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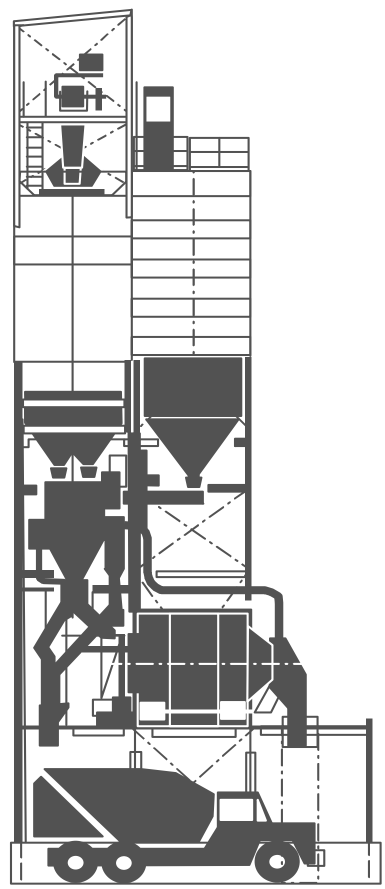
Department of Transportation

2



Concrete Plant Quality Control Technician Course

Tennessee Department of Transportation

Volume 3.2

Concrete Plant Quality Control Technician Course

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Concrete Plant Quality Control Technician Course

Tennessee Department of Transportation

Volume 3.2

<u>Class Schedule</u>

1. Registration
2. Introduction
3. Construction and Maintenance of Aggregate Stockpiles
4. Sampling of Aggregates (T-2)
5. Reducing Samples of Aggregate to Testing Size (T-248)
6. Total Evaporable Moisture Content of Aggregate by Drying (T-255)
7. Break
8. Moisture Correction for Aggregates
9. Materials Finer than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing (T-11)
10. Sieve Analysis of Fine and Coarse Aggregates (T-27)
11. Lunch
12. Quality Assurance/ Quality Control
13. Written Exam

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Volume 3.2

Table of Contents

1

Sampling of Aggregates

AASHTO T 2

ASTM D 75

TDOT Standard Method of Test for

Sampling of Aggregates

References

TDOT Standard Specifications
AASHTO T 2
ASTM D 75

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Apparatus

- Shovel
- Scoops
- Brushes
- Sampling tubes
- Sample containers
- Tags

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Purpose

- Preliminary investigation of the potential source of supply
  - Sample at source
  - Complete quality testing (dependent upon application)
- Control of the product at the source
- Control of the operations at the site of use
  - Project site
  - Concrete plant
- Acceptance or rejection of the materials
  - TDOT Standard Specifications

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Size of Aggregate

- <u>Nominal maximum size</u> of aggregate is the first sieve upon which any material is retained
- <u>Maximum size</u> of aggregate is the sieve size above the nominal maximum size

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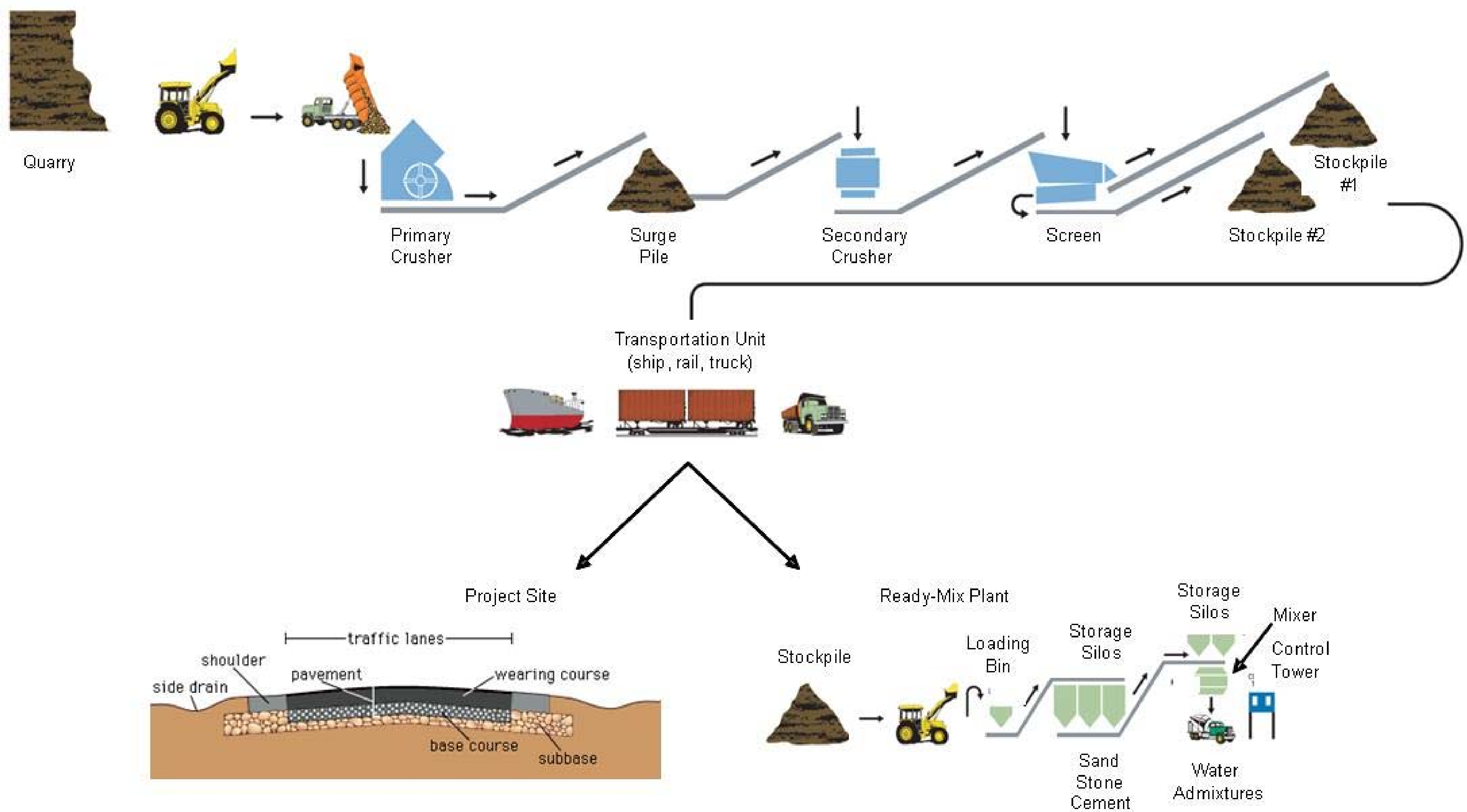
Field Sample Size

D75/D75M – 13

TABLE 1 Minimum Size of Field Samples

Aggregate Size[A]	Field Sample Mass, min, kg[B] [lb]	Field Sample Volume, min, L [gal]
Fine Aggregate		
2.36 mm [No. 8]	10 [22]	8 [2]
4.75 mm [No. 4]	10 [22]	8 [2]
Coarse Aggregate		
9.5 mm [3/8 in.]	10 [22]	8 [2]
12.5 mm [½ in.]	15 [35]	12 [3]
19.0 mm [¾ in.]	25 [55]	20 [5]
25.0 mm [1 in.]	50 [110]	40 [10]
37.5 mm [1½ in.]	75 [165]	60 [15]
50 mm [2 in.]	100 [220]	80 [21]
63 mm [2½ in.]	125 [275]	100 [26]
75 mm [3 in.]	150 [330]	120 [32]
90 mm [3½ in.]	175 [385]	140 [37]

Aggregate Production and Use



Methods of Sampling

- Flowing aggregate stream
- Conveyor belt
- Stockpiles
  - with power equipment
  - without power equipment
- Roadways
- Transportation units

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Flowing Aggregate Stream

- From bins, for example
- Three increments
- Each increment obtained using a suitable sampling device
- Device must be capable of interrupting the entire flow of material as it passes off the belt

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Conveyor Belts

- Three increments
- Production suspended while sampling
- Designated sampling area
- Templates useful for defining sampling area
- All material within sampling area is removed including fines (with a brush)

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Stockpiles

- Stockpile must be checked for <u>segregation</u> and noted in log
- Segregation is the separation of varying sizes of aggregate
- Power equipment is recommended
- Portions collected at various locations around the main stockpile

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With Power Equipment

- Loader bucket digs straight into pile level to ground
- Loader bucket is raised (perpendicular to the ground) through the entire height of the pile

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With Power Equipment

- Portion is dropped onto a clear spot away from the main pile
- The loader is then used to blend and backblade the smaller stockpile

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With Power Equipment

- The new stockpile can now be sampled at even intervals
- Material is obtained from each location with a shovel by digging into the pile
- The three increments are then combined to comprise the final field sample

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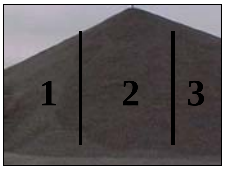
Without Power Equipment

If power equipment is not available:

- The stockpile is checked for segregation (and noted in log)
- The pile is visually divided into three even sections
- Portions are obtained from each section at least 12" below the surface by removing the outer layer of material
- The three increments are then combined to comprise the final field sample



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Without Power Equipment

In lieu of shoveling:

- **The stockpile is checked for segregation (and noted in log)**
- **Sampling tubes may be used**
- **Sampling tubes may <u>not be</u> used on stockpiles containing coarse aggregate**
- **A minimum of <u>five increments</u> must be collected**
- **The five increments are then combined to comprise the final field sample**

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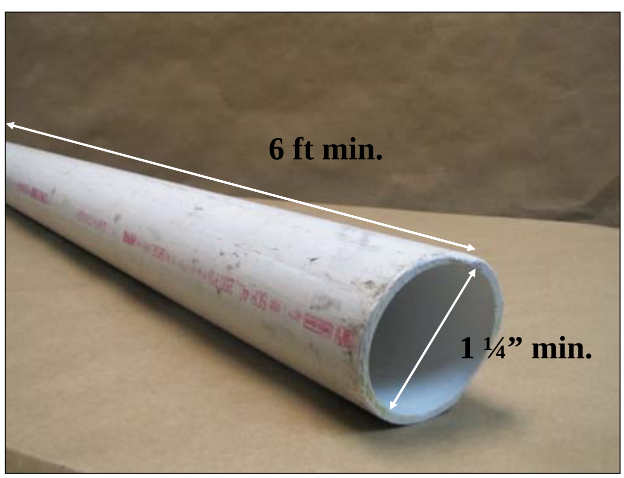
Without Power Equipment

(Sampling Tube)



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Roadways

- Three increments
- Sample obtained from uncompacted or loosely-compacted base or sub base material
- Predetermined random locations
- Full depth of layer must be sampled
- Avoid contamination from underlying material

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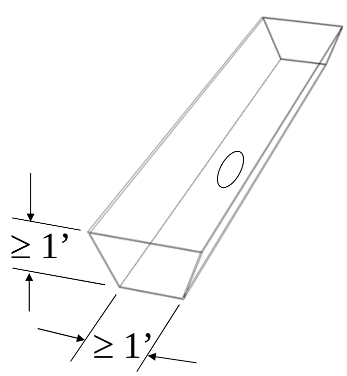
Transportation Units

- Railroad cars, barges, trucks
- Power equipment is recommended
- Various levels and random locations
- Three or more trenches



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Sample Containers

- Durable
- Strong
- Able to be carried

  [≤ 50 lbs. (23 kg)]
- Portion the sample, if necessary
- Appropriate container for test to be performed

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Tagging the Sample

Project Number: *55001-3231-18*

Date Sampled: *11 Mar 02* Submitted: *12 Mar 02*

Sampled by: *F. Flintstone*

Submitted by: *F. Flintstone*

Producer: *Stone Materials, Inc.*

Pit Number: *185* Sampled from: *Stockpile*

County: *Davidson* Region: *3*

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Questions

2

Reducing Samples of Aggregate to Testing Size

AASHTO T 248

ASTM C 702

TDOT Standard Method of Test for

Reducing Samples of Aggregate to Testing Size

References

TDOT Standard Specifications
AASHTO T 248
ASTM C 702

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Methods of Reduction

- Method A - Mechanical Splitter
- Method B - Cone and Quarter
- Method C - Miniature Stockpile

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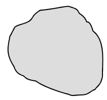
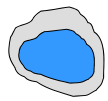
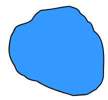
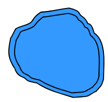
To Determine Method

- **Moisture condition of the aggregate**
  - **Dry** 
  - **Moist** 
  - **SSD/Absorption** 
  - **Wet/Free Moisture** 

To Determine Method

- **Size of aggregate**
  - **Coarse**

  - **Fine**

  - **Combined**

Determine Method

Moisture \ Aggregate Size	Coarse	Combined	Fine
Drier than saturated-surface-dry	A, B	A, B	A
Free moisture on surface	A, B	A, B	B, C

Splitting Method

- Method A - Mechanical Splitter
- Method B - Cone and Quarter
- Method C - Miniature Stockpile

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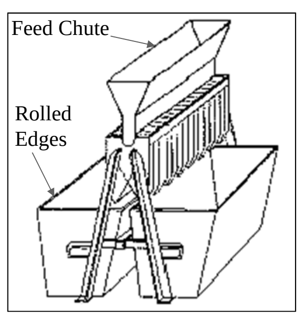
Mechanical Splitter / Method A

For Coarse and Mixed Aggregate

- Even number of chutes
- Chutes of equal width
- At least 8 chutes
- Individual chutes about 50% larger than largest particles



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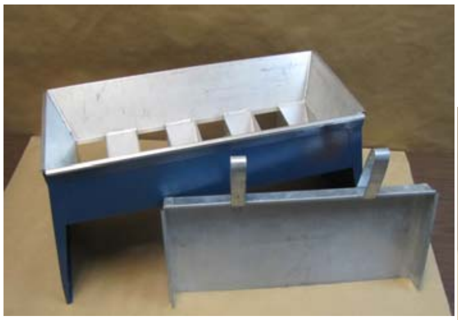
Mechanical Splitter / Method A



COARSE or COMBINED AGGREGATE

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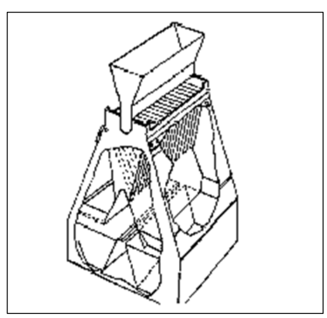
Mechanical Splitter / Method A

For Fine Aggregate

- **Even number of chutes**
- **Chutes of equal width**
- **At least 12 chutes**
- **Individual chutes about 50% larger than largest particles (3/4" max.)**



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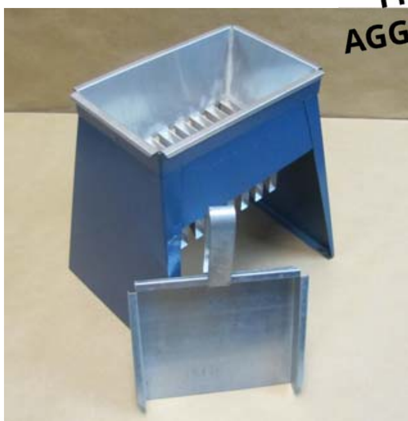
Mechanical Splitter / Method A

FINE AGGREGATE



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Cone and Quarter / Method B

Cone the sample on a hard, clean, level surface.

Mix. Form a new cone.

Flatten the cone to a uniform thickness.

Diameter = 4 x thickness to 8 x thickness

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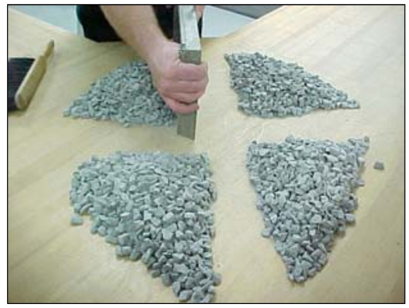
Cone and Quarter / Method B

Divide the flattened cone.



After dividing, remove two diagonal quarters (including fines).

Mix and quarter the remaining material until sample is adequately reduced.

Cone and Quarter / Method B

Turn material over 3 times and place into a cone

Flatten to uniform thickness D=4t to 8t

Cone and Quarter / Method B

Use scoop to separate into four quarters

Collect diagonal quadrants as the sample

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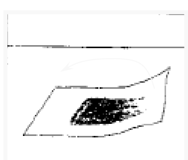
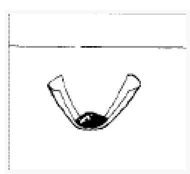
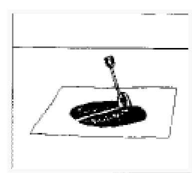
Quartering Alternative / Method B



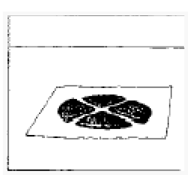
Mix with a shovel or with the canvas blanket



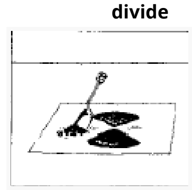
Form the material into a cone



After flattening the cone, use a shovel to divide



Quarter the material



Remove diagonal quarters (including fines)

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Quartering Alternative/Method B

Mix on canvas cloth by rolling aggregate on cloth.

Flatten aggregate pile to constant thickness with shovel.

Quartering Alternative/Method B

Using a stick, divide the aggregate into four separate quarters

Quartering Alternative/Method B

Collect fines using brush to include with the sample.

Remove diagonal quarters to use including the fines.

Miniature Stockpile / Method C

- Place sample on hard, clean, level surface
- Mix thoroughly by turning over three times
- Form a cone with the last turning
- Flatten, if desired, to a uniform thickness
- Select at least five increments at random locations using a shovel, scoop, or spoon

Miniature Stockpile / Method C

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3

Total Evaporable Moisture Content of Aggregate by Drying

AASHTO T 255

ASTM C 566

TDOT Standard Method of Test for

Total Evaporable Moisture Content of Aggregate by Drying

References

TDOT Standard Specifications
AASHTO T 255
ASTM C566

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Apparatus

- Balance
- Heat Source
- Sample Container
- Stirring Spoon

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Sample Size

TABLE 1 Sample Size for Aggregate

Nominal Maximum Size of Aggregate, mm (in.)[A]	Mass of Normal Weight Aggregate Sample, min, kg[B]
4.75 (0.187) (No. 4)	0.5
9.5 (3/8)	1.5
12.5 (1/2)	2
19.0 (3/4)	3
25.0 (1)	4
37.5 (1 1/2)	6
50 (2)	8
63 (2 1/2)	10
75 (3)	13
90 (3 1/2)	16
100 (4)	25
150 (6)	50

[A] Based on sieves meeting Specification E11.

[B] Determine the minimum sample mass for lightweight aggregate by multiplying the value listed by the dry-loose unit mass of the aggregate in kg/m^3 (determined using Test Method C29/C29M) and dividing by 1600.

Samples

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Determine Sample Mass

- **Weigh the sample to the nearest 0.1 of a unit of the original sample mass**

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Dry the Sample

- Dry the aggregate to a constant mass in an oven at 110 ± 5°C (230 ± 9°F)
- Allow the material to cool

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Reweigh the Sample

- Weigh the sample to the nearest 0.1 of a unit of the original sample mass

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Calculations

$$P_{Moisture,Total} = \frac{M_{Original} - M_{Dry}}{M_{Dry}} \times 100$$

$$P = \frac{W - D}{D} \times 100$$

$$P = \frac{6285.6 - 6163.8}{6163.8} \times 100 = 1.98\% \approx \underline{2.0\%}$$

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Problem

Given:

- **Weight of the original sample (W) = 1092.4 g**
- **Weight of sample after drying (D) = 1080.5 g**

Determine:

Total percent (P) moisture content of the aggregate.

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Solution

$$P = \frac{W - D}{D} \times 100$$

$$P = \frac{1092.4 - 1080.5}{1080.5} \times 100 = 1.101 \approx \underline{1.1\%}$$

Practice

Sample Number	Original Weight	Dry Weight	Moisture Content
1	588.3	570.9	
2	1556.8	1540.9	
3	1225	1220.1	
4	1665.2	1650.5	

Solutions

Sample Number	Original Weight	Dry Weight	Moisture Content
1	588.3	570.9	3.04782
2	1556.8	1540.9	1.03186
3	1225	1220.1	0.40161
4	1665.2	1650.5	0.89064

$$p_1 = \frac{588.3 - 570.9}{570.9} \times 100 = 3.048 \sim 3.0\%$$

$$p_2 = \frac{1556.8 - 1540.9}{1540.9} \times 100 = 1.032 \sim 1.0\%$$

$$p_3 = \frac{1225.0 - 1220.1}{1220.1} \times 100 = 0.402 \sim 0.4\%$$

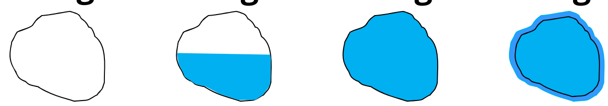
$$p_4 = \frac{1665.2 - 1650.5}{1650.5} \times 100 = 0.891 \sim 0.9\%$$

Determine the percent moisture content in the wet condition:

Determine the percent moisture of the aggregate at SSD (Absorption):

DRY | **MOIST** | **SSD** | **WET**

900g | **930g** | **955g** | **975g**



Determine the percent of free moisture on the sample:

Determine the amount of water the aggregate has in the wet condition:

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4

Aggregate Moisture Corrections

For Concrete Batching

Aggregate Moisture Corrections for Concrete Batching

References

TDOT Standard Specifications

TN TDOT Department of Transportation

Purpose

- Control the amount of mixing water that actually ends up in mix.
- Biggest source of water to be accounted for:
  - Coarse Aggregate
  - Fine Aggregate
- Aggregates contain both absorbed and free water.
- Reference: TDOT Standard Specification 501.03

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Aggregate Moisture Content

- Dry Weight
  - Weight of sample no longer changes after being heated
- Absorbed Water
  - Not included in the mixing water
  - Determine Percent Absorption of Aggregate
- SSD Condition (Saturated Surface Dry)
  - Pores and Cavities are filled with absorbed water , but the surface is dry
- Wet Condition
  - Contains both free and absorbed water
  - Free water must be included in the design as mixing water

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Aggregate Moisture Content Formulas

1. **Determine Percent Free Moisture in Aggregates:**

   % Free Moisture = % Moisture – Absorption

2. **Determine SSD Batch Weights**

3. **Calculate Aggregate Moisture Corrections:**

   Moisture Correction = SSD Weight x % Free Moisture

4. **Amount of Water to Subtract from Mixing Water based off moisture corrections:**

   Mixing Water Correction = [CA Moisture Correction (lbs) + FA Moisture Correction (lbs)] / 8.34 lbs/gal

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Aggregate Moisture Content Formulas
(Continued)

5. **Determine Actual CA & FA Batch Weights:**

   Actual Aggregate Batch Weights = SSD Batch Weight + Moisture Correction

6. **Determine Actual Water to be Batched:**

   Actual Water Batched= Designed Water – Mixing Water Correction

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CONTRACTOR'S DAILY REPORT OF CONCRETE INSPECTION

Completed by Contractor's Concrete Plant Inspector

Date ______

Contract No. ______

Proj. Ref. No. ______ County (Leave blank) Region ______ Project ______

Contractor ______ Sub-Contractor ______

Ready Mix Co. ______ Location ______

Type of Plant Mixer ______ Date Scales Checked: ______

Transit Mixer Checked for Presence of Water Before Batching: ☐ Yes ☐ No

Plant and Trucks Checked (Form T-232): ☐ Yes ☐ No Date ______

Approved Process Control Plan: ☐ Yes ☐ No Date ______

Daily Stockpile Check Results: ☐ Satisfactory ☑ Unsatisfactory Aggr. Card No. C.A. ______

W.R.A. / Retarder oz. ______ A.E.A. oz. ______ F.A. ______

W.R.A. / Retarder oz. ______ A.E.A. oz. ______ Total C.Y. Batched ______

Batch Size	Water		Cement	Fly Ash	GGBFS	Coarse Aggregate		Fine Aggregate	
______ yd^3 (m^3)	gal (L)	lbs. (kg)	lbs. (kg)	lbs. (kg)	lbs. (kg)	lbs. (kg)		lbs. (kg)	
Agg. Size / Other Material									
Percent Free Moisture						0.5%		4%	
SSD Batch Wts.	30		479	106		1912		1138	
Moisture Corrections	6.6					9.56		45.52	
Actual Batch Wts.	23.4					1922		1184	

Remarks ______

SCREEN ANALYSIS TOTAL PERCENT PASSING SIEVE

Size No.	2"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200
Size No.	3/8"	#4	#8	#16	#30	#50	#100	#200	F.M.

Date Tested: C.A. ______ F.A. ______ Plant Technician ______ Cert. No. ______

Example

Batch Size m³ (yd³)	Water gal (L)	Water lbs. (kg)	Cement lbs. (kg)	Fly Ash lbs. (kg)	GGBFS lbs. (kg)	Coarse Aggregate lbs. (kg)		Fine Aggregate lbs. (kg)	
Agg. Size / Other Material									
Percent Free Moisture						1.1%		2.5%	
SSD Batch Wts.	25		425	140		1810		1229	
Moisture Corrections									
Actual Batch Wts.									

Determine the Moisture Corrections and Actual Batch Weights for the following example:

Example Results

Batch Size m^3 (yd^3)	Water gal (L)	Water lbs. (kg)	Cement lbs. (kg)	Fly Ash lbs. (kg)	GGBFS lbs. (kg)	Coarse Aggregate lbs. (kg)		Fine Aggregate lbs. (kg)	
Agg. Size / Other Material									
Percent Free Moisture						1.1%		2.5%	
SSD Batch Wts.	25		425	140		1810		1229	
Moisture Corrections	6.1					19.91		30.73	
Actual Batch Wts.	18.9					1830		1260	

Coarse Aggregate
1810 x 1.1% = 19.91 lbs.
1810+ 19.91 = 1830 lbs.

Fine Aggregate
1229 x 2.5% = 30.73 lbs.
1229+ 30.73 = 1260 lbs.

Water
(19.91+30.73) / 8.34 lbs = 6.1 gals
25 - 6.1 = 18.9 gals

5

Materials Finer Than 75-μm (No.200) Sieve

In Mineral Aggregates by Washing

AASHTO T 11

ASTM C 117

TDOT Standard Method of Test for

Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing

References

TDOT Standard Specifications
AASHTO T 11
ASTM C 117

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Apparatus

- Balance
- Sieves
- Container
- Oven
- Wetting Agent

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Sample Size

Nominal Maximum Size[A]	Minimum Mass, g
4.75 mm (No. 4) or smaller	300
Greater than 4.75 mm (No. 4) to 9.5 mm (3⁄8 in.)	1000
Greater than 9.5 mm (3⁄8 in.) to 19.0 mm (3⁄4 in.)	2500
Greater than 19.0 mm (3⁄4 in.)	5000

[A] Based on sieve sizes meeting Specification E11.

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Minus 200 Material

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Dry the Material

- Dry the aggregate to a constant mass in an oven at 110 ± 5°C (230 ± 9°F)
- Allow the material to cool

Determine the Sample Mass

- Weigh the sample to the nearest 0.1 of a unit of the original sample mass

Two Procedures

Procedure A - Washing with plain water

- **Dust of Fracture**

Procedure B - Washing using a wetting agent

- **Clay Particles**

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Procedure

- **Place the sample in the container**
- **Add water to cover the sample**
- **Add wetting agent if performing Procedure B**

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Procedure

- Agitate the sample
- Use a spoon to stir, if desired
- Ensure complete separation of particles

Procedure

- Pour the wash water with suspended solids over the nested sieves

Procedure

- Repeat the washing with plain water
- Repeat until wash water is clear
- Use wetting agent first wash only

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Dry the Material

- Dry the aggregate to a constant mass in an oven at 110 ± 5°C (230 ± 9°F)
- Allow the material to cool

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Determine the Sample Mass

- **Weigh the sample to the nearest 0.1 of a unit of the original sample mass**

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Calculations

$$P_{\leq 75\,\mu m} = \frac{M_{Dry,Before} - M_{Dry,After}}{M_{Dry,Before}} \times 100$$

$$A = \frac{B - C}{B} \times 100$$

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Results

- If the amount of material finer than 75-μm is <u>less than 10%</u> then report the results to the nearest 0.1.
- If the amount of material finer than 75- μm is <u>greater than 10%</u> then report the results to the whole number.

Problem

Given:

- Original mass of the sample = 595.6 g
- Mass of the sample after washing = 579.3 g

Determine:

- The percent (P) of material finer than the No. 200 sieve in the sample.

Solution

$$P_{\leq 75\,\mu m} = \frac{595.6 - 579.3}{595.6} \times 100 = 2.737 \approx \underline{2.7\%}$$

Practice

Given:

- **Original mass of the sample = 6895.5 g**
- **Mass of the sample after washing = 6045.0 g**

Determine:

- **The percent (P) of material finer than the No. 200 sieve in the sample**

Solution

$$P_{\le 75\,\mu m} = \frac{6895.5 - 6045.0}{6895.5} \times 100 = 12.33 \approx \underline{12\%}$$

6

Sieve Analysis of Fine and Coarse Aggregates

AASHTO T 27

ASTM C 136

TDOT Standard Method of Test for

Sieve Analysis of Fine and Coarse Aggregates

References

TDOT Standard Specifications
AASHTO T 27
ASTM C 136

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Apparatus

- Balance
- Oven
- Sieves
- Mechanical Shaker

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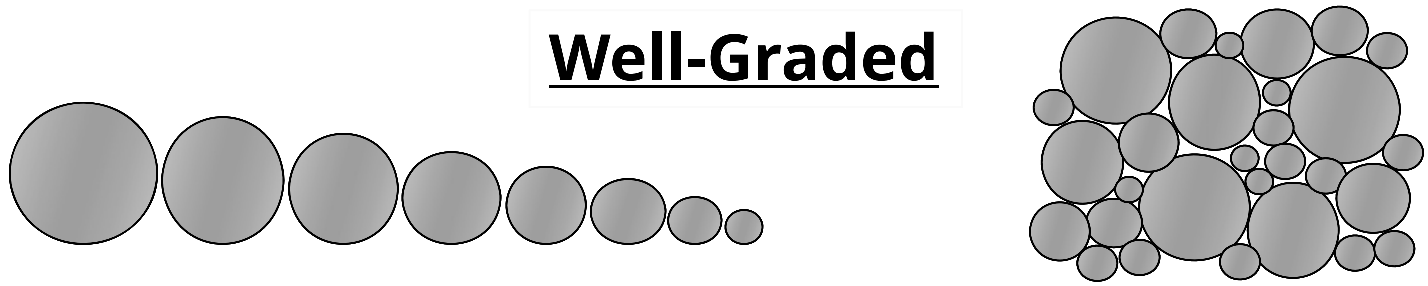
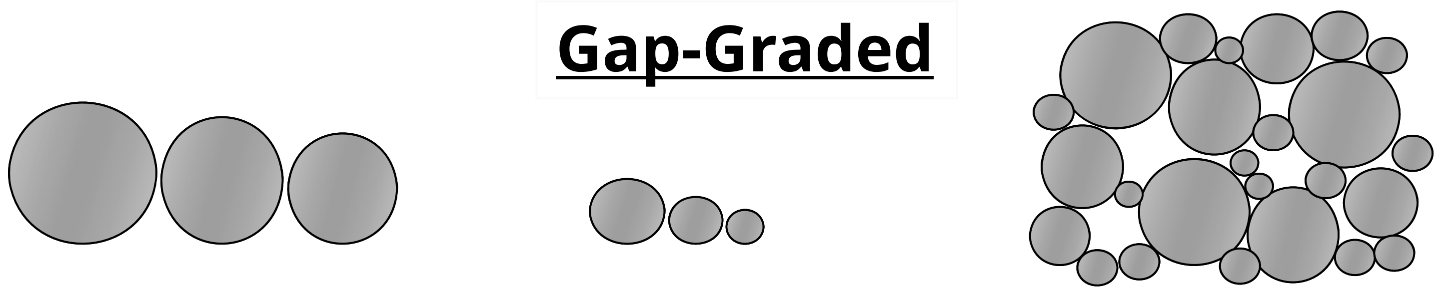
Aggregate Gradation

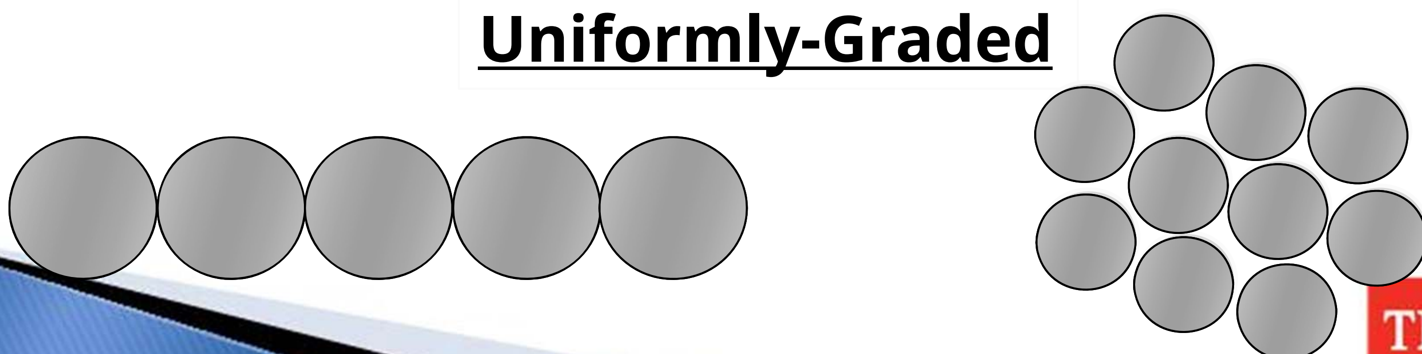
Well-Graded



Gap-Graded



Uniformly-Graded



Field Sample Size

D75/D75M – 13

TABLE 1 Minimum Size of Field Samples

Aggregate Size[A]	Field Sample Mass, min, kg[B] [lb]	Field Sample Volume, min, L [gal]
	Fine Aggregate	
2.36 mm [No. 8]	10 [22]	8 [2]
4.75 mm [No. 4]	10 [22]	8 [2]
	Coarse Aggregate	
9.5 mm [⅜ in.]	10 [22]	8 [2]
12.5 mm [½ in.]	15 [35]	12 [3]
19.0 mm [¾ in.]	25 [55]	20 [5]
25.0 mm [1 in.]	50 [110]	40 [10]
37.5 mm [1½ in.]	75 [165]	60 [15]
50 mm [2 in.]	100 [220]	80 [21]
63 mm [2½ in.]	125 [275]	100 [26]
75 mm [3 in.]	150 [330]	120 [32]
90 mm [3½ in.]	175 [385]	140 [37]

Test Sample Size

7.4 *Coarse Aggregate*—The size of the test sample of coarse aggregate shall conform with the following:

Nominal Maximum Size, Square Openings, mm (in.)	Test Sample Size, min, kg (lb)
9.5 (3⁄8)	1 (2)
12.5 (1⁄2)	2 (4)
19.0 (3⁄4)	5 (11)
25.0 (1)	10 (22)
37.5 (1 1⁄2)	15 (33)
50 (2)	20 (44)
63 (2 1⁄2)	35 (77)
75 (3)	60 (130)
90 (3 1⁄2)	100 (220)

Dry the Material

- **Dry the aggregate to a constant mass in an oven at 110 ± 5°C (230 ± 9°F)**
- **Allow the material to cool**

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Determine the Sample Mass

- **Weigh the sample to the nearest 0.1 of a unit of the original sample mass**

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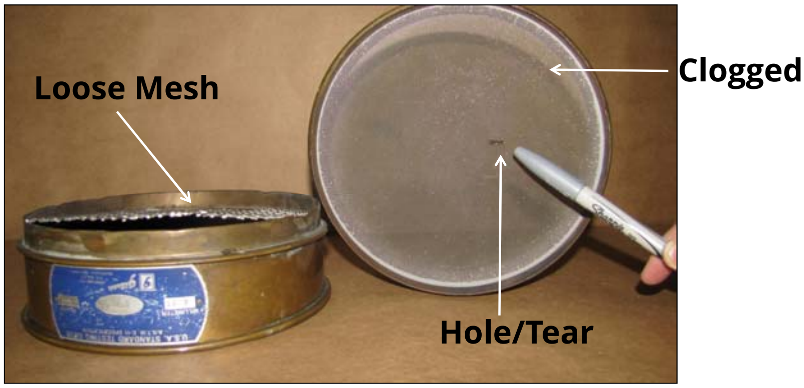
Sieves



Mechanical Shaker

- Use a mechanical shaker to agitate the sieves

Weighing

- Weigh the sample to the nearest 0.1 of a unit of the original sample mass

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Overloaded Sieve

Options for Overloading

- Use larger sieve
- Portion the sample
- Place another sieve in the nest

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Maximum Loading of Sieves

TABLE 1 Maximum Allowable Quantity of Material Retained on a Sieve, kg

Sieve Opening Size, mm	Nominal Dimensions of Sieve[A]				
	203.2-mm dia[B]	254-mm dia[B]	304.8-mm dia[B]	350 by 350 mm	372 by 580 mm
	Sieving Area, m^2				
	0.0285	0.0457	0.0670	0.1225	0.2158
125	*C*	*C*	*C*	*C*	67.4
100	*C*	*C*	*C*	30.6	53.9
90	*C*	*C*	15.1	27.6	48.5
75	*C*	8.6	12.6	23.0	40.5
63	*C*	7.2	10.6	19.3	34.0
50	3.6	5.7	8.4	15.3	27.0
37.5	2.7	4.3	6.3	11.5	20.2
25.0	1.8	2.9	4.2	7.7	13.5
19.0	1.4	2.2	3.2	5.8	10.2
12.5	0.89	1.4	2.1	3.8	6.7
9.5	0.67	1.1	1.6	2.9	5.1
4.75	0.33	0.54	0.80	1.5	2.6

[A] Sieve frame dimensions in inch units: 8.0-in. diameter; 10.0-in. diameter, 12.0-in. diameter; 13.8 by 13.8 in. (14 by 14 in. nominal); 14.6 by 22.8 in. (16 by 24 in. nominal).

[B] The sieve area for round sieve frames is based on an effective diameter 12.7 mm (½ in.) less than the nominal frame diameter, because Specification E11 permits the sealer between the sieve cloth and the frame to extend 6.35 mm (¼ in.) over the sieve cloth. Thus the effective sieving diameter for a 203.2-mm (8.0-in.) diameter sieve frame is 190.5 mm (7.5 in.). Sieves produced by some manufacturers do not infringe on the sieve cloth by the full 6.35 mm (¼ in.).

[C] Sieves indicated have less than five full openings and should not be used for sieve testing except as provided in 8.6.

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Sample Problem #1

Original Sample Mass (g)		507.8
Sieve Size or Designation		Individual Weight Retained (g)
4.75 mm	No. 4	0.0
2.36 mm	No. 8	51.0
1.18 mm	No. 16	98.0
600 um	No. 30	106.0
300 um	No. 50	117.0
150 um	No. 100	95.0
75 um	No. 200	29.0
< 75 um	< No. 200	11.0
Total		

Sample Problem #1

Original Sample Mass (g)		507.8
Sieve Size or Designation		Individual Weight Retained (g)
4.75 mm	No. 4	0.0
2.36 mm	No. 8	51.0
1.18 mm	No. 16	98.0
600 um	No. 30	106.0
300 um	No. 50	117.0
150 um	No. 100	95.0
75 um	No. 200	29.0
< 75 um	< No. 200	11.0
Total		507.0

$$\text{AASHTO Loss} = \frac{\text{Original Sample Mass} - \text{Sum of Individual } Wt.}{\text{Original Sample Mass}} \text{ x } 100$$

$$\text{AASHTO Loss} = \frac{507.8 - 507.0}{507.8} \text{ x } 100$$

✓ AASHTO Loss = 0.16% ≤ 0.3%

Sample Problem # 1

Original Sample	507.8

Sieve Size or Designation		Individual Weight Retained (g)	Individual Percent Retained	Cumulative Percent Retained	Cumulative Percent Passing
4.75 mm	No. 4	0.0	0.0	0.0	100.0
2.36 mm	No. 8	51.0			
1.18 mm	No. 16	98.0			
600 um	No. 30	106.0			
300 um	No. 50	117.0			
150 um	No. 100	95.0			
75 um	No. 200	29.0			
< 75 um	< No. 200	11.0			

Sample Problem # 1

Original Sample	507.8

Sieve Size or Designation		Individual Weight Retained (g)	Individual Percent Retained	Cumulative Percent Retained	Cumulative Percent Passing
4.75 mm	No. 4	0.0	0.0	0.0	100.0
2.36 mm	No. 8	51.0	10.0	10.0	90.0
1.18 mm	No. 16	98.0	19.3	29.3	70.7
600 um	No. 30	106.0	20.9	50.2	49.8
300 um	No. 50	117.0	23.0	73.3	26.7
150 um	No. 100	95.0	18.7	92.0	8.0
75 um	No. 200	29.0	5.7	97.7	2.3
< 75 um	< No. 200	11.0	2.2	99.8	0.2

Fineness Modulus

Sieve	Cumulative Percent Retained
3 in	
1 1/2 in	
3/4 in	
3/8 in	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
Total	
FM	

Fineness Modulus

Sieve	Cumulative Percent Retained
3 in	0.0
1 1/2 in	0.0
3/4 in	0.0
3/8 in	0.0
No. 4	0.0
No. 8	10.0
No. 16	29.3
No. 30	50.2
No. 50	73.3
No. 100	92.0
Total	254.82
FM	2.55

Sample Problem #2

Original Sample Mass (g)		91.2
Sieve Size or Designation		Individual Weight Retained (g)
75 mm	3 in	0.0
50 mm	2 in	0.0
37.5 mm	1 1/2 in	6.0
25 mm	1 in	20.0
19 mm	3/4 in	16.0
12.5 mm	1/2 in	13.0
9.5 mm	3/8 in	28.0
4.75 mm	No. 4	8.0
< 4.75 mm	< No. 4	0.0
Total		

Sample Problem #2

Original Sample Mass (g)		91.2
Sieve Size or Designation		Individual Weight Retained (g)
75 mm	3 in	0.0
50 mm	2 in	0.0
37.5 mm	1 1/2 in	6.0
25 mm	1 in	20.0
19 mm	3/4 in	16.0
12.5 mm	1/2 in	13.0
9.5 mm	3/8 in	28.0
4.75 mm	No. 4	8.0
< 4.75 mm	< No. 4	0.0
Total		91.0

$$\text{AASHTO Loss} = \frac{\text{Original Sample Mass} - \text{Sum of Individual Weights}}{\text{Original Sample Mass}} \times 100$$

$$\text{AASHTO Loss} = \frac{91.2 - 91.0}{91.2} \times 100$$

✓ $$\text{AASHTO Loss} = 0.22\% \leq 0.3\%$$

Sample Problem # 2

Original Sample	91.2

Sieve Size or Designation		Individual Weight Retained	Individual Percent Retained	Cumulative Percent Retained	Cumulative Percent Passing
75 mm	3 in	0.0	0.0	0.0	100.0
50 mm	2 in	0.0	0.0	0.0	100.0
37.5 mm	1 1/2 in	6.0			
25 mm	1 in	20.0			
19 mm	3/4 in	16.0			
12.5 mm	1/2 in	13.0			
9.5 mm	3/8 in	28.0			
4.75 mm	No. 4	8.0			
< 4.75 mm	< No. 4	0.0			

Sample Problem # 2

Original Sample	91.2

Sieve Size or Designation		Individual Weight Retained	Individual Percent Retained	Cumulative Percent Retained	Cumulative Percent Passing
75 mm	3 in	0.0	0.0	0.0	100.0
50 mm	2 in	0.0	0.0	0.0	100.0
37.5 mm	1 1/2 in	6.0	6.6	6.6	93.4
25 mm	1 in	20.0	21.9	28.5	71.5
19 mm	3/4 in	16.0	17.5	46.0	54.0
12.5 mm	1/2 in	13.0	14.3	60.3	39.7
9.5 mm	3/8 in	28.0	30.7	91.0	9.0
4.75 mm	No. 4	8.0	8.8	99.8	0.2
< 4.75 mm	< No. 4	0.0	0.0	99.8	0.2

Fineness Modulus

Sieve	Cumulative Percent Retained
3 in	
1 1/2 in	
3/4 in	
3/8 in	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
Total	
FM	

Fineness Modulus

Sieve	Cumulative Percent Retained
3 in	0.0
1 1/2 in	6.6
3/4 in	46.0
3/8 in	91.0
No. 4	99.8
No. 8	99.8
No. 16	99.8
No. 30	99.8
No. 50	99.8
No. 100	99.8
Total	742.34
FM	7.42

7

Quality Assurance / Quality Control

TDOT Standard Method of Test for

Quality Assurance / Quality Control

References

TDOT Standard Specifications
Standard Operating Procedures (SOP)
FHWA Publication Np. HIF-07-004

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QA / QC

- **Quality Assurance (QA)**
  A set of activities conducted by the owner to insure that the product delivered complies with the specifications
- **Quality Control (QC)**
  A set of activities conducted by the contractor to monitor the process to insure that the concrete will meet or exceed the QA test requirements

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Quality Assurance

- Associated with Acceptance
- Performed by TDOT or TDOT representative
- Example : Air Content, Slump, & Compressive Strength

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Quality Control

AASHTO states:

"The sum total of activities performed by the seller to make sure that a product meets contract specifications".

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Q/C Program

- Training
- Preliminary material testing
- Equipment and process monitoring
- Testing of concrete and individual materials during trial batching and production
- Analysis of QC test results and process monitoring
- Minimum requirements are listed in Batch Plant Process Control Plan (Page 82)

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Testing

- All personnel involved with QA and QC should receive proper training
- TDOT requires Concrete Field Testing Technician and Concrete Plant Quality Control Technician certification
- All certified technicians should be listed on the Concrete Certified Technicians Form (Page 111)

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Record Keeping

- Concrete Plant Records Minimum Requirements (Page 81)
- Proper documentation is a key factor for interpreting data, making informed decisions, and troubleshooting problems that may arise
- Elements : Clear / Consistent labeling, accurate sample locations, and an organized filing system
- The batch plant must be continuously monitored and regularly calibrated

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Batching Tolerance

- Standard Specifications 501.09
- Aggregate : 1.5% of the required weight
- Cementitious Materials : no less than 1% nor no more than 4% of the required weight
- Water : accuracy of measuring the water shall be within a range of error of not over 1%

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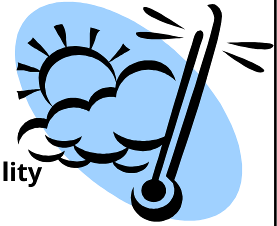
Temperature



- High Temperature :
  - Increased water demand to maintain workability
  - Decrease set time
  - Increase danger of plastic and early-age shrinkage cracking
  - Reduction in air void system effectiveness
  - Lower ultimate strength
- Options for lowering temperature of concrete
  - Cool aggregate by shading stockpile and sprinkling with water
  - Chill mixing water or use ice
- Standard Specification 604.11: The temperature of the concrete at point of discharge shall not exceed 90ºF

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Temperature

- Low Temperature:
  - Reduced early strength
  - Freezing of concrete before it sets
  - Reduced rate of hydration, thus shrinkage cracking and changing the saw-cutting window
- Options:
  - Heat aggregate
  - Heat mixing water
- Standard Specifications 501.11
  - Pour if temperature is 35º and rising
  - Do Not Pour if 40º and falling

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Air Content

- Achieving the target air content and air void system is one of the most challenging aspects of controlling concrete mixtures
- Factors
  - Ingredients
  - Temperature
  - Mixing time
  - Batching sequence
  - Slump
  - Admixture Interaction
  - Haul Time
  - Vibrations

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Additional TDOT Forms

- Process Control Inspection (Page 78)
- Placement Site Process Control Plan (Page 84)
- Concrete Delivery Ticket- (Page 90)
  - TDOT Standard Specification 501.03 B. & 604.03 B.
- Concrete Truck Check List (Page 103)
- Materials List (Page 112)

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Process Control – Truck Counter

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Process Control – Water Meter

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Process Control – Aggregate Separation

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Process Control – Scale Calibrations

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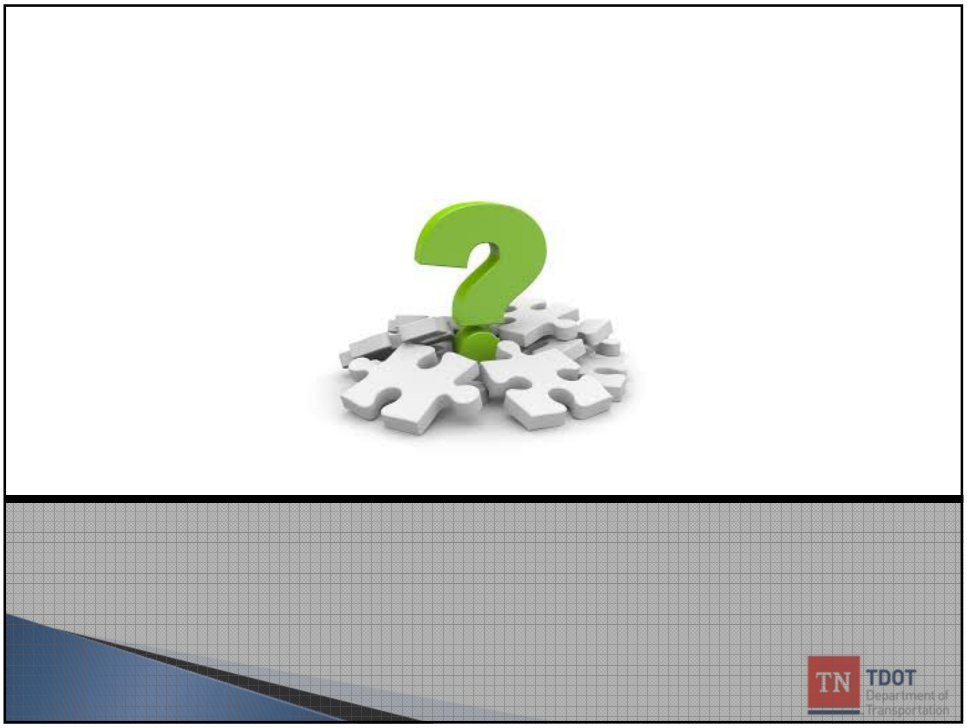
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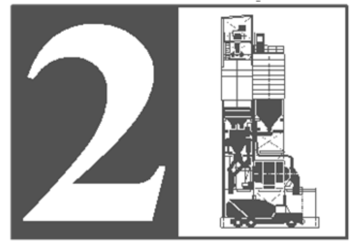

Concrete Plant Quality Control Technician Course

Tennessee Department of Transportation

Volume 3.1

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Appendix

INSPECTION OF PROCESS CONTROL
CONCRETE PLANT OR BRIDGE DECK POUR

Date:	
Producer:	
Plant:	
Region:	
HQ M&T Inspector:	
Regional M&T Representative:	
Plant Representative:	
For Deck Pours:	
Contract:	
Contractor:	
Project Manager:	
Engineer:	
Regional Inspector:	
Additional Remarks *(major deficiencies, scheduled follow-up visits, etc.)*:	

CONCRETE PLANT QUALITY CONTROL
INSPECTION CHECKLIST

INSPECTION ITEM	YES	NO	COMMENTS
Is the process control plan posted in plain view at the plant?			
Does the Process Control include all TDOT or ACI qualified Concrete Class 2 or higher technicians employed by the concrete supplier that may be responsible for any concrete testing, plant operations or any changes involving concrete mixing?			
Is a copy of the Concrete Class 2 or Class 3 certification for these personnel posted on the wall or available upon request?			
Does the concrete producer have an approved concrete design for the type of concrete being produced?			
Are gradations on fine and coarse aggregate being run according to the recommended (weekly or minimum 500 C.Y. for bridge decks & other) (1,500 C.Y. for roadway paving), including fineness modulus tests and recorded in the files at the concrete plant location?			
Are weight checks of aggregate, cement, fly-ash, water, and admixtures being recorded and placed in the files?			
Are moisture checks and calculations being made on stockpiles before any batching of concrete? These checks can be made by the use of moisture probes or other. At least, one (1) check shall be made in the AM and one (1) in the PM. Are the checks being made and is this information being recorded?			
Have scale checks been made on the aggregate and cement scales with a TDOT representative present? Have the scale checks been recorded and posted at the plant?			
Are the aggregate stockpiles being kept cool on hot days and warm on cold days by some approved method?			
Is there a qualified technician at the plant to do QC testing as concrete is being batched?			
Are calculated corrections recorded for adjustments made when water is withheld or added on the delivery ticket? (ice should also be shown in adjustments)			
Do all the batch tickets reflect the adjustments to the concrete mixture at the plant such as added water, ice, admixtures and etc?			
Is the initial slump, air, and temperature tests being performed from the first concrete delivery truck for a particular pour and is this information being recorded?			
Is the plant keeping records of any and all adjustments made to the concrete at the plant such as adding ice?			
Is a list posted at the plant of approved concrete trucks? (The list shall be in a conspicuous location and kept up-dated for accuracy). (A copy of this list shall be sent to Regional M & T every 6 months).			
Has TDOT M & T checked the concrete lab this year and is the completed plant check posted in a conspicuous place that indicates the plant meets the specifications meets all lab requirements and is an approved concrete supplier?			
Does the concrete supplier keep a record of all tests and inspections performed at the plant by QC personnel?			

Are the records kept in order, current, and readily available at the concrete plant for review at any time by TDOT personnel and/or FHWA representatives?			
Is the wash water being dumped from all trucks before batching operations begin?			
Are the aggregate stockpiles separated in an approved fashion and uncontaminated?			
You are being asked to observe a concrete truck being loaded to send to a TDOT project. Does the concrete truck have a working revolution counter? Does the concrete truck have a manufacturers' identification plate? Does the concrete truck have a working water meter?			
Are records of delivery tickets of all materials such as coarse and fine aggregates, cement, fly-ash and all other admixtures and additives used for state projects kept in the plant files until the project is complete?			
Is it raining too hard to continue batching concrete?			
Is it too hot or cold to be batching concrete?			
Are the admixtures being introduced into the concrete trucks at the correct time and in the correct dosage?			
Is the slump of the concrete within specifications and being checked before any High Range Water Reducer (or super-plasticizer) is being added?			
Do the concrete trucks have the tare, maximum interstate, and maximum non-interstate weight limits marked on the driver's side of the truck and visible at a distance of 50 feet (a minimum of 2-inch lettering is recommended?			
Is there any "Completed Projects" documentation left in the Concrete Supplier's files that has not been picked up by the Project Supervisor or his representative for incorporation into the project final records for those "Completed Projects"?			

CONCRETE PLANT RECORDS
MINIMUM REQUIREMENTS

1. The contractor/material supplier shall keep a **record of all tests and inspections performed** at the plant by QC personnel. The records shall be kept current and shall be readily available at the concrete plant for review at any time by TDOT personnel and/or FHWA representatives. It is required that a file cabinet or other suitable filing system be maintained at the concrete plant with this information and documentation.

2. **A process control plan shall be posted** in plain view at the plant location. This process control shall include all TDOT or ACI qualified Concrete Class 2 or higher technicians employed by the concrete supplier that may be responsible for any concrete testing, plant operations or any changes involving concrete mixing. A copy of the Concrete Class 2 or 3 certification for these personnel should be available upon request at the plant.

3. **Gradations on fine and coarse aggregate (including fineness modulus tests)** shall be maintained in a file at the concrete plant location. According to the minimum requirements of the specifications a gradation must be run weekly or every 1500 C.Y. for 501 Items and every 500 C.Y. for 604 Items.

4. **Checks on accurate weightings** of aggregates, cement, fly-ash, water and admixtures shall be maintained in the records at the plant site. Scales shall be inspected and checked as often as the Engineer may deem necessary to assure their continued accuracy. The scale checks must be recorded and documentation of this shall be retained in the project files at the plant.

5. **Moisture checks and calculations** shall be made on stockpiles before any batching of materials. These checks can be made by the use of moisture probes or other means but this information must be recorded and the documentation retained in the project files at the plant. At least, one (1) check shall be made in the A.M. and one (1) check in the P.M.

6. **Calculated corrections or adjustments made for water withheld or added** shall be recorded. If ice is used, the calculations shall reflect this adjustment in the batching information. All batch tickets must reflect these adjustments also. Retain documentation of these adjustments in the plant files.

7. An **initial slump, air and temperature of the concrete** shall be made from the first truck to be loaded out for delivery to the job-site. If a deck pour is involved, the first three (3) loads should be checked to ensure each load complies or it may be rejected at the job-site for failure to meet specifications (refer to SOP 4-1). Also, the slump before the addition of the HRWRA or MRWRA shall be 3 inches maximum. Any check for slump shall be more than a visual check. An actual slump tests shall be performed. Random checks on the slump, air and temperature shall continue throughout all concrete pours and be documented. Documentation of this information shall be retained at the plant.

8. Keep **records of delivery tickets** of all materials such as coarse and fine aggregates, cement, fly-ash and all other admixtures and additives used for state projects at the plant site.

9. **Record any and all adjustments made to the concrete at the plant**. These records will be maintained at the plant site and given to the Project Supervisor at the conclusion of the project along with a letter stating the concrete incorporated into the work meets the requirements of the specifications as outlined in Section 501 or 604, whichever is applicable. It shall be the responsibility of the project supervisor to collect this documentation and records at the conclusion of the project.

10. **Truck checks** are to be made on a periodic basis, checking for the blade wear, working revolutions counters, identification plates and water meters. A copy of these checks must be sent to the Regional Materials & Tests office at least every six (6) months or whenever trucks are added or taken away from the fleet. Trucks not shown on the up-dated list are not to be used on a state project. Post a copy of the active list of approved trucks in a conspicuous place at the concrete plant. Retain historical records of these periodic truck checks in the files at the plant.

11. **A completed plant check by TDOT Materials & Tests** shall be posted in a conspicuous place that indicates the plant meets the specification requirements and is an approved material supplier for concrete.

Revised: 8/21/2012
9/05/2013
12/03/2013

ANNUAL BATCH PLANT
CONCRETE PROCESS CONTROL PLAN
PART 1 OF 2

DATE: ___________________________________

READY MIX CONCRETE COMPANY: ____

READY MIX COMPANY LOCATION: ____

All qualified TDOT Level 2 or higher qualified Concrete Technicians shall be listed in this section or on attached sheets. Include every technician that will be working on this project and update as needed.	NAME:	CERT.#
	NAME:	CERT.#
	NAME:	CERT.#
	NAME:	CERT.#

We hereby propose to utilize the below listed process controls to insure that the concrete delivered to the above referenced project meets Tennessee Department of Transportation Specifications. If approved, this plan will be posted at the concrete plant along with approved mix designs for each particular project.

The following Sampling, Testing, and Inspections will be performed by T.D.O.T. Certified Plant Technicians.

1.) Tests to determine aggregate gradations (AASHTO T-27 with T-11 when required) will be performed prior to any batching and then a minimum of once per week or every 500 C.Y. for each source of aggregate utilized for this project. *Perform fineness modulus test on fine aggregate per AASHTO M-6 with each gradation.*

2.) Stockpiles will be checked daily to insure that they are being maintained in an uncontaminated and unsegregated manner. Current aggregate quality reports shall be kept on file at the plant.

3.) Calibration of weighing systems for aggregates, cement, fly ash, water meters, and admixture dispensing systems will be performed at the beginning of the project, then every month or as conditions warrant. Scale checks may be performed by a Certified Scale Company at a minimum interval of six (6) months.

4.) Assurance of accurate weighing, proper metering, and mixing of all materials and the quality of water will be verified daily.

5.) Mixing trucks and/or equipment, counters, concrete build – up in drums, blade wear, water gauges, etc. will be checked at the beginning of each project and randomly thereafter. Transport trucks shall be checked and approved by Tennessee Department of Transportation before use. The Producer shall update the concrete truck checklist every six (6) months and distribute to Regional Materials and Tests.

6.) Adjustment of mix proportions due to the moisture content of both fine and course aggregates will be performed prior to initial daily mixing and again in the afternoon if operations are continuous through AM and PM hours of the day. Moisture determination will be in accordance with AASHTO-T255. Moisture Probes may be utilized but must be correlated and verified with a dry moisture check weekly.

7.) Slump (AASHTO T119), air entrainment (AASHTO T-152 – AASHTO T-196 for concrete containing light weight aggregates) and ambient air and mix temperatures shall be checked for specifications compliance on the initial load and randomly thereafter for each day's run. Air loss during transport shall be determined on initial loads and randomly verified thereafter.

8.) If Class "D" Concrete is included in the plans, SOP 4-1 is applicable. The Producer/Contractor shall check slump and air at the plant initially and randomly throughout pour to assure that the requirements are met.

9.) An approved report will be furnished daily to the project supervisor showing all pertinent information. Records of tests and inspections that are project specific and not included on the daily reports are to be maintained and submitted to the project supervisor upon project completion. Documents that are plant and lab specific shall be maintained at the plant systematically.

10.) An approved delivery ticket will accompany each load sent to the project. All information including actual batch weights of each component identified as well as other information in the Standard Specification shall be identified on the delivery ticket.

The above scheduled frequencies of testing are a minimum. Should problems become evident, they will be increased as the conditions require.

Sign Name: ______________________________
Representative Concrete Supplier

Print Name: ______________________________
Representative Concrete Supplier

PLACEMENT SITE CONCRETE PROCESS CONTROL PLAN PART 2 OF 2

DATE: ____

CONTRACT NO: ____

PROJECT NO: ____

REFERENCE NO: ____

COUNTY: ____

CONTRACTOR: ____

READY MIX COMPANY AND LOCATION: ____

PRIME CONTRACTOR: ____

All qualified Field Technician or higher qualified Concrete Technicians shall be listed in this section or on attached sheets. Include every technician that will be working on this project and update as needed.	NAME:	CERT.#
	NAME:	CERT.#
	NAME:	CERT.#
	NAME:	CERT.#

We hereby propose to utilize the below listed process controls to insure that the concrete incorporated in the work on the above referenced project meets Tennessee Department of Transportation's specifications. If approved, this plan will be posted on the project at a place accessible to all quality control personnel.

Initial concrete loads at the beginning of pours will be checked for specification compliance prior to use. Loads that test out of specification will be rejected. All sampling, testing, and inspections will be performed by ACI or TDOT Certified Personnel.

1.) Tests for slump (AASHTO T-119), air and mix temperatures, and air content (AASHTO T-152 / T-196) will **be performed prior to placement** of the first load and for each sample from which early and/or 28 day test cylinders are obtained. For bridge decks, slump, temperatures, and air content tests shall be performed on the first three loads. Thereafter, they shall be conducted at least once every fifty cubic yards (50cy). No concrete shall be placed when the rate of moisture evaporation from the freshly placed concrete exceeds 0.2 $lb/ft^2/hr$ as determined by Figure 2.1.5, American Concrete Institute Publication "ACI 305R-89." If data collected during the 24 hours prior to the pour or predictions from the National Weather Service indicate the moisture evaporation rate of 0.2 $lb/ft^2/hr$ or more, the pour should be rescheduled or the Contractor shall demonstrate to the satisfaction of the Engineer prior to the pour, that protection can be provided.

2.) Early test specimens for Tennessee Department of Transportation compression testing will be cast in accordance with AASHTO T-23. The Contractor shall supply the necessary curing equipment, molds, and wheelbarrow as identified in Standard Specification Subsection 604.03(b) and a temporary storage facility in accordance with Standard Specification Subsection 722.09. The frequency of casting early break cylinders will be as follows:

For Bridge Decks:
Not less than one pair to represent every fifty cubic yards (50cy). See SOP 1-1 and 4-1

For Major Structures:
Contractor shall perform all tests on the first load. At least one pair of cylinders will be made per unit per structure to represent up to 100cy for that unit of pour. See SOP 1-1

For Minor Structures:
Contractor shall perform all tests on the first load. At least one pair of cylinders will be made to represent up to 100cy for that unit of pour. See SOP 1-1

For Small Quantities:
As specified in the Standard Specifications Subsection 604.03 and SOP 1-1.

For Concrete Pavement:
One pair for each 300m^3 (400 cy) minimum of 1 pair AM and 1 pair PM. If Class A is used, the frequency shall be as for major structures as listed above.

3.) Yield tests will be performed in accordance with AASHTO T-121 initially per mix design, at 240m^3 (300cy) intervals and/or during pours exceeding 80m^3 (100 cy), and/or one for each bridge deck pour.

4.) A Tennessee Department of Transportation approved report will be furnished daily showing all pertinent information (Date, Contract, Item Number(s), Batch Weights, Moisture Corrections, Admixtures, Slump, Air Content, Temperatures, etc.) A delivery ticket shall accompany each load. Information to be included shall be in accordance with Section 604 of the Standard Specifications. Records of tests and inspections performed at both the batch and placement sites will be submitted to the project supervisor upon completion of the project. This submission will also include certification that the concrete incorporated into the work meets Tennessee Department of Transportation specifications.

The above scheduled frequencies of testing are a minimum, should problems become evident, they will be increased as the conditions require.

Sign Name: ______________________ Print Name: ______________________
Representative Prime Contractor — Representative Prime Contractor

Sign Name: ______________________ Print Name: ______________________
Sub-Contractor — Sub-Contractor

Item No(s) 501.02

Report No. 345

Design No. 02-999

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
DIVISION OF MATERIALS AND TESTS
6601 CENTENNIAL BLVD.
NASHVILLE, TENNESSEE 37243-0360

CONTRACTOR'S DAILY REPORT OF CONCRETE INSPECTION

TO BE DELIVERED TO THE PROJECT WITH THE INITIAL LOAD

Completed by Contractor's Concrete Plant Inspector

SAMPLE

Date 12-Jan-03

Contract No. 5678

Proj. Ref. No. SP   County Montgomery   Region 4   Project 12345-6789-10

Contractor Wrong Bros.   Sub-Contractor Billy Bob

Ready Mix Co. City Ready Mix Co.   Location Clarksville, TN

Type of Plant Mixer ____   Date Scales Checked: 08-Aug-01

Transit Mixer Checked for Presence of Water Before Batching: ☑ Yes ☐ No

Plant and Trucks Checked (Form T-232): ☑ Yes ☐ No   Date 01-Aug-01

Approved Process Control Plan: ☑ Yes ☐ No   Date 01-Jul-01

Daily Stockpile Check Results: ☑ Satisfactory ☐ Unsatisfactory   Aggr. Card No. C.A. 2559

W.R.A. / Retarder oz. 15   A.E.A. oz. 5.25   F.A. 5669

W.R.A. / Retarder oz. ____   A.E.A. oz. ____   Total C.Y. Batched 300

Batch Size ____ m^3 (yd^3)	Water gal (L)	Water lbs. (kg)	Cement lbs. (kg)	Fly Ash lbs. (kg)	GGBFS lbs. (kg)	Coarse Aggregate lbs. (kg)		Fine Aggregate lbs. (kg)	
Agg. Size / Other Material									
Percent Moisture									
Dry Batch Wts.	30		479	106		1912		1138	
Moisture Corrections	6.6					9.56		45.52	
Actual Batch Wts.	23.4					1922		1184	

Remarks ____

SCREEN ANALYSIS TOTAL PERCENT PASSING SIEVE

Size No.	2"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#200
CA	100	100	100	89.2	36.1	18.1	3.6	2.8	

Size No.	3/8"	#4	#8	#16	#30	#50	#100	#200	F.M.
FA	100	96.3	88.8	81.8	63.4	9.3	0.5	0.2	2.6

Date Tested: C.A. ____ F.A. ____ Plant Technician ____ Cert. No. ____

DAILY INSPECTION REPORT OF ROADWAY CONCRETE

Completed By Contractor's Q.C. Placement Site Technician from T-2A Information

Locations Used on Project Paved Ditch

Air Temp: High 90   Low 85   Brand or Type of Curing water

Method of Curing Cyl. ____   Technican Responsible for Cyl. James Williams

Average Time in Truck 30 min.

Cylinder No.	Station Made	Slump	% Air	Mix Temp.	Age of Test	Cylinder Made By
297, 297A	90+00	3.25	5.1	80	28 days	Jones Bros.

Ticket Numbers ____

Additional Water Required: Roadway (Gals). ____ Requested by: ____

Remarks: ____

Contractor Technician ____ Cert. No. 1234

Original to:

Item No(s) ______________________

____

Report No. ______________________

Design No. ______________________

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
DIVISION OF MATERIALS AND TESTS
6601 CENTENNIAL BLVD.
NASHVILLE, TENNESSEE 37243-0360

PORTLAND CEMENT CONCRETE BRIDGE DECK POUR

QUALITY CONTROL AND ACCEPTANCE REPORT

Completed by Contractor's Concrete Placement Site Technician

Date ______________________

Contract No. ______________________

Proj. Ref. No. ______________________ County ______________________ Region ______ Project ______________________

Contractor ______________________ Sub-Contractor ______________________

Ready Mix Co. ______________________

End Configuration: ☐ 90 Loop ☐ J-Hook ☐ Diffuser Hose ☐ Horizontal on Mat

DAILY INSPECTION REPORT OF CONCRETE

Completed By Contractor's Q.C. Placement Site Technician from T-2A Information

NOTE: First 3 trucks to be tested for air content, slump, and temperature; one set of cylinders are to be made from one of the first 3 trucks. Acceptance cylinders, air content, slump, and temperature shall be taken randomly every 50 CY thereafter.

Cylinder No.	Concrete Represented	Slump in.	Air Content %	Temperature, ºF		QC or Acc.	Tested By
				Mix	Air		

Remarks: ______________________

TDOT Inspector ______________________ Cert. No. __________

Contractor Technician ______________________ Cert. No. __________

Original to:
Headquarters Materials and Tests
Copies to:
Regional Materials and Tests
Project Supervisor
Form DT-0311 Attachment A

Reviewed by: ______________________
TDOT Project Supervisor or Representative Date

FOR INFORMATION ONLY - PUMPING AIR LOSS

The same truck shall be sampled at the chute and at the end of hose; 2 minimum per pour.D21

Cylinder No.	Air Content at Truck	Air Content at Pump Hose	% Difference

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
DIVISION OF MATERIALS AND TESTS
6601 CENTENNIAL BLVD.
NASHVILLE, TENNESSEE 37243-0360

DAILY REPORT OF CEMENT CONCRETE PAVING

This Section To Be Completed By Producer

Section No. *501-01.02* (Pay Item)
Date *01-Aug-02*
Contract No. *18-May-03*
Report No. *13* County *Dickson* Region *3*
Project Reference No. *SP* Route No. *I-40*
Project No. *12345-6789-10*
Source of Cement *Lonestar* Location *Cape Girardeau, Missouri*
Source of Fly Ash *M.R.S.* Location *Joppa, Illinois*
Source of F.A. *Ingram Materials* Location *Clarksville, Tennessee*
Source of C.A. *Vulcan Materials* Location *Dickson, Tennessee*

	WATER		CEMENT	FLY ASH	F.A.	C.A. SIZE 4	C.A. SIZE 67	C.A. SIZE
	GALS.	LBS.	(LBS.)	(LBS.)	(LBS.)	LBS.	LBS.	LBS.
Specific Gravity	1		3.15	2.67	2.61	2.63	2.63	
Solid Volume Proportions	13.97		7.44	2.91	28.48	21.09	21.11	
Ave. Daily Free Moisture								
Dry Batch Amounts	28	235	395	131	1253	935	935	
Moisture Correction					1344	0.9	0.9	
Actual Batch Amounts	17.08				730	918	918	

Concrete Laid - Sta. *384+73* to Sta. *387+40* Surface Pavement Length *267'*
Cross Section Width *Variable* Right or Left of C/L
Bridge - Sta. to Sta. Equation - Sta. =Sta.
Extra Width - Sq. Yds. Concrete Cu. Yds. Concrete
No. Batches Total Sq. Yds. Concrete *217.1* Total Cu. Yds. Concrete *29-Feb-00*
Air Temp.: A.M. *75* P.M. *94*
Concrete Temp.: A.M. *90* P.M. Brand A.E.A. *Mas. Bld.* Cure Type or Brand

To Be Completed By Contractor's Q.C. Placement Site Technician from T-2A Information

Ins. Slump	% Air	Spec. No.	Test No.	STATION NO. OF SPECIMENS Cylinders	CEMENT USED Station to Station		Tons	Truck or Car No.
3	5.2	1175	1	384+73 to 387+40	384+73	387+40		
2.5	5.3	1176	2	384+73 to 387+40	384+73	387+40		
WATER CHANGES			CALCULATED					
			ACTUAL					

Size of Batch in Cu. Yds. *10* % Size No. 4 *30* % Size No. 67 *30*

Design No. *02-1234*

Remarks: *Inspection Card Nos.: C.A. 3456; F.A. 3457*
Contractor: Wright Bros.; Subcontractor: H.M.C; Concrete supplied by IMI.

Original to:
Headquarters Materials and Tests
Copies to:
Regional Materials and Tests
Project Supervisor

Signature
Title *Project Inspector*

Form DT-0292 (Rev. 10-02)

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
DIVISION OF MATERIALS AND TESTS
6601 CENTENNIAL BLVD.
NASHVILLE, TENNESSEE 37243-0360

CONCRETE CYLINDER/CORE TEST REPORT
Information to be completed by TDOT personnel for cylinders/cores tested for acceptance

Reference No. *STP-M-1234(5)* County *Davidson* Region *3*
Project No. *01234-5678-90* Contract No. *1234* Date *12-Jan-03*
Contractor Placing Concrete *Bob Jones* Volume Poured this Date (m^3, yd^3) *600 cu. yds.*
Daily Report No. *5678* Date of Pour *30-Jan-03* Requested Age of Test *28 days*
Concrete Producer *Nashville Ready Mix* Location *Nashville*
Cyl./Core Numbers *45, 45A, 45B* Volume Represented by Cyls/Cores (m^3, yd^3) *402 cu. yds.*
Design Number *02 1234* Design Strength *3000 psi* Concrete Class *A - PCCP*
TDOT Supervisor *Bill Smith* Date Placed in Wet Curing Environment *08-Feb-03*

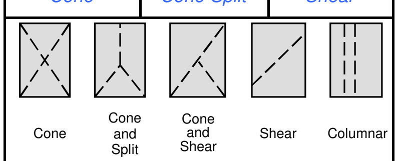
Item Number	*501.01*	*501.01*	*604.03.01*		
Pay Quantity	*150 sq. yds.*	*150 sq. yds.*	*368 cu. yds.*		
Quantity Delivered	*16.67 cu. yds.*	*16.67 cu. yds.*	*368 cu. yds.*		
Sta. of Cyl./Core	*012+3.67*	*123+4.67*	*123+4.67*		

Description of Pour(s):

Remarks: *Partly cloudy, 80 degrees F, 60% RH, winds from NW at 4 mph.*

Laboratory Test Data *(ASTM C-39, C-511, and C1231)*

Cylinder No. / Core No.	*45*	*45A*	*45B*
Serial No.	*12345*	*67890*	*98765*
Date Received	*31-Jan-03*	*31-Jan-03*	*31-Jan-03*
Date Tested	*14-Feb-03*	*14-Feb-03*	*14-Feb-03*
Date Reported	*15-Feb-03*	*15-Feb-03*	*15-Feb-03*
Diameter (in)	*6*	*6*	*6*
Cross-sectional Area (in²)	*28.26*	*28.26*	*28.26*
Maximum Load (lbf)	*97497*	*100323*	*10032*
Compressive Strength (psi)	*3450*	*3550*	*3550*
Ave. Compressive Strength (psi)	*3517*		
Type of Fracture	*Cone*	*Cone-Split*	*Shear*
Performed by	*RPG*	*RPG*	*RPG*
Technician Certification No.	*2345*	*2345*	*2345*



Field Test Data

Slump, in. *(ASTM C-143)*	
Air Temp., °F	
Concrete Temp., °F *(ASTM C-1064)*	
% Air *(ASTM C-173, C-231 , or C-138)*	
Unit Weight (lbs/ft³) *(ASTM C-138)*	
Performed by/ Cert. No.	
Contractor Observer/Cert. No.	

Comments:

Original to:
Headquarters Materials and Tests
Copies to:
Regional Materials and Tests
Project Supervisor
Copy to Contractor to accompany shipment of cylinders

Approved by ______________________
Director of Materials and Tests

Date ______________________

Contractor: Received by ____________ Date ____________

Form DT-0062 (Rev. 06-14)

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
DIVISION OF MATERIALS AND TESTS
6601 CENTENNIAL BLVD.
NASHVILLE, TN 37243

CONCRETE DELIVERY TICKET

Date: ____________________ Ticket # ____________________

Contract # __________________ County __________________________ Region _______ Load # ____________________

Project # ____ Proj. Ref. # ____

Conc. Design # ______________ Concrete Class: _____________ No. Cubic Yards: ___________ Actual W/C : _________

			ACTUAL	TARGET[3]	TOLERANCE
CEMENT		**lbs.**			
FLYASH	**F☐C☐**	**lbs.**			
SLAG		**lbs.**			
ROCK		**lbs.**			
SAND		**lbs.**			
WATER		**gal.**			

		ACTUAL	TARGET
A.E.A.	**oz.**		
W.R.A.	**oz.**		
WATER	**oz.**		
MISC.	**oz.**		

Will accept computer generated equivalent

Max. water allowed[1] (Actual) ____ Gallons

Total water [2](Plant) ____ Gallons

Max. water allowed (Project) ____ Gallons

Water added (Project) ____ Gallons

No. Rev. @ Mixing Speed (Plant) ____

No. Rev. @ Mixing Speed (Project) ____

Time loaded: ______________________________ Time discharged: ______________________________

Truck No. ______________________________ Loc. Sta. ______________________________

____
(Unit of Structure)

____________________ ____________________ ____________________
Print Name (Plant Tech) Plant Tech Cert. No. Plant Tech. Signature

____________________ ____________________ ____________________
Print Name (Inspector at delivery point) Field Tech Cert. No. (TDOT Rep.) Inspector Signature

1 **Based on actual cementious material allowed by design**

2 **Actual used at plant**

3 **May be adjusted to meet specification requirements.**

Form DT-1756 (Rev.06-17-14)
RDA# 1942

RESET

SAVE

Ready-Mix Concrete Producer Comment Form

Concrete Producer:

Producer Location:

Contract/Project #:

Contractor:

TDOT/CEI Inspector:

Please leave detailed comments concerning the sampling, handling, testing, or curing of concrete on TDOT projects below and e-mail to jamie.waller@tn.gov. All comments will be reviewed and addressed accordingly.

E-Signed: Date:

Company:

E-mail address:

CIRCULAR LETTER

SECTION: **109.01 MEASUREMENT OF QUANTITIES**
NUMBER: **109.01-02**
SUBJECT: **TRUCK WEIGHT LIMITS**
DATE: **JANUARY 1, 2010**

The Department now will require that all weight tickets conform to the new limits outlined on these sheets as required by law.

Interstate weight limits shall apply when hauling on any of the following:

a) Ramps entering or exiting the interstate system.
b) Any portion of an existing interstate open or previously opened to traffic.
c) The surface course of a new interstate facility (never opened to public traffic). However, Non-Interstate Highway limits will apply to hauling on the subgrade or base courses of newly constructed interstate widening projects if accessed by non-interstate routes.
d) New and existing structures on interstates.

In consideration of the status of construction, relative to the present federal interstate system, it is considered that the above determinations provide adequate guidance as to the applicability of interstate truck weights.

SECTION I: Non-Interstate Highway

1) Two axle truck (one front, one rear)
   20,000# each axle
   Maximum gross weight = 40,000# *

2) Three axle straight (one front, tandem rear)
   Front axle = 20,000#
   Tandem axle = 34,000#
   Maximum gross weight = 54,000# *

   Exception: Class 9 tag or zone tag
   Maximum gross weight = 66,000# *

3) Four axle straight (one front, three rear)
   Front axle = 20,000#
   Single axle rear = 20,000#
   Tandem axle = 34,000#
   Maximum gross weight = 74,000# *

4) Three axle truck tractor and trailer (one axle front of tractor, one rear of tractor, one rear of trailer)
   Front axle = 20,000#
   Rear axle Tractor = 20,000#
   Rear axle Trailer = 20,000#
   Maximum gross weight = 60,000# *

5) Four axle truck tractor and trailer (one front of tractor, one rear of tractor, tandem rear of trailer)
   Front axle Tractor = 20,000#
   Rear axle Tractor = 20,000#
   Tandem axle Trailer = 34,000#
   Maximum gross weight = 74,000# *

6) Four axle truck tractor and trailer (one front of tractor, tandem rear of tractor, one rear of trailer)
   Front axle Tractor = 20,000#
   Tandem rear Tractor = 34,000#
   Single axle Trailer = 20,000#
   Maximum gross weight = 74,000# *

7) Five axle tractor and trailer (one front of tractor, tandem rear of tractor, tandem rear of trailer)
   Maximum gross weight = 80,000# *

* A tolerance of up to 500 pounds will be allowed over the maximum gross weight.

SECTION II: Interstate Highway (Contracts Let On or After October 31, 2008)

Per Section 107.02 of the Standard Specifications, all trucks delivering material (rock, asphalt, concrete, etc.) to construction projects shall display the allowable gross weight for the Interstate System on the side of the truck. The Bridge Formula shall be used to determine Interstate System gross weights as defined below and in the attached Bridge Formula Weights brochure:

Weight Distribution Formula (Bridge Formula)

$$W = 500 ((L\ N)/(N-1) + 12N + 36)$$

W = overall gross weight
N = number of axles under consideration
L = distance in feet between extremes of axles under consideration

SECTION III: Interstate Highway (Contracts Let Prior to October 31, 2008)

A. Weight based on axle loadings

1) Two axle truck (one front, one rear)
   18,000# each axle
   Total = 36,000#

2) Three axle straight (one front, tandem rear)
   Front axle = 18,000#
   Tandem rear = 32,000#
   Total = 50,000#

3) Four axle straight (one front, three rear)
   Front axle = 18,000#
   Single axle rear = 18,000#
   Tandem axle rear = 32,000#
   Total = 68,000#

4) Three axle truck tractor and trailer (one axle front of tractor, one rear of tractor, one rear of trailer)
   Front axle = 18,000#
   Rear axle Tractor = 18,000#
   Rear axle Trailer = 18,000#
   Total = 54,000#

5) Four axle truck and trailer (one front of tractor, one rear of tractor, tandem rear of trailer)
   Front axle Tractor = 18,000#
   Rear axle Tractor = 18,000#
   Tandem axle Trailer = 32,000#
   Total = 68,000#

6) Four axle truck tractor and trailer (one front of tractor, tandem rear of tractor, one rear of trailer)

Front axle Tractor = 18,000#
Tandem rear Tractor = 32,000#
Single axle Trailer = 18,000#
Total = 68,000#

7) Five axle tractor and trailer (one front of tractor, tandem rear of tractor, tandem rear of trailer)

Total = 73,280#

B. Weight Distribution Formula (Bridge Formula)

W = 500 ((L N)/(N-1) + 12N + 36)

W = overall gross weight
N = number of axles under consideration
L = distance in feet between extremes of axles under consideration

The weights shown in Sub-Section A above can be increased if the Weight Distribution Formula is not violated. However, the weights shown in the section for Non-Interstate Highways may not be exceeded on Interstate Highways regardless of the Weight Distribution Formula.

Copy of Bridge Formula Weights brochure is attached.

Note

This pamphlet paraphrases the provisions in 23 U.S.C. 127 and 23 CFR 658 for the sake of clarity. In case of a dispute, the statue and regulations take precedence.

Previous editions of this pamphlet, entitled *Bridge Gross Weight Formula* (April 1984) and *Bridge Formula Weights* (January 1994), remain valid. Neither the Bridge Formula nor any resulting maximum gross weight values (table entries) has been changed.

U.S. Department of Transportation
Federal Highway Administration

Office of Freight Management and Operations
Phone: 202-366-9210
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August 2006

FHWA-HOP-06-105

Bridge Formula Weights

August 2006

U.S. Department of Transportation
Federal Highway Administration

Bridge Formula Weights

With a few exceptions noted in this pamphlet, the Bridge Formula establishes the maximum weight any set of axles on a motor vehicle may carry on the Interstate highway system. This pamphlet describes the Bridge Formula, why it was established, and how it is used.

What Is It?

Congress enacted the Bridge Formula in 1975 to limit the weight-to-length ratio of a vehicle crossing a bridge. This is accomplished either by spreading weight over additional axles or by increasing the distance between axles.

Compliance with Bridge Formula weight limits is determined by using the following formula:

$$W = 500 \left[\frac{LN}{N-1} + 12N + 36 \right]$$

W = the overall gross weight on any group of two or more consecutive axles to the nearest 500 pounds.

L = the distance in feet between the outer axles of any group of two or more consecutive axles.

N = the number of axles in the group under consideration.

In addition to Bridge Formula weight limits, Federal law states that single axles are limited to 20,000 pounds, and axles closer than 96 inches apart (tandem axles) are limited to 34,000 pounds. Gross vehicle weight is limited to 80,000 pounds (23 U.S.C. 127).

Is the Formula Necessary?

Bridges on the Interstate System highways are designed to support a wide variety of vehicles and their expected loads. As trucks grew heavier in the 1950s and 1960s, something had to

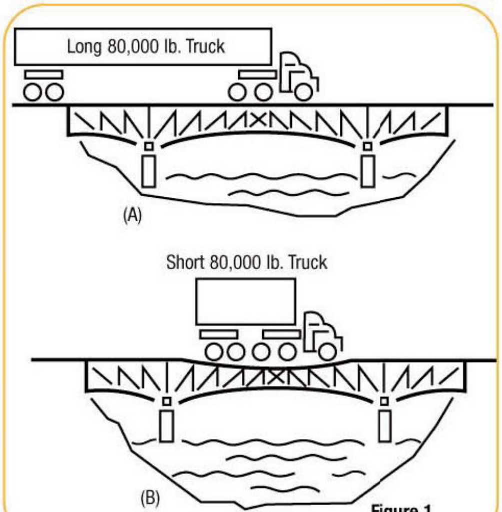

Figure 1

be done to protect bridges. The solution was to link allowable weights to the number and spacing of axles.

Axle spacing is as important as axle weight in designing bridges. In Figure 1A, the stress on bridge members as a longer truck rolls across is much less than that caused by a short vehicle as shown in Figure 1B, even though both trucks have the same total weight and individual axle weights. The weight of the longer vehicle is spread out, while the weight of the shorter vehicle is concentrated on a smaller area.

How Is the Formula Used?

The weight on various axle configurations must be checked to determine compliance with the Bridge Formula. Three definitions are needed to use the Bridge Formula correctly.

Gross Weight—the weight of a vehicle or vehicle combination and any load thereon. The Federal gross weight limit on the Interstate System is 80,000 pounds unless the Bridge Formula dictates a lower weight limit.

Single-Axle Weight—The total weight on one or more axles whose centers are spaced not more 40 inches apart. The Federal single-axle weight limit on the Interstate System is 20,000 pounds.

Tandem-Axle Weight—The total weight on two or more consecutive axles whose centers are spaced more than 40 inches apart but not more than 96 inches apart. The Federal tandem-axle weight limit on the Interstate System is 34,000 pounds.

Interstate System weight limits in some States may be higher than the figures noted above due to "grandfather" rights. When the Interstate System axle and gross weight limits were first adopted in 1956, and amended in 1975, States were allowed to keep or "grandfather" weight limits that were higher.

Bridge Formula calculations yield a series of weights (Bridge Table, pages 5-6). It is important to note that the single-axle weight limit replaces the Bridge Formula weight limit on axles not more than 40 inches apart, and the tandem-axle weight limit replaces the Bridge Formula weight limit for axles over 40 but not more than 96 inches apart. At 97 inches apart, for example, two axles may carry 38,000 pounds (Figure 2A), and three axles may carry 42,000 pounds, as shown in Figure 2B.

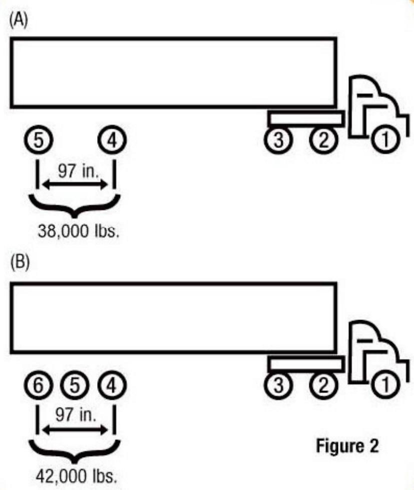

Figure 2

Federal law states that any two or more consecutive axles may not exceed the weight computed by the Bridge Formula even though single axles, tandem axles, and gross weight are within legal limits. As a result, the axle group that includes the entire truck—sometimes called the "outer bridge" group—must comply with the Bridge Formula. However, interior combinations of axles, such as the "tractor bridge" (axles 1, 2, and 3) and "trailer bridge" (axles 2, 3, 4, and 5), must also comply with weights computed by the Bridge Formula (Figure 3).

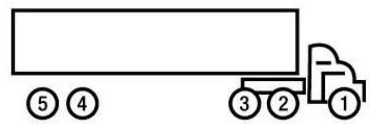

Figure 3

Figure 3 shows the most common vehicle checked for compliance with weight limit requirements. Although the Bridge Formula applies to each combination of two or more axles, experience shows that axle combinations 1 through 3, 1 through 5, and 2 through 5 are critical and must be checked. If these combinations are found to be satisfactory, then all of the others on this type of vehicle normally will be satisfactory.

The vehicle with weights and axle dimensions shown in Figure 4 is used to illustrate a Bridge Formula check.

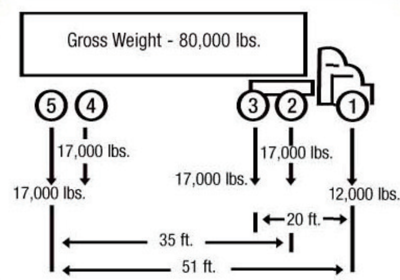

Figure 4

Permissible Gross Loads for Vehicles in Regular Operation[1]

Based on weight formula $W = 500 \left[\frac{LN}{N-1} + 12N + 36 \right]$

Distance in feet (L) between the extremes of any group of 2 or more consecutive axles — Maximum load in pounds carried on any group of 2 or more consecutive axles[2]

L	N= 2 AXLES	3 AXLES	4 AXLES	5 AXLES	6 AXLES	7 AXLES	8 AXLES	9 AXLES
Tandem Axle Weight (see pages 3 & 4) 4	34,000							
5	34,000							
6	34,000							
7	34,000							
8	34,000	34,000						
More than 8/less than 9	38,000	42,000						
9	39,000	42,500						
10	40,000	43,500						
11		44,000						
12		45,000	50,000					
13		45,500	50,500					
14		46,500	51,500					
15		47,000	52,000					
16		48,000*	52,500	58,000				
17		48,500	53,500	58,500				
18		49,500	54,000	59,000				
19 Example		50,000	54,500	60,000				
20 (see page 7)		51,000	55,500	60,500	66,000			
21		51,500	56,000	61,000	66,500			
22		52,500	56,500	61,500	67,000			
23		53,000	57,500	62,500	68,000			
24		54,000	58,000	63,000	68,500	74,000		
25		54,500	58,500	63,500	69,000	74,500		
26		55,500	59,500	64,000	69,500	75,000		
27		56,000	60,000	65,000	70,000	75,500		
28		57,000	60,500	65,500	71,000	76,500	82,000	
29		57,500	61,500	66,000	71,500	77,000	82,500	
30		58,500	62,000	66,500	72,000	77,500	83,000	
31		59,000	62,500	67,500	72,500	78,000	83,500	
32		60,000	63,500	68,000	73,000	78,500	84,500	90,000
33			64,000	68,500	74,000	79,000	85,000	90,500
34			64,500	69,000	74,500	80,000	85,500	91,000
35			65,500	70,000	75,000	80,500	86,000	91,500
36		Exception	66,000	70,500	75,500	81,000	86,500	92,000
37		(see page 9)	66,500	71,000	76,000	81,500	87,000	93,000
38			67,500	71,500	77,000	82,000	87,500	93,500
39			68,000	72,000	77,500	82,500	88,500	94,000
40			68,500	73,000	78,000	83,500	89,000	94,500
41			69,500	73,500	78,500	84,000	89,500	95,000
42			70,000	74,000	79,000	84,500	90,000	95,500
43			70,500	75,000	80,000	85,000	90,500	96,000
44			71,500	75,500	80,500	85,500	91,000	96,500
45			72,000	76,000	81,000	86,000	91,500	97,500
46			72,500	76,500	81,500	87,000	92,500	98,000
47			73,500	77,500	82,000	87,500	93,000	98,500
48			74,000	78,000	83,000	88,000	93,500	99,000
49			74,500	78,500	83,500	88,500	94,000	99,500
50			75,500	79,000	84,000	89,000	94,500	100,000
51			76,000	80,000	84,500	89,500	95,000	100,500
52			76,500	80,500	85,000	90,500	95,500	101,000
53			77,500	81,000	86,000	91,000	96,500	101,500
54			78,000	81,500	86,500	91,500	97,000	102,000
55			78,500	82,500	87,000	92,000	97,500	102,500
56		Interstate Gross	79,500	83,000	87,500	92,500	98,000	103,000
57		Weight Limit	80,000	83,500	88,000	93,000	98,500	104,000
58		(see page 2)		84,000	89,000	94,000	99,000	104,500
59				85,000	89,500	94,500	99,500	105,000
60				85,500	90,000	95,000	100,500	105,500

[1] The values in this table reflect FHWA's policy of rounding down when calculated weights fall exactly halfway between 500-pound increments. Because the Bridge Formula is designed to protect highway infrastructure, FHWA determined that this conservative policy is consistent with the statutory mandate.

[2] The following loaded vehicles must not operate over H15-44 bridges; 3-S2 (5-axle tractor semitrailer with a wheelbase of less than 38 feet), 2-S1-2 (5-axle semitrailer combination with a wheelbase of less than 45 feet), 3-3 (6-axle truck trailer combination with a wheelbase less than 45 feet), and any truck with 7 or more axles. H15-44 bridges are designed for a specific vehicle load; H15 refers to a 15-ton 2-axle truck; 44 refers to the year AASHTO published the loading information. See *AASHTO Standard Specifications for Highway Bridges.*

5 6

Before checking for compliance with the Bridge Formula, a vehicle's single-axle, tandem-axle, and gross weight should be checked. Here the single axle (number 1) does not exceed 20,000 pounds, tandems 2-3 and 4-5 do not exceed 34,000 pounds each, and the gross weight does not exceed 80,000 pounds. Thus, these preliminary requirements are satisfied. The first Bridge Formula combination is checked as follows:

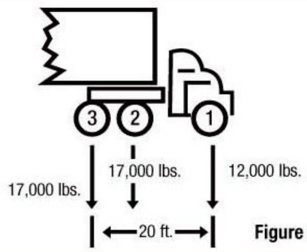

Figure 5

Check axles 1 through 3 (Figure 5)

Actual weight = 12,000 + 17,000 + 17,000 = 46,000 pounds.

N = 3 axles

L = 20 feet

$$W = 500 \left[\frac{LN}{N-1} + 12N + 36 \right]$$

$$W = 500 \left[\frac{(20 \times 3)}{(3-1)} + (12 \times 3) + 36 \right] = 51{,}000 \text{ lbs.}$$

Maximum weight (W) = 51,000 pounds, which is more than the actual weight of 46,000 pounds. Thus, the Bridge Formula requirement is satisfied.

Example From the Bridge Table (pages 5 & 6)

The same number (51,000 pounds) could have been obtained from the Bridge Table by reading down the left side to L = 20 and across to the right where N = 3.

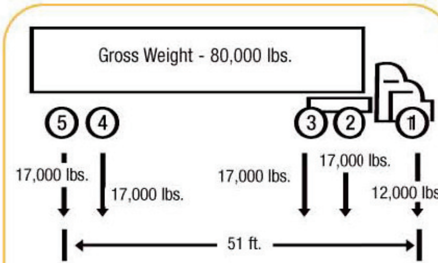

Figure 6

Now check axles 1 through 5 (Figure 6)

Actual weight = 12,000 + 17,000 + 17,000 + 17,000 + 17,000 = 80,000 pounds.

Maximum weight (W) = 80,000 pounds (Bridge Table for "L" of 51 feet and "N" of 5 axles).

Therefore, this axle spacing is satisfactory.

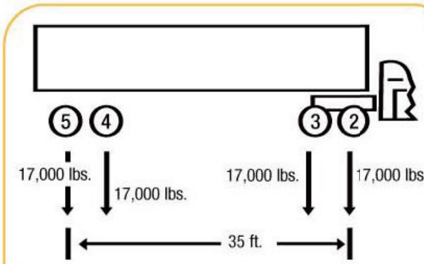

Figure 7

Now check axles 2 through 5 (Figure 7)

Actual weight = 17,000 + 17,000 + 17,000 + 17,000 = 68,000 pounds.

Maximum weight (W) = 65,500 pounds (Bridge Table for "L" of 35 feet and "N" of 4 axles).

This is a violation because the actual weight exceeds the weight allowed by the Bridge Formula. To correct the situation, some load must be removed from the vehicle or the axle spacing (35 feet) must be increased.

Exception to Formula and Bridge Table

In addition to the grandfather rights noted on page 3, Federal law (23 U.S.C. 127) includes one other exception to the Bridge Formula and the Bridge Table—two consecutive sets of tandem axles may carry 34,000 pounds each if the overall distance between the first and last axles of these tandems is 36 feet or more. For example, a five-axle tractor-semitrailer combination may carry 34,000 pounds both on the tractor tandem (axles 2 and 3) and the trailer tandem (axles 4 and 5), provided axles 2 and 5 are spaced at least 36 feet apart. Without this exception, the Bridge Formula would allow an actual weight of only 66,000 to 67,500 pounds on tandems spaced 36 to 38 feet apart.

Bridge Formula Application to Single-Unit Trucks

The procedure described above could be used to check any axle combinations, but several closely spaced axles usually produce the most critical situation.

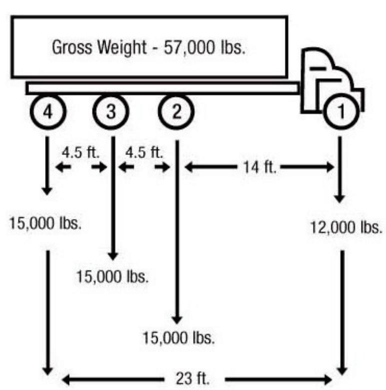

Figure 8

The truck shown in Figure 8 satisfies the single-axle weight limit (12,000 pounds are less than 20,000 pounds), the tandem-axle limit (30,000 pounds are less than 34,000 pounds) and the gross-weight limit (57,000 pounds are less than 80,000 pounds). With these restrictions satisfied, a check is done for Bridge Formula requirements, axles 1 through 4.

Actual Weight= 12,000 + 15,000 + 15,000 + 15,000 = 57,000 pounds.

Maximum weight (W) = 57,500 pounds (Bridge Table for "L" of 23 feet and "N" of 4 axles).

Since axles 1 through 4 are satisfactory, check axles 2 through 4:

Actual weight = 15,000 + 15,000 + 15,000 = 45,000 pounds.

Maximum weight (W) = 42,500 pounds (Bridge Table for "L" of 9 feet and "N" of 3 axles).

This is a violation because the actual weight exceeds the weight allowed by the Bridge Formula. The load must either be reduced, axles added, or spacing increased to comply with the Bridge Formula.

Quality Assurance Statement

The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

Example of Truck Weight Limits Calculations

Truck Weight Formula:

$$= 500\left(\frac{LN}{N-1} + 12N + 36\right)$$

Determine Maximum Total Truck Weight Limit:

Truck # 3 from List: L = 19 ft (Distance between Extreme Axles)
N = 4 (Number of Axles)

$$= 500\left(\frac{19 \times 4}{4-1} + 48 + 36\right)$$

$$= 54{,}650\ lbs.$$

Determine Weight of Concrete:

Class D Design for CNM 364 has a unit weight of 141.4 $\frac{lbs.}{ft^3}$

Convert Unit Weight from $\frac{lbs.}{ft^3}$ to $\frac{lbs.}{yd^3}$

$$141.4\frac{lbs.}{ft^3} \times 27\frac{ft^3}{yd^3} = 3{,}817.8\frac{lbs.}{yd^3}$$

Determine Maximum Concrete Weight Allowed:

Tare Weight = 33,420 lbs. for Truck 3 from List.

$$Max\ Truck\ Wt. - Truck\ \#3\ Tare\ Wt. = Concrete\ Weight\ Allowed$$

$$54{,}650\ lbs. - 33{,}420\ lbs. = 21{,}230\ lbs.$$

Determine Concrete Load size:

$$\frac{Weight\ of\ Concrete\ Allowed\ (lbs.)}{Unit\ Weight\ of\ Concrete\ (\frac{lbs.}{yd^3})} = Concrete\ Load\ Size\ (yd^3)$$

$$\frac{21{,}230\ lbs.}{3{,}817.8\ \frac{lbs.}{yd^3}} = 5.5\ yd^3$$

TENNESSEE DEPARTMENT OF TRANSPORTATION
CONCRETE TRUCK CHECKLIST

DATE 07/01/2014

PRODUCER Concrete Ready Mix PLANT LOCATION Nashville, TN

TRUCK NO.	VERIFY ITEMS MEET SPECIFICATIONS				TAG #	BASE COUNTY	NO. AXLES	DISTANCE FROM CL FRONT TO CL REAR AXLE	TARE WEIGHT	ALLOWABLE GROSS WEIGHT	
	MANUFACTURERS PLATE	REVOLUTION COUNTER	MIXER BLADE WEAR	WATER GAUGE						INTERSTATE	NON-INTERSTATE
F1	Yes	Yes	Yes	Yes	XXXXX	Davidson	4	19 ft	32,700	54,640	74,000
F2	Yes	Yes	Yes	Yes	XXXXX	Davidson	4	19 ft	33,000	54,640	74,000
F3	Yes	Yes	Yes	Yes	XXXXX	Davidson	4	19 ft	33,420	54,640	74,000
F4	Yes	Yes	Yes	Yes	XXXXX	Davidson	3	19 ft	31,140	50,000	66,000
F5	Yes	Yes	Yes	Yes	XXXXX	Davidson	3	19 ft	31,300	50,000	66,000
F6	Yes	Yes	Yes	Yes	XXXXX	Davidson	3	19 ft	31,350	50,000	66,000

CIRCULAR LETTER

SECTION: **604.17 CONCRETE STRUCTURES**
NUMBER: **604.17-01**
SUBJECT: **BRIDGE DECK CONSTRUCTION CHECKLIST**
DATE: **JANUARY 25, 2000**

The following pages contain a checklist procedure to be followed before, during and after bridge deck pours and a list of factors that adversely affect deck construction.

PAGE 1
STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

CONTRACT _______________ CONTRACTOR ____________________

PROJECT _______________ BRIDGE NUMBER ____________________

REFERENCE _______________ STATION NUMBER ____________________

COUNTY _______________ LANE (IF APPL) ____________________

BRIDGE DECK CONSTRUCTION CHECK LIST
TO BE COMPLETED BEFORE, DURING AND AFTER BRIDGE DECK POURS

****
****
****

THIS REPORT IS TO COMPLETED BY THE
APPROPRIATE PROJECT PERSONNEL
AND COPIES SENT TO
THE CONTRACTOR
AND
MAINTAINED IN
THE PROJECT FILES FOR REVIEW

****
****
****

BRIDGE DECK CONSTRUCTION
PRE-POUR CHECKLIST

CONTRACT	______________	CONTRACTOR	______________
PROJECT	______________	STRUCTURE	______________
REFERENCE	______________	STATION	______________
COUNTY	______________	LANE/SPAN	______________

1. Check forms:
   a. Clean, free of major defects. _______
   b. Mortar tight. _______
   c. Line and grade. _______
   d. Structurally adequate to insure minimum settlement in deck or overhang. _______

2. Check rebar:
   a. Clean. _______
   b. Dimensionally correct. _______
   c. Supported per specs and Standard Drawing STD-9-1. _______
      Note: Overhang may require different supports.
   d. Document rebar quantities in field book. _______

3. Check screed rails and headers for line and grade. _______

4. Check screed for camber, insure is correct for template. _______

5. Make dry run with screed, check for correct slab thickness and rebar clearance. Document thickness and clearances in field book.
   Note: Check mechanical condition of screed. _______

6. Check access to site for concrete trucks, have equipment on hand for towing, grading, etc., if required. _______

7. Check concrete plant:
   a. Up-to-date scales check. _______
   b. Check concrete trucks to be sure on approved list, all revolution counters and water gauges working, and load does not exceed mixing capacity. _______
   c. Insure enough approved trucks available to maintain required pouring rate. _______
   d. Insure adequate supply of aggregates, cement, and additives are on hand for deck pour. _______

8. Check to be sure Contractor has scheduled enough personnel to handle pour, including equipment mechanics. _______

BRIDGE DECK CONSTRUCTION (Cont'd)
PRE-POUR CHECKLIST

9. Have Contractor verify the availability and operability of all necessary equipment, including finishing machines, continuous water source or portable tanks, water distribution equipment, two work bridges, vibrators, sprayers, 12 ft. straightedge and appropriate backup items. _______

10. Obtain material certifications for the curing compound and burlap, and for the polyethylene where applicable. Check to be sure an adequate supply of these curing materials is available. _______

11. Where placement by pumping requires more than one setup, obtain proposed plan from the Contractor showing the locations of the pumping equipment, the location(s) of the leading edge of the concrete pour while repositioning the pumping equipment and a realistic time for each work delay anticipated while repositioning pumping equipment. _______

12. Require the Contractor to designate which of the pumping configurations listed in Subsection 604.17(a) will be used at the end of the discharge line. No exceptions are to be made, other than alternative equipment proposed under Subsection 105.17 and approved in writing by the Division of Structures under the conditions of that Subsection. _______

13. Have the Contractor designate his/her authorized representative who will be present and have the authority to represent the Contractor during the bridge deck pour. _______

14. Hold Pre-Pour Conference to coordinate and confirm above items.
Note: Place copy of Pre-pour conference minutes in project files. _______

INSPECTOR ________________________________

TITLE ________________________________

DATE ________________________________

BRIDGE DECK CONSTRUCTION
CHECKLIST DURING POUR

Answer "Yes" or "No" except as noted and elaborate on "No" answers.

1. Are all concrete trucks on the approved list? _______

2. Is plastic concrete checked several times behind screed for slab depth and rebar cover and documented? _______

3. Do pour, finishing operations and deck finish comply with specifications? _______

4. Do checks of the pour rate indicate it is satisfactory? (at least 20'/hr. along roadway) _______

5. Has the deck been straightedged and any deficiencies corrected? _______

6. Are required tests on concrete made and the data recorded in book and on tickets? _______

7. Is the amount of curing compound checked both before use and after deck pour to determine quantity used? Compute rate and show here in $ft.^2/gal$. _______

8. Is the curing compound applied as soon as the water sheen disappears from the surface of the concrete? _______

9. From a work bridge, is damp burlap placed as soon as surface will support the burlap without undue marring of the concrete? _______

10. After placement, is the burlap immediately wet with a misty spray and kept wet thereafter with a continuously fed soaker hose? _______

11. Is the burlap properly anchored to provide full protection to the concrete? _______

INSPECTOR ______________________________

TITLE ______________________________

DATE ______________________________

BRIDGE DECK CONSTRUCTION
POST POUR CHECKLIST

1. Check curing process every day to be sure deck is kept wet.
   Note: Suggest checking early A.M., midday, and late P.M., at a minimum. _______

2. Check bridge deck for deficiencies using 12' straightedge and/or profilograph as required by specifications and have contractor make necessary corrections. _______

3. Review "Pre-Pour" and "During Pour" checklists and observations, give written instructions to Contractor concerning any unsatisfactory conditions of deficiencies to insure these are not repeated on next pour. _______

4. Place copy of all checklists, Pre-Pour Conference minutes, and instructions to Contractor in project file. _______

INSPECTOR ____

TITLE ____

DATE ____

FACTORS THAT ADVERSELY AFFECT DECK CONSTRUCTION

I. Failure to Conduct Proper Pre-pour Inspections
   a. Inadequate use of pre-pour conferences.
   b. Insufficient checking of screed ordinates, header profiles, screed rail profiles, condition of equipment, forming, slab thickness and bar reinforcement cover.
   c. Non-compliance with Section 511 of the Special Provisions and insufficient knowledge of current contract documents.
   d. Inadequate dry run with screed to check slab thickness and bar reinforcement cover.
   e. Failure to take strong positive corrective action.
   f. Failure to observe and adhere to plan notes requiring that all elevations and dimensions on structures to be widened be verified in the field prior to ordering materials.

II. Condition of Equipment
   a. Poor Maintenance.
   b. Inadequate backup system.
   c. Inability to vary speed of screed strike-off mechanism and travel speed of screed independently.
   d. Lack of adequate review of equipment condition.

III. Improper Use of Screeds
   a. Failure to keep concrete raked down in front of screed.
   b. Failure to make more than one pass with a longitudinal screed.
   c. A & B above adversely affects deck profile and deck finish.

IV. Failure to Meet the Minimum Required Concrete Placement Rates
   a. Concrete Supply Problems
      i. Inadequate delivery
      ii. Failure to receive a uniform or consistent concrete mix.
   b. Concrete Placement Problems
      i. Inability to strike-off concrete in a timely fashion in order to straightedge and achieve corrective work that may be necessary.
      ii. Failure to achieve adequate final finish and curing.
      iii. Failure to achieve a reasonable concrete placement rate contributes to shy deck thickness and bar reinforcement cover.

V. Failure to Read and Have Current Knowledge of Contract Documents

VI. Lack of Sufficiently Trained and Experienced Personnel on the Part of the Department of Transportation and the Contractor.

Concrete Certified Technicians

CONCRETE PRODUCER ______________________________ LOCATION: _________________________

TECHNICIAN QUALIFICATIONS

Concrete Field Testing Technicians *(TDOT Level 1 or equivalent)*		
Name	**Certification Number**	**Expiration Date**

Concrete Plant Technicians *(TDOT Level 2 or equivalent)*		
Name	**Certification Number**	**Expiration Date**

Concrete Mix Design Technicians *(TDOT Level 3 or equivalent)*		
Name	**Certification Number**	**Expiration Date**

Concrete Constituent Materials

CONCRETE PRODUCER _______________________________ **LOCATION:** __________________________

MATERIALS, SOURCES, LOCATIONS

MATERIAL	TYPE/BRAND	PRODUCER	LOCATION
Coarse Aggregate 1			
Coarse Aggregate 2			
Coarse Aggregate 3			
Coarse Aggregate 4			
Fine Aggregate 1 (Nat.)			
Fine Aggregate 2 (Nat.)			
Fine Aggregate 3 (Mfg.)			
Fine Aggregate 4 (Mfg.)			
Cement (specify Type)			
Flyash (specify Class)			
Slag (specify Grade)			
Water Reducer			
Retarder			
Accelerator			
Reducer/Retarder			
High-Range Reducer			
High-Range Reducer/Retarder			
Air Entrainer			
Latex Modifier			
Fibers			
Lithium Nitrate			
Corrosion Inhibitor			
Coloring			

REVISED: 2/26/09

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
DIVISION OF MATERIALS AND TESTS
6601 CENTENNIAL BLVD.
NASHVILLE, TENNESSEE 37243-0360

SAMPLE

CONTRACTOR MATERIAL CERTIFICATION
AND/OR
SAMPLING AND TESTING RECORD

☐ Original Sample ☐ Check Sample

Project Reference No.	STP-M-1234(5)	County	MONTGOMERY Region 3
Project No.	12345-6789-10	Contract No.	1234
Contractor	Bob Jones	Heat No.	Size
Date Sampled	12-Jan-03	Date Received at Lab	13-Jan-03
Identification	see below	Date Reported	14-Jan-03
Submitted by	John Smith	Sampled by	Bill Smith
Sampled from	Certifications	Amount Represented	see below
Producer	Kern Brothers	Location	Clarksville
Manufacturer	see below	Location	Atlanta, GA
Lab Serial No.	A123	Report No.	34-234

ITEM NUMBER	DESCRIPTION, FIELD USE AND/OR LAB USE	QUANTITY
	PAVEMENT MARKING SHEETS	
716.05.20	SHERWIN WILLIAMS - WHITE PAINT - BATCH NO.	
716.05.20	M2501	560 GAL
716.05.20	M3171	23 GAL
716.05.20	M2681	5 GAL
	TOTAL	588 GAL
	SHERWIN WILLIAMS - WHITE PAINT - BATCH NO.	
716.05.20	M2991	296 GAL
716.05.20	M1701	78 GAL
716.05.20	M2971	40 GAL
	TOTAL	414 GAL
	INCIDENTAL ITEMS:	

Bob Jones
Contractor's Personnel Signature

THE CONTRACTOR MUST FILL OUT THIS PORTION PROVIDED THE MATERIAL IS PROPERLY CERTIFIED BUT IS NOT PROJECT IDENTIFIED. A NOTARIZED SIGNATURE IS REQUIRED.

I hereby certify that the above referenced material to be incorporated into this project is represented by the attached manufacturer's certification.

Contractor/Employee Signature Billy Bob Company B.B. Construction Co.

Sworn to and subscribed before me this 20th day of January 20 03

WITNESSED BY: Jim Williams My commission expires on 23-Dec-05

Notary Public

JIM WILLIAMS MONTGOMERY COUNTY TENN. NOTARY PUBLIC AT LARGE

T.D.O.T. Use Only

This materials accepted by certification and visual inspection.

Accepted By: Project Inspector **OR** John Smith Project Supervisor

Reviewed By: Robert Head Regional Materials and Tests

This material ☑ meets ☐ does not meet the requirements of the specification for see item numbers above

Tested by Approved Engr. Of Materials and Tests

Form DT-0044 (Rev. 10-02)