Appendix D

Data Collection

Table D-1: Descriptions of projects

Project No.	Alternative No.	Route	Pavement Type	C.S.	J.N.	Submitted Date
1	2	I-75	JRCP	82191 & 82194	45699	12-Jun-01
2	2A	I-96	JRCP	23152	45640	20-Mar-01
	2B		JRCP			
	2C		JRCP			
3	2	I-69	JPCP	12033 & 12034	49921	16-Apr-01
4	2A	US-127	JPCP	38111	43497	27-Nov-00
	2B		JPCP			
	2C		JPCP			
5	2	M-39	JPCP	82192	45702	5-Jul-00
6	2	US-127	JRCP	82011 & 82061	45688	20-Mar-00
7	2	US-24	JRCP	63031	45714	1-Nov-99
8	2	I-96	JPCP	41024	51908	30-Aug-99
9	2	I-496	JRCP	33045	51396	19-Jul-00
10	2	I-75	JRCP	09034 & 09035	46575	1-Apr-00

Table D-2: Summary of pavement data from MDOT

Proj. No.	Date	Route	Alt. No.	Pavement Type	PCC Thickness (mm)			Base Thickness (mm)		
					Mainline	Outside Shoulder	Inside Shoulder	Mainline	Outside Shoulder	Inside Shoulder
1	12-Jun-01	I-75	2	JRCP	300	300	220	400	400	480
2	20-Mar-01	I-96	2A	JRCP	280	AC	AC	100	NA	NA
			2B	JRCP	280	AC	AC	100	NA	NA
			2C	JRCP	280	AC	AC	100	NA	NA
3	16-Apr-01	I-69	2	JPCP	280	AC	AC	100	NA	NA
4	27-Nov-00	US-127	2A	JPCP	240	AC	AC	100	NA	NA
			2B	JPCP	240	AC	AC	100	NA	NA
			2C	JPCP	240	AC	AC	100	NA	NA
5	5-Jul-00	M-39	2	JPCP	260	Valley Gutter	Valley Gutter	400	NA	NA
6	20-Mar-00	US-127	2	JRCP	280	280	220	100	100	160
7	1-Nov-99	US-24	2	JRCP	240	Valley Gutter	Valley Gutter	100	NA	NA
8	30-Aug-99	I-96	2	JPCP	260	AC	AC	100	NA	NA
9	19-Jul-00	I-496	2	JRCP	260	260	220	100	100	140
10	1-Apr-00	I-75	2	JRCP	260	260	220	100	100	140

Table D-2 (continued): Summary of pavement data from MDOT

Proj. No.	Date	Route	Alt.	Subbase1		Subbase2		MR of soils	Jt. Spa	Width (m)	DARWin Inputs			
			No.	Thickness	Type	Thickness	Type	(kPa)	(m)	Inner shoulder/lanes/outer shoulder	Sc (kPa)	E (kPa)	k-value (kPa/mm)	J
1	12-Jun-01	I-75	2	NA	NA	NA	NA	20,684	8	2.4/3.6/3.6/3.6/3.0	4,620	28,958,000	27	2.7
2	20-Mar-01	I-96	2A	300	Sand	NA	NA	22,260	8	3.0(AC)/3.6/3.6/3.6/3.0(AC)	4,620	28,958,000	35	2.7
			2B	46	Sand	254	Ex. Subbase	22,260	8	3.0(AC)/3.6/3.6/3.6/3.0(AC)	4,620	28,958,000	35	2.7
			2C	300	Sand	NA	NA	22,260	8	3.0(AC)/3.6/3.6/3.6/3.0(AC)	4,620	28,958,000	35	2.7
3	16-Apr-01	I-69	2	300	Sand	NA	NA	26,890	4.5	1.2(FSO)/3.6/4.2/2.4(FSO)	4,620	28,958,000	46	2.7
4	27-Nov-00	US-127	2A	305	Ex. Subbase	NA	NA	31,000	4.5	1.2(FSO)/3.6/4.2/2.4(FSO)	4,620	28,958,000	43	2.7
			2B	182	Sand	305	Ex. Subbase	31,000	4.5	1.2(FSO)/3.6/4.2/2.4(FSO)	4,620	28,958,000	43	2.7
			2C	300	Sand	NA	NA	31,000	4.5	1.2(FSO)/3.6/4.2/2.4(FSO)	4,620	28,958,000	43	2.7
5	5-Jul-00	M-39	2	NA	NA	NA	NA	24,475	4.5	NA/3.6/3.6/3.6/NA	4,620	28,958,000	60	2.7
6	20-Mar-00	US-127	2	300	Sand	NA	NA	20,680	8	1.5/3.6/3.6/3.0	4,620	28,958,000	35	2.7
7	1-Nov-99	US-24	2	300	Sand	452	Ex. Subbase	20,684	8	3.658/3.658/3.658/3.658	4,620	28,958,000	38	2.7
8	30-Aug-99	I-96	2	280	Ex. Sand	NA	NA	26,200	4.5	1.2(AC)/3.6/3.6/3.0(AC)	4,620	28,958,000	43	2.7
9	19-Jul-00	I-496	2	219	Ex. Subbase	NA	NA	20,684	8	2.4/3.6/3.6/3.6/3.0	4,620	28,958,000	24	2.7
10	1-Apr-00	I-75	2	300	Sand	NA	NA	27,500	8	2.4/3.6/3.6/3.6/3.6	4,620	28,958,000	41	2.7

Table D-3: Source of input

Inputs	MDOT	Other sources
Slab width (outer), in	✔	
Slab width (next to outer), in	✔	
Outer shoulder width (if PCC), in	✔	
Outer shoulder width (if AC), in	✔	
Joint spacing, in.	✔	
PCC thickness, in	✔	
PCC elastic modulus, psi	✔	
PCC CTE, in./in./°F		✔
PCC unit weight, lb/in^3		✔
PCC Poisson's ratio		✔
AC elastic modulus (AC shoulder), psi		✔
Interface condition		✔
Base thickness, in	✔	
Base elastic modulus, psi		✔
Base CTE, in./in./°F		✔
Base unit weight, lb/in^3		✔
Base Poisson's ratio		✔
Subbase thickness, in	✔	
Subbase elastic modulus, psi		✔
Subbase CTE, in./in./°F		✔
Subbase unit weight, lb/in^3		✔
Subbase Poisson's ratio		✔
k-value, psi/in	✔	
Dowel bar diameter, in.	✔	
Dowel bar spacing, in.	✔	
LTE lane/lane (AGG), psi		✔
LTE lane/shoulder (AGG), psi		✔
Total	12	15

Table D-4: Additional inputs used in ISLAB2000 analysis

Inputs	Possible Range		Selected Value	Reason for Selection
	Min.	Max.		
PCC CTE, in./in./^{o}F	3.3×10^{-6}	6.7×10^{-6}	5.0×10^{-6}	typical value
PCC unit weight, lb/in^{3}	0.070	0.104	0.087	typical value (150 pcf)
PCC Poisson's ratio	0.15	0.20	0.15	typical value
AC elastic modulus (AC shoulder), psi	300,000	600,000	300,000	conservative value
Interface condition	unbonded	bonded	unbonded	untreated granular base
Base elastic modulus, psi	15,000	45,000	30,000	typical value
Base CTE, in./in./^{o}F	3.0×10^{-6}	6.0×10^{-6}	3.0×10^{-6}	typical value for limestone
Base unit weight, lb/in^{3}	0.049	0.070	0.061	typical value (105 pcf)
Base Poisson's ratio	0.30	0.40	0.35	typical value
Subbase elastic modulus, psi	10,000	25,000	15,000	typical value for sand
Subbase CTE, in./in./^{o}F	3.0×10^{-6}	6.0×10^{-6}	3.0×10^{-6}	typical value for sand
Subbase unit weight, lb/in^{3}	0.049	0.070	0.061	typical value (105 pcf)
Subbase Poisson's ratio	0.30	0.45	0.35	typical value
LTE lane/lane (AGG), psi	1,000	1,000,000	1,000,000	high aggregate interlock
LTE lane/shoulder (AGG), psi	1,000	1,000,000	1,000 (AC shoulder)	low aggregate interlock
			1,000,000 (PCC shoulder)	high aggregate interlock

Table D-5: Summary of inputs used in ISLAB2000 analysis

Inputs			1/2	2/2A	2/2B	2/2C	3/2	4/2A	4/2B
Slab width (outer), in			142	142	142	142	165	165	165
Slab width (next to outer), in			142	142	142	142	142	142	142
Outer shoulder width (if PCC), in			118	0	0	0	0	0	0
Outer shoulder width (if AC), in			0	118	118	118	94	94	94
Joint spacing, in.			315	315	315	315	177	177	177
PCC thickness, in			12	11	11	11	11	9	9
PCC elastic modulus, psi			$4.2x10^6$	$4.2x10^6$	$4.2x10^6$	$4.2x10^6$	$4.2x10^6$	$4.2x10^6$	$4.2x10^6$
PCC CTE, in./in./^{o}F			$5.0x10^{-6}$	$5.0x10^{-6}$	$5.0x10^{-6}$	$5.0x10^{-6}$	$5.0x10^{-6}$	$5.0x10^{-6}$	$5.0x10^{-6}$
PCC unit weight, lb/in^2			0.087	0.087	0.087	0.087	0.087	0.087	0.087
PCC Poisson's ratio			0.15	0.15	0.15	0.15	0.15	0.15	0.15
AC elastic modulus (for AC shoulder), psi			0	300,000	300,000	300,000	300,000	300,000	300,000
Interface condition			unbonded	unbonded	unbonded	unbonded	unbonded	unbonded	unbonded
Most realistic simulation		Base thickness, in	15.75	3.94	3.94	3.94	3.94	3.94	3.94
		Base elastic modulus, psi	30,000	30,000	30,000	30,000	30,000	30,000	30,000
		Base CTE, in./in./^{o}F	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$
		Base unit weight, lb/in^3	0.061	0.061	0.061	0.061	0.061	0.061	0.061
		Base Poisson't ratio	0.35	0.35	0.35	0.35	0.35	0.35	0.35
		Subbase thickness, in	0.0	11.8	11.8	11.8	11.8	12.0	19.2
		Subbase elastic modulus, psi	15,000	15,000	15,000	15,000	15,000	15,000	15,000
		Subbase CTE, in./in./^{o}F	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$
		Subbase unit weight, lb/in^3	0.061	0.061	0.061	0.061	0.061	0.061	0.061
		Subbase Poisson's ratio	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Simplified simulation	Combined base/subbase	Base/subbase thickness, in	15.75	9.60	9.60	9.60	9.60	9.75	15.31
		Base/subbase elastic modulus, psi	30,000	30,000	30,000	30,000	30,000	30,000	30,000
		Base/subbase CTE, in./in./^{o}F	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$
		Base/subbase unit weight, lb/in3	0.061	0.061	0.061	0.061	0.061	0.061	0.061
		Base/subbase Poisson's ratio	0.35	0.35	0.35	0.35	0.35	0.35	0.35
	No subbase layer	Base thickness, in	15.75	3.94	3.94	3.94	3.94	3.94	3.94
		Base elastic modulus, psi	30,000	30,000	30,000	30,000	30,000	30,000	30,000
		Base CTE, in./in./^{o}F	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$
		Base unit weight, lb/in^3	0.061	0.061	0.061	0.061	0.061	0.061	0.061
		Base Poisson't ratio	0.35	0.35	0.35	0.35	0.35	0.35	0.35
		Subbase layer	No	No	No	No	No	No	No
k-value, psi/in			99.5	128.9	128.9	128.9	169.5	158.4	158.4
Dowel bar diameter, in.			1.25	1.25	1.25	1.25	1.25	1.25	1.25
Dowel bar spacing, in.			12	12	12	12	12	12	12
Dowel bar in shoulder			No	No	No	No	No	No	No
LTE lane/lane (AGG), psi			$1x10^6$	$1x10^6$	$1x10^6$	$1x10^6$	$1x10^6$	$1x10^6$	$1x10^6$
LTE lane/shoulder (AGG), psi			$1x10^6$	1,000	1,000	1,000	1,000	1,000	1,000

Table D-5: Summary of inputs used in ISLAB2000 analysis (continued)

Inputs			4/2C	5/2	6/2	7/2	8/2	9/2	10/2
Slab width (outer), in			165	142	142	144	142	142	142
Slab width (next to outer), in			142	142	142	144	142	142	142
Outer shoulder width (if PCC), in			0	12	118	12	0	118	142
Outer shoulder width (if AC), in			94	0	0	0	118	0	0
Joint spacing, in.			177	177	315	315	177	315	315
PCC thickness, in			9	10	11	9	10	10	10
PCC elastic modulus, psi			$4.2x10^6$	$4.2x10^6$	$4.2x10^6$	$4.2x10^6$	$4.2x10^6$	$4.2x10^6$	$4.2x10^6$
PCC CTE, in./in./^{o}F			$5.0x10^{-6}$	$5.0x10^{-6}$	$5.0x10^{-6}$	$5.0x10^{-6}$	$5.0x10^{-6}$	$5.0x10^{-6}$	$5.0x10^{-6}$
PCC unit weight, lb/in^2			0.087	0.087	0.087	0.087	0.087	0.087	0.087
PCC Poisson's ratio			0.15	0.15	0.15	0.15	0.15	0.15	0.15
AC elastic modulus (for AC shoulder), psi			300,000	0	0	0	300,000	0	0
Interface condition			unbonded	unbonded	unbonded	unbonded	unbonded	unbonded	unbonded
Most realistic simulation		Base thickness, in	3.94	15.75	3.94	3.94	3.94	3.94	3.94
		Base elastic modulus, psi	30,000	30,000	30,000	30,000	30,000	30,000	30,000
		Base CTE, in./in./^{o}F	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$
		Base unit weight, lb/in^3	0.061	0.061	0.061	0.061	0.061	0.061	0.061
		Base Poisson't ratio	0.35	0.35	0.35	0.35	0.35	0.35	0.35
		Subbase thickness, in	11.8	0.0	11.8	29.6	11.0	8.6	11.8
		Subbase elastic modulus, psi	15,000	15,000	15,000	15,000	15,000	15,000	15,000
		Subbase CTE, in./in./^{o}F	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$
		Subbase unit weight, lb/in^3	0.061	0.061	0.061	0.061	0.061	0.061	0.061
		Subbase Poisson's ratio	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Simplified simulation	Combined base/subbase	Base/subbase thickness, in	9.60	15.75	9.60	23.54	9.01	7.25	9.60
		Base/subbase elastic modulus, psi	30,000	30,000	30,000	30,000	30,000	30,000	30,000
		Base/subbase CTE, in./in./^{o}F	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$
		Base/subbase unit weight, lb/in3	0.061	0.061	0.061	0.061	0.061	0.061	0.061
		Base/subbase Poisson's ratio	0.35	0.35	0.35	0.35	0.35	0.35	0.35
	No subbase layer	Base thickness, in	3.94	15.75	3.94	3.94	3.94	3.94	3.94
		Base elastic modulus, psi	30,000	30,000	30,000	30,000	30,000	30,000	30,000
		Base CTE, in./in./^{o}F	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$	$2.0x10^{-6}$
		Base unit weight, lb/in^3	0.061	0.061	0.061	0.061	0.061	0.061	0.061
		Base Poisson't ratio	0.35	0.35	0.35	0.35	0.35	0.35	0.35
		Subbase layer	No	No	No	No	No	No	No
k-value, psi/in			158.4	221.0	128.9	140.0	158.4	88.4	151.0
Dowel bar diameter, in.			1.25	1.25	1.25	1.25	1.25	1.25	1.25
Dowel bar spacing, in.			12	12	12	12	12	12	12
Dowel bar in shoulder			No	No	No	No	No	No	No
LTE lane/lane (AGG), psi			$1x10^6$	$1x10^6$	$1x10^6$	$1x10^6$	$1x10^6$	$1x10^6$	$1x10^6$
LTE lane/shoulder (AGG), psi			1,000	$1x10^6$	$1x10^6$	$1x10^6$	1,000	$1x10^6$	$1x10^6$

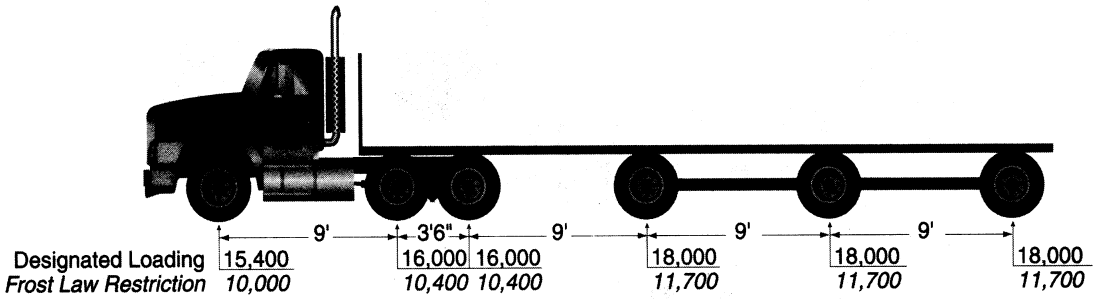

Figure D-1: Example of truck configuration (MI-9)

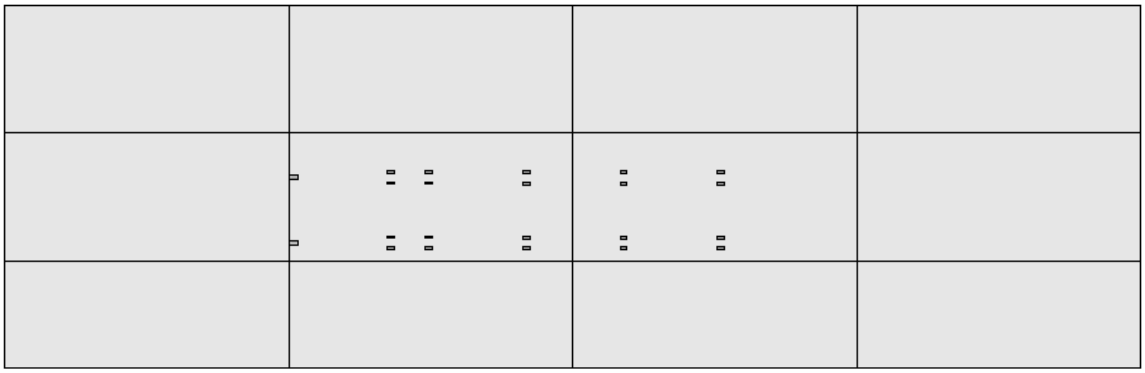

Figure D-2: Example of pavement feature with PCC/AC shoulder in ISLAB2000 analysis

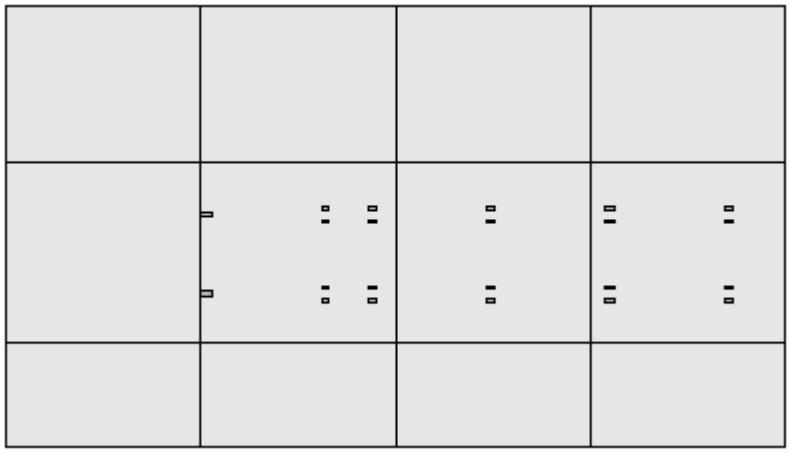

Figure D-3: Example of pavement feature with widened lane in ISLAB2000 analysis

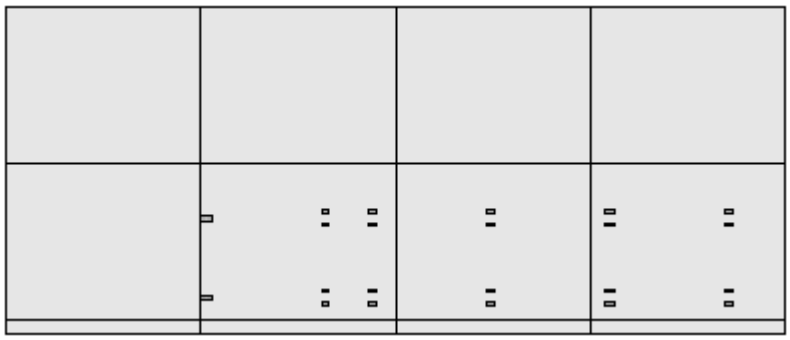

Figure D-4: Example of pavement feature with valley gutter in ISLAB2000 analysis