E73-24

IBC: 1011.7.2 (New), 1011.7.2.1 (New), 1011.7.2.2 (New); IFC: 1011.7.2 (New), 1011.7.2.1 (New), 1011.7.2.2 (New)

Proposed Change as Submitted

Proponents: Nancy Clanton, Clanton & Associates, Inc, representing Clanton & Associates, Inc. (nancy@clantonassociates.com); Brittany Lynch, representing Clanton & Associates (brittany@clantonassociates.com); Eunice Noell-Waggoner, President, Center of Design for an Aging Society, representing IES Lighting for Seniors and the Visually Impaired Committee (eunice@centerofdesign.org); Jonathan McHugh, McHugh Energy Consultants Inc., representing California Investor Owned Utilities (jon@mchughenergy.com); Harold Jepsen, representing Legrand (harold.jepsen@legrand.com)

2024 International Building Code

Add new text as follows:

1011.7.2 Markings on stairways. Egress path markings shall be provided on interior and exterior stairways in accordance with Sections 1011.7.2.1 and 1011.7.2.2.

Exceptions:

1. Stairways within individual dwelling units.
2. Stairways with stripes complying with Section 1025.

1011.7.2.1 Steps. A solid and continuous stripe shall be applied to the horizontal leading edge of each step and shall extend for the full length of the step. Stripes shall be a solid color having a visual contrast of dark-on-light or light-on dark from the remainder of the tread or landing surface. Stripes have a minimum horizontal width of 1 inch (25 mm) and a maximum width of 3 inches (76 mm). The leading edge of the stripe shall be placed not more than ½ inch (12.7 mm) from the leading edge of the step and the stripe shall not overlap the leading edge of the step by not more than 1/2 inch (12.7 mm) down the vertical face of the step. The stripe shall be of material that is at least as slip resistant as the other tread surface.

1011.7.2.2 Landings. The leading edge of landings shall be marked with a stripe consistent with the dimensional requirements for steps.

2024 International Fire Code

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1011.7.2.2 Landings. The leading edge of landings shall be marked with a stripe consistent with the dimensional requirements for steps.

Reason: From Cohen and Pauls (2006) they cite the following statistics about stair safety. *"According to the National Public Services Research Institute, in 1995, it was estimated that stair-related injuries in the United States were associated with comprehensive costs of $50 billion, including $4.7 billion in medical costs, $7.1 billion in productivity losses, and $38.1 billion in quality of life losses (T. Miller, Personal Communication. 1998). Even the smallest of these component costs is astonishing relative to annual stair construction costs in the United States; these are only approximately $5 billion. With the possible exception of products, such as handguns, tobacco and illegal drugs, this 10-to-l ratio of injury costs to product production costs is extraordinary."*

Cohen and Pauls also note that increasing quantity of lighting alone is not sufficient to incease the visibility of the edge of the stair tread. *"In addition to lighting, there are other important factors in visibility of steps, including careful choice of stairway covering materials to avoid patterns that tend to camouflage the step nosings and the critical leading edges of treads. and to use highly contrasting tread markings."*

The Illuminating Engineering Society's Recommended Practice for Lighting and the Visual Environment for Older Adults and the Visually Impaired (IES-RP-28-20) notes the following concerning the use of reflectance contrast for increasing visibility: *Value contrast should be a design consideration in the selection of finishes for corridors, stairs, lobbies and spaces that become part of the path of egress. Contrast helps to define the space and the elements within the space, e.g., doorways, changes of floor level or direction, and obstructions such as columns, to increase visibility and the occupant's confidence. Everyone's sight benefits from value contrast in low-light conditions, regardless of age or visual acuity.*

The IES also recommends that *"All stairs should have clearly marked edge strips, staircase borders, and handrails to meet the needs of older people and persons with low vision."*

Similar to what has been recommended by Cohen and Pauls and the Illuminating Engineering Society, this proposal would increase the safety of stairways by increasing the reflectance contrast (and thus the luminance contrast) by requiring colored stripes on the nosing or leading edges of stairs. The difference in reflectance between the edge stripe and the rest of the stair tread will to increase the visibility of the edge of the stair. These colored stripes would be one to two inches wide on the edge of nosing the stair. This proposal is written the same format as the requirement as IBC *Section 1011.5.4.1 Nonuniform height risers*. However the distinguishing difference between stripes on nonuniform height risers and those proposed for all other stairs is "nonuniform height risers shall have a distinctive marking stripe, different from any other nosing marking provided on the stair flight."

The description of the marking stripes are written to be in alignment with ANSI/ICC 117.1 Accessibility Standard Section 504.6 "Visual Contrast". Addtionally this proposal modifies both Section 1011.5.4.1 and 1011.7.1 on the geometrical description of the contrasting marking stripe. Originally the stripe is defined as being one to two inches wide, this proposal more clearly defines the stripes as being one to two inches in depth and having a width that extends the width of the stair tread.

Bibliography: ANSI/IES RP-28-20. *Recommended Practice: Lighting and the Visual Environment for Older Adults and the Visually Impaired.* Illuminating Engineering Society. New York.

Cohen, Harvey and Pauls, Jake. *Warnings and Markings for Stairs and Pedestrian Terrain*. **Handbook on Warnings.** In: Michael Wogalter (Ed.),Lawrence Erlbaum, Inc., 2006, pp. 711-722.

Cost Impact: Increase

Estimated Immediate Cost Impact:

The lowest cost method for adding a stripe to stairs is painting a stripe. However to provide conservatively high estimate we have used the cost of adding a metal nosing strip to the tread of each stair and on the nosing of the landing above a stair. From estimates of costs published on the internet the costs of aluminum stair nosing are $6 to $21 per linear foot. https://kofflersales.com/product/metal-stair-nosing Similar costs are found on Grainger's and Lowes websites.

Using a medium costs of $12.50/linear foot, the material cost of adding an aluminum nosing to a 4 foot wide tread is $50/stair. According

one home improvement website, “A beginner can install a nosing on a tread in 15 to 30 minutes.” https://www.thespruce.com/installing-a-stair-nosing-strip-1822570 According to the US Bureau of Labor Statistics, the Mean Labor wage for carpenter, US average May 2022 is $ 27.99/hr https://www.bls.gov/oes/current/oes472031.htm Thus the labor cost is $14 per step to install a $50 nosing strip for a total installed cost of $64/stair tread. With 50% overhead and profit for carpenters (2020 RS Means), total cost is $96 per installed 4 foot wide nosing. For a 12 foot tall story, with 6 inch risers per step, there are 24 nosings with an installed cost of 24 x $96 = $2,304 per story.

This cost for nosings is compared against the cost adding stairs per story. In the Economics of Egress Alternatives and Life-Safety Costs, NIST Special Publication 1109. September 2010. Gaithersburg, Maryland (https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication1109.pdf) describes the costs of adding an additional exit stair to a 13 story prototypical building as follows: “The baseline value for the life-cycle costs of installing an additional exit stair in Building 2 ranges from $1.5 million for the 44 in (112 cm) stair width to $2.4 million for the 66 in (168 cm) stair width.” The cost per story of this added exit stair is $1.5 Million/ 12 = $125,000 per story. The fractional cost of adding aluminum stair nosings strips is $2,300/$125,000 = 1.8

Estimated Immediate Cost Impact Justification (methodology and variables):

Adding striping to stairs increases the cost of stairs by 1.8%. However, this cost is offset by the societal savings associated with avoiding trip and fall hazards on stairways.

Estimated Life Cycle Cost Impact:

In Cohen and Pauls, Warnings and Markings for Stairs and Pedestrian Terrain (see bibliography), they estimate that the ratio of the cost of annual injuries on stairs to the annual cost of stair construction is 10 to one. The annual construction rate of nonresidential buildings is 1.3% (table B7 of the US EIA 2012 Commercial Buildings Energy Consumption Survey). Thus the annual value of injuries on stairs are 10 x 0.013 = 13% of the value of the stock of all stairs. Assuming that metal nosing lasts at least 10 years, the ratio of the value of injuries on stairs over 10 years to cost of the stairs is 10 x 13% = 130% of the value of the stairs. As described in the cost impact statement, a conservatively high estimate of the cost of stair striping is 1.8% of total stair cost. Thus, the ratio of the cost of stair striping to the cost of injuries on stairs is 1.8%/130% = 1.4%. If stair striping reduces injuries on stairs, by 1.4% this will pay for the added cost of striping stairs by adding an aluminum nosing that is conspicuously different than the reflectance of the rest of the stair tread. Given the mechanisms of how falls are induced on stairs, we expect that stair striping will reduce the percentage of falls significantly more than 1.4%.

Estimated Life Cycle Cost Impact Justification (methodology and variables):

If the striping reduces falls in stairs by any amount greater than 1.4%, life cycle cost is decreased.

In Cohen and Pauls, Warnings and Markings for Stairs and Pedestrian Terrain, they identify three factors to stair safety.

1. visibility of the stair flight and its individual steps, especially when viewed in descent;

2. adequacy and uniformity of step dimensions in relation to human gait; and

3. availability of reachable, graspable handrails that also provide accurate visual cues about the presence and location of steps.

Items 2 is addressed by IBC Section 1011.5. Item 3 is addressed by IBC section 1011.11. Visibility is only partially addressed by illuminance requirements in IBC Section 1008. Critical to visibility of steps is the luminance contrast of the tread edge; luminance contrast is the ratio of reflected light from the stair edge as compared to other surfaces on the stair. When stairs are uniformly illuminated, luminance contrast is a function of reflectance contrast of the stair edge from the surrounding tread and riser. Increasing illuminance without adjusting the ratios of surface reflectances of stair edge from its surroundings does not increase luminance contrast because with increasing illuminance, the luminance of both the stair edge and its surroundings will both rise proportionately and thus the ratio of the stair edge to its surroundings have not changed. We expect that lack of reflectance contrast is a significant cause of falls on stairs and thus addressing this issue will result in substantially more savings associated with avoided injuries and deaths than its first cost. Reducing stairway falls by only 1.4% will pay for the cost of the stair striping. See the calculations below for the rationale.

Public Hearing Results (CAH1)

Committee Action: **Disapproved**

Committee Reason: While contrast on stairways is important, the proposed requirements are not clear. The committee felt that the language was not clear enough to apply consistently and correctly in the field. The terms 'steps' is not defined in the code - this should be 'treads'. The requirements for the treads and landings should be in Sections 1011.5 and 1011.6. The application of this to "interior and exterior stairways" would include to all convenience stairways (exit access), as well as stairways in the exit discharge - this is over reaching. Are there any studies that have taken into consideration stairway continuity and handrails to address the safety concerns brought up by the proponents? What would be an acceptable material for the stripes? How would you verify contrast on stairways that were not a solid color? See also E74-24. (Vote: 13-1)

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Public Hearing Results (CAH2)

Committee Action: **As Modified by Committee (AMC2)**

Approved Comments: Comment 1

Committee Reason: The comment addressed the concerns expressed in the committee reason to CAH1. Contrast is understood without a referenced standard. The stripes on every tread for all exit stairways will improve safety and reduce fall hazards. (Vote: 10-3)

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Individual Consideration Agenda

Public Comment GROVE-PC1:

IBC: 1011.5, 1011.5.6, 1011.6.1; IFC: [BE] 1011.5, [BE] 1011.5.6, [BE] 1011.6.1

Proponents: Jeff Grove, Chair, representing Building Code Action Committee (BCAC) (bcac@iccsafe.org) requests As Modified by Public Comment (PCH)

Further modify as follows:

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1011.5 Stair treads and risers. *Stair* treads and risers shall comply with Sections 1011.5.1 through 1011.5.6.

Revise as follows:

1011.5.6 Marking stripes on tread nosings. For interior exit stairways and exterior exit stairways, the horizontal leading edge ~~1 to 2 inches (25 to 51 mm)~~ of every tread nosing shall have a solid marking stripe of a ~~solid~~ contrasting color that is lighter or darker than the remainder of the tread. The marking stripe shall be durable and shall extend the full legth ~~from one side of the tread to the other side~~ of each tread. Stripes shall have a minimum horizontal width of 1 inch (25 mm) and a maximum width of 2 inches (51 mm). The leading edge of the stripe shall be placed not more than 1/2 inch (12.7 mm) from the leading edge of the step and the stripe shall not overlap the leading edge of the step by not more than 1/2 inch (12.7 mm) down the vertical face of the step.

Exceptions:

1. Portions of treads with distinctive marking stripes complying with Section 1011.5.4.1 are not required to comply with this section.

2. Stairways with stripes complying with Section 1025 are not required to comply with this section.

3. Stairways that provide a contrasting marking stripe on the top landing and bottom tread of each stair run and not required to provide a contrasting marking stripe on every tread.

1011.6.1 Marking stripes on landing nosings. For *interior exit stairways* and *exterior exit stairways*, the nosing of all landings shall have a marking stripe complying with Section 1011.5.6.

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[BE] 1011.5 Stair treads and risers. *Stair* treads and risers shall comply with Sections 1011.5.1 through 1011.5.6.

Revise as follows:

[BE] 1011.5.6 Marking stripes on tread nosings. For interior exit stairways and exterior exit stairways, the horizontal leading edge ~~1 to 2 inches (25 to 51 mm)~~ of every tread nosing shall have a solid marking stripe of a ~~solid~~ contrasting color that is lighter or darker than the remainder of the tread. The marking stripe shall be durable and shall extend the full legth ~~from one side of the tread to the other side~~ of each tread. Stripes shall have a minimum horizontal width of 1 inch (25 mm) and a maximum width of 2 inches (51 mm). The leading edge of the stripe shall be placed not more than 1/2 inch (12.7 mm) from the leading edge of the step and the stripe shall not overlap the leading edge of the step by not more than 1/2 inch (12.7 mm) down the vertical face of the step.

Exceptions:

1. Portions of treads with distinctive marking stripes complying with Section 1011.5.4.1 are not required to comply with this section.
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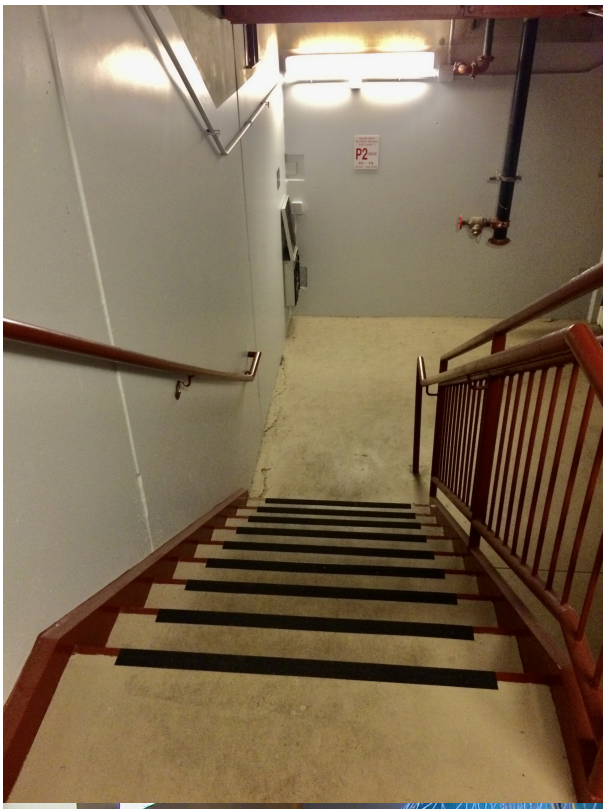
[BE] 1011.6.1 Marking stripes on landing nosings. For *interior exit stairways* and *exterior exit stairways*, the nosing of all landings shall have a marking stripe complying with Section 1011.5.6.

Reason: While we agree that markings should be provide to aid people in using a stairway, we feel that some additional clarifications and options are warrented.

The language for lighter and darker does not guarentee a contrasting stripe. This needs to be stressed.

During the testimony it was brought up that the location of the stripe is not as clear as it is for stripes in Section 1025. The current text does not indicate clearly which edge of the stripe, the width or the stripe, or the distance forward or back from the nosing. The proposed text is similar to 1025.2.1.

The intent of the proposal is to indicate to people with visions impairments that they are approaching or leaving steps. That can be done with either stripes on all treads, or at the landing and bottom tread. Along the stairway people have muscle memory and handrails for guidance. You do not need to look at every tread. Below are examples of each option. The option for the stripe at the top and bottom of the stairway run is a requirement in California.



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. In 2023 and 2024 the BCAC has held several virtual meetings open to any interested party. In addition, there were numerous virtual Working Group meetings for the current code development cycle, which included members of the committee as well as interested parties. Related documents and reports are posted on the BCAC website at BCAC webpage.