

Inspection and Testing

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True or False

You never need inspection or
testing

until there's a problem.

QA / QC

- QC –Quality Control – To catch problems before incorporation into a product.
 - Generally a Contractor Supplier Responsibility
 - Use of certified (pre-tested / pre-inspected) material
 - Testing prior to and during production
- QA – Quality Assurance – Testing and Inspection
 - Agency or Independent hired by the contractor or Agency/Owner
 - Review QC process and any testing performed
 - Perform assurance testing
- Verification –
 - Agency / Owner Acceptance
 - Generally used when contractor performs QC and QA.

Role of Inspection

- Direct and Observe the Testing
Judgments as to whether the plans and specifications are being met.
- Extrapolation of Test Results to the Work Performed
Test Results are small discreet measurements
Sample size limitations
Limitation of the amount of testing
- Calibration of Perception - Pass/Fail
What is acceptable
What should not be accepted
- Evaluation and Acceptance

Reality: If something goes wrong you blame the inspector because they were standing right there watching and telling me what to do.

Role of Testing

- Fact not Opinion
 - Why guess when you can know
 - Evidence in a dispute
- Verification through Measurement
- Calibration and Extrapolation for Inspection
- Common Understanding
 - What is Quality
 - What do the minimum contract requirements look like

Reality: Testing and Inspection tell designers and courts you did what you were told and met expectations.

Provides a Perception of Quality and Owner Confidence

Concrete

What Should be Evaluated

Input Measures: (Plant Inspection)

- Aggregate and Sand Selection
 - Gradation and Quality
- Pozzolans - Cement, Flyash
- Water including moisture in components
- Admixtures
- Measuring Proportions - Scales

Concrete

What Should be Evaluated

Field Inspection – Output Measures

- Weather and Temperature - Wet or Dry - Hot or Cold
- Reinforcement - Dowel Bars and Tie Steel
- Batch Ticket
- Volume
- Finishing - Smoothness and Texture
- Saw cuts and Joints
- Curing - Wet or surface sealing
- Joint Sealing
- Air, Slump and Strength

Aggregates

- Approximately 80% of concrete is aggregate
- Aggregate size, shape and surface texture affect workability, quality, and cost
 - round, angular, elongated, flaky
 - Effects Water demand
 - Which Effects Cement content
 - Which Effects Strength (cracking)
 - Which Effects Hardness and abrasion resistance
 - Which Effects Freeze / Thaw durability
 - Which Effects Cost and Life Cycle Cost

Aggregate Reactivity

- Alkali Silica reactions (ASR)

Reactive silica in aggregate + cement alkalis = Gel Expands = Cracking

- Alkali Carbonate reactions (ACR)

Dolomite in reactive carbonate rocks + cement alkalis = Calcite + Brucite

- D - Cracking

- Result: Expansion, cracking
Poor performance

Field Inspection

■ Water

- At time of Batching
- Water left in Ready Mix Trucks
- Adding Water in Transit
- Adding Water at the project site
- Re - tempering at placement

■ Admixtures

My Recommendation:

Unless you have done your own testing - tell your ready mix supplier what you want the concrete to do not what to add.

Because of the need for control we write a prescriptive specification.

Because we don't want responsibility we include performance requirements.

Because you are a contractor/supplier you should have known that our prescription would not meet our performance expectations.

Prescriptive Specifications

Contractors should insist the owner or agency perform enough of the right inspection and testing at production and placement to accept the work at that time.

Contractors should perform enough inspection and testing to ensure acceptable work is being performed.

Will the owner believe your passing tests when there's a problem ?
Will the Judge

Performance Specifications

Does the contractor need to inspect and test ?

Does the owner need to inspect and test ?

Types of deterioration generally appearing in concrete:

- – Scaling
- – Spalling
- – Cracking
- – Abrasion damage
- – Mortar flaking
- – Alkali aggregate reactivity
- – Delamination
- – Freeze thaw
- – Sulphate attack

None of these defects are a real or immediate problem - ?

Scaling

Local flaking or peeling away of the near surface portion of hardened concrete

- **Common Causes:**

- Poor air entrainment
- Improper finishing
- Inadequate curing
- Inadequate protection from deicing salts

None of this is a problem except for shopping carts trying to maneuver and perception of poor quality

Perception

Buy a Toyota because it's perfect.

Then one day it's no longer perfect.

Spalling

- Occurs when a segment of the concrete surface becomes missing.
 - Two common causes of spalling are:
 - corrosion of the reinforcement
 - improperly constructed or maintained joints

This is not a problem unless you are under or on the bridge when it happens or you trip in a pothole.

Cracking

- Plastic Shrinkage Cracks reduce concrete life

- Settlement/Subsidence Cracks

Make sure you are constructing the concrete surface on a competent base.

- Temperature Induced Cracks

Jointing and load transfer

A faulted joint is equal to a crack

- Other Cracks

Poor design and placement

Cracks are not a problem unless you trip over it.

Life Cycle Cost

Annualized cost of the surfacing material including maintenance and repairs along with construction.

Poor construction increases life cycle cost