**APPENDIX**

**Table 2501.03-1 (English Units)**
**Energy Values For Gravity And Diesel Hammers**

| Minimum Energy Required for Gravity Hammers (Ft. - Kips[(b)]) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pile Length (ft.) | Wood Pile | Concrete Pile | | Steel H-Pile | | | | | |
| | | 12" to 14" | 16" | 10 x 42 | 10 x 57 | 12 x 53 | 12 x 74 | 14 x 73 | 14 x 89 |
| 25' or less | 15 | 25 | 27 | 23 | 23 | 23 | 25 | 25 | 32 |
| 26' to 40' | 15 | 25 | 27 | 23 | 23 | 23 | 30 | 30 | 35 |
| 41' to 50' | 15 | 25 | 27 | 25 | 25 | 25 | 30 | 30 | 36 |
| 51' to 65' | (a) | (a) | (a) | 25 | 25 | 25 | 30 | 30 | 36 |
| 66' to 90' | (a) | (a) | (a) | 30 | 30 | 30 | 33 | 33 | 36 |

| Maximum Energy Allowed for Gravity Hammers (Ft. - Kips[(b)]) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pile Length (ft.) | Wood Pile | Concrete Pile | | Steel H-Pile | | | | | |
| | | 12" to 14" | 16" | 10 x 42 | 10 x 57 | 12 x 53 | 12 x 74 | 14 x 73 | 14 x 89 |
| 25' or less | 25 | 34 | 36 | 28 | 28 | 28 | 35 | 35 | 42 |
| 26' to 40' | 25 | 34 | 36 | 32 | 35 | 35 | 38 | 38 | 45 |
| 41' to 50' | 25 | 34 | 36 | 38 | 38 | 42 | 42 | 42 | 48 |
| 51' to 65' | (a) | (a) | (a) | 35 | 38 | 38 | 42 | 42 | 48 |
| 66' to 90' | (a) | (a) | (a) | 35 | 38 | 38 | 42 | 42 | 50 |

| Minimum Energy Required for Diesel Hammers (Ft. - Kips[b]) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pile Length (ft.) | Wood Pile | Concrete Pile | Steel H-Pile | | | | | | |
| | | 12" to 14" | 16" | 10 x 42 | 10 x 57 | 12 x 53 | 12 x 74 | 14 x 73 | 14 x 89 |
| 25' or less | 17 | 23 | 28 | 22 | 24 | 24 | 29 | 29 | 33 |
| 26' to 40' | 17 | 23 | 28 | 22 | 24 | 24 | 29 | 29 | 40 |
| 41' to 50' | 17 | 23 | 28 | 22 | 26 | 26 | 33 | 33 | 40 |
| >51' to 65' | [a] | [a] | [a] | 22 | 26 | 26 | 33 | 33 | 40 |
| 66' to 90' | [a] | [a] | [a] | 22 | 29 | 29 | 40 | 40 | 49 |
| Maximum Energy Allowed for Diesel Hammers (Ft. - Kips[b]) | | | | | | | | | |
| Pile Length (ft.) | Wood Pile | Concrete Pile | Steel H-Pile | | | | | | |
| | | 12" to 14" | 16" | 10 x 42 | 10 x 57 | 12 x 53 | 12 x 74 | 14 x 73 | 14 x 89 |
| 25' or less | 24 | 32 | 40 | 33 | 33 | 33 | 40 | 40 | 43 |
| 26' to 40' | 24 | 32 | 40 | 33 | 33 | 33 | 40 | 40 | 47 |
| 41' to 50' | 33 | 32 | 40 | 40 | 40 | 40 | 43 | 43 | 52 |
| 51' to 65' | [a] | [a] | [a] | 40 | 40 | 40 | 43 | 43 | 52 |

[a] Wave equation analysis.

[b] Ft. - Kips - 1,000 foot pounds.

For design bearings under 40 tons, minimum diesel hammer energies listed may be reduced by 20% for concrete pile and 10% for steel pile.

**Table 2501.03-2 (Metric Units)**
**Energy Values For Gravity And Diesel Hammers**

| Minimum Energy Required for Gravity Hammers (kilojoules) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pile Length (meters) | Wood Pile | Concrete Pile | | Steel H-Pile | | | | | |
| | | 305 mm to 356 mm | 406 mm | 250 x 62 | 250 x 85 | 310 x 79 | 310 x 110 | 360 x 108 | 360 x 132 |
| 7.5 or less | 20 | 34 | 37 | 31 | 31 | 31 | 34 | 34 | 43 |
| 7.6 to 12.0 | 20 | 34 | 37 | 31 | 31 | 31 | 41 | 41 | 47 |
| 12.1 to 15.0 | 20 | 34 | 37 | 34 | 34 | 34 | 41 | 41 | 49 |
| 15.1 to 20.0 | (a) | (a) | (a) | 34 | 34 | 34 | 41 | 41 | 49 |
| 20.1 to 28.0 | (a) | (a) | (a) | 41 | 41 | 41 | 45 | 45 | 49 |
| Maximum Energy Allowed for Gravity Hammers (kilojoules) | | | | | | | | | |
| Pile Length (meters) | Wood Pile | Concrete Pile | | Steel H-Pile | | | | | |
| | | 305 mm to 356 mm | 406 mm | 250 x 62 | 250 x 85 | 310 x 79 | 310 x 110 | 360 x 108 | 360 x 132 |
| 7.5 or less | 34 | 46 | 49 | 38 | 38 | 38 | 47 | 47 | 57 |
| 7.6 to 12.0 | 34 | 46 | 49 | 43 | 47 | 47 | 52 | 52 | 61 |
| 12.1 to 15.0 | 34 | 46 | 49 | 47 | 52 | 52 | 57 | 57 | 65 |
| 15.1 to 20.0 | (a) | (a) | (a) | 47 | 52 | 52 | 57 | 57 | 65 |
| 20.1 to 28.0 | (a) | (a) | (a) | 52 | 52 | 57 | 57 | 57 | 68 |

| Minimum Energy Required for Diesel Hammers (kilojoules) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pile Length (meters) | Wood Pile | Concrete Pile | | Steel H-Pile | | | | | |
| | | 305 mm to 356 mm | 406 mm | 250 x 62 | 250 x 85 | 310 x 79 | 310 x 110 | 360 x 108 | 360 x 132 |
| 7.5 or less | 23 | 31 | 38 | 30 | 33 | 33 | 39 | 39 | 45 |
| 7.6 to 12.0 | 23 | 31 | 38 | 30 | 33 | 33 | 39 | 39 | 54 |
| 12.1 to 15.0 | 23 | 31 | 38 | 30 | 35 | 35 | 45 | 45 | 54 |
| 15.1 to 20.0 | (a) | (a) | (a) | 30 | 35 | 35 | 45 | 45 | 54 |
| 20.1 to 28.0 | (a) | (a) | (a) | 30 | 39 | 39 | 54 | 54 | 66 |
| Maximum Energy Allowed for Diesel Hammers (kilojoules) | | | | | | | | | |
| Pile Length (meters) | Wood Pile | Concrete Pile | | Steel H-Pile | | | | | |
| | | 305 mm to 356 mm | 406 mm | 250 x 62 | 250 x 85 | 310 x 79 | 310 x 110 | 360 x 108 | 360 x 132 |
| 7.5 or less | 33 | 43 | 54 | 45 | 45 | 45 | 54 | 54 | 58 |
| 7.6 to 12.0 | 33 | 43 | 54 | 45 | 45 | 45 | 54 | 54 | 64 |
| 12.1 to 15.0 | 45 | 43 | 54 | 54 | 54 | 54 | 58 | 58 | 70 |
| 15.1 to 20.0 | (a) | (a) | (a) | 54 | 54 | 54 | 58 | 58 | 70 |
| 20.1 to 28.0 | (a) | (a) | (a) | 54 | 54 | 64 | 66 | 66 | 81 |

(a) Wave equation analysis. For design bearings under 355 kN, minimum diesel hammer energies listed may be reduced by 20% for concrete pile and 10% for steel pile.

**Table 2550.02-1: Fabric Form Minimum Property Requirements**

| Property | Test Method | Units | Armor Unit | Articulating Block Mat |
|---|---|---|---|---|
| Composition of Yarns | | | Nylon or Polyester | Nylon or Polyester |
| Mass Per Unit Area (double-layer) | ASTM D 5261 | oz/yd$^2$ (g/m$^2$) | 14 (470) | 12 (403) |
| Thickness | ASTM D 5199 | Mils (mm) | 28 (0.7) | 25 (0.6) |
| Mill Width | | In (m) | 76 (1.92) | 76 (1.92) |
| Wide-Width Strip Tensile Strength<br>-Machine<br>- Cross | <br>ASTM D 4595<br>ASTM D 4595 | <br>lbf/in (kN/m)<br>lbf/in (kN/m) | <br>190 (33.2)<br>140 (24.5) | <br>140 (24.5)<br>110 (19.3) |
| Elongation at Break<br>- Machine<br>- Cross | <br>ASTM D 4595<br>ASTM D 4595 | <br>%<br>% | <br>20<br>30 | <br>20<br>30 |
| Trapezoidal Tear Strength<br>- Machine<br>- Cross | <br>ASTM D 4533<br>ASTM D 4533 | <br>lbf (N)<br>lbf (N) | <br>180 (800)<br>115 (510) | <br>150 (665)<br>100 (445) |
| Apparent Opening Size (AOS) | ASTM D 4751 | U.S. Std. Sieve (mm) | 60 (0.250) | 40 (0.425) |
| Flow Rate | ASTM D 4491 | gal/min/ft$^2$<br>(l/min/m$^2$) | 50 (2035) | 90 (3665) |

Notes:
a. Conformance of fabric to specification property requirements is based on ASTM D 4759.
b. All numerical values represent minimum average roll values (i.e., average of test results from any sample roll in a lot shall meet or exceed the minimum values). Sample lots according to ASTM D 4354.

**Table ~~2553.02-1~~ 2552.02-1: Class II Material**

| Class | Type | Soil Group Symbol ASTM D 2487 | Description | Percentage Passing Sieve Sizes | | | Atterberg Limits | | Coefficients | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1½ in. (37.5 mm) | No. 4 (4.75 mm) | No. 200 (75 µm) | LL | PI | Uniformity $C_u$ | Curvature $C_c$ |
| II | Coarse-Grained Soils, clean | GW | Well-graded gravels and gravel-sand mixtures; little or no fines | 100% | ‹50% of "Coarse Fraction" | ‹5% | Non Plastic | | ›4 | 1 to 3 |
| | | GP | Poorly-graded gravels and gravel-sand mixtures; little or no fines. | | | | | | ‹4 | ‹1 or ›3 |
| | | SW | Well-graded sands and gravelly sands; little or no fines. | | ›50% of "Coarse Fraction" | | | | ›6 | 1 to 3 |
| | | SP | Poorly-graded sands and gravelly sands; little or no fines. | | | | | | ‹6 | ‹1 or ›3 |
| | Coarse-Grained Soils, borderline clean to with fines | e.g. GW-GC, SP-SM | Sands and gravels which are borderline between clean and with fines. | 100% | Varies | 5% to 12% | Non Plastic | | Same as for GW, GP, SW and SP | |

**Table ~~2553.02-2~~ 2552.02-2: Class III Material**

| Class | Type | Soil Group Symbol ASTM D 2487 | Description | Percentage Passing Sieve Sizes | | | Atterberg Limits | | Coefficients | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1½ in. (37.5 mm) | No. 4 (4.75 mm) | No. 200 (75 μm) | LL | PI | Uniformity $C_u$ | Curvature $C_c$ |
| III | Coarse-Grained Soils, with fines | GM | Silty gravels, gravel-sand-silt mixtures. | 100% | ‹50% of "Coarse Fraction" | 12% to 50% | N/A | ‹4 or ‹"A" Line | N/A | N/A |
| | | GC | Clayey gravels, gravel-sand-clay mixtures. | | | | | ‹7 and ›"A" Line | | |
| | | SM | Silty sands, sand-silt mixtures. | | ›50% of "Coarse Fraction" | | | ›4 or ‹"A" Line | | |
| | | SC | Clayey sands, sand-clay mixtures. | | | | | ›7 and ›"A" Line | | |

**Table ~~2553.02-3~~ 2552.02-3: Class IVA Material**

| Class | Type | Soil Group Symbol ASTM D 2487 | Description | Percentage Passing Sieve Sizes | | | Atterberg Limits | | Coefficients | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1½ in. (37.5 mm) | No. 4 (4.75 mm) | No. 200 (75 µm) | LL | PI | Uniformity $C_u$ | Curvature $C_c$ |
| IVA | Fine-Grained Soils (inorganic) | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, silts with slight plasticity. | 100% | 100% | ›50% | ‹50 | ‹4 or ‹"A" Line | N/A | N/A |
| | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clay, lean clays. | | | | | ›7 and ›"A" Line | | |

**Table ~~2553.02-4~~ 2552.02-4: Class IVB Material**

| Class | Type | Soil Group Symbol ASTM D 2487 | Description | Percentage Passing Sieve Sizes | | | Atterberg Limits | | Coefficients | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1½ in. (37.5 mm) | No. 4 (4.75 mm) | No. 200 (75 μm) | LL | PI | Uniformity $C_u$ | Curvature $C_c$ |
| IVB | Fine-Grained Soils (inorganic) | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts. | 100% | 100% | ›50% | ›50 | ‹"A" Line | N/A | N/A |
| | | CH | Inorganic clays of high plasticity, fat clays. | | | | | ›"A" Line | | |

**Table ~~2553.02-5~~ 2552.02-5: Class V Material**

| Class | Type | Soil Group Symbol ASTM D 2487 | Description | Percentage Passing Sieve Sizes | | | Atterberg Limits | | Coefficients | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1½ in. (37.5 mm) | No. 4 (4.75 mm) | No. 200 (75 µm) | LL | PI | Uniformity $C_u$ | Curvature $C_c$ |
| V | Organic Soils (Unsuitable for backfill) | OL | Organic silts and organic silty clays of low plasticity. | 100% | 100% | ›50% | ‹50 | ‹4 or ‹"A" Line | N/A | N/A |
| | | OH | Organic clays of medium to high plasticity, organic silts. | | | | ›50 | ‹"A" Line | | |
| | Highly Organic (Unsuitable for backfill) | PT | Peat and other high organic soils. | | | | | | | |

| AGGREGATE GRADATION TABLE - ENGLISH | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Grad. No.** | **Section No.** | **Std. Sieve Sz.** | **1 1/2”** | **1.00”** | **3/4”** | **1/2”** | **3/8”** | **4** | **8** | **30** | **50** | **100** | **200** | |
| | | **Intended Use** | **Percent Passing** | | | | | | | | | | | **Notes** |
| 1 | 4110, 4125, 4133 | PCC FA, Cover Agg. | | | | | 100 | 90-100 | 70-100 | 10-60 | | | 0-1.5 | 1 |
| 3 | 4115 (57, 2-8) | PCC CA | 100 | 95-100 | | 25-60 | | 0-10 | 0-5 | | | | 0-1.5 | 2, 11 |
| 4 | 4115 (2-8) | PCC CA | 100 | 50-100 | 30-100 | 20-75 | 5-55 | 0-10 | 0-5 | | | | 0-1.5 | 11 |
| 5 | 4115 (67, 2-8) | PCC CA | | 100 | 90-100 | | 20-55 | 0-10 | 0-5 | | | | 0-1.5 | 11 |
| 6 | 4115.06 (Repair & Overlay) | PCC CA | | | 100 | 97-100 | 40-90 | 0-30 | | | | | 0-1.5 | 11 |
| 7 | 4117 (Class V) | PCC FA & CA | 100 | | | | | 80-92 | 60-75 | 20-40 | | | | |
| 8 | 4117.03 (Class V) | Fine Limestone | | | | | 100 | 90-100 | | | | | 0-30 | |
| 10 | 4120.02, 4120.03 (C gravel) | Granular Surface | | | 100 | | | 50-80 | 25-60 | | | | | 3, 12 |
| 11 | 4120.02, 4120.04, 4120.05, 4120.07, (A, B Cr. St.) | Granular Surface & Shoulder | | 100 | 95-100 | 70-90 | | 30-55 | 15-40 | | | | 6-16 | 4, 5, 12 |
| 12a | 4121 (Cr. St.) | Granular Subbase | 100 | | | 40-80 | | | 5-25 | | | | 0-6 | 6, 12 |
| 12b | 4121 (Cr. Gravel) | Granular Subbase | 100 | | | 50-80 | | | 10-30 | | 5-15 | | 3-7 | 7, 12 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 4122.02 (Cr. St.) | Macadam St. Base | 3” nominal maximum size screened over 3/4” or 1.00” screen. | | | | | | | | | | | |
| 14 | 4123 | Modified Subbase | 100 | | 70-90 | | | | 10-40 | | | | 3-10 | 5, 7, 12 |
| 19 | 4125 (1/2”) Cr. Gr. or Cr. St.) | Cover Aggregate | | | 100 | 97-100 | 40-90 | 0-30 | 0-15 | | | | 0-2 | 12 |
| 20 | 4125 (1/2” Scr. Gr.) | Cover Aggregate | | | 100 | 95-100 | 40-80 | 0-15 | 0-7 | | | | 0-1.5 | 12 |
| 21 | 4125 (3/8”) | Cover Aggregate | | | | 100 | 90-100 | 10-55 | 0-20 | 0-7 | | | 0-1.5 | 12 |
| 22 | 4124.02B | Fine Slurry Mixture | | | | | 100 | 85-100 | 40-95 | 20-60 | 14-35 | 10-25 | 5-25 | 10, 12 |
| 23 | 4124.02B (Cr. St.) | Coarse Slurry Mixture | | | | | 100 | 70-90 | 40-70 | 19-42 | | | 5-15 | 12 |
| 29 | 4131 | Porous Backfill | | | 100 | 95-100 | 50-100 | 0-50 | 0-8 | | | | | 12 |
| 30 | 4132.02 (Cr. St.) | Special Backfill | 100 | | | | | | 10-40 | | | | 0-10 | 5, 12 |
| 31 | 4132.03 (Gravel) | Special Backfill | | 100 | 90-100 | 75-100 | | | 30-55 | | | | 3-7 | 12 |
| 32 | 4133 (Sand/Gr./Cr. St.) | Granular Backfill | 100% passing the 3” screen | | | | | | 10-100 | | | | 0-10 | 8, 12 |
| 35 | 4134 (Natural Sand/Gr.) | Floodable Backfill | 100 | | | | | | 20-90 | | | | 0-4 | 12 |
| 36 | 4134 (Natural Sand) | Floodable Backfill | | | | | | | 100 | | | | 0-2 | 12 |

**Notes: (Gradations No. 2, 9, 15, 16, 17, 18, 24, 25, 26, 27, 28, 33, and 34 have been deleted)**

**1.** For Section 4110, when the fine aggregate is sieved through the following numbered sieves - 4, 8, 16, 30, 50, and 100 - no more than 40% shall pass one sieve and be retained on the sieve with the next higher number.

**2.** When used in precast and prestressed concrete bridge beams, 100% shall pass the 1.00" sieve.

**3.** When compaction of material is a specification requirement, the minimum percent passing the No. 200 sieve is 6%.

**4.** See specifications for combination of gravel and limestone.

**5.** Unwashed air dried samples of crushed composite material shall be tested for gradation compliance except that no gradation determination will be made for material passing the No. 200 sieve.

**6.** The gradation requirement for the No. 8 sieve shall be 5% to 20% when recycled material is supplied.

**7.** For Section 4121 gravel, one fractured face on 30% or more of the particles retained on the 3/8 inch sieve. For Section 4123 gravel, one fractured face on 75% or more of the particles retained on the 3/8 inch sieve.

**8.** Crushed stone shall have 100% passing the 1.50" sieve.

**9.** When granular backfill material is used in floodable applications, use gradation 35 or 36. When granular backfill material is used under flowable mortar, one of the following alternative materials shall be used: natural sand compliant with Section 4110 (except the percent passing the No. 200 sieve shall not exceed 4%), gravel, crushed stone, or crushed concrete meeting the gradation requirements of Section 4121.

**10.** Gradation limitations for the 30, 50, and 100 sieves shall not apply when slurry mixture is applied by hand lutes, such as for slurry leveling.

**11.** Maximum of 2.5% passing the No. 200 sieve allowed if generated from the parent material when documented production is 1% or less as determined by the Office of Materials.

**12.** When Producer gradation test results are used for acceptance, test results representing at least 90% of the material being produced shall be within the gradation limits and the average of all gradation results shall be within the gradations limits. Stockpiled material not meeting the criteria may, at the District Materials Engineer’s discretion, be resampled using Materials I.M. 301 procedures. One hundred percent of the stockpile quality control and verification test results shall be within the gradation l

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| AGGREGATE GRADATION TABLE - METRIC | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Grad. No. | Section No. | Std. Sieve Sz. | 37.5mm | 25mm | 19mm | 12.5mm | 9.5mm | 4.75mm | 2.36mm | 600µm | 300µm | 150µm | 75µm | |
| | | Intended Use | Percent Passing | | | | | | | | | | | Notes |
| 1 | 4110, 4125, 4133 | PCC FA, Cover Agg. | | | | | 100 | 90-100 | 70-100 | 10-60 | | | 0-1.5 | 1 |
| 3 | 4115 (57, 2-8) | PCC CA | 100 | 95-100 | | 25-60 | | 0-10 | 0-5 | | | | 0-1.5 | 2, 11 |
| 4 | 4115 (2-8) | PCC CA | 100 | 50-100 | 30-100 | 20-75 | 5-55 | 0-10 | 0-5 | | | | 0-1.5 | 11 |
| 5 | 4115 (67, 2-8) | PCC CA | | 100 | 90-100 | | 20-55 | 0-10 | 0-5 | | | | 0-1.5 | 11 |
| 6 | 4115.06 (Repair & Overlay) | PCC CA | | | 100 | 97-100 | 40-90 | 0-30 | | | | | 0-1.5 | 11 |
| 7 | 4117 (Class V) | PCC FA & CA | 100 | | | | | 80-92 | 60-75 | 20-40 | | | | |
| 8 | 4117.03 (Class V) | Fine Limestone | | | | | 100 | 90-100 | | | | | 0-30 | |
| 10 | 4120.02, 4120.03 (C gravel) | Granular Surface | | | 100 | | | 50-80 | 25-60 | | | | | 3, 12 |
| 11 | 4120.02, 4120.04, 4120.05, 4120.07 (A, B Cr. St.) | Granular Surface & Shoulder | | 100 | 95-100 | 70-90 | | 30-55 | 15-40 | | | | 6-16 | 4, 5, 12 |
| 12a | 4121 (Cr. St.) | Granular Subbase | 100 | | | 40-80 | | | 5-25 | | | | 0-6 | 6, 12 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12b | 4121 (Cr. Gravel) | Granular Subbase | 100 | | | 50-80 | | | 10-30 | | 5-15 | | 3-7 | 7, 12 |
| 13 | 4122.02 (Cr. St.) | Macadam St. Base | 75 mm nominal maximum size screened over 19 mm or 25 mm screen. | | | | | | | | | | | |
| 14 | 4123 | Modified Subbase | 100 | | 70-90 | | | | 10-40 | | | | 3-10 | 5, 7, 12 |
| 19 | 4125 (12.5mm Cr. Gr. or Cr. St.) | Cover Aggregate | | | 100 | 97-100 | 40-90 | 0-30 | 0-15 | | | | 0-2 | 12 |
| 20 | 4125 (12.5mm Scr. Gr.) | Cover Aggregate | | | 100 | 95-100 | 40-80 | 0-15 | 0-7 | | | | 0-1.5 | 12 |
| 21 | 4125 (9.5mm) | Cover Aggregate | | | | 100 | 90-100 | 10-55 | 0-20 | 0-7 | | | 0-1.5 | 12 |
| 22 | 4124.02B | Fine Slurry Mixture | | | | | 100 | 85-100 | 40-95 | 20-60 | 14-35 | 10-25 | 5-25 | 10, 12 |
| 23 | 4124.02B (Cr. St.) | Coarse Slurry Mixture | | | | | 100 | 70-90 | 40-70 | 19-42 | | | 5-15 | 12 |
| 29 | 4131 | Porous Backfill | | | 100 | 95-100 | 50-100 | 0-50 | 0-8 | | | | | 12 |
| 30 | 4132.02 (Cr. St.) | Special Backfill | 100 | | | | | | 10-40 | | | | 0-10 | 5, 12 |
| 31 | 4132.03 (Gravel) | Special Backfill | | 100 | 90-100 | 75-100 | | | 30-55 | | | | 3-7 | 12 |
| 32 | 4133 (Sand/Gr./Cr. St.) | Granular Backfill | 100% passing the 76.2 mm screen | | | | | | 10-100 | | | | 0-10 | 8, 12 |
| 35 | 4134 (Natural Sand/Gr.) | Floodable Backfill | 100 | | | | | | 20-90 | | | | 0-4 | 12 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36 | 41334 (Natural Sand) | Floodable Backfill | | | | | | | 100 | | | | 0-2 | 12 |

**Notes: (Gradations No. 2, 9, 15, 16, 17, 18, 24, 25, 26, 27, 28, 33, and 34 have been deleted)**

**1.** For Section 4110, when the fine aggregate is sieved through the following numbered sieves - 4.75 mm, 2.36 mm, 1.18 mm, 600 µm, 300 µm, and 150 µm - not more than 40% shall pass one sieve and be retained on the sieve with the next higher number.

**2.** When used in precast and prestressed concrete bridge beams, 100% shall pass the 25 mm sieve.

**3.** When compaction of material is a specification requirement, the minimum percent passing the 75 µm sieve is 6%.

**4.** See specifications for combination of gravel and limestone.

**5.** Unwashed air dried samples of crushed composite material shall be tested for gradation compliance except that no gradation determination will be made for material passing the 75 µm sieve.

**6.** The gradation requirement for the 2.36 mm sieve shall be 5% to 20% when recycled material is supplied.

**7.** For Section 4121 gravel, one fractured face on 30% or more of the particles retained on the 9.5 mm sieve. For Section 4123 gravel, one fractured face on 75% or more of the particles retained on the 9.5 mm sieve.

**8.** Crushed stone shall have 100% passing the 37.5 mm sieve.

**9.** When granular backfill material is used in floodable applications, use gradation 35 or 36. When granular backfill material is used under flowable mortar, one of the following alternative materials shall be used: natural sand compliant with Section 4110 (except the percent passing the 75 µm sieve shall not exceed 4%) gravel, crushed stone, or crushed concrete meeting the gradation requirements of Section 4121.

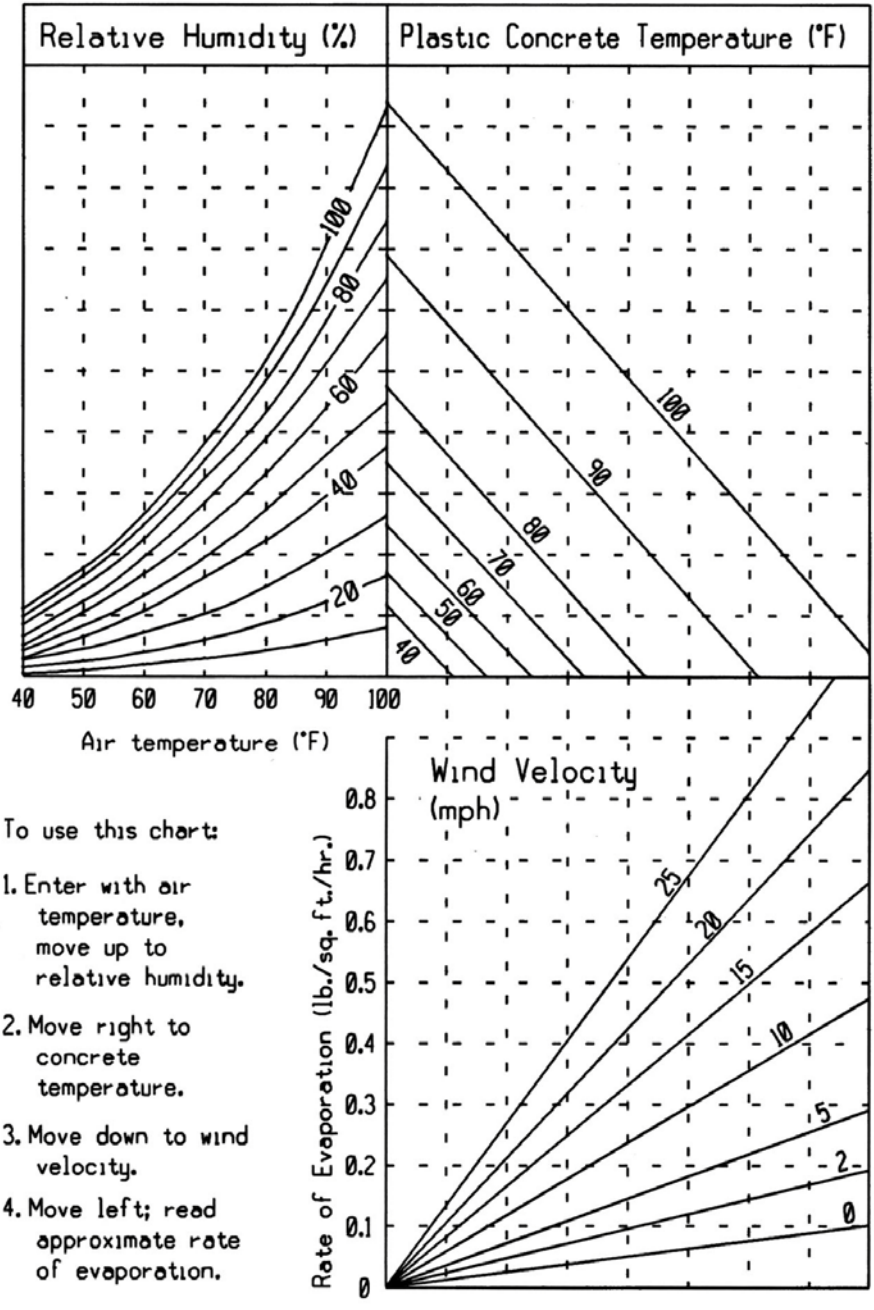
**10.** Gradation limitations for the (600 µm, 300 µm, and 150 µm) sieves shall not apply when slurry mixture is applied by hand lutes such as for slurry leveling.

**11.** Maximum of 2.5% passing the 75 µm sieve allowed if generated from the parent material when documented production is 1% or less as determined by the Office of Materials.

**12**. When Producer gradation test results are used for acceptance, test results representing at least 90% of the material being produced shall be within the gradation limits and the average of all gradation results shall be within the gradations limits. Stockpiled

material not meeting the criteria may, at the District Materials Engineer’s discretion, be resampled using Materials I.M. 301 procedures. One hundred percent of the stockpile quality control and verification test results shall be within the gradation limits.

## THEORETICAL RATE OF EVAPORATION CHART (English Units)



**APPENDIX**

## THEORETICAL RATE OF EVAPORATION CHART (Metric Units)