RowanUniversity
CENTER FOR RESEARCH & EDUCATION IN ADVANCED TRANSPORTATION ENGINEERING SYSTEMS

Influence of Temperature and Seasonal Correction Methods on Falling Weight Deflectometer (FWD) based Overlay Thickness for Asphalt Pavements in New Jersey

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Background & Goal of the study

- Falling Weight Deflectometer (FWD) testing is widely used in the rehabilitation design of asphalt pavements; however, proper consideration of temperature and seasonal variations significantly influences final overlay thickness.
- Typically, corrections are applied either to measured deflections or to back-calculated layer moduli. Nevertheless, limited research has been conducted on the selection of correction approach affects the final design thickness.
- ***Goal of the study:*** To evaluate the influence of correction approaches (deflection and modulus) on asphalt overlay thickness design for thin pavements, with reference to the standard AASHTO 1993 design procedure.

Data Collection

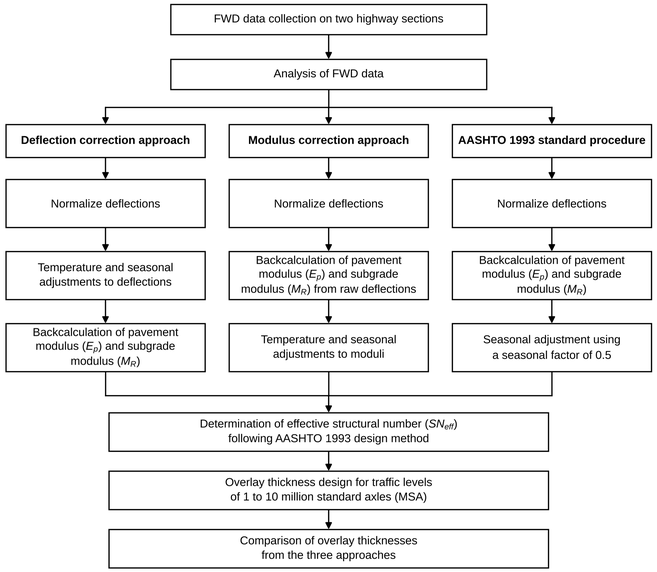
- FWD deflection data were collected from two highway sections in New Jersey, representing thin (<10 inches) pavement classifications as defined in the New Jersey Department of Transportation (NJDOT) FWD manual.
- Pavements are classified as thin if they have an asphalt layer less than 10 inches or a total pavement thickness above the subgrade of less than 30 inches.
- The thin pavement section, located on Interstate-295 Southbound, consisted of a 7-inch asphalt layer over 19 inches of granular base and subbase, yielding a total thickness of 26 inches.
- Another section was NJ-47 northbound section, the thicknesses of the asphalt, granular layers are 4.5 inches and 12 inches,





FWD data collection on I-295 Southbound section

Methodology



Raw Deflection Data

Route	Station	Load (lbs)	Air temp (°F)	Surface temp (°F)	Pave-ment temp (°F)	Deflections (mils)								
I-295	41.136	9347	75	76	74	9.81	7.42	8.42	7.49	4.97	3.2	2.1	1.48	1.09
I-295	41.136	9355	75	76	74	9.82	7.39	8.41	7.46	4.96	3.2	2.1	1.48	1.1
I-295	41.136	9421	75	76	74	9.97	7.48	8.52	7.58	5	3.22	2.11	1.44	1.11
I-295	41.183	9490	75	75	74	15.71	11.22	12.75	10.91	6.58	3.92	2.44	1.74	1.33
I-295	41.183	9490	75	75	74	15.65	11.19	12.71	10.88	6.56	3.93	2.45	1.75	1.31
I-295	41.183	9509	75	75	74	15.88	11.3	12.84	10.98	6.6	3.93	2.44	1.78	1.3
I-295	41.233	9620	75	75	74	13.07	9.11	10.23	8.62	4.93	2.79	1.65	1.15	0.81

Raw Deflection Data of I-295 Southbound section

Data Analysis and Results

Traffic level	Subgrade Resilient Modulus (psi)				Required Structural number (SN_{req})				Effective Structural number (SN_{eff})				Overlay thickness (inches)				Thickness difference (inches) compared to 0.5-factor design method			
	NJDOT manual		FWD manual		NJDOT manual		FWD manual		NJDOT manual		FWD manual		NJDOT manual		FWD manual		NJDOT manual		FWD manual	
	Without factor 0.5	With factor 0.5	Deflection	Modulus	Without factor 0.5	With factor 0.5	Deflection	Modulus	Without factor 0.5	With factor 0.5	Deflection	Modulus	Without factor 0.5	With factor 0.5	Deflection	Modulus	Without factor 0.5	With factor 0.5	Deflection	Modulus
10	7757.4	3878.7	6957.5	6594.1	5.01	6.23	5.19	5.28	5.30	5.30	5.04	5.07	NR	2.1	0.3	0.5	-2.1	-	-1.9	-1.6
7					4.76	5.95	4.93	5.02	5.30	5.30	5.04	5.07	NR	1.5	NR	NR	-1.5	-	-1.5	-1.5
5					4.53	5.69	4.70	4.78	5.30	5.30	5.04	5.07	NR	0.9	NR	NR	-0.9	-	-0.9	-0.9
3					4.19	5.30	4.35	4.44	5.30	5.30	5.04	5.07	NR	NR	NR	NR	-	-	-	-
1					3.51	4.52	3.66	3.74	5.30	5.30	5.04	5.07	NR	NR	NR	NR	-	-	-	-

SNeff and Overlay Thickness for the Southbound Section of I-295

Traffic level	Subgrade Resilient Modulus (psi)				Required Structural number (SN_{req})				Effective Structural number (SN_{eff})				Overlay thickness (inches)				Thickness difference (inches) compared to 0.5-factor design method			
	NJDOT manual		FWD manual		NJDOT manual		FWD manual		NJDOT manual		FWD manual		NJDOT manual		FWD manual		NJDOT manual		FWD manual	
	Without factor 0.5	With factor 0.5	Deflection	Modulus	Without factor 0.5	With factor 0.5	Deflection	Modulus	Without factor 0.5	With factor 0.5	Deflection	Modulus	Without factor 0.5	With factor 0.5	Deflection	Modulus	Without factor 0.5	With factor 0.5	Deflection	Modulus
10	5292.4	2646.2	4486.7	4249.4	5.66	6.99	5.96	6.06	3.11	3.11	2.91	2.80	5.8	8.8	6.9	7.4	-3.0	-	-1.9	-1.4
7					5.40	6.68	5.69	5.78	3.11	3.11	2.91	2.80	5.2	8.1	6.3	6.8	-2.9	-	-1.8	-1.3
5					5.15	6.39	5.43	5.52	3.11	3.11	2.91	2.80	4.6	7.5	5.7	6.2	-2.8	-	-1.8	-1.3
3					4.78	5.98	5.06	5.15	3.11	3.11	2.91	2.80	3.8	6.5	4.9	5.3	-2.7	-	-1.6	-1.2
1					4.05	5.15	4.30	4.38	3.11	3.11	2.91	2.80	2.1	4.6	3.2	3.6	-2.5	-	-1.4	-1.0

SNeff and Overlay Thickness for the Northbound Section of NJ47

Conclusions

Overlay thickness: The NJDOT companion-manual approach with the 0.5 seasonal factor gave the largest overlay thickness. Without the 0.5 factor, it gave a higher SNeff and a thinner overlay than the FWD manual methods.

Deflection correction: The FWD manual method gave lower Ep and SNeff than the current NJDOT procedure. NJDOT (AASHTO 1993) corrects deflections for temperature only, while the FWD manual also applies a seasonal correction.

Modulus correction: The FWD manual method also gave lower Ep and SNeff than the NJDOT method, because its seasonal multipliers reduce Ep directly.

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