**Designation: ~~C33/C33M – 18~~ C33/C33M – 23**

# Standard Specification for Concrete Aggregates[1]

This standard is issued under the fixed designation C33/C33M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope*

1.1 This specification defines the requirements for grading and quality of fine and coarse aggregate (other than lightweight or heavyweight aggregate) for use in concrete.[2]

1.2 This specification is for use by a contractor, concrete supplier, or other purchaser as part of the purchase document describing the material to be furnished.

NOTE 1—This specification is regarded as adequate to ensure satisfactory materials for most concrete. It is recognized that, for certain work or in certain regions, it may be either more or less restrictive than needed. For example, where aesthetics are important, more restrictive limits may be considered regarding impurities that would stain the concrete surface. The specifier should ascertain that aggregates specified are or can be made available in the area of the work, with regard to grading, physical, or chemical properties, or combination thereof.



1.3 This specification is also for use in project specifications to define the quality of aggregate, the nominal maximum size of the aggregate, and other specific grading requirements. Those responsible for selecting the proportions for the concrete mixture shall have the responsibility of determining the proportions of fine and coarse aggregate and the addition of blending aggregate sizes if required or approved.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 The text of this standard ~~references~~ refers to notes and footnotes ~~which~~that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this standard.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[3]

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[1] This specification is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.20 on Aggregates.

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[2] For lightweight aggregates, see Specifications C330/C330M, C331/C331M, and C332; for heavyweight aggregates see Specification C637 and Descriptive Nomenclature C638.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

C29/C29M Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
C40/C40M Test Method for Organic Impurities in Fine Aggregates for Concrete
C87/C87M Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
~~C88~~C88/C88M Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C117 Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
C123/C123M Test Method for Lightweight Particles in Aggregate (Withdrawn 2023)[4]
C125 Terminology Relating to Concrete and Concrete Aggregates
C131/C131M Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
C136/C136M Test Method for Sieve Analysis of Fine and Coarse Aggregates
C142/C142M Test Method for Clay Lumps and Friable Particles in Aggregates
C294 Descriptive Nomenclature for Constituents of Concrete Aggregates
C295/C295M Guide for Petrographic Examination of Aggregates for Concrete
C330/C330M Specification for Lightweight Aggregates for Structural Concrete
C331/C331M Specification for Lightweight Aggregates for Concrete Masonry Units
C332 Specification for Lightweight Aggregates for Insulating Concrete
C535 Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
C637 Specification for Aggregates for Radiation-Shielding Concrete
C638 Descriptive Nomenclature of Constituents of Aggregates for Radiation-Shielding Concrete
C666/C666M Test Method for Resistance of Concrete to Rapid Freezing and Thawing
C1778 Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete
D75/D75M Practice for Sampling Aggregates
D422 Test Method for Particle-Size Analysis of Soils (Withdrawn 2016)[4]
D2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate
D3665 Practice for Random Sampling of Construction Materials
E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

2.2 *Other Standards:*

AASHTO T 330 Method of Test for the Qualitative Detection of Harmful Clays of the Smectite Group in Aggregates Using Methylene Blue[5]



## 3. Terminology

3.1 For definitions of terms used in this standard, refer to Terminology C125.



3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *aggregate, recycled, n*—granular material that has been diverted, separated, or removed from the solid waste stream, and processed for use in the form of raw materials or products.

## 4. Ordering and Specifying Information

4.1 The direct purchaser of aggregates shall include the information in 4.2 in the purchase order as applicable. A project specifier shall include in the project documents information to describe the aggregate to be used in the project from the applicable items in 4.3.

4.2 Include in the purchase order for aggregates the following information, as applicable:

4.2.1 Reference to this specification, as C33____,

4.2.2 Whether the order is for fine aggregate or for coarse aggregate,

4.2.3 Quantity, in metric tons or tons,

4.2.4 When the order is for fine aggregate:

[4] The last approved version of this historical standard is referenced on www.astm.org.

[5] *AASHTO Standard Specifications, Part 2B: Tests*. Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, http://www.transportation.org.

4.2.4.1 Requirements for alkali-aggregate reactivity (see 7.3),

4.2.4.2 In the case of the sulfate soundness test (see 8.1) which salt is to be used. If none is stated, either sodium sulfate or magnesium sulfate shall be used,

4.2.4.3 The appropriate limit for material finer than 75-µm (No. 200) sieve (see Table 1). If not stated, the 3.0 % limit shall apply,

4.2.4.4 The appropriate limit for coal and lignite (see Table 2). If not stated, the 1.0 % limit shall apply,

4.2.5 When the order is for coarse aggregate:

4.2.5.1 The grading (size number) (see 10.1 and Table 3), or alternate grading as agreed between the purchaser and aggregate supplier.

4.2.5.2 The appropriate limit for material finer than 75 µm (No. 200) sieve (see Table 3). If not stated, the 1.0 % limit shall apply,

4.2.5.3 The class designation (see 11.1 and Table 4),

4.2.5.4 Requirements for alkali-aggregate reactivity (see 11.2),

4.2.5.5 In the case of the sulfate soundness test (see Table 4), which salt is to be used. If none is stated, either sodium sulfate or magnesium sulfate shall be used, and

4.2.6 Any exceptions or additions to this specification (see Note 1).

4.3 Include in project specifications for aggregates the following information, as applicable:

4.3.1 Reference to this specification, as C33____.

4.3.2 When the aggregate being described is fine aggregate:

4.3.2.1 Requirements for alkali-aggregate reactivity (see 7.3),

4.3.2.2 In the case of the sulfate soundness test (see 8.1) which salt is to be used. If none is stated, either sodium sulfate or magnesium sulfate shall be used.

4.3.2.3 The appropriate limit for material finer than the ~~75-µm~~75 µm (No. 200) sieve (see Table 1). If not stated, the 3.0 % limit shall apply, and

4.3.2.4 The limit that applies with regard to coal and lignite (Table 2). If not stated, the 1.0 % limit shall apply.

4.3.3 When the aggregate being described is coarse aggregate, include:

**TABLE 1 Grading Requirements for Fine Aggregate**

| Sieve (Specification E11) | Percent Passing |
|---|---|
| 9.5-mm (⅜-in.) | 100 |
| 4.75-mm (No. 4) | 95 to 100 |
| 2.36-mm (No. 8) | 80 to 100 |
| 1.18-mm (No. 16) | 50 to 85 |
| 600-µm (No. 30) | 25 to 60 |
| 300-µm (No. 50) | 5 to 30 |
| 150-µm (No. 100) | 0 to 10 |
| 75-µm (No. 200) | 0 to 3.0[A,B] |

[A] For concrete not subject to abrasion, the limit for material finer than the 75-µm (No. 200) sieve shall be 5.0 % maximum.
[B] For manufactured fine or other recycled aggregate, if the material finer than the 75-µm (No. 200) sieve consists of the dust of fracture, essentially free of clay or shale, this limit shall be 5.0% for concrete subject to abrasion, and 7% maximum for concrete not subject to abrasion.

**TABLE 2 Limits for Deleterious Substances in Fine Aggregate for Concrete**

| Item | Mass Percent of Total Sample, max |
|---|---|
| Clay lumps and friable particles | 3.0 |
| Coal and lignite: | |
| Where surface appearance of concrete is of importance | 0.5 |
| All other concrete | 1.0 |

4.3.3.1 The nominal maximum size or sizes permitted, based on thickness of section or spacing of reinforcing bars or other criteria. In lieu of stating the nominal maximum size, the specifier shall designate an appropriate size number or numbers (see 10.1 and Table 3). Designation of a size number to indicate a nominal size shall not restrict the person responsible for selecting proportions from combining two or more gradings of aggregate to obtain a desired grading, provided that the gradings are not otherwise restricted by the project specifier and the nominal maximum size indicated by the size number is not exceeded,

4.3.3.2 The class designation (see 11.1 and Table 4),

4.3.3.3 Requirements for alkali-aggregate reactivity (see 11.2),

4.3.3.4 In the case of the sulfate soundness test (see Table 4), which salt is to be used. If none is stated, either sodium sulfate or magnesium sulfate shall be used, and

4.3.4 The person responsible for selecting the concrete proportions if other than the concrete producer.

4.3.5 Any exceptions or additions to this specification (see Note 1).



## FINE AGGREGATE

### 5. General Characteristics

5.1 Fine aggregate shall consist of natural sand, manufactured sand, or other recycled aggregate, or a combination thereof.



NOTE 2—This standard only addresses properties of aggregates considered necessary for use in concrete and the associated test methods contained within this standard. Certain recycled aggregate sources may contain materials and properties not addressed as part of the document specifications, limits, or test methods. Recycled aggregates may require evaluation for environmental considerations (air quality, water quality, storage) using the appropriate local, state, and federal test methods in effect at the time of use.

### 6. Grading

6.1 *Sieve Analysis*—Fine aggregate, except as provided in 6.2 and 6.3 shall be graded within the limits in Table 1.

NOTE 3—Concrete with fine aggregate gradings near the minimums for percent passing the ~~300 µm~~ 300 µm (No.50) and ~~150 µm~~ 150 µm (No.100) sometimes have difficulties with workability, pumping or excessive bleeding. The addition of entrained air, additional cement, or the addition of an approved mineral admixture to supply the deficient fines, are methods used to alleviate such difficulties.

6.2 The fine aggregate shall have not more than 45 % passing any sieve and retained on the next consecutive sieve of those shown in 6.1, and its fineness modulus shall be not less than 2.3 nor more than 3.1.

6.3 Fine aggregate failing to meet these grading requirements shall meet the requirements of this section provided that the supplier can demonstrate to the purchaser or specifier that concrete of the class specified, made with fine aggregate under consideration, will have relevant properties (see Note 6) at least equal to those of concrete made with the same ingredients, with the exception that the reference fine aggregate shall be selected from a source having an acceptable performance record in similar concrete construction.

NOTE 4—Manufactured fine aggregate having elevated proportions of material passing the 75-µm (No. 200) sieve may need further evaluation to ensure

**TABLE 3 Grading Requirements for Coarse Aggregates**

| Size Number | Nominal Size (Sieves with Square Openings) | Amounts Finer than Each Laboratory Sieve (Square-Openings), Mass Percent | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 100 mm (4 in.) | 90 mm (3½ in.) | 75 mm (3 in.) | 63 mm (2½ in.) | 50 mm (2 in.) | 37.5 mm (1½ in.) | 25.0 mm (1 in.) | 19.0 mm (¾ in.) | 12.5 mm (½ in.) | 9.5 mm (⅜ in.) | 4.75 mm (No. 4) | 2.36 mm (No. 8) | 1.18 mm (No. 16) | 300 µm (No.50) | 75 µm (No.200) |
| 1 | 90 to 37.5 mm (3½ to 1½ in.) | 100 | 90 to 100 | ... | 25 to 60 | ... | 0 to 15 | ... | 0 to 5 | ... | ... | ... | ... | ... | ... | 0 to 1.0[B] |
| 2 | 63 to 37.5 mm (2½ to 1½ in.) | ... | ... | 100 | 90 to 100 | 35 to 70 | 0 to 15 | ... | 0 to 5 | ... | ... | ... | ... | ... | ... | 0 to 1.0[B] |
| 3 | 50 to 25.0 mm (2 to 1 in.) | ... | ... | ... | 100 | 90 to 100 | 35 to 70 | 0 to 15 | ... | 0 to 5 | ... | ... | ... | ... | ... | 0 to 1.0[B] |
| 357 | 50 to 4.75 mm (2 in. to No. 4) | ... | ... | ... | 100 | 95 to 100 | ... | 35 to 70 | ... | 10 to 30 | ... | 0 to 5 | ... | ... | ... | 0 to 1.0[B] |
| 4 | 37.5 to 19.0 mm (1½ to ¾ in.) | ... | ... | ... | ... | 100 | 90 to 100 | 20 to 55 | 0 to 15 | ... | 0 to 5 | ... | ... | ... | ... | 0 to 1.0[B] |
| 467 | 37.5 to 4.75 mm (1½ in. to No. 4) | ... | ... | ... | ... | 100 | 95 to 100 | ... | 35 to 70 | ... | 10 to 30 | 0 to 5 | ... | ... | ... | 0 to 1.0[B] |
| 5 | 25.0 to 12.5 mm (1 to ½ in.) | ... | ... | ... | ... | ... | 100 | 90 to 100 | 20 to 55 | 0 to 10 | 0 to 5 | ... | ... | ... | ... | 0 to 1.0[B] |
| 56 | 25.0 to 9.5 mm (1 to ⅜ in.) | ... | ... | ... | ... | ... | 100 | 90 to 100 | 40 to 85 | 10 to 40 | 0 to 15 | 0 to 5 | ... | ... | ... | 0 to 1.0[B] |
| 57 | 25.0 to 4.75 mm (1 in. to No. 4) | ... | ... | ... | ... | ... | 100 | 95 to 100 | ... | 25 to 60 | ... | 0 to 10 | 0 to 5 | ... | ... | 0 to 1.0[B] |
| 6 | 19.0 to 9.5 mm (¾ to ⅜ in.) | ... | ... | ... | ... | ... | ... | 100 | 90 to 100 | 20 to 55 | 0 to 15 | 0 to 5 | ... | ... | ... | 0 to 1.0[B] |
| 67 | 19.0 to 4.75 mm (¾ in. to No. 4) | ... | ... | ... | ... | ... | ... | 100 | 90 to 100 | ... | 20 to 55 | 0 to 10 | 0 to 5 | ... | ... | 0 to 1.0[B] |
| 7 | 12.5 to 4.75 mm (½ in. to No. 4) | ... | ... | ... | ... | ... | ... | ... | 100 | 90 to 100 | 40 to 70 | 0 to 15 | 0 to 5 | ... | ... | 0 to 1.0[B] |
| 8 | 9.5 to 2.36 mm (⅜ in. to No. 8) | ... | ... | ... | ... | ... | ... | ... | ... | 100 | 85 to 100 | 10 to 30 | 0 to 10 | 0 to 5 | ... | 0 to 1.0[B] |
| 89 | 9.5 to 1.18 mm ( ⅜ in. to No. 16) | ... | ... | ... | ... | ... | ... | ... | ... | 100 | 90 to 100 | 20 to 55 | 5 to 30 | 0 to 10 | 0 to 5 | 0 to 1.0[B] |
| 9[A] | 4.75 to 1.18 mm (No. 4 to No. 16) | ... | ... | ... | ... | ... | ... | ... | ... | ... | 100 | 85 to 100 | 10 to 40 | 0 to 10 | 0 to 5 | 0 to 1.0[B] |

[A] Size number 9 aggregate is defined in Terminology C125 as a fine aggregate. It is included as a coarse aggregate when it is combined with a size number 8 material to create a size number 89, which is a coarse aggregate as defined by Terminology C125.

[B] This percentage under either of the following conditions: *(1)* is permitted to be increased to 1.5 if the material is essentially free of clay or shale; or *(2)* if the source of the fine aggregate to be used in the concrete is known to contain less than the specified maximum amount passing the 75 µm (No. 200) sieve Table 1 the percentage limit (*L*) on the amount in the coarse aggregate is permitted to be increased to $L = 1 + [(P)/(100 - P)] (T - A)$, where $P$ = percentage of sand in the concrete as a percent of total aggregate, $T$ = the Table 1 limit for the amount permitted in the fine aggregate, and $A$ = the actual amount in the fine aggregate. (This provides a weighted calculation designed to limit the maximum mass of material passing the 75 µm (No. 200) sieve in the concrete to that which would be obtained if both the fine and coarse aggregate were supplied at the maximum tabulated percentage for each of these ingredients.)

**TABLE 4 Limits for Deleterious Substances and Physical Property Requirements of Coarse Aggregate for Concrete**

NOTE 1—See Fig. 1 for the location of the weathering regions and Note 12 for guidance in using the map. The weathering regions are defined as follows:
(S) Severe Weathering Region—A cold climate where concrete is exposed to deicing chemicals or other aggressive agents, or where concrete may become saturated by continued contact with moisture or free water prior to repeated freezing and thawing.
(M) Moderate Weathering Region—A climate where occasional freezing is expected, but where concrete in outdoor service will not be continually exposed to freezing and thawing in the presence of moisture or to deicing chemicals.
(N) Negligible Weathering Region—A climate where concrete is rarely exposed to freezing in the presence of moisture.

| Class Designation | Type or Location of Concrete Construction | Maximum Allowable, % | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Clay Lumps and Friable Particles | Chert (Less Than 2.40 sp gr SSD) | Sum of Clay Lumps, Friable Particles, and Chert (Less Than 2.40 sp gr SSD) | ~~Material Finer Than 75-μm (No. 200) Sieve~~ | Coal and Lignite | Abrasion[A] | Magnesium Sulfate Soundness (5 cycles)[B] |
| | | Severe Weathering Regions | | | | | | |
| ~~1S~~ | ~~Footings, foundations, columns and beams not exposed to the weather, interior floor slabs to be given coverings~~ | ~~10.0~~ | ~~...~~ | ~~...~~ | ~~1.0[C]~~ | ~~1.0~~ | ~~50~~ | ~~...~~ |
| 1S | Footings, foundations, columns and beams not exposed to the weather, interior floor slabs to be given coverings | 10.0 | ... | ... | 1.0 | 50 | ... | |
| ~~2S~~ | ~~Interior floors without coverings~~ | ~~5.0~~ | ~~...~~ | ~~...~~ | ~~1.0[C]~~ | ~~0.5~~ | ~~50~~ | ~~...~~ |
| 2S | Interior floors without coverings | 5.0 | ... | ... | 0.5 | 50 | ... | |
| ~~3S~~ | ~~Foundation walls above grade, retaining walls, abutments, piers, girders, and beams exposed to the weather~~ | ~~5.0~~ | ~~5.0~~ | ~~7.0~~ | ~~1.0[C]~~ | ~~0.5~~ | ~~50~~ | ~~18~~ |
| 3S | Foundation walls above grade, retaining walls, abutments, piers, girders, and beams exposed to the weather | 5.0 | 5.0 | 7.0 | 0.5 | 50 | 18 | |
| ~~4S~~ | ~~Pavements, bridge decks, driveways and curbs, walks, patios, garage floors, exposed floors and porches, or waterfront structures, subject to frequent wetting~~ | ~~3.0~~ | ~~5.0~~ | ~~5.0~~ | ~~1.0[C]~~ | ~~0.5~~ | ~~50~~ | ~~18~~ |
| 4S | Pavements, bridge decks, driveways and curbs, walks, patios, garage floors, exposed floors and porches, or waterfront structures, subject to frequent wetting | 3.0 | 5.0 | 5.0 | 0.5 | 50 | 18 | |
| ~~5S~~ | ~~Exposed architectural or decorative concrete~~ | ~~2.0~~ | ~~3.0~~ | ~~3.0~~ | ~~1.0[C]~~ | ~~0.5~~ | ~~50~~ | ~~18~~ |
| 5S | Exposed architectural or decorative concrete | 2.0 | 3.0 | 3.0 | 0.5 | 50 | 18 | |
| | | Moderate Weathering Regions | | | | | | |
| ~~1M~~ | ~~Footings, foundations, columns, and beams not exposed to the weather, interior floor slabs to be given coverings~~ | ~~10.0~~ | ~~...~~ | ~~...~~ | ~~1.0[C]~~ | ~~1.0~~ | ~~50~~ | ~~...~~ |
| 1M | Footings, foundations, columns, and beams not exposed to the weather, interior floor slabs to be given coverings | 10.0 | ... | ... | 1.0 | 50 | ... | |
| ~~2M~~ | ~~Interior floors without coverings~~ | ~~5.0~~ | ~~...~~ | ~~...~~ | ~~1.0[C]~~ | ~~0.5~~ | ~~50~~ | ~~...~~ |
| 2M | Interior floors without coverings | 5.0 | ... | ... | 0.5 | 50 | ... | |
| ~~3M~~ | ~~Foundation walls above grade, retaining walls, abutments, piers, girders, and beams exposed to the weather~~ | ~~5.0~~ | ~~8.0~~ | ~~10.0~~ | ~~1.0[C]~~ | ~~0.5~~ | ~~50~~ | ~~18~~ |

| Class Designation | Type or Location of Concrete Construction | Maximum Allowable, % | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Clay Lumps and Friable Particles | Chert (Less Than 2.40 sp gr SSD) | Sum of Clay Lumps, Friable Particles, and Chert (Less Than 2.40 sp gr SSD) | ~~Material Finer Than 75-µm (No. 200) Sieve~~ | Coal and Lignite | Abrasion[A] | Magnesium Sulfate Soundness (5 cycles)[B] |
| 3M | Foundation walls above grade, retaining walls, abutments, piers, girders, and beams exposed to the weather | 5.0 | 8.0 | 10.0 | 0.5 | 50 | 18 | |
| ~~4M~~ | ~~Pavements, bridge decks, driveways and curbs, walks, patios, garage floors, exposed floors and porches, or water-front structures subject to frequent wetting~~ | ~~5.0~~ | ~~5.0~~ | ~~7.0~~ | ~~1.0[C]~~ | ~~0.5~~ | ~~50~~ | ~~18~~ |
| 4M | Pavements, bridge decks, driveways and curbs, walks, patios, garage floors, exposed floors and porches, or water-front structures subject to frequent wetting | 5.0 | 5.0 | 7.0 | 0.5 | 50 | 18 | |
| ~~5M~~ | ~~Exposed architectural or decorative concrete~~ | ~~3.0~~ | ~~3.0~~ | ~~5.0~~ | ~~1.0[C]~~ | ~~0.5~~ | ~~50~~ | ~~18~~ |
| 5M | Exposed architectural or decorative concrete | 3.0 | 3.0 | 5.0 | 0.5 | 50 | 18 | |
| | Negligible Weathering Regions | | | | | | | |
| ~~1N~~ | ~~Slabs subject to traffic abrasion, bridge decks, floors, sidewalks, pavements~~ | ~~5.0~~ | ~~...~~ | ~~...~~ | ~~1.0[C]~~ | ~~0.5~~ | ~~50~~ | ~~...~~ |
| 1N | Slabs subject to traffic abrasion, bridge decks, floors, sidewalks, pavements | 5.0 | ... | ... | 0.5 | 50 | ... | |
| ~~2N~~ | ~~All other classes of concrete~~ | ~~10.0~~ | ~~...~~ | ~~...~~ | ~~1.0[C]~~ | ~~1.0~~ | ~~50~~ | ~~...~~ |
| 2N | All other classes of concrete | 10.0 | ... | ... | 1.0 | 50 | ... | |

[A] Crushed air-cooled blast-furnace slag is excluded from the abrasion requirements. The rodded or jigged bulk density (unit weight) of crushed air-cooled blast-furnace slag shall be not less than 1120 kg/m$^3$ [70 lb/ft$^3$]. The grading of slag used in the bulk density (unit weight) test shall conform to the grading to be used in the concrete. Abrasion loss of gravel, crushed gravel, or crushed stone shall be determined on the test size or sizes most nearly corresponding to the grading or gradings to be used in the concrete. When more than one grading is to be used, the limit on abrasion loss shall apply to each.

[B] The allowable limits for soundness shall be 12 % if sodium sulfate is used.

~~[C] This percentage under either of the following conditions: (*1*) is permitted to be increased to 1.5 if the material is essentially free of clay or shale; or (*2*) if the source of the fine aggregate to be used in the concrete is known to contain less than the specified maximum amount passing the 75-µm (No. 200) sieve Table 1 the percentage limit *(L)* on the amount in the coarse aggregate is permitted to be increased to $L = 1 + [(P)/(100 – P)] (T – A)$, where $P$ = percentage of sand in the concrete as a percent of total aggregate, $T$ = the Table 1 limit for the amount permitted in the fine aggregate, and $A$ = the actual amount in the fine aggregate. (This provides a weighted calculation designed to limit the maximum mass of material passing the 75-µm (No. 200) sieve in the concrete to that which would be obtained if both the fine and coarse aggregate were supplied at the maximum tabulated percentage for each of these ingredients.)~~