IDOT
FULL-DEPTH HMA DESIGN

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JOINT HMA CONFERENCE
NCAU/PG
&
IL BITUMINOUS PAVING

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IDOT

FULL-DEPTH HMA DESIGN

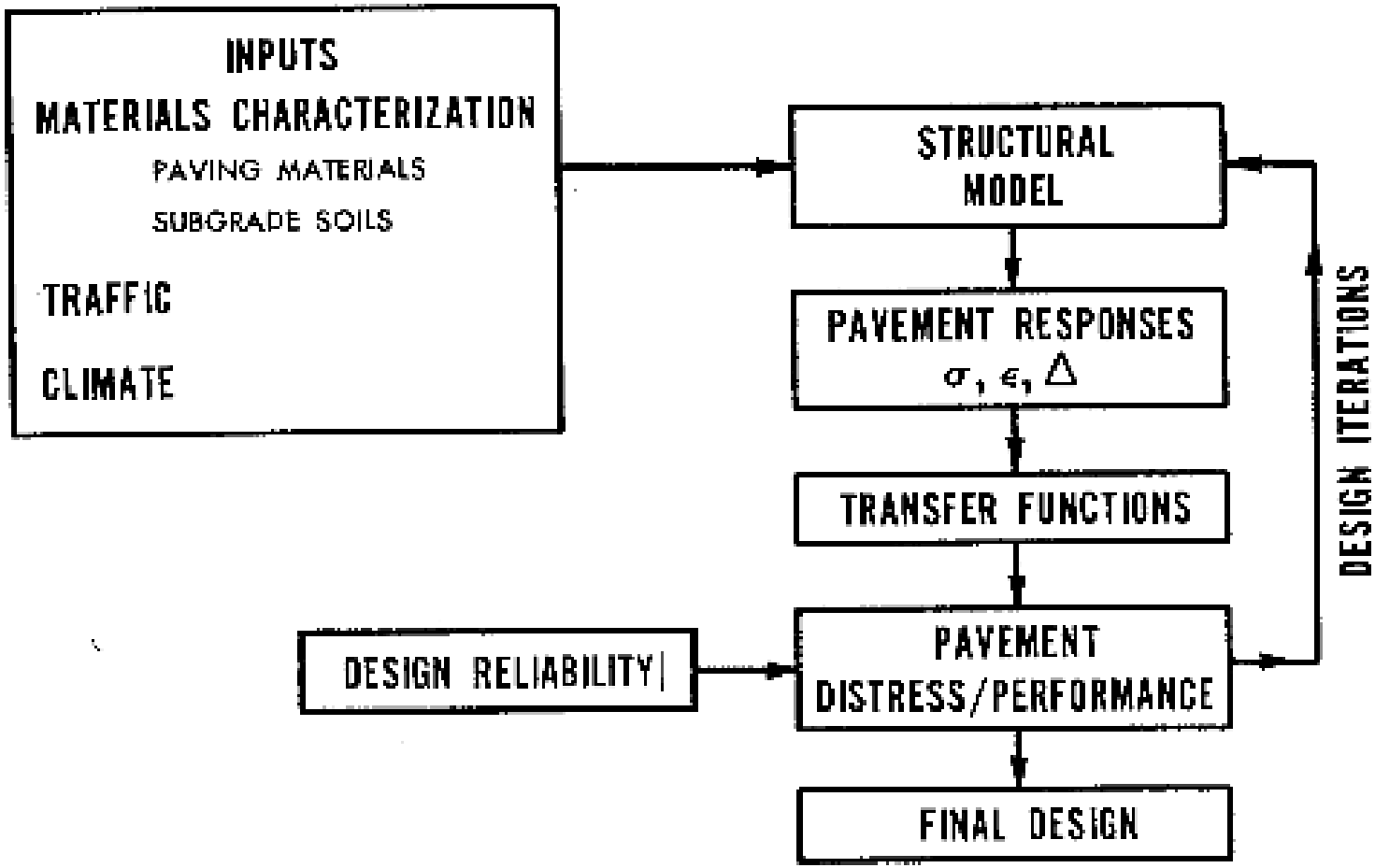
ADOPTED IN 1989

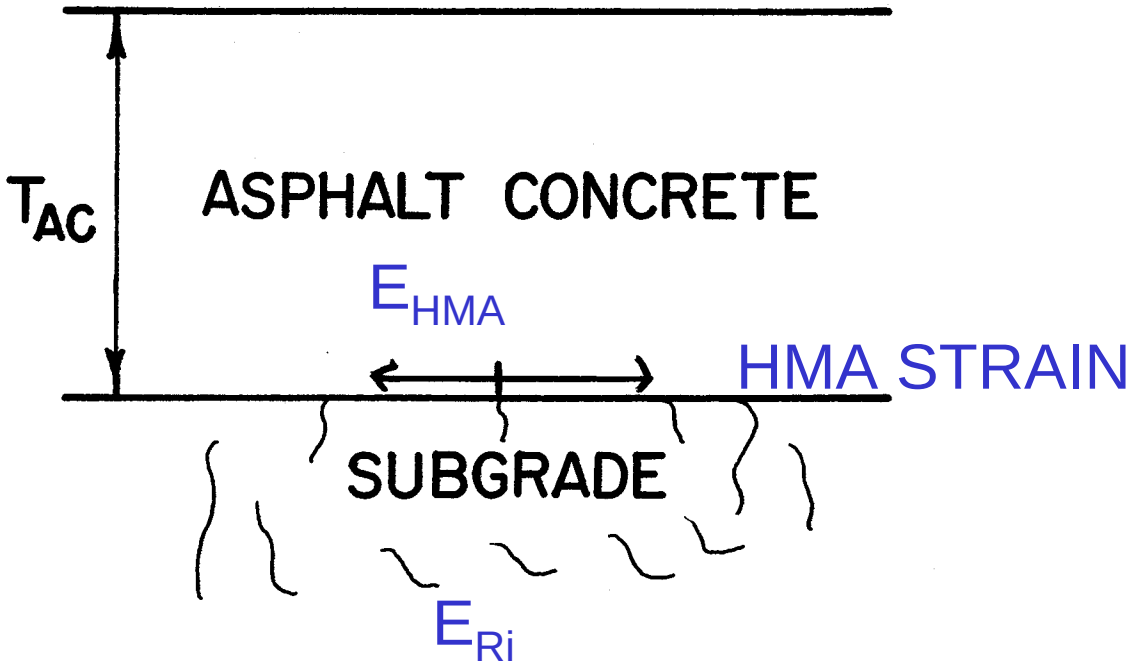
IL DOT

BUREAU OF
DESIGN AND ENVIRONMENT MANUAL

Chapter Fifty-Four
PAVEMENT DESIGN

M-E DESIGN FLOW CHART





DESIGN

- AC FATIGUE !!!!!!
- AC RUTTING
- SUBGRADE RUTTING

EARLY DEVELOPMENT
(IDOT R&D @ UofIL)

CHARACTERIZE MATERIALS

+ HMA – LINEAR ELASTIC
AI PROCEDURE / MS-1/ 1982
(TEMP & “f” DEPENDENT)

+ COHESIVE SOILS - “STRESS SOFTENING”

+ GRANULAR MATERIALS
“STRESS HARDENING”

SELECT STRUCTURAL MODEL

+ ILLI-PAVE

STRESS DEPENDENT

MOHR-COULOMB FAILURE

SELECT HMA FATIGUE ALGORITHM

+ BASED ON AVAILABLE DATA

+ $N = 5E\text{-}06 * (1/\text{HMA STRAIN})^3$

STRUCTURAL MODEL

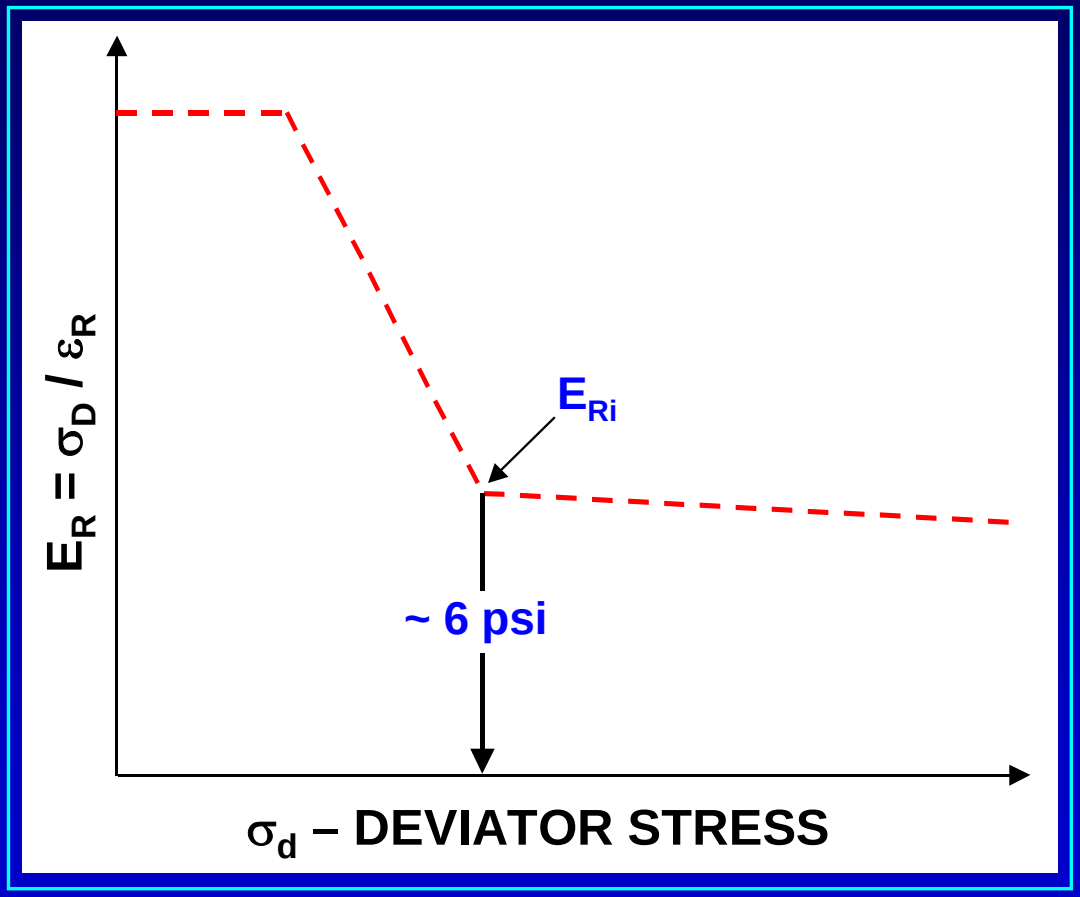
ILLI-PAVE

ILLI-PAVE INPUTS

* SUBGRADE MODULUS (E_{Ri})

* HMA MODULUS

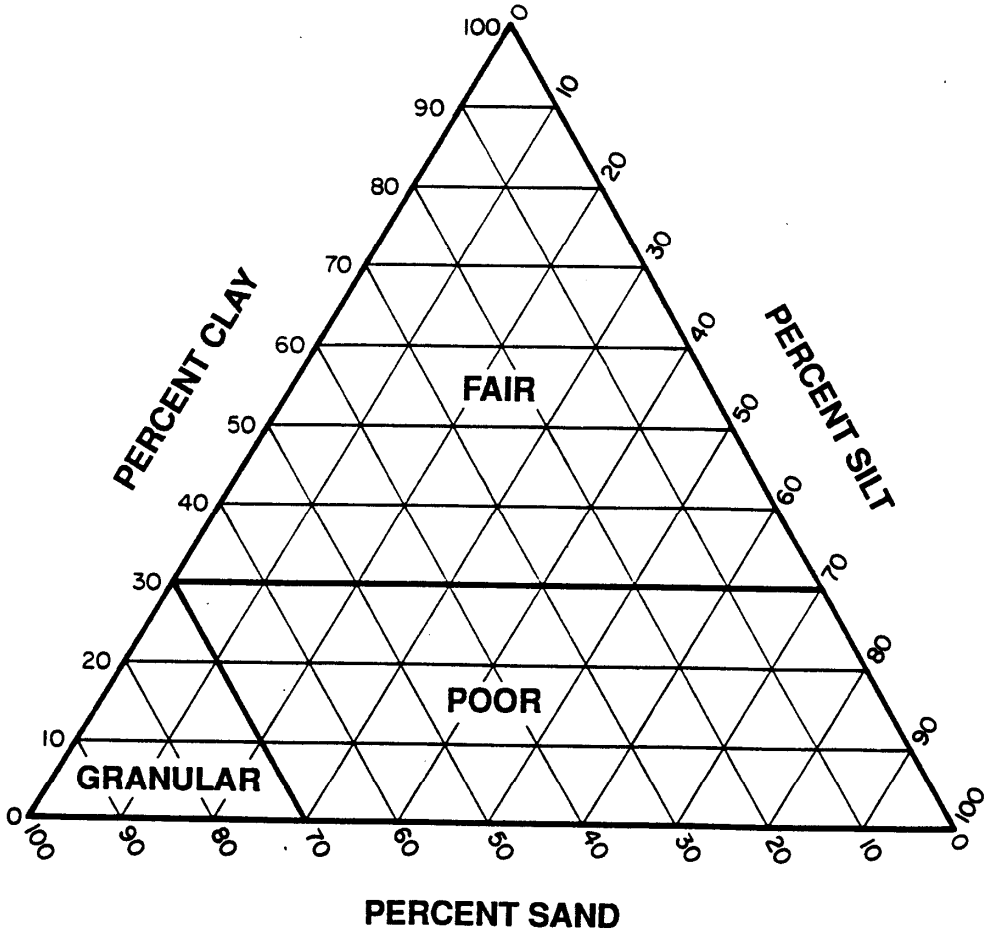
FINE - GRAINED



MODULUS CLASSES
FINE-GRAINED SOILS

SOIL	E_{Ri} (ksi)	Qu (psi)	CBR
STIFF	12.3	33	8
MEDIUM	7.7	23	5
SOFT	3.0	13	2
VERY SOFT	1.0	6	1

$$E_{Ri} \text{ (ksi)} = 0.42 \text{ Qu (psi)} - 2$$



IDOT
SSR PLOT
FIG. 54-2D

POOR- E_{Ri} = 2ksi
FAIR - E_{Ri} = 5 ksi

Particle-Size Limits

Sand 2.000 - 0.075 mm
Silt 0.075 - 0.002 mm
Clay finer than 0.002 mm

HOT MIX ASPHALT

LINEAR ELASTIC (E)

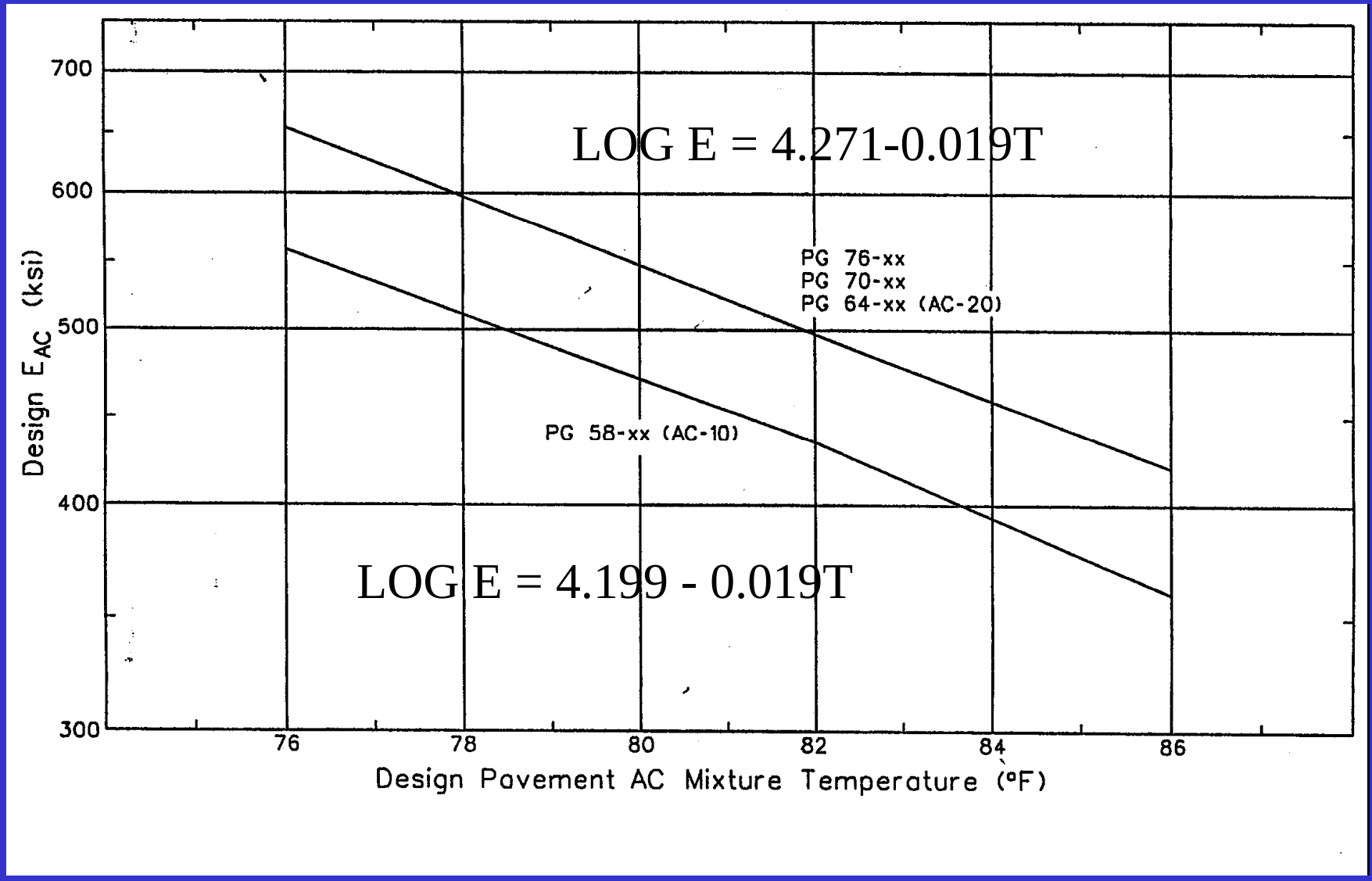
E = f (Temp & Freq)

AI PROCEDURE / MS-1/ 1982

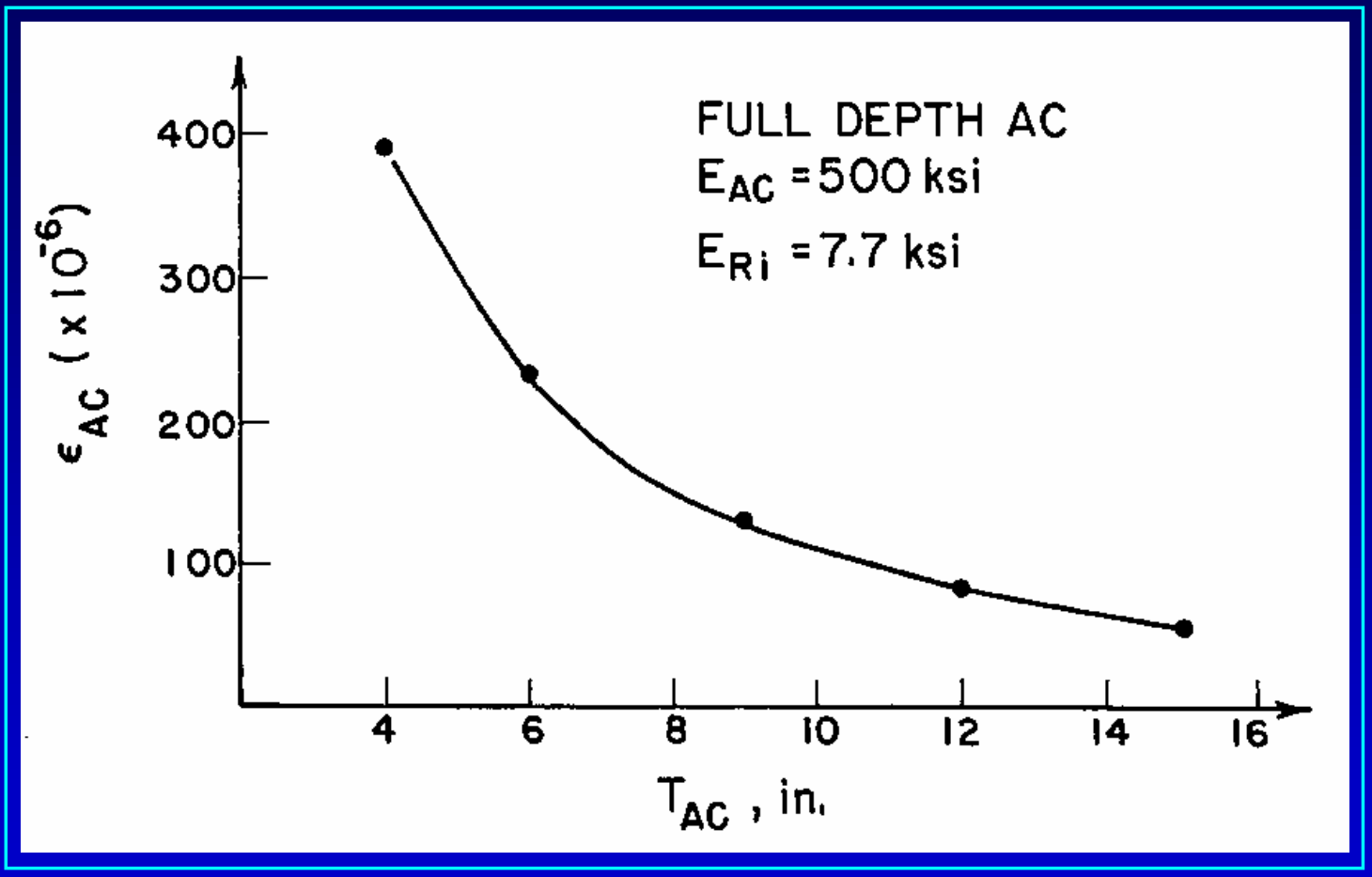
FULL-DEPTH HMA

$$\text{LOG } \varepsilon_{HMA} = 5.746 - 1.589 \text{ LOG } T_{HMA} - 0.774 \text{ LOG } E_{HMA} - 0.097 \text{ LOG } E_{Ri}$$

ε_{HMA}: $\mu\varepsilon$ T_{HMA} : in. E_{HMA}:ksi E_{Ri} : ksi



5% ASPHALT – 5% PASS#200 – 2%VOIDS - 10Hz

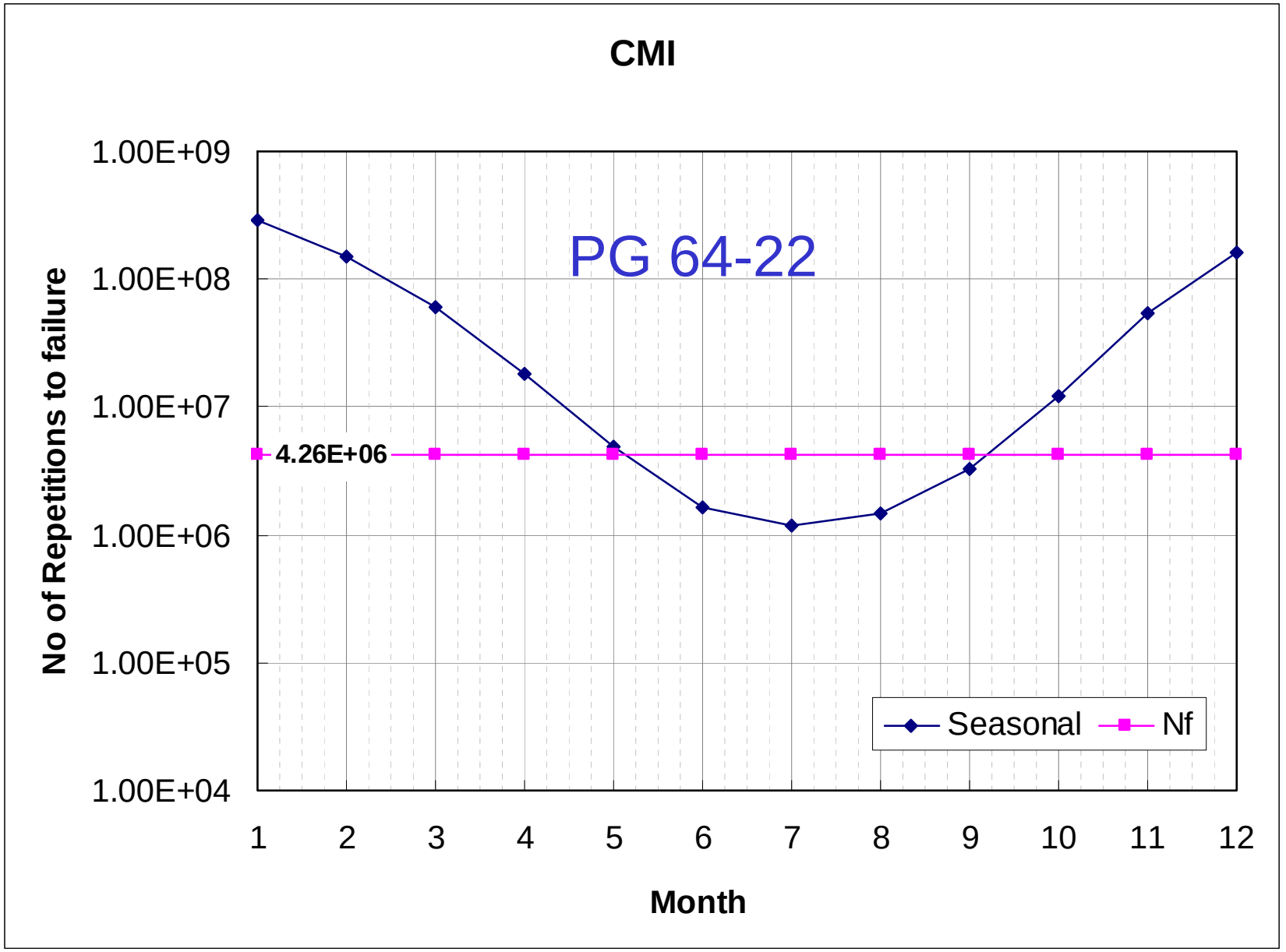

FULL DEPTH AC
E_{AC} = 500 ksi
E_{Ri} = 7.7 ksi
ϵ_{AC} ($\times 10^{-6}$)
400
300
200
100
4
6
8
10
12
14
16
T_{AC} , in.

IDOT FATIGUE ALGORITHM

$$N = 5E\text{-}06 \left(1 / \text{HMA STRAIN}\right)^3$$

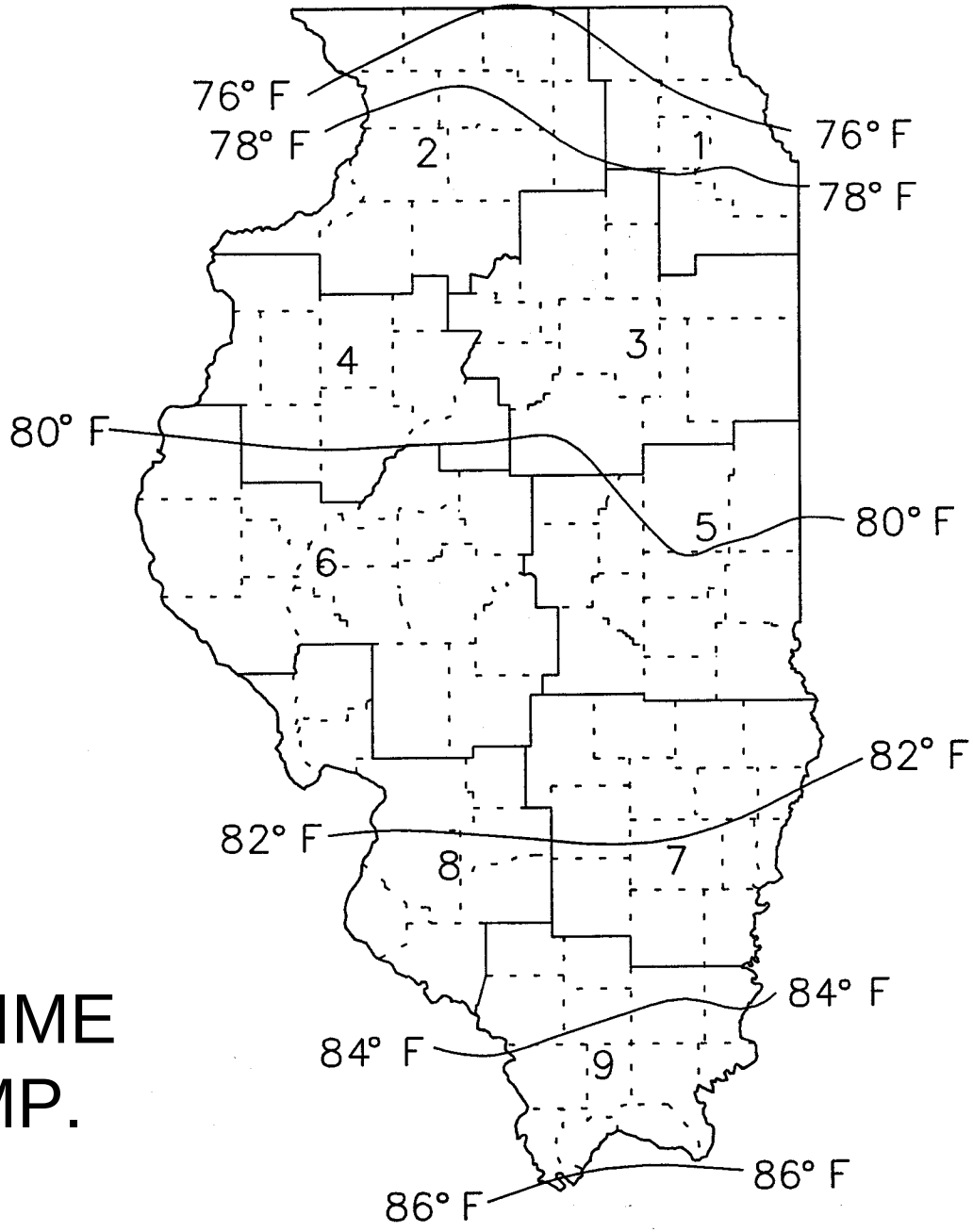
(VERY CONSERVATIVE !!)

DESIGN TIME TEMPERATURE



HMA T = 8 INS / E_{Ri} = 5 ksi

DESIGN TIME HMA TEMP.



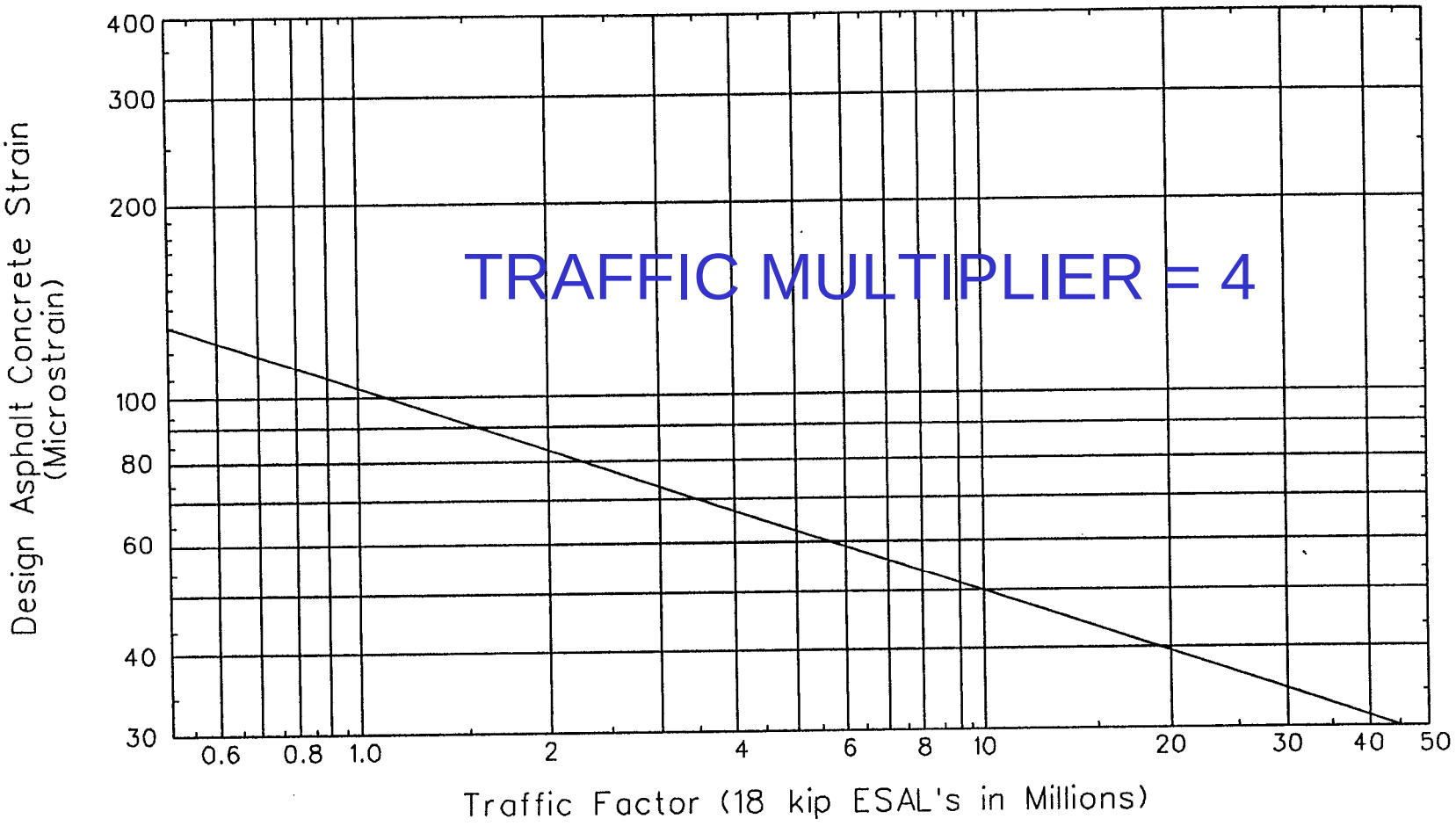
TRAFFIC FACTOR
(TF = (ESALs / 1E6)

IDOT STANDARD APPROACH

95% RELIABILITY

TRAFFIC MULTIPLIER = 4

DESIGN TRAFFIC ESALS
(4 * IDOT ESAL ESTIMATE)



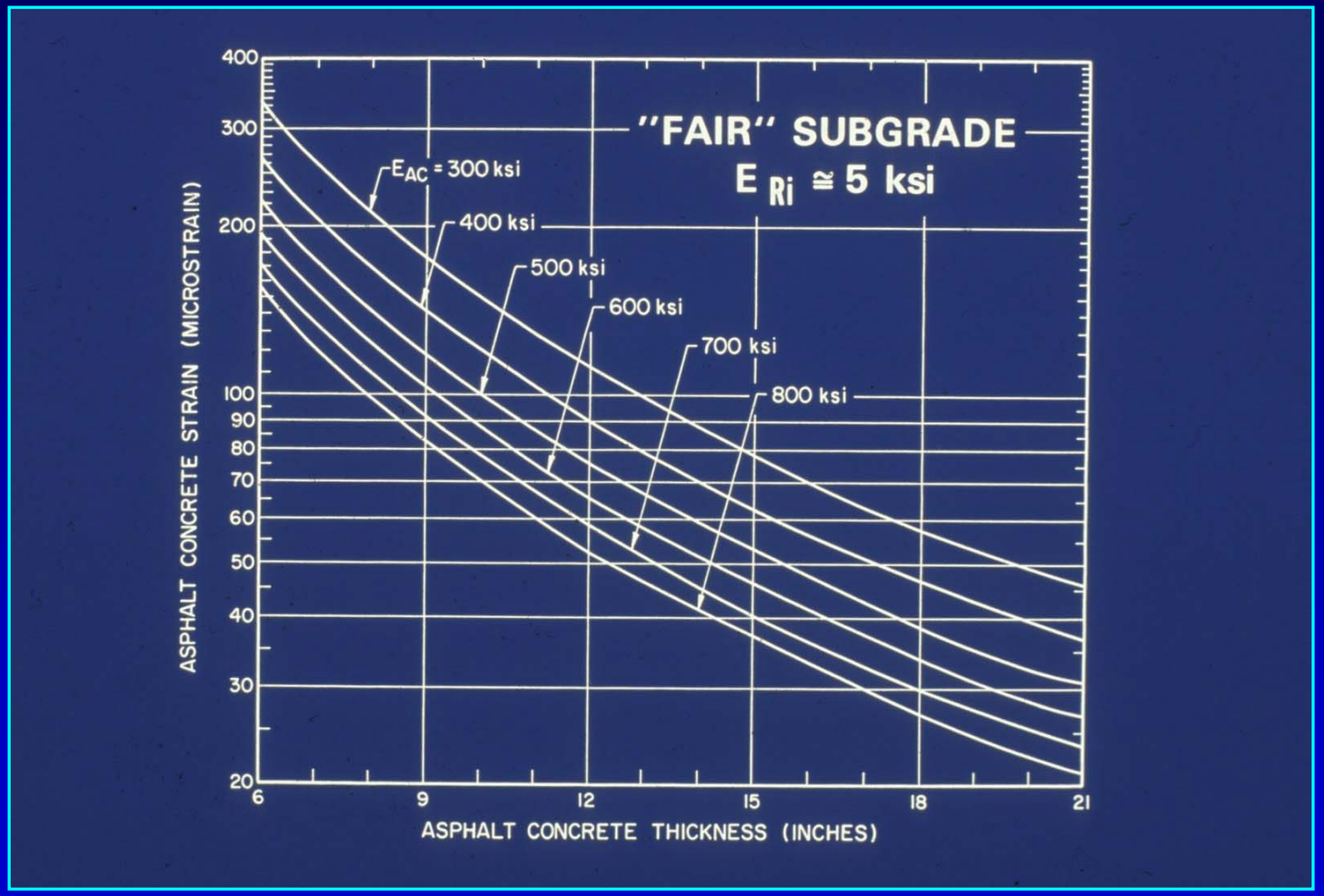
DESIGN AC STRAIN
(Mechanistic Design: Flexible Pavement)

Figure 54-5E

HMA THICKNESS

VERY SENSITIVE TO

HMA MODULUS !!!


"FAIR" SUBGRADE
$E_{Ri} \cong 5$ ksi
E_{AC} = 300 ksi
400 ksi
500 ksi
600 ksi
700 ksi
800 ksi
ASPHALT CONCRETE STRAIN (MICROSTRAIN)
400
300
200
100
90
80
70
60
50
40
30
20
6
9
12
15
18
21
ASPHALT CONCRETE THICKNESS (INCHES)

HMA THICKNESS:

MOST CRITICAL INPUT FOR LCCA !!!

$$$$$$

1-inch HMA = 400 tons / Lane-Mile

$ / Ton HMA	$ / Lane-Mile
40	16,000
50	20,000
60	24,000
70	28,000

IDOT IS CURRENTLY UPDATING/MODIFYING

BEST DEMONSTRATED AVAILABLE TECHNOLOGY

“BDAT”