**INTERNATIONAL CODE COUNCIL (ICC)**
**Code Technology Committee (CTC)**

# FINAL REPORT OF THE CTC
# AREA OF STUDY – CLIMBABLE GUARDS

**May 21, 2008**
**Four Points Sheraton BWI Airport**
**Baltimore, Maryland**

In accordance with ICC Council Policy No. 5, the CTC held several open meetings to receive written and verbal comments regarding the ICC Board-approved area of study entitled Climbable Guards. This report includes the final recommendations for this area of study, approved by the CTC upon the conclusion of the open meeting on May 21, 2008. The recommendations contained in this report have been processed in accordance with ICC's Code Development Process as stipulated in ICC Council Policy No. 5.

**Scope:** As noted in the CTC approved Scope & Objectives Statement, the scope of this activity is:

> The study of climbable guards will focus on determining the need for appropriate measures to prevent or inhibit an individual from utilizing the elements of a guard system, including rails, balusters and ornamental patterns, to climb the guard, thereby subjecting that person to the falling hazard with the guard system is intended to prevent.

**Recommendation:**

> The Code Technology Committee recommends that there is no reason to make additional changes in the ICC Code provisions for guards beyond those already forwarded in Interim Reports No. 1 and 2 which formed the basis for the code changes submitted as E96-06/07 and the follow-up code change E85-07/08. The proposed text revisions for the IBC and IRC found in code change E85-07/08 reflect the final position of the CTC and is reproduced in the appendix to this report.
>
> In making this recommendation, the CTC notes the discussions held during several open meetings, a review of the available information presented during the open meetings, and the findings documented in a report entitled Review of Fall Safety of Children Between the Ages of 18 Months and 4 Years in Relation to Guards and Climbing in the Built Environment dated December 2007 With Peer Review. This report was prepared for the National Ornamental & Miscellaneous Metals Association (NOMMA) and was prepared by the National Association of Home Builders (NAHB) Research Center. The most important finding being: "***Recent fall injury data from the U.S. Consumer Product Safety Commission on accidents with guards is analyzed. The results indicate that climbing and falls from these assemblies among young children aged 18 months to 4 years account for an estimated 0.032 percent of injuries resulting in emergency room visits in that population."***
>
> In addition, the following findings from the report that form part of the basis for the CTC recommendation include:
>
> - "The human child is built to climb and loves to do so!" (Readdick and Park, 1998).

- Climbing is involved in the child's physical, psychological and social development.
- Climbing skills are often taught and encouraged by parents, especially with boys
- Climbing is a part of physical education at school.
- No evidence of a gender difference in either climbing skill or climbing speed in young children.
- Difficult barrier designs merely present a greater challenge to the determined child.
- Studies also generally agree that it is probably impossible and most likely undesirable to render any environment completely "safe" from children's climbing.
- The incident rate is approximately 2.5 per 100,000 children between 18 months and 4 years of age
- There is much uncertainty in the data to ascribe causality or the physical situation that lead to reported injuries.

Despite the fact that this subject has a high level of emotional attention, the most current and thorough documentation available shows no indication that a problem exists and that there has not been sufficient justification established to mandate a higher level of climbability restriction on guards than what is currently required in the 2006 ICC codes or covered in E85-07/08.

Of note in E85-07/08 is the change related to a possible fall over guards adjacent to fixed seating. The other proposed revisions are either editorial clarifications or further restricting opening limitations. These recommendations, although not directly related to limiting climbing, will make guards safer as a result of what has been discovered.

**Background:** The scope and objectives were approved on April 14, 2005. Since that date the CTC has held 13 open meetings to receive information and to allow an open discussion of the issues surrounding children falling related to guards. The study of the issues surrounding climbable guards focused on determining if appropriate or additional measures are needed to be added to the existing ICC family of codes to prevent or inhibit an individual from utilizing the elements of a guard system, including rails, balusters and ornamental patterns, to climb the guard, thereby subjecting that person to the falling hazard which the guard system is intended to prevent.

Over the last three years, the CTC has reviewed and weighed testimony and documentation on this topic by reviewing past code development history, demographics of persons and age groups to be reasonably protected, identified possible use group occupancies where additional restrictions could be applied, acquired and reviewed injury data from multiple sources, and reviewed patterns and arrangements of possible guard infill elements. Consideration was given to the impact additional code restrictions would have on design and construction and the probable reduction of deaths and injuries (if any) that enacting additional code change restrictions might affect.

The information presented to the CTC has been documented and made available to all interested parties on the ICC website (http://www.iccsafe.org/cs/cc/ctc/Climbable.html). At the time of this report there are 39 documents on the website, including the final report issued by NOMMA. The website also lists the two interim reports noted previously and guard related code change proposals submitted in the 2006/2007 and 2008/2008 cycles.

While reviewing the climbable guards area of study, the CTC narrowed the demographics of the population to children 4 years of age and younger. It was concluded early on that children 4 years of age and older could climb any guard with a height of 42 inches or less -- even solid walls.

In a response to on-going discussions and to get a better understanding of the available literature, the National Ornamental and Miscellaneous Metals Association (NOMMA) Education Foundation (www.nomma.org), commissioned a preliminary report and then a final study by an independent third party reviewer which documented with more detailed information. During the process of selecting a group to perform the independent review, NOMMA openly requested and received comments from the CTC and solicited public comments from various entities and interested parties. NOMMA used that documentation and verbal information in the process to select the NAHB Research Center to perform the independent study and produce a report. The study was commissioned and funded by NOMMA to provide information sought to clarify conflicting interpretations of guard climbing studies and injury data.

The NAHB Research Center's report covers 40 peer-reviewed studies concerning the areas of children's physical development and their interaction with the built environment. The NAHB Research Center's review also analyzed Consumer Product Safety Commission (CPSC) data collected by the National Electronic Injury Surveillance System (NEISS). Previous analyses of this data had been unscientific and inconclusive.

The report was published as a final draft in December/2007 prior to undergoing a peer review process. The peer review process has been completed and the report has been published as a final report and is cited in this CTC recommendation.

## APPENDIX

The following is code change E85 – 07/08 submitted in the 2007/2008 Code Development Cycle which was approved by the both the IBC- Means of Egress and IRC- Building/Energy code committees.

## PART I – IBC MEANS OF EGRESS

**1. Revise as follows:**

### SECTION 1013.0
### GUARDS

**1013.1 (IFC [B] 1013.1) (Supp) Where required.** Guards shall be located along open-sided walking surfaces, including mezzanines, equipment platforms, ~~stairways~~, stairs, ramps and landings, that are located more than 30 inches measured vertically to the floor or grade below at any point within 36 inches ( 914 mm) horizontally to the edge of the open side ~~above the floor or grade below~~.. Guards shall be adequate in strength and attachment in accordance with Section 1607.7. ~~Where glass is used to provide a guard or as a portion of the guard system, the guard shall also comply with Section 2407. Guards shall also be located along glazed sides of stairways, ramps and landings that are located more than 30 inches (762 mm) above the floor or grade below where the glazing provided does not meet the strength and attachment requirements in Section 1607.7.~~

**Exception:** Guards are not required for the following locations:

1. On the loading side of loading docks or piers.
2. On the audience side of stages and raised platforms, including steps leading up to the stage and raised platforms.
3. On raised stage and platform floor areas such as runways, ramps and side stages used for entertainment or presentations.
4. At vertical openings in the performance area of stages and platforms.
5. At elevated walking surfaces appurtenant to stages and platforms for access to and utilization of special lighting or equipment.
6. Along vehicle service pits not accessible to the public.
7. In assembly seating where guards in accordance with Section 1025.14 are permitted and provided.

**2. Add new text as follows:**

**1013.1.1 (IFC [B] 1013.1.1) Glazing.** Where glass is used to provide a guard or as a portion of the guard system, the guard shall also comply with Section 2407. Where the glazing provided does not meet the strength and attachment requirements in Section 1607.7, complying guards shall also be located along glazed sides of open-sided walking surfaces.

**3. Revise as follows:**

**1013.2 (IFC [B] 1013.2) (Supp) Height.** Required guards shall ~~form a protective barrier~~ be not less than 42 inches (1067 mm) high, measured vertically above the adjacent walking surfaces, adjacent fixed seating or the line connecting the leading ~~edge~~ edges of the ~~tread~~ treads ~~, adjacent walking surface or adjacent seatboard~~.

**Exceptions:**

1. For occupancies in Group R-3, and within individual dwelling units in occupancies in Group R-2, ~~guards whose top rail also serves as a handrail shall have a height not less than 34 inches (864 mm) and not more than 38 inches (965 mm) measured vertically from the leading edge of the stair tread nosing.~~ guards on the open sides of stairs shall have a height not less than 34 inches (864 mm) measured vertically from a line connecting the leading edges of the treads.
2. For occupancies in Group R-3, and within individual dwelling units in occupancies in Group R-2, where the top of the guard also serves as a handrail on the open sides of stairs, the top of the guard shall not be less than 34 inches (864 mm) and not more than 38 inches (965 mm) measured vertically from a line connecting the leading edges of the treads.
~~2.~~ 3. The height in assembly seating areas shall be in accordance with Section 1024.14.
~~3~~. 4. Along alternating tread device, guards whose top rail also serves as a handrail, shall have height not less than 30 inches (762 mm) and not more than 34 inches (864 mm), measured vertically from the leading edge of the device tread nosing.

**1013.3 (IFC [B] 1013.3) (Supp) Opening limitations.** ~~Open~~ Required guards shall ~~have balusters or ornamental patterns such that a~~ not have openings which allow passage of a sphere 4 ~~inch~~ inches (102 mm) ~~diameter sphere~~ in diameter from the walking surface to the required guard height ~~cannot pass through any opening up to a height of 34 inches (864 mm). From a height of 34 inches (864 mm) to 42 inches (1067 mm) above the adjacent walking surfaces, a sphere 8 inches (203 mm) in diameter shall not pass.~~

**Exceptions:**

1. From a height of 36 inches (914 mm) to 42 inches (1067 mm), guards shall not have openings which allow passage of a sphere 4.375 inches (111 mm) in diameter.
~~1.~~ 2. The triangular openings at the open sides of a stair, formed by the riser, tread and bottom rail, ~~at the open side of a stairway~~ shall ~~be of a maximum size such that a sphere of 6 inches (152 mm) in diameter cannot pass through the opening.~~ not allow passage of a sphere 6 inches (152 mm) in diameter.
~~2~~ 3. At elevated walking surfaces for access to and use of electrical, mechanical or plumbing systems or equipment, guards shall ~~have balusters or be of solid materials such that a sphere with a diameter of 21 inches (533 mm) cannot pass through any opening.~~ not have openings which allow passage of a sphere 21 inches (533 mm) in diameter.
~~3.~~ 4. In areas which are not open to the public within occupancies in Group I-3, F, H or S, and for alternating tread devices ~~balusters, horizontal intermediate rails or other construction shall not permit a sphere with a diameter of 21 inches (533 mm) to pass through any opening.~~ guards shall not have openings which allow passage of a sphere 21 inches (533 mm) in diameter.
~~4.~~ 5. In assembly seating areas, guards at the end of aisles where they terminate at a fascia of boxes, balconies and galleries shall ~~have balusters or ornamental patterns such that a~~ not have openings which allow passage of a sphere 4 ~~inch~~ inches (102mm) in diameter ~~sphere cannot pass through any opening~~ up to a height of 26 inches (660 mm). From a height of 26 inches (660 mm) to 42 inches (1067 mm) above the adjacent walking surfaces, guards shall not have openings which allow passage of a sphere 8 inches (203 mm) in diameter ~~shall not pass~~.
~~5.~~ 6. Within individual dwelling units and sleeping units in Group R-2 and R-3 occupancies, ~~openings for required guards on the sides of stair treads shall not allow a sphere of 4.375 inches (111 mm) to pass through.~~ guards on the open sides of stairs shall not have openings which allow passage of a sphere 4.375 (111 mm) inches in diameter.

**1013.4. (IFC [B] 1013.4) Screen porches.** (No change to current text)

**1013.5 (IFC [B] 1013.5) Mechanical equipment.** Guards shall be provided where appliances, equipment, fans, roof hatch openings or other components that require service are located within 10 feet (3048 mm) of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches (762 mm) above the floor, roof or grade below. The guard shall be constructed so as to prevent the passage of a sphere 21 ~~inch~~ inches (533 mm) in diameter ~~sphere~~. The guard shall extend not less than 30 inches (762 mm) beyond each end of such appliance, equipment, fan or component.

**1013.6 (IFC [B] 1013.6) Roof access.** Guards shall be provided where the roof hatch opening is located within 10 feet (3048 mm) of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches (762 mm) above the floor, roof or grade below. The guard shall be constructed so as to prevent the passage of a sphere 21 ~~inch~~ inches (533 mm) in diameter ~~sphere.~~

**PART II – IRC BUILDING AND ENERGY**

**1. Revise as follows:**

**SECTION R312**
**GUARDS**

**R312.1 (Supp) Where ~~Guards~~ required.** ~~Guards shall be provided on all decks, landings, porches, balconies, ramps or raised floor surfaces located more than 30 inches (762 mm) above the floor or grade below.. Required guards shall not be less than 36 inches in height. Open sides of stairs with a total rise of more than 30 inches (762 mm) above the floor or grade below shall have guards not less than 34 inches (864 mm) in height measured vertically from the nosing of the treads.~~ Guards shall be located along open-sided walking surfaces, including stairs, ramps and landings, that are located more than 30 inches measured vertically to the floor or grade below at any point within 36 inches ( 914 mm) horizontally to the edge of the open side Insect screening shall not be considered as a guard. ~~Porches and decks which are enclosed with insect screening shall be equipped with guards where the walking surface is located more than 30 inches (762 mm) above the floor or grade below.~~

**2. Add new text as follows:**

**R312.2 Height.** Required guards at open-sided walking surfaces, including stairs, porches, balconies or landings, shall be not less than 36 inches (914 mm) high measured vertically above the adjacent walking surface, adjacent fixed seating or the line connecting the leading edges of the treads.

**Exceptions:**

1. Guards on the open sides of stairs shall have a height not less than 34 inches (864 mm) measured vertically from a line connecting the leading edges of the treads.
2. Where the top of the guard also serves as a handrail on the open sides of stairs, the top of the guard shall not be not less than 34 inches (864 mm) and not more than 38 inches (965 mm) measured vertically from a line connecting the leading edges of the treads.

**3. Revise as follows:**

~~**R312.2**~~ **R312.3** ~~**Guard**~~ **Opening limitations.** Required guards ~~on open sides of stairways, raised floor areas, balconies and porches~~ shall not have openings ~~intermediate rails or ornamental closures~~ which ~~do not~~ allow passage of a sphere 4 inches (102 mm) ~~or more~~ in diameter from the walking surface to the required guard height.

**Exceptions:**

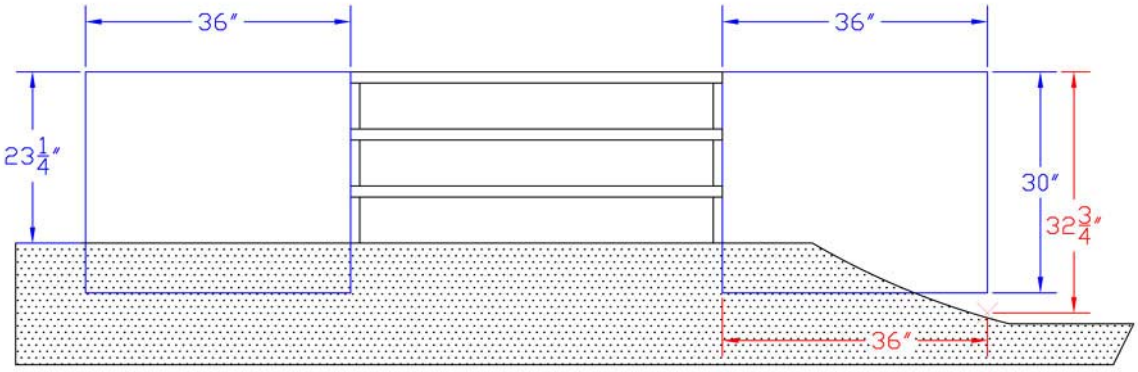
1. The triangular openings at the open side of a stair, formed by the riser, tread and bottom rail of a guard, ~~at the open side of a stairway~~ shall ~~are permitted to be of such a size that a sphere 6 inches cannot pass through.~~ not allow passage of a sphere 6 inches (153 mm) in diameter.
2. ~~Openings for required guards on the open sides of stair treads stairs shall not allow passage of a sphere 43/8 inches or more in diameter to pass through~~ Guards on the open sides of stairs shall not have openings which allow passage of a sphere 4.375 inches (111 mm) in diameter

**Reason:** The ICC Board established the ICC Code Technology Committee (CTC) as the venue to discuss contemporary code issues in a committee setting which provides the necessary time and flexibility to allow for full participation and input by any interested party. The code issues are assigned to the CTC by the ICC Board as "areas of study". Information on the CTC, including: meeting agendas; minutes; reports; resource documents; presentations; and all other materials developed in conjunction with the CTC effort can be downloaded from the following website: http://www.iccsafe.org/cs/cc/ctc/index.html. Since its inception in Aprril/2005, the CTC has held twelve meetings - all open to the public. This proposed change is a result of the CTC's investigation of the area of study entitled "Climbable Guards". The scope of the activity is noted as:

The study of climbable guards will focus on determining the need for appropriate measures to prevent or inhibit an individual from utilizing the elements of a guard system, including rails, balusters and ornamental patterns, to climb the guard, thereby subjecting that person to the falling hazard which the guard system is intended to prevent.

This proposal is a follow-up to E96 – 06/07.As of this writing this area of study has been completed by the CTC relative to these proposals. The general focus of these two proposals, one to the IBC and one to the IRC, is to create consistency in language regulating guards in the two codes.

**Part I – IBC**
IBC 1013.1. Laundry lists of items in the code are typically not all-inclusive. The word "including" provides this clarification in the following sections as well. This section is divided into two paragraphs with the second paragraph dealing with glass and glazing without a change in intent. The key part of this change to IBC 1013.1 is submitted in order to clarify how the height measurement which triggers the guard requirement is made relative to proximity to the adjacent fall-off. This is illustrated in the following figure:




The view is taken from the landing of a 3 riser stair, looking towards the face of the risers.


IBC 1013.2: The technical portions of this change are the changes that stipulates that the provisions are applicable to only required guards and that a fixed seat becomes a potential walking surface to a child and thus warrants the guard height to be measured from that point. The remainder does not change the intent but rather provides standardized text dealing with stair treads and the determination of how to measure guard height. This public comment revises the term to “fixed seating” so as to clarify the measurement, using common terminology. Fixed seating represents a walking surface that is sure to be utilized by children. As such, the measurement of the guard must be taken from this location to address the hazard of a child falling over the guard. It is impossible for the code to regulate ornamentals such as planters, furniture and the like and this proposal does not intend to regulate them.

IBC 1013.3: This section is also clarified to apply to only required guards. In the disapproval of E96-06/07, committee notes that they feel that exceptions 1 and 2 are redundant. A careful reading of the text revisions reveals a subtle difference. Exception 1 is a general exception for guard height along stairs. Exception 2 addresses the guard height where the top of the guard serves as a handrail. This distinction is intended to provide clarification in the code for the two possible scenarios.

The majority of the revision in this section and exception involve editorial rewording of the sentences for clarity and consistency. The technical change is to exception 1 to reduce the maximum opening (8" to 4-3/8" inches) for this upper portion of the guard above 36 inches.

The 8 inch limitation on openings at the upper section of the guard was based on the difference between the 34 inch height being the part of the guard that protects small children and the 42 inch height for the rest of the population. However this does not take into account that residential R-3 use groups require a minimum guard height of 36 inches. Proposed exception 1 raises the height for which the 4 inch opening requirement is applicable - to coincide with the minimum guard height of 36 inches in residential occupancies.

The change in maximum opening size at the upper portion of the guard, from the current 8 inch sphere criteria to a 4-3/8 inch sphere, is based on providing an equivalent level of protection as that provided by the current 4 inch opening on the lower portion of the guard. As a point of reference, the following measurements of head sizes of infants are excerpted from Drawing #2 Measurement of Infants from a book entitled "The Measure of Man and Woman: Human Factors" by Alvin R. Tilley, first published by Whitney Library of Design in 1993, republished and copyrighted by John Wiley & Sons, New York (ISBN 0-471-09955-4) in 2002.The publication states "We have chosen to accommodate 98% of the U.S. population, which lies between the 99 percentile and the 1 percentile, for product designs for civilians" page 10-11 headlined percentiles.

| Age | Side-to-side measurement | Back-to-front measurement |
|---|---|---|
| 12-15 months: | 5" | 6.5" |
| 16-19 months: | 5" | 6.5" |
| 20-23 months: | 5.1" | 6.8" |

Additional point of reference, from the same book entitled "The Measure of Man and Woman: Human Factors" by Alvin R. Tilley, figure number 8, page 14, showing child age 2.5 – 3 years. The chest dimension when scaled (1" = 12") shows a 4-3/4" dimension from the back to the front.
The following information from various resources has been compiled to illustrate how countries outside of the US are regulating the openings in guards:

| **Country of Origin** | **Sphere Rule Metric** | **Sphere Rule Inches** |
|---|---|---|
| Canada | 100mm | 3.94" |
| United Kingdom | 100mm | 3.94" |
| United States | 102mm | 4" |
| Australia | 125mm | 4.92" |
| Germany | 120mm | 4.72" |
| France | 110mm | 4.33" |
| Mexico (no code – standard followed) | 102mm – 152mm | 4" – 6" |
| Russia | 100mm | 3.94" |
| Romania | 100mm | 3.94" |
| Trinidad & Tobago | 102mm | 4" |
| Japan (Confirmation Pending) | 125mm | 4.92" |
| Spain (Confirmation Pending) | (120mm) (125mm) | (4.72") (4.92") |
| Switzerland | 120mm | 4.72" |
| Sweden | 100mm | 3.94" |

| | | |
|---|---|---|
| Taiwan (Confirmation Pending) | 125mm | 4.92” |
| Singapore (Confirmation Pending) | 125mm | 4.92” |
| Poland ( Confirmation Pending) | 100mm | 3.94” |
| Turkey | 100 mm | 3.94” |
| Netherlands (Confirmation Pending) | 100mm | 3.94” |

**Part II – IRC**

IRC R312.1: This section is being divided into two sections, similar to the IBC. The first section includes the general guard requirement, and the new section (R312.2) includes the height requirements. See reason for IBC Section 1013.1.

IRC R312.2: This new section includes the guard height requirements. It is reformatted to place emphasis on the 36” high guard required at level surfaces. There are not technical changes to the minimum height. As noted in the current text to IRC Section R312.2, the IRC applies to required guards. The term “required” is proposed here as well. This section uses the term “adjacent fixed seating” – intended to clarify that where there is built-in seating, the guard height is to be measured from the seat itself to provide for the minimum required height where it is assumed that children may be standing. See reason for IBC Section 1013.2.

IRC R312.3: The majority of the revision in this section and exception involve editorial rewording of the sentences for clarity and consistency.