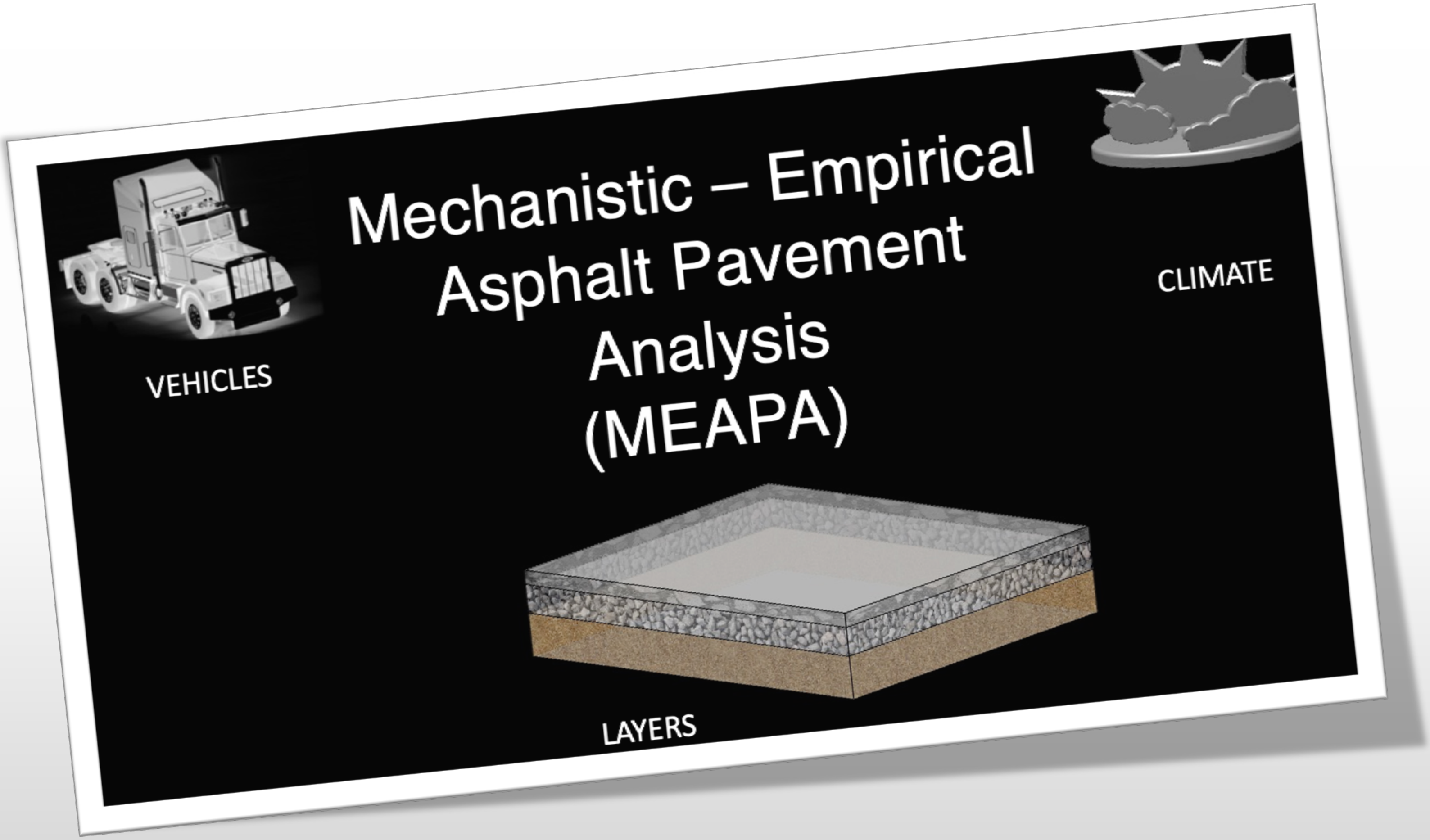
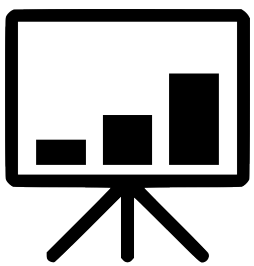


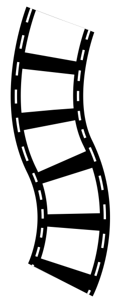
A web-based pavement design app

Housekeeping



You can find these **slides** on the MEAPA website

https://paveapps.com/meapa/



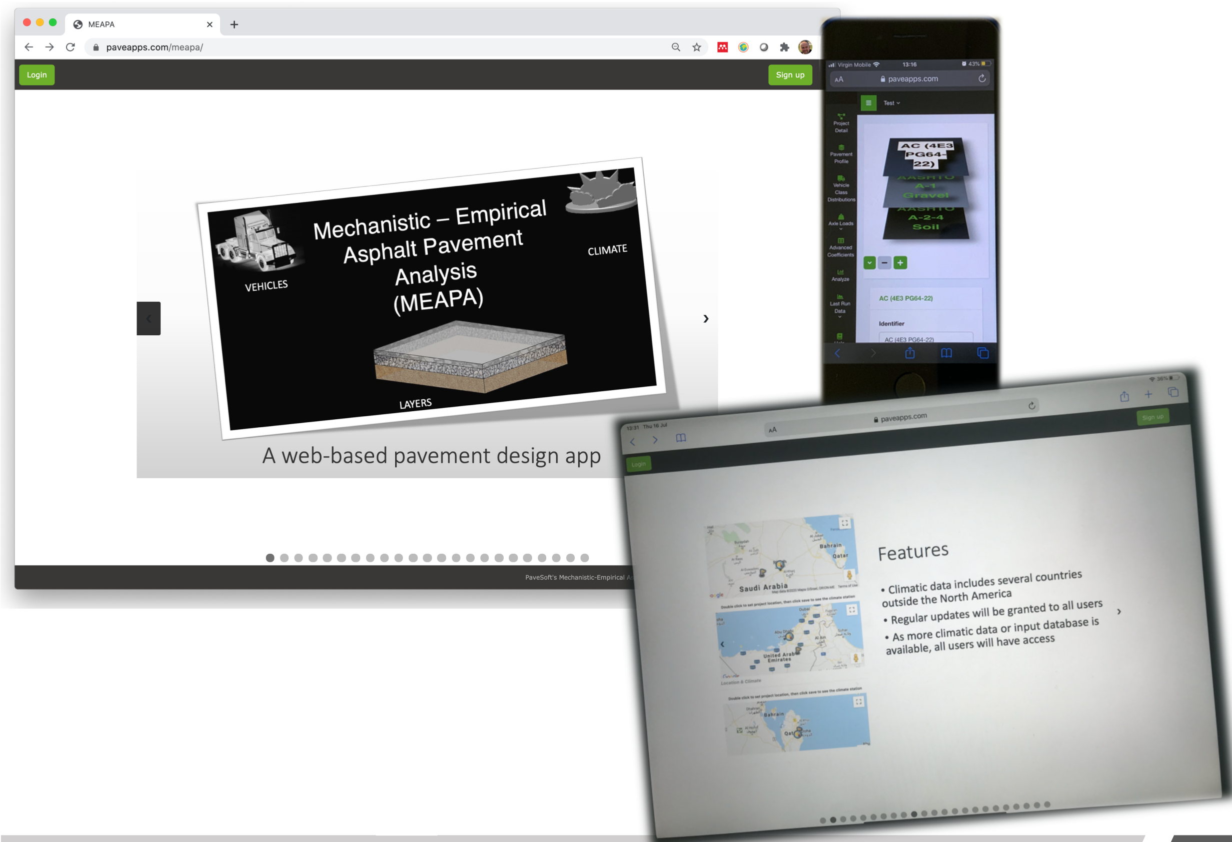
You will get a **recording** of this session by email

Click on the icon and **ask your questions** to the panelists

Webinar objectives

Introduce MEAPA
and some of its
features

Provide a
quick user guide



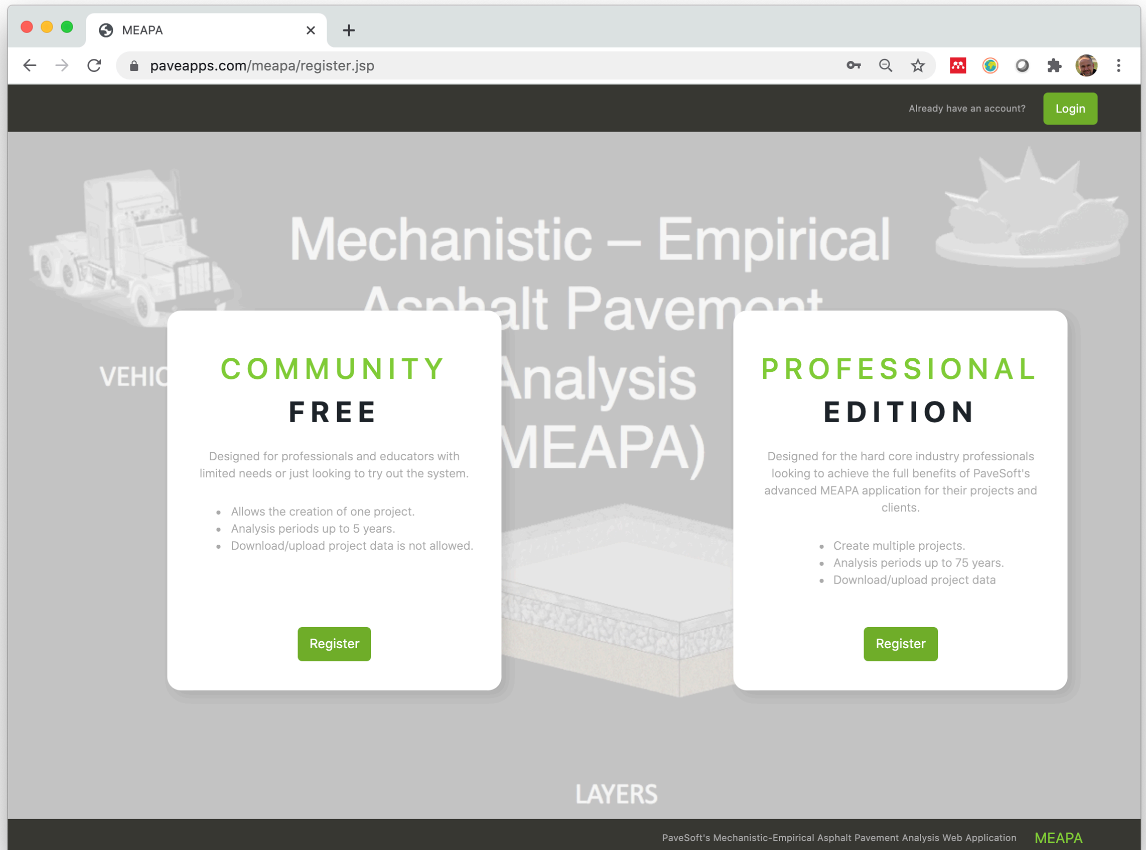
- ❑ Access from any web browser
  - Google Chrome is recommended
  - Smartphone
  - iPad/tablet
  - Other handheld device
- ❑ No installation
- ❑ All data is saved in the cloud

https://paveapps.com/meapa/

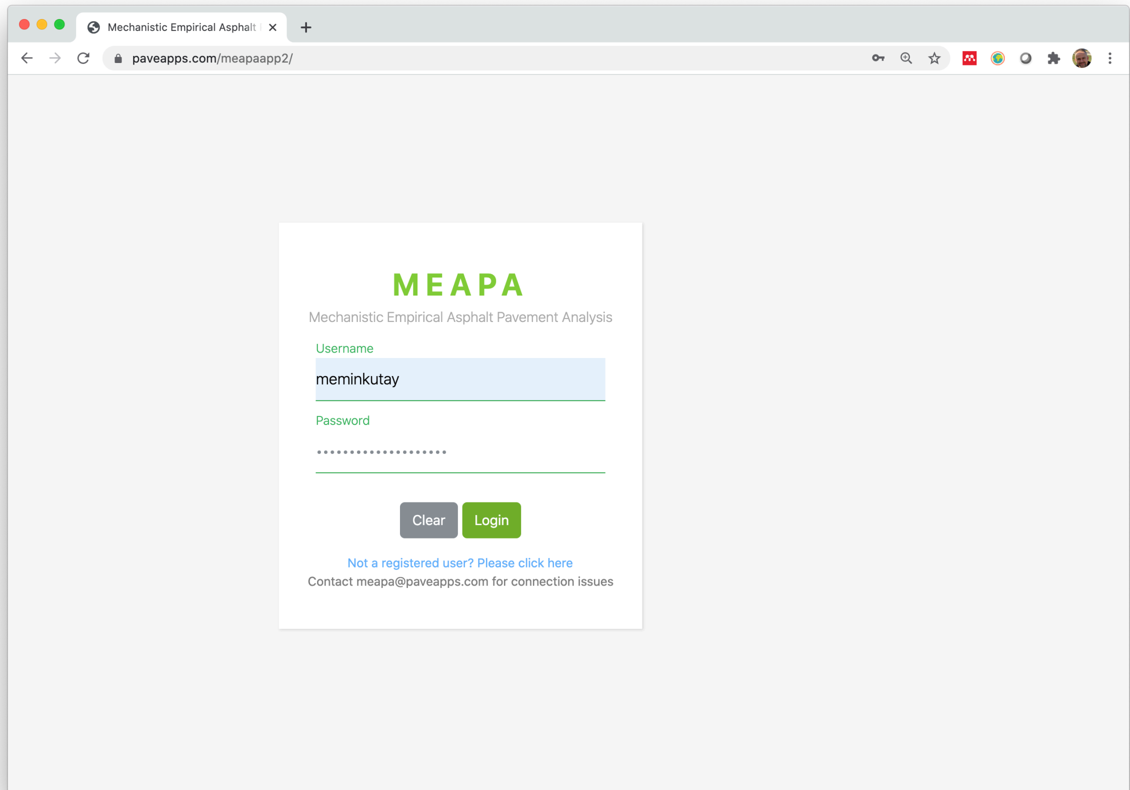
MEAPA Webinar

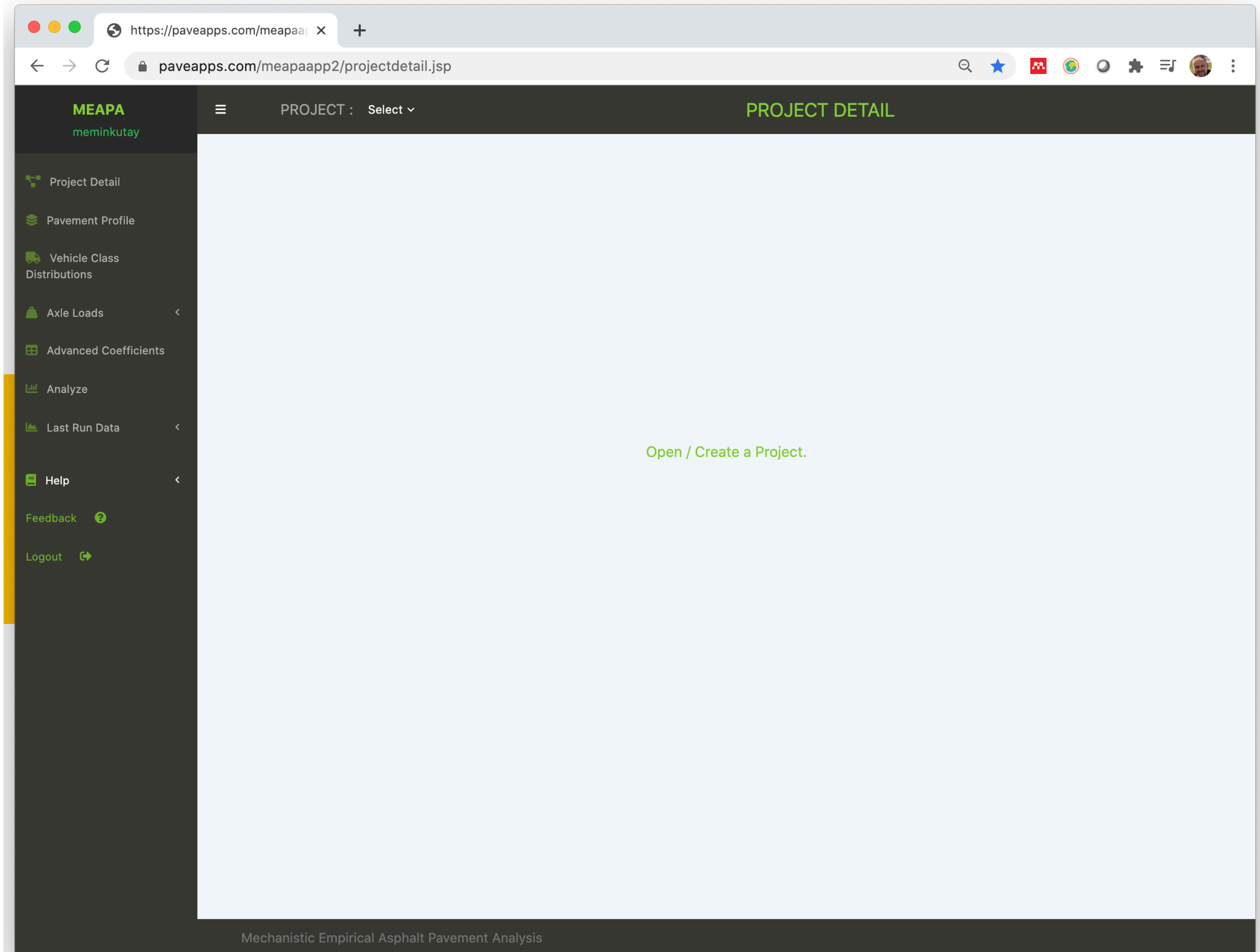
M. Emin Kutay, Ph.D., P.E.
Professor
Department of Civil and Environmental Engineering
Michigan State University

Registration

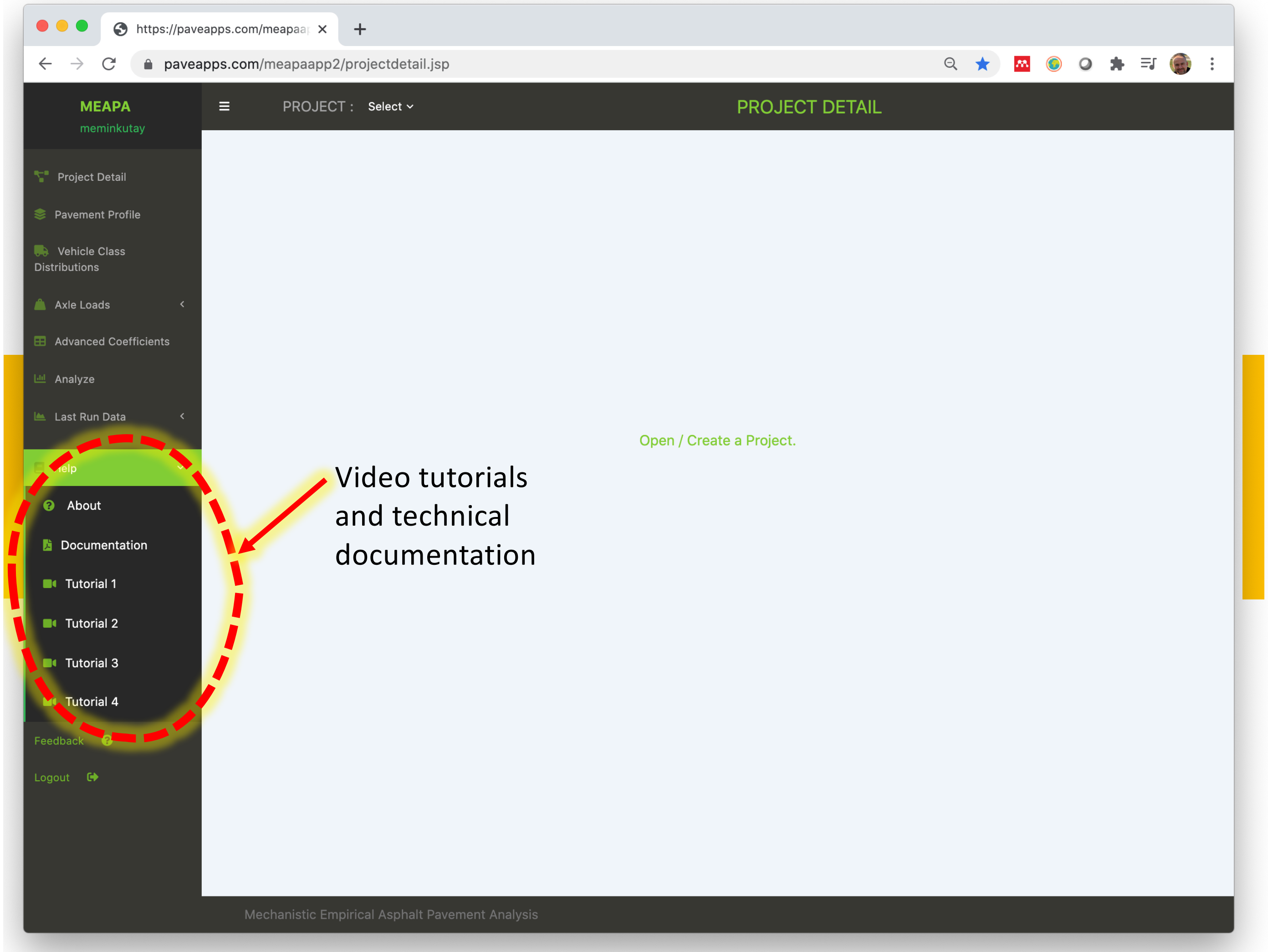


Log-in page


Mechanistic Empirical Asphalt
paveapps.com/meapaapp2/
MEAPA
Mechanistic Empirical Asphalt Pavement Analysis
Username
meminkutay
Password
Clear
Login
Not a registered user? Please click here
Contact meapa@paveapps.com for connection issues



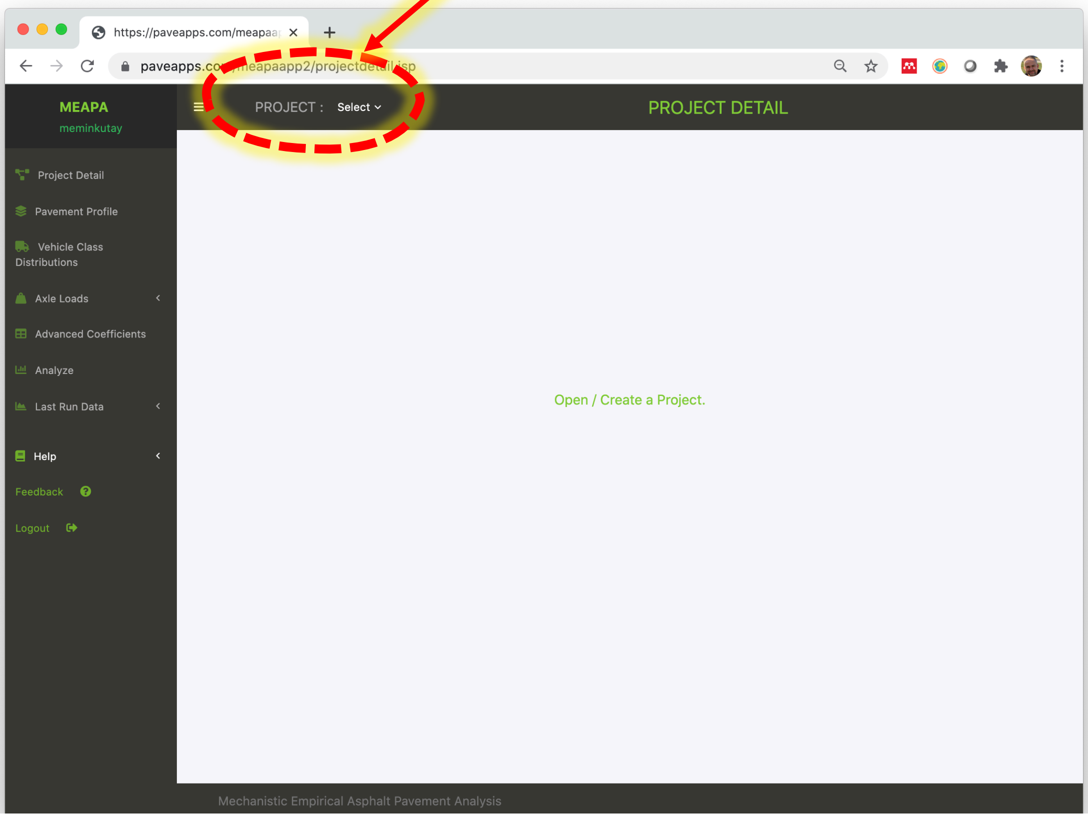
Initial page



Initial page

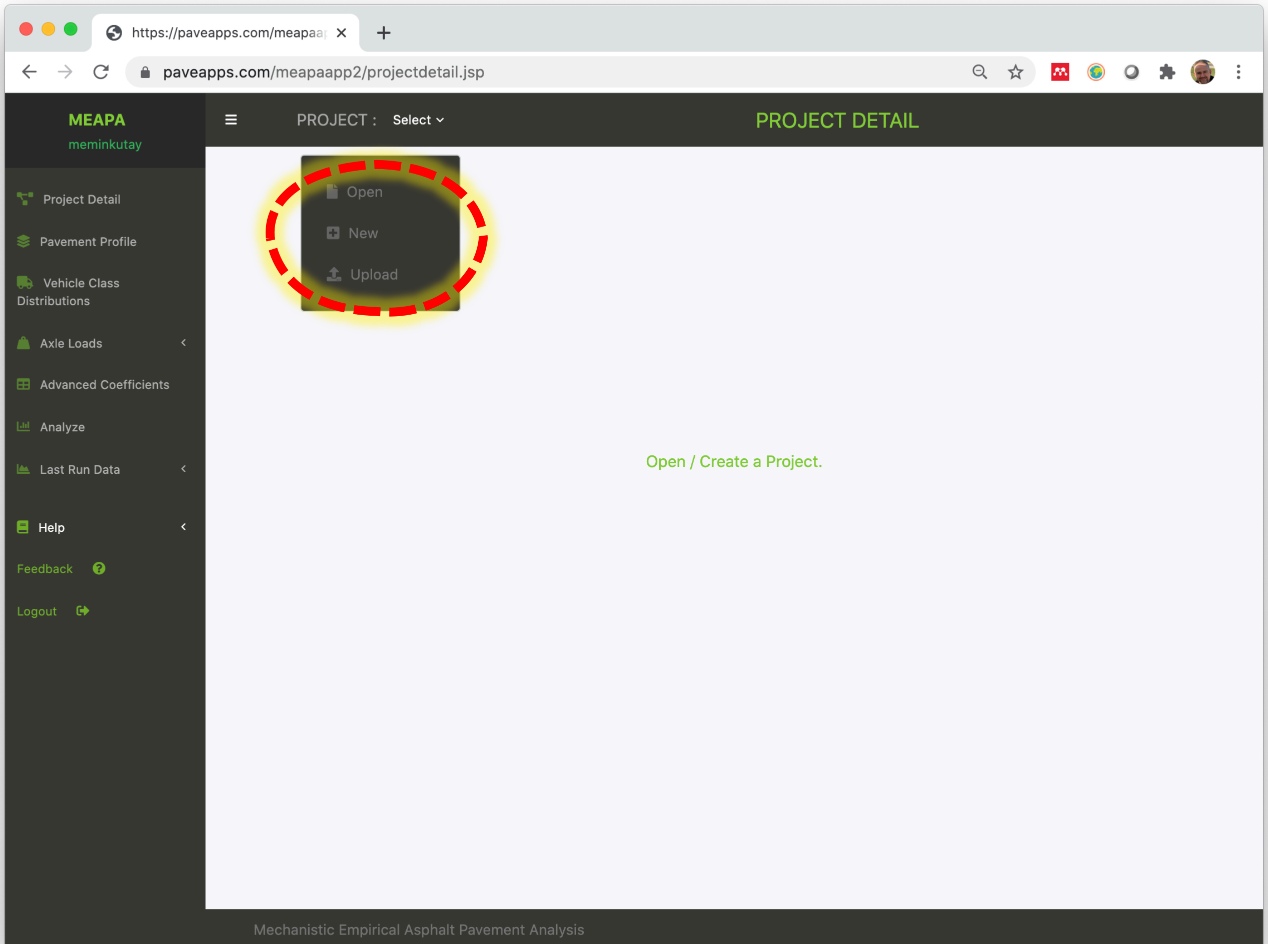
Please make sure to go through the video tutorials.

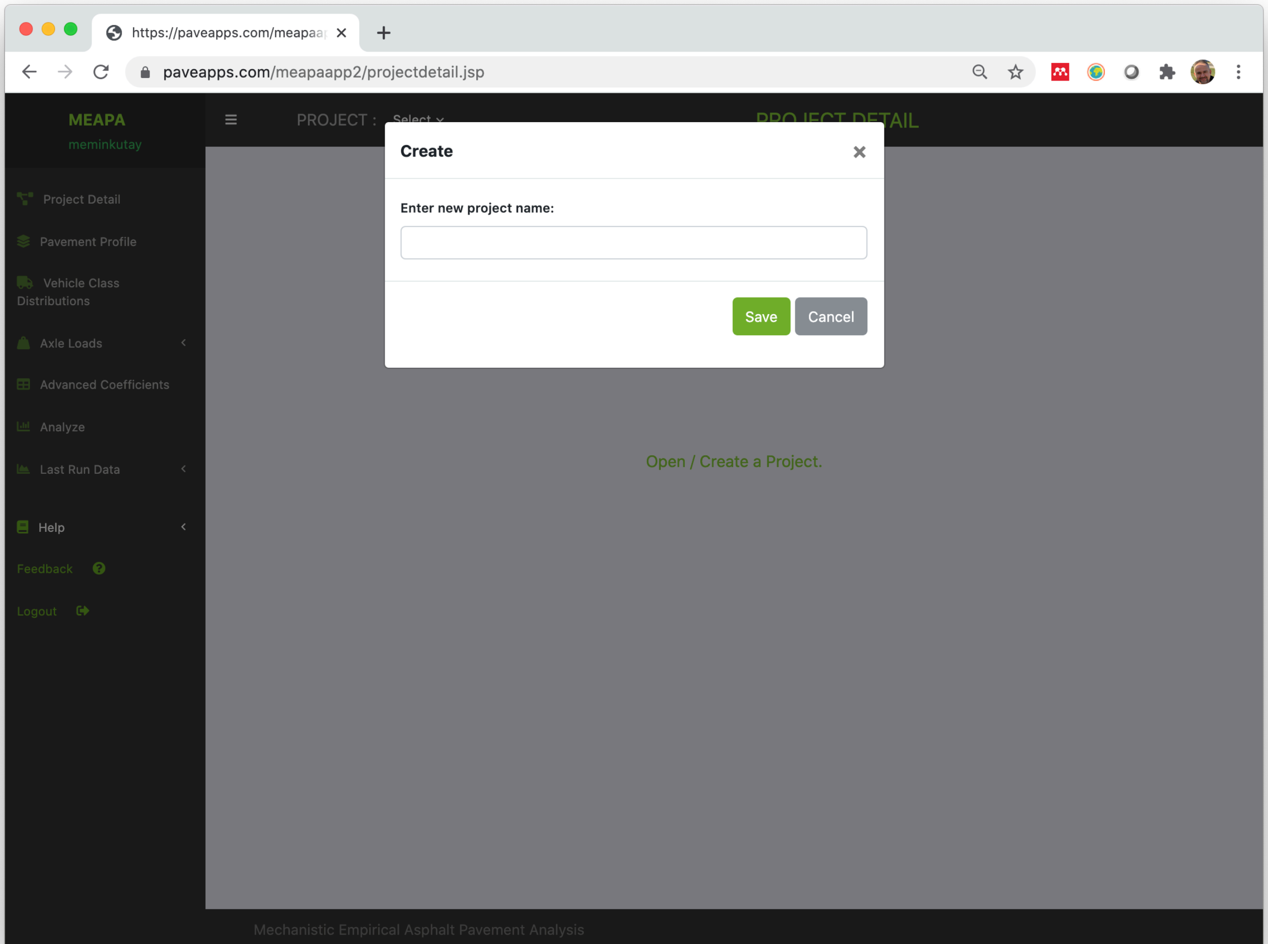
Start here

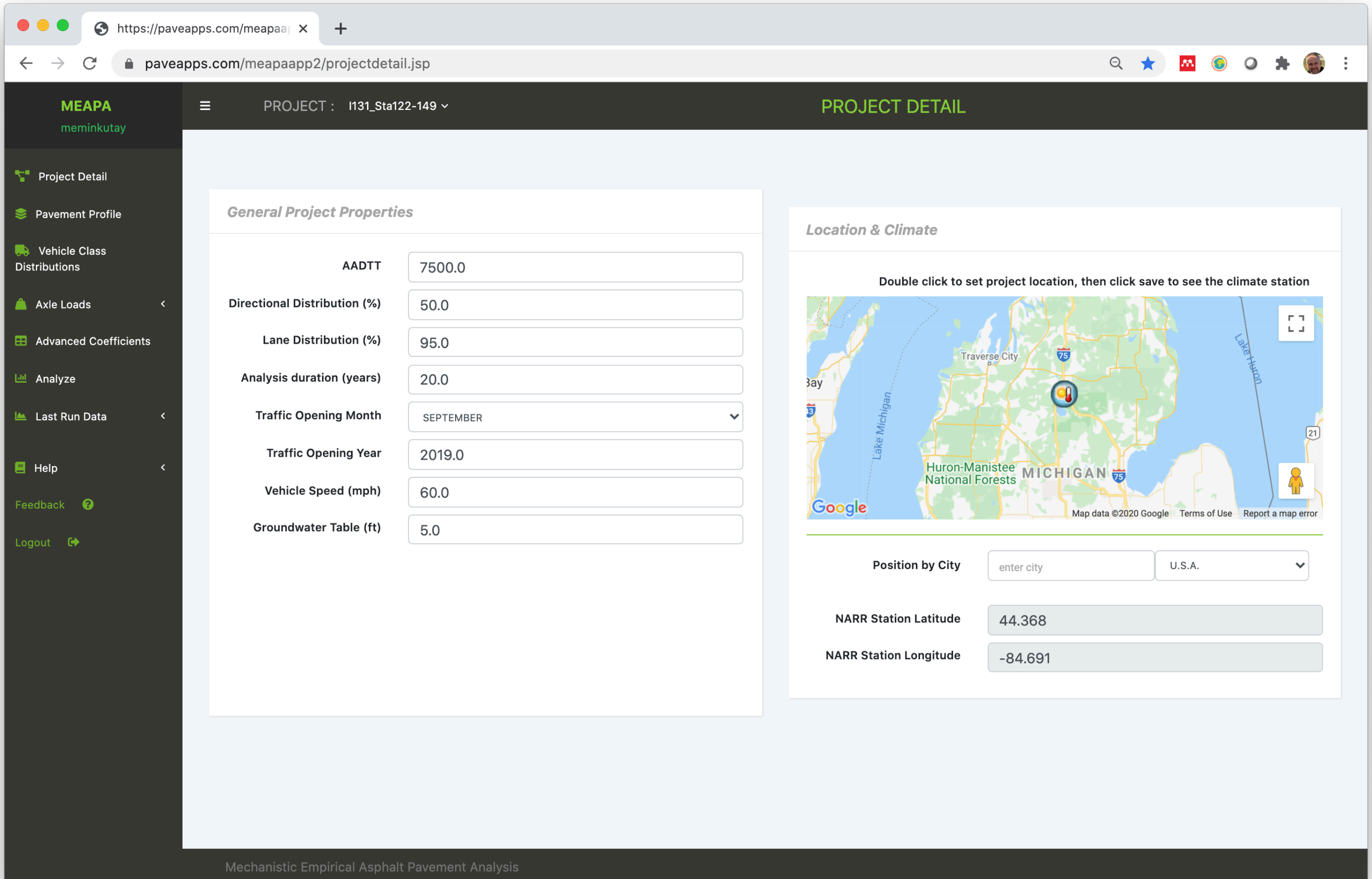


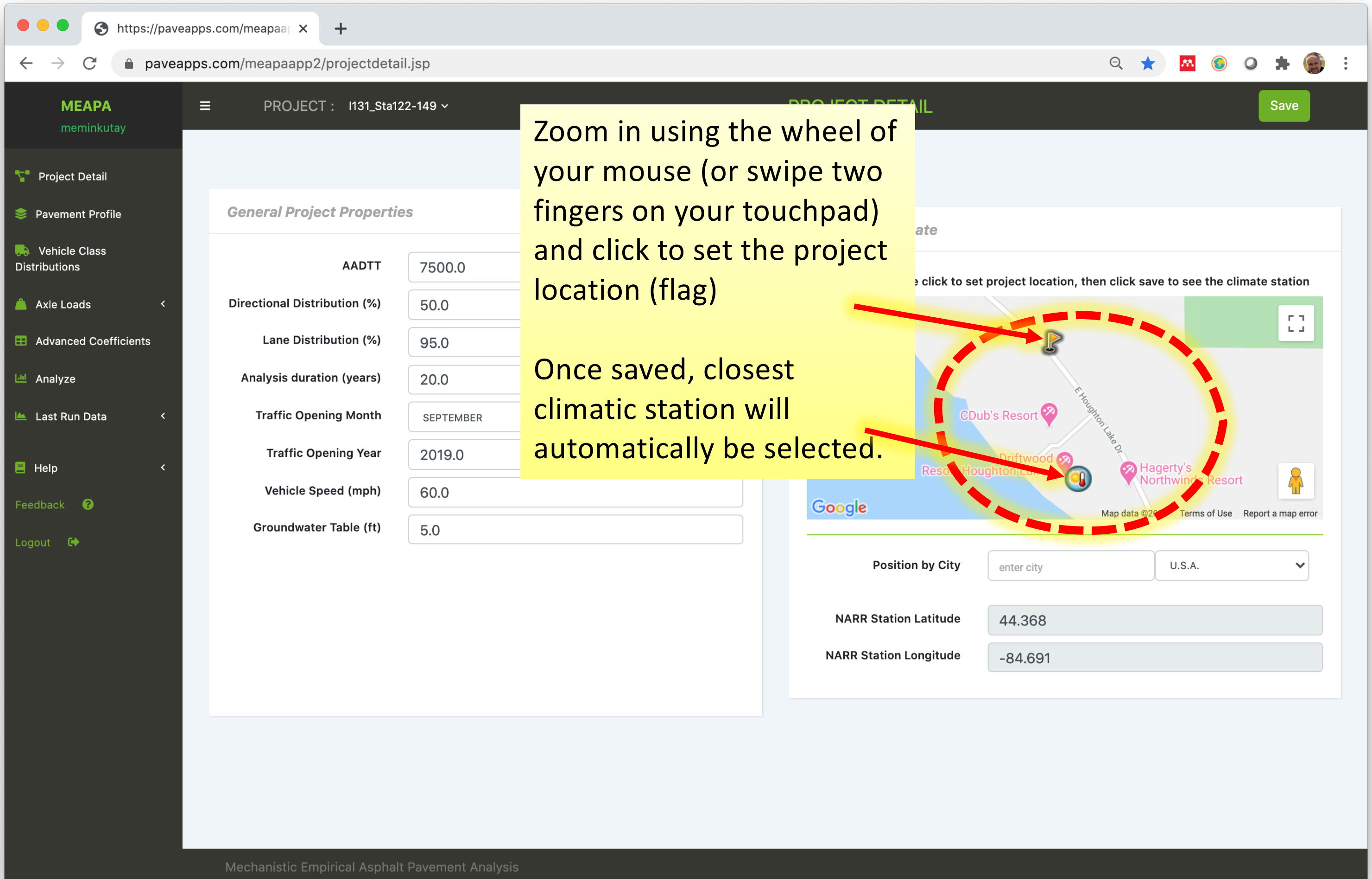
Project detail page

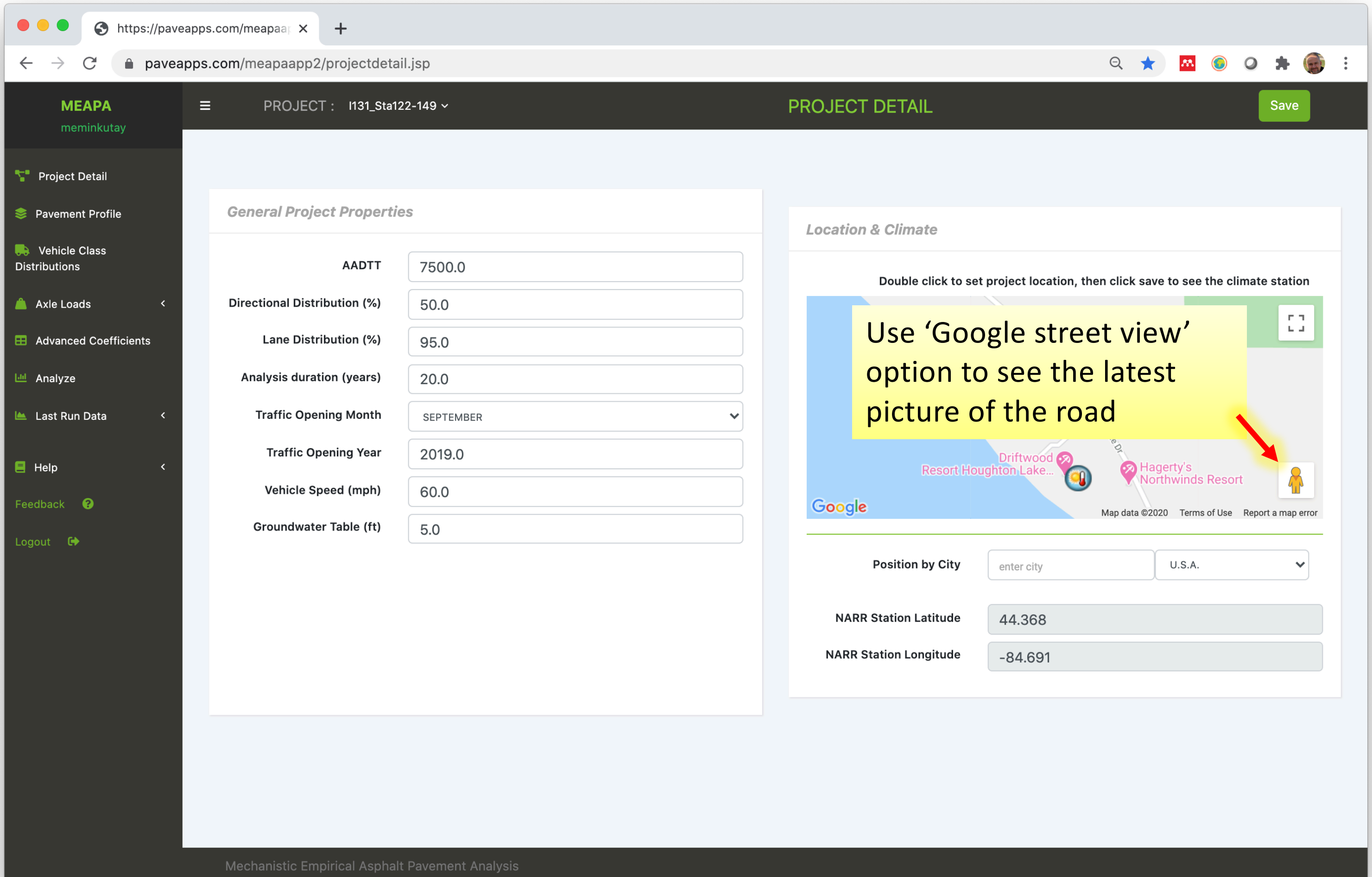
Click PROJECT to start

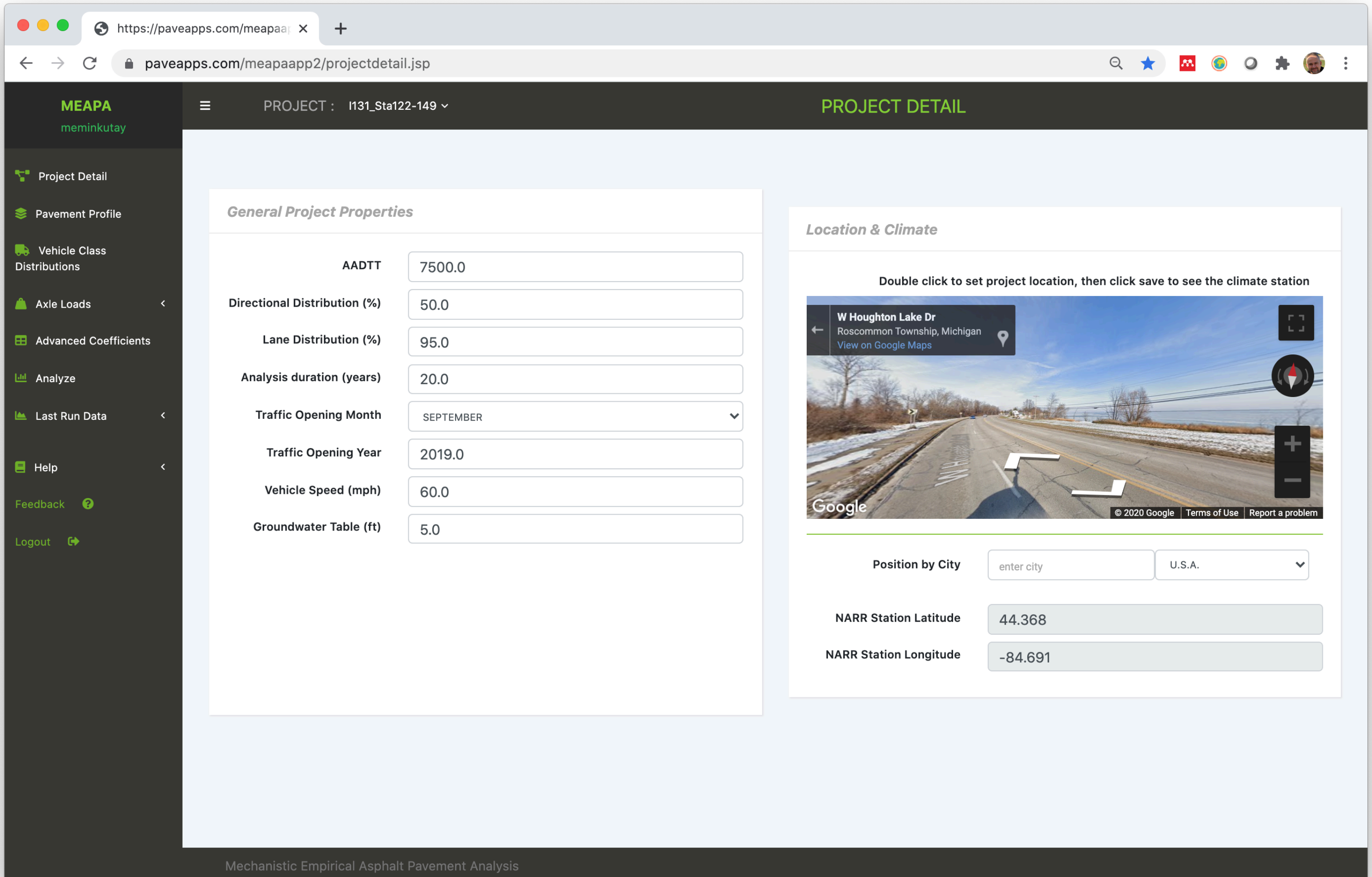

https://paveapps.com/meapaa
paveapps.com/meapaapp2/projectdetail.jsp
MEAPA
meminkutay
PROJECT :
Select
PROJECT DETAIL
Open
New
Upload
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
Open / Create a Project.
Mechanistic Empirical Asphalt Pavement Analysis


https://paveapps.com/meapaa
paveapps.com/meapaapp2/projectdetail.jsp
MEAPA
meminkutay
PROJECT :
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
Create
Enter new project name:
Save
Cancel
Open / Create a Project.
Mechanistic Empirical Asphalt Pavement Analysis


https://paveapps.com/meapaa
paveapps.com/meapaapp2/projectdetail.jsp
MEAPA
meminkutay
PROJECT : I131_Sta122-149
PROJECT DETAIL
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
General Project Properties
AADTT
7500.0
Directional Distribution (%)
50.0
Lane Distribution (%)
95.0
Analysis duration (years)
20.0
Traffic Opening Month
SEPTEMBER
Traffic Opening Year
2019.0
Vehicle Speed (mph)
60.0
Groundwater Table (ft)
5.0
Location & Climate
Double click to set project location, then click save to see the climate station
Traverse City
Lake Michigan
Lake Huron
Huron-Manistee National Forests
MICHIGAN
Google
Map data ©2020 Google
Terms of Use
Report a map error
Position by City
enter city
U.S.A.
NARR Station Latitude
44.368
NARR Station Longitude
-84.691
Mechanistic Empirical Asphalt Pavement Analysis


https://paveapps.com/meapaa
paveapps.com/meapaapp2/projectdetail.jsp
MEAPA
meminkutay
PROJECT : I131_Sta122-149
Save
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
General Project Properties
AADTT
7500.0
Directional Distribution (%)
50.0
Lane Distribution (%)
95.0
Analysis duration (years)
20.0
Traffic Opening Month
SEPTEMBER
Traffic Opening Year
2019.0
Vehicle Speed (mph)
60.0
Groundwater Table (ft)
5.0
Zoom in using the wheel of your mouse (or swipe two fingers on your touchpad) and click to set the project location (flag)
Once saved, closest climatic station will automatically be selected.
click to set project location, then click save to see the climate station
CDub's Resort
Driftwood
Hagerty's Northwinds Resort
E Houghton Lake Dr
Google
Terms of Use
Report a map error
Position by City
enter city
U.S.A.
NARR Station Latitude
44.368
NARR Station Longitude
-84.691
Mechanistic Empirical Asphalt Pavement Analysis


https://paveapps.com/meapaa
paveapps.com/meapaapp2/projectdetail.jsp
MEAPA
meminkutay
PROJECT : I131_Sta122-149
PROJECT DETAIL
Save
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
General Project Properties
AADTT
7500.0
Directional Distribution (%)
50.0
Lane Distribution (%)
95.0
Analysis duration (years)
20.0
Traffic Opening Month
SEPTEMBER
Traffic Opening Year
2019.0
Vehicle Speed (mph)
60.0
Groundwater Table (ft)
5.0
Location & Climate
Double click to set project location, then click save to see the climate station
Use 'Google street view' option to see the latest picture of the road
Driftwood Resort Houghton Lake...
Hagerty's Northwinds Resort
Google
Map data ©2020
Terms of Use
Report a map error
Position by City
enter city
U.S.A.
NARR Station Latitude
44.368
NARR Station Longitude
-84.691
Mechanistic Empirical Asphalt Pavement Analysis


https://paveapps.com/meapaa
paveapps.com/meapaapp2/projectdetail.jsp
MEAPA
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PROJECT : I131_Sta122-149
PROJECT DETAIL
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
General Project Properties
AADTT
7500.0
Directional Distribution (%)
50.0
Lane Distribution (%)
95.0
Analysis duration (years)
20.0
Traffic Opening Month
SEPTEMBER
Traffic Opening Year
2019.0
Vehicle Speed (mph)
60.0
Groundwater Table (ft)
5.0
Location & Climate
Double click to set project location, then click save to see the climate station
W Houghton Lake Dr
Roscommon Township, Michigan
View on Google Maps
Google
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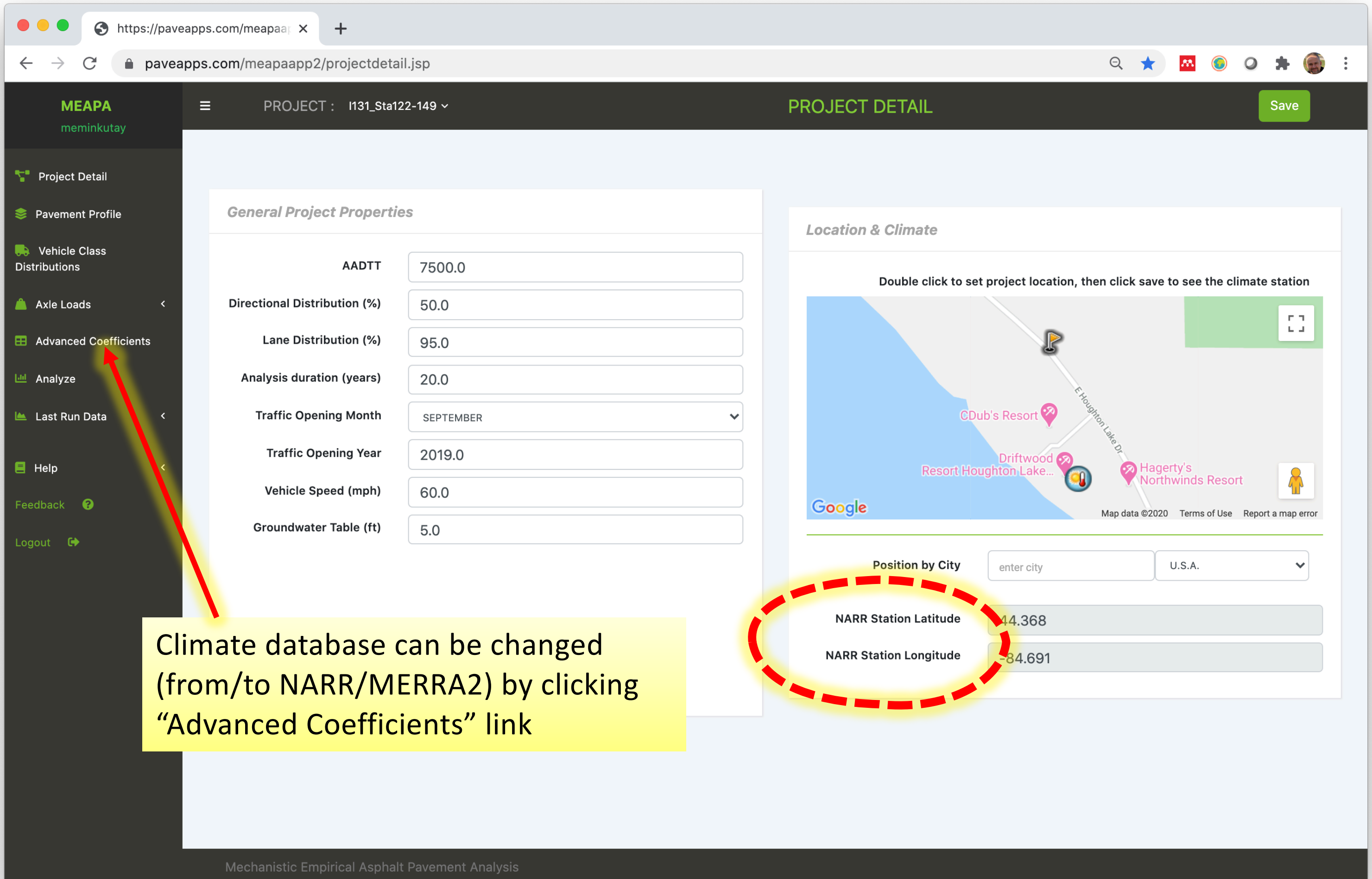
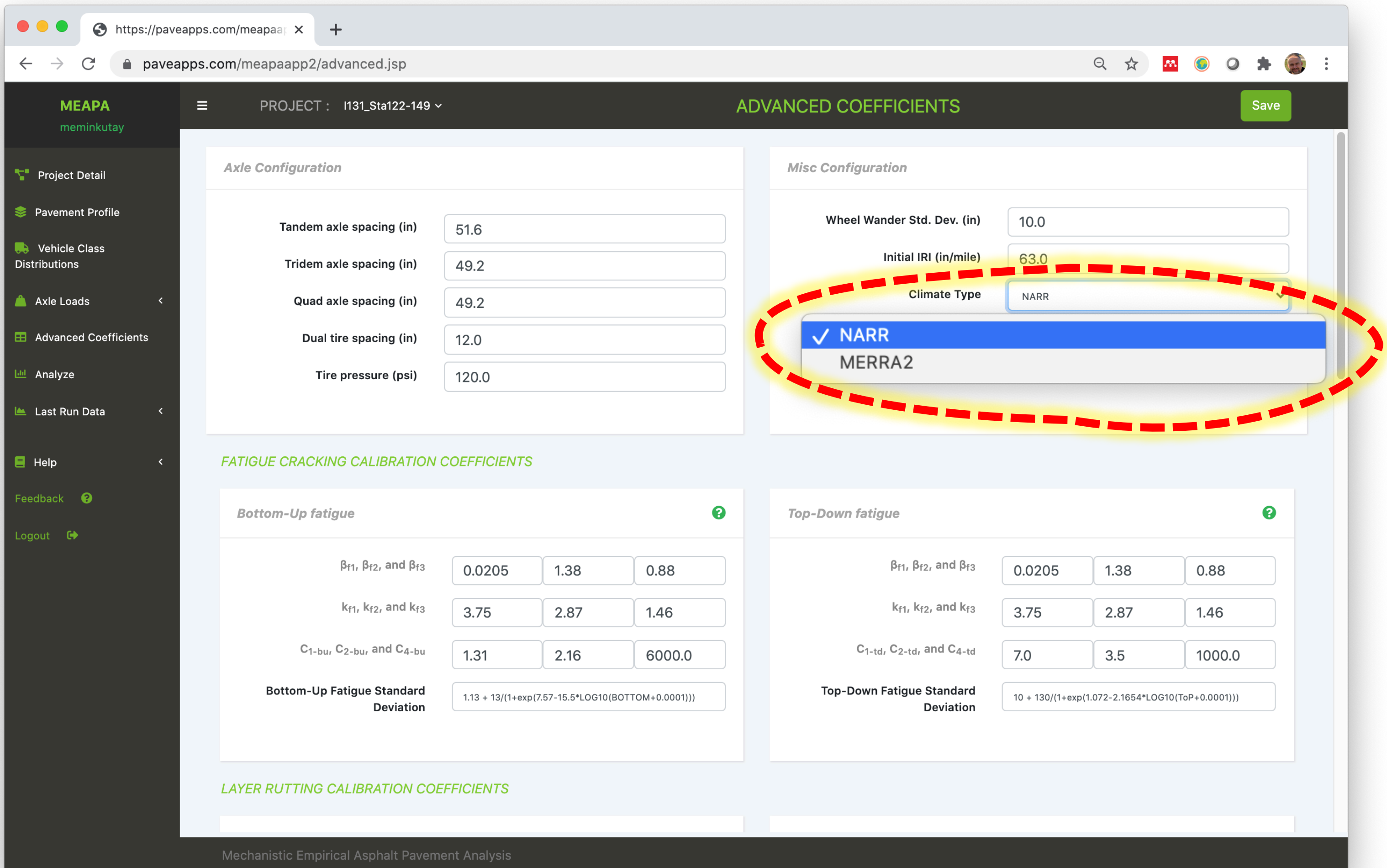
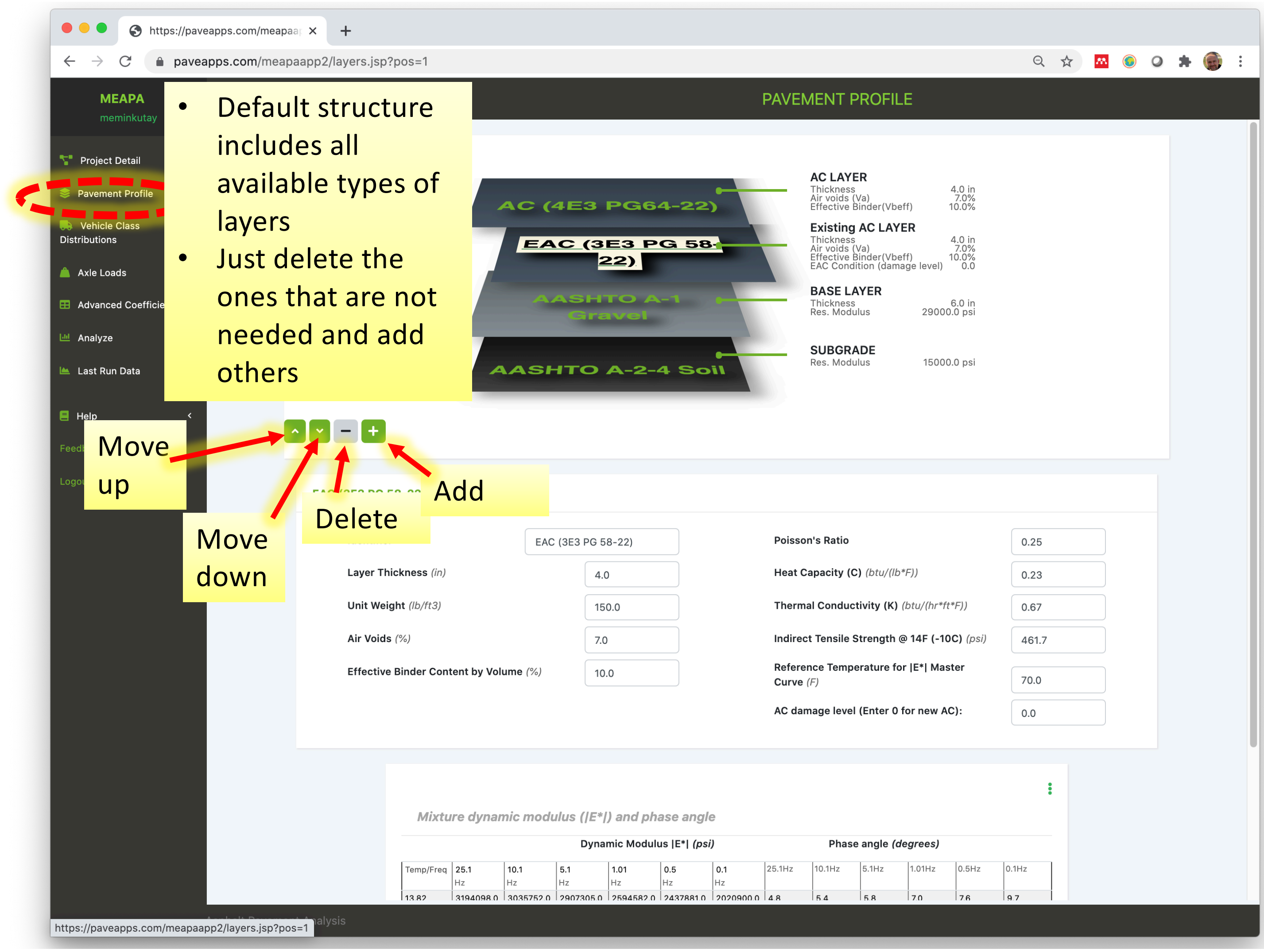
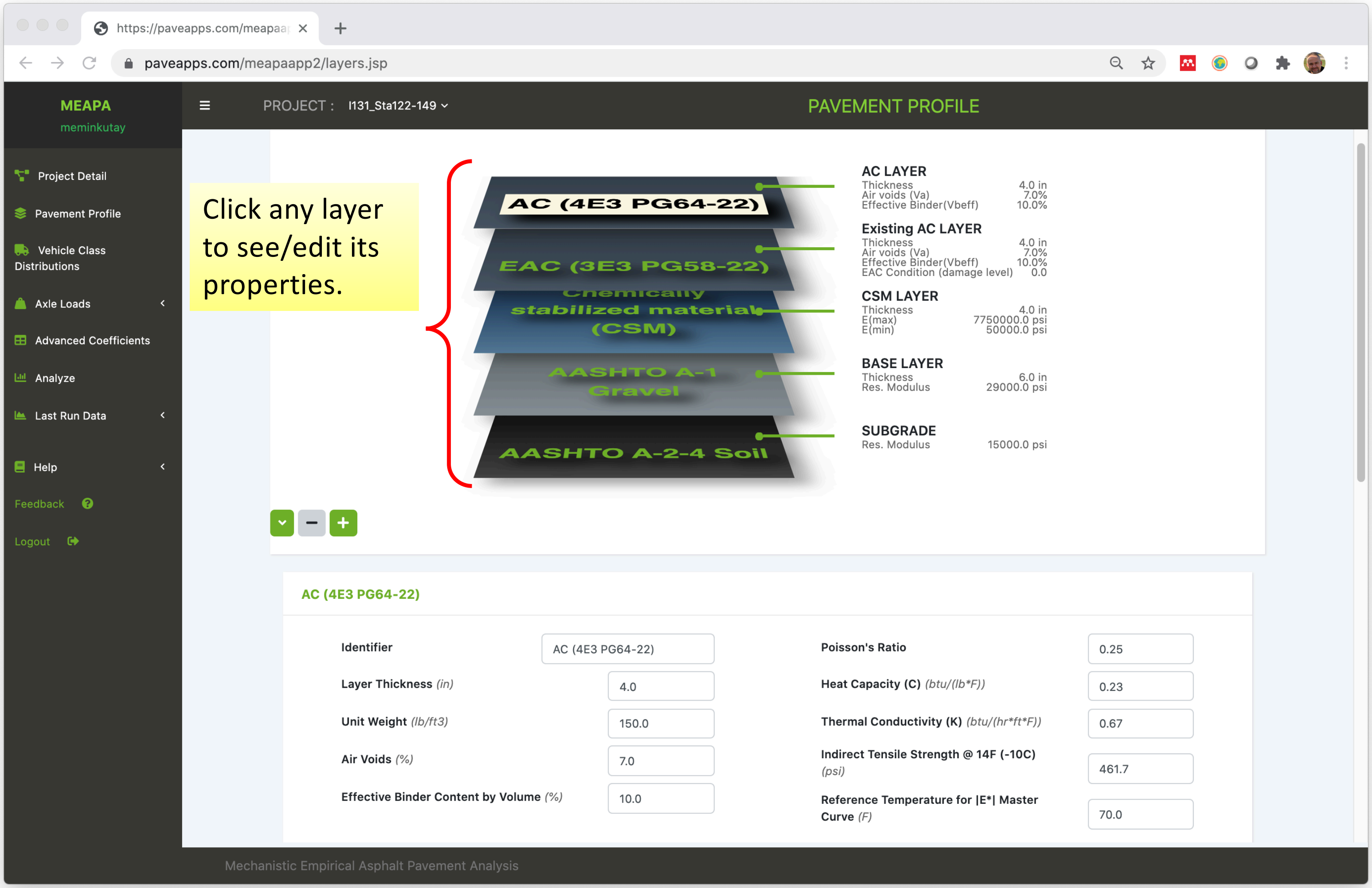
Terms of Use
Report a problem
Position by City
enter city
U.S.A.
NARR Station Latitude
44.368
NARR Station Longitude
-84.691
Mechanistic Empirical Asphalt Pavement Analysis

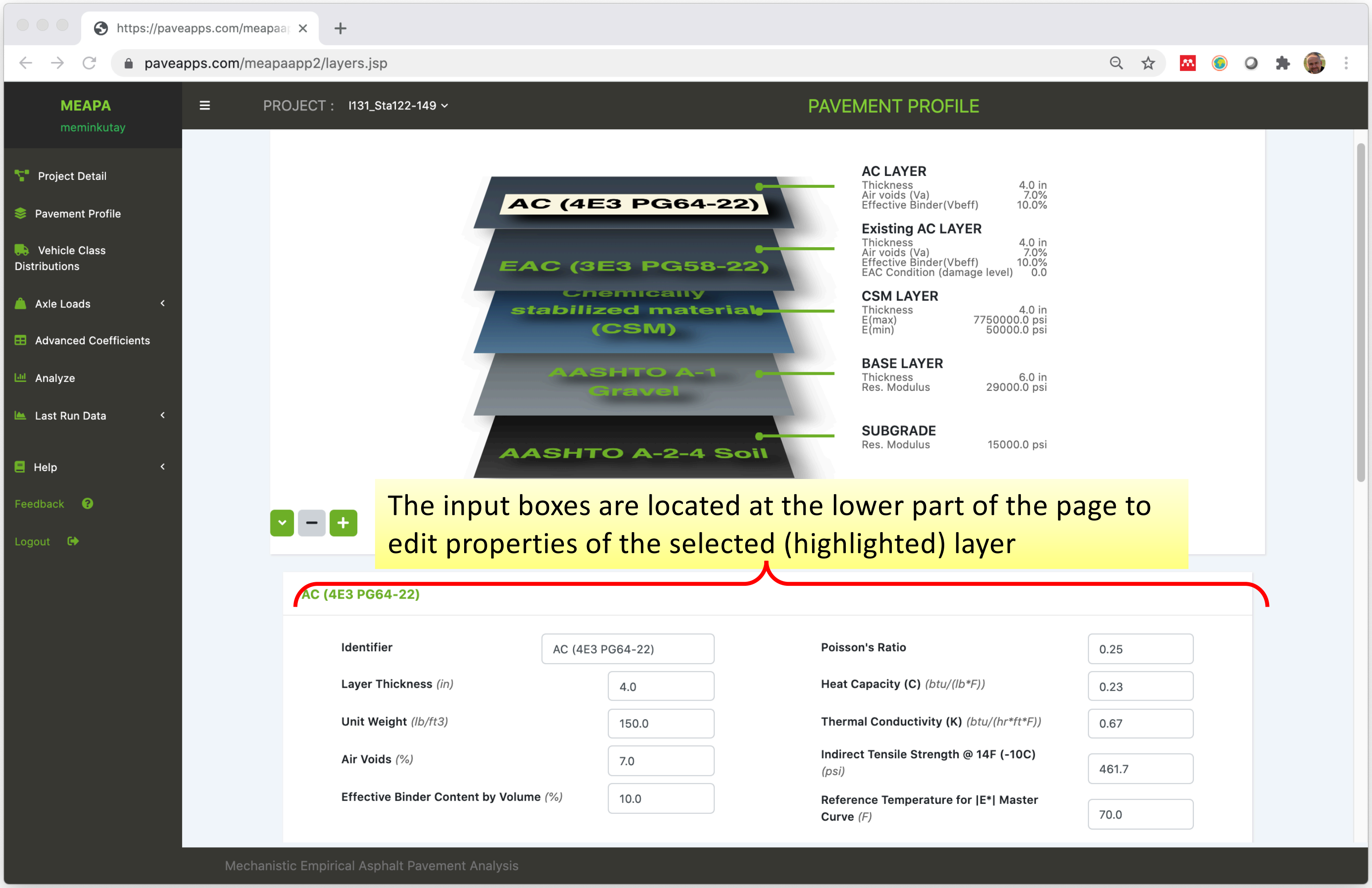

https://paveapps.com/meapaa
paveapps.com/meapaapp2/projectdetail.jsp
MEAPA
meminkutay
PROJECT : I131_Sta122-149
PROJECT DETAIL
Save
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
General Project Properties
AADTT
7500.0
Directional Distribution (%)
50.0
Lane Distribution (%)
95.0
Analysis duration (years)
20.0
Traffic Opening Month
SEPTEMBER
Traffic Opening Year
2019.0
Vehicle Speed (mph)
60.0
Groundwater Table (ft)
5.0
Location & Climate
Double click to set project location, then click save to see the climate station
CDub's Resort
Driftwood Resort Houghton Lake...
Hagerty's Northwinds Resort
E Houghton Lake Dr
Google
Map data ©2020
Terms of Use
Report a map error
Position by City
enter city
U.S.A.
NARR Station Latitude
44.368
NARR Station Longitude
-84.691
Climate database can be changed (from/to NARR/MERRA2) by clicking “Advanced Coefficients” link
Mechanistic Empirical Asphalt Pavement Analysis

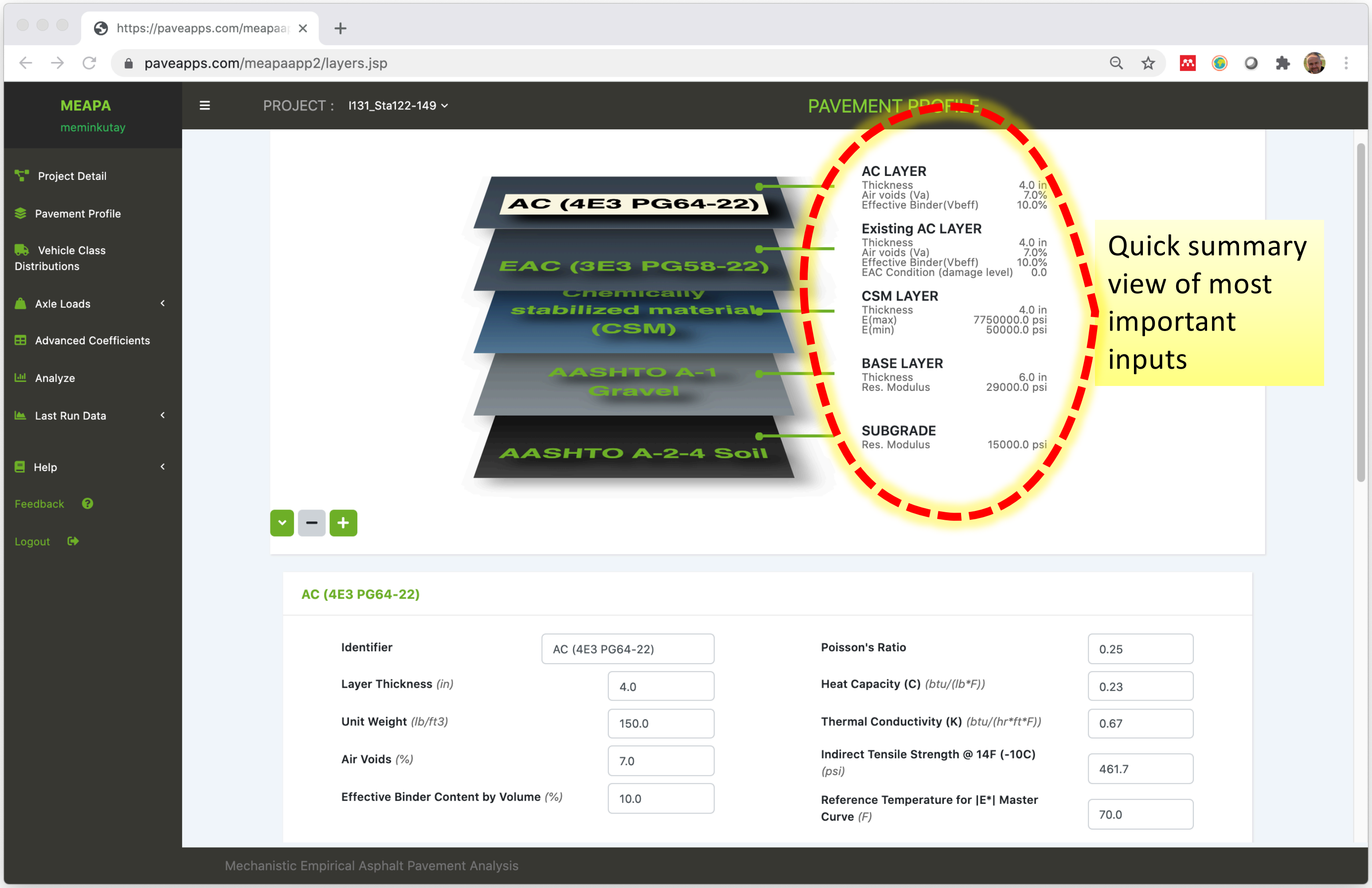

https://paveapps.com/meapaa
paveapps.com/meapaapp2/advanced.jsp
MEAPA
meminkutay
PROJECT : I131_Sta122-149
ADVANCED COEFFICIENTS
Save
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
Axle Configuration
Tandem axle spacing (in) 51.6
Tridem axle spacing (in) 49.2
Quad axle spacing (in) 49.2
Dual tire spacing (in) 12.0
Tire pressure (psi) 120.0
Misc Configuration
Wheel Wander Std. Dev. (in) 10.0
Initial IRI (in/mile) 63.0
Climate Type NARR
NARR
MERRA2
FATIGUE CRACKING CALIBRATION COEFFICIENTS
Bottom-Up fatigue
β_{f1}, β_{f2}, and β_{f3} 0.0205 1.38 0.88
k_{f1}, k_{f2}, and k_{f3} 3.75 2.87 1.46
C_{1-bu}, C_{2-bu}, and C_{4-bu} 1.31 2.16 6000.0
Bottom-Up Fatigue Standard Deviation 1.13 + 13/(1+exp(7.57-15.5*LOG10(BOTTOM+0.0001)))
Top-Down fatigue
β_{f1}, β_{f2}, and β_{f3} 0.0205 1.38 0.88
k_{f1}, k_{f2}, and k_{f3} 3.75 2.87 1.46
C_{1-td}, C_{2-td}, and C_{4-td} 7.0 3.5 1000.0
Top-Down Fatigue Standard Deviation 10 + 130/(1+exp(1.072-2.1654*LOG10(ToP+0.0001)))
LAYER RUTTING CALIBRATION COEFFICIENTS
Mechanistic Empirical Asphalt Pavement Analysis



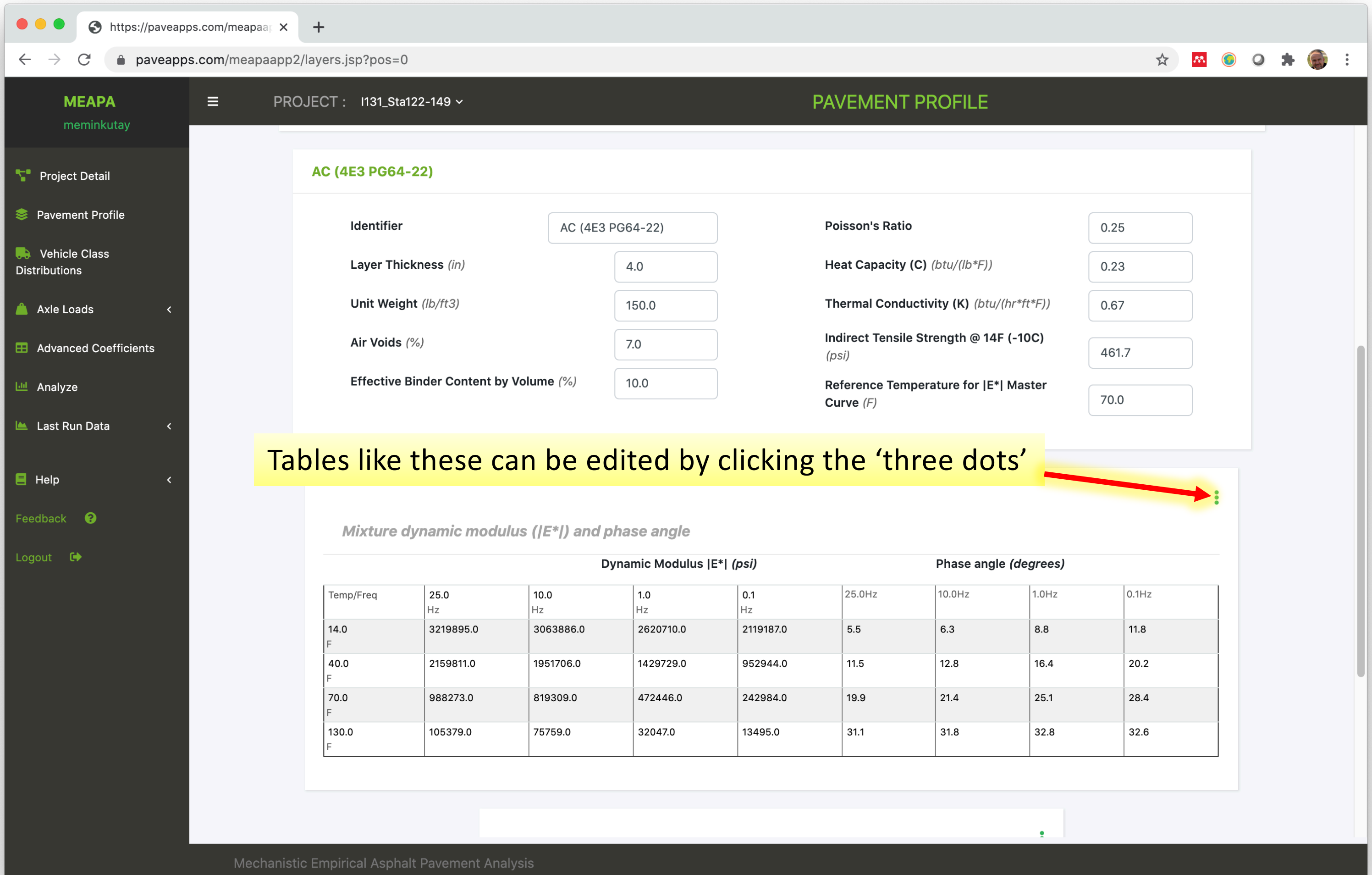
https://paveapps.com/meapaapp2/layers.jsp?pos=1
MEAPA
meminkutay
PAVEMENT PROFILE
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficie
Analyze
Last Run Data
Help
• Default structure includes all available types of layers
• Just delete the ones that are not needed and add others
AC (4E3 PG64-22)
EAC (3E3 PG 58-22)
AASHTO A-1 Gravel
AASHTO A-2-4 Soil
AC LAYER
Thickness 4.0 in
Air voids (Va) 7.0%
Effective Binder(Vbeff) 10.0%
Existing AC LAYER
Thickness 4.0 in
Air voids (Va) 7.0%
Effective Binder(Vbeff) 10.0%
EAC Condition (damage level) 0.0
BASE LAYER
Thickness 6.0 in
Res. Modulus 29000.0 psi
SUBGRADE
Res. Modulus 15000.0 psi
Move up
Move down
Delete
Add
EAC (3E3 PG 58-22)
Layer Thickness (in) 4.0
Unit Weight (lb/ft3) 150.0
Air Voids (%) 7.0
Effective Binder Content by Volume (%) 10.0
Poisson's Ratio 0.25
Heat Capacity (C) (btu/(lb*F)) 0.23
Thermal Conductivity (K) (btu/(hr*ft*F)) 0.67
Indirect Tensile Strength @ 14F (-10C) (psi) 461.7
Reference Temperature for |E*| Master Curve (F) 70.0
AC damage level (Enter 0 for new AC): 0.0
Mixture dynamic modulus (|E*|) and phase angle
Dynamic Modulus |E*| (psi)
Phase angle (degrees)


https://paveapps.com/meapaa
paveapps.com/meapaapp2/layers.jsp
MEAPA
meminkutay
PROJECT : I131_Sta122-149
PAVEMENT PROFILE
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
Click any layer to see/edit its properties.
AC (4E3 PG64-22)
EAC (3E3 PG58-22)
Chemically stabilized material (CSM)
AASHTO A-1 Gravel
AASHTO A-2-4 Soil
AC LAYER
Thickness 4.0 in
Air voids (Va) 7.0%
Effective Binder(Vbeff) 10.0%
Existing AC LAYER
Thickness 4.0 in
Air voids (Va) 7.0%
Effective Binder(Vbeff) 10.0%
EAC Condition (damage level) 0.0
CSM LAYER
Thickness 4.0 in
E(max) 7750000.0 psi
E(min) 50000.0 psi
BASE LAYER
Thickness 6.0 in
Res. Modulus 29000.0 psi
SUBGRADE
Res. Modulus 15000.0 psi
AC (4E3 PG64-22)
Identifier AC (4E3 PG64-22)
Layer Thickness (in) 4.0
Unit Weight (lb/ft3) 150.0
Air Voids (%) 7.0
Effective Binder Content by Volume (%) 10.0
Poisson's Ratio 0.25
Heat Capacity (C) (btu/(lb*F)) 0.23
Thermal Conductivity (K) (btu/(hr*ft*F)) 0.67
Indirect Tensile Strength @ 14F (-10C) (psi) 461.7
Reference Temperature for |E*| Master Curve (F) 70.0
Mechanistic Empirical Asphalt Pavement Analysis

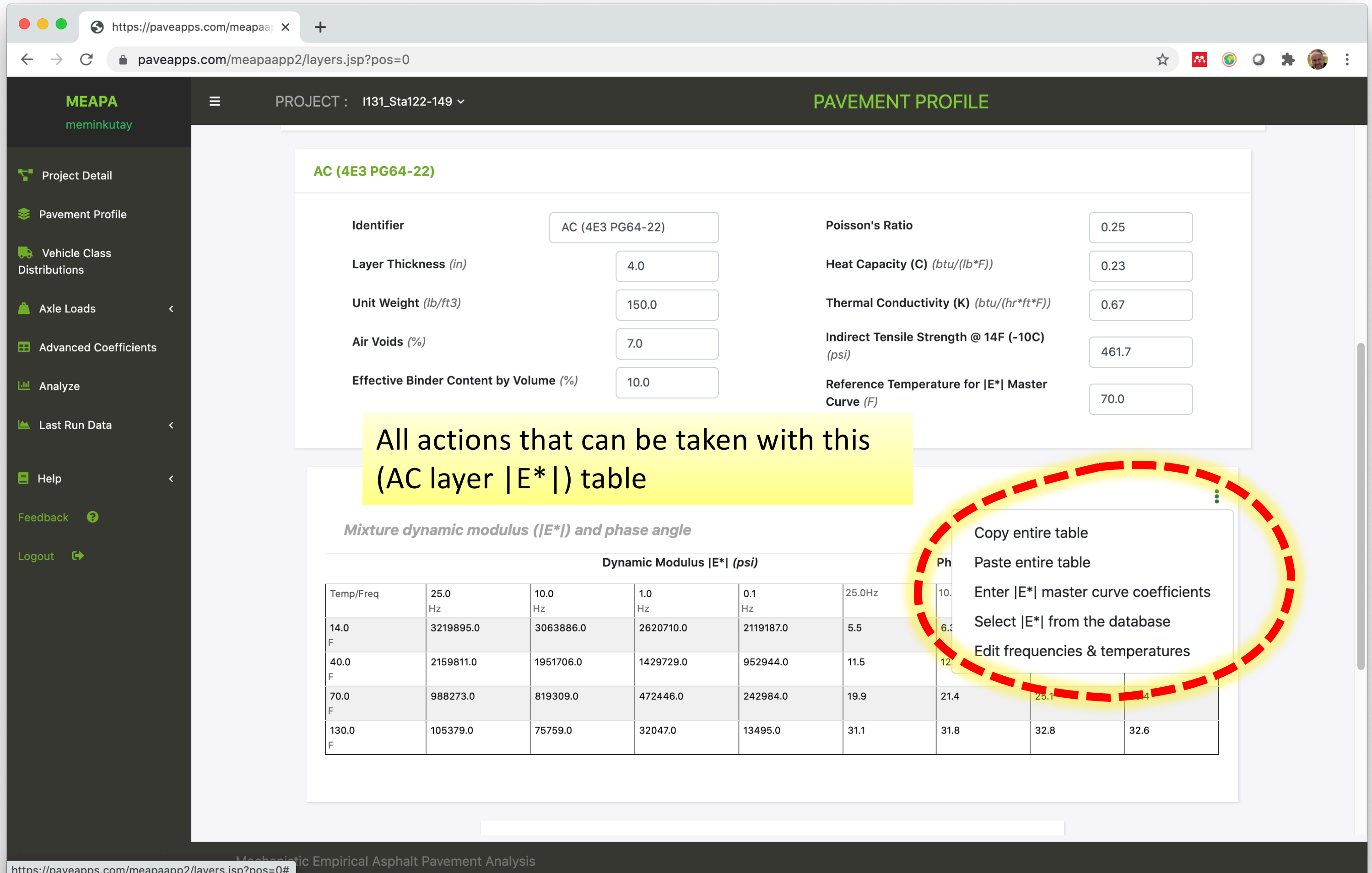

https://paveapps.com/meapaa
paveapps.com/meapaapp2/layers.jsp
MEAPA
meminkutay
PROJECT : I131_Sta122-149
PAVEMENT PROFILE
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
AC (4E3 PG64-22)
EAC (3E3 PG58-22)
Chemically stabilized material (CSM)
AASHTO A-1 Gravel
AASHTO A-2-4 Soil
AC LAYER
Thickness 4.0 in
Air voids (Va) 7.0%
Effective Binder(Vbeff) 10.0%
Existing AC LAYER
Thickness 4.0 in
Air voids (Va) 7.0%
Effective Binder(Vbeff) 10.0%
EAC Condition (damage level) 0.0
CSM LAYER
Thickness 4.0 in
E(max) 7750000.0 psi
E(min) 50000.0 psi
BASE LAYER
Thickness 6.0 in
Res. Modulus 29000.0 psi
SUBGRADE
Res. Modulus 15000.0 psi
The input boxes are located at the lower part of the page to edit properties of the selected (highlighted) layer
AC (4E3 PG64-22)
Identifier AC (4E3 PG64-22)
Layer Thickness (in) 4.0
Unit Weight (lb/ft3) 150.0
Air Voids (%) 7.0
Effective Binder Content by Volume (%) 10.0
Poisson's Ratio 0.25
Heat Capacity (C) (btu/(lb*F)) 0.23
Thermal Conductivity (K) (btu/(hr*ft*F)) 0.67
Indirect Tensile Strength @ 14F (-10C) (psi) 461.7
Reference Temperature for |E*| Master Curve (F) 70.0
Mechanistic Empirical Asphalt Pavement Analysis



https://paveapps.com/meapaa
paveapps.com/meapaapp2/layers.jsp
MEAPA
meminkutay
PROJECT : I131_Sta122-149
PAVEMENT PROFILE
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
AC (4E3 PG64-22)
EAC (3E3 PG58-22)
Chemically stabilized material (CSM)
AASHTO A-1 Gravel
AASHTO A-2-4 Soil
AC LAYER
Thickness 4.0 in
Air voids (Va) 7.0%
Effective Binder(Vbeff) 10.0%
Existing AC LAYER
Thickness 4.0 in
Air voids (Va) 7.0%
Effective Binder(Vbeff) 10.0%
EAC Condition (damage level) 0.0
CSM LAYER
Thickness 4.0 in
E(max) 7750000.0 psi
E(min) 50000.0 psi
BASE LAYER
Thickness 6.0 in
Res. Modulus 29000.0 psi
SUBGRADE
Res. Modulus 15000.0 psi
Quick summary view of most important inputs
AC (4E3 PG64-22)
Identifier AC (4E3 PG64-22)
Layer Thickness (in) 4.0
Unit Weight (lb/ft3) 150.0
Air Voids (%) 7.0
Effective Binder Content by Volume (%) 10.0
Poisson's Ratio 0.25
Heat Capacity (C) (btu/(lb*F)) 0.23
Thermal Conductivity (K) (btu/(hr*ft*F)) 0.67
Indirect Tensile Strength @ 14F (-10C) (psi) 461.7
Reference Temperature for |E*| Master Curve (F) 70.0
Mechanistic Empirical Asphalt Pavement Analysis



	Dynamic Modulus |E*| (psi)				Phase angle (degrees)			
Temp/Freq	25.0 Hz	10.0 Hz	1.0 Hz	0.1 Hz	25.0Hz	10.0Hz	1.0Hz	0.1Hz
14.0 F	3219895.0	3063886.0	2620710.0	2119187.0	5.5	6.3	8.8	11.8
40.0 F	2159811.0	1951706.0	1429729.0	952944.0	11.5	12.8	16.4	20.2
70.0 F	988273.0	819309.0	472446.0	242984.0	19.9	21.4	25.1	28.4
130.0 F	105379.0	75759.0	32047.0	13495.0	31.1	31.8	32.8	32.6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paveapps.com/meapaapp2/layers.jsp?pos=0
MEAPA
meminkutay
PROJECT : I131_Sta122-149
PAVEMENT PROFILE
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
AC (4E3 PG64-22)
Identifier
AC (4E3 PG64-22)
Layer Thickness (in)
4.0
Unit Weight (lb/ft3)
150.0
Air Voids (%)
7.0
Effective Binder Content by Volume (%)
10.0
Poisson's Ratio
0.25
Heat Capacity (C) (btu/(lb*F))
0.23
Thermal Conductivity (K) (btu/(hr*ft*F))
0.67
Indirect Tensile Strength @ 14F (-10C) (psi)
461.7
Reference Temperature for |E*| Master Curve (F)
70.0
All actions that can be taken with this (AC layer |E*|) table
Mixture dynamic modulus (|E*|) and phase angle
Dynamic Modulus |E*| (psi)
Temp/Freq
25.0 Hz
10.0 Hz
1.0 Hz
0.1 Hz
25.0Hz
14.0 F
3219895.0
3063886.0
2620710.0
2119187.0
5.5
40.0 F
2159811.0
1951706.0
1429729.0
952944.0
11.5
70.0 F
988273.0
819309.0
472446.0
242984.0
19.9
21.4
130.0 F
105379.0
75759.0
32047.0
13495.0
31.1
31.8
32.8
32.6
Copy entire table
Paste entire table
Enter |E*| master curve coefficients
Select |E*| from the database
Edit frequencies & temperatures
Mechanistic Empirical Asphalt Pavement Analysis
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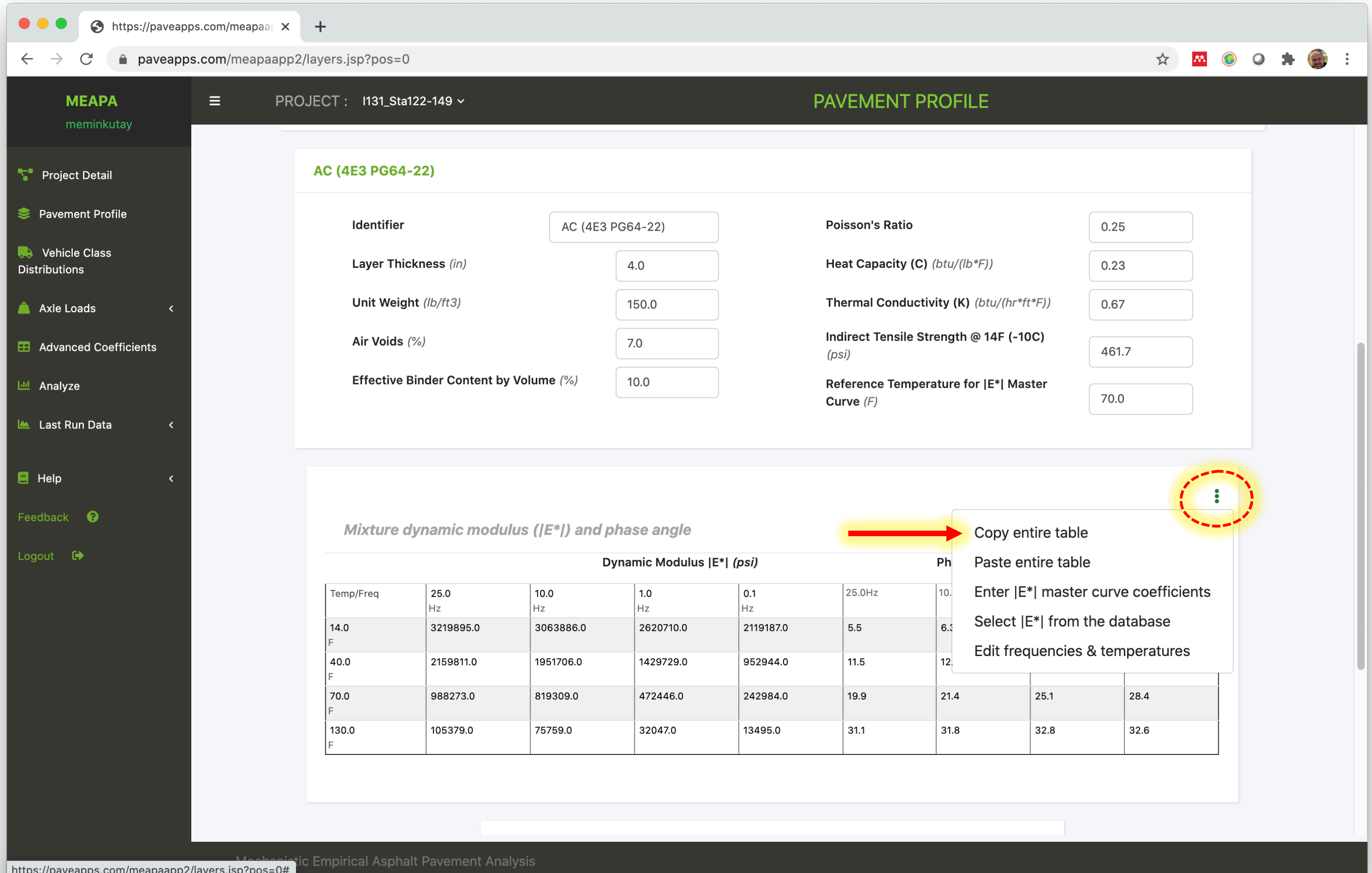
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MEAPA
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PROJECT : I131_Sta122-149
PAVEMENT PROFILE
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AC (4E3 PG64-22)
Identifier
AC (4E3 PG64-22)
Layer Thickness (in)
4.0
Unit Weight (lb/ft3)
150.0
Air Voids (%)
7.0
Effective Binder Content by Volume (%)
10.0
Poisson's Ratio
0.25
Heat Capacity (C) (btu/(lb*F))
0.23
Thermal Conductivity (K) (btu/(hr*ft*F))
0.67
Indirect Tensile Strength @ 14F (-10C) (psi)
461.7
Reference Temperature for |E*| Master Curve (F)
70.0
Mixture dynamic modulus (|E*|) and phase angle
Dynamic Modulus |E*| (psi)
Copy entire table
Paste entire table
Enter |E*| master curve coefficients
Select |E*| from the database
Edit frequencies & temperatures
Temp/Freq
25.0 Hz
10.0 Hz
1.0 Hz
0.1 Hz
25.0Hz
14.0 F
3219895.0
3063886.0
2620710.0
2119187.0
5.5
40.0 F
2159811.0
1951706.0
1429729.0
952944.0
11.5
70.0 F
988273.0
819309.0
472446.0
242984.0
19.9
21.4
25.1
28.4
130.0 F
105379.0
75759.0
32047.0
13495.0
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32.8
32.6
Mechanistic Empirical Asphalt Pavement Analysis
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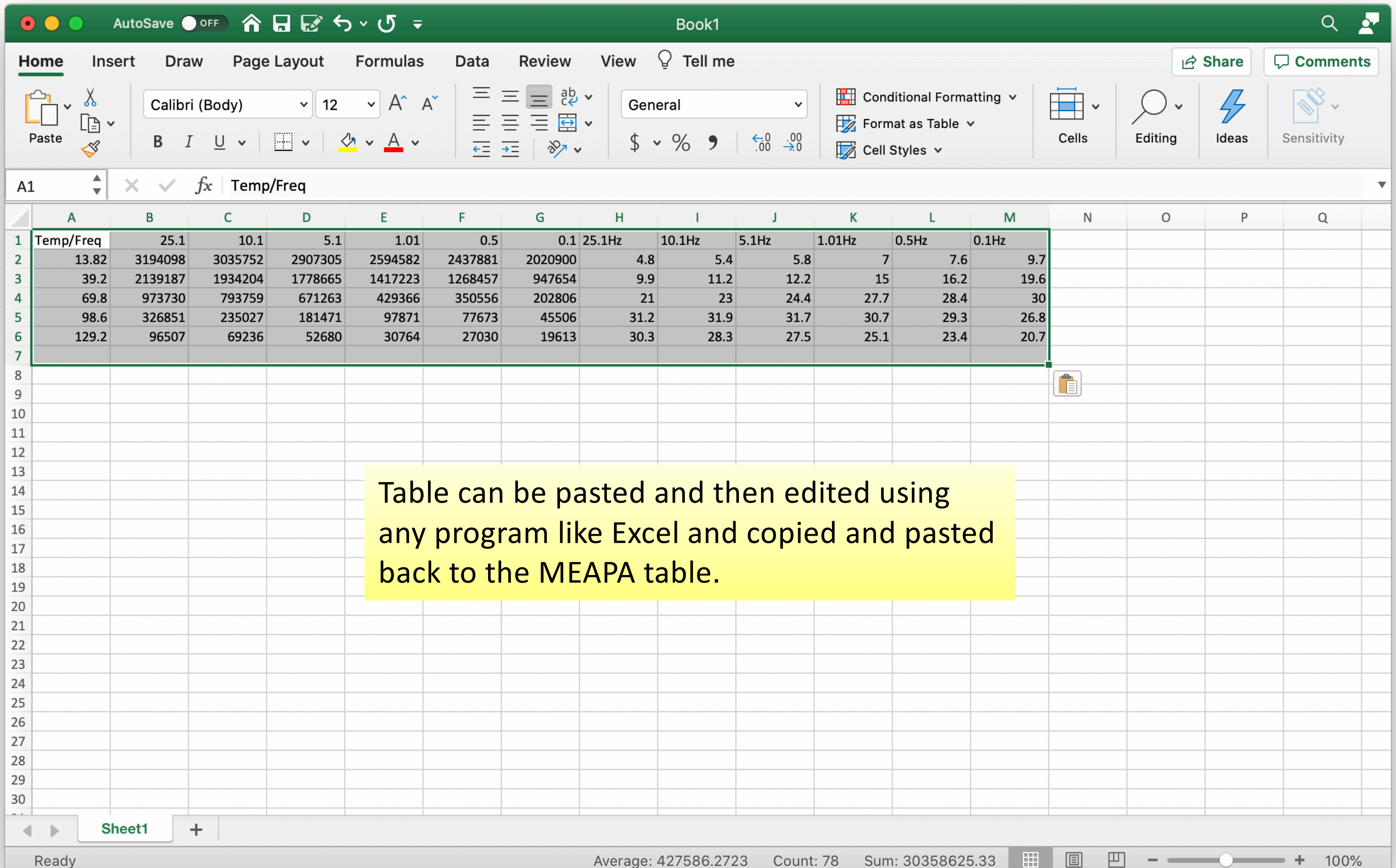
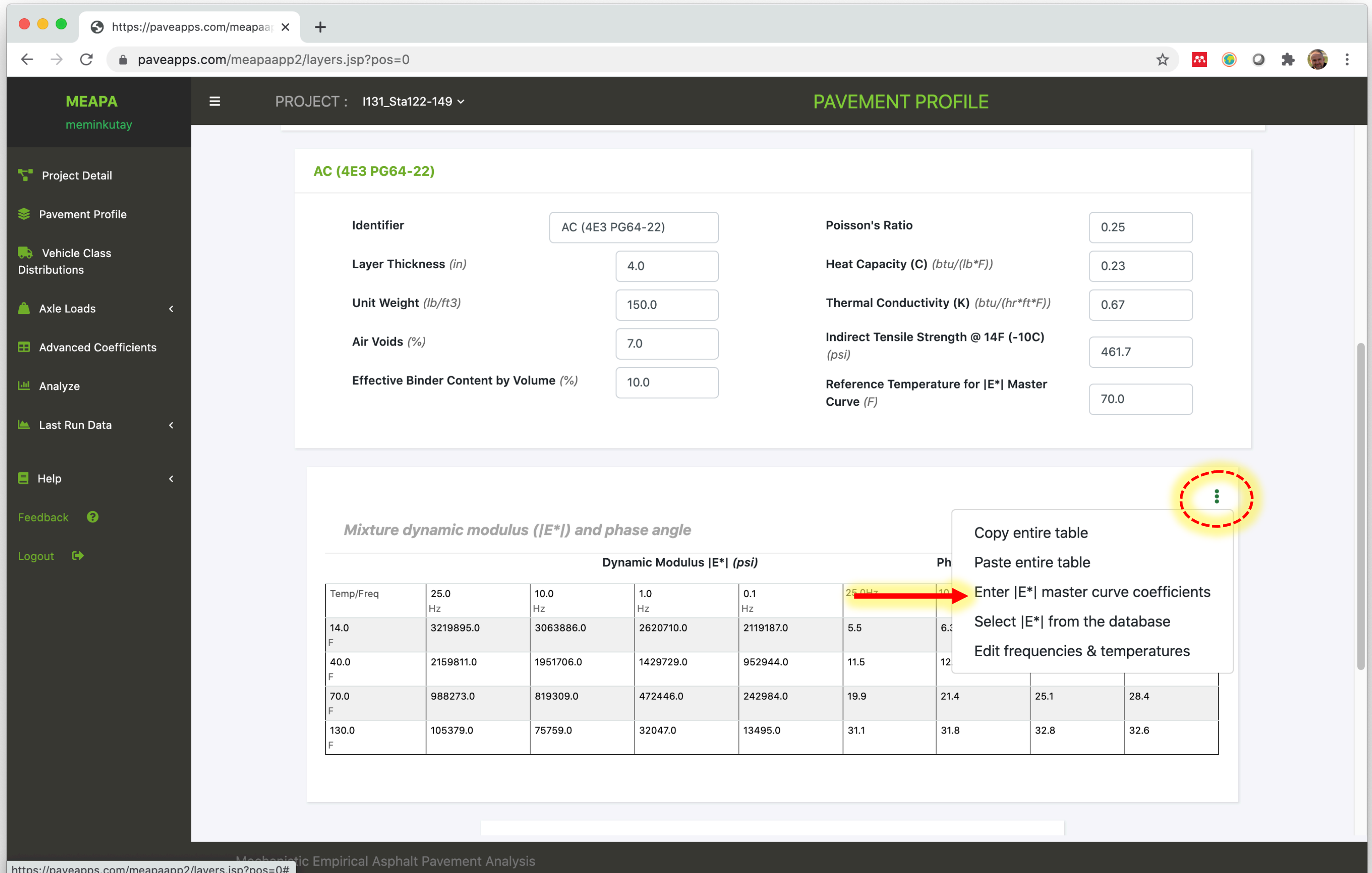


Temp/Freq	25.1	10.1	5.1	1.01	0.5	0.1	25.1Hz	10.1Hz	5.1Hz	1.01Hz	0.5Hz	0.1Hz
13.82	3194098	3035752	2907305	2594582	2437881	2020900	4.8	5.4	5.8	7	7.6	9.7
39.2	2139187	1934204	1778665	1417223	1268457	947654	9.9	11.2	12.2	15	16.2	19.6
69.8	973730	793759	671263	429366	350556	202806	21	23	24.4	27.7	28.4	30
98.6	326851	235027	181471	97871	77673	45506	31.2	31.9	31.7	30.7	29.3	26.8
129.2	96507	69236	52680	30764	27030	19613	30.3	28.3	27.5	25.1	23.4	20.7



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PAVEMENT PROFILE
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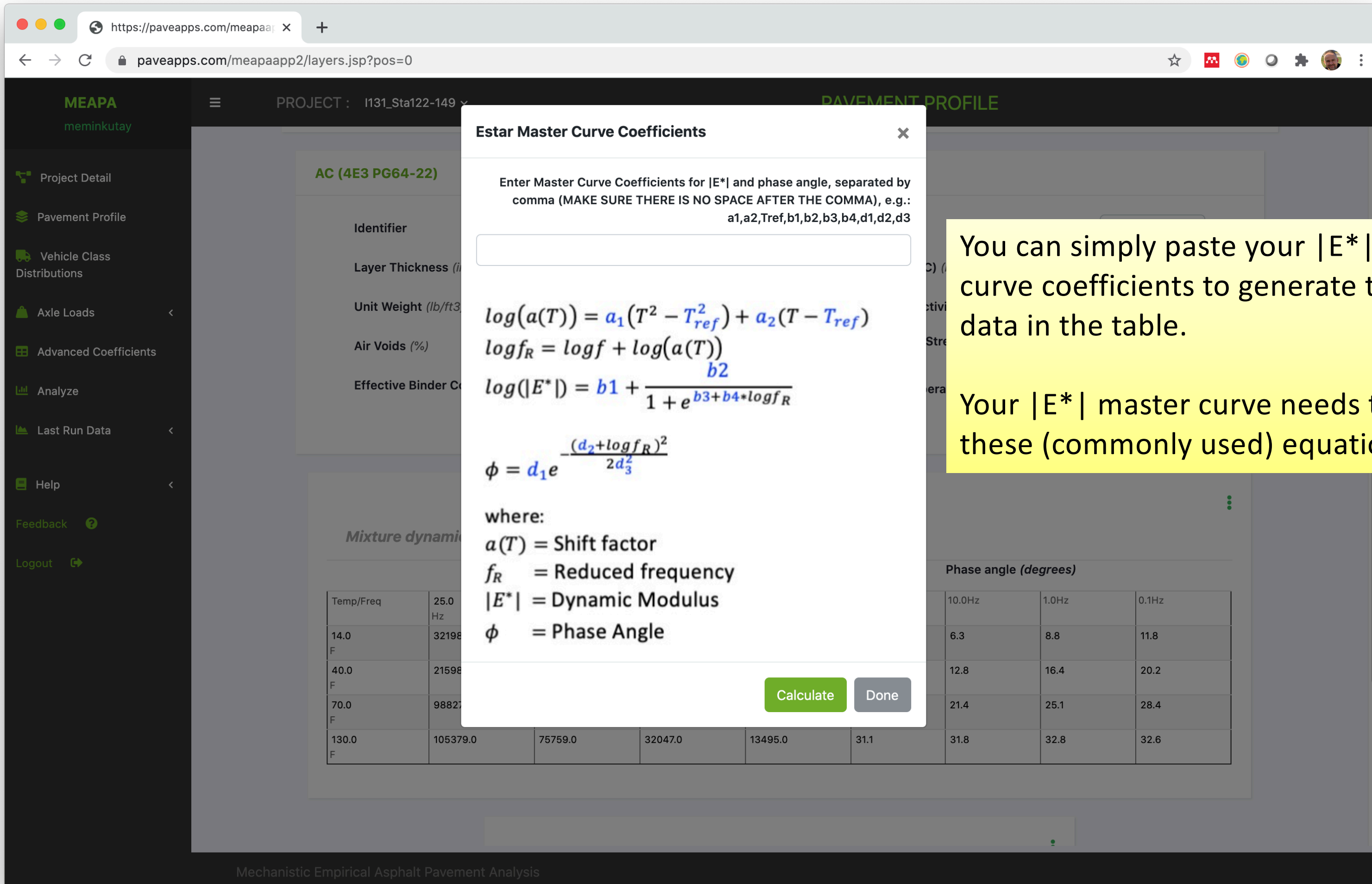
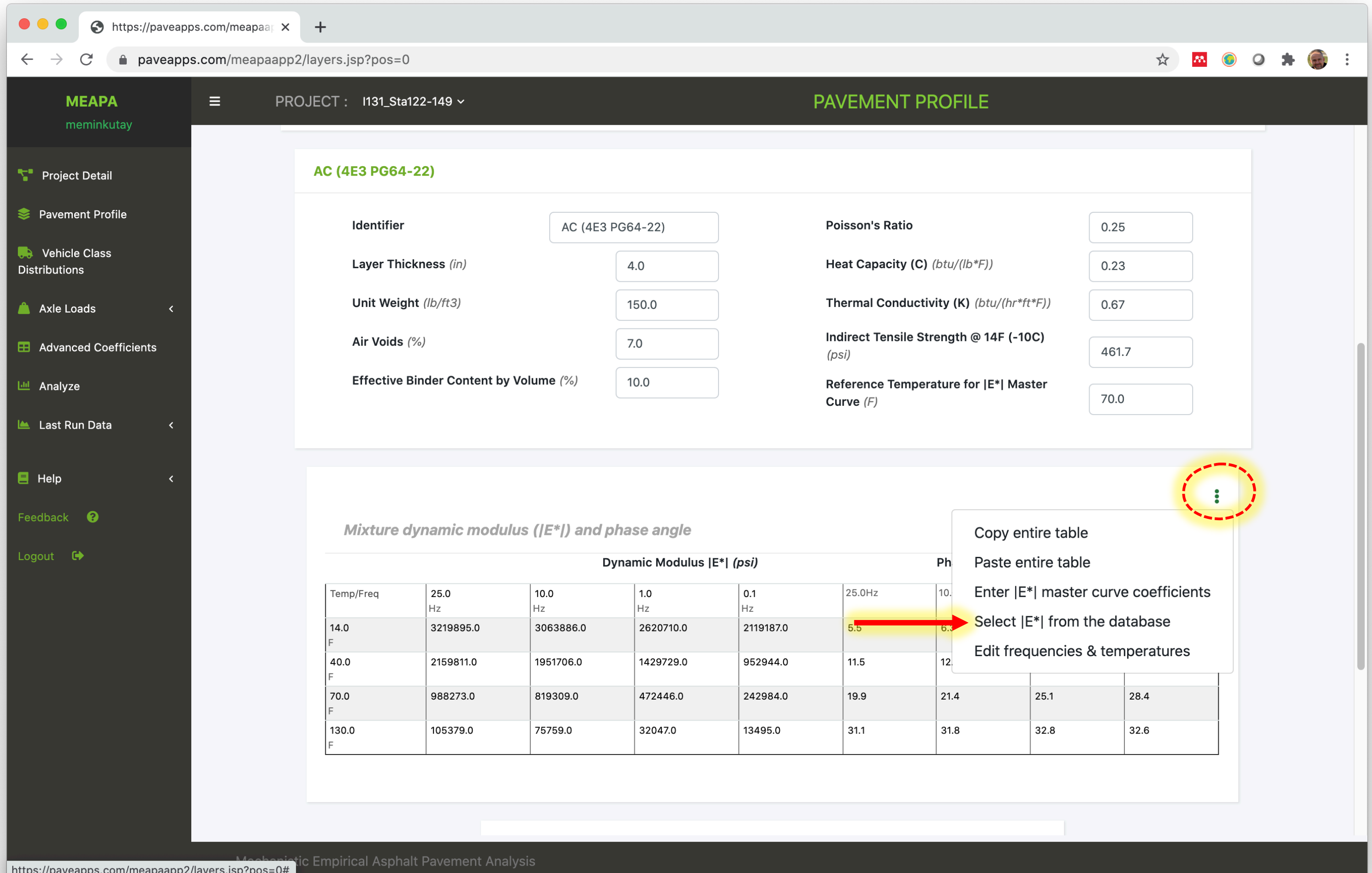
AC (4E3 PG64-22)
Identifier
AC (4E3 PG64-22)
Layer Thickness (in)
4.0
Unit Weight (lb/ft3)
150.0
Air Voids (%)
7.0
Effective Binder Content by Volume (%)
10.0
Poisson's Ratio
0.25
Heat Capacity (C) (btu/(lb*F))
0.23
Thermal Conductivity (K) (btu/(hr*ft*F))
0.67
Indirect Tensile Strength @ 14F (-10C) (psi)
461.7
Reference Temperature for |E*| Master Curve (F)
70.0
Mixture dynamic modulus (|E*|) and phase angle
Dynamic Modulus |E*| (psi)
Temp/Freq
25.0 Hz
10.0 Hz
1.0 Hz
0.1 Hz
14.0 F 3219895.0 3063886.0 2620710.0 2119187.0 5.5
40.0 F 2159811.0 1951706.0 1429729.0 952944.0 11.5
70.0 F 988273.0 819309.0 472446.0 242984.0 19.9 21.4 25.1 28.4
130.0 F 105379.0 75759.0 32047.0 13495.0 31.1 31.8 32.8 32.6
Copy entire table
Paste entire table
Enter |E*| master curve coefficients
Select |E*| from the database
Edit frequencies & temperatures
https://paveapps.com/meapaapp2/layers.jsp?pos=0#
Mechanistic Empirical Asphalt Pavement Analysis



You can simply paste your |E*| master curve coefficients to generate the |E*| data in the table.

Your |E*| master curve needs to follow these (commonly used) equations.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MEAPA
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PAVEMENT PROFILE
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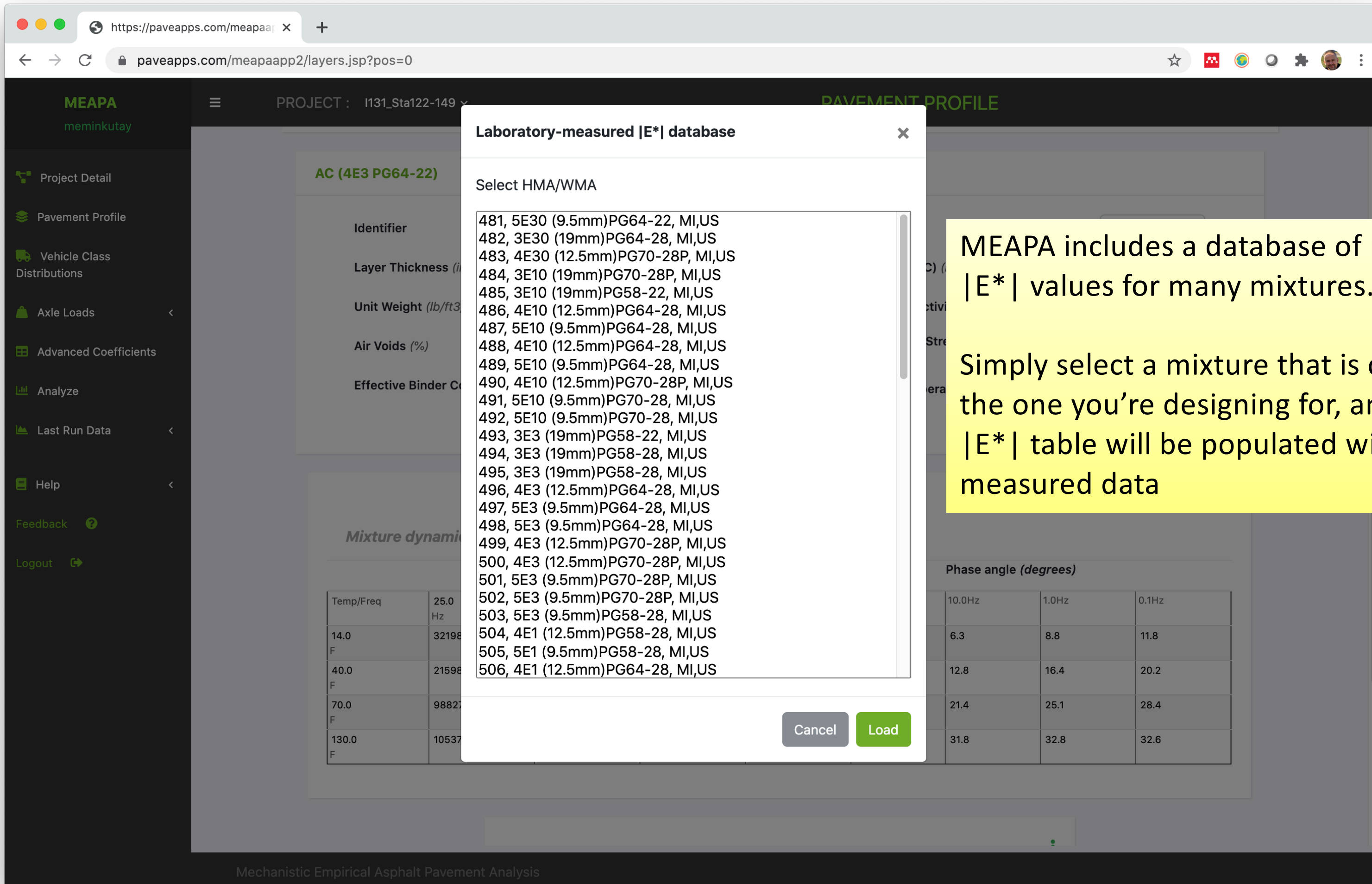
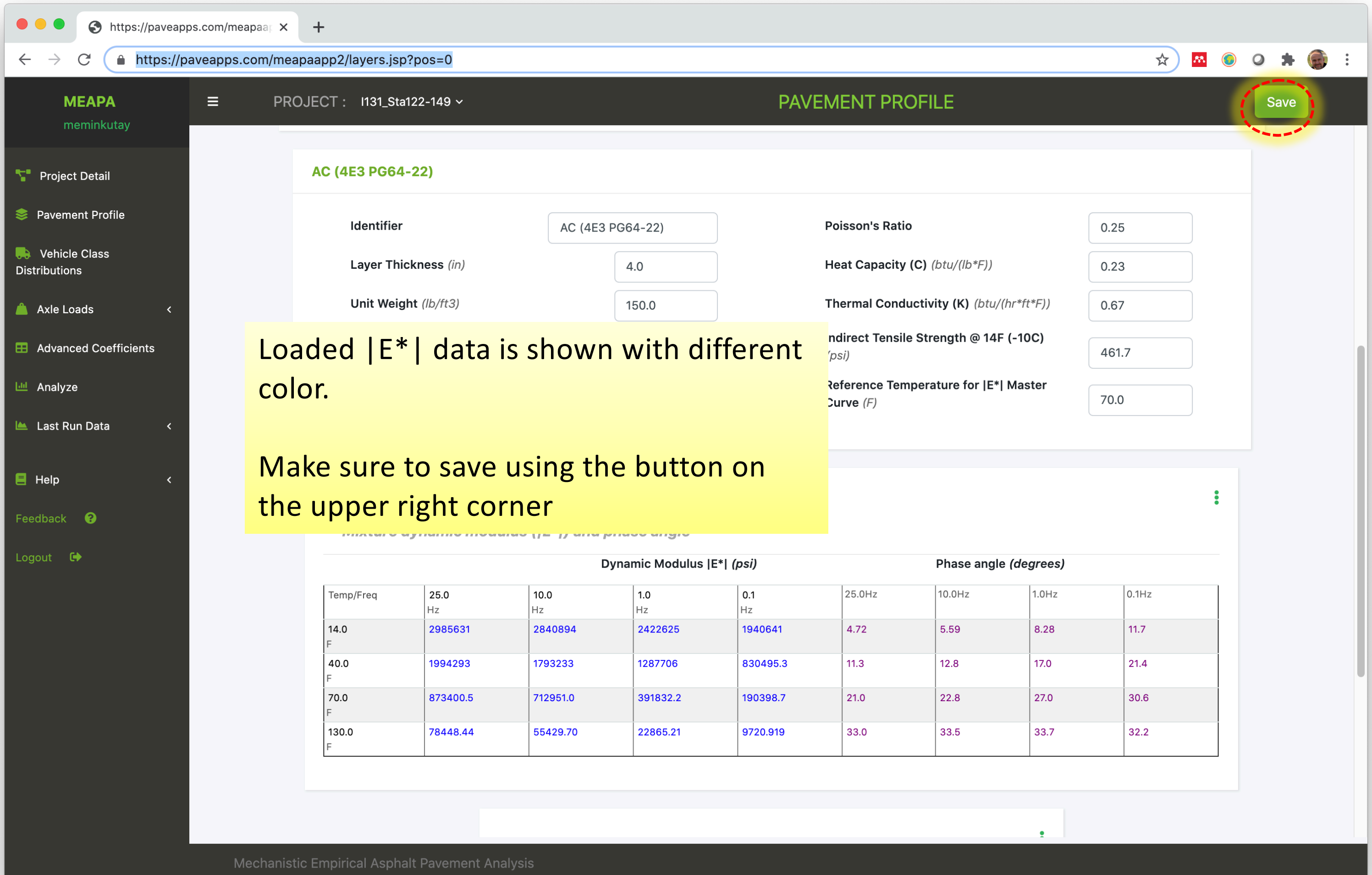
Logout
AC (4E3 PG64-22)
Identifier
AC (4E3 PG64-22)
Layer Thickness (in)
4.0
Unit Weight (lb/ft3)
150.0
Air Voids (%)
7.0
Effective Binder Content by Volume (%)
10.0
Poisson's Ratio
0.25
Heat Capacity (C) (btu/(lb*F))
0.23
Thermal Conductivity (K) (btu/(hr*ft*F))
0.67
Indirect Tensile Strength @ 14F (-10C) (psi)
461.7
Reference Temperature for |E*| Master Curve (F)
70.0
Mixture dynamic modulus (|E*|) and phase angle
Dynamic Modulus |E*| (psi)
Temp/Freq
25.0 Hz
10.0 Hz
1.0 Hz
0.1 Hz
25.0Hz
14.0 F
3219895.0
3063886.0
2620710.0
2119187.0
5.5
40.0 F
2159811.0
1951706.0
1429729.0
952944.0
11.5
70.0 F
988273.0
819309.0
472446.0
242984.0
19.9
21.4
25.1
28.4
130.0 F
105379.0
75759.0
32047.0
13495.0
31.1
31.8
32.8
32.6
Copy entire table
Paste entire table
Enter |E*| master curve coefficients
Select |E*| from the database
Edit frequencies & temperatures
https://paveapps.com/meapaapp2/layers.jsp?pos=0#
Mechanistic Empirical Asphalt Pavement Analysis



MEAPA includes a database of measured |E*| values for many mixtures.

Simply select a mixture that is closest to the one you're designing for, and MEAPA |E*| table will be populated with measured data


https://paveapps.com/meapaapp2/layers.jsp?pos=0
MEAPA
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PROJECT : I131_Sta122-149
PAVEMENT PROFILE
Save
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
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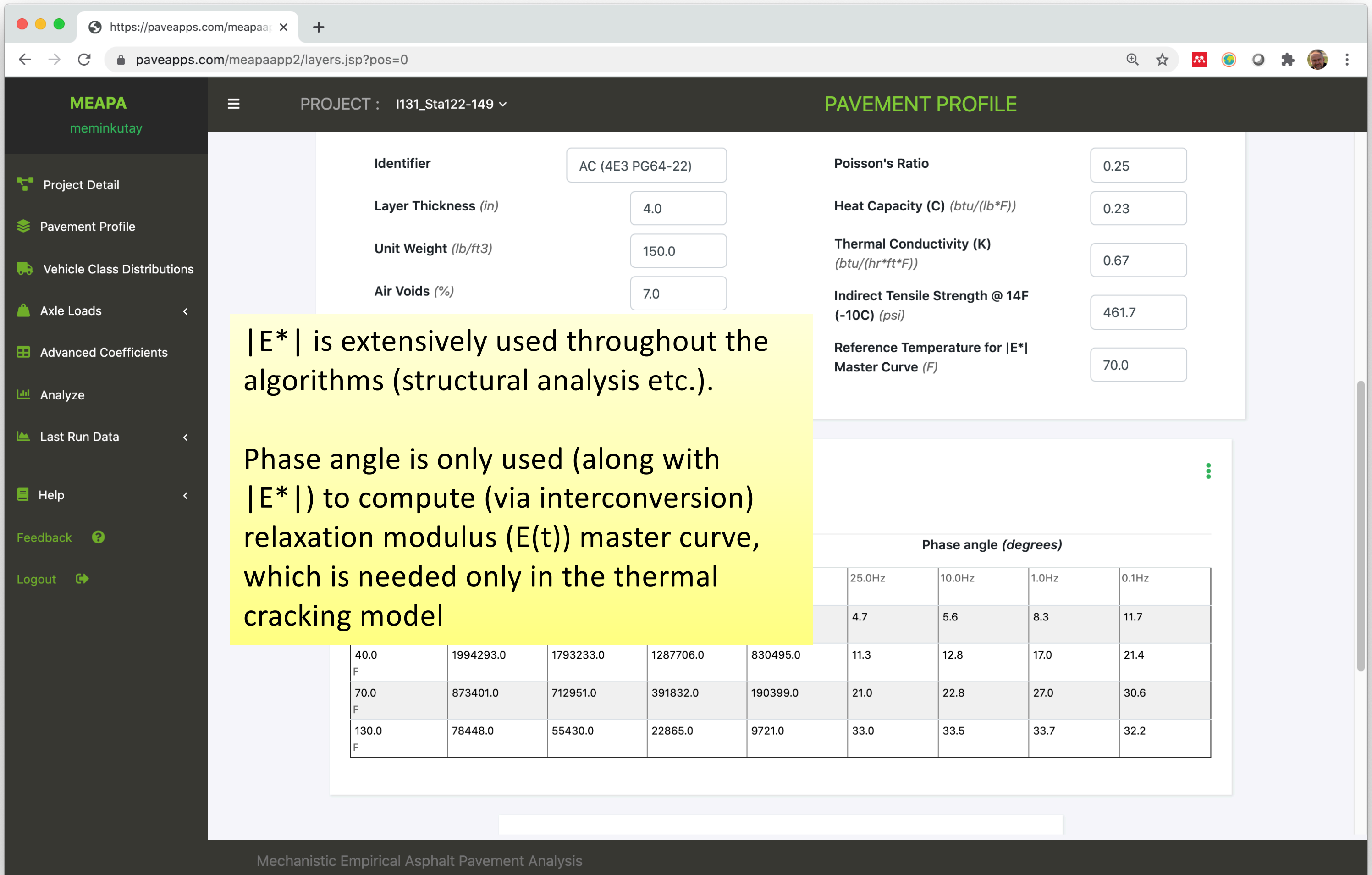
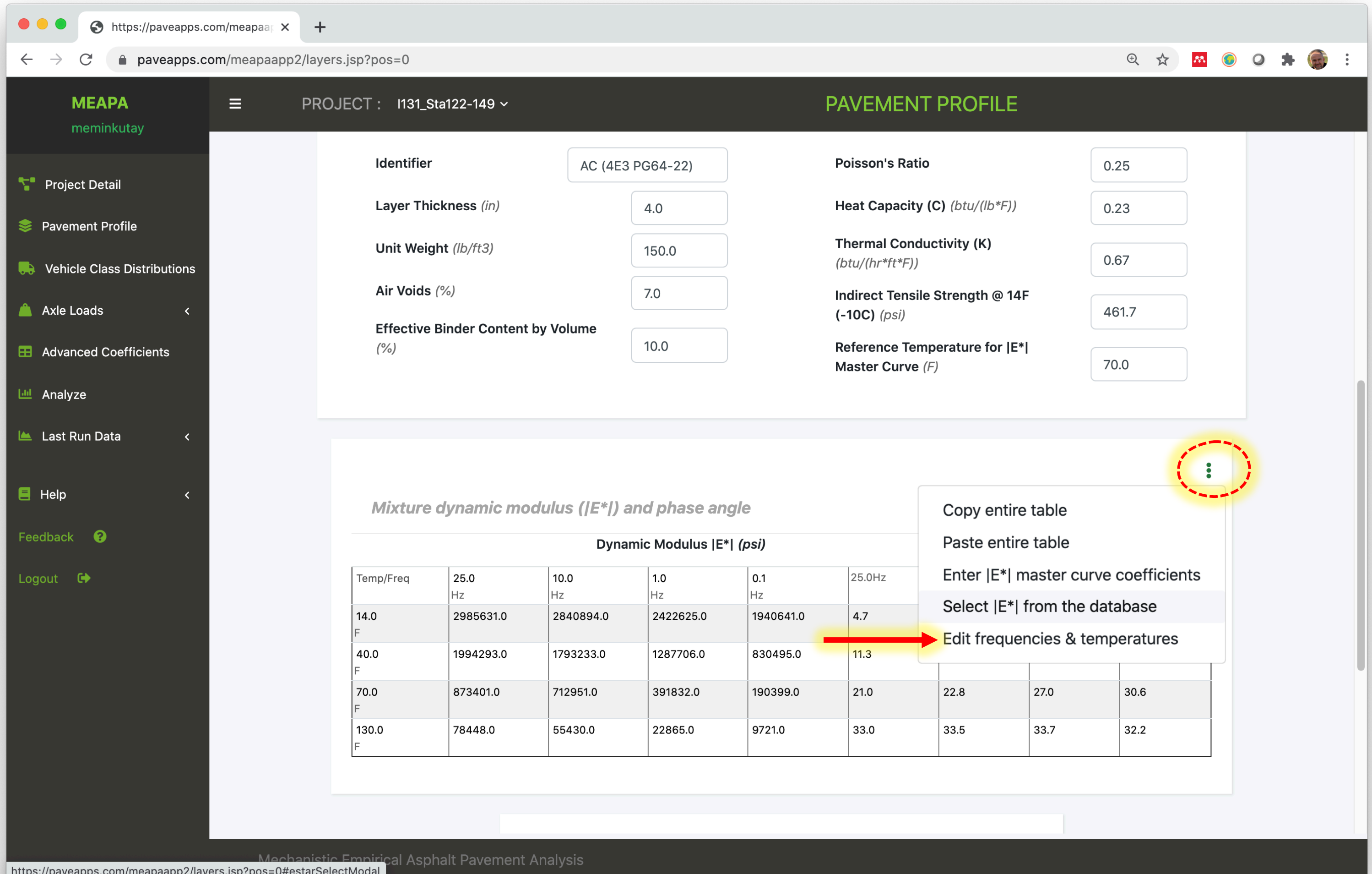
Help
Feedback
Logout
AC (4E3 PG64-22)
Identifier AC (4E3 PG64-22)
Layer Thickness (in) 4.0
Unit Weight (lb/ft3) 150.0
Poisson's Ratio 0.25
Heat Capacity (C) (btu/(lb*F)) 0.23
Thermal Conductivity (K) (btu/(hr*ft*F)) 0.67
Indirect Tensile Strength @ 14F (-10C) (psi) 461.7
Reference Temperature for |E*| Master Curve (F) 70.0
Loaded |E*| data is shown with different color.
Make sure to save using the button on the upper right corner
Dynamic Modulus |E*| (psi)
Phase angle (degrees)
Temp/Freq 25.0 Hz 10.0 Hz 1.0 Hz 0.1 Hz 25.0Hz 10.0Hz 1.0Hz 0.1Hz
14.0 F 2985631 2840894 2422625 1940641 4.72 5.59 8.28 11.7
40.0 F 1994293 1793233 1287706 830495.3 11.3 12.8 17.0 21.4
70.0 F 873400.5 712951.0 391832.2 190398.7 21.0 22.8 27.0 30.6
130.0 F 78448.44 55429.70 22865.21 9720.919 33.0 33.5 33.7 32.2
Mechanistic Empirical Asphalt Pavement Analysis



|E*| is extensively used throughout the algorithms (structural analysis etc.).

Phase angle is only used (along with |E*|) to compute (via interconversion) relaxation modulus (E(t)) master curve, which is needed only in the thermal cracking model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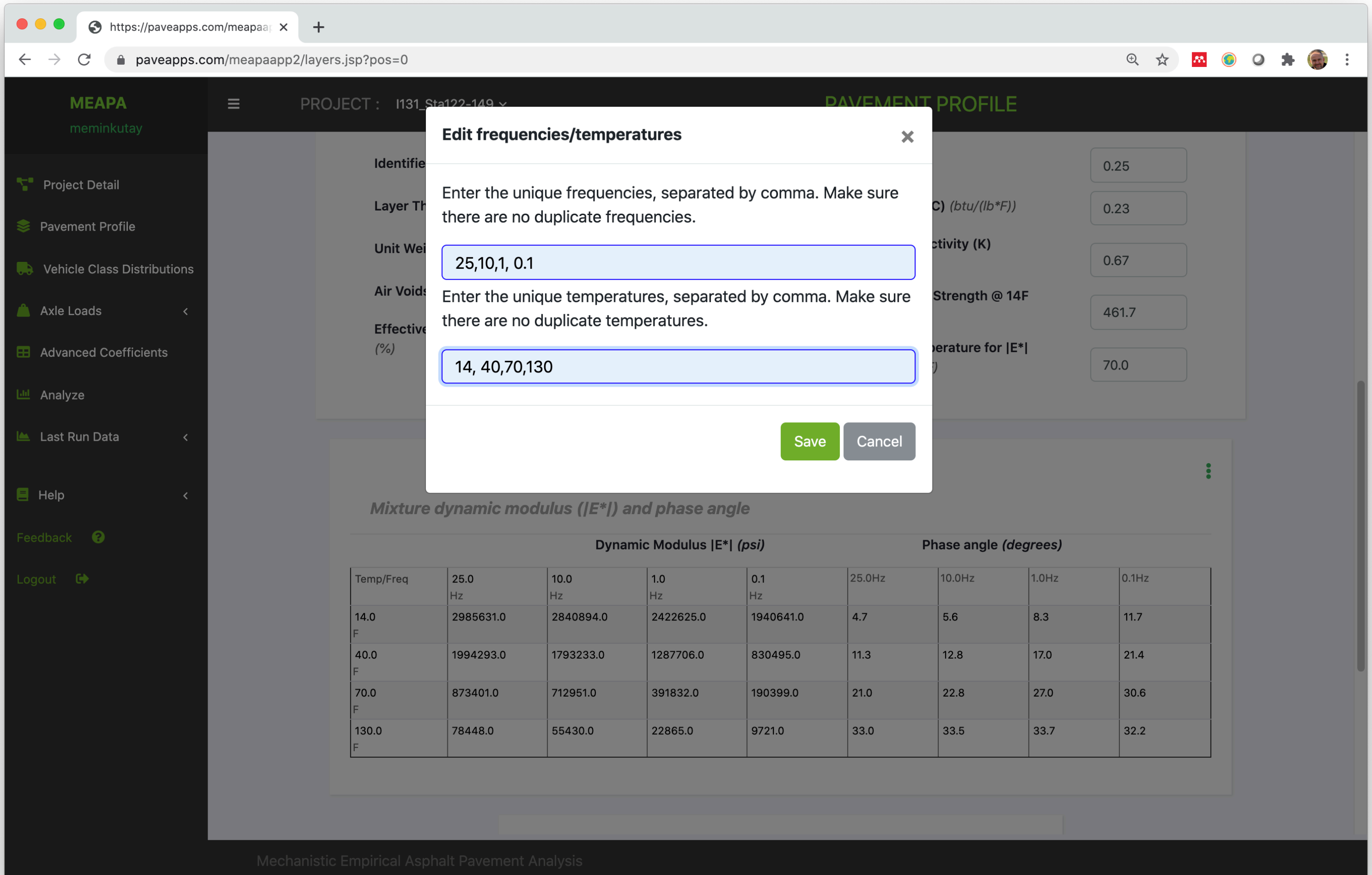
Identifier
AC (4E3 PG64-22)
Layer Thickness (in)
4.0
Unit Weight (lb/ft3)
150.0
Air Voids (%)
7.0
Effective Binder Content by Volume (%)
10.0
Poisson's Ratio
0.25
Heat Capacity (C) (btu/(lb*F))
0.23
Thermal Conductivity (K) (btu/(hr*ft*F))
0.67
Indirect Tensile Strength @ 14F (-10C) (psi)
461.7
Reference Temperature for |E*| Master Curve (F)
70.0
Mixture dynamic modulus (|E*|) and phase angle
Dynamic Modulus |E*| (psi)
Temp/Freq
25.0 Hz
10.0 Hz
1.0 Hz
0.1 Hz
25.0Hz
14.0 F
2985631.0
2840894.0
2422625.0
1940641.0
4.7
40.0 F
1994293.0
1793233.0
1287706.0
830495.0
11.3
70.0 F
873401.0
712951.0
391832.0
190399.0
21.0
22.8
27.0
30.6
130.0 F
78448.0
55430.0
22865.0
9721.0
33.0
33.5
33.7
32.2
Copy entire table
Paste entire table
Enter |E*| master curve coefficients
Select |E*| from the database
Edit frequencies & temperatures
Mechanistic Empirical Asphalt Pavement Analysis
https://paveapps.com/meapaapp2/layers.jsp?pos=0#estarSelectModal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MEAPA
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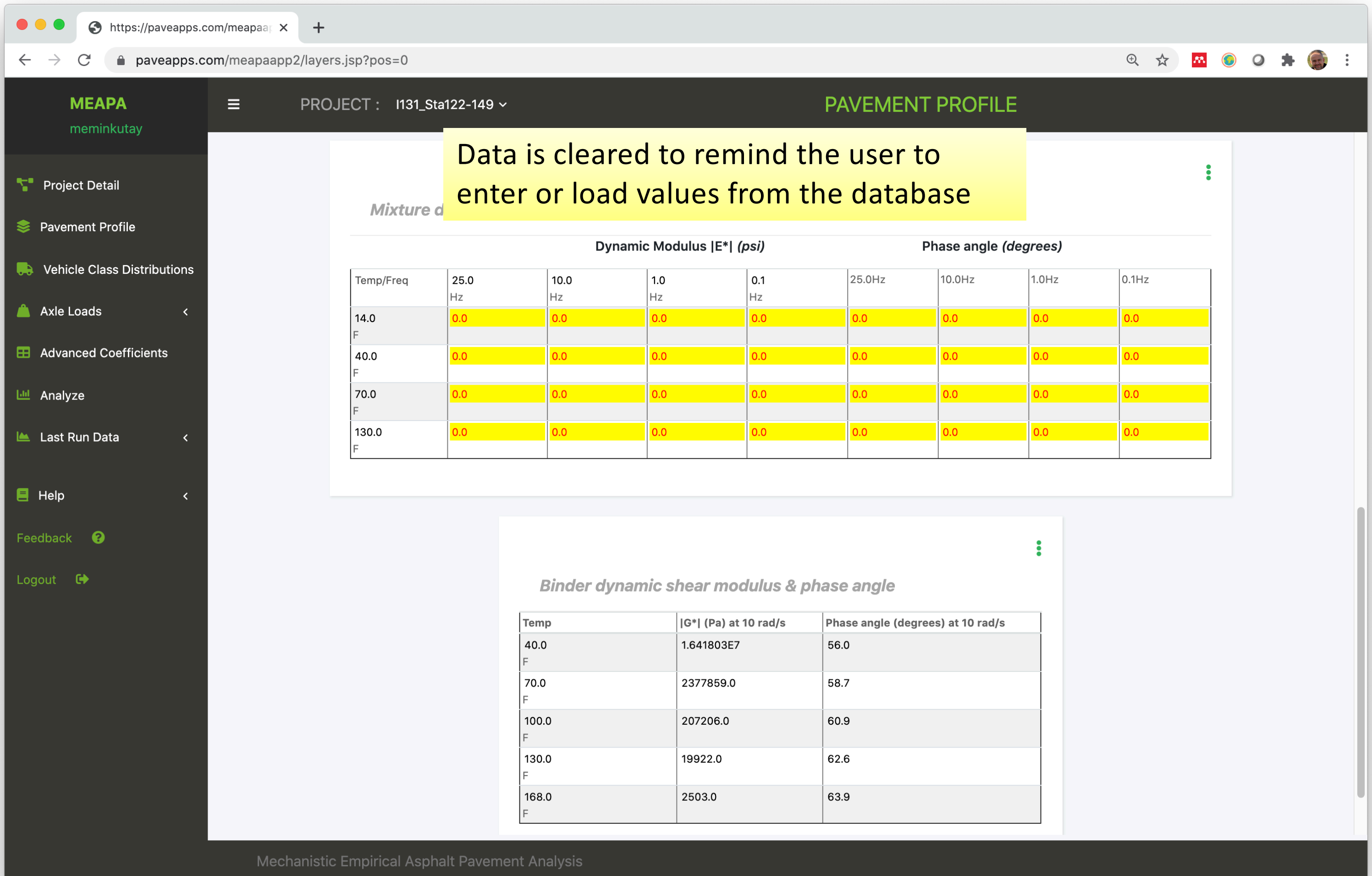
PROJECT :
PAVEMENT PROFILE
Edit frequencies/temperatures
Enter the unique frequencies, separated by comma. Make sure there are no duplicate frequencies.
25,10,1, 0.1
Enter the unique temperatures, separated by comma. Make sure there are no duplicate temperatures.
14, 40,70,130
Save
Cancel
0.25
0.23
0.67
461.7
70.0
Mixture dynamic modulus (|E*|) and phase angle
Dynamic Modulus |E*| (psi)
Phase angle (degrees)
Temp/Freq
25.0 Hz
10.0 Hz
1.0 Hz
0.1 Hz
25.0Hz
10.0Hz
1.0Hz
0.1Hz
14.0 F
2985631.0
2840894.0
2422625.0
1940641.0
4.7
5.6
8.3
11.7
40.0 F
1994293.0
1793233.0
1287706.0
830495.0
11.3
12.8
17.0
21.4
70.0 F
873401.0
712951.0
391832.0
190399.0
21.0
22.8
27.0
30.6
130.0 F
78448.0
55430.0
22865.0
9721.0
33.0
33.5
33.7
32.2
Mechanistic Empirical Asphalt Pavement Analysis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PROJECT : I131_Sta122-149
PAVEMENT PROFILE
Data is cleared to remind the user to enter or load values from the database
Project Detail
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Vehicle Class Distributions
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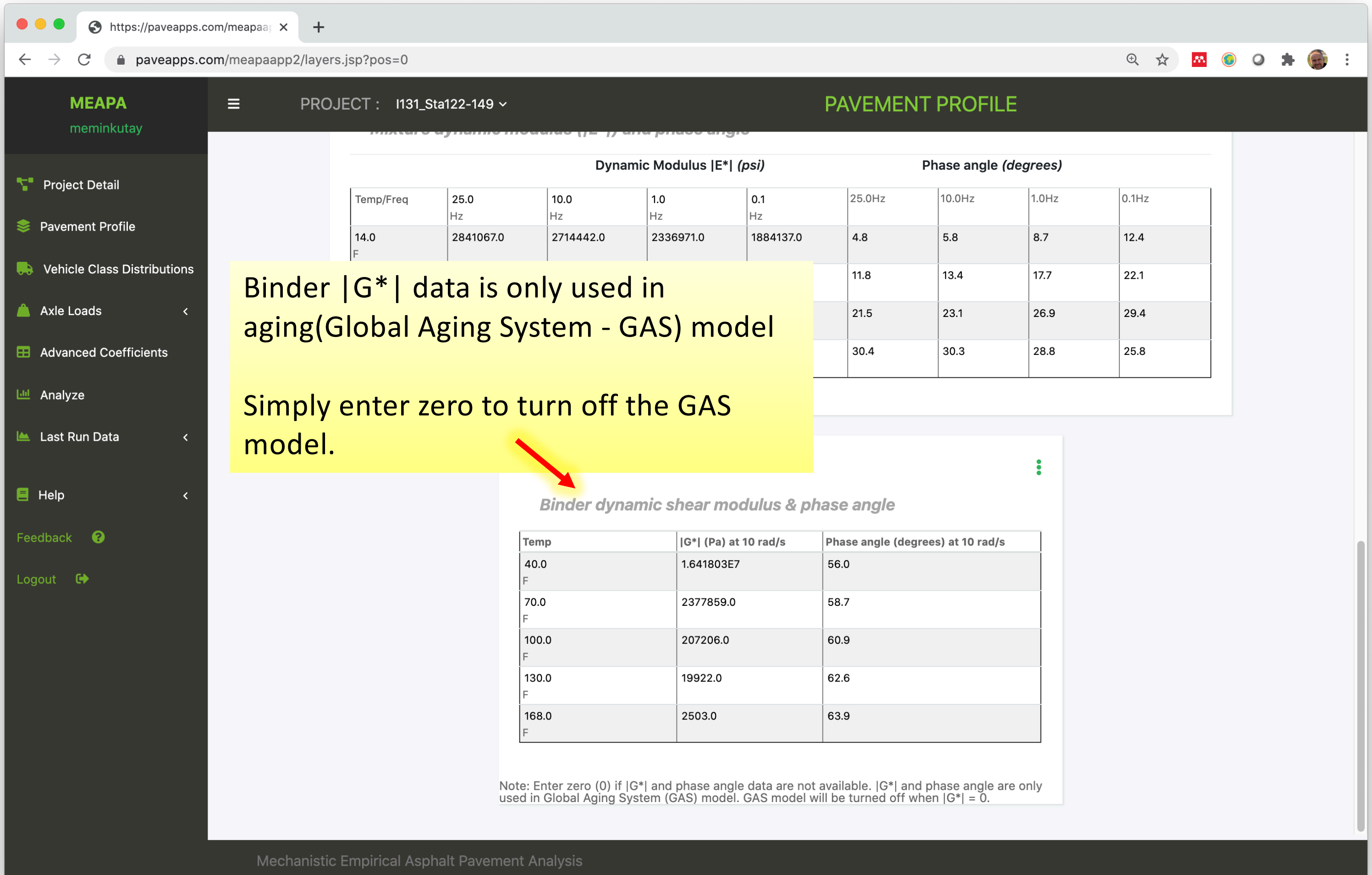
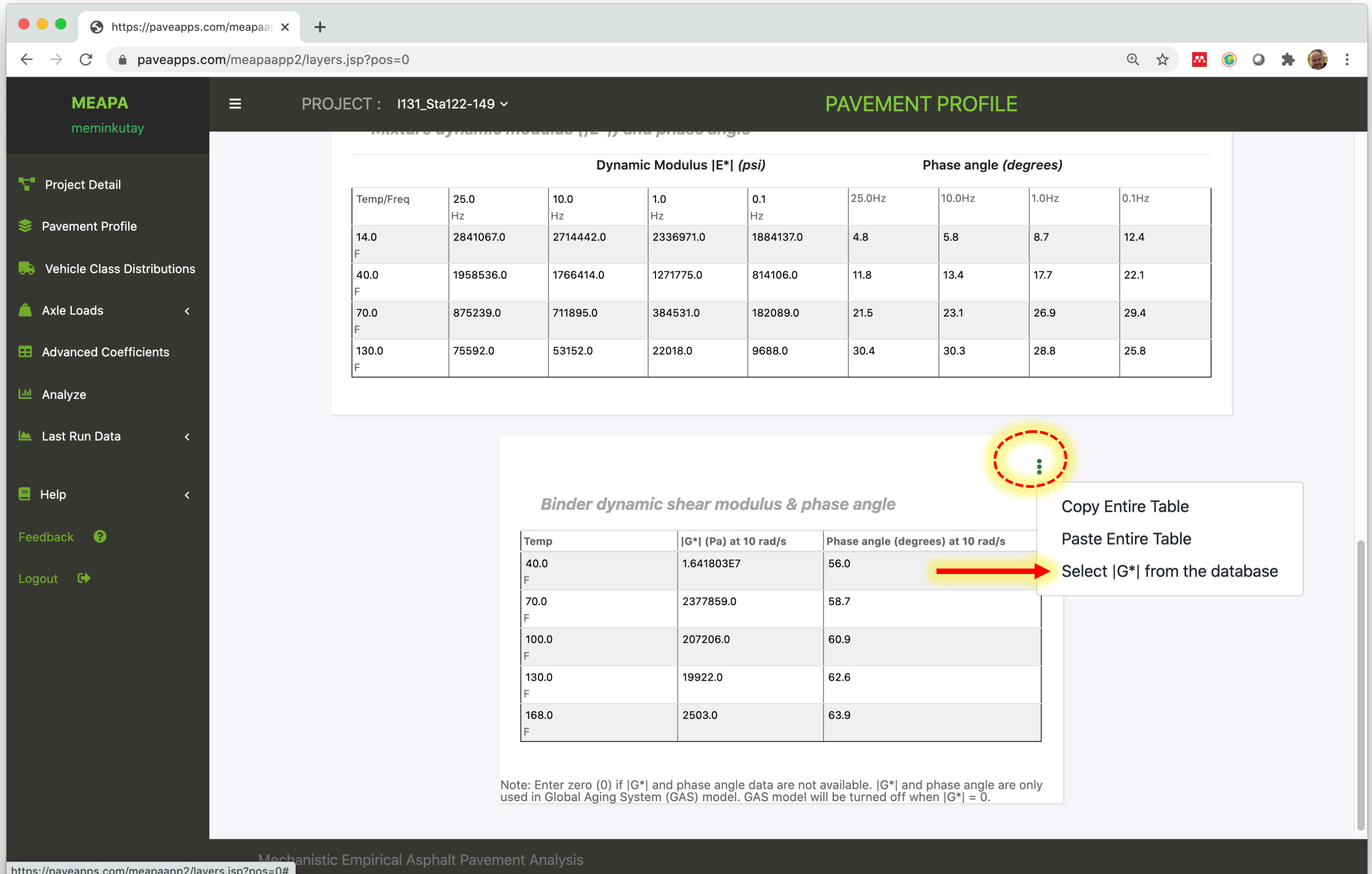
Logout
Mixture d
Dynamic Modulus |E*| (psi)
Phase angle (degrees)
Temp/Freq 25.0 Hz 10.0 Hz 1.0 Hz 0.1 Hz 25.0Hz 10.0Hz 1.0Hz 0.1Hz
14.0 F 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
40.0 F 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
70.0 F 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
130.0 F 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
Binder dynamic shear modulus & phase angle
Temp |G*| (Pa) at 10 rad/s Phase angle (degrees) at 10 rad/s
40.0 F 1.641803E7 56.0
70.0 F 2377859.0 58.7
100.0 F 207206.0 60.9
130.0 F 19922.0 62.6
168.0 F 2503.0 63.9
Mechanistic Empirical Asphalt Pavement Analysis



Temp/Freq	25.0 Hz	10.0 Hz	1.0 Hz	0.1 Hz	25.0Hz	10.0Hz	1.0Hz	0.1Hz
14.0 F	2841067.0	2714442.0	2336971.0	1884137.0	4.8	5.8	8.7	12.4
					11.8	13.4	17.7	22.1
					21.5	23.1	26.9	29.4
					30.4	30.3	28.8	25.8

Temp	|G*| (Pa) at 10 rad/s	Phase angle (degrees) at 10 rad/s
40.0 F	1.641803E7	56.0
70.0 F	2377859.0	58.7
100.0 F	207206.0	60.9
130.0 F	19922.0	62.6
168.0 F	2503.0	63.9



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PAVEMENT PROFILE
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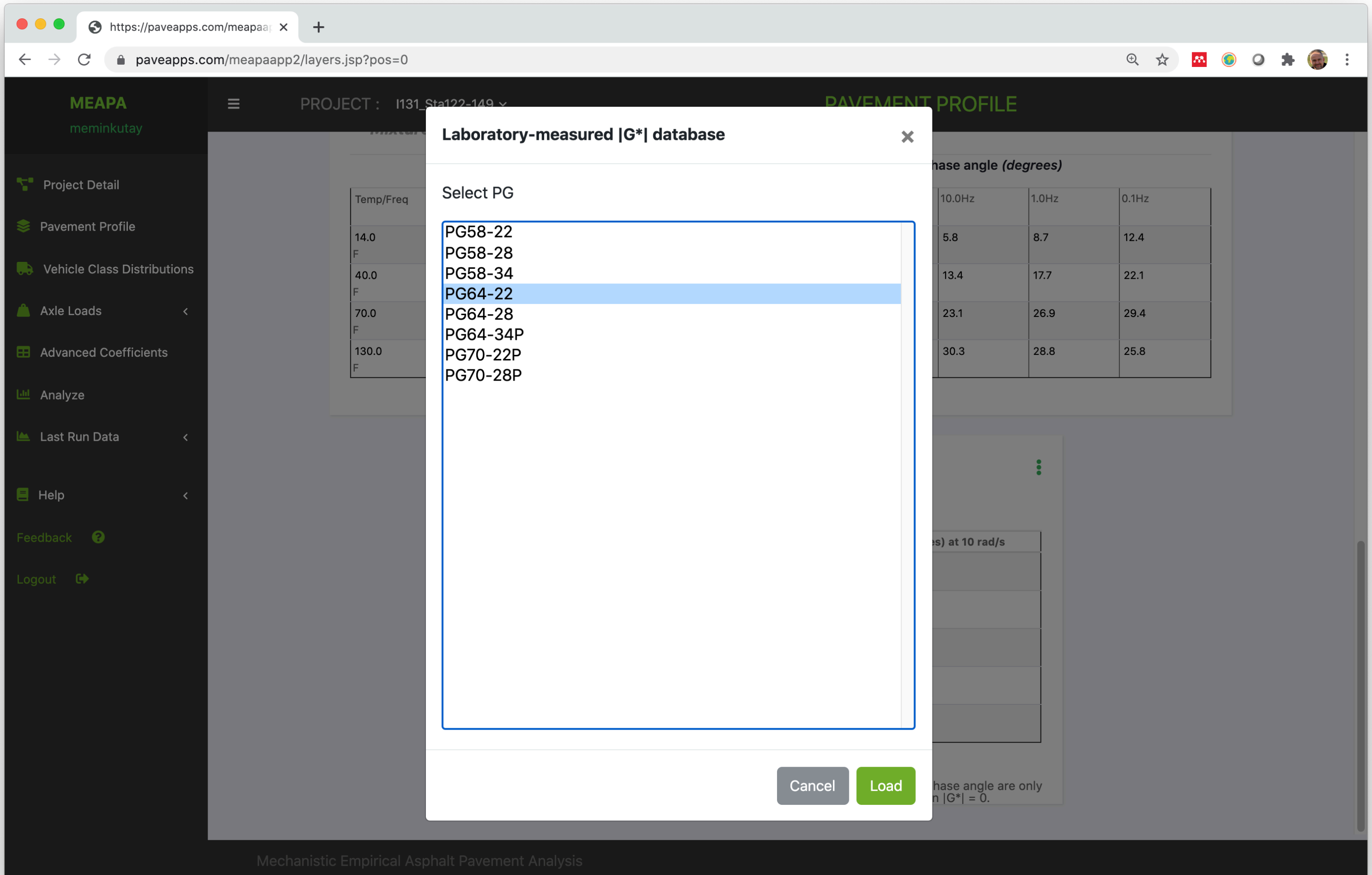
Dynamic Modulus |E*| (psi)
Phase angle (degrees)
Temp/Freq 25.0 Hz 10.0 Hz 1.0 Hz 0.1 Hz 25.0Hz 10.0Hz 1.0Hz 0.1Hz
14.0 F 2841067.0 2714442.0 2336971.0 1884137.0 4.8 5.8 8.7 12.4
40.0 F 1958536.0 1766414.0 1271775.0 814106.0 11.8 13.4 17.7 22.1
70.0 F 875239.0 711895.0 384531.0 182089.0 21.5 23.1 26.9 29.4
130.0 F 75592.0 53152.0 22018.0 9688.0 30.4 30.3 28.8 25.8
Binder dynamic shear modulus & phase angle
Copy Entire Table
Paste Entire Table
Select |G*| from the database
Temp |G*| (Pa) at 10 rad/s Phase angle (degrees) at 10 rad/s
40.0 F 1.641803E7 56.0
70.0 F 2377859.0 58.7
100.0 F 207206.0 60.9
130.0 F 19922.0 62.6
168.0 F 2503.0 63.9
Note: Enter zero (0) if |G*| and phase angle data are not available. |G*| and phase angle are only used in Global Aging System (GAS) model. GAS model will be turned off when |G*| = 0.
Mechanistic Empirical Asphalt Pavement Analysis
https://paveapps.com/meapaapp2/layers.jsp?pos=0#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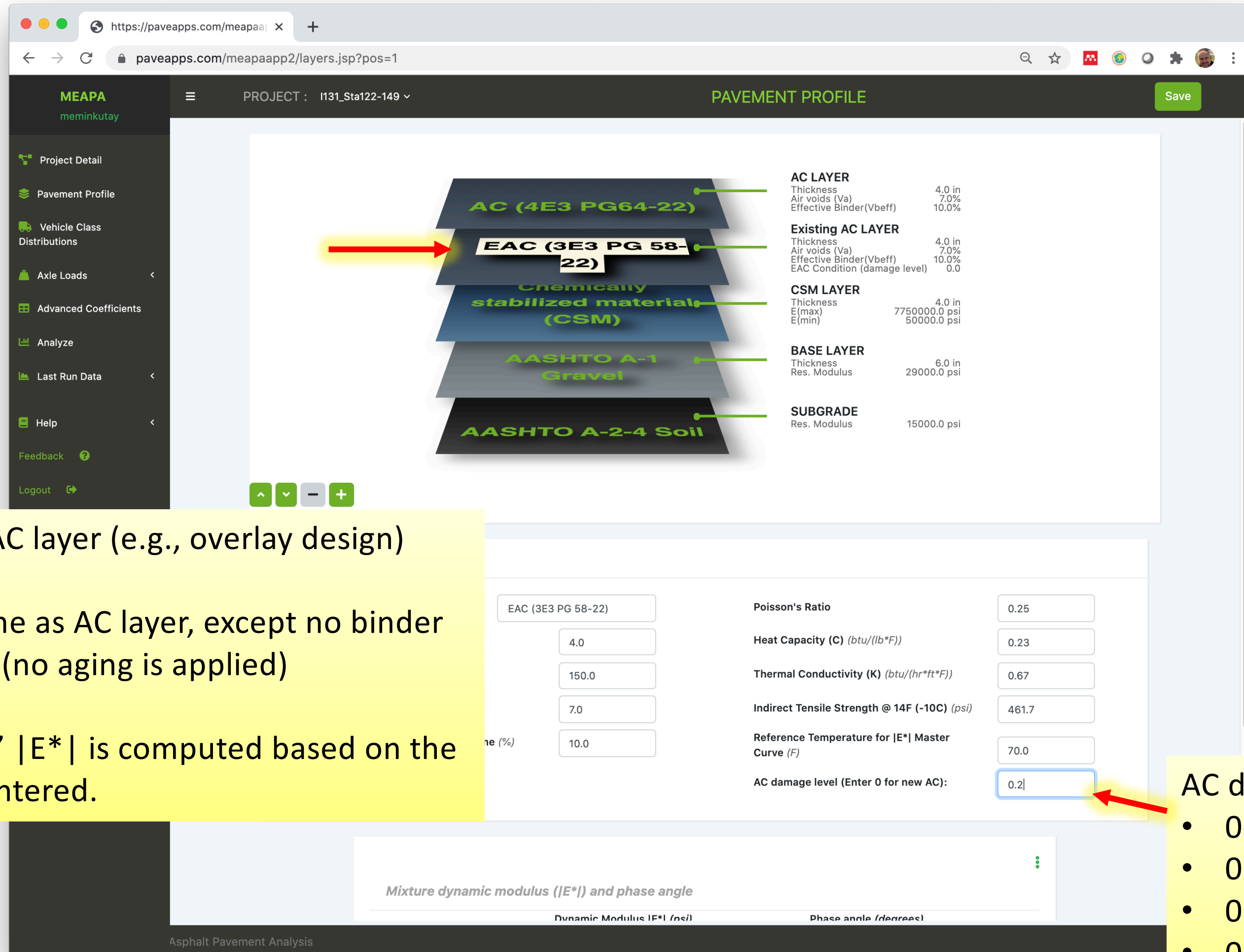
Laboratory-measured |G*| database
Select PG
PG58-22
PG58-28
PG58-34
PG64-22
PG64-28
PG64-34P
PG70-22P
PG70-28P
Cancel
Load
Temp/Freq
14.0 F
40.0 F
70.0 F
130.0 F
hase angle (degrees)
10.0Hz
1.0Hz
0.1Hz
5.8
8.7
12.4
13.4
17.7
22.1
23.1
26.9
29.4
30.3
28.8
25.8
s) at 10 rad/s
hase angle are only
n |G*| = 0.
Mechanistic Empirical Asphalt Pavement Analysis



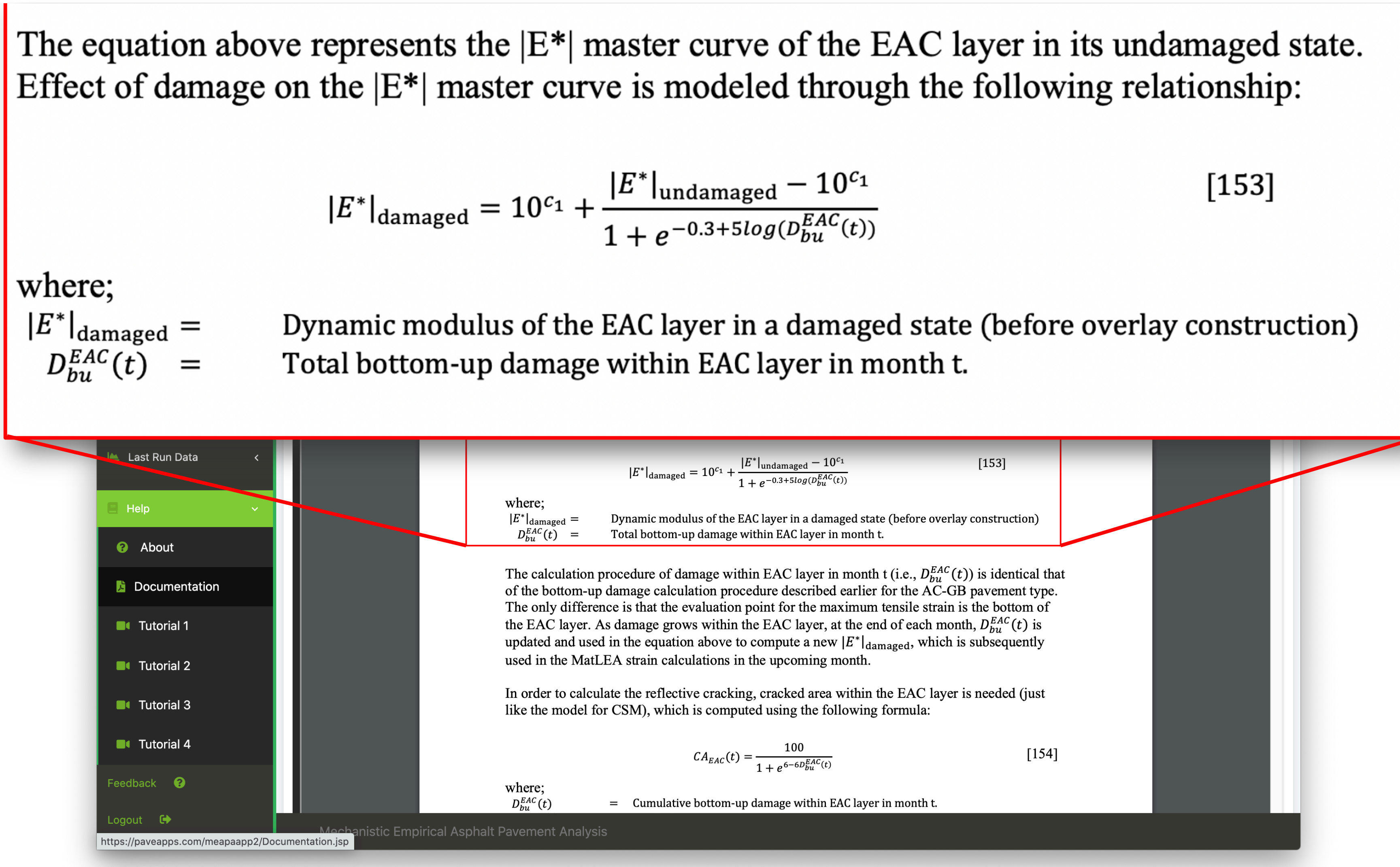
EAC = Existing AC layer (e.g., overlay design)

EAC layer is same as AC layer, except no binder data is entered (no aging is applied)

Also, 'damaged' |E*| is computed based on the damage level entered.

AC damage level:

- 0-0.2: Excellent
- 0.2-0.4 Good
- 0.4-0.8: Fair
- 0.8-1.2: Poor
- >1.2: Very Poor



The equation above represents the |E*| master curve of the EAC layer in its undamaged state. Effect of damage on the |E*| master curve is modeled through the following relationship:

$$|E^*|_{\text{damaged}} = 10^{c_1} + \frac{|E^*|_{\text{undamaged}} - 10^{c_1}}{1 + e^{-0.3+5log(D_{bu}^{EAC}(t))}} \qquad [153]$$

where;

$|E^*|_{\text{damaged}}$ = Dynamic modulus of the EAC layer in a damaged state (before overlay construction)

$D_{bu}^{EAC}(t)$ = Total bottom-up damage within EAC layer in month t.

$$|E^*|_{\text{damaged}} = 10^{c_1} + \frac{|E^*|_{\text{undamaged}} - 10^{c_1}}{1 + e^{-0.3+5log(D_{bu}^{EAC}(t))}} \qquad [153]$$

where;

$|E^*|_{\text{damaged}}$ = Dynamic modulus of the EAC layer in a damaged state (before overlay construction)

$D_{bu}^{EAC}(t)$ = Total bottom-up damage within EAC layer in month t.

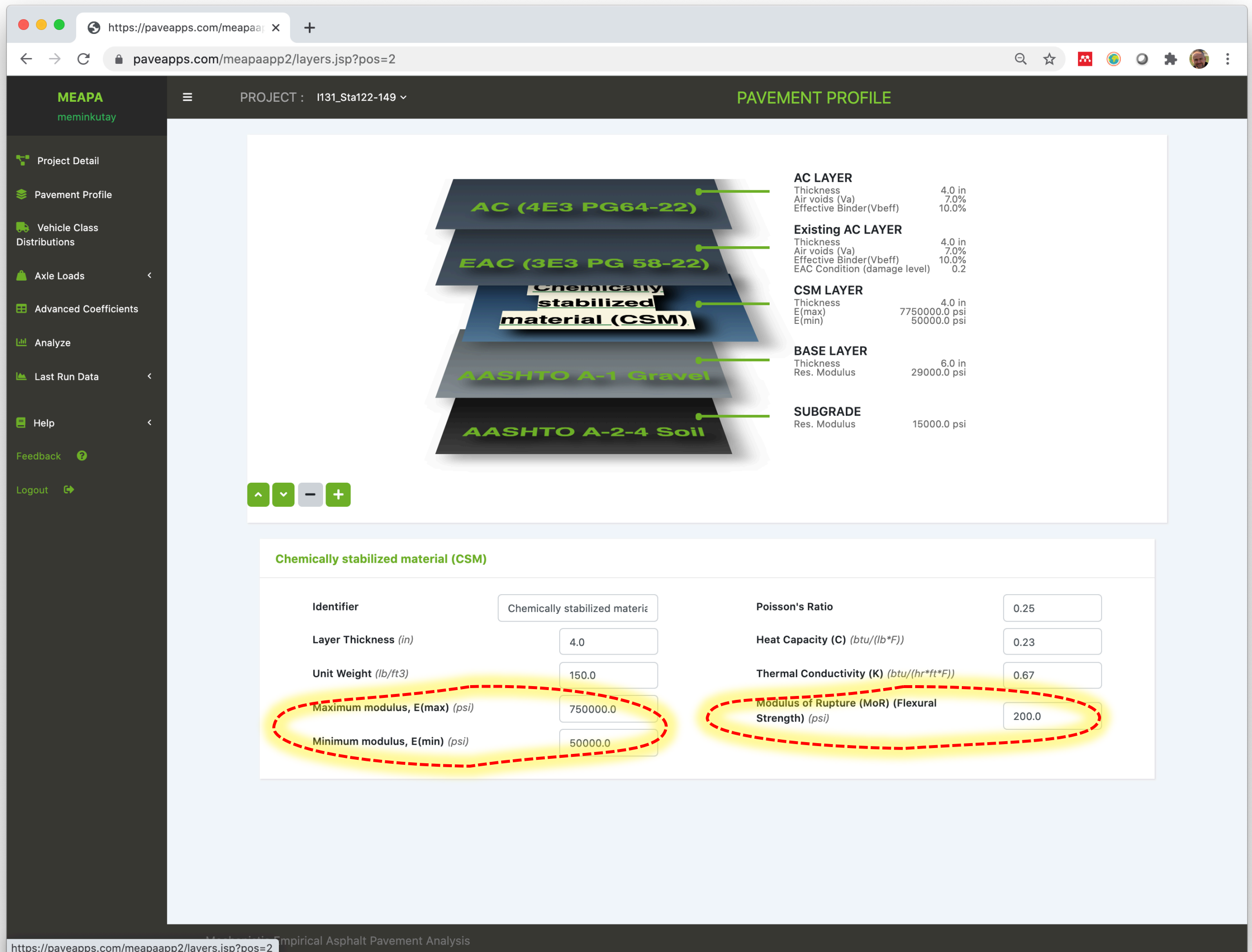
The calculation procedure of damage within EAC layer in month t (i.e., $D_{bu}^{EAC}(t)$) is identical that of the bottom-up damage calculation procedure described earlier for the AC-GB pavement type. The only difference is that the evaluation point for the maximum tensile strain is the bottom of the EAC layer. As damage grows within the EAC layer, at the end of each month, $D_{bu}^{EAC}(t)$ is updated and used in the equation above to compute a new $|E^*|_{\text{damaged}}$, which is subsequently used in the MatLEA strain calculations in the upcoming month.

In order to calculate the reflective cracking, cracked area within the EAC layer is needed (just like the model for CSM), which is computed using the following formula:

$$CA_{EAC}(t) = \frac{100}{1 + e^{6-6D_{bu}^{EAC}(t)}} \qquad [154]$$

where;

$D_{bu}^{EAC}(t)$ = Cumulative bottom-up damage within EAC layer in month t.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MEAPA
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AC (4E3 PG64-22)
EAC (3E3 PG 58-22)
Chemically stabilized material (CSM)
AASHTO A-1 Gravel
AASHTO A-2-4 Soil
AC LAYER
Thickness 4.0 in
Air voids (Va) 7.0%
Effective Binder(Vbeff) 10.0%
Existing AC LAYER
Thickness 4.0 in
Air voids (Va) 7.0%
Effective Binder(Vbeff) 10.0%
EAC Condition (damage level) 0.2
CSM LAYER
Thickness 4.0 in
E(max) 7750000.0 psi
E(min) 50000.0 psi
BASE LAYER
Thickness 6.0 in
Res. Modulus 29000.0 psi
SUBGRADE
Res. Modulus 15000.0 psi
Chemically stabilized material (CSM)
Identifier: Chemically stabilized materia
Layer Thickness (in): 4.0
Unit Weight (lb/ft3): 150.0
Maximum modulus, E(max) (psi): 750000.0
Minimum modulus, E(min) (psi): 50000.0
Poisson's Ratio: 0.25
Heat Capacity (C) (btu/(lb*F)): 0.23
Thermal Conductivity (K) (btu/(hr*ft*F)): 0.67
Modulus of Rupture (MoR) (Flexural Strength) (psi): 200.0
Mechanistic-Empirical Asphalt Pavement Analysis
https://paveapps.com/meapaapp2/layers.jsp?pos=2

Typical CSM layer modulus is initially quite high. However, as fatigue damage grows within the CSM layer, this modulus decreases with time. Reduction of modulus of CSM layer is modeled using the following relationship:

$$E(t) = E_{min} + \frac{E_{max} - E_{\min}}{1 + e^{-4+14D_{csm}^{cum}(t)}} \qquad [146]$$

where;

E_{max}	=	Maximum CSM modulus, psi
$E_{\min}$	=	Minimum CSM modulus, psi
$D_{csm}^{cum}(t)$	=	Cumulative damage in CSM layer, at the end of each month,t.

$$E(t) = E_{min} + \frac{E_{max} - E_{\min}}{1 + e^{-4+14D_{csm}^{cum}(t)}} \qquad [146]$$

where;

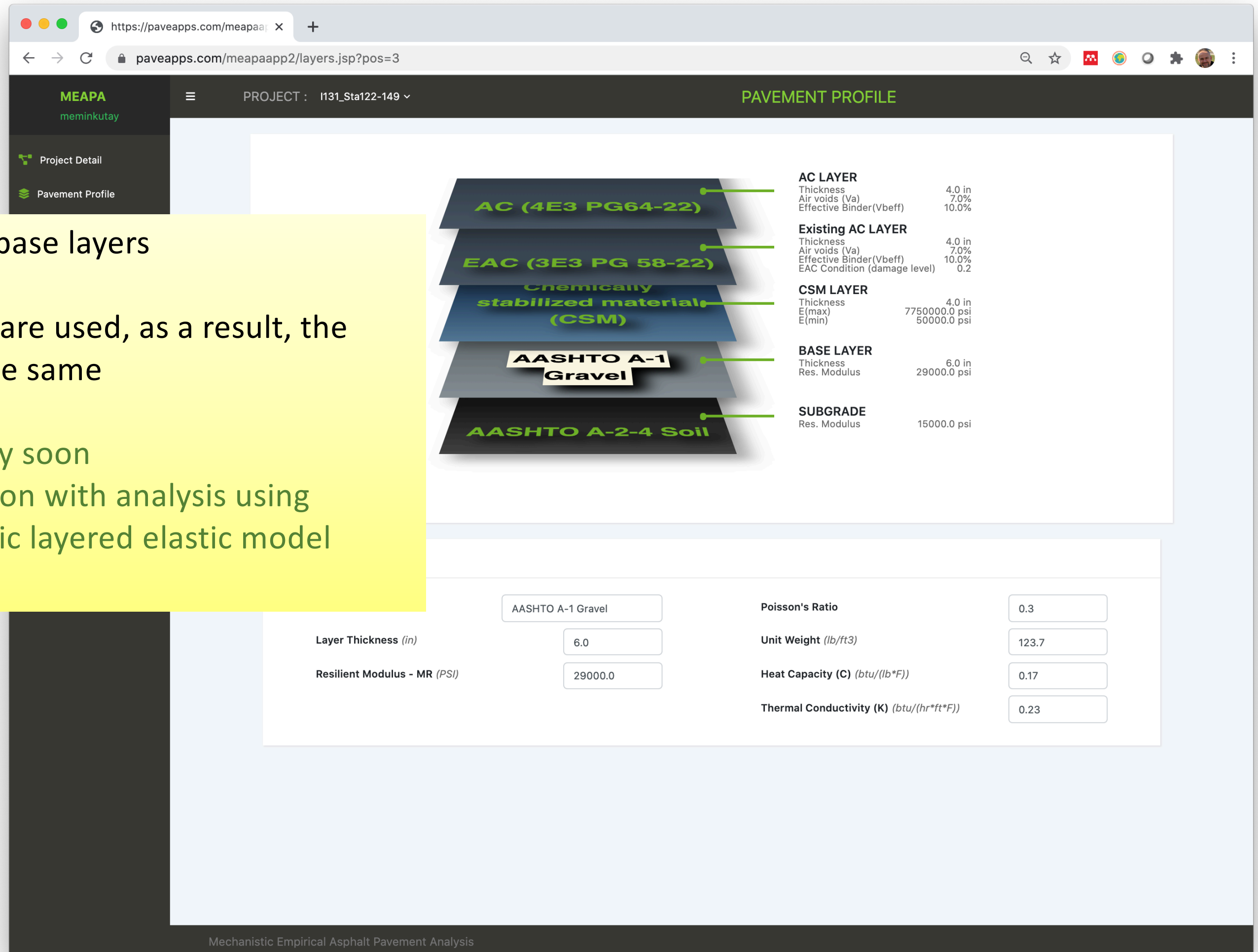
E_{max} = Maximum CSM modulus, psi
$E_{\min}$ = Minimum CSM modulus, psi
$D_{csm}^{cum}(t)$ = Cumulative damage in CSM layer, at the end of each month,t.

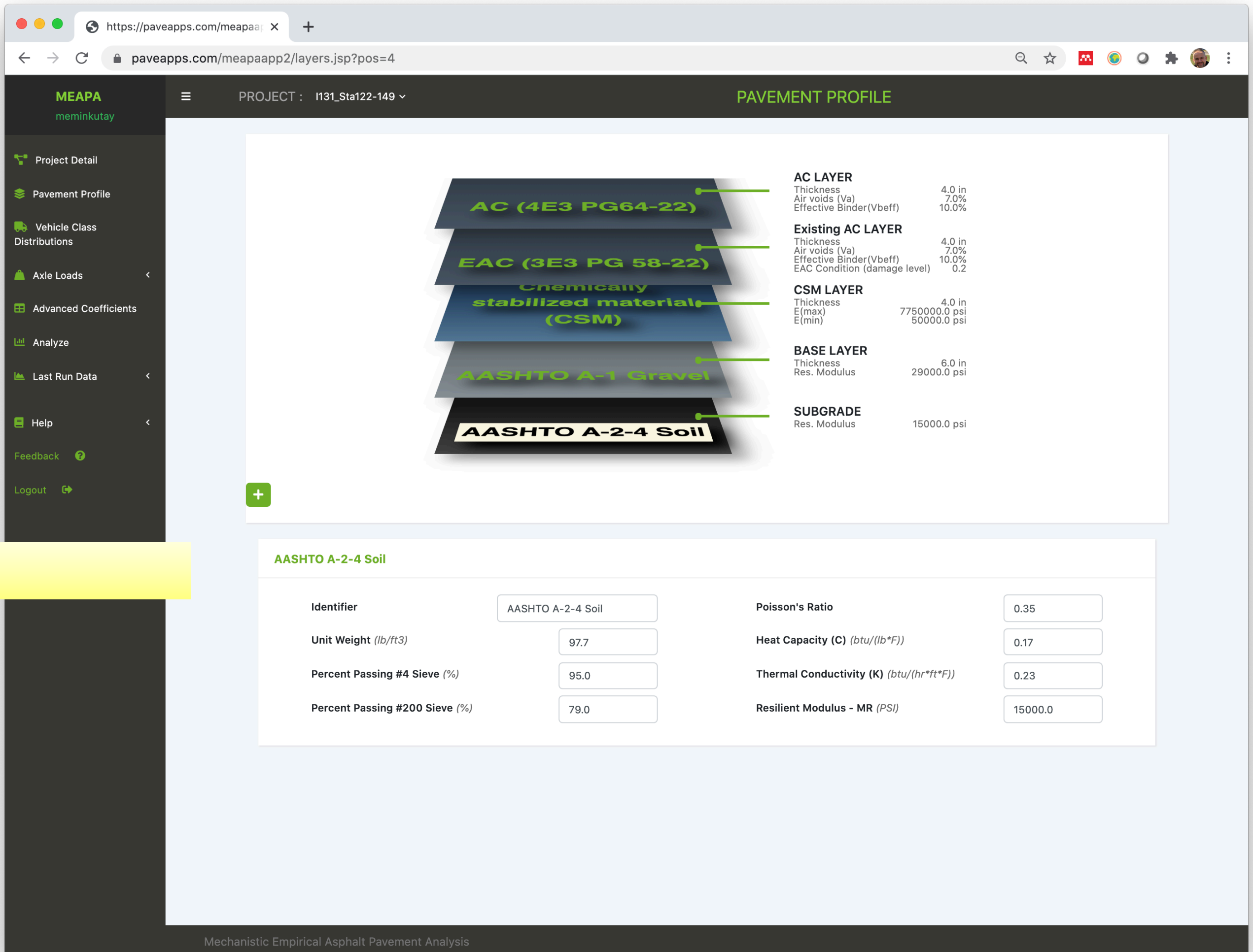
An example intermediate outputs of the CSM model is shown in Figure 51, which shows the reduction in CSM modulus with time, growth of cracked area in CSM with time and progression of reflective cracking.

Unbound Base/Subbase layers

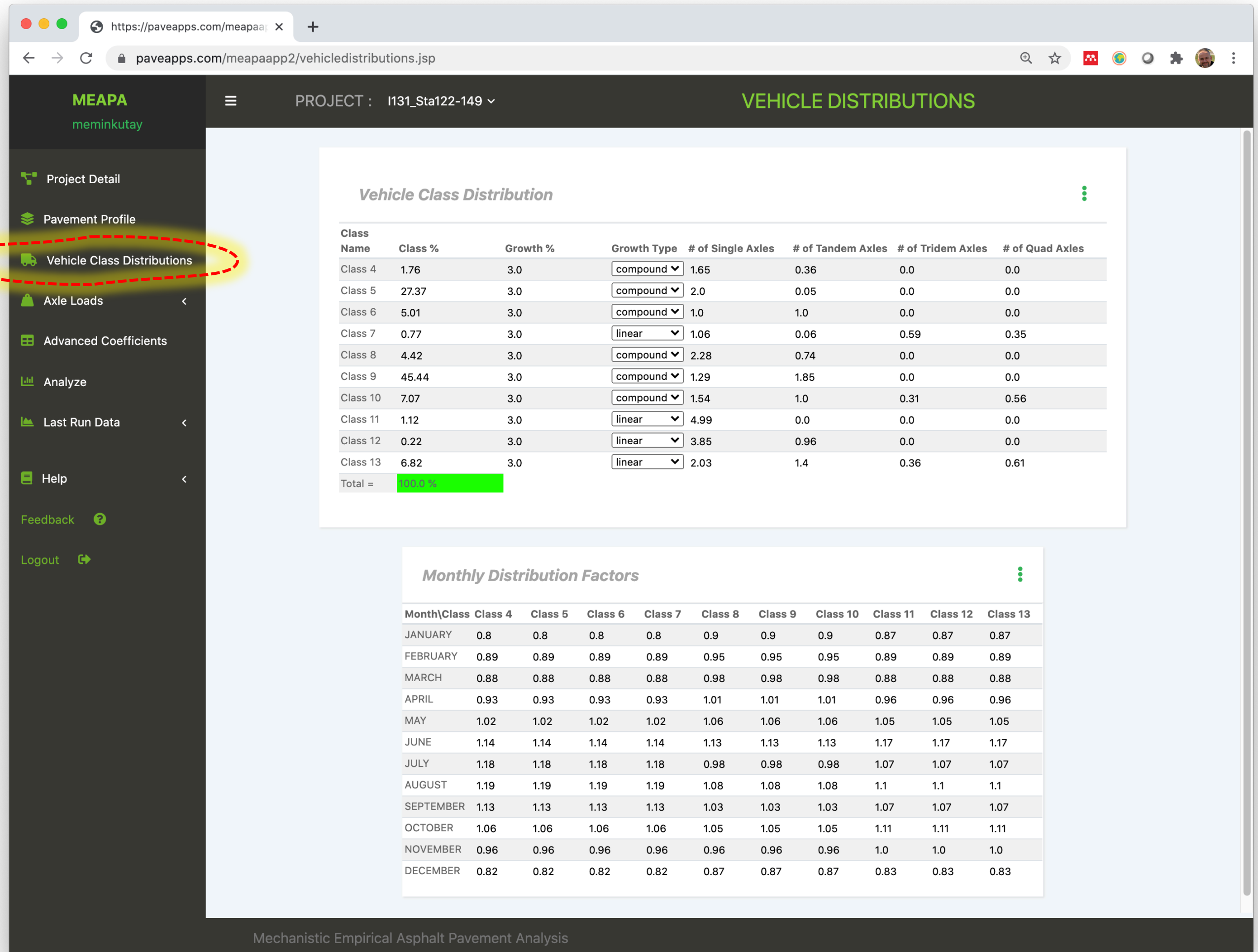
Same exact models are used, as a result, the input options are the same

Will be updated very soon
 - to provide an option with analysis using nonlinear anisotropic layered elastic model (MatLEA-TAN)





Subgrade layer

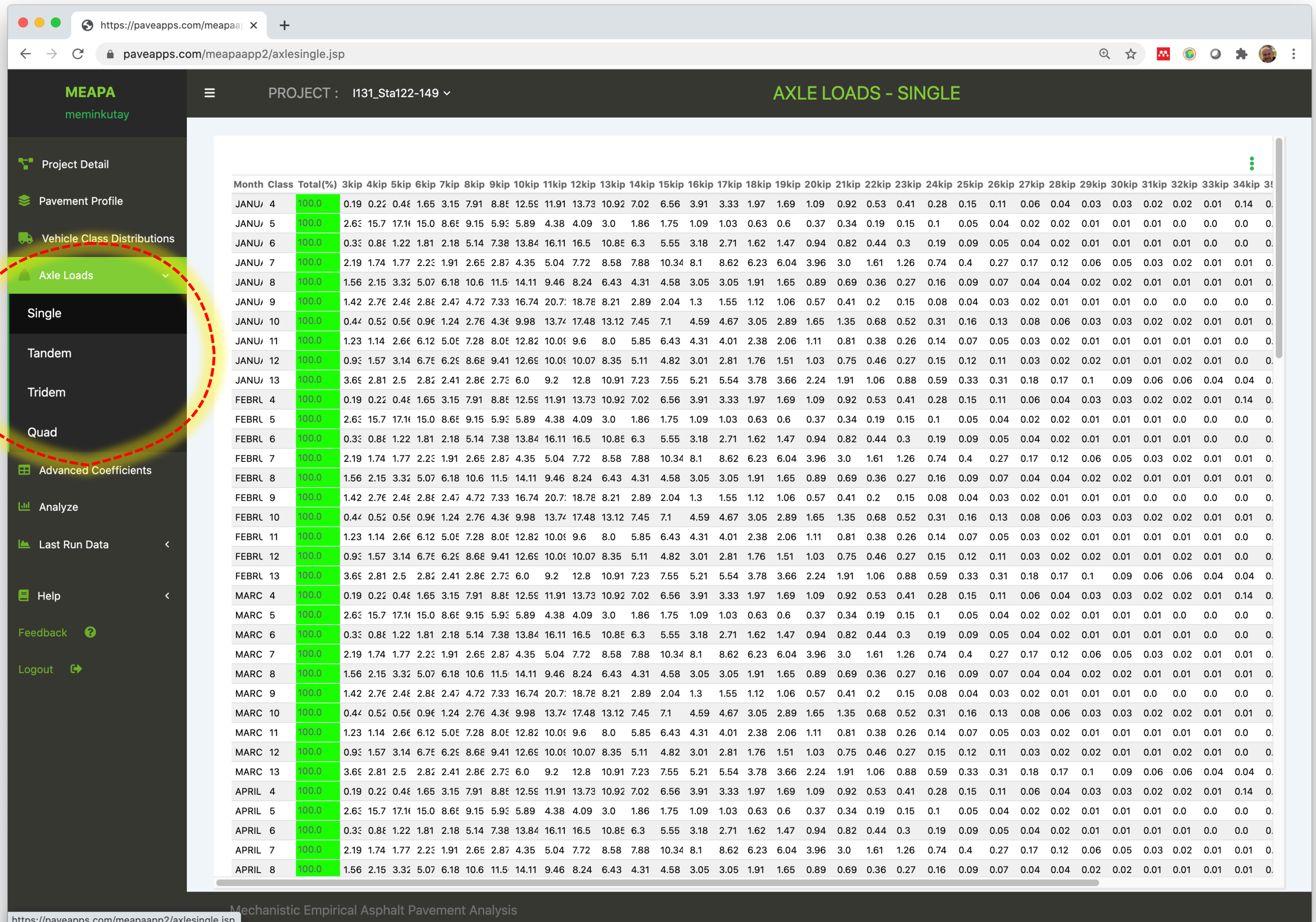


Vehicle Class Distribution

Class Name	Class %	Growth %	Growth Type	# of Single Axles	# of Tandem Axles	# of Tridem Axles	# of Quad Axles
Class 4	1.76	3.0	compound	1.65	0.36	0.0	0.0
Class 5	27.37	3.0	compound	2.0	0.05	0.0	0.0
Class 6	5.01	3.0	compound	1.0	1.0	0.0	0.0
Class 7	0.77	3.0	linear	1.06	0.06	0.59	0.35
Class 8	4.42	3.0	compound	2.28	0.74	0.0	0.0
Class 9	45.44	3.0	compound	1.29	1.85	0.0	0.0
Class 10	7.07	3.0	compound	1.54	1.0	0.31	0.56
Class 11	1.12	3.0	linear	4.99	0.0	0.0	0.0
Class 12	0.22	3.0	linear	3.85	0.96	0.0	0.0
Class 13	6.82	3.0	linear	2.03	1.4	0.36	0.61
Total =	100.0 %						

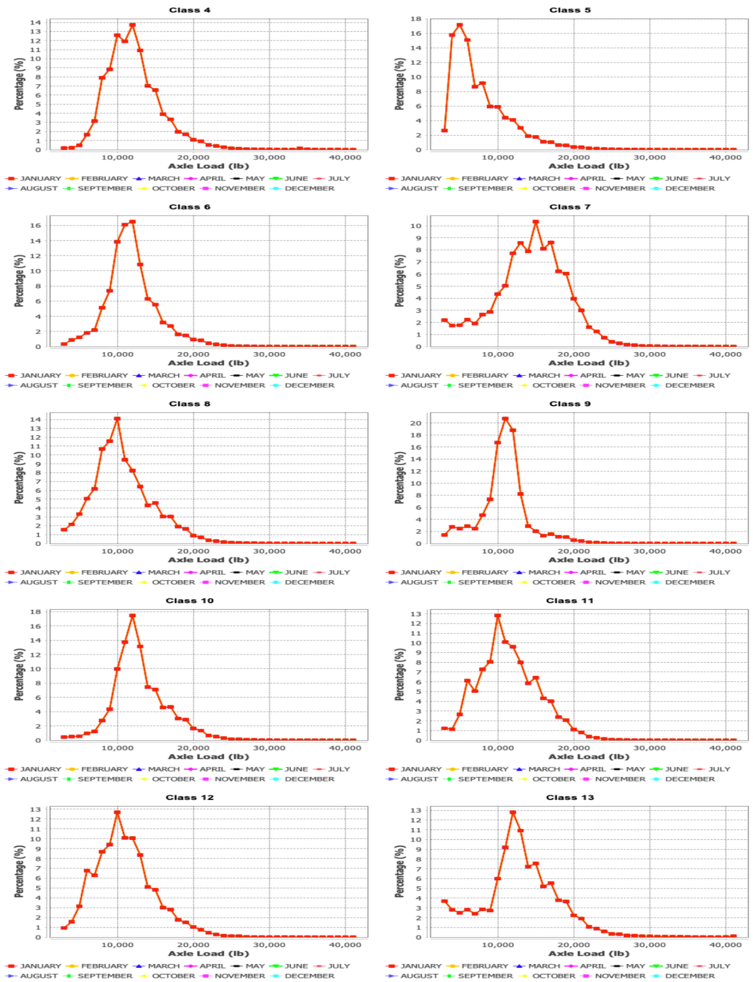
Monthly Distribution Factors

Month\Class	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
JANUARY	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.87	0.87	0.87
FEBRUARY	0.89	0.89	0.89	0.89	0.95	0.95	0.95	0.89	0.89	0.89
MARCH	0.88	0.88	0.88	0.88	0.98	0.98	0.98	0.88	0.88	0.88
APRIL	0.93	0.93	0.93	0.93	1.01	1.01	1.01	0.96	0.96	0.96
MAY	1.02	1.02	1.02	1.02	1.06	1.06	1.06	1.05	1.05	1.05
JUNE	1.14	1.14	1.14	1.14	1.13	1.13	1.13	1.17	1.17	1.17
JULY	1.18	1.18	1.18	1.18	0.98	0.98	0.98	1.07	1.07	1.07
AUGUST	1.19	1.19	1.19	1.19	1.08	1.08	1.08	1.1	1.1	1.1
SEPTEMBER	1.13	1.13	1.13	1.13	1.03	1.03	1.03	1.07	1.07	1.07
OCTOBER	1.06	1.06	1.06	1.06	1.05	1.05	1.05	1.11	1.11	1.11
NOVEMBER	0.96	0.96	0.96	0.96	0.96	0.96	0.96	1.0	1.0	1.0
DECEMBER	0.82	0.82	0.82	0.82	0.87	0.87	0.87	0.83	0.83	0.83

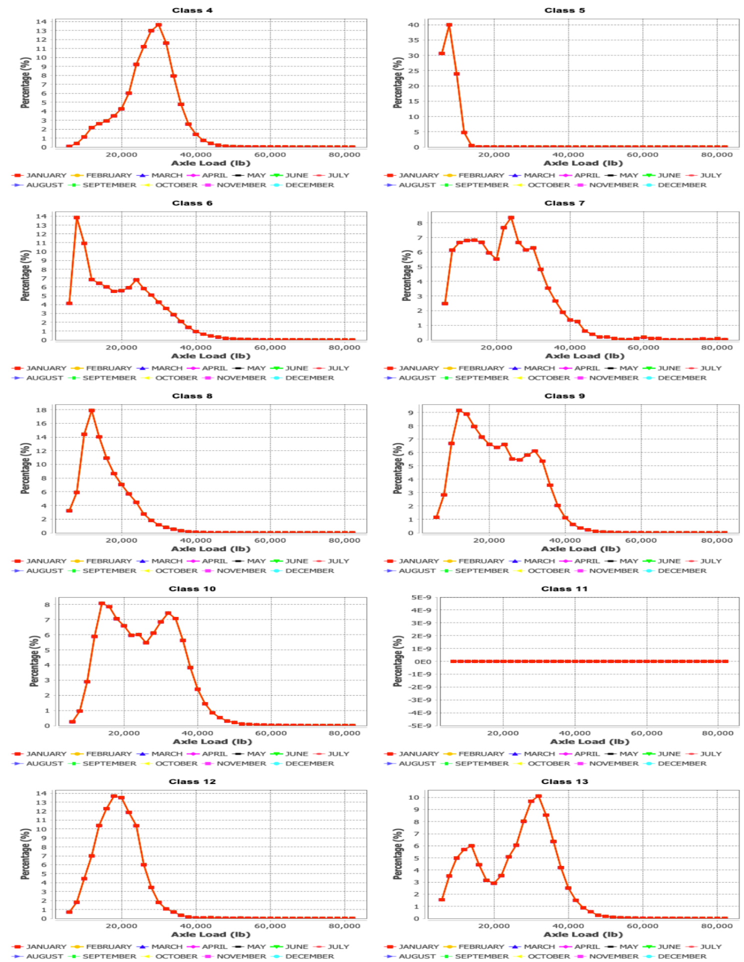


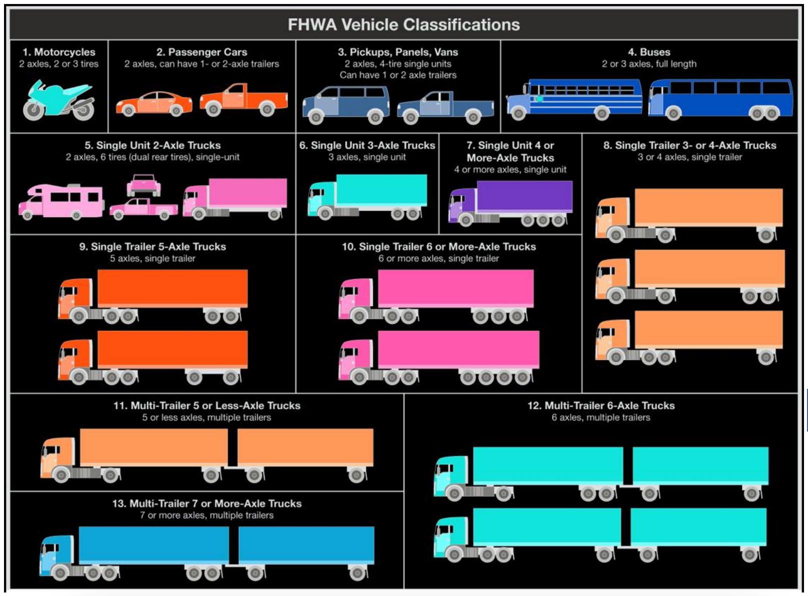
Month	Class	Total(%)	3kip	4kip	5kip	6kip	7kip	8kip	9kip	10kip	11kip	12kip	13kip	14kip	15kip	16kip	17kip	18kip	19kip	20kip	21kip	22kip	23kip	24kip	25kip	26kip	27kip	28kip	29kip	30kip	31kip	32kip	33kip	34kip	3
JANU	4	100.0	0.19	0.22	0.48	1.65	3.15	7.91	8.85	12.59	11.91	13.73	10.92	7.02	6.56	3.91	3.33	1.97	1.69	1.09	0.92	0.53	0.41	0.28	0.15	0.11	0.06	0.04	0.03	0.03	0.02	0.02	0.01	0.14	0.
JANU	5	100.0	2.63	15.7	17.16	15.0	8.65	9.15	5.93	5.89	4.38	4.09	3.0	1.86	1.75	1.09	1.03	0.63	0.6	0.37	0.34	0.19	0.15	0.1	0.05	0.04	0.02	0.02	0.01	0.01	0.01	0.0	0.0	0.0	0.
JANU	6	100.0	0.33	0.88	1.22	1.81	2.18	5.14	7.38	13.84	16.11	16.5	10.85	6.3	5.55	3.18	2.71	1.62	1.47	0.94	0.82	0.44	0.3	0.19	0.09	0.05	0.04	0.02	0.01	0.01	0.01	0.01	0.0	0.0	0.
JANU	7	100.0	2.19	1.74	1.77	2.23	1.91	2.65	2.87	4.35	5.04	7.72	8.58	7.88	10.34	8.1	8.62	6.23	6.04	3.96	3.0	1.61	1.26	0.74	0.4	0.27	0.17	0.12	0.06	0.05	0.03	0.02	0.01	0.01	0.
JANU	8	100.0	1.56	2.15	3.32	5.07	6.18	10.6	11.5	14.11	9.46	8.24	6.43	4.31	4.58	3.05	3.05	1.91	1.65	0.89	0.69	0.36	0.27	0.16	0.09	0.07	0.04	0.04	0.02	0.02	0.01	0.01	0.01	0.01	0.
JANU	9	100.0	1.42	2.76	2.48	2.88	2.47	4.72	7.33	16.74	20.7	18.78	8.21	2.89	2.04	1.3	1.55	1.12	1.06	0.57	0.41	0.2	0.15	0.08	0.04	0.03	0.02	0.01	0.01	0.01	0.0	0.0	0.0	0.0	0.
JANU	10	100.0	0.44	0.52	0.56	0.96	1.24	2.76	4.36	9.98	13.74	17.48	13.12	7.45	7.1	4.59	4.67	3.05	2.89	1.65	1.35	0.68	0.52	0.31	0.16	0.13	0.08	0.06	0.03	0.03	0.02	0.02	0.01	0.01	0.
JANU	11	100.0	1.23	1.14	2.66	6.12	5.05	7.28	8.05	12.82	10.09	9.6	8.0	5.85	6.43	4.31	4.01	2.38	2.06	1.11	0.81	0.38	0.26	0.14	0.07	0.05	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.0	0.
JANU	12	100.0	0.93	1.57	3.14	6.75	6.29	8.68	9.41	12.69	10.09	10.07	8.35	5.11	4.82	3.01	2.81	1.76	1.51	1.03	0.75	0.46	0.27	0.15	0.12	0.11	0.03	0.02	0.02	0.01	0.01	0.02	0.01	0.0	0.
JANU	13	100.0	3.69	2.81	2.5	2.82	2.41	2.86	2.73	6.0	9.2	12.8	10.91	7.23	7.55	5.21	5.54	3.78	3.66	2.24	1.91	1.06	0.88	0.59	0.33	0.31	0.18	0.17	0.1	0.09	0.06	0.06	0.04	0.04	0.
FEBRU	4	100.0	0.19	0.22	0.48	1.65	3.15	7.91	8.85	12.59	11.91	13.73	10.92	7.02	6.56	3.91	3.33	1.97	1.69	1.09	0.92	0.53	0.41	0.28	0.15	0.11	0.06	0.04	0.03	0.03	0.02	0.02	0.01	0.14	0.
FEBRU	5	100.0	2.63	15.7	17.16	15.0	8.65	9.15	5.93	5.89	4.38	4.09	3.0	1.86	1.75	1.09	1.03	0.63	0.6	0.37	0.34	0.19	0.15	0.1	0.05	0.04	0.02	0.02	0.01	0.01	0.01	0.0	0.0	0.0	0.
FEBRU	6	100.0	0.33	0.88	1.22	1.81	2.18	5.14	7.38	13.84	16.11	16.5	10.85	6.3	5.55	3.18	2.71	1.62	1.47	0.94	0.82	0.44	0.3	0.19	0.09	0.05	0.04	0.02	0.01	0.01	0.01	0.01	0.0	0.0	0.
FEBRU	7	100.0	2.19	1.74	1.77	2.23	1.91	2.65	2.87	4.35	5.04	7.72	8.58	7.88	10.34	8.1	8.62	6.23	6.04	3.96	3.0	1.61	1.26	0.74	0.4	0.27	0.17	0.12	0.06	0.05	0.03	0.02	0.01	0.01	0.
FEBRU	8	100.0	1.56	2.15	3.32	5.07	6.18	10.6	11.5	14.11	9.46	8.24	6.43	4.31	4.58	3.05	3.05	1.91	1.65	0.89	0.69	0.36	0.27	0.16	0.09	0.07	0.04	0.04	0.02	0.02	0.01	0.01	0.01	0.01	0.
FEBRU	9	100.0	1.42	2.76	2.48	2.88	2.47	4.72	7.33	16.74	20.7	18.78	8.21	2.89	2.04	1.3	1.55	1.12	1.06	0.57	0.41	0.2	0.15	0.08	0.04	0.03	0.02	0.01	0.01	0.01	0.0	0.0	0.0	0.0	0.
FEBRU	10	100.0	0.44	0.52	0.56	0.96	1.24	2.76	4.36	9.98	13.74	17.48	13.12	7.45	7.1	4.59	4.67	3.05	2.89	1.65	1.35	0.68	0.52	0.31	0.16	0.13	0.08	0.06	0.03	0.03	0.02	0.02	0.01	0.01	0.
FEBRU	11	100.0	1.23	1.14	2.66	6.12	5.05	7.28	8.05	12.82	10.09	9.6	8.0	5.85	6.43	4.31	4.01	2.38	2.06	1.11	0.81	0.38	0.26	0.14	0.07	0.05	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.0	0.
FEBRU	12	100.0	0.93	1.57	3.14	6.75	6.29	8.68	9.41	12.69	10.09	10.07	8.35	5.11	4.82	3.01	2.81	1.76	1.51	1.03	0.75	0.46	0.27	0.15	0.12	0.11	0.03	0.02	0.02	0.01	0.01	0.02	0.01	0.0	0.
FEBRU	13	100.0	3.69	2.81	2.5	2.82	2.41	2.86	2.73	6.0	9.2	12.8	10.91	7.23	7.55	5.21	5.54	3.78	3.66	2.24	1.91	1.06	0.88	0.59	0.33	0.31	0.18	0.17	0.1	0.09	0.06	0.06	0.04	0.04	0.
MARC	4	100.0	0.19	0.22	0.48	1.65	3.15	7.91	8.85	12.59	11.91	13.73	10.92	7.02	6.56	3.91	3.33	1.97	1.69	1.09	0.92	0.53	0.41	0.28	0.15	0.11	0.06	0.04	0.03	0.03	0.02	0.02	0.01	0.14	0.
MARC	5	100.0	2.63	15.7	17.16	15.0	8.65	9.15	5.93	5.89	4.38	4.09	3.0	1.86	1.75	1.09	1.03	0.63	0.6	0.37	0.34	0.19	0.15	0.1	0.05	0.04	0.02	0.02	0.01	0.01	0.01	0.0	0.0	0.0	0.
MARC	6	100.0	0.33	0.88	1.22	1.81	2.18	5.14	7.38	13.84	16.11	16.5	10.85	6.3	5.55	3.18	2.71	1.62	1.47	0.94	0.82	0.44	0.3	0.19	0.09	0.05	0.04	0.02	0.01	0.01	0.01	0.01	0.0	0.0	0.
MARC	7	100.0	2.19	1.74	1.77	2.23	1.91	2.65	2.87	4.35	5.04	7.72	8.58	7.88	10.34	8.1	8.62	6.23	6.04	3.96	3.0	1.61	1.26	0.74	0.4	0.27	0.17	0.12	0.06	0.05	0.03	0.02	0.01	0.01	0.
MARC	8	100.0	1.56	2.15	3.32	5.07	6.18	10.6	11.5	14.11	9.46	8.24	6.43	4.31	4.58	3.05	3.05	1.91	1.65	0.89	0.69	0.36	0.27	0.16	0.09	0.07	0.04	0.04	0.02	0.02	0.01	0.01	0.01	0.01	0.
MARC	9	100.0	1.42	2.76	2.48	2.88	2.47	4.72	7.33	16.74	20.7	18.78	8.21	2.89	2.04	1.3	1.55	1.12	1.06	0.57	0.41	0.2	0.15	0.08	0.04	0.03	0.02	0.01	0.01	0.01	0.0	0.0	0.0	0.0	0.
MARC	10	100.0	0.44	0.52	0.56	0.96	1.24	2.76	4.36	9.98	13.74	17.48	13.12	7.45	7.1	4.59	4.67	3.05	2.89	1.65	1.35	0.68	0.52	0.31	0.16	0.13	0.08	0.06	0.03	0.03	0.02	0.02	0.01	0.01	0.
MARC	11	100.0	1.23	1.14	2.66	6.12	5.05	7.28	8.05	12.82	10.09	9.6	8.0	5.85	6.43	4.31	4.01	2.38	2.06	1.11	0.81	0.38	0.26	0.14	0.07	0.05	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.0	0.
MARC	12	100.0	0.93	1.57	3.14	6.75	6.29	8.68	9.41	12.69	10.09	10.07	8.35	5.11	4.82	3.01	2.81	1.76	1.51	1.03	0.75	0.46	0.27	0.15	0.12	0.11	0.03	0.02	0.02	0.01	0.01	0.02	0.01	0.0	0.
MARC	13	100.0	3.69	2.81	2.5	2.82	2.41	2.86	2.73	6.0	9.2	12.8	10.91	7.23	7.55	5.21	5.54	3.78	3.66	2.24	1.91	1.06	0.88	0.59	0.33	0.31	0.18	0.17	0.1	0.09	0.06	0.06	0.04	0.04	0.
APRIL	4	100.0	0.19	0.22	0.48	1.65	3.15	7.91	8.85	12.59	11.91	13.73	10.92	7.02	6.56	3.91	3.33	1.97	1.69	1.09	0.92	0.53	0.41	0.28	0.15	0.11	0.06	0.04	0.03	0.03	0.02	0.02	0.01	0.14	0.
APRIL	5	100.0	2.63	15.7	17.16	15.0	8.65	9.15	5.93	5.89	4.38	4.09	3.0	1.86	1.75	1.09	1.03	0.63	0.6	0.37	0.34	0.19	0.15	0.1	0.05	0.04	0.02	0.02	0.01	0.01	0.01	0.0	0.0	0.0	0.
APRIL	6	100.0	0.33	0.88	1.22	1.81	2.18	5.14	7.38	13.84	16.11	16.5	10.85	6.3	5.55	3.18	2.71	1.62	1.47	0.94	0.82	0.44	0.3	0.19	0.09	0.05	0.04	0.02	0.01	0.01	0.01	0.01	0.0	0.0	0.
APRIL	7	100.0	2.19	1.74	1.77	2.23	1.91	2.65	2.87	4.35	5.04	7.72	8.58	7.88	10.34	8.1	8.62	6.23	6.04	3.96	3.0	1.61	1.26	0.74	0.4	0.27	0.17	0.12	0.06	0.05	0.03	0.02	0.01	0.01	0.
APRIL	8	100.0	1.56	2.15	3.32	5.07	6.18	10.6	11.5	14.11	9.46	8.24	6.43	4.31	4.58	3.05	3.05	1.91	1.65	0.89	0.69	0.36	0.27	0.16	0.09	0.07	0.04	0.04	0.02	0.02	0.01	0.01	0.01	0.01	0.

Single Axle Load Distribution:



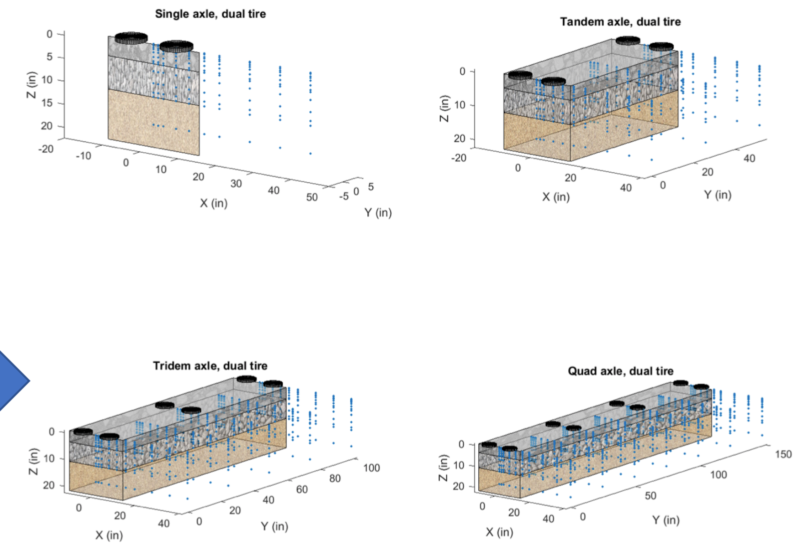
Tandem Axle Load Distribution:





Vehicle Class Distribution

Class Name	Class %	Growth %	Growth Type	# of Single Axles	# of Tandem Axles	# of Tridem Axles	# of Quad Axles
Class 4	1.76	3.0	compound	1.65	0.36	0.0	0.0
Class 5	27.37	3.0	compound	2.0	0.05	0.0	0.0
Class 6	5.01	3.0	compound	1.0	1.0	0.0	0.0
Class 7	0.77	3.0	linear	1.06	0.06	0.59	0.35
Class 8	4.42	3.0	compound	2.28	0.74	0.0	0.0
Class 9	45.44	3.0	compound	1.29	1.85	0.0	0.0
Class 10	7.07	3.0	compound	1.54	1.0	0.31	0.56
Class 11	1.12	3.0	linear	4.99	0.0	0.0	0.0
Class 12	0.22	3.0	linear	3.85	0.96	0.0	0.0
Class 13	6.82	3.0	linear	2.03	1.4	0.36	0.61
Total =	100.0 %						



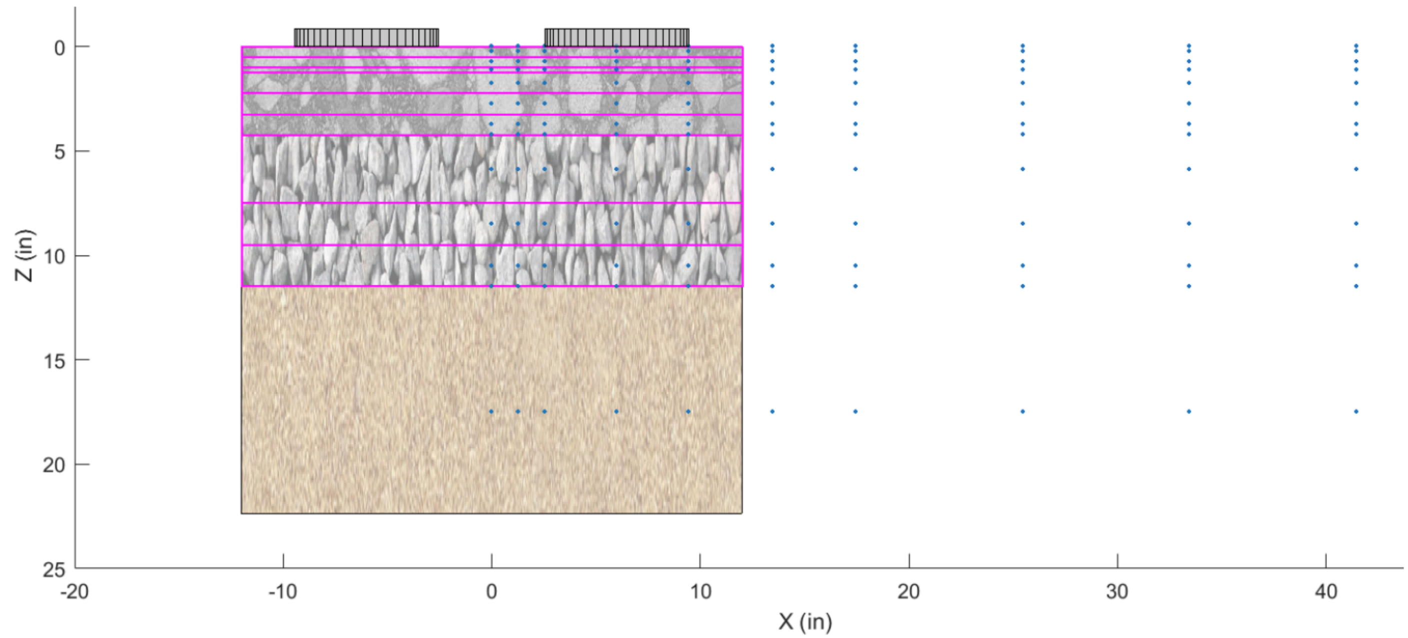
Total number of applications of single, tandem, tridem and quad axles, <u>*regardless of the class:*</u>

$\boldsymbol{NA_{i,t,w_k}^{single}}$ = Number of single axles for each month i ($i = 1 \dots 12$), for year t ($t = 1 \dots t_a$, where t_a is analysis duration), corresponding to axle weight $\boldsymbol{w_k}$ Where $k = 1 \dots 39$ and $\boldsymbol{w_k} = 3000, 4000, \dots 41000$ (lb).

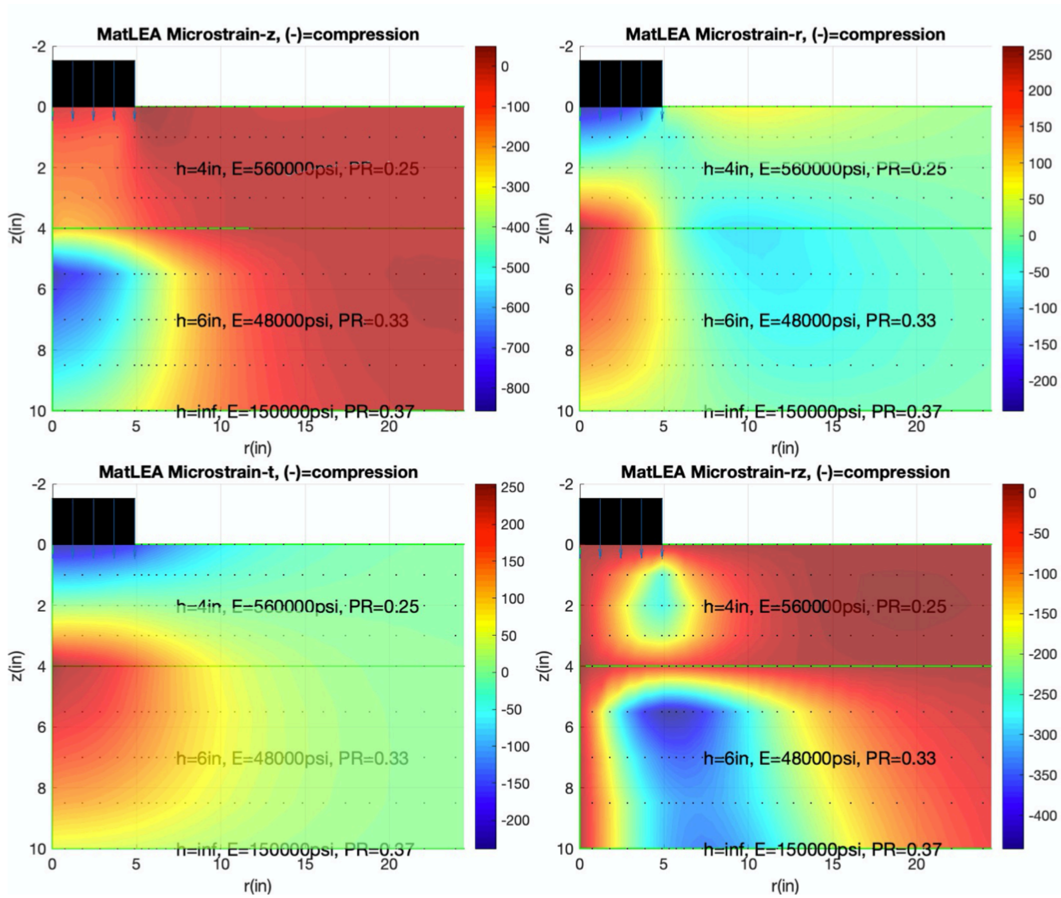
$\boldsymbol{NA_{i,t,w_k}^{tandem}}$ = Number of tandem axles for each month i ($i = 1 \dots 12$), for year t ($t = 1 \dots t_a$, where t_a is analysis duration), corresponding to axle weight $\boldsymbol{w_k}$ Where $k = 1 \dots 39$ and $\boldsymbol{w_k} = 6000, 8000, \dots 82000$ (lb).

$\boldsymbol{NA_{i,t,w_k}^{tridem}}$ = Number of tridem axles, for each month i ($i = 1 \dots 12$), for year t ($t = 1 \dots t_a$, where t_a is analysis duration), corresponding to axle weight $\boldsymbol{w_k}$, where $k = 1 \dots 31$ and $\boldsymbol{w_k} = 12000, 15000, \dots 102000$ (lb).

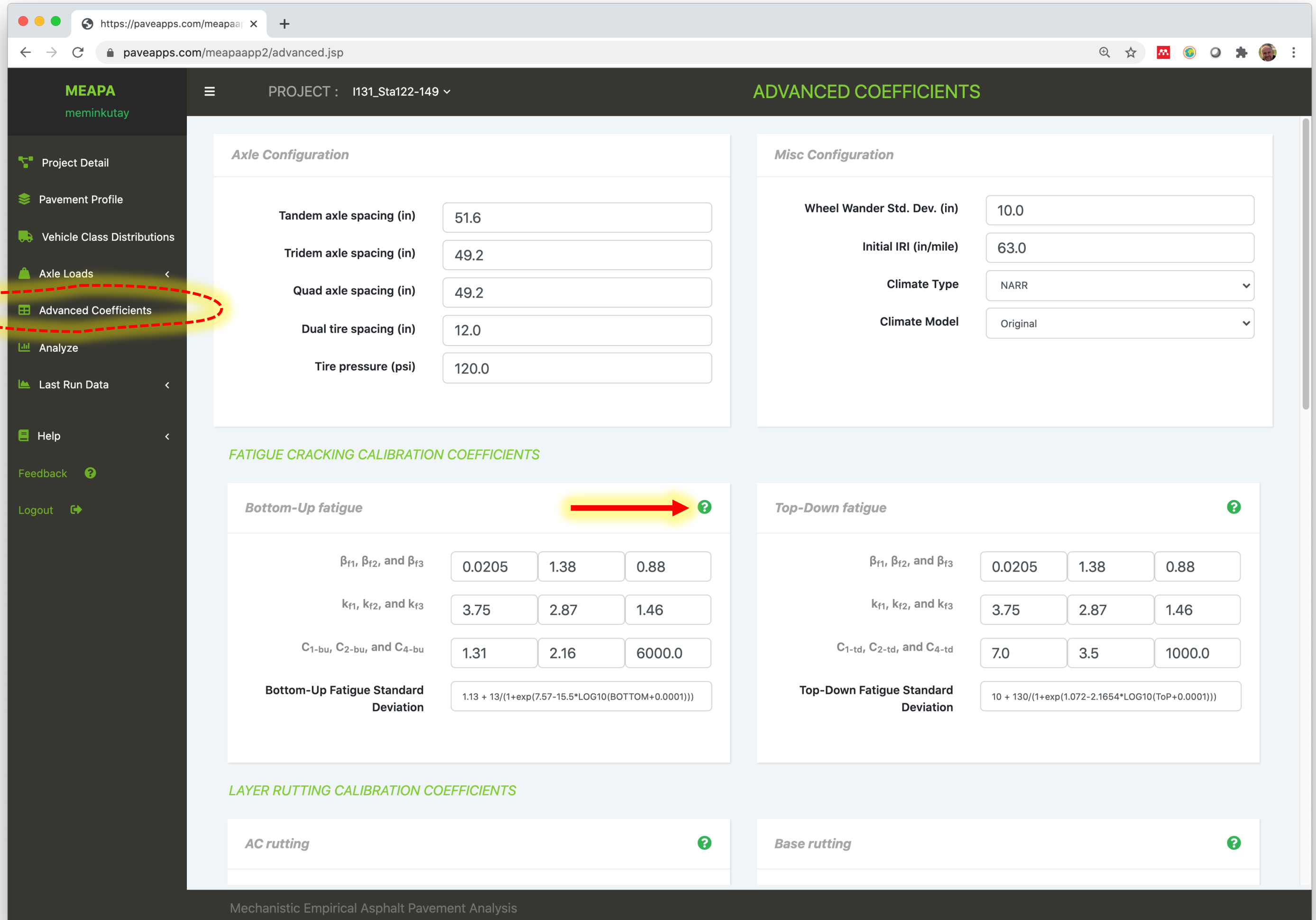
$\boldsymbol{NA_{i,t,w_k}^{quad}}$ = Number of quad axles i, for each month i ($i = 1 \dots 12$), for year t ($t = 1 \dots t_a$, where t_a is analysis duration), corresponding to axle weight $\boldsymbol{w_k}$ Where $k = 1 \dots 31$ and $\boldsymbol{w_k} = 12000, 15000, \dots 102000$ (lb).



Example sub-layering of a three-layer structure and analysis points for the single axle dual tire configuration



Example structural response computed by MatLEA sub algorithm in MEAPA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paveapps.com/meapaapp2/advanced.jsp
MEAPA
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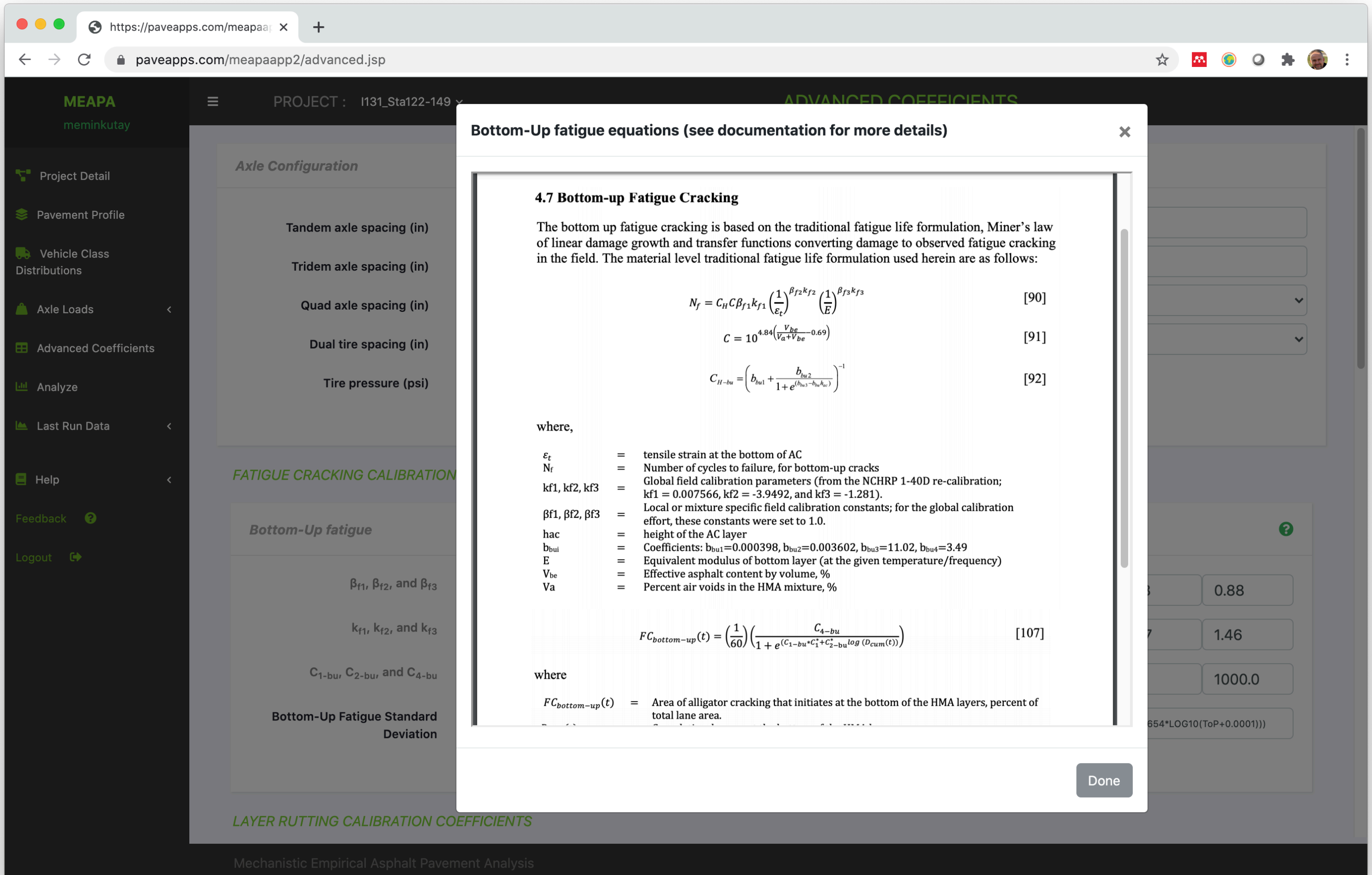
PROJECT : I131_Sta122-149
ADVANCED COEFFICIENTS
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
Axle Configuration
Tandem axle spacing (in) 51.6
Tridem axle spacing (in) 49.2
Quad axle spacing (in) 49.2
Dual tire spacing (in) 12.0
Tire pressure (psi) 120.0
Misc Configuration
Wheel Wander Std. Dev. (in) 10.0
Initial IRI (in/mile) 63.0
Climate Type NARR
Climate Model Original
FATIGUE CRACKING CALIBRATION COEFFICIENTS
Bottom-Up fatigue
βf1, βf2, and βf3 0.0205 1.38 0.88
kf1, kf2, and kf3 3.75 2.87 1.46
C1-bu, C2-bu, and C4-bu 1.31 2.16 6000.0
Bottom-Up Fatigue Standard Deviation 1.13 + 13/(1+exp(7.57-15.5*LOG10(BOTTOM+0.0001)))
Top-Down fatigue
βf1, βf2, and βf3 0.0205 1.38 0.88
kf1, kf2, and kf3 3.75 2.87 1.46
C1-td, C2-td, and C4-td 7.0 3.5 1000.0
Top-Down Fatigue Standard Deviation 10 + 130/(1+exp(1.072-2.1654*LOG10(ToP+0.0001)))
LAYER RUTTING CALIBRATION COEFFICIENTS
AC rutting
Base rutting
Mechanistic Empirical Asphalt Pavement Analysis



4.7 Bottom-up Fatigue Cracking

The bottom up fatigue cracking is based on the traditional fatigue life formulation, Miner's law of linear damage growth and transfer functions converting damage to observed fatigue cracking in the field. The material level traditional fatigue life formulation used herein are as follows:

$$N_f = C_H C \beta_{f1} k_{f1} \left(\frac{1}{\varepsilon_t}\right)^{\beta_{f2} k_{f2}} \left(\frac{1}{E}\right)^{\beta_{f3} k_{f3}} \quad [90]$$

$$C = 10^{4.84\left(\frac{V_{be}}{V_a + V_{be}} - 0.69\right)} \quad [91]$$

$$C_{H-bu} = \left(b_{bu1} + \frac{b_{bu2}}{1 + e^{(b_{bu3} - b_{bu} h_{ac})}}\right)^{-1} \quad [92]$$

where,

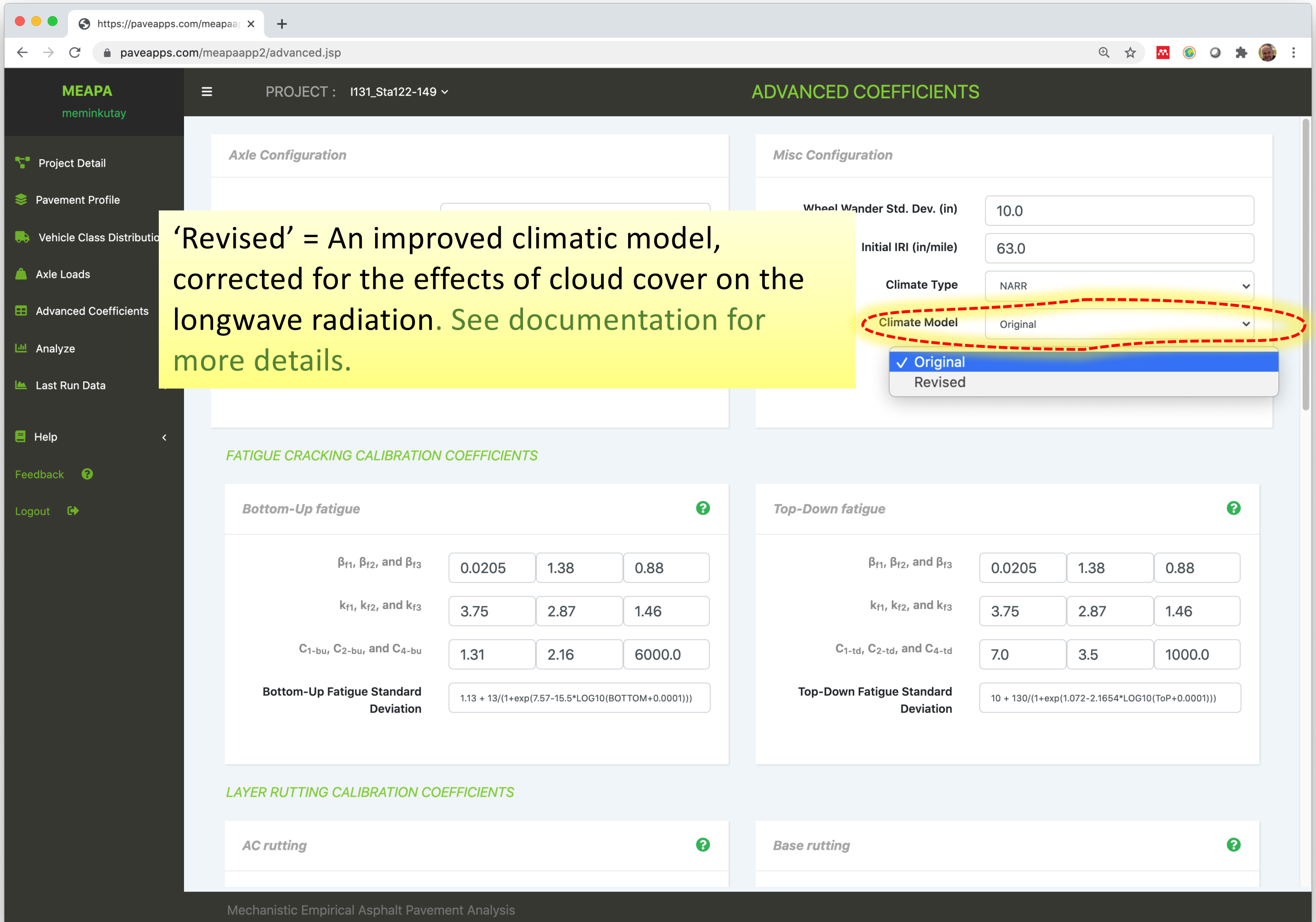
ε_t	=	tensile strain at the bottom of AC
N_f	=	Number of cycles to failure, for bottom-up cracks
kf1, kf2, kf3	=	Global field calibration parameters (from the NCHRP 1-40D re-calibration; kf1 = 0.007566, kf2 = -3.9492, and kf3 = -1.281).
βf1, βf2, βf3	=	Local or mixture specific field calibration constants; for the global calibration effort, these constants were set to 1.0.
hac	=	height of the AC layer
b_{bui}	=	Coefficients: b_{bu1}=0.000398, b_{bu2}=0.003602, b_{bu3}=11.02, b_{bu4}=3.49
E	=	Equivalent modulus of bottom layer (at the given temperature/frequency)
V_{be}	=	Effective asphalt content by volume, %
Va	=	Percent air voids in the HMA mixture, %

$$FC_{bottom-up}(t) = \left(\frac{1}{60}\right)\left(\frac{C_{4-bu}}{1 + e^{(C_{1-bu} * C_1^* + C_{2-bu}^* \log(D_{cum}(t)))}}\right) \quad [107]$$

where

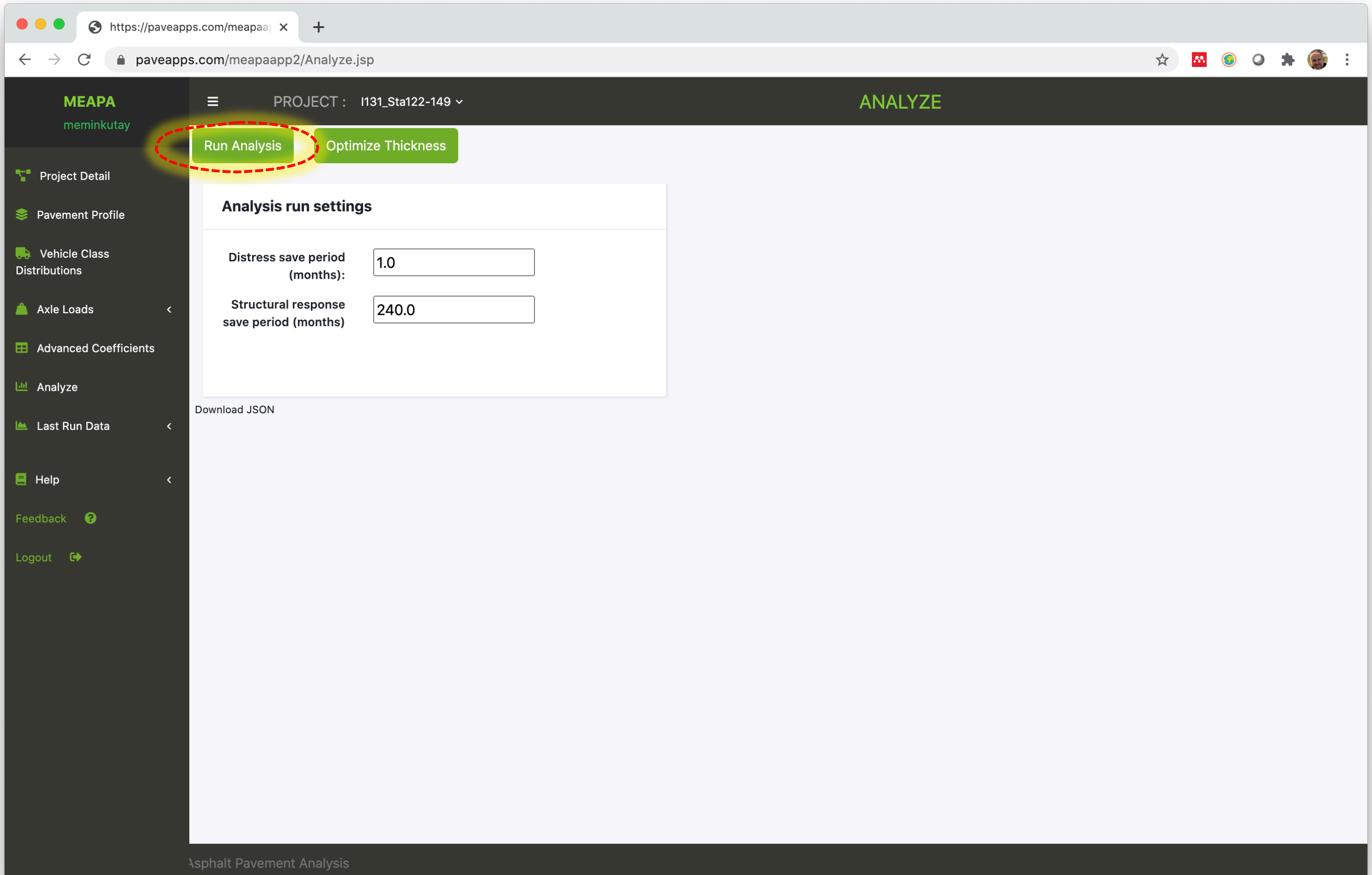
$FC_{bottom-up}(t)$	=	Area of alligator cracking that initiates at the bottom of the HMA layers, percent of total lane area.

‘Revised’ = An improved climatic model, corrected for the effects of cloud cover on the longwave radiation. See documentation for more details.



Distresses computed by MEAPA

Distress output	Pavement type: AC-GB	AC-CSM	AC-EAC-GB	AC-EAC-CSM	AC-GB-EAC-GB	AC-GB-EAC-CSM
AC top-down fatigue cracking (ft/mile)	✓	✓	✓	✓	✓	✓
AC bottom-up fatigue cracking (%)	✓	✓	✓	✓	✓	✓
AC thermal cracking (ft/mile)	✓	✓	✓	✓	✓	✓
Rutting – AC, base subbase and subgrade (in)	✓	✓	✓	✓	✓	✓
Reflective cracking (% lane area)	-	✓	✓	✓(1)	-	-
Chemically stabilized layer - fatigue fracture damage (% lane area)	-	✓	-	✓	-	-
Existing AC layer - fatigue fracture damage (% lane area)	-	-	✓	✓	-	-
International Roughness Index (IRI) (in/mile)	✓	✓	✓	✓	✓	✓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paveapps.com/meapaapp2/Analyze.jsp
MEAPA
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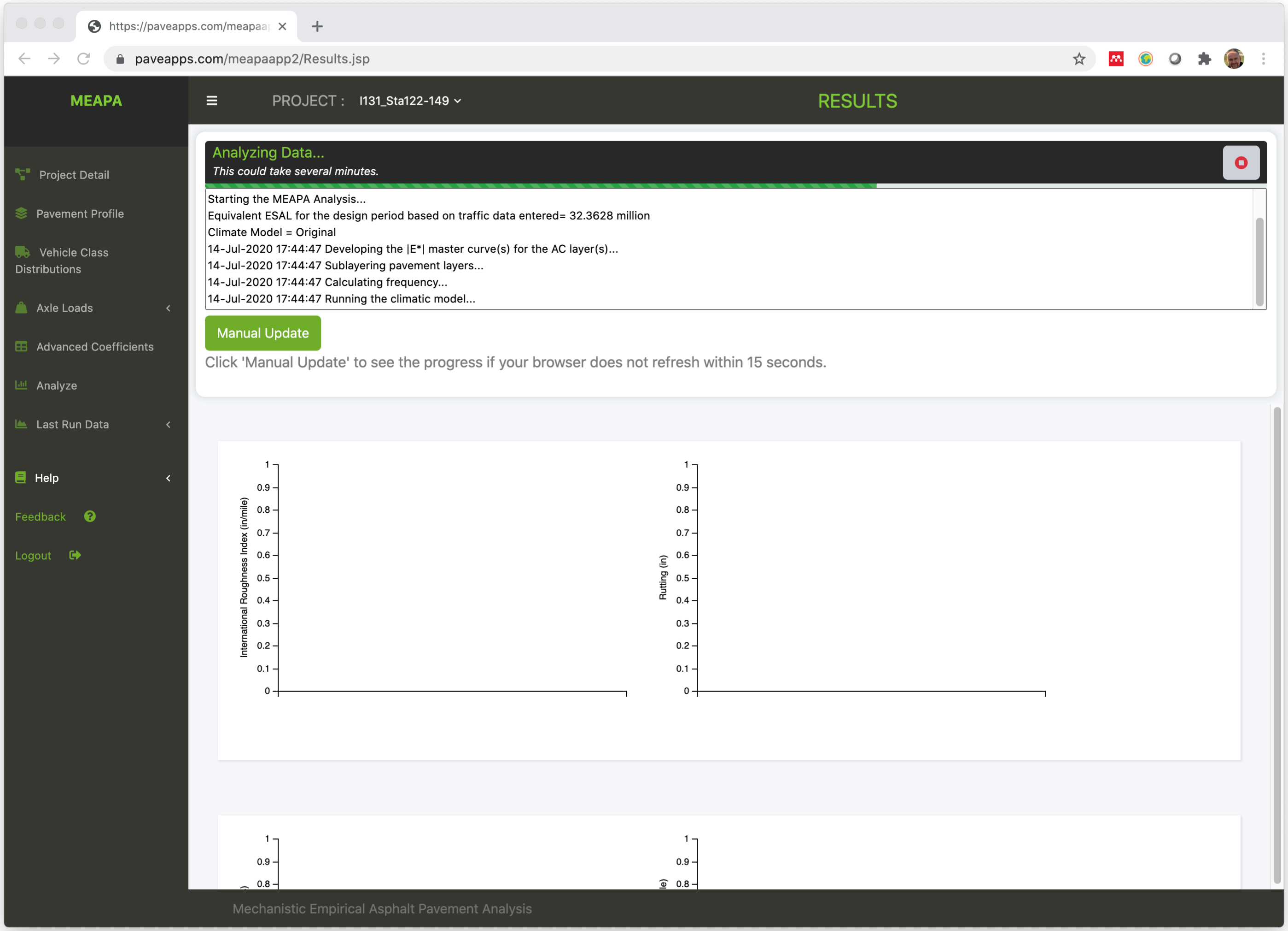
PROJECT : I131_Sta122-149
ANALYZE
Run Analysis
Optimize Thickness
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
Analysis run settings
Distress save period (months):
1.0
Structural response save period (months)
240.0
Download JSON
Asphalt Pavement Analysis



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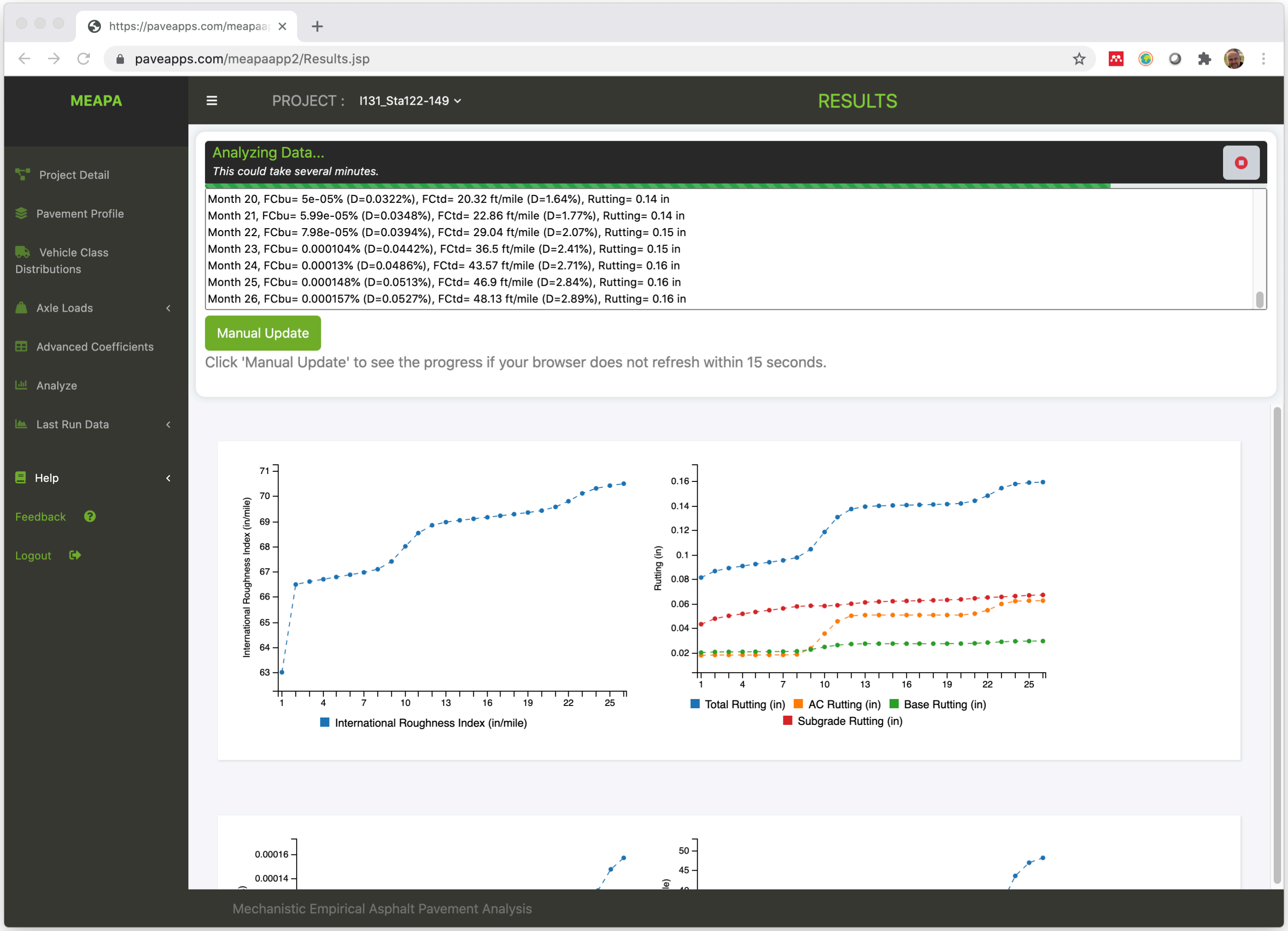
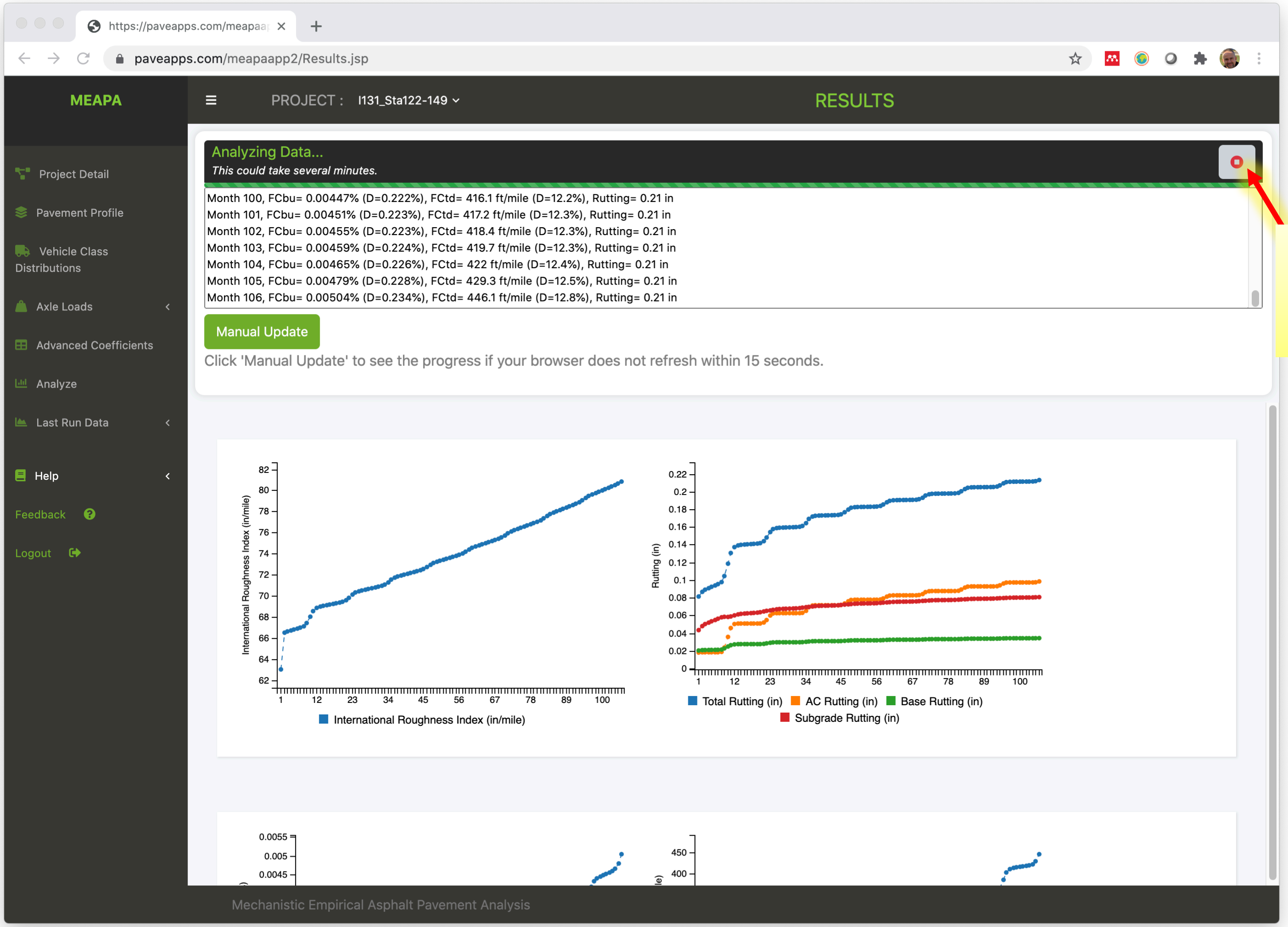
paveapps.com/meapaapp2/Results.jsp
MEAPA
PROJECT : I131_Sta122-149
RESULTS
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
Analyzing Data...
This could take several minutes.
Starting the MEAPA Analysis...
Equivalent ESAL for the design period based on traffic data entered= 32.3628 million
Climate Model = Original
14-Jul-2020 17:44:47 Developing the |E*| master curve(s) for the AC layer(s)...
14-Jul-2020 17:44:47 Sublayering pavement layers...
14-Jul-2020 17:44:47 Calculating frequency...
14-Jul-2020 17:44:47 Running the climatic model...
Manual Update
Click 'Manual Update' to see the progress if your browser does not refresh within 15 seconds.
International Roughness Index (in/mile)
Rutting (in)
Mechanistic Empirical Asphalt Pavement Analysis


https://paveapps.com/meapaa
paveapps.com/meapaapp2/Results.jsp
MEAPA
PROJECT : I131_Sta122-149
RESULTS
Analyzing Data...
This could take several minutes.
Month 20, FCbu= 5e-05% (D=0.0322%), FCtd= 20.32 ft/mile (D=1.64%), Rutting= 0.14 in
Month 21, FCbu= 5.99e-05% (D=0.0348%), FCtd= 22.86 ft/mile (D=1.77%), Rutting= 0.14 in
Month 22, FCbu= 7.98e-05% (D=0.0394%), FCtd= 29.04 ft/mile (D=2.07%), Rutting= 0.15 in
Month 23, FCbu= 0.000104% (D=0.0442%), FCtd= 36.5 ft/mile (D=2.41%), Rutting= 0.15 in
Month 24, FCbu= 0.00013% (D=0.0486%), FCtd= 43.57 ft/mile (D=2.71%), Rutting= 0.16 in
Month 25, FCbu= 0.000148% (D=0.0513%), FCtd= 46.9 ft/mile (D=2.84%), Rutting= 0.16 in
Month 26, FCbu= 0.000157% (D=0.0527%), FCtd= 48.13 ft/mile (D=2.89%), Rutting= 0.16 in
Manual Update
Click 'Manual Update' to see the progress if your browser does not refresh within 15 seconds.
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
International Roughness Index (in/mile)
Rutting (in)
Total Rutting (in)
AC Rutting (in)
Base Rutting (in)
Subgrade Rutting (in)
Mechanistic Empirical Asphalt Pavement Analysis



Analysis can be stopped by clicking here

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MEAPA
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PROJECT : I131_Sta122-149
RESULTS
Run Start : 7/14/2020, 5:44:43 PM
Run End : 7/14/2020, 5:49:21 PM
Calculate distresses at reliability
Click here to compute the distresses at different Reliability levels
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
International Roughness Index (in/mile)
Rutting (in)
Total Rutting (in)
AC Rutting (in)
Base Rutting (in)
Subgrade Rutting (in)
Bottom-up Fatigue Cracking (%)
Top-down Fatigue Cracking (ft/mile)
Mechanistic Empirical Asphalt Pavement Analysis

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MEAPA

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- Project Detail
- Pavement Profile
- Vehicle Class Distributions
- Axle Loads
- Advanced Coefficients
- Analyze
- Last Run Data
- Help
- Feedback
- Logout

PROJECT : I131_Sta122-149

RESULTS

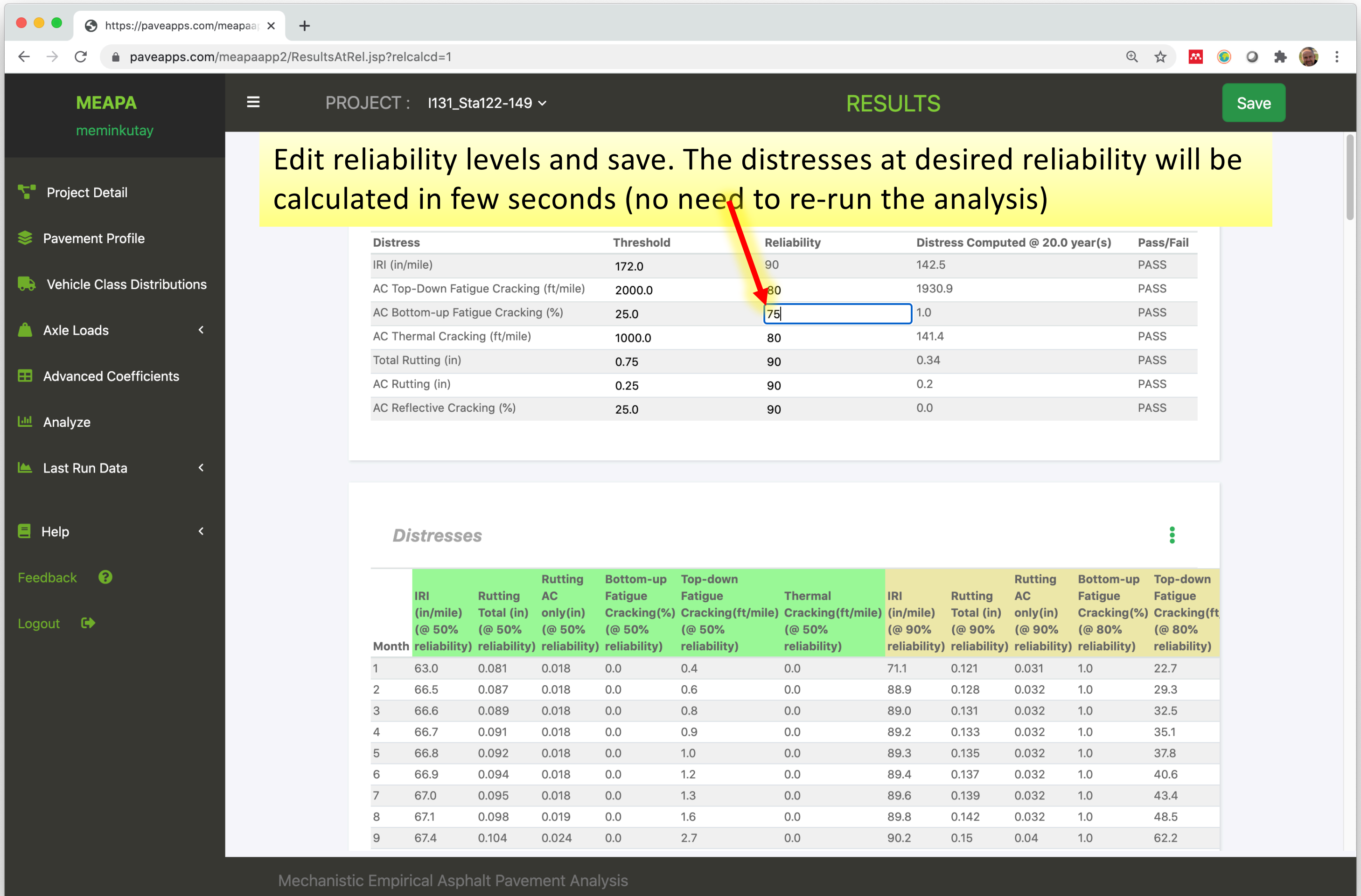
Reliability and Terminal Distresses

Distress	Threshold	Reliability	Distress Computed @ 20.0 year(s)	Pass/Fail
IRI (in/mile)	172.0	90	142.5	PASS
AC Top-Down Fatigue Cracking (ft/mile)	2000.0	80	1930.9	PASS
AC Bottom-up Fatigue Cracking (%)	25.0	80	1.0	PASS
AC Thermal Cracking (ft/mile)	1000.0	80	141.4	PASS
Total Rutting (in)	0.75	90	0.34	PASS
AC Rutting (in)	0.25	90	0.2	PASS
AC Reflective Cracking (%)	25.0	90	0.0	PASS

Distresses

Month	IRI (in/mile) (@ 50% reliability)	Rutting Total (in) (@ 50% reliability)	Rutting AC only(in) (@ 50% reliability)	Bottom-up Fatigue Cracking(%) (@ 50% reliability)	Top-down Fatigue Cracking(ft/mile) (@ 50% reliability)	Thermal Cracking(ft/mile) (@ 50% reliability)	IRI (in/mile) (@ 90% reliability)	Rutting Total (in) (@ 90% reliability)	Rutting AC only(in) (@ 90% reliability)	Bottom-up Fatigue Cracking(%) (@ 80% reliability)	Top-down Fatigue Cracking(ft (@ 80% reliability)
1	63.0	0.081	0.018	0.0	0.4	0.0	71.1	0.121	0.031	1.0	22.7
2	66.5	0.087	0.018	0.0	0.6	0.0	88.9	0.128	0.032	1.0	29.3
3	66.6	0.089	0.018	0.0	0.8	0.0	89.0	0.131	0.032	1.0	32.5
4	66.7	0.091	0.018	0.0	0.9	0.0	89.2	0.133	0.032	1.0	35.1
5	66.8	0.092	0.018	0.0	1.0	0.0	89.3	0.135	0.032	1.0	37.8
6	66.9	0.094	0.018	0.0	1.2	0.0	89.4	0.137	0.032	1.0	40.6
7	67.0	0.095	0.018	0.0	1.3	0.0	89.6	0.139	0.032	1.0	43.4
8	67.1	0.098	0.019	0.0	1.6	0.0	89.8	0.142	0.032	1.0	48.5
9	67.4	0.104	0.024	0.0	2.7	0.0	90.2	0.15	0.04	1.0	62.2

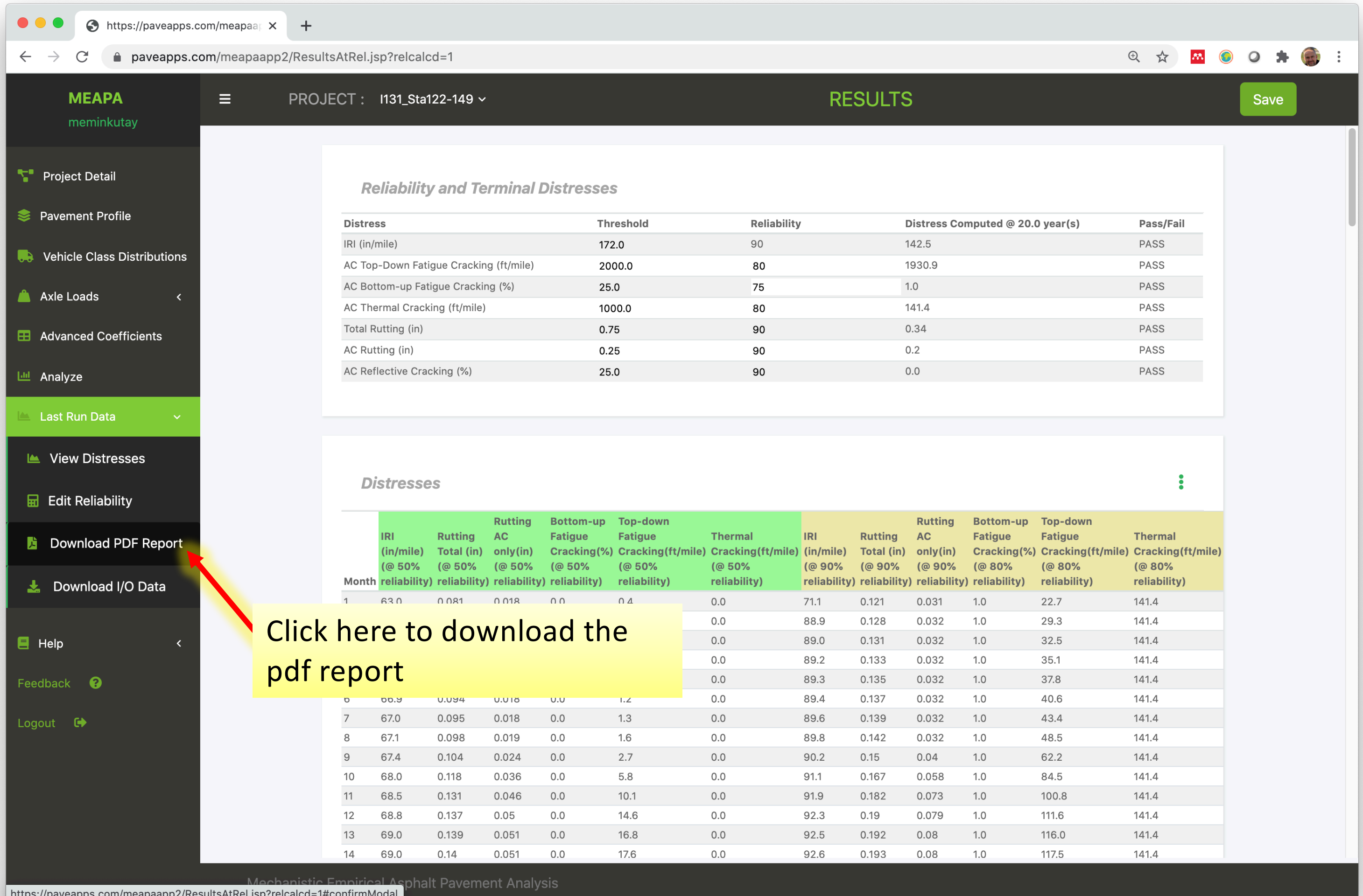
Mechanistic Empirical Asphalt Pavement Analysis



Distress	Threshold	Reliability	Distress Computed @ 20.0 year(s)	Pass/Fail
IRI (in/mile)	172.0	90	142.5	PASS
AC Top-Down Fatigue Cracking (ft/mile)	2000.0	80	1930.9	PASS
AC Bottom-up Fatigue Cracking (%)	25.0	75	1.0	PASS
AC Thermal Cracking (ft/mile)	1000.0	80	141.4	PASS
Total Rutting (in)	0.75	90	0.34	PASS
AC Rutting (in)	0.25	90	0.2	PASS
AC Reflective Cracking (%)	25.0	90	0.0	PASS

Distresses

Month	IRI (in/mile) (@ 50% reliability)	Rutting Total (in) (@ 50% reliability)	Rutting AC only(in) (@ 50% reliability)	Bottom-up Fatigue Cracking(%) (@ 50% reliability)	Top-down Fatigue Cracking(ft/mile) (@ 50% reliability)	Thermal Cracking(ft/mile) (@ 50% reliability)	IRI (in/mile) (@ 90% reliability)	Rutting Total (in) (@ 90% reliability)	Rutting AC only(in) (@ 90% reliability)	Bottom-up Fatigue Cracking(%) (@ 80% reliability)	Top-down Fatigue Cracking(ft (@ 80% reliability)
1	63.0	0.081	0.018	0.0	0.4	0.0	71.1	0.121	0.031	1.0	22.7
2	66.5	0.087	0.018	0.0	0.6	0.0	88.9	0.128	0.032	1.0	29.3
3	66.6	0.089	0.018	0.0	0.8	0.0	89.0	0.131	0.032	1.0	32.5
4	66.7	0.091	0.018	0.0	0.9	0.0	89.2	0.133	0.032	1.0	35.1
5	66.8	0.092	0.018	0.0	1.0	0.0	89.3	0.135	0.032	1.0	37.8
6	66.9	0.094	0.018	0.0	1.2	0.0	89.4	0.137	0.032	1.0	40.6
7	67.0	0.095	0.018	0.0	1.3	0.0	89.6	0.139	0.032	1.0	43.4
8	67.1	0.098	0.019	0.0	1.6	0.0	89.8	0.142	0.032	1.0	48.5
9	67.4	0.104	0.024	0.0	2.7	0.0	90.2	0.15	0.04	1.0	62.2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Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
View Distresses
Edit Reliability
Download PDF Report
Download I/O Data
Help
Feedback
Logout
Reliability and Terminal Distresses
Distress | Threshold | Reliability | Distress Computed @ 20.0 year(s) | Pass/Fail
IRI (in/mile) | 172.0 | 90 | 142.5 | PASS
AC Top-Down Fatigue Cracking (ft/mile) | 2000.0 | 80 | 1930.9 | PASS
AC Bottom-up Fatigue Cracking (%) | 25.0 | 75 | 1.0 | PASS
AC Thermal Cracking (ft/mile) | 1000.0 | 80 | 141.4 | PASS
Total Rutting (in) | 0.75 | 90 | 0.34 | PASS
AC Rutting (in) | 0.25 | 90 | 0.2 | PASS
AC Reflective Cracking (%) | 25.0 | 90 | 0.0 | PASS
Distresses
Month | IRI (in/mile) (@ 50% reliability) | Rutting Total (in) (@ 50% reliability) | Rutting AC only(in) (@ 50% reliability) | Bottom-up Fatigue Cracking(%) (@ 50% reliability) | Top-down Fatigue Cracking(ft/mile) (@ 50% reliability) | Thermal Cracking(ft/mile) (@ 50% reliability) | IRI (in/mile) (@ 90% reliability) | Rutting Total (in) (@ 90% reliability) | Rutting AC only(in) (@ 90% reliability) | Bottom-up Fatigue Cracking(%) (@ 80% reliability) | Top-down Fatigue Cracking(ft/mile) (@ 80% reliability) | Thermal Cracking(ft/mile) (@ 80% reliability)
1 | 63.0 | 0.081 | 0.018 | 0.0 | 0.4 | 0.0 | 71.1 | 0.121 | 0.031 | 1.0 | 22.7 | 141.4
0.0 | 88.9 | 0.128 | 0.032 | 1.0 | 29.3 | 141.4
0.0 | 89.0 | 0.131 | 0.032 | 1.0 | 32.5 | 141.4
0.0 | 89.2 | 0.133 | 0.032 | 1.0 | 35.1 | 141.4
0.0 | 89.3 | 0.135 | 0.032 | 1.0 | 37.8 | 141.4
6 | 66.9 | 0.094 | 0.018 | 0.0 | 1.2 | 0.0 | 89.4 | 0.137 | 0.032 | 1.0 | 40.6 | 141.4
7 | 67.0 | 0.095 | 0.018 | 0.0 | 1.3 | 0.0 | 89.6 | 0.139 | 0.032 | 1.0 | 43.4 | 141.4
8 | 67.1 | 0.098 | 0.019 | 0.0 | 1.6 | 0.0 | 89.8 | 0.142 | 0.032 | 1.0 | 48.5 | 141.4
9 | 67.4 | 0.104 | 0.024 | 0.0 | 2.7 | 0.0 | 90.2 | 0.15 | 0.04 | 1.0 | 62.2 | 141.4
10 | 68.0 | 0.118 | 0.036 | 0.0 | 5.8 | 0.0 | 91.1 | 0.167 | 0.058 | 1.0 | 84.5 | 141.4
11 | 68.5 | 0.131 | 0.046 | 0.0 | 10.1 | 0.0 | 91.9 | 0.182 | 0.073 | 1.0 | 100.8 | 141.4
12 | 68.8 | 0.137 | 0.05 | 0.0 | 14.6 | 0.0 | 92.3 | 0.19 | 0.079 | 1.0 | 111.6 | 141.4
13 | 69.0 | 0.139 | 0.051 | 0.0 | 16.8 | 0.0 | 92.5 | 0.192 | 0.08 | 1.0 | 116.0 | 141.4
14 | 69.0 | 0.14 | 0.051 | 0.0 | 17.6 | 0.0 | 92.6 | 0.193 | 0.08 | 1.0 | 117.5 | 141.4
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Mechanistic Empirical Asphalt Pavement Analysis
https://paveapps.com/meapaapp2/ResultsAtRel.jsp?relcalcd=1#confirmModal

MEAPA

Mechanistic Empirical Asphalt Pavement Analysis

Detailed Analysis Report

Project: I131_Sta122-149

User: meminkutay

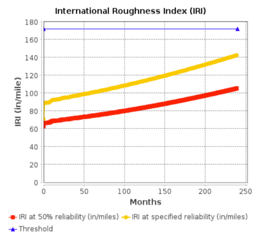
Report created on: 2020-07-14

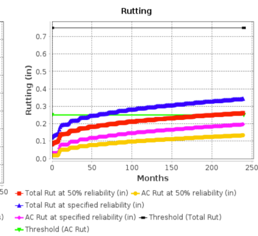
Analysis run date/time: 07/14/2020 at 05:44 PM

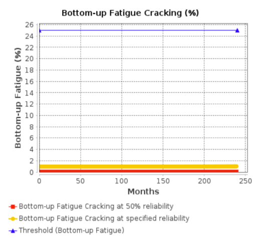
Distress Summary

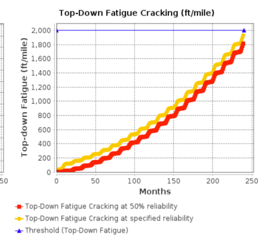
Distress	Threshold	Target Reliability	Distress @ 20.0 year(s)	Pass /Fail
IRI (in/mile)	172.0	90.0%	142.5	PASS
AC Top-Down Fatigue Cracking (ft/mile)	2000.0	80.0%	1930.9	PASS
AC Bottom-up Fatigue Cracking (%)	25.0	80.0%	1.0	PASS
AC Thermal Cracking (ft/mile)	1000.0	80.0%	141.4	PASS
Total Rutting (in)	0.75	90.0%	0.34	PASS
AC Rutting (in)	0.25	90.0%	0.2	PASS
AC Reflective Cracking (%)	25.0	90.0%	0.0	N/A

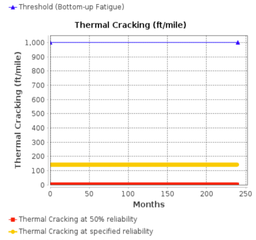
Distresses:

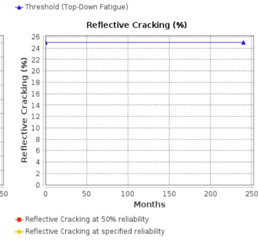

International Roughness Index (IRI)
IRI (in/mile)
Months
IRI at 50% reliability (in/miles)
IRI at specified reliability (in/miles)
Threshold

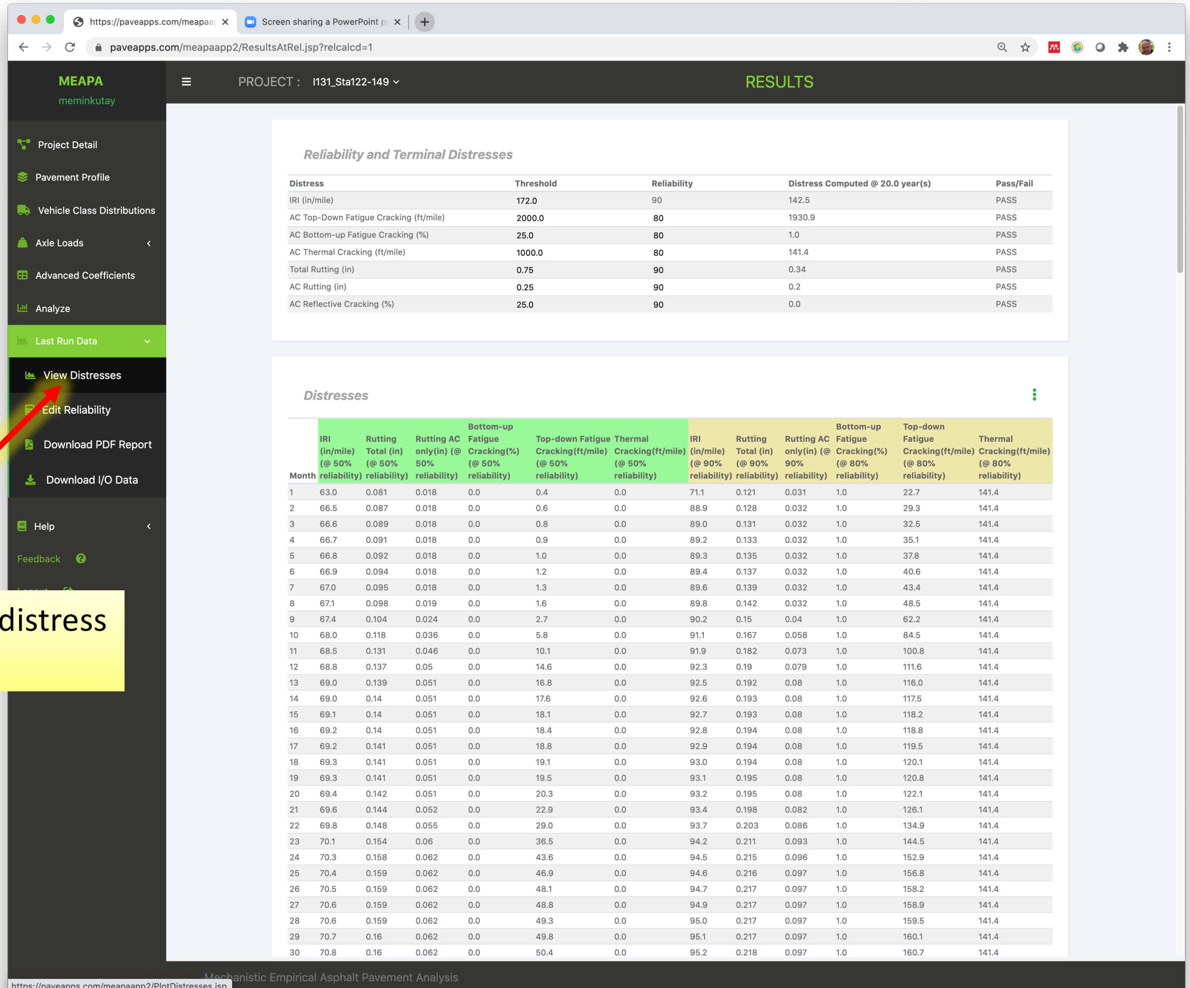

Rutting
Rutting (in)
Months
Total Rut at 50% reliability (in)
AC Rut at 50% reliability (in)
Total Rut at specified reliability (in)
AC Rut at specified reliability (in)
Threshold (Total Rut)
Threshold (AC Rut)


Bottom-up Fatigue Cracking (%)
Bottom-up Fatigue (%)
Months
Bottom-up Fatigue Cracking at 50% reliability
Bottom-up Fatigue Cracking at specified reliability
Threshold (Bottom-up Fatigue)


Top-Down Fatigue Cracking (ft/mile)
Top-down Fatigue (ft/mile)
Months
Top-Down Fatigue Cracking at 50% reliability
Top-Down Fatigue Cracking at specified reliability
Threshold (Top-Down Fatigue)


Thermal Cracking (ft/mile)
Thermal Cracking (ft/mile)
Months
Thermal Cracking at 50% reliability
Thermal Cracking at specified reliability
Threshold (Thermal Cracking)


Reflective Cracking (%)
Reflective Cracking (%)
Months
Reflective Cracking at 50% reliability
Reflective Cracking at specified reliability
Threshold (Reflective Cracking)



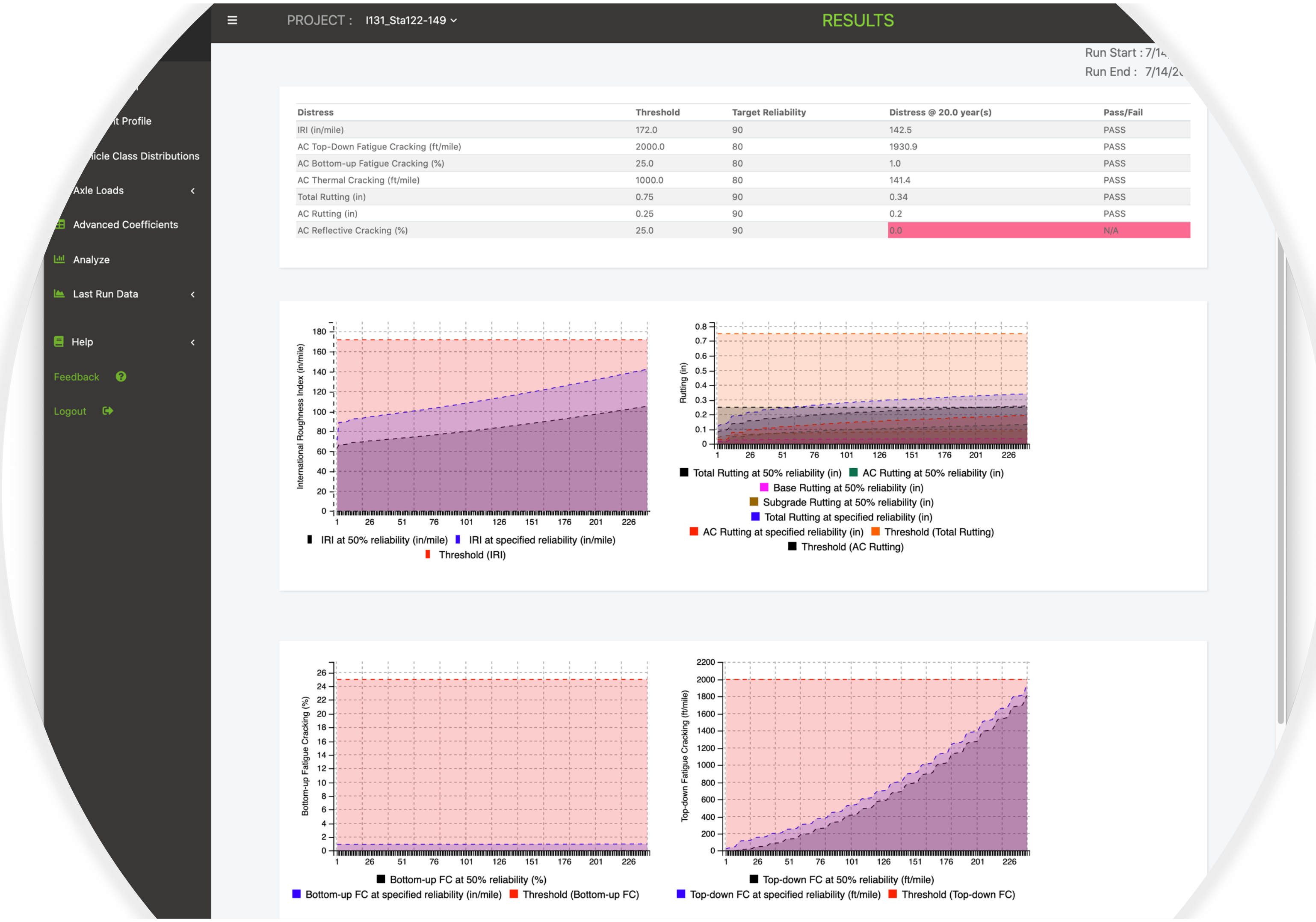
Click here to view the distress graphs

Reliability and Terminal Distresses

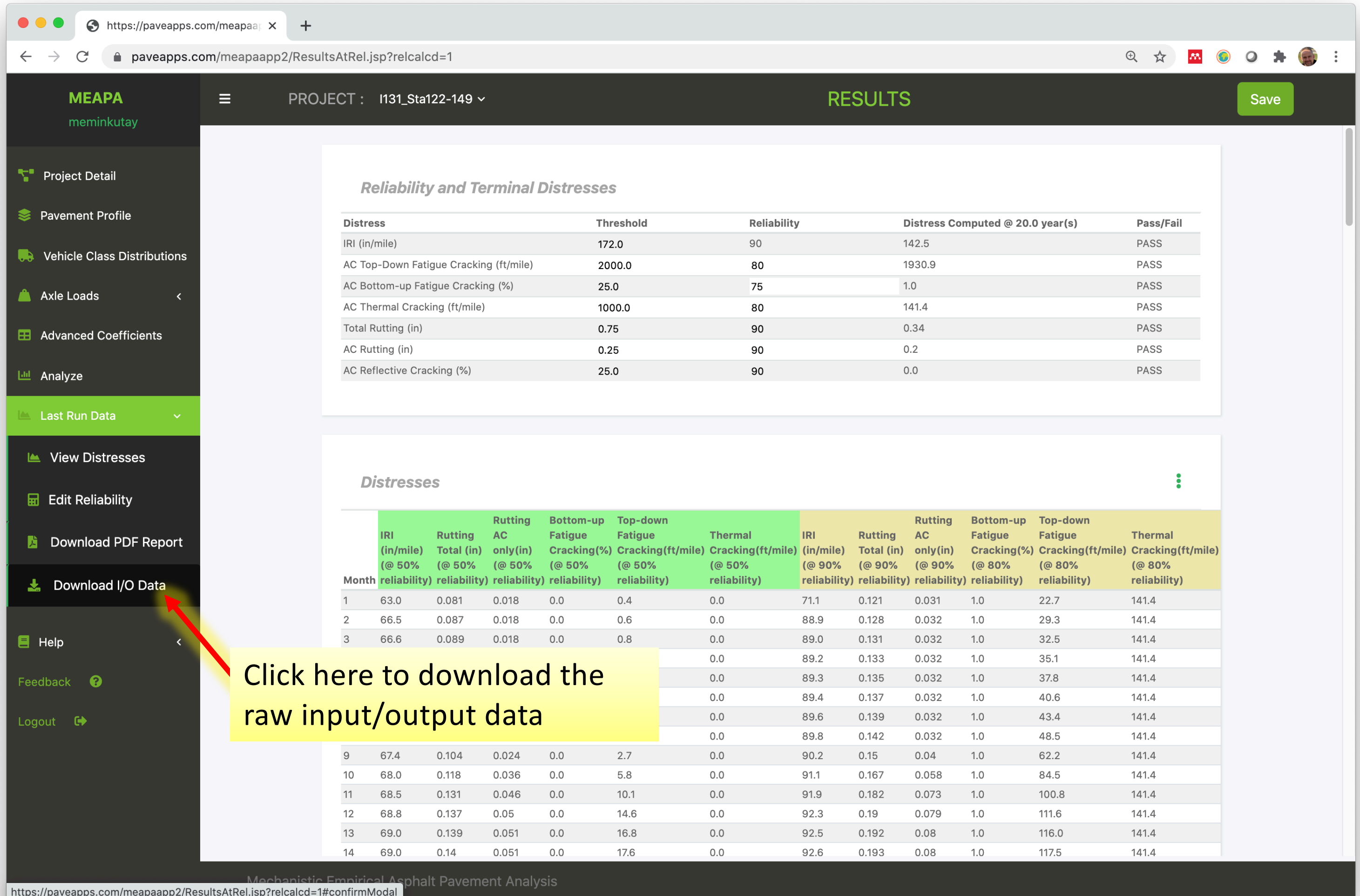
Distress	Threshold	Reliability	Distress Computed @ 20.0 year(s)	Pass/Fail
IRI (in/mile)	172.0	90	142.5	PASS
AC Top-Down Fatigue Cracking (ft/mile)	2000.0	80	1930.9	PASS
AC Bottom-up Fatigue Cracking (%)	25.0	80	1.0	PASS
AC Thermal Cracking (ft/mile)	1000.0	80	141.4	PASS
Total Rutting (in)	0.75	90	0.34	PASS
AC Rutting (in)	0.25	90	0.2	PASS
AC Reflective Cracking (%)	25.0	90	0.0	PASS

Distresses

Month	IRI (in/mile) (@ 50% reliability)	Rutting Total (in) (@ 50% reliability)	Rutting AC only(in) (@ 50% reliability)	Bottom-up Fatigue Cracking(%) (@ 50% reliability)	Top-down Fatigue Cracking(ft/mile) (@ 50% reliability)	Thermal Cracking(ft/mile) (@ 50% reliability)	IRI (in/mile) (@ 90% reliability)	Rutting Total (in) (@ 90% reliability)	Rutting AC only(in) (@ 90% reliability)	Bottom-up Fatigue Cracking(%) (@ 80% reliability)	Top-down Fatigue Cracking(ft/mile) (@ 80% reliability)	Thermal Cracking(ft/mile) (@ 80% reliability)
1	63.0	0.081	0.018	0.0	0.4	0.0	71.1	0.121	0.031	1.0	22.7	141.4
2	66.5	0.087	0.018	0.0	0.6	0.0	88.9	0.128	0.032	1.0	29.3	141.4
3	66.6	0.089	0.018	0.0	0.8	0.0	89.0	0.131	0.032	1.0	32.5	141.4
4	66.7	0.091	0.018	0.0	0.9	0.0	89.2	0.133	0.032	1.0	35.1	141.4
5	66.8	0.092	0.018	0.0	1.0	0.0	89.3	0.135	0.032	1.0	37.8	141.4
6	66.9	0.094	0.018	0.0	1.2	0.0	89.4	0.137	0.032	1.0	40.6	141.4
7	67.0	0.095	0.018	0.0	1.3	0.0	89.6	0.139	0.032	1.0	43.4	141.4
8	67.1	0.098	0.019	0.0	1.6	0.0	89.8	0.142	0.032	1.0	48.5	141.4
9	67.4	0.104	0.024	0.0	2.7	0.0	90.2	0.15	0.04	1.0	62.2	141.4
10	68.0	0.118	0.036	0.0	5.8	0.0	91.1	0.167	0.058	1.0	84.5	141.4
11	68.5	0.131	0.046	0.0	10.1	0.0	91.9	0.182	0.073	1.0	100.8	141.4
12	68.8	0.137	0.05	0.0	14.6	0.0	92.3	0.19	0.079	1.0	111.6	141.4
13	69.0	0.139	0.051	0.0	16.8	0.0	92.5	0.192	0.08	1.0	116.0	141.4
14	69.0	0.14	0.051	0.0	17.6	0.0	92.6	0.193	0.08	1.0	117.5	141.4
15	69.1	0.14	0.051	0.0	18.1	0.0	92.7	0.193	0.08	1.0	118.2	141.4
16	69.2	0.14	0.051	0.0	18.4	0.0	92.8	0.194	0.08	1.0	118.8	141.4
17	69.2	0.141	0.051	0.0	18.8	0.0	92.9	0.194	0.08	1.0	119.5	141.4
18	69.3	0.141	0.051	0.0	19.1	0.0	93.0	0.194	0.08	1.0	120.1	141.4
19	69.3	0.141	0.051	0.0	19.5	0.0	93.1	0.195	0.08	1.0	120.8	141.4
20	69.4	0.142	0.051	0.0	20.3	0.0	93.2	0.195	0.08	1.0	122.1	141.4
21	69.6	0.144	0.052	0.0	22.9	0.0	93.4	0.198	0.082	1.0	126.1	141.4
22	69.8	0.148	0.055	0.0	29.0	0.0	93.7	0.203	0.086	1.0	134.9	141.4
23	70.1	0.154	0.06	0.0	36.5	0.0	94.2	0.211	0.093	1.0	144.5	141.4
24	70.3	0.158	0.062	0.0	43.6	0.0	94.5	0.215	0.096	1.0	152.9	141.4
25	70.4	0.159	0.062	0.0	46.9	0.0	94.6	0.216	0.097	1.0	156.8	141.4
26	70.5	0.159	0.062	0.0	48.1	0.0	94.7	0.217	0.097	1.0	158.2	141.4
27	70.6	0.159	0.062	0.0	48.8	0.0	94.9	0.217	0.097	1.0	158.9	141.4
28	70.6	0.159	0.062	0.0	49.3	0.0	95.0	0.217	0.097	1.0	159.5	141.4
29	70.7	0.16	0.062	0.0	49.8	0.0	95.1	0.217	0.097	1.0	160.1	141.4
30	70.8	0.16	0.062	0.0	50.4	0.0	95.2	0.218	0.097	1.0	160.7	141.4



Distress	Threshold	Target Reliability	Distress @ 20.0 year(s)	Pass/Fail
IRI (in/mile)	172.0	90	142.5	PASS
AC Top-Down Fatigue Cracking (ft/mile)	2000.0	80	1930.9	PASS
AC Bottom-up Fatigue Cracking (%)	25.0	80	1.0	PASS
AC Thermal Cracking (ft/mile)	1000.0	80	141.4	PASS
Total Rutting (in)	0.75	90	0.34	PASS
AC Rutting (in)	0.25	90	0.2	PASS
AC Reflective Cracking (%)	25.0	90	0.0	N/A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MEAPA
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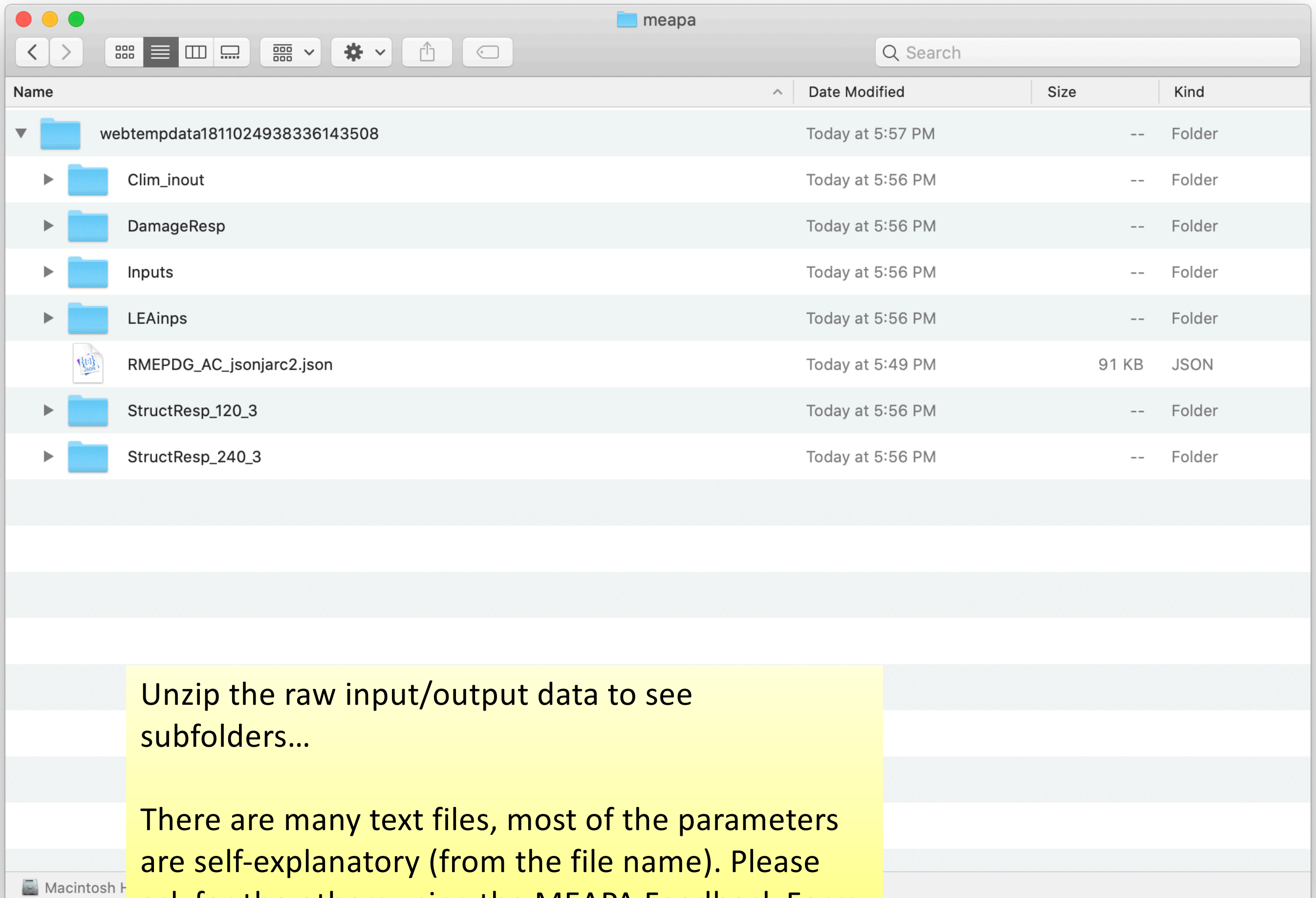
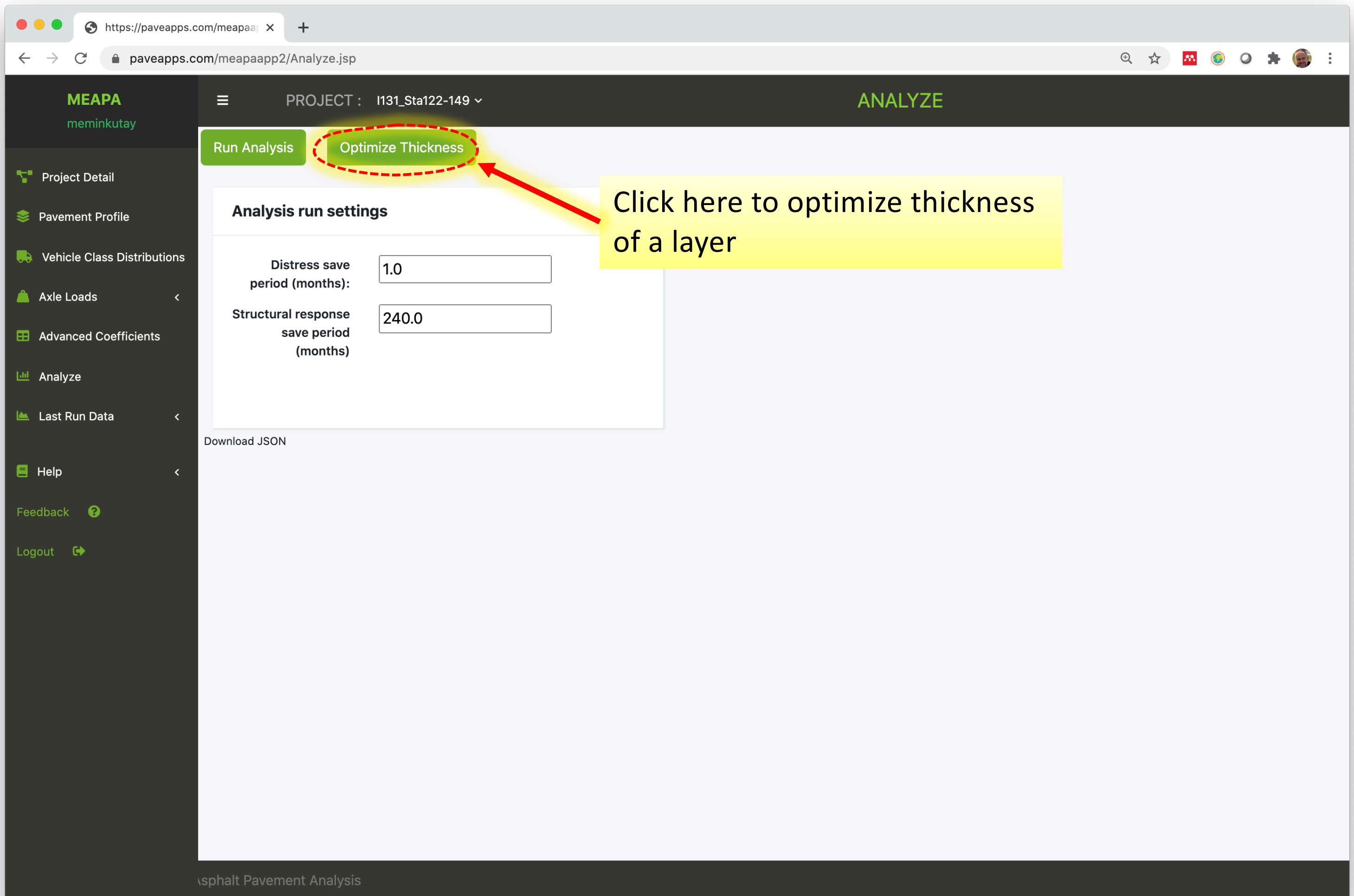
RESULTS
Save
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
View Distresses
Edit Reliability
Download PDF Report
Download I/O Data
Help
Feedback
Logout
Reliability and Terminal Distresses
Distress Threshold Reliability Distress Computed @ 20.0 year(s) Pass/Fail
IRI (in/mile) 172.0 90 142.5 PASS
AC Top-Down Fatigue Cracking (ft/mile) 2000.0 80 1930.9 PASS
AC Bottom-up Fatigue Cracking (%) 25.0 75 1.0 PASS
AC Thermal Cracking (ft/mile) 1000.0 80 141.4 PASS
Total Rutting (in) 0.75 90 0.34 PASS
AC Rutting (in) 0.25 90 0.2 PASS
AC Reflective Cracking (%) 25.0 90 0.0 PASS
Distresses
Month
IRI (in/mile) (@ 50% reliability)
Rutting Total (in) (@ 50% reliability)
Rutting AC only(in) (@ 50% reliability)
Bottom-up Fatigue Cracking(%) (@ 50% reliability)
Top-down Fatigue Cracking(ft/mile) (@ 50% reliability)
Thermal Cracking(ft/mile) (@ 50% reliability)
IRI (in/mile) (@ 90% reliability)
Rutting Total (in) (@ 90% reliability)
Rutting AC only(in) (@ 90% reliability)
Bottom-up Fatigue Cracking(%) (@ 80% reliability)
Top-down Fatigue Cracking(ft/mile) (@ 80% reliability)
Thermal Cracking(ft/mile) (@ 80% reliability)
1 63.0 0.081 0.018 0.0 0.4 0.0 71.1 0.121 0.031 1.0 22.7 141.4
2 66.5 0.087 0.018 0.0 0.6 0.0 88.9 0.128 0.032 1.0 29.3 141.4
3 66.6 0.089 0.018 0.0 0.8 0.0 89.0 0.131 0.032 1.0 32.5 141.4
0.0 89.2 0.133 0.032 1.0 35.1 141.4
0.0 89.3 0.135 0.032 1.0 37.8 141.4
0.0 89.4 0.137 0.032 1.0 40.6 141.4
0.0 89.6 0.139 0.032 1.0 43.4 141.4
0.0 89.8 0.142 0.032 1.0 48.5 141.4
9 67.4 0.104 0.024 0.0 2.7 0.0 90.2 0.15 0.04 1.0 62.2 141.4
10 68.0 0.118 0.036 0.0 5.8 0.0 91.1 0.167 0.058 1.0 84.5 141.4
11 68.5 0.131 0.046 0.0 10.1 0.0 91.9 0.182 0.073 1.0 100.8 141.4
12 68.8 0.137 0.05 0.0 14.6 0.0 92.3 0.19 0.079 1.0 111.6 141.4
13 69.0 0.139 0.051 0.0 16.8 0.0 92.5 0.192 0.08 1.0 116.0 141.4
14 69.0 0.14 0.051 0.0 17.6 0.0 92.6 0.193 0.08 1.0 117.5 141.4
Click here to download the raw input/output data
Mechanistic Empirical Asphalt Pavement Analysis
https://paveapps.com/meapaapp2/ResultsAtRel.jsp?relcalcd=1#confirmModal



Unzip the raw input/output data to see subfolders…

There are many text files, most of the parameters are self-explanatory (from the file name). Please ask for the others using the MEAPA Feedback Form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MEAPA
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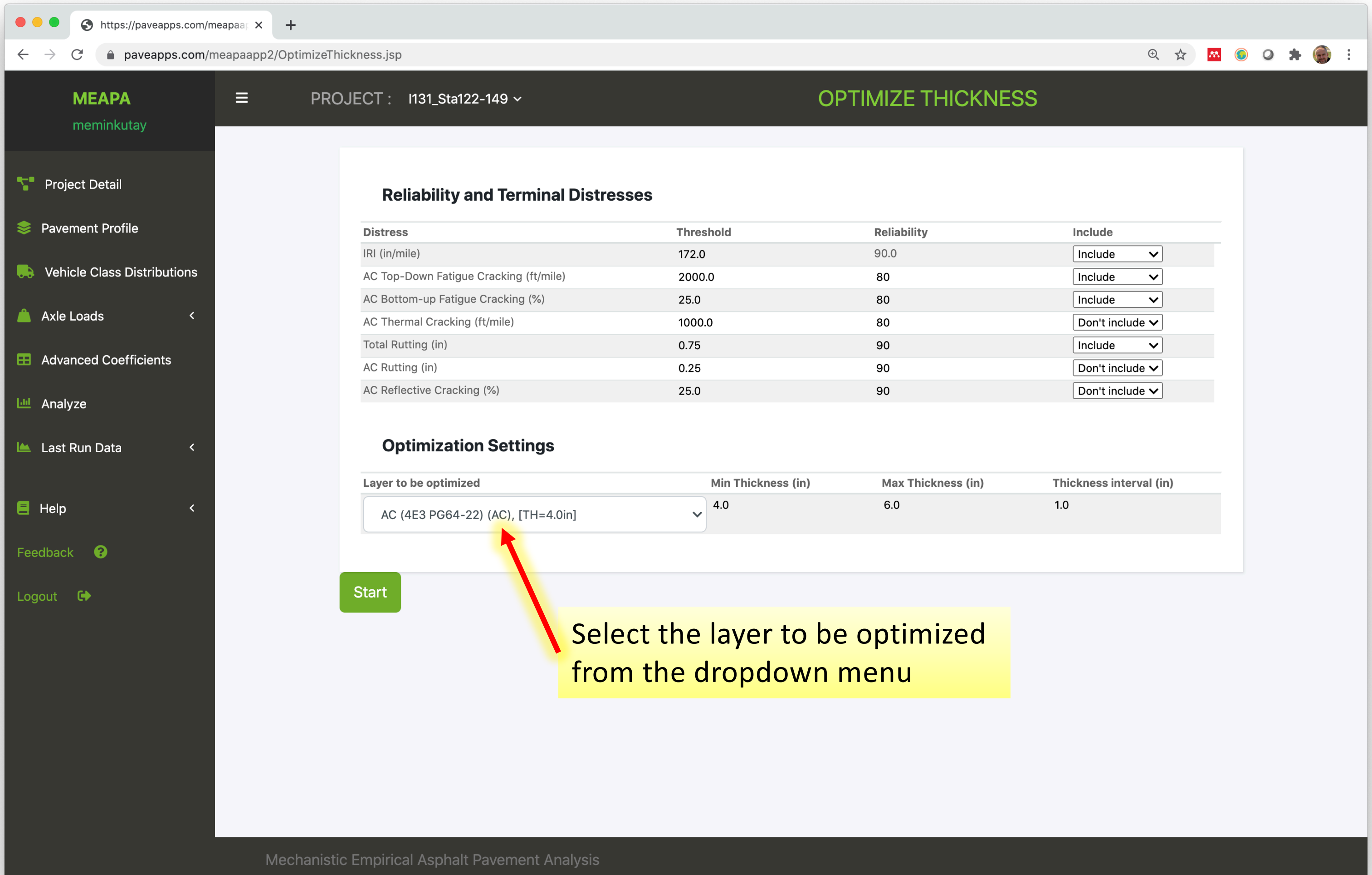
PROJECT : I131_Sta122-149
ANALYZE
Run Analysis
Optimize Thickness
Click here to optimize thickness of a layer
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
Analysis run settings
Distress save period (months):
1.0
Structural response save period (months)
240.0
Download JSON
sphalt Pavement Analysis


https://paveapps.com/meapaa
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MEAPA
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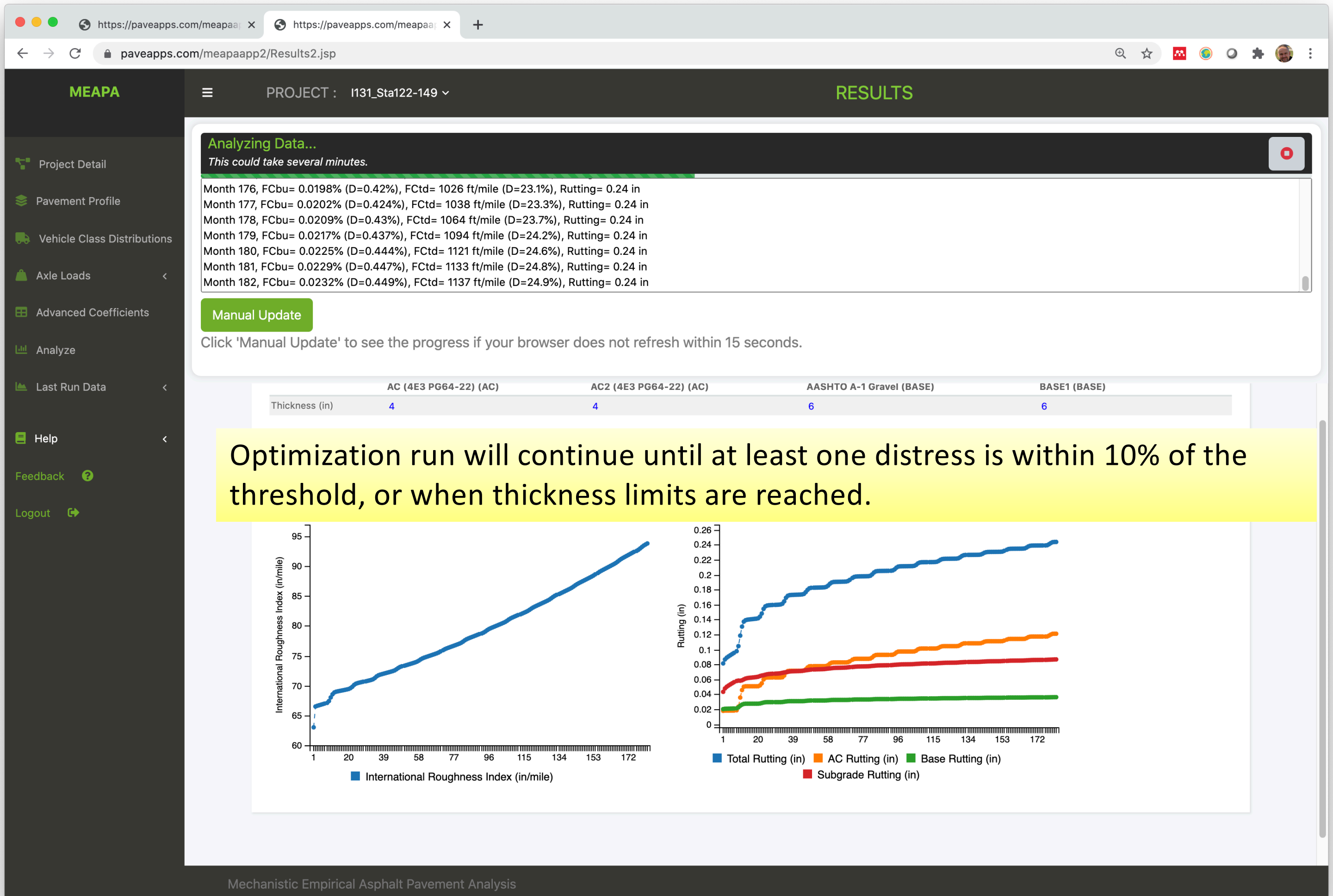
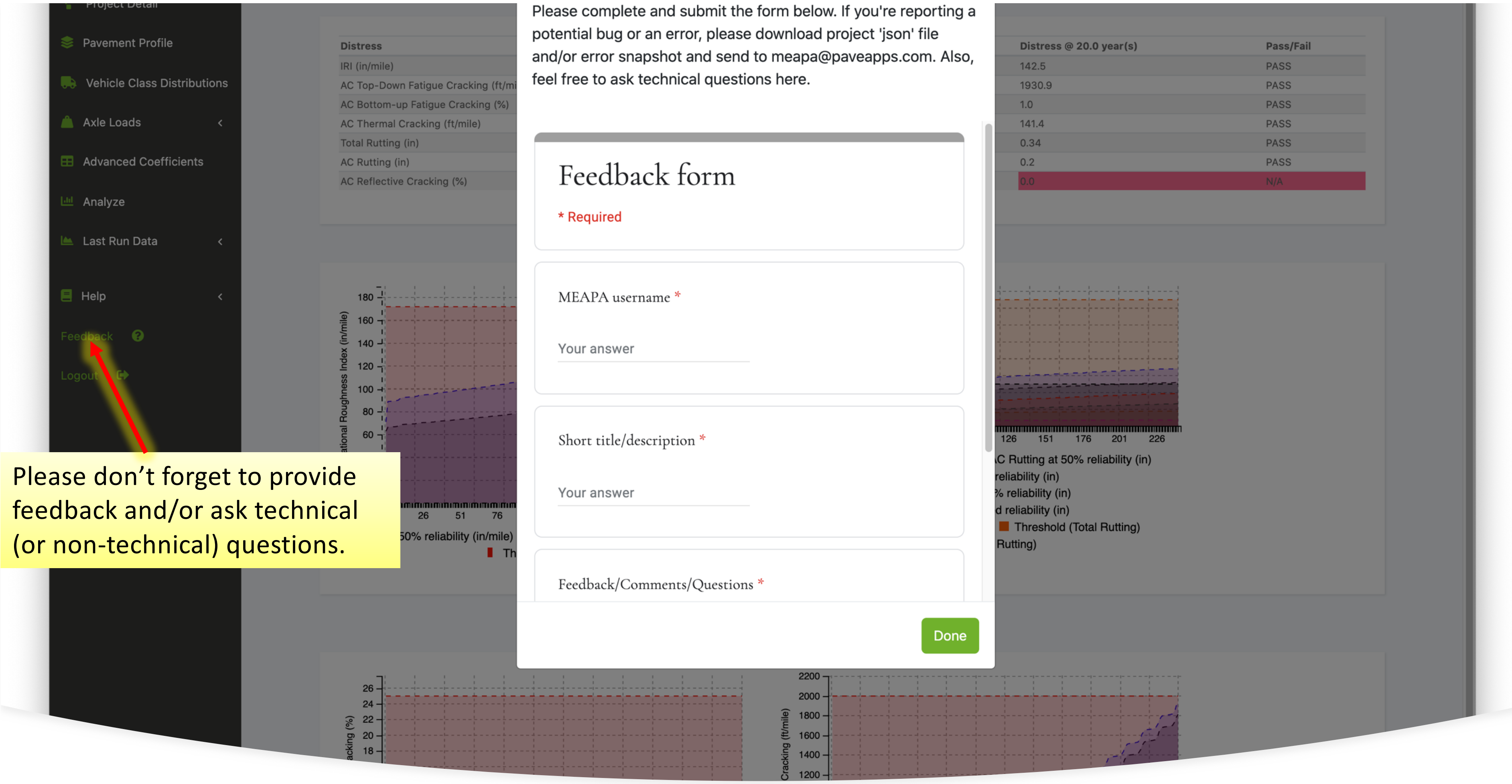
PROJECT : I131_Sta122-149
OPTIMIZE THICKNESS
Project Detail
Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
Reliability and Terminal Distresses
Distress Threshold Reliability Include
IRI (in/mile) 172.0 90.0 Include
AC Top-Down Fatigue Cracking (ft/mile) 2000.0 80 Include
AC Bottom-up Fatigue Cracking (%) 25.0 80 Include
AC Thermal Cracking (ft/mile) 1000.0 80 Don't include
Total Rutting (in) 0.75 90 Include
AC Rutting (in) 0.25 90 Don't include
AC Reflective Cracking (%) 25.0 90 Don't include
Optimization Settings
Layer to be optimized Min Thickness (in) Max Thickness (in) Thickness interval (in)
AC (4E3 PG64-22) (AC), [TH=4.0in] 4.0 6.0 1.0
Start
Select the layer to be optimized from the dropdown menu
Mechanistic Empirical Asphalt Pavement Analysis

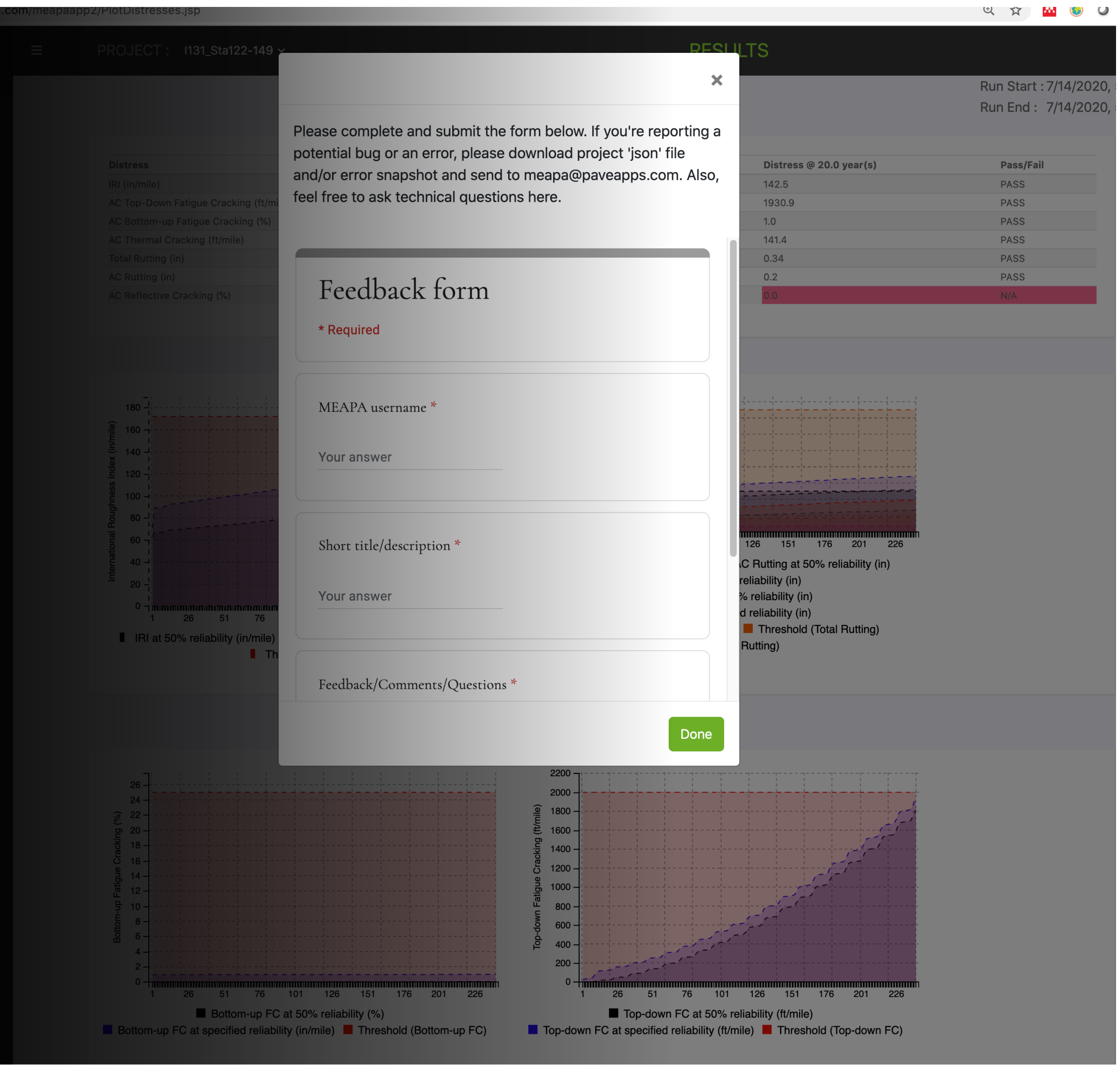


Optimization run will continue until at least one distress is within 10% of the threshold, or when thickness limits are reached.

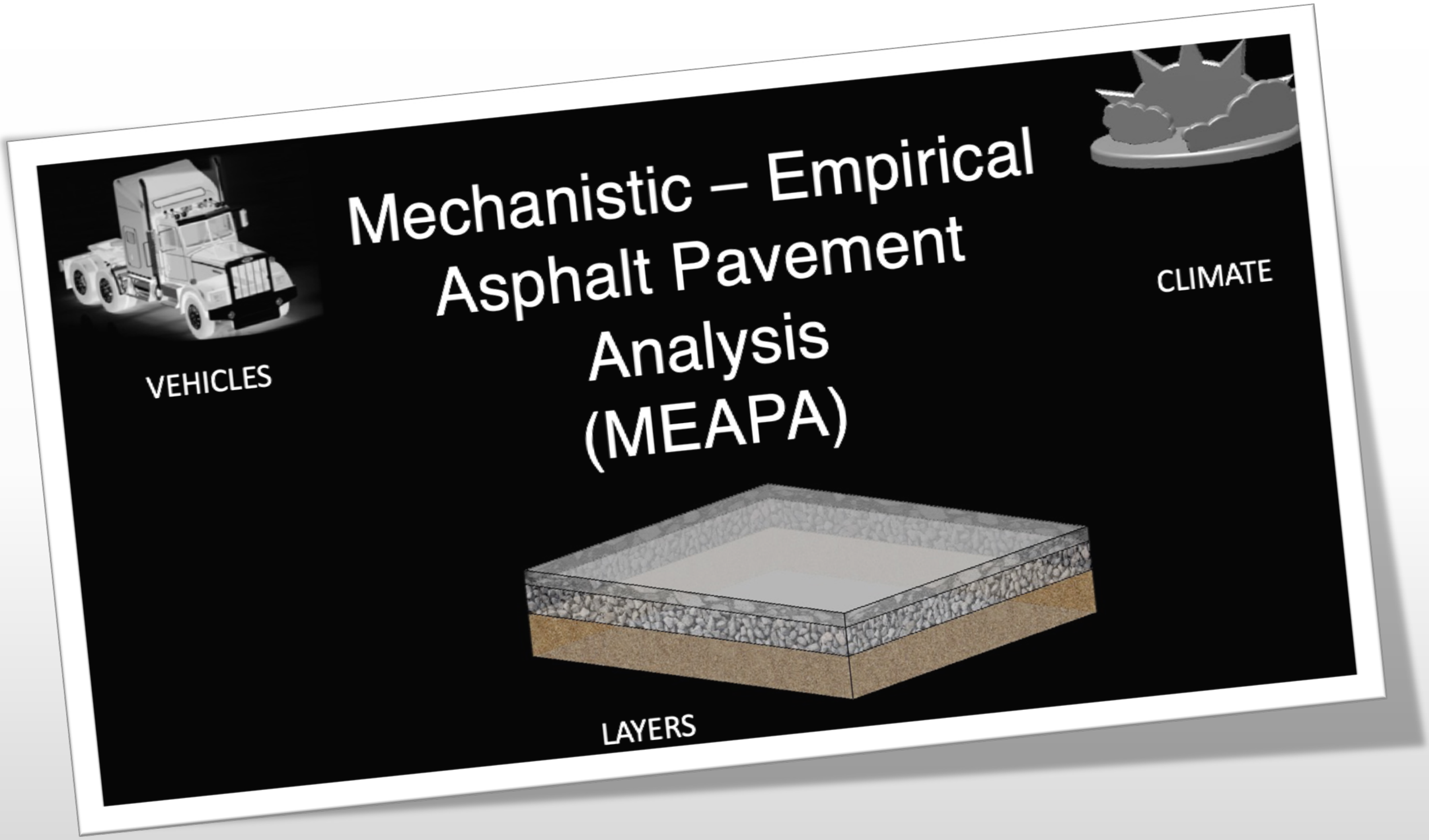

Pavement Profile
Vehicle Class Distributions
Axle Loads
Advanced Coefficients
Analyze
Last Run Data
Help
Feedback
Logout
Please complete and submit the form below. If you're reporting a potential bug or an error, please download project 'json' file and/or error snapshot and send to meapa@paveapps.com. Also, feel free to ask technical questions here.
Feedback form
* Required
MEAPA username *
Your answer
Short title/description *
Your answer
Feedback/Comments/Questions *
Done
Distress
IRI (in/mile)
AC Bottom-up Fatigue Cracking (%)
AC Thermal Cracking (ft/mile)
Total Rutting (in)
AC Rutting (in)
AC Reflective Cracking (%)
Distress @ 20.0 year(s)
Pass/Fail
142.5
1930.9
1.0
141.4
0.34
0.2
0.0
PASS
N/A
Threshold (Total Rutting)
Please don't forget to provide feedback and/or ask technical (or non-technical) questions.

The End

Q/A session



https://paveapps.com/meapa/



A web-based pavement design app