

Calibration of the 2002 AASHTO Pavement Design Guide for Minnesota Portland Cement Concrete Pavements and Hot Mix Asphalt Pavements

TAP meeting
February 10, 2004

Project Objectives

- Calibrate the 2002 Design Guide for Mn conditions
- Develop default inputs and a catalog of trial designs
- Develop training materials
- Develop recommendations for future improvements

Improvement of the 2002 Guide is NOT an objective of this study

Project Tasks

- Task 1: Determine typical design features
- Task 2: Evaluate typical 2002 Design Guide Inputs
- Task 3: Conduct laboratory testing
- Task 4: Establish performance criteria
- Task 5: Perform sensitivity runs
- Task 6: Predict pavement performance

- Task 7: Recalibrate 2002 Design prediction models
- Task 8: Develop catalog for trail designs
- Task 9: Modify training manuals
- Task 10: Develop a report documenting the work and findings.

Task 1: Determine typical design features

- Design Features
 - pavement cross-section
 - presence of shoulder
 - lane width
 - presence of dowels, etc
- Data sources
 - MnRoad
 - PM database and other MnDOT data
 - LTPP
 - RIPPER
 - Sections surveyed in this study

Task 2: Evaluate typical 2002 Design Guide Inputs

- Traffic inputs
- Material properties of typical PCC mixes, asphalt mixes, and granular bases.
- Resilient properties of the subgrade
- Seasonal variation of subgrade properties
- Seasonal variation of depth to water table
- PCC pavements construction data

An attempt to assign inputs for the projects identified in task 1 will be made

Task 2: Evaluate typical 2002 Design Guide Inputs – Traffic Inputs

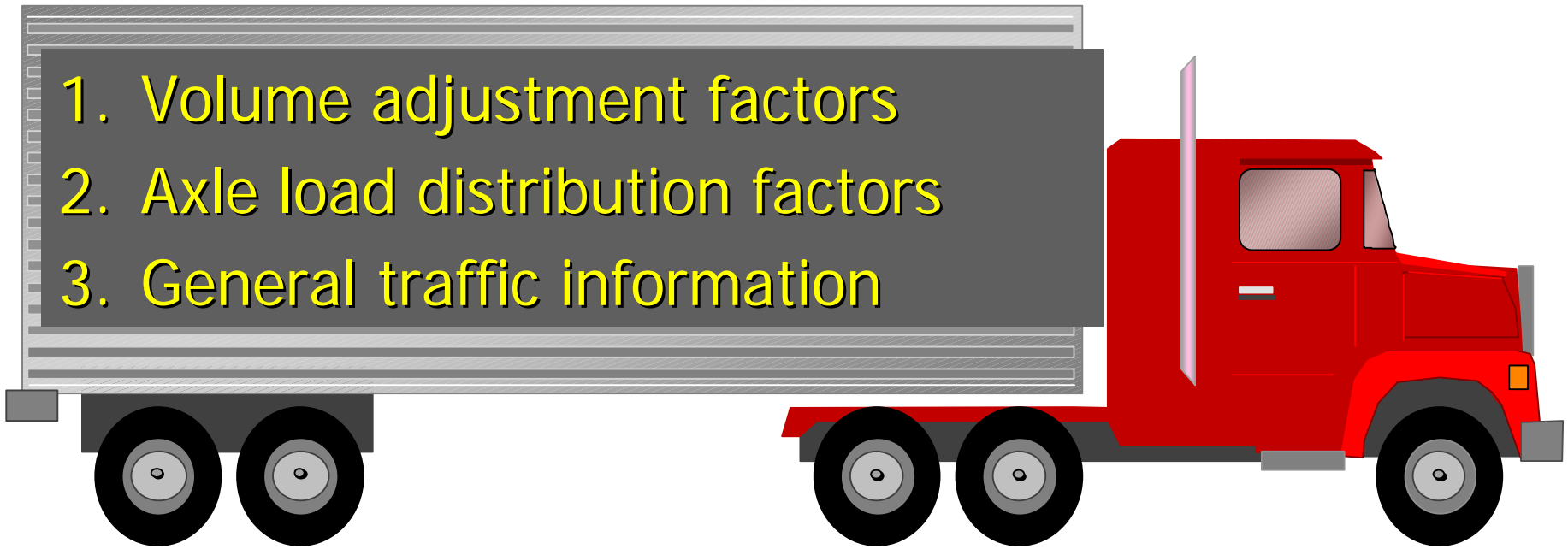
- Current AASHTO – ESALs
- MnPave – ESALs or axle spectrum
- 2002 Guide – AADT and/or axle spectrum

2002 GuideTraffic Hierarchical Input Levels

Input Level	Input Values	Knowledge of Parameters
1	Segment-Specific Data (AVC, WIM, vehicle counts)	Good
2	Regional/Statewide Data (AVC, WIM, vehicle counts)	Fair
3	National Data (AVC, WIM, vehicle counts) Educated Guess based on local experience	Poor

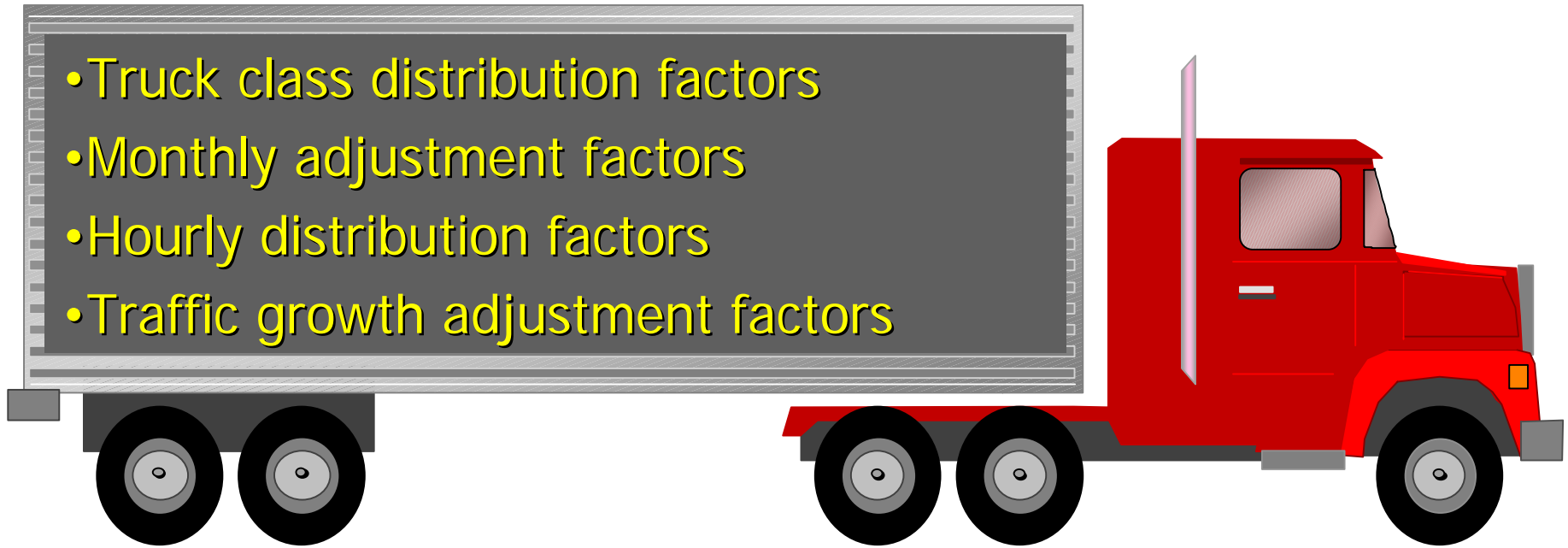
Traffic Module – Input Categories

1. Volume adjustment factors
2. Axle load distribution factors
3. General traffic information



Truck Traffic Volume Adjustment Factors

- Truck class distribution factors
- Monthly adjustment factors
- Hourly distribution factors
- Traffic growth adjustment factors

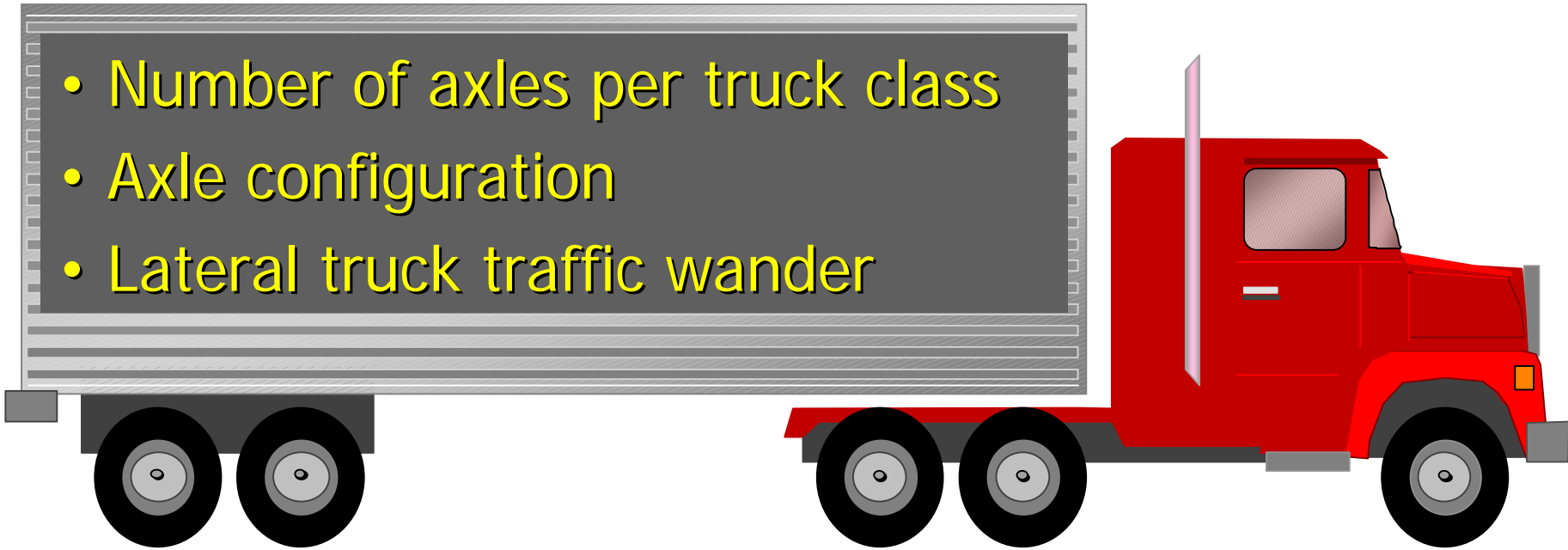


Axle Load Distribution Factors



General Truck Traffic Information

- Number of axles per truck class
- Axle configuration
- Lateral truck traffic wander



Task 2: Evaluate typical 2002 Design Guide Inputs – Climatic Data

- Location
 - Latitude
 - Longitude
 - Elevation
- Depth of water table (seasonal)

Task 2: Evaluate typical 2002 Design Guide Inputs – PCC properties

Input	Used to predict
General properties	<ul style="list-style-type: none">•Mechanistic response
Thermal properties	<ul style="list-style-type: none">•Slab deformations due to temperature changes•Temperature profile in slab
Mix properties	<ul style="list-style-type: none">•Concrete set temperature•Strength gain over time
Strength properties	<ul style="list-style-type: none">•Strength gain over time•Mechanistic response

Task 2: Evaluate typical 2002 Design Guide Inputs – AC properties

- Asphalt mix properties
- Asphalt binders properties
- Asphalt general properties

Asphalt General Properties

- Reference temperature (a temperature at which a master curve is constructed)
- Volumetric properties
 - Effective binder content (% by volume)
 - Air void
 - Total unit weight (pcf)
- Thermal properties
 - Thermal conductivity
 - Heat capacity
- Poisson's ratio
 - Direct input
 - Equation

Task 2: Evaluate typical 2002 Design Guide Inputs – subgrade properties

Unbound Layer - Layer #3

Unbound Material: A-6 Thickness(in): Last layer

Strength Properties ICM

Input Level

Level 1:
 Level 2:
 Level 3:

Poisson's ratio: 0.35

Coefficient of lateral pressure, K_0 : 0.5

Analysis Type

Using ICM

ICM Inputs

Not Using ICM

Seasonal input (design value)
 Representative value (design value)

Material Property

Modulus (psi)
 CBR
 R - Value
 Layer Coefficient - a_i
 Penetration (DCP)
 Based upon PI and Gradation

AASHTO Classification

Unified Classification

Modulus (input) (psi):

View Equation Calculate >>

OK Cancel

Task 2: Evaluate typical 2002 Design Guide Inputs – subgrade properties (cont.)

Unbound Layer - Layer #3

Unbound Material: A-6 Thickness(in): Last layer

Strength Properties ICM

Gradation and Plasticity Index

Plasticity Index, PI:

Passing #200 sieve (%):

Passing #4 sieve (%):

D60 (mm):

Compacted unbound material

Uncompacted/natural unbound material

Calculated/Derived Parameters

Maximum dry unit weight (pcf):

Specific gravity of solids, G_s:

Saturated hydraulic conductivity (ft/hr):

Optimum gravimetric water content (%):

Calculated degree of saturation (%):

Soil water characteristic curve parameters

Parameter	Value
af	174
bf	1.05
cf	0.707
hr	8.19e+003

OK Cancel

Task 2: Evaluate typical 2002 Design Guide Inputs – PCC Construction Data

- Zero-stress temperature
- Zero-stress temperature gradient (built-in curling)

Task 3: Laboratory Testing

- Will be conducted jointly by MnDOT and UMn
- Detailed program will be determined later

Task 4: Establish performance criteria

- PCC
 - Cracking
 - Faulting
- AC
 - Cracking (top-down and alligator)
 - Rutting (total and AC only)
 - Thermal cracking
 - CTB fatigue
- PCC and AC

Task 4: Establish Performance Criteria (cont.)

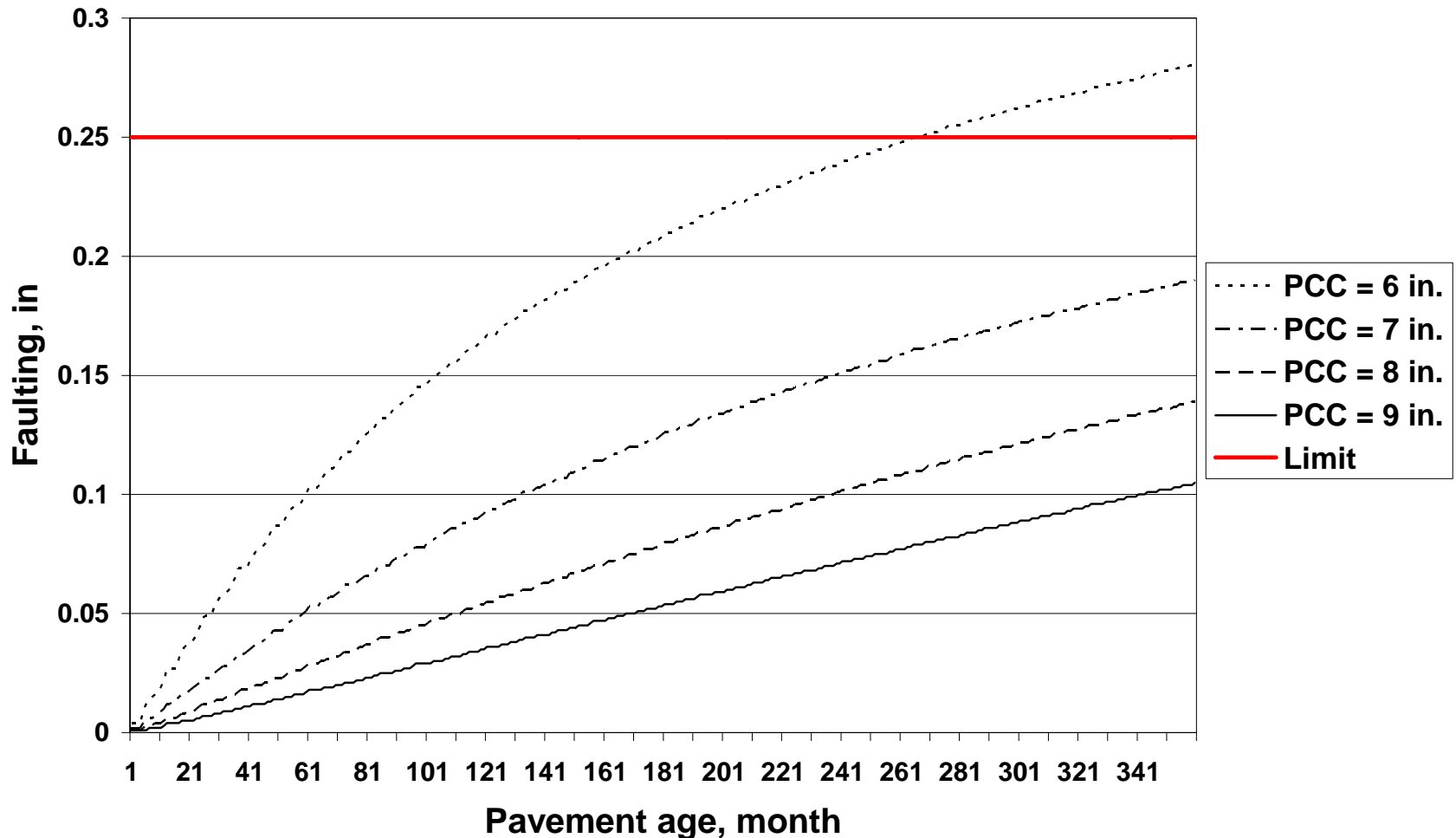
- Obtain inputs from the industries
- Obtain inputs from MnDOT
- Organize consensus building meeting

Task 5: Perform Sensitivity Runs

- Various cross-sections
- Various design features
- Various locations

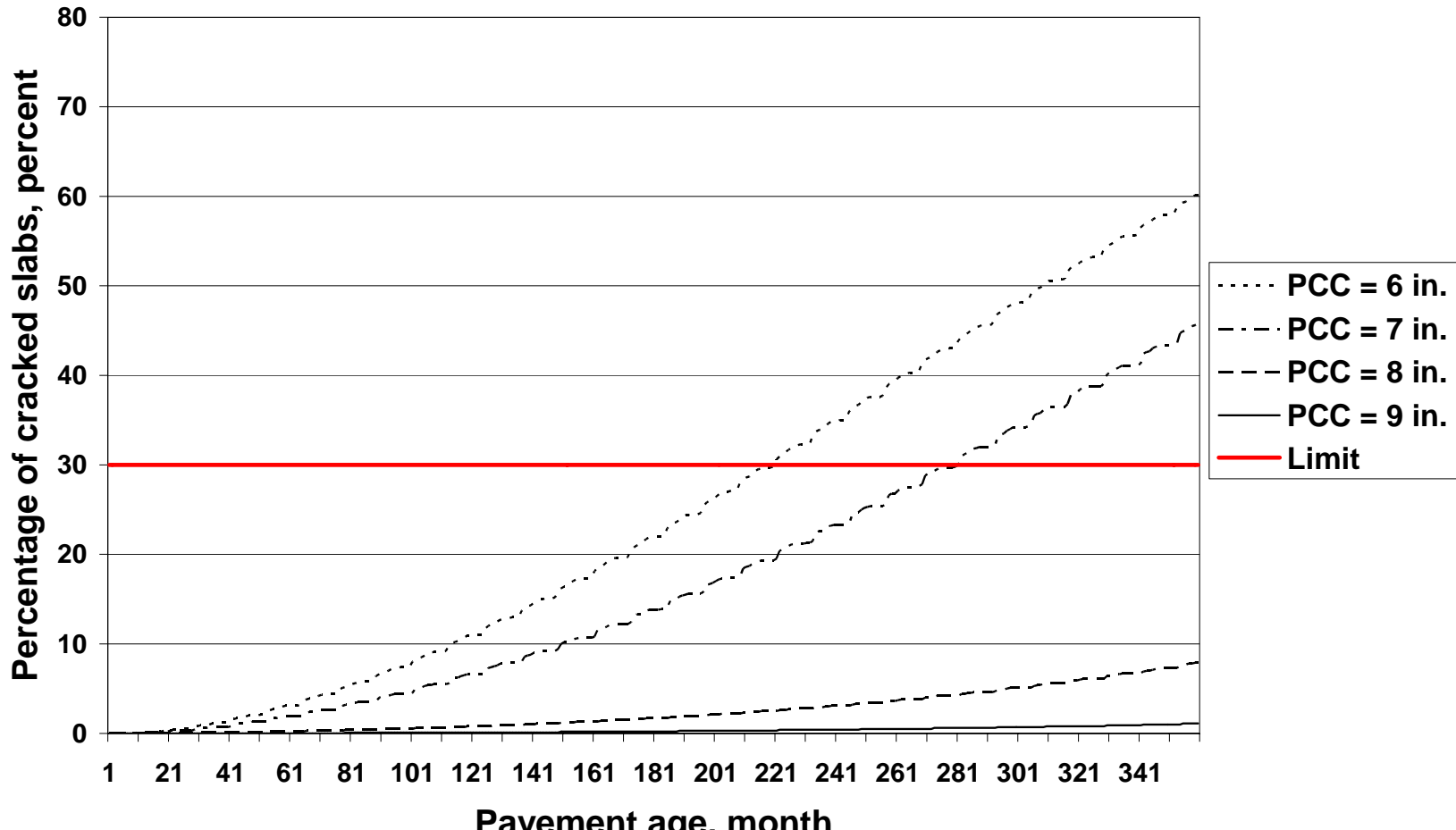
Task 5: Perform Sensitivity Runs - Example

Faulting, AGG base, A-2-5 subgrade



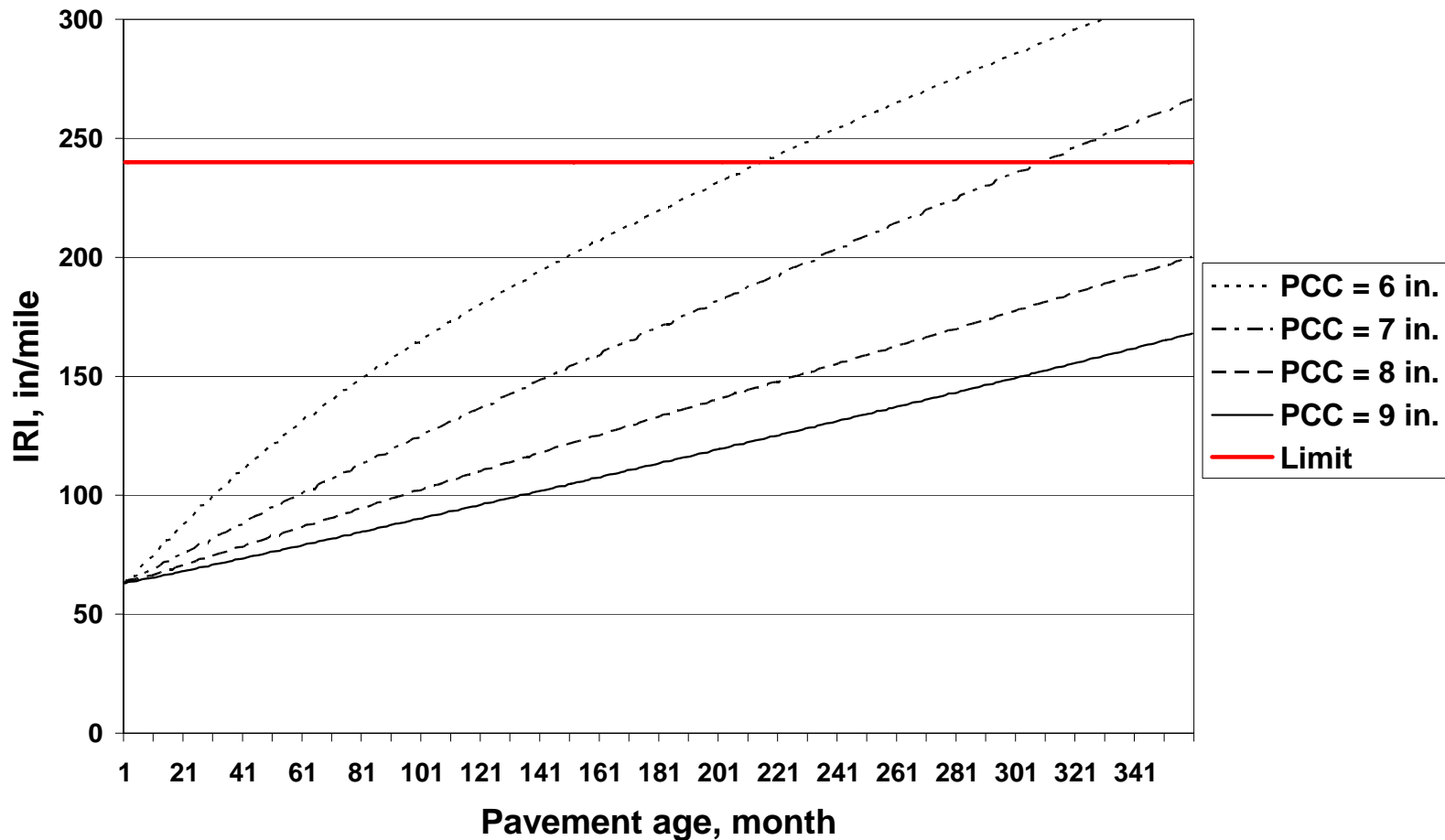
Task 5: Perform Sensitivity Runs - Example

Cracking, AGG base, A-2-7 subgrade



Task 5: Perform Sensitivity Runs - Example

IRI, AGG base, A-4 subgrade



Task 3: Predict pavement performance

- Run 2002 Design Guide Software for the project identified in task 1 using:
 - Project-specific inputs
 - Level 3 inputs
- Compare predicted and measured performance
- Identify needs for re-calibration

