

ATT-38/22, SAMPLING, Gravel and Sand**1.0 SCOPE**

This method describes the procedures for obtaining representative samples of gravel, sand, and pit run aggregate for:

- a) Routine testing and quality control or assurance of materials as they are produced in the field, or
- b) Quality Assurance testing, or
- c) Submission to a testing laboratory for specific tests or designs.

2.0 EQUIPMENT

square nosed shovel (*round point shovels not allowed*)
 metal (or plastic) pail(s), or large mixing pan(s) or tarps
 brush and dustpan (for sampling from a conveyor belt)
 board (for stockpile sampling only)
 large canvas bags or 5 gallon plastic pails with lids (for shipping aggregates)
 sample splitter

3.0 PROCEDURE**3.1 General**

All samples are obtained by qualified people. Inexperienced personnel must be fully familiar with the correct sampling procedures before they are allowed to obtain samples without supervision.

Every precaution must be used to obtain samples that show the true nature and condition of the materials which they represent. Care must be taken to prevent contamination of the sample.

Quality control samples shall be obtained during crushing operations. Acceptance of processed aggregates shall take place when they are in their final positions. Sample sources for acceptance testing are shown in Table 1.

Sampling Virgin Aggregates

Designation	Aggregate Type	Acceptance Sample Source
2	Base Course Aggregate	Windrow
3	Seal Coat Aggregate	Stockpile (after washing)
4 and 5	Gravel Surfacing Aggregate	Crusher Discharge
6 and 8	Gravel Fill, Granular Filter Agg.	In-place
7	CSBC Aggregate	Plant Cold Feed

TABLE 1

Aggregate samples from a drum mix plant can only be obtained from the cold feed system at the lower end of the inclined conveyor belt.

Belt or discharge samples must only be taken once the crusher or plant has been running consistently, and with no segregation for at least 10 minutes.

This is roughly the time the material would take from the moment it is introduced to the crusher or plant to the time the same material is discharged. The time period will vary with varying production rates.

3.2 Sample Size

Table 2 below shows the minimum "original" sample sizes for field quality control or quality assurance testing.

TABLE 2	
TESTS REQUIRED	MIN. ORIGINAL SAMPLE SIZE
-25 000 µm Sieve Analysis	1 plastic pail* (25 kg)
-25 000 µm % Fractures	¾ plastic pail (15 kg)
-80 000 µm Sieve Analysis	2½ plastic pails (60 kg)
-80 000 µm % fractures	3 or 2 plastic pails (75, 60, or 35 kg)*
Pit Run Contamination Sieve Analysis	4 plastic pails (100 kg or less)**
Extraction Correction Factor	½ plastic pail (or 10 kg) of each agg. type
* Depending on aggregate topsize **as per ATT-25, Part II	

When submitting samples to a testing laboratory, use the following Table 3 as a guide for sample sizes.

TABLE 3		
TYPE OF AGGREGATE	TESTS REQUIRED	SAMPLE SIZE
CRUSHED AGGREGATE	Sieve Analysis Cement Stabilized Base Course Design Seal Coat Design	1 bag (25 kg) 8 bags (200 kg) 2 bags (50 kg)
PIT RUN	Pit Run Sieve Analysis	3 bags (60 kg)
SAND	Cement Stabilized Base Course Design	8 bags (200 kg)
NOTE: Large canvas bags, or 5 gal. plastic pail, should be two thirds full.		

If sampling for an ACP or ASBC Mix Design, obtain the total sample throughout the longest crushing period possible, but allow enough time for a mix design to be completed before mixing begins.

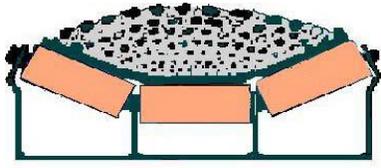
Refer to the Contract Specifications for sampling requirements for ACP and ASBC mix designs.

3.3 Frequency

The Contract Specifications shows the minimum required sampling frequency for quality control testing. For quality assurance testing, refer to the Contract Specifications or Engineering Consultant Standards.

3.4 Conveyors

Sampling aggregate from the conveyor belt of a crusher, asphalt plant or CSBC plant is performed as follows:

1. Once the crusher or plant has been running consistently for at least 10 minutes and the aggregate feed is representative of the pit or stockpile, ***have the belt stopped***. Ensure that the plant operator can see you, and that he knows you will inform him when you are finished taking your sample, so that the belt does not get started up before you are finished taking your sample.
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2. Use a square nosed shovel and remove all the material contained on a one metre length as follows:
 - a) Push the material in from all four sides towards the center, leaving the center high and slightly rounded.
 - b) Transfer the material to a pail until all of the aggregate from the chosen area has been retrieved. Ensure no material is lost in the transfer. If necessary, use a brush and dustpan to remove the finer aggregate.

NOTE: The one metre length has been arbitrarily chosen; for high production conveyors, less length may be used, while for low production conveyors more length may be sampled.

3. If sampling for quality control, combine samples randomly selected throughout the production unit and use the total as the unit sample.

3.5 Chutes (Free-Fall) Using Automatic Sampler

There are also automatic belt sampling devices that have the advantage of sampling the aggregate without stopping the belt.

At the point of discharge, non-uniformly distributed material is free falling either onto another belt, as in the case of asphalt plant cold feed systems and crushers, or onto a stockpile, if sampling from crushers. A representative sample of free falling aggregate consists of a cross-section of the entire flow of the material and is obtained using an automatic sampling device.

There are various types of automatic sampling devices available. With one type, the aggregate is diverted to a chute and then collected onto a tarp or large mixing pan, as shown in Figure 1. If the diversion chute is set too high above the tarp or container, the sample will segregate.

With another device, a container is passed through the flow of material. A container is placed on a chain moved trolley. The sample receiver is passed through the flow of material by turning a crank, as shown in Figure 2.

The speed at which the container is passed through the flow of material should be constant and fast enough to avoid overflowing.

In a third type, a container is **electronically** passed through the flow of material, as shown in Figure 3.

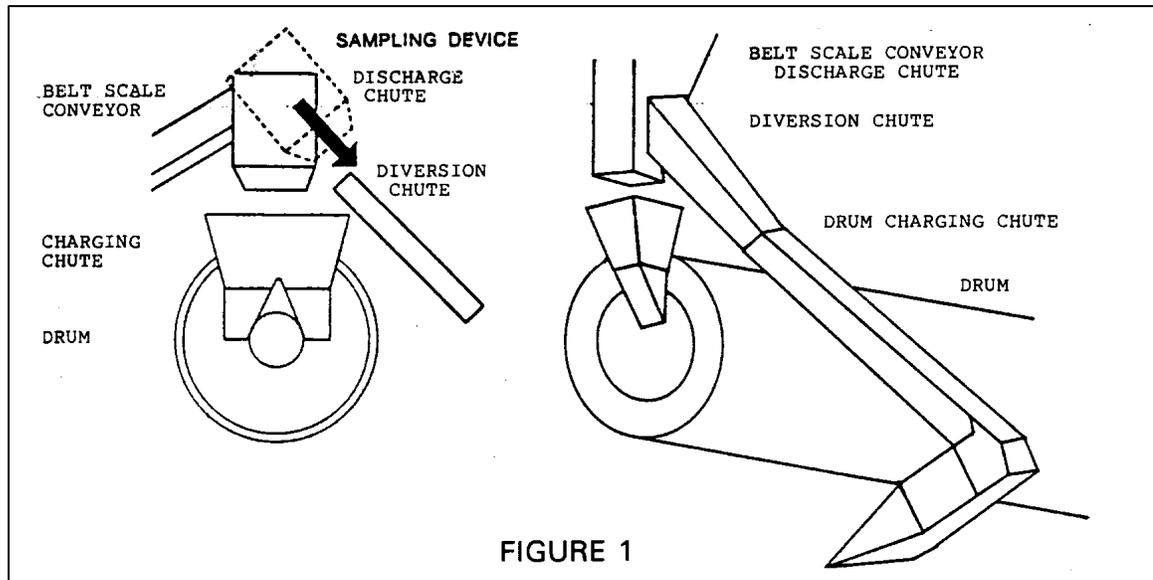


FIGURE 1

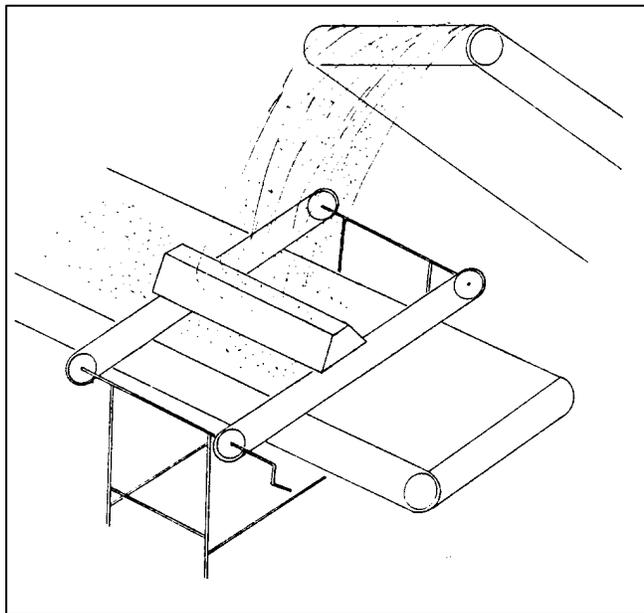


FIGURE 2

When activated, the sample receiver moves from its resting position under the hood of the receiving hopper and towards the flow of the material to be sampled.

The sample receiver then comes around and passes through the flow of material to take the sample. The sample receiver then continues around and dumps the sample into the hopper. The material is collected onto a tarp or large mixing pan. This cycle is continued until the desired amount of material is obtained.

Sample free-falling aggregate using an automatic sampling device as follows:

1. Ensure the plant or crusher has been running consistently for at least 10 minutes.
2. Place a large mixing pan or tarp under the discharge or diversion chute of the automatic sampling device.
3. Activate the sampling device.
4. When sampling is complete, transfer the sampled aggregate to the metal pail, avoiding loss of material.

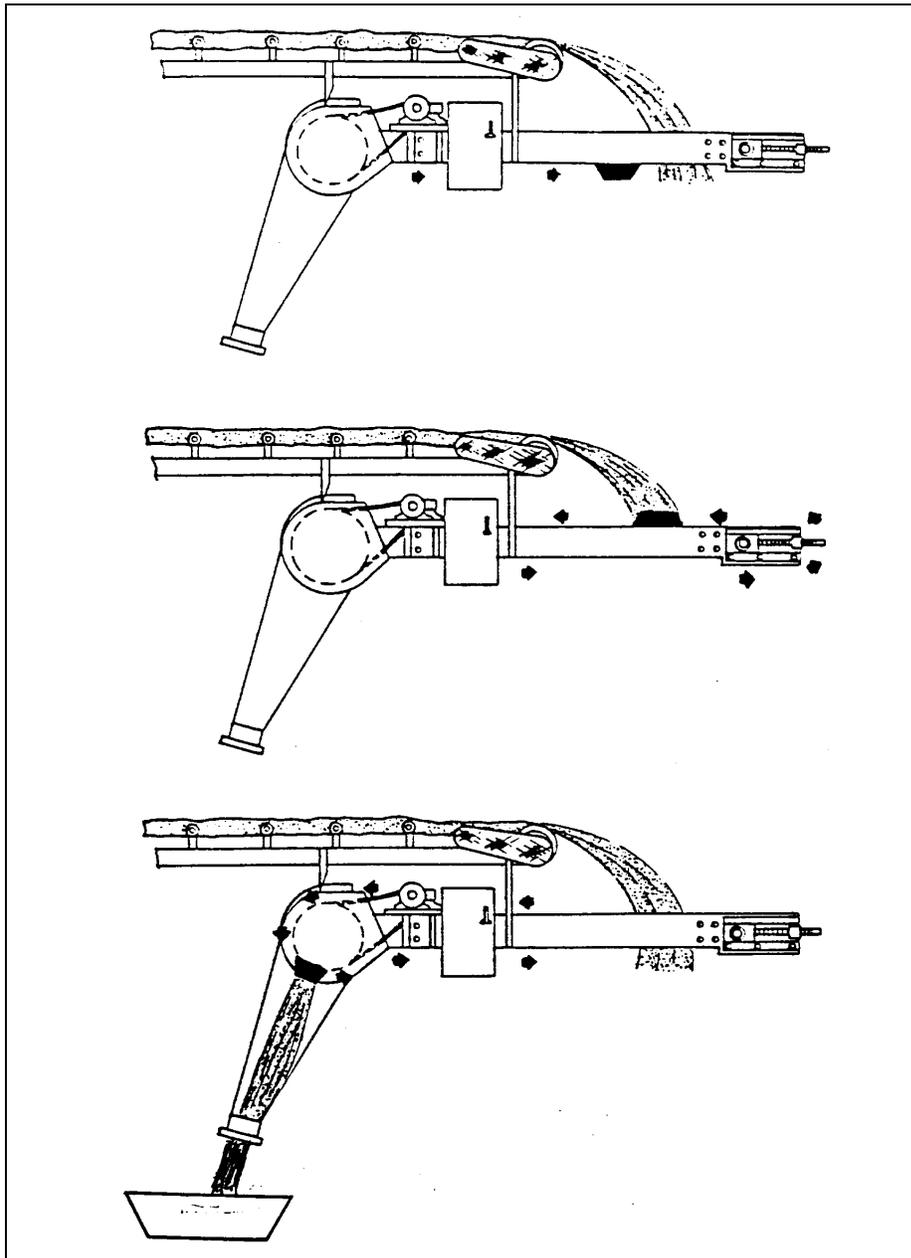


FIGURE 3

5. Repeat steps 2 to 4 above until the minimum required original sample size is obtained.
6. If sampling for field quality control, combine discharged samples randomly selected throughout the production unit and use the total as the unit sample.

3.6 Trucks

Do not sample from trucks for quality assurance testing.

Use a sampling stand to sample the aggregates from haul trucks as follows:

1. Dig a trench approximately 0.3 m wide across the box, from the top of the mound to the side of the box at a point that appears on the surface to be representative of the material.
2. Use a shovel to obtain the material at the bottom of the trench as shown in Figure 4.

SAMPLING FROM A TRUCK BOX

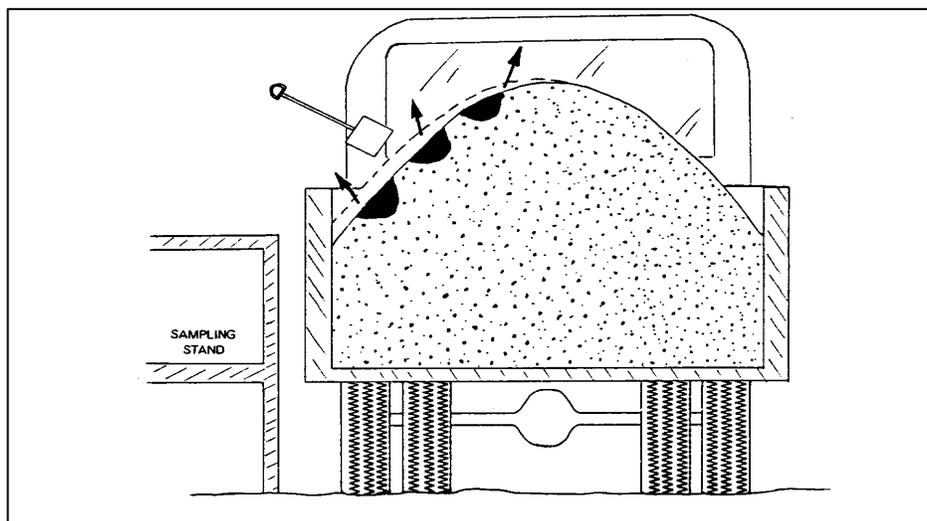


FIGURE 4

3. Place the aggregate in the metal pail, avoiding loss of material.
4. Repeat steps 2 and 3 at about half way up the mound and at near the top of the mound. Obtain equal portions of aggregate from each of the three equally spaced locations. The truck sample is the total material from the three locations and must meet the minimum original sample size requirements.

3.7 Stockpiles

3.7.1 Sampling from Stockpiles built using Conveyors

Getting a sample from a stockpile is not easy, and great care must be taken to obtain a truly representative sample. Segregation usually occurs when the material is stockpiled and the coarser particles will roll to the base of the pile. Samples of coarse aggregates from stockpiles should be taken at or near the top and base, and some intermediate point. To prevent further segregation while sampling, a board may be inserted into the pile just above the sampling area.

Samples of stockpiled crushed aggregate and sand must be taken at 3 separate areas of the pile:

- at, or near, the base of the pile,
- at, or near, the middle of the pile, and
- at, or near, the top of the pile at several areas about the pile,

(as shown in Figure 5)

Sample from stockpiles as follows:

1. Insert a board into the pile just above the point of sampling to prevent segregation during sampling.
2. Dig a step into the pile, discarding the material.
3. Dig into the step and place one shovelful of the aggregate into the metal pail. Avoid loss of material.
4. Repeat steps 1 to 3 at each location, at several areas about the pile, obtaining equal quantities of material from each hole. The aggregate sample is the total material from all holes combined and must meet the minimum original sample size requirement.

SAMPLING AGGREGATE FROM STOCKPILE BUILT USING CONVEYORS

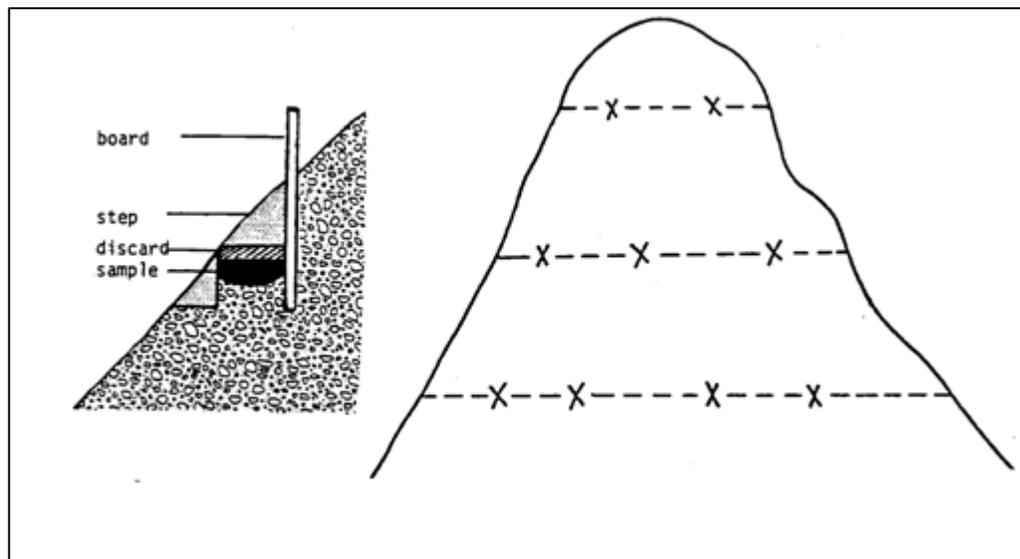


FIGURE 5

Another method of sampling aggregate from a stockpile is with a front-end loader.

- 1) The front-end loader scoops a sample in the bucket starting from the bottom to the top and then dumps the material in a convenient location for sampling. The sample container is then filled by randomly taking samples from around pile of aggregate.

or

- 2) Using a front-end loader, dig into the stockpile at several locations and set aside a small pile of 10 to 15 t of aggregate. When forming the small pile, the loader bucket should be kept as low as possible, and the operator should try and roll the aggregate out of the bucket rather than just rapidly dumping the aggregate. Reducing the distance the aggregate is allowed to free-fall will reduce the amount of segregation that may occur in the small pile. Each additional bucket load of aggregate should be taken and dumped in the same manner as stated above, and should be placed uniformly over the preceding one.
- 3) Thoroughly mix the small pile. Using the loader bucket, go to the end of the oblong pile and roll the material over. Keeping the loader bucket as low as possible, push the bucket into the aggregate until the front of the bucket passes the midpoint of the original pile. The loader bucket should then be slowly raised and rolled forward thus producing a smooth mixing of the material. Go to the opposite end of the pile, and repeat this mixing procedure. If the pile does not appear to be reasonably uniform, additional mixing should be done.
- 4) The pile is now ready for sampling. Do not strike off the top. The sample will be taken at the center of the volume which is approximately one-third of the height of the pile. The sample shall consist of not less than 6 full shovels of material taken at equal increments around the pile. The shovel shall be inserted full-depth horizontally into the material and raised vertically. Care should be taken to retain as much of the material as possible on the blade of the shovel.



3.7.2 Sampling from a Stockpile built using Haul Trucks

Samples of stockpiled aggregate are obtained while the stockpile is being built using haul trucks as follows:

1. Randomly select an individual load.
2. Dig a trough about 0.3 m deep and discard the aggregate, as shown in Figure 6.
3. Sample from the bottom of the trough.

SAMPLING AGGREGATE WHILE BUILDING A STOCKPILE WITH HAUL TRUCKS

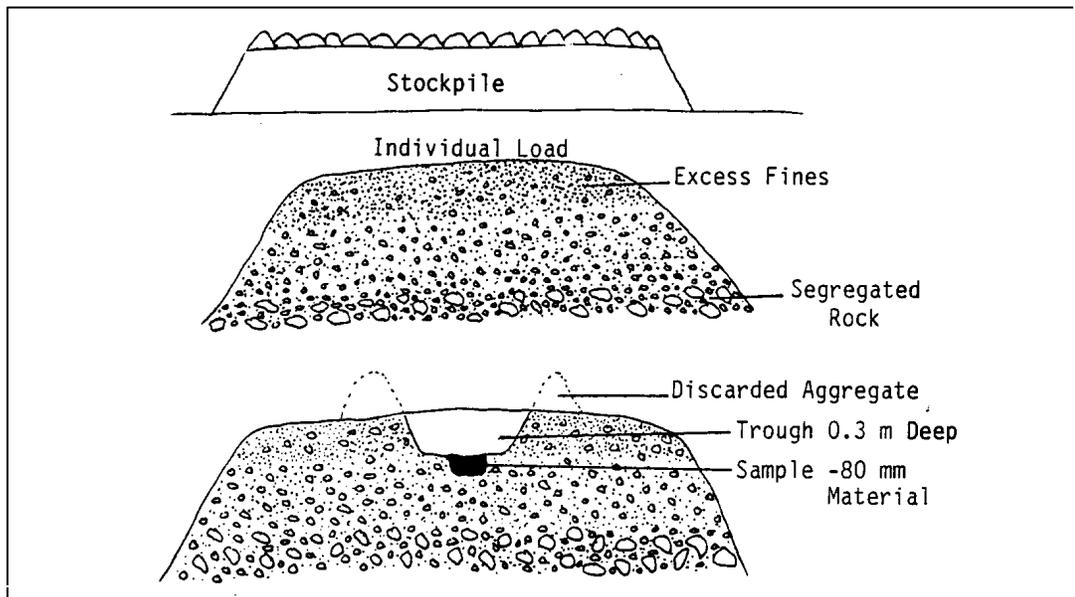


FIGURE 6

3.7.3 Sampling a Pit Run Stockpile as it is Constructed

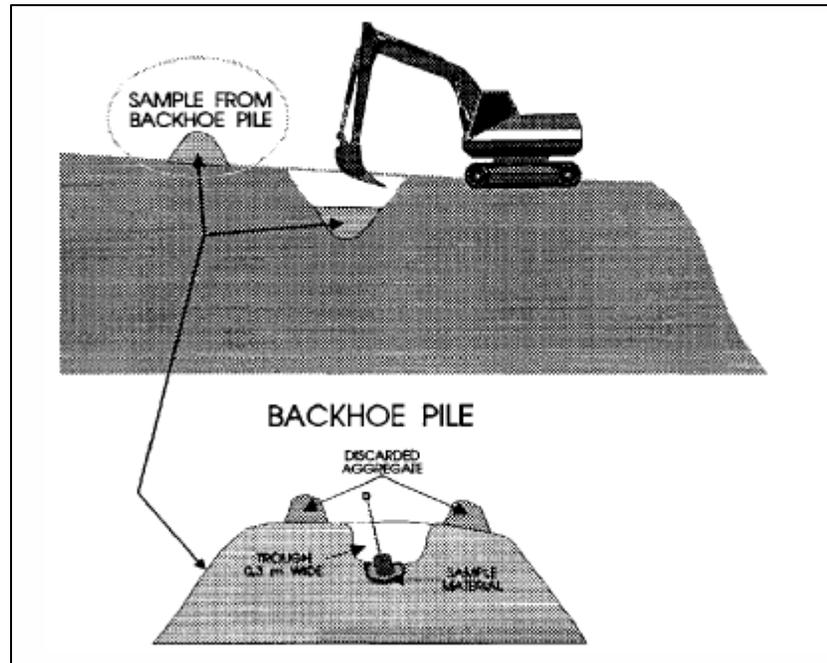
1. Estimate the percentage of oversize (+80,000 μm material) by looking at the face of the deposit.
2. Repeat steps 1 and 2 of Section 3.7.2 and sample from 5 or more randomly chosen truck loads, until a sample of at least 60 kg is obtained. Discard all rock larger than 80 mm.

3.7.4 Sampling an Existing Stockpile using a Backhoe

This procedure is used to confirm the gradation of an existing stockpile. Samples of stockpiled aggregate are obtained from at least 10 different locations using a backhoe on top of and around the stockpile as follows :

1. Dig a hole at approximately 1 metre intervals.
2. Sample from piles of excavated backhoe material, as described in steps 1 and 2 of section 3.7.2.

Figure 7 illustrates this sampling procedure.

SAMPLING AN AGGREGATE STOCKPILE USING A BACKHOE**FIGURE 7****3.8 Sampling Granular Base Course from Windrows**

Granular base course aggregate samples are obtained from windrows for quality assurance sieve analysis testing.

A partial quality assurance testing program is normally used. This program requires one random sample per day of windrowed GBC aggregate at a randomly selected station.

A full quality assurance testing program is done by Lot. A Lot is defined as one day's hauled quantity of windrowed aggregate. The length of a lot is divided into segments. **One sample** at a randomly calculated station is required **for each segment**. The full testing program is required:

- a) At the beginning of the project haul.
- b) When the one sample obtained for the partial testing program does not meet gradation specifications.

Once the Lot gradation meets specifications, the frequency of testing may be reduced and the **partial quality assurance testing program** used.

3.8.1 Partial Testing Program

For each day of hauling, obtain one sample of 60 kg (three pails - $\frac{3}{4}$ full) at a random station as follows:

1. Obtain the beginning station and estimate the ending station for the day's haul, if the sample is to be obtained during hauling. If the windrow has already been placed, use the actual ending station of the lot.
2. Use ATT-56, STRATIFIED RANDOM TEST SITES to calculate the random station of the sample site.
3. Use a shovel to remove the top of the windrow for a 2 m length and to a depth of approximately 0.3 m, discarding the material to either side, as shown in Figure 8.
4. Step the aggregate on one side of the windrow and take three or more samples at equally distributed points along the stepped portion. Ensure no material from the subgrade is included in the sample.
5. Take enough material from each point until a total of three pails, each $\frac{3}{4}$ full, totaling 60 kg of GBC aggregate, are obtained.

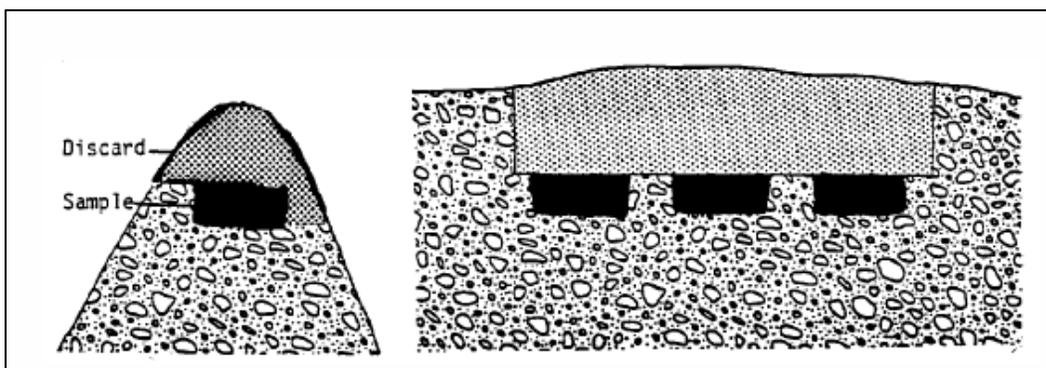


FIGURE 8

3.8.2 Full Testing Program

Table 4 below shows the number of segments or samples required for each lot when using the full quality assurance testing program.

Tonnes Placed	No. of Segments
less than 10 000	3
10 000 to 15 000	4
greater than 15 000	5

3.8.2.1 Sampling during Hauling

If obtaining windrow samples while the windrow is being placed, the length of the Lot is not known until the end of the days hauling. Therefore, the length of each segment is determined as follows:

1. Three samples or segments are required for Lot quantities of 10,000 t, or less. For example, if hauling stops after 7,000 tonnes and only two samples have been obtained, one additional sample is required. The additional random sample site station is calculated as directed in steps 1 and 2 of Section 3.8.1 (where the total length of the lot is used).
2. When more than 10,000 t are hauled, an additional segment is required for each additional 5,000 t hauled (to a maximum of 5 samples per lot).
3. The last segment of the Lot may represent a quantity of material less than 5,000 t. For example, if 18,000 t were hauled in one day, five samples would be required, or three samples for the first 10,000 t, one for the 10,000t to 15,000 t hauled distance, and one for the 15,000 t to 18,000 t of material.

A judgement whether to obtain another sample is required when a small tonnage in excess of the 5,000 t is placed.

Obtain one sample (three pails, each $\frac{3}{4}$ -full) at a random station within each segment as follows:

1. Obtain the beginning and end stations of each segment as described above.
2. For each segment, repeat steps 2 to 5 of section 3.8.1

3.8.2.2 Sampling after Haul is Complete

1. If the Lot windrow has already been placed, calculate the length of each segment by dividing the length of the lot by the number of required segments shown in Table 4.
2. Use ATT-56, STRATIFIED RANDOM TEST SITES to calculate each segment's beginning and ending stations and the station of each segment random sample site.
3. For each site, repeat steps 3 to 5 of Section 3.8.1.

3.9 Appeal Aggregate Sampling from the Compacted Base

1. Use ATT-56, STRATIFIED RANDOM TEST SITES to calculate each segment's beginning and ending stations and the station and location of each segment random sample site. Use the same number of segments as the number of tests that were used for the quality assurance testing of the appealed Lot.
2. Use the following Table as a guide in determining the square area on the compacted base to be removed in order to obtain approximately a 60 kg sample.

Compacted Lift Thickness (mm)	⁽¹⁾Square Area Required
100	520 mm x 520 mm
125	460 mm x 460 mm
150	420 mm x 420 mm
⁽¹⁾ Based on a compacted density of 2250 kg/m ³	

3. Clearly mark the specific area on the compacted base from which the samples are to be taken.
4. The samples shall be obtained by suitable means in such a manner as to ensure there is no degradation of the material.
5. The Contractor may use a grader blade or ripper to dig around the area of the samples to be taken, but the lowering of the blade or teeth should occur outside of the area to avoid degrading the sample.
6. Remove the samples from the roadway for the full depth of the material, taking care to exclude any underlying lifts or subgrade material.

3.10 Reducing Samples

1. Reduce the original sample to the required testing size, using the splitting or the quartering method, as described in ATT-57.
2. Proceed with the sieve analysis, moisture content or percent fractures test. If submitting the sample to a testing Laboratory for specific tests or design, ship the sample as directed in Section 4.0.

4.0 SAMPLE IDENTIFICATION AND SHIPPING

1. Inspect the sample containers supplied with each field lab. Ensure they are clean, to prevent contamination, and free of holes, to prevent the loss of any fines.
2. Pour the sample into the sample container, but do not overfill it. Each container should be $\frac{3}{4}$ full, which should weigh approximately 20 kg. Use as many containers as required for the entire sample.

If you feel it is too heavy to carry the 3 pails, with the 20 kg in each pail, you can use more pails to carry the total sample. Eg. You can use 5 pails with 12 kg in each, so that you still have the total sample weight of 60 kg.

3. Complete an Aggregate Sample Identification form, for each set of sample containers being submitted.
4. Insert the form in an envelope. or in a plastic bag if the sample is moist, and seal it.
5. Place the sealed envelope or plastic bag in one of the bags containing the aggregate to which the data pertains. Use survey flagging to identify the sample container with the identification form.
6. Securely tie each bag, or use a lid to seal each plastic pail.
7. For each sample container, complete a Shipping Tag, as follows:
 - a) On the front side record the page number as part of a whole, if more than one bag is being shipped.
 - b) On the reverse side of the tag, enter the name of the project manager and his cell phone number.
8. Affix a tag to each sample container. Obtain the approximate weight of each bag so that later it can be compared to the weight shown on the bill of lading.
9. Ship the samples.

5.0 HINTS AND PRECAUTIONS

1. Prior to entering the construction zone or pit, make sure that you have all the necessary personal protective equipment (PPE). This equipment includes, but is not limited to; steel-toed work boots, reflective vest or clothing, hard hat, safety glasses, hearing and dust protection. It is the technologists' responsibility to make sure that their PPE meets current Occupational Health and Safety Administration standards.
2. When entering a construction zone or pit, always check in with the designated person in charge of the operation (project supervisor). Never enter a site to take samples without informing an on-site project supervisor. Observe traffic patterns and park your vehicle in a safe, out of the way, location. Ask for permission before you climb onto any equipment, or venture around the site to observe the operation.
3. The sampling of aggregate can expose the technologist to machinery, moving belts, large stockpiles, and other potential dangers. Proper safety practices are always your number one concern.
4. **NEVER climb onto stockpiles** to obtain samples, due to the potential hazard of burial and suffocation from unstable stockpiles of unconsolidated materials. Also, over-steepened stockpiles may sluff at any time and engulf any personnel in the immediate area.
5. Always remember that the stability of the stockpile slope can quickly change with fluctuations in the weather (changes in moisture, freezing and thawing, etc.).
6. **It is always beneficial,** with approval of the pit supervisor, that the technologist **take reference pictures** of the following items; a wide view of the pit operation, the sampling location in the pit, a close-up of the material in the stockpile being sampled (when applicable), and a close-up of the material sampled.

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