

QUALITY

What It Is and How to Get It

Quality in General

- What is it?
- Who's Quality?
- How do we get it?

Quality of the Work Earthwork and Base Courses

- Define Quality
 - Compliance with Specifications
 - Materials
 - Workmanship
- Why Earthwork and Base?
 - Pavement Life Rides on It
 - Opportunities for improvements
 - Data Available

How Do You Know When You Get Quality?

- Documented Compliance
 - Test Reports
 - Field Book Records
- Can't Say, But I'll Know it When I See it
 - Workmanship
 - Detail Compliance

Workmanship

“I believe quality is the result of good contractors/craftsmen who care about their work. Good Inspectors definitely contribute to quality, but I think it starts with the people who are providing the materials and performing the work.”

Is Quality Cheap?

- Could Make the Argument that it is
- Quality Control (Testing) Costs
- Quality Assurance Costs

Former DOTD Process, QC and QA

- Close Relation Between Acceptance Testing And QC Testing
- DOTD Performed All Testing
- Contractor Used Information For Process Control, Such As:
 - Determine If Rolling Pattern For Compaction Required Changes
 - Determine If New Equipment Was Needed
- DOTD Assumed Responsibility For Contractor's Work
- Manpower Required

Current DOTD Process

- Requires Contractors To Perform All QC Tests
- DOTD Continues To Run Same Number of Tests For Acceptance Purposes
- Effectively Doubles Testing Frequencies

More Testing, More Quality, Right

- Yes, If You Have the Resources
- If You're Short On Resources, Testing Becomes More Important Than Inspection
- You've Paid For The Test – Use Them

Contractor QC Test For Acceptance FHWA 23 CFR 637B (6):

- *Quality Control Sampling And Testing Results May Be Used As Part Of The Acceptance Decision Provided That:*
 - *The Sampling And Testing Has Been Performed By Qualified Laboratories And Qualified Sampling And Testing Personnel*
 - *The Quality Of The Material Has Been Validated By The Verification Testing And Sampling. The Verification Shall Be Performed On Samples That Are Taken Independently Of The Quality Control Samples*

Qualified Personnel

- Certified Inspectors Required
- DOTD Specifications Require Contractor to Use Qualified/Certified Technicians
- DOTD Training Requirements

A New QA/QC System

- System Which Uses The Contractor's Testing In The Acceptance Decision
- Opportunity for Reduction In The Overall Testing Requirements
- Key Is To Have Confidence In The Contractor's Test Results

Accomplishing Confidence In Contractor QC

- Inspect Contractor Work (The Testing)
- Verification Testing To Compare Results



Statistical Verification

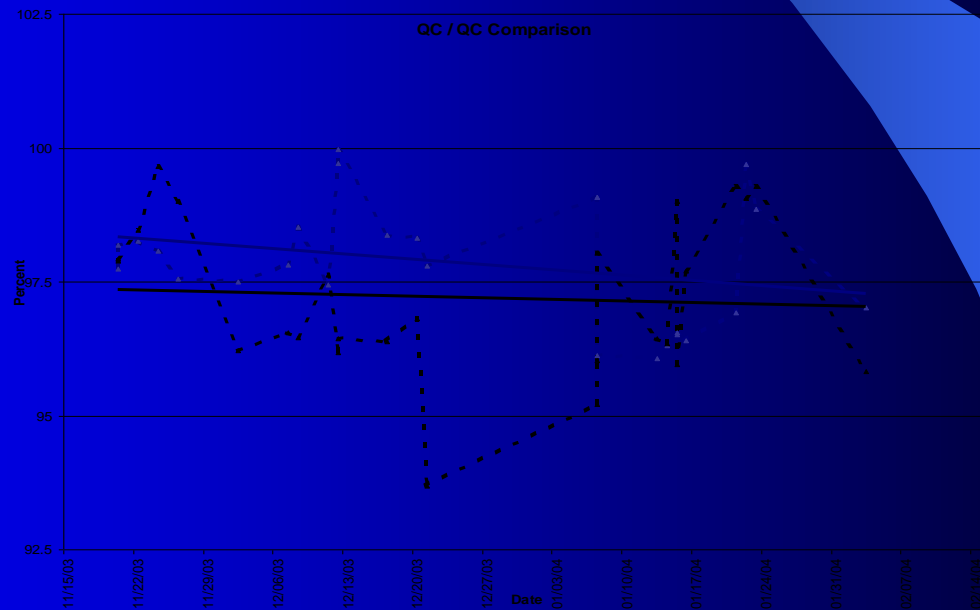
- F-test

- Determines The Probability That The Variances In One Group Of Tests Is Not Significantly Different Than The Variances In Another Group Of Tests.

$$f' = \frac{\left(\frac{s_c^2}{n_c} + \frac{s_a^2}{n_a} \right)^2}{\left[\frac{\left(\frac{s_c^2}{n_c} \right)^2}{n_c + 1} + \frac{\left(\frac{s_a^2}{n_a} \right)^2}{n_a + 1} \right]} - 2 \quad t = \frac{\bar{X} - \bar{Y}}{\sqrt{\frac{s_x^2(n_x - 1) + s_y^2(n_y - 1)}{n_x + n_y - 2} \times \sqrt{\frac{1}{n_x} + \frac{1}{n_y}}}}$$

- T-test

- Determines If Two Samples Are Likely To Have Come From The Same Underlying Populations



Earthwork Compaction

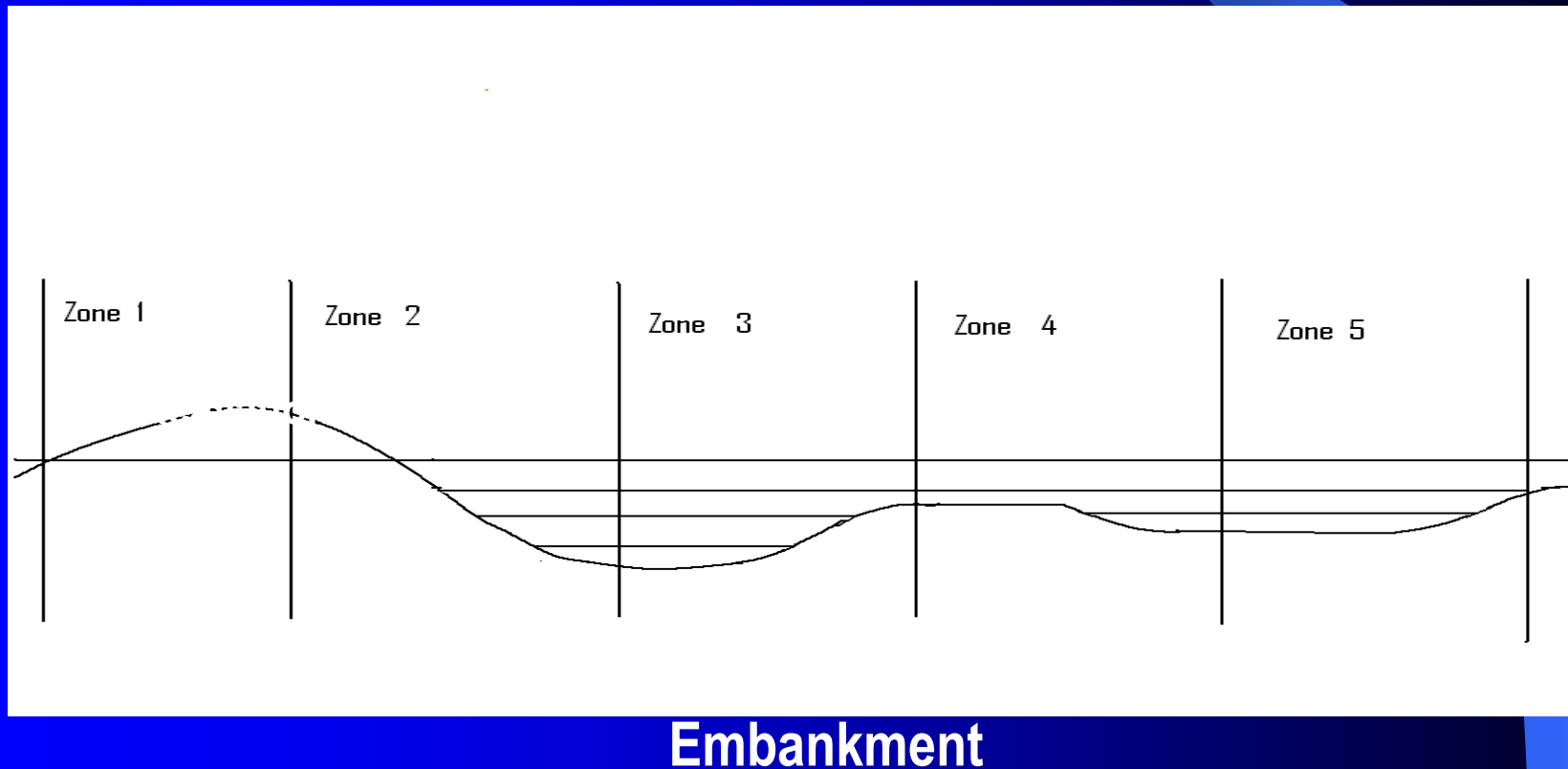
Testing Locations, QA & QC

- 1000 ft Zones
- Testing Frequency = 1 test/Lift/Zone



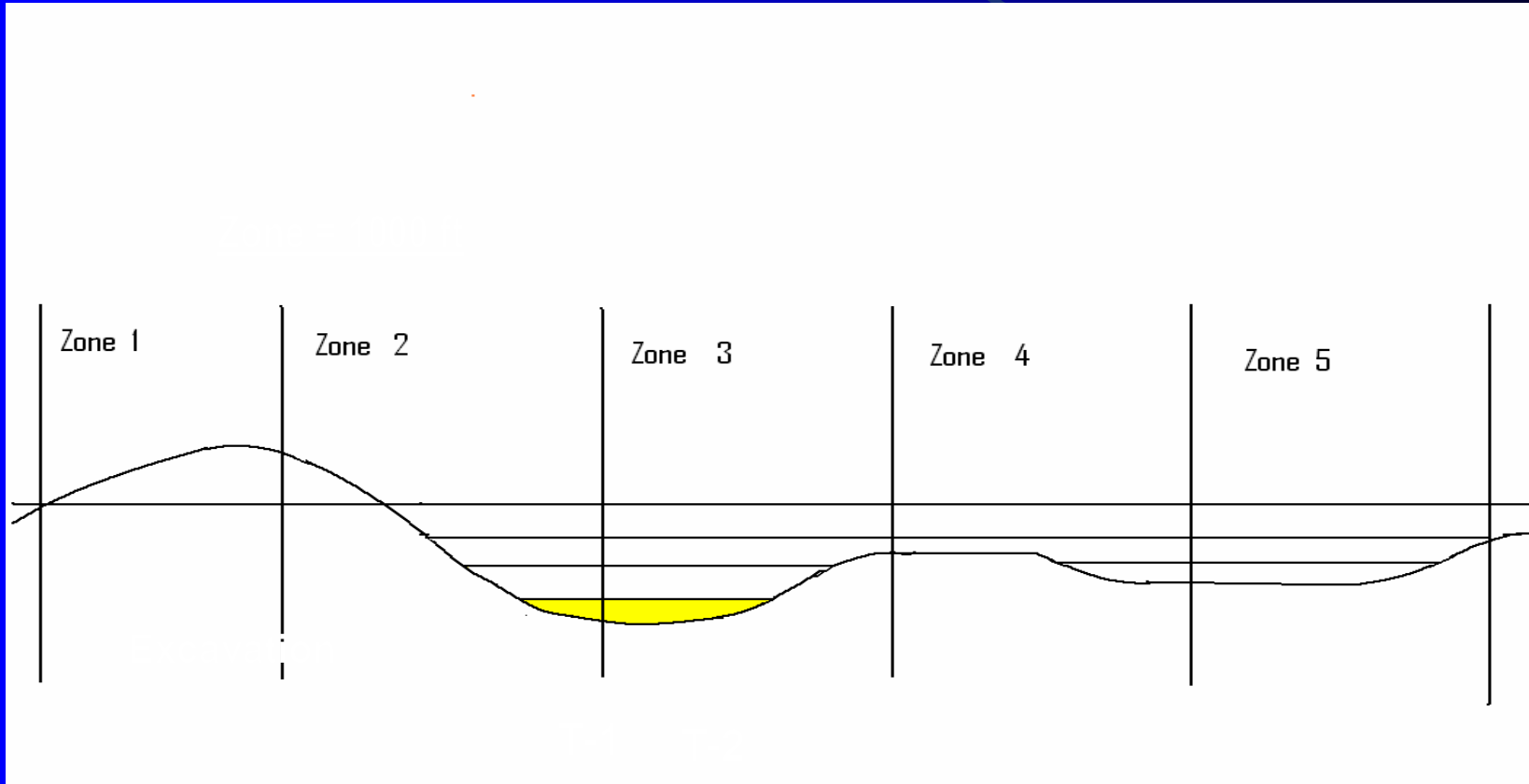
QA Tests In Multiple Lift Areas

- Not Just Reduced QA
- Contractor QC Must Be Considered As Acceptance



QA Tests In Multiple Lift Areas

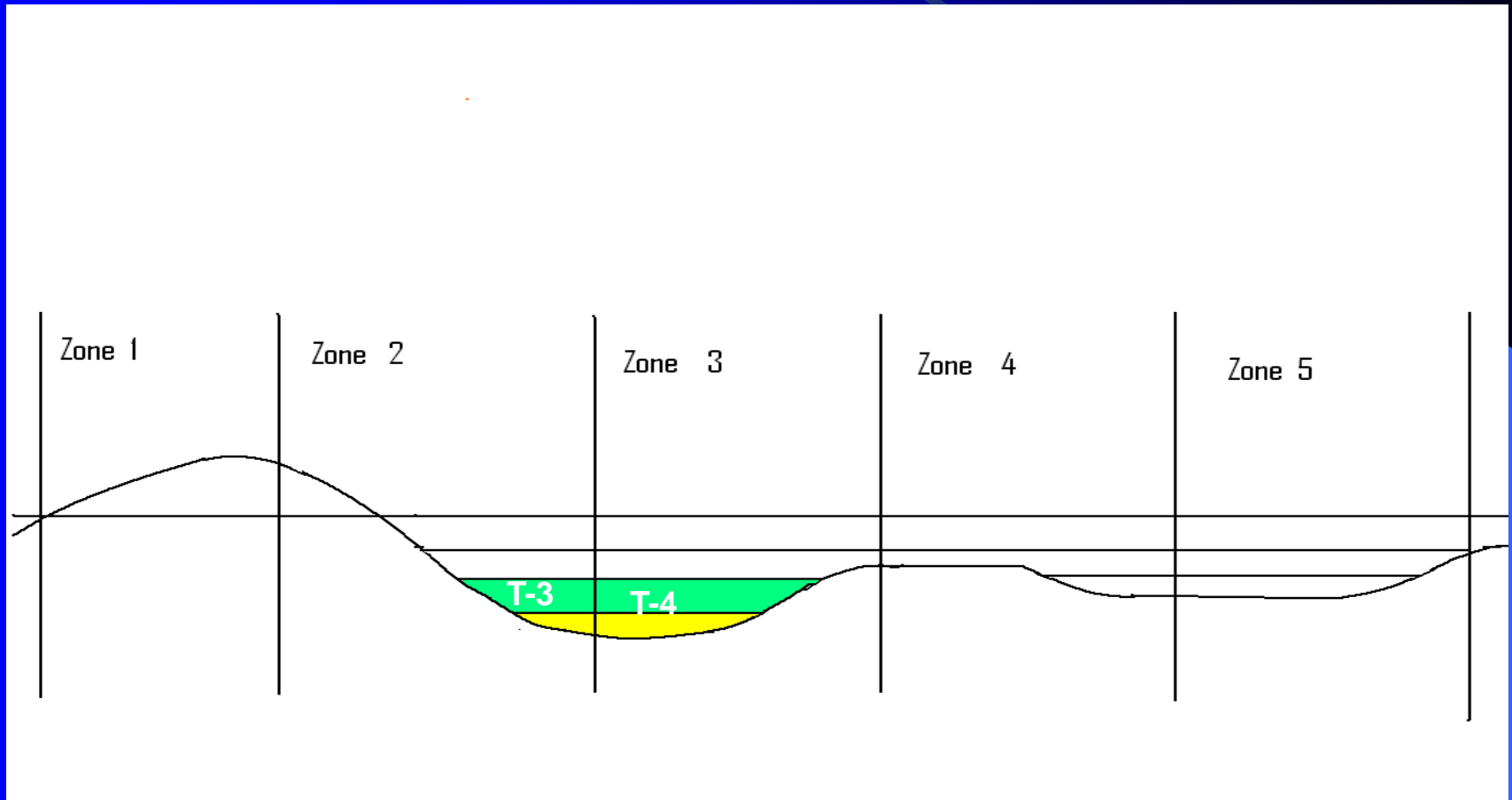
- Test 1 & 2



Embankment

QA Tests In Multiple Lift Areas

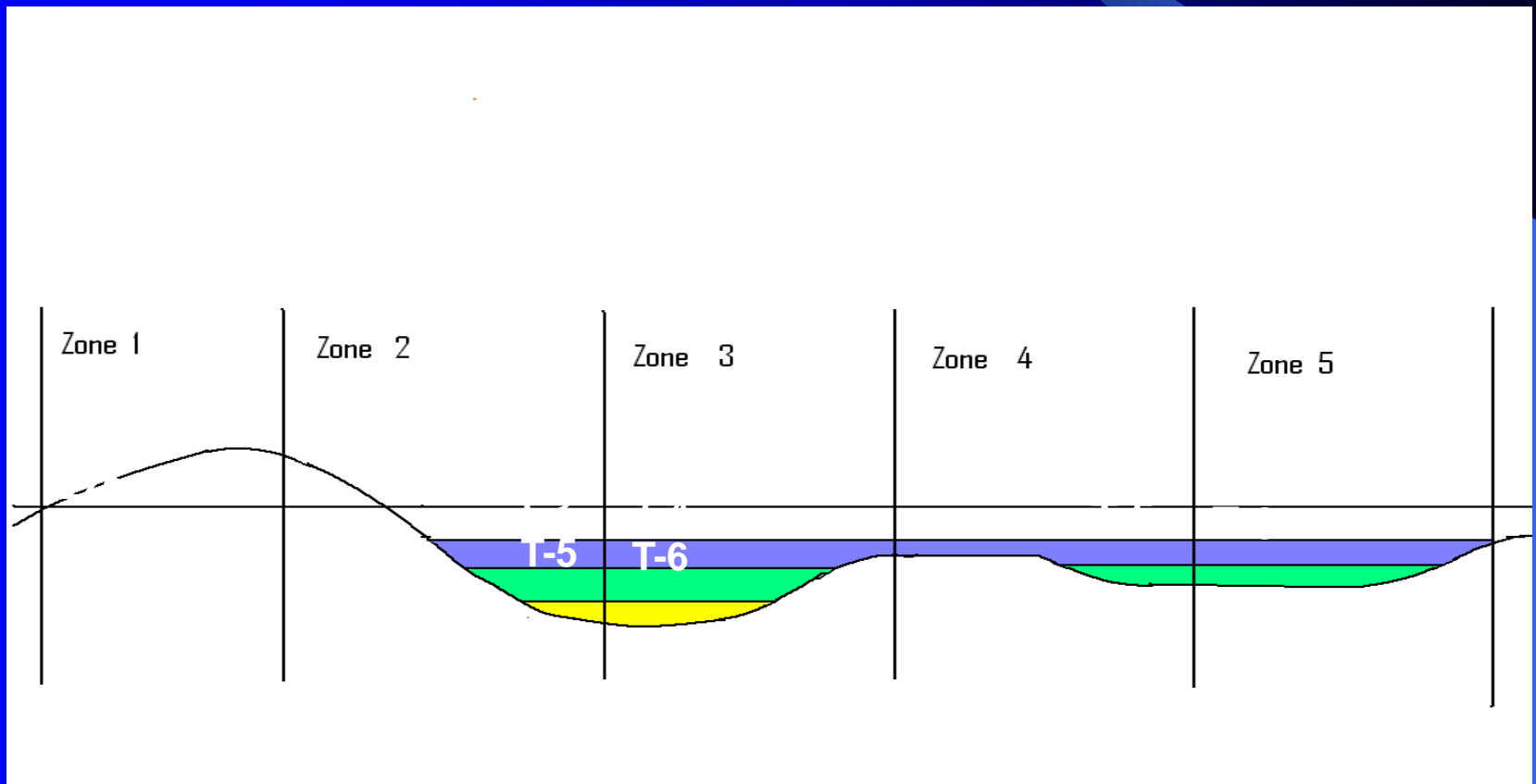
- Test 3 & 4



Embankment

QA Tests In Multiple Lift Areas

- Test 5 & 6



Summary of Statistical Verification

- Can it Work - Yes
- Does it Accomplish the Goal of more Documentation – Yes
- Does it Accomplish the Goal of better inspection – No
- Is this the way to Go???

What Now

- Make it Simple
- There Are More Important Things To Do Than Spending Office Time Filling Out Spreadsheets
- Others Have Done It – We Can Too

Other Efficiencies

- Limited TR602 by the Lab
 - Require contractor to core
 - Observed by Inspector
- Aggregate Gradations, Base Course
- % Cement for Soil Cement

Other Challenges in Earthwork

- Materials
- First Lift – Basing In
- Cut Section Preparation
- Uniformity

LTRC Seminar - Building Quality Pavements



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Wrap Up

- Quality is What It's Defined to Be
- People Are the Key to Quality
- The Quality System Needs To Make Best Use of Allocated Resources
- We Need to Continually Look for New Ideas to Obtain Quality