



ACPTP 2022-4

Quality Control and Quality Assurance of Concrete Airfield Pavement

(For CAPTG Workshop)

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ACPTP 2022-4

Quality Control and Quality Assurance of Concrete Airfield Pavement

CAPTG Workshop—SWIFT Conference 2025

Niagara Falls, Canada



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Objectives/Deliverables

1

QC Best Practice Manual

2

Model QC Plan

3

Training Course (Modules)

Each of these three objectives is considered essential to achieve a successful project outcome for FAA and the Military Tri-Services

Literature Review

- FAA specifications and supporting documents
 - FAA AC 150/5370-10H – Standard Specifications for Construction of Airports
 - FAA AC 150 5370-12B - Quality Management for Federally Funded Airport Construction Projects
 - Many more
- Military Tri-Services specifications and supporting documents
 - UFGS 32 13 14.13 - Concrete Paving for Airfields and Other Heavy-Duty Pavements
 - UFGS 01 45 00.00 10 Division 01 – General Requirements, Quality Control
 - Many more
- Industry guidance and quality-related references
 - ACPA, ACRP, IPRF, others

Existing Training/Certification Programs

- Industry-Developed/Sponsored Training
 - ACPA
 - Airport Consultants Council Construction Administration and Observation Course
 - GOMACO University, Guntert & Zimmerman (G&Z Equipment Training)
- Agency Developed/Sponsored Training
 - Air Force Institute of Technology (AFIT) courses
 - Army Corps of Engineers Airfield PCC Paving Workshop
 - National Highway Institute Quality Assurance for Highway Construction Projects
 - FHWA Best Practices Workshops and Highway Engineering Materials Course
- Certification Programs
 - ACI
 - NRMCA
 - ACPA Central Plant Certification Checklist

SMArT (*Subject Matter Advisory Team*)

Stakeholder Type	Name	Position and Affiliation	Additional Contributor(s), Position, and Affiliation
Owners	Ashton Watson	Airport Engineer, CLT	<ul style="list-style-type: none"> Cody Smith, Construction Manager, CLT Brian McMahon, Project Manager, Talbert Bright & Ellington
	Saher Khilfeh	Senior Construction Inspector, Port of Seattle	<ul style="list-style-type: none"> Rayan Ehtesham, Aviation Engineer, Jacobs
	Greg Gorup	Airfield Pavement Engineer, USACE TSC	<ul style="list-style-type: none"> Nicholas Barrio, Materials Engineer, USACE TSC
	Rauri McGee	Airfield Pavement Engineer, NAVFAC	
	Eric Miller	Senior Airfield Engineer, AFCEC/CFTP	
Engineering Firms	Lance McIntosh	Group Services Manager, C&S Companies	
	Quintin Watkins	Vice President, Michael Baker	<ul style="list-style-type: none"> Joseph Snyder, Aviation Department Manager, Michael Baker
	Andy Shook	Engineer, Talbert Bright and Ellington	
	Brook Corney	Construction/Project Manager and Group Leader, Jacobs	
Contractors	Bryan White	Senior Project Manager, ACME Paving	
	Casey Kozak	Concrete QC Manager, Plote Construction	
	Pete Mann	Senior Project Manager, AJAX Paving Industries	
	Brian Martinez	Area Manager (Denver), IHC Scott	
	Dave Sciuillo	Vice President, Golden Triangle Construction	<ul style="list-style-type: none"> Ryan Pendeville, QC Manager, Golden Triangle Construction
	Brook Corney	Project Manager, Jacobs	
	Lars Huizenga	Duininck, Inc.	
QC Consulting Firm	Jeffrey Elliott	Vice President, TTL Associates	

SMArT Interviews – Guidance and Training

- Thorough guidance and training specific to airfield concrete paving QC and QA does not exist
- Much of the orientation personnel receive covers “paperwork” requirements and **not the fundamental knowledge required to support QC and QA.**
- QC and QA personnel training is **offered on the job.** But barriers exist!

- In-person training preferred, multiple stakeholders receiving same training.
- Many personnel do not understand the “**why**” behind many specification provisions.
- Training should include:
 - 1) fundamentals, 2) addressing specific challenges, 3) tools to support decision-making

SMArT Interviews – Culture of Quality

- **Company philosophy** may drive the level of quality that a contractor's project team can produce.
- If **quality in paving is prioritized** by company and project management then high-level results may be most readily achieved in the field when QA works with them as a team.
- An us/them mindset that does not foster successful quality results.

- Stakeholders need to understand the level of quality required, and CARE.
- 2022-4 products could establish/emphasize level of quality expected by Owner.
- A company's ability to meet the required level of quality for airfield paving should be considered when bidding airport pavement projects.
- Communication is key
- Foster a "team mindset" between QA and QC personnel.

SMArT Interviews – Quality Assurance

- Pool of experienced QA and QC personnel is very limited, and the **demand to hire these people exceeds the supply**.
- Many of the available QA and QC personnel have **never been introduced to a consistent philosophy** of quality management.
- QA and QC personnel increasingly have **limited experience**, impacting their ability to use engineering judgment and make proactive decisions.
- Seasoned employees are often devoted to the more high-profile projects, which can limit other projects to **less experienced personnel**.

- Role of QA personnel differs between FAA and DoD.
- Presence and authority of QA personnel differs by type of project and location.
- Enforcement of specification provisions varies.
- Improve how means and methods requirements are enforced alongside acceptance criteria.
- Improve guidance for proceeding when QA and QC test results disagree.

SMArT Interviews – Quality Control

- Difference in the “**degree of difficulty**” for contractors to meet airfield specifications compared to highway specifications. The bar is higher on airfield paving, particularly with materials.
- Airfield paving specifications are more performance-based with accompanying means and method requirements; **owners aim for durability and safety to a higher standard than highway agencies.**

- Owners hope to remove box-checking and cookie-cutter QC plan approaches.
- Specified minimum QC is not enough for some projects, Owners expect thoughtful, proactive QC plans.
- Retaining personnel is an issue.
- Chain of command issues exist and lack of respect for QC personnel can occur.
- Control charts are produced as required but not used to inform proactive decision-making.

Quality Management

A required philosophy of entities involved in producing, measuring, and paying for work, which relies on trained people to control and test paving outcomes.

QM involves owner, engineer, contractor.

QM requires people with requisite technical skills required to knowledgeably and properly use required tools/tests.

The logo consists of the letters 'Q' and 'M' in a bold, dark blue, sans-serif font. The 'Q' is on the left and the 'M' is on the right, with a small gap between them.

Quality Acceptance (QAcc)

This is an FAA term only.

Definition: The Owner's responsibility to ensure work complies with specifications for payment, including verification sampling, testing, and documentation.



Quality Assurance

Systematic umbrella for programs, tests and actions that provide confidence in a product's quality and satisfactory performance.

Includes evaluation of:

- Development of plans and specifications,
- Advertising & awarding contracts,
- Acquisition of materials,
- Construction, and
- Interaction of these activities.

The letters 'QA' are rendered in a bold, dark blue, sans-serif font. The 'Q' and 'A' are connected at the top, with the 'Q' having a small tail that curves under the 'A'.

Quality Control

A Contractor responsibility to monitor, assess, and adjust production processes to ensure the final product will meet the specified measures of quality.

FAA and DoD specify QC.

Includes:

- Acquiring and producing acceptable materials.
- Sampling, testing, inspecting & corrective actions.
- Timely use of measurement data to bring unacceptable deviations into tolerance.
- Additional measures that the Contractor may self-monitor that are not used for acceptance.

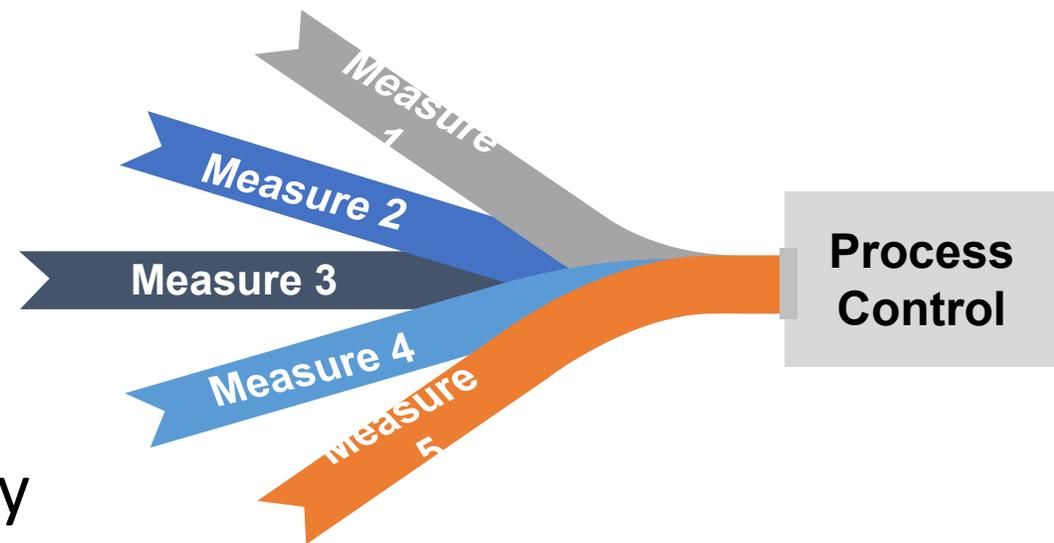
The logo consists of the letters 'Q' and 'C' in a bold, dark blue, sans-serif font. The 'Q' has a small tail at the bottom right, and the 'C' is a simple open circle.

Process Control

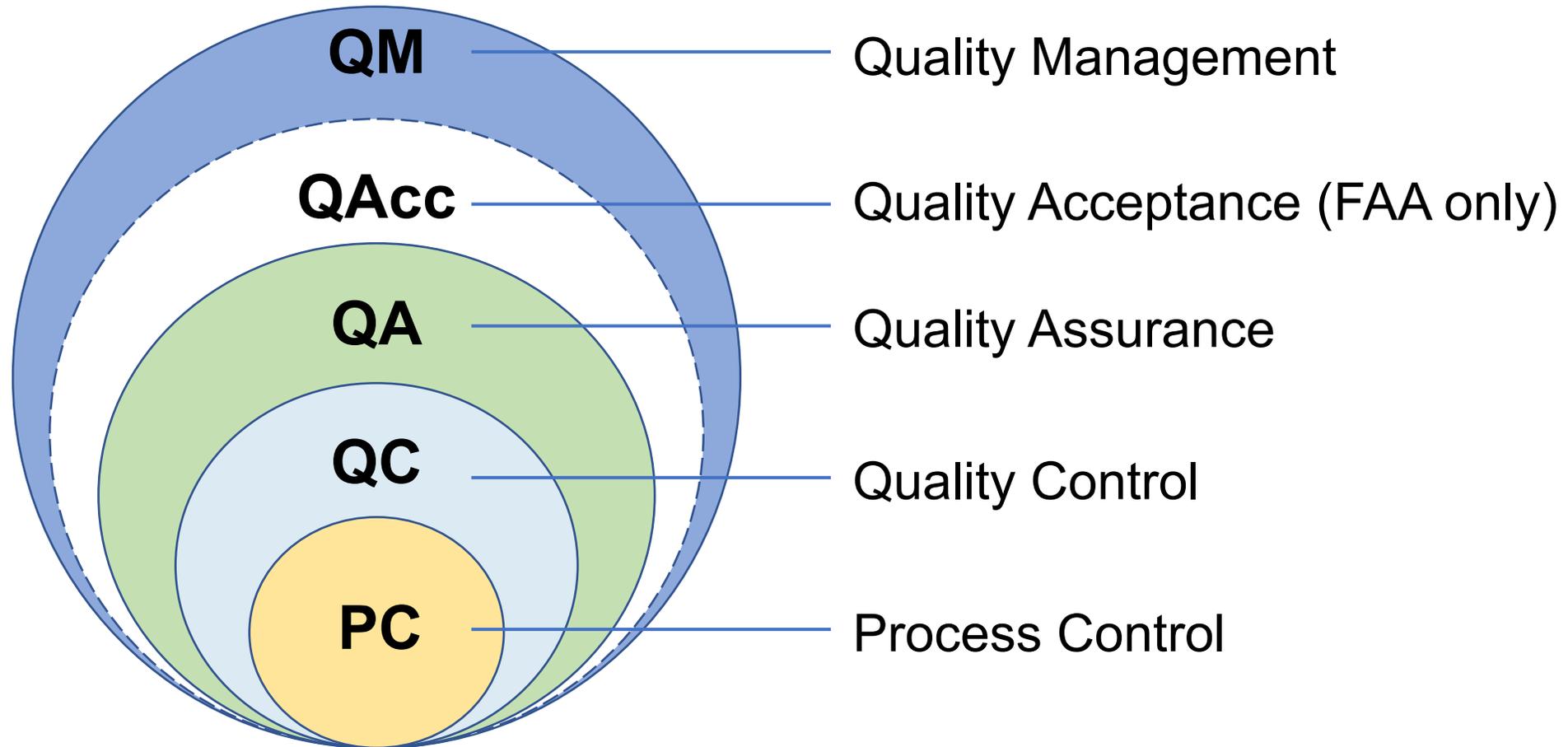
Contractor's active monitoring and adjusting of materials and construction to minimize variability and keep quality factors within defined tolerances.

Includes:

- Self-inspection.
- Visual monitoring.
- Sampling & testing.
- Proactive corrective actions.
- Monitoring factors not required by the Owner in the specifications.



Putting Airport Quality Terminology into Perspective



Objectives/Deliverables

1

QC Best Practice Manual

2

Model QC Plan

3

Training Course (Modules)

01

The **best practices manual** will provide comprehensive guidance to all stakeholders on the QC and QA process.

The manual will distinguish between QC and QA roles, responsibilities, activities, and authorities, ensuring all parties are operating on the same page during each stage of the concrete paving process.

QC Manual

CH 1	Introduction	<ul style="list-style-type: none"> ▪ Goal of quality systems for concrete airport pavements - terminology and definitions ▪ Overview of QA and the role of QC within the QA system ▪ Acceptance, independent assurance, and dispute resolution
CH 2	Quality Assurance Essentials	<ul style="list-style-type: none"> ▪ Role of owner/operator, role of QA personnel ▪ QA specifications, quality parameters/tests, approaches and best practices ▪ Activities and meetings and before each phase of work (subgrade, subbase, base, pavement) ▪ Guidance for enforcement of production tolerances/acceptance criteria
CH 3	Tools for Quality Acceptance	<ul style="list-style-type: none"> ▪ Recordkeeping, forms, check sheets, spreadsheets ▪ Statistical approaches with tutorial ▪ Analysis of risk allocation
CH 4	QC Programs, Plans, and Process Control	<ul style="list-style-type: none"> ▪ Introduction ▪ QC Programs ▪ QC Plans ▪ Process Control ▪ Minimum Requirements for Quality Control Programs and Plans ▪ Components of a QC Plan and QC Plan Outline
CH 5	QC for Airport Concrete Pavements	<ul style="list-style-type: none"> ▪ Implementation ▪ QC for Material Suppliers ▪ QC for Paving Contractor – each phase of project
CH 6	Tools for Quality Control	<ul style="list-style-type: none"> ▪ Overview of recordkeeping, forms, check sheets, spreadsheets ▪ Control charts, statistical approaches with tutorial, discussion of action and suspension limits ▪ Discussion on how to use a feedback loop of data in a process control environment
CH 7	Acceptance	<ul style="list-style-type: none"> ▪ Overview of acceptance decision for FAA and DOD projects ▪ Definition of authority and responsibility for enforcing requirements ▪ Guidance on how to handle discrepancies between agency and contractor data ▪ Dispute resolution including appropriate remedial actions ▪ f- and t- tests
Appendix	Model QC Plan	

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02

The **Model QC Plan** will include examples for quality processes specifically for concrete airfield sites applicable to FAA P-501 and UFGS 32 13 14.13

The model will be a “go by” for contractors to follow on future projects

Will include spreadsheet tools and examples for statistical analysis

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Training Course (Modules)

03

The materials will focus on training agency and contractor staff to become fully conversant with all aspects of quality control and quality assurance of airfield construction.

- PowerPoint modules
- Instructor guidance
- Online training - Synchronous (live) and adaptable for asynchronous (recorded for on-demand viewing)

Eight Special Topic Guides

ST#1 - Preparations for Executing a Concrete Airport Pavement Project

ST#2 - Prevention of ASR through Aggregate Testing and Alkali Loading

ST#3 - Concrete Aggregate Acquisition and Stockpile Management for Airport Pavement Construction

ST#4 - Guideline for Qualifying Contractors for Production Paving by Control Strip/Test Section

ST#5 - Guide to Adjusting Concrete Mixtures Under Airport Requirements

ST#6 - Guidance for Handling of Concrete Beam Specimens

ST#7 - Guideline for Pavement Surface and Edge Testing by Straightedge

ST#8 - Pay Factor Combo

Putting it all together...

- 8 special topics briefs complete
 - Appendices to Best Practices Manual
- Practices Manual
 - Completed and under 508 compliance production
- Model QC plan developed
- Training materials in development—nearly complete

Discussion and Questions



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IOWA STATE UNIVERSITY
Institute for Transportation



**National Concrete Pavement
Technology Center**





Preparations for Executing an Airport Concrete Pavement Project

Special Topic #1 - Technical Training Module

Importance of Proper Preparation

- Critical for compliance with FAA and DoD standards.
- Avoids delays and ensures project consistency.
- Reduces risk of costly errors and rework.
- Avoids contractors bidding “over their heads”.

- Importance of familiarizing team with specifications:
 - Detailed QC and compliance requirements.
 - Include the core principles for airport project construction management.
 - Define QA and acceptance criteria.

Pre-Bid Considerations

- Evaluate project's environmental and logistical challenges.
- Review site-specific specifications closely.
- Assess site and conditions in person.
 - The pre-bid site visit is very important to ensure bid aligns with actual needs and conditions.
- Familiarize with work environment and requirements.
- Address site-specific challenges proactively.
- Identify potential conflicts early.

Site Evaluation and Planning

- Thorough project understanding enhances bidding success.
 - Pre-bid information requests for clarity.
 - Highlight relevant experience in proposal.
-
- Evaluate material accessibility and site conditions.
 - Assess potential conflicts, bottlenecks and challenges.
 - Plan for equipment mobilization and material delivery.

Understanding Key Project Requirements

- In-depth analysis of FAA or DoD specifications.
- Pay attention to surface elevation and cross-slope requirements.
- Importance of compliance with elevation tolerances.

Prebid site-visit

- Familiarizes contractors with the project environment.
- Essential for assessing logistical challenges.
- Opportunity to clarify specification ambiguities.

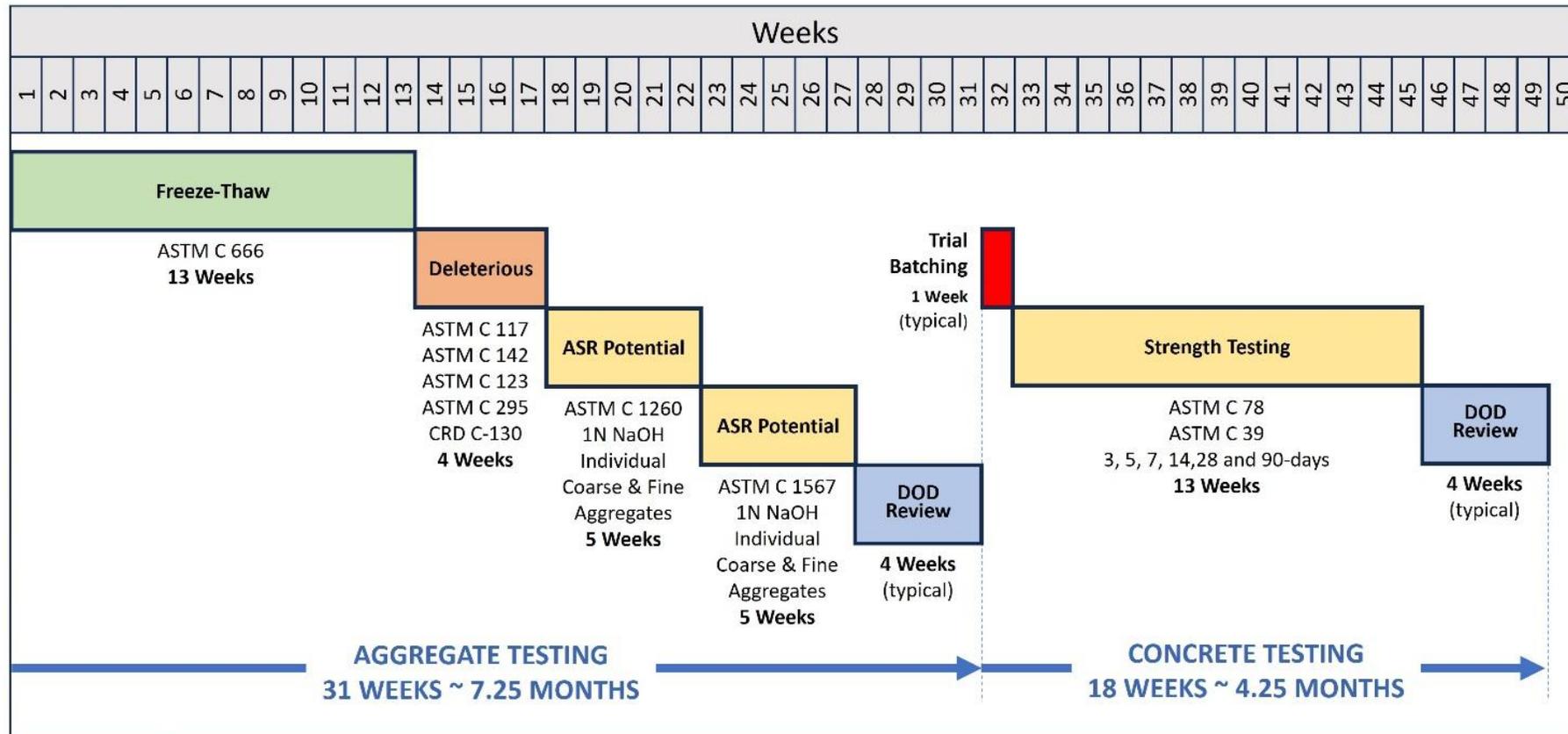
Developing a Comprehensive Project Plan

- Identify key project milestones and goals.
- Outline resource allocation for equipment and personnel.
- Review project duration and active airport zone requirements.

- Project Start-up Timeline:
 - Long lead times for aggregate testing and approval.
 - Start-up timelines influence mobilization and QC plans.
- Key steps:
 - material submission, review, and monitoring.

Aggregate and Material Procurement

- Early sourcing of aggregates crucial for consistency.
- Verify supplier compliance with FAA or DoD specifications.
- Establish contingency plans for supply chain disruptions.



Equipment for Pavement Construction

- Equipment selection: pavers, batch plants, saws.
- Schedule for procurement and on-site delivery.
- Plan for maintenance schedules to ensure reliability.

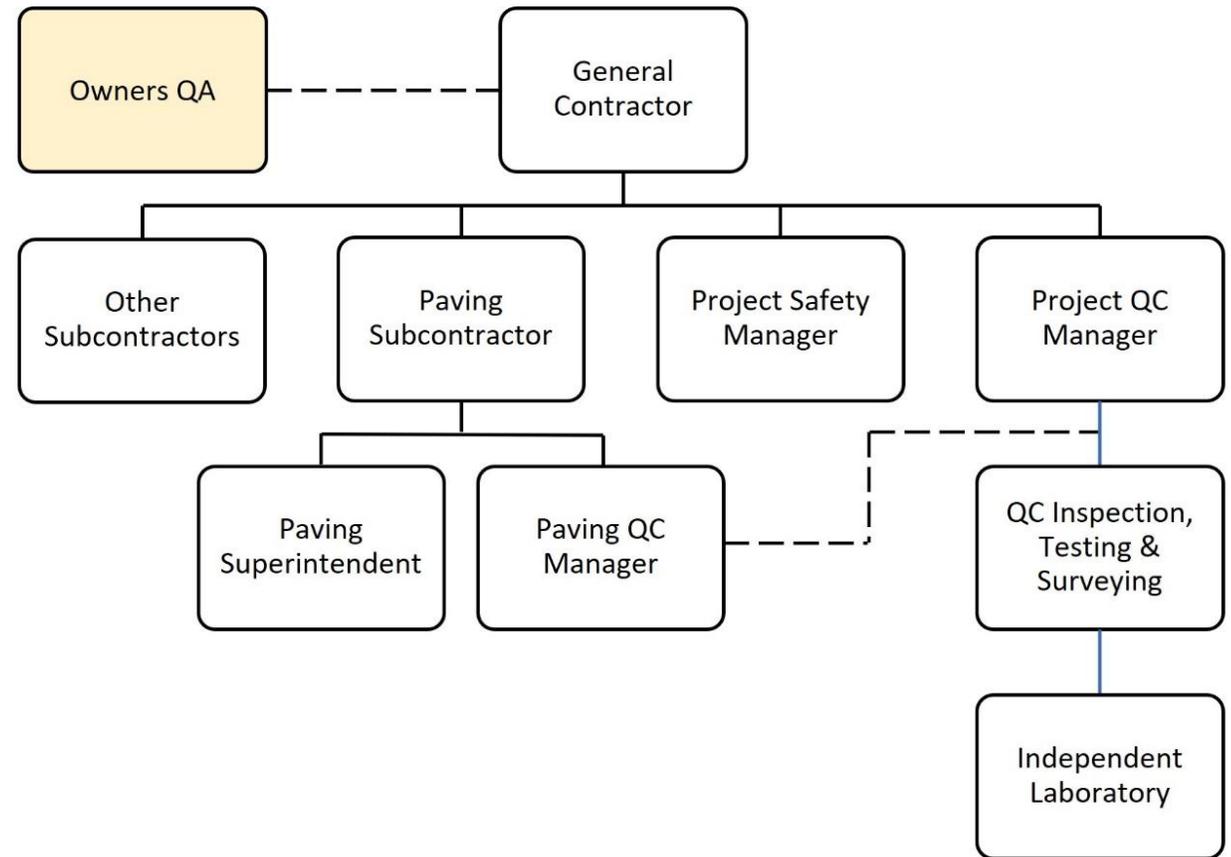


Quality Control (QC) Plan Essentials

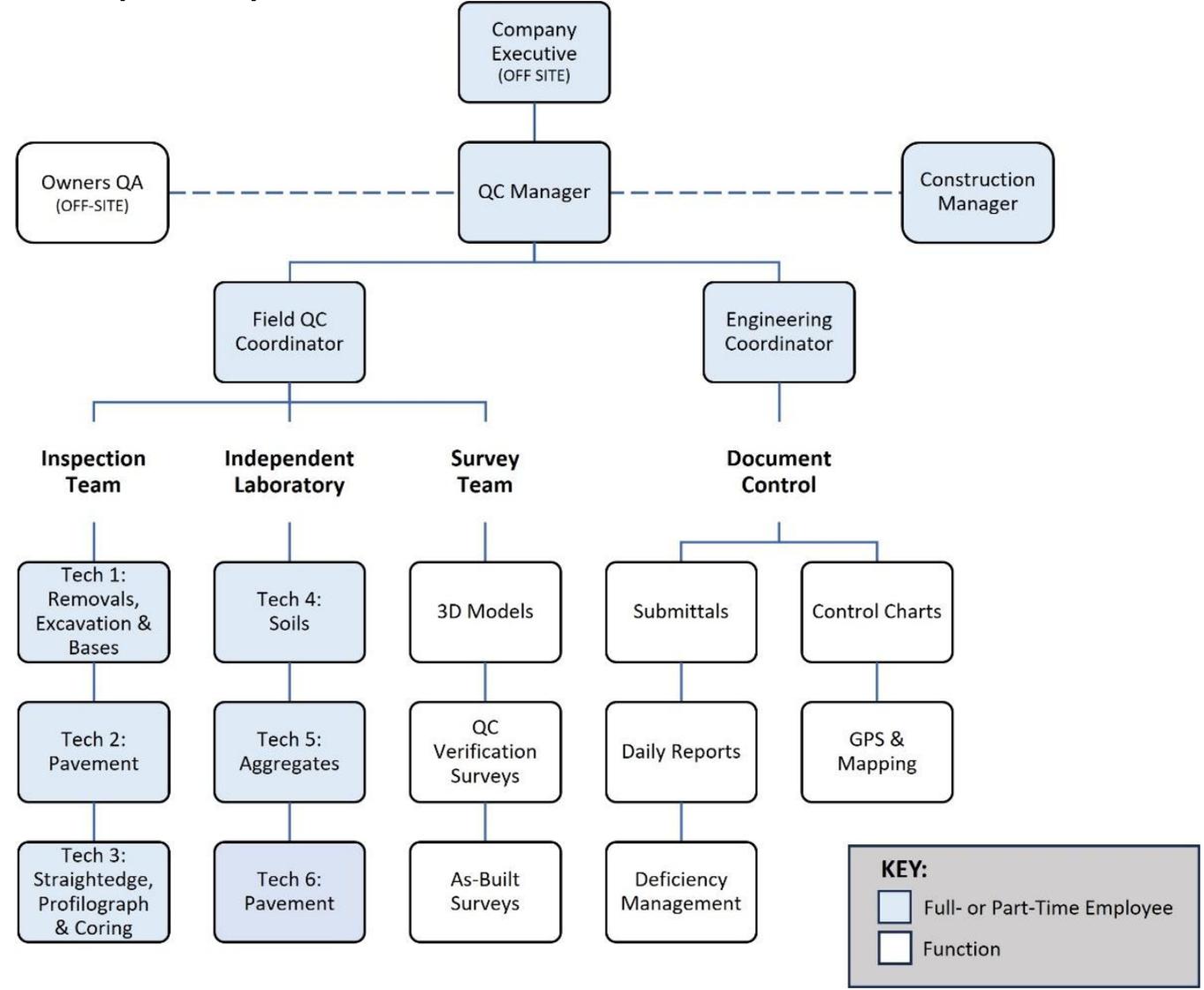
- Robust QC plan from material procurement to final placement.
- Monitor compliance with FAA/DoD standards.
- Ensure qualified personnel for QC roles.
- Equipment maintenance protocols
- Documentation and recordkeeping
- Emphasizing quality, not just productivity
- Value of early QC team preparation and coordination
- Prepare corrective actions immediately when needed.

Contractor's QC Relationships and Responsibilities

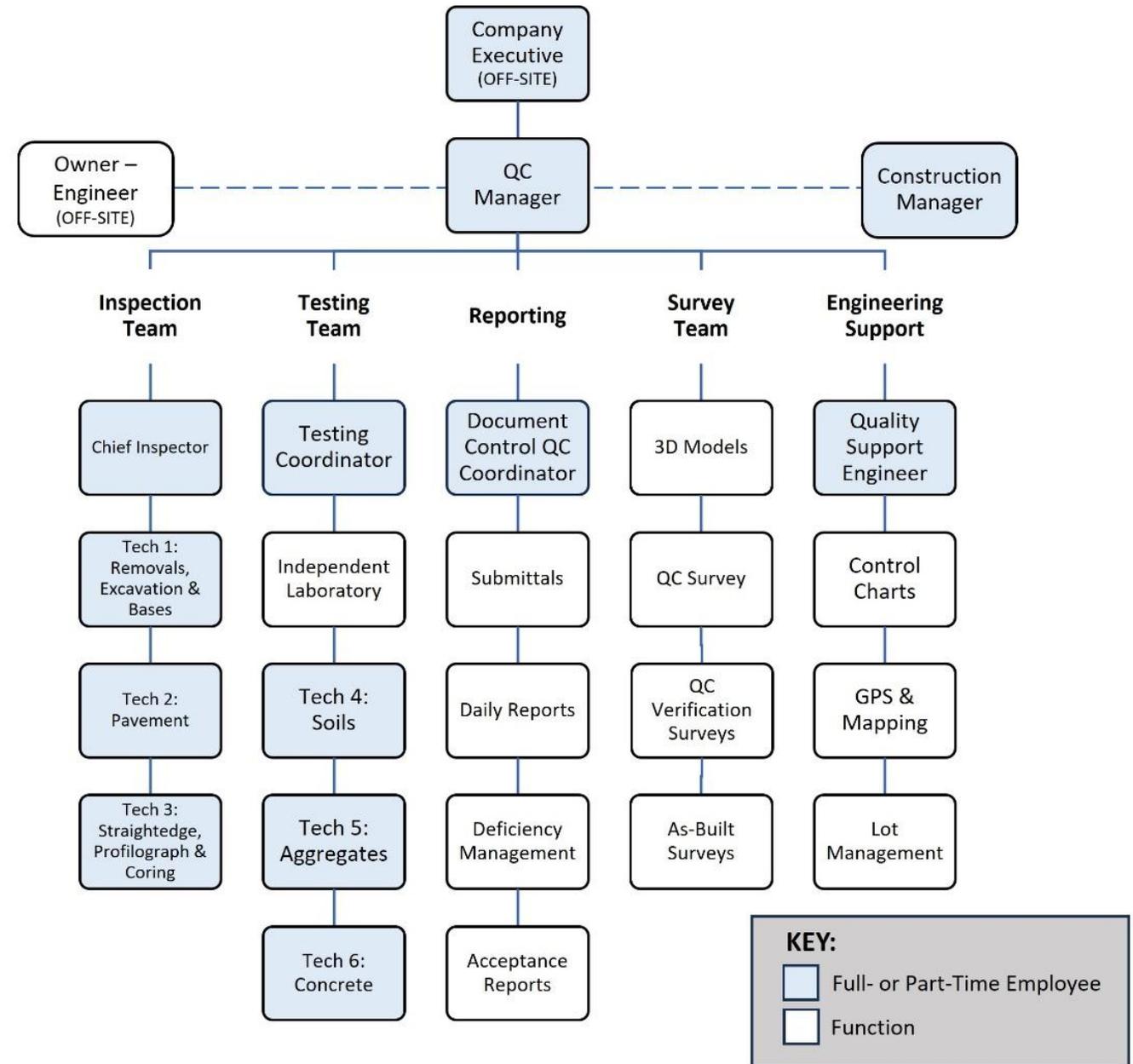
Typical reporting structure when paving contractor is operating as a subcontractor to a general contractor (adapted from Holt, 2019)



QC personnel and QC function organizational structure typical for FAA commercial airport projects (adapted from Holt, 2019).



QC personnel and QC function organizational structure typical of smaller DOD projects (adapted from Holt, 2019).



Note: The Chief Inspector may serve as the required ACI-certified transportation inspector.

Importance of Early QC Testing

- Perform aggregate testing immediately post-award.
- Validation of supplier materials precludes later issues.
- Importance of aligning QC plan with specified standards.

Process Control for Aggregate Quality

- Role of QC Manager in real-time monitoring and corrections.
- Frequent gradation testing for aggregate consistency.
- Align QC practices with project's concrete mix design.

Administrative Compliance and Approvals

- Ensure all permits and submittal approvals are obtained.
- Align construction plan with FAA/DoD requirements.
- Security clearance and training for personnel on-site.

Safety and Emergency Preparedness

- Develop comprehensive emergency response plans.
- Include drills and training for high-stress situations.
- Prepare site-specific safety protocols for personnel.

Stakeholder Communication

- Apply proactive communication with airport authorities.
- Maintain transparency with regular updates.
- Address community concerns proactively.

Staff Training and Competency

- Ensure QC staff are trained and certified.
- Role-specific training for project requirements.
- Regular training updates for new personnel.

Meetings Included in Current FAA Advisory Circulars

Meeting	Scheduled Timing	Attendees	Purpose/Intent
<p style="text-align: center;">Prebid Conference AC 150/5370-12B</p>	<p style="text-align: center;">Concurrent with the bid announcement</p>	<p>Sponsor Engineer of Record RPR Contractors Material Suppliers FAA Representative Airport Operators</p>	<p>Number of Participants vary with project size and content specific to:</p> <ul style="list-style-type: none"> • Scope • Phasing • Operational Limitations • Procurement Type • Bonding • Subcontracting
<p style="text-align: center;">Preconstruction Conference AC 150/5370-12B</p>	<p style="text-align: center;">At Project Award and prior to NTP</p>	<p>FAA/ADO and ATO Airport Operators Contractor QA/QC Managers Subcontractors</p>	<p>Table of meetings provided for:</p> <ul style="list-style-type: none"> • Required per current DOD specifications • Recommended for FAA projects • Recommended for DOD projects <ul style="list-style-type: none"> • Security • Critical Elements of the Project • Phasing • Operational Limitations • Schedule



Concrete Aggregate Acquisition and Stockpile Management

Special Topic #3 - Technical Training Module

Introduction

- Purpose: Ensure aggregate consistency for airport pavement quality.
- Scope:
 - Fundamentals.
 - Acquisition.
 - Stockpile management.
 - Moisture management.
 - Quality control.



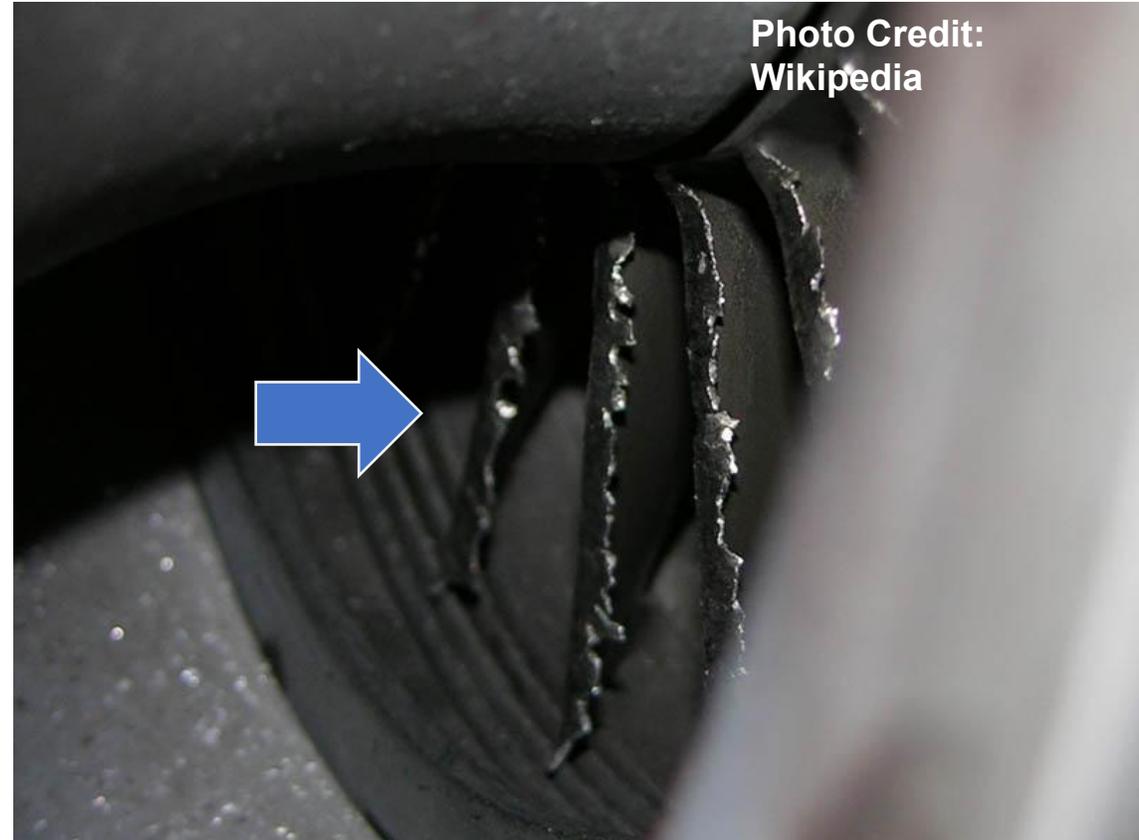
Photo Credit:
Voigt

Aggregates Influence Concrete Physical Properties

- Durability – freeze thaw and alkali reactions.
- Uniformity – paste volume per lineal foot of paving.
- Smoothness – minimizing adjustments by paving machine.
- Workability – how easily the concrete consolidates.
- Finishing – how easy it is to “close” the surface.
- Sawing – how difficult it is to cut.
- Thermal expansion/contraction – sensitivity to cracking.

Importance of Aggregate Consistency

- Directly impacts important concrete properties.
- Problematic issues from higher variability in aggregates:
 - Near-term – Increased frequency and negative consequences of poor workability.
 - Long-Term – Increased risk of FOD potential.



FOD = Foreign Object Debris – or – Foreign Object Damage

The Cost of Poor Workability

- Non-compliance with requirements for:
 - Surface smoothness.
 - Edge slump.
 - Vertical face deformations.
 - Concrete air content.
 - Concrete durability.
 - Concrete strength.
 - PWL acceptance criteria.
- Costs for deviation repairs.

INTERMEDIAT
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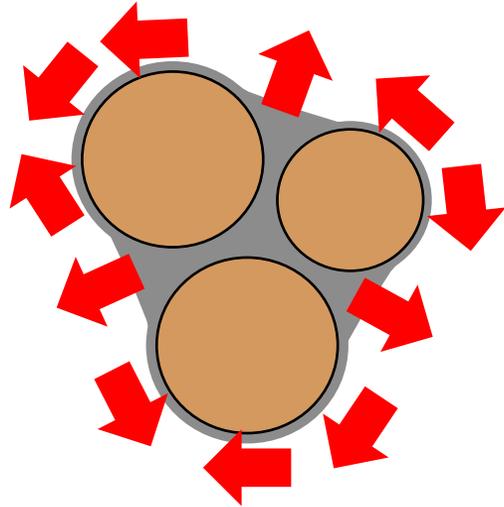
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Key Aggregate Properties

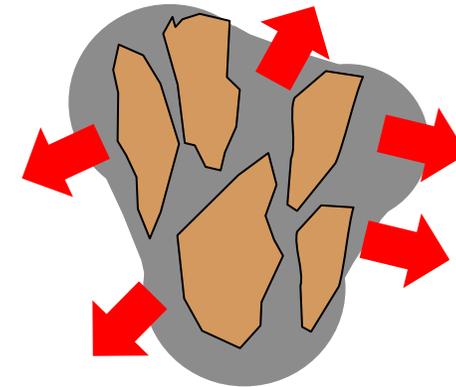
Shape and gradation affect concrete workability, finishing and strength

Round and cubic particles



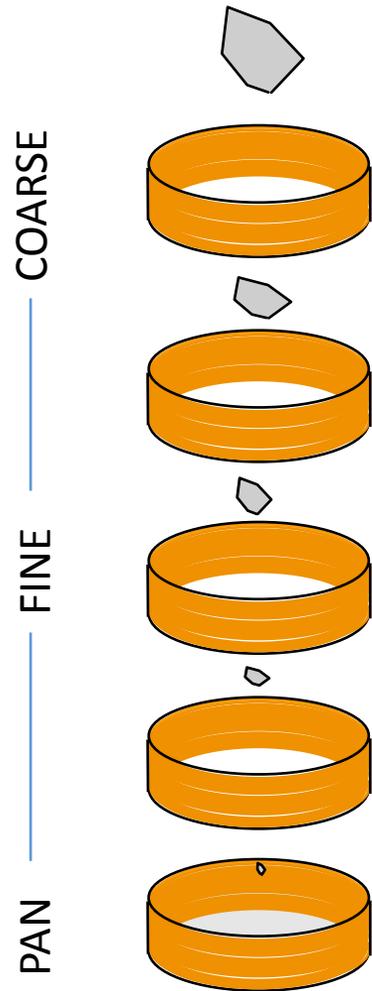
Requires less paste and can move and rotate more freely in all directions during consolidation

Elongated particles

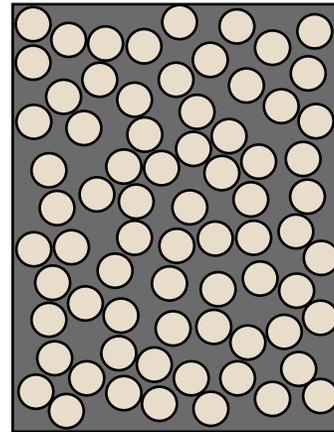


Requires more paste and may flocculate interfering with movement during consolidation

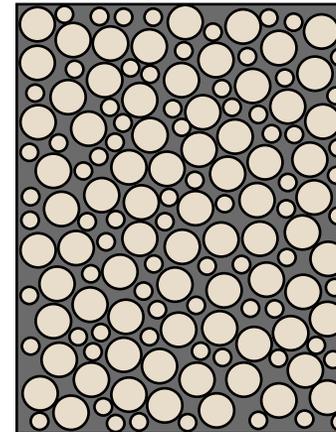
Gradation and Sieve Analysis



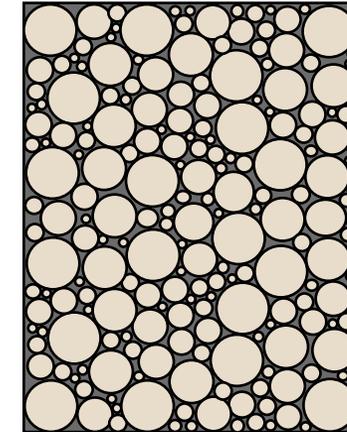
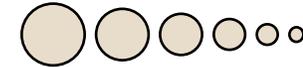
Uniformly-Graded



Gap-Graded



Well-Graded



Requires More Cement Paste & Water to Coat Particles. Can Lead to Workability and Constructability Problems

Optimal for Coating Particles, Particle Contact and Paving Results

Four Concrete Aggregate Challenges

Moisture Content – The quantity of water in the particles at the stockpile near the concrete plant.

Contamination – The inadvertent introduction of undesirable or unfit material into a specification aggregate.

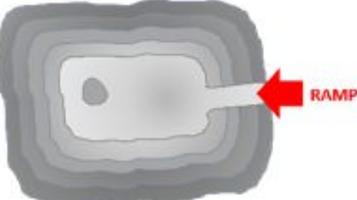


Segregation – The separation of one size of particles from a mass of particles of different sizes which was produced to comply with the gradation specification.

Degradation – The breakdown of a specification aggregate into smaller particles due to impact, abrasion or crushing.

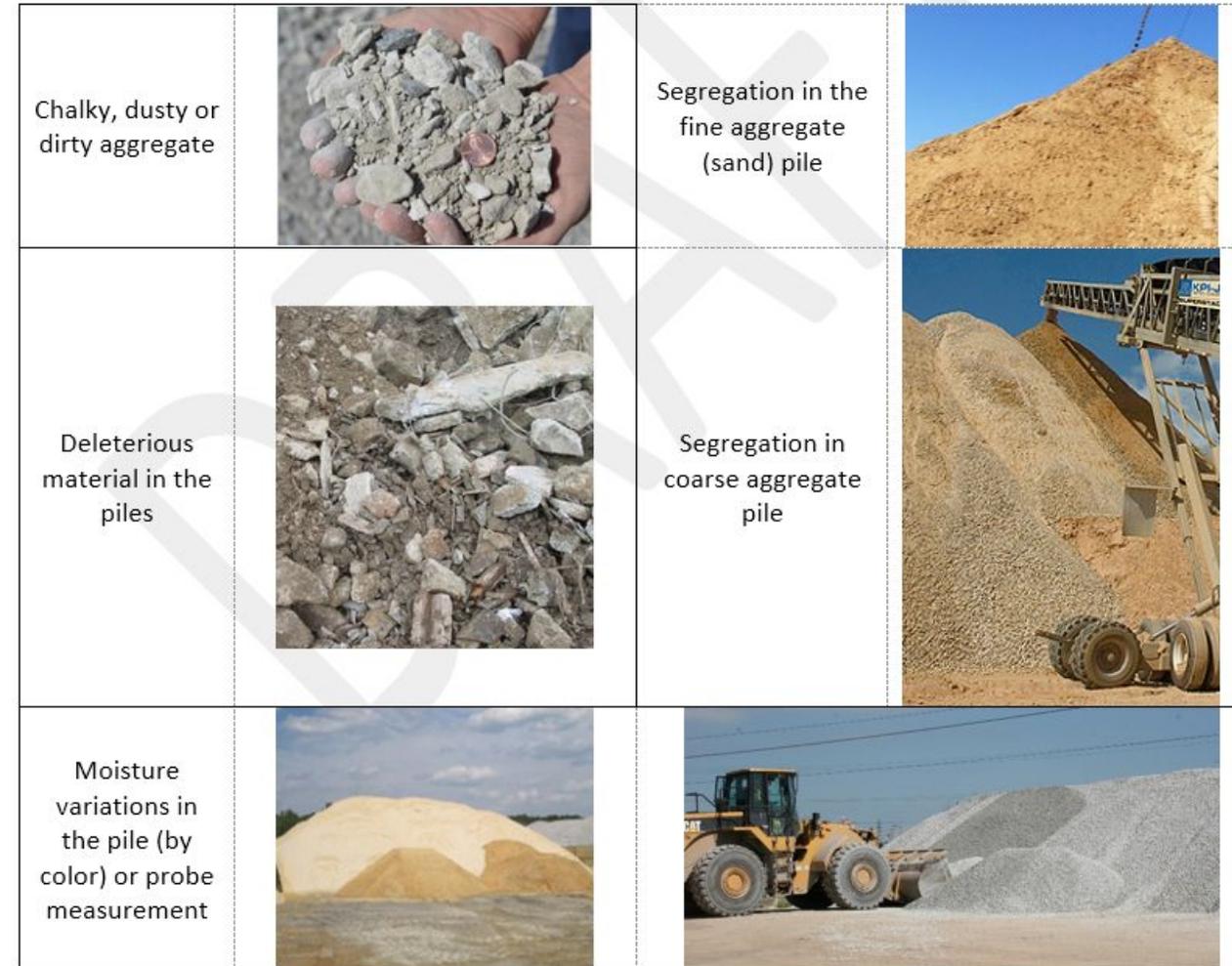
In-depth discussion and guidance:

- Aggregate acquisition.
- Sources of aggregate variability.
- Preventing segregation and degradation.
- Managing aggregate contamination.
- Stockpile management.
- Moisture management.

Tent-Shaped Stockpile Construction by Loader	
<p>Stockpile material from separate batches, each no larger than a truckload, so that material remains near where placed and does not run down along slopes causing segregation. Build the stockpile in multiple lifts.</p>	
<p>Keep the edges of successive lifts at least 4 ft (1.2 m) short of previous lifts and only stack a lift as high as the loader can reach without running wheels over the pile to avoid aggregate degradation.</p>	<p>Keep 4 ft (1.2 m) away from edges of lift below</p> 
<p>Build multiple lifts at relatively uniform thickness. A range of 6 to 12 ft (1.8 to 3.6 m) is recommended as a practical suggestion for most loaders.</p>	<p>6 to 12 ft (1.8 to 3.6 m)</p> 
<p>Flatten the top of each lift so the next lift can be carried onto the stockpile by ramp. Restrict ramp size to minimize the amount of material driven over repeatedly by haul vehicles</p>	<p>TOP VIEW</p>  <p>RAMP</p> <p>SIDE VIEW</p> 

Aggregate QC Testing Regime

- Initial qualification tests.
- Ongoing QC checks for consistency at quarry and concrete plant.
- QC at supplier's site.
- QC at concrete plant.
- Tests and control charts.
- Visual QC techniques.
- Key operator roles in aggregate QC:
 - Loader operator, plant staff, plant manager, QC staff.
- Impacts of poor aggregate QC on concrete mixture and construction quality.



Common QC Issues and Solutions

- Dirty aggregates
- Excessive material passing the No. 200 sieve
- Excessive lignite and coal particles in aggregate
- Lightweight chert particles in aggregate
- Mudballs in aggregate
- Sand balls in aggregate
- Tearing
- Segregation

Example 1 – Dirty Aggregates



- **Problem description:**

- Clay, silt or dust from degraded aggregates clings to the coarse or larger fine particles.

- **The impacts on concrete are:**

- Increased risk of low strength – clay may coat the surface of aggregates and impair bond strength between aggregate and cement paste.
- Increased water demand requirement.
- Potentially reduced concrete durability.
- Increased risk of cracking.

Example 2 – Excessive Material Passing No. 200



- **Problem description:**
 - Fines are introduced to specification aggregate from degradation of coarse particles through handling, a poor stockpile foundation, or from poor loader practices.
- **The impacts on concrete are:**
 - Increased water demand.
 - Potential reduction of air-entrainment – risk of poor freeze-thaw resistance.
 - Increased risk of low strength from poor cement paste bonding to aggregate.

Example 6 – Sand Balls in Aggregate



- **Problem description:**
 - Sand balls form in the fine aggregate from moisture in stockpile, insufficient loader observation and cross mixing, and/or insufficient mixing time in the concrete plant.
- **The impacts on concrete are:**
 - Likely to cause surface voids.
 - Likely to cause surface popouts.
 - This is not generally considered a risk for FOD because the particles are small.

Example 8 – Aggregate Segregation in Concrete



- **Problem description:**
 - Aggregate segregation within the concrete caused by a gap gradation and/or excessive vibration. The problem can be exacerbated by insufficient stockpiling practices or poor loader operations.

- **The impacts on concrete are:**
 - Requires more cement and water.
 - Workability issues leading to surface and edge slump deviations.
 - Decreased concrete durability from loss of entrained air in pockets or vibrator trails.

When You Get it Right!



- **Description**

- Well-graded aggregate in the concrete from proper mix design, and attention to detail in aggregate acquisition, stockpiling practices and loader operations.

- **The impacts on concrete are:**

- Requires less cement.
- Requires intended amount of water and no more.
- Easier to slipform concrete with our surface and edge deviations.
- More consistently meet specification acceptance requirements.
- More durable pavement long term.



Straightedge Guidance for Pavement Surface and Edge Testing

Special Topic #7 - Technical Training Module

Introduction to Straightedge Testing



- Purpose: Assess surface smoothness and edge evenness of airfield pavement.
- Importance: Ensures airport pavement safety and specification compliance.

Historical Background



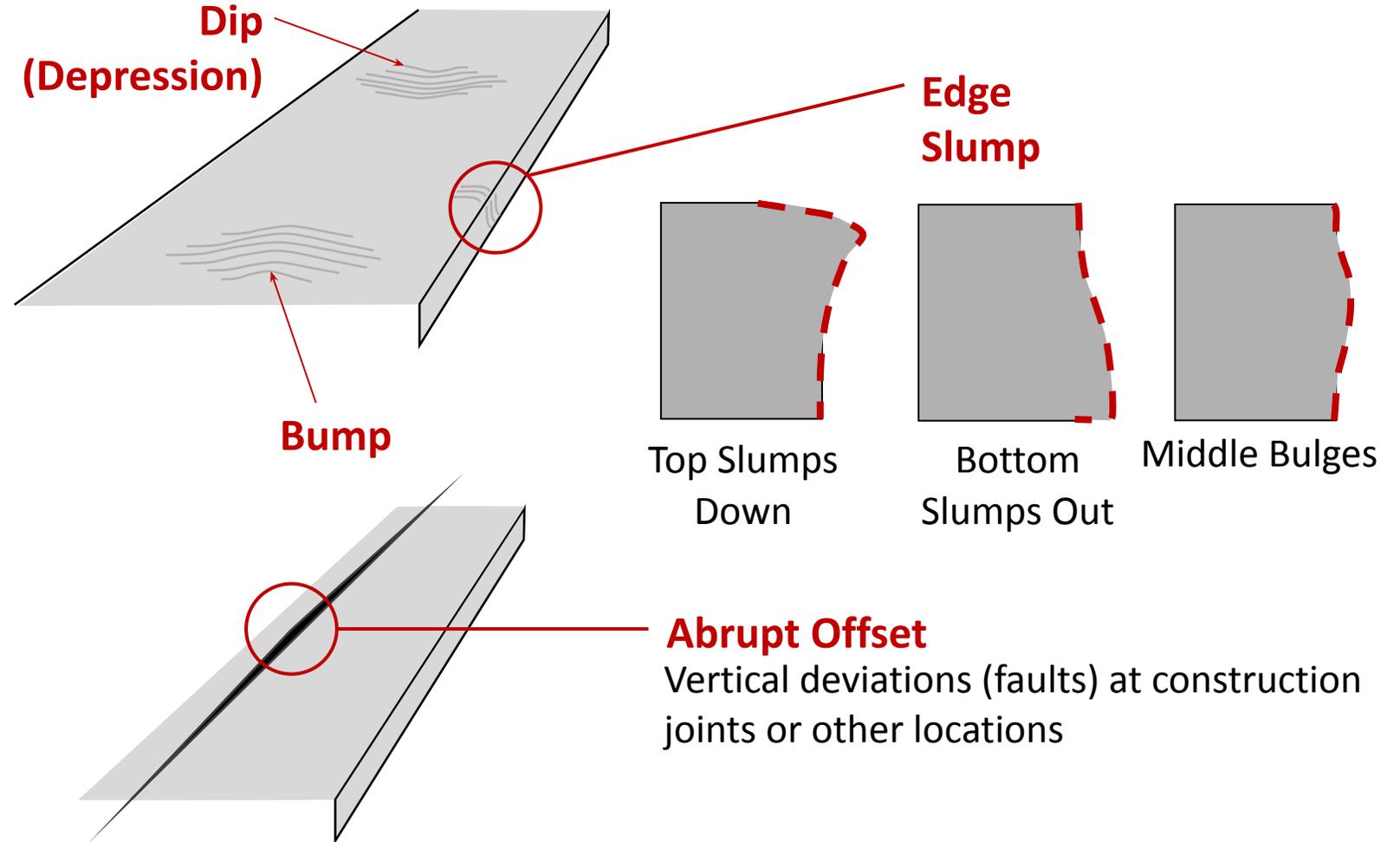
- Early 20th-century is the origin of straightedge testing.
- No standard exists to this day!
- Required use in modern specifications:
 - FAA P-501,
 - UFGS 32 13 14.13, and
 - their applications.

Why Straightedge Testing Matters

- Must assess critical features for airfield pavements.
- Deviations from gravity (slump/slough) larger with thicker paving.
- Horizontal surface profile and vertical edge slump deviations affect safety.
- User (pilot and passenger) safety concerns:
 - Water ponding,
 - Aircraft traction, and
 - Structural integrity.

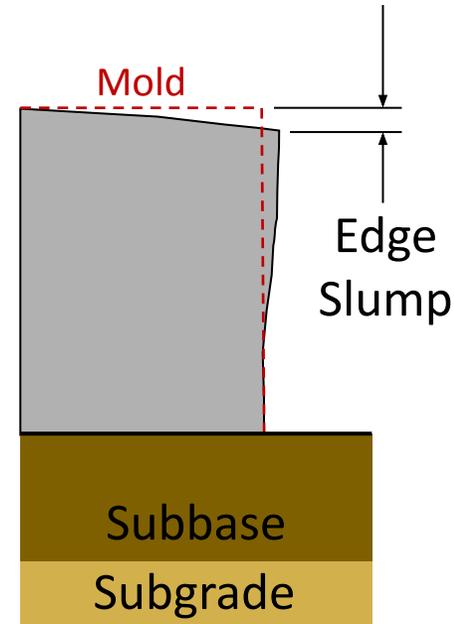
Types of Deviations in Pavements

- Bumps.
- Dips.
- Offsets.
- Edge slump.

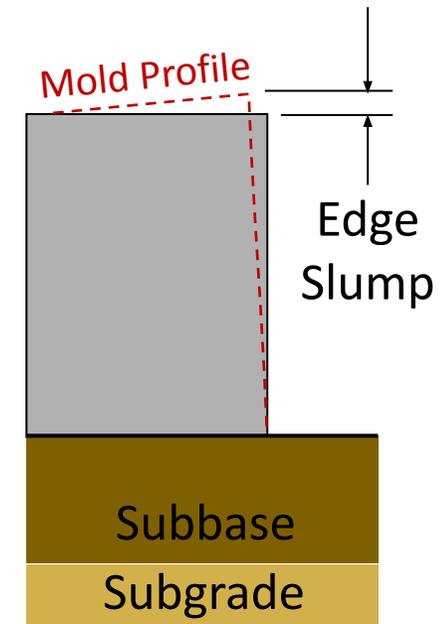


Basic Considerations to Minimize Deviations

- Concrete mixture design
- Process control in production
- Tuning slipform machine to the mix
- Maintaining paving continuity
- Basic consideration in slipform paver setup
 - Overbuild option to slipform mold.
 - Prevents edge slump when adjusted for the concrete.
 - Attitude of the pan matters.
 - Detailed walk-through of paver setup



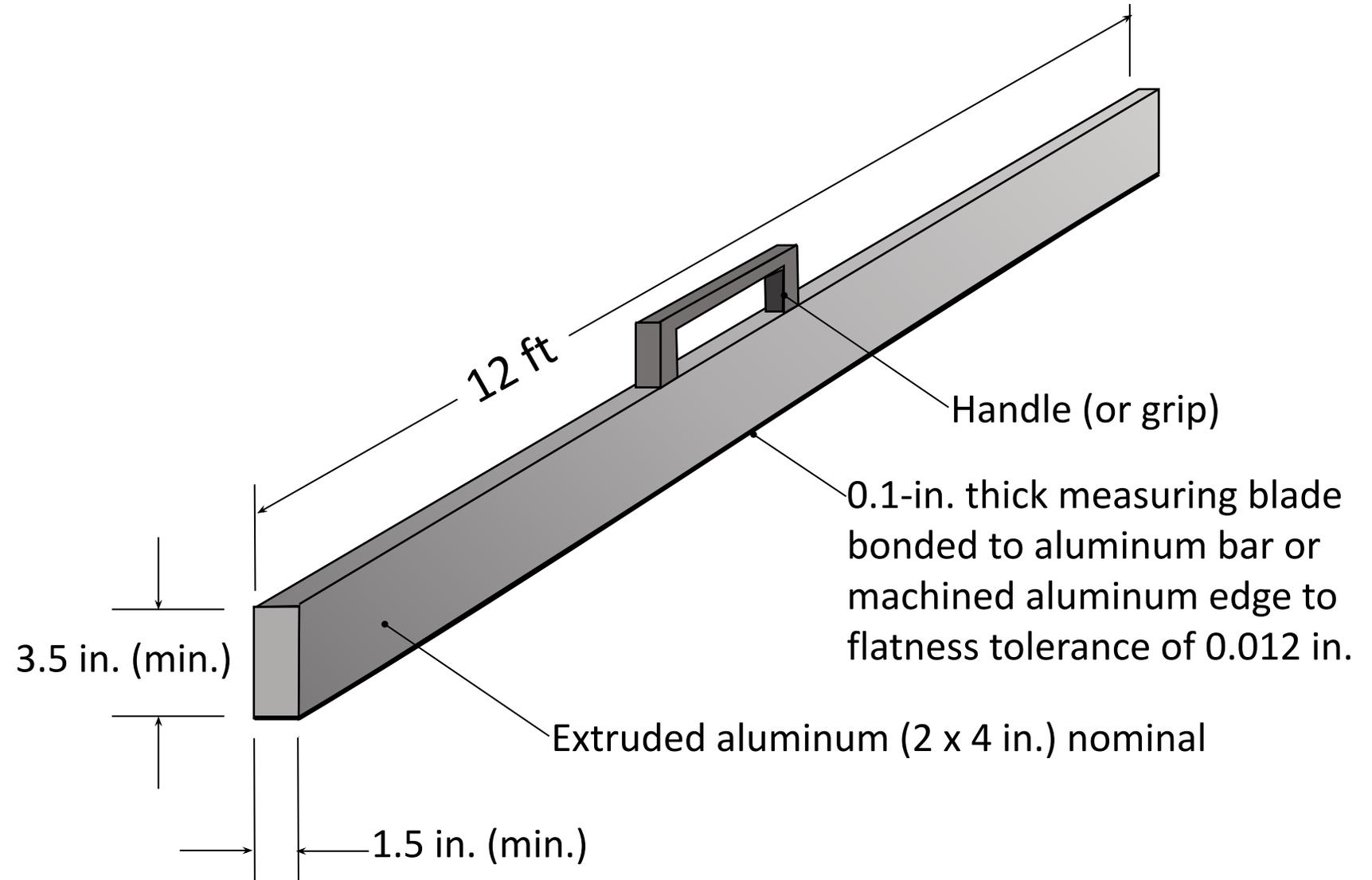
**Horizontal
(Unadjusted)
Slipform Mold**



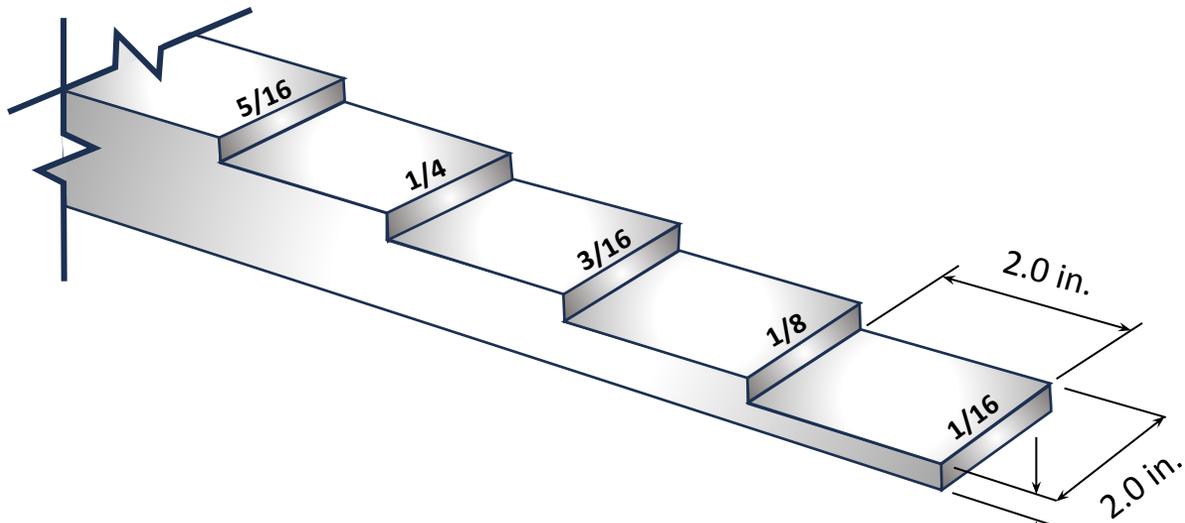
**Edge-Slump
Adjusted
Slipform Mold**

Tools for Surface and Edge Testing

- Straightedge.
- Step gauge.
- Gauge blocks.
- Framing square.
- I-beam level.

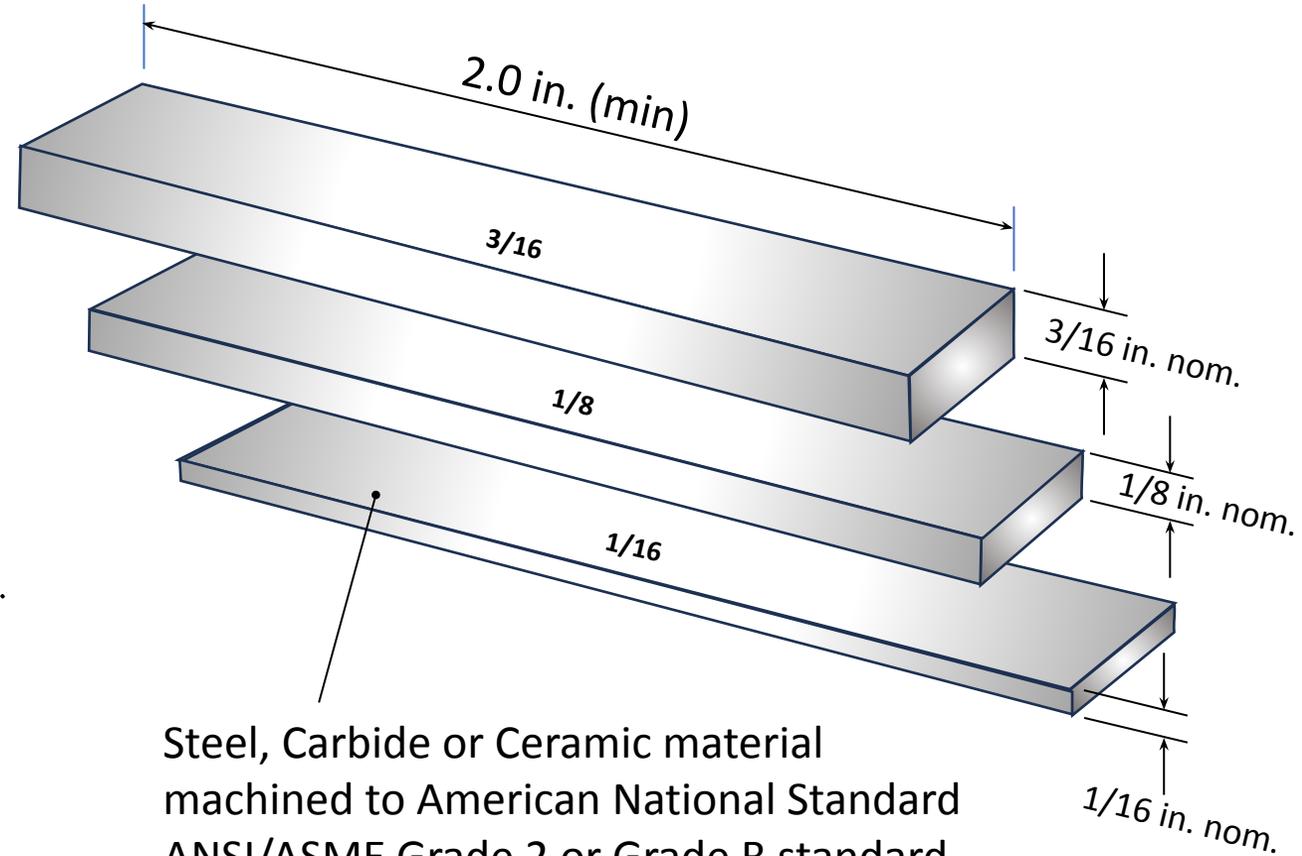


Step Gage & Gage Blocks



1/16 in. machined increments (typ.)

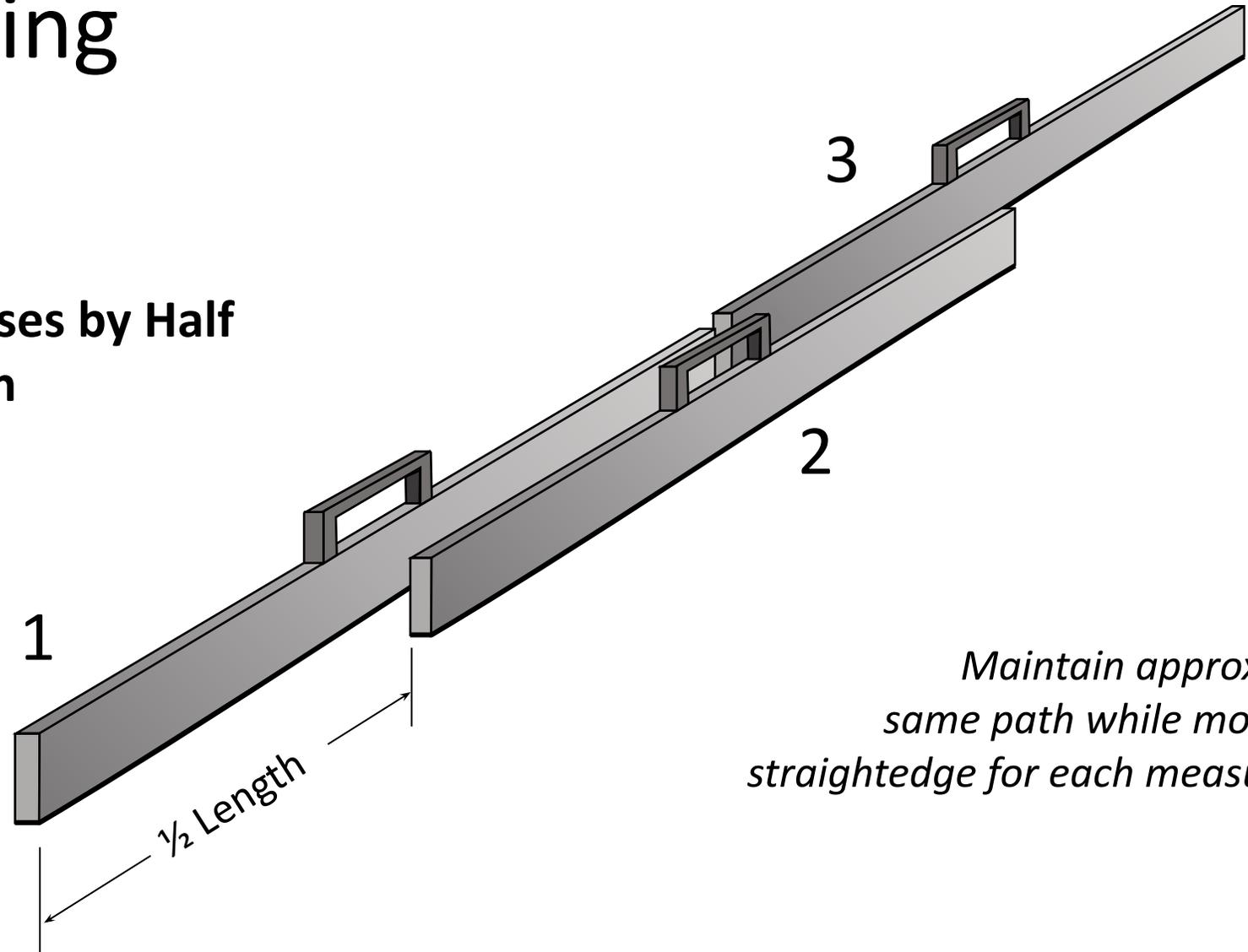
Aluminum or stainless steel tool body with steps
machined to 0.01 in. flatness tolerance



Steel, Carbide or Ceramic material
machined to American National Standard
ANSI/ASME Grade 2 or Grade B standard

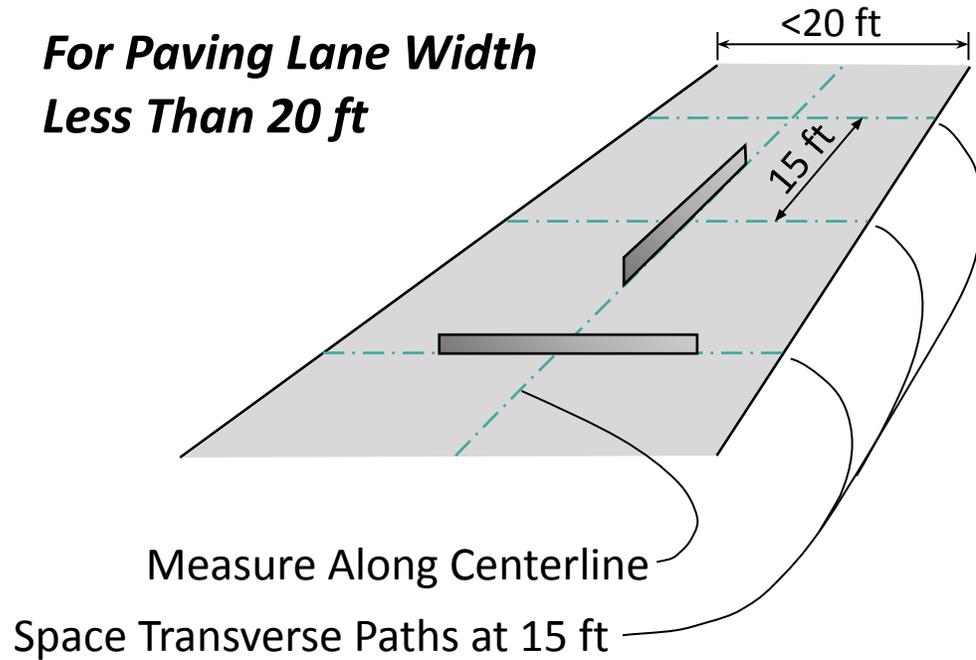
Required Patterns for Surface and Edge Testing

**Proper Technique:
Overlap Successive Passes by Half
the Straightedge Length**

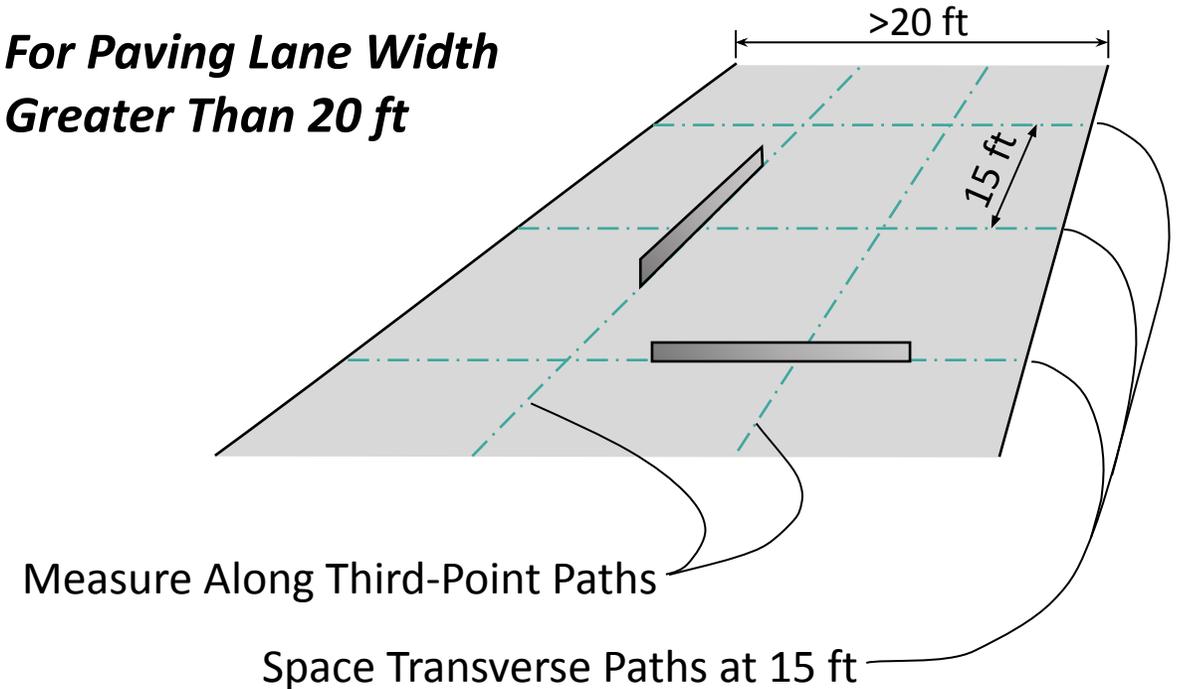


Surface Test Positioning – FAA P-501 Measurement Paths

***For Paving Lane Width
Less Than 20 ft***

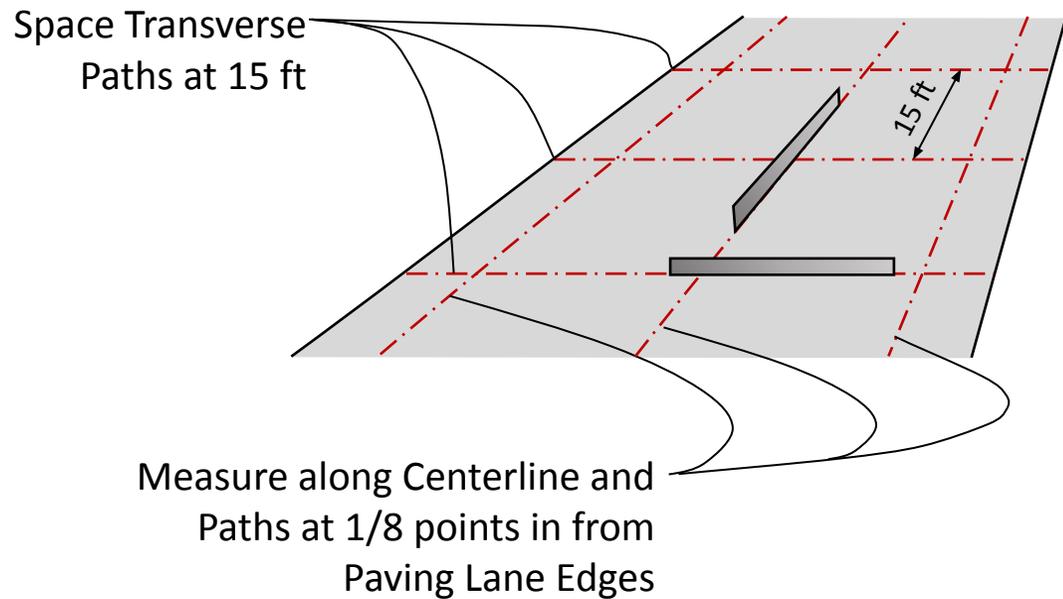


***For Paving Lane Width
Greater Than 20 ft***



Surface Test Positioning – DOD UFGS 32 13 14.13 Measurement Paths

For Any Paving Lane Regardless of Width

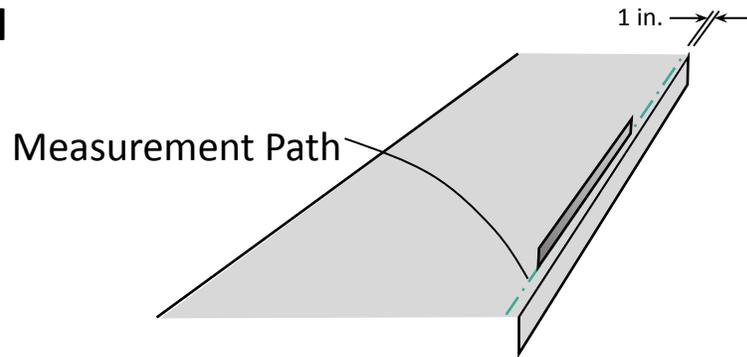


Guideline:

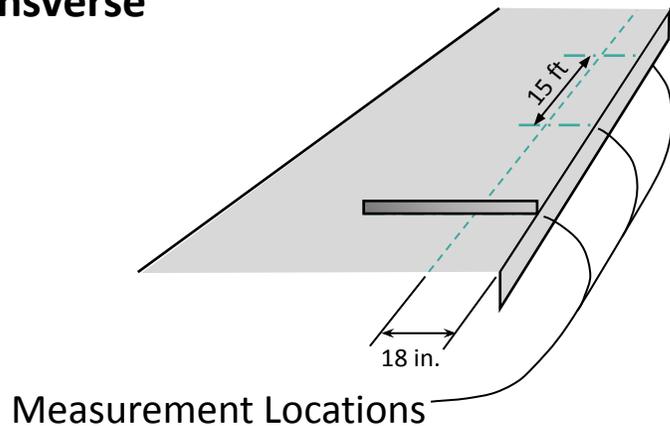
- Allow straightedge to rest on its own on the pavement. Do not press down on either end.
- Check transverse measurements every 15 ft.
- Check longitudinal measurements along specified path as denoted for either specification.
- See Table 1 for allowable deviations/tolerances for both FAA P-501 and UFGS 32 13 14.13.
- Report any deviation to the nearest 1/8 in.
- For all measurements record location (by stationing) and deviation (if present).

Edge Test Positioning - DOD

Longitudinal



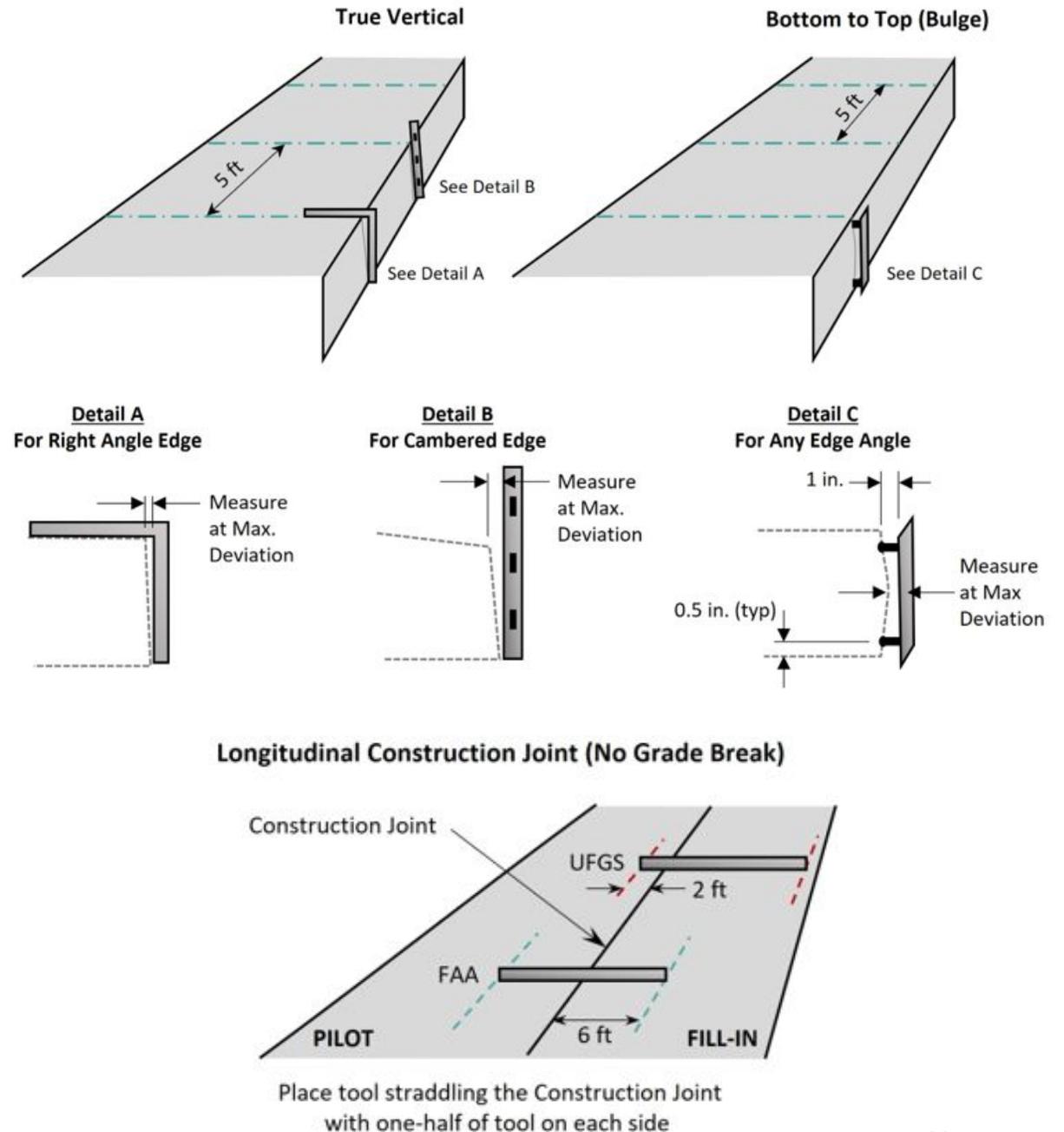
Transverse



- Allow straightedge to rest on its own on the pavement. Do not press down on either end.
- Check for edge slump deviations within 18 inches of free edge.
- Transverse: It is advisable to check transverse measurements every 5 ft at beginning of project (proceed to specified 15 ft interval when no deficiencies are found).
- Longitudinal: Check continuously at 1 inch from paving lane edge (free edge).
- See Table 1 for allowable deviations/tolerances for both FAA P-501 and UFGS 32 13 14.13.
- Report all out of tolerance deviations to the paving foreman and concrete plant operator for corrective action.
- Record any deviation to the nearest 1/8 in.
- For all measurements record location (by stationing) and deviation (if present).

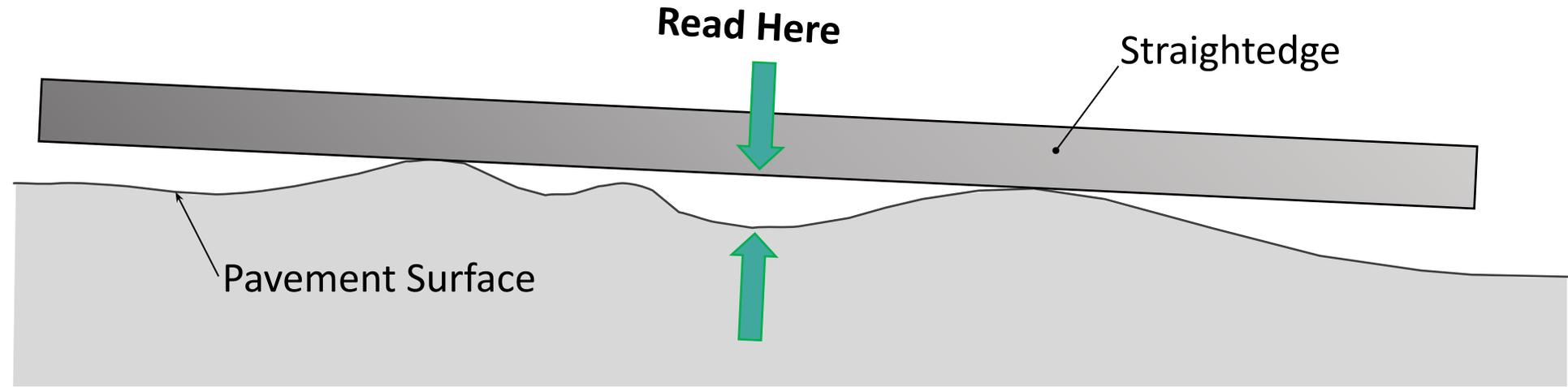
Other guidance

- Longitudinal – along joint face
- Vertical face and angles
- Longitudinal construction joint – no grade break
- Longitudinal construction joint – with grade break
- At pavement transitions or placement termini



Where to Take Surface Measurement

Take Measurement at Largest Deviation Between High Points

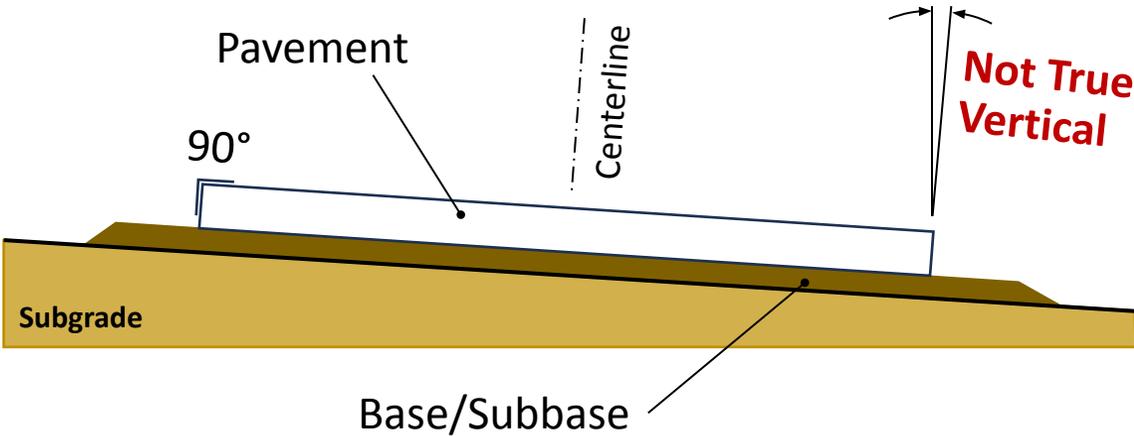


NOT TO SCALE

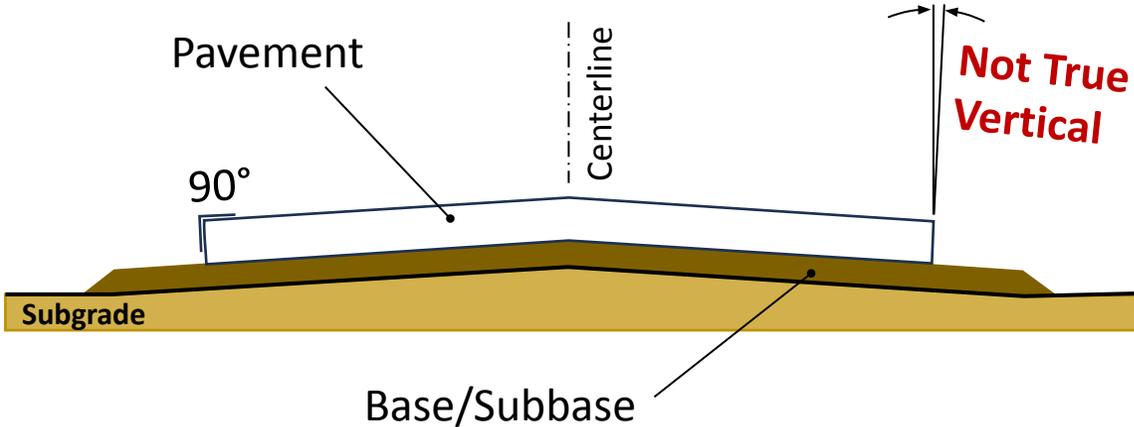
Allow straightedge to rest on surface. Do not press down on either end.

True Vertical?

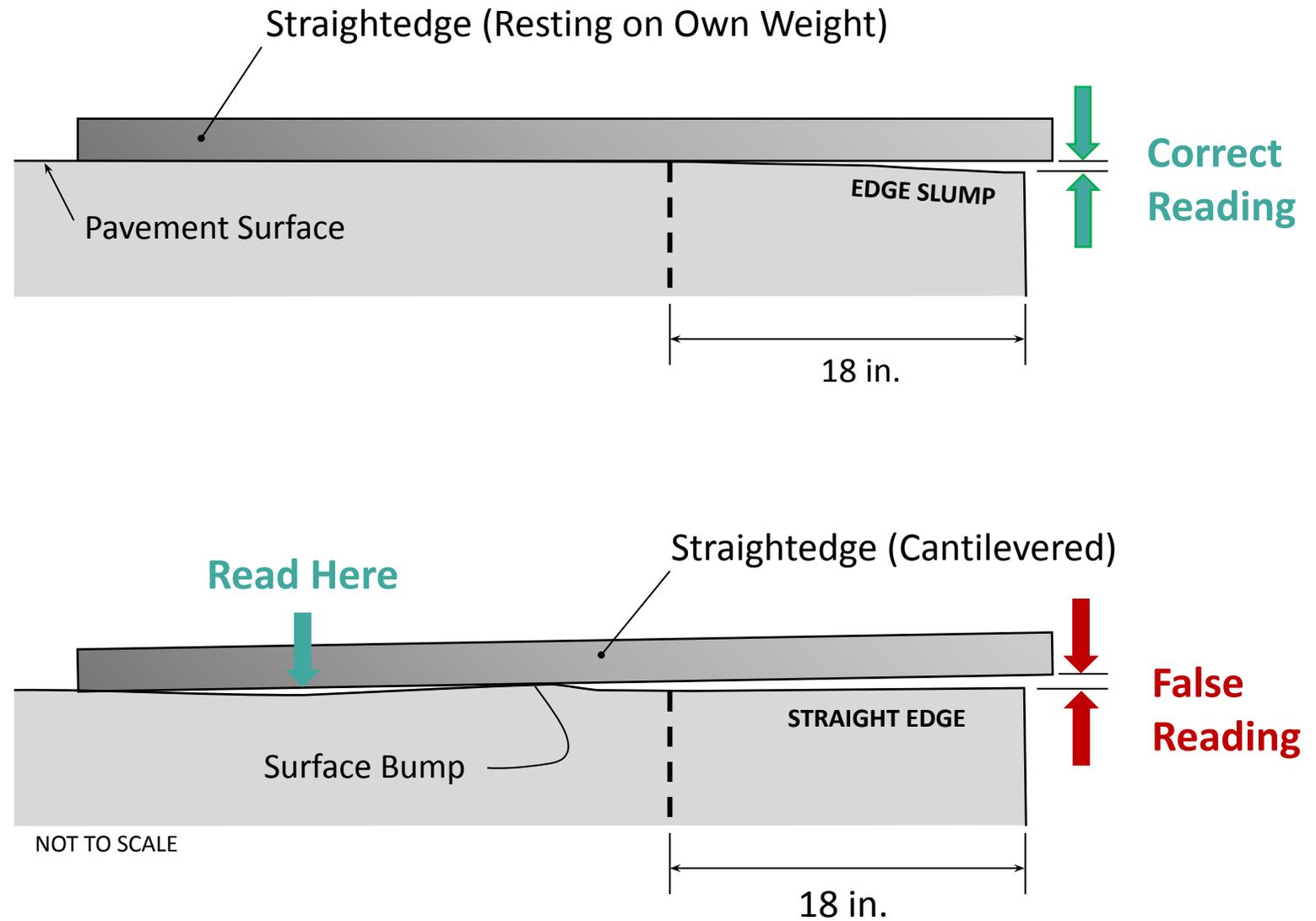
Uniform Slope



Crowned Slope

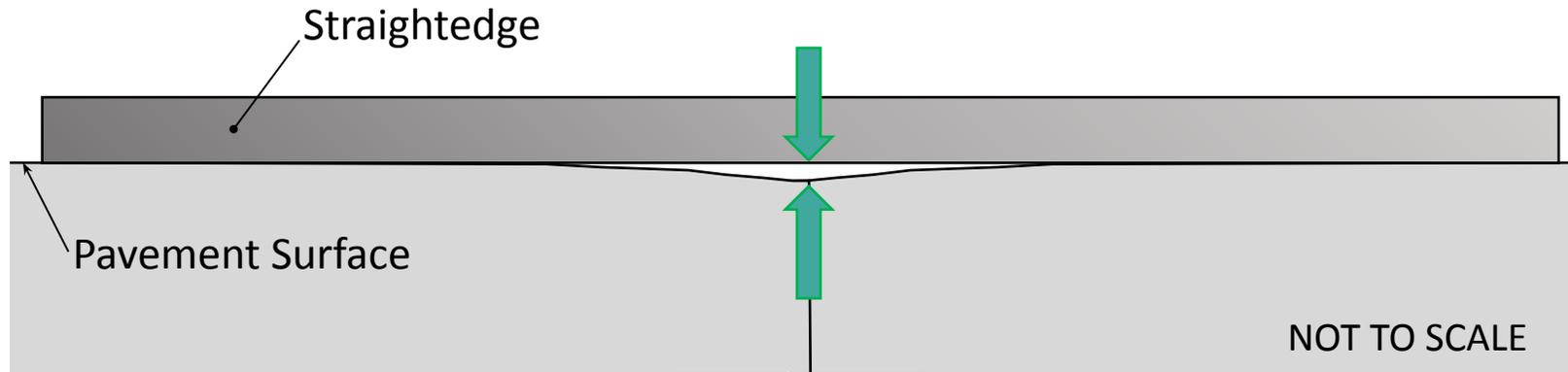


Where to Take Edge Slump Measurements



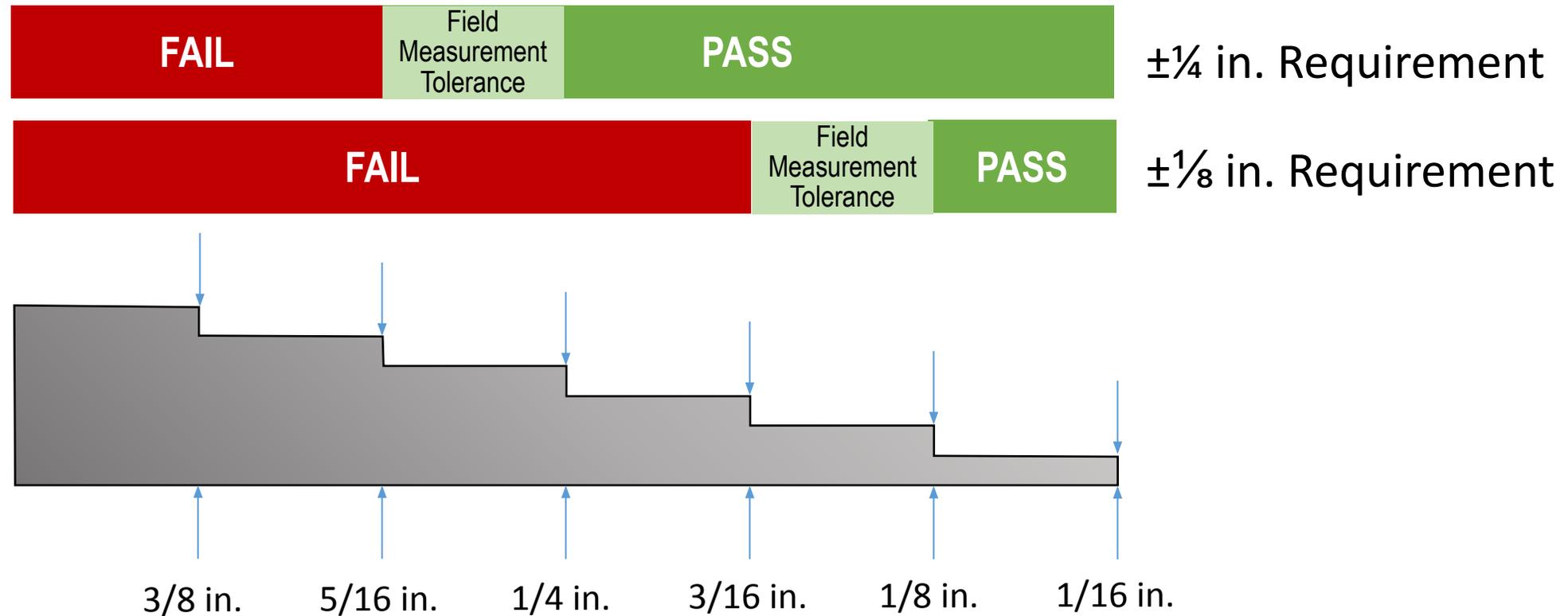
Where to Take Edge Slump Measurements

Take Edge Measurement Straddling
Transverse Construction Joint

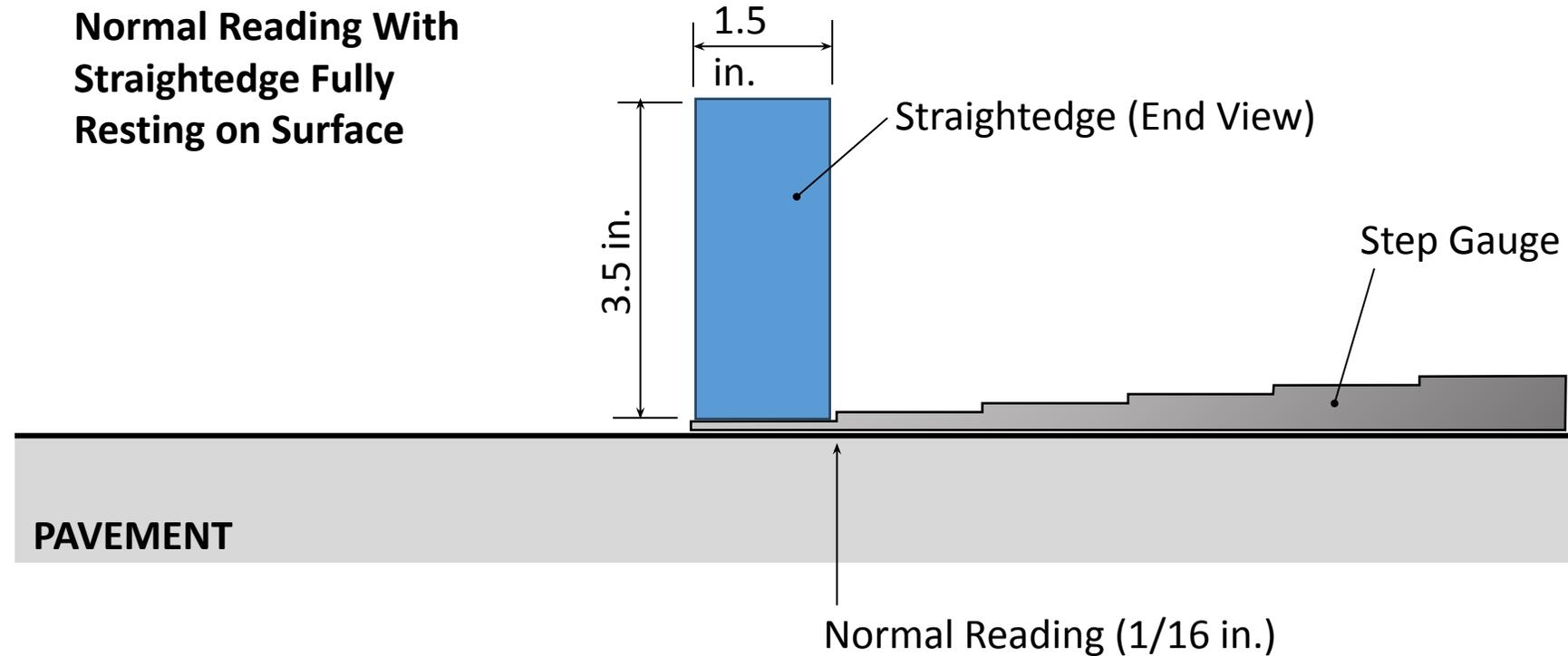


Allow straightedge to rest on surface. Do not press down on either end.

How to Read Step Gage



How to Read Step Gage

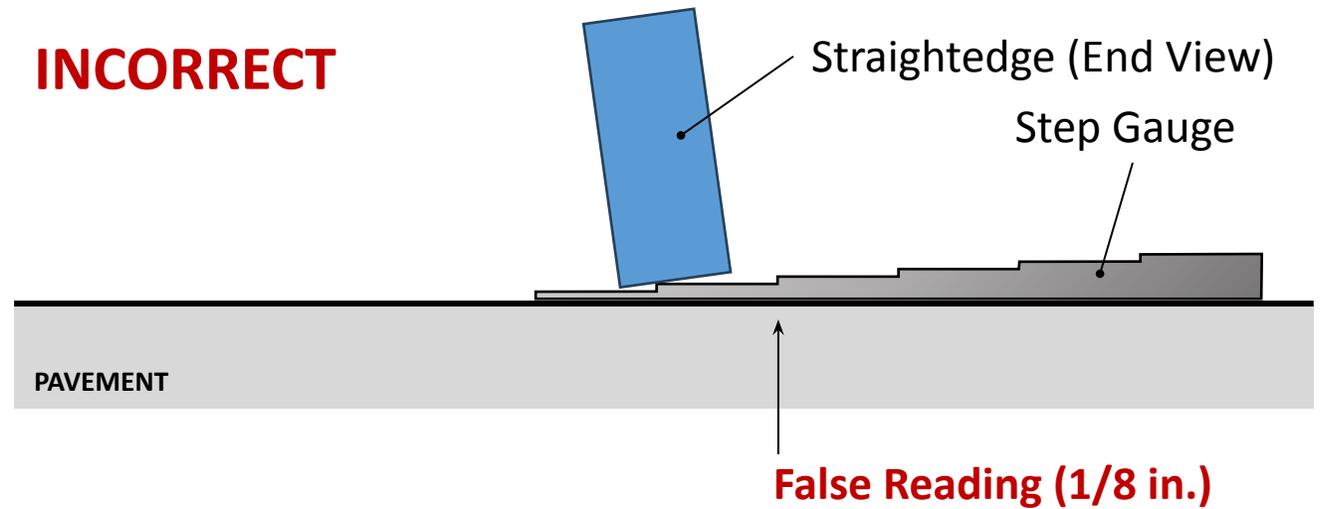


How to Read Step Gage if Resting on Slight Angle

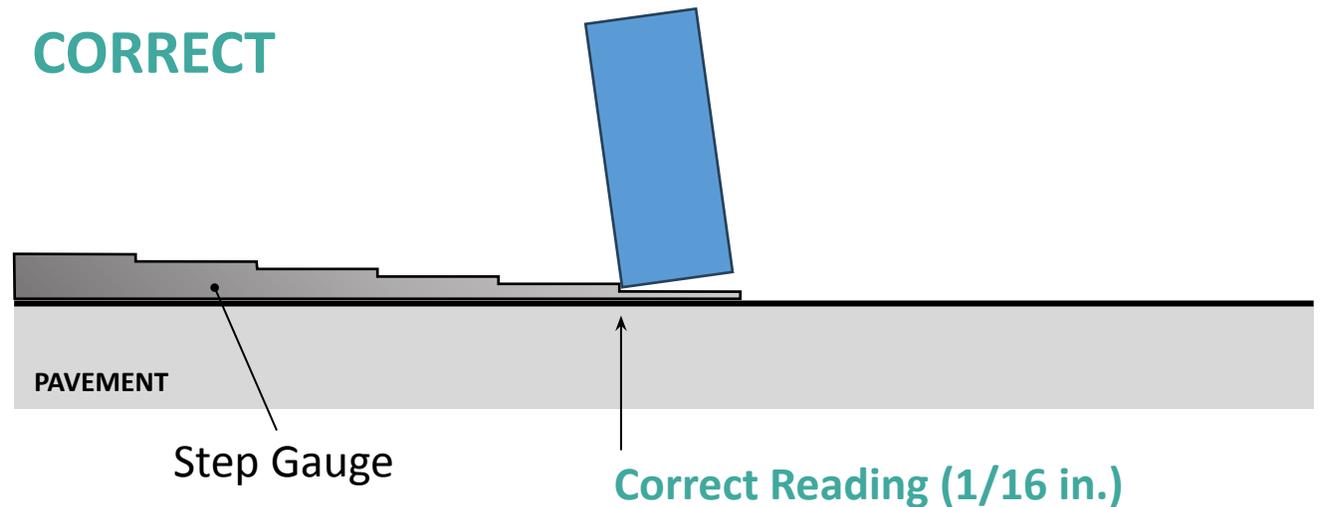
Always approach from both directions if straightedge is leaning on edge.

Record the deviation on side with more pavement contact.

INCORRECT



CORRECT



Tolerance Requirements for Deviations

- FAA and DoD standards for deviation limits.
- Visual table comparing limits for longitudinal, transverse, and edge slump deviations.

Location/Orientation	Deviation Limits*
FAA P-501	
Slab Surface – Transverse	≤1/4 in in 12 ft.
Slab Surface – Longitudinal	≤1/4 in in 12 ft.
UFGS 32 13 14.13	
Any Slab Surface – Abrupt Change	≤1/4 in in 12 ft.
Runway/Taxiway – Transverse	≤1/4 in in 12 ft.
Runway/Taxiway – Longitudinal	≤1/8 in in 12 ft.
Runway w/in 200 ft Either Side of Arresting Gear	≤1/8 in in 12 ft.
All Other Slab Surfaces – Transverse or Longitudinal	≤1/4 in in 12 ft.
Edge Slump w/in 18 in. of Slipform (Free) Edge	No deviation >3/8 in. in 12 ft. & Not more than 15% length w/deviations >1/4 in. in 12 ft
On Surface 1 in. from Free Edge - Longitudinal	≤1/8 in in 12 ft.
Joint Face – Longitudinally Along Vertical Edge at mid-depth of slab thickness	≤1/4 in in 12 ft.
Joint Face – Top to Bottom	≤3/8 in.
Joint Face – Abrupt Offset in Any Direction on vertical plane	≤1/4 in in 12 ft.
Joint Face – Offset from True Vertical	≤1 in. per 12 in.

Supporting guidance

- Best practices in QC
 - Dedicating QC technicians
 - Proactive checking
 - real-time data sharing
- Referee proof testing for water ponding

