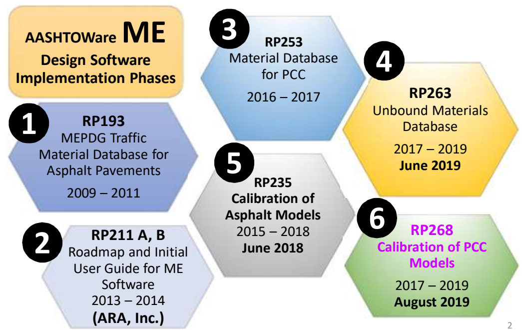
59th Idaho Asphalt Conference, 2019

Implementation and Calibration of AASHTOWare Pavement ME Design for Idaho

Fouad Bayomy
University of Idaho

ITD – UI Projects to Implement AASHTOWare Pavement ME Design



Acknowledgements

RP193, 235, 253, 263, 268 Contributors

- UI Team (RP193, 253, 263, 235 and 268)
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- BSU Team (RP263)
  - Deb Mishra (Co-PI)
  - Md Jibon (Grad Student)
- ARA
  - RP 211 (A, B)
  - Workshops
    - Dec 2012
    - Apr 2018
    - July 2019
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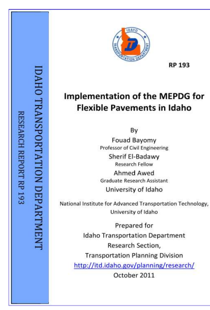
  - John Bilderback
  - John Arambarri
  - Dave Richards
  - Chad Clawson
  - Clint Hoops
  - James Poorbaugh
  - Mark Wheeler
  - Ned Parrish (Res. Mgr.)
- FHWA
  - Kyle Holman, ITD Office

RP 193

ITD_ME Material and Traffic Database



IDAHO TRANSPORTATION DEPARTMENT
RESEARCH REPORT RP 193

RP 193

Implementation of the MEPDG for Flexible Pavements in Idaho

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Prepared for
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Research Section,
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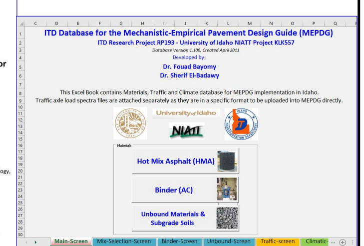
http://itd.idaho.gov/planning/research/
October 2011



Binder Characterization

- **Levels 1 and 2: G* and δ at 10 rad/sec (RTFO)**
- **Level 3: choose binder grade**

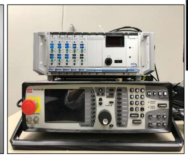
E* for Idaho Superpave Mixes

GS Determination from Servopac Gyratory Compactor data

E* Testing using AMPT Machine

IDT and Creep Compliance

- IDT and Creep Compliance data is necessary for the calibration of the Thermal cracking model.
- A total of 18 mixes were tested for CC and IDT. This was added as a separate task during RP235
- Database was updated in 2017 to include these results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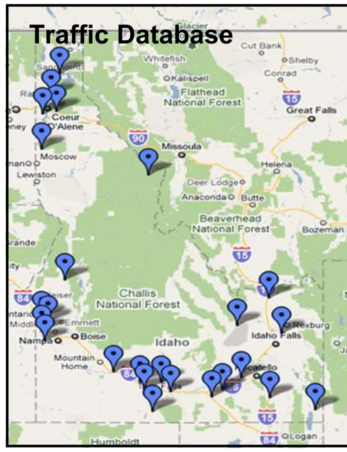
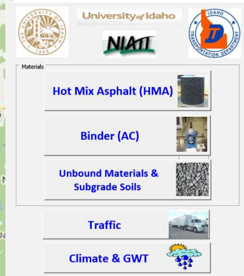
Traffic Database — Idaho WIM Sites





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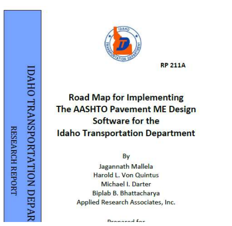
RP 211 A, B

Road Map and User Guide

http://itd.idaho.gov/alt-programs/?target=research-program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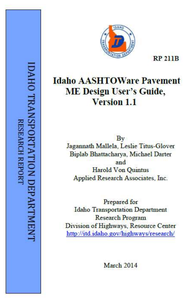
RESEARCH REPORT

RP 211A

Road Map for Implementing The AASHTO Pavement ME Design Software for the Idaho Transportation Department

By
Jagannath Mallela
Harold L. Von Quintus
Michael I. Darter
Biplab B. Bhattacharya
Applied Research Associates, Inc.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RESEARCH REPORT

RP 211B

Idaho AASHTOWare Pavement ME Design User's Guide, Version 1.1

By
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Biplab Bhattacharya, Michael Darter
and
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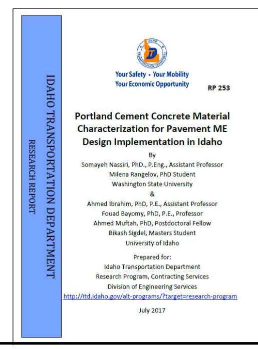
Prepared for
Idaho Transportation Department
Research Program
Division of Highways, Resource Center
http://itd.idaho.gov/highways/research/

March 2014

RP 253

PCC Materials Database

http://itd.idaho.gov/alt-programs/?target=research-program


IDAHO TRANSPORTATION DEPARTMENT
RESEARCH REPORT

Your Safety • Your Mobility
Your Economic Opportunity

RP 253

Portland Cement Concrete Material Characterization for Pavement ME Design Implementation in Idaho

By
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Prepared for:
Idaho Transportation Department
Research Program, Contracting Services
Division of Engineering Services
http://itd.idaho.gov/alt-programs/?target=research-program

July 2017

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Modulus of elasticity & Compressive strength

- ASTM C39 ASTM C469
- 6 by 12-in cylinders, gypsum capped
- Loading rate: 35 psi/min
- 7-, 14-, 28-, 90-day tests


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Mechanical tests- split tensile & Modulus of rupture

- ASTM C496
- 6 by 12-in cylinders
- Three cylinders from one batch for each test day
- 7-, 14-, 28-, 90-day tests

- ASTM C293
- 6 x 6 x 20-in beams
- Three beams from one batch for each test day
- 7-, 14-, 28-, 90-day tests


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Coefficient of thermal expansion & Drying shrinkage

- AASHTO T 336-15
- Two 4 by 8-in cylinders
- Length change to uniform temp cycling (condition at 50°F, raise to 122°F, cool down to 50°F, repeat
- FHWA Calibration specimen tested

- ASTM C157
- 2 x 2 x 12-in prisms
- Length change due to drying shrinkage
- Moist cure until 28 days then air cure
- Length measurements 4, 7, 14, 28 days & 8, 16, 32 and 64 weeks of air curing

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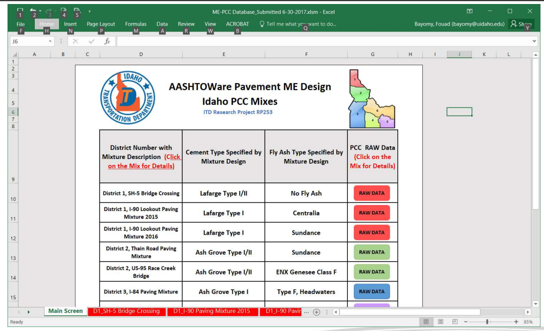
PCC Material Database



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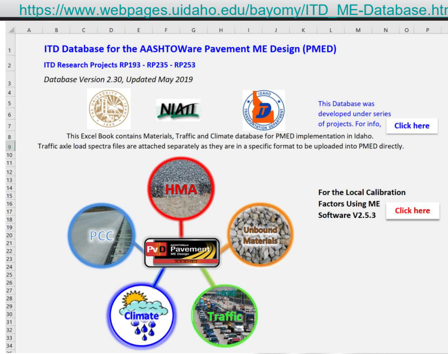
ITD_ME Database V2.3

https://www.webpages.uidaho.edu/bayomy/ITD_ME-Database.htm



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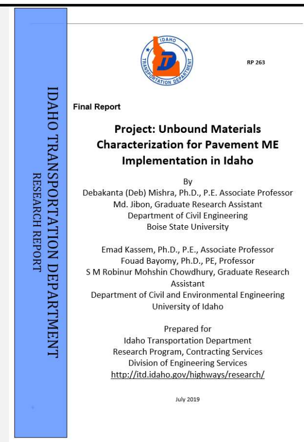
RP 263
Mr for Soils and Unbound Materials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RESEARCH REPORT

RP 263

Final Report

Project: Unbound Materials Characterization for Pavement ME Implementation in Idaho

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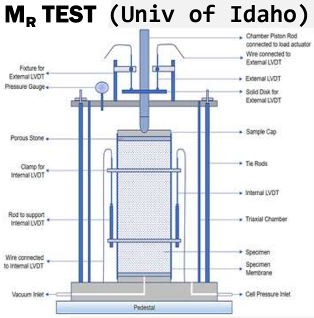
Idaho Transportation Department
Research Program, Contracting Services
Division of Engineering Services
http://itd.idaho.gov/highways/research/

July 2019

M_R TEST (Univ of Idaho)



M_R TEST

	MEPDG Model			
Material ID	K_1	K_2	K_3	R^2
A	935.207	0.711	-0.075	0.996
B	997.734	0.685	-0.073	0.994
BK - 100	849.221	0.717	-0.081	0.994
BK - 181	561.249	0.621	0.453	0.993
BR - 2	1367.016	0.666	-0.151	0.998
CS - 184	748.290	0.643	0.006	0.997
EL - 132	819.292	0.755	-0.098	0.994
IMC - 140	821.516	0.687	-0.016	0.995
KT - 215	699.299	0.664	0.282	0.974
LE - 160	974.164	0.648	0.046	0.997
LN - 80	895.024	0.675	0.019	0.988
NP - 82	944.597	0.706	-0.087	0.997
PW -84	463.894	0.432	0.916	0.980
Vy - 63	832.396	0.664	0.208	0.988
WCW	864.330	0.666	-0.012	0.999
CN - 148 SB	1067.651	0.673	-0.157	0.995
CS - 184 SB	388.543	0.152	1.244	0.981
PY -720 SB	1008.901	0.657	-0.142	0.997

MEPDG Model parameters for constitutive models for base/subbase materials

M_R TEST

Material ID	0.9*OMC				OMC				1.10*OMC			
	k_1	k_2	k_3	R^2	k_1	k_2	k_3	R^2	k_1	k_2	k_3	R^2
D1-ML	768.4	0.67	-2.61	0.88	260.6	0.76	-0.72	0.77	-	-	-	-
D1-GM	1001.4	0.84	-2.72	0.91	744.8	0.99	-2.47	0.89	263.5	0.81	0.07	0.78
17-9SL-0101	-	-	-	-	888.4	0.58	-2.25	0.70	-	-	-	-
TP-8	555.9	0.57	-2.66	0.86	377.2	0.68	-2.68	0.76	-	-	-	-
D3-SM	608.9	0.10	-0.57	0.59	563.6	0.21	-1.60	0.79	-	-	-	-
D3-SC	587.8	0.26	-1.82	0.90	541.9	0.18	-1.75	0.89	124.4	0.25	-0.2	0.30
Cs-184	1346.5	0.34	-1.93	0.95	767.2	0.52	-3.1	0.90	-	-	-	-
LN-80	1182.4	0.69	-1.74	0.95	486.9	0.55	0.53	0.84	283.6	0.26	2.17	0.89
Bk-180c	410.2	0.23	2.35	0.92	397.6	0.26	1.94	0.85	-	-	-	-
JF-83	371.14	0.22	2.03	0.87	383.1	0.45	0.79	0.74	-	-	-	-
17-9SL-0054	-	-	-	-	340.2	0.09	1.95	0.98	-	-	-	-
17-9SL-0055	327.4	0.17	1.58	0.94	223.6	0.25	2.78	0.94	190.1	0.19	3.17	0.91
17-9SL-0057	273.9	0.25	1.25	0.89	175.2	0.24	2.7	0.94	-	-	-	-
17-9SL-0058	-	-	-	-	667.1	0.38	-1.88	0.78	-	-	-	-

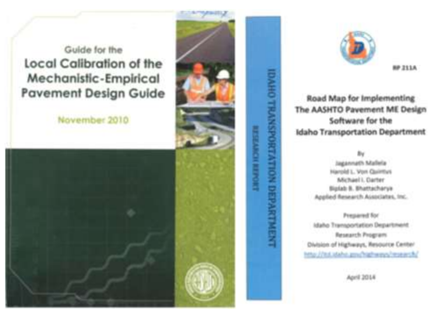
Note: cells with no data indicate the specimen could not be tested for resilient modulus properties

MEPDG Model parameters for subgrade soil materials

Calibration
RP235 and RP268

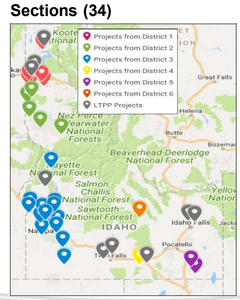
- RP235 – Local Calibration of Flexible Pavement Models for ME software v2.3.1
- RP268 – Local Calibration of PCC Pavement Models, and Re-Calibration of Flexible models for ME software v2.5.3

Calibration

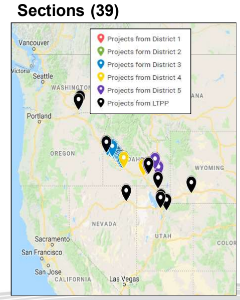


Selected Section for Flexible and JCPC Pavements

Selected Flexible Pavement Sections (34)



Selected Rigid Pavement Sections (39)



Selected Projects for Flexible Pavements

- 80% of the selected projects were used for calibration

ITD District #	Construction Year	Route	Beg MP	End MP
D1	2008	US-95	403.5	408.75
	2004	US-95	411.84	415.83
	2002	US-95	415.5	421.3
	2006	SH-3	76.822	84.201
	2013	US-95	477.1	486.36
D2	2008	SH006	100	104.5
	2004	SH008	0	1.76
	2003	US-95	344	344.57
	2007	US-95	319.88	337.67
	2008	SH003	5.00	8.5
	2011	SH013	11.257	18.711
	2010	SH013	18.68	25.378
	2005	US-95	277.28	279.1
	2010	US 95	64.94	67.14
	2011	US 95	0	16.7
	2012	US 95	38.4	46.6
D3	2011	SH 55	66.1	80.63
	2010	SH 78	0	11.5
	2011	SH 51	60	76.9
	2011	SH 51	47.7	54.6
	2011	SH 78	60	76
	2012	SH 55	13.1	18
	2012	US 20/26	0	1.58
	2012	US 95	47.58	60.87
	2012	SH 16	0	13.392
	2013	SH 52	14.4	30.42
D4	2000	SH 77	18.5	23
D5	2014	US30	328.6	330.7
D6	2012	US20	328.6	335.7

- 20% of the selected projects were set aside for validation

District #	Construction Year	Route	Beg MP	End MP
D1	2013	SH-3	103.15	111.38
D2	2003	US-95	366.59	373.03
D3	2012	SH 55	113.9	115.9
D3	2010	SH 78	29.1	36.7
D5	2011	SH 55	63.2	66.1
D6	1985	U. S.-20	319.6	331

Selected Projects for Rigid Pavements

- 80% of the selected projects were used for calibration

ITD District #	Construction Year	Route	Beg MP	End MP
D1	1991	I-90	58.5	62.25
D2	1924	US-95	0.06	0.11
	2011	SH008	2.77	3.27
	1976	US-95	251.075	261.588
	2004	US-12	2.197	2.62
D3	1981	I-84	26.35	28.3
	2011	I-84	36	38.7
	2009	I-84	41.3	43.8
	2004	I-84	49.15	49.73
	1996	I-84	49.73	50.21
	1972	I-84	58.8	59
	2001	I-84	70.1	82.3
	1996	I-84	90	94.6
	1983	I-84	94.3	103.5
	1994	I-84	103.5	109.1
	1995	I-84	114.5	121.2
D4	1979	I-84	120.66	127.945
D5	1972	I-15	30.87	36.207
	1960	I-86	14.808	25.98
	1985	US-91	80.15	81.02
	1986	US-91	78.81	79.66

- 20% of the selected projects were set aside for validation

Number	Construction Year	Route	Beg MP	End MP
1	1986	I-86	24.7	-
2	1985	I-215	28.5	-
3	2004	US-12	2.197	2.62
4	1983	I-84	12.6	17.61
5	1995	I-84	109.1	114.5
6	1986	U.S. - 395	26.1	-
7	1979	I-84	120.66	127.95

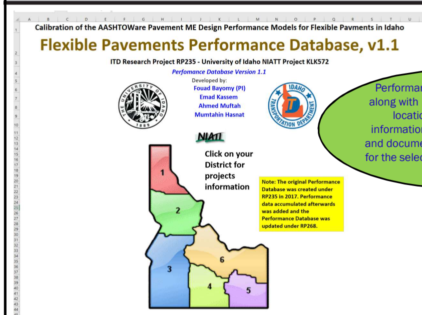
ITD ME-Performance Database

Source: TAMS and Video Logs (PathView Software)

Field and Forensic Investigations Example: SH-8 (Moscow)

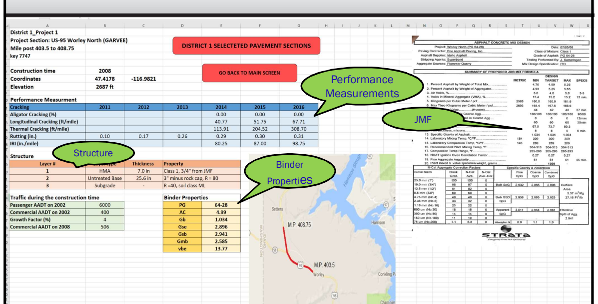
Field and Forensic Investigations Example: SH-8 (Moscow)

ITD ME-Performance Database (**Flexible Pavements**)

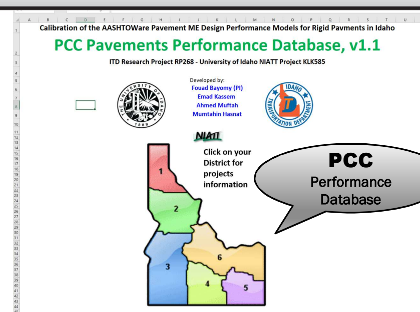


Performance Data for all sections along with pavement structure data, location map and material information (JMF) are all integrated and documented in a single database for the selected sections for future re-calibration.

ITD ME-Performance Database (**Flexible Pavements**)

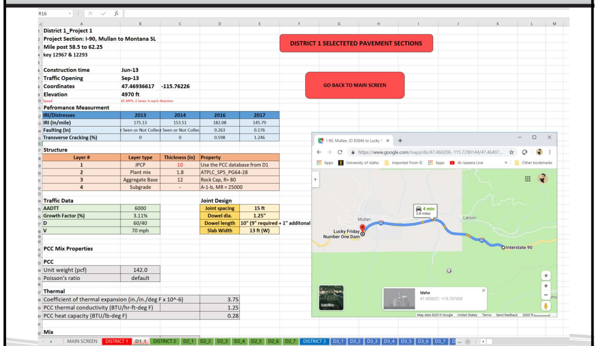


ITD ME-Performance Database (**PCC Pavements**)



PCC Performance Database

ITD ME-Performance Database (PCC Pavements)



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Data Analysis and Development of Local Calibration Factors

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Calibration of Performance Models – Flexible Pavements

RUTTING MODELS

$$\Delta_{p(HMA)} = \frac{\varepsilon_{p(HMA)}}{\varepsilon_{r(HMA)}} \times h_{HMA} = \beta_{1r} k_z 10^{k_{1r}} n^{k_{2r}\beta_{2r}} T^{k_{3r}\beta_{3r}} \times h_{HMA}$$

$$\Delta_{p(soil)} = \beta_{s1} k_{s1} \varepsilon_v h_{soil} \left(\frac{\varepsilon_o}{\varepsilon_r}\right) e^{-\left(\frac{\rho}{n}\right)^{\beta}}$$

FATIGUE CRACKING MODEL

$$FC_{Bottom} = \left(\frac{1}{60}\right)\left(\frac{C_3}{1 + e^{(C_1 C_1^* + C_2 C_2^* Log(DI_{Bottom} * 100))}}\right)$$

$$FC_{TOP} = 10.56 \left(\frac{C_4}{1 + e^{(C_1 - C_2 Log(DI_{TOP}))}}\right)$$

THERMAL CRACKING MODEL

$$TC = \beta_{t1} N\left[\frac{1}{\sigma_d} Log\left(\frac{C_d}{h_{HMA}}\right)\right]$$

INTERNATIONAL ROUGHNESS INDEX (IRI) MODEL

$$IRI = IRI_o + C_1(RD) + C_2(FC_{Total}) + C_3(TC) + C_4(SF)$$

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Rutting Model Calibration

$$\Delta_{p(HMA)} = \beta_{1r} k_z \varepsilon_{r(HMA)} 10^{k_{1r}} n^{k_{2r}\beta_{2r}} T^{k_{3r}\beta_{3r}} h_{(HMA)}$$

$$\Delta_{p(soil)} = \beta_{s1} k_{s1} \varepsilon_v h_{soil} \left(\frac{\varepsilon_0}{\varepsilon_r}\right) e^{-\left(\frac{\rho}{n}\right)^{\beta}}$$

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Rutting Model Calibration Example of Data Analysis

Trials	β_{1r}	$\beta_{1s\ (coarse)}$	$\beta_{1s(fine)}$	Bias, err	Standard Error, S_e	P-value
NC Factors	0.40	1.00	1.00	-0.0592	0.150	2.74E-06
Trial #1	1.50	1.00	1.00	-6.5	0.210	1.5E-07
Trial #2	1.25	1.00	1.00	-4.47	0.191	5.62E-07
Trial #3	1.00	1.00	1.00	-1.21	0.172	1.13E-06
Trial #4	0.75	1.00	1.00	-0.9	0.165	4.5E-06
Trial #5	0.50	1.00	1.00	-0.21	0.156	7.1E-06
Trial #6	0.25	1.00	1.00	1.4	0.12	4.84E-05
Trial #7	1.25	1.25	1.00	-5.71	0.214	1.17E-07
Trial #8	0.75	0.75	1.00	-0.83	0.158	2.1E-04
Trial #9	0.50	0.50	1.00	-0.11	0.134	4.9E-3
Trial #10	0.25	0.25	1.00	3.4	0.117	1.2E-03
Trial #11	1.25	1.25	1.25	-7.4	0.241	5.48E-07
Trial #12	0.75	0.75	0.75	-0.51	0.146	8.4E-04
Trial #13	0.50	0.50	0.50	1.48	0.128	7.87E-03
Trial #14	0.25	0.75	0.75	0.007	0.114	0.03
Trial #15	0.25	0.50	0.50	3.4	0.105	1.53E-02
Trial #16	0.30	1.00	1.00	-0.02	0.121	8.36E-03
Trial #17	0.30	0.75	1.00	-0.009	0.116	0.08
Trial #18	0.30	1.00	0.75	-0.008	0.115	0.12
Trial #19	**0.30**	**0.86**	**0.736**	**0.0002**	**0.103**	**0.37**
Trial #20	0.30	0.90	0.74	-0.005	0.112	0.24

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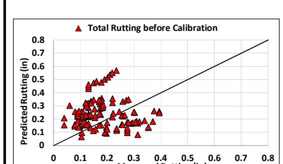
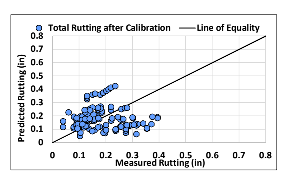
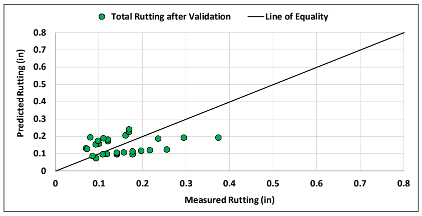
Rutting Models Calibration - PMED v2.5.3





Calibration Factors	β_{1r}	β_{2r}	β_{3r}	β_{1s} (Coarse)	β_{1s} (Fine)	N	Bias, $e_{r(mean)}$	Standard Error, S_e	P-value (Paired t-test)
Global	0.4	0.52	1.36	1.00	1.00	123	-0.059	0.15	2.74E-07
Local	0.3	0.52	1.36	0.86	0.736	123	0.0002	0.1	0.49

Rutting Models Validation - PMED v2.5.3



N	Bias, $e_{r(mean)}$	Standard Error, S_e	P-value (Paired t-test)
28	0.0065	0.074	0.33

Fatigue Models Calibration

$$N_{f-HMA} = k_{f1}(C)(C_H)\beta_{f1}(\varepsilon_t)^{k_{f2}\beta_{f2}}(E_{HMA})^{k_{f3}\beta_{f3}}$$

$$FC_{Bottom} = \left(\frac{1}{60}\right)\left(\frac{C_4}{1+e^{(C_1C_1^*+C_2C_2^*Log(DI_{Bottom}*100))}}\right)$$

$$FC_{Top} = 10.56\left(\frac{C_4}{1+e^{(C_1-C_2Log(DI_{Top}))}}\right)$$

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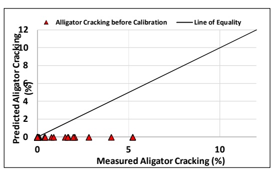
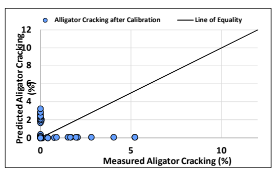
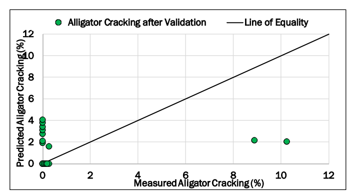
Alligator Cracking Models Calibration





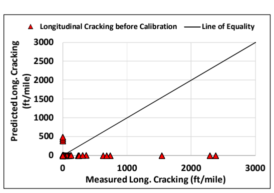
Calibration Factors	C_1	C_2: h_{ac}<5 in.	C_2: h_{ac} > 12 in.	C_2: 5in. <= h_{ac} <= 12 in.	N	Bias, $e_{r(mean)}$	Standard Error, S_e	P-value (Paired t-test)
Global	1.31	2.1585	3.9666	1	70	0.45	1.20	0.001
Local	0.31	1.1585	3.9666	0.2	70	-0.19	1.07	0.18

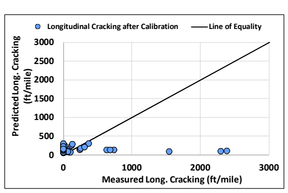
Alligator Cracking Models Validation



N	Bias, $e_{r(mean)}$	Standard Error, S_e	P-value (Paired t-test)
19	-0.36	3.10	0.31

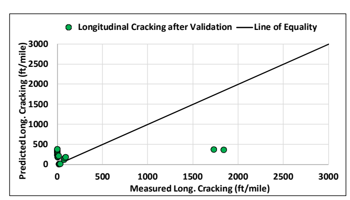
Longitudinal Cracking Models Calibration





Calibration Factors	C_1	C_2	N	Bias, $e_{r(mean)}$	Standard Error, S_e	P-value (Paired t-test)
Global	7.0	3.50	71	132.4	471.7	0.008
Local	3.3	1.0	71	2.3	450	0.48

Longitudinal Cracking Models Validation

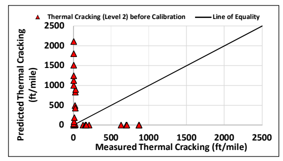


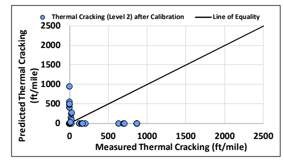
N	Bias, $e_{r(mean)}$	Standard Error, S_e	P-value (Paired t-test)
18	-1.7	518	0.5

Thermal Cracking Model

$$TC = \beta_{t1} N \left[\frac{1}{\sigma_d} Log\left(\frac{C_d}{H_{HMA}}\right)\right]$$

Transverse (Thermal) Cracking Model Calibration





Calibration Factors	K (Mean Annual Air Temperature (MAAT) <= 57 deg F)	N	Bias, $e_{r(mean)}$	Standard Error, S_e	P-value (Paired t-test)
Global	[**3** $*10^{-7}*MAAT^{4.0319}$]*1 + 0	35	-174.35	746.201	0.03
Local	[**2.591** $*10^{-7}*MAAT^{4.0319}$]*1 + 0	35	-0.00029	529.394	0.5

Transverse (Thermal) Cracking Model Validation

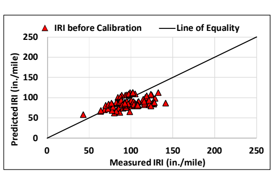
The transverse cracking model at level 2 was not validated in this study due to lack of projects with level 2 low temperature cracking data.

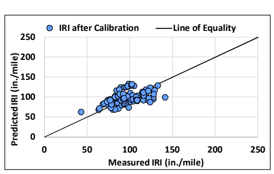
IRI Model Calibration

$$IRI = IRI_o + C_1(RD) + C_2(FC_{Total}) + C_3(TC) + C_4(SF)$$

Data collected form TAMS Database

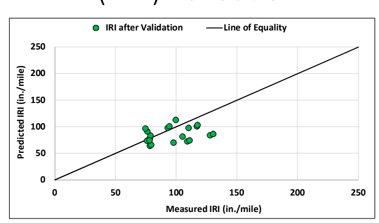
International Roughness Index Model (IRI) Calibration





Calibration Factors	C_1	C_2	C_3	C_4	N	Bias, $e_{r(mean)}$	Standard Error, S_e	P-value (Paired t-test)
Global	40	0.40	0.008	0.015	94	10.3	19.5	2.10E-08
Local	80	0.60	0.008	0.02	94	-1.2	17.5	0.24

International Roughness Index Model (IRI) Validation



N	Bias, $e_{r(mean)}$	Standard Error, S_e	P-value (Paired t-test)
23	2.8	28.7	0.32

Summary of Flexible Pavement Calibration Factors **PMED_v2.5.3**

Performance Model	Calibration Parameters	Global Factors (as per PMED V2.5.3)	Local Factors for Idaho
AC Rutting	β_{1r}	0.4	**0.3**
	β_{2r}	0.52	0.52
	β_{3r}	1.36	1.36
Unbound Base Rutting	β_{1s}	1.00	**0.86**
Subgrade Rutting	β_{1s}	1.00	**0.736**
Longitudinal Cracking (Top-Down Cracking)	C_1	7	**3.3**
	C_2	3.5	**0.825**
Alligator Cracking (Bottom-Up Cracking)	C_1	1.31	**0.31**
	C_2: h_{ac} < 5 in.	2.1585	**1.1585**
	C_2: h_{ac} > 12 in.	3.9666	3.9666
	C_2: 5in.<= h_{ac} <= 12 in.	(0.867 + 0.2583 * h_{ac}) * 1	(0.867 + 0.2583 * h_{ac}) * **0.2**
Thermal Cracking (Level 2)	K (MAAT <= 57 deg F)	[3 *10^{-7}*$MAAT^{4.0319}$]*1 + 0	[**2.591** *10^{-7}*$MAAT^{4.0319}$]*1 + 0
IRI	C_1	40	80
	C_2	0.4	0.6
	C_3	0.008	0.008
	C_4	0.015	0.02

Calibration of Performance Models – PCC Pavements

JOINT FAULTING MODEL

$$Fault_m = \sum_{i=1}^{m} \Delta Fault_i$$

$$\Delta Fault_i = (F3 + F4 \cdot FR^{0.25}) \cdot (FaultMax_{i-1} - Fault_{i-1})^2 DE_i$$

$$FaultMax_i = FaultMax_0 + F7 \sum_{k=1}^{i} DE_k \cdot \log(1 + F5 \cdot 5^{EROD})^{F6}$$

$$FaultMax_0 = (F1 + F2 \cdot FR^{0.25})\delta_{curing}\left[\log(1 + F5 \cdot 5^{EROD}) \cdot Log(\frac{P_{200} \cdot WetDays}{P_s})\right]^{F6}$$

TRANSVERSE CRACKING MODEL

$$TCRACK = (CRK_{Bottom-up} + CRK_{Top-down} - CRK_{bottom-up} \cdot CRK_{Top-down}) \cdot 100$$

$$Crack = \frac{100^{log(N_{allowable})}}{1 + C4 \cdot FD^{C5}} = \frac{100^{\wedge}C1\left(\frac{MR}{\sigma}\right)^{C2}}{1 + C4 \cdot \left(\frac{N_{applied}}{N_{allowable}}\right)^{C5}}$$

INTERNATIONAL ROUGHNESS INDEX (IRI) MODEL

$$IRI = IRI_0 + J1 \cdot Crack + J2 \cdot Spall + J3 \cdot Fault + J4 \cdot SiteFactor$$

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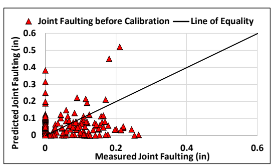
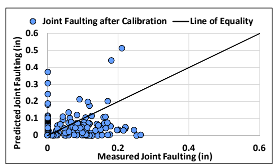
JPCP Mean Transverse Joint Faulting Model – Calibration

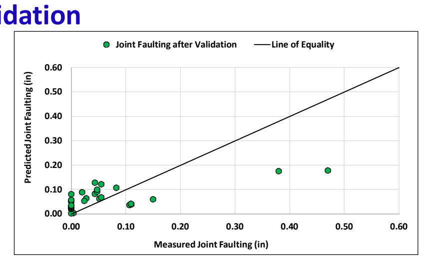




Parameter	Global Calibration Factors	N	Bias, $e_{r(mean)}$	Standard Error, S_e	p-value (Paired t-test)
F1	0.595	178	-0.725	0.1	0.285
F2	1.636				
F3	0.00217				
F4	0.00444				
F5	250				
F6	0.47				
F7	7.3				
F8	400				

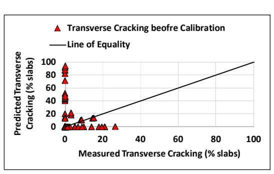
Parameter	Local Calibration Factors	N	Bias, $e_{r(mean)}$	Standard Error, S_e	p-value (Paired t-test)
F1	0.516	178	0.002	0.093	0.499
F2	1.636				
F3	0.00217				
F4	0.00444				
F5	250				
F6	0.47				
F7	7.3				
F8	400				

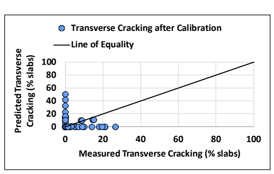
JPCP Mean Transverse Joint Faulting Model – Validation



N	Bias, $e_{r(mean)}$	Standard Error, S_e	P-value (Paired t-test)
33	-0.214	0.078	0.32

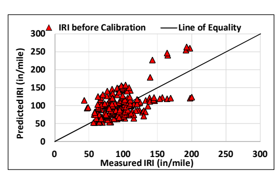
JPCP Transverse Slab Cracking Model – Calibration

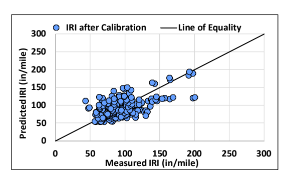




Calibration Factors	C_1	C_2	C_3	C_4	N	Bias, $e_{r(mean)}$	Standard Error, S_e	P-value (Paired t-test)
Global	2	1.22	0.52	-2.17	196	-767.6	18.9	0.002
Local	2.366	1.22	0.52	-2.17	196	-69.02	7	0.258

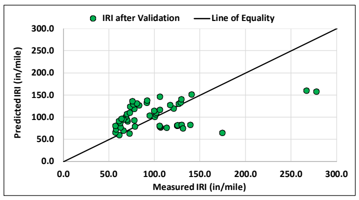
PCC **IRI** Model – Calibration





Calibration Factors	J_1	J_2	J_3	J_4	N	Bias, $e_{r(mean)}$	Standard Error, S_e	P-value (Paired t-test)
Global	0.8203	0.4417	1.4929	25.24	213	1233.6	31.1	0.003
Local	0.845	0.4417	1.4929	28.24	213	-0.37	25.3	0.5

PCC **IRI** Model – **Validation**



N	Bias, $e_{r(mean)}$	Standard Error, S_e	P-value (Paired t-test)
59	-11.55	21.04	0.49

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Summary of Rigid **JPCP** Pavement Calibration Factors
PMED_v2.5.3

Performance Model	Calibration Parameters	Global Factors (PMED V2.5.3)	Idaho Local Calibration Factors
Faulting	F1	0.595	**0.516**
	F2	1.636	1.636
	F3	0.00217	0.00217
	F4	0.00444	0.00444
	F5	250	250
	F6	0.47	0.47
	F7	7.3	7.3
	F8	400	400
Transverse Cracking	C1	2	**2.366**
	C2	1.22	1.22
	C4	0.52	0.52
	C5	-2.17	-2.17
IRI	J1	0.8203	**0.845**
	J2	0.4417	0.4417
	J3	1.4929	1.4929
	J4	25.24	**28.24**

PAPERS – TRB 2019

Chowdhury, R., Kassem, E., Alkuime, H., Bayomy. F., Mishra, D. "**Resilient Modulus Prediction Model for Unbound Coarse Materials**," The 98th Annual Meeting, Transportation Research Board, January 13-17, 2019, Washington, D.C.

Muftah, A., Bayomy, A., Kassem, E. "**Calibration of the AASHTOWare Pavement ME Design Performance Models for Flexible Pavement in Idaho**," The 98th Annual Meeting, Transportation Research Board, January 13-17, 2019, Washington, D.C.

PAPERS – TRB 2020

Muftah, A., Bayomy, F., and Kassem, E., "**Calibration of the AASHTOWare Pavement ME Design Performance Models for Flexible Pavements in Idaho**," Transportation research Board, paper No. TRB 19-02996. Presented at the 2019 TRB Annual meeting, Washington, DC, January 2019

Chowdhury*, R. M., Kassem, E., Alkumie*, H., Bayomy, F., and Mishra, D., "**Resilient Modulus Prediction Model for Unbound Coarse Materials,**" Transportation research Board, paper No. TRB 19-02590. Presented at the 2019 TRB Annual meeting, Washington, DC, January 2019

TRAINING WORKSHOPS

- DARWin ME, Boise 2014
- AASHTOWare PMED, Boise 2018
- AASHTOWare PMED, Boise 2019