

# Concrete Pavement – the Design Perspective



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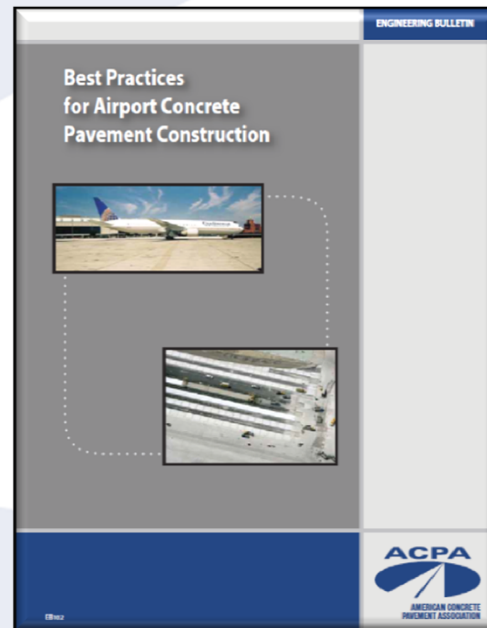
# Concrete Pavement—the Design Perspective

## Introduction

- **Planning**
- **Procurement & Contract**
- **Design**

# Resources

- Innovative Pavement Research Foundation
- ACPA Publication
- FAA (or applicable agency)



An **IPRF** *Research Report*  
Innovative Pavement Research Foundation  
Airport Concrete Pavement Technology Program

Report IPRF-01-G-00



Programs Manager  
5420 Old Orchard Road  
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**IPRF** *Research Report*  
Innovative Pavement Research Foundation  
Airport Pavement Technology

Report IPRF 01-G-002-03-1



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REPORT IPRF 01-G-002-05-1

### AIRFIELD MARKING HANDBOOK



Photograph courtesy of NASA

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5420 Old Orchard Road  
Skokie, IL 60077

September 2008

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Innovative Pavement Research Foundation  
Airport Concrete Pavement Technology Program

Report IPRF-01-G-002-1

### Best Practices for Airport Portland Cement Concrete Pavement Construction (Rigid Airport Pavement)



Programs Management Office  
1010 Massachusetts Avenue, N.W.  
Suite 200  
Washington, DC 20001

April 2003

ACPA Document No. JP007P

Innovative Pavement  
Research Foundation  
[www.iprf.org](http://www.iprf.org)

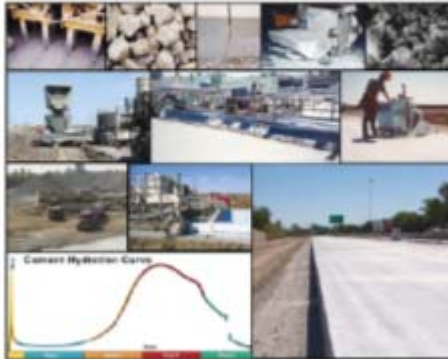
# Integrated Materials and Construction Practices for Concrete Pavement:

A State-of-the-Practice Manual

HMMA Publication No. 187 - 07 - CD4

U.S. Department of Transportation  
Federal Highway Administration

Second printing October 2007  
(December 2004)



National Concrete Pavement  
Technology Center

ctre  
Center for Transportation Research  
and Education  
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EUA STATE  
UNIVERSITY

## CONCRETE PAVING Technology



### Concrete Pavement for General-Aviation, Business and Commuter Aircraft ■■■■■■■■■■

Many communities recognize that increasing safety for aircraft operations is a necessity. But, to meet such the condition of pavement surfaces at small airports continues to degrade because of limited funding sources. And, contrary to the funding trends, the number of aircraft operations at small airports increases as regulatory agencies promote larger airports to reduce congestion by diverting private and business aircraft to major airports and release airports. In addition, many airports that also release airports are expanding their development programs for including airport small terminals, stabilizations, and roadways.

The majority of communities with small airports depend upon local or private funding for the construction and rehabilitation of pavements. Comparisons for funding sources is extremely intense and the planning for the acquisition and optimum use of available funding is a necessity.

The Federal Aviation Administration (FAA) requires that airports adhere to minimum design and construction standards, in the form of Advisory Circular (AC), in order to qualify for a Federal funding grant. However, the FAA ACs do not contain a regulation, and in general are not mandatory. But, use of FAA guidelines is mandatory for airport pavement design and construction projects funded under the Airport Improvement Program (AIP) or the Airport Trust Funds (ATF), respectively.

In September 1998, the FAA issued a new advisory circular (AC) AC 1520-100 that sets forth the minimum standards for airport pavement design for projects funded under the AIP or ATF programs. The new design procedure requires the use of a three-dimensional finite element analysis software that analyzes the effects of an entire fleet size of aircraft on a pavement. Because use of the FAA software requires that all aircraft operations be analyzed for use in the analysis. The FAA guidance also requires minimum thickness for facilities designed for aircraft under 10,000 lb gross weight, otherwise airports in necessity to provide facilities for their fleet size that are designed for a specific aircraft or aircraft, such as a general aviation may not be warranted. In addition, there are also within the analysis of construction equipment or service vehicles is necessary.

This publication provides guidance for the design and construction of concrete runways, taxiways, and aprons supporting general aviation, business and commuter aircraft for facilities that are funded by private sources, where a cost-benefit analysis may not be warranted. The information presented in this document may be used for planning new construction or rehabilitation of concrete pavements at small airports, including an economic analysis for small, lightweight aircraft including business jets, all types, and commuter aircraft with gross weight up to 10,000 to 10,000 kg. The pavement thickness requirements shown herein also account for an occasional overload.

This document should not be used as a construction contract document. A professional engineer familiar with the aircraft traffic, and local conditions should prepare the necessary documents used for the construction contracts.

#### Advantages of Concrete

The curing, setting, and open permeability—the surface on which aircraft operate—are the chief functional components of an airport, and pavement quality is critical to the safe operation of aircraft. The following properties of concrete pavement contribute to low pavement maintenance and safe aircraft operations:

- Resistant to rutting capacity
- Resistance to degradation by fuel spillage, oil, deicing, or heat and cold
- No raveling under chemical traffic or parked aircraft
- Light reflective for excellent runway visibility for approaching aircraft
- Permanent surface texture or grooving to minimize potential of aircraft skidding or hydroplaning
- Low buildup of suspended oil films above pavement surfaces and
- No periodic resurfacing or surface sealing

## Concrete Pavement Field Reference Paving



A practical guide to understanding and troubleshooting

Quality control  
Problems with concrete  
Paving concrete  
Finishing & curing  
Jointing  
Opening to traffic

American Concrete Pavement Association

Other Great Resources:  
[www.cptechcenter.org](http://www.cptechcenter.org)  
[www.acpa.org/bookstore](http://www.acpa.org/bookstore)

# Planning Considerations:

- Coordination with stakeholders
- Identify Key Personnel
- Eliminate the Unknowns



# Geotechnical



# Utilities





# Weather



# Procurement and Contracts

Deliver Options

Require Minimum Quals

Pre-Qualify Bidders Early

Early Procurement of Long Lead Items

Early NTP

Set Aside Funding for Contingencies

Bonus for Early or "on-time"

Completion

# Phasing and Scheduling

Security Fencing

Time of Year/Week/Day

Minimize the Number of Phases

Overlap Phases

Alternate Facilities

Partial Use of Runway/Taxiway

Affects on Other Work

Solicit Contractor Input

10 vs. 1

# 10 versus 1 Rule



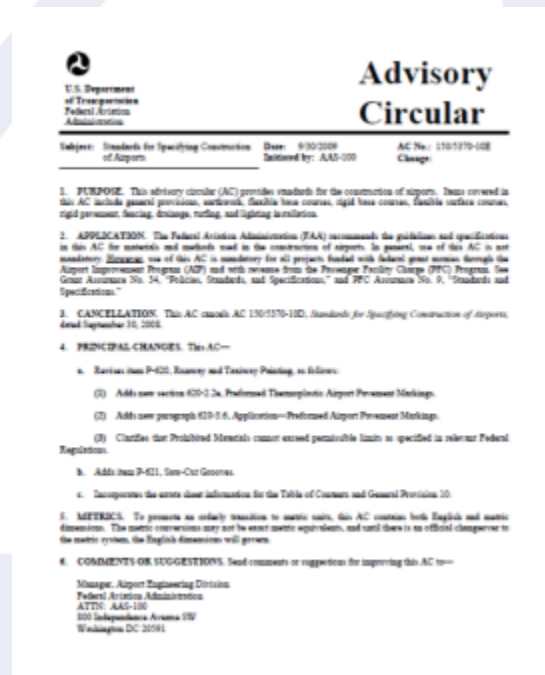
# Project Staging Areas

- Level
- Well drained (throughout construction)
- Size
- Access



# Construction Specifications

- Establish the acceptable parameters
- Easy to understand
- May be prescriptive and/or end-result based
- Provide guidance/requirements for:
  - Materials
  - Construction methods
  - Methods of measurement for compliance with specs
  - Testing requirements
  - Basis of payment



# Pre-Bid, -Award, and -Construction Meetings

- Project overview
- Administrative/contractual details
- Construction scheduling & phasing
- Contractor's access to site & staging area
- Addendums to plans & specifications, if any
- Detailed review of project scope of work
- Bidder's questions
- Site visit



**(THIS IS THE TIME TO RESOLVE ANY CONTRACTOR QUESTIONS/CONCERNS)**

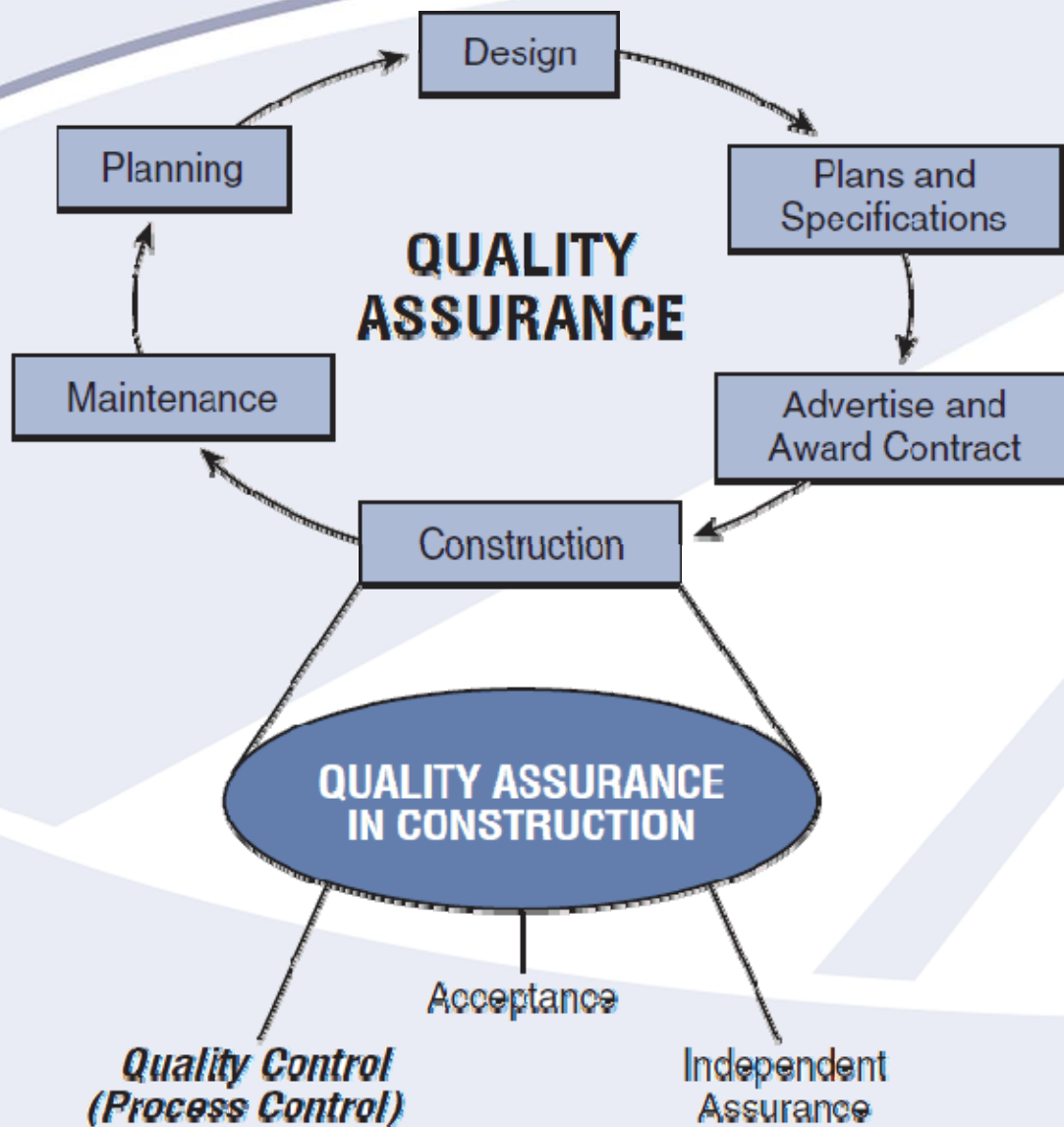
# Partnering Pays Dividends!

- A joint meeting between QC and QA reps before construction starts
  - Review project requirements
  - Review action and suspension limits
  - Identify & clarify gaps and ambiguous items
  - Review handling of non-conforming test results
  - Review chain of command for decision making
  - Establish QA/QC data management & data review plan
- Designer, Owner, Program Manager, Contractor





# QC versus QA



## Quality Assurance (QA)

Ensures that the end product is of the proper quality (checks that things are done properly)

Responsibility of the specifying agency

Motivates proper QC practices

## Quality Control (QC)

Makes the product of the proper quality through QC processes (ensures that things are done properly)

Responsibility of the producer and/or contractor

Motivated by QA and acceptance procedures

# Cost of Poor Quality

- For airport owner
  - Operational delays & loss of revenues
  - Cost of claims (litigation)
  - Reduced service life
- For contractor
  - Corrective measures
  - Partial payments
  - Cost of claims (litigation)
  - Liquidated damages



# Acceptance Criteria

- (Slump and air content) \*\*
- Flexural strength
- Thickness
- Smoothness
- Grade: lateral & vertical deviations
- Edge slump
- Dowel bar alignment



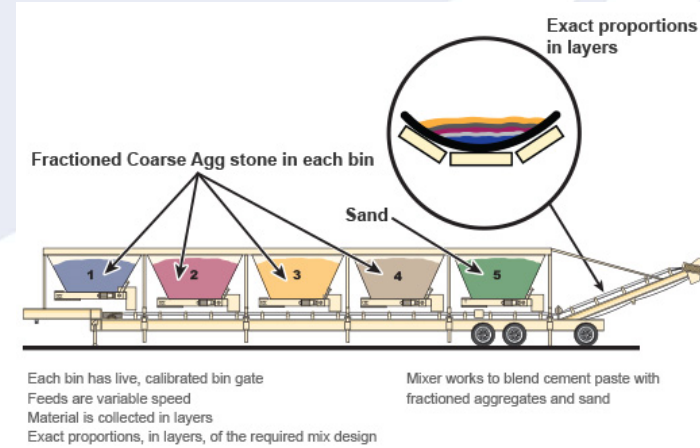
# Manual Paving

- Labor intensive
- Used for small areas only
- Reinforcement in odd shaped panels (only)



# Fillet Details





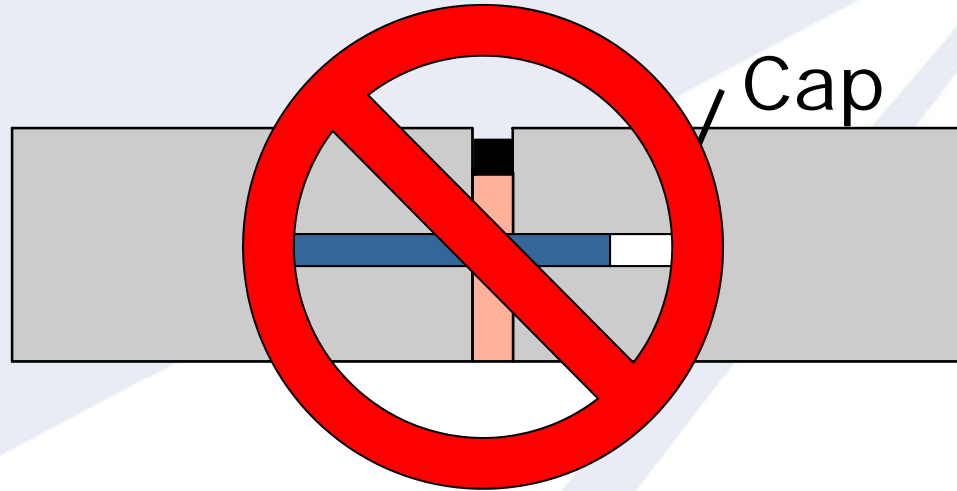
Best Practices for Airport Pavement Construction

# Concrete Mixture

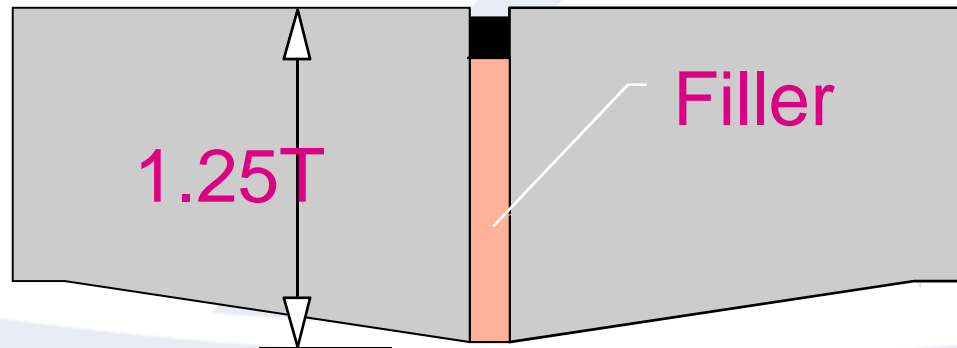
# Attention to Detail

## Isolation/~~Expansion~~ Joints

Doweled

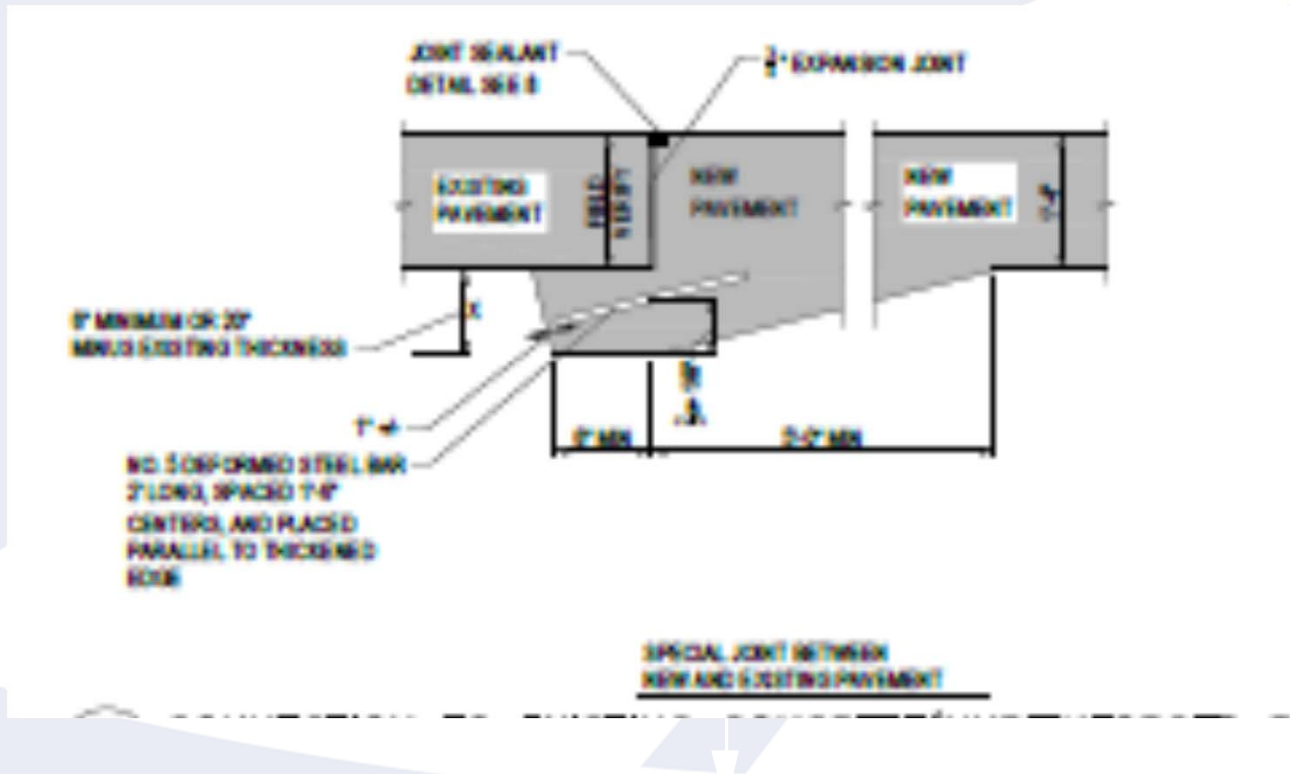


Thickened  
Edge



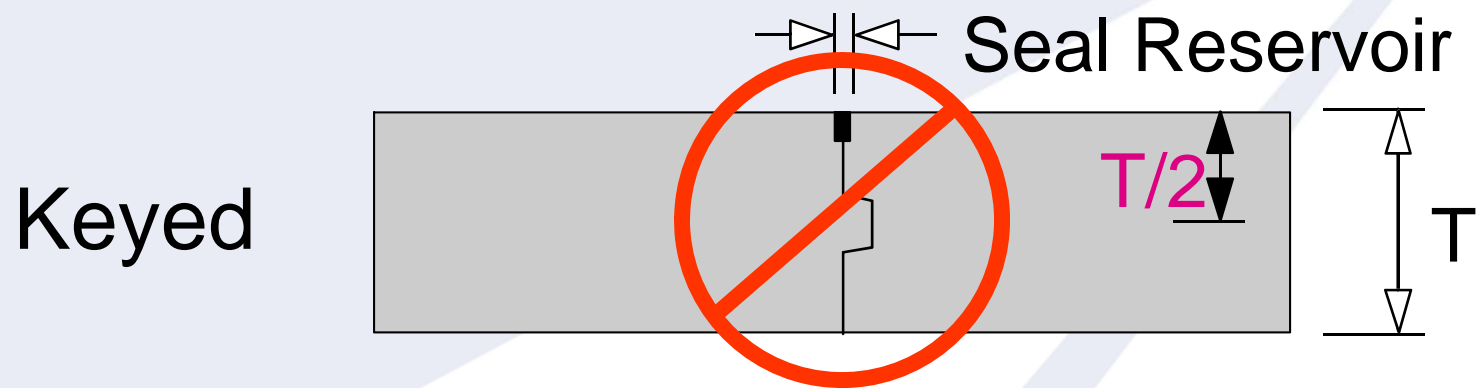
# Details

Poor hard to construct details





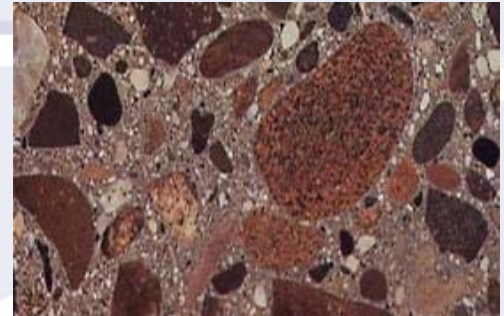
# Keyed Construction Joint



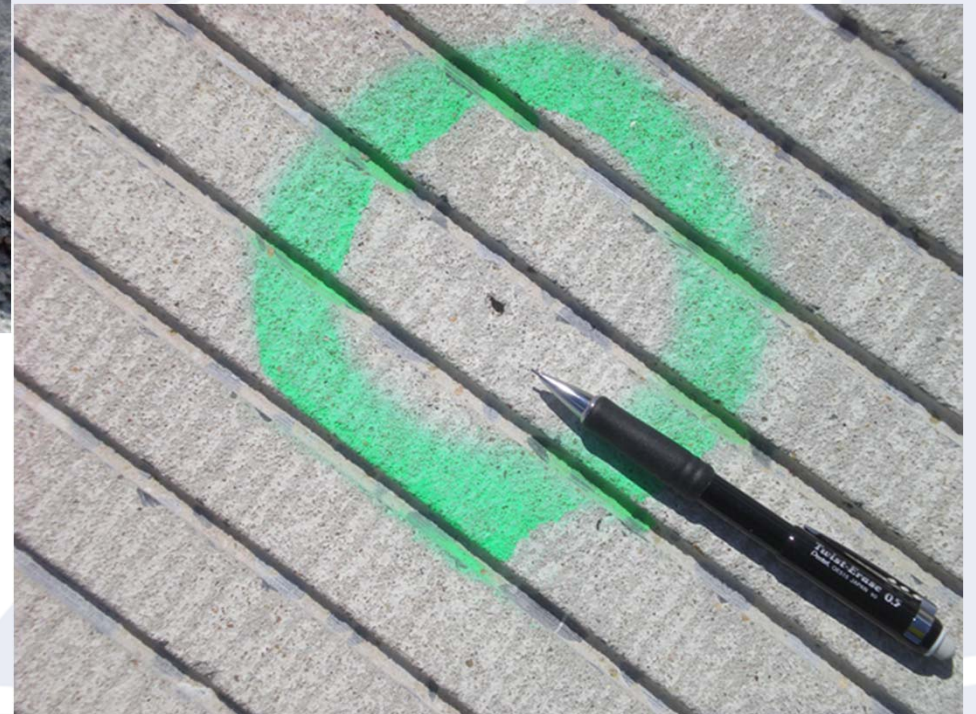
**FAA AC/150-5320-6E:  
Detail has been  
removed**

# Concrete Consolidation

- Inadequate consolidation
  - Lower in-place concrete strength
  - Honey-combing
- Over-consolidation
  - Poor air void system
  - Less durable concrete
- Monitor vibration effort regularly
  - vibrator smart system recommended
    - continuous monitoring



# What is reasonable?



# Paving Around In-Pavement Structures

- Lights, hydrant pits, utility manholes & drainage structures (trenches)
- Properly planned for and executed – consider during design phase
- For light cans, methods include
  - Blockouts
  - Split can & coring

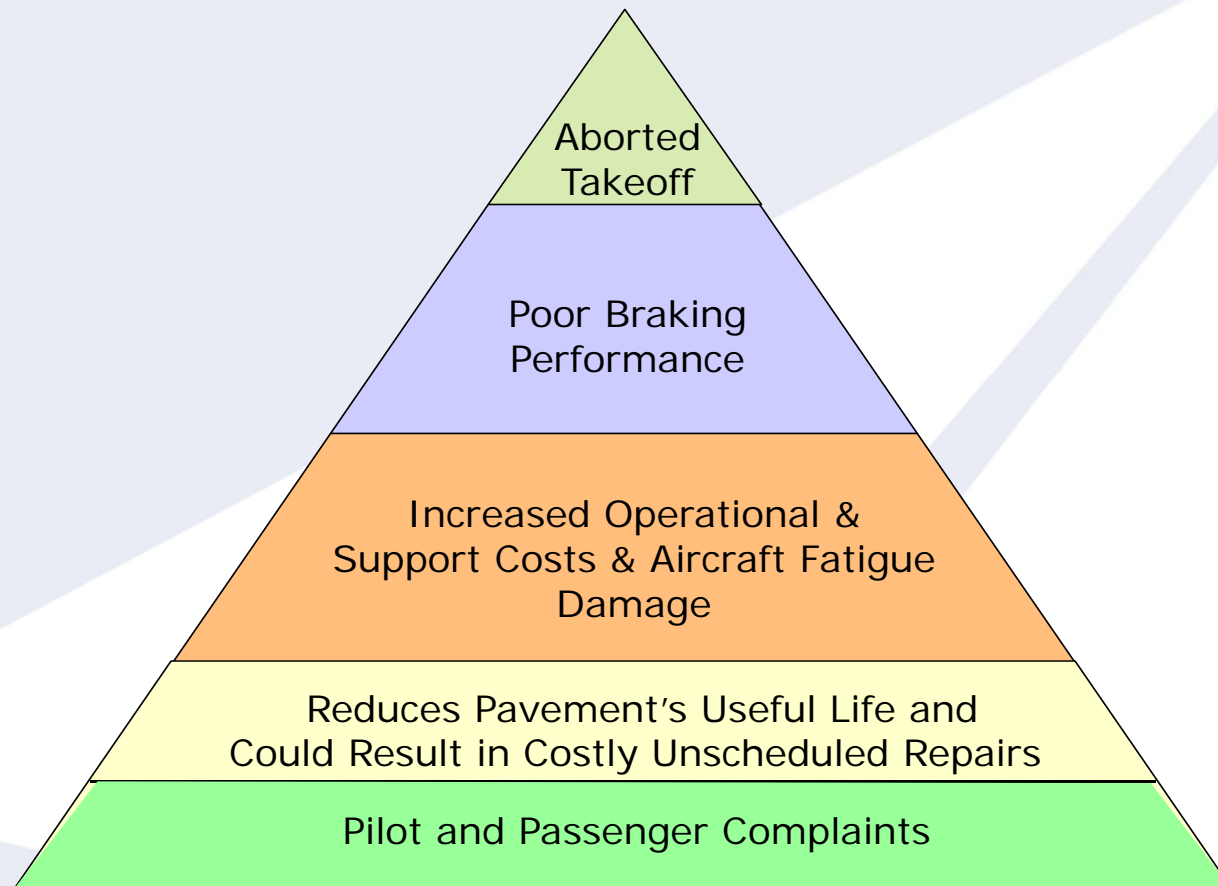


# Runway Roughness Evaluation: A Unique Problem

- Landing Gear Spacing of nearly 100 Feet
- Speeds up to 150 Knots
- Aircraft will Respond to Bumps 300 Feet Long or Longer
- Multiple Bumps in Succession; Non-Linear Effect
- Struts are Primarily Designed for Landing Impact



# Why Be Concerned About Runway Roughness?



# What is the goal for smoothness?

## FAA Advisory Circular 150/5380-9 (Based on Boeing Bump Criteria)

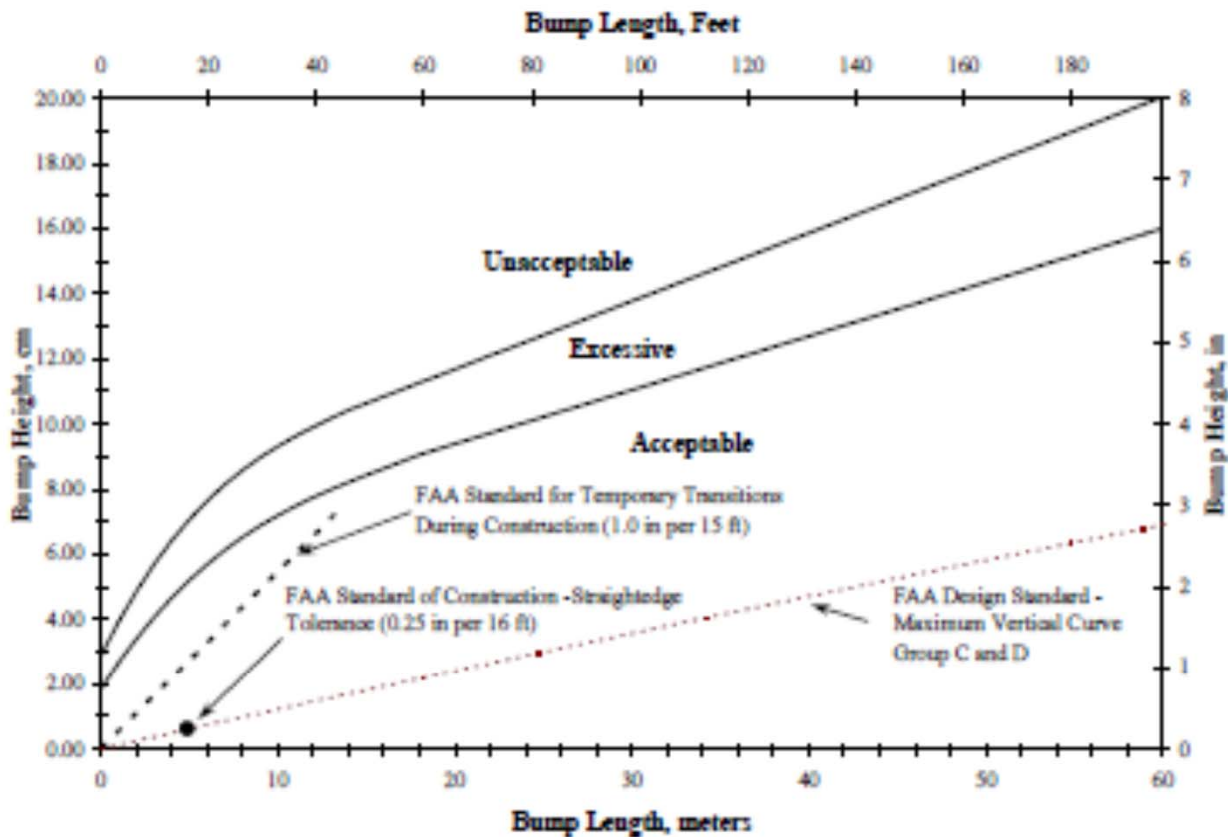


FIGURE 2-3. SINGLE EVENT BUMP - ROUGHNESS ACCEPTANCE CRITERIA

# Current Smoothness Criteria

- 12 feet straightedge
- Threshold of Acceptability –  $\frac{1}{4}$  inch measured anywhere between two high points of the straightedge
- No criteria for long wavelength profile of a pavement feature
- Therefore no criteria exist for smoothness of an entire pavement feature
- This issue is drainage and aircraft safety





Best Practices for Airport Pavement Construction

**There's More!**

Thank You!  
Questions?

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