ITEM 703 AGGREGATE

703.01 General.

The following abbreviations apply:

CCS	Crushed Carbonate Stone.
ACBFS	Air Cooled Blast Furnace Slag
GS	Granulated Slag
RACP	Reclaimed Asphalt Concrete Pavement
RPCC	Recycled Portland Cement Concrete
OH	Open Hearth Slag
EAF	Electric Arc Furnace Slag
BOF	Basic Oxygen Furnace Slag
PCS	Petroleum Contaminated Soil

A. Soundness. When the major portion of the unsound material in a coarse aggregate acquires a mud-like condition when tested for soundness, ensure a maximum loss of 5 percent for all uses.

B. Stockpiles. Use stockpiling and loading methods that permit ready identification of the aggregates and to minimize segregation. Clean the sites for stockpiles before storing materials. Do not remove aggregates from stockpiles within 1 foot (0.3 m) of the ground until final cleanup of the work. Do not use material mixed with foreign matter, wood or other size or grades of aggregates.

Handle aggregates in such a manner as to ensure that the moisture content remains reasonably uniform for each day's run.

C. Size. Provide aggregate according to the size specified in the material specification, the construction item, or as shown in AASHTO M 43.

D. Method of Test. Provide aggregate tested by the following methods:

Amount finer than No. 200 (75 μm) sieve	CS1004
Clay lumps	OS1017
Coal and lignite	AASHTO T 113
Crushed pieces	ASTM D 5821
Deleterious materials	OS1029
Effect of organic impurities on strength of mortar	AASHTO T 71
Liquid limit	AASHTO T 89
Percent of wear, Los Angeles abrasion test	AASHTO T 96 or ASTM C 535
Plasticity index	AASHTO T 90
Sieve analysis	CS1004, OS1005
Sieve analysis of mineral filler	AASHTO T 37
Sodium sulfate soundness test, 5 cycle	AASHTO T 104
Specific Gravity and percent absorption for fine and coarse aggregate	OS1031
Unit weight	AASHTO T 19
Lightweight chert in aggregates	AASHTO T 113
Sand equivalent	AASHTO T 176

Uncompacted void content ..... AASHTO T 304
Flat and elongated ..... ASTM D 4791
Rapid freezing and thawing .... ASTM C 666, Procedure B
Insoluble residue of carbonate
aggregates ..... ASTM D 3042
Compaction testing of Unbound Materials OS1015
In place gradation sampling CS1090
Soundness of aggregate by freezing
and thawing ..... AASHTO T 103
Micro-Deval ..... AASHTO T 327
Silicon Dioxide ..... ASTM C 146
Sodium sulfate soundness test,
Rock slabs ..... ASTM D 5240

F. Restrictions. When using an aggregate source specially designated with a "SR or SRH" according to ODOT's *Guidelines for Maintaining Adequate Pavement Friction in Surface Pavements,* the City will restrict use of the aggregate source in surface pavement according to the methods in the guidelines. View ODOT's document, *Guidelines for Maintaining Adequate Pavement Friction in Surface Pavements*, on ODOT's OMM website under "Material Information by Category, Aggregate", or ODOT's Office of Pavement Engineering's website.

TABLE 703.01-1 SIZE OF COARSE AGGREGATE (AASHTO M 43)

Size No.	Nominal size [1] square openings inch	mm	Amounts finer than each laboratory sieve (square openings), percent by weight 4 in. 100 mm	3 1/2 in. 90 mm	3 in. 75 mm	2 1/2 in. 63 mm	2 in. 50 mm	1 1/2 in. 37.5 mm	1 in. 25 mm	3/4 in. 19 mm	1/2 in. 12.5 mm	3/8 in. 9.5 mm	No. 4 4.75 mm	No. 8 2.36 mm	No. 16 1.18 mm	No. 50 300 µm	No. 100 150 µm
1	3 1/2 to 1 1/2	90 to 37.5	100	90 to 100		25 to 60		0 to 15		0 to 5							
2	2 1/2 to 1 1/2	63 to 37.5			100	90 to 100	35 to 70	0 to 15		0 to 5							
24	3 1/2 to 3/4	63 to 19			100	90 to 100		25 to 60		0 to 10	0 to 5						
3	2 to 1	50 to 25				100	90 to 100	35 to 70	0 to 15		0 to 5						
357	2 to No. 4	50 to 4.75				100	95 to 100		35 to 70		10 to 30		0 to 5				
4	1 1/2 to 3/4	37.5 to 19					100	90 to 100	20 to 55	0 to 15		0 to 5					
467	1 1/2 to No. 4	37.5 to 4.75					100	95 to 100		35 to 70		10 to 30	0 to 5				
5	1 to 1/2	25 to 12.5						100	90 to 100	20 to 55	0 to 10	0 to 5					
56	1 to 3/8	25 to 9.5						100	90 to 100	40 to 75	15 to 35	0 to 15	0 to 5				
57	1 to No. 4	25 to 4.75						100	95 to 100		25 to 60		0 to 10	0 to 5			
6	3/4 to 3/8	19 to 9.5							100	90 to 100	20 to 55	0 to 15	0 to 5				
67	3/4 to No. 4	19 to 4.75							100	90 to 100		20 to 55	0 to 10	0 to 5			
68	3/4 to No. 8	19 to 2.36							100	90 to 100		30 to 65	5 to 25	0 to 10	0 to 5		
7	1/2 to No. 4	12.5 to 4.75								100	90 to 100	40 to 70	0 to 15	0 to 5			
78	1/2 to No. 8	12.5 to 2.36								100	90 to 100	40 to 75	5 to 25	0 to 10	0 to 5		
8	3/8 to No. 8	9.5 to 2.36									100	85 to 100	10 to 30	0 to 10	0 to 5		
89	3/8 to No. 16	9.5 to 1.18									100	90 to 100	20 to 55	5 to 30	0 to 10	0 to 5	
9	No. 4 to 16	4.75 to 1.18										100	85 to 100	10 to 40	0 to 10	0 to 5	
10	No. 4 to 0 [2]	4.75 to 0 [2]										100	85 to 100				10 to 30

[1] Numbered sieves are those of the United States Standard Sieve Series.

[2] Screenings.

Where standard size of coarse aggregate designated by two or three digit numbers are specified, obtain the specified gradation by combining the appropriate single digit standard size aggregates by a suitable proportioning device which has a separate compartment for each coarse aggregate combined. Perform the blending as directed by the Laboratory.

703.02 Aggregate for Portland Cement Concrete.

A. Fine Aggregate.

1. Provide fine aggregate consisting of natural sand or sand manufactured from stone.

2. Sieve analysis.

Sieve Size		Total Percent Passing
3/8 inch	(9.5 mm)	100
No. 4	(4.75 mm)	95 to 100
No. 8	(2.36 mm)	70 to 100
No. 16	(1.18 mm)	38 to 80
No. 30	(600 μm)	18 to 60
No. 50	(300 μm)	5 to 30
No. 100	(150 μm)	0 to 10
No. 200	(75 μm)	0 to 5

The City may reject sand if the fineness modulus of a job control sample of sand from any source vary by more than 0.20 percent from that of the representative sample from that source.

3. Physical properties.

	Maximum
Loss, sodium sulfate soundness test	
Item 305	12 %
Items 255, 256, 451, 452, 511, 515, 519, 526, 602, 603, 604, 608, 609, 610, 622, and 625	10 %
Aggregations of soil, silt, etc. by weight	0.5 %

When tested for the effect of organic impurities on strength of mortar, ensure that the compressive strength at 3 and 7 days of mortar made with untreated sand is not less than 95 percent of the compressive strength of mortar made with treated sand. Provide fine aggregate for Items 255, 256, 451, 452, 526, and 511 deck slabs with at least 25 percent siliceous particles as determined by the acid insoluble residue test [ASTM D3042]. Ensure material has been tested and results are on file at the Laboratory. For sources not tested and on file at the laboratory, submit certified test data from an AMRL accredited independent laboratory verifying the minimum 25 percent.

B. Coarse Aggregate.

1. Provide coarse aggregate consisting of washed gravel, CCS, or crushed ACBFS.

2. Physical properties.

Percent of wear, Los Angeles test, maximum (CCS or washed gravel)	40 %
Unit weight, compacted, minimum (slag)	70 lb/ft3 (1120 kg/m3)
Loss, sodium sulfate soundness test, maximum:	
Item 305	15 %
Items 255, 256, 451, 452, 511, 519, 526, 602, 603, 604, 609, 610, 622, and 625	12 %
Item 515	10 %

Do not exceed the following percentages of deleterious substances.:

	Percent by Weight	
Material Type	Super-Structure	All Other Concrete
Soft pieces	2.0	3.0
Coal and lignite	0.25	1.0
Clay lumps	0.25	0.25
Pieces having a length greater than 5 times the average thickness	15	15
Shale and shaly material	0.5	1.0
Limonitic concretions	0.5	1.0
Alkali	0.5	1.0
Metallic particles	0.5	1.0
Chert, that disintegrates in 5 cycles of the soundness test	0.5	1.0

3. Amount passing the No. 200 (75 μm) sieve. Ensure that the percent by weight of material passing the No. 200 (75 μm) sieve in the aggregate portion of the concrete mix does not exceed the following:

	Percent by Weight	
Material Type	Super-Structure	All Other Concrete
CCS and crushed ACBFS	3.4	3.8
Washed gravel	2.0	2.2

703.03 Fine Aggregate for Mortar or Grout.

A. Provide fine aggregate consisting of natural sand or sand manufactured from stone or ACBFS.

B. Sieve Analysis.

Sieve Size		Natural Sand	Manufactured Sand
		Total Percent Passing	
No. 4	(4.75 mm)	100	100
No. 8	(2.36 mm)	95 to 100	95 to 100
No. 50	(300 μm)	10 to 40	20 to 40
No. 100	(150 μm)	0 to 15	10 to 25
No. 200	(75 μm)	0 to 5	0 to 10

C. Physical properties.

	Maximum
Loss, sodium sulfate soundness test	10 %
Aggregations of soil, silt, etc. by weight	0.5 %

When using mortar made with untreated sand, testing for the effect of organic impurities on strength of mortar must show a compressive strength no less than 95 percent of the compressive strength of mortar made with treated sand.

703.04 Aggregate for Asphalt Concrete Base (301 and 302).

A. Provide coarse aggregate for asphalt concrete base used in combination with rigid pavement consisting of CCS, gravel, or crushed ACBFS.

Provide coarse aggregate for asphalt concrete base used in flexible pavements consisting of CCS, gravel (see note [1] in table below), or crushed ACBFS. Provide fine aggregate for asphalt concrete base consisting of natural sand or sand manufactured from stone, gravel, or ACBFS. The City will allow the use of Crushed Steel Slag (OH, EAF or BOF) conforming to 703.01.E and 401.03 for coarse and fine aggregate in asphalt concrete base used in flexible pavements.

B. Physical properties.

Percent of wear, Los Angeles test, maximum (CCS or washed gravel)	50 %
Unit weight, compacted, minimum (slag)	65 lb/ft3 (1040 kg/m3)
Loss, sodium sulfate soundness test, maximum	15 %
Percent by weight of fractured pieces (one or more faces), minimum	40 %
Micro-Deval Abrasion Loss test, maximum (for coarse aggregate gravel only)	22 % [1]

[1] For MD values greater than the specification limit, conform to ODOT Supplement 1010.

Do not exceed the following percentages of deleterious substances:

703.05 Material Type	Percent by Weight
Soft pieces	3.0
Coal and lignite	1.0
Clay lumps	0.25
Pieces having a length greater than 5 times the average thickness	15
Shale and shaly material	2.5
Chert that disintegrates in 5 cycles of the soundness test	2.5

703.05 Aggregate for Asphalt Concrete (Intermediate and Surface Courses), Prime Coat (408) and Microsurfacing (421).

A. Fine Aggregate.

1. Provide fine aggregate consisting of natural sand or sand manufactured from stone, gravel, ACBFS or, for intermediate courses only, steel slag (OH, EAF or BOF) conforming to 703.01.E and 401.03.

2. Sieve analysis.

Sieve Size		Total Percent Passing
3/8 inch	(9.5 mm)	100
No. 4	(4.75 mm)	90 to 100
No. 8	(2.36 mm)	65 to 100
No. 16	(1.18 mm)	40 to 85
No. 30	(600 μm)	20 to 60
No. 50	(300 μm)	7 to 40
No. 100	(150 μm)	0 to 20
No. 200	(75 μm)	0 to 10

3. Physical properties.

	Maximum
Loss, sodium sulfate soundness test	15 %
Aggregations of soil, silt, etc., by weight	0.5 %

B. Coarse Aggregate.

1. Provide coarse aggregate consisting of CCS, crushed ACBFS, washed gravel, or for intermediate courses only, steel slag (OH, EAF or BOF) conforming to 703.01.E and 401.03.

2. Physical properties.

Percent of wear, Los Angeles test, maximum (CCS or washed gravel)	40 %
Unit weight, compacted, minimum (slag):	
Asphalt Concrete and 408	70 lb/ft3 (1120 kg/m3)
Loss, sodium sulfate soundness test, maximum:	
Asphalt Concrete	12 %
421	15 %
Percent by weight of fractured pieces (one or more faces), minimum	40 %
Micro-Deval Abrasion Loss test, maximum (for gravel only)	20 % [1]

[1] For MD values greater than the specification limit, conform to ODOT Supplement 1010.

Do not exceed the following percentages of deleterious substances:

Material Type	Percent by Weight
Soft pieces	3.0
Coal and lignite	1.0
Clay lumps	0.25
Amount finer than No. 200 (75 µm) sieve	3.0
Pieces having a length greater than 5 times the average thickness	15
Shale and shaly material	2.5
Limonitic concretions	2.5
Alkali	2.5
Chert that disintegrates in 5 cycles of the soundness test	2.5

C. General Requirements for Fine Aggregate. For fine aggregate calculate each individual sieve fraction soundness loss and ensure that the fractional size does not exceed 13.0 percent for all surface courses, intermediate courses and any asphalt concrete course directly below an open graded friction course.

703.06 Sand Cover (407 and 408).

A. Furnish sand cover consisting of natural sand or sand manufactured from stone or ACBFS.

B. Sieve analysis.

Sieve Size		Total Percent Passing
No. 4	(4.75 mm)	90 to 100
No. 50	(300 µm)	7 to 40
No. 200	(75 µm)	0 to 10

703.07 Mineral Filler.

A. Furnish mineral filler consisting of limestone dust, portland cement, or other inert mineral matter. Provide a thoroughly dry mineral filler free from lumps.

B. Sieve analysis.

Sieve Size		Total Percent Passing
No. 30	(600 μm)	100
No. 50	(300 μm)	95 to 100
No. 200	(75 μm)	65 to 100

703.10 Screenings.

A. Furnish screenings for No. 10 size gravel, or stone. Provide crushed material, when specified, crushed from material larger than the 1/2-inch (12.5 mm) sieve.

B. Physical properties.

	Maximum
Loss, sodium sulfate soundness test	15 %

703.11 Structural Backfill for 603 Bedding and Backfill. Furnish structural backfill for 603 bedding and backfill consisting of CCS, gravel, natural sand, sand manufactured from stone, or foundry sand.

Do not use RPCC for any bedding or backfill materials.

Do not use reclaimed asphalt concrete for any bedding or backfill materials.

Use foundry sand if the material meets these requirements and meets the requirements of the Ohio EPA, Division of Surface Water, Policy 400.007 "Beneficial use of Non-Toxic Bottom Ash, Fly Ash and Spent Foundry Sand and Other Exempt Waste," and all other regulations. Ten days before using foundry sand on the project, submit written permission from the Ohio EPA to the Engineer. Instead of written permission from the Ohio EPA, the Contractor may elect to have an independent consultant pre-qualified by ODOT in remedial design environmental site assessment review the proposed usage. The consultant will provide all documentation utilized to usage according to all Ohio EPA regulations. Ensure that the consultant coordinates all EPA required meetings, documentation, and testing requirements. Ensure that the consultant certifies this to the City.

A. Structural Backfill Type 1.

1. Furnish Type 1 structural backfill that meets the gradations of Items 304, except 0 to 20 percent may pass the No. 200 sieve.

2. Physical properties.

Percent of wear, Los Angeles test, maximum (CCS or washed gravel)	50 %
Loss, sodium, sulfate soundness test, maximum	15 %
Percent by weight of fractured pieces (one or more faces), minimum (Type 3 only)	90 %

Do not exceed the following percentages of deleterious substances:

Material Type	Percent by weight
Shale and shaly material	5.0
Chert, that disintegrates in 5 cycles of the soundness test	5.0

Ensure that the portion of the material passing through the No. 40 (425 μm) sieve has a maximum liquid limit of 25 and a maximum plasticity index of 6.

B. Structural Backfill Type 2.

1. Furnish Type 2 structural backfill that meets the gradation below:

Sieve Size		Total Percent Passing
2 1/2 inch	(63 mm)	100
1 inch	(25.0 mm)	70 to 100
3/4 inch	(19.0 mm)	–
3/8 inch	(9.5 mm)	–
No. 4	(4.75 mm)	25 to 100
No. 8	(2.36 mm)	–
No. 40	(425 μm)	10 to 50
No. 50	(300 μm)	–
No. 200	(75 μm)	5 to 15

2. Physical properties:

Percent of wear, Los Angeles test, maximum (CCS or gravel)	50 %
Loss, sodium sulfate soundness test, maximum	15 %

Ensure that the portion of the material passing through the No. 40 (425 mm) sieve has a maximum liquid limit of 25 and a maximum plastic index of 6.

703.13 Coarse Aggregate for Items 305, 451 and 452. In addition to the requirements of 703.02, the following aggregate requirements apply.

For a total combined quantity of the listed items greater than 10,000 square yards (8000 m^2), provide size No. 57 or 67 from Table 703.01-1. For a total combined quantity of the listed items less than 10,000 square yards (8000 m^2), provide one of the following sizes from Table 703.01-1: No. 7, 78, 8, 57, or 67.

When selecting gravel or limestone No. 57 or 67 size in either of the above cases, test the coarse aggregate incorporated into the concrete according to ASTM C 666, Procedure B. Ensure that the area generated under the curve obtained by plotting the expansions of test specimens verses the number of test cycles does not exceed 2.05 at 350 or less cycles.

Ensure valid results of freeze thaw-resistance testing as outlined below:

Range of Area under Curve[1]	Status of Source Approval
0.00 to 1.00	Valid for two years from date approved[2]
1.01 to 2.05	Valid for one year from date approved[2]
2.06 to 4.00	Not Approved, one retest allowed[3]
> 4.00	Not Approved, no retesting allowed[3]

[1] As measured at 350 cycles.

[2] The City may require a retest of freeze-thaw resistance before the original expiration date if quality control testing determines a notable change in the properties of the aggregate originating from the affected source. The Laboratory will make the determination to retest.

[3] Except as noted, the City will not retest the material unless the producer of the material sends a written request to the City with substantiation that the producer made significant changes in operation (e.g., new processing equipment, material from a new ledge, etc.).

The Laboratory will maintain a list of approved sources.

703.14 Non Pavement Open-Hearth, Electric Arc Furnace, and Basic Oxygen Furnace Steel Slag Aggregate Use. Provide steel slag according to the following requirements.

1. Non-confined Applications. When using OH, EAF, and BOF slag in applications with unconfined steel slag, ensure that the slag meets the requirements in 703.14.A (deleterious substances and crushing), and in 703.14.B (aging and stockpiling requirements). The City will allow use of recycled steel slag from City or non-City projects in applications with unconfined recycled steel slag.

2. Confined Applications. When using OH, EAF, and BOF slag in applications with unconfined steel slag, ensure the steel slag meets all requirements of 703.14. The City will not allow use of recycled steel slag from City or non-City projects in confined applications.

A. Deleterious Substances (soft pieces). Deleterious substances include soft lime, lime oxide, or magnesia agglomerations or any foreign materials prone to rapid disintegration under construction processing and weathering conditions.

Furnish steel slag with less than 3 percent deleterious substances (soft pieces) by weight. The City will use ODOT Supplement 1029 (hand crushing of soft pieces) to determine the soft pieces. The City will not allow crushing of steel slag.

B. Aging and Stockpiling Requirements. Stockpile and age all steel slag as follows:

1. Grade and stockpile the material into maximum size piles of 25,000 ton (23,000 metric tons). Before and during the stockpiling operation, add water to these materials to provide a uniform moisture content not less than their absorbed moisture. Maintain the stockpile in a moist condition during the required stockpiling period.

2. Ensure that the producer mixes the stockpile when the outside surface of the pile has crusted over. The City will inspect the stockpile every 2 months to ensure no crusting occurs. Do not mix frozen stockpile material. Suspend the aging period for stockpiles frozen for more than one month.

3. Ensure an aging period of at least 6 months in duration and start over when adding any new material to the pile during the aging period.

C. Identification of Steel Slag. Provide clear, definitive, and undisputable identification of the proposed material as steel slag.

Obtain evidence from the producer that certifies the material as steel slag and show to the City. Provide information consisting of, but not limited to, the following:

1. Steel producer.
2. Production dates.
3. Production rates.
4. Stockpiling dates.
5. Type of steel furnace(s).
6. All known City and non-City projects where the material was previously used.

The City will allow the Contractor to supplement this identification of steel slag and the source by other information approved by the City or by using 10 years of good performance data. Ensure that the producer submits to the City projects where contractors used the steel slag used without expansion or tufa problems. The City will review the above projects as part of the identification approval process.

D. Tufa Performance Verification of Steel Slag. The City defines tufa as a precipitate form of calcium carbonate that can clog up the underdrain systems. Some steel slag sources clog up underdrain systems and some do not. Base tufa performance verification on field performance and City's inspection of the underdrain systems.

Verify tufa performance.

Ensure that the producer submits past projects at least 10 years old that used the proposed steel slag source to the City. The City may consider projects less than 10 years old for tufa performance verification if the City determines that the project used steel slag 10 years old or greater. Ensure the producer supplies the City with construction plans with the underdrains and underdrain outlets marked on the plans, or other suitable method, approved by the City, showing the underdrain system. Ensure the producer marks the underdrain outlets in the field for inspection. The City will inspect the underdrain systems for tufa deposits. If the City finds tufa deposits in the outlets or in the underdrain system, the City will reject the steel slag source.

E. Expansion Testing of Steel Slag. After meeting the aging and stockpiling requirements, expansion test the steel slag.

Perform expansion testing according to Pennsylvania Department of Transportation PTM No. 130, the ODOT equivalent to this test or expansion testing acceptable to the City.

Ensure that the producer hires an independent AASHTO accredited and City approved laboratory to perform at least half of the expansion testing. The City will allow the producer to perform up to half of the required expansion testing using the producer's laboratory. The Laboratory will observe the expansion testing and approve each independent and producer laboratory.

Perform expansion testing for every 2500 tons (2300 metric tons) or fraction thereof of the material stockpiled in accordance with 703.14.B. For steel slag less than 10 years old, retain a spilt portion of the expansion sample. Reduce the split sample to 5 lbs (2500 g) and test for total percent MgO by X-Ray florescence and total percent periclase (hard burned MgO) by X-Ray diffraction.

The City will allow a maximum allowable total expansion for each test of no less than 0.50 percent. If any one test fails in the stockpile, the City will reject the entire stockpile. When sampling for expansion, ensure that the producer notifies the City at least 48 hours before the sampling. The City will verify that the sample came from the correct stockpile and take independent split samples, if required.

Submit the expansion test data and a suitably presented summary of the expansion test data to the City for approval. Submit X-Ray florescence and X-Ray diffraction data to the City. The City reserves the right to perform independent testing to verify the laboratory results at any time.

The City expansion test data takes precedence over the producer or independent laboratory expansion testing results in the event of a conflict. The City will make the final determination on all conflicting data.

If the material fails the expansion testing, then stockpile the material for a minimum of 2 additional months from the date of last sampling and retest for expansion. The City will only approve materials that pass the expansion test for use.

703.15 Suitable Materials for Embankment Construction. The City will allow use of natural soil, natural granular material, granular material types, brick, shale, rock, or random material, as further defined below, in embankment construction. The Engineer will submit samples of soils not identified from the plan subsurface investigation, from borrow sources or materials appearing questionable in the field.

When using coal, completely blend it with natural soil or natural granular materials. Make at least 90 percent of the blend natural soil or natural granular materials.

A. Natural Soils. Furnish natural soils as defined in 203.02.I and classified as City Group Classifications A-4-a, A-4-b, A-6-a, A-6-b, and A-7-6 as further defined below: Furnish soils with a maximum dry density of at least 90 pounds per cubic foot (1450 kg/m^3).

Do not use soils having a liquid limit in excess of 65 or soils identified as City Group Classifications A-5, or A-7-5 in the work.

B. Granular Embankment Materials. Furnish natural granular materials as defined in 203.02.H and classified as City Group Classifications A-1-a, A-1-b, A-3, A-3-a, A-2-4, A-2-6, or A-2-7.

Do not use granular material classified as A-2-5.

C. Granular Material Types. Furnish CCS, gravel, durable sandstone, durable siltstone, or blended natural soil or natural granular materials blended with OH, BOF, EAF, or RPCC as detailed above. Furnish durable sandstone and siltstone with a slake durability index greater than 90 percent according to ASTM D 4644.

Except for GS, furnish the following gradations for the granular material types, by weight:

1. Granular Material, Type A. Furnish material having less than 25 percent by weight of the grains or particles passing the No. 200 (75 µm) sieve.

2. Granular Material Type B. For Item 204, furnish the gradation of Items 304, 411, or 617. For Item 203, furnish the gradation of Items 304, 411, or 617 except the City will allow 0 to 20 percent to pass the No. 200 (75 µm) sieve.

3. Granular Material Type C. Furnish well graded material that meets the following gradation:

Sieve Size		Total Percent Passing
3 inch	(75 mm)	100
2 inch	(50 mm)	70 to 90
1/2 inch	(12.5 mm)	30 to 60
No. 200	(75 µm)	0 to 13

4. Granular Material Type D. Furnish the gradation of 100 percent passing the 8 inch (200 mm) sieve, less than 60 percent passing the 3 inch (76 mm) sieve, less than 40 percent passing the 3/4 inch (19 mm) sieve, and 0 to 20 percent passing the No. 200 (75 µm) sieve.

5. Granular Material Type E. Furnish any of the coarse aggregates from No. l through 67 inclusive on Table 703.01-1.

6. Granular Material Type F. Furnish material according to the following:

   a. Well graded material.
   b. A gradation with a top size from 8 inches (200 mm) to 3 inches (76 mm) and a bottom size of No. 200 (75 µm) sieve.
   c. An evenly graded material between the top and bottom size.
   d. Compactable, stable, and serves the intended use.

D. Shale. Furnish shale as defined in 203.02 and as further defined below. Test shale for durability to classify the shale as hard or soft shale. The Engineer will field test the shale according to the following:

1. The Engineer will obtain a typical 6-inch (150 mm) diameter piece of shale. If the City cannot obtain a 6-inch (150 mm) diameter sample, the City will classify the shale as soft shale.

2. The Engineer will place the shale in a bucket of water. The Engineer will examine the deterioration or slaking after 48 hours.

3. If the material does not deteriorate after 48 hours the City will break the shale down by hand pressure. The City will classify the shale as soft shale if the 3/4 inch (19.0 mm) sieve retains 75 percent or less of the material.

4. If the 3/4 inch (19.0 mm) sieve retains more than 75 percent of the shale or if the material does not deteriorate, the City will field test the shale for hardness. The field test for hardness will consist of compacting the shale with a steel drum roller with a minimum compressive force of 500 pounds per lineal inch (57 kN/mm) of roller drum width. Provide documentation to the Engineer to verify the steel drum meets the compressive force requirements.

a. If more than 40 percent of the shale breaks down, by visual inspection, with six complete passes with a steel drum roller, then the shale is soft shale.
b. If less than 40 percent of the shale breaks down with six complete passes with a steel drum roller, by visual inspection, the shale is hard shale.

703.16 Aggregate Materials for 304. Furnish CCS, or crushed gravel aggregate.

Determine aggregate acceptance before incorporation into the work based on samples taken from stockpiles.

A. Furnish CCS, and crushed gravel that meets the following gradation:

Sieve Size		Total Percent Passing
2 inch	(50 mm)	100
1 inch	(25.0 mm)	70 to 100
3/4 inch	(19.0 mm)	50 to 90
No. 4	(4.75 mm)	30 to 60
No. 30	(600 μm)	9 to 33
No. 200	(75 μm)	0 to 15 [1]

[1] Furnish OH slag that has 0 to 10 percent passing through the No. 200 (75μm) sieve

Furnish gravel used under Item 304 that is crushed from material retained on the 1/2 inch (12.5 mm) sieve.

B. Furnish CCS, and crushed gravel that meets the physical property requirements:

Percent of wear, Los Angeles test, maximum (CCS or crushed gravel)	50 %
Loss, sodium sulfate soundness test, maximum	15 %
Percent by weight of fractured pieces (one or more faces), minimum	90 % [1]

[1] Does not apply to OH slag

Ensure deleterious substances in CCS, and crushed gravel do not exceed the following:

Material Type	Percent by weight
Shale and shaly material	5.0
Chert, that disintegrates in 5 cycles of the soundness test	5.0

Ensure a maximum liquid limit of 25 and a maximum plasticity index of 6 for the portion of the material passing through the No. 40 (425 μm) sieve.

703.17 Materials for Items 410, 411, and 617. Furnish CCS, gravel, or RPCC, for materials.

If using RPCC , provide the following information:

1. Specification item that the material was originally constructed under.

2. The applicable material requirements of the original construction item.

If the original construction requirements meet or exceed the requirements of this specification, then the City may waive the shale, sodium soundness and Los Angeles abrasion test for RPCC. The City will not require plastic index and clay requirements for RACP. Use RPCC free of steel.

A. Gradations.

Use the following gradations for Items 410, 411, and 617.

Furnish materials for Item 410 according to one of the following gradations:

Sieve Size		Type A	Type B	Type C
		Total Percent Passing		
1 1/2 inch	(37.5 mm)	100	100	Size No. 4 or 57 from Table 703.01-1
1 inch	(25.0 mm)	90 to 100	75 to 100	
3/4 inch	(19.0 mm)	60 to 100	60 to 100	
3/8 inch	(9.5 mm)	40 to 60	35 to 75	
No. 4	(4.75 mm)	15 to 30	30 to 60	

Furnish materials for Item 411 according to the following gradation:

Sieve Size		Total Percent Passing
1 1/2 inch	(37.5 mm)	100
1 inch	(25.0 mm)	75 to 100
3/4 inch	(19.0 mm)	60 to 100
3/8 inch	(9.5 mm)	35 to 75
No. 4	(4.75 mm)	30 to 60
No. 30	(600 μm)	7 to 30
No. 200	(75 μm)	3 to 15

Furnish materials for Item 617 according to the following gradation:

Sieve Size		Total Percent Passing
1 inch	(25.0 mm)	100
3/4 inch	(19.0 mm)	60 to 100
3/8 inch	(9.5 mm)	35 to 75
No. 4	(4.75 mm)	30 to 60
No. 30	(600 μm)	9 to 33
No. 200	(75 μm)	0 to 15

B. Physical properties.

	Item 410	Item 411	Item 617
Percent of wear, Los Angeles test, maximum	50 %	–	–
Loss, sodium sulfate soundness test, maximum	–	15 %	–
Percent by weight of fractured pieces (one or more faces), minimum	–	–	90 %
Gravel used, portion retained on a No. 4 (4.75 mm) sieve (one or more faces) minimum crushed	–	40 %	–
Maximum plasticity index of material passing No. 40 (425 μm) sieve	–	6	–

Do not exceed the following percentages of deleterious substances:

	Percent by weight		
Material Type	Item 410	Item 411	Item 617
Shale and shaly material	–	5 % [1]	12 %
Clay	10 %	–	–

[1] Where the major portion of the material in a coarse aggregate, from a source on record at the Laboratory, shows the characteristics of acquiring a mud-like condition when tested for soundness, test it for soundness and ensure a maximum loss of no more than 5 percent.

703.18 Rock and Aggregate Materials for Item 601.

A. Crushed Aggregate Slope Protection and Filter Aggregate for Dump Rock Fill. Furnish crushed gravel, limestone, sandstone, or RPCC for crushed aggregate slope protection and filter aggregate for dump rock fill.

Furnish Size No. 1 or 2 from Table 703.01-1, or according to the following gradation for crushed aggregate slope protection:

Sieve Size	Total Percent Passing
4 inch (100 mm)	100
3 1/2 inch(90 mm)	90 to 100
2 1/2 inch(63 mm)	25 to 90
1 1/2 inch(37.5 mm)	0 to 25
3/4 inch (19.0 mm)	0 to 10

For a filter for rock channel protection, use Size No. 3 or 4 from Table 703.01-1.

Physical properties.

Percent of wear, Los Angeles Test, maximum (CCS or gravel)	50 %
Loss, sodium sulfate soundness test, maximum (except for RPCC)	15 %
Percent by weight of fractured pieces minimum (CCS or gravel)	90 %
Loss for RPCC, AASHTO T 103 Soundness of Aggregates by Freezing and Thawing	20 % [1]

[1] Use Method C using 25 cycles.

B. Dumped Rock Fill and Rock Channel Protection. Furnish gravel, broken recycled portland cement concrete (RPCC), broken sandstone, broken siltstone, and broken limestone for dumped rock fill and rock channel protection. Furnish sandstone, siltstone, and limestone free of laminations, seams, and fractures, or injury due to blasting.

Except for RPCC, test for soundness according to ASTM D 5240. Use materials having a maximum 30 percent single slab loss and a maximum 20 percent cumulative loss. Ensure a minimum of 8 inch slab heights and lengths.. For RPCC, test for soundness according to AASHTO T 103 as stated in 703.18.A.

The City may waive testing when the stone comes from a source with a known durability history.

Do not use thin, slab-like pieces, or any pieces having a dimension larger than 36 inches (1 m). Do not use RPCC with reinforcing steel protruding more than 1 inch (25 mm) beyond the outside surface of the concrete pieces.

Furnish dumped rock fill and rock channel protection materials consisting of the four material types defined below:

1. Type A material has at least 85 percent of the total material by weight larger than an 18-inch (0.5 m) but less than a 30-inch (0.8 m) square opening and at least 50 percent of the total material by weight larger than a 24-inch (0.6 m) square opening. Furnish material smaller than an 18-inch (0.5 m) square opening that consists predominantly of rock spalls and rock fines free of soil.

2. Type B material has at least 85 percent of the total material by weight larger than a 12-inch (0.3 m) but less than a 24-inch (0.6 m) square opening and at least 50 percent of the total material by weight larger than an 18-inch (0.5 m) square opening. Furnish material smaller than a 12-inch (0.3 m) square opening that consists predominantly of rock spalls and rock fines free of soil.

3. Type C material has at least 85 percent of the total material by weight larger than a 6-inch (150 mm) but less than an 18-inch (0.5 m) square opening and at least 50 percent of the total material by weight larger than a 12-inch (0.3 m) square opening. Furnish material smaller than a 6-inch (150 mm) square opening that consists predominantly of rock spalls and rock fines free of soil.

4. Type D material has at least 85 percent of the total material by weight larger than a 3-inch (75 mm) but less than a 12-inch (0.3 m) square opening and at least 50 percent of the total material by weight larger than a 6-inch (150 mm) square opening.

Furnish material smaller than a 3-inch (75 mm) square opening that consists predominantly of rock spalls and rock fines free of soil.