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The Unseen Impact of California Wildfires on Affected Roadway Pavements

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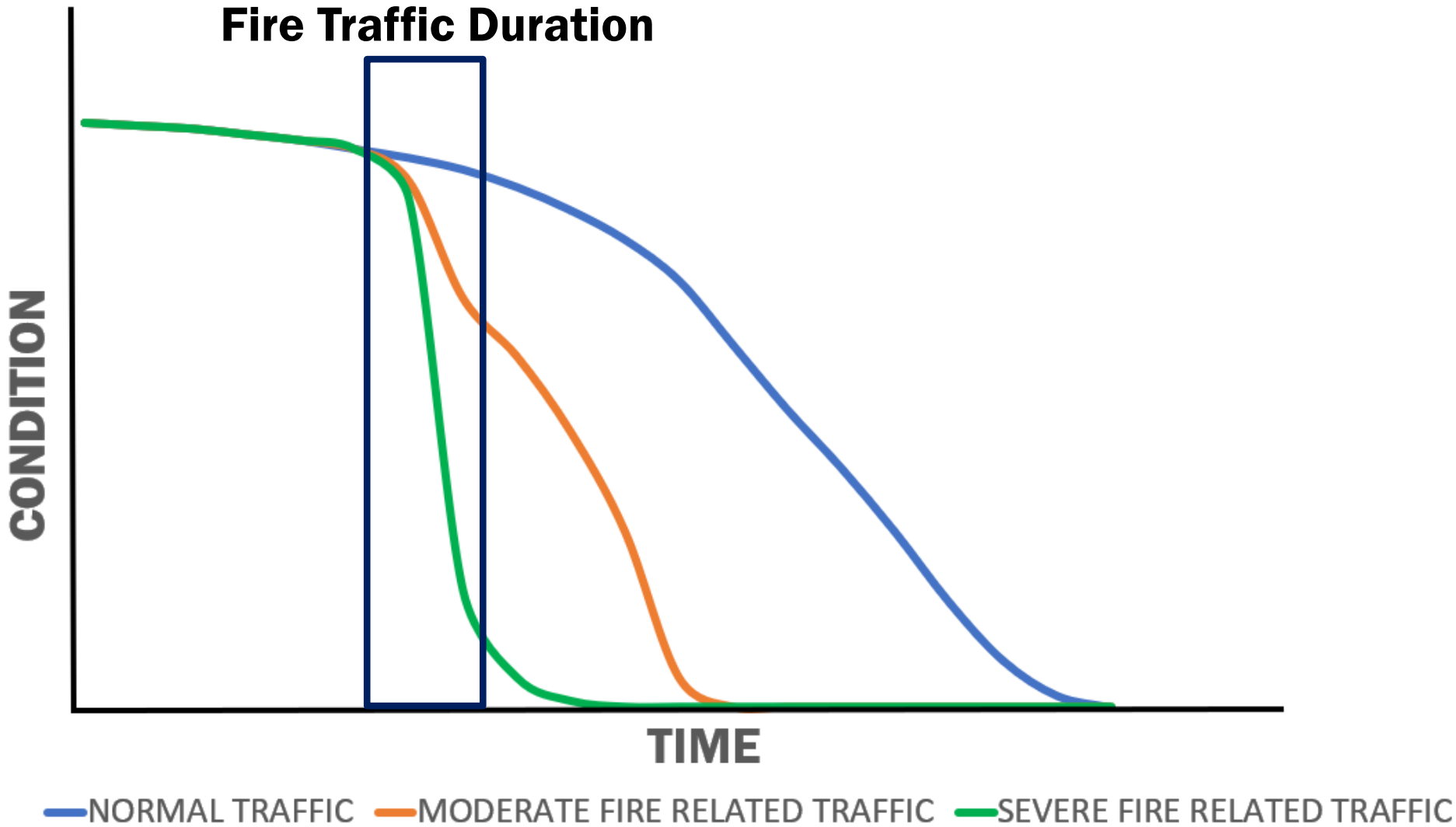
Overview

- Pavement Condition
- Pavement Damage Estimation
  - Visual - PCI
  - Structural - “Use of Life”
  - Examples
- Agency Expectations and What To Do
- Conclusions

Wildfires and Pavement Condition



Pavement Damage

- Environmental
  - Sun
  - Temperature
  - Water
  - Time
  - Fire
- Trucks
  - Fire & Related Vehicles
  - Debris/Recycling
  - Construction
  - ESAL – Equivalent Single Axle Load

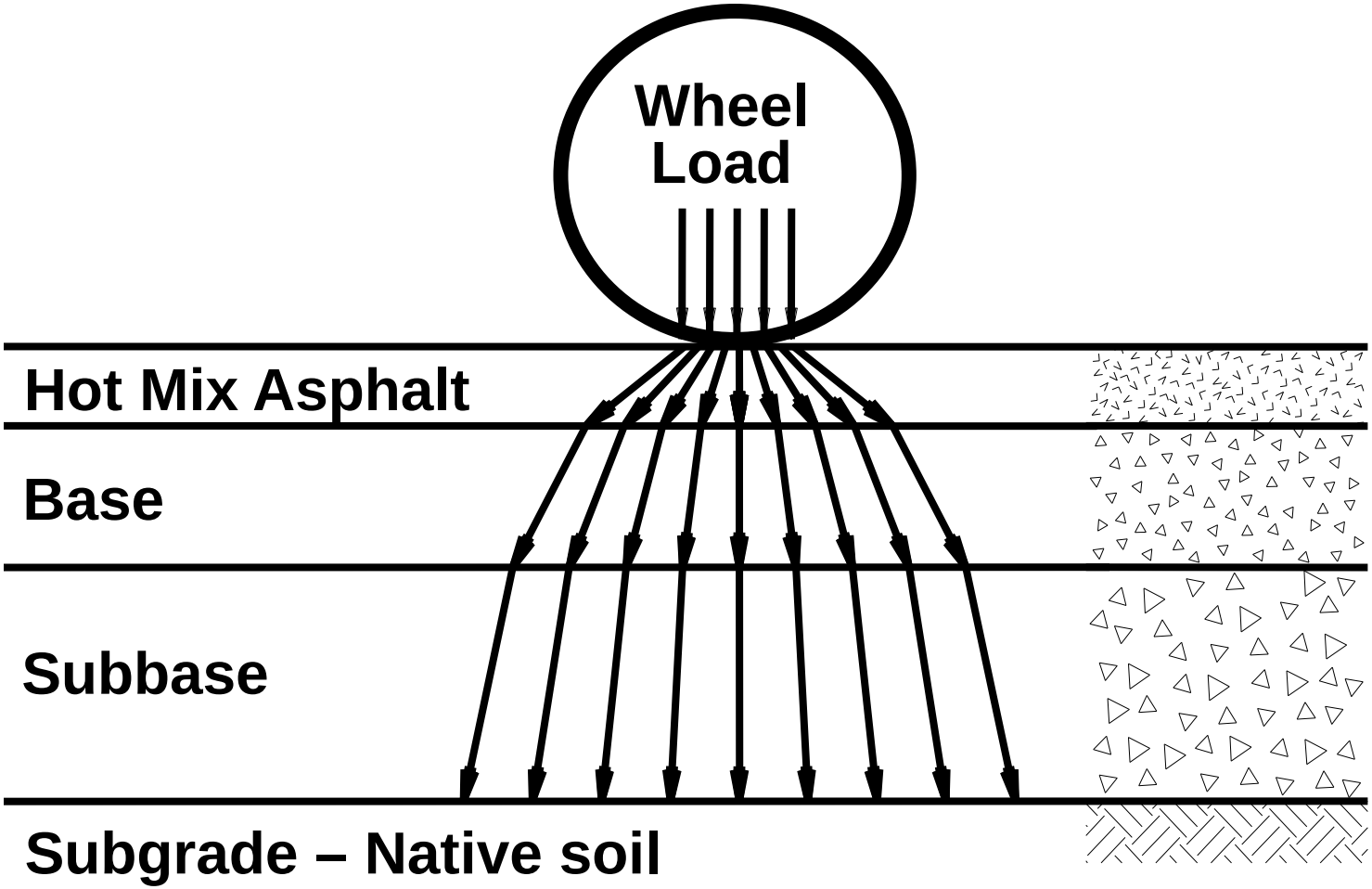
Fire-Related Damage – Most Common

- Alligator Cracking / Fatigue Cracking
- Edge Cracking (non-improved/rural)
- Rutting – on low volume/thin section roads
- Accelerated aging – due to fire itself

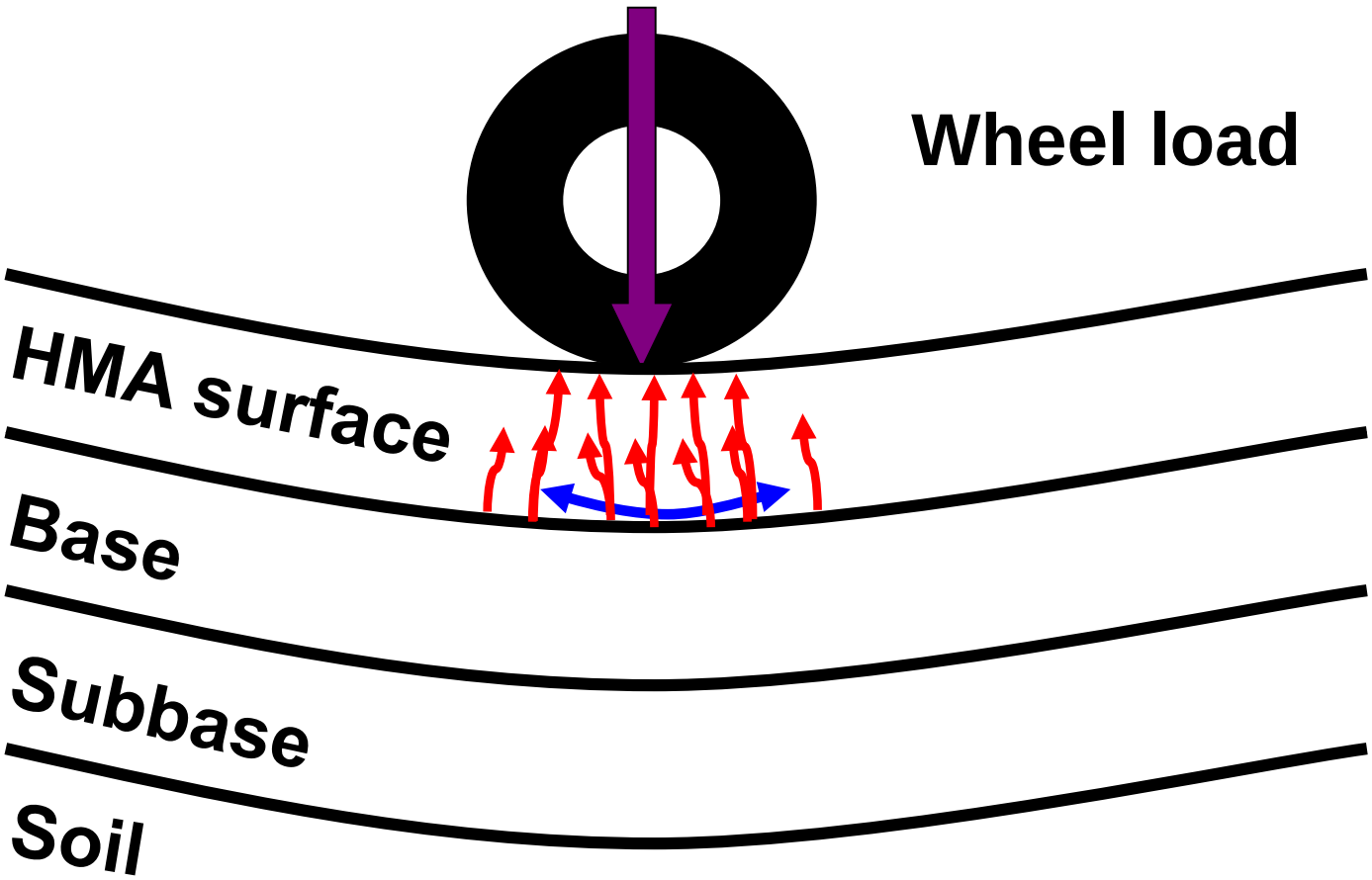
Decreasing Prevalence

- Not absolute and varies by location

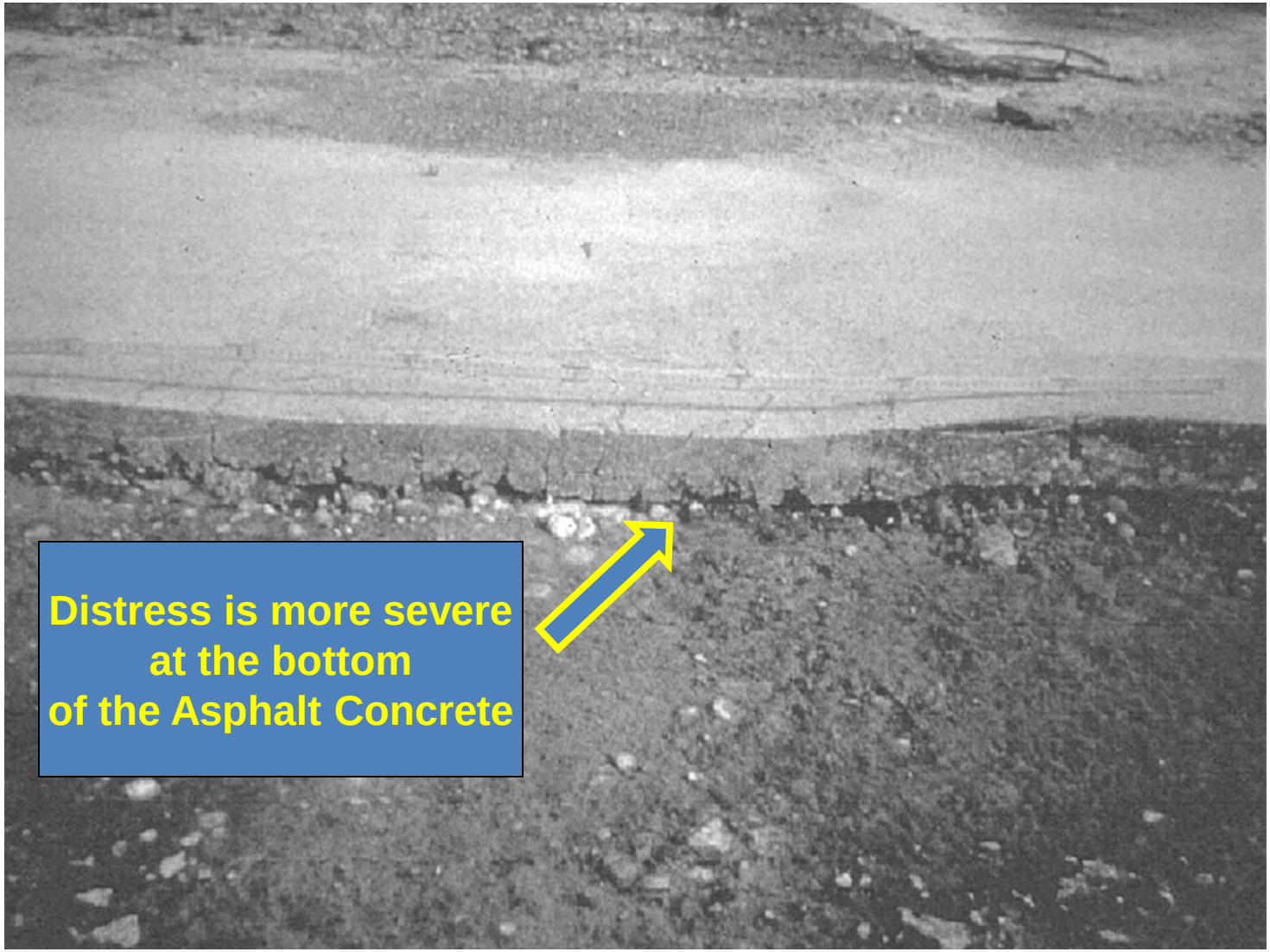
Vehicle Loading on a Pavement



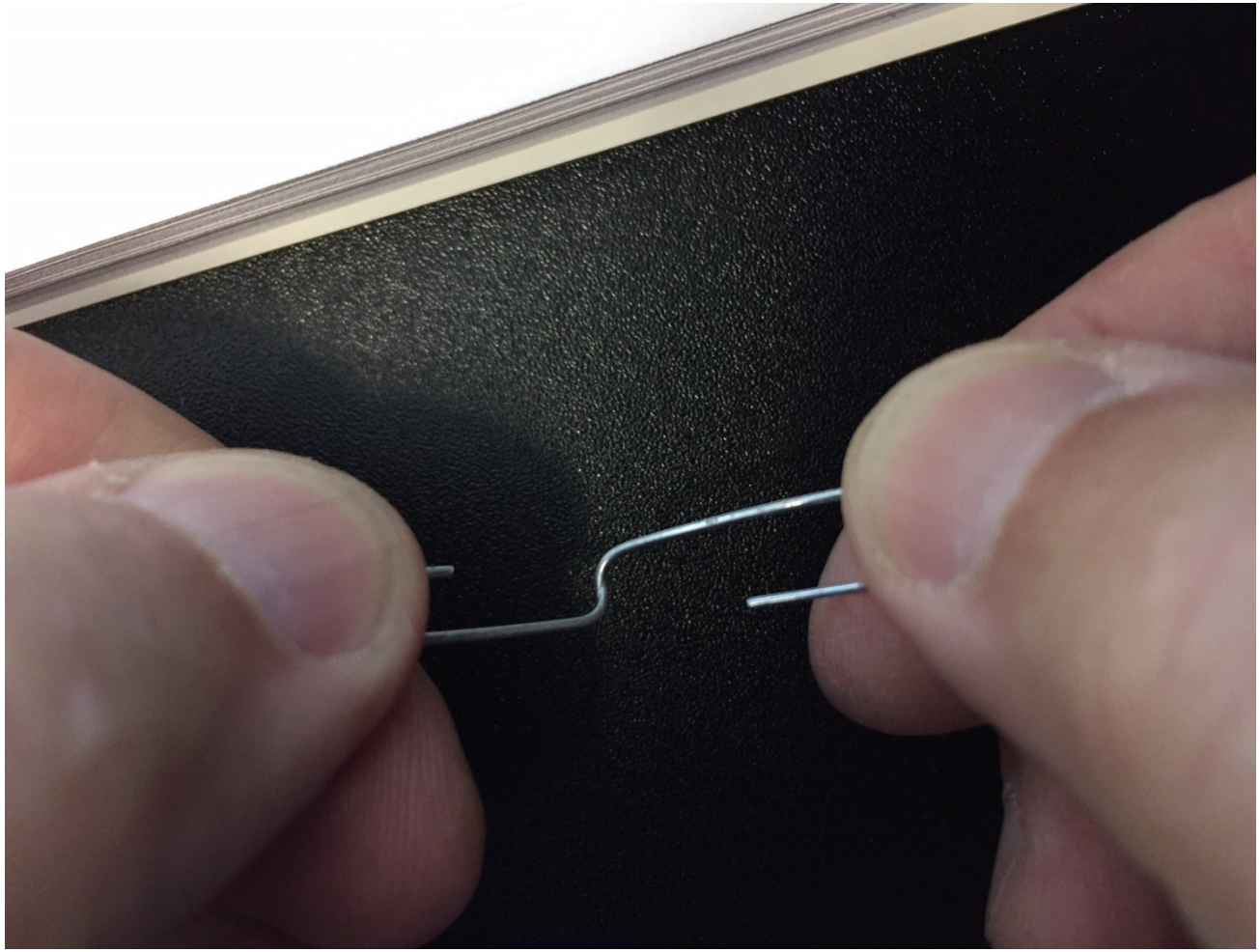
Alligator Cracking (Fatigue) Mechanism



Propagation of Fatigue Cracking



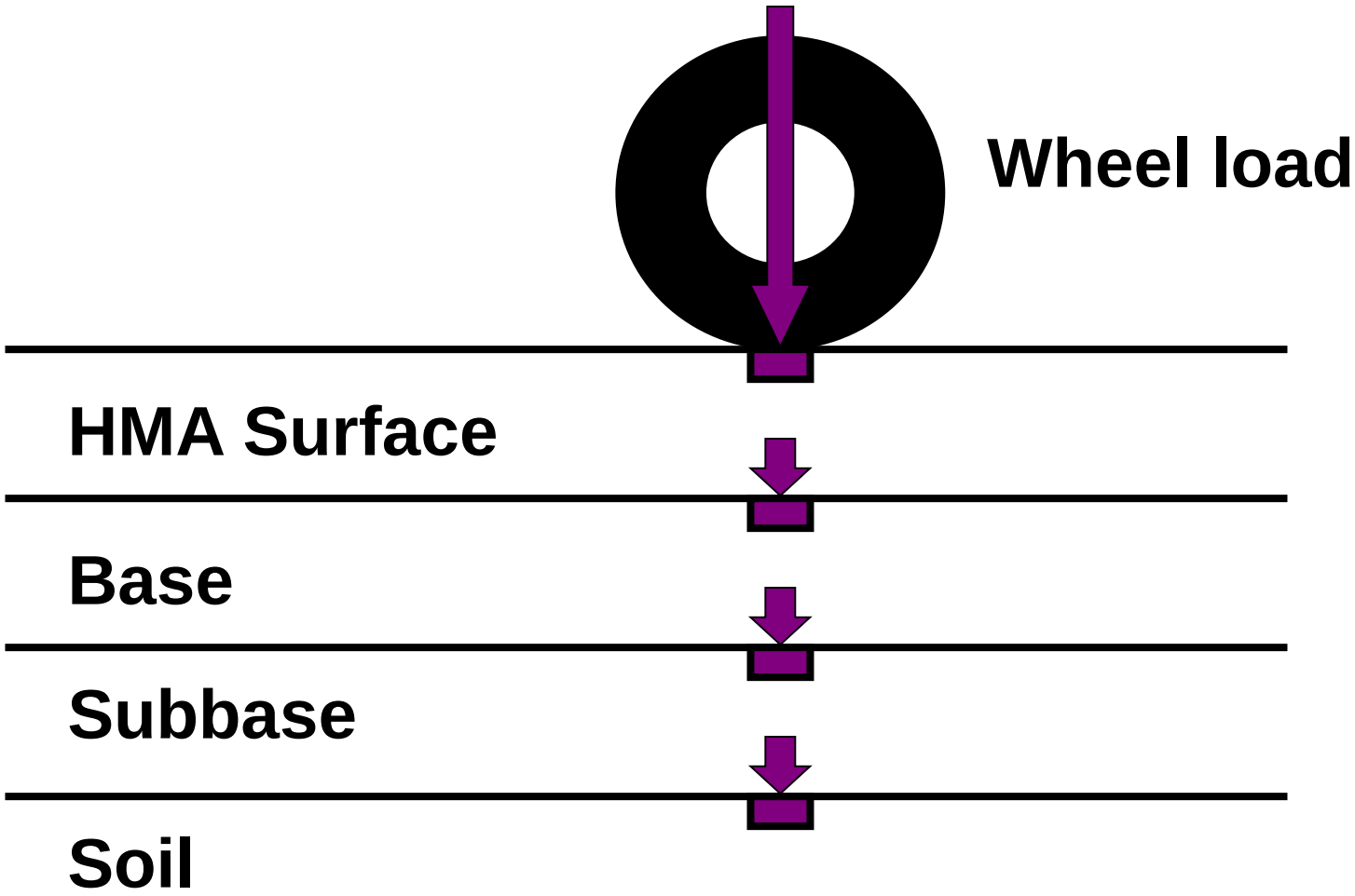
Fatigue



Alligator Cracking (Truck Loading)

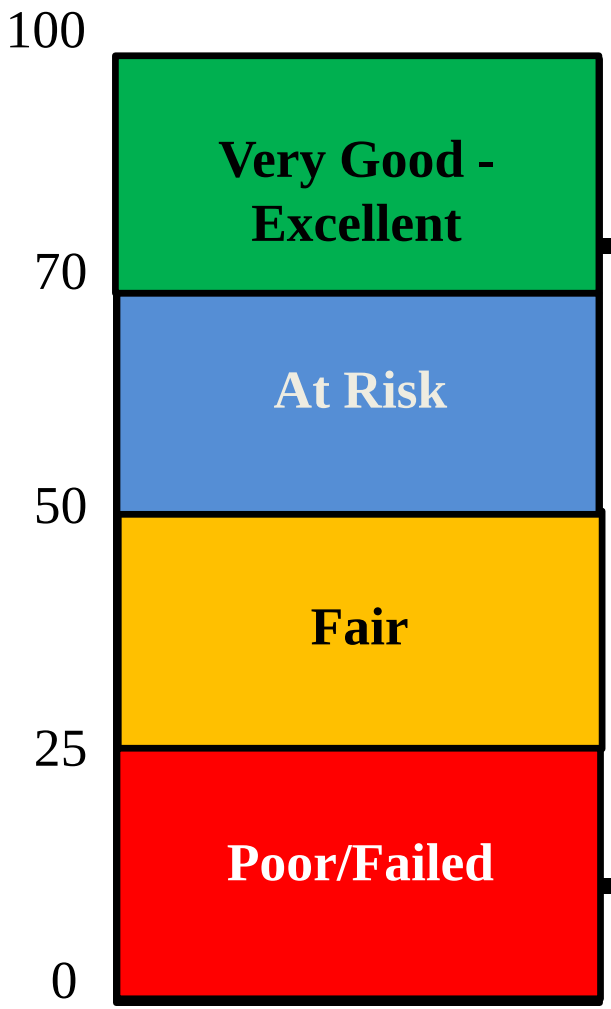
Rutting

Rutting (Permanent Deformation)



Courtesy FHWA

Assessing Pavement Condition: Pavement Condition Index (PCI)



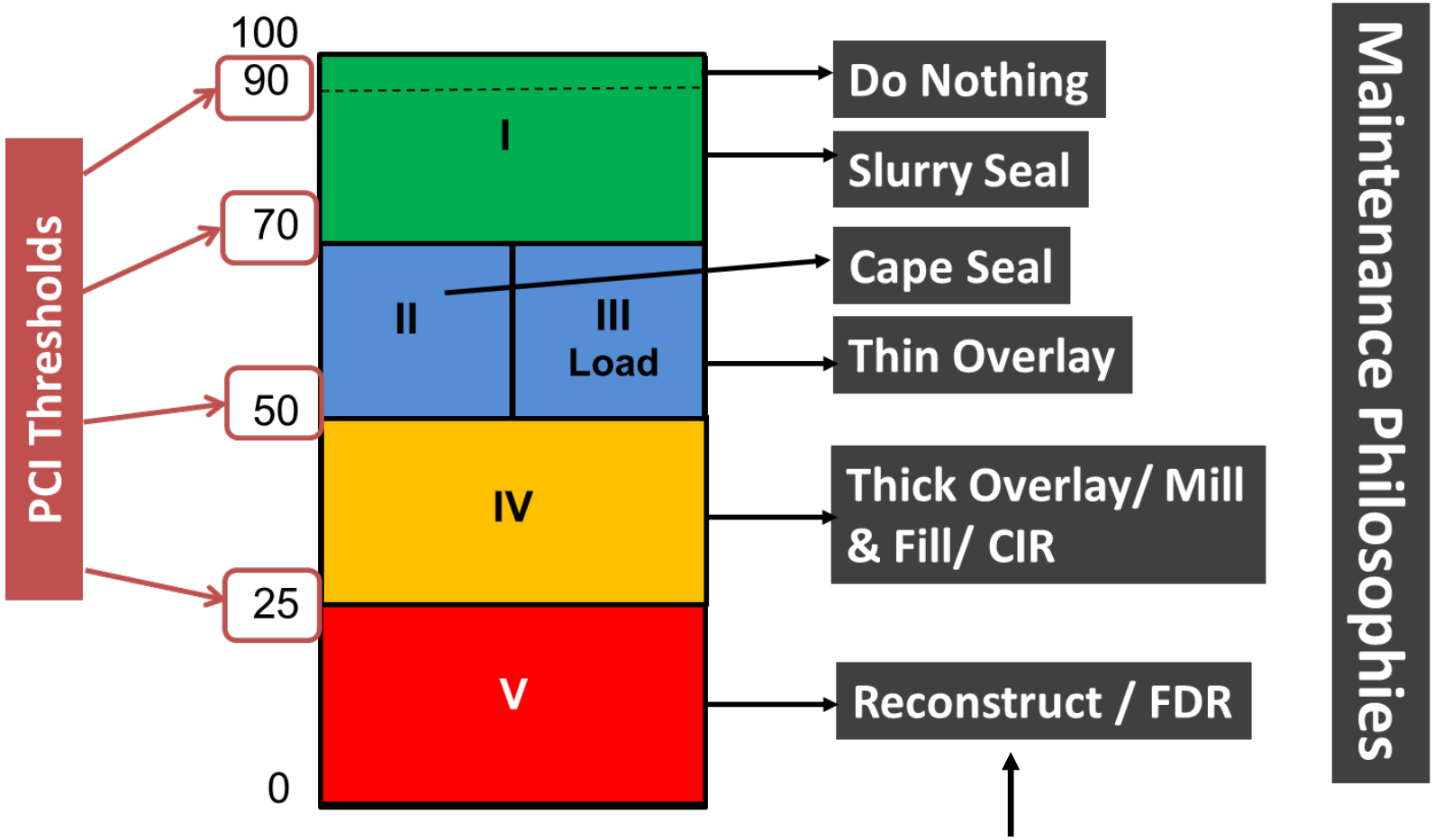
Two Pavement Damage ($$) Estimation Methods

- Pavement Condition Index (PCI) Drop *(Visible)*
- Structural Assessment/"Use of Life" *(Not / min. visible)*
- Pick one - can't do both methods together

PCI Drop Damage Estimation Method

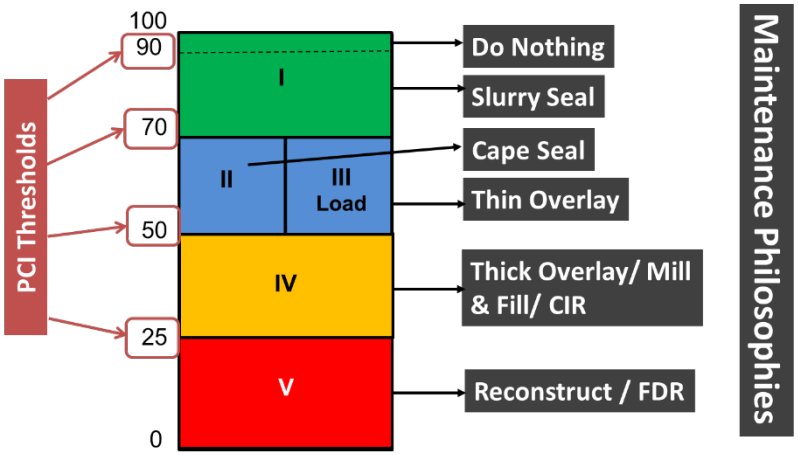
- Pavement Condition Index Drop
  - Based on knowledge of visible distress pre and post fire
  - Change in PCI may yield change in Agency maintenance
  - Subsequent increase in maintenance needs and moves maintenance window forward
  - Difference in cost between treatment needs pre/post fire
  - Simplistic method and 'advanced' method
  - Distress is often a "lagging indicator" of overall condition

Example Agency Decision Tree



Costs known for each treatment

Simplified Example: PCI Drop Method



- 10,000 SY of pavement
- Pre-Fire PCI 85
- Post-Fire PCI 55
- Unit cost is difference between slurry seal and thin overlay cost
- Total cost is treatment unit cost x pavement area

- Slurry - $3/SY
- Cape Seal - $7/SY
- Damage = 10,000 x ($7-$3) = $40,000
- If no PCI drop-> $0
- Advanced method allows for damage calculation if no change in categories (ex. drop from 89 to 72)

Structural "Use of Life" Damage Estimation Method

- Structural Assessment/"Use of Life"
  - Does not depend on measurement of visible distress
  - Concept is to assess how much of the life of the pavement was lost due to fire traffic
  - Cost expressed as a percentage of the value of the pavement

Structural "Use of Life" Method

- Assess pavement structure and value
  - Lengths, widths, layers, thicknesses
  - Subgrade characterization/stiffness
  - Calculate $$ value to replace
  - Based primarily upon fatigue damage
- Estimate design traffic from structure
  - or use design traffic data if available
- Estimate fire-related traffic from number of trucks, truck weights, and distribution (fire trucks, haul trucks…)
- Pavement fire damage = fire traffic/design traffic
- Value of fire damage $$ = pavement fire damage x replacement value

Simplified Example: Structural "Use of Life" Method

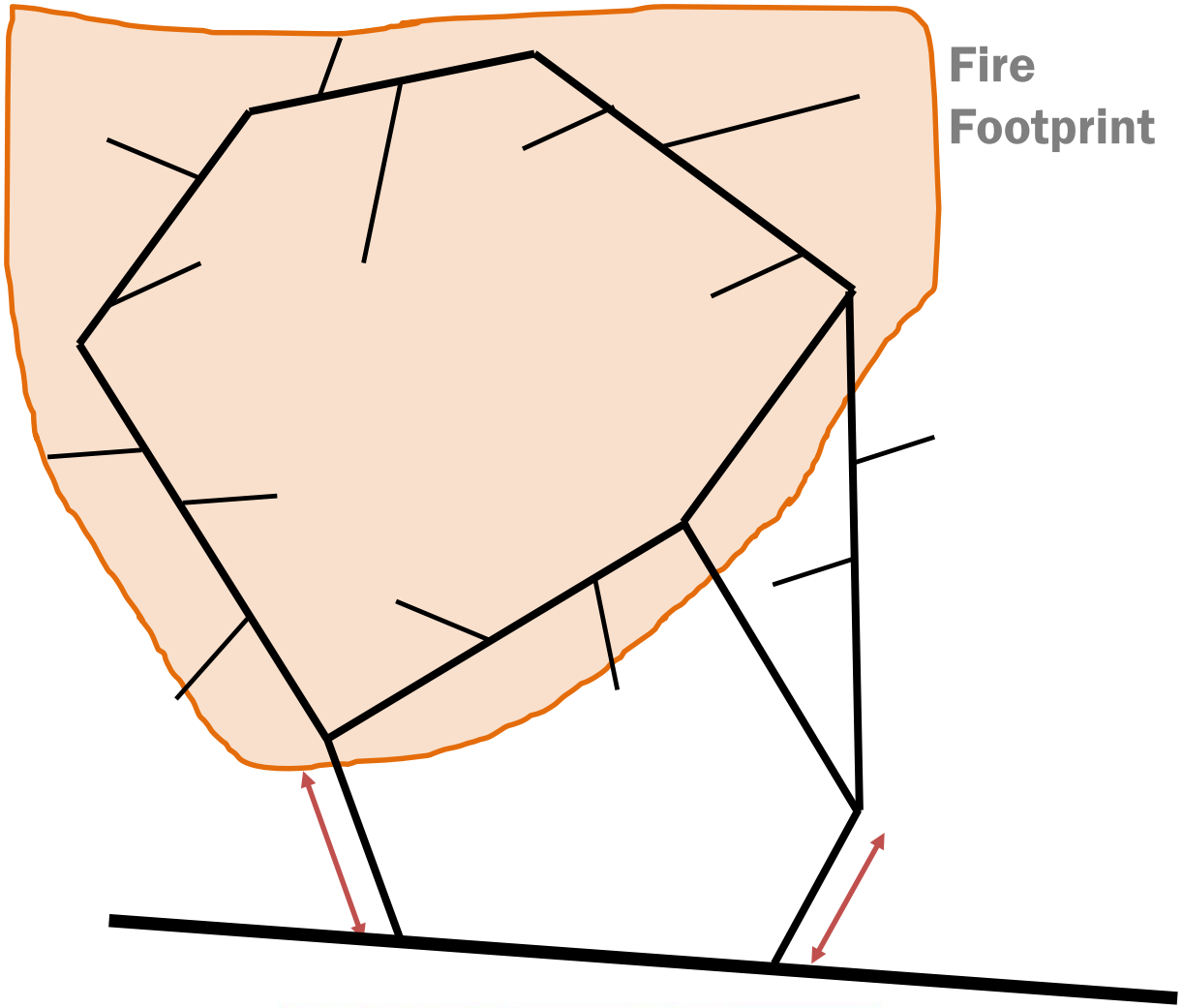
- Major collector 10,000 SY designed to handle 200,000 ESALs (Traffic Index = 7.5)
- Replacement Value: $400,000
- Fire-related traffic: 20,000 ESALs
- Fire-related damage = 20,000/200,000 = 10%
- Damage value = 10% x $400,000 = $40,000
  - Regardless of any visible distress increase

How Much $$ Should an Agency Expect

- Depends on:
  - Types of roads/streets (classification, thickness, etc.)
  - Network layout of roads/streets and location of fire damage
  - Nature of fire traffic patterns and duration
  - Type of trucks loading pavement

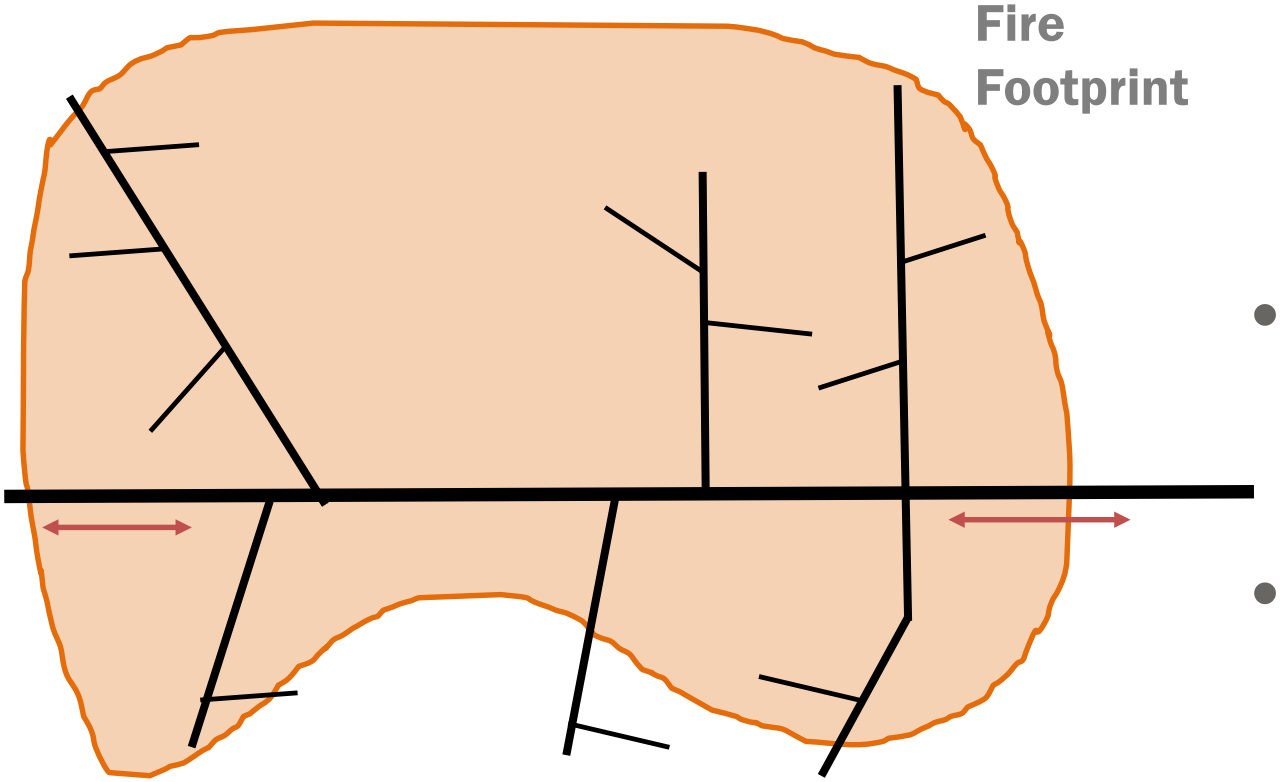
- Not all are fire damage claims are created equal

Example "Distributed" Network



- Two entry/exit points
- Main roads carry traffic for entire network
- Minor roads receive minimal traffic

Example "Railroad" Network



- Caltrans or arterial road carries all in/out traffic
- Collectors only receive traffic for their area
- Minor roads receive minimal traffic

What should an Agency Do?

- Know condition of pavements on continual basis
  - Get regular PCI distress surveys – automated or walking
- Assess conditions immediately after fire
  - For PCI Method
    - Walking or automated survey
    - If automated – remove debris before surveying
    - Take lots of photos – document!

What should an Agency Do?

- Assess conditions immediately after fire
  - For Structural Method
    - Know pavement structure(s) or be willing to measure
      - Layer types, thicknesses, subgrade characterization
    - Document as much about fire-related traffic as possible
      - Truck weights, sizes, start/end locations, fire truck staging areas…

Conclusions

- Fire damage to pavements is a complex topic
- Post-fire pavement damage may or may not be visible
  - Or quantifiable – particularly if you don't know your pre-fire conditions
  - Therefore - know your network, PCI, thicknesses, materials
- Multiple methods available to assess damage $$
  - Presented two here
- Damage may well continue during rebuilding phase
- Costs increase over time – and you will be rebuilding with future costs
- Document, Document, Document

Thank you !

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