American Concrete Institute

38800 Country Club Drive
Farmington Hills, MI 48331 USA
+1.248.848.3700
www.concrete.org

ACI Proposed Changes to Develop the 2027 I-codes (Modifications to the 2024 I-codes)

Group A

Committee Action Hearings in 2024

April 7-16, 2024 and October 23-31, 2024

FS2-24 – Provides criteria for restraint of structural concrete elements without having to reference Table X3.1of ASTM E119: Standard Test Methods for Fire Tests of Building Construction and Materials.
FS80-24 – With the addition of ACI CODE 440.11 to the 2024 IBC, clarifies that provisions in Table 721.1(1) are only applicable to concrete elements reinforced with steel reinforcement.
FS84-24 – Adds ACI/TMS 216.1 for prescriptive details of fire-resistance-rated building elements, components or assemblies.
FS86-24 – Allows compliance for fire protection of steel columns using ACI/TMS 216.1
FS87-24 – Clarifies that ACI/TMS 216.1 remains applicable for precast and prestressed concrete elements.

FS2-24 Restraint Classification

IBC: 703.2.1.3

Proponents: Stephen Szoke, American Concrete Institute, American Concrete Institute (steve.szoke@concrete.org)

2024 International Building Code
Revise as follows:

703.2.1.3 Restrained classification. Fire-resistance-rated assemblies tested under ASTM E119 or UL 263 shall not be considered to be restrained unless evidence satisfactory to the building official is furnished by the registered design professional showing that the construction qualifies for a restrained classification in accordance with ASTM E119 or UL 263. Restrained construction shall be identified on the construction documents.

Exception Unless otherwise determined by the registered design professional, concrete girders, beams, and slabs connected to structural concrete framing or structural concrete walls in accordance with ACI 318 shall be considered restrained. Restrained concrete construction shall be identified on the construction documents.

Reason: *This code change proposal does not alter the technical requirements of the code. The exception is simply to avoid sending the Registered Design Professional (RDP) to ASTM E119 to discover that all concrete connections designed in accordance with ACI 318 restrain movement relative to the supporting structural members. This is consistent with the classification described in ASM E119 Standard Test Methods for Fire Tests of Building Construction and Materials. Appendix X3 Guide for Determining Condition of Restrain for Floor and Roof Assemblies and for Individual Beams of ASTM E119 advises that concrete framing is to be considered restrained for:*

(1) Beams fastened to the framing members,

(2) All types of concrete cast-in-place floor or roof construction (such as beam-and-slabs, flat slabs, pan joists, and waffle slabs) where the floor or roof construction is cast with the framing members

(3) Interior and exterior spans of precast construction with cast-in-place joints resulting in restraint equivalent to that which would exist in condition (1).

(4) All types of prefabricated floor or roof construction where the structural members are secured to such construction.

The minimum structural integrity requirements of ACI 318 are such that horizontal structural concrete elements are required to have connections restraining movement relative to the supporting structural member. ACI 318 Table 4.10.2.1 – Minimum requirements for structural integrity based on member type directs the RDP to the appropriate structural integrity sections of ACI 318:

Nonprestressed one-way cast-in-place slabs – 7.7.7 Nonprestressed two-way slabs – 8.7.4.2 Prestressed two-way slabs – 8.7.5.6 Nonprestresssed two-way joint systems – 8.8.1.6 Cast-in-place beam – 9.7.7

Nonprestressed one-way joint system – 9.8.1.6 Precast joint and connection – 16.2.1.8

For those interested in the minimum structural integrity requirements of ACI 318, they are as follows:

Nonprestressed one-way cast-in-place slabs

7.7.7 Structural integrity reinforcement in cast-in-place one-way slabs

7.7.7.1 Longitudinal structural integrity reinforcement consisting of at least one-quarter of the maximum positive moment reinforcement shall be continuous.

7.7.7.2 Longitudinal structural integrity reinforcement at noncontinuous supports shall be anchored to develop f_y at the face of the support.

7.7.7.3 If splices are necessary in continuous structural integrity reinforcement, the reinforcement shall be spliced near supports. Splices shall be mechanical or welded in accordance with 25.5.7 or Class B tension lap splices in accordance with 25.5.2.

Nonprestressed two-way slabs

8.7.4.2 Structural integrity

8.7.4.2.1 All bottom deformed bars or deformed wires within the column strip, in each direction, shall be continuous or spliced using mechanical or welded splices in accordance with 25.5.7 or Class B tension lap splices in accordance with 25.5.2. Splices shall be located in accordance with Fig. 8.7.4.1.3.

8.7.4.2.2 At least two of the column strip bottom bars or wires in each direction shall pass within the region bounded by the longitudinal reinforcement of the column and shall be anchored at exterior supports.

Prestressed two-way slabs

8.7.5.6 Structural integrity

8.7.5.6.1 Except as permitted in 8.7.5.6.3, at least two tendons with 1/2 in. diameter or larger strand shall be placed in each direction at columns in accordance with (a) or (b):

(a) Tendons shall pass through the region bounded by the longitudinal reinforcement of the column.

(b) Tendons shall be anchored within the region bounded by the longitudinal reinforcement of the column, and the anchorage shall be located beyond the column centroid and away from the anchored span.

8.7.5.6.2 Outside of the column and shear cap faces, the two structural integrity tendons required by 8.7.5.6.1 shall pass under any orthogonal tendons in adjacent spans.

8.7.5.6.3 Slabs with tendons not satisfying 8.7.5.6.1 shall be permitted if bonded bottom deformed reinforcement is provided in each direction in accordance with 8.7.5.6.3.1 through 8.7.5.6.3.3.

8.7.5.6.3.1 Minimum bottom deformed reinforcement As in each direction shall be the larger of (a) and (b). The value of f_y shall be limited to a maximum of 80,000 psi:

(a) $As = [4.5 (fc')0.5c2d]/f_y$ (8.7.5.6.3.1a)

(b) $As = [300c2d/f_y]$ (8.7.5.6.3.1b)

where c2 is measured at the column faces through which the reinforcement passes.

8.7.5.6.3.2 Bottom deformed reinforcement calculated in 8.7.5.6.3.1 shall pass within the region bounded by the longitudinal reinforcement of the column and shall be anchored at exterior supports.

8.7.5.6.3.3 Bottom deformed reinforcement shall be anchored to develop f_y beyond the column or shear cap face.

Nonprestresssed two-way joint systems

8.8.1.6 For structural integrity, at least one bottom bar in each joist shall be continuous and shall be anchored to develop f_y at the face of supports.

Cast-in-place beam

9.7.7 Structural integrity reinforcement in cast-in-place beams

9.7.7.1 For beams along the perimeter of the structure, structural integrity reinforcement shall be in accordance with (a) through (c):

(a) At least one-quarter of the maximum positive moment reinforcement, but not less than two bars or strands, shall be continuous

(b) At least one-sixth of the negative moment reinforcement at the support, but not less than two bars or strands, shall be continuous

(c) Longitudinal structural integrity reinforcement shall be enclosed by closed stirrups in accordance with 25.7.1.6 or hoops along the clear span of the beam.

9.7.7.2 For other than perimeter beams, structural integrity reinforcement shall be in accordance with (a) or (b):

(a) At least one-quarter of the maximum positive moment reinforcement, but not less than two bars or strands, shall be continuous.

(b) Longitudinal reinforcement shall be enclosed by closed stirrups in accordance with 25.7.1.6 or hoops along the clear span of the beam.

9.7.7.3 Longitudinal structural integrity reinforcement shall pass through the region bounded by the longitudinal reinforcement of the column.

9.7.7.4 Longitudinal structural integrity reinforcement at noncontinuous supports shall be anchored to develop f_y at the face of the support.

9.7.7.5 If splices are necessary in continuous structural integrity reinforcement, the reinforcement shall be spliced in accordance with (a) and (b):

(a) Positive moment reinforcement shall be spliced at or near the support

(b) Negative moment reinforcement shall be spliced at or near midspan

9.7.7.6 Splices shall be mechanical or welded in accordance with 25.5.7 or Class B tension lap splices in accordance with 25.5.2.

Nonprestressed one-way joint system

9.8.1.6 For structural integrity, at least one bottom bar in each joist shall be continuous and shall be anchored to develop f_y at the face of supports

Precast joint and connection

16.2.1.8 Integrity ties shall be provided in the vertical, longitudinal, and transverse directions and around the perimeter of a structure in accordance with 16.2.4 or 16.2.5

16.2.4 Minimum connection strength and integrity tie requirements

16.2.4.1 Except where the provisions of 16.2.5 govern, longitudinal and transverse integrity ties shall connect precast members to a lateral-force-resisting system, and vertical integrity ties shall be provided in accordance with 16.2.4.3 to connect adjacent floor and roof levels.

16.2.4.2 Where precast members form floor or roof diaphragms, the connections between the diaphragm and those members being laterally supported by the diaphragm shall have a nominal tensile strength of not less than 300 lb per linear ft.

16.2.4.3 Vertical integrity ties shall be provided at horizontal joints between all vertical precast structural members, except cladding, and shall satisfy (a) or (b):

(a) Connections between precast columns shall have vertical integrity ties, with a nominal tensile strength of at least 200Aglb, where Ag is the gross area of the column. For columns with a larger cross section than required by consideration of loading, a reduced effective area based on the cross section required shall be permitted. The reduced effective area shall be at least one-half the gross area of the column.

(b) Connections between precast wall panels shall have at least two vertical integrity ties, with a nominal tensile strength of at least 10,000 lb per tie.

16.2.5 Integrity tie requirements for precast concrete bearing wall structures three stories or more in height.

16.2.5.1 Integrity ties in floor and roof systems shall satisfy (a) through (f):

(a) Longitudinal and transverse integrity ties shall be provided in floor and roof systems to provide a nominal tensile strength of at least 1500 lb per foot of width or length.

(b) Longitudinal and transverse integrity ties shall be provided over interior wall supports and between the floor or roof system and exterior walls.

(c) Longitudinal and transverse integrity ties shall be positioned in or within 2 ft of the plane of the floor or roof system.

(d) Longitudinal integrity ties shall be oriented parallel to floor or roof slab spans and shall be spaced not greater than 10 ft on center. Provisions shall be made to transfer forces around openings.

(e) Transverse integrity ties shall be oriented perpendicular to floor or roof slab spans and shall be spaced not greater than the bearing wall spacing.

(f) Integrity ties at the perimeter of each floor and roof, within 4 ft of the edge, shall provide a nominal tensile strength of at least 16,000 lb.

16.2.5.2 Vertical integrity ties shall satisfy (a) through (c):

(a) Integrity ties shall be provided in all wall panels and shall be continuous over the height of the building.

(b) Integrity ties shall provide a nominal tensile strength of at least 3000 lb per horizontal foot of wall.

(c) At least two integrity ties shall be provided in each wall panel.

***Cost Impact:** The change proposal is editorial in nature or a clarification and has no cost impact on the cost of construction.*

Justification for no cost impact:

No technical change to the provisions of the code. Proposal simply adds language to IBC that reflects the nature of the provisions in ASTM E119

FS80-24 Clarifies Only Steel Reinforcement

IBC: TABLE 721.1(1)

Proponents: Stephen Szoke, American Concrete Institute, American Concrete Institute (steve.szoke@concrete.org); Amy Trygestad, Concrete Reinforcing Steel Institute, Concrete Reinforcing Steel Institute (atrygestad@crsi.org)

2024 International Building Code

Revise as follows:

TABLE 721.1(1) MINIMUM PROTECTION OF STRUCTURAL PARTS BASED ON TIME PERIODS FOR VARIOUS NONCOMBUSTIBLE INSULATING MATERIALS[m]

Portions of table not shown remain unchanged.

STRUCTURAL PARTS BEING PROTECTED	ITEM NUMBER	INSULATING MATERIAL USED	MINIMUM THICKNESS OF INSULATING MATERIAL FOR THE FOLLOWING FIRE-RESISTANCE PERIODS (inches)			
			4 hrs	3 hrs	2 hrs	1 hr
5. Reinforcing steel in reinforced concrete columns, beams girders and trusses	5-1.1	Carbonate, lightweight and sand-lightweight aggregate concrete, members 12" or larger, square or round. (Size limit does not apply to beams and girders monolithic with floors.)	$1^1/_2$	$1^1/_2$	$1^1/_2$	$1^1/_2$
		Siliceous aggregate concrete, members 12" or larger, square or round. (Size limit does not apply to beams and girders monolithic with floors.)	2	$1^1/_2$	$1^1/_2$	$1^1/_2$
6. Reinforcing steel in reinforced concrete joists[l]	6-1.1	Carbonate, lightweight and sand-lightweight aggregate concrete	$1^1/_4$	$1^1/_4$	1	$^3/_4$
	6-1.2	Siliceous aggregate concrete	$1^3/_4$	$1^1/_2$	1	$^3/_4$
7. Reinforcing steel and tie rods in floor and roof slabs[l]	7-1.1	Carbonate, lightweight and sand-lightweight aggregate concrete	1	1	$^3/_4$	$^3/_4$
	7-1.2	Siliceous aggregate concrete	$1^1/_4$	1	1	$^3/_4$

For SI: 1 inch = 25.4 mm, 1 square inch = 645.2 mm2, 1 cubic foot = 0.0283 m3, 1 pound per cubic foot = 16.02 kg/m3.

a. Reentrant parts of protected members to be filled solidly.

b. Two layers of equal thickness with a 3/4-inch airspace between.

c. For all of the construction with gypsum wallboard described in Table 721.1(1), gypsum base for veneer plaster of the same size, thickness and core type shall be permitted to be substituted for gypsum wallboard, provided that attachment is identical to that specified for the wallboard and the joints on the face layer are reinforced, and the entire surface is covered with not less than 1/16- inch gypsum veneer plaster.

d. An approved adhesive qualified under ASTM E119 or UL 263.

e. Where lightweight or sand-lightweight concrete having an oven-dry weight of 110 pounds per cubic foot or less is used, the tabulated minimum cover shall be permitted to be reduced 25 percent, except that the reduced cover shall be not less than 3/4 inch in slabs or 11/2 inches in beams or girders.

f. For solid slabs of siliceous aggregate concrete, increase tendon cover 20 percent.

g. Adequate provisions against spalling shall be provided by U-shaped or hooped stirrups spaced not to exceed the depth of the member with a clear cover of 1 inch.

h. Prestressed slabs shall have a thickness not less than that required in Table 721.1(3) for the respective fire-resistance time period.

i. Fire coverage and end anchorages shall be as follows: Cover to the prestressing steel at the anchor shall be 1/2 inch greater than that required away from the anchor. Minimum cover to steel-bearing plate shall be 1 inch in beams and 3/ 4 inch in slabs.

j. For beam widths between 8 inches and 12 inches, cover thickness shall be permitted to be determined by interpolation.

k. Interior spans of continuous slabs, beams and girders shall be permitted to be considered restrained.

l. For use with concrete slabs having a comparable fire endurance where members are framed into the structure in such a manner as to provide equivalent performance to that of monolithic concrete construction.

m. Generic fire-resistance ratings (those not designated as PROPRIETARY* in the listing) in GA-600 shall be accepted as if herein specified.

n. Additional insulating material is not required on the exposed outside face of the column flange to achieve a 1-hour fire-resistance rating.

Reason: *This code change adds the word "steel" to item 7 thereby aligning with items 5 and 6. This code change clarifies the provisions are only applicable to concrete reinforced with steel and are not applicable to concrete reinforced with glass fiber reinforced polymer (GFRP) reinforcement in concrete.*

Cost Impact: *The change proposal is editorial in nature or a clarification and has no cost impact on the cost of construction.*

Justification for no cost impact:

This code change only adds the word "steel" to items 3, 4 and 7 thereby aligning with items 5 and 6 and providing needed clarify now that GFRP reinforced concrete is permitted in the IBC.

FS84-24 Clarify Use of 216.1

IBC: 721.1

Proponents: Stephen Szoke, American Concrete Institute, American Concrete Institute (steve.szoke@concrete.org); Nicholas Lang, Concrete Masonry & Hardscapes Association, Masonry Alliance for Codes & Standards (nlang@ncma.org)

2024 International Building Code
Revise as follows:

721.1 General. The provisions of this section contain prescriptive details of fire-resistance-rated building elements, components or assemblies. The materials of construction specified in Tables 721.1(1), 721.1(2) and 721.1(3) shall be assumed to have the fire-resistance ratings prescribed therein. Where materials that change the capacity for heat dissipation are incorporated into a fire-resistance-rated assembly, fire test results or other substantiating data shall be made available to the building official to show that the required fire-resistance-rating time period is not reduced.

721.1.1 Concrete. Prescriptive details of fire resistance-rated concrete building components shall comply with Section 721.1, ACI/TMS 216.1, or PCI 124.

721.1.2 Masonry. Prescriptive details of fire resistance-rated masonry building components shall comply with Section 721.1 or ACI/TMS 216.1

Reason*: This change adds the prescriptive fire resistance ratings for concrete and masonry assemblies compliant with ACI/TMS 216.1 Code Requirements for Determining the Fire Resistance Rating of Concrete and Masonry Construction Assemblies. ACI/TMS 216.1 provides prescriptive requirements for fire resistance-rated concrete and masonry and thus, is a viable alternative compliance path for Section 721. ACI/TMS 216.1 is already referenced in Section 722 Calculated Fire Resistance. The prescriptive requirements are in addition to those of Section 721.*

Cost Impact: *The change proposal is editorial in nature or a clarification and has no cost impact on the cost of construction.*

Justification for no cost impact:
No technical changes. Proposal cites an existing referenced standard that provides additional prescriptive options.

FS86-24 ACI 216.1 for Steel Column Protection

IBC: 722.1

Proponents: Stephen Szoke, American Concrete Institute, American Concrete Institute (steve.szoke@concrete.org); Nicholas Lang, Concrete Masonry & Hardscapes Association, Representing Masonry Alliance for Codes and Standards, Masonry Alliance for Codes & Standards (nlang@ncma.org)

2024 International Building Code
Revise as follows:

722.1 General. The provisions of this section contain procedures by which the fire resistance of specific materials or combinations of materials is established by calculations. These procedures apply only to the information contained in this section and shall not be otherwise used. The calculated fire resistance of specific materials or combinations of materials shall be established by one of the following:

1. Concrete, concrete masonry and clay masonry assemblies shall be permitted in accordance with ACI 216.1/TMS 0216.
2. Precast and precast, prestressed concrete assemblies shall be permitted in accordance with PCI 124.
3. Steel assemblies shall be permitted in accordance with Chapter 5 of ASCE 29.
4. Exposed wood members and wood decking shall be permitted in accordance with Chapter 16 of ANSI/AWC NDS.
5. Steel columns protected with concrete or masonry and hollow steel tubes filled with concrete shall be permitted in accordance with ACI/TMS 216.1

Reason: *This code change proposal adds ACI/TMS 216.1 as a compliance path for structural steel columns protected with concrete or masonry and hollow structural steel columns filled with concrete. ACI/TMS 216.1 continues to provide the methods to provide fire protection for structural steel columns using concrete or masonry and fire resistance ratings for hollow steel columns filled with concrete. This adds an alternative to ASCE 29 as an additional resource for determining compliance.*

Cost Impact*: The change proposal is editorial in nature or a clarification and has no cost impact on the cost of construction.*

Justification for no cost impact*:*
This change does not increase cost as it provides an alternative compliance method to those already permitted in the code.

FS87-24 22 Clarifies ACI 216.1 Remains Applicable for Precast

IBC: 722.1

Proponents: Stephen Szoke, American Concrete Institute, American Concrete Institute (steve.szoke@concrete.org)

2024 International Building Code
Revise as follows:

722.1 General. The provisions of this section contain procedures by which the fire resistance of specific materials or combinations of materials is established by calculations. These procedures apply only to the information contained in this section and shall not be otherwise used. The calculated fire resistance of specific materials or combinations of materials shall be established by one of the following:

1. Concrete, concrete masonry and clay masonry assemblies shall be permitted in accordance with ACI 216.1/TMS 0216.
2. Precast and precast, prestressed concrete assemblies shall be permitted in accordance with PCI 124 or ACI/TMS 216.1.
3. Steel assemblies shall be permitted in accordance with Chapter 5 of ASCE 29.
4. Exposed wood members and wood decking shall be permitted in accordance with Chapter 16 of ANSI/AWC NDS.

Reason: *This proposal clarifies that ACI/TMS 216.1 is a appropriate for determining the fire resistance ratings of precast, prestressed concrete assemblies. Item 1, does not distinguish between prestressed and non-prestressed assemblies and both are covered in ACI/TMS 216.1. By reading Item 2 as currently written implies that only compliance with PCI 124 is acceptable precast, prestressed concrete assemblies. Prior to the addition of PCI 124 to the IBC, the user was directed to ACI/TMS 216.1 for all concrete assemblies including precast, prestressed concrete. This change provides clarity that ACI/TMS 216.1 remains an appropriate compliance path for precast, prestressed concrete assemblies.*

Cost Impact: *The change proposal is editorial in nature or a clarification and has no cost impact on the cost of construction*

Justification for no cost impact:
No technical change, simply clarifies that ACI/TMS 216.1 remains applicable for precast, prestressed concrete, per Item 1.