

HMA Fatigue in FAARFIELD

Presented to: REDAC

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Federal Aviation
Administration

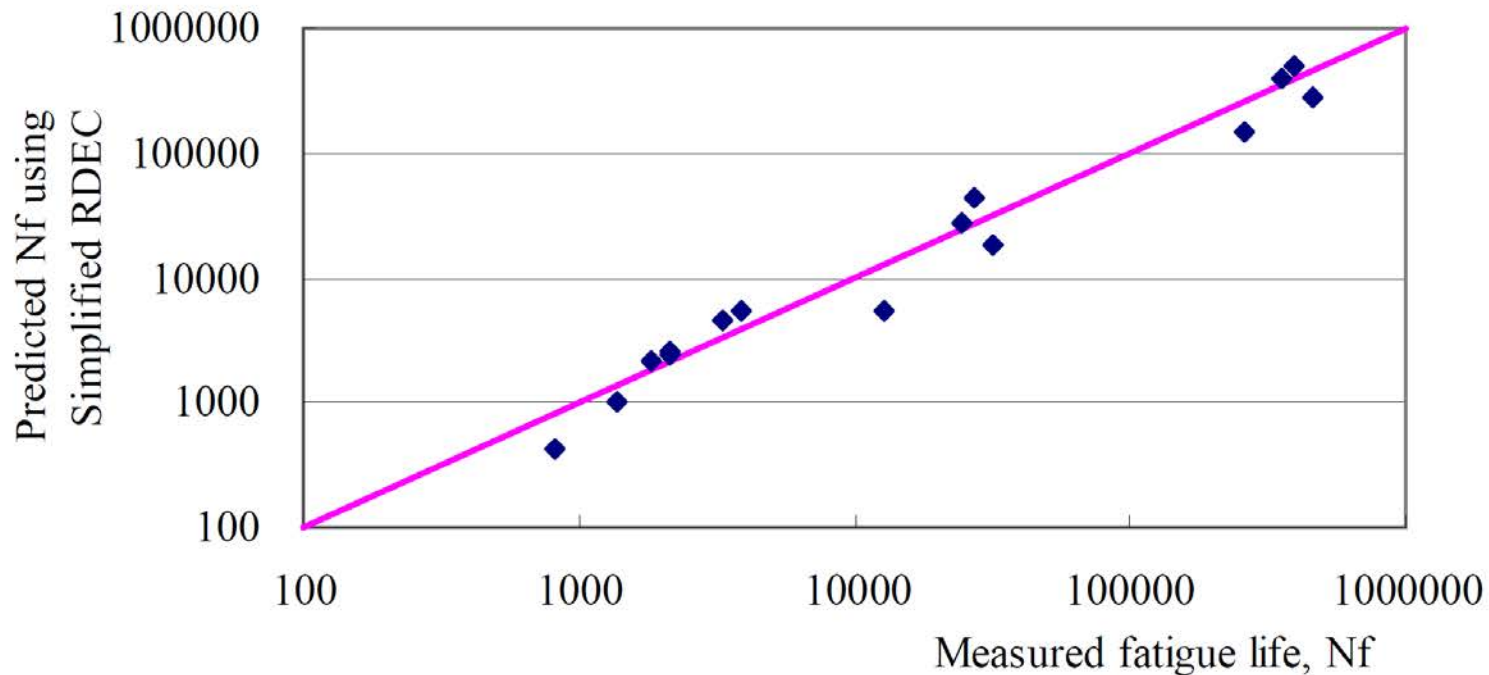


HMA Fatigue in FAARFIELD

- ❖ FAARFIELD is a computer program for airport pavement thickness design. FAA AC 150/5320-6F.
- ❖ Old HMA Fatigue Model: Heukelom & Klomp [1962]
$$\log_{10}(C) = 2.68 - 5 \times \log_{10}(\epsilon_h) - 2.665 \times \log_{10}(E_A)$$

AASHTO T321-14, Standard Method of Test for Determining the Fatigue Life of Compacted Asphalt Mixtures Subjected to Repeated Flexural Bending

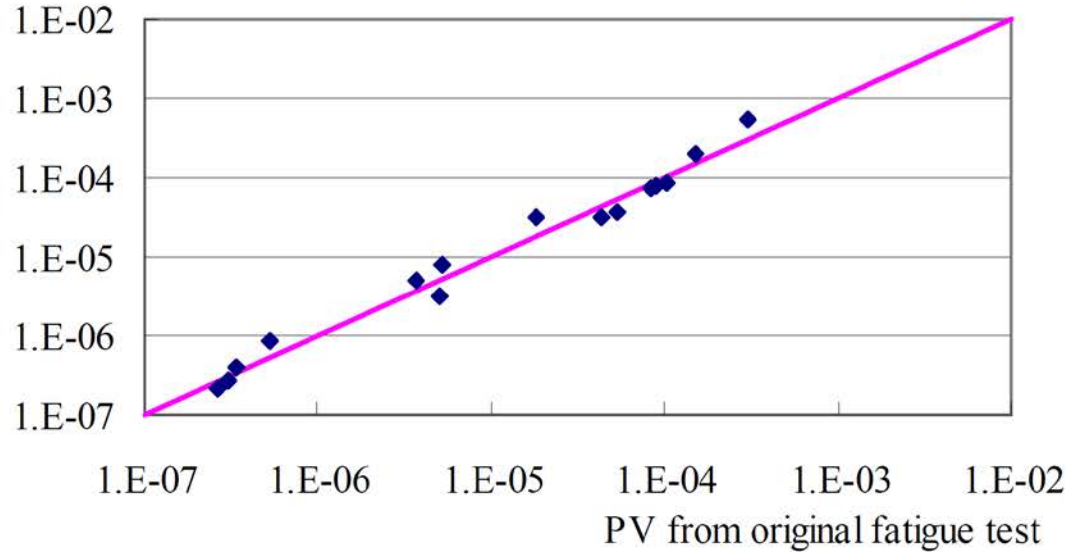




AN ENERGY APPROACH FOR AIRPORT PAVEMENT
LOW DAMAGE FATIGUE BEHAVIOR

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Predicted PV using Simplified RDEC



◆ Plateau Value Data — line of equality

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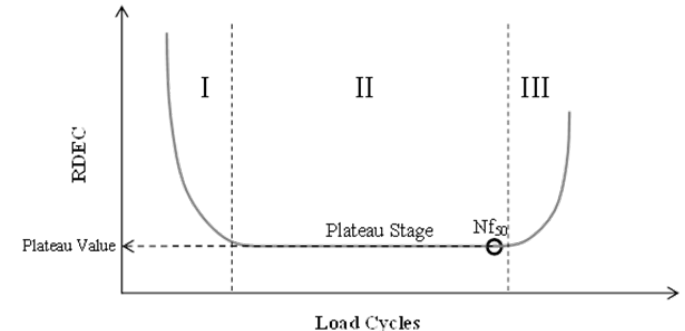
❖ New HMA Fatigue Model: Carpenter et.al. [1997, 2000, 2001, 2007]

$$N_f = 0.4801 \times PV^{-0.9007}$$

$$PV = 44.422 \times \varepsilon_h^{5.14} \times S^{2.993} \times VP^{1.85} \times GP^{-0.4063}$$

where PV is the estimated value of RDEC plateau value (dimensionless),
S is HMA flexural stiffness (psi),
 ε_h is horizontal strain at the bottom of the asphalt layer,
VP is the volumetric parameter, and
GP is gradation parameter.

(AASHTO T321-14, Standard Method of Test for Determining the Fatigue Life of Compacted Asphalt Mixtures Subjected to Repeated Flexural Bending)



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$$VP = V_a / (V_a + V_b)$$

$$GP = (P_{NMS} - P_{PCS}) / P_{200}$$

where

V_a is air voids,

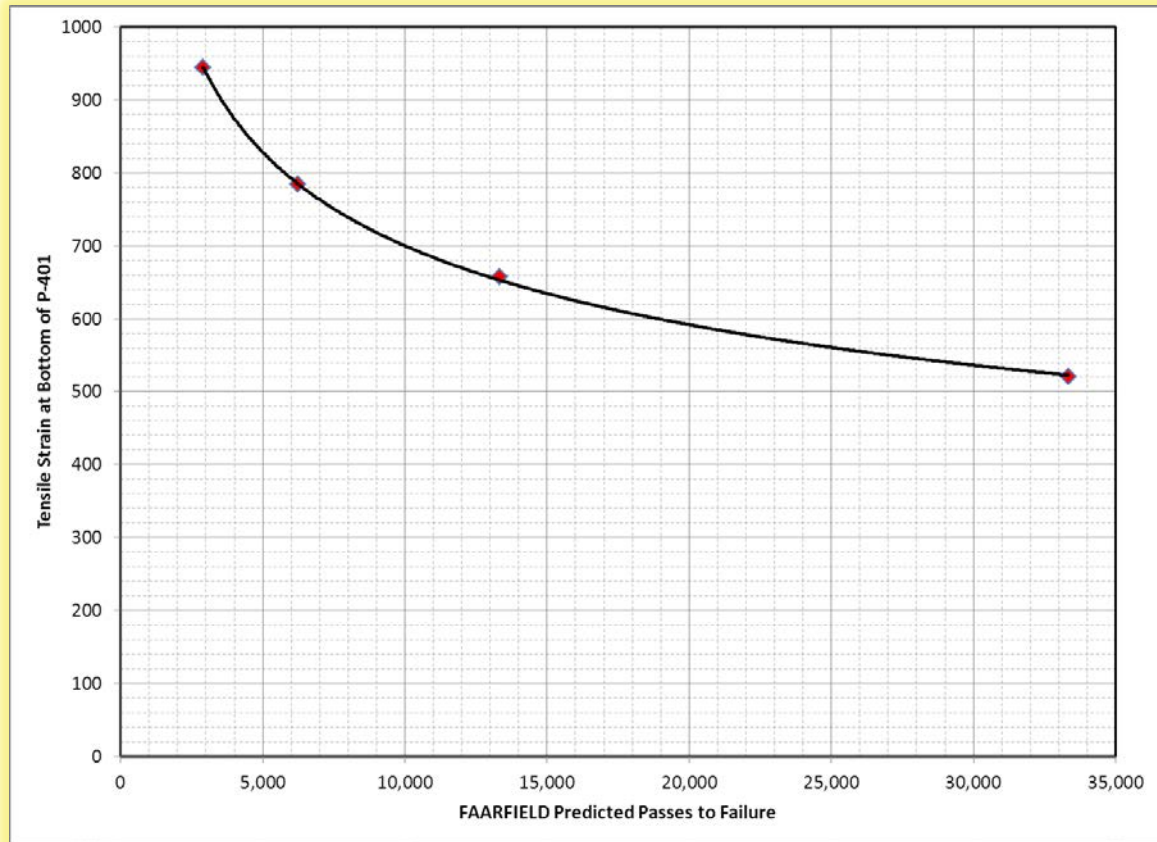
V_b is asphalt content by volume,

P_{NMS} is the % of aggregate passing the nominal maximum size sieve,

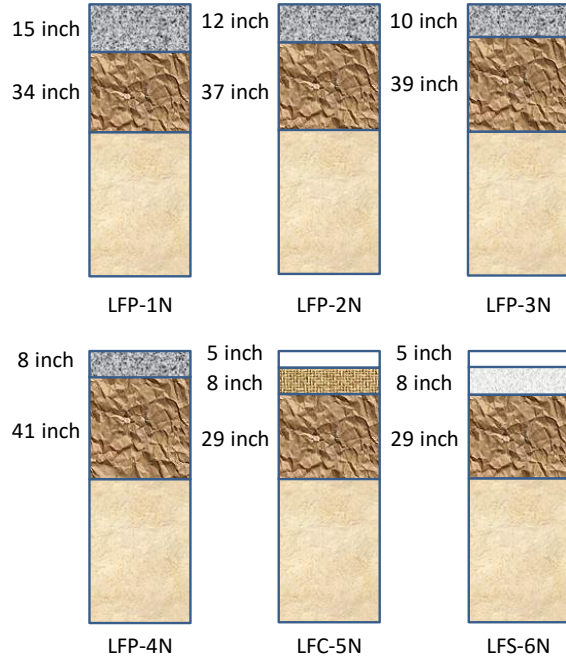
P_{PCS} is the % of aggregate passing the primary control sieve, and

P_{200} is the % of aggregate passing the #200 (0.075 mm) sieve.

CC7 – Perpetual Pavements



Pavement Cross Sections

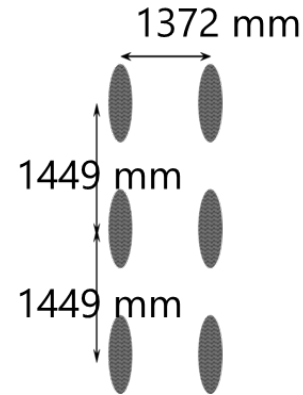


Traffic Tests

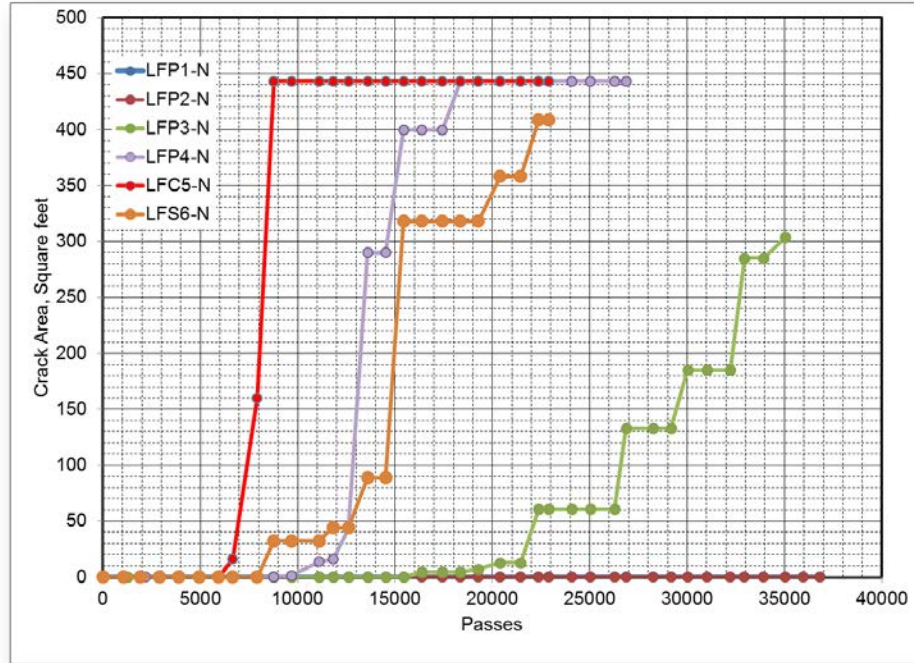
- Standard NAPTF wander pattern.

		51 & 52	63 & 64	65 & 66	61 & 62	55 & 56		
19 & 20	43 & 44	45 & 46	59 & 60	53 & 54	57 & 58	49 & 50	37 & 38	
1 & 2	35 & 36	21 & 22	41 & 42	47 & 48	39 & 40	25 & 26	29 & 30	27 & 28
	17 & 18	3 & 4	33 & 34	23 & 24	31 & 32	7 & 8	11 & 12	9 & 10
			15 & 16	5 & 6	13 & 14			
-4	-3	-2	-1	0	1	2	3	4

- 55 kips (245 kN) wheel load
- 6-wheel gear.



Crack Monitoring





PREDICTED & OBSERVED FATIGUE LIFE

Test Section	HMA Strain (from FAARFIELD)	PV	Pass to Coverage (P/C) Ratio	N _f from FAARFIELD		N _f from Full-Scale APT		Ratio (N _f APT/ N _f FAARFIELD)
				Passes	Coverages	Passes	Coverages	
PP-1	0.000524	2.14E-06	0.650	40000	61538	NO CRACKS OBSERVED		
PP-2	0.000657	6.86E-06	0.730	15385	21075			
PP-3	0.000781	1.67E-05	0.790	7407	9376	21450	27152	2.90
PP-4	0.000932	4.14E-05	0.860	3636	4228	11814	13737	3.25