ASPHALT BINDER

Section 11 – Correlation of Testing Technicians For Core Densities WYDOT MTM 423.0

Correlation of Testing Technicians for Core Density

The actual calculations of the correlation will not be on the exam but you would need to have an appreciation to the process. In addition, you would need to be able to answer general questions about the process.

Correlation of Testing Technicians for Core Densities

- **General**
  - **Compares the hot plant mix pavement densities determined by WYDOT field laboratory and Contractor's laboratory.**
  - **The paired t-test is used**
  - **If difference is significance, then the dispute resolution procedure will start**

Correlations of Testing Technicians for Core Densities (continued)

- **Procedure**
  - **Obtain 14 cores**
    - **Cores are collected in pairs**
    - **Pairs are taken within 2 ft of each other**
    - **Each pair is split up**
    - **7 cores for WYDOT and 7 cores for contractor**
  - **Test samples**
    - **WYDOT MTM 423.0**
      - **Report densities to the nearest 0.1 pcf**

Procedure (continued)

- Determine densities to the nearest 0.1 pcf
- Perform the paired t-test
- Calculate the difference between densities
- Determine the S.D. of the differences
- Eliminate up to one outlier based on 2 S.D. (use calculated S.D.)
- S Range= 0.5 to 2.0 pcf

$$T = \frac{|\bar{z}|}{\sqrt{\frac{S^2}{n}}}$$

- If T< 3.707; No significant difference; for n=7
- If T> 4.032; Significant difference
- For n=6

Directional Bisa

- **"Directional bias" is considered to exist when all, or all but one of the tests are higher for one laboratory than the other and the average difference exceeds 0.5 lb/ft3**

Resolving Directional Bias

Perform additional correlation tests if the correlation procedure shows that directional bias is present. Continue performing correlation testing until the directional bias no longer exists in accordance with Subsection 114.3.4, Resolving Field Test Discrepancies. The department's test results will be used for pay factor analysis while correlation testing is being done. Perform new correlation tests if new equipment or personnel (department or contractor) are introduced during testing.

114.3.4 Resolving Field Testing Discrepancies

1. Meet with department personnel and review testing procedures, equipment condition, and equipment calibrations in attempt to solve the problem.
2. When cause of the discrepancy has been identified and corrected, repeat the correlation procedure.
3. If the second correlation determines that the contractor's and department's test results represent different sample populations, conduct referee testing.

114.3.4 Resolving Field Testing Discrepancies

4. The Materials Program will conduct the referee tests using the retained referee samples for aggregate gradations and the department's cores for density testing.
5. The Materials Program will make its results available within five working days of receiving the samples.
6. If the samples represent a quality acceptance lot, the engineer will use test results correlating with the Materials Program test results for the quality acceptance calculations.

Correlation of Core Densities

Project No(s): _____

Tester A: _____ Organization A: _____

Tester B: _____ Organization B: _____

Resident Engineer: _____ Contractor: _____

Testing Date: _____

Sample Pair ID	Densities, pcf		Differences, pcf	Outlier?	Differences, pcf
	A	- B	=		
1	153.00	151.20	**1.80**	**NO**	
2	151.60	153.40	**- 1.80**	**NO**	
3	148.30	150.30	**- 2.00**	**NO**	
4	151.40	152.90	**- 1.50**	**NO**	
5	151.60	150.90	**0.70**	**NO**	
6	149.60	150.70	**- 1.10**	**NO**	
7	155.00	155.50	**- 0.50**	**NO**	

Average Difference: **- 0.629** pcf Avg Diff: _____ pcf

Standard Deviation of Difference: **1.409** pcf SD of Diff: _____ pcf

Maximum Standard Deviation: **2.00** pcf Max. SD: _____ pcf

Minimum Standard of Deviation: **0.50** pcf Min. SD: _____ pcf

Avg. Diff + 2*SD: **-0.629 + 2*1.409 = 2.190** t_{crit}: **3.707** t_{crit}: _____

Avg. Diff. – 2*SD: **-0.629 – 2*1.409 = -3.447** t: **1.18** **1.18 ≤ 3.707** t: _____

Any Diff. more (+) than + 2.190 ? Pass/Fail: **Pass** Pass / Fail: _____

Any Diff. more (-) than – 3.447 ? Directional Bias: **No** Directional Bias: _____

Comments:

$$T = \frac{|\bar{Z}|}{\sqrt{s^2/7}} = \frac{0.629}{\sqrt{1.409^2/7}} = 1.18$$

CORRELATION OF CORE DENSITIES

Tester A: _____ Organization of A: _____ Project No(s): _____

Tester B: _____ Organization of B: _____ QC Supervisor: _____

Testing Date: _____ Contractor: _____ Resident Engineer: _____

Sample Pair ID	Densities, pcf A	B	Differences pcf	Outlier?	Differences (outlier Removed)
A	144.2	143.9			
B	143.8	144.3			
C	142.3	142.7			
D	143.7	143.5			
E	144.2	144.5			
F	143.9	143.6			
G	145.1	144.8			

Average Difference: _____pcf Avg. Dif. _____pcf

Standard Deviation of Differences: _____pcf SD of Dif. _____pcf

Maximum Standard Deviation: _____pcf Max. SD _____pcf

Minimum Standard Deviation: _____pcf Min. SD _____pcf

Avg Dif. + 2(SD) _____ t_{crit}: _____ t_{crit}: _____

Avg Dif. - 2(SD) _____ t: _____ t: _____

Pass / Fail: _____ Pass / Fail: _____

Directional Bias: _____ Directional Bias: _____

Cost Analysis

- **Three Questions**
  - **Mix cost per ton - $/ton**
  - **Mix cost per cubic yard - $/yd^3**
  - **Mix cost per square yard - $/yd^2**

Cost Analysis Example

Material	% of Total Mix	Cost($)/Ton	Solution to Mix Cost per Ton ($/ton)
Aggregate #1	25	4.00	25% *x* 4.00 *or* 0.25 *x* 4.00 = 1.00
Aggregate #2	35	6.00	35% x 6.00 or 0.35 x 6.00 = 2.10
Aggregate #3	35	2.00	35% x 2.00 or 0.35 x 2.00 = 0.70
Asphalt	5	150.00	5% x 150 o 0.05 x 150 = 7.50

$11.30/ton

Density = 156 lb/ft^3 Thickness 4 in.

$$\frac{\$}{yd^3} = \frac{\$11.30}{ton} \; x \frac{156\ lb}{ft^3} x \frac{1\ ton}{2000\ lb} x \frac{27\ ft3}{yd^3} = \$23.80/yd^3$$

$$\frac{\$}{yd^2} = \frac{\$23.80}{yd^3} \; x\ 4\ in\ x \frac{1\ yd}{36\ in} = \$2.64/yd^2$$

Homework

Work the following problems tonight:

15-4 Cost Analysis

15-5 Cost Analysis

Change all pcf to

S Range 8 to 32 kg/ **kg/m^3** *tric problem*

Section 16 - Problems from material covered earlier today including tank problem and 16-5