SECTION 703 - AGGREGATES

703.01 Fine Aggregate for Concrete. Fine aggregate for portland cement concrete may be a combination of calcareous sand and basalt, or basalt alone, both being free of vegetable matter and other deleterious substances. Natural sand or manufactured sand from a brackish water source shall be processed by washing with fresh water.

Submit Quality Control Plan (QCP) with detailed process control procedures and type and frequency of sampling and testing. For aggregate used in structural concrete, exclusive of concrete for incidental construction, minimum frequency of sieve analysis and sand equivalent testing shall be once a day. Provide the Engineer access to project-related plant production records and when requested, informational copies of sampling and testing reports.

Absolute volume of calcareous sand in fine aggregate shall be limited to 50 percent. Absolute volume of calcareous sand of up to 70 percent of absolute volume of fine aggregate will be acceptable, provided fine aggregate meets minimum insoluble residue of 60 percent; and processing or manufacturing of calcareous sand removes deleterious coatings and unsound materials. Insoluble residue content shall be determined in accordance with ASTM D 3042.

Fine aggregate shall be from an approved source and shall conform to Table 703.01-1 - Physical Properties.

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TABLE 703.01-1 - PHYSICAL PROPERTIES		
Test	**Method**	**Requirements**
Sand Equivalent	AASHTO T 176	70 Minimum (a)
Soundness Sodium Sulfate (5 cycles)	AASHTO T 104	10 Maximum (b)
Abrasion (500 Revolutions)	AASHTO T 96	40 Maximum (c)
Organic Impurities	AASHTO T 21	Not darker than the reference standard color (d)
Coal and Lignite	AASHTO T 113	1 Maximum

Notes:

(a) Sand equivalent (SE) requirement will be waived if material finer than No. 200 sieve does not exceed 5 percent when tested in accordance with AASHTO T 11.

(b) When material has satisfactory service record of at least five years, soundness test will be waived

(c) Parent material of fine aggregate manufactured by crushing shall have a loss by abrasion of less than 40 percent when tested in accordance with AASHTO T 96.

(d) Materials that fail to meet organic impurity color test will be accepted, provided relative strength at 7 and 28 days is more than 95 percent when tested in accordance with AASHTO T 71.

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Fine aggregate grading shall conform to Table 703.01-2 - Fine Aggregate Grading Requirements. On the islands of Hawaii and Kauai, fine aggregate grading shall conform to Table 703.01-2 - Fine Aggregate Grading Requirements or Table 703.01-3 - Fine Aggregate Grading Requirements, Hawaii and Kauai.

TABLE 703.01-2 - FINE AGGREGATE GRADING REQUIREMENTS

Sieve Sizes	Percent Passing by Weight
3/8 Inch	100
No. 4	95 – 100
No. 8	80 – 100
No. 16	50 – 85
No. 30	25 – 60
No. 50	10 – 30
No.100	2 - 12

TABLE 703.01-3 - FINE AGGREGATE GRADING REQUIREMENTS, HAWAII AND KAUAI

Sieve Sizes	Percent Passing by Weight	
	Calcareous Sand	Crusher Screenings
3/8 Inch	100	100
No. 4	95 – 100	95 - 100
No. 8	-	50 - 85
No. 16	-	-
No. 30	-	32 - 60
No. 50	-	15 - 30
No. 100	0 – 5	5 - 20

Fine aggregate consisting of blend of fine natural sand with fineness modulus of less than 2.1 and basalt for concrete conforming to Table 703.01-4 - Fine Aggregate Grading Requirements Fine Natural Sand Blend may be used, provided the Contractor furnishes test data, accepted by the Engineer, indicating that concrete produced will have properties equal to those of concrete made with designated grading.

TABLE 703.01-4 - FINE AGGREGATE GRADING REQUIREMENTS FINE NATURAL SAND BLEND

Sieve Size	Percent Passing by Weight
3/8 Inch	100
No. 4	95 - 100
No. 8	65 - 95
No. 16	x ± 10
No. 30	x ± 9
No. 50	x ± 6
No. 100	2 - 14
The symbol x is grading that the Contractor proposes to furnish for specific sieve size	

Before beginning concrete work, typical grading of calcareous sand and crushed lava rock fines shall be submitted; and blend proportion proposed to be furnished shall be specified. Grading shall not have more than 45 percent retained between two consecutive sieves that are specified in control of fineness modulus.

Target fineness modulus shall be designated between 2.4 and 3.1. Fineness modulus using No. 4, 8, 16, 30, 50, and 100 sieves shall be computed. Fineness modulus shall be maintained at not more than 0.2 from target.

703.02 Coarse Aggregate for Portland Cement Concrete. Coarse aggregate for portland cement concrete shall consist of crushed basalt free of adherent coatings.

Coarse aggregate shall conform to Table 703.02-1 - Physical Properties.

TABLE 703.02-1 - PHYSICAL PROPERTIES		
Deleterious Substances and Physical Properties	**Test Method**	**Maximum Allowable (percent)**
Clay Lumps and Friable Particles	AASHTO T 112	2.0
Materials Finer than No. 200 (75-µm) Sieve	AASHTO T 11	1.5
Lightweight Pieces (Less than 2.0 specific gravity SSD)	AASHTO T 113	0.5
Absorption	AASHTO T 85	6
Abrasion (500) Revolutions	AASHTO T 96	40
Soundness (Sodium Sulfate)	AASHTO T 104	12

When material has satisfactory service record of at least five years, soundness requirement will be waived.

Coarse aggregate grading shall conform to appropriate size designation of AASHTO M 43 when tested in accordance with AASHTO T 27. Grading and material finer than No. 200 (75 µm) sieve testing shall be part of the Quality Control Plan required in Subsection 703.01 - Fine Aggregate for Concrete.

703.03 Aggregate for Hot Mix Asphalt Base Course. Aggregate for HMA base course shall conform to Subsection 703.09 - Aggregate for Hot Mix Asphalt Pavement, except grading shall conform to Table 703.03-1 - HMA Base Course Grading Requirements.

TABLE 703.03-1 - HMA BASE COURSE GRADING REQUIREMENTS

Sieve Size	Percent Passing by Weight
1-1/4 Inch	100
1 Inch	85 - 100
3/4 Inch	73 – 92
1/2 Inch	60 - 80
3/8 Inch	52 – 72
No. 4	36 - 55
No. 8	25 – 42
No. 16	18 – 33
No. 30	12 - 24
No. 50	7 – 18
No. 100	4 – 12
No. 200	1 – 8

703.04 Aggregate for Untreated Permeable Base. Aggregate for untreated permeable base shall conform to the following:

(A) Coarse Aggregate. Coarse aggregate shall consist of crushed and screened basalt that is free of soft or disintegrated pieces, clay, dirt, and other deleterious substances.

Coarse aggregate shall conform to Table 703.04-1 - Aggregate Test Requirements.

TABLE 703.04-1 - AGGREGATE TEST REQUIREMENTS		
Test	**Test Method**	**Requirement**
Los Angeles Abrasion	ASTM C 535 (Coarse Aggregate) AASHTO T 96 (Filler)	40 Percent Maximum
Grading	AASHTO T 27	Refer to Table 703.04-2

(B) Filler. Filler material shall conform to Subsection 703.04(A) - Coarse Aggregate, except grading shall conform to Table 703.04-2 - Grading Requirements.

TABLE 703.04-2 - GRADING REQUIREMENTS		
Sieve Size	**Coarse Aggregate Modified Size 4 (Percent Passing By Weight)**	**Filler Size 8 (Percent Passing By Weight)**
2 Inch	100	
1-1/2 Inch	75-100	
1 Inch	15-55	
3/4 Inch	0-15	
1/2 Inch		100
3/8 Inch	0-5	85-100
No.4		10-30
No. 8		0-10
No. 16		0-5

703.05 (Unassigned)

703.06 Aggregate for Untreated Base. Aggregate for untreated base shall consist of crushed stone free of vegetable matter and other deleterious substances. Neither reclaimed asphalt pavement (RAP) nor reclaimed concrete pavement will be allowed for untreated base.

Crushing shall be regulated so that at least 80 percent, by weight, of material retained on No. 4 sieve is crushed and has at least one mechanically fractured face.

Aggregate for untreated base, in combination with binder material, if used, shall conform to Table 703.06-1 - Untreated Base Test Requirements and Table 703.06-2 - Untreated Base Grading Requirements.

TABLE 703.06-1 - UNTREATED BASE TEST REQUIREMENTS

Test	Test Method	Requirement
Los Angeles Abrasion	AASHTO T 96	40 Percent Maximum
Sand Equivalent	AASHTO T 176	30 Percent Minimum
Plasticity Index	AASHTO T 90	6 Maximum
Grading	AASHTO T 27	Refer to Table 703.06-2

TABLE 703.06-2 - UNTREATED BASE GRADING REQUIREMENTS			
Sieve Size	Percent Passing by Weight		
	2-1/2 Inch Maximum Nominal	1-1/2 Inch Maximum Nominal	3/4 Inch Maximum Nominal
3 Inch	100	-	-
2-1/2 Inch	90 - 100	-	-
2 Inch	-	100	-
1-1/2 Inch	65 - 90	90 - 100	-
1 Inch	-	-	100
3/4 Inch	45 - 70	50 - 90	90 – 100
No. 4	25 - 45	25 - 50	35 – 55
No. 200	3 - 9	3 - 9	3 – 9

Unless otherwise indicated in the contract documents, 1-1/2 inch maximum nominal size aggregate shall be furnished.

Material used as foundation for corrugated metal pipe culvert shall be tested in accordance with Hawaii Test Method HDOT TM 4 and shall have field resistivity and pH value that provide minimum 50-year service life for gage being installed. Material used as backfill against aluminum pipe shall have field resistivity of more than 500 ohm-centimeter and pH value between 5.5 and 9.0, using same test procedure.

703.07 (Unassigned)

703.08 (Unassigned)

703.09 Aggregate for Hot Mix Asphalt Pavement. Aggregate for HMA pavement shall be crushed and screened basalt free of soft or disintegrated pieces, clay, dirt, and other deleterious substances.

Submit Quality Control Plan (QCP) with detailed process control procedures and type and frequency of sampling and testing. For aggregate used in HMA pavement, minimum frequency of sieve analysis and sand equivalent testing shall be once a day. Provide the Engineer access to project-related plant production records and when requested, informational copies of sampling and testing reports.

Coarse aggregate is defined as material retained on No.4 sieve, and fine aggregate is defined as material passing No. 4 sieve.

At least 90 percent, by weight, of material retained on No. 4 sieve shall consist of crushed particles. At least 70 percent of material passing No. 4 sieve and retained on No. 8 sieve shall consist of crushed particles. A crushed particle is defined as particle having at least one mechanically fractured face.

The combined aggregate for HMA pavement, including filler, if any, shall conform to Table 703.09-1 - HMA Test Requirements and Table 703.09-2 - HMA Grading Requirements.

TABLE 703.09-1 - HMA TEST REQUIREMENTS

Test	Test Method	Requirement
Sand Equivalent	AASHTO T 176	45 Percent Minimum
Los Angeles Abrasion	AASHTO T 96	30 Percent Maximum
Stripping	AASHTO T 182	Above 95 Percent
K-factor	ASTM D 5148	Kc-2.0 Maximum Km-1.7 Maximum
Flat and elongated pieces (Length to thickness ratio of 3)	ASTM D 4791 (By Weight)	25 Percent Maximum
Grading	AASHTO T 11 AASHTO T 27	Job-mix formula based on Table 703.09-2
Soundness	AASHTO T 104 (5 cycles using sodium sulfate)	9 Percent Maximum
Absorption	AASHTO T 84 AASHTO T 85	5 Percent Maximum

If chemical additive resulting in bituminous film retention greater than 95 percent is used, aggregates not meeting stripping test requirements for HMA pavement may be used.

TABLE 703.09-2 - HMA GRADING REQUIREMENTS				
MIX NO.	**II**	**III**	**IV**	**V**
Sieve Sizes	**Combined Aggregate Percent Passing by Weight**			
1-1/4 Inch	100	-	-	-
1 Inch	85 - 100	100	-	-
3/4 Inch	-	90 - 100	100	-
1/2 Inch	60 - 85	70 - 90	90 - 100	100
3/8 Inch	-	-	72 - 90	80 - 100
No. 4	36 - 55	40 - 57	48 - 66	55 - 75
No. 8	26 - 41	30 - 47	32 - 48	35 - 52
No. 16	17 - 32	20 - 36	21 - 37	22 - 38
No. 30	12 - 25	16 - 28	15 - 27	14 - 26
No. 50	8 - 18	10 - 22	9 - 21	8 - 20
No. 100	5 - 14	8 - 17	6 - 16	6 - 15
No. 200	1 - 8	4 - 8	4 - 8	4 - 8

703.10 (Unassigned)

703.11 Aggregate for Slurry Seal. Aggregate for slurry seal shall consist of crushed rock and shall be free of dirt, clay, and other deleterious material. Aggregate shall be nonplastic in accordance with AASHTO T 89 and AASHTO T 90 and shall not contain free water, which is defined as water that is free to move under influence of gravity.

When tested in accordance with AASHTO T 176, aggregate shall have SE greater than 45 percent.

When tested in accordance with AASHTO T 96, aggregate shall be from parent rock with abrasion loss of less than 35 percent.

Aggregate for slurry seal shall conform to Table 703.11-1 - Slurry Seal Grading Requirements.

TABLE 703.11-1 - SLURRY SEAL GRADING REQUIREMENTS

Sieve Size	Percent Passing by Weight			Stockpile Tolerance (Percent)
	Type 1	Type 2	Type 3	
3/8 Inch	-	100	100	-
No. 4	100	90 - 100	70 - 90	± 5
No. 8	90 - 100	65 - 90	45 - 70	± 5
No. 16	65 - 90	45 - 70	28 - 50	± 5
No. 30	40 - 65	30 - 50	19 - 34	± 5
No. 50	25 - 42	18 - 30	12 - 25	± 4
No. 100	15 - 30	10 - 21	7 - 18	± 3
No. 200	10 - 20	5 - 15	5 - 15	± 2

Type 1 - Crack filling and fine seal.
Type 2 - Medium seal.
Type 3 - 1st and/or 2nd application, two-course seal.

703.12 (Unassigned)

703.13 (Unassigned)

703.14 Blotter. Blotter aggregate shall conform to grading requirements of AASHTO M 43, Size No. 10 and shall be free of vegetable matter and other deleterious substances.

703.15 Filler. Filler shall conform to AASHTO M 17.

703.16 Bed Course Material for Crushed Rock Cradle. Bed course material shall consist of crushed basalt that is free of vegetable matter and other deleterious substances. When tested in accordance with AASHTO T 96, wear shall not exceed 40 percent at 500 revolutions.

Aggregate size No. 67 shall be provided with percent composition by weight within limits shown in AASHTO M 43, Table 1 - Standard Sizes of Processed Aggregate.

703.17 Aggregate for Subbase. Aggregate for subbase shall consist of gravel, stone, basalt, or coral, or combination thereof, and shall be free of overburden, vegetable matter, and other deleterious substances. When tested in accordance with AASHTO T 27, subbase shall conform to Table 703.17-1 - Subbase Grading Requirements.

TABLE 703.17-1 - SUBBASE GRADING REQUIREMENTS

Sieve Size	Percent Passing by Weight	
	Subbase Material Placed in Top 6 Inches	Subbase Material Placed Below Top 6 Inches
6 Inch	-	100
2-1/2 Inch	100	-
No. 4	20 - 60	20 - 60
No. 200	0 - 15	0 - 15

When tested in accordance with AASHTO T 176, SE value shall not be less than 25. A minimum SE of 20 shall be provided when material passing No. 4 sieve is entirely crushed coral limestone.

When tested in accordance with AASHTO T 89 and AASHTO T 90, subbase shall conform to Table 703.17-2 - Subbase Plasticity Index.

TABLE 703.17-2 - SUBBASE PLASTICITY INDEX

Percent Passing No. 200 Sieve	Plasticity Index
0 - 9	15 Maximum
10 - 15	10 Maximum

703.18 Filter Material. Filter material shall consist of hard, tough, durable, lava rock conforming to Table 703.18-1 - Filter Material Test Requirements and Table 703.18-2 - Filter Material Grading Requirements.

TABLE 703.18-1 - FILTER MATERIAL TEST REQUIREMENTS

Test	Test Method	Requirement
Los Angeles Abrasion	AASHTO T 96 (Grading A)	10% Maximum @ 100 Rev. 40% Maximum @ 500 Rev.
Sand Equivalent	AASHTO T 176	35% Minimum
Plasticity Index	AASHTO T 90	6% Maximum
Grading	AASHTO T 27	Refer to Table 703.18-2

TABLE 703.18-2 - FILTER MATERIAL GRADING REQUIREMENTS

Sieve Size	Percent Passing by Weight
2 Inch	100
1-1/2 Inch	90 - 100
3/4 Inch	50 - 90
No. 4	15 - 50
No. 200	0 - 5

703.19 (Unassigned)

703.20 Structure Backfill Material. Structure backfill material shall be free of vegetable matter and other deleterious substance and shall conform to Table 703.20-1 - Structure Backfill Grading Requirements and other requirements of this subsection. RAP shall not be used for structural backfill material A.

TABLE 703.20-1 - STRUCTURE BACKFILL GRADING REQUIREMENTS

Sieve Size	Percent Passing by Weight	
	Structure Backfill Material A	Structure Backfill Material B
3 Inch	100	100
No. 4	20 - 75	20 - 100
No. 200	0 - 15	-

SE shall be tested in accordance with AASHTO T 176. Structural backfill material A shall have minimum SE of 20. Structural backfill material B shall have SE equal to or greater than SE of surrounding soil in area to be backfilled.

703.21 Trench Backfill Material. Trench backfill material shall consist of sand-silt mixture conforming to Table 703.21-1 - Trench Backfill Grading Requirements and other requirements of this subsection. Coarse aggregate material shall be used for trenches where invert of pipe is in swampy areas or under water. Coarse aggregate material shall conform to ASTM C 33, size number 67, and shall be completely encapsulated with geotextile conforming to Subsection 716.03 - Geotextiles for Underdrain Applications. Trench backfill material shall be free of trash, roots, organic matter, and other deleterious materials.

TABLE 703.21-1 - TRENCH BACKFILL GRADING REQUIREMENTS

Sieve Size	Percent Passing by Weight	
	Trench Backfill Material A	Trench Backfill Material B
3 Inch	-	100
1 Inch	100	-
No. 4	75 - 100	20 - 100
No. 200	0 - 15	-

Trench backfill material placed against corrugated metal pipe culvert shall be tested in accordance with Hawaii Test Method HDOT TM 4 and shall have field resistivity and pH value that provide minimum 50-year service life for gage being installed. Trench backfill material placed against aluminum pipe shall have field resistivity of more than 500 ohm-centimeter and pH value between 5.5 and 9.0, using same test procedure.

(A) Trench Backfill Material A. Trench backfill material shall be sandy material classified as SW, SP, SM, SW-SM, or SP-SM in accordance with ASTM D 2487. SE value of trench backfill A, determined in accordance with AASTHO T 176, shall not be less than 20 and not less than SE value of surrounding soil in trench to be backfilled. Reclaimed asphalt pavement (RAP) shall not be used for trench backfill material A.

(B) Trench Backfill Material B. SE value of trench backfill B, determined in accordance with AASHTO T 176, shall be not less than SE value of surrounding soil in trench to be backfilled.

703.22 (Unassigned)

703.23 Aggregate for Dressing of Shoulders. Aggregate for dressing of shoulders shall conform to Subsection 703.17 - Aggregate for Subbase, except that 100 percent of material shall pass 1-1/2-inch sieve.

703.24 Granular Material for Embankment. Granular material for embankment shall consist of gravel, stone, lava rock, coral, or cinders, or combination thereof, and shall be free of overburden, vegetable matter, and other deleterious substances. Pit run material is acceptable. When tested in accordance with AASHTO T 27, grading shall conform to Table 703.24-1 - Embankment Material Grading Requirements.

TABLE 703.24-1 - EMBANKMENT MATERIAL GRADING REQUIREMENTS

Sieve Size	Percent Passing by Weight
6 Inch	100
3 Inch	75 - 100
No. 4	20 - 75
No. 200	0 - 15

END OF SECTION 703