Flexible Overlay Pavement Design Example
1993 AASHTO Pavement Design

Project Name and Location:
Route 123, MP 7.3 – 11.0
Hometown, NJ

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Description:
This project will consist of the construction of a flexible overlay of an existing flexible pavement to extend Route 123 to intersect with Route I-80 in North Jersey.

General Information:

		Reference:
Initial Serviceability, p_o	4.2	II-10 & NJ serviceability loss
Terminal Serviceability, p_t	2.5	II-10 & NJ serviceability loss
Reliability Level, R	90%	I-53 to I-64 or II-9, III-82 & NJ Reliability
Overall Standard Deviation, S	0.45	I-62 or II-9 & NJ Standard Deviation
Performance Period	20 years	II-5 to II-8 & NJ Performance Period

Design Overlay Thickness, D_{OL}
(Thickness precision: Round up to nearest 1/2 inch)

$SN_f = SN_{eff}$-(milling depth)*(a_1 of existing HMA)+(a_{OL}*D_{OL})

SN_{OL}= Structural Number of the Overlay = (a_{OL}*D_{OL})
a_{OL}= Structural layer coefficient of the HMA overlay material
D_{OL}= Thickness of the HMA overlay, inch
SN_f= Structural Number to carry future traffic
SN_{eff}= Structural Number of the existing pavement

Step 4 III-96 or
Figure 5.8 III-103

Step 1: Exiting pavement design

Thickness	Layer Material
2 inch	I-4 Bituminous Surface Cource
8 inch	I-2 Bituminous Base Cource
8 inch	DGABC
8 inch	Subbase
26 inch	.Total

Step 2: Traffic Analysis

Traffic Data and Analysis:

Initial AADT	30127	Based on data supplied by the NJDOT Project Manager
Final AADT	42,628	

CAR%	84	
CAR_f	0.0008	
LT%	8	
LT_f	0.163	
HT%	8	
HTf	1.655	
Year	20	
Days	365	
DD%	58	II-7 & NJ Directional Distribution
DL%	90	II-7, 8 & NJ Lane Distribution

Step 3: Condition Survey

Surface has extensive deterioration and raveling. There is approximately ¾ inch of rutting and 10% moderate longitudinal and transverse cracks.

Step 4: Deflection Testing

Effective Roadbed Soil Resilient Modulus Data:

Month	Monthly MR
1 January	20000
2 February	20000
3 March	2800
4 April	4500
5 May	6500
6 June	7200
7 July	7600
8 August	8000
9 September	8000
10 October	7500
11 November	1000
12 December	18000
Effective MR	6000

II-12 to II-16 & I-13 to I-15 & III-91-97 & NJ Regional Season Lengths

Laboratory MR values for estimated conditions and stress levels.

Step 5: Coring and Material Testing
(backcalculated material properties will be used to estimate existing material properties)

Deterioration is limited to the surface course.

Step 6: Determining required structural number for future traffic

II-7 to II-9 & D-3 to D-11 & II-7 & II-8 & NJ Directional and Lane Distribution Factors

Accumulated ESALs Over 20 years in all lanes in each directions:

$$w_{18} = \left(\frac{AADT_i + AADT_f}{2} \right) * (Car\% * Carf + LT\% * LTf + HT\% * HTf) * Years * 365 \quad day/year$$

$$w_{18} = \left(\frac{30{,}127 + 42{,}628}{2} \right) * (84\% * 0.0008 + 8\% * 0.163 + 8\% * 1.655) * 20 * 365 \, day/year$$

= 41,180,995

Design ESALs (in Design Lane) Initial Performance Period:
Design ESALs = Accumulated ESALs * D_D*D_L
41,180,995*0.580*0.90=23,734,332

Design Structural Number Calculation, SN_f: = 6.30

Step 7: Determining effective structural number of existing pavement, (SN_{eff})

From FWD

$SN_{eff} = 0.0045 * D * \sqrt[3]{E_p} = 5.76$

D= Total thickness of all pavement layers of existing pavement above the subgrade, inch
E_p= Effective combined modulus of all pavement layers above the subgrade, psi

From condition estimate

Thickness	Layer Material	Estimated Layer Coefficient	Estimated SN
2 inch	I-4 Bituminous Surface Cource	.35	0.70
8 inch	I-2 Bituminous Base Cource	.44	3.52
8 inch	DGABC	.14	1.12
8 inch	Subbase	.08	0.64
	.	Total	5.98

Use SN_{eff} = 5.76

Step 8: Determining overlay thinkness, (D_{OL})

The project will be milled 2 inch. The existing HMA a_1 = 0.39

SN_{OL}= SN_f - SN_{eff}+(milling depth)*(a_1 of existing HMA) =

=6.30 - 5.76 + (2)(0.39)= 1.32

* $D_{OL}= \frac{1.32}{0.44} = 3.0$ inch

Thickness	Layer Material	Estimated Layer Coefficient	Estimated SN
3 inch	HMA 12.5H76 Surface Course	.44	1.32
2 inch	milling	.35	-.70
2 inch	I-4 Bituminous Surface Cource	.35	0.70
8 inch	I-2 Bituminous Base Cource	.44	3.52
8 inch	DGABC	.14	1.12
8 inch	Subbase	.08	0.64
	.	Total	6.60

SN(6.60 SN_f(6.30)
SN_{OL} (1.32) SN_{OL}= 1.32 Acceptable Design