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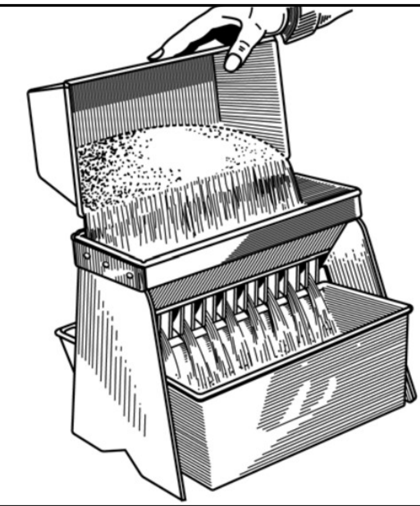

AGGREGATE TECHNICIAN COURSE

Division of Materials and Tests

2024

Aggregate Technician Course

2024 Manual

Table of Contents

WELCOME!

Aggregate Testing Technician Course

1

Purpose of Certification

- To ensure proper performance of tests
- To improve reliability of results
- For quality control
- To comply with federal requirements

2

Course Highlights

- Slide presentations
- Written Exam (No Phones Allowed)
  - Closed Book – Multiple Choice
  - Must get 70% overall to pass
- Performance Exam
  - Closed Book
- Results
- Recertification - Every 5 years

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3

Course Highlights Recertification

- Attend respective course as needed
- Written Assessment REQUIRED
  - ≥80 requires no performance/demonstration
  - 70-79 requires performance/demonstration
  - ≤69 requires course to be repeated
- Performance/Demonstration
  - Proficient at ALL test methods per course requirements
  - Nonproficient requires performance/demonstration to be repeated

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4

Course Highlights

- TDOT & CEI/Industry
  - Course & Written Assessment
  - Performance/Demonstration Assessment(s)
    - CEI/Industry
      - Same Day
    - TDOT
      - REQUIRED within 6 months of course

5

Resources

- Course materials
  - Course manual
  - Presentation slides and videos
- TDOT
  - 2021 Standard Specifications
  - Supplemental Specifications
  - Special Provisions
  - https://www.tn.gov/tdot/materials-and-tests.html

6

ADA Notice of Requirements

- To be in compliance with TDOT's requirements listed on the website above, it is our goal to provide reasonable accommodations to those who identify themselves as having a disability and request such accommodations
- Please feel free to bring it to any of the course instructors and accommodations will be administered as discretely as possible
- Can be found at the following website:
  - https://www.tn.gov/tdot/government/g/ada-office0.html

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7

Tell Us About Yourself

- Who are you?
- Where do you work?
- What experience do you have?

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8

Questions

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9

1

Quality Assurance & Quality Control

Introduction to

Quality Control & Quality Assurance

References

Standard Specifications

Standard Operating Procedure (SOP)

FHWA-HIF-07-004

10

FHWA Definition of QC / QA

- Quality Control (QC)
  - A set of activities conducted by the contractor to monitor the process to ensure that the concrete will meet or exceed the QA test requirements
- Quality Assurance (QA)
  - A set of activities conducted by the owner to ensure that the product delivered complies with the specifications
- How often should TDOT discover failing material?
  - Rarely if ever

11

Quality Control Program (Producer)

- Training
  - Every person (TDOT, Producer, & Contractor) on the project contributes to quality
  - Individuals who oversee producing, sampling, testing, and inspections for quality control must be at least a certified TDOT Aggregate Technician
- Testing Materials
  - Before and after it is produced
  - Individual materials during production
- Quality Control Plan
  - A detailed description of the type and frequency of inspection, sampling, and testing to measure the various properties described in the specifications
  - Procedures to prevent quality deficiencies and actions for when deficiencies occur

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12

Quality Assurance (SOP 1-1: Parts 2 and 3)

- Associated with Acceptance and Verification
- Complies with Code of Federal Regulations
  - 23 CFR 637
- Independent of QC

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13

Quality Assurance Testing (SOP 1-1)

- Quality Acceptance testing shall consist of:
  - Gradation
    - Specific sizing of materials
  - Moisture
    - Measures amount of water in the materials
  - Density
    - Compaction requirements (mass equals weight per volume)
- Refer to SOP 1-1 Part 2: Acceptance Samples and Tests for sampling location, frequency, and who is responsible for various samples.

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14

TDOT Required Training

- TDOT requires each producer to have a certified Aggregate Technician
  - All personnel involved with QA and QC should receive proper training

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15

Record Keeping

- ALL records shall be available and *organized* for review at the facility
  - **A binder including the Quality Control Manual, Aggregate Technician certifications, scale calibrations, qualities, gradations, etc.**
- Proper documentation is a key factor for interpreting data, making informed decisions, and troubleshooting problems that may arise

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16

Acceptance Testing Frequencies (SOP 1-1)

Part Two: Acceptance Samples and Tests

Type of Construction	Material	Test	Sampled By	Frequency	Location or Time of Sampling	Remarks
AGGREGATE						
Aggregate for Underdrains	Aggregate	Gradation	M&T	Per month	Project site or plant stockpile	Project Inspector to notify M&T
Base Courses (Aggregate-Cement OR Aggregate-Lime-Fly Ash)	Aggregate	Gradation	Project Inspector	Every 2,500 tons	Plant stockpile	
		Moisture		Every 2,500 tons or two per day	At time of weighing	First sample should be taken at beginning of day.
	Aggregate-Cement Mixture, & Aggregate-Lime-Fly Ash Mixture	Density, Gauge Moisture		Five tests per 10,000 square-yard lot	Immediately following compaction	
		Thickness		Every 500 linear feet		
Bedding, Backfill	Aggregate for Bridges, Box Culverts, & other major structures	Gradation, Moisture	Project Inspector	At beginning of project and every 2500 tons thereafter (Minimum of 1 per week)	Plant or roadway	
		Density, Gauge Moisture		Three tests per layer	Immediately following compaction	
	Aggregate for Pipe Culverts	Gradation, Moisture		At beginning of project and as material changes	Plant or roadway	
		Density, Gauge Moisture		Per layer every 50 linear feet	Immediately following compaction	
Mineral Aggregate Base	Mineral Aggregate	Gradation, Moisture	Project Inspector	At beginning of project and every 2500 tons thereafter (Minimum of 1 per week)	Plant or roadway	First sample should be taken at beginning of day.
		Density, Gauge Moisture		Five tests per 10,000 square-yard lot	Immediately following compaction	Refer to Section 310 for Conditioning Mineral Aggregate Base

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17

18

2

Aggregate Safety

Aggregate Safety

References

TDOT Lab Guidelines

Mine Safety and Health Administration

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19

Personal Protective Equipment

- Safety Vest
- Safety Glasses
- Hard Hat
- Protective Footwear
- Ear Protection
- Gloves
- Additional safety equipment may be required and should be provided by the facility
  - Fall protection, life vests for boats, etc.

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20

General Safety: Field/Lab

- Abide by facility requirements
  - MSHA at quarries
    - Pit and laboratory
  - OSHA in TDOT Lab
  - Traffic Patterns
- Must be accompanied and escorted by a certified miner at the quarry

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TDOT Lab Requirements

- Safety Glasses

- Protective Footwear

- Gloves (as needed)

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Site Safety

- Site specific training upon first visit per calendar year.
- Sign in/out when:
  - Visiting an aggregate facility
  - Visiting a concrete/asphalt plant on quarry property

VISITOR SIGN-IN / SIGN-OUT LOG

The Federal Mine Safety and Health Act of 1977 requires that all persons (miners) working at any time at a mine must undergo extensive training (30 CFR Part 46.5, 46.6, 46.7, and 46.8). Additionally, all persons visiting a mine site must receive Site-Specific Hazard Awareness Training (30 CFR Part 46.11). Please carefully review the safety rules being provided to you, and sign in and out as provided below each time you arrive at and leave the facility.

DATE	TIME IN	TIME OUT	PURPOSE OF VISIT	COMPANY NAME	INDIVIDUAL'S NAME (Printed)	INDIVIDUAL'S SIGNATURE	Site Specific Training Completed? (Yes/No)

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MSHA Checklist

MSHA Site Specific Hazard Awareness Training Checklist, Training Record and Certification

Quarry/Mine Name:______________________MSHA ID#:__________

Quarry is providing this listing of potential hazards, rules, and regulations to inform and help protect contractors, vendors, visitors, etc. while on our property. Ask an Quarry representative if you do not understand any of this information.

- When entering Quarry property, travel should be limited to the authorized areas where your services are required.
- Quarry company vehicles and equipment always have the Right of Way. CB channel at this operation is ______
- Mobile equipment has blind spots. Do not approach mobile equipment unless authorized, the operator knows you are there and signals that it is okay to approach. Do not park in the blind spots of equipment.
- Traffic pattern in the pit is (Place "X" in correct box): **[ ] left hand [ ] right hand [ ] combination of both**
- Stay at least **300** feet back from equipment on ramps. Equipment in front of you can coast downhill if the engine or drive-line fails. Material can also fall out of loaded trucks in front of you.
- Seat belts must be worn at all times.
- Posted traffic rules and regulations are to be followed at all times. Speed limit is 15 miles per hour unless otherwise posted.
- Do not leave your vehicle unattended. Unattended vehicles must have the controls placed in park and parking brake set. If parked on a grade, the wheels must be chocked or turned into a berm or bank.
- Inspect highwall areas before approaching, do not go past berms or barricades at highwalls. Barricade and report hazards.
- Blasting takes place at this operation. Know the blast signals and go to designated areas. Unless authorized, stay away from blasting/loading operations.
- When working or walking in elevated areas that are not protected by hand rails, a safety harness with lanyard or retractable must be used for fall protection. Use 3 points of contact when climbing.
- Lockout/Tagout: Do not work on any machinery or equipment that has not been stopped and blocked to prevent movement. Electrically powered equipment must be shut off, locked out, tagged out and tried before work commences. Address all energy sources to prevent movement. Replace all guards before operating any equipment. See an Quarry supervisor for specific Lockout/Tagout requirements for the site you are working.
- **If you experience an accident/injury on this property, you MUST immediately report it to an Quarry, supervisor.**
- Other:

...ing Checklist, Training Record and Certification

MSHA ID#:__________

MSHA ID# ______ (if available)

...cific Hazard Awareness Training Checklist, Training ... my being allowed on Quarry property as a contractor, ... this document during this and future visits.

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Emergency Procedures

- Be aware of the facility's emergency procedures

EMERGENCY TELEPHONE NUMBERS

Ambulance
Rescue Squad
Fire
Police/Sheriff

911

Quarry Manager	Phone Number
Quarry Supervisor	Phone Number
General Plant Superintendent	Phone Number
Area Manager	Phone Number
Safety & Health Manager	Phone Number

THIS LOCATION IS

QUARRY
Address

Telephone:

EMERGENCY ACTION PROCEDURES

PIT, SHOP AND PLANT AREAS

1. SOUND ALARM BY WORD OF MOUTH (including CB and two-way radios).
2. EVACUATE BUILDINGS OR STRUCTURES BY THE NEAREST EXIT AS APPROPRIATE (personnel doors, roll-up doors, stairs, or ladders).
3. START RESCUE PROCEDURES
   A. GET HELP.
   B. START FIRST AID.
   C. CALL 911.
   D. CALL PLANT MANAGER, AREA MANAGER, AND SAFETY AND HEALTH MANAGER.
4. POST AT LEAST ONE PERSON AT THE MAIN ENTRANCE GATE.
   A. DIRECT RESCUE PERSONNEL.
   B. PARK ALL CUSTOMER & CONTRACT HAUL TRUCKS where they will not block access by rescue vehicles.
   C. STOP ALL NON-ESSENTIAL PERSONNEL: Tell Media Personnel this is private property, to please wait off to the side. The Designated Media Contact will make a statement as soon as possible.
5. ASSEMBLE ALL PERSONNEL AT EMPLOYEE PARKING LOT IF NOT INVOLVED IN HELPING RESCUE PERSONNEL. DETERMINE WHO IS NOT PRESENT AND WHERE THEY ARE LOCATED.
6. SET UP A SECOND PERIMETER LINE (as close as reasonable for conditions).
   A. DIRECT RESCUE PERSONNEL.
   B. STOP ALL NON-ESSENTIAL PERSONNEL.

SEVERE WEATHER EMERGENCY PROCEDURES

SEVERE STORM/TORNADO WATCH ISSUED

1. SCALE HOUSE WILL MONITOR AND UPDATE MANAGEMENT OF STORM PROGRESS.
2. INFORM ALL QUARRY LOCATIONS (Pit, Primary, etc.) OF POSSIBLE STORM THREAT.

SEVERE STORM/TORNADO WARNING ISSUED

1. SECURE ALL ITEMS THAT COULD BECOME AIRBORNE DURING THE STORM.
2. UNPLUG AND WATERPROOF ALL ELECTRICAL CABINETS.
3. SHUT DOWN AND HAVE PERSONNEL TAKE SHELTER IN DESIGNATED LOCATION(S).
4. *DESINGATED LOCATION FOR TORNADO WILL BE IN THE PRIMARY OR SAND SURGE TUNNELS*

ACTIVITY DURING THE STORM

1. STAY IN DESIGNATED LOCATION, AWAY FROM WINDOWS & ELECTRICAL EQUIPMENT.

ACTIVITY AFTER THE STORM

1. ORGANIZE SURVEY OF PLANT DAMAGE CAUSED BY THE STORM.
   A. TAKE PICTURES OF ANY DAMAGE TO EQUIPMENT OR STRUCTURES.
   B. PREPARE DAMAGE REPORT AND SEND TO AREA OPERATIONS MANAGER.

STORM MESSAGES

Storm Update - Information about severe storms that may impact this site's operations.

Severe Storm/Tornado Watch - Issued when there is a threat of severe storm conditions.

Severe Storm/Tornado Warning - Issued when it is expected that damaging winds, rain, hail or lightning will hit the area. Final preparations should be made immediately to protect life and property.

Storm All Clear - Used when the danger from a particular storm appears to have passed.

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Daily Workplace Examination

- MSHA Regulation
- To be completed if individual will be working in a particular area
- Coordinate with aggregate operation

56.18002 Examination of working places. (a) A competent person designated by the operator shall examine each working place at least once each shift before work begins or as miners begin work in that place, for conditions that may adversely affect safety or health. (b) A record of each examination shall be made before the end of the shift for which the examination was conducted. The record shall contain the name of the person conducting the examination; date of the examination; location of all areas examined, and description of each condition found that may adversely affect the safety or health of miners and is not corrected promptly. (c) When a condition that may adversely affect safety or health is not corrected promptly, the examination record shall include, or be supplemented to include, the date of the corrective action. (d) The operator shall maintain the examination records for at least one year.

Plant/Quarry Name:__________

Date:__________ Shift:__________

This record verifies that I examined the working place(s) listed below for conditions adversely affecting safety or health.

______Pit and Highwall Areas	______Primary Crusher Area	______Secondary Plant Area
______Sand Plant Area	______Wash Plant Area	______Tertiary Plant Area
______Pug Mill Area	______Stockpile/Loadout Areas	______Roads and Entrances
______Berms	______Stripping Area	______Overburden Dump
______Drill/Blast Area	______QC Lab	______Shop
______Fuel Area	______Pump/Sump Area	______Other______

List specific areas inspected if needed (i.e. entire area not inspected):__________

Describe each condition found that may adversely affect the safety or health of miners that is not promptly corrected. Promptly notify miners about the adverse conditions described below before they are potentially exposed. Once the adverse condition is corrected, you must note the date of correction.

Description of Adverse Conditions	Date of Correction

Name of Examiner:__________ Date:__________

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27

3

Introduction to Aggregates

Introduction to Aggregates

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28

Introduction Video

https://www.youtube.com/watch?v=qWEci7TbjBk&feature=youtu.be

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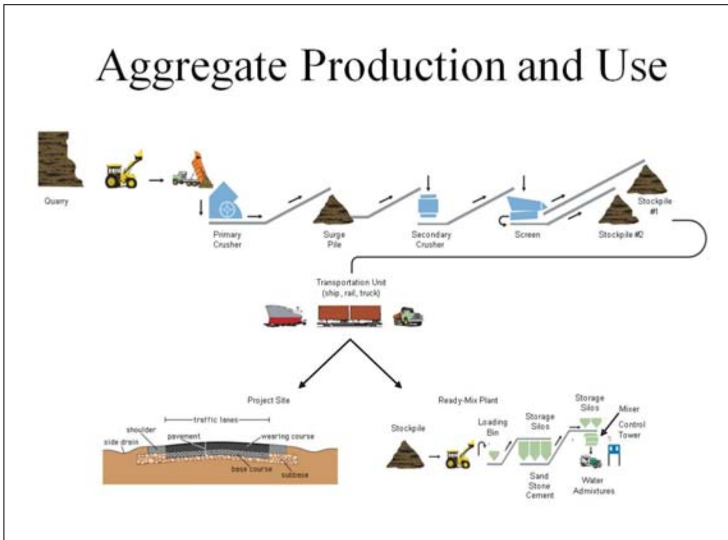
29

Aggregate Production and Use



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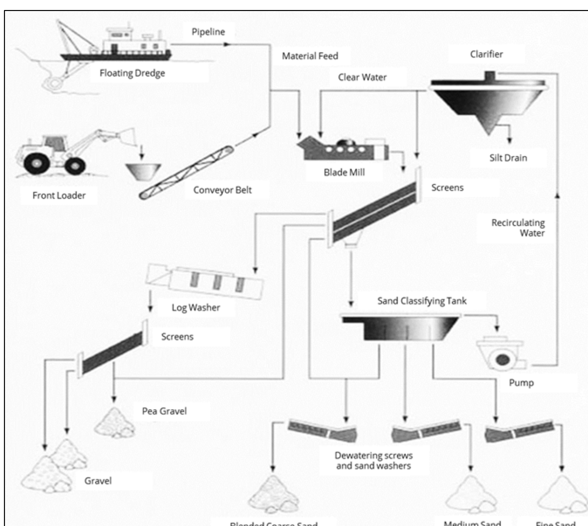
30

Aggregate Production and Use



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31

Aggregate Sizes (Coarse & Fine)

- Coarse aggregate is **retained** on the No. 4 sieve
- Fine aggregate **passes** the No. 4 sieve

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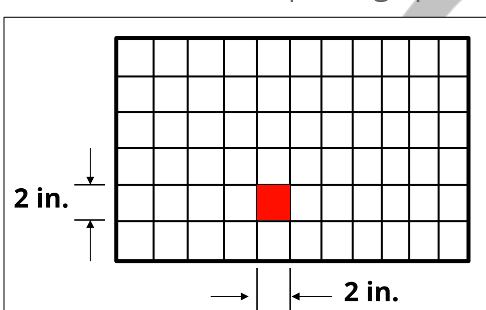
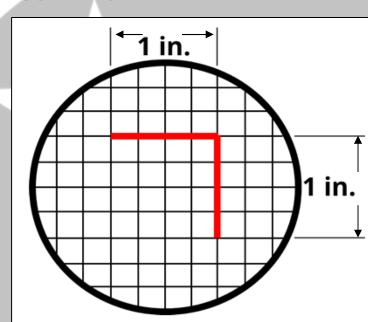
Sieves

- Separates aggregate of different sizes
- Size designation by either:
  - Nominal sieve opening
  - Number of openings per linear inch





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Size of Aggregate

- **Maximum size** of aggregate is the smallest sieve opening through which the entire amount of aggregate is required to pass
- **Nominal maximum size** of aggregate is the smallest sieve opening through which the entire amount of the aggregate is permitted to pass

Size	Nominal Size, Square Openings	Amount Finer than Each Laboratory Sieve (Square Openings), Percent by Weight														
		4"	3-1/2"	3"	2-1/2"	2"	1-1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 16	No. 50	No. 100
57	1" - No. 4	--	--	--	--	--	100	95 - 100	--	25 - 60	--	0 - 10	0 - 5	--	--	--

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34

Size of Coarse Aggregate

Size	Nominal Size, Square Openings	Amount Finer than Each Laboratory Sieve (Square Openings), Percent by Weight														
		4"	3-1/2"	3"	2-1/2"	2"	1-1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 16	No. 50	No. 100
1	3-1/2" - 1-1/2"	100	90 - 100	--	25 - 60	--	0 - 15	--	0 - 5	--	--	--	--	--	--	--
2	2-1/2" - 1-1/2"	--	--	100	90 - 100	35 - 70	0 - 15	--	0 - 5	--	--	--	--	--	--	--
24	2-1/2" - 3/4"	--	--	100	90 - 100	--	25 - 60	--	0 - 10	0 - 5	--	--	--	--	--	--
3	2" - 1"	--	--	--	100	90 - 100	35 - 70	0 - 15	--	0 - 5	--	--	--	--	--	--
357	2" - No. 4	--	--	--	100	95 - 100	--	35 - 70	--	10 - 30	--	0 - 5	--	--	--	--
4	1-1/2" - 3/4"	--	--	--	--	100	90 - 100	20 - 55	0 - 15	--	0 - 5	--	--	--	--	--
467	1-1/2" - No. 4	--	--	--	--	100	95 - 100	--	35 - 70	--	10 - 30	0 - 5	--	--	--	--
5	1" - 1/2"	--	--	--	--	--	100	90 - 100	20 - 55	0 - 10	0 - 5	--	--	--	--	--
56	1" - 3/8"	--	--	--	--	--	100	90 - 100	40 - 85	10 - 40	0 - 15	0 - 5	--	--	--	--
57	1" - No. 4	--	--	--	--	--	100	95 - 100	--	25 - 60	--	0 - 10	0 - 5	--	--	--
6	3/4" - 3/8"	--	--	--	--	--	--	100	90 - 100	20 - 55	0 - 15	0 - 5	--	--	--	--
67	3/4" – No. 4	--	--	--	--	--	--	100	90 - 100	--	20 - 55	0 - 10	0 - 5	--	--	--
68	3/4" - No. 8	--	--	--	--	--	--	100	90 - 100	--	30 - 65	5 - 25	0 - 10	0 - 5	--	--
7	1/2" – No. 4	--	--	--	--	--	--	--	100	90 - 100	40 - 70	0 - 15	0 - 5	--	--	--
78	1/2" - No. 8	--	--	--	--	--	--	--	100	90 - 100	40 - 75	5 -25	0 - 10	0 - 5	--	--
8	3/8" - No. 8	--	--	--	--	--	--	--	--	100	85 - 100	10 - 30	0 - 10	0 - 5	--	--
89	3/8" - No. 16	--	--	--	--	--	--	--	--	100	90 - 100	20 - 55	5 - 30	0 - 10	0 - 5	--
9	No. 4 - No. 16	--	--	--	--	--	--	--	--	--	100	85 - 100	10 - 40	0 - 10	0 - 5	--
10	No. 4 - 0[(1)]	--	--	--	--	--	--	--	--	--	100	85 - 100	--	--	--	10 - 30

(1) Screenings

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35

Let's Review!

- What type of aggregate is retained on the No. 4 sieve?
- How many openings are there per linear inch on a No. 4 sieve?
- What is the nominal maximum size?

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36

Questions

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37

4

Sampling of Aggregates

AASHTO R 90

ASTM D75

TDOT Standard Method of Test for

Sampling of Aggregates

References

Standard Specifications

AASHTO R 90

ASTM D75

38

Purpose

- Proper sampling is critical
- Reasons for sampling aggregate:
  - Preliminary investigation of the potential source
  - Control of the product at the source
  - Control of the operations at the site of use
    - Project site
    - Asphalt or Concrete Plant
  - Acceptance or rejection of the materials

39

Equipment

- Shovel, Scoops
- Brushes
- Sampling Tubes
- Belt Template
- Mechanical Sampling Systems
- Sample Containers
- Tags

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40

Minimum Field Sample Size

Nominal Maximum Aggregate Size	Minimum Field Sample Mass, lbs
#8	22
#4	22
3/8"	22
½"	35
¾"	55
1"	110
1 ½"	165
2"	220
2 ½"	275
3"	330
3 ½"	385

Methods of Sampling

- Flowing aggregate stream
- Conveyor belt
- Stockpiles
  - With power equipment
  - Without power equipment
- Roadways
- Transportation units

42

Flowing Aggregate Stream

- 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

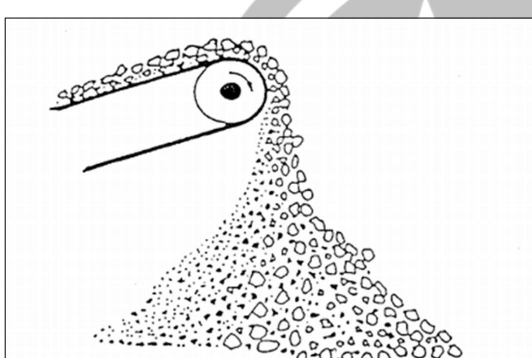
43

Conveyor Belt

- Three increments
- Production must be suspended while sampling
  - Lockout-tagout is an MSHA requirement!
- All material within sampling area is removed including fines (with a brush)
  - Templates useful for defining sampling area

Stockpiles

- Stockpiles have a tendency to segregate during their construction
  - Segregation is the separation of varying sizes of aggregate



With Power Equipment

- After re-blending, loader enters stockpile with bucket approximately 6 in. above ground level
- Loader bucket is raised perpendicular to the ground
- Bucket is tilted forward to roll material out into a separate stockpile

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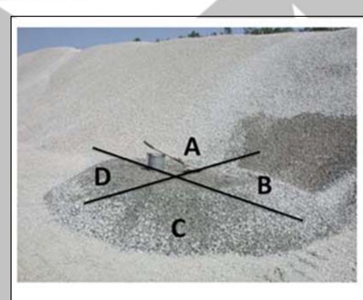
With Power Equipment

- The loader is then used to backblade the smaller stockpile one time
- Divide the sample pad into four quadrants and sample equal amounts
- Avoid sampling within 1 ft of sample pad edge
- The four increments are then combined to comprise the final field sample



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With Power Equipment

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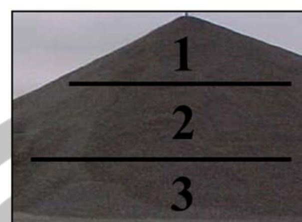
48

Without Power Equipment

- Three increments
  - Visually divide stockpile into three even sections
- Portions are obtained from each section at least 12 in. below the surface by removing the outer layer of material
- A producer may not allow people on stockpiles for safety reasons



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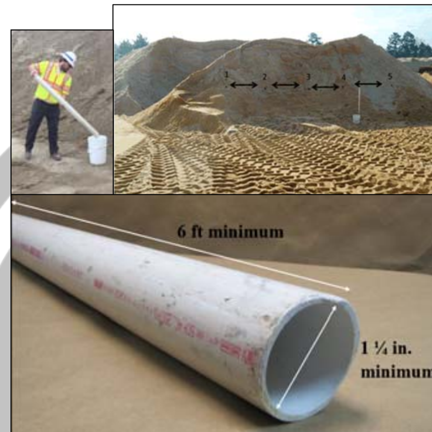
49

Sampling Tubes (Fine Aggregate)

- Five increments
  - Tube insertions randomly spaced across the stockpile
- Sample shall be taken at a minimum height of 3 ft from the surrounding grade



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50

Roadways

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

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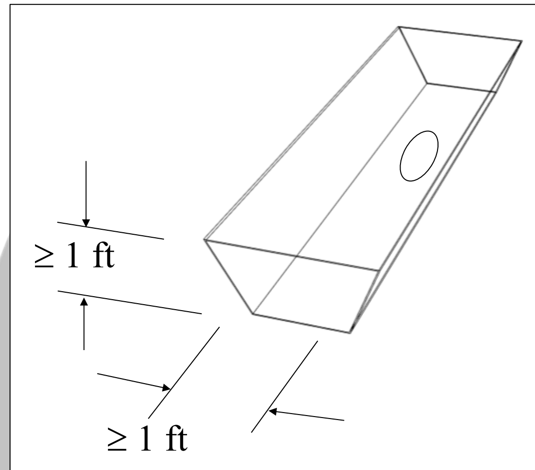
51

Transportation Units

- Three increments
  - Three or more trenches
- Applicable for:
  - Railroad cars
  - Barges
  - Trucks



Sample Containers

- OSHA requirement
  [≤ 50 lbs]
- Use an appropriate container for the test to be performed
  - Durable
  - Moisture proof
- Portion the sample if necessary

Number of Sample Containers

$$Containers = (Field\ Sample\ Mass) \div (50\ lbs)$$

$$Containers_{3"} = (330\ lbs) \div (50\ lbs)$$

Nominal Maximum Aggregate Size	Minimum Field Sample Mass, lbs
#8	22
#4	22
3/8"	22
½"	35
¾"	55
1"	110
1 ½"	165
2"	220
2 ½"	275
3"	330
3 ½"	385

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54

Labeling a Sample

- Tagging
- Directly on container

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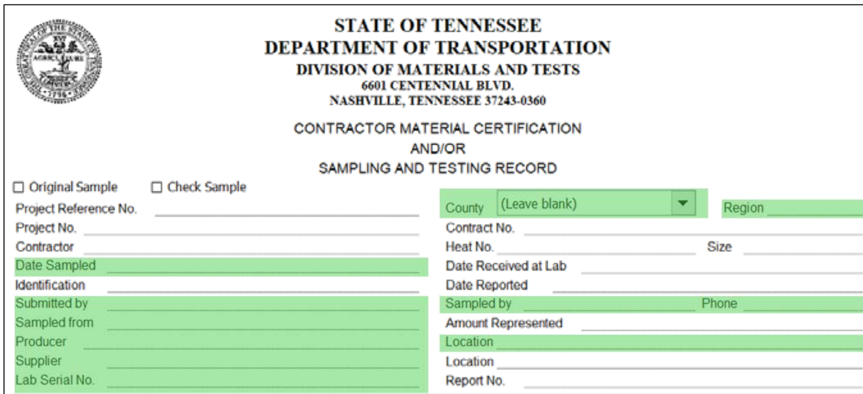
55

Submitting a Sample



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

CONTRACTOR MATERIAL CERTIFICATION
AND/OR
SAMPLING AND TESTING RECORD

☐ Original Sample ☐ Check Sample

Project Reference No.	County (Leave blank) Region
Project No.	Contract No.
Contractor	Heat No. Size
Date Sampled	Date Received at Lab
Identification	Date Reported
Submitted by	Sampled by Phone
Sampled from	Amount Represented
Producer	Location
Supplier	Location
Lab Serial No.	Report No.

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56

Let’s Review!

- If sampling from an aggregate stream, how many increments must you take?
- How many inches should a loader’s bucket be off the ground when taking aggregate from a stockpile?
- Name two methods of labeling your sample once it has been stored in a container.

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57

Questions

58

5

Reducing Samples of Aggregate to Testing Size

AASHTO R 76

ASTM C702

TDOT Standard Method of Test for

Reducing Samples of Aggregate to Testing Size

References

Standard Specifications

AASHTO R 76

ASTM C702

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Purpose

- It may not be practical to use the entire field sample for a particular test
- Properly reducing the field sample to the required test size will ensure it remains a representative sample

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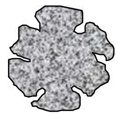
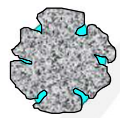
Moisture Conditions

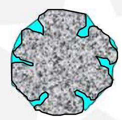
- Dry



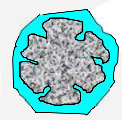
- Moist



- Saturated-Surface-Dry (SSD/Absorption)



- Wet/Free Moisture



Size of Aggregate

- Coarse

- Fine

- Combined

Determine Method

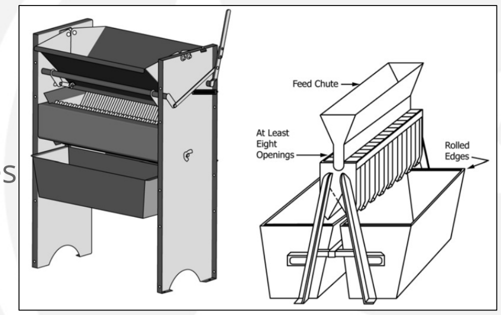
Aggregate Size / Moisture	Coarse	Combined	Fine
SSD and drier	A, B	A, B	A
Free moisture on surface	A, B	B	B, C

Splitting Method

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

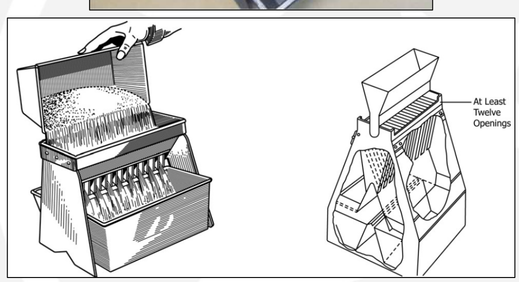
Method A – Mechanical Splitter

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



Method A – Mechanical Splitter

- Fine Aggregate setup
- At least 12 chutes
  - Even number of chutes
  - Chutes of equal width
  - Individual chutes ½ in. to ¾ in. wide



Method B – Cone and Quarter

Mix by rolling on canvas

Flatten aggregate pile to a diameter 4 to 8 times the thickness

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Method B – Cone and Quarter

Divide the aggregate into four separate quarters using a shovel or stick

Remove two diagonally opposite quarters including fines

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Method B – Cone and Quarter

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Method C - Miniature Stockpile

- Five increments using a scoop or spoon

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Let's Review

- What does SSD stand for?
- When can you use miniature stockpiling as a method of reducing your sample?
- How many chutes should you have in your mechanical splitter when sampling coarse aggregates and fine aggregates?
- When using the Cone and Quarter method, what diameter should you flatten your cone to?

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?

Questions

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6

Total Evaporable Moisture Content of Aggregate by Drying

AASHTO T 255

ASTM C566

TDOT Standard Method of Test for

Total Evaporable Moisture Content of Aggregate by Drying

References

Standard Specifications

AASHTO T 255

ASTM C566

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Purpose

- Accurately determine how much water is in the aggregate
- Used to make moisture corrections for batching concrete
- Indicates to asphalt producers how much water they will have to dry
- Standard Specification 303.14.B
  - TDOT will deduct weight of material in excess of 3% of optimum moisture content

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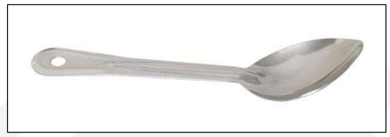
Equipment

- Balance
- Heat Source
- Sample Container
- Stirring Spoon
- Brush
- Gloves



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.

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Samples (Wet and Dry)

Determine Sample Mass

- Weigh the sample to the nearest 0.1%

Example

- Wet mass: 6286 g

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Dry the Sample

- Dry the aggregate to a constant mass in an oven at 230 ± 9°F
- Constant mass is reached when the sample weight changes <0.1% from the previous measurement
- When not using an oven, stir periodically to accelerate drying and prevent local overheating
- Allow the material to cool

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Reweigh the Sample

- Weigh the sample to the nearest 0.1%

Example

- Dry mass: 6164 g

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Moisture Content (MC) Calculations

$$MC(\%) = \frac{(M_{Original} - M_{Dry})}{M_{Dry}} \times 100$$

$$MC(\%) = \frac{(W - D)}{D} \times 100$$

Example:

$$MC(\%) = \frac{(6286 - 6164)}{6164} \times 100 =$$

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Problem

Given:

- Weight of the original sample (W) = 1206 g
- Weight of sample after drying (D) = 1132 g

Determine:

- Total Moisture Content of the aggregate

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Solution

$$MC(\%) = \frac{W - D}{D} \times 100$$

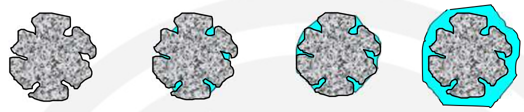
Practice

Sample Number	Original Weight	Dry Weight	$\frac{W-D}{D} x100$	Moisture Content
1	568.3	560.9		
2	1357	1342		
3	924.0	920.3		
4	1828	1739		

Practice

- Determine the percent moisture content in the
  - Wet condition:

DRY	MOIST	SSD	WET
800 g	825 g	865 g	885 g



$$MC(\%) = \frac{(885-800)}{800} \times 100 =$$

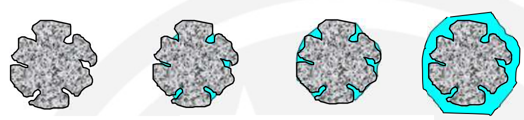
  - SSD (Absorption):

$$MC(\%) = \frac{(865-800)}{800} \times 100 =$$

Practice

- Determine the percent of free moisture on the sample:

DRY	MOIST	SSD	WET
800 g	825 g	865 g	885 g



- OR

Let’s Review

- How long should you dry the aggregate?
- Determine the moisture content of the aggregate if it is 840 g in the wet condition, and 790 g in the dry condition:
- How can you determine the free moisture in an aggregate?

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? Questions

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7

Materials Finer Than #200 Sieve

In Mineral Aggregates by Washing

AASHTO T 11

ASTM C117

TDOT Standard Method of Test for

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

References

Standard Specifications

AASHTO T 11

ASTM C117

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Purpose

- Accurately determine the amount of material finer than No. 200 sieve (dust of fracture)
  - Dust can be separated from larger particles by wet sieving completely and more efficiently as compared to dry sieving
  - Too much dust could be detrimental to concrete and asphalt mixtures

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Equipment

- Balance
- Sieves
  - No. 16 on top to protect
  - No. 200 on bottom
- Container
- Oven
- Wetting Agent
- Mechanical Washer
  - Optional, saves time

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Sample Size

Nominal Maximum Size[A]	Minimum Mass, g
4.75 mm (No. 4) or smaller	300
9.5 mm (3/8")	1000
12.5 mm to 19.0 mm (½" to ¾")	2500
25 mm (1") or larger	5000

[A] Based on sieve sizes meeting Specification E11.

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Dry the Sample

- Dry the aggregate to a constant mass (does not vary more than 0.1%) in an oven at 230 ± 9°F
- Allow the material to cool

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Determine the Sample Mass

- Weigh the sample to the nearest 0.1%

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Two Procedures

- Procedure A - Washing with plain water
  - Dust of Fracture
- Procedure B - Washing using a wetting agent
  - Clay Particles
  - Only use the wetting agent on the first wash

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Procedure

- Place the sample in the container
- Add water to cover the sample
- Add wetting agent if performing Procedure B
- Agitate the sample
  - Use a spoon to stir, if desired
- Ensure complete separation of particles

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Procedure

- Pour the wash water with suspended solids over the nested sieves
- Take care to avoid spilling aggregate

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Procedure

- Repeat the washing with plain water until wash water is clear
- Wetting agent is only used on the first wash

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Alternate Procedures

- Mechanical washing is allowable
- Some samples may degrade in mechanical washers

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Procedure

- Flush material retained on sieves back into container
- Do not splash as this may lose material

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Procedure

- Be sure to wash material off spoon into container
- Do not pour excess water from container
  - Must evaporate by drying

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Dry the Sample

- Dry the aggregate to a constant mass (does not vary more than 0.1%) in an oven at 230 ± 9°F
- Allow the material to cool

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Determine the Sample Mass

- Weigh the sample to the nearest 0.1%

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Percent (P) ≤ No. 200 Calculations

- If the percent (P) of material finer than No. 200 is <u>less than 10%,</u> then report the results to the nearest tenth (0.1)
- If the percent (P) of material finer than No. 200 is <u>greater than 10%,</u> then report the results to the nearest whole number

$$P_{\leq No.\,200} = \frac{(M_{Dry,Before} - M_{Dry,After})}{M_{Dry,Before}} \times 100$$

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Problem

Given:

- Original mass of the sample = 475.6 g
- Mass of the sample after washing = 439.3 g

Determine:

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

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Solution

$$P_{\leq No.\,200} = \frac{(M_{Dry,Before} - M_{Dry,After})}{M_{Dry,Before}} \times 100$$

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Practice

Given:

- Original mass of the sample = 5893 g
- Mass of the sample after washing = 5017 g

Determine:

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

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Solution

$$P_{\leq No.\,200} = \frac{(M_{Dry,Before} - M_{Dry,After})}{M_{Dry,Before}} \times 100$$

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Let's Review!

- When should a wetting agent be used?
- How many times should you repeat washing the aggregate?
- What should you report your results to when the percent of material finer than No. 200 is **less** than 10%?
- What should you report your results to when the percent of material finer than No. 200 is **more** than 10%?

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?

Questions

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8

Sieve Analysis of

Fine & Coarse Aggregates

AASHTO T 27

ASTM C136

TDOT Standard Method of Test for

Sieve Analysis of Fine and Coarse Aggregates

References

Standard Specifications

AASHTO T 27

ASTM C136

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Purpose

- Determine particle size distribution of an aggregate
- Determine compliance of specification requirements
- Quality control of crushing and screening process
- In aggregate products and mixtures, it is useful for determining relationships with porosity and density

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Equipment

- Balance
- Oven
- Sieves
- Mechanical Shaker

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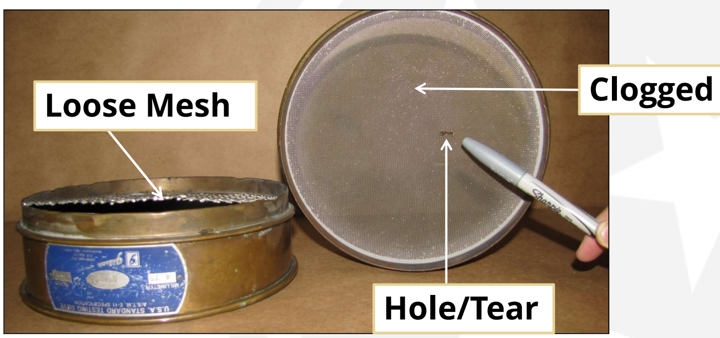
Sieve Selection

- Appropriate sieves <u>must</u>:
  - Provide required sizing information
  - Not be damaged and/or dirty
  - Be capable of regulating the amount on each sieve
    - i.e., prevent overloading of any individual sieve.



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Overloaded Sieve

Prevent overloading by:

- Using larger sieves
- Portioning the sample
- Placing another sieve size in the stack

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Maximum Loading of Sieves

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

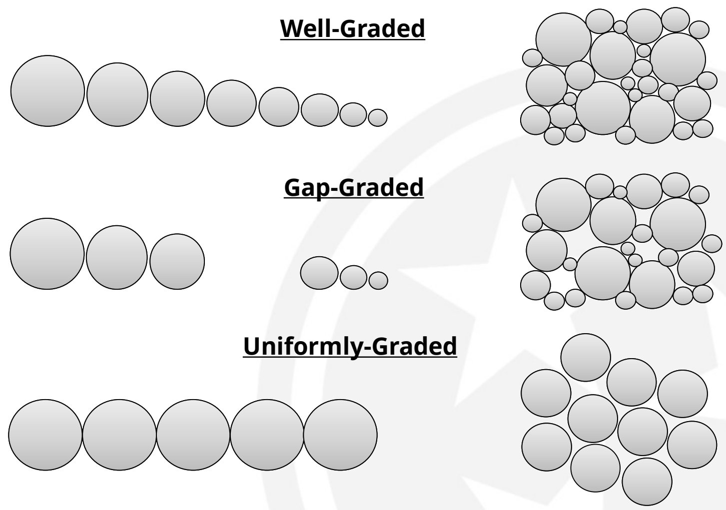
Sieve Opening Size	Nominal Dimensions of Sieve[a]				
	203.2-mm, dia[b]	254-mm, dia[b]	304.8-mm, dia[b]	350 by 350, mm	372 by 580, mm
	Sieving Area, m^2				
	0.0285	0.0457	0.0670	0.1225	0.2158
125 mm (5 in.)	[c]	[c]	[c]	[c]	67.4
100 mm (4 in.)	[c]	[c]	[c]	30.6	53.9
90 mm (3 1/2 in.)	[c]	[c]	15.1	27.6	48.5
75 mm (3 in.)	[c]	8.6	12.6	23.0	40.5
63 mm (2 1/2 in.)	[c]	7.2	10.6	19.3	34.0
50 mm (2 in.)	3.6	5.7	8.4	15.3	27.0
37.5 mm (1 1/2 in.)	2.7	4.3	6.3	11.5	20.2
25.0 mm (1 in.)	1.8	2.9	4.2	7.7	13.5
19.0 mm (3/4 in.)	1.4	2.2	3.2	5.8	10.2
12.5 mm (1/2 in.)	0.89	1.4	2.1	3.8	6.7
9.5 mm (3/8 in.)	0.67	1.1	1.6	2.9	5.1
4.75 mm (No. 4)	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 sieves is based on an effective diameter 12.7 mm (1/2 in.) less than the nominal frame diameter, because ASTM E11 permits the sealer between the sieve cloth and the frame to extend 6.35 mm (1/4 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 (1/4 in.).

[c] Sieves indicated have less than five full openings and should not be used for sieve testing.

Aggregate Gradation



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Test Sample Size

7.3 *Fine Aggregate*—The size of the test sample, after drying, shall be 300 g minimum.

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)

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Dry the Sample

- Dry the aggregate to a constant mass (does not vary more than 0.1%) in an oven at 230±9°F
- Allow the material to cool

Determine the Sample Mass

Mechanical Shaker

- Shake thoroughly
  - Agitating for more than 10 minutes may degrade the sample

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Weigh Sieves Cumulatively

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AASHTO Loss

- AASHTO Loss $= \frac{Original\ Sample\ Wt. - Total\ Cumulative\ Wt.}{Original\ Sample\ Wt.} x\ 100$

- AASHTO Loss must be ≤ **0.3%** of the original sample mass

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Calculations

- Cumulative %Retained = $\frac{Cumulative\ Wt\ \ Retained}{Original\ Sample\ Wt} x\ 100$

- Cumulative %Passing = 100 – Cumulative %Retained

- Report percentages to the nearest whole number

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Sample Problem #1

- AASHTO Loss = $\frac{Original\ Sample\ Wt\ -Total\ Cumulative\ Wt}{Original\ Sample\ Wt}\ x\ 100$

Natural Sand for Concrete	
Original Sample Weight (g)	503.5
Sieve Size	Cumulative Weight Retained
No. 4	0.0
No. 8	49.0
No. 16	146.0
No. 30	259.0
No. 50	368.0
No. 100	466.0
No. 200	494.0
Pan	503.0

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Sample Problem #1

- AASHTO Loss = $\frac{Original\ Sample\ Wt\ - Total\ Cumulative\ Wt}{Original\ Sample\ Wt}\ x\ 100$

1. $503.5g - 503.0g = 0.5\ g$
2. $0.5g \div 503.5g = 0.00099$
3. $0.00099 \approx 0.001$
4. $0.001 \times 100 =$

Natural Sand for Concrete	
Original Sample Weight (g)	503.5
Sieve Size	Cumulative Weight Retained
No. 4	0.0
No. 8	49.0
No. 16	146.0
No. 30	259.0
No. 50	368.0
No. 100	466.0
No. 200	494.0
Pan	503.0

Sample Problem #1

- Max AASHTO loss = 0.3%
- 0.1% ≤ 0.3%
- This aggregate sample is within tolerance

Natural Sand for Concrete	
Original Sample Weight (g)	503.5
Sieve Size	Cumulative Weight Retained
No. 4	0.0
No. 8	49.0
No. 16	146.0
No. 30	259.0
No. 50	368.0
No. 100	466.0
No. 200	494.0
Pan	503.0

Sample Problem #1

Original Sample Weight	503.5 g

Original Data

Sieve Size	Cumulative Wt Retained (g)	Cumulative %Retained	Cumulative %Passing	Specification 903.01	Meets? Yes/No
No. 4	0.0			95 - 100	
No. 8	49.0			-	
No. 16	146.0			50 - 90	
No. 30	259.0			-	
No. 50	368.0			5 - 35	
No. 100	466.0			0 - 20	
No. 200	494.0			0 - 3	
Pan	503.0			-	

$$Cumulative\ \%\ Retained = \frac{Cumulative\ Wt\ Retained\ (Sieve\ Size)}{Original\ Sample\ Weight} * 100$$

Fineness Modulus (FM)

- Numerical value to indicate fineness of aggregate
  - Higher fineness modulus means material is more coarse
- Aggregate with same fineness modulus will require the same quantity of water to produce a mix of the same consistency and strength
- For concrete sand, 2.3 - 3.1 is specified

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FM Sample #1

- Add Cumulative Percent Retained on
  - **No. 100**
  - **No. 50**
  - **No. 30**
  - **No. 16**
  - **No. 8**
  - **No. 4**
  - **3/8 in.**
  - **¾ in.**
  - **1 ½ in.**
  - **3 in.**
- Divide by 100

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	

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Sample Problem #2

- AASHTO Loss = $\frac{Original\ Sample\ Wt\ - Total\ Cumulative\ Wt}{Original\ Sample\ Wt.} x\ 100$

#57 Limestone	
Original Sample Weight (lbs)	25.60
Sieve Size	Cumulative Weight Retained
1 1/2 in.	0.00
1 in.	0.00
3/4 in.	0.60
1/2 in.	8.80
3/8 in.	16.50
No. 4	24.30
No. 8	24.60
Pan	25.40

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Sample Problem #2

- AASHTO Loss $= \frac{Original\ Sample\ Wt\ - Total\ Cumulative\ Wt}{Original\ Sample\ Wt.} x\ 100$

- AASHTO Loss $= \frac{(25.60 - 25.40)}{25.60} x\ 100$

#57 Limestone	
Original Sample Weight (lbs)	25.60
Sieve Size	Cumulative Weight Retained
1 1/2 in.	0.00
1 in.	0.00
3/4 in.	0.60
1/2 in.	8.80
3/8 in.	16.50
No. 4	24.30
No. 8	24.60
Pan	25.40

Sample Problem #2

Original Sample Weight	25.60 lbs

Sieve Size	Cumulative Wt Retained (lbs)	Cumulative %Retained	Cumulative %Passing	Specification 903.22	Meets? Yes/No
1 ½ in	0.00			100	
1 in	0.00			95 - 100	
¾ in	0.60			-	
½ in	8.80			25 - 60	
3/8 in	16.50			-	
No. 4	22.30			0 - 10	
No. 8	24.60			0 - 5	
Pan	25.40			-	

$$Cumulative\ \%\ \ Retained = \frac{Cumulative\ Wt\ Retained\ (Sieve\ Size)}{Original\ Sample\ Weight} * 100$$

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Let’s Review!

- Agitating for more than ___ minutes can degrade the sample?
- What is the maximum allowable AASHTO loss?
- The higher the fineness modulus , the ______ the aggregate is.

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Questions

TN TDOT Department of Transportation

9

Aggregate Quality Testing

Specific Gravity

References

Standard Specifications

AASHTO T 84 & T 85

ASTM C127 & C128

TN TDOT Department of Transportation

Purpose

- Weight-Volume Conversions
- Identifying Deleterious Materials
  - e.g. shale or chert
- Mining Operations/Planning
- Void Calculations

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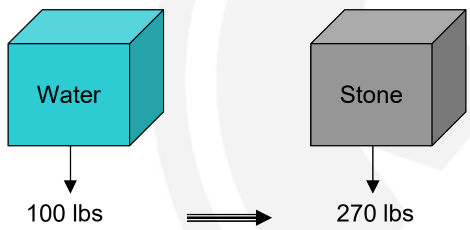
Specific Gravity

- Ratio of aggregate weight to the weight of an equal volume of water
  - Dimensionless number (i.e., no units attached)
- Example:
  - Specific Gravity = 2.70 means that the rock weighs 2.70 times an equal volume of water



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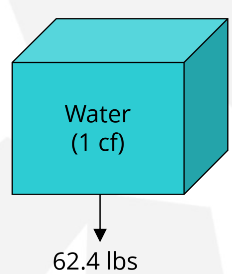
Specific Gravity

$$Specific\ Gravity = \frac{Weight}{Volume \times (Unit\ Weight\ of\ Water)}$$

Unit Weight of Water = 62.4 pcf =



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Recording Specific Gravity

- If not otherwise specified, specific gravity results shall be reported to the nearest 0.001
  - Specific gravity for concrete aggregate may be reported to the nearest 0.01

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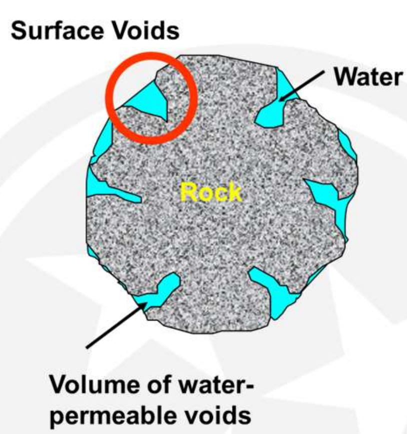
Rock and Water

Considerations:

- Rock has weight
- Rock takes up space (volume)
- Absorbed Water has weight
- Absorbed Water takes up space (volume)



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Types of Specific Gravity

- Apparent
  - Rarely useful in concrete or asphalt mix designs
  - Used for conversions from surveyed volumes to calculate tons
- Bulk Saturated Surface Dry
  - Used in concrete mix designs to account for absorbed water
- Bulk
  - More common value
  - Used in Superpave design

All three types of specific gravity can be calculated using one test

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Sodium Sulfate Soundness

References

Standard Specifications

AASHTO T 104

ASTM C88

Soundness Test

- Test that estimates aggregate's "soundness" by saturating in **sodium sulfate solution** and drying
  - Simulates weathering under exposure
  - 5 cycles
  - Aggregate loss is tracked

Soundness

- Sound aggregate can help prevent pavement distresses:
  - Aggregate pop-outs
  - Asphalt raveling
  - Freeze-Thaw damage

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TDOT Soundness Specifications

Specification	Description	Max Loss, %
Asphalt Aggregates		
903.11	Surface (Coarse)	9.0
903.06	Base & Leveling (Coarse)	9.0
903.11	Surface (Fine)	12.0
903.06	Base & Leveling (Fine)	12.0
Concrete Aggregates		
903.03	Coarse	9.0
903.01	Fine	10.0
903.19	Lightweight	9.0
Base Aggregates		
903.05	Type A	15.0
903.05	Type B	20.0
Miscellaneous		
203.02	Borrow (GSR)	12.0
205.04	Embankments (Solid Rock Fill)	12.0
709.02	Riprap	12.0
921.07	Masonry Stone	12.0
--	ASTM D692*	12.0

**Materials referring to ASTM D692 adhere to this quality unless specified differently*

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L.A. Abrasion

References

Standard Specifications

AASHTO T 96

ASTM C131

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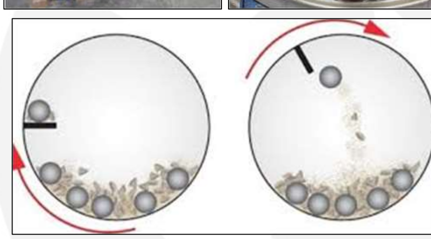
What is L.A. Abrasion?

- Measure of a coarse aggregate's resistance to degradation after undergoing a combination of abrasion, grinding, and impact
- Widely used to indicate relative quality among aggregate sources

Average 416 g



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L.A. Abrasion

- Abrasion resistant aggregate can help prevent pavement distresses:
  - Aggregate pop-outs
  - Asphalt raveling
  - Settlement of base stone

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TDOT L.A. Abrasion Specifications

Specification	Description	Max Loss, %
Asphalt Aggregates		
903.11	Surface	40
903.06	Base & Leveling	50
Concrete Aggregates		
903.03	(Coarse)	40
903.01	(Fine)*	40
903.19	Lightweight	40
Base Aggregates		
903.05	Type A	50
903.05	Type B	50
903.05	RCA	50
Miscellaneous		
	ASTM D692**	40

** Applies to source material for manufactured fine aggregate (Limestone or Dolomite)*

*** ASTM D692 applies to coarse fractions (per ASTM D448) unless specified otherwise. Crushed Blast Furnace Slag not to be tested.*

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Questions

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10

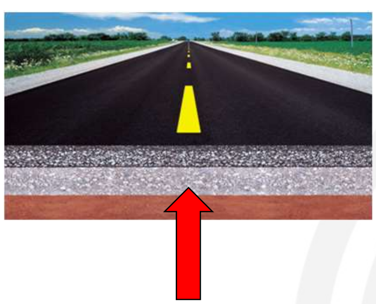
Base Stone

Base Stone

References

Standard Specifications

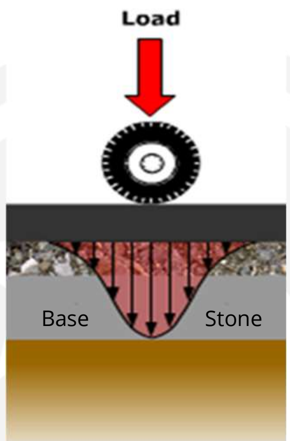
Base Stone



Base Stone Layer

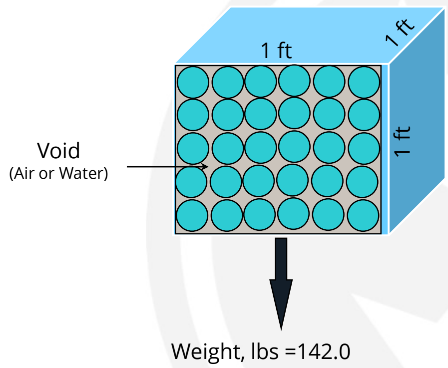
Purpose

- Protect the subgrade
  - A load-bearing layer to help transition the load from the surface to the subgrade
- Protect the pavement system from water intrusion and deformation



Density

- Density of an Aggregate is Defined as Weight per Unit Volume
  - Pounds per Cubic Foot (pcf) = *lbs/ft*^{3}



Influences of Density

- Moisture
- Gradation
- Particle Shape
- Construction Foundation
- Compactive Effort
  - Type of compactor

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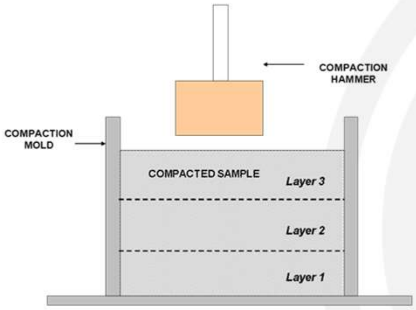
Moisture – Density Relationship

- Moisture-Density Relationship
  - AASHTO T180: Standard proctor density and optimum moisture content determination



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Moisture Influences

- Too Wet
  - Base is “soupy” & water pushes particles apart
- Too Dry
  - No lubrication to enhance compaction
- Just Right
  - Particles move easier and voids replaced with solid particles

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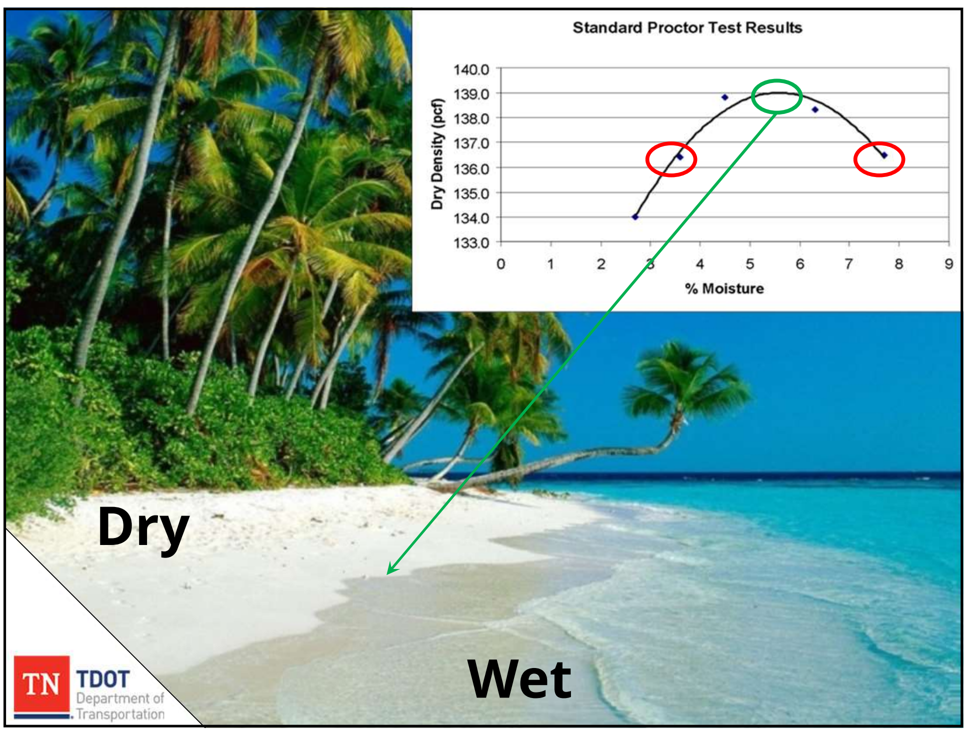

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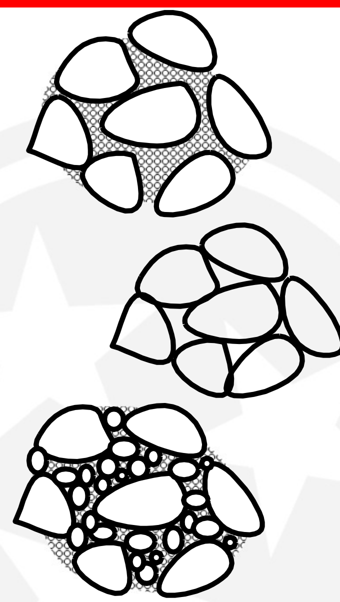
Gradation Influence

- Too Fine
  - Coarse particles float in fines
- Too Coarse
  - Excessive voids & lower internal friction
- Just Right
  - Well-graded material with well-proportioned particle distribution



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Gradation Influence

Table 903.05-2: Grading Table for Type A and Type B Aggregate for Mineral Aggregate Base and Surface Courses

Sieve Size	Total Percent by Weight, Passing Sieves				
	Grading A	Grading B	Grading C	Grading D	Grading E
2-1/2 inch	100	--	--	--	--
2 inch	95-100	100	--	--	--
1-1/2 inch	--	95-100	100	100	--
1 inch	--	--	90-100	85-100	100
3/4 inch	--	65-95	--	60-95	90-100
3/8 inch	35-65	--	45-74	50-80	65-100
No. 4	--	35-55	30-55	40-65	--
No. 16	--	15-45	--	20-40 (1)	--
No. 100	0-10	4-15	4-15	9-18 (2)	5-15

(1) For gravel and chert bases containing clay, the range is 20-43.

(2) For gravel and chert bases containing clay, the range is 7-18.

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Particle/Foundation Influences

- Particle Shape

- Construction Foundation

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Compaction Influences

- Too Little
  - Particles are not tightly packed together
- Too Much
  - Breakdown particles
  - Generate fines
  - Coarse float in fines matrix
- Good Compaction leads to good performance

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Questions

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11

TDOT Surface Aggregates

TDOT Surface Aggregates

References

Standard Specifications

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Purpose

- Increase safety
  - Some aggregates tend to polish
  - Maintain quality frictional properties throughout the life of a pavement or bridge

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TDOT Friction Testing Program

- Continually evaluate aggregate & track performance over time
- Research new material & products such as high friction surfaces
- Able to identify low friction routes through TDOT's Friction Program

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TN Geology

West

Sedimentary
Limestone
Siliceous -- Quartz Gravels and Sands

Middle

Sedimentary
Carbonate Rocks -- Limestone
Siliceous-Rich Limestones

East

Sedimentary	Igneous
Carbonate Rocks -- Limestone and dolomites	Granites in Upper East
Siliceous Rocks -- Sandstones, Quartzites	

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Approved Surface Aggregate Sources

Revised: Wednesday, August 17, 2022

Region 1 - Surface Aggregates

Producer	Location	Type	Material
Blue Water Industries (Elizabethton)	Elizabethton, TN	1	Quartz
Duracap Materials (Goins Hollow)	Tazewell, TN	4	Limestone
Harrison Construction (APAC)	Waynesville, NC	1	Granite
Maymead	Mt. City, TN	1	Granite
Newport Sand & Gravel	Newport, TN	1	Pea Gravel & Sand
Rogers Group	Caryville, TN	4	Limestone
Tube City IMS	Knoxville, TN	1	Slag
Vulcan Materials	Enka, NC	1	Granite
Vulcan Materials (Greystone)	Greeneville, TN	1	Pea Gravel & Sand

Region 2 - Surface Aggregates

Producer	Location	Type	Material
Copperhill Quarry	Copperhill, TN	1	Slag
Harrison Construction (APAC)	Hayesville, NC	1	Granite
Harrison Construction (APAC)	Cherokee County, NC	1	Granite
Martin Marietta	Dallas, GA	1	Granite
Midsouth Aggregates	Dallas, GA	1	Granite
Rogers Group	Allons, TN	1	Sandstone
Rogers Group	Englewood, TN	2	Limestone
Rogers Group	Algood, TN	3	Limestone
Vulcan Materials	Blairsville, GA	1	Granite
Vulcan Materials	Cartersville, GA	1	Granite
Vulcan Materials	Ellijay, GA	1	Granite

Region 3 - Surface Aggregates

Producer	Location	Type	Material
Arcosa	Brooks, KY	1	Lightweight
Rogers Group	Cross Plains, TN	2	Limestone
Rogers Group	Gordonsville, TN	4	Limestone
Rogers Group	Hickman Co. (Bon Aqua), TN	2	Limestone
Rogers Group	Lawrenceburg, TN	2	Limestone
Rogers Group	Tanner, AL	2	Limestone
Rogers Group - TN River Sand & Gravel	Linden, TN	1	Gravel
Volunteer Sand & Gravel	Hurricane Mills, TN	1	Gravel
Vulcan Materials	Clarksville, TN	2	Limestone
Vulcan Materials	Dickson, TN	2	Limestone
Vulcan Materials	Pleasant View, TN	3	Limestone
Vulcan Materials	Springfield, TN	2	Limestone

Region 4 - Surface Aggregates

Producer	Location	Type	Material
Ford Construction	Troy, TN	1	Gravel
IMS (Delta Contracting)	Jackson, TN	1	Slag
J.R. Hayes Construction	Buchanan, TN	1	Gravel
Martin Marietta	Malvern, AR	1	Granite
Memphis Stone & Gravel	Arlington, TN	1	Gravel
Memphis Stone & Gravel	Hernando, MS	1	Gravel
Metro Materials	Memphis, TN (Rozelle St)	1	Gravel
Standard Construction	Byhalia, MS	1	Gravel
Standard Construction	Collierville, TN	1	Gravel
Standard Construction	Millington, TN	1	Gravel
Standard Construction	Stantonville, TN	1	Gravel
Standard Construction	Como, MS	1	Gravel
Tomahawk Materials	Crump, TN	1	Gravel
Trap Rock & Granite	Ironton, MO	1	Granite

TDOT Surface Aggregates Program

Type	Applications	Min Silica Dioxide SiO_2(1) (%)	Max Calcium Carbonate $CaCO_2$(1) (%)	Min Acid Insol.(2) (%)	Min 9-Hour BPN(3)	Traffic Test Section for Approval
I	All Pavements	40	32	50	30	N/A
II	All Pavements	30	N/A	35	30	20,000 ADT(4) min. for two (2) years, OR 7.3 million vehicle passes per test lane for min. two (2) years (4-lane rural interstate, Max. ADT(4) 35,000 allowable)
III	Non-Interstate < 15,000 ADT(4)	20	N/A	25	25	20,000 ADT(4) min. for two (2) years, OR 7.3 million vehicle passes per test lane for min. two (2) years (non-interstate)
IV	2-Lane < 5,000 ADT(4)	10	N/A	N/A	22	10,000 ADT(4) min. for two (2) years, OR 3.65 million vehicle passes per test lane for min. 2 years (non-interstate)

(1)ASTM C25
(2)ASTM D3042
(3)AASHTO T 278, T 279
(4)ADT = Average Daily Traffic

Approval Component

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TDOT Surface Aggregates Program

Type	Applications	Min Silica Dioxide SiO_2[(1)] (%)	Max Calcium Carbonate $CaCO_2$[(1)] (%)	Min Acid Insol.[(2)] (%)	Min 9-Hour BPN[(3)]	Traffic Test Section for Approval
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(2)ASTM D3042
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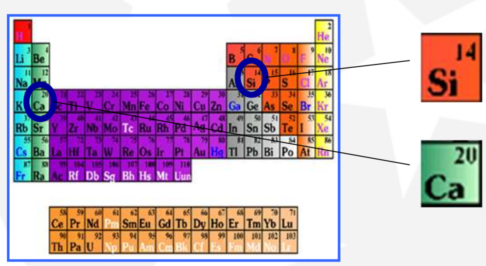
(4)ADT = Average Daily Traffic

Chemistry Component

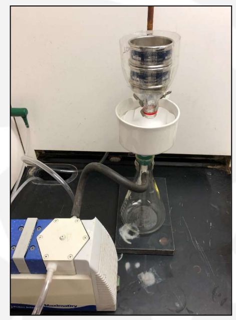
Chemistry

- **Silica Dioxide** is a very hard mineral that resists polishing under traffic. TDOT requires min amount of silica
- **Calcium Carbonate** is the primary mineral in limestone. Limestones tend to polish under traffic. Max amount specified for Type I applications



Acid Insoluble Residue

- Aggregate is exposed to acid solution
- The residue that remains is typically silica, alumina, iron, etc.



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TDOT Surface Aggregates Program

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IV	2-Lane < 5,000 ADT[4]	10	N/A	N/A	22	10,000 ADT[4] min. for two (2) years, OR 3.65 million vehicle passes per test lane for min. 2 years (non-interstate)

[1] ASTM C25
[2] ASTM D3042
[3] AASHTO T 278, T 279
[4] ADT = Average Daily Traffic

Polishing Component

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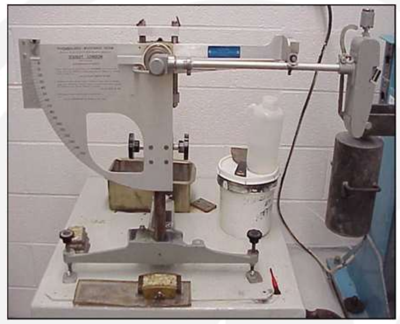
British Wheel & Pendulum

- Simulates traffic

- Measures polishing characteristics



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TDOT Surface Aggregates Program

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(1)ASTM C25
(2)ASTM D3042
(3)AASHTO T 278, T 279
(4)ADT = Average Daily Traffic

Traffic Component

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Surface Aggregates Test Strip

- Test Strips required for Type II, III, & IV surface aggregate
  - All strips have a minimum test time of 2 years
  - Must be ~0.5 mile in both directions without signals or stop signs (≥40 mph)
  - Each type requires a certain amount of traffic to simulate polishing and may need to operate longer to achieve minimum traffic
  - The producer is responsible for finding and coordinating a test strip with the contractor and providing appropriate calculations for ADT

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Surface Aggregates Test Strip

- Test strip will be periodically tested for frictional value throughout the required duration
- After test period, frictional value must exceed 40 to qualify

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Questions

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12

Appendix

Appendix

Contacts

- Regional Contacts
  - Region 1: Brad Baskette - 865-594-4552
  - Region 2: Tony Renfro - 423-510-1190
  - Region 3: Kevin Isenberg - 615-350-4312
  - Region 4: Lindsey Skaggs - 731-935-0216
- HQMT Training Coordinator
  - Kim Whitby – 615-350-4158; Kimberly.Whitby@tn.gov

Regional Safety Contacts

- Region1: Duane Manning - 865-594-4512
- Region 2: Christopher Smith, P.E. - 423-634-2178
- Region 3: Webb Rizor - 615-350-4494
- Region 4: John Thomas - 731-935-0312

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AASHTO/ASTM Resources

- Sampling of Aggregates: R 90/D75
- Reducing Samples of Aggregate to Testing Size: R 76/C702
- Total Evaporable Moisture Content of Aggregate by Drying: T 255/C566
- Materials Finer than #200 Sieve in Mineral Aggregate by Washing: T 11/C117
- Sieve Analysis of Fine & Coarse Aggregate: T 27/C136
- Specific Gravity of Coarse Aggregate: T 85/C127
- Specific Gravity of Fine Aggregate: T 84/C128
- Soundness of Aggregate: T 104/C88
- L.A. Abrasion: T 96/C131

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Resources

- Tennessee Department of Transportation
  - https://www.tn.gov/tdot.html
- American Road & Transportation Builders Association
  - https://www.artba.org/
- Tennessee Road Builders Association
  - www.trba.org/
- Tennessee Ready Mixed Concrete Association
  - www.tnconcrete.org/
- American Association of State Highway Transportation Officials
  - https://www.transportation.org
- American Society for Testing and Materials
  - https://www.astm.org/
- American Concrete Institute
  - https://www.concrete.org/
- Construction Materials Engineering Council
  - https://www.cmec.org/
- Portland Cement Association
  - www.cement.org/

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SOP 2-1

- Approval Procedures
- Quality Monitoring Process
- Facility Removal
- QC Plan
- Surface Aggregate Requirements
- Quality Requirements

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Generic Aggregate QC Plan

- QC Plan layout
- Contact information
- Location map
- Minimum topics to cover

Review Answer Slides

Intro to Aggregates Review

- What type of aggregate is retained on the No. 4 sieve?
  - coarse aggregate
- How many openings are there per linear inch on a No. 4 sieve?
  - 4
- What is the nominal maximum size?
  - The smallest screen size which permits 100% of the sample to pass through.

Sampling Review

- If sampling from an aggregate stream, how many increments must you take?
  - **3**
- How many inches should a loader's bucket be off the ground when taking aggregate from a stockpile?
  - **6 inches**
- Name two methods of labeling your sample once it has been stored in a container.
  - **label/tag –or- written on the container**

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Reducing Review

- What does SSD stand for?
  - **Saturated Surface Dry**
- When can you use miniature stockpiling as a method of reducing your sample?
  - **If the aggregate is fine and wet**
- How many chutes should you have in your mechanical splitter when sampling coarse aggregates and fine aggregates?
  - **At least 8 for coarse and 12 for fine**
- When using the Cone and Quarter method, what diameter should you flatten your cone to?
  - **4 to 8 times the thickness**

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Moisture Content Review

- How long should you dry the aggregate?
  - **Until it reaches a constant mass**
- Determine the moisture content of the aggregate if it is 840 g in the wet condition, and 790 g in the dry condition:
  - **6.3%**
- How can you determine the free moisture in an aggregate?
  - **Find the difference between absorption and total moisture**

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Finer than #200 Review

- When should a wetting agent be used?
  - **When there are clay particles present**
- How many times should you repeat washing the aggregate?
  - **Until the water is clear**
- What should you report your results to when the percent of material finer than No. 200 is **less** than 10%?
  - **The nearest 0.1**
- What should you report your results to when the percent of material finer than No. 200 is **more** than 10%?
  - **The nearest whole number**

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Sieve Analysis Review

- Agitating for more than ___ minutes can degrade the sample?
  - **10**
- What is the maximum allowable AASHTO loss?
  - **0.3%**
- The higher the fineness modulus , the ______ the aggregate is.
  - **Coarser**

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?

Questions

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Materials & Tests Website

https://www.tn.gov/tdot/materials-and-tests.html

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THANK YOU!