Slag Cement: Overview of Key Standards, Specifications and Guides

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Slag Cement School
April 29, 2024

- Assist Nick Brimley and Shawn Kalyn with the business of the SCA Technical Marketing Committee (TMC) and with responding to SCA Technical Inquiries
- Represent SCA on various technical committees and task groups:
  - ASTM C09.27 Slag Cement
  - Joint AASHTO/ASTM Harmonization Task Group (JAAHTG)
  - ACI 233 – Ground Slag in Concrete
  - FHWA Sustainable Pavements Program
  - ASHRAE 189.1 Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings WG9 Materials & Resources
  - Alliance for Concrete Codes & Standards (ACCS)

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Did anyone catch this presentation?

Recent presentation by Dr. Peter Taylor,
National Concrete Pavement Technology Center,
Iowa State University

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Objectives:

- Briefly review current standards, specifications and guides related to slag cement use in concrete (Building Code, Residential, DOT)
- Discuss current, new, upcoming standards, guides related to **sustainable** concrete construction and low carbon concrete
- Examples Specifications: New and Old

Why Specify Slag Cement?

Many Benefits:

- Effects on Plastic Concrete
  - Set time
  - Reduced rate of slump loss
  - Better concrete workability
  - Improved finish ability
- Effects on Hardened Concrete
  - Higher compressive and flexural strengths
  - Lighter color
  - Reduced early rate of heat generation (mass concrete)
  - Reduced permeability
- Durability
  - Increase sulfate resistance
  - ASR Mitigation
  - Reduced permeability/chloride ingress
- Sustainability
  - Lowers embodied carbon of concrete mix
  - Is a recovered material
  - Reduces use of virgin raw materials

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Standard Specifications

Slag cement as a Supplementary Cementitious Material (SCM) in concrete:

- **ASTM C989/C989M-24** and **AASHTO M302** Standard Specification for Slag Cement for Use in Concrete and Mortar
- Material described in this specification can be used for blending with portland cement to meet C595/C595M or as a separate ingredient in concrete.
- Specified through a Slag Activity Index to classify three grades of slag cement (80, 100 and 120)
  - **C989/C989M-24** adds reference cement Type IL for slag activity tests
  - **M302 -24** expected to be published in July 2024


Designation: C989/C989M – 24

Standard Specification for
Slag Cement for Use in Concrete and Mortars[1]

1. Scope*

1.1 This specification covers slag cement for use as a cementitious material in concrete and mortar.

2. Referenced Documents

2.1 ASTM Standards:[2]

C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens)

C114 Test Methods for Chemical Analysis of Hydraulic Cement

Standard Specifications

Slag cement as a material used in blended cements:

- **ASTM C595/C595M-23** and **AASHTO M240** Standard Specifications for Blended Hydraulic Cements
- Pertains to blended hydraulic cements for both general and special applications, using slag or pozzolan, or both, with portland cement, or Portland cement clinker or slag with lime. Types of blended cements utilizing slag are:
    - Type IS – Portland blast-furnace slag
    - Type IT - Ternary blended cement

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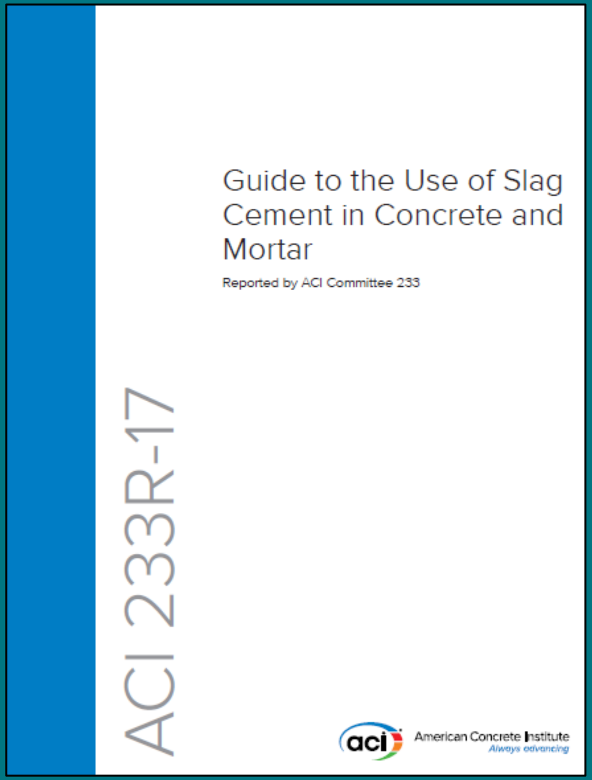
Reference Guide on Slag Cement

ACI 233R-17 Guide to the Use of Slag Cement in Concrete and Mortar



ACI 233

CHAPTER 1—GENERAL INFORMATION
CHAPTER 2—DEFINITIONS
CHAPTER 3—PROPERTIES AND PRODUCT TYPES
CHAPTER 4—STORAGE, HANDLING, AND BATCHING
CHAPTER 5—PROPORTIONING CONCRETE CONTAINING SLAG CEMENT
CHAPTER 6—EFFECTS ON PROPERTIES OF FRESH CONCRETE
CHAPTER 7—EFFECTS ON PROPERTIES OF HARDENED CONCRETE AND MORTAR
CHAPTER 8—SLAG CEMENT APPLICATIONS
CHAPTER 9—SUSTAINABLE DEVELOPMENT

Currently under review/update by ACI 233 Ground Slag in Concrete Committee

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Reference in ACI CODE 318-19(22)

ACI 318-19(22) Building Code Requirements for Structural Concrete

CHAPTER 19 CONCRETE: DESIGN AND DURABILITY REQUIREMENTS

Durability:

Exposure Categories for concrete:
F- Moisture and cycles of freezing and thawing (class 0-3)
S- In contact with soil or water containing deleterious amounts of water-soluble sulfate ions.
W- In contact with water
C- nonprestressed and prestressed concrete requiring additional protection from corrosion

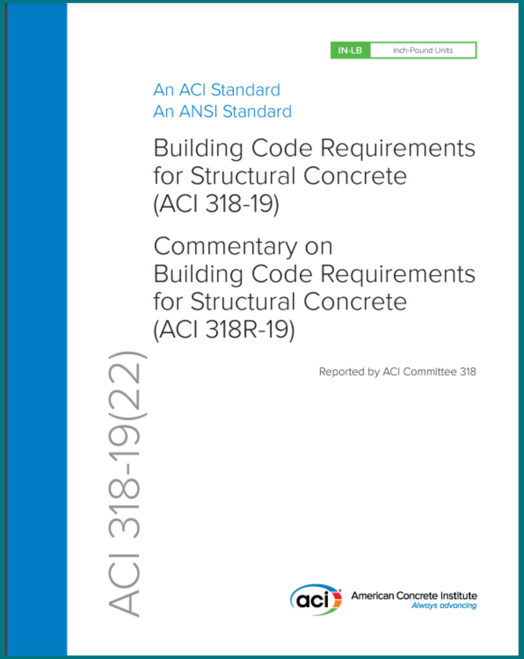

Table 19.3.1.1—Exposure categories and classes

Category	Class	Condition
Freezing and thawing (F)	F0	Concrete not exposed to freezing-and-thawing cycles
	F1	Concrete exposed to freezing-and-thawing cycles with limited exposure to water
	F2	Concrete exposed to freezing-and-thawing cycles with frequent exposure to water
	F3	Concrete exposed to freezing-and-thawing cycles with frequent exposure to water and exposure to deicing chemicals

CODE — COMMENTARY

Table 19.3.2.1—Requirements for concrete by exposure class

Exposure class		Maximum w/cm[1,2]	Minimum f_c', psi	Additional requirements			Limits on cementitious materials
				Air content			
F0		N/A	2500	N/A			N/A
F1		0.55	3500	Table 19.3.3.1 for concrete or Table 19.3.3.3 for shotcrete			N/A
F2		0.45	4500	Table 19.3.3.1 for concrete or Table 19.3.3.3 for shotcrete			N/A
F3		0.40[3]	5000[3]	Table 19.3.3.1 for concrete or Table 19.3.3.3 for shotcrete			26.4.2.2(b)
				Cementitious materials[4] — Types			Calcium chloride admixture
				ASTM C150	ASTM C595	ASTM C1157	
S0		N/A	2500	No type restriction	No type restriction	No type restriction	No restriction
S1		0.50	4000	II[5][6]	Types with (MS) designation	MS	No restriction
S2		0.45	4500	V[6]	Types with (HS) designation	HS	Not permitted
S3	Option 1	0.45	4500	V plus pozzolan or slag cement[7]	Types with (HS) designation plus pozzolan or slag cement[7]	HS plus pozzolan or slag cement[7]	Not permitted
	Option 2	0.40	5000	V[8]	Types with (HS) designation	HS	Not permitted
W0		N/A	2500	None			
W1		N/A	2500	26.4.2.2(d)			
W2		0.50	4000	26.4.2.2(d)			
				Maximum water-soluble chloride ion (Cl^-) content in concrete, percent by mass of cementitious materials[9,10]		Additional provisions	
				Nonprestressed concrete	Prestressed concrete		
C0		N/A	2500	1.00	0.06	None	
C1		N/A	2500	0.30	0.06		
C2		0.40	5000	0.15	0.06	Concrete cover[11]	

[1]The w/cm is based on all cementitious and supplementary cementitious materials in the concrete mixture.
[2]The maximum w/cm limits do not apply to lightweight concrete.
[3]For plain concrete, the maximum w/cm shall be 0.45 and the minimum f_c' shall be 4500 psi.
[4]Alternative combinations of cementitious materials to those listed are permitted for all sulfate exposure classes when tested for sulfate resistance and meeting the criteria in 26.4.2.2(c).
[5]For seawater exposure, other types of portland cements with tricalcium aluminate (C_3A) contents up to 10 percent are permitted if the w/cm does not exceed 0.40.
[6]Other available types of cement such as Type I or Type III are permitted in Exposure Classes S1 or S2 if the C_3A contents are less than 8 percent for Exposure Class S1 or less than 5 percent for Exposure Class S2.
[7]The amount of the specific source of the pozzolan or slag cement to be used shall be at least the amount that has been determined by service record to improve sulfate resistance

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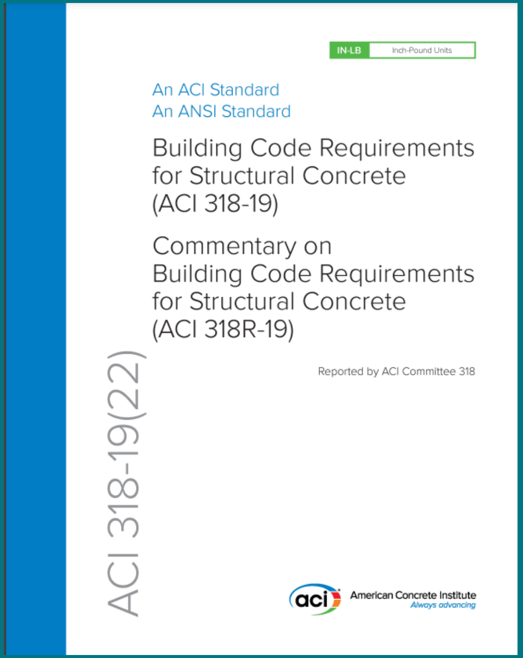
Reference in ACI CODE 318-19(22)

ACI 318-19(22) Building Code Requirements for Structural Concrete

CHAPTER 26 CONSTRUTION DOCUMENTS AND INSPECTION

26.4 Concrete Materials and mixture requirements
26.4.1.1 Cementitious materials – Slag cement (C989)
26.4.2.2 Compliance requirements in Table 26.4.2.2(b), limits on slag cement for Class F3 (50%)*
*ACI 201.2R-16 Guide to Durable Concrete - Explanation for restriction. (Modification of the air void system as well as superficial changes to W/CM, hand work only.



26.4—Concrete materials and mixture requirements

26.4.1 *Concrete materials*

26.4.1.1 *Cementitious materials*

26.4.1.1.1 Compliance requirements:

(a) Cementitious materials shall conform to the specifications in Table 26.4.1.1.1(a), except as permitted in 26.4.1.1.1(b).

Table 26.4.1.1.1(a)—Specifications for cementitious materials

Cementitious material	Specification
Portland cement	ASTM C150
Blended hydraulic cements	ASTM C595, excluding Type IS (≥70) and Type IT ($S \geq 70$)
Expansive hydraulic cement	ASTM C845
Hydraulic cement	ASTM C1157
Fly ash and natural pozzolan	ASTM C618
Slag cement	ASTM C989
Silica fume	ASTM C1240

(b) Alternative cements shall be permitted if approved by the licensed design professional and the building official.

R26.4—Concrete materials and mixture requirements

R26.4.1 *Concrete materials*

R26.4.1.1 *Cementitious materials*

R26.4.1.1.1(b) Provisions for strength and durability in Chapter 19 and many requirements in Chapter 26 are based

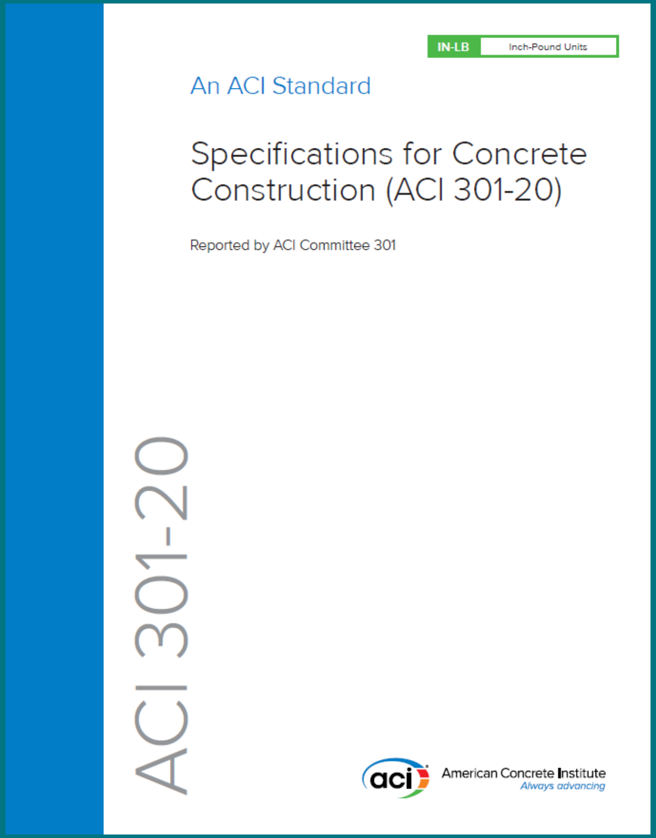
CODE

Table 26.4.2.2(b)—Limits on cementitious materials for concrete assigned to Exposure Class F3

Supplementary cementitious materials	Maximum percent of total cementitious materials by mass
Fly ash or natural pozzolans conforming to ASTM C618	25
Slag cement conforming to ASTM C989	50
Silica fume conforming to ASTM C1240	10
Total of fly ash or natural pozzolans and silica fume	35
Total of fly ash or natural pozzolans, slag cement, and silica fume	50

Reference Specification ACI 301-20

ACI 301-20 Specification for Concrete Construction



CHAPTER 4 PRODUCTS

4.2.1(e) Slag cement conforming to ASTM C989/C989M

Table 4.2.1.1(b) Limits on SCMs for concrete assigned to Exposure Categories Class F3

OPTIONAL REQUIREMENTS CHECKLIST

8.1.3 Mass concrete

8.2.1.1 Alternate requirements to Section 4

Table 4.2.1.1(b)—Limits on supplementary cementitious materials for concrete assigned to Exposure Class F3

Supplementary cementitious material	Maximum percent of total cementitious material by mass[*]
Fly ash or natural pozzolans conforming to ASTM C618	25
Slag cement conforming to ASTM C989/C989M	50
Silica fume conforming to ASTM C1240	10
Total of fly ash or natural pozzolans, slag cement, and silica fume	50[†]
Total of fly ash or natural pozzolans and silica fume	35[†]

[*]Total cementitious material also includes ASTM C150/C150M, C595/C595M, and C1157/C1157M cement. The maximum percentages above shall include:
(a) Fly ash or natural pozzolans present in ASTM C1157/C1157M or C595/C595M Type IP blended cement.
(b) Slag cement present in ASTM C1157/C1157M or C595/C595M Type IS blended cement.
(c) Silica fume conforming to ASTM C1240 present in ASTM C1157/C1157M or C595/C595M Type IP blended cement.
[†]Fly ash or natural pozzolans and silica fume shall constitute no more than 25 percent and 10 percent, respectively, of the total mass of the cementitious materials.

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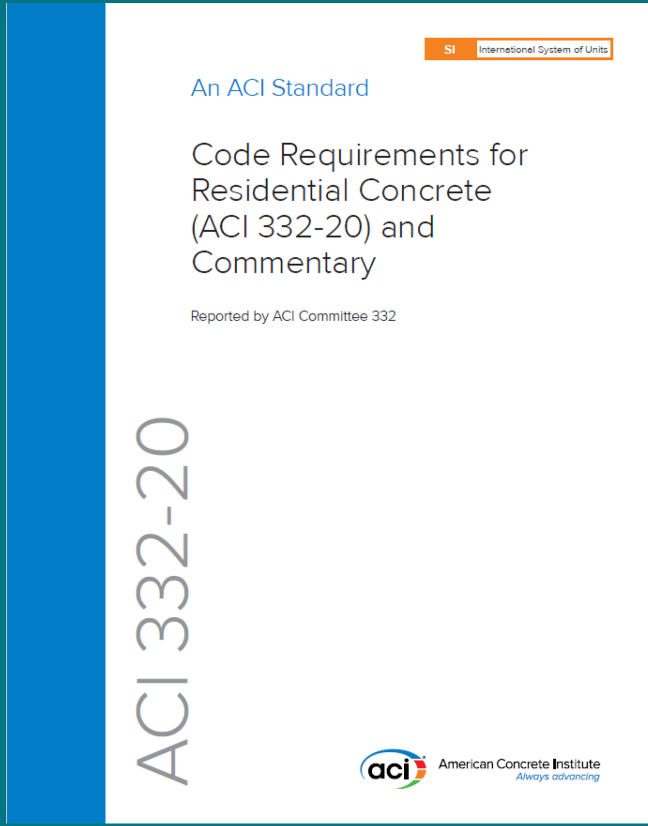
Reference in ACI 332-20

ACI 332-20 Code Requirements for Residential Concrete



CHAPTER 5 CONCRETE REQUIREMENTS

Exposure Categories for concrete members (RF, RS, RC):
5.1 - Exposure classes shall be assigned to concrete members based on severity of the anticipated exposure for each category of Table 5.1.1 or as determined by the building official.

RF freezing and thawing (0-4)
RS sulfate (0-3)
RC corrosion protection of reinforcement (0-2)

Table 5.4.2 Restrictions on requirements for exposure RF3 and RF4 (exposed to deicing chemicals)
Slag conforming to ASTM C989/C989M (50%)

Table 5.4.2—Requirements for concrete subject to exposure class RF3 and RF4

Cementitious materials	Maximum percent of total cementitious materials by weight*
Fly ash or other pozzolans conforming to ASTM C618	25
Slag conforming to ASTM C989/C989M	50
Silica fume conforming to ASTM C1240	10
Total of fly ash or other pozzolans, slag, and silica fume	50†
Total of fly ash or other pozzolans and silica fume	35†

*The total cementitious material also includes ASTM C150/C150M, C595/C595M, C845, and C1157/C1157M cement.

The maximum percentages above shall include:
(a) Fly ash or other pozzolans in Type IP blended cement, ASTM C595/C595M, or ASTM C1157/C1157M
(b) Slag used in the manufacture of an IS blended cement, ASTM C595/C595M, or ASTM C1157/C1157M
(c) ASTM C1240 silica fume present in a blended cement

†Fly ash or other pozzolans and silica fume shall constitute no more than 25 and 10 percent, respectively, of the total weight of the cementitious materials.

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SCA Information Sheets

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12: Terminology and Specifications

Terminology

Slag cement (Ground-granulated blast-furnace slag): A hydraulic cement formed when granulated blast-furnace slag is ground to a suitable fineness.

Granulated blast-furnace slag: The glassy, granular material formed when molten blast-furnace slag is rapidly chilled as by immersion in water. Also referred to as granules.

Blast-furnace slag: The non-metallic product, consisting essentially of silicates and aluminosilicates of calcium and other bases, which is developed in a molten condition simultaneously with iron in a blast-furnace.

Blast-furnace: A furnace used to reduce raw materials into molten iron. Combustion is forced with pressurized air.

Binary blended cement: a blended hydraulic cement consisting of portland cement with either a slag, a pozzolan, or a limestone.

Ternary blended cement: a blended hydraulic cement consisting of portland cement with either a combination of two different pozzolans, slag, and a pozzolan, a pozzolan, and a limestone, or a slag and a limestone.

Air-cooled blast-furnace slag: The material resulting from the solidification of molten blast-furnace slag under atmospheric conditions. Subsequent cooling may be accelerated by application of water to the solidified surface. (This material can be mined and crushed for use as aggregate in concrete or fill material, but is not cementitious.)

Expanded blast-furnace slag: The light weight cellular material obtained by controlled processing of molten blast-furnace slag with water, or water and other agents, such as steam or compressed ai. or both. (This is commonly used as lightweight aggregate and is not cementitious.)

Portland cement: A hydraulic cement produced by pulverizing portland-cement clinker and usually containing calciu. sulfate.

Portland-limestone cement: a type of blended cement with a higher limestone content than straight portland cement

Blended cement: A hydraulic cement produced by inter-grinding portland cement clinker with other materials, or by blending portland cement with other materials, or by a combination of inter-grinding and blending.

Specifications: *Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars*—ASTM C989/C989M-22[1]

This specification covers three grades (grades 80, 100, and 120) of finely ground granulat- ed blast-furnace slag for use as a cementitious material in concrete and mortar. The material described in this specification can be used for blending with portland cement to produce a cement meeting the requirements of Specification C595/C595M; or 2) as a separate ingre- dient in concrete and mortar mixtures. The material may also be useful in a variety of grouts an. mortars.

Standard Specification for Blended Hydraulic Cements—ASTM C595/C595M-21[2]

This specification pertains to five classes of blended hydraulic cement for both general and special applications, using slag cement, or a pozzolan or both, with portland cement, or portland cement clinker or slag with limestone. This specification prescribes ingredients proportions, and testing requirements. The two most common types of binary blended cement using slag cement are:

- Type IS—Portland blast-furnace slag cement (in which slag constituent is between 25% and 70% by mass)
- Type I(SM)—Slag-modified portland cement (in which slag constituent is less than 25%)

Standard Performance Specification for Hydraulic Cement— ASTM C1157/C1157M-20a[3]

This specification covers hydraulic cements for both general and special applications. It is a specification that defines performance requirements for cement and does not restrict the composition of the cement or its constituents. The specification classifies cements, based on specific requirements for general use, high early strength, resistance to attack by sulfates, and heat of hydration.

Optional requirements are provided for the property of low reactivity with alkali-silica-reactive aggregates and for air-entraining cements.

Ground Granulated Blast-Furnace Slag as a Cementitious Constituent in Concrete[4] (Reported by ACI Committee 233)

This report primarily addresses the use of slag cement as a separate cementitious material added along with portland cement or portland-limestone

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13: Suggested Specifications for Slag Cement in Concrete

Slag cement is a material that is used in a wide variety of commercial and architectural concrete construction applications. This information sheet is intended to provide guidance to specifiers in the absence of slag cement specifications, or for the addition of slag cement to an existing specification.

Slag cement should be used as a pound for pound replacement for a portion of the portland cement in a concrete mixture. Depending on the desired properties or application, various replacement levels can be used. Table 1 lists suggested replacement levels for a variety of common applications.

Percentages indicate replacement for portland cement by mass. These replacement rates are recommended for individual applications and are based on historical performance. Variations in material sources and environmental conditions may require alternate substitution rates. Consult your slag cement supplier for additional assistance.

As with all concrete mixtures, trial batches should be performed to verify concrete properties. Listed replacement rate ranges provide a starting point for trial concrete mixture design. These ranges typically accommodate optimization of replacement rates to achieve desired concrete performance in different environments and temperatures. Results may vary due to a variety of circumstances, including temperature and mixture components, among other things. You should consult your local slag cement representative for assistance in how to achieve maximum benefits using slag cement in your concrete project. Nothing contained herein shall be considered or construed as a warranty or guarantee, either expressed or implied, including any warranty of fitness for a particular purpose.

Table 1

Concrete Application	Slag Cement
Concrete paving	25-50%
Exterior flatwork not exposed to deicer- salts	25-50%
Exterior flatwork exposed to deicer salts with *w/cm* = 0.45	25-50%
Interior flatwork	25-50%
Basement floors	25-50%
Footings	30-65%
Walls & columns	25-50%
Tilt-up panels	25-50%
Pre-stressed concrete	20-50%
Pre-castconcrete	20-50%

For General Use Cementitious Materials

1. Portland cement shall conform to the requirements in ASTM C150[1] or ASTM C1157[2].
2. Slag cement shall conform to the requirements in ASTM C989[3].
3. Blended cement shall conform to the requirements in ASTM C595[4].
4. Pozzolans shall conform to the requirements in ASTM C618[5].
5. Silica fume shall conform to the requirements in ASTM C1240[6].
6. The water-cementitious materials ratio (*w/cm*) shall be calculated by dividing the weight of water by the weight of portland cement, plus slag cement plus pozzolans.

Exposure to Sulfates

1. For moderate exposure, where ASTM C150, Type II cement is required, a Type I with 25 to 50% slag cement (by mass of cementitious material) can be used.
2. For severe exposure, where ASTM C150, Type V cement is required, a Type I or a Type II cement with 50 to 65% slag cement (by mass of cementitious material) can be used.
3. For very severe exposure, an ASTM C150 Type V cement with a minimum of 50% slag cement (by mass of cementitious material) can be used.
4. The sulfate resistance of the concrete shall be confirmed by testing in accordance to ASTM C1012[7].

Mass Concrete

1. For mass concrete placements, the percentage of portland cement to be replaced shall be 50 to 80% (by mass of cementitious material).
2. Thermal properties of the concrete shall be verified prior to construction to ensure conformity to project requirements.

Alkali-Silica and Alkali-Aggregate Reactivity

1. Mitigation of ASR shall refer to ASTM C1778 for guidance; on reducing the risk of alkali-aggregate reaction in concrete.
2. When using reactive aggregate, slag cement shall be used at replacement levels between 25 and 70% (by mass of cementitious material).
3. If the specific slag/portland cement mixture is shown to mitigate ASR in accordance with ASTM C177[8], low alkali cement is not necessary.

Exposure to Deicing Salts

1. Concrete exposed to deicing salts shall have a *w/cm* ratio of 0.45.

Sustainability/Low Carbon Concrete – Role of Slag Cement

- Legislation with Global Warming Potential limits tracking to zero with time
- Large scale implementation of current sustainable practices
- Owners targeting carbon neutrality goals
- Significant innovations in materials and processes

Several upcoming proposed NEW Standards, Codes and Guides, and other:

ACI 318-25 Building Code Requirements for Structural Concrete with Appendix on Sustainability (in development)

ACI 323-25 Low Carbon Concrete Code (References ACI 301, 318 and 332) Out for public comment

ASTM proposed ballots addressing C595 Type IT revision, new Type IC definition?

Guide for Reducing Cradle-to Gate Embodied Carbon Emissions for Paving Concrete – interim guide (National Concrete Pavement Technology Center, w/support of FHWA), Table 2C-Summary of Slag Cement, under review

Public interest groups outside the cement and concrete industry developing standards and guides. (Example: Ann Arbor, MI Low – Embodied Carbon Materials Resource Guide)

RMI (Rocky Mountain Institute) download “The Road to Decarbonization: Unlocking State DOT Concrete Specifications

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What about DOT specifications?

The Road to Decarbonization: Unlocking State DOT Concrete Specifications

April 5, 2024

By Satyam Maharaj, Anish Tilak

- **RMI website and location of article:**
  - https://rmi.org/the-road-to-decarbonization-unlocking-state-dot-concrete-specifications/

"Supplementary cementitious materials (SCMs), such as slag and fly ash, as well as portland limestone cement (PLC or Type 1L), have all been used successfully by state DOTs. Even with the wide availability of these materials,. **however, state DOTs face constraints in maximizing their use due to overly prescriptive criteria in their concrete material specifications**"

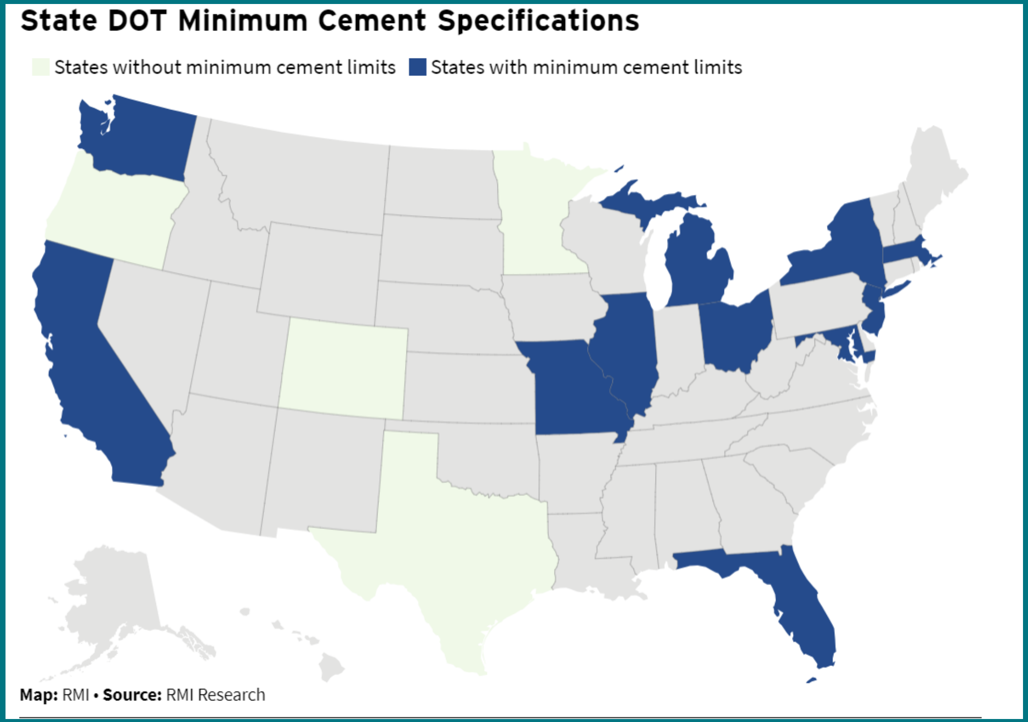
"Revising these specifications offers a pathway for DOTs to improve their concrete mixes and reduce carbon emissions. By optimizing specifications to lower cement use and increase SCM use, **DOTs have the potential to slash their carbon emissions by an impressive 32%."**

RMI Study of 15 State DOTs

The Road to Decarbonization: Unlocking State DOT Concrete Specifications

April 5, 2024

By Satyam Maharaj, Anish Tilak



Three Key Insights:

1. **DOTs should remove cement limits.** Removing limits can serve as a catalyst for innovation in concrete mid designs, promote carbon reduction, explore emerging materials.
2. **DOTs can slash emissions through simple specification changes.** By tracking and reporting GHG emissions, it will provide states with a clear understanding of potential GHG impacts.
3. **DOTs should pursue the following specification adjustments to reduce emissions today.**
   - ☐ Remove minimum cement limits
   - ☐ Expand SCM maximum limits to allow for greater cement reductions
   - ☐ Revise approved material lists to enable wider use of blended cements and emerging alternate SCMs

ACI CODE 323 - Low Carbon Concrete (draft document)

CHAPTER 1—GENERAL

CODE	COMMENTARY
1.1—Scope of ACI 323	**R1.1—Scope of ACI 323**
1.1.1 This Code shall apply to cast-in-place concrete structures as: 1. A reference in a building or structural design code. 2. A reference in a design and construction standard, rule, or regulation. 3. A reference in a sustainable construction code. 4. A reference in a code, standard, rule or regulation governing the global warming potential (GWP) of materials, 5. A reference in construction documents, or 6. A stand-alone code governing the GWP of concrete.	**R1.1.1** The Code includes provisions for low-carbon structural concrete governed by a building code, bridge code, or other infrastructure code that governs the use of concrete. Throughout the Code, the term "structure" means a building, non-building structure, member, system, or element, if the construction includes concrete. Pavements are considered structures for purposes of the Code. Chapters 1 through 4 of the Code apply to all structure types. Chapters 5 through 8 of the Code include requirements by structure type. See Chapter 2 for definitions of global warming potential (GWP), structural concrete, and low-carbon concrete.

- Established Global Warming Potential (GWP) limits for concrete mixtures based on regional benchmarks provided by NRMCA or local authority.
- Utilizes LCA reports, EPDs and LCA tools
- GWP limits assigned to a class of concrete based on 28 day compressive strength
- Ch. 5 Applies to building projects within scope of ACI 318, 301, 332)
- Ch. 6 Applies to concrete pavement and hardscape within scope of ACI 330, 325, FAA A/C 150-5370-10H, State DOTs
- Ch. 6 Applies to bridge superstructure, substructure, deep foundations and associated ancillary concrete within scope of AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020.
- Ch 8 Other structures within ACI requirements.

City of Ann Arbor, MI - Low Embodied Carbon White Paper


Low Embodied Carbon Concrete Task Force

This white paper provides the results of the Low Embodied Carbon Concrete Task Force's testing into new concrete mixes, as well as the first pours of one of the mixes.

July 2022

- Task Force charged with developing recommendations for Concrete specifications that will lower embodied carbon. (Also done for steel)
- Develop recommendations that may need further research, market transformation or industry & professional education before implementing.
- Discuss strategies and policies that reinforce & promote these materials.
- Information referenced in City of Ann Arbor Low – Embodied Carbon Materials Resource Guide
- Task Force Principles:
  1. Maximize the use of Portland Limestone Cement
  2. Use well-graded aggregates
  3. Maximize the use of Supplementary Cementitious Materials
  4. Specifications should be performance based and include GWP as a criteria
  5. Increase the long-term performance potential of concrete

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What we are trying to avoid is..Outdated Specifications

Example: Mass Concrete Project

2.03 Concrete Materials

A. Portland cement per ASTM C 150. Do not use slag cement. Cement used shall be of one brand, color, and source throughout the work.

1. Type I or II for standard 28 day strength concrete.
2. Type II for mass concrete and sulfate resistance.
3. Type III for 7 day high early strength concrete.

B. Coarse aggregate for normal weight concrete shall be crushed stone, crushed gravel, or washed gravel per ASTM C 33, including Table 2 for grading requirements and Table 3 for deleterious substances and physical property requirements.

C. Fine aggregate shall be natural sand per ASTM C 33.

D. Provide ASTM C33, size No. 467 aggregate for concrete slabs on grade.

SCA SLAG CEMENT ASSOCIATION

Thank you!