applied pavement TECHNOLOGY

Evaluating Progression of Cracking in Asphalt Concrete Pavements

PETER-PAUL DZWILEWSKI, P.E
TRAVIS GAGNON, P.E.
KATHERINE GAUTHIER, P.E.
GENEVIEVE LONG, P.E.
MONTY WADE, P.E.

SWIFT

captg Canadian Airfield Pavement Technical Group

Introduction

- Several pavement performance metrics are frequently to evaluate pavements, including:
  - Pavement Condition Index (PCI)
  - Structural Index (SI)
  - Pavement Classification Rating (PCR)
- PCI data can be analyzed to better understand pavement performance beyond the PCI value itself

Analysis Goal

- For asphalt-surfaced pavements
  - Non-fatigue cracking is one of the most frequently occurring distresses
  - Fatigue cracking is less common but can significantly impact performance
- What densities of non-fatigue and fatigue cracking are “normal?”
  - Provide better understanding of current and likely future condition
  - Impacts maintenance, repair, and rehabilitation activities
  - Better consideration during Life Cycle Cost Analysis (LCCA)

Analysis

- Pavements types:
  - Asphalt concrete (AC)
  - Asphalt overlay over AC (AAC)
  - Asphalt overlay over portland cement concrete (APC)
- Cracking classifications
  - Non-fatigue cracking (i.e., climate-related cracking)
  - Fatigue cracking
  - Joint reflection cracking for APC pavement
- Average density of cracking at a given age determined
- Upper and lower normal boundary limits identified
- Photos mined to connect to field conditions

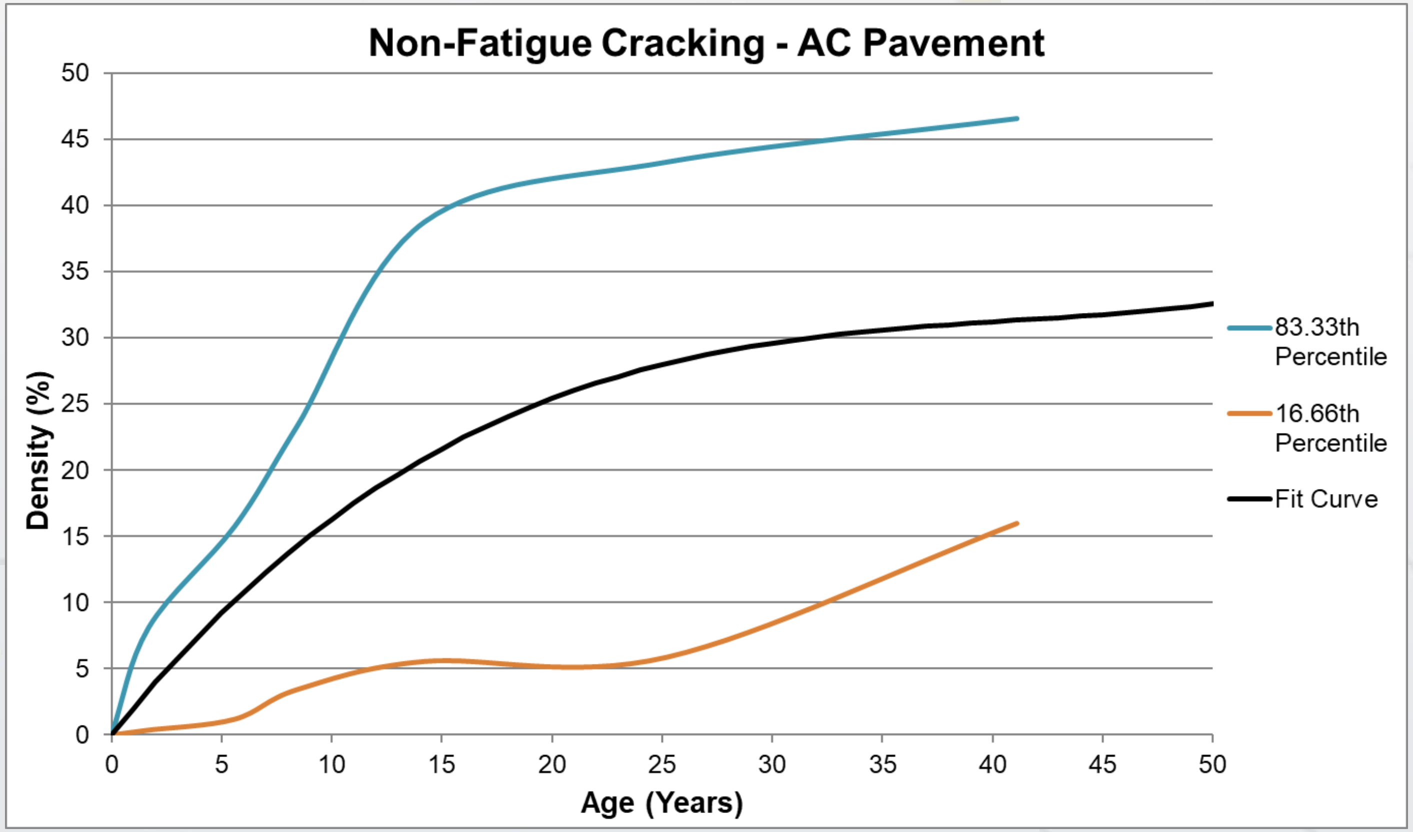
Assumptions

- Active load-bearing aircraft pavement examined
- Handful of unique outliers removed from data set
- Length of cracking within block cracking transformed to aggregate with longitudinal and transverse (L&T) cracking

Development of Normal Boundary Lines

- Upper and lower normal boundary limits defined
- Data broken into age groups and percentiles examined
  - 0 to 5 years old
  - 5 to 10 years old
  - 10 to 20 years old
  - 20 to 30 years old
  - 30 to 40 years old
  - 40 to 50 years old
- Middle 2/3 of data points defined as normal

Non-Fatigue Cracking – AC Pavement



Non-Fatigue Cracking – AC Pavement

UPPER BOUNDARY – 0 TO 5 YEARS

TRENDLINE – 0 TO 5 YEARS

Non-Fatigue Cracking – AC Pavement

UPPER BOUNDARY – 5 TO 10 YEARS

TRENDLINE – 5 TO 10 YEARS

Non-Fatigue Cracking – AC Pavement

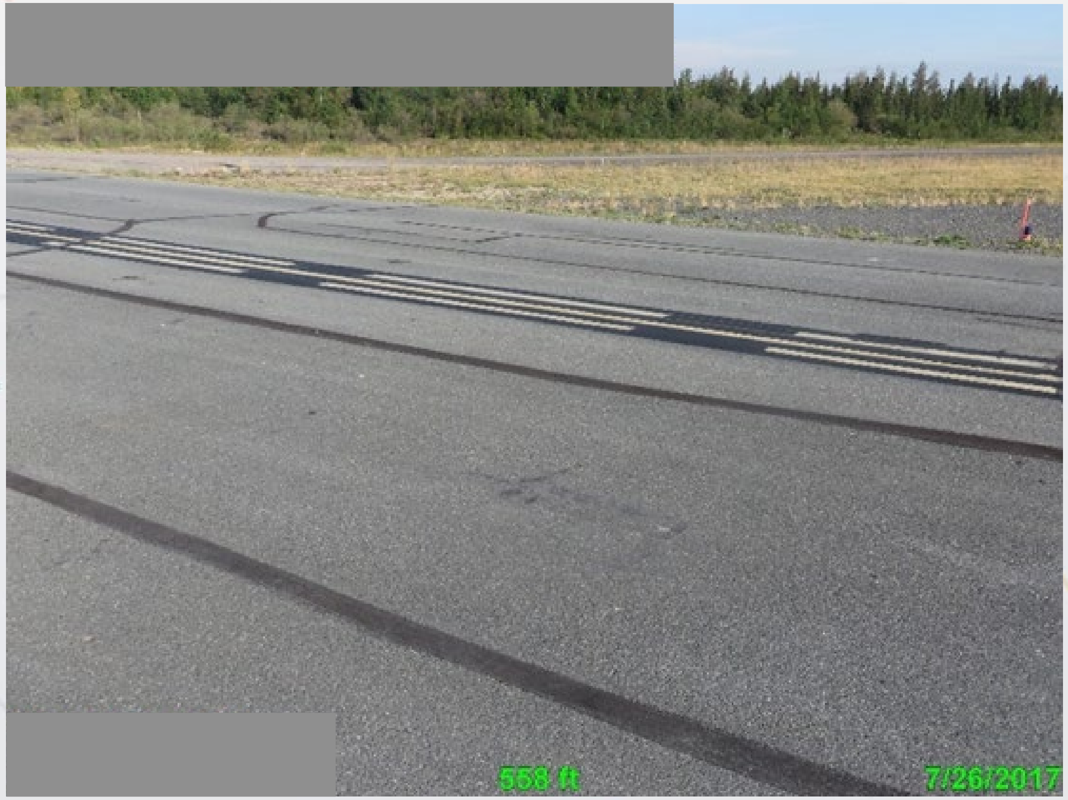
UPPER BOUNDARY – 10 TO 20 YEARS

TRENDLINE – 10 TO 20 YEARS

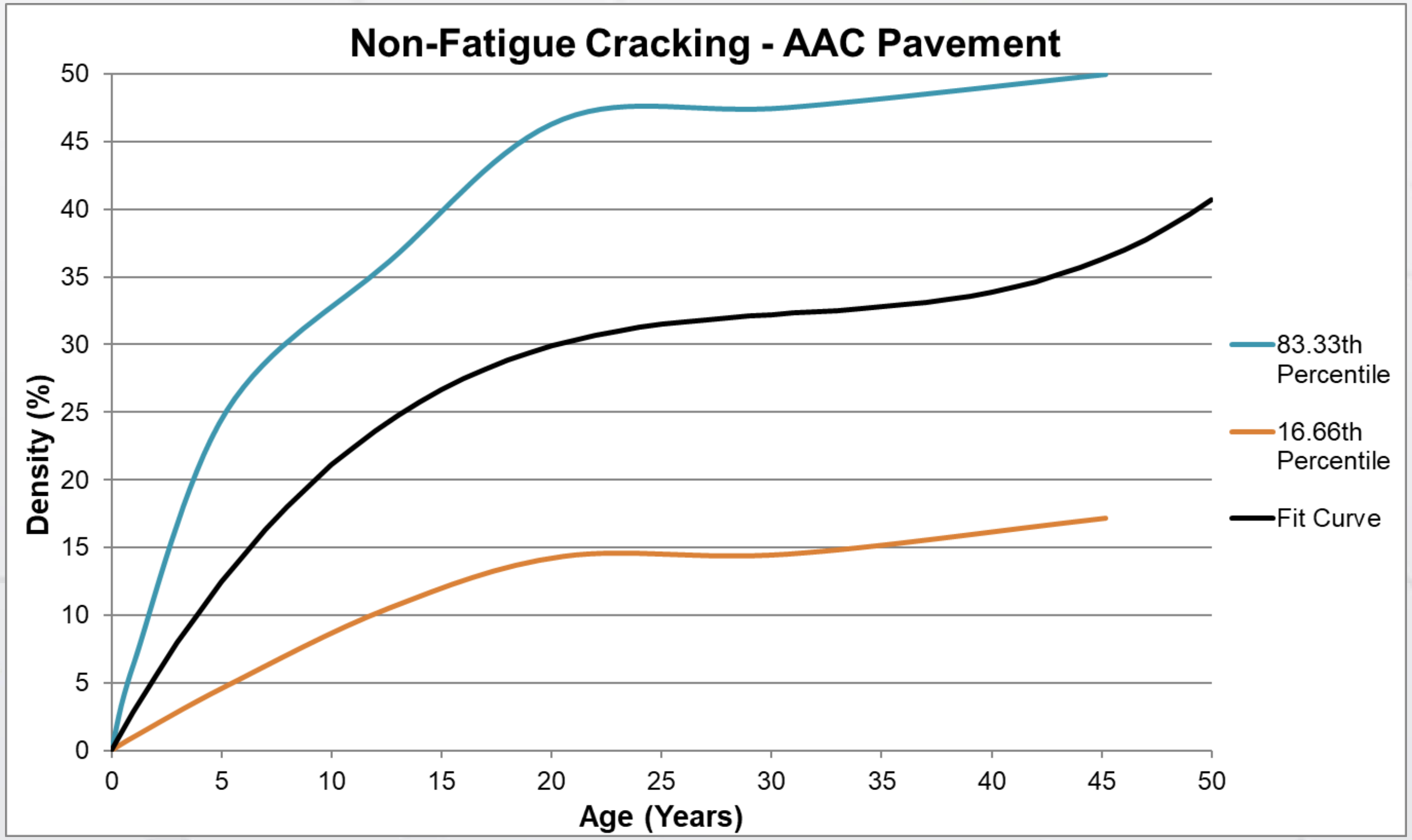
Non-Fatigue Cracking – AC Pavement

UPPER BOUNDARY – 20 TO 30 YEARS

TRENDLINE – 20 TO 30 YEARS



Non-Fatigue Cracking – AAC Pavement



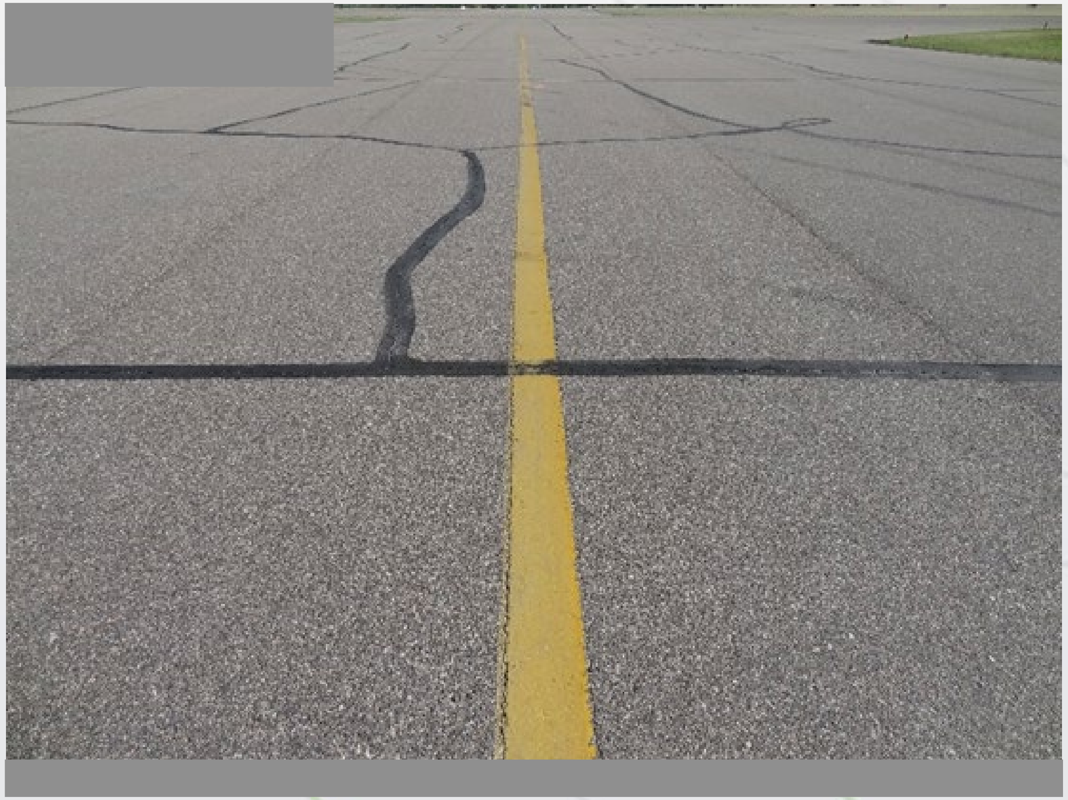
Non-Fatigue Cracking – AAC Pavement

UPPER BOUNDARY – 0 TO 5 YEARS

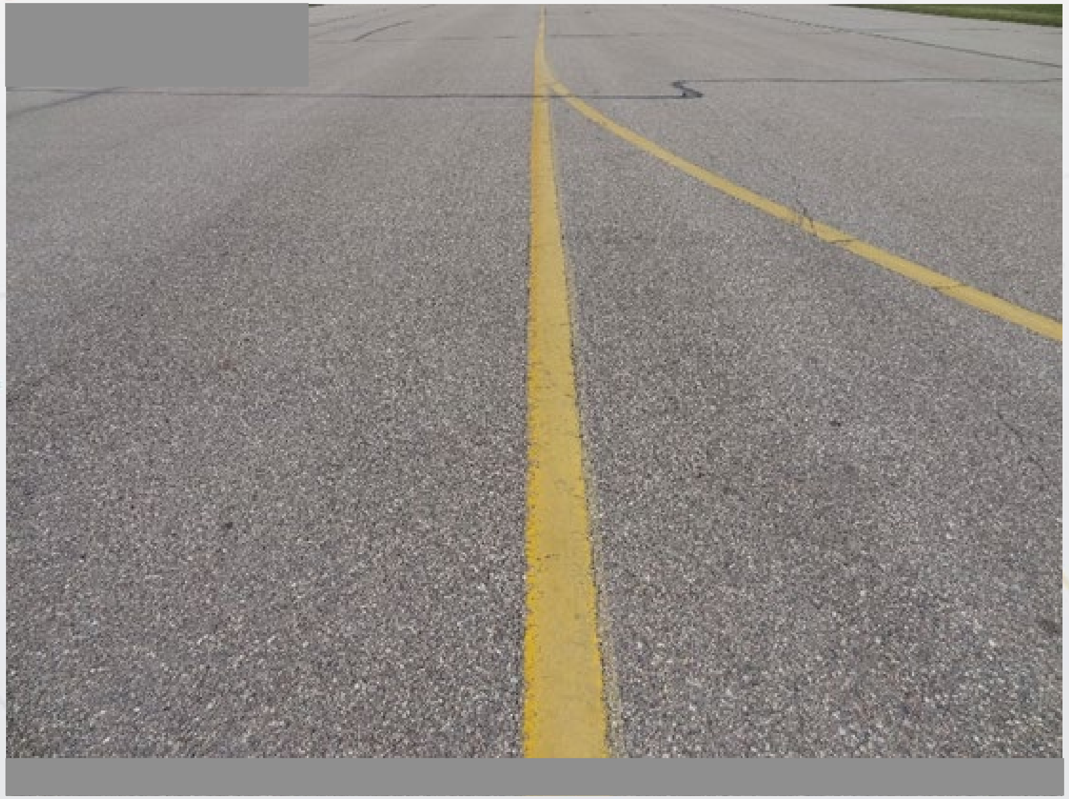
TRENDLINE – 0 TO 5 YEARS

Non-Fatigue Cracking – AAC Pavement

UPPER BOUNDARY – 5 TO 10 YEARS



TRENDLINE – 5 TO 10 YEARS



Non-Fatigue Cracking – AAC Pavement

UPPER BOUNDARY – 10 TO 20 YEARS

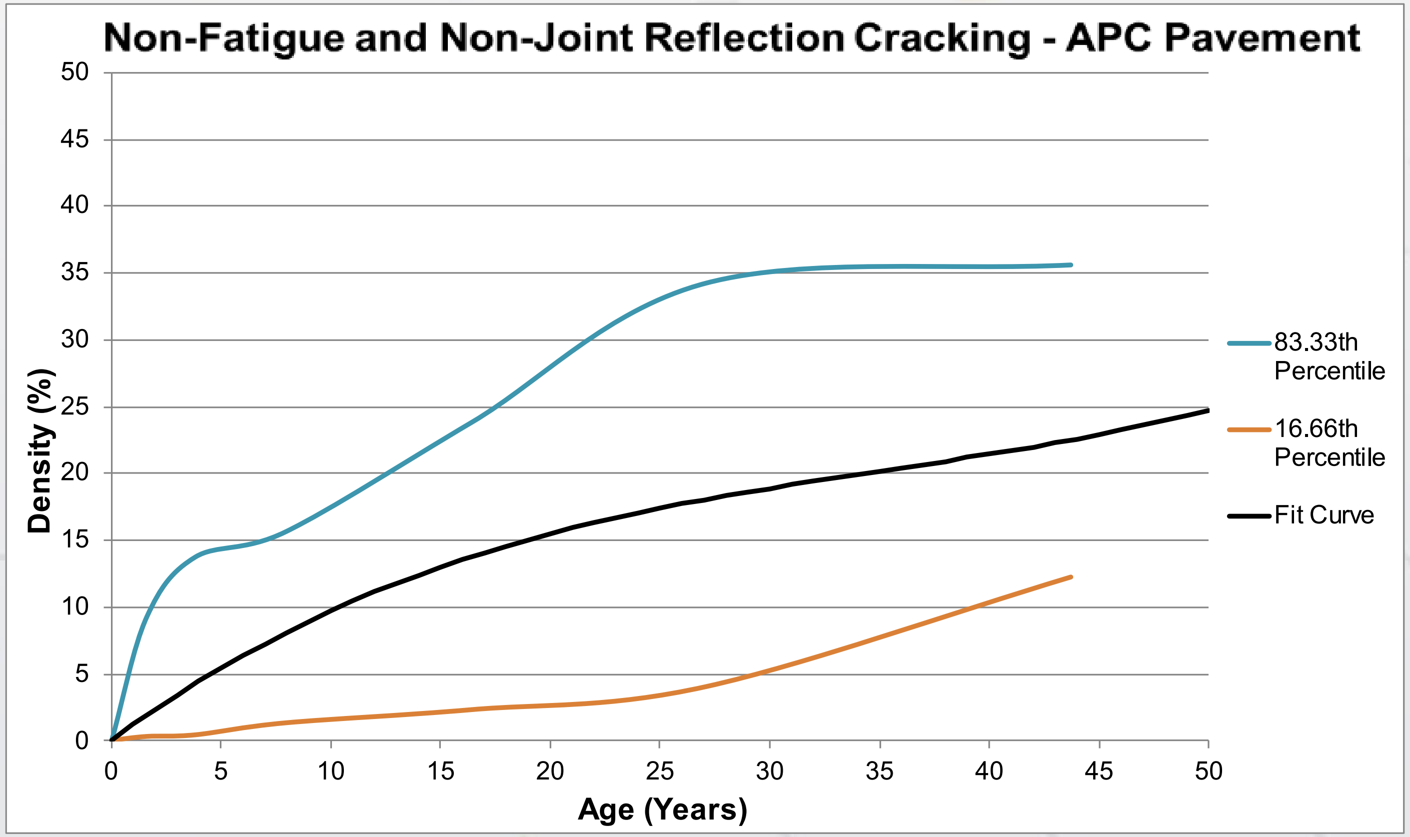
TRENDLINE – 10 TO 20 YEARS

Non-Fatigue Cracking – AAC Pavement

UPPER BOUNDARY – 20 TO 30 YEARS

TRENDLINE – 20 TO 30 YEARS

Non-Fatigue and Non-Joint Reflection Cracking – APC Pavement



Non-Fatigue Cracking – APC Pavement

UPPER BOUNDARY – 5 TO 10 YEARS

TRENDLINE – 5 TO 10 YEARS

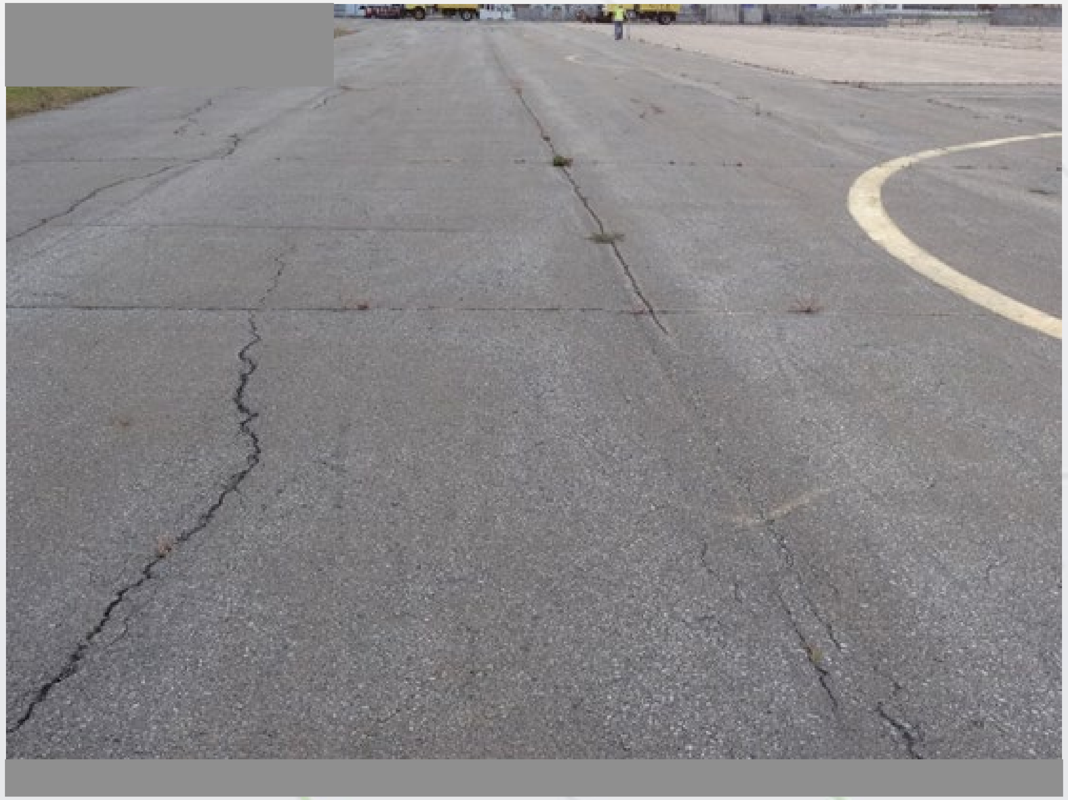
Non-Fatigue Cracking – APC Pavement

UPPER BOUNDARY – 10 TO 20 YEARS

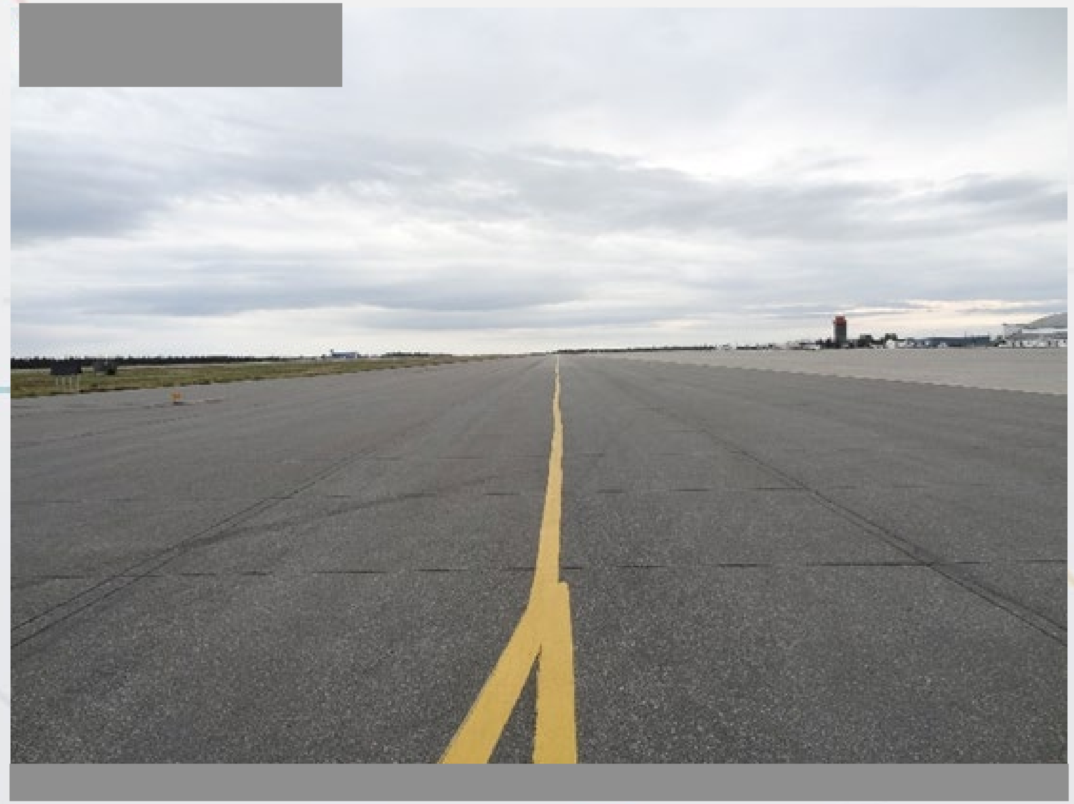
TRENDLINE – 10 TO 20 YEARS

Non-Fatigue Cracking – APC Pavement

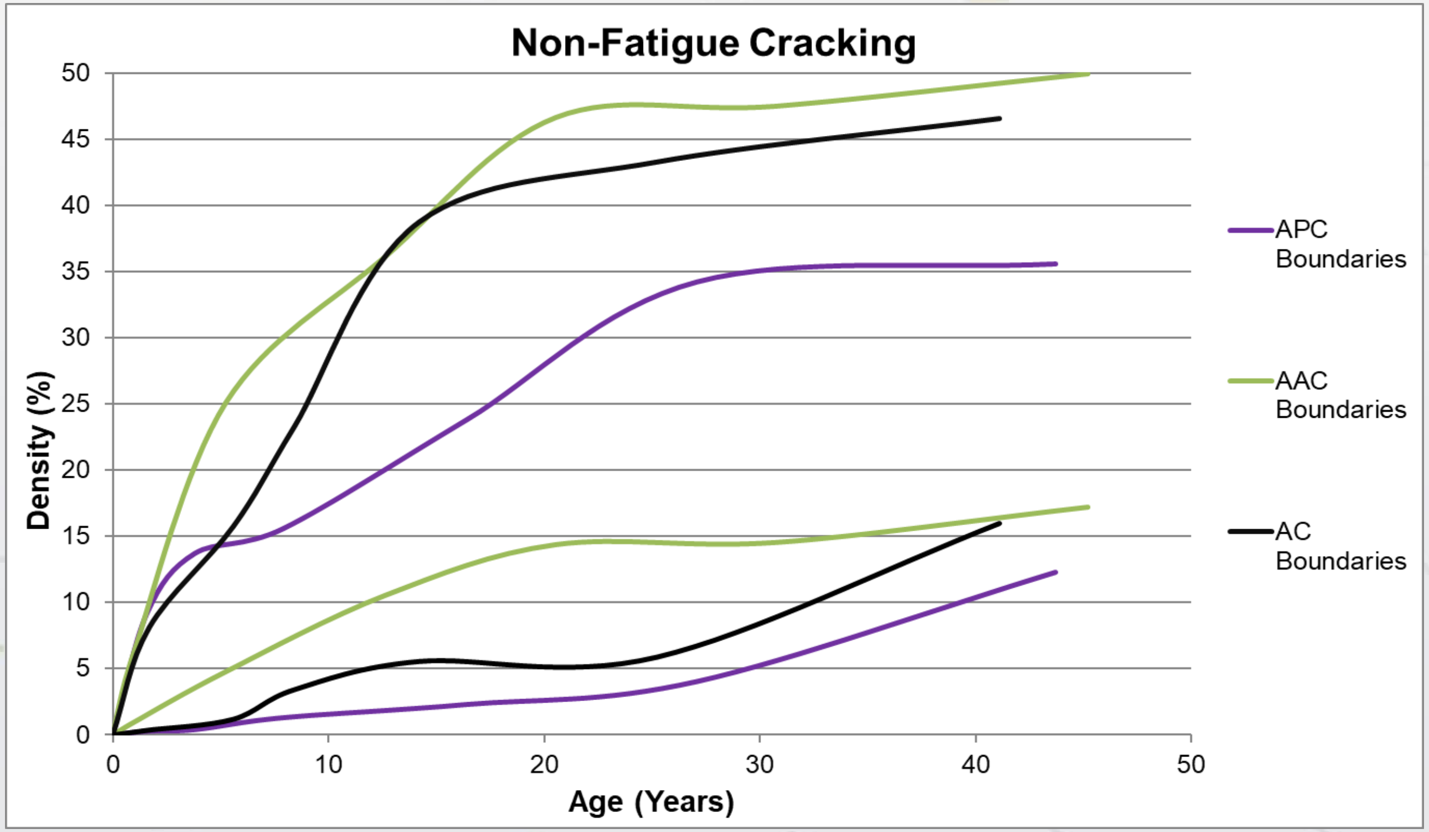
UPPER BOUNDARY – 20 TO 30 YEARS



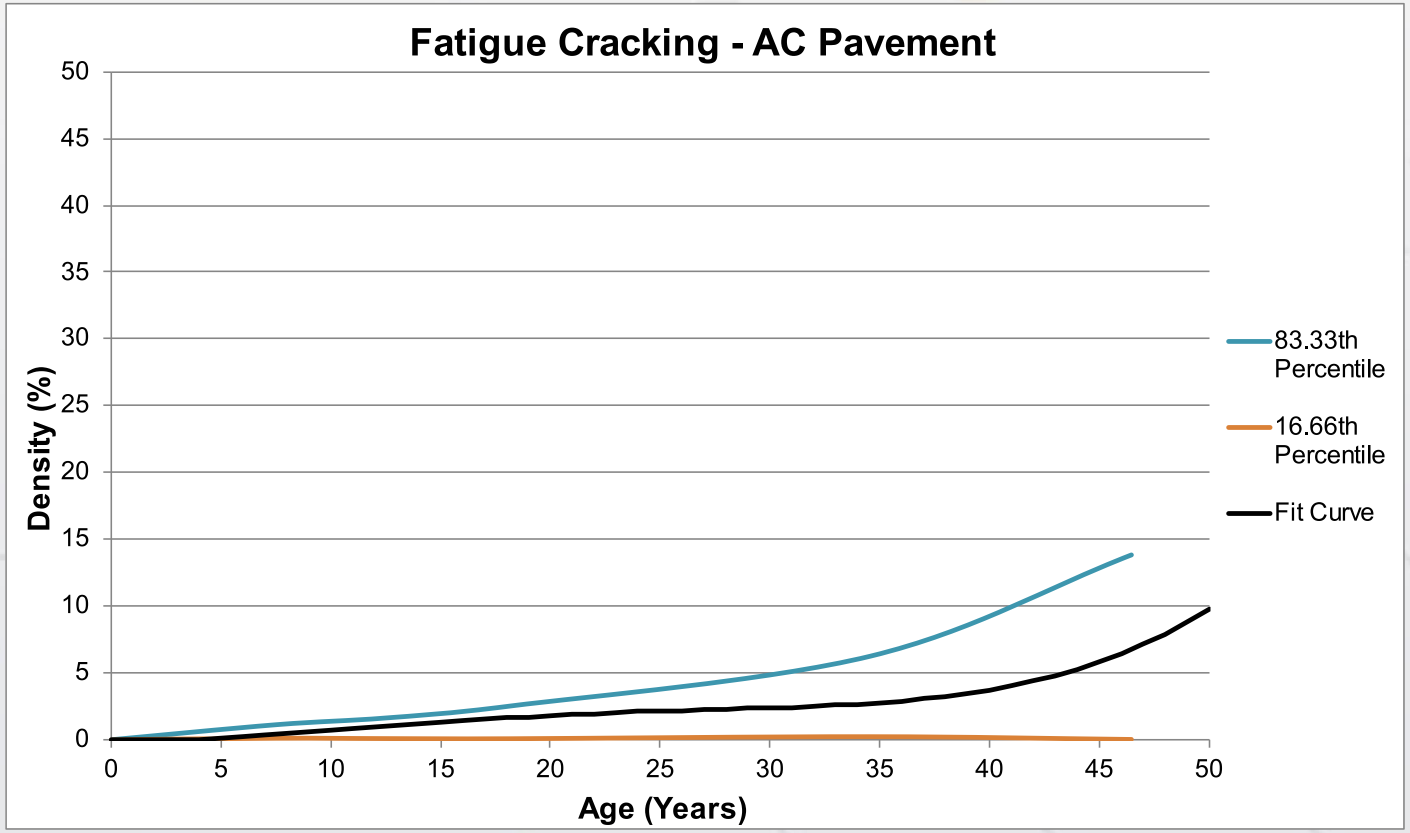
TRENDLINE – 20 TO 30 YEARS



Non-Fatigue Cracking – Summary



Fatigue Cracking – AC Pavement



Fatigue Cracking – AC Pavement

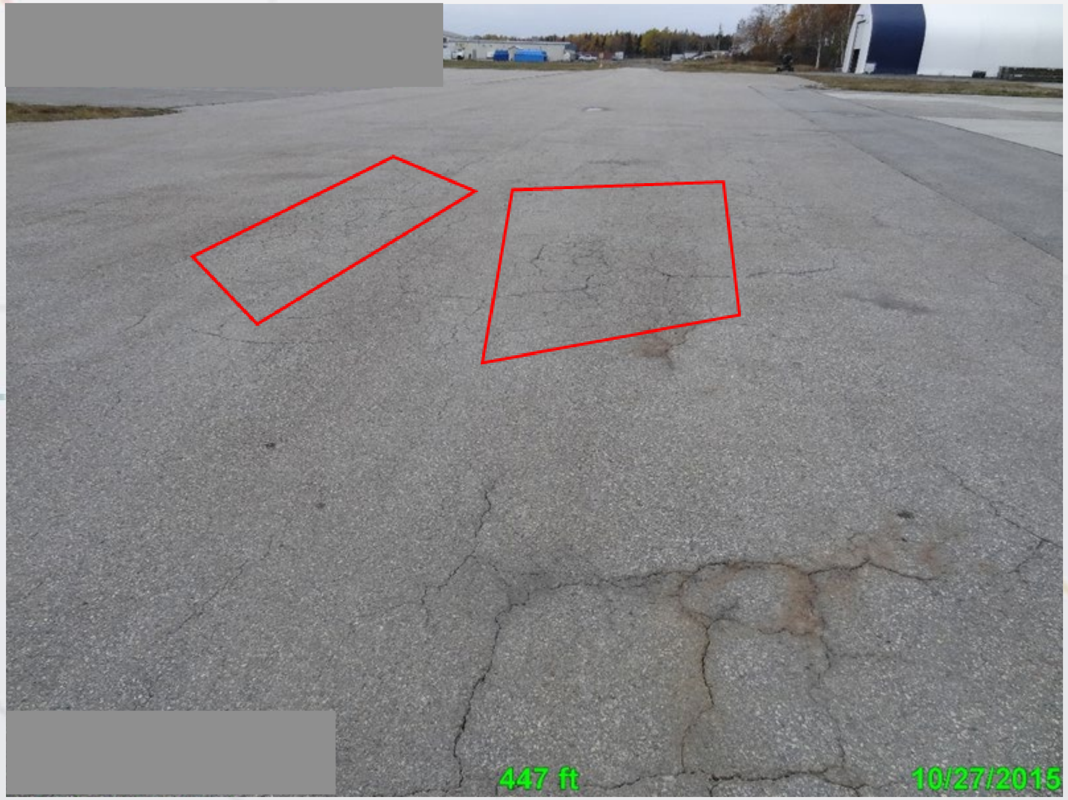
UPPER BOUNDARY – 5 TO 10 YEARS

UPPER BOUNDARY – 10 TO 20 YEARS

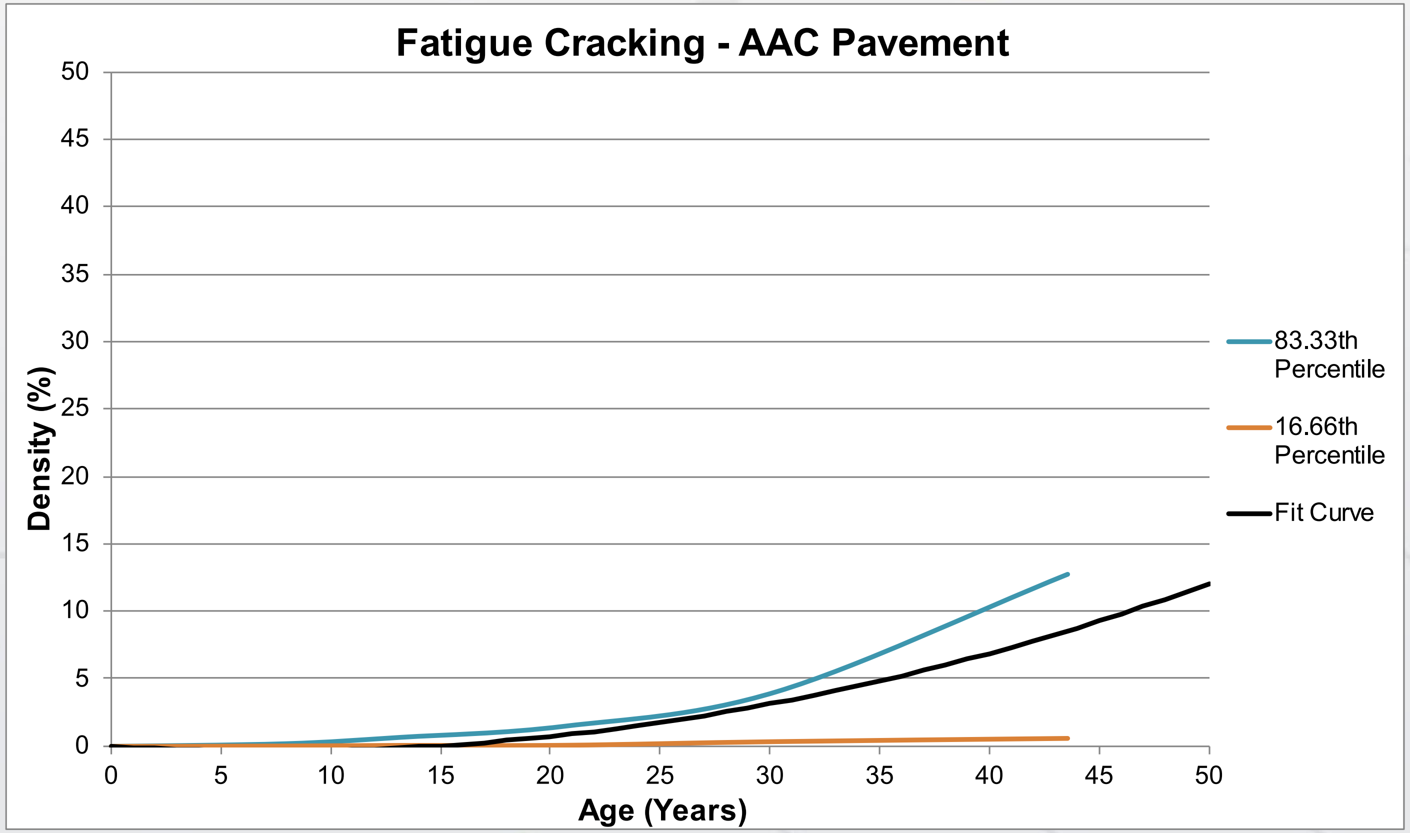
Fatigue Cracking – AC Pavement

UPPER BOUNDARY – 20 TO 30 YEARS

UPPER BOUNDARY – 30 TO 40 YEARS



Fatigue Cracking – AAC Pavement



Fatigue Cracking – AAC Pavement

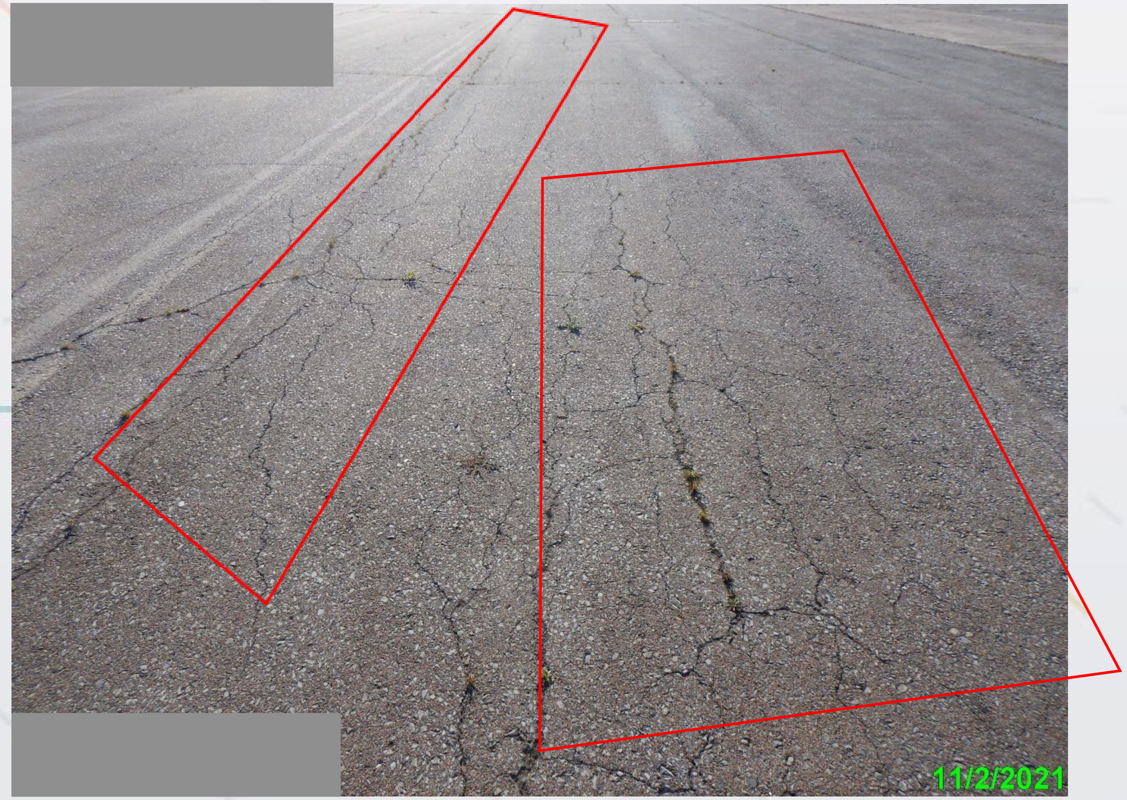
UPPER BOUNDARY – 5 TO 10 YEARS

UPPER BOUNDARY – 10 TO 20 YEARS

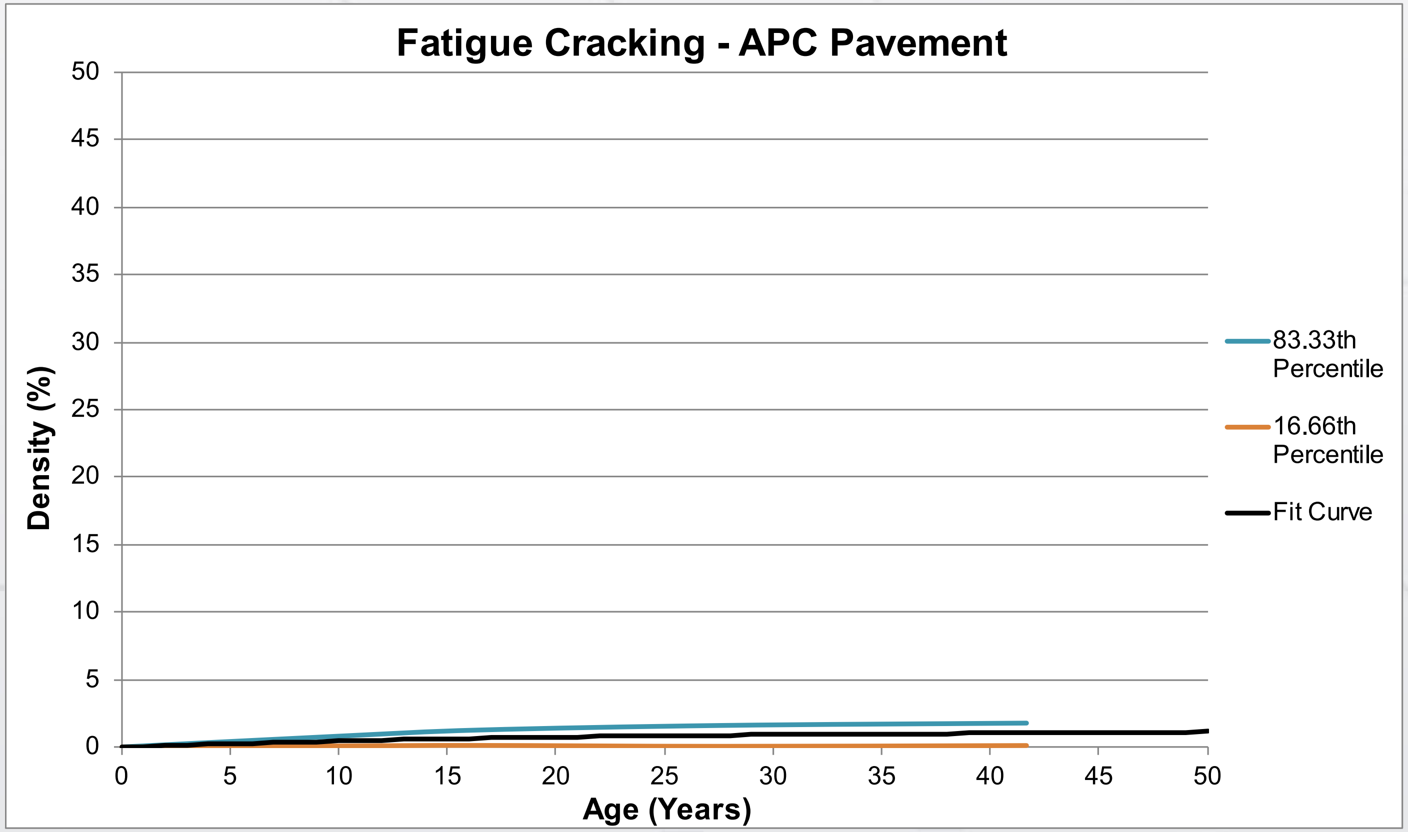
Fatigue Cracking – AAC Pavement

UPPER BOUNDARY – 20 TO 30 YEARS

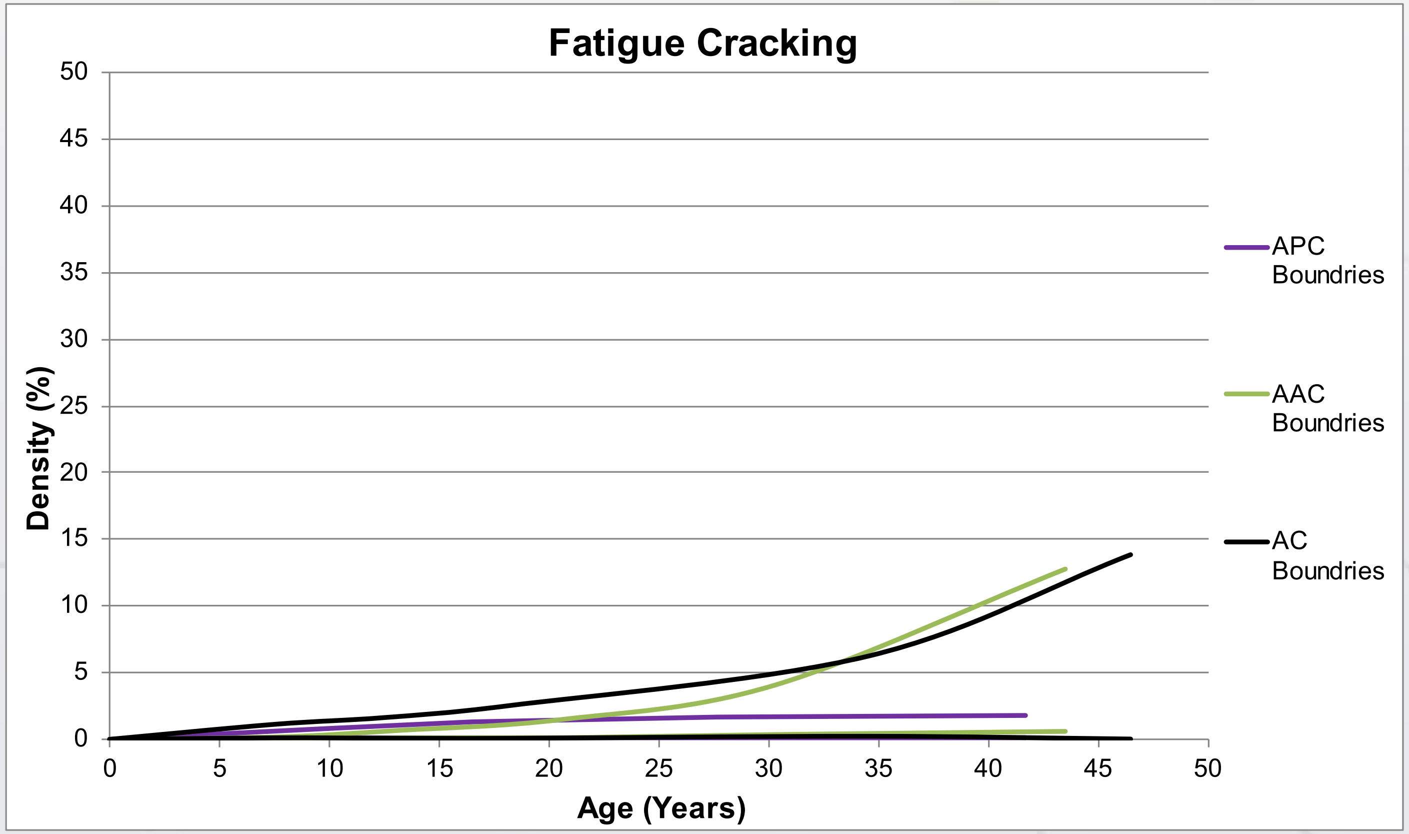
UPPER BOUNDARY – 30 TO 40 YEARS



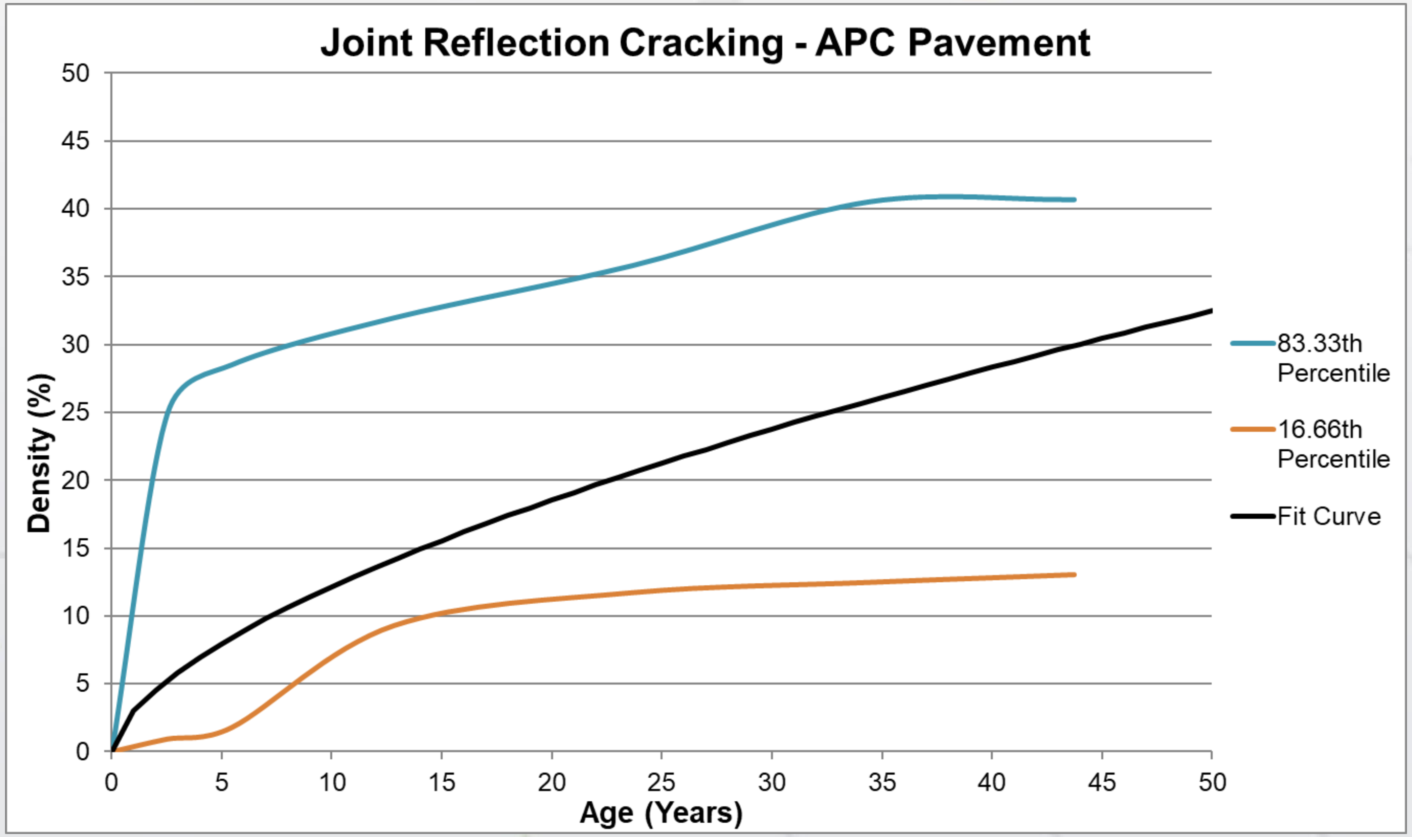
Fatigue Cracking – APC Pavement



Fatigue Cracking – Summary



Joint Reflection Cracking – APC Pavement



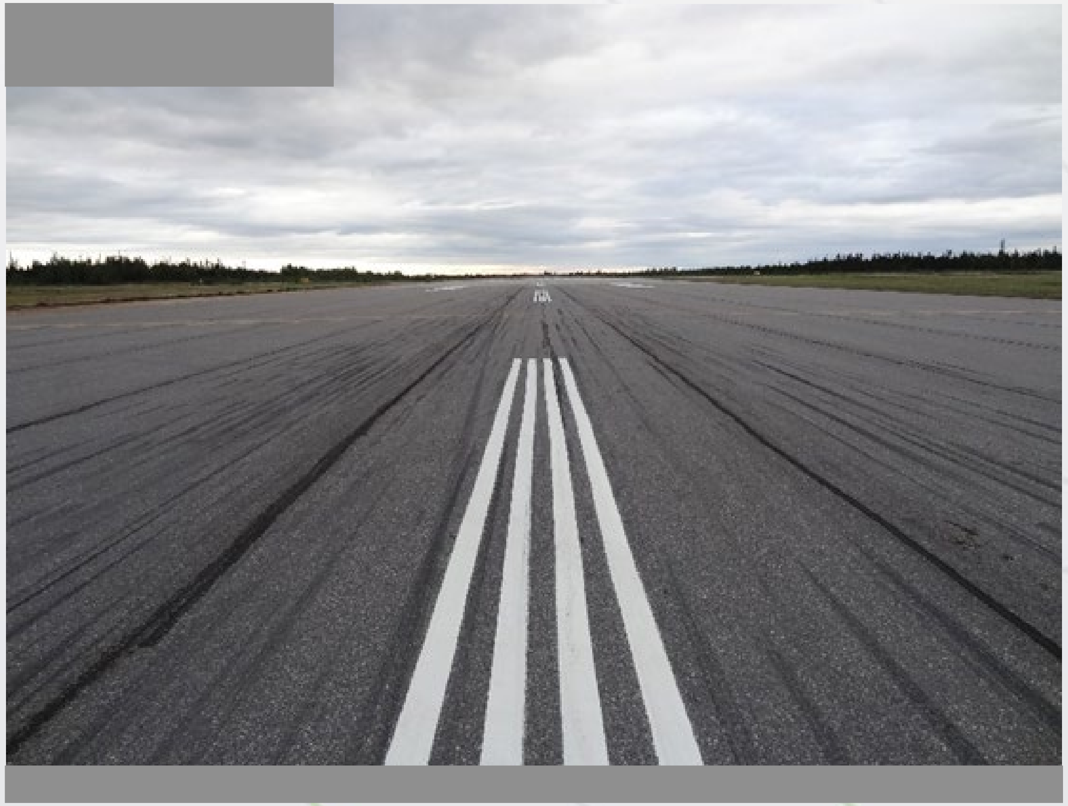
Joint Reflection Cracking – APC Pavement

UPPER BOUNDARY – 0 TO 5 YEARS

TRENDLINE – 0 TO 5 YEARS

Joint Reflection Cracking – APC Pavement

UPPER BOUNDARY – 5 TO 10 YEARS



TRENDLINE – 5 TO 10 YEARS

Joint Reflection Cracking – APC Pavement

UPPER BOUNDARY – 10 TO 20 YEARS

TRENDLINE – 10 TO 20 YEARS

Joint Reflection Cracking – APC Pavement

UPPER BOUNDARY – 20 TO 30 YEARS

TRENDLINE – 20 TO 30 YEARS

Application to Pavement Management – AC

- Non-fatigue cracking density can vary widely starting at an early age
- Largest changes in non-fatigue cracking density can occur at an early age or at a late age
- End-of-life fatigue cracking density may increase rapidly
- Some sections do not develop an appreciable quantity of fatigue cracking

Application to Pavement Management – AAC

- Non-fatigue cracking density can vary widely
- Non-fatigue cracking may stabilize around 15 to 20 years
  - Largest changes in non-fatigue cracking density usually at an early age
- Non-fatigue cracking generally has slightly higher densities than AC
- End-of-life fatigue cracking density may increase rapidly
- Fatigue cracking similar to AC with lower densities at many ages
- Some sections do not develop an appreciable quantity of fatigue cracking

Application to Pavement Management – APC

- Non-fatigue cracking density can vary widely but is less than AC or AAC
- Fatigue cracking recorded at very low densities and usually in unique situations
- Some sections do not develop an appreciable quantity of fatigue cracking
- Joint reflection cracking density largest increases are generally within first 10 years

Questions

PETER-PAUL DZWILEWSKI, P.E
PDZWILEWSKI@APPLIEDPAVEMENT.COM
(303) 489-6137