042 (25 years)	4,812,060

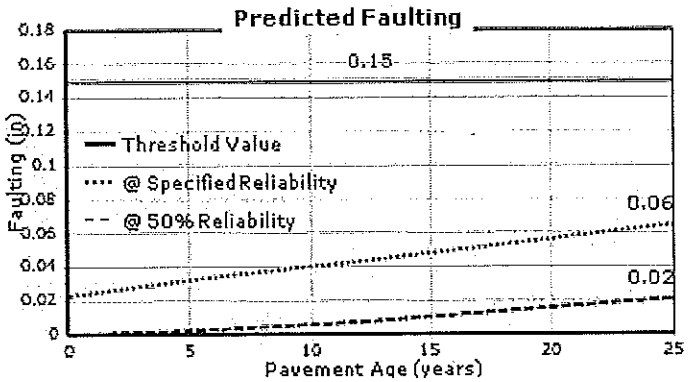
Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in./mile)	200.00	107.50	95.00	100.00	Pass
Mean joint faulting (in.)	0.15	0.06	95.00	100.00	Pass
JPCP transverse cracking (percent slabs)	15.00	6.52	95.00	99.99	Pass

Distress Charts





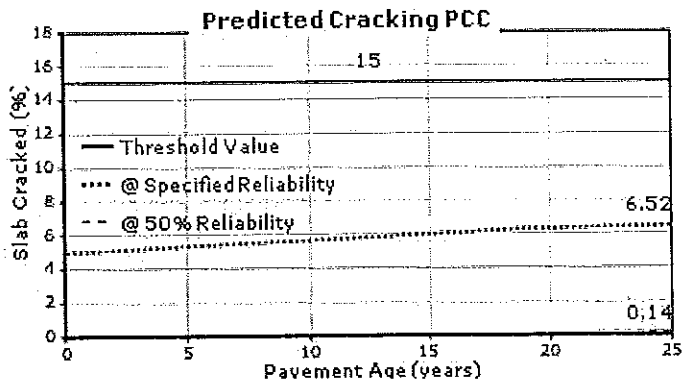
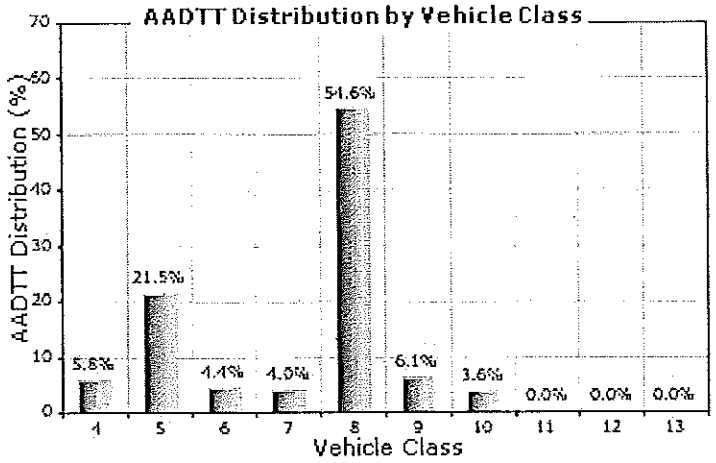


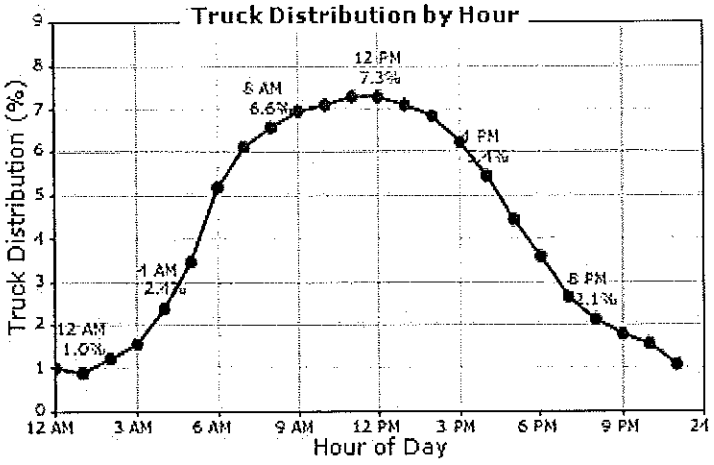
EXHIBIT #108

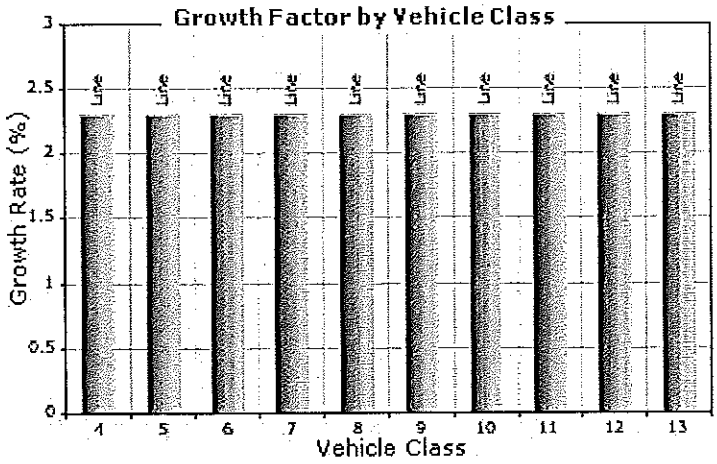
Traffic Inputs

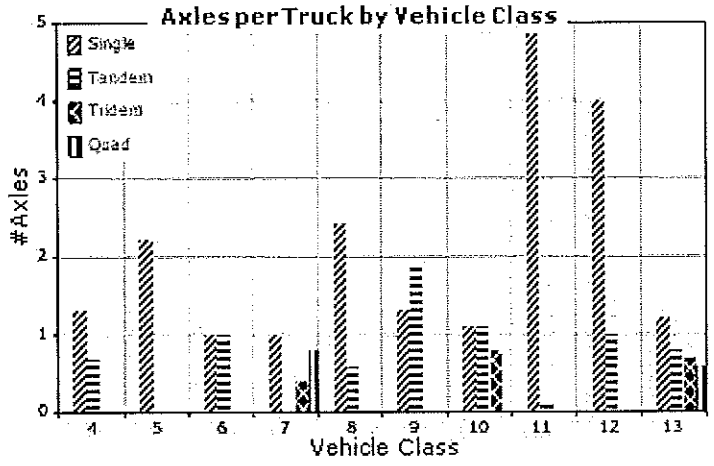
Graphical Representation of Traffic Inputs

Initial two-way AADTT:	826	Percent of trucks in design direction (%):	50.0
Number of lanes in design direction:	2	Percent of trucks in design lane (%):	100.0
		Operational speed (mph)	45.0









Traffic Volume Monthly Adjustment Factors

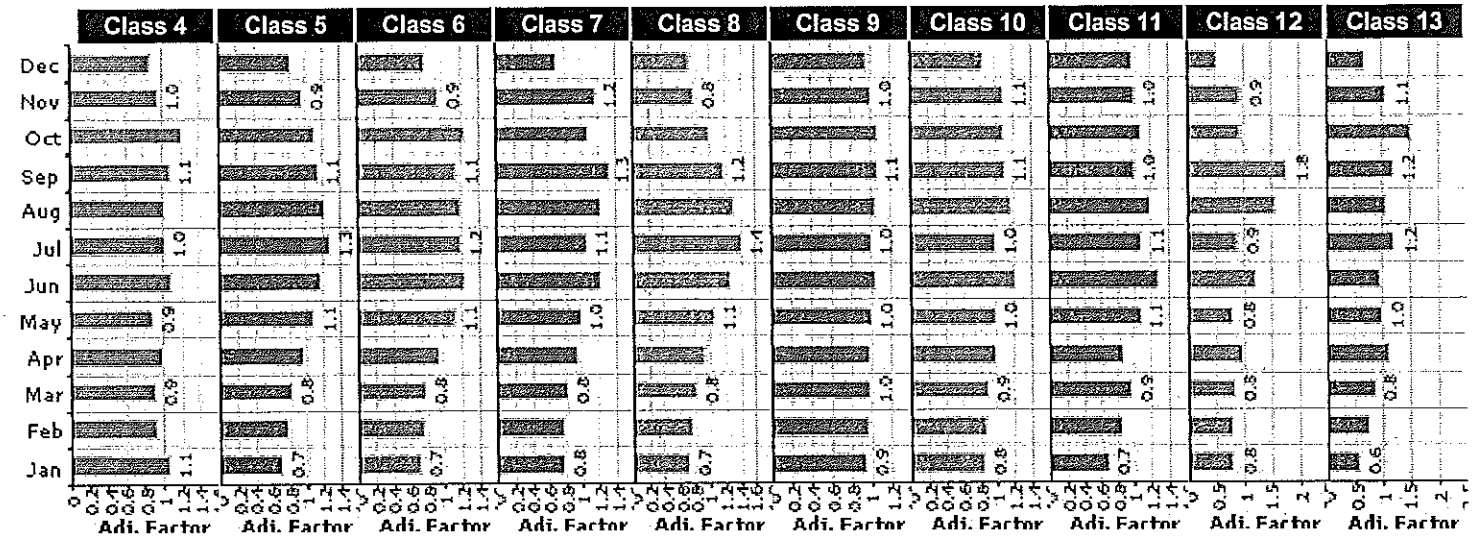


EXHIBIT #109

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	1.1	0.7	0.7	0.8	0.7	0.9	0.8	0.7	0.8	0.6
February	0.9	0.8	0.8	0.8	0.8	1.0	0.9	0.8	0.8	0.7
March	0.9	0.8	0.8	0.8	0.8	1.0	0.9	0.9	0.8	0.8
April	1.0	1.0	0.9	0.9	0.9	1.0	1.0	0.9	1.0	1.1
May	0.9	1.1	1.1	1.0	1.1	1.0	1.0	1.1	0.8	1.0
June	1.1	1.2	1.2	1.2	1.3	1.1	1.2	1.3	1.2	1.0
July	1.0	1.3	1.2	1.1	1.4	1.0	1.0	1.1	0.9	1.2
August	1.0	1.2	1.2	1.2	1.3	1.1	1.2	1.2	1.6	1.1
September	1.1	1.1	1.1	1.3	1.2	1.1	1.1	1.0	1.8	1.2
October	1.2	1.1	1.2	1.1	1.0	1.1	1.1	1.1	0.9	1.5
November	1.0	0.9	0.9	1.2	0.8	1.0	1.1	1.0	0.9	1.1
December	0.9	0.8	0.8	0.7	0.7	1.0	0.8	1.0	0.5	0.7

Distributions by Vehicle Class

Vehicle Class	AADTT Distribution (%) (Level 3)	Growth Factor	
		Rate (%)	Function
Class 4	5.8%	2.3%	Linear
Class 5	21.5%	2.3%	Linear
Class 6	4.4%	2.3%	Linear
Class 7	4%	2.3%	Linear
Class 8	54.6%	2.3%	Linear
Class 9	6.1%	2.3%	Linear
Class 10	3.6%	2.3%	Linear
Class 11	0%	2.3%	Linear
Class 12	0%	2.3%	Linear
Class 13	0%	2.3%	Linear

Truck Distribution by Hour

Hour	Distribution (%)	Hour	Distribution (%)
12 AM	1.02%	12 PM	7.3%
1 AM	0.93%	1 PM	7.09%
2 AM	1.25%	2 PM	6.82%
3 AM	1.58%	3 PM	6.23%
4 AM	2.39%	4 PM	5.44%
5 AM	3.46%	5 PM	4.44%
6 AM	5.19%	6 PM	3.58%
7 AM	6.12%	7 PM	2.67%
8 AM	6.59%	8 PM	2.14%
9 AM	6.93%	9 PM	1.79%
10 AM	7.09%	10 PM	1.56%
11 AM	7.3%	11 PM	1.09%
		Total	100%

Axle Configuration

Traffic Wander	
Mean wheel location (in.)	15
Traffic wander standard deviation (in.)	10
Design lane width (ft)	12

Axle Configuration	
Average axle width (ft)	8.5
Dual tire spacing (in.)	12
Tire pressure (psi)	120

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

Wheelbase				
Value Type	Axle Type	Short	Medium	Long
Average spacing of axles (ft)		12	15	18
Percent of Trucks (%)		17	22	61

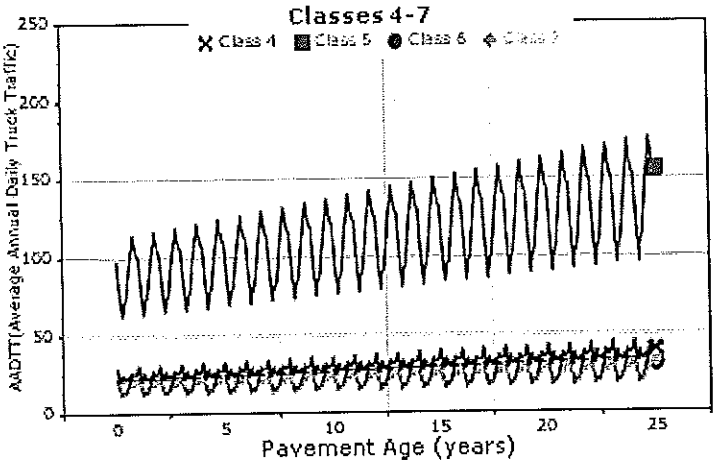
Number of Axles per Truck

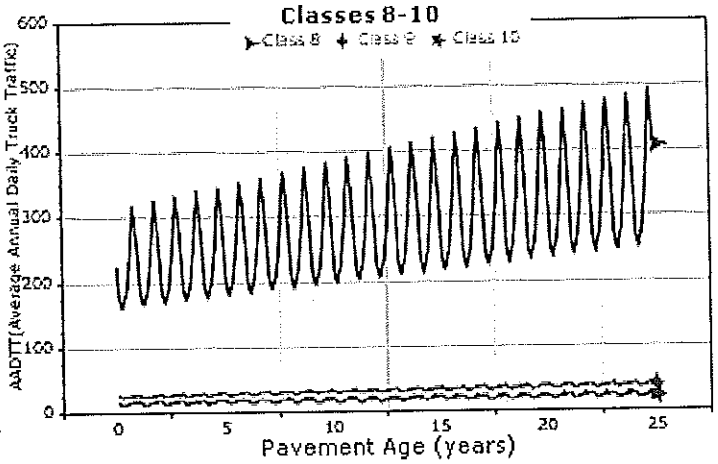
Vehicle Class	Single Axle	Tandem Axle	Tridem Axle	Quad Axle
Class 4	1.3	0.7	0	0
Class 5	2.2	0	0	0
Class 6	1	1	0	0
Class 7	1	0	0.4	0.8
Class 8	2.4	0.6	0	0
Class 9	1.3	1.9	0	0
Class 10	1.1	1.1	0.8	0
Class 11	4.9	0.1	0	0
Class 12	4	1	0	0
Class 13	1.2	0.8	0.7	0.6

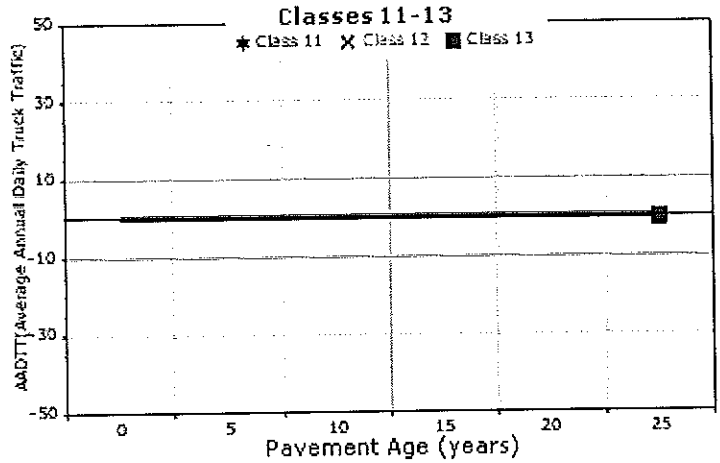
EXHIBIT #110

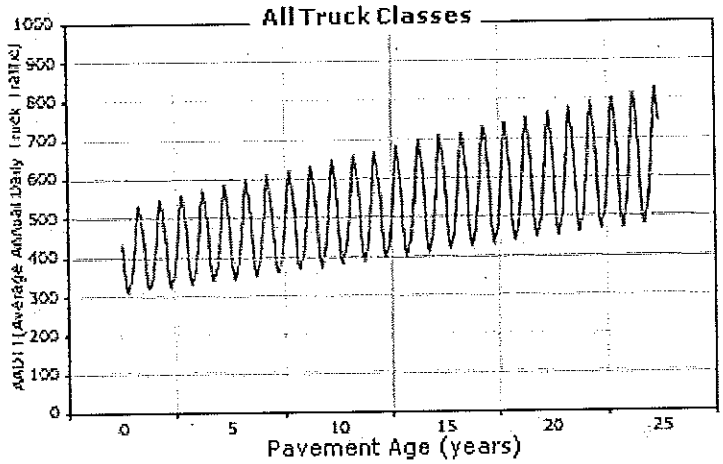
AADTT (Average Annual Daily Truck Traffic) Growth

* Traffic cap is not enforced









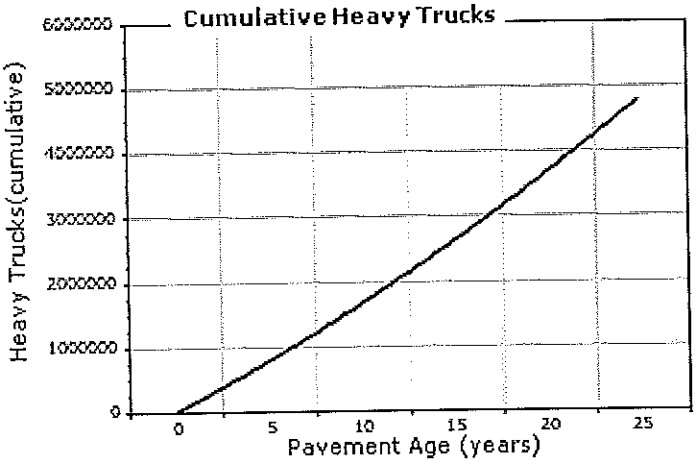
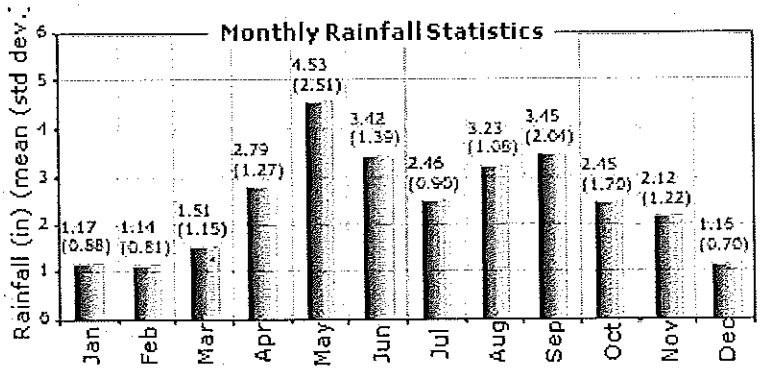


EXHIBIT #111

Climate Inputs

Climate Data Sources:

Climate Station Cities:	Location (lat lon elevation(ft))
RACINE, WI	42.76100 -87.81400 665

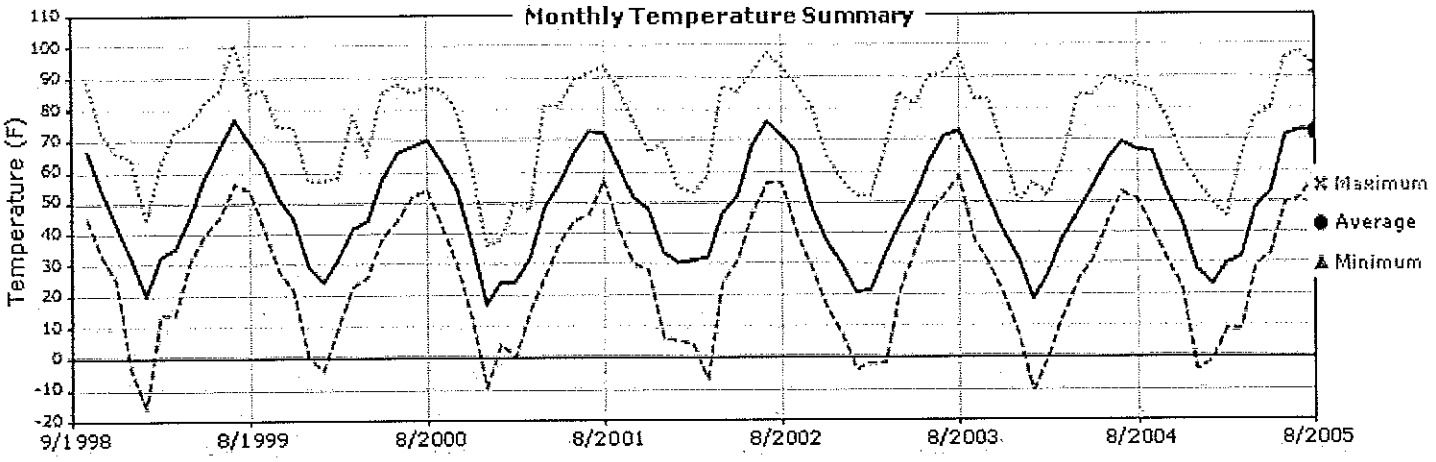


Annual Statistics:

Mean annual air temperature (°F)	48.60
Mean annual precipitation (in.)	29.44
Freezing index (°F - days)	786.30
Average annual number of freeze/thaw cycles:	55.83

Water table depth (ft) 10.00

Monthly Climate Summary:



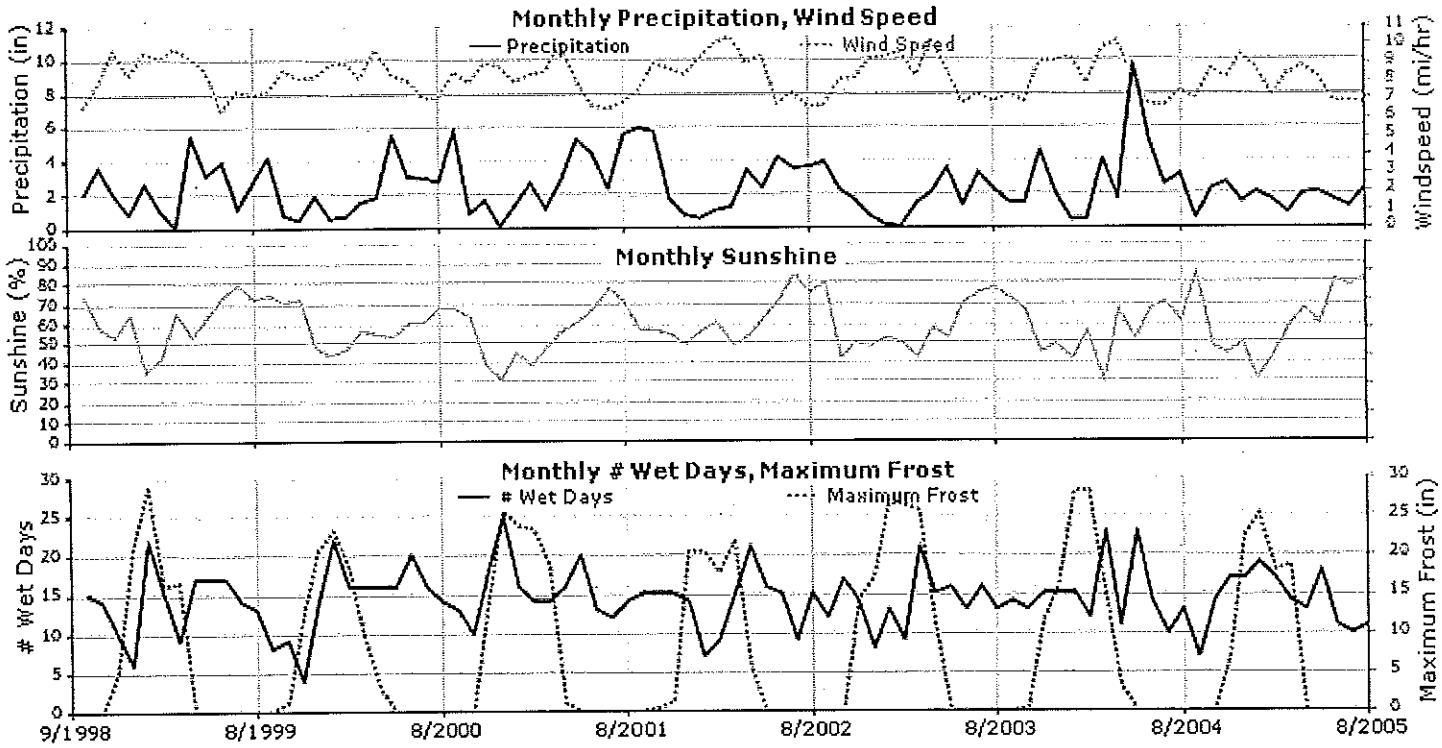


EXHIBIT #112

27880001 Wauk Bypass Section#4 PCC 1-12-15

File Name: C:\ME Designs\12290401 IH43 10-29-14\27880001 Wauk Bypass Section#4 PCC 1-12-15.dgpx

Hourly Air Temperature Distribution by Month:

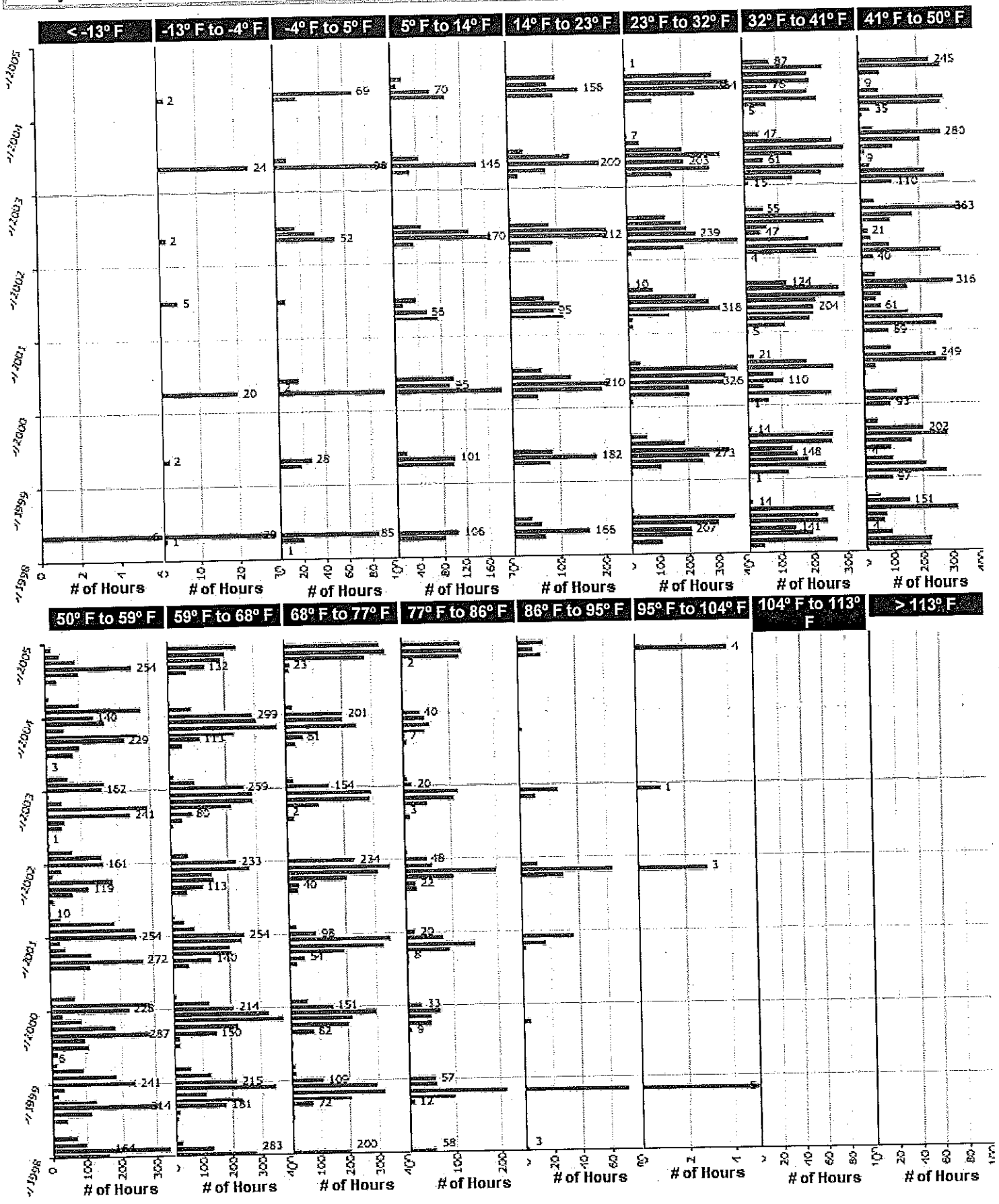


EXHIBIT #113

Design Properties

JPCP Design Properties

Structure - ICM Properties	
PCC surface shortwave absorptivity	0.85

Doweled Joints	
Is joint doweled ?	True
Dowel diameter (in.)	1.25
Dowel spacing (in.)	12.00

Tied Shoulders	
Tied shoulders	True
Load transfer efficiency (%)	50.00

PCC joint spacing (ft)	
Is joint spacing random ?	False
Joint spacing (ft)	15.00

Widened Slab	
Is slab widened ?	False
Slab width (ft)	12.00

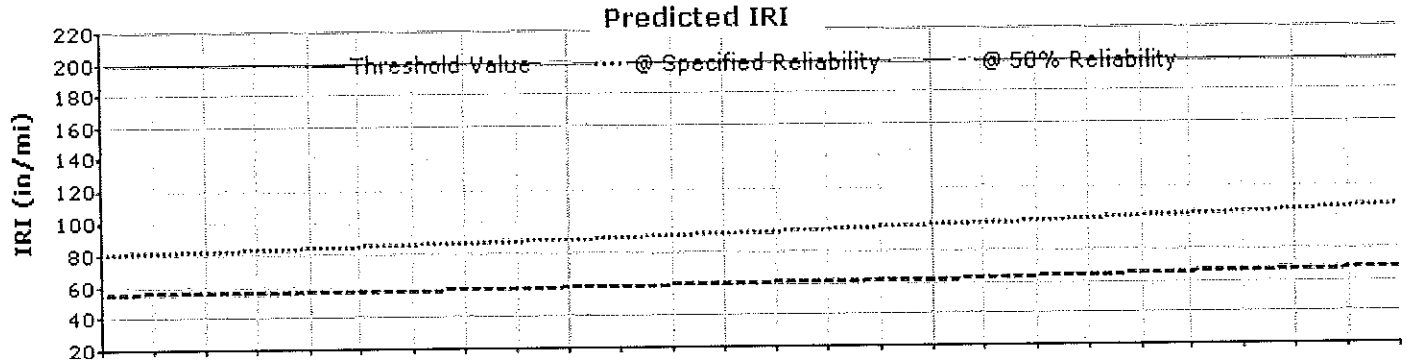
PCC-Base Contact Friction	
PCC-Base full friction contact	True
Months until friction loss	240.00

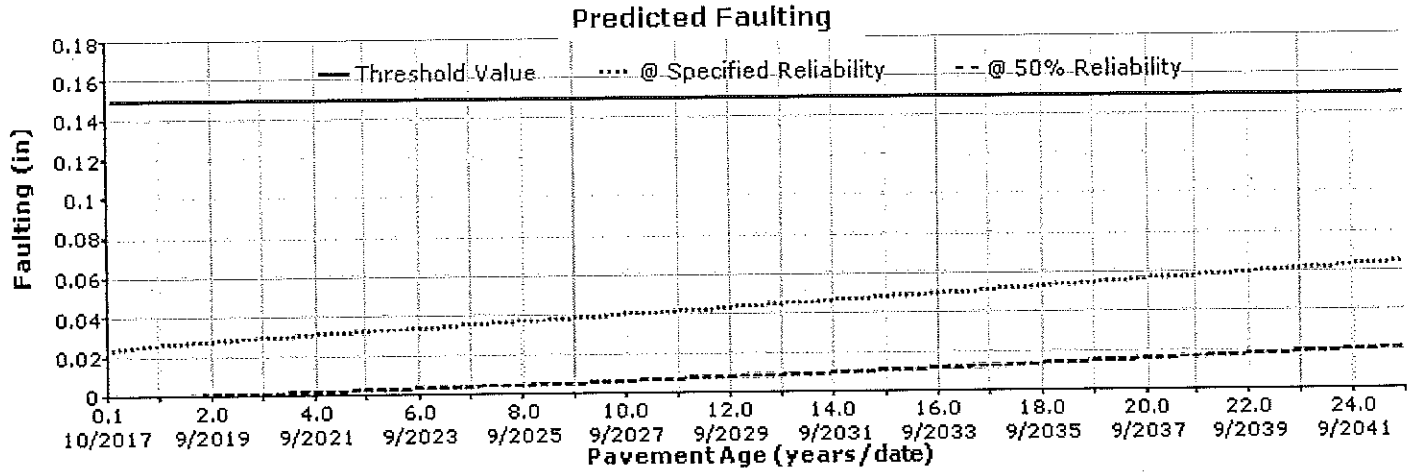
Sealant type	Preformed

Erodibility index	3

Permanent curl/warp effective temperature difference (°F)	-10.00

Analysis Output Charts





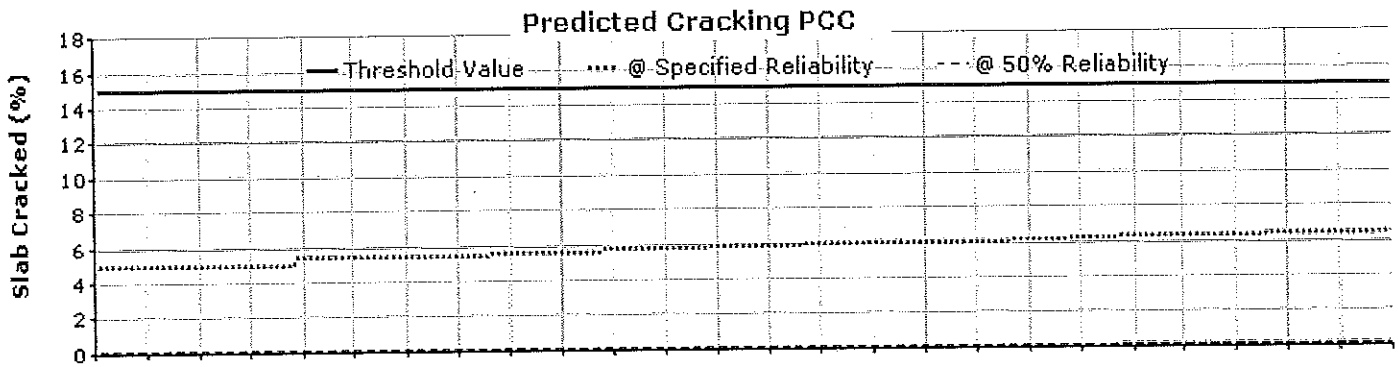
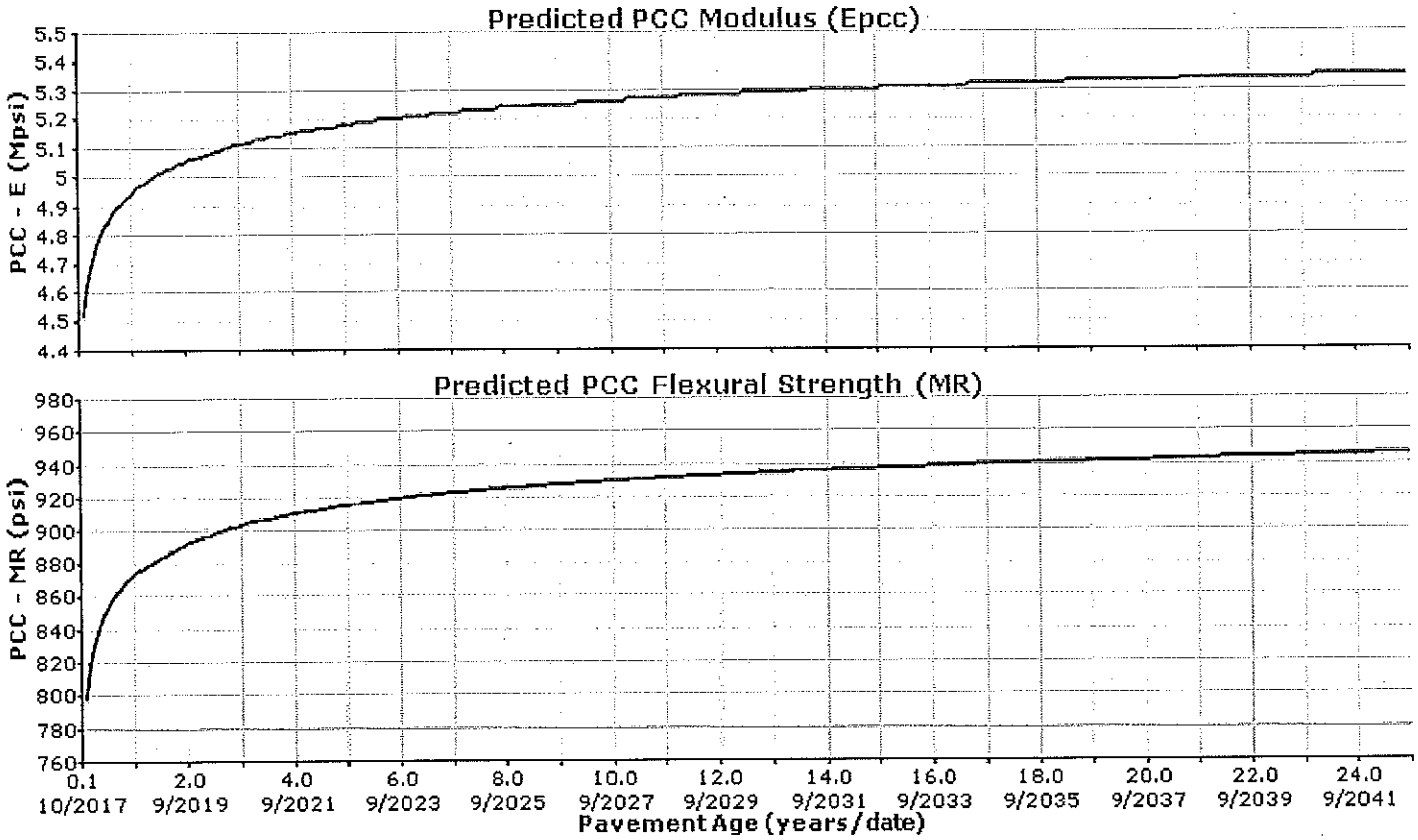


EXHIBIT #115


Predicted PCC Modulus (Epcc)
PCC - E (Mpsi)
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
4.4
Predicted PCC Flexural Strength (MR)
PCC - MR (psi)
980
960
940
920
900
880
860
840
820
800
780
760
0.1 10/2017
2.0 9/2019
4.0 9/2021
6.0 9/2023
8.0 9/2025
10.0 9/2027
12.0 9/2029
14.0 9/2031
16.0 9/2033
18.0 9/2035
20.0 9/2037
22.0 9/2039
24.0 9/2041
Pavement Age (years/date)

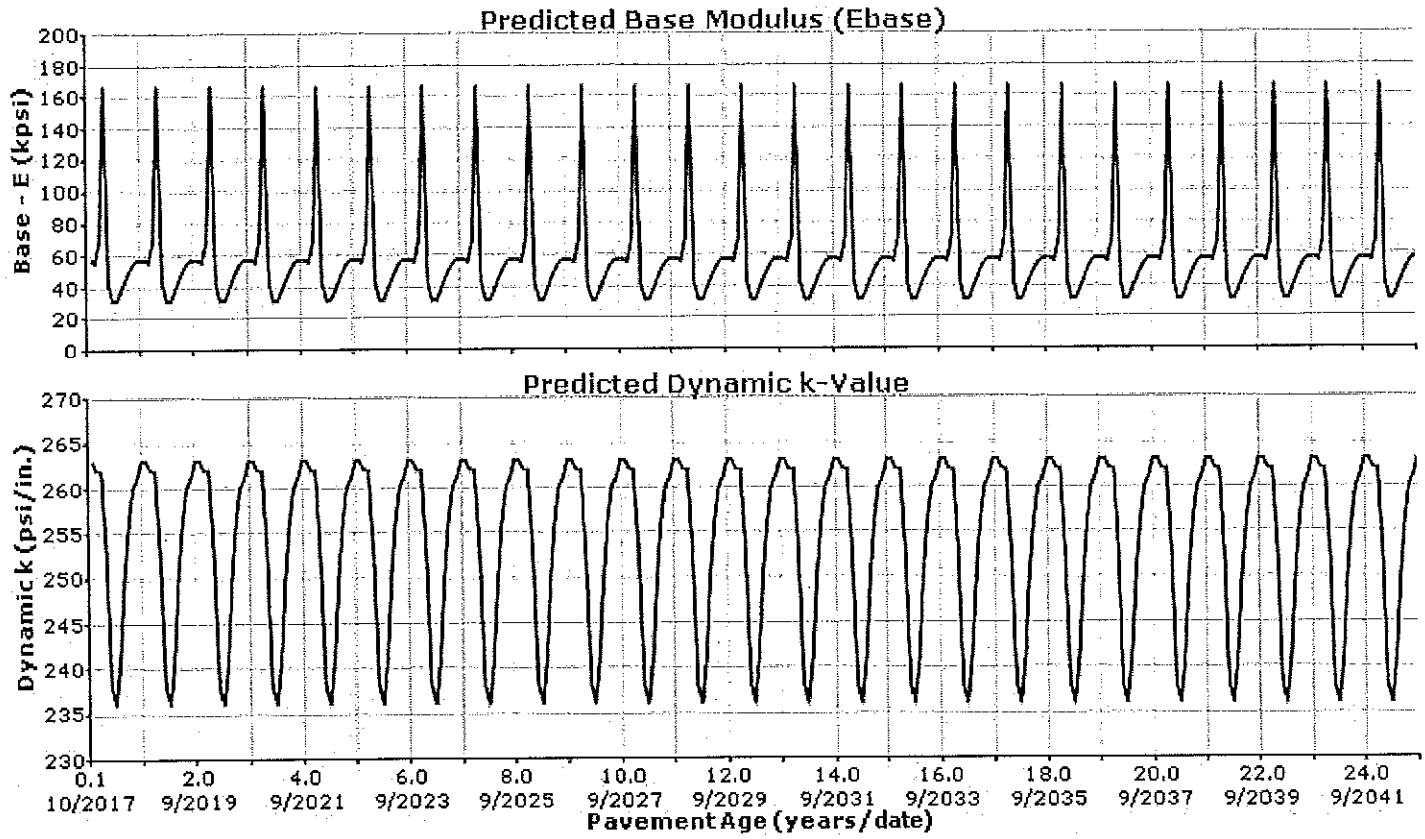
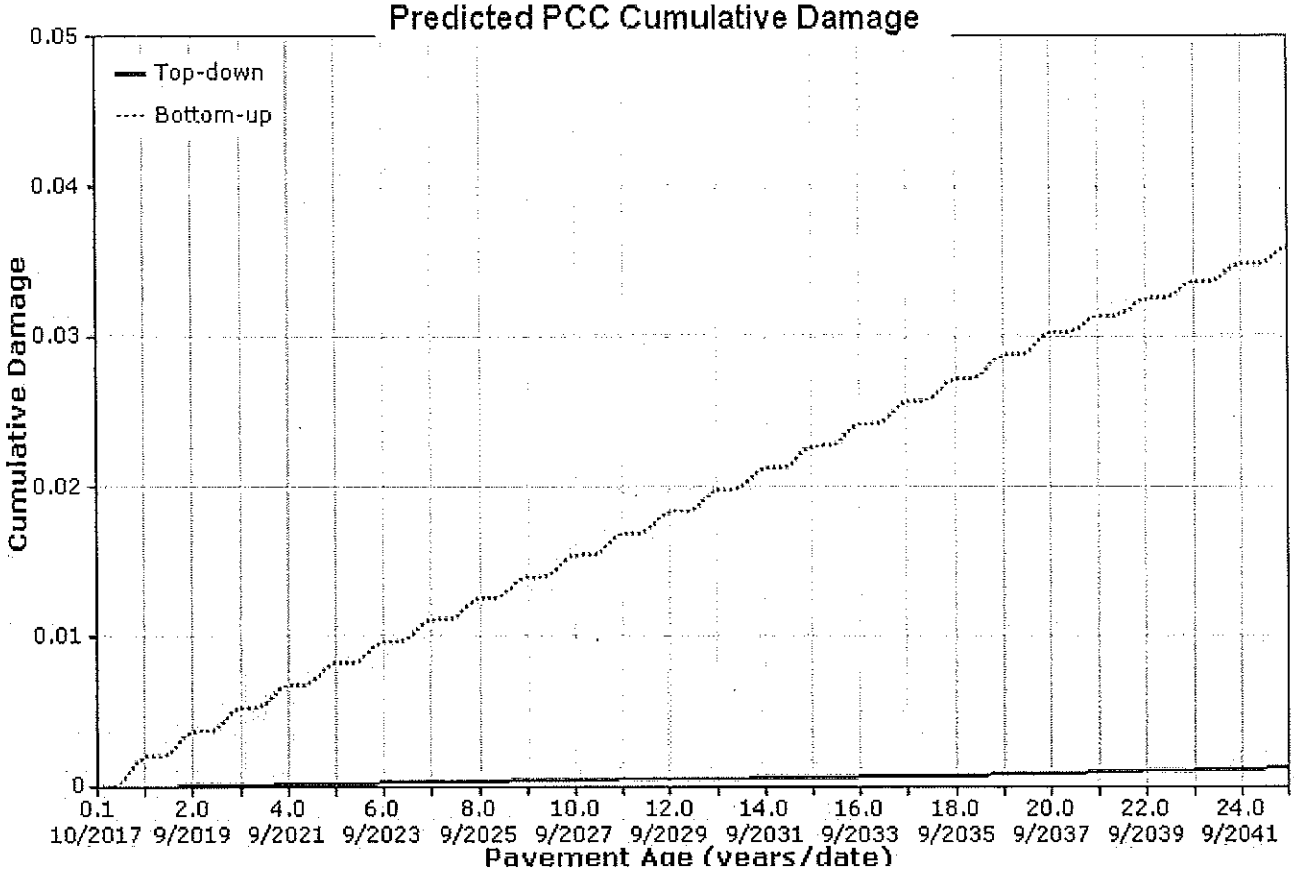

Predicted Base Modulus (Ebase)
Base - E (kpsi)
200
180
160
140
120
100
80
60
40
20
0
Predicted Dynamic k-Value
Dynamic k (psi/in.)
270
265
260
255
250
245
240
235
230
0.1 10/2017
2.0 9/2019
4.0 9/2021
6.0 9/2023
8.0 9/2025
10.0 9/2027
12.0 9/2029
14.0 9/2031
16.0 9/2033
18.0 9/2035
20.0 9/2037
22.0 9/2039
24.0 9/2041
Pavement Age (years/date)

EXHIBIT #116

Predicted PCC Cumulative Damage



Predicted Load Transfer Efficiency

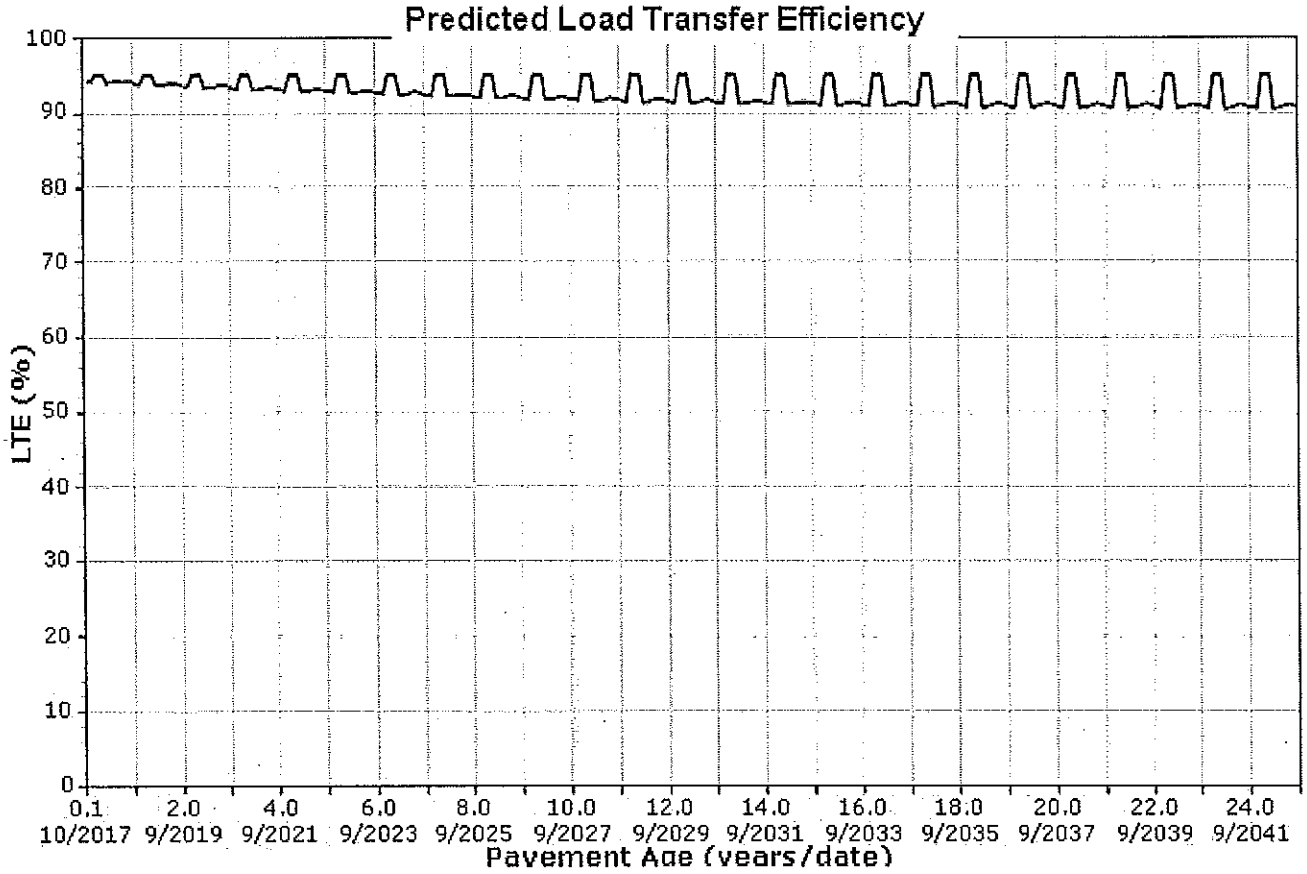


EXHIBIT #117

Layer Information

Layer 1 PCC : JPCP Default

PCC	
Thickness (in.)	8.0
Unit weight (pcf)	148.0
Poisson's ratio	0.2

Thermal	
PCC coefficient of thermal expansion (in./in./°F x 10^-6)	5.37
PCC thermal conductivity (BTU/hr-ft-°F)	1.25
PCC heat capacity (BTU/lb-°F)	0.28

Mix		
Cement type		Type II (2)
Cementitious material content (lb/yd^3)		780
Water to cement ratio		0.37
Aggregate type		Dolomite (2)
PCC zero-stress temperature (°F)	Calculated Internally?	True
	User Value	-
	Calculated Value	102.5
Ultimate shrinkage (microstrain)	Calculated Internally?	True
	User Value	-
	Calculated Value	600.7
Reversible shrinkage (%)		50
Time to develop 50% of ultimate shrinkage (days)		35
Curing method		Curing Compound

PCC strength and modulus (Input Level: 3)

28-Day PCC modulus of rupture (psi)	780.0
28-Day PCC elastic modulus (psi)	4413000.0

Identifiers

Field	Value
Display name/identifier	JPCP Default
Description of object	
Author	
Date Created	1/12/2015 12:00:00 AM
Approver	
Date approved	1/12/2015 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Layer 2 Non-stabilized Base : A-1-a

Unbound	
Layer thickness (in.)	6.0
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)
40000.0

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

Identifiers

Field	Value
Display name/identifier	A-1-a
Description of object	Default material
Author	AASHTO
Date Created	1/12/2015 12:00:00 AM
Approver	
Date approved	12/9/2014 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	True

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	128.1
Saturated hydraulic conductivity (ft/hr)	False	2.616e-02
Specific gravity of solids	False	2.7
Optimum gravimetric water content (%)	False	7.2

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	4.7511
bf	1.7494
cf	0.7630
hr	184.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	7.0
#100	
#80	
#60	
#50	
#40	18.0
#30	
#20	
#16	
#10	32.0
#8	
#4	44.0
3/8-in.	61.0
1/2-in.	
3/4-in.	82.0
1-in.	
1 1/2-in.	97.0
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	

EXHIBIT #119

Layer 3 Non-stabilized Base : A-1-a

Unbound	
Layer thickness (in.)	16.0
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)
42000.0

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

Identifiers

Field	Value
Display name/identifier	A-1-a
Description of object	Default material
Author	AASHTO
Date Created	1/12/2015 12:00:00 AM
Approver	
Date approved	12/9/2014 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	True

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	109.6
Saturated hydraulic conductivity (ft/hr)	False	8.267e+02
Specific gravity of solids	True	2.6
Optimum gravimetric water content (%)	True	16.6

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	9.2765
bf	3.7128
cf	2.9466
hr	160.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	5.0
#100	
#80	
#60	
#50	
#40	
#30	
#20	
#16	
#10	10.0
#8	
#4	
3/8-in.	
1/2-in.	30.0
3/4-in.	
1-in.	
1 1/2-in.	60.0
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	90.0

EXHIBIT #120

Layer 4 Subgrade : A-4

Unbound	
Layer thickness (in.)	Semi-infinite
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)
15000.0

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

Identifiers

Field	Value
Display name/identifier	A-4
Description of object	Default material
Author	AASHTO
Date Created	1/12/2015 3:54:50 PM
Approver	
Date approved	12/9/2014 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	False

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	114
Saturated hydraulic conductivity (ft/hr)	False	1.205e-05
Specific gravity of solids	True	2.65
Optimum gravimetric water content (%)	True	14

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	69.7987
bf	0.9890
cf	0.4694
hr	500.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	52.0
#100	
#80	
#60	
#50	
#40	65.0
#30	
#20	
#16	
#10	74.0
#8	
#4	85.0
3/8-in.	
1/2-in.	
3/4-in.	
1-in.	
1 1/2-in.	
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	

EXHIBIT #121

Calibration Coefficients

PCC Faulting

$$C_{12} = C_1 + (C_2 * FR^{0.25})$$
$$C_{34} = C_3 + (C_4 * FR^{0.25})$$
$$FaultMax_0 = C_{12} * \delta_{curling} * \left[\log(1 + C_5 * 5.0^{ERODE}) * \log\left(P_{200} * \frac{WetDays}{p_S}\right)\right]^{C_6}$$
$$FaultMax_i = FaultMax_0 + C_7 * \sum_{j=1}^{m} DE_j * \log(1 + C_5 * 5.0^{ERODE})^{C_8}$$
$$\Delta Fault_i = C_{34} * (FaultMax_{i-1} - Fault_{i-1})^2 * DE_i$$
$$C_8 = DowelDeterioration$$

C1: 1.0184	C2: 0.91656	C3: 0.0021848	C4: 0.000883739
C5: 250	C6: 0.4	C7: 1.83312	C8: 400

PCC Reliability Faulting Standard Deviation

Pow(0.0097*FAULT,0.5178)+0.014

IRI-jpcp

C1 - Cracking	C1: 0.8203	C2: 0.4417
C2 - Spalling	C3: 1.4929	C4: 25.24
C3 - Faulting	**Reliability Standard Deviation**	
C4 - Site Factor	5.4	

PCC Cracking

$$\log(N) = C1 \cdot \left(\frac{MR}{\sigma}\right)^{C2}$$

$$CRK = \frac{100}{1 + C4\ FD^{C5}}$$

Fatigue Coefficients		Cracking Coefficients	
C1: 2	C2: 1.22	C4: 1	C5: -1.98

PCC Reliability Cracking Standard Deviation

Pow(5.3116*CRACK,0.3903) + 2.99

EXHIBIT #122

27880001 Wauk Bypass Section#4 HMA 1-13-15

File Name: C:\ME Designs\12290401 IH43 10-29-14\27880001 Wauk Bypass Section#4 HMA 1-13-15.dgpx

Design Inputs

Design Life: 18 years
Design Type: Flexible Pavement

Base construction: September, 2017
Pavement construction: October, 2017
Traffic opening: November, 2017

Climate Data Sources (Lat/Lon): 42.761, -87.814

Design Structure

Layer type	Material Type	Thickness (in.):
Flexible	Default asphalt concrete	5.5
NonStabilized	A-1-a	11.0
NonStabilized	A-1-a	16.0
Subgrade	A-4	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	9.2
Air voids (%)	7.0

Traffic

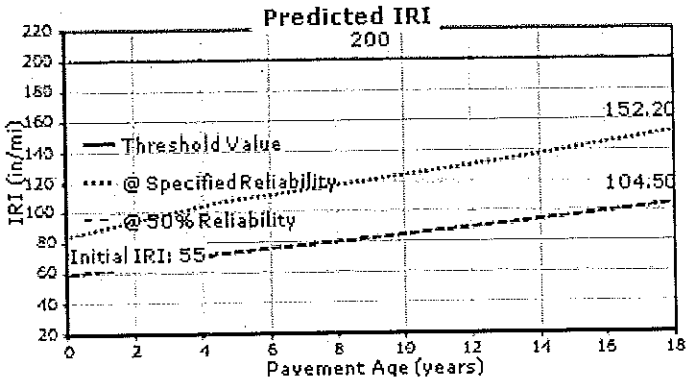
Age (year)	Heavy Trucks (cumulative)
2017 (initial)	826
2026 (9 years)	1,459,590
2035 (18 years)	3,148,570

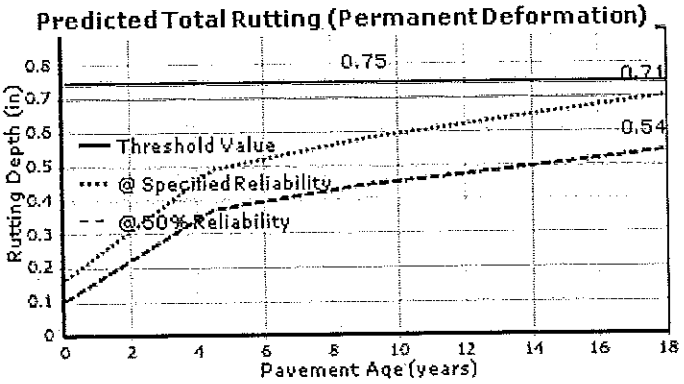
Design Outputs

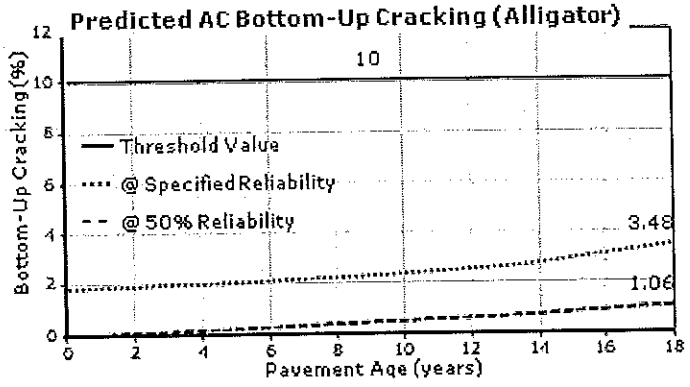
Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in./mile)	200.00	152.22	95.00	99.95	Pass
Permanent deformation - total pavement (in.)	0.75	0.71	95.00	98.13	Pass
AC bottom-up fatigue cracking (percent)	10.00	3.48	95.00	100.00	Pass
AC thermal cracking (ft/mile)	1500.00	35.03	95.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	5000.00	1999.44	95.00	100.00	Pass
Permanent deformation - AC only (in.)	0.40	0.34	95.00	99.30	Pass

Distress Charts







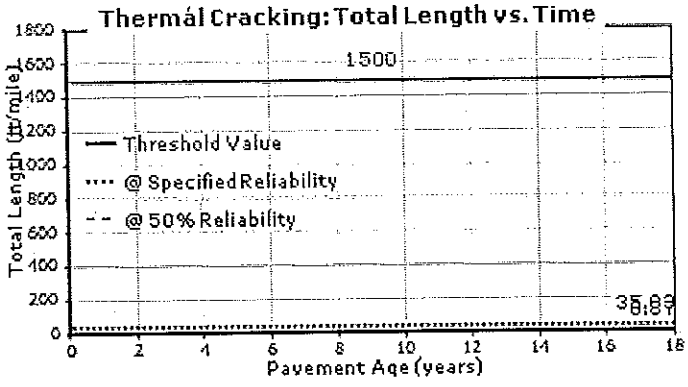
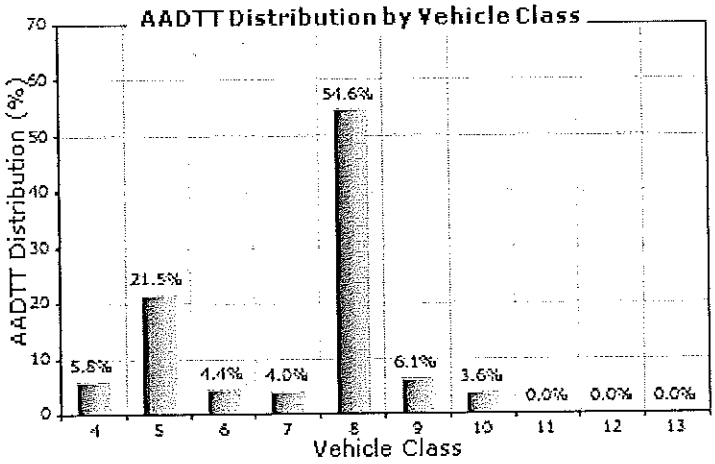


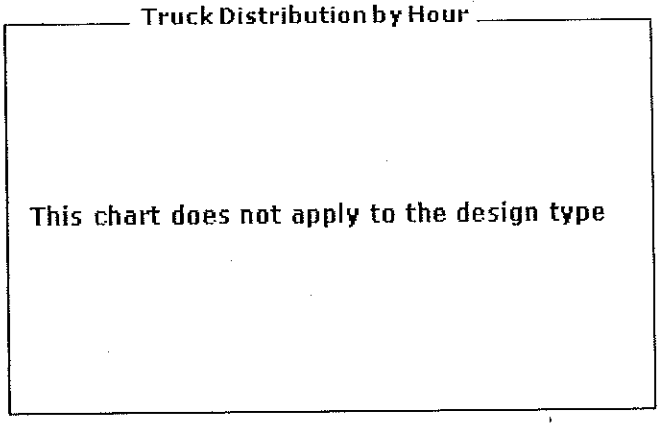
EXHIBIT #123

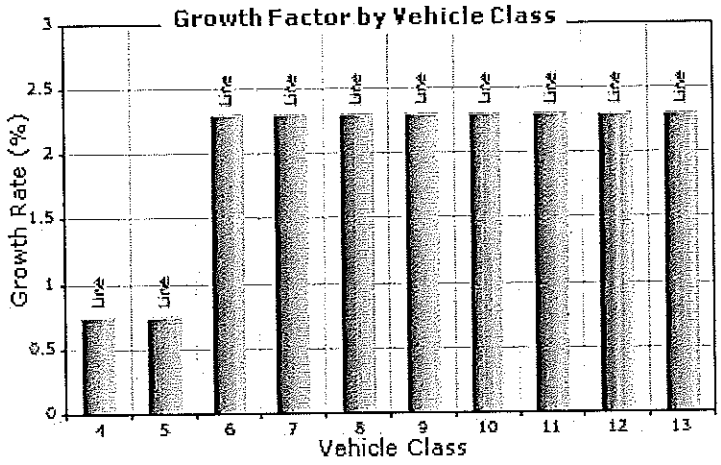
Traffic Inputs

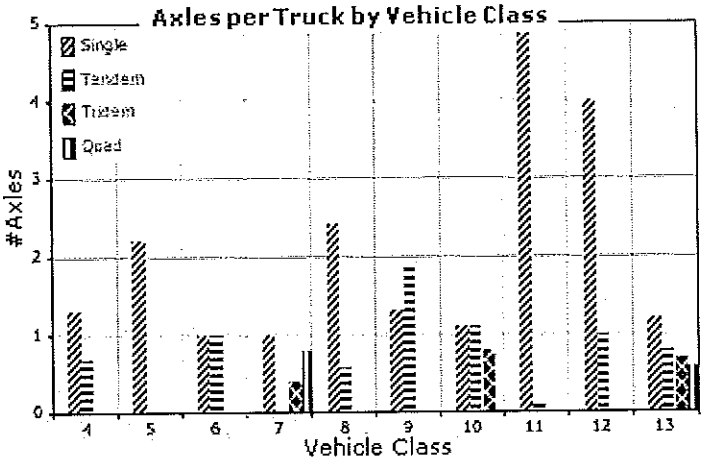
Graphical Representation of Traffic Inputs

Initial two-way AADTT:	826	Percent of trucks in design direction (%):	50.0
Number of lanes in design direction:	2	Percent of trucks in design lane (%):	100.0
		Operational speed (mph)	45.0









Traffic Volume Monthly Adjustment Factors

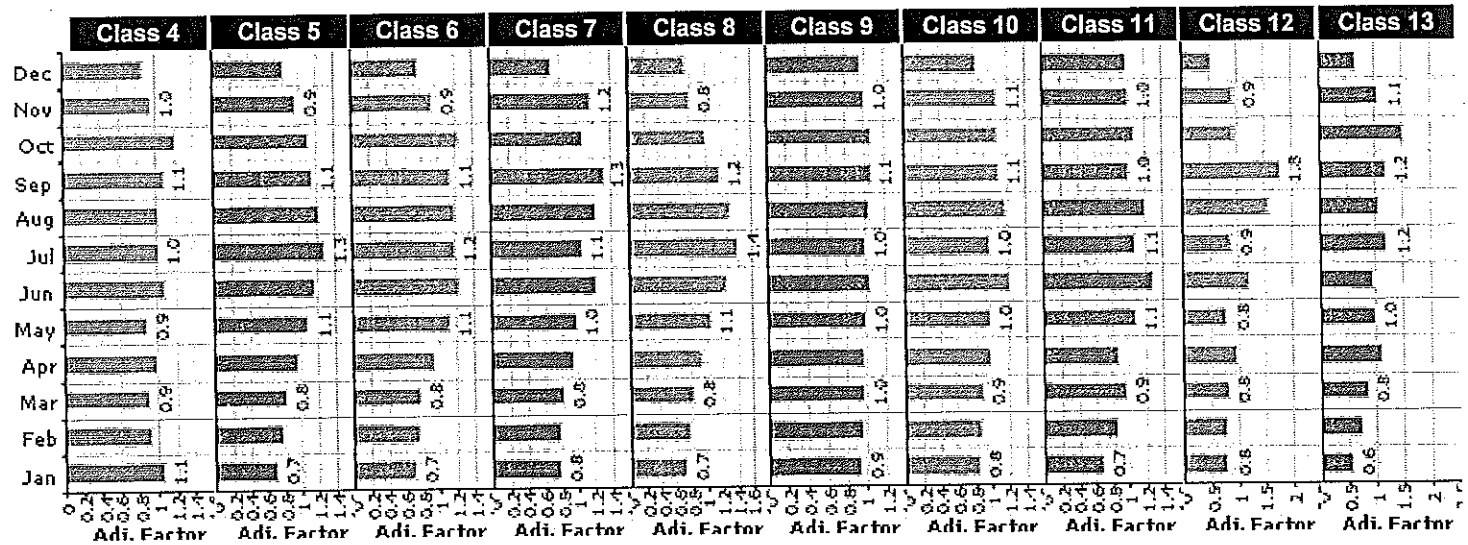


EXHIBIT #124

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	1.1	0.7	0.7	0.8	0.7	0.9	0.8	0.7	0.8	0.6
February	0.9	0.8	0.8	0.8	0.8	1.0	0.9	0.8	0.8	0.7
March	0.9	0.8	0.8	0.8	0.8	1.0	0.9	0.9	0.8	0.8
April	1.0	1.0	0.9	0.9	0.9	1.0	1.0	0.9	1.0	1.1
May	0.9	1.1	1.1	1.0	1.1	1.0	1.0	1.1	0.8	1.0
June	1.1	1.2	1.2	1.2	1.3	1.1	1.2	1.3	1.2	1.0
July	1.0	1.3	1.2	1.1	1.4	1.0	1.0	1.1	0.9	1.2
August	1.0	1.2	1.2	1.2	1.3	1.1	1.2	1.2	1.6	1.1
September	1.1	1.1	1.1	1.3	1.2	1.1	1.1	1.0	1.8	1.2
October	1.2	1.1	1.2	1.1	1.0	1.1	1.1	1.1	0.9	1.5
November	1.0	0.9	0.9	1.2	0.8	1.0	1.1	1.0	0.9	1.1
December	0.9	0.8	0.8	0.7	0.7	1.0	0.8	1.0	0.5	0.7

Distributions by Vehicle Class

Vehicle Class	AADTT Distribution (%) (Level 3)	Growth Factor	
		Rate (%)	Function
Class 4	5.8%	0.752%	Linear
Class 5	21.5%	0.752%	Linear
Class 6	4.4%	2.3%	Linear
Class 7	4%	2.3%	Linear
Class 8	54.6%	2.3%	Linear
Class 9	6.1%	2.3%	Linear
Class 10	3.6%	2.3%	Linear
Class 11	0%	2.3%	Linear
Class 12	0%	2.3%	Linear
Class 13	0%	2.3%	Linear

Truck Distribution by Hour

Hour	Distribution (%)	Hour	Distribution (%)
12 AM	1.02%	12 PM	7.3%
1 AM	0.93%	1 PM	7.09%
2 AM	1.25%	2 PM	6.82%
3 AM	1.58%	3 PM	6.23%
4 AM	2.39%	4 PM	5.44%
5 AM	3.46%	5 PM	4.44%
6 AM	5.19%	6 PM	3.58%
7 AM	6.12%	7 PM	2.67%
8 AM	6.59%	8 PM	2.14%
9 AM	6.93%	9 PM	1.79%
10 AM	7.09%	10 PM	1.56%
11 AM	7.3%	11 PM	1.09%
		Total	100%

Axle Configuration

Traffic Wander	
Mean wheel location (in.)	15
Traffic wander standard deviation (in.)	10
Design lane width (ft)	12

Axle Configuration	
Average axle width (ft)	8.5
Dual tire spacing (in.)	12
Tire pressure (psi)	120

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

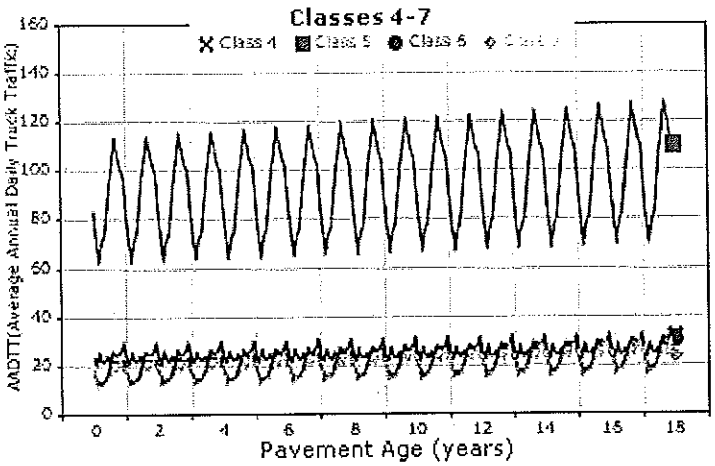
Number of Axles per Truck

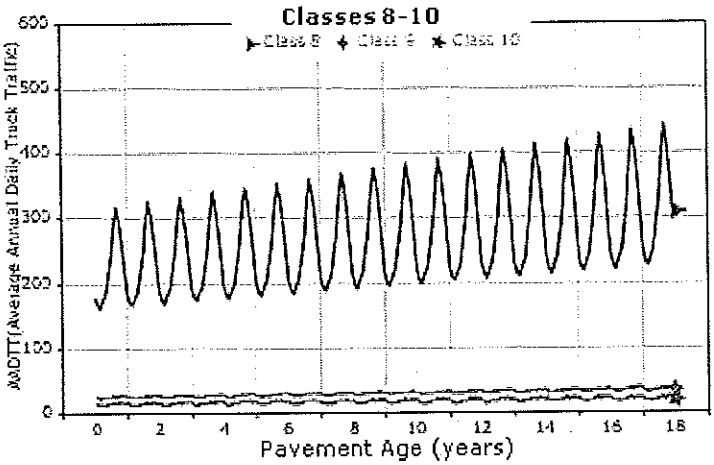
Vehicle Class	Single Axle	Tandem Axle	Tridem Axle	Quad Axle
Class 4	1.3	0.7	0	0
Class 5	2.2	0	0	0
Class 6	1	1	0	0
Class 7	1	0	0.4	0.8
Class 8	2.4	0.6	0	0
Class 9	1.3	1.9	0	0
Class 10	1.1	1.1	0.8	0
Class 11	4.9	0.1	0	0
Class 12	4	1	0	0
Class 13	1.2	0.8	0.7	0.6

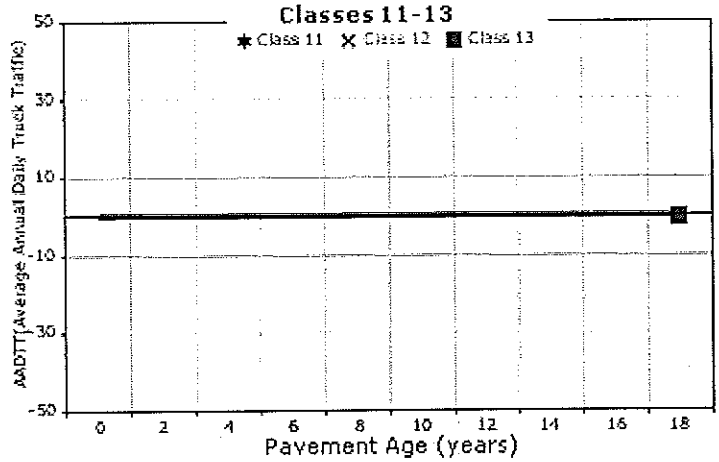
EXHIBIT #125

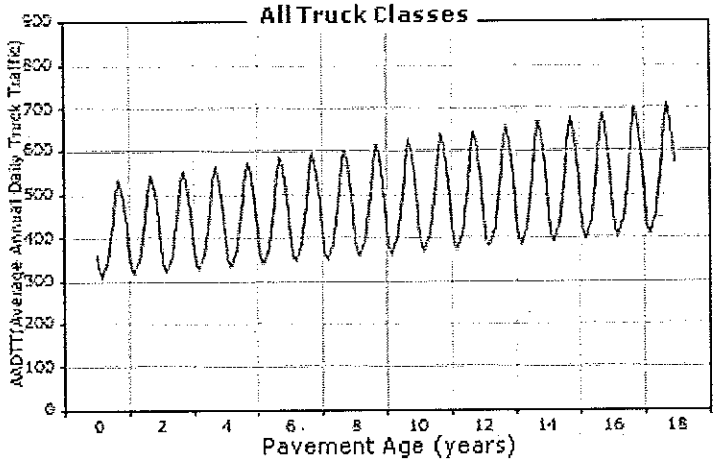
AADTT (Average Annual Daily Truck Traffic) Growth

* Traffic cap is not enforced









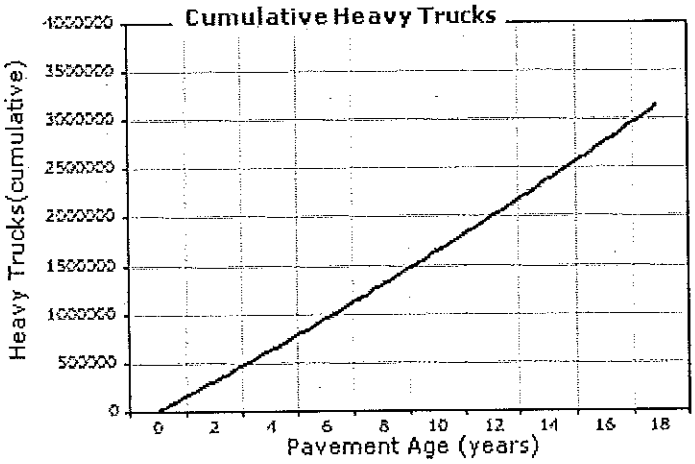
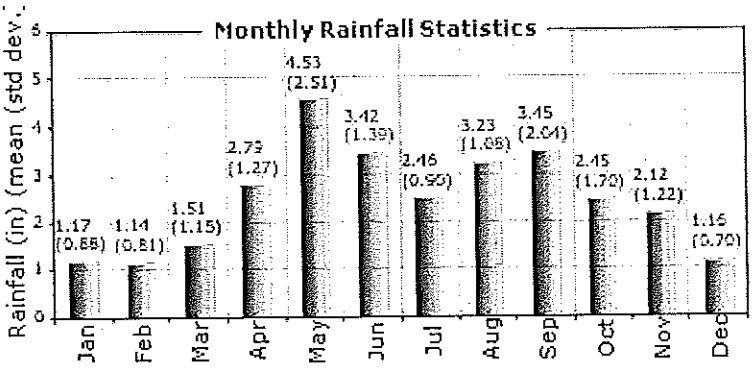


EXHIBIT #126

Climate Inputs

Climate Data Sources:

Climate Station Cities:	Location (lat lon elevation(ft))
RACINE, WI	42.76100 -87.81400 665

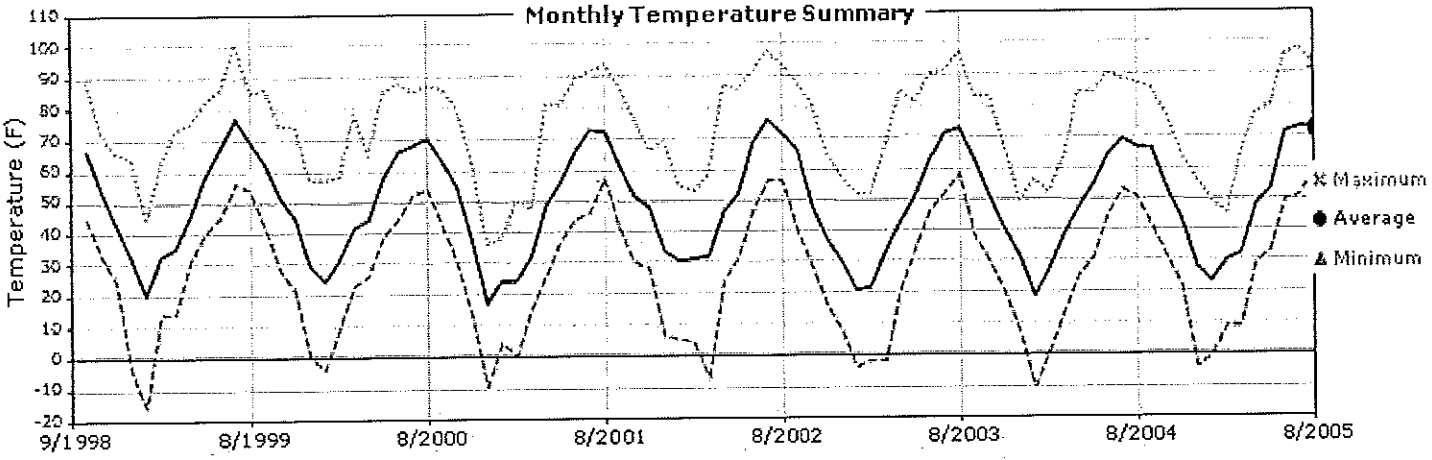


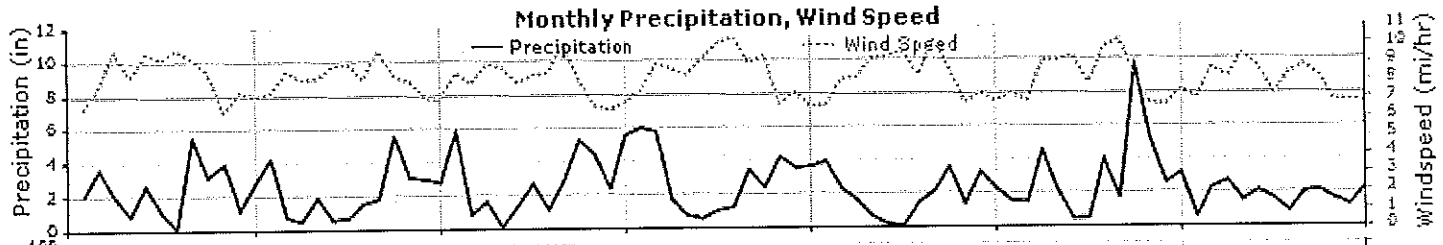
Annual Statistics:

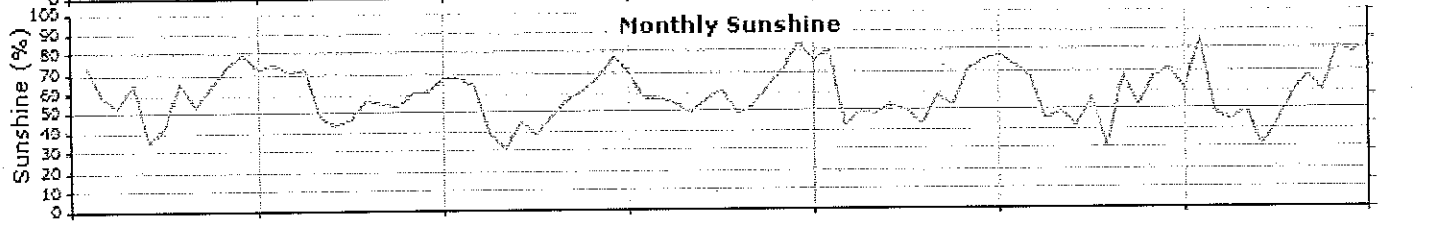
Mean annual air temperature (°F)	48.60
Mean annual precipitation (in.)	29.44
Freezing index (°F - days)	786.30
Average annual number of freeze/thaw cycles:	55.83

Water table depth (ft) 10.00

Monthly Climate Summary:







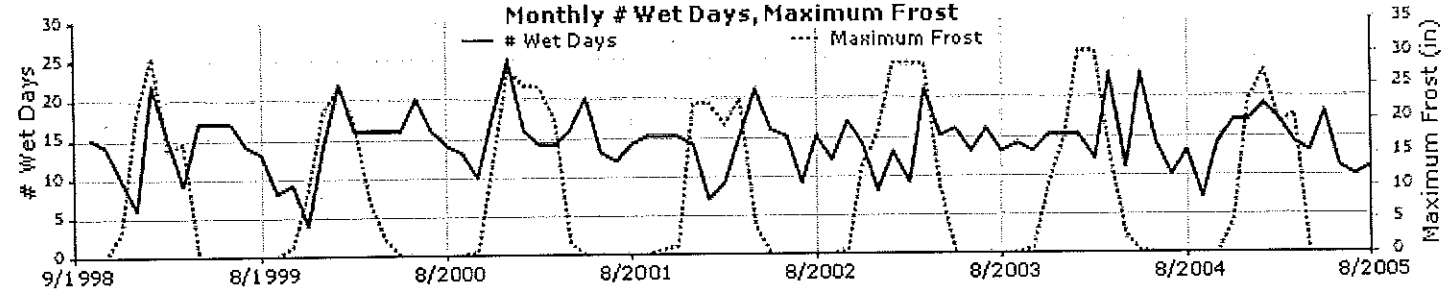


EXHIBIT #127

Hourly Air Temperature Distribution by Month:

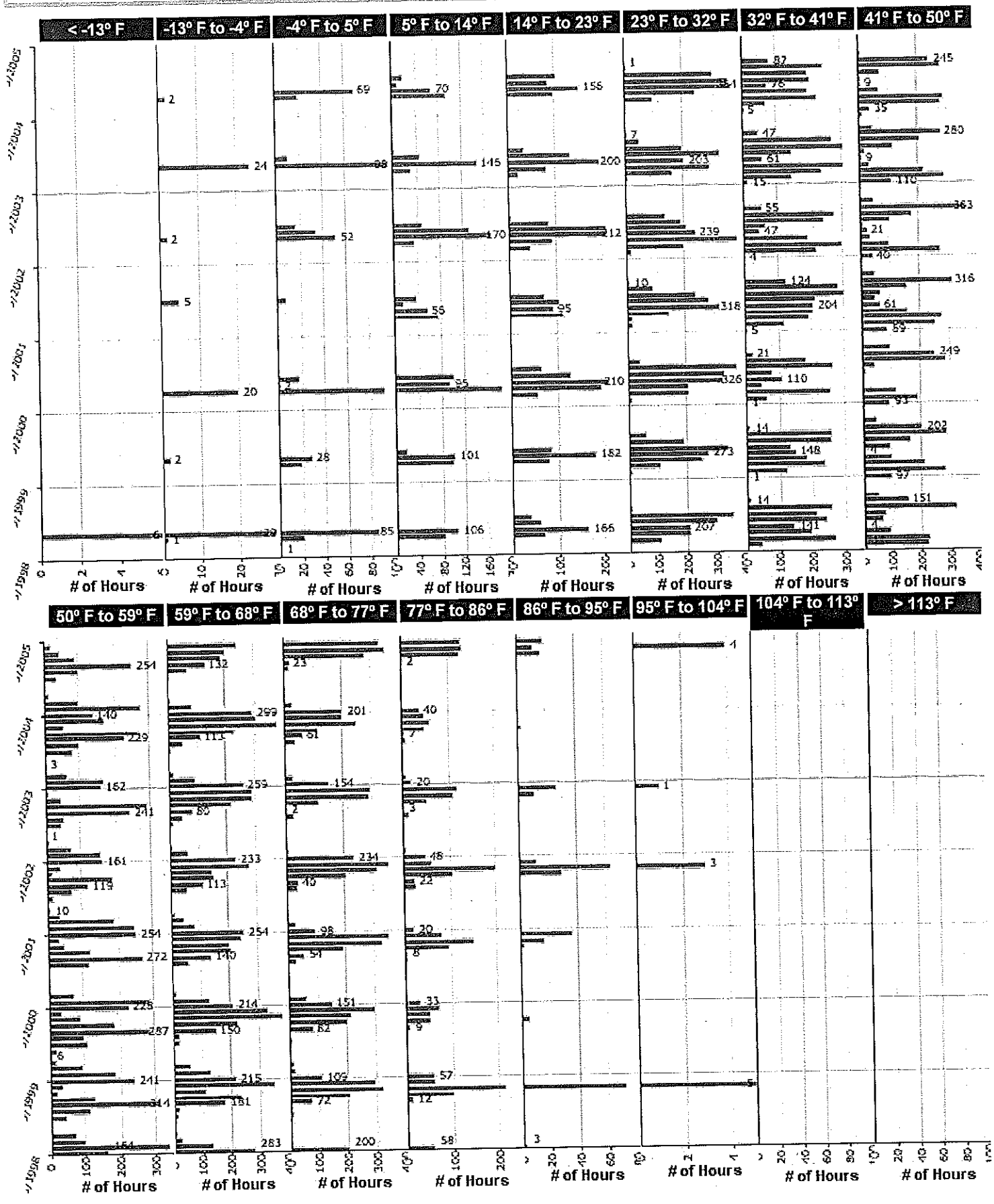


EXHIBIT #128

Design Properties

HMA Design Properties

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 Non-stabilized Base : A-1-a	Non-stabilized Base (4)	1.00
Layer 3 Non-stabilized Base : A-1-a	Non-stabilized Base (4)	1.00
Layer 4 Subgrade : A-4	Subgrade (5)	-

EXHIBIT #129

Thermal Cracking (Input Level: 3)

Indirect tensile strength at 14 °F (psi)	554.33

Thermal Contraction	
Is thermal contraction calculated?	True
Mix coefficient of thermal contraction (in./in./°F)	-
Aggregate coefficient of thermal contraction (in./in./°F)	5.0e-006
Voids in Mineral Aggregate (%)	16.2

	Creep Compliance (1/psi)		
Loading time (sec)	-4 °F	14 °F	32 °F
1	1.91e-007	3.42e-007	4.91e-007
2	2.14e-007	4.08e-007	6.57e-007
5	2.49e-007	5.16e-007	9.67e-007
10	2.79e-007	6.15e-007	1.30e-006
20	3.13e-007	7.34e-007	1.73e-006
50	3.63e-007	9.28e-007	2.55e-006
100	4.08e-007	1.11e-006	3.42e-006

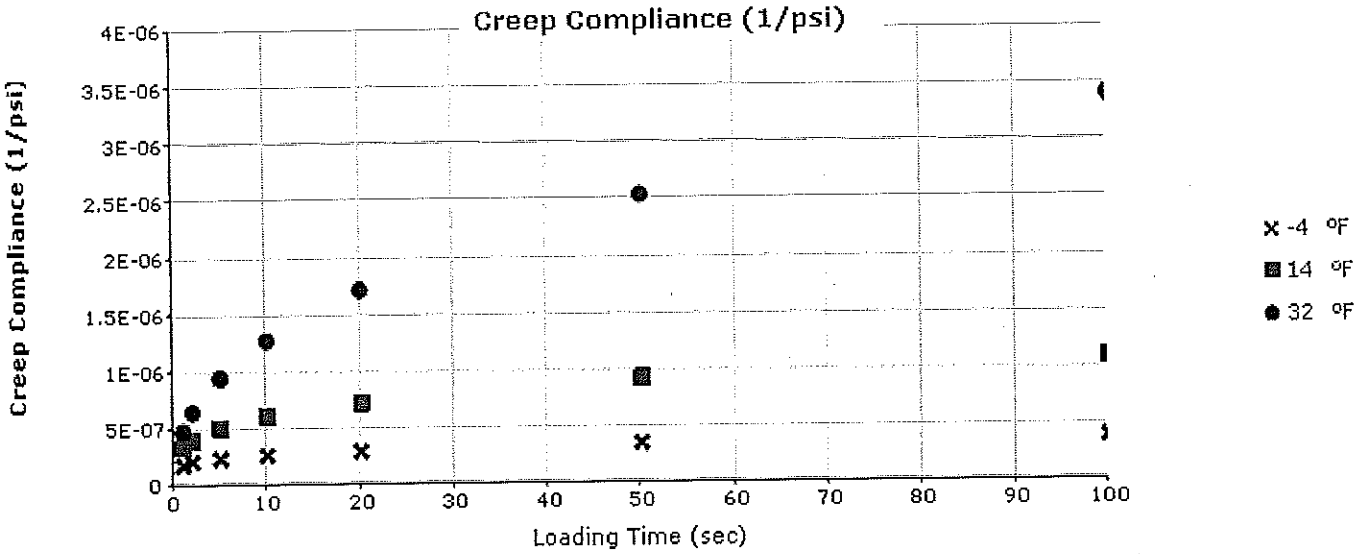
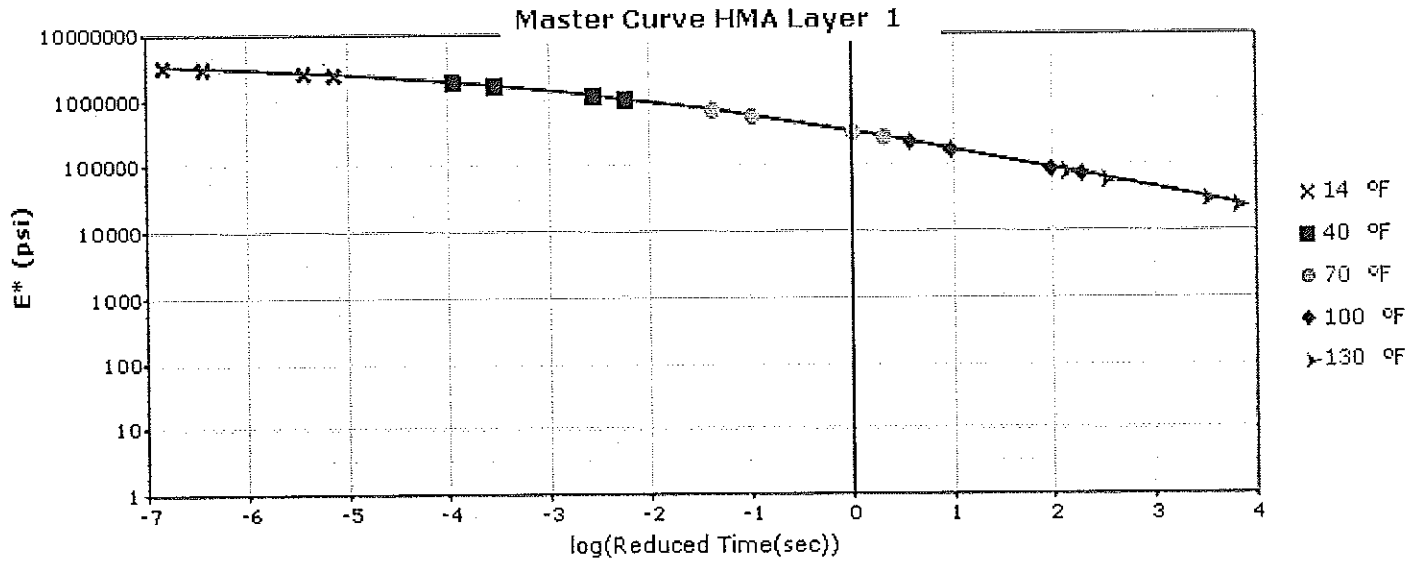
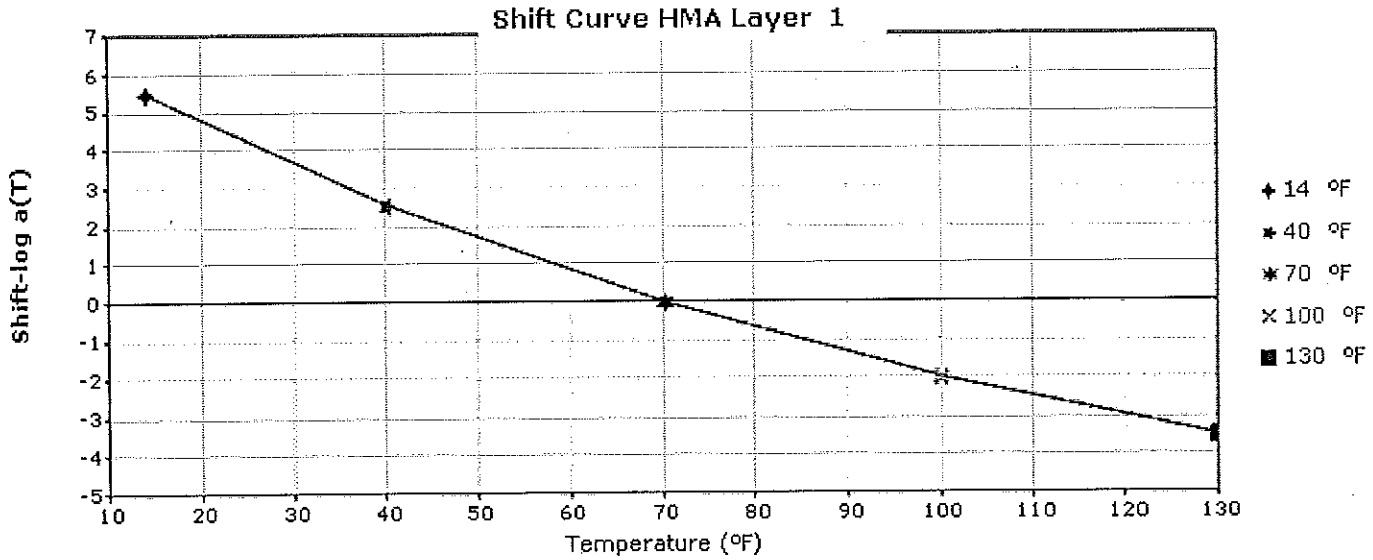


EXHIBIT #130

HMA Layer 1: Layer 1 Flexible : Default asphalt concrete





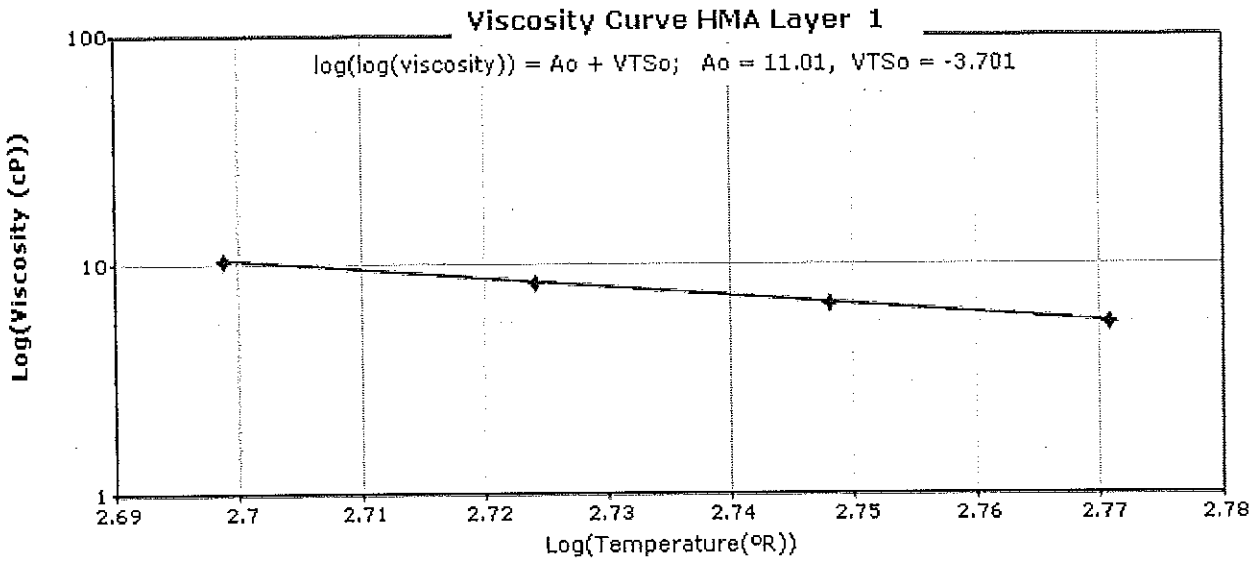
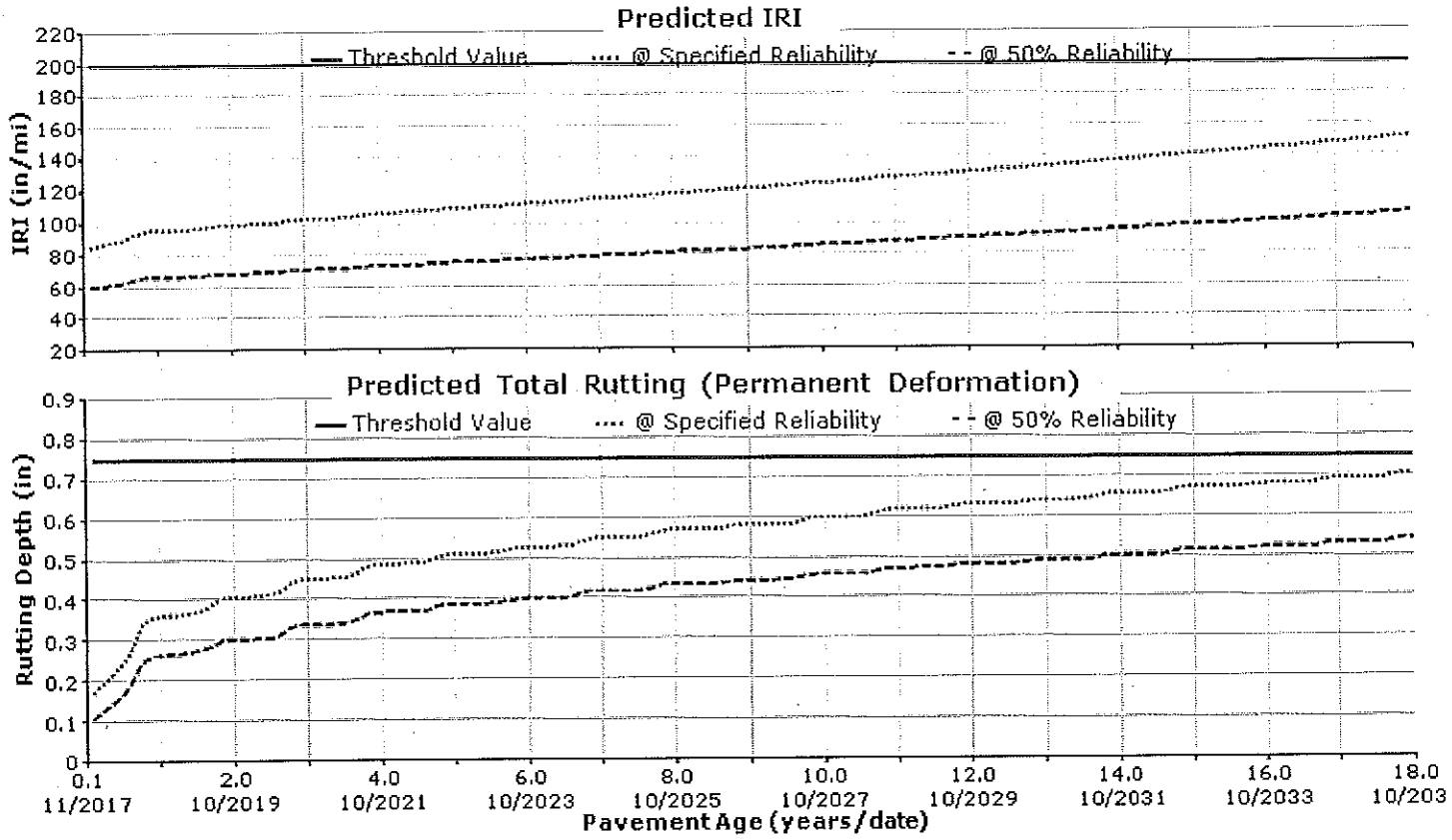
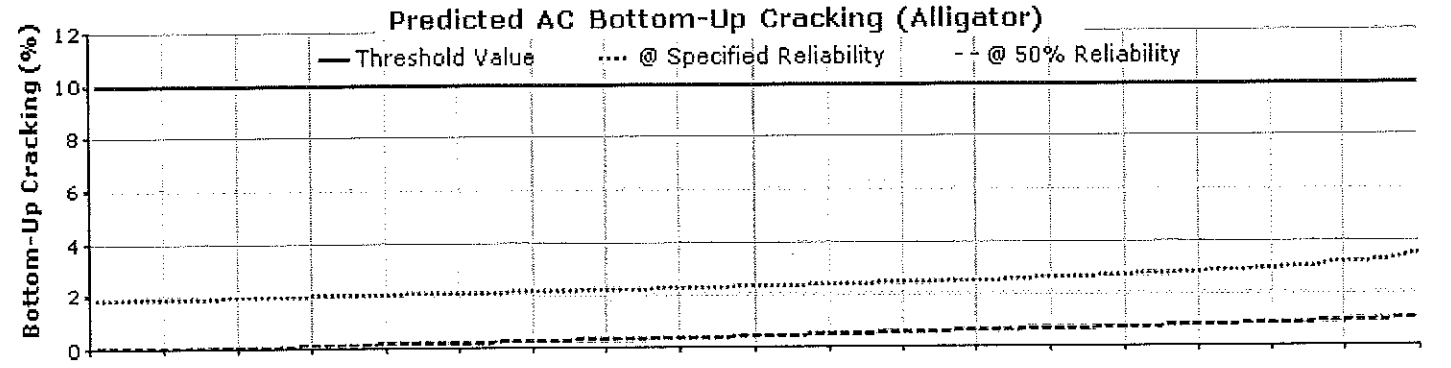


EXHIBIT #131

Analysis Output Charts





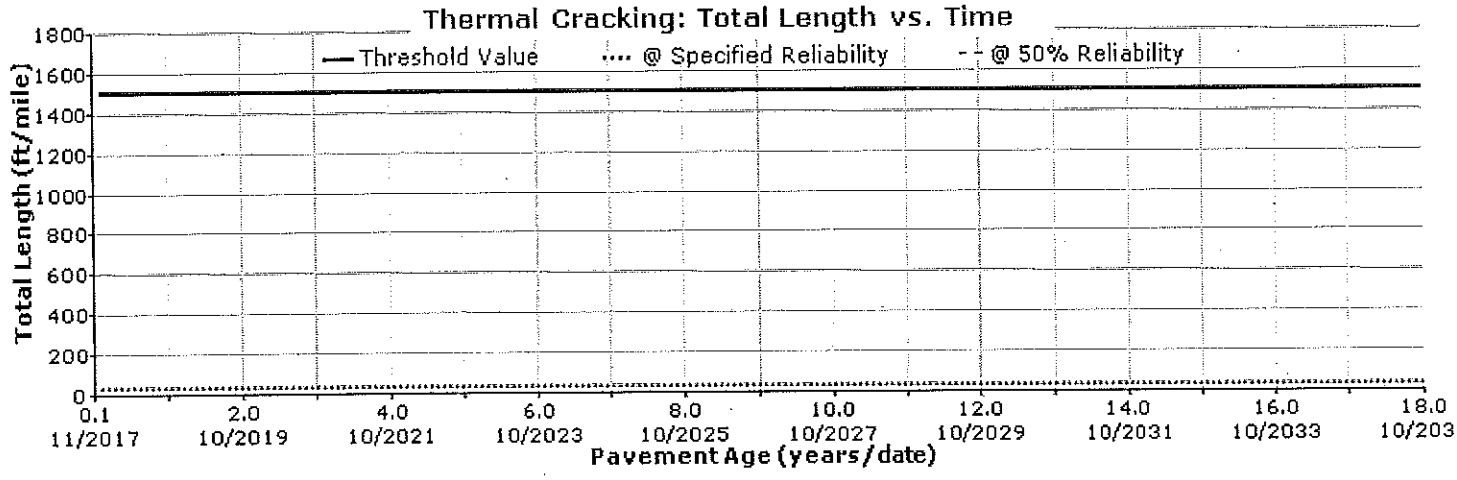
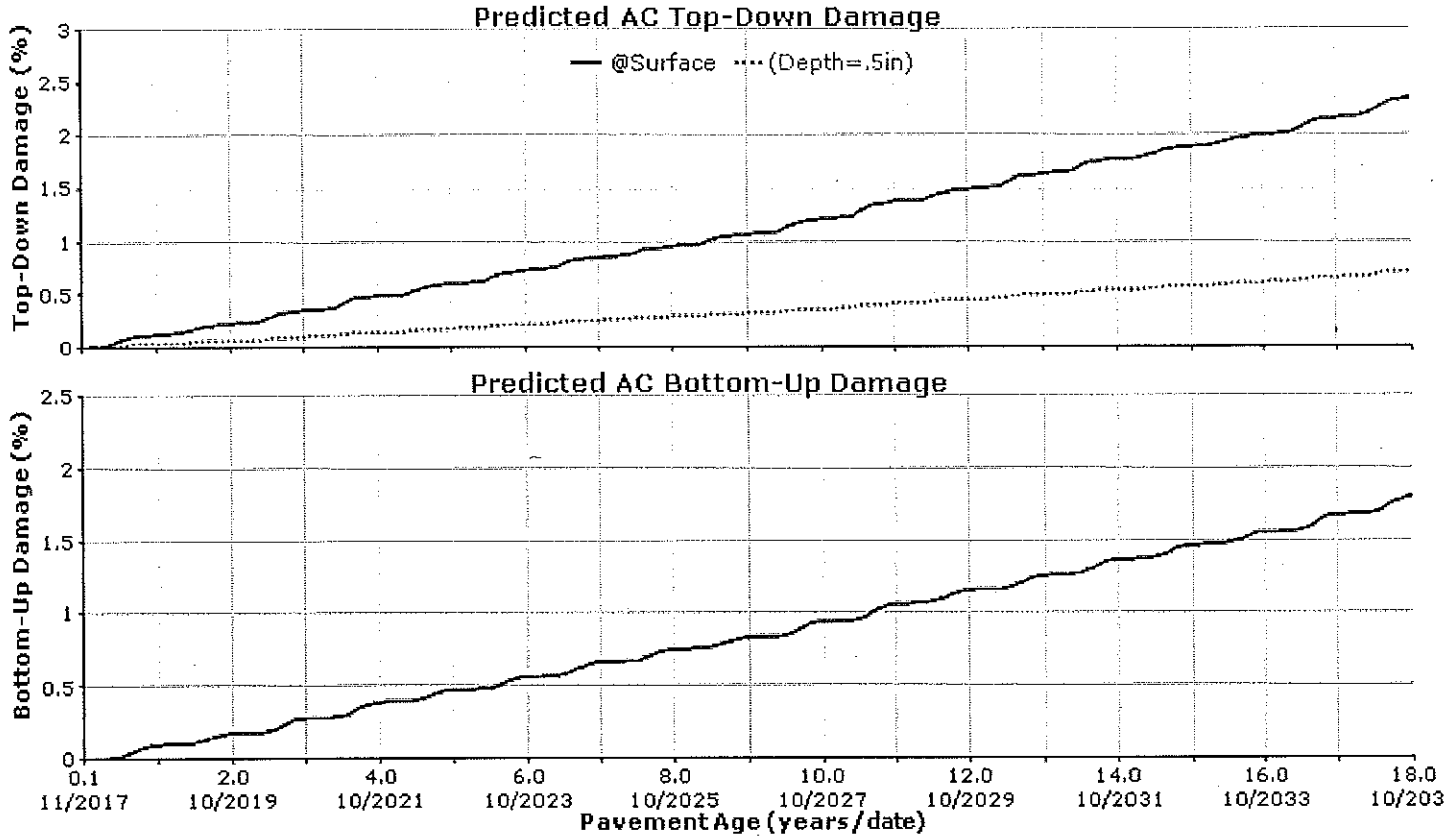


EXHIBIT #132

27880001 Wauk Bypass Section#4 HMA 1-13-15

File Name: C:\ME Designs\12290401 IH43 10-29-14\27880001 Wauk Bypass Section#4 HMA 1-13-15.dgpx



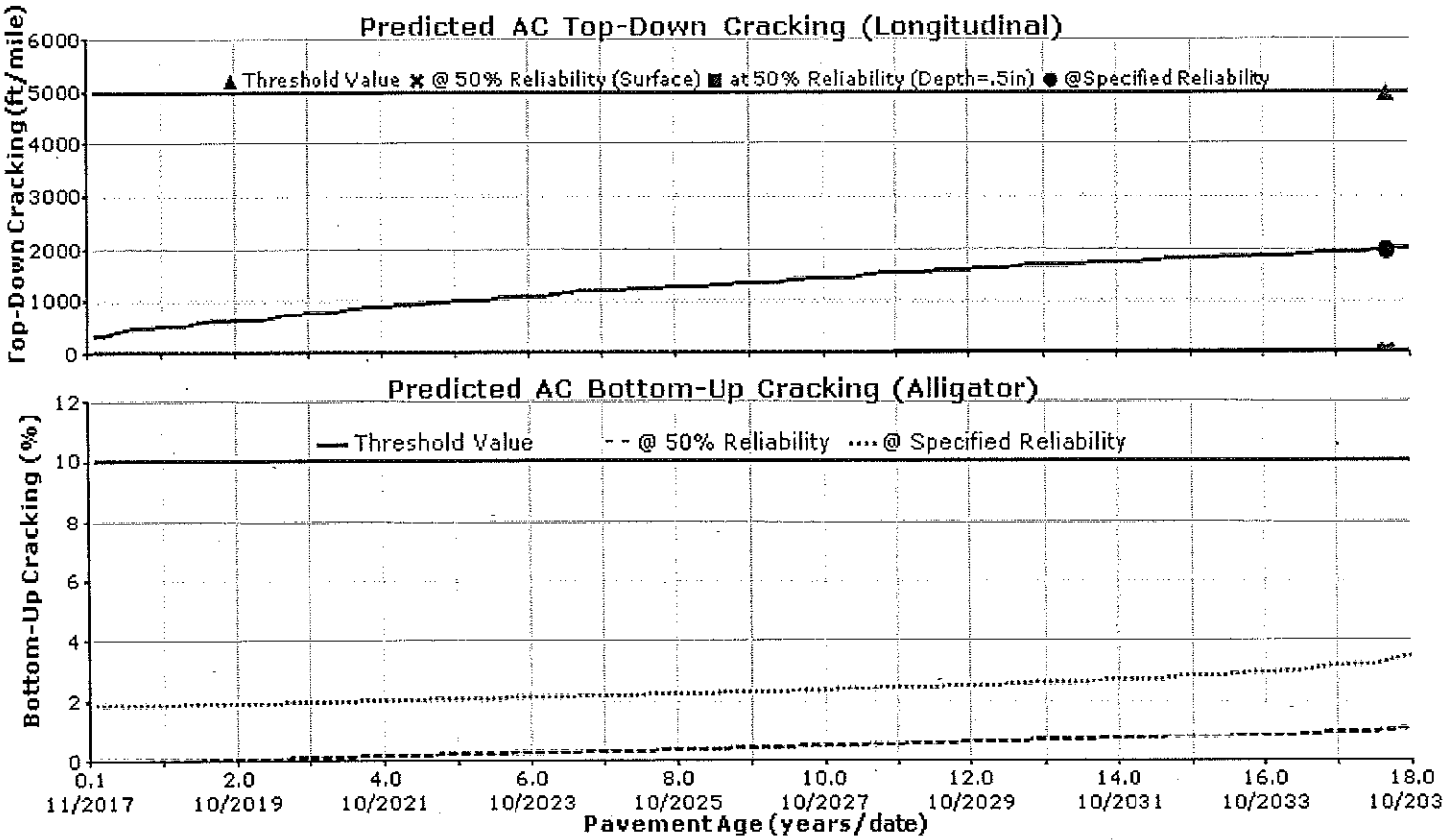


EXHIBIT #133

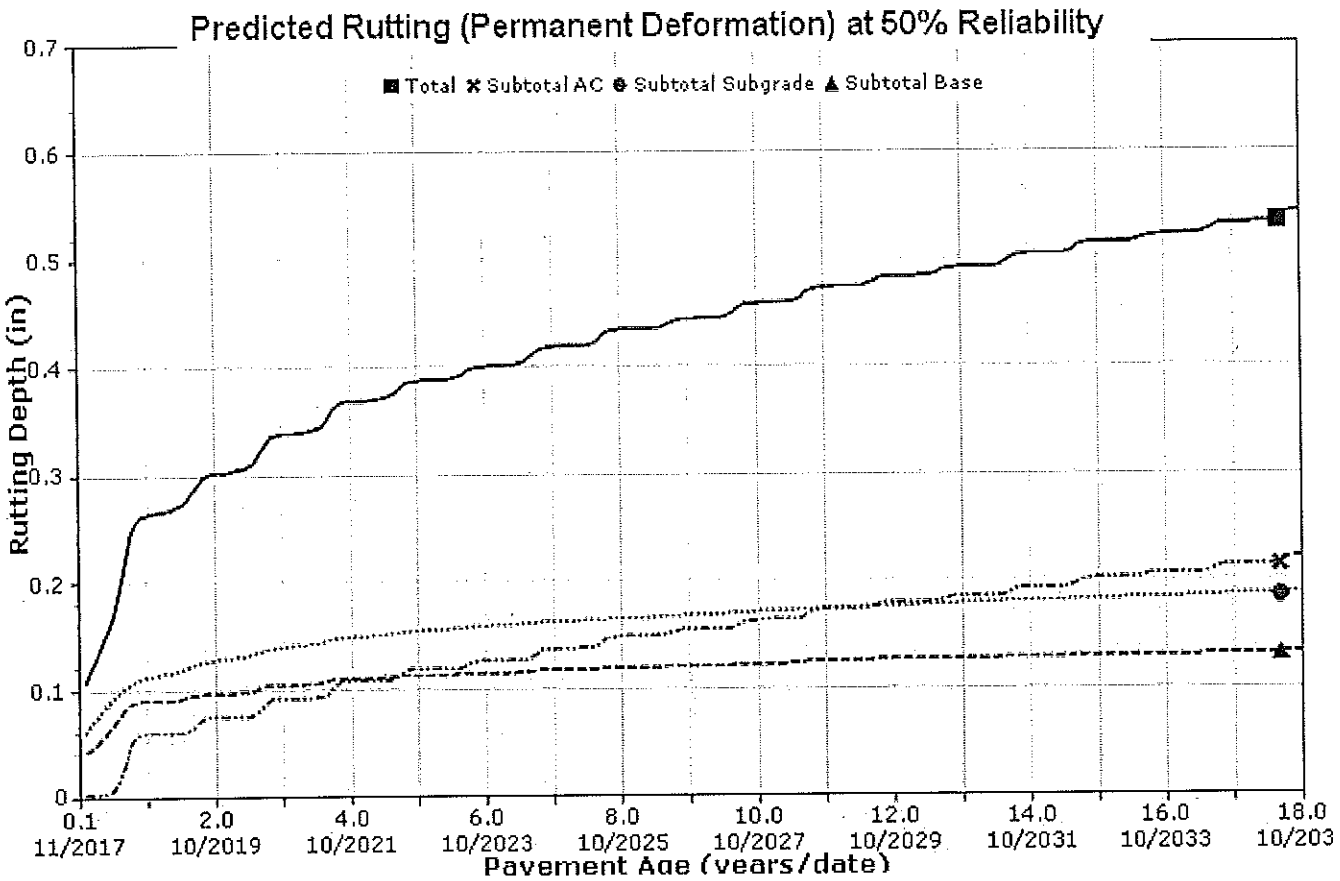
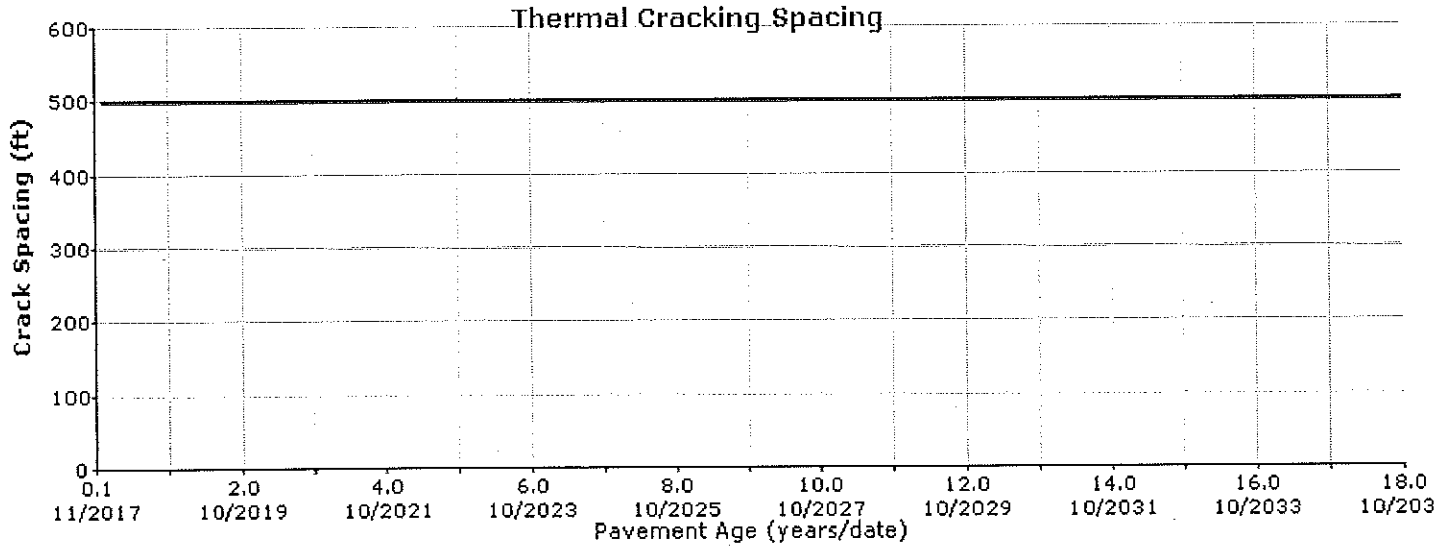

Predicted Rutting (Permanent Deformation) at 50% Reliability
Total
Subtotal AC
Subtotal Subgrade
Subtotal Base
Rutting Depth (in)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)

EXHIBIT #134


Thermal Cracking Spacing
Crack Spacing (ft)
600
500
400
300
200
100
0
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)

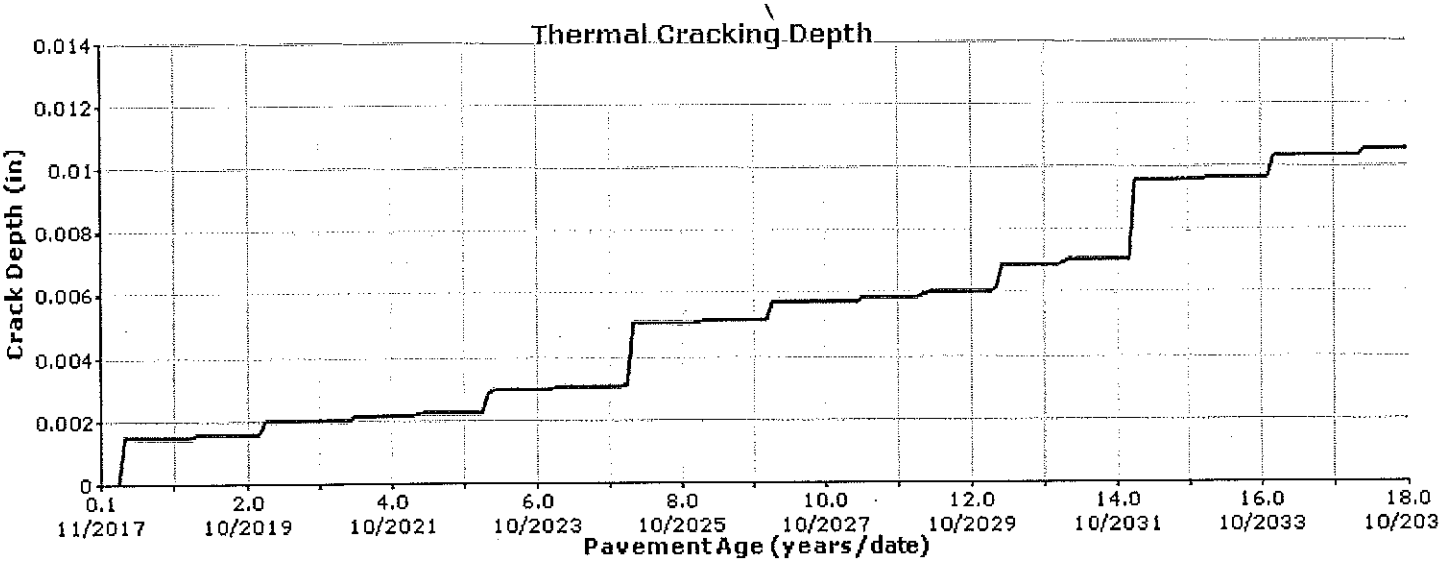
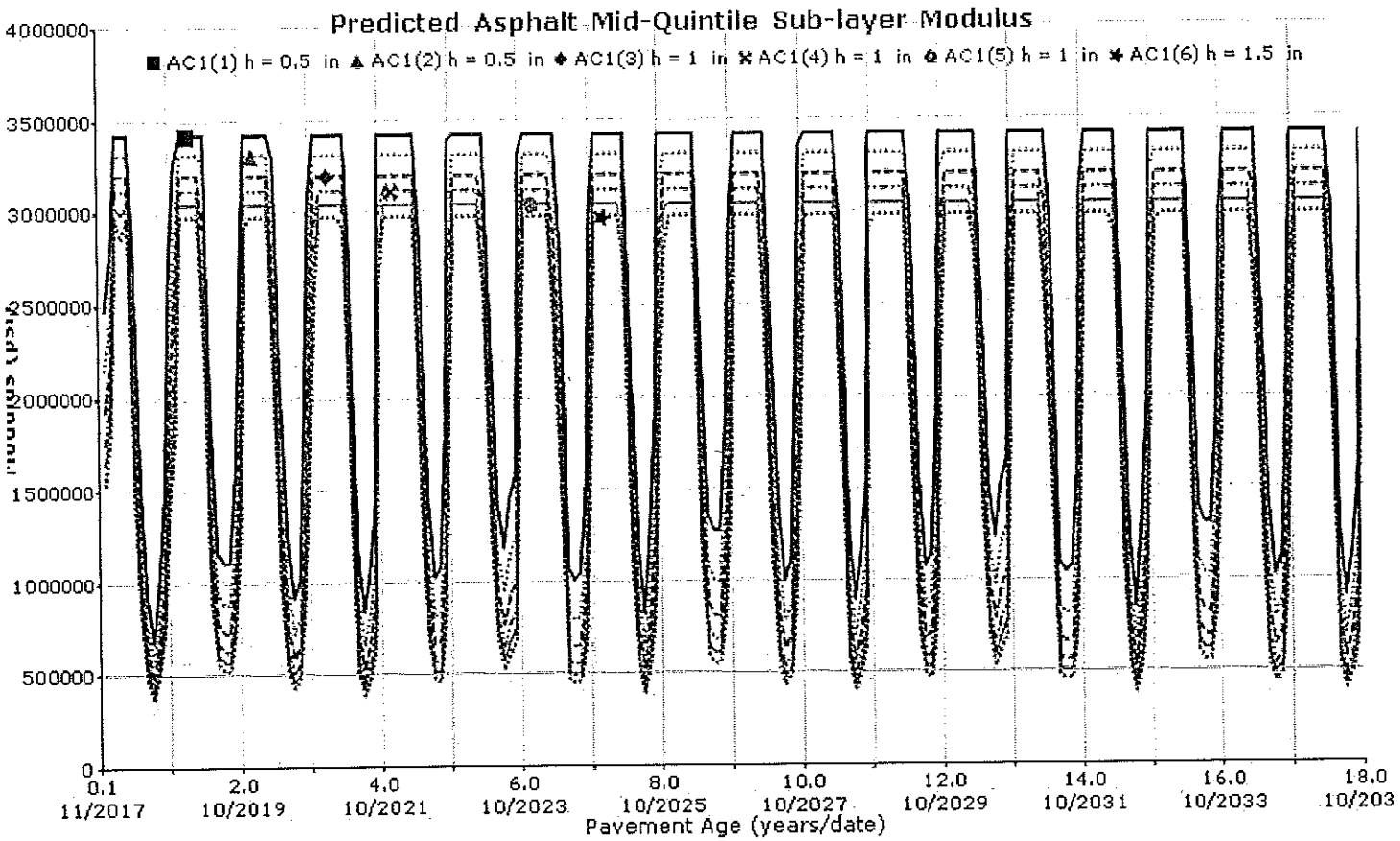
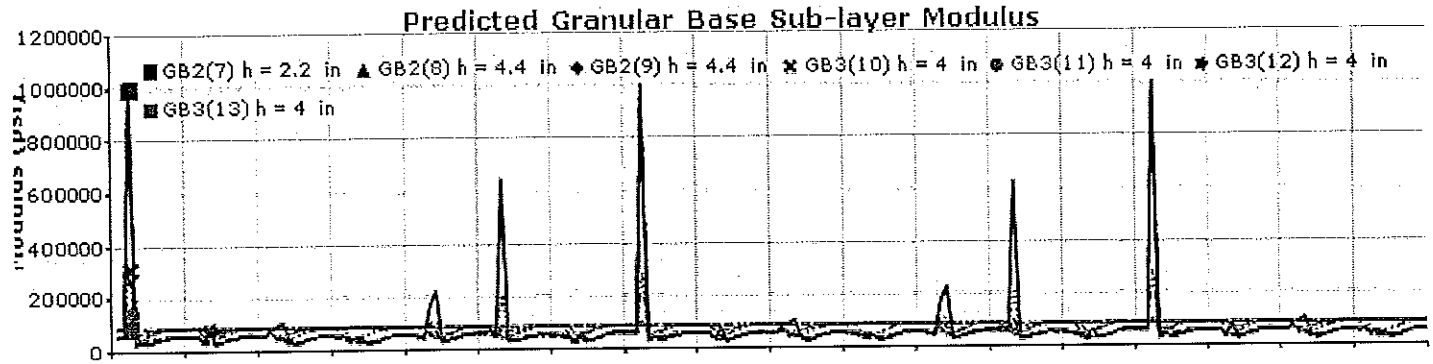

Thermal Cracking Depth
Crack Depth (in)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)

EXHIBIT #135


Predicted Asphalt Mid-Quintile Sub-layer Modulus
AC1(1) h = 0.5 in
AC1(2) h = 0.5 in
AC1(3) h = 1 in
AC1(4) h = 1 in
AC1(5) h = 1 in
AC1(6) h = 1.5 in
Modulus (psi)
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)


Predicted Granular Base Sub-layer Modulus
GB2(7) h = 2.2 in
GB2(8) h = 4.4 in
GB2(9) h = 4.4 in
GB3(10) h = 4 in
GB3(11) h = 4 in
GB3(12) h = 4 in
GB3(13) h = 4 in
Modulus (psi)
1200000
1000000
800000
600000
400000
200000
0

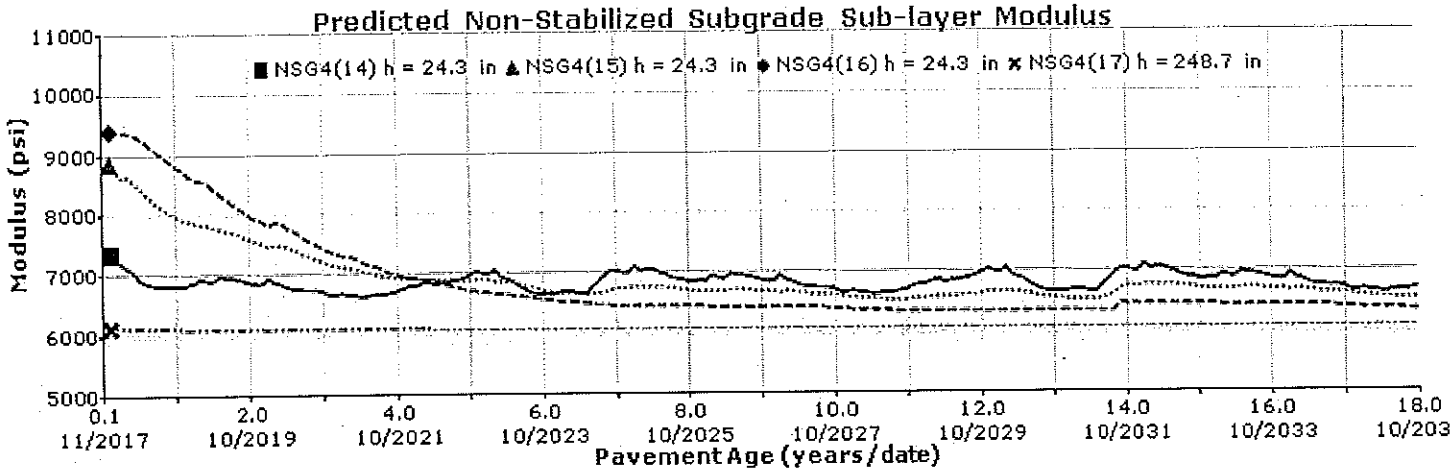

Predicted Non-Stabilized Subgrade Sub-layer Modulus
NSG4(14) h = 24.3 in
NSG4(15) h = 24.3 in
NSG4(16) h = 24.3 in
NSG4(17) h = 248.7 in
Modulus (psi)
11000
10000
9000
8000
7000
6000
5000
0.1
11/2017
2.0
10/2019
4.0
10/2021
6.0
10/2023
8.0
10/2025
10.0
10/2027
12.0
10/2029
14.0
10/2031
16.0
10/2033
18.0
10/203
Pavement Age (years/date)

EXHIBIT #136

Layer Information

Layer 1 Flexible : Default asphalt concrete

Asphalt		
Thickness (in.)	5.5	
Unit weight (pcf)	145.0	
Poisson's ratio	Is Calculated?	False
	Ratio	0.30
	Parameter A	-
	Parameter B	-

Asphalt Dynamic Modulus (Input Level: 3)

Gradation	Percent Passing
3/4-inch sieve	95
3/8-inch sieve	90
No.4 sieve	60
No.200 sieve	5

Asphalt Binder

Parameter	Value
Grade	Superpave Performance Grade
Binder Type	58-28
A	11.01
VTS	-3.701

General Info

Name	Value
Reference temperature (°F)	70
Effective binder content (%)	9.2
Air voids (%)	7
Thermal conductivity (BTU/hr-ft-°F)	0.67
Heat capacity (BTU/lb-°F)	0.23

Identifiers

Field	Value
Display name/identifier	Default asphalt concrete
Description of object	
Author	
Date Created	1/13/2015 12:00:00 AM
Approver	
Date approved	1/13/2015 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

EXHIBIT #137

Layer 2 Non-stabilized Base : A-1-a

Unbound	
Layer thickness (in.)	11.0
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)
40000.0

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

Identifiers

Field	Value
Display name/identifier	A-1-a
Description of object	Default material
Author	AASHTO
Date Created	12/9/2014 12:00:00 AM
Approver	
Date approved	12/9/2014 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	True

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	128.1
Saturated hydraulic conductivity (ft/hr)	False	2.616e-02
Specific gravity of solids	False	2.7
Optimum gravimetric water content (%)	False	7.2

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	4.7511
bf	1.7494
cf	0.7630
hr	184.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	7.0
#100	
#80	
#60	
#50	
#40	18.0
#30	
#20	
#16	
#10	32.0
#8	
#4	44.0
3/8-in.	61.0
1/2-in.	
3/4-in.	82.0
1-in.	
1 1/2-in.	97.0
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	

EXHIBIT #138

Layer 3 Non-stabilized Base : A-1-a

Unbound	
Layer thickness (in.)	16.0
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)
42000.0

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

Identifiers

Field	Value
Display name/identifier	A-1-a
Description of object	Default material
Author	AASHTO
Date Created	12/9/2014 12:00:00 AM
Approver	
Date approved	12/9/2014 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	True

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	109.6
Saturated hydraulic conductivity (ft/hr)	False	8.267e+02
Specific gravity of solids	True	2.6
Optimum gravimetric water content (%)	True	16.6

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	9.2765
bf	3.7128
cf	2.9466
hr	160.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	5.0
#100	
#80	
#60	
#50	
#40	
#30	
#20	
#16	
#10	10.0
#8	
#4	
3/8-in.	
1/2-in.	30.0
3/4-in.	
1-in.	
1 1/2-in.	60.0
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	90.0

EXHIBIT #139

Layer 4 Subgrade : A-4

Unbound	
Layer thickness (in.)	Semi-infinite
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)
9450.0

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

Identifiers

Field	Value
Display name/identifier	A-4
Description of object	Default material
Author	AASHTO
Date Created	1/13/2015 12:00:00 AM
Approver	
Date approved	1/13/2015 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	25.0
Plasticity Index	6.0
Is layer compacted?	False

	Is User Defined?	Value
Maximum dry unit weight (pcf)	True	116
Saturated hydraulic conductivity (ft/hr)	False	9.138e-06
Specific gravity of solids	True	2.65
Optimum gravimetric water content (%)	True	14

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	69.7987
bf	0.9890
cf	0.4694
hr	500.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	52.0
#100	
#80	
#60	
#50	
#40	65.0
#30	
#20	
#16	
#10	74.0
#8	
#4	85.0
3/8-in.	
1/2-in.	
3/4-in.	
1-in.	
1 1/2-in.	
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	

EXHIBIT #140

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: 0.007566	
k2: 3.9492	
k3: 1.281	
Bf1: 1	
Bf2: 1	
Bf3: 1	

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:

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

$\varepsilon_p = plastic\ strain\left(^{in}/_{in}\right)$

$\varepsilon_r = resilient\ strain\left(^{in}/_{in}\right)$

$T = layer\ temperature(^{\circ}F)$

$N = number\ of\ load\ repetitions$

K1: -3.35412	K2: 1.5606	K3: 0.4791
Br2: 1	Br3: 1	Br1: 1

AC Rutting Standard Deviation

0.24*Pow(RUT,0.8026)+0.001

Thermal Fracture

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

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

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

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

Level 1 K: 1.5	Level 1 Standard Deviation: 0.1468 * THERMAL + 65.027
Level 2 K: 0.5	Level 2 Standard Deviation: 0.2841 *THERMAL + 55.462
Level 3 K: 1.5	Level 3 Standard Deviation: 0.3972 * THERMAL + 20.422

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: 1	k2: 1	Bc1: 1	Bc2:1

EXHIBIT #141

Subgrade Rutting

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

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

Granular		Fine	
k1: 2.03	Bs1: 1	k1: 1.35	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 Cracking Top Standard Deviation

200 + 2300/(1+exp(1.072-2.1654*LOG10 (TOP+0.0001)))

AC Bottom Up Cracking

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

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

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

c1: 1	c2: 1	c3: 6000

AC Cracking Bottom Standard Deviation

1.13+13/(1+exp(7.57-15.5*LOG10 (BOTTOM+0.0001)))

CSM Cracking

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

C1: 1	C2: 1	C3: 0	C4: 1000

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

EXHIBIT #142