



RPUG 2018 CONFERENCE - SOUTH DAKOTA

30 Years On The Road To Progressively Better Data

Rapid City September 18-21

Cracking Definitions through Consensus for the Future

NCHRP 01-57A

Developing Standard Definitions for Comparable Pavement Cracking Data

By

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Objectives of NCHRP 01-57A

- ❑ Develop standard, discrete definitions for common cracking types in flexible, rigid, and composite pavements
- ❑ Reposition the roles of service providers and of SHAs for objective cracking measurements and continuing technological innovations by researchers and vendors
- ❑ Facilitate comparable measurement and interpretation of pavement cracking
- ❑ Have sufficient details to meet requirements for developing automated cracking software, for being compatible with existing and emerging image-based technologies
- ❑ Develop primarily for network level surveys and help application of new technologies at the project level.

Phase-I, 9-Month

- ❑ Task 1: Conduct Review of Existing Cracking Data Collection Practices
- ❑ Task 2: Conduct Review of Role of Cracking Data in Decision-Making Processes
- ❑ Task 3: Deliver A Summary of Cracking Data Desired by SHAs
- ❑ Task 4: Deliver An Interim Report

Phase-II, 12-Month

- ❑ Task 5: Propose Standard Definitions for Common Cracking Types
- ❑ Task 6: Identify Gaps and Deliver Revised AASHTO PP67 and PP68
- ❑ Task 7: Identify Future Research Needs and Activities
- ❑ Task 8: Submit Final Report and AASHTO Protocols

Core Thinking

- ❑ Full Automation of Cracking Survey
- ❑ Compatible with Existing and Future Practices in Both Design and Management
- ❑ Not based on LTPP Distress Manual, PCI Definitions, or Other Manual Processes
- ❑ Extensions or Customizations for Project Level Work

Three Levels of Cracking Definitions (Level 3)

□ Level 3: Percent of cracking (baseline performance); Single Value

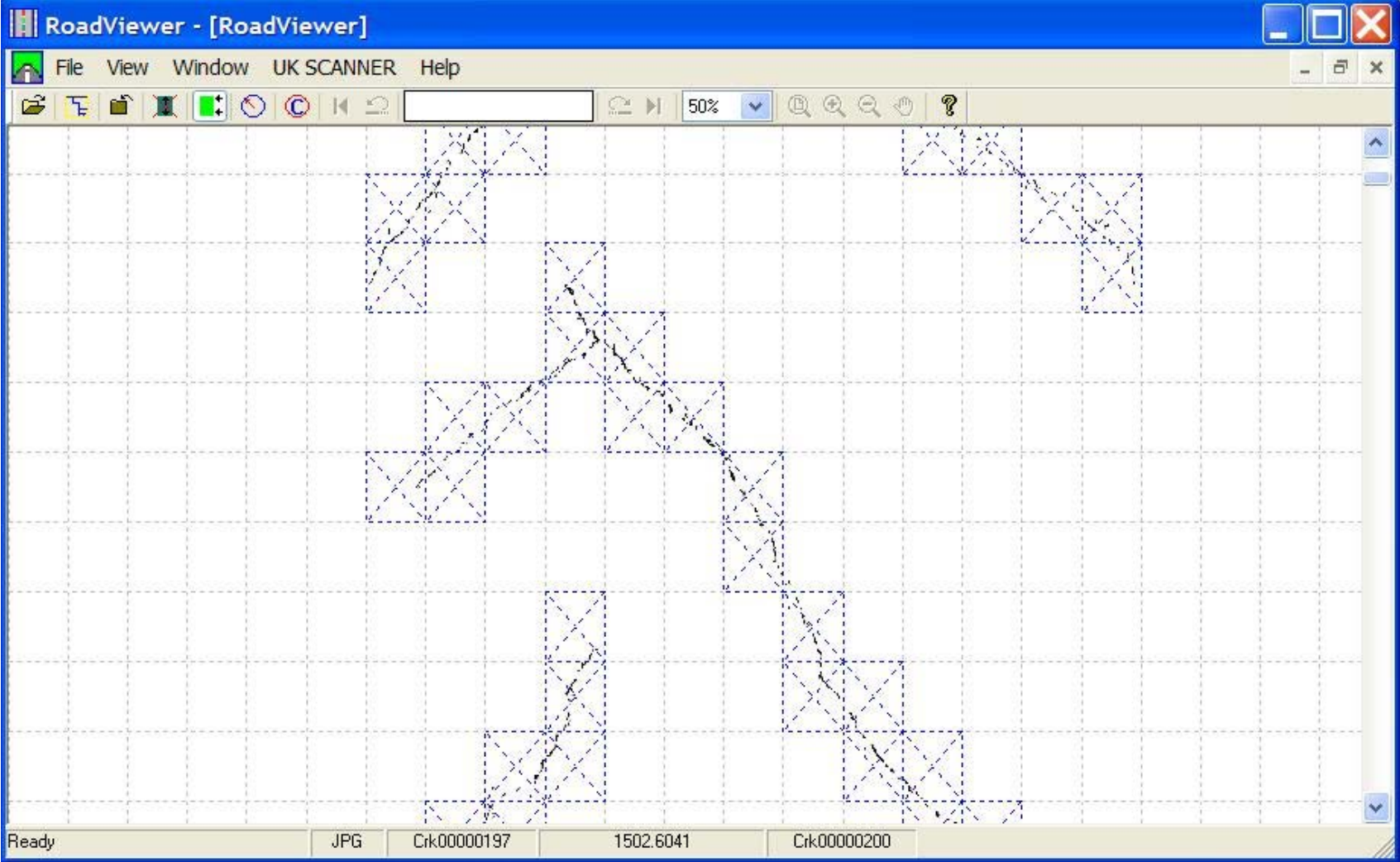
$$Index = \frac{n_c}{N} \times 100\%$$

Where:

n_c : 200mm x 200mm grid number containing cracks in one 50m subsection

N : Total 200mm x 200mm grid number in one 50m subsection

Percent of Cracking Illustration



Three Levels of Cracking Definitions (Level 2)

- ❑ Level 2: Load associated cracking on wheel-paths with severity details (moderate performance)
 - Cracking data at three severity levels within two wheel-path areas at 50-meter or 1/10-mile intervals:
 - Severity 1: average crack width less than 3mm
 - Severity 2: average crack width between 3mm & 6 mm
 - Severity 3: average crack width greater than 6mm
- ❑ Area 1: Inner wheel-path
- ❑ Area 2: Outer wheel-path
- ❑ Six Values + One Value from Level 3

Three Levels of Cracking Definitions (Level 1)

- ❑ Level 1: cracking with type, extent, and severity details (highest performance)
- ❑ Linear cracking of transverse and longitudinal nature is determined outside of the two wheel-paths along with their severity levels;
- ❑ Cracking details on wheel-paths remain the same as these at Level 2.
- ❑ Level 1: the most detailed definitions
- ❑ The focus: the definitions at Levels 2 and 3

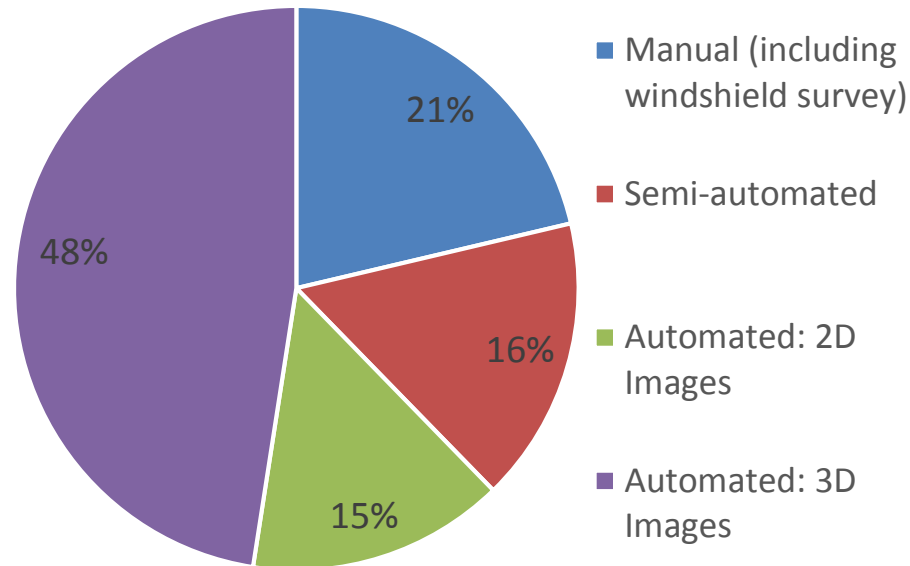
Online Survey

- From April to May 2018

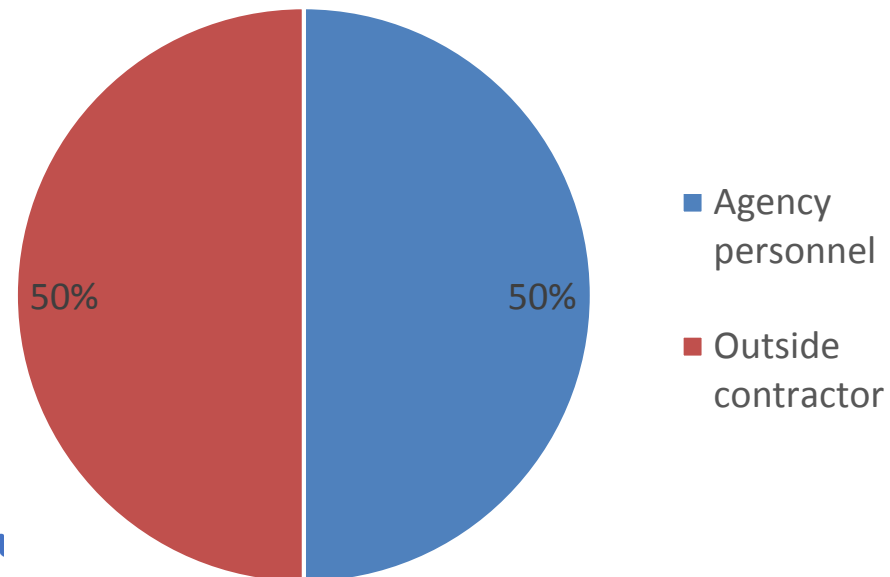
- Five Sections
 - ✓ Part I: Cracking data collection, processing, and common issues
 - ✓ Part II: Cracking Definitions including transverse cracking, longitudinal cracking, alligator/fatigue cracking, block cracking, edge cracking, durability “D” cracking, corner break, and other cracking data
 - ✓ Part III: Wheel-path Definitions
 - ✓ Part IV: AASHTO PP 67 Applications
 - ✓ Part V: General Comments

- Responses from 38 Different SHAs

Part I: Cracking Data Collection, Processing, and Common Issues

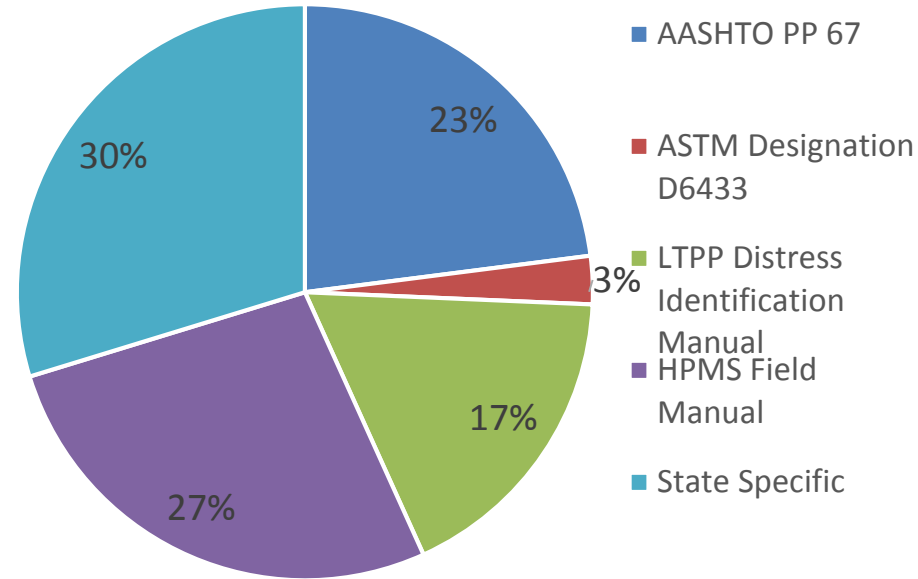


63% of SHAs Apply 2D/3D Image based Automated Technologies for Cracking Data Collection and Processing Methods

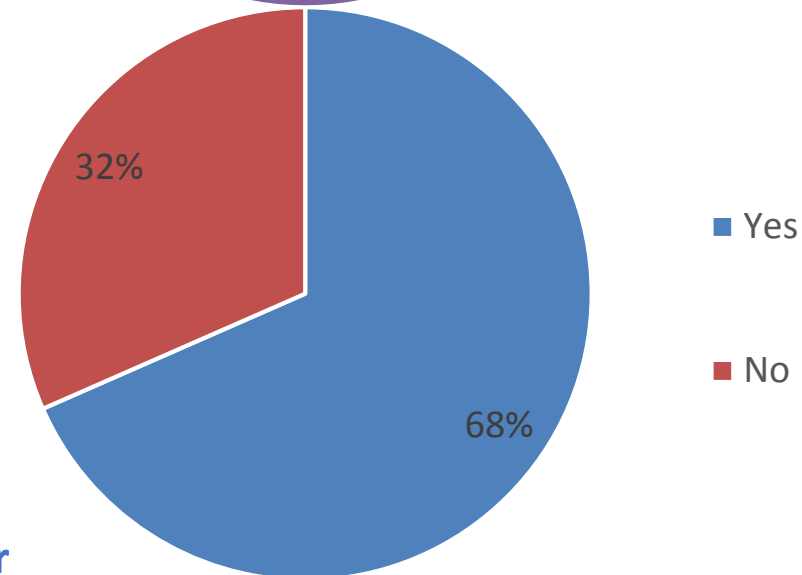


Data Collection and Processing Personnel

Part I: Cracking Data Collection, Processing, and Common Issues

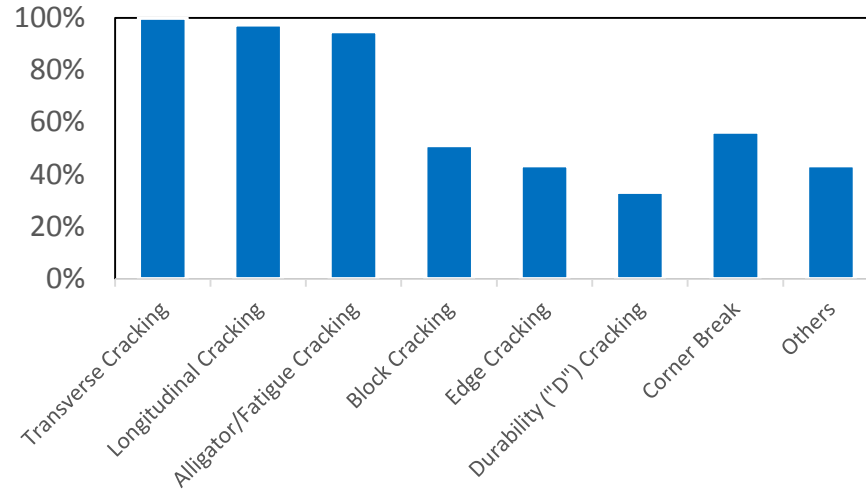


Data Collection and Processing Protocols

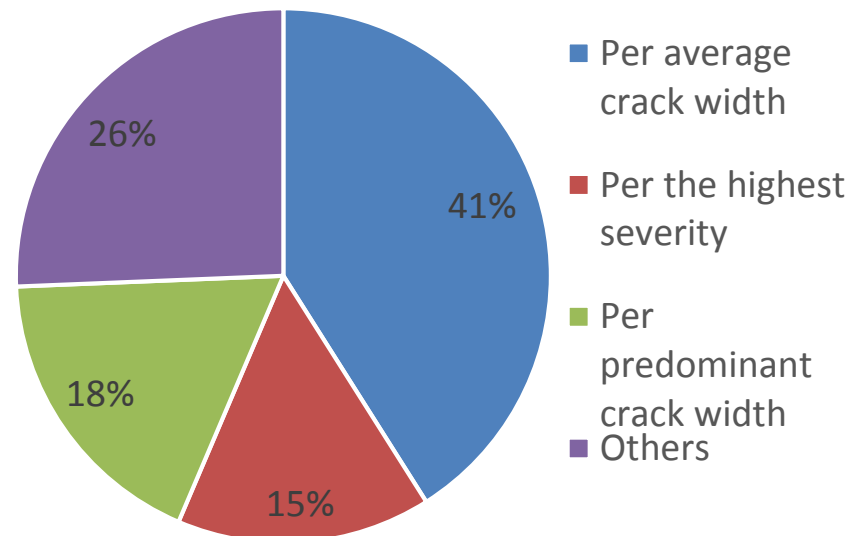


68% SHAs Conduct QA/AC on Automated Cracking Analysis Results

Part I: Cracking Data Collection, Processing, and Common Issues

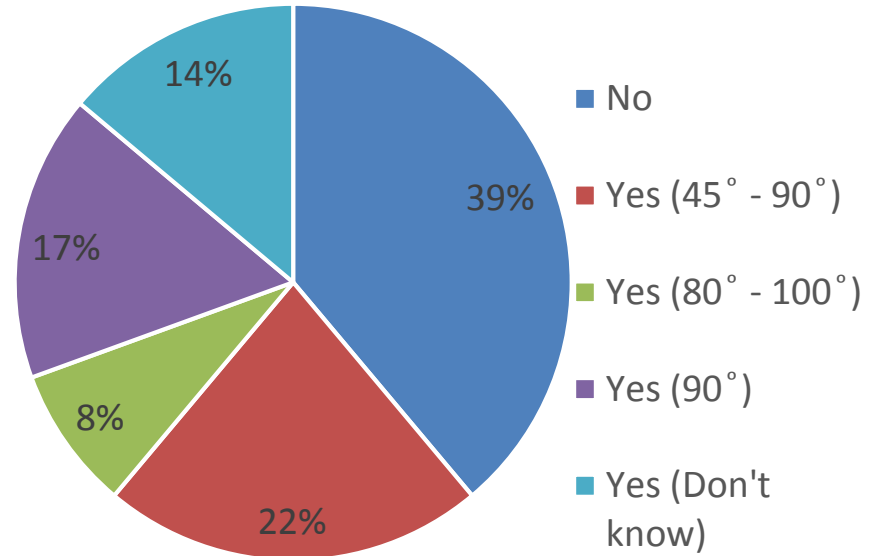


Almost All the SHAs Collect Transverse Cracking, Longitudinal Cracking, and Alligator/Fatigue Cracking

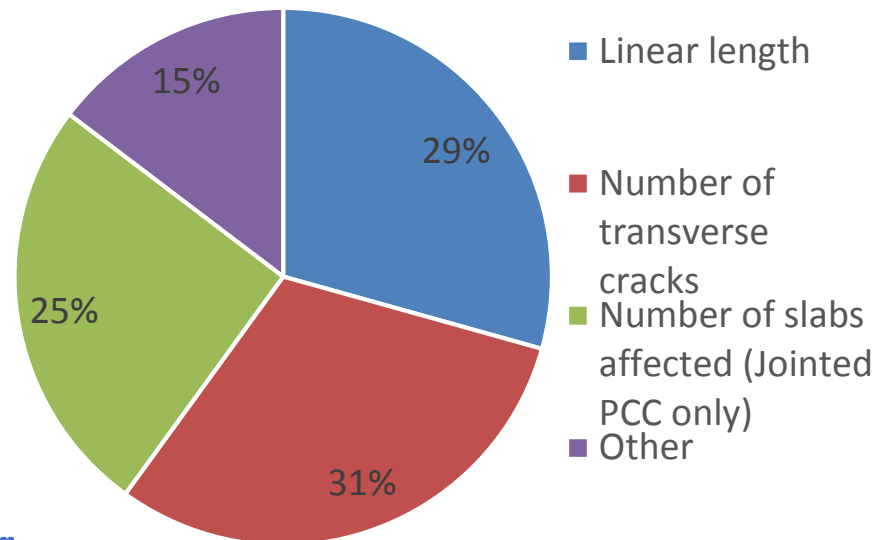


Cracking Severity Levels: 41% SHAs Use Average Crack Width

Part II: Cracking Definitions, Transverse Cracking

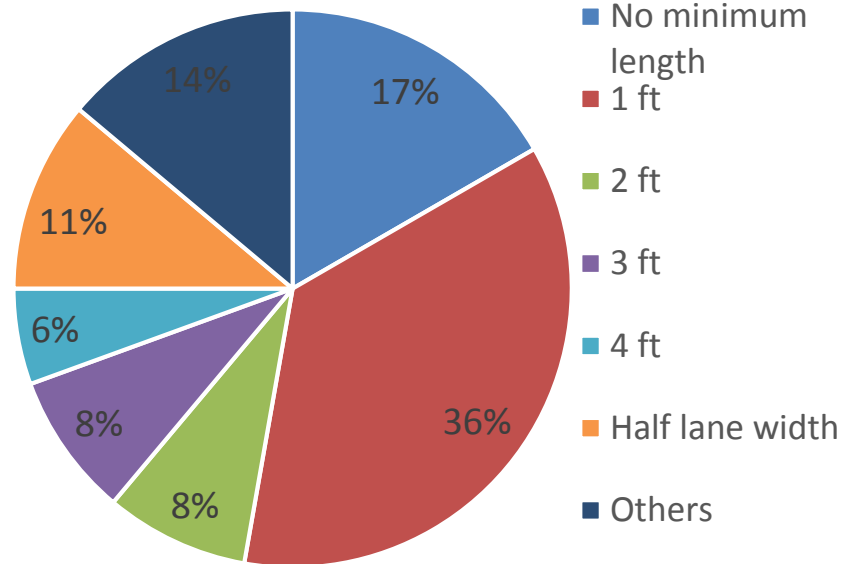


61% SHAs Use Angle Orientation To Define Transverse Cracking

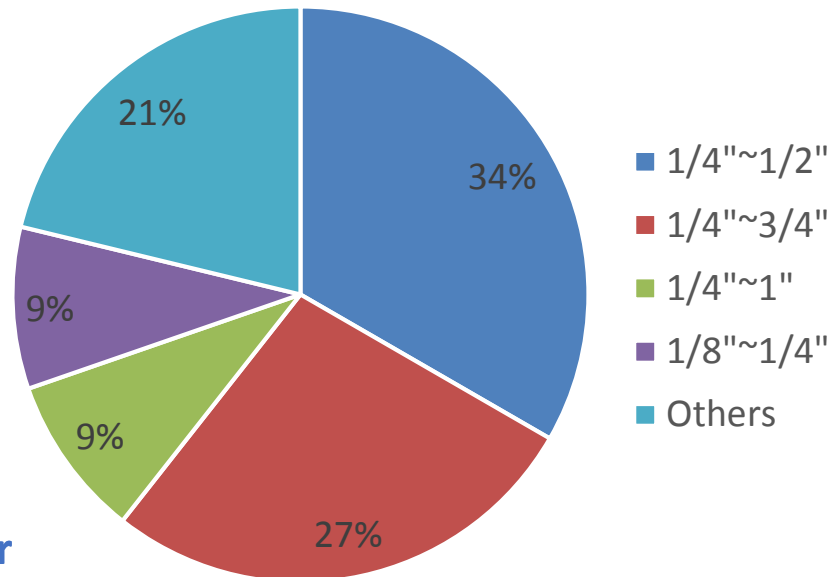


Extent Evaluation Factors:
 Linear Length (29%)
 Number of Transverse Cracks (31%)
 Number of Slabs Affected (Jointed PCC only) (25%)

Part II: Cracking Definitions, Transverse Cracking

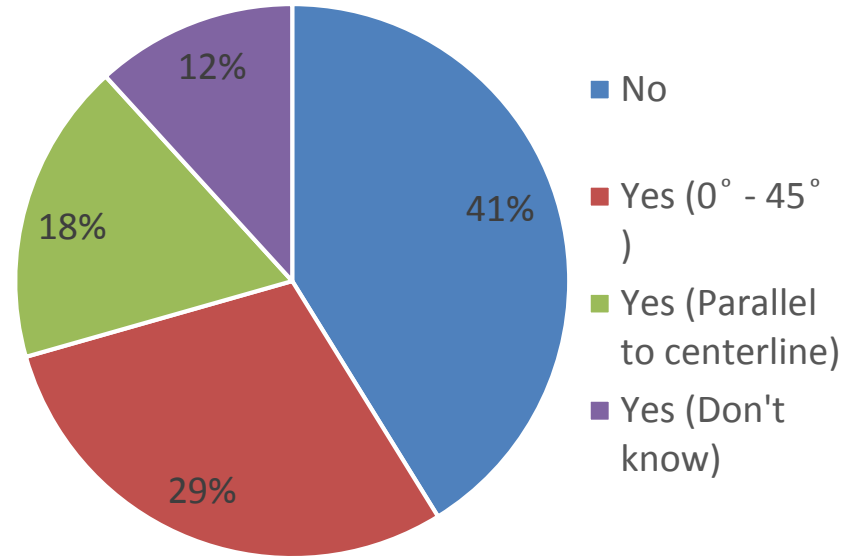


Minimum Length:
1 ft. (36%)

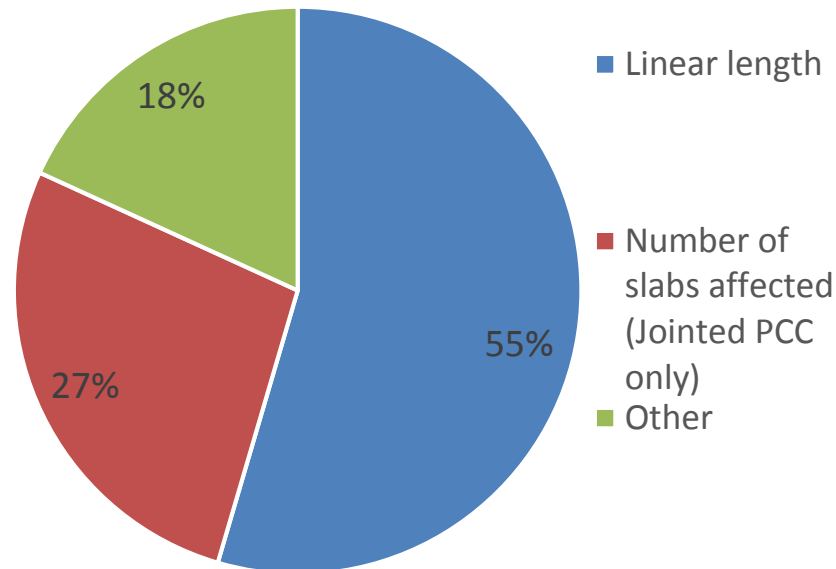


Crack Width Thresholds:
1/4"~1/2" (34%)
1/4"~3/4" (27%)

Part II: Cracking Definitions, Longitudinal Cracking

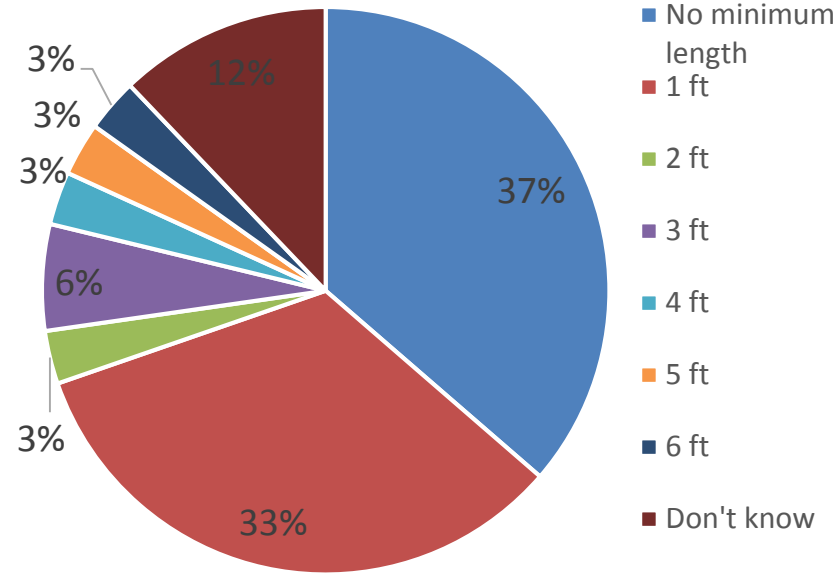


59% SHAs Use Angle Orientation To Define Longitudinal Cracking

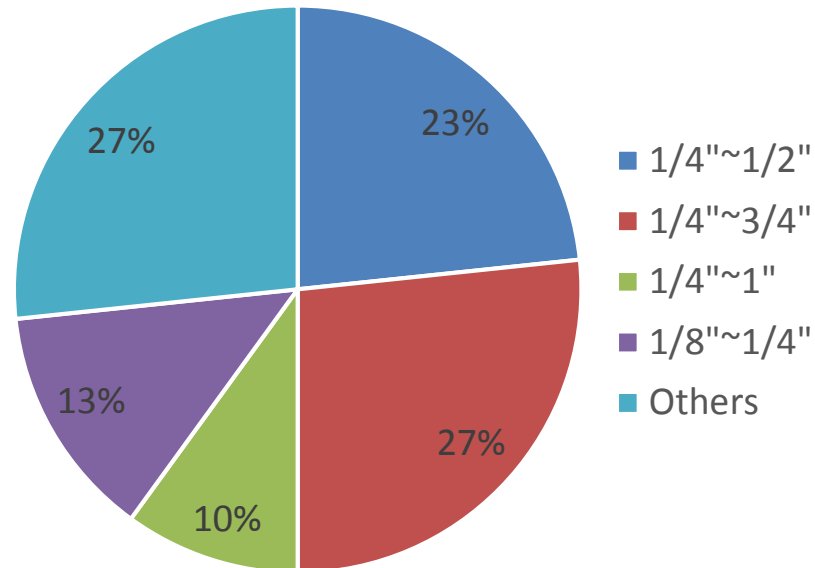


Extent Evaluation Factors:
Linear length (55%)

Part II: Cracking Definitions, Longitudinal Cracking

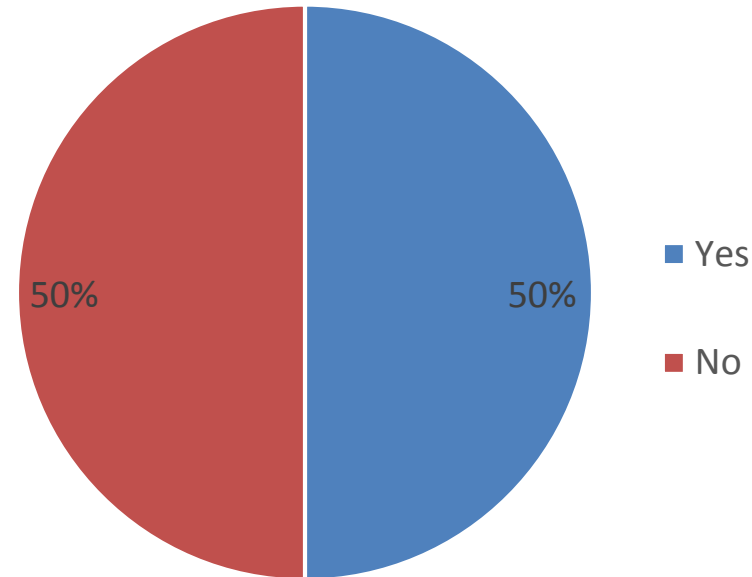


Minimum Length:
1 ft. (33%)

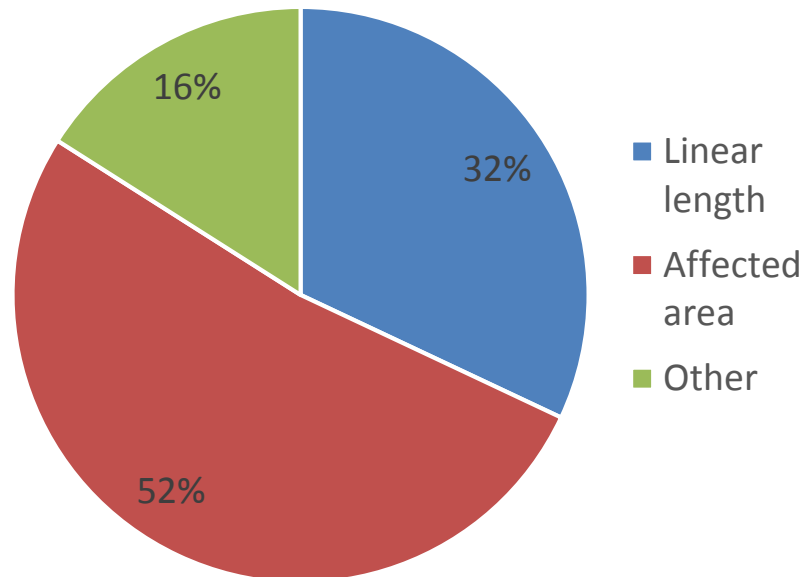


Crack Width Thresholds:
1/4"~1/2" (23%)
1/4"~3/4" (27%)

Part II: Cracking Definitions, Alligator/Fatigue Cracking

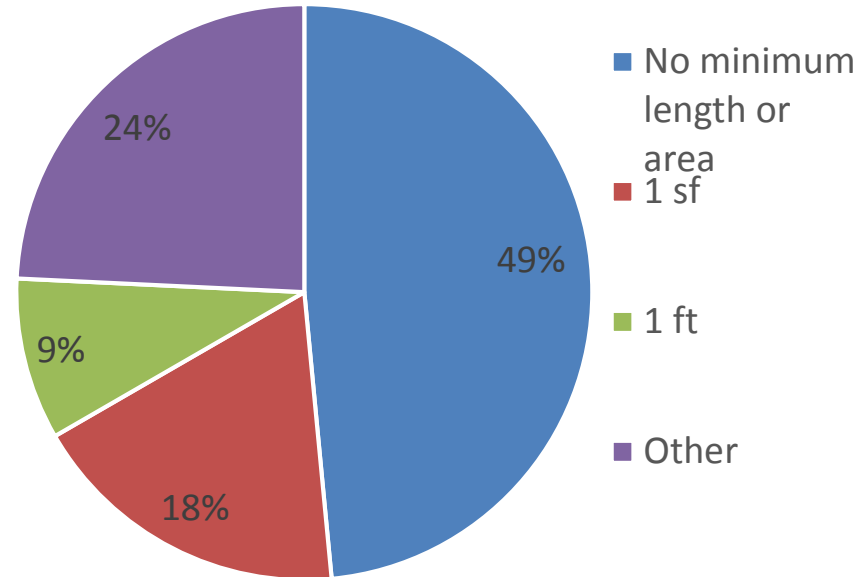


50% of SHAs Count The Portion of Cracking in Wheel-path As Alligator/Fatigue Cracking

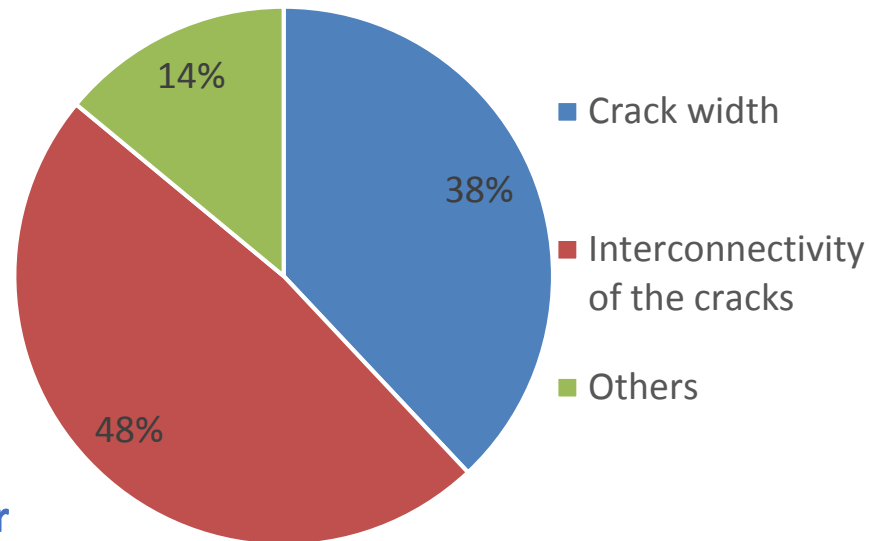


Extent Evaluation Factors: Affected Area (52%)

Part II: Cracking Definitions, Alligator/Fatigue Cracking

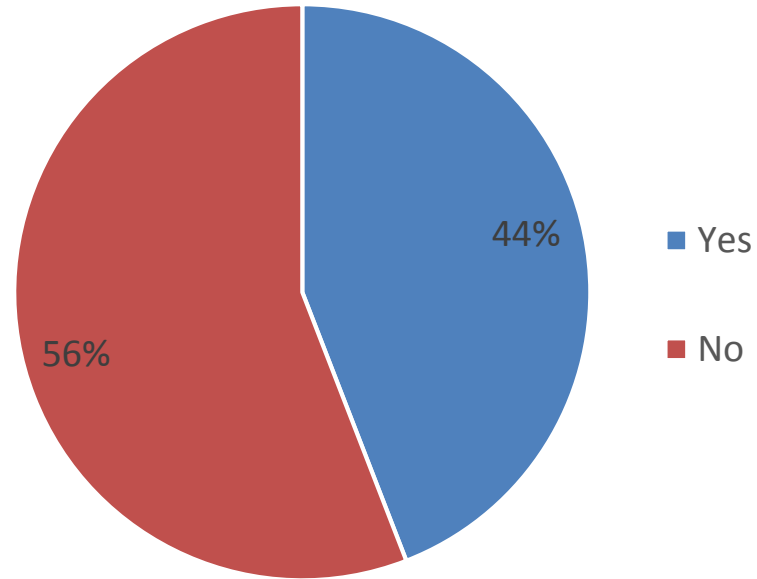


Minimum Length or Area:
No Requirement (49%)

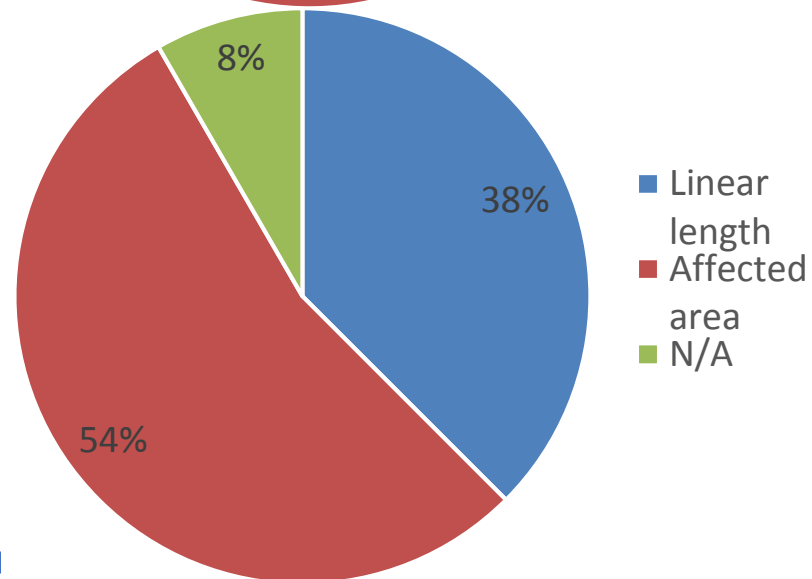


Severity Evaluation Factors:
Crack Width (23%)
Interconnectivity of the
cracks (27%)

Part II: Cracking Definitions, Block Cracking

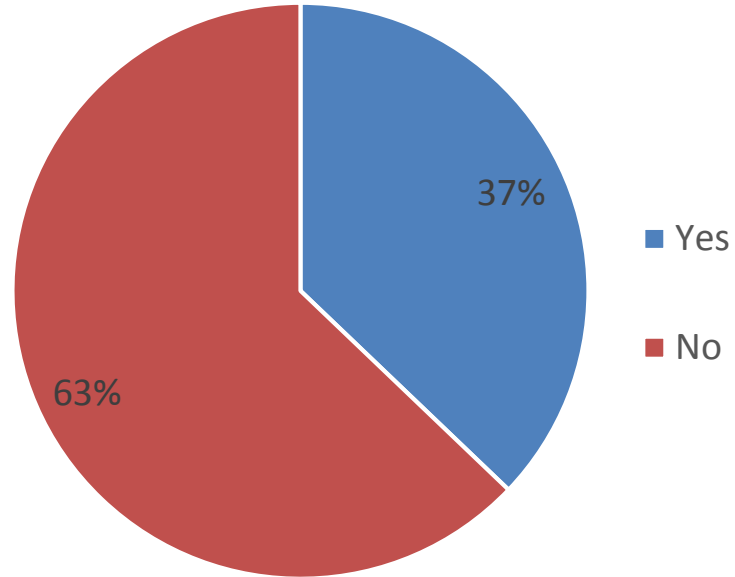


44% of SHAs Collect Block Cracking

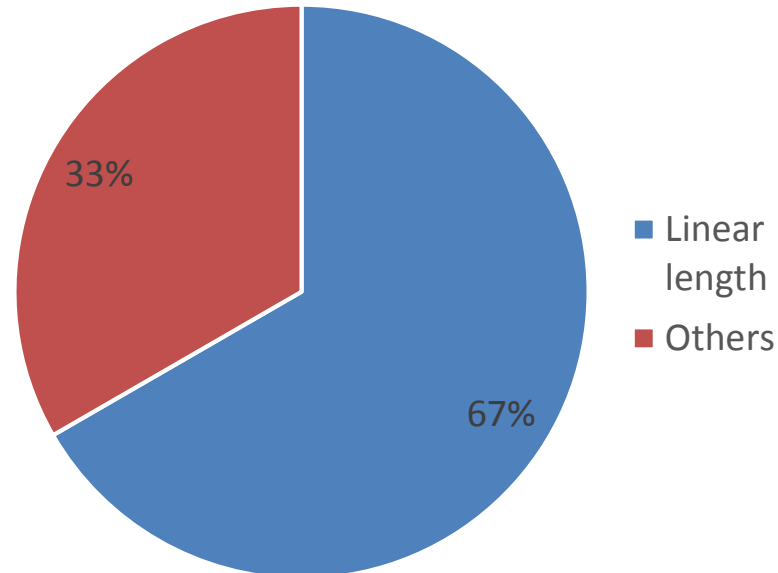


Extent Evaluation Factors:
Linear Length (38%)
Affected Area (54%)

Part II: Cracking Definitions, Edge Cracking

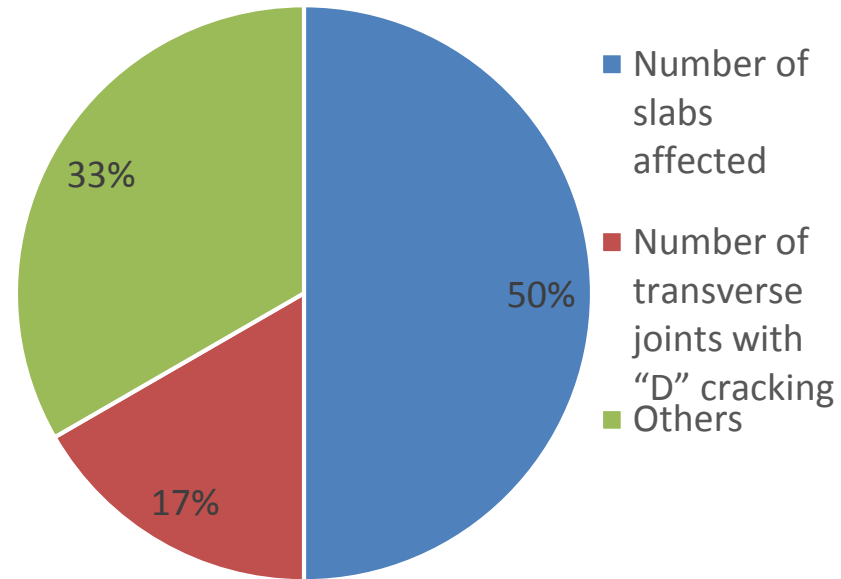


37% of SHAs Collect Edge Cracking

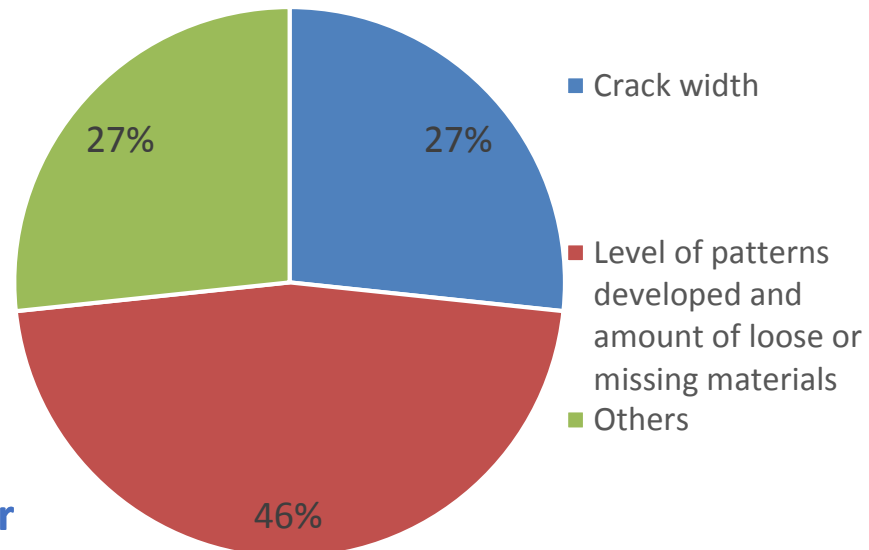


Extent Evaluation Factors:
Linear Length (67%)

Part II: Cracking Definitions, Durability (“D”) Cracking

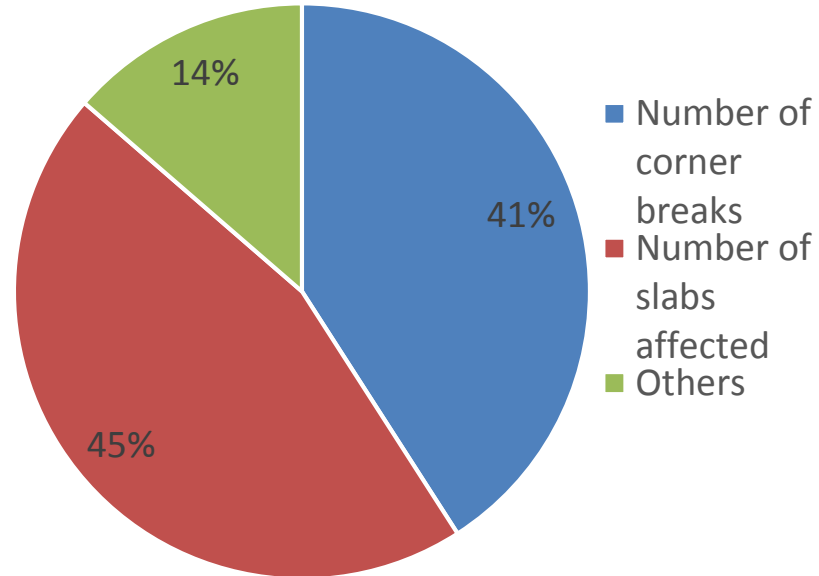


Extent Evaluation Factor:
Number of Slabs Affected
(50%)

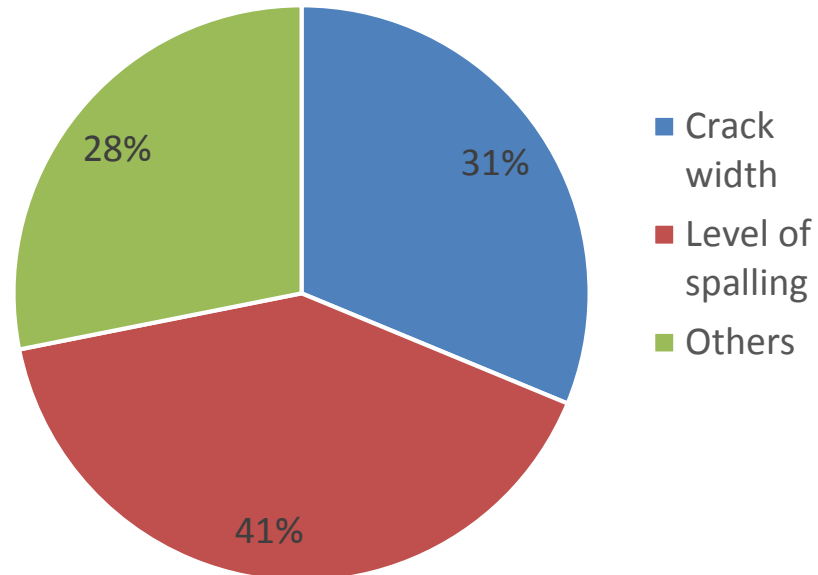


Severity Evaluation Factors:
Level of Patterns Developed
and Amount of Loose or
Missing Materials (46%)

Part II: Cracking Definitions, Corner Break

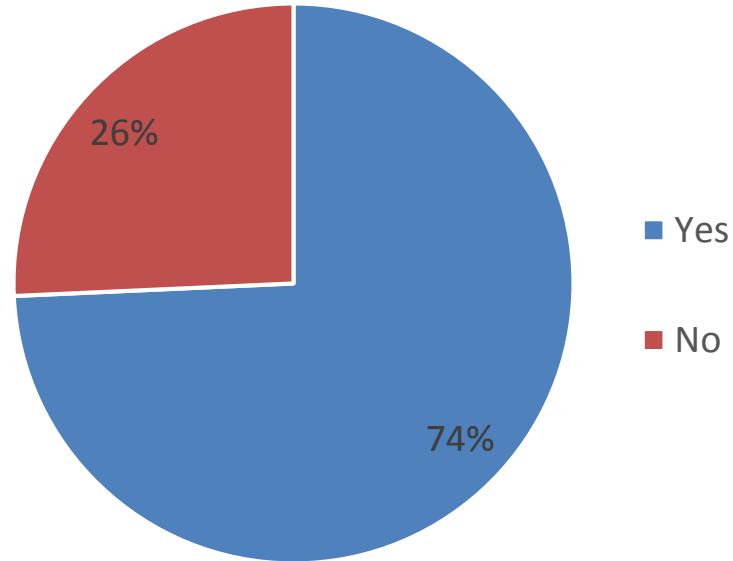


Extent Evaluation Factor:
Number of Corner Breaks (41%)
Number of Slabs Affected (45%)

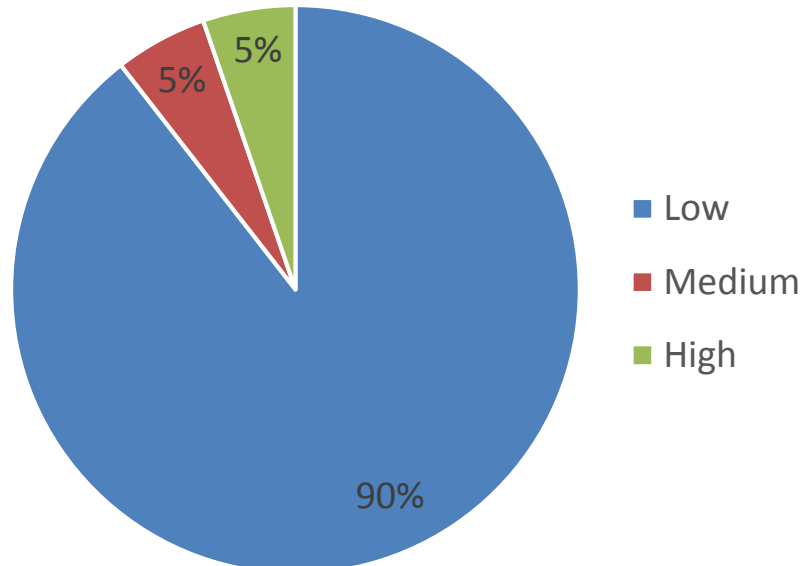


Severity Evaluation Factors:
Crack Width (31%)
Level of Spalling (41%)

Part II: Cracking Definitions, Sealed Cracking

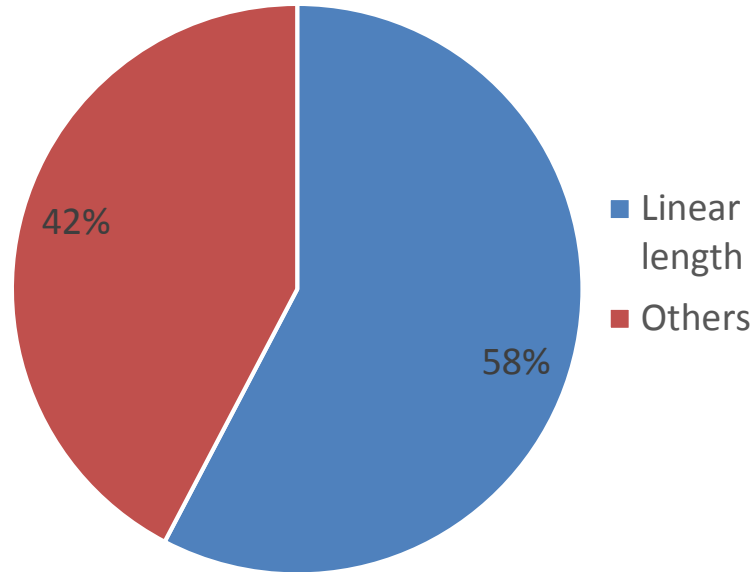


74% of SHAs Collect Sealed Cracking

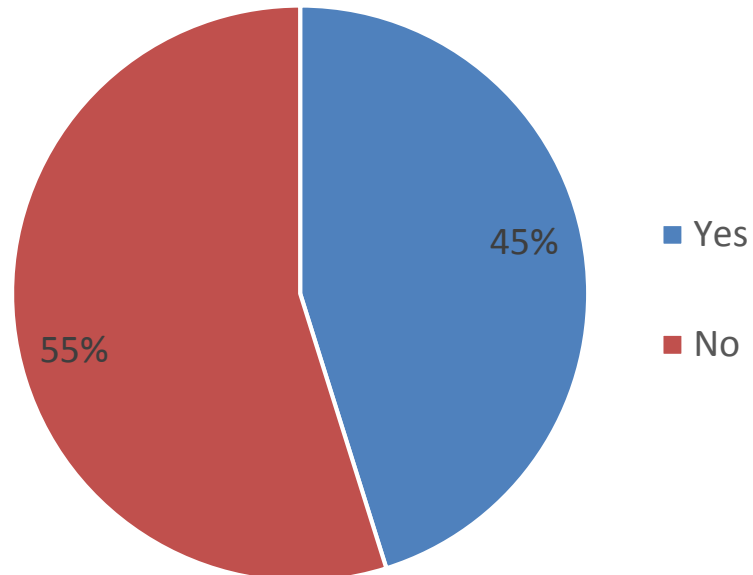


90% of SHAs Rate Sealed Cracking as "Low" Severity Level

Part II: Cracking Definitions, Sealed Cracking

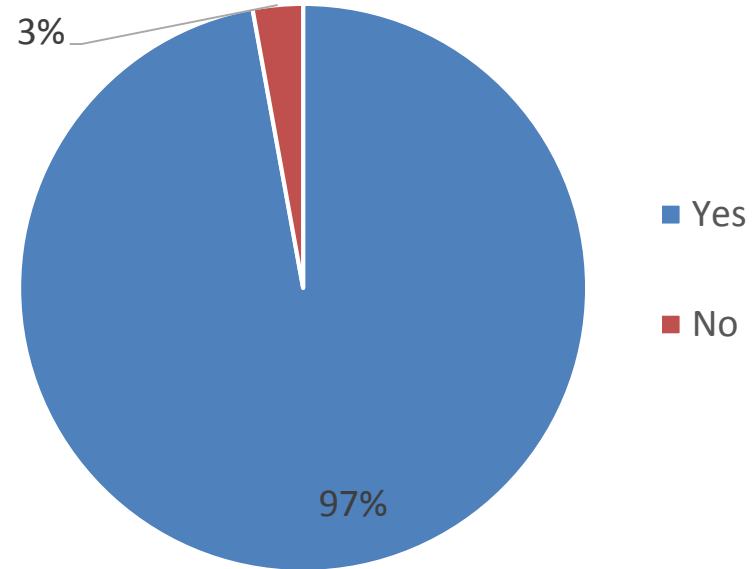


58% of SHAs Report
“Linear Length” for Sealed
Cracking

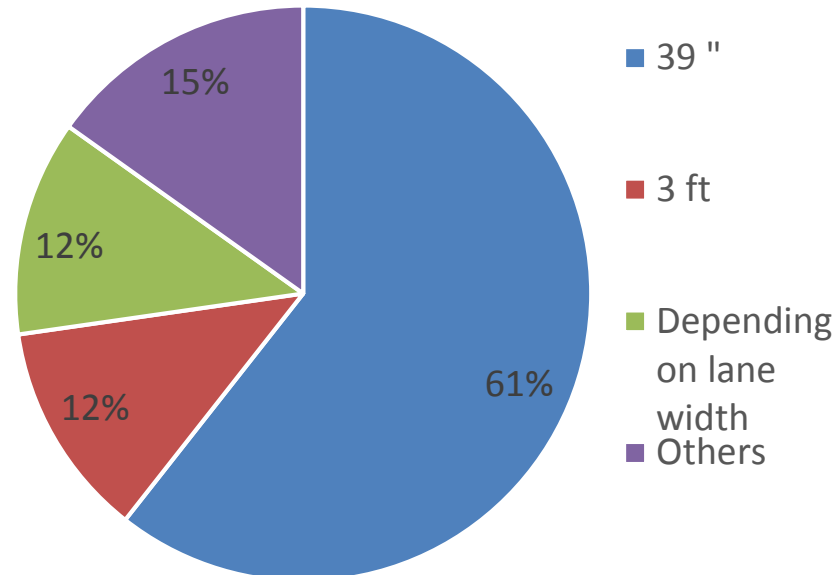


55% of SHAs Do Not
Collect and Report Other
Cracking Data

Part III: Wheel-Path Definitions

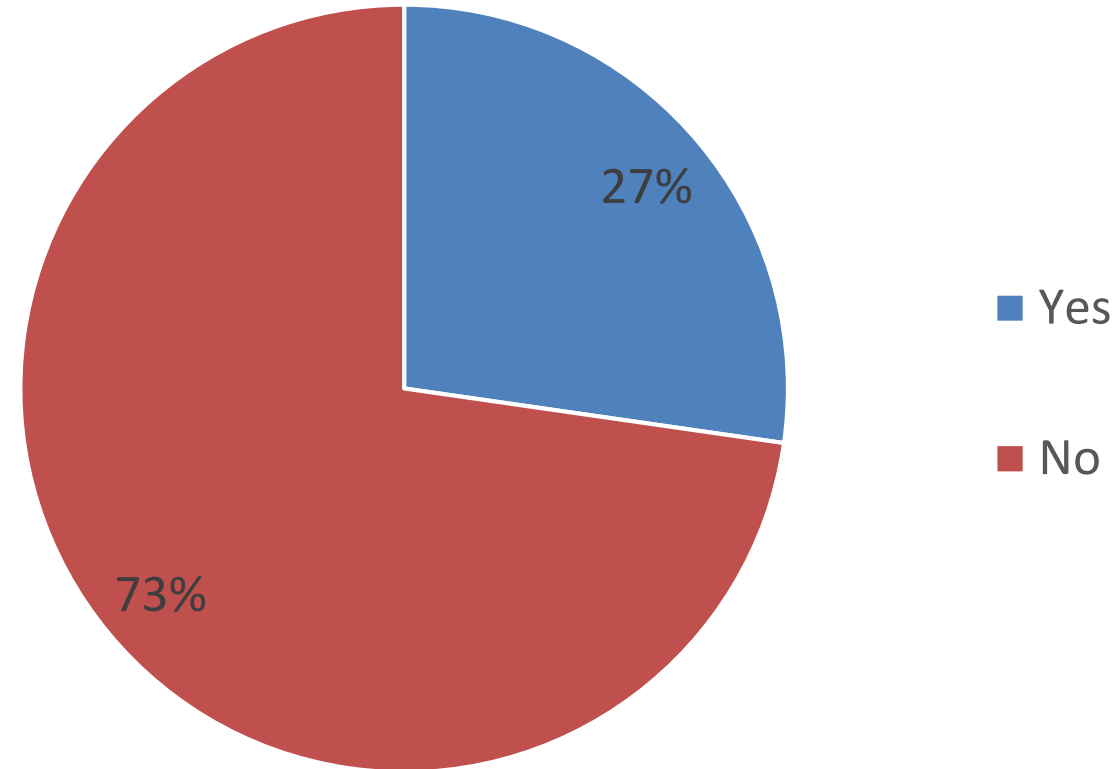


97% of SHAs Differentiate Wheel-Path and Non-Wheel-Path Zones



61% of SHAs Use 39"-1m as Wheel-Path Width

Part IV: AASHTO PP 67 Application



73% of SHAs Have Not Implemented AASHTO PP 67

Part IV: AASHTO PP 67 Application

Pros

- ✓ Particular for automated cracking collection and analysis
- ✓ Clear and reasonable wheel-path definition

Cons

- ✓ Do not meet data needs for HPMS reporting, PMS, or Pavement ME Design
- ✓ Inconsistency with the historical data

Recommendations: add severity levels and cracking density

Part V: General Comments

- ❑ 23 SHAs provide opinions and comments for a new cracking protocol for fully automated system in next 10 years
 - ✓ Development of cracking certification standard or practice similar to that for ride quality
 - ✓ Improved crack detection accuracy
 - ✓ Consistent and repeatable cracking results from automated systems
 - ✓ A protocol keeping up with the evolvement of automated cracking data collection technology
 - ✓ Real time automation in cracking detection and reporting

Conclusions

- ❑ Survey results: a foundation for desired cracking data for pavement management activities
- ❑ The current state of diversified protocols at SHAs
 - ❑ Limited the application of automated technologies,
 - ❑ Hindered the progress of producing consistent and comparable cracking data.
- ❑ A highly focused new cracking standard needs to be developed