

**STATE OF OHIO
DEPARTMENT OF TRANSPORTATION
SUPPLEMENTAL SPECIFICATION 871
EMBANKMENT CONSTRUCTION USING RECYCLED MATERIALS
APRIL 15, 2005**

871.01 Description

871.02 Materials

871.03 Environmental Requirements

871.04 Geotechnical Requirements

871.05 Construction Requirements

871.01 Description. This work consists of constructing embankments with recycled material and material from other approved sources as necessary to complete the planned embankments. Item 203, Roadway Excavation and Embankment shall apply as modified herein.

871.02. Materials. Only these materials will be allowed:

A. Fly Ash. Furnish Fly Ash conforming to ASTM E-2277.

B. Bottom Ash. Furnish Bottom Ash conforming to ASTM E-2277.

C. Foundry Sand. Furnish Foundry Sand that is generated from foundry operations.

D. Glass. Furnish Glass, Ceramic, or Earthenware with a maximum dimension of 1 inch any direction and, by visual inspection, 95 percent free from foreign material. Glass containing hazardous wastes or hazardous substances such as glass from automobiles, light bulbs of any kind, laboratory glass, television glass, computer or other cathode monitor tubes is not suitable.

E. Tire Shreds. Furnish Tire Shreds as defined in ASTM D 6270 and the following:

1. Class 1 tire shreds shall have a maximum of 50 percent passing the 1-1/2 inch (38 mm) square mesh sieve, and a maximum of 5 percent passing the No. 4 (4.75mm) sieve. All percentages are calculated by weight.

2. Class 2 tire shreds shall have a maximum of 25 percent passing the 1-1/2 inch (38 mm) square mesh sieve and a maximum of 1 percent passing the No. 4 (4.75 mm) sieve. All percentages are calculated by weight.

3. Restrictions on all tire shreds are as follows:

a. Furnish tire shreds, which are not contaminated with fuels or lubricants.

b. Furnish tire shreds that have not been subjected to a fire.

c. Furnish tire shreds containing no more than 1 percent metal fragments which are not at least partially encased in rubber. Metal fragments that are partially encased in rubber shall protrude no more than 1 inch (25 mm) from the edge of the tire shred on 75 percent of the pieces and no more than 2 inches (50 mm) on 100 percent of the pieces. All percentages are calculated by weight.

d. Furnish tire shreds with at least one sidewall severed from the tread of each tire.

e. Furnish tire shreds with a maximum dimension of 8 inches (200mm) measures in any direction.

f. Furnish tire shreds free from wood chips, other fibrous organic matter, ice and snow.

F. Natural soil. Furnish natural soil conforming to 203.02.I.

G. Natural Granular Material. Furnish natural granular material conforming to 203.02.H and conforming to the gradation and physical requirements of 703.16.C, Granular Material Type B.

H. Drainage Material. Furnish aggregate drains conforming to Item 605. Completely wrap the aggregate drains with geotextile fabric. As an alternative, 707.45 pipe may be furnished, provided that the inner end of the pipe is completely wrapped with 712.09 Type A fabric.

I. Geotextile Fabric. Furnish geotextile fabric conforming to 712.09 Type A.

871.03. Environmental Requirements. Use recycled materials that conform to all current environmental policies, rules, and regulations and the following:

Fly Ash, Bottom Ash, and Foundry Sand. Ohio EPA, Division of Surface Water, Policy 0400.007 "A Beneficial use of Nontoxic Bottom Ash, Fly Ash and Spent Foundry Sand and other Exempt Wastes." Provide a certified letter from the Local Ohio EPA Chief allowing the use of this material on the project.

Glass. Provide a certified letter from the Local Ohio EPA Chief allowing the use of glass on the project.

Tire Shreds. Ohio Administrative Code 3745-27-78.

Select an independent consultant pre-qualified by the Department for environmental site assessment and remedial design to prepare the notification documents. The consultant shall coordinate all Ohio EPA required meetings, documentation, and testing. The consultant shall monitor the construction according to 203.03.I. to ensure that the environmental requirements are carried out on the project. The consultant shall report any discrepancies to the Department and the Contractor. The consultant shall certify the report or reports to the Department.

Submit to the Engineer for approval, prior to use, documentation that demonstrates compliance with all current environmental policies, rules and regulations.

871.04. Geotechnical Requirements. Select an independent soils consultant pre-qualified by the Department. The consultant shall:

A. Classify the Materials. Classify Fly Ash, Bottom Ash and Foundry Sand according to Ohio Department of Transportation, Division of Planning, Office of Geotechnical Engineering, Specifications for Subsurface Investigations. When fly ash is used, clearly identify it as self-hardening, (Class C), or non self-hardening fly ash, (Class F).

Classify Tire Shreds according to ASTM D-6270.

B. Perform an Engineering Analysis to demonstrate that the material is suitable to construct the planned embankments. The engineering analysis shall include;

1. a stability analysis
2. a stability sensitivity analysis
3. a total settlement analysis
4. a total settlement sensitivity analysis
5. a differential settlement analysis
6. a differential settlement sensitivity analysis

Perform the appropriate laboratory tests necessary to validate the assumptions used in the engineering analysis.

C. Prepare moisture density curves or relative density results for the recycled materials that is required for compaction acceptance.

D. Submit to Engineer 30 days prior to use:

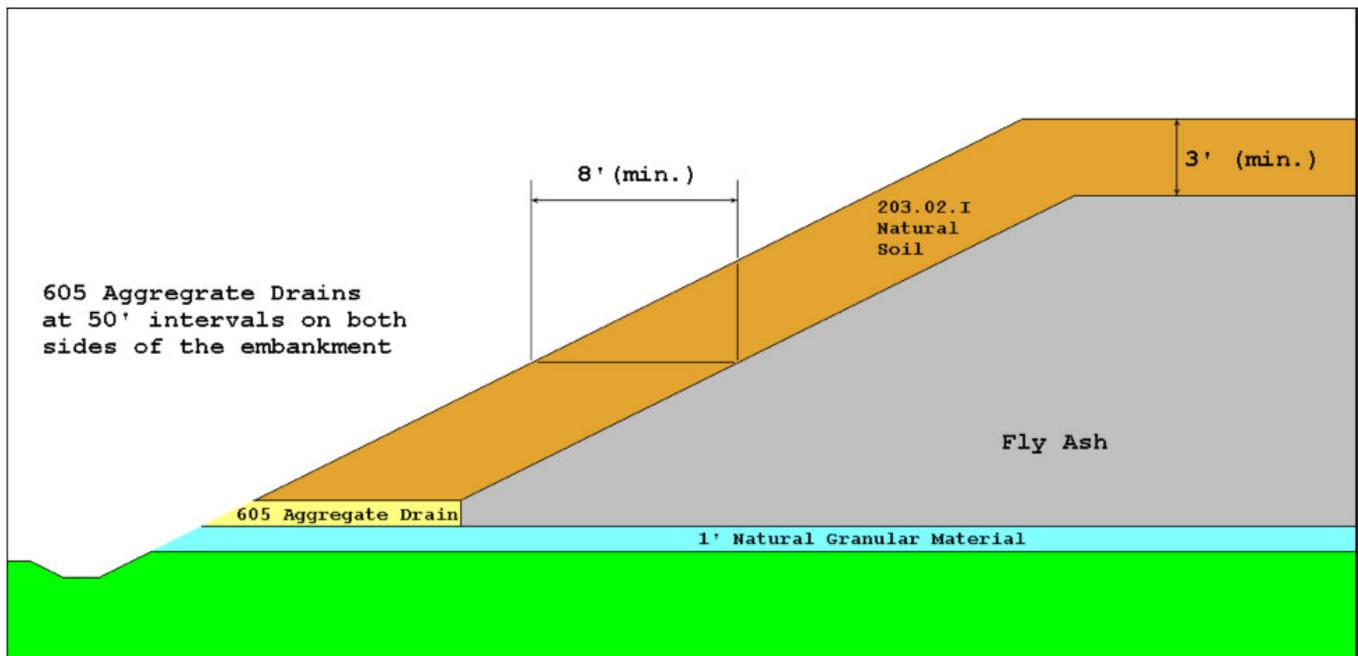
1. The location where recycled materials will be used for embankment construction in the project plan, profile, and cross-section views.
2. The estimated volume of embankment to be constructed using recycled materials.
3. All electronic files for the Engineering Analyses.
4. A summary of the Engineering Analysis, tests and proposed compaction acceptance information.

E. Receive Engineer's approval prior to use.

871.05. Construction Requirements.

A. Fly Ash.

Figure 871.05.A



Place and compact a 1 foot (0.3 m) layer of natural granular material on the prepared foundation. Spread Fly Ash in horizontal loose lifts not to exceed 8 inches (200 mm). Compact Fly Ash at 3 percent below optimum moisture or dryer. Uniformly apply and evenly mix water into dry material. Disc and aerate wet material.

Compact the lifts to a stable, durable condition with at least eight passes of a vibratory steel wheel roller. The roller shall have a minimum weight of 10 tons (9 metric tons) or its centrifugal equivalent.

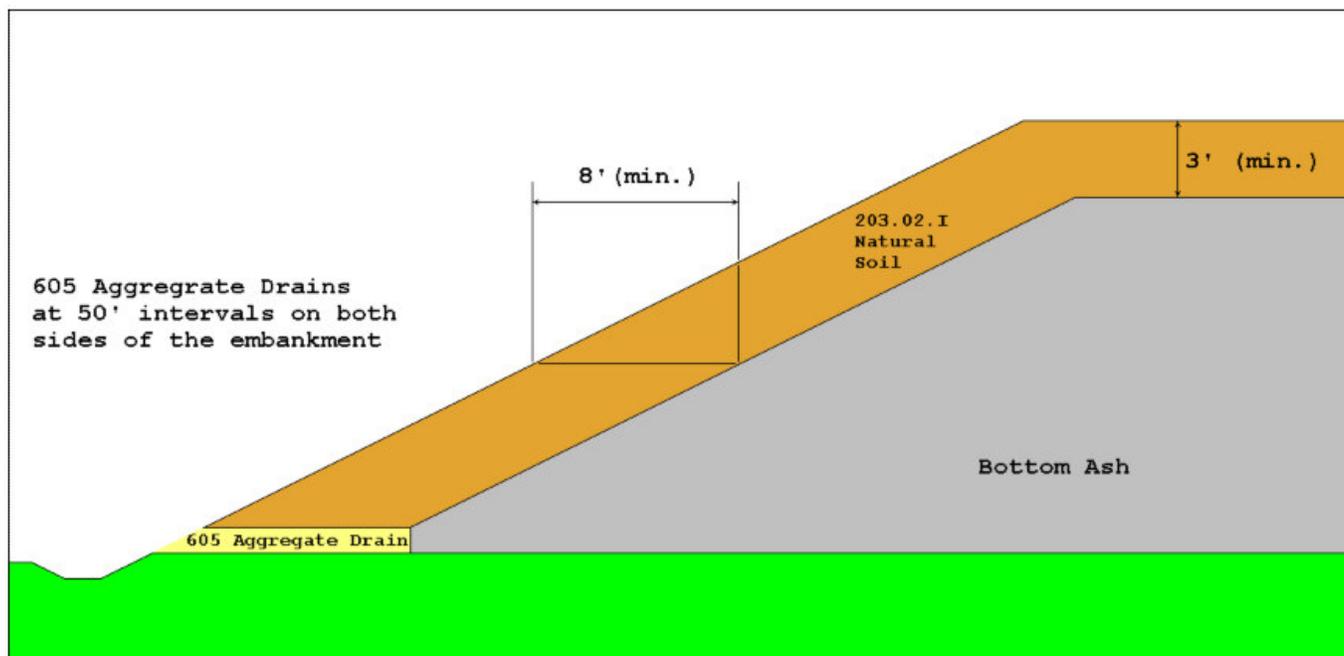
Compact lifts to: 100 percent of the AASHTO T-99 Maximum Density or, 98 percent of the Supplement 1015 Test Section Maximum Density.

Cover the sides and top of Fly Ash embankment with natural soil. The minimum vertical cover is 3 feet, (1.0 m) (measured from subgrade elevation). The minimum horizontal cover is 8 feet, (2.5 m) (measured from final slope line).

Install the drains detailed in 871.02.H at 50 foot (15 m) intervals on both sides of the embankment.

B. Bottom Ash.

Figure 871.05.B



Place Bottom Ash on the prepared foundation in horizontal loose lifts not to exceed 8 inches (200 mm).

Compact Bottom Ash at 3 percent below optimum moisture or dryer. Uniformly apply and evenly mix water into dry material. Disc and aerate wet material.

Compact the lifts to a stable, durable condition with at least eight passes of a vibratory steel wheel roller. The roller shall have a minimum weight of 10 tons (9 metric tons) or its centrifugal equivalent.

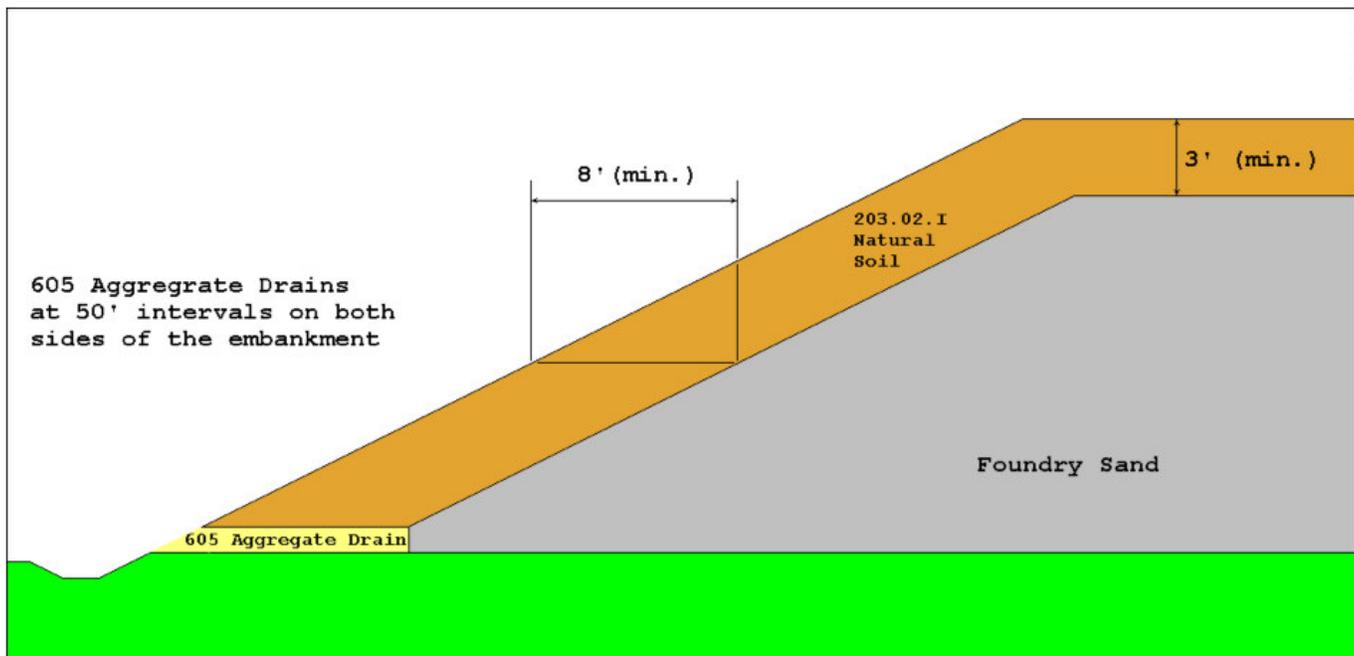
Compact lifts to: An ASTM D-4253/D-4254 Relative Density of 70 percent or, 100 percent of the AASHTO T-99 Maximum Density or, 98 percent of the Supplement 1015 Test Section Maximum Density.

The Engineer will use the density determined by Supplement 1015 to resolve conflicts that may occur using the other methods.

Cover the sides and top of Bottom Ash embankment with natural soil. The minimum vertical cover is 3 feet, (1.0 m) (measured from subgrade elevation). The minimum horizontal cover is 8 feet, (2.5 m) (measured from final slope line). Install the drains detailed in 871.02.H at 50 foot (15 m) intervals on both sides of the embankment.

C. Foundry Sand.

Figure 871.05.C



Place Foundry Sand on the prepared foundation in horizontal loose lifts not to exceed 8 inches (200 mm). Compact the lifts to a stable, durable condition with at least eight passes of a vibratory steel wheel roller. The roller shall have a minimum weight of 10 tons (9 metric tons) or its centrifugal equivalent. Compact lifts to 98 percent of the Supplement 1015.06 Test Section Method B Maximum Density.

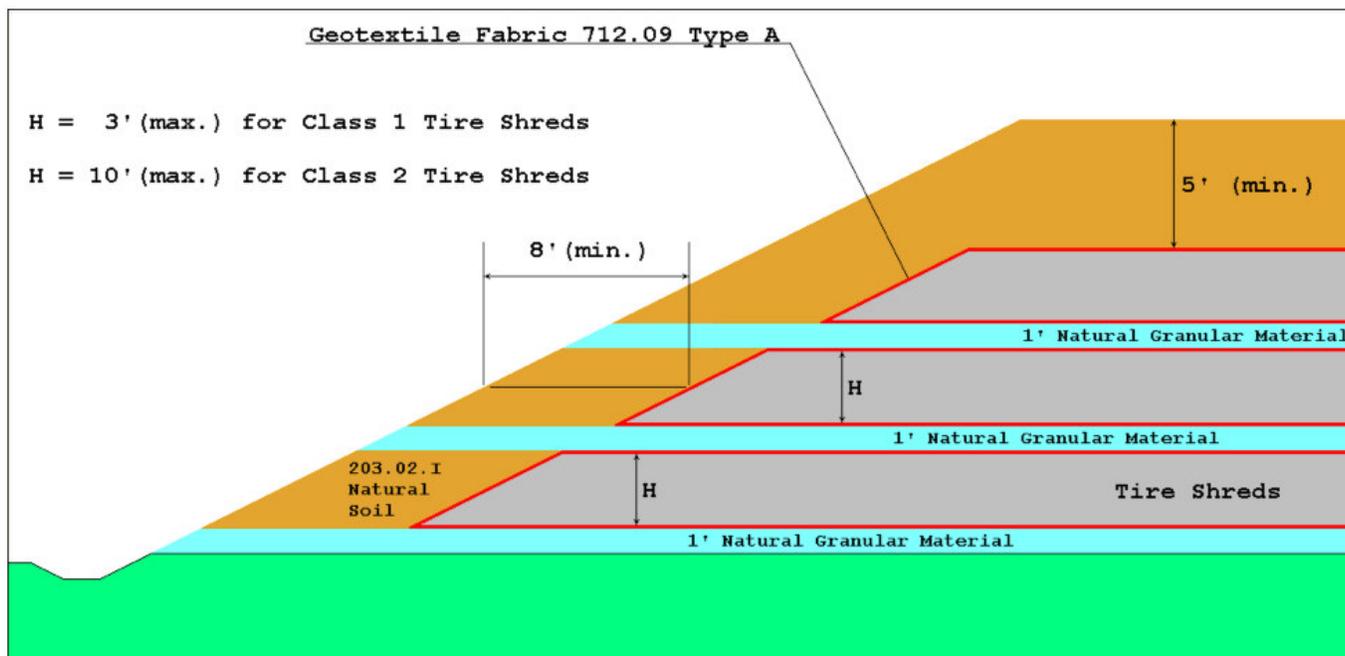
Cover the sides and top of Foundry Sand embankment with natural soil. The minimum vertical cover is 3 feet, (1.0m) (measured from subgrade elevation). The minimum horizontal cover is 8 feet, (2.5 m) (measured from final slope line).

Install the drains detailed in 871.02.H at 50 foot (15 m) intervals on both sides of the embankment.

D. Glass. Place Glass on the prepared foundation in horizontal loose lifts not to exceed 8 inches (200 mm). Water is not needed to aid compaction of Glass lifts. Compact the lifts to a stable, durable condition with at least eight passes of a vibratory steel wheel roller. The roller shall have a minimum weight of 10 tons (9 metric tons) or its centrifugal equivalent. Compact lifts to 98 percent of the Supplement 1015 Test Section Maximum Density. Alternate lifts of glass with lifts of natural soil. Construct 4 inches (100mm) of natural soil on the outside slopes using the construction details for topsoil placement in 659.11. Do not use glass within 3.0 feet (1.0m) of the subgrade.

E. Tire Shreds.

Figure 871.05.E



Place and compact a 1 foot (0.3 m) layer of natural granular material on a prepared foundation.

Place a layer of Geotextile Fabric, (712.09 Type A) on top of the Natural Granular Material. Place Tire Shreds in horizontal loose lifts not to exceed 8 inches (200 mm).

Compact each lift of Tire Shreds to a stable, durable condition with eight passes of a steel wheel roller. The steel wheel roller shall have a minimum weight of 10 tons (9 metric tons) or its centrifugal equivalent.

Place additional Tire Shred lifts to construct a Tire Shred layer. The maximum layer thickness for Class 1 Tire Shreds is 3 feet (1.0 m). The maximum layer thickness for Class 2 Tire Shreds is 10 feet (3.3 m).

Separate Tire Shred layers completely from natural granular material and natural soil by enclosing the top, bottom and sides of the of Tire Shreds with Geotextile Fabric. Alternate natural granular material layers with Geotextile Fabric enclosed Tire Shred layers. Cover sides and top of Tire Shred embankment with natural soil. The minimum vertical cover is 5 feet, (1.5 m) (measured from subgrade elevation). The minimum horizontal cover is 8 feet, (2.5 m) (measured from final slope line).

Place a 1 foot (0.3 m) of natural soil surcharge on the subgrade for 60 days. Do not use tire shreds for the bedding and backfill of any conduit or retaining wall. Do not use tire shreds for embankment construction within 100 feet, (30.0m) of any structure.

Designer Note for Supplemental Specification 871, Embankment Using Recycled Material

This specification was written to allow the Districts to use recycled materials in embankment construction.

It was written to safely use these recycled products without jeopardizing the embankment or pavement integrity or long-term performance. The Department does not require the use of recycled materials because this specification does not eliminate all risk or liability to the Department, it only minimizes such risks.

The utilization of this specification is totally at the Districts discretion. Districts are advised to consider all the plusses and potential problems prior to allowing these materials.

Benefits:

Recycled materials can be cheaper and provided engineering improvements to the embankment construction. For example, fly ash and tires can provide lighter weight materials.

By using these materials, the Department will save land fill space in the state. The Department may minimize the potential future legislation that would require the use of these materials. (Note: A few years ago, the state legislators required us to allow petroleum contaminated soil for embankment material.)

Potential Problems:

Once these materials are placed on ODOT property, then the recycled materials will become the responsibility of the Department. ODOT will assume any future liability and costs for removal and proper disposal of material according to future EPA regulations. In the future, if this embankment is repaired then the material may have to be disposed of in a landfill, if required by EPA regulations.

A small percentage of tire fills have spontaneously combust into fires. Fly ash is silt and may be susceptible to frost heave and capillary action. Both problems are minimized by the engineering controls in the specification.

The District may pick and choose which recycled material to use or allow all of the recycled materials.

The District may allow different materials at certain locations along the project.

No change in the cross sections are needed to include SS-871 in the plans. This specification delineates the areas that the recycled materials are allowed.

Use the following plan note to incorporate SS 871 in the contract.

Embankment Construction Using Recycled Materials.

On this project, Supplemental Specification 871 Embankment Construction Using Recycled Materials applies. _____(Put in the materials wanted or needed) may be substituted for Item 203 Embankment in the contract.

The Department will measure and pay for all work detailed in SS-871 according to the Unit Bid Price for Item 203 Embankment.