BUILDING CODE ACTION COMMITTEE MEETING STRUCTURAL WORK GROUP

APRIL 11-12, 2019 MEETING

GROUP B 2019

S184-19 Part I

IBC®: 2308.5.9, 2308.5.10; IFGC®: [BS] 302.3.3; IPC®: [BS] C101.2, [BS] C101.3

Proponent: Ed Kulik, representing ICC Building Code Action Committee (bcac@iccsafe.org)

2018 International Building Code

Revise as follows:

2308.5.9 Cutting and notching. In exterior walls and bearing partitions, a wood ~~studs are permitted to~~ stud shall not be cut or notched ~~to a depth not exceeding 25 percent of the width of the stud. Cutting or notching of studs to a depth not greater than 40 percent of the width of the stud is permitted in nonbearing partitions not supporting~~ in excess of 25 percent of its depth. In nonbearing partitions that do not support loads other than the weight of the partition , a stud shall not be cut or notched in excess of 40 percent of its depth.

2308.5.10 Bored holes. ~~Bored holes not greater than~~ The diameter of bored holes in wood studs shall not exceed 40 percent of the stud ~~width are permitted to be bored in any wood stud. Bored holes not greater than~~ depth. The diameter of bored holes in wood studs shall not exceed 60 percent of the stud ~~width are permitted in nonbearing partitions or~~ depth in nonbearing partitions. The diameter of bored holes in wood studs shall not exceed 60 percent of the stud depth in any wall where each ~~bored~~ stud is doubled, provided that not more than two such successive doubled studs are so bored. The edge of ~~a~~ the bored hole shall not be ~~nearer~~ closer than 5/8 inch (15.9 mm) to the edge of the stud. Bored holes shall not be located at the same section of stud as a cut or notch.

2018 International Fuel Gas Code

[BS] 302.3.3 Stud cutting and notching. In exterior walls and bearing partitions, ~~any~~ a wood stud ~~is permitted to~~ shall not be cut or notched ~~to a depth not exceeding~~ in excess of 25 percent of its
~~width. Cutting or notching of studs to a depth not greater than 40 percent of the width of the stud is permitted in nonload-bearing partitions supporting no loads other than the weight of the partition.~~
depth. In nonbearing partitions that do not support loads other than the weight of the partition, a stud shall not be cut or notched in excess of 40 percent of its depth.

2018 International Plumbing Code

[BS] C101.2 Stud cutting and notching. In exterior walls and bearing partitions, ~~any~~ a wood stud ~~is permitted to~~ shall not be cut or notched ~~to a depth not exceeding~~ in excess of 25 percent of its
~~width. Cutting or notching of studs to a depth not greater than 40 percent of the width of the stud is permitted in nonbearing partitions supporting no~~
depth. In nonbearing partitions that do not support loads other than the weight of the ~~partition.~~ partition, a stud shall not be cut or notched in excess of 40 percent of its depth.

[BS] C101.3 Bored holes. The diameter of bored holes in wood studs shall not exceed 40 percent of the stud depth. The diameter of bored holes in wood studs shall not exceed 60 percent of the stud depth in nonbearing partitions. The diameter of bored holes in wood studs shall not exceed 60 percent of the stud depth in any wall where each stud is doubled, provided that not more than two such successive doubled studs are so bored. The edge of the bored hole shall be not ~~be~~closer than $^5/_8$ inch (15.9 mm) to the edge of the stud. Bored holes shall be not located at the same section of stud as a cut or notch.

Reason: International Building Code: The current text uses the word width, when actually it is the depth that is meant. The depth of a stud is the plane in which a hole is bored. Holes are not bored in the width (1 ½ inches) of a stud. This revision also gets rid of unenforceable permissive language. The current text says that any stud is permitted to be notched to a depth not exceeding 25%. This is stating a permitted limit; not a mandatory limit. A highway speed limit is not permitted to be 55 miles per hour, rather it is an absolute limit of 55. If the stud is permitted to be notched to not exceed 25%, then it also permitted to be notched to not exceed other percentages. Lastly, this proposal corrects a flaw where the text said that the edge of the hole cannot be more than 5/8 inch to the edge of the stud. The intent is exactly the opposite. The edge of the hole must not be less than 5/8 inch to the edge of the stud. This language currently exists in the IMC. Similar changes are being proposed in the IRC, IFGC and IPC to coordinate the terms between I-codes.
This proposal is submitted by the ICC Building Code Action Committee (BCAC) and the he ICC Plumbing/Mechanical/Gas Code Action Committee (PMG CAC). BCAC and PMG CAC were established by the ICC Board of Directors in July 2011 to pursue opportunities to improve and enhance assigned International Codes or portions thereof. Since 2017 the BCAC has held 6 open meetings. In addition, there were numerous Working Group meetings and conference calls for the current code development cycle, which included members of the committee as well as any interested party to discuss and debate the proposed changes. Related documentation and reports are posted on the BCAC website at: https://www.iccsafe.org/codes-tech-support/codes/code-development-process/building-code-action-committee-bcac/

Cost Impact: This proposal is a clarification of terms and current requirements for coordination between I-codes.

S184-19 Part I

S184-19 Part II

IRC®: R602.6

Proponent: Ed Kulik, representing ICC Building Code Action Committee (bcac@iccsafe.org)

2018 International Residential Code

Revise as follows:

R602.6 Drilling and notching of studs. Drilling and notching of studs shall be in accordance with the following:

1. Notching. ~~Any~~ A stud in an exterior wall or bearing partition shall ~~be permitted to~~ not be cut or notched to a depth ~~not~~ exceeding 25 percent of its ~~width.~~ depth. Studs in nonbearing partitions shall ~~be permitted to~~ not be notched to a depth ~~not to exceed~~ exceeding 40 percent of a single stud ~~width.~~ depth.
2. ~~Drilling. Any stud shall be permitted to be bored or drilled, provided that the diameter of the resulting hole is not more than 60~~ Boring. The diameter of bored holes in studs shall not exceed 60 percent of the stud ~~width~~ depth, the edge of the hole ~~is~~ shall not ~~more~~ be less than $^5/_8$ inch (16 mm) ~~to~~ from the edge of the stud, and the hole ~~is~~ shall not be located in the same section as a cut or notch. ~~Studs~~ Where the diameter of a bored hole in a stud located in exterior walls or bearing partitions ~~drilled~~ is over 40 percent ~~and up to 60 percent~~ such stud shall be doubled ~~with~~ and not more than two successive doubled studs shall be so bored. See Figures R602.6(1) and R602.6(2).

   Exception: ~~Use of~~ Where *approved* stud shoes ~~is permitted where they~~ are installed in accordance with the manufacturer's ~~recommendations.~~ instructions.

Reason: The current text uses the word width, when actually it is the depth that is meant. The depth of a stud is the plane in which a hole is bored. Holes are not bored in the width (1 ½ inches) of a stud. This revision also gets rid of unenforceable permissive language. The current text says that any stud is permitted to be notched to a depth not exceeding 25%. This is stating a permitted limit; not a mandatory limit. A highway speed limit is not permitted to be 55 miles per hour, rather it is an absolute limit of 55. If the stud is permitted to be notched to not exceed 25%, then it also permitted to be notched to not exceed other percentages. Lastly, this proposal corrects a flaw where the text said that the edge of the hole cannot be more than 5/8 inch to the edge of the stud. The intent is exactly the opposite. The edge of the hole must not be less than 5/8 inch to the edge of the stud. This language currently exists in the IMC. Similar changes are being proposed in the IBC, IFGC and IPC to coordinate the terms between I-codes. This proposal is submitted by the ICC Building Code Action Committee (BCAC). BCAC was established by the ICC Board of Directors in July 2011 to pursue opportunities to improve and enhance assigned International Codes or portions thereof. Since 2017 the BCAC has held 6 open meetings. In addition, there were numerous Working Group meetings and conference calls for the current code development cycle, which included members of the committee as well as any interested party to discuss and debate the proposed changes. Related documentation and reports are posted on theBCAC website at: https://www.iccsafe.org/codes-tech-support/codes/code-development-process/building-code-action-committee-bcac/.

Cost Impact: This proposal will not increase the cost of construction as it is a clarification of terms and current requirements only.

Proposal # 4118

RB46-19

IRC®: TABLE R301.5

Proponent: Ed Kulik, representing ICC Building Code Action Committee (bcac@iccsafe.org)

2018 International Residential Code

Revise as follows:

TABLE R301.5
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS (in pounds per square foot)

USE	LIVE LOAD
Uninhabitable attics without storage[b]	10
Uninhabitable attics with limited storage[b, g]	20
Habitable attics and attics served with fixed stairs	30
Balconies (exterior) and decks[e]	40
Fire escapes	40
Guards ~~and handrails [d]~~ [i]	200[h,i]
Guard in-fill components[f]	50[h]
Handrails [d]	200[h]
Passenger vehicle garages[a]	50[a]
Rooms other than sleeping rooms	40
Sleeping rooms	30
Stairs	40[c]

For SI: 1 pound per square foot = 0.0479 kPa, 1 square inch = 645 mm^2, 1 pound = 4.45 N.

a. Elevated garage floors shall be capable of supporting a 2,000-pound load applied over a 20-square-inch area.

b. Uninhabitable attics without storage are those where the clear height between joists and rafters is not more than 42 inches, or where there are not two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses. This live load need not be assumed to act concurrently with any other live load requirements.

c. Individual stair treads shall be designed for the uniformly distributed live load or a 300-pound concentrated load acting over an area of 4 square inches, whichever produces the greater stresses.

d. A single concentrated load applied in any direction at any point along the top.

e. See Section R507.1 for decks attached to exterior walls.

f. Guard in-fill components (all those except the handrail), balusters and panel fillers shall be designed to withstand a horizontally applied normal load of 50 pounds on an area equal to 1 square foot. This load need not be assumed to act concurrently with any other live load requirement.

g. Uninhabitable attics with limited storage are those where the clear height between joists and rafters is 42 inches or greater, or where there are two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses.The live load need only be applied to those portions of the joists or truss bottom chords where all of the following conditions are met:

1. The attic area is accessed from an opening not less than 20 inches in width by 30 inches in length that is located where the clear height in the attic is not less than 30 inches.
2. The slopes of the joists or truss bottom chords are not greater than 2 inches vertical to 12 units horizontal.
3. Required insulation depth is less than the joist or truss bottom chord member depth.

The remaining portions of the joists or truss bottom chords shall be designed for a uniformly distributed concurrent live load of not less than 10 pounds per square foot.

h. Glazing used in handrail assemblies and guards shall be designed with a safety factor of 4. The safety factor shall be applied to each of the concentrated loads applied to the top of the rail, and to the load on the in-fill components. These loads shall be determined independent of one another, and loads are assumed not to occur with any other live load.

i. For a guard system not required to serve as a handrail, a single concentrated load applied at any point along the top, in the vertical downward direction and in the horizontal direction toward the lower surface. For a guard also serving as a handrail, a single concentrated load applied in any direction at any point along the top.

Reason: The purpose of this proposal is to revise the load on guard systems for one- and two-family dwellings to align with common industry practice. Extensive discussion has occurred in recent code cycles on load requirements and details for guard systems on decks accessory to one- and two-family dwellings. In particular, the directions in which the 200 pound guard load needs to be applied has been a topic of debate.
The IRC and IBC define a guard as “a building component or a system of building components located near the open sides of elevated walking surfaces that minimizes the possibility of a fall from the walking surface to the lower level.” The ASCE definition of a guardrail system is very similar. Clearly, a fall from the edge of an unprotected deck to the ground, which can be as much as 10 feet or more, carries a much greater risk of injury than a fall backwards onto the surface of the deck, which is only a few feet.

Further, a guard system can be constructed without a handrail, as under both the IRC and IBC a handrail is only required at a flight of stairs, a ramp, a stepped aisle, or a ramped aisle. Nor is the top rail of a guard system required to be graspable by occupants of a deck or other elevated walking surface, unless the guard is specifically designed to also serve as a handrail. In fact, a guard need not even have a top rail unless specifically required by the codes or the reference standards for guard systems, or desired as part of the design of the guard system.

As such, industry standards such as ASTM D7032 for wood and plastic composite decks boards and guards (referenced in both the IBC and IRC) and code evaluation acceptance criteria such as ICC-ES AC 174 for deck boards and guardrails, call for applying the 200 pound load in the outward and downward directions only, not inward or upward and certainly not parallel to the guard. Despite this apparent deviation from the IRC, IBC and ASCE 7 load requirements, thousands of guard systems, when designed, tested, and constructed in accordance with these industry standards and acceptance criteria and used properly, have performed exceptionally well and have protected occupants of decks against falls from the deck.

Cost Impact: The code change will recognize existing practices in the design and testing of guard systems as specified in ASTM D7032, ICC-ES AC 174 and other industry standards for guard systems and components. Manufacturers with existing products designed and tested to those standards will remain compliant with the IRC and will not need to conduct additional engineering or testing. If this change is not approved, manufacturers may eventually be required to test or design their products for additional load directions, which would substantially increase cost.

Proposal # 4044

RB46-19

RB47-19

IRC®: TABLE R301.5

Proponent: Ed Kulik, representing ICC Building Code Action Committee (bcac@iccsafe.org)

2018 International Residential Code

Revise as follows:

TABLE R301.5
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS (in pounds per square foot)

USE	LIVE LOAD
Uninhabitable attics without storage[b]	10
Uninhabitable attics with limited storage[b, g]	20
Habitable attics and attics served with fixed stairs	30
Balconies (exterior) and decks[e]	40
Fire escapes	40
Guards ~~and handrails~~[d]	200[h]
Guard in-fill components[f]	50[h]
Handrails [d]	200[h]
Passenger vehicle garages[a]	50[a]
Rooms other than sleeping rooms	40
Sleeping rooms	30
Stairs	40[c]

For SI: 1 pound per square foot = 0.0479 kPa, 1 square inch = 645 mm^2, 1 pound = 4.45 N.

a. Elevated garage floors shall be capable of supporting a 2,000-pound load applied over a 20-square-inch area.
b. Uninhabitable attics without storage are those where the clear height between joists and rafters is not more than 42 inches, or where there are not two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses. This live load need not be assumed to act concurrently with any other live load requirements.
c. Individual stair treads shall be designed for the uniformly distributed live load or a 300-pound concentrated load acting over an area of 4 square inches, whichever produces the greater stresses.
d. A single concentrated load applied in any direction at any point along the top. For a guard not required to serve as a handrail, the load need not be applied to the top element of the guard in a direction parallel to such element.
e. See Section R507.1 for decks attached to exterior walls.
f. Guard in-fill components (all those except the handrail), balusters and panel fillers shall be designed to withstand a horizontally applied normal load of 50 pounds on an area equal to 1 square foot. This load need not be assumed to act concurrently with any other live load requirement.
g. Uninhabitable attics with limited storage are those where the clear height between joists and rafters is 42 inches or greater, or where there are two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses.The live load need only be applied to those portions of the joists or truss bottom chords where all of the following conditions are met:

1. The attic area is accessed from an opening not less than 20 inches in width by 30 inches in length that is located where the clear height in the attic is not less than 30 inches.
2. The slopes of the joists or truss bottom chords are not greater than 2 inches vertical to 12 units horizontal.
3. Required insulation depth is less than the joist or truss bottom chord member depth.

The remaining portions of the joists or truss bottom chords shall be designed for a uniformly distributed concurrent live load of not less than 10 pounds per square foot.

h. Glazing used in handrail assemblies and guards shall be designed with a safety factor of 4. The safety factor shall be applied to each of the concentrated loads applied to the top of the rail, and to the load on the in-fill components. These loads shall be determined independent of one another, and loads are assumed not to occur with any other live load.

Reason: The purpose of this proposal is to revise the load on guard systems for one- and two-family dwellings to align with common industry

practice. Extensive discussion has occurred in recent code cycles on load requirements and details for guard systems on decks accessory to one- and two-family dwellings. In particular, the directions in which the 200 pound guard load needs to be applied has been a topic of debate.
The IRC and IBC define a guard as “a building component or a system of building components located near the open sides of elevated walking surfaces that minimizes the possibility of a fall from the walking surface to the lower level.” The ASCE 7 definition of a guardrail system is very similar. Clearly, a fall from the edge of an unprotected deck to the ground, which can be as much as 10 feet or more, carries a much greater risk of injury than a fall backwards onto the surface of the deck, which is only a few feet.

Further, a guard system can be constructed without a handrail, as under both the IRC and IBC a handrail is only required at a flight of stairs, a ramp, a stepped aisle, or a ramped aisle. Nor is the top rail of a guard system required to be graspable by occupants of a deck or other elevated walking surface, unless the guard is specifically designed to also serve as a handrail. In fact, a guard need not even have a top rail unless specifically required by the codes or the reference standards for guard systems, or desired as part of the design of the guard system.

As such, industry standards such as ASTM D7032 for wood and plastic composite decks boards and guards (referenced in both the IBC and IRC) and code evaluation acceptance criteria such as ICC-ES AC 174 for deck boards and guardrails, call for applying the 200 pound load in the outward and downward directions only, representing the most significant loads on a guard and the most significant directions in which a fall need be prevented. Since by code a guard need not meet the requirements of a handrail, these standards and criteria do not require the 200 pound load be applied in-line along the top of the rail. Despite this apparent deviation from the IRC, IBC and ASCE 7 load requirements, thousands of guard systems, when designed, tested, and constructed in accordance with these industry standards and acceptance criteria and used properly, have performed exceptionally well and have protected occupants of decks against falls from the deck.

Cost Impact: The code change will recognize existing practices in the design and testing of guard systems as specified in ASTM D7032, ICC-ES AC 174 and other industry standards for guard systems and components. Manufacturers with existing products designed and tested to those standards will remain compliant with the IRC and will not need to conduct additional engineering or testing. If this change is not approved, manufacturers may eventually be required to test or design their products for additional load directions, which would substantially increase cost.

Proposal # 4125

RB47-19

RB48-19

IRC®: TABLE R301.5

Proponent: Stephanie Young, representing National Council of Structural Engineers Associations (stephanie@mattsonmacdonald.com)

2018 International Residential Code

Revise as follows:

TABLE R301.5
MINIMUM UNIFORMLY DISTRIBUTED AND CONCENTRATED LIVE LOADS ~~(in pounds per square foot)~~

OCCUPANCY OR USE	UNIFORM ~~LIVE~~ LOAD (psf)	CONCENTRATED LOAD (lbs)
Uninhabitable attics without storage[b]	10	-
Uninhabitable attics with limited storage[b, g]	20	-
Habitable attics and attics served with fixed stairs	30	-
Balconies (exterior) and decks[e]	40	-
Fire escapes	40	-
Guards and handrails[d]	~~200~~	200[h]
Guard in-fill components[f]	~~50~~	50[h]
Passenger vehicle garages[a]	50[a]	2,000[a]
Rooms other than sleeping rooms	40	-
Sleeping rooms	30	-
Stairs	40[c]	300[c]

For SI: 1 pound per square foot = 0.0479 kPa, 1 square inch = 645 mm^2, 1 pound = 4.45 N.

a. Elevated garage floors shall be capable of supporting the uniformly distributed live load or a 2,000-pound ~~load applied over a 20-square-inch area.~~ concentrated load applied on an area of 4 1/2 inches by 4 1/2 inches, whichever produces the greater stresses.

b. Uninhabitable attics without storage are those where the clear height between joists and rafters is not more than 42 inches, or where there are not two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses. This live load need not be assumed to act concurrently with any other live load requirements.

c. Individual stair treads shall be ~~designed for~~ capable of supporting the uniformly distributed live load or a 300-pound concentrated load ~~acting over~~ applied on an area of ~~4 square~~ 2 inches by 2 inches, whichever produces the greater stresses.

d. A single concentrated load applied in any direction at any point along the top.

e. See Section R507.1 for decks attached to exterior walls.

f. Guard in-fill components (all those except the handrail), balusters and panel fillers shall be designed to withstand a horizontally applied normal load of 50 pounds on an area equal to 1 square foot. This load need not be assumed to act concurrently with any other live load requirement.

g. Uninhabitable attics with limited storage are those where the clear height between joists and rafters is 42 inches or greater, or where there are two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses.

The live load need only be applied to those portions of the joists or truss bottom chords where all of the following conditions are met:

1. The attic area is accessed from an opening not less than 20 inches in width by 30 inches in length that is located where the clear height in the attic is not less than 30 inches.
2. The slopes of the joists or truss bottom chords are not greater than 2 inches vertical to 12 units horizontal.
3. Required insulation depth is less than the joist or truss bottom chord member depth.

The remaining portions of the joists or truss bottom chords shall be designed for a uniformly distributed concurrent live load of not less than 10 pounds per square foot.

h. Glazing used in handrail assemblies and guards shall be designed with a ~~safety~~ load adjustment factor of 4. The ~~safety~~ load adjustment factor shall be applied to each of the concentrated loads applied to the top of the rail, and to the load on the in-fill components. These loads shall be determined independent of one another, and loads are assumed not to occur with any other live load.

Reason: As currently presented, the title of Table R301.5 states that loads shown are uniformly distributed and are listed in pounds per square foot. This is incorrect as the guardrail and handrail loads shown are intended as concentrated loads. By splitting the loads into two columns, the Live Load table will more accurately represent the necessary information. It will also allow for loads only previously noted in the footnotes to be incorporated into the body of the table. These changes will make the IRC Live Load table more closely match the format and values of the ASCE7 and IBC Live Load tables.
The language added to the footnote regarding garage slab design is intended to reiterate that both the uniform load condition as well as the concentrated load condition must be evaluated to determine the most severe case. This footnote will now more closely match that of the similar note indicated for determining the proper design load conditions for stair treads.

The has been much confusion regarding the use of of the words 'safety factor' when dealing with glazing used as handrails, guards, and infill components. 'Safety factors' and the use of them can be confusing as to whether you are using them from the load side or from the material strength side of the design. By changing the word 'safety' to 'load adjustment', it should be more apparent that the intent is to multiply the minimum design load found in the table by the factor indicated.

Cost Impact: The modified language is only intended to clarify existing requirements.

Proposal # 4600

RB48-19

S105-19

IBC®: 1705.11.1, 1705.11.2, 1705.12.2, 1705.12.3

Proponent: Ed Kulik, representing ICC Building Code Action Committee (bcac@iccsafe.org)

2018 International Building Code

Revise as follows:

1705.11.1 Structural wood. *Continuous special inspection* is required during field gluing operations of elements of the main windforce-resisting system. *Periodic special inspection* is required for nailing, bolting, anchoring and other fastening of elements of the main windforce-resisting system, including wood shear walls, wood diaphragms, drag struts, braces and hold-downs.

> **Exception:** *Special inspections* are not required for wood shear walls, shear panels and diaphragms, including nailing, bolting, anchoring and other fastening to other elements of the main windforce-resisting system, where the lateral resistance is provided by structural sheathing and the specified fastener spacing at panel edges is more than 4 inches (102 mm) on center.

1705.11.2 Cold-formed steel light-frame construction. *Periodic special inspection* is required for welding operations of elements of the main windforce-resisting system. *Periodic special inspection* is required for screw attachment, bolting, anchoring and other fastening of elements of the main windforce-resisting system, including shear walls, braces, diaphragms, collectors (drag struts) and hold-downs.

> **Exception:** *Special inspections* are not required for cold-formed steel light-frame shear walls and diaphragms, including screwing, bolting, anchoring and other fastening to components of the windforce resisting system, where either of the following applies:
>
> 1. The sheathing is gypsum board or fiberboard.
> 2. The sheathing is wood structural panel or steel sheets on only one side of the shear wall, shear panel or diaphragm assembly and the specified fastener spacing of at the ~~sheathing~~ panel or sheet edges is more than 4 inches (102 mm) on center (o.c.).

1705.12.2 Structural wood. For the *seismic force-resisting systems* of structures assigned to *Seismic Design Category* C, D, E or F:

1. *Continuous special inspection* shall be required during field gluing operations of elements of the seismic force-resisting system.
2. *Periodic special inspection* shall be required for nailing, bolting, anchoring and other fastening of elements of the seismic force-resisting system, including wood shear walls, wood diaphragms, drag struts, braces, shear panels and hold-downs.

> **Exception:** *Special inspections* are not required for wood shear walls, shear panels and diaphragms, including nailing, bolting, anchoring and other fastening to other elements of the seismic force-resisting system, where the lateral resistance is provided by structural sheathing, and the fastener spacing ~~of~~ at the ~~sheathing is~~ panel edges is more than 4 inches (102 mm) on center.

1705.12.3 Cold-formed steel light-frame construction. For the *seismic force-resisting systems* of structures assigned to *Seismic Design Category* C, D, E or F, periodic special inspection shall be required for both:

1. Welding operations of elements of the seismic force-resisting system.
2. Screw attachment, bolting, anchoring and other fastening of elements of the seismic force-resisting system, including shear walls, braces, diaphragms, collectors (drag struts) and hold-downs.

> **Exception:** *Special inspections* are not required for cold-formed steel light-frame shear walls and diaphragms, including screw installation, bolting, anchoring and other fastening to components of the seismic force-resisting system, where either of the following applies:
>
> 1. The sheathing is gypsum board or fiberboard.
> 2. The sheathing is wood structural panel or steel sheets on only one side of the shear wall, shear panel or diaphragm assembly and the specified fastener spacing ~~of the sheathing~~ at the panel or sheet edge is more than 4 inches (102 mm) on center.

Reason: The primary purpose of this proposal is to clarify the intent of the exceptions from special inspection of wood diaphragms and shear walls in high-seismic and high wind areas. The original exception was intended to apply to buildings of light-frame construction where wood studs or joists are sheathed with a variety of structural sheathing materials (e.g. oriented-strand board, plywood, or gypsum board) to form the diaphragm, and where the capacity of shear walls, panels, and diaphragms for resisting wind and seismic loads is defined in the American Wood Council's Special Design Provisions for Wind and Seismic (AWC SDPWS). The exceptions should apply to shear walls, shear panels and diaphragms constructed with traditional 2x dimensional lumber or equivalent products (e.g. I-joists or LVL's) andstructural sheathing, or nail-laminated or dowel laminated diaphragms with sheathing, but not to lateral force-resisting systems relying solely on mass timber products for lateral resistance.
In evaluating special inspection requirements for mass timber buildings, the ICC Ad-Hoc Committee on Tall Wood Buildings did not feel the exception should apply unless a mass timber building relied on a separate layer of wood structural panel sheathing or other sheathing to provide lateral load resistance. However, since this issue is not specific to tall mass timber buildings, the TWB determined that proposing changes to the exception was out of its scope, and referred the issue to the BCAC for review and modification as needed.

Similar exceptions to those for special inspection of wood diaphragms and wood shear walls on wood buildings are provided for wood structural panel or steel sheet diaphragms on cold-formed steel buildings. The same clarifications that the fastener spacing is the specified fastener spacing based on the structural engineer's design and tabulated diaphragm and shear wall capacities in the material design standards and that the fastening in question is that at panel edges (or sheet edges for diaphragms and shear walls sheathed with steel sheet) are made for the corresponding wind and seismic special inspections for cold-formed steel buildings.

This proposal is submitted by the ICC Building Code Action Committee (BCAC). BCAC was established by the ICC Board of Directors in July 2011 to pursue opportunities to improve and enhance assigned International Codes or portions thereof. Since 2017 the BCAC has held 6 open meetings. In addition, there were numerous Working Group meetings and conference calls for the current code development cycle, which included members of the committee as well as any interested party to discuss and debate the proposed changes. Related documentation and reports are posted on theBCAC website at: https://www.iccsafe.org/codes-tech-support/codes/code-development-process/building-code-action-committee-bcac/.

Cost Impact: The code change does not change the application of the two exceptions to diaphragms and shear walls using sheathing materials currently permitted by the code via the reference to the AWC SDPWS. Thus, there is no cost increase for light-frame buildings that currently qualify for the exception. Mass timber buildings not already permitted under existing limits on Type IV construction must go through an alternate means and methods process to gain approval. The work of the AHC-TWB to gain code recognition for tall wood buildings will reduce the cost of construction for such buildings as they will not require special approval procedures. The corresponding clarifications for cold-formed steel buildings do not change the intended application of those exceptions.

Proposal # 4126

S105-19

S104-19

IBC®: 1705.11

Proponent: Don Scott, representing Representing National Council of Structural Engieers Association (dscott@pcs-structural.com)

2018 International Building Code

Revise as follows:

1705.11 Special inspections for wind resistance. *Special inspections* for wind resistance specified in Sections 1705.11.1 through 1705.11.3, unless exempted by the exceptions to Section 1704.2, are required for buildings and structures constructed in the following areas:

1.In wind Exposure Category B, where V ~~asd~~ ~~as determined in accordance with Section 1609.3.1 is 120~~ is 150 miles per hour (~~52.8~~ 67 m/sec) or greater.
2.In wind Exposure Category C or D, where V ~~asd~~ ~~as determined in accordance with Section 1609.3.1 is 110~~ is 140 mph (~~49~~ 62.6 m/sec) or greater.

Reason: This is an editorial change to reference the wind speed triggers to the Chapter 16 mapped basic design wind speed, V for consistency with other section of this chapter. Currently the user would be required to convert the mapped basic design wind speed to Vasd. Thus the change in wind speed indicated is a conversion from the previous Vasd values to V.

Cost Impact: This is an editorial change to reference the wind speed triggers to the Chapter 16 mapped basic design wind speed, V for consistency with other section of this chapter. Currently the user would be required to convert the mapped basic design wind speed to Vasd. Thus the change in wind speed indicated is a conversion from the previous Vasd values to V.

Proposal # 4756

S106-19

IBC®: 1705.11.1, 1705.12.2

Proponent: Stephen Skalko, self, representing self (svskalko@svskalko-pe.com)

2018 International Building Code

Revise as follows:

1705.11.1 Structural wood. *Continuous special inspection* is required during field gluing operations of elements of the main windforce-resisting system. *Periodic special inspection* is required for nailing, bolting, anchoring and other fastening of elements of the main windforce-resisting system, including wood shear walls, wood diaphragms, drag struts, braces and hold-downs.

> **Exception:** *Special inspections* are not required for light-frame wood shear walls, shear panels and diaphragms, including nailing, bolting, anchoring and other fastening to other elements of the main windforce-resisting system, where the specified fastener spacing at panel edges is more than 4 inches (102 mm) on center.

1705.12.2 Structural wood. For the *seismic force-resisting systems* of structures assigned to *Seismic Design Category* C, D, E or F:

1. *Continuous special inspection* shall be required during field gluing operations of elements of the seismic force-resisting system.
2. *Periodic special inspection* shall be required for nailing, bolting, anchoring and other fastening of elements of the seismic force-resisting system, including wood shear walls, wood diaphragms, drag struts, braces, shear panels and hold-downs.

> **Exception:** *Special inspections* are not required for light-frame wood shear walls, shear panels and diaphragms, including nailing, bolting, anchoring and other fastening to other elements of the seismic force-resisting system, where the fastener spacing of the sheathing is more than 4 inches (102 mm) on center.

Reason: The term "light-frame" is added to the exceptions in Sections 1705.11.1 and 1705.12.2 to make clear the special inspection exemption only applies to light wood frame assemblies and not assemblies of mass timber such as CLT panels that may be serving as shear walls, shear panels or diaphragms.

Cost Impact: The code change is a clarification of the code and should not have an impact on construction costs.

Proposal # 5654

S12-19

IBC: 1503.3, 1503.3.1 (New), 1503.3.2 (New)

Proponent: Ed Kulik, representing ICC Building Code Action Committee (bcac@iccsafe.org)

2018 International Building Code

Revise as follows:

1503.3 ~~Coping.~~ Parapet walls. Parapet walls shall be ~~properly coped with noncombustible, weatherproof materials of a width not less than the thickness of the parapet wall.~~ coped or covered in accordance with Sections 1503.3.1 and 1503.3.2. The top surface of the parapet wall shall provide positive drainage..

Add new text as follows:

1503.3.1 Fire-resistance-rated parapet walls. Parapet walls required by section 705.11 shall be coped or covered with non-combustible, weatherproof materials of a width not less than the thickness of the parapet wall.

Revise as follows:

1503.3.2 Other parapet walls. Parapet walls meeting one of the exceptions in Section 705.11 shall be coped or covered with weatherproof materials of a width not less than the thickness of the parapet wall.

Reason: The current language in this section is in dire need of an update, as it does not address current technologies or practices. This language is a carry over from the legacy code and was meant to apply to the coping of masonry parapet walls. The use of the word coping is also confusing, as it is often used interchangeably with the word covered. Depending on the type of roofing system that is being used, traditional metal or masonry copings are not always used to cap or cover a parapet wall.
This proposal provides the much needed clarity as to when and how parapet walls are to be properly coped or covered. The requirement has been broken out into 2 subsections for the two different parapet wall types. 1503.3.1 is for parapet walls that are required to comply with 705.11 must be coped or covered with weatherproof and noncombustible materials.

1503.3.2 is for parapet walls that do not have to comply with 705.11, are required to be coped or covered with weatherproof materials.

This revision will provide additional options for maintaining a continuous air barrier. For example, the roof membrane could be used to wrap the top of the parapet wall and extend down the exterior side of the wall. The membrane could then be tied into the wall air barrier system. See also Figures 1 through 4.

This proposal is submitted by the ICC Building Code Action Committee (BCAC). BCAC was established by the ICC Board of Directors in July 2011 to pursue opportunities to improve and enhance assigned International Codes or portions thereof. Since 2017 the BCAC has held 6 open meetings. In addition, there were numerous Working Group meetings and conference calls for the current code development cycle, which included members of the committee as well as any interested party to discuss and debate the proposed changes. Related documentation and reports are posted on theBCAC website at: https://www.iccsafe.org/codes-tech-support/codes/code-development-process/building-code-action-committee-bcac/.

Cost Impact: No additional materials or detailing will be required based on this code change proposal; therefore it will not increase the cost of construction.

Proposal # 4127

S13-19

IBC: 1503.3, 1503.3.1 (New), 1503.3.2 (New)

Proponent: Amanda Hickman, The Hickman Group, representing The Single-Ply Roofing Industry (SPRI) (amanda@thehickmangroup.com)

2018 International Building Code

Revise as follows:

1503.3 ~~Coping.~~ Parapet Walls. Parapet walls shall be ~~properly~~coped ~~with noncombustible, weatherproof materials of a width not less than the thickness of the parapet wall.~~ or covered in accordance with Sections 1503.3.1 and 1503.3.2. The top surface of the parapet wall shall provide positive drainage.

Add new text as follows:

1503.3.1 Fire-resistance-rated parapet walls. Parapet walls required by section 705.11 shall be coped or covered with non-combustible, weatherproof materials of a width not less than the thickness of the parapet wall.

1503.3.2 Other parapet walls. Parapet walls meeting one of the exceptions in Section 705.11 shall be coped or covered with weatherproof materials of a width not less than the thickness of the parapet wall.

Reason: This proposal clarifies how to properly cope or cover the two different types of parapet wall types (those that must comply with Section 705.11 and those that do not).
The current language does not address current technologies or practices. This language is a carry over from the legacy code and was meant to apply to the coping of masonry parapet walls. The use of the word coping is also confusing, as it is often used interchangeably with the word covered. Depending on the type of roofing system that is being used, traditional metal or masonry copings are not always used to cap or cover a parapet wall.

This revision will provide additional options for maintaining a continuous air barrier. For example, the roof membrane could be used to wrap the top of the parapet wall and extend down the exterior side of the wall. The membrane could then be tied into the wall air barrier system.

Examples of covered parapets as required by 1503.3.2.

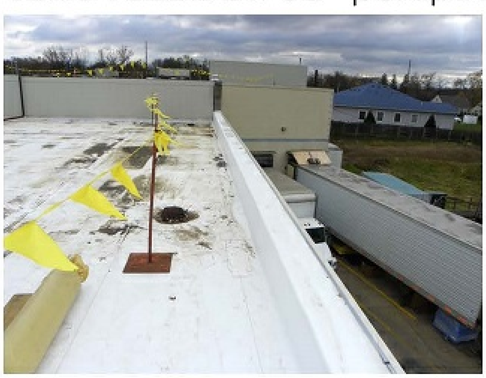
Examples of coped parapets as required by 1503.3.1.

Fascia on 6” wide by 4” high “Parapet”

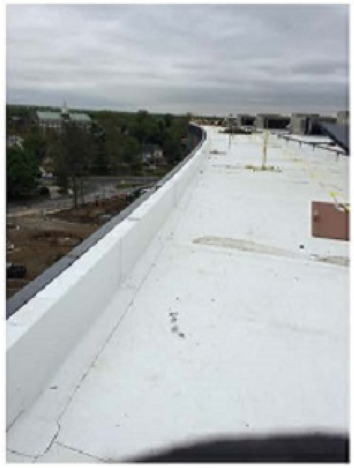
Note 4” high x 6” wide “parapet”

Adelman Travel - Fascia on radius “parapet” @ 6” high x 6” wide

Hyvee Iowa Fascia on 18” parapet condition



Rowan project – Fascia on 24” parapet



Cost Impact: The code change proposal will decrease the cost of construction. This proposal clarifies the difference between parapet wall types and how they should be covered or coped. Where metal coping is not required this proposal would lead to a decrease in the cost of construction by reducing material and labor. This could result in a cost reduction as much as $5-10 per foot.

Proposal # 4542

S16-19

IBC®: 1504.5

Proponent: Ed Kulik, representing ICC Building Code Action Committee (bcac@iccsafe.org); Amanda Hickman, representing The Single-Ply Roofing Industry (SPRI) (amanda@thehickmangroup.com)

2018 International Building Code

Revise as follows:

1504.5 Edge ~~securement~~ <u>systems</u> for low-slope roofs. ~~Low-slope~~ <u>Metal edge systems, except gutters, installed on</u> built-up, modified bitumen and single-ply roof ~~system metal edge securement, except gutters,~~ <u>systems having a slope less than 2:12,</u> shall be designed and installed for wind loads in accordance with Chapter 16 and tested for resistance in accordance with Test Methods RE-1, RE-2 and RE-3 of ANSI/SPRI ES-1, except basic design wind speed, V, shall be determined from Figures 1609.3(1) through 1609.3(8) as applicable.

Reason: KULIK: This proposal is intended to clarify that regardless if the roof membrane is either independently or dependently terminated, the edge metal system needs to be properly tested to the appropriate standard. Metal edge systems prevent water infiltration, and in many cases to also secure the roof membrane. Loss of the edge system or components of the edge system during a high wind event could allow for water infiltration even if the roof membrane remains secure. Furthermore, any component of the edge system that becomes disengaged during a high wind event will become a projectile that can damage the roof membrane and other building components (windows, doors, walls, etc.), and possibly injure people. Therefore, metal edge systems should be tested per ES-1 whether they secure the membrane or not.
This proposal is submitted by the ICC Building Code Action Committee (BCAC). BCAC was established by the ICC Board of Directors in July 2011 to pursue opportunities to improve and enhance assigned International Codes or portions thereof. Since 2017 the BCAC has held 6 open meetings. In addition, there were numerous Working Group meetings and conference calls for the current code development cycle, which included members of the committee as well as any interested party to discuss and debate the proposed changes. Related documentation and reports are posted on theBCAC website at: https://www.iccsafe.org/codes-tech-support/codes/code-development-process/building-code-action-committee-bcac/.

HICKMAN: This proposal clarifies that the edge metal systems need to be properly tested to the appropriate standard regardless if the roof membrane is either independently or dependently terminated.

Metal edge systems prevent water infiltration, and in many cases to also secure the roof membrane. Loss of the edge system or components of the edge system during a high wind event could allow for water infiltration even if the roof membrane remains secure.

Furthermore, any component of the edge system that becomes disengaged during a high wind event will become a projectile that can damage the roof membrane and other building components (windows, doors, walls, etc.), and possibly injure people. Therefore, metal edge systems should be tested per ES-1 whether they secure the membrane or not.

Cost Impact: KULIK: This proposal just clarifies that this test applies to edge metal regardless of installation method.
HICKMAN: The code change proposal will not increase or decrease the cost of construction. This proposal only clarifies that this test applies to edge metal regardless of installation method.

Proposal # 4128

S17-19

IBC: 1504.5.1 (New), SPRI Chapter 35 (New)

Proponent: Ed Kulik, representing ICC Building Code Action Committee (bcac@iccsafe.org); Amanda Hickman, representing The Single-Ply Roofing Industry (SPRI) (amanda@thehickmangroup.com)

2018 International Building Code

Add new text as follows:

1504.5.1 Gutter securement for low-slope roofs. External gutters that are used to secure the edge of the roof membrane on low-slope (less than 2:12 slope) built-up, modified bitumen, and single ply roofs, shall be designed, constructed and installed to resist wind loads in accordance with Section 1609 and shall be tested in accordance with Test Methods G-1 and G-2 of SPRI GT-1.

SPRI

Single-Ply Roofing Institute
465 Waverly Oaks Road, Suite 421
Waltham MA 02452

GT-1-2016: Test Standard for Gutter Systems

Reason: KULIK: Studies of the aftermath of high-wind events revealed that many gutter systems did not resist the loads that occur during these high-wind events. Examples of these observations are shown below. SPRI developed the gutter test standard to address this issue. The wind resistance tests included in this standard measure the resistance of the gutter system to wind forces acting outwardly (away from the building) and to wind forces acting upwardly tending to lift the gutter off of the building. The standard also measures the resistance of the gutter system to static forces of water, snow and ice acting downward. The six figures at the end of this reason statement are examples of gutter failures during high wind events observed during investigations conducted by the Roofing Industry Committee on Weather Issues (RICOWI).
This proposal is submitted by the ICC Building Code Action Committee (BCAC). BCAC was established by the ICC Board of Directors in July 2011 to pursue opportunities to improve and enhance assigned International Codes or portions thereof. Since 2017 the BCAC has held 6 open meetings. In addition, there were numerous Working Group meetings and conference calls for the current code development cycle, which included members of the committee as well as any interested party to discuss and debate the proposed changes. Related documentation and reports are posted on theBCAC website at: https://www.iccsafe.org/codes-tech-support/codes/code-development-process/building-code-action-committee-bcac/.


HICKMAN: This proposal requires that gutters that are used as part of the edge securement of single-ply roof membranes be tested to the appropriate standard for acceptable wind resistance performance.

Studies of the aftermath of high-wind events revealed that many gutter systems did not resist the loads that occur during these high-wind events. When gutters are used to secure the roof membrane, a gutter failure can become a much bigger problem as it can cause a roof failure. Examples of these observations are shown below.

SPRI developed the gutter test standard to address this issue. The wind resistance tests included in this standard measure the resistance of the gutter system to wind forces acting outwardly (away from the building) and to wind forces acting upwardly tending to lift the gutter off of the building. Following are examples of gutter failures during high wind events observed during investigations conducted by the Roofing Industry Committee on Weather Issues (RICOWI).

2.11-2. Membrane peeled away from the insulation and detached from the roof in most

2.11-10. Photo of gutter/cleat attachment is a good example of damage progression.

3-08-1. Small retail building. Close up of windblown, deflected gutter.

3-08-2. Small retail building. Roof view of lifted gutter and metal edge. Note roof membrane has not peeled back.

3-09-2. Large retail building. Gutter metal blew across the roof, puncturing the roof membrane and breaking skylights.

3-09-3. Large retail building. Broken skylights became wind-borne debris, puncturing roof membrane—SE view.

Cost Impact: KULIK: Even though there would be some increased cost to the manufacturer due to the testing of the gutter, it would be negligible, estimated around $0.058 /LF. This would be a one-time cost amortized over production time of the gutter. The nominal cost would most likely not increase the cost of construction. Not every gutter is required to be tested (depends on profile and attachment type). Once the gutter is tested, it is good forever so the cost of the test is spread out over time and over all the feet of gutter produced.
HICKMAN: The code change proposal will not increase or decrease the cost of construction. This would be a one-time cost amortized over production time of the gutter. Once the gutter is tested, it is good forever so the cost of the test is spread out over time and over all the feet of gutter produced. Even though there would be some increased cost to the manufacturer due to the testing of the gutter, it would be negligible, less than $0.05 /LF. Not every gutter is required to be tested (depends on profile and attachment type).

Staff Analysis: A review of the standard proposed for inclusion in the code, SPRIGT-1-2016 , with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 2, 2019.

Proposal # 4129

S15-19

IBC®: 1504.4, 1504.8

Proponent: Amanda Hickman, The Hickman Group, representing The Single-Ply Roofing Industry (SPRI) (amanda@thehickmangroup.com); Jay Crandell, P.E., ARES Consulting, representing self (jcrandell@aresconsulting.biz)

2018 International Building Code

Revise as follows:

1504.4 Ballasted low-slope single-ply roof systems. Ballasted low-slope (roof slope < 2:12) single-ply roof system coverings installed in accordance with Sections 1507.12 and 1507.13 shall be designed in accordance with ~~Section 1504.8 and~~ANSI/SPRI RP-4.

1504.8 Surfacing and ballast materials in hurricane-prone regions. For a building located in a hurricane-prone region as defined in Section 202, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the site, the following materials shall not be used on the roof:

1. Aggregate used as surfacing for roof coverings.
2. Aggregate, gravel or stone used as ballast.

Exception: Ballasted single-ply roof systems complying with Section 1504.4

Reason: This proposal makes a much-needed correction to section 1504.4 for ballasted roof systems for low-slope single-ply roofs. This proposal revises Section 1504.4 so that ballasted roofs comply with ANSI/SPRI RP-4 and not 1504.8. The requirements in RP-4 were developed for the appropriate application, installation and to prevent ballast scour for this specific type of single-ply ballasted system. The scour wind speed is below that at which blowoff would occur. It also provides design options for various conditions.
Section 1504.8 is based on the wind speeds for blow-off and only deals with smaller aggregate used for surfacing of built up roofs (BUR) and sprayed polyurethane foam (SPUF) roofs, which are completely different systems than ballasted roofs. For this reason an exception has been added in Section 1504.8 for ballasted single-ply roof systems complying with Section 1504.4.

The requirements in ANSI/SPRI RP-4 are based on a complete set of wind tunnel tests conducted in the largest commercially available wind tunnel in North America located at the National Research Council Canada. In this test series all variables that would impact the wind performance of ballasted single ply roof assemblies were evaluated, including stone size and size distribution as specified in ASTM D7655 Standard Classification for Size of stone used as ballast for membrane roof systems.

In this series of tests three critical windspeeds were identified for each condition of parapet height and stone size, windspeed 1 is the speed at which the stone distribution first begins to move, windspeed 2 is the speed is that which if maintained would result in stone scouring, and windspeed three is the speed at which stone blow-off occurs. The requirements in the Design Table of ANSI/SPRI RP-4 are based on windspeed 2, or the windspeed at which stone scour would occur.

The requirements of this standard have been updated based on field performance and in the most recent edition the design tables have been revised to reflect current methodology for interpreting wind tunnel data. Section 1504.8 does not consider the critical variables of parapet height and stone size and should not be applicable to ballasted single ply roof systems.

Cost Impact: This proposal only clarifies what design requirements are to be used for ballasted single-ply roof systems.

Proposal # 4545

S18-19

IBC®: 1504.7

Proponent: Mike Fischer, representing The Asphalt Roofing Manufacturers Association (mfischer@kellencompany.com)

2018 International Building Code

Revise as follows:

1504.7 Impact resistance. Roof coverings installed on low-slope roofs (roof slope < 2:12) in accordance with Section 1507 shall resist impact damage based on the results of tests conducted in accordance with ASTM D3746, ASTM D4272 or the "Resistance to Foot Traffic Test" in ~~Section 5.5 of~~FM 4470.

Reason: The proposal removes the section reference to avoid correlation issues should the referenced standard section numbering be revised in the future. The correct refernce is section 4.6 of FM 4470 which has been corrected from section 5.5 per the errata for IBC 2018.

Cost Impact: The proposal is editorial.

Proposal # 5681

S19-19

IBC: 1504.8, 1607.13.6 (New)

Proponent: Edwin Huston, representing National Council of Structural Engineers' Associations (NCSEA (huston@smithhustoninc.com)

2018 International Building Code

Revise as follows:

1504.8 Surfacing and ballast materials in hurricane-prone regions. For a building located in a hurricane-prone region as defined in Section 202, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the site, the following materials shall not be used on the roof:

1. Aggregate used as surfacing for roof coverings.
2. Aggregate, gravel or stone used as ballast.

Exception: A roof that complies with all of the following:

1. A parapet is placed on all exterior sides of the roof.
2. The parapet is tall enough to retain the volume of roofing material, regardless of wind direction.
3. The roof and parapet are designed for the additional live load of the retained aggregate at the edge of the roof.

Add new text as follows:

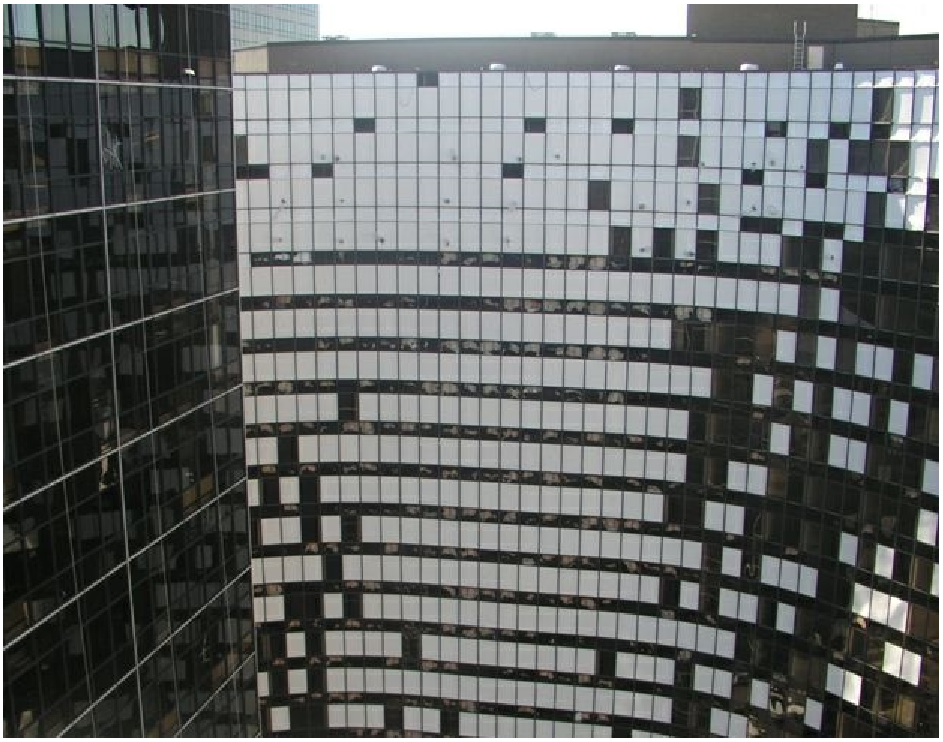
1607.13.6 Surfacing and ballast materials. For a building located in a hurricane-prone region, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the site, where aggregate is used as surfacing for roof coverings or aggregate, gravel or stone is used as ballast and a parapet is placed on all exterior sides of the roof to retain the volume of roofing material, the roof and parapet shall be designed for the additional live load of the retained aggregate, regardless of wind direction.

Reason: In the 2018 code change cycle, S20-16 proposed the replacement of Table 1504.8 with a table that would allow aggregate roofing systems to be used on roofs in various wind speed and wind exposure conditions if the building being designed had a parapet whose minimum height equaled or exceeded the parapet height noted in the revised table.
The reason statement for the 2018 code change S20-16 implies that this proposal was based on "the K-W design method (Kind Wardlaw 1976), the wind tunnel studies underlying the KW design method (Kind 1977), or a quantitative analysis of observed good and bad roofing system performances in real wind events".

NCSEA opposed S20-16. The proposal was revised by a public comment from the proponents, which was unsuccessful. However, members of the Structural Committee appeared to be in favor of using parapets to retain roofing aggregate.

Aggregate blow-off from roofs was reported in Houston, TX during Hurricane Alicia in 1982, in Miami-Dade County, FL during Hurricane Andrew, in New Orleans, LA during Hurricane Katrina, and in other cities during these and other events. After Hurricane Katrina, the NCSEA Code Advisory Committee witnessed the damage to the glazing systems of The New Orleans Shopping Center Office Building and The Amoco Building both of which were on Poydrus Street in New Orleans, LA. The glazing systems of these buildings were damaged by aggregate blown off buildings on the north side of Poydrus Street. We also witnessed the damage to the glazing system of the Hyatt Regency Hotel from the vantage point of the roof of the Amoco Building. The Amoco Building previously had an aggregate ballasted roof. Most of the aggregate had been blown off of the roof. Much of the aggregate that remained on the roof was ramped up against the parapet on the south side of the building. Once the aggregate ramp height equaled the parapet height, the remaining aggregate was swept up the ramp and off the roof. Directly south of the Amoco Building, windows of the Hyatt Regency Hotel had been broken (see Figure 1), and aggregate was retrieved from the bedrooms of the hotel.

Figure 1 - Glazing failures in Hyatt Regency Hotel, New Orleans, LA following Hurricane Katrina.



Source NCSEA Code Advisory Committee

Wind speeds in New Orleans, LA during Hurricane Katrina were reported as being less than the design wind speeds from ASCE7.

In the 2006 Public Comment Hearing John Loscheider testified that the national roofing Contractors Association's magazine reported aggregate roofing blow-off damage to other buildings in New Orleans after Hurricane Katrina.

The presence of aggregate ramps and aggregate blow-off has been reported previously. For example, aggregate ramps were observed against the six-foot tall parapets of the National Hurricane Center in Miami after Hurricane Andrew. We understand that aggregate blow-off from this roof was also reported.

This code change proposal would allow buildings, whose height exceeds the limitations of Table 1504.8, to be constructed using an aggregate surfaced or aggregate ballasted roof, if the building had a parapet that was of sufficient height that it could retain the volume of aggregate.

We note that there are other alternates to aggregate used as surfacing for roof coverings or for aggregate, gravel or stone used as ballast. They are probably more expensive, but we believe that they are almost certainly less expensive than the window replacement costs due to aggregate blow-off.

If the aggregate is transported to the edge of the roof, there may be the need for additional gravity load capacity. This requirement is dealt with by adding section 1607.13.6.

Bibliography: Crandell, J. H. and Smith, T.L. (2010) Design Method Improvements to Prevent Roof Aggregate Blow-Off, Hugo Conference International Building Code. Falls Church, VA

Kind, R.J. and Wardlaw R.L. (1976). Design of Rooftops Against Gravel Blow-Off. National Aeronautical Establishment, National Research Council, Canada. Kind, R.J. (1977). Further Wind Tunnel Tests on Building Models to Measure Wind Speeds at Which Gravel is Blown Off Rooftops. LTR-LA-189. National Aeronautical Establishment, National Research Council, Canada.

National Institute of Standards and Technology, Technical Note 1476 (2006) Performance of Physical Structures in Hurricane Katrina and Hurricane Rita: A Reconnaissance Report

Federal Emergency Management Agency FIA-22 (1993, Building Performance: Hurricane Andrew in Florida

Federal Emergency Management Agency FEMA 548 (2006), Summary Report on Building Performance Hurricane Katrina 2005

Cost Impact: Increasing parapet height may increase the cost of construction if the parapet retention system is used, but it is not mandated, it is listed as an alternate. Another roofing alternative may be less expensive.

S20-19

IBC®: 1504.8

Proponent: Jay Crandell, P.E., ARES Consulting, representing self (jcrandell@aresconsulting.biz); Ellen Thorp, EPDM Roofing Association; Mike Fischer, representing The Asphalt Roofing Manufacturers Association (mfischer@kellencompany.com)

2018 International Building Code

Revise as follows:

1504.8 Surfacing and ballast materials in hurricane-prone regions. For a building located in a hurricane-prone region as defined in Section 202, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the site, the following materials shall not be used on the roof:

1. Aggregate used as surfacing for roof coverings.
2. Aggregate, gravel or stone used as ballast.

Exception: Where the aggregate surfaced roof system and parapets shall be designed by a *registered design professional* to control aggregate blow-off.

Reason: There are proven and accepted design methods to control aggregate blow-off from roofs which are superior to those in Table 1504.8. These include the prescribed provisions in the code-referenced ANSI/SPRI RP-4 standard and also the design methodology used to develop those provisions (Kind and Wardlaw, 1976). Newer methodologies based on Kind and Wardlaw (1976) are explained and verified as being effective based on comparison to numerous sources of field data (Crandell and Smith, 2009; Crandell and Fischer, 2010; Morrison, 2011).
Why is this important? The provisions of existing Table 1504.8 lack any requirement for use of parapets for building heights of up to 170-feet in height because the science and design approach behind the table is seriously flawed. Consequently, the requirements in Table 1504.8 are incomplete and potentially unsafe. For these reasons, alternative solutions by registered design professionals should be explicitly permitted. This proposal is also compatible with a separate proposal (by the same proponents) to fix the many problems with existing Table 1504.8 and Section 1504.8 as explained in the reason statement to that proposal.

Bibliography: Crandell, J. H. and Smith, T.L.. (2010) Design Method Improvements to Prevent Roof Aggregate Blow -Off, Hurricane Hugo 20th Anniversary Symposium on Building Safer Communities – Improving Disaster Resistance, ATC-77, North Charleston, SC, October 22-23, 2009
Kind, R.J. and Wardlaw R.L. (1976). Design of Rooftops Against Gravel Blow -Off. National Aeronautical Establishment, National Research Council, Canada.

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Morrison, R.V. (2011). Field Investigation of Aggregate Blow-off of Spray Polyurethane Foam Roofs, *RCI Interface*, Technical Journal of RCI, Inc. (presented at RICOWI Fall Symposium, November 11, 2010)

Cost Impact: The proposed exception provides an alternative to Table 1504.8 and does not replace or change it.

Proposal # 5001

S21-19

IBC®: 1504.8, TABLE 1504.8

Proponent: Jay Crandell, P.E., ARES Consulting, representing self; Mike Fischer, representing The Asphalt Roofing Manufacturers Association (mfischer@kellencompany.com); Ellen Thorp, EPDM Roofing Association

2018 International Building Code

Delete and substitute as follows:

~~**1504.8 Surfacing and ballast materials in hurricane-prone regions.** For a building located in a hurricane-prone region as defined in Section 202, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the site, the following materials shall not be used on the roof:~~

1. ~~Aggregate used as surfacing for roof coverings.~~
2. ~~Aggregate, gravel or stone used as ballast.~~

1504.8 Wind resistance of aggregate-surfaced roofs. Aggregate surfaced roofs shall comply with Table 1504.8.

~~**TABLE 1504.8**~~
~~**MAXIMUM ALLOWABLE MEAN ROOF HEIGHT PERMITTED FOR BUILDINGS WITH AGGREGATE ON THE ROOF IN AREAS OUTSIDE A HURRICANE-PRONE REGION**~~

~~NOMINAL DESIGN WIND SPEED, V_{asd} (mph)[b, d]~~	~~MAXIMUM MEAN ROOF HEIGHT (ft)[a, c]~~		
	~~Exposure category~~		
	~~B~~	~~C~~	~~D~~
~~85~~	~~170~~	~~60~~	~~30~~
~~90~~	~~110~~	~~35~~	~~15~~
~~95~~	~~75~~	~~20~~	~~NP~~
~~100~~	~~55~~	~~15~~	~~NP~~
~~105~~	~~40~~	~~NP~~	~~NP~~
~~110~~	~~30~~	~~NP~~	~~NP~~
~~115~~	~~20~~	~~NP~~	~~NP~~
~~120~~	~~15~~	~~NP~~	~~NP~~
~~Greater than 120~~	~~NP~~	~~NP~~	~~NP~~

~~For SI:1 foot = 304.8 mm; 1 mile per hour = 0.447 m/s.~~

a. ~~Mean roof height as defined in ASCE 7.~~
b. ~~For intermediate values of V_{asd}, the height associated with the next higher value of V_{asd} shall be used, or direct interpolation is permitted.~~
c. ~~NP = gravel and stone not permitted for any roof height.~~
d. ~~V_{asd} shall be determined in accordance with Section 1609.3.1.~~

TABLE 1504.8
MINIMUM REQUIRED PARAPET HEIGHT (INCHES) FOR AGGREGATE SURFACED ROOFS[a,b,c]

AGGREGATE SIZE	MEAN ROOF HEIGHT (ft)	WIND EXPOSURE AND BASIC DESIGN WIND SPEED (MPH)																	
		Exposure B									Exposure C[d]								
		<=95	100	105	110	115	120	130	140	150	<=95	100	105	110	115	120	130	140	150
ASTM D1863 (No.7 or No.67) or ASTM D7655 (No.4)	15	2	2	2	2	12	12	16	20	24	2	13	15	18	20	23	27	32	37
	20	2	2	2	2	12	14	18	22	26	12	15	17	19	22	24	29	34	39
	30	2	2	2	13	15	17	21	25	30	14	17	19	22	24	27	32	37	42
	50	12	12	14	16	18	21	25	30	35	17	19	22	25	28	30	36	41	47
	100	14	16	19	21	24	27	32	37	42	21	24	26	29	32	35	41	47	53

	150	17	19	22	25	27	30	36	41	46	23	26	29	32	35	38	44	50	56
ASTM D1863 (No.6)	15	2	2	2	2	12	12	12	15	18	2	2	2	13	15	17	22	26	30
	20	2	2	2	2	12	12	13	17	21	2	2	12	15	17	19	23	28	32
	30	2	2	2	2	12	12	16	20	24	2	12	14	17	19	21	26	31	35
	50	12	12	12	12	14	16	20	24	28	12	15	17	19	22	24	29	34	39
	100	12	12	14	16	19	21	26	30	35	16	18	21	24	26	29	34	39	45
	150	12	14	17	19	22	24	29	34	39	18	21	23	26	29	32	37	43	48

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 mile per hour = 0.447 m/s.

a.Interpolation shall be permitted for mean roof height and parapet height.

b. Basic design wind speed, V, and wind exposure shall be determined in accordance with Section 1609.

c. Where the minimum required parapet height is indicated to be 2 inches (51 mm), a gravel stop shall be permitted and shall extend not less than 2 inches (51 mm) from the roof surface and not less than the height of the aggregate.

d. For Exposure D, add 8 inches (203 mm) to the parapet height required for Exposure C and the parapet height shall not be less than 12 inches (305 mm).

Reason: In summary, this proposal has the following features:
1. Updates Table 1504.8 to a “basic design wind speed” basis and eliminates use of ASD wind speed to be consistent with changes made throughout the IBC in previous cycle to correlate with newer wind maps based on “ultimate” wind speeds (now called basic design wind speed).

2. Provides an engineering and scientific basis for roof design to prevent aggregate blow-off based on over 200 wind tunnel tests coupled with subsequent field studies from several different hurricane events with documented conditions and performance. See Bibliography (Kind-Wardlaw, 1976; Kind, 1977; Crandell & Smith, 2009; Crandell & Fischer, 2010; etc.)

3. Corrects unsafe conditions that the current Table 1504.8 allows based on scientifically incorrect assumptions (e.g., allows 170’ tall buildings with aggregate surfaced roofs and NO PARAPET).

4. Accounts for aggregate size distribution in the referenced ASTM aggregate standards, including the minimum permitted aggregate size in the referenced mixes as addressed in the referenced wind tunnel studies for this proposal which replicated actual aggregate size distribution (Kind, 1977) as also confirmed in field studies (e.g., Crandell & Smith, 2009).

5. Has been independently confirmed by later field study subsequent to the original research with the purpose of verifying the accuracy and effectiveness of the design methodology based on actual performance of real buildings and real hurricane events (Morrison, 2011).

This proposal is consistent with S19-16 and a public comment (PC#2) that was submitted in response to the structural committee’s direction in 2016. The public comment was approved at public hearing only to be spuriously overturned during the on-line governmental vote. What follows, for the record, are the reason statements from the original S19-16 proposal and PC#2 (with modest editing to fit the context of this proposal):

A) From the original S19-16 proposal (excerpt slightly edited):

The current provisions in Section 1504.8, and specifically Table 1504.8, are not based on the Kind-Wardlaw (K-W) design method (Kind Wardlaw 1976), the wind tunnel studies underlying the K-W design method (Kind 1977), or a quantitative analysis of observed good and bad roofing system performances in real wind events. Instead, current building code requirements are based on variation in surface pressure with building height which is known to be an inappropriate predictor of aggregate blow -off or scour due to pressure equalization effects (Smith, 1997). Furthermore, these recent requirements do not address critical parameters such as aggregate size and parapet height which govern performance. This code change proposal replaces the current Table 1504.8 with one based on the K-W design method and new research by the Asphalt Roofing Manufacturers Association (ARMA) (Crandell and Fischer, 2010). Results demonstrate that the use of aggregate-surfaced roofing systems is a viable option in high wind areas with appropriate aggregate sizing and parapet design. The K-W design method has been simplified, improved, and calibrated to a number of field observations from actual hurricane events to refine its application to low-slope, built-up roof (BUR) and sprayed polyurethane foam (SPF) roof systems (Crandell Smith, 2009).

B) From PC2 on S19-16 (slightly edited):

In response to the structural committee’s comments and indication that “this proposal is headed in the right direction”, this public comment addresses the committee's recommendation to simplify and improve readability of the table (which was partly a font size or CDP access table formatting issue). These revisions are technically consistent with the original S19-16 proposal and the referenced research.

The 2016 committee also mentioned that questions were raised with regard to how the provisions were developed from the referenced research. The methodology (and design procedure) is clearly documented in the referenced research in an understandable, repeatable, and scientific manner (see original S19-16 proposal's reason statement (above) and bibliography (below) for referenced research reports and papers. The procedure used is consistent with the findings of many wind tunnel studies and uses the same principles as applied in the ANSI/SPRI RP-4 standard currently referenced in the code. It is also consistent with the treatment of aggregate blow-off as incorporated in wind risk models. Furthermore, the analytical procedure was evaluated by comparison to numerous documented field studies of successful and failed loose aggregate surfaced roofs systems in various high wind events to confirm its ability to reliably predict performance as a means to design roofs (or develop prescriptive provisions as proposed) to prevent roof aggregate blow-off. Thus, a robust combination of current engineering practice, wind tunnel data, and field research was used to support development of the requirements as proposed for Table 1504.8.

However, this proposal does not merely provide a more academic solution. It is necessary to correct deficiencies in the current code provisions. For example, the current Table 1504.8 allows buildings up to 170' tall or buildings in areas with design wind speeds up to 120 mph with NO PARAPET which creates a general safety hazard (e.g., falling debris from the roof) and unacceptable wind damage vulnerability (i.e., aggregate blow-off risk). This proposal corrects this safety and building performance issue based on correct scientific principles and sound engineering practices.

If implemented, this proposal will serve to prevent many past observations of roof aggregate blow-off from being repeated. Simply put, this proposal is implementing lessons learned in a rational, scientific manner based on real-world and wind tunnel laboratory data to prevent history from repeating itself in an unfavorable manner. Any argument against this proposal as being inadequate is an argument to leave the code in a far worse condition from a building safety and performance standpoint.

In closing, the following quote from Morrison (2011) provides independent, confirmation of the design methodology used for this proposal and is based on the documented performance (and aggregate and parapet conditions) of 20 buildings with aggregate surfaced roofs experiencing Hurricanes Francis and Jeanne in 2004:

"The major intent of this study was to determine the validity of Crandell's Modified Kind-Wardlaw Design Method for Buildings of All Heights [Crandell & Smith, 2009; Crandell & Fischer, 2010].

An X-value calculation was determined to compare the adjusted critical wind speed (Vcr') to the actual estimated wind speed (Vroof). Per Crandell's Method, a positive X-value would be "safe" from the standpoint of aggregate blow-off. Indeed, this was consistent with the observations.

In fact, Crandell's Method appears to be quite conservative since 12 of the 20 roofs observed had negative X-values but no observed or reported aggregate blow-off. The single roof that did experience blow-off had an X-value of -52. While this might suggest that Crandell's Method has a "safety factor" of about 50 mph wind speed, this is only one sample, and there were multiple uncertainties in this analysis."

In summary, this proposal is a significant improvement of the existing provisions in the code and will result in better performing and safer aggregate surfaced roofs based on a proven and robust design approach.

Bibliography: Crandell, J. H. and Smith, T.L.. (2009) Design Method Improvements to Prevent Roof Aggregate Blow -Off, Hurricane Hugo 20th Anniversary Symposium on Building Safer Communities – Improving Disaster Resistance, ATC-77, North Charleston, SC, October 22-23, 2009
Kind, R.J. and Wardlaw R.L. (1976). Design of Rooftops Against Gravel Blow -Off. National Aeronautical Establishment, National Research Council, Canada.

Kind, R.J. (1977). Further Wind Tunnel Tests on Building Models to Measure Wind Speeds at Which Gravel is Blow n Off Rooftops. LTR-LA-189. National Aeronautical Establishment, National Research Council, Canada.

Smith, T.L. (June 1997). Aggregate Blow -Off from BUR and SPF Roofs: Recognizing the Potential Hazards and Avoiding Problems. Proceedings of The 8th U.S. Conference on Wind

Engineering, AAWE.

ANSI/SPRI RP-4 (2013). Wind Design Standard for Ballasted Single-Ply Roofing Systems. SPRI, Waltham, MA (www.spri.org)

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Morrison, R.V. (2011). Field Investigation of Aggregate Blow-off of Spray Polyurethane Foam Roofs, *RCI Interface*, Technical Journal of RCI, Inc. (presented at RICOWI Fall Symposium, November 11, 2010)

Cost Impact: Overall, the proposed new Table 1504.8 will provide additional options for use of aggregate surfaced roofs that are safer than the current provisions and which may reduce cost. In some cases, depending on current practice and the basic design wind speed condition for a building site, a parapet (or taller parapet) and/or larger aggregate may be required for compliance. In these cases, an incremental cost increase can be expected.