Safe Stairs ● ● ● Handrails & Railings

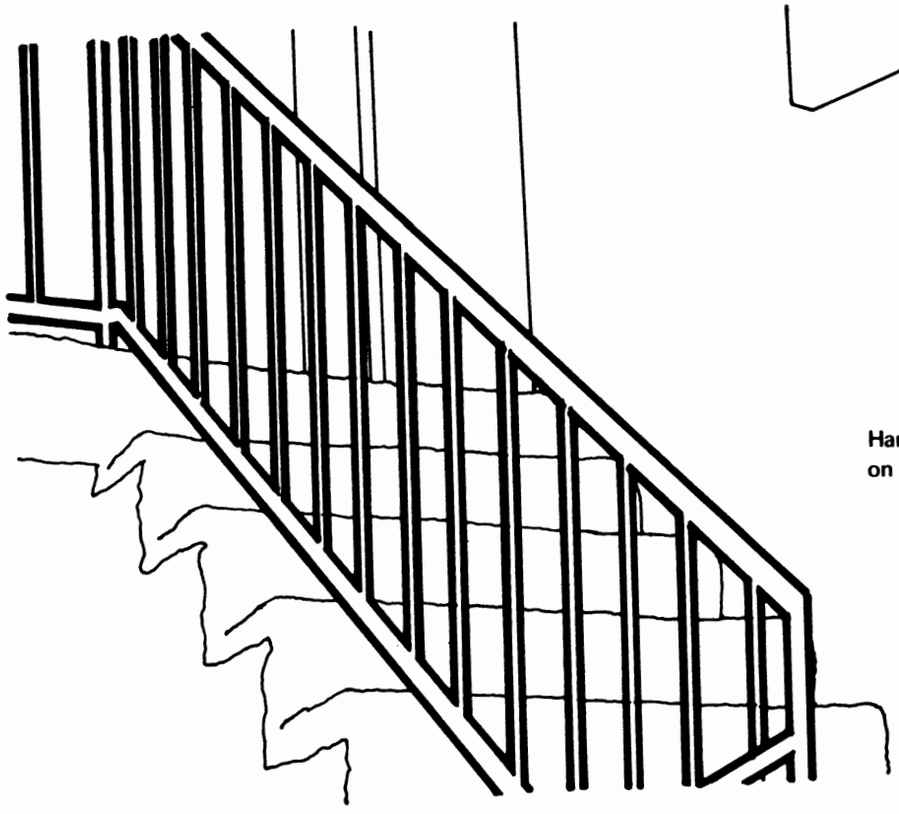
Handrails, railings, and associated components should provide substantial support and convenient assistance capabilities for a wide range of user requirements. Additionally, they should serve as safeguards for the prevention of falls from stairs and ramps as well as recovery aids in the event of falls. To meet these needs, a continuous handrail should be installed on at least one side of each flight of stairs having more than 3 risers. All open stairs should have a continuous railing on both sides. Stairs and ramps that are open on one side should have a continuous railing on the open side in addition to the handrail on the wall side.

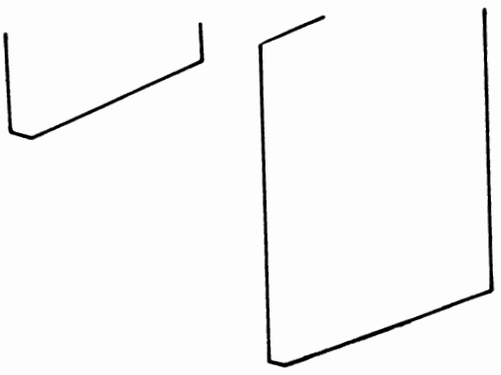
People are predominantly right-hand oriented; therefore, placement of the handrail is important. The average individual's coordination, strength, and ability are in his right arm and hand. Since the accident potential is greatest on descent of a flight of stairs, single handrails should be placed on the right side, descending.

RECOMMENDATIONS:

The following recommendations provide for additional safety in ascending the descending stairs:

- **Provide a handrail on the right side of stairs descending.**
- **A handrail or railing shall be installed on at least one side of each flight of interior stairs having more than three risers. Open stairs shall be protected with railings on both sides. Stairs that are open on one side shall have a continuous railing on the open side and a handrail on the wall side.**
- **Continuous handrails shall be installed on both sides of exterior stairs (attached to dwelling) leading to a platform more than four risers, or 24 inches above finished grade.**
- **Handrails shall be installed on both sides of single flights of exterior stairs (unattached to dwelling) which exceed 30 inches of total rise.**

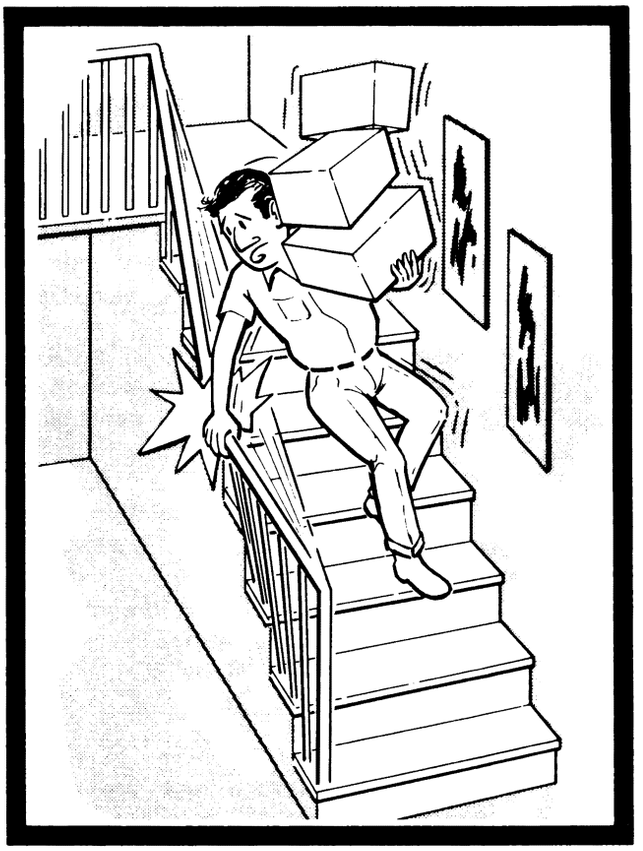




Handrailings should be installed on stairs, on the right-hand side, descending.

Load Factors

Handrails, railings, and balustrades should provide substantial support and assistance capabilities to all individuals ranging from the small child to the adult, including the elderly and semi-invalid. These components should be capable of withstanding the weight and force of a falling adult who may collide with or grasp the rail in an attempt to arrest a fall. Therefore, the minimum load factor should be such that the effect of the severest potential incident would not result in a complete failure of the component, nor would the component itself compound the severity of the accident by contributing additional injury. Handrails, railings, and balustrades that are to be used with residential stairs should be structurally designed and installed to resist a minimum horizontal force, applied at the top of the railing, of 20 pounds per linear foot, or 200 pounds, whichever is greater. These values are adequate for most conditions of normal usage, as well as for use as an emergency load restraint.



Handrailings should be designed and installed to withstand the potentially severe load factors imposed under emergency conditions.

RECOMMENDATION:

The following load factors are recommended as guidelines in the provision of safety in the fabrication and installation of residential stair handrails and railings:

- **Residential stair handrails and railings shall be designed and installed to resist a horizontal force applied at the top of the railing of 20 pounds per linear foot, or 200 pounds, whichever is the greater.**

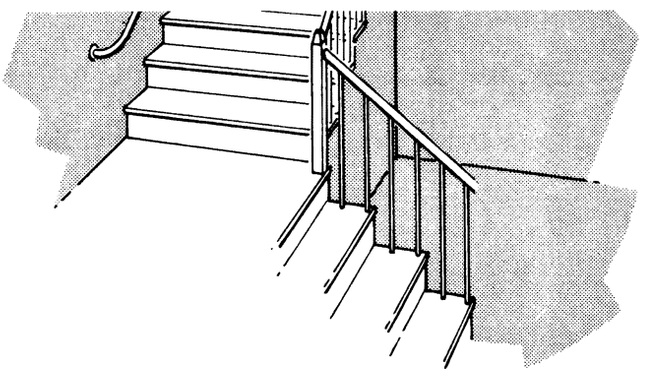
Height

The height of the handrail above the stair tread should allow any individual to reach and grasp it with ease and comfort. A position approaching the optimum must be a wise compromise in consideration of the varying reach and grasp capabilities of children and adults. Small children must reach upward to grasp the handrail, whereas adults must generally reach downward. Therefore, the near optimum handrail location which meets these two extremes of use should place the handrail low enough for children to reach without overextending themselves, but not so low that an adult is required to stoop. If the handrail is inconveniently located, its use will be inhibited. Physiological dimensional studies indicate that handrails located 30 to 34 inches above the nose of the stair tread are adequately accessible for the majority of users.

RECOMMENDATION:

The following placement dimensions are recommended for the provision of a safe and adequate height of stair handrails to accommodate the majority of users of all ages:

- **The height of handrails above the nosing of the tread shall be 30 to 34 inches.**



Before building, consult the BOCA code.

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Handrail Grip Size

Handrails are designed to meet several practical needs: to provide a person support in maintaining balance while negotiating stairs; to assist the handicapped or semi-invalid in ascending and descending stairs; and to minimize the effect of a potential fall by providing a person the means by which he can control a fall in progress; or to arrest the motion before injury occurs. Balance is achieved by sliding the hand along the railing while moving up or down a flight of stairs. Falls are arrested by pressing downward on the rail in a forward moving fall, and by grasping the rail as a backward fall becomes eminent.

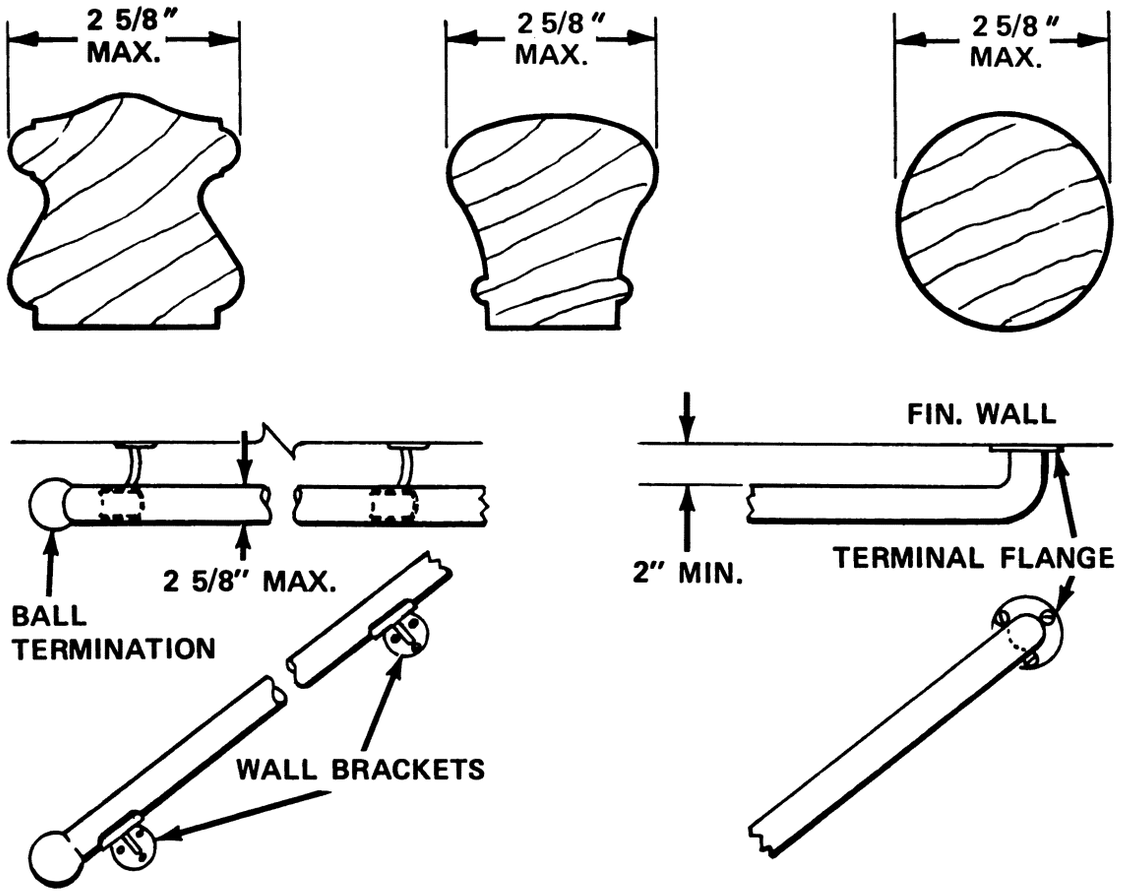
To be effective, the handrail must be designed and configured for the user's comfort. Rails which are difficult to grasp or are too wide for the average hand when applying downward pressure are uncomfortable and, therefore, ineffective.

A study of the usage of handrails reveals that they are normally grasped or pressed from the top of the rail rather than from the sides. First consideration in the design of handrails, therefore, should be directed to dimensional and configuration aspects of the top of the rail. Physiological studies relating to handrail configuration indicate that a horizontal cross-sectional dimension of no more than 2 5/8 inches is the maximum acceptable handrail width suitable for use by both children and adults.

RECOMMENDATION:

The provision of a safe and easily grasped stair handrail for all users shall incorporate the following horizontal dimension recommendation:

- **The maximum horizontal dimension of a stair handrail shall not exceed 2-5/8 inches.**



Handrail Termination Design

Handrails which extend appreciably beyond their upper or lower attachment points are hazardous and are the cause of injuries sustained in the event of accidental collisions. These protrusions may also snag clothing of an individual and be the direct cause of a fall, or be a distracting factor which could lead to a fall.

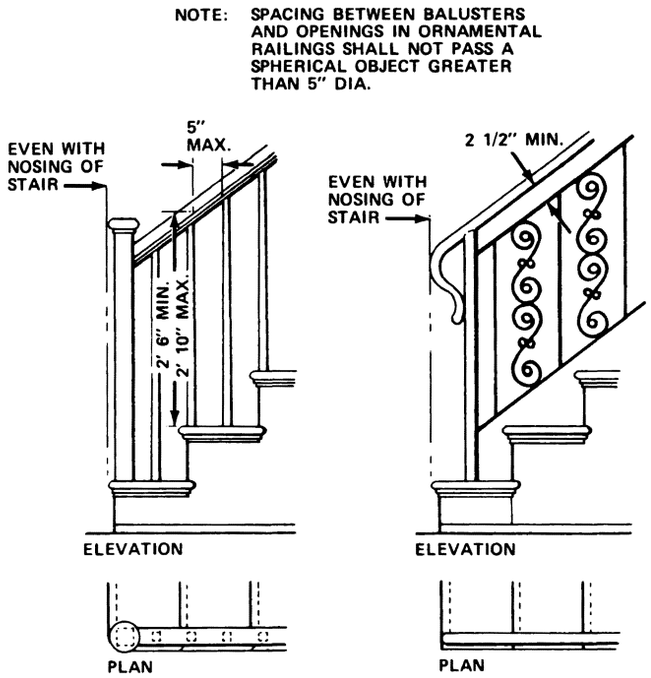
This hazard can be eliminated by the designer who is conscious of these potential consequences. Several design alternatives which may be employed are: return the handrail to the wall; turn the rail end downward toward the floor; terminate the handrail in a newel post, scroll, or loop.

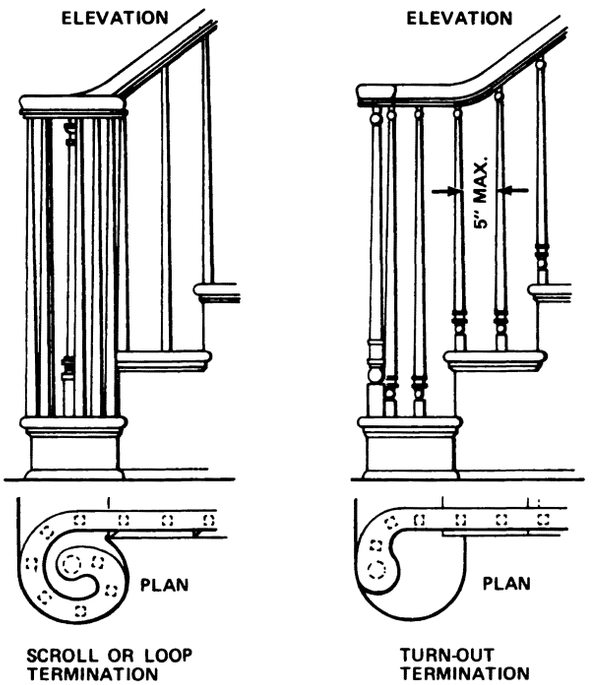
Another consideration in handrail design is the relation of terminal posts to the run of the stairs. To be effective, the handrail must be easily accessible to the user as he approaches the stairs in ascent or descent. This is especially applicable to the welfare of the handicapped and the elderly who depend on substantial assistance in negotiating stairs alone.

RECOMMENDATIONS:

To eliminate the possibility of snagged clothing, with its resultant injury potential, and to minimize injury from collisions with protruding handrail ends, the following design alternatives are recommended:

- **Handrails shall be terminated in a newel post, a scroll, or a loop.**
- **Handrails shall be terminated toward the wall or floor.**
- **To ensure adequate accessibility of stair handrails to all users, stair handrails shall extend at least from a point directly above the nose edge of the lower tread to a point directly above the nose edge of the upper landing.**





Handrail Apertures

The spaces between balusters and the openings in ornamental railings can present a hazardous invitation to children at play. The normally, inquisitive child will put his hands, feet, and head into openings which appear to be large enough to accommodate them, often with painfully disastrous results. Children also attempt to crawl through or into tempting openings which may restrict their ability to move, or which may set up a serious fall potential.

At the age of two years in normal child development, children can negotiate stairs unaided. At this point in physiological development, the average child's head exceeds 5 inches in diameter. Therefore, open spaces in stair railings should not allow passage of a spherical object greater than 5 inches in diameter.

RECOMMENDATION:

The following recommendation is made to lesser the hazard of children getting their heads caught in stairway railings:

- **Apertures between the various parts of stair handrailings shall not allow the passage of a spherical object having a diameter greater than 5 inches.**

Spaces between balusters in hand railings can present a hazardous invitation to children at play.

Decorative Railings

The process of manufacturing ornamental cast or wrought iron stair railings often produces burrs and sharp edges in the component, which if not properly smoothed or dulled, will pose the safety hazards of snagged clothing and potential cuts. Filigree designs in cast iron and wrought iron also contain acute angles which have caused serious cuts and even amputations of fingers that became entangled in the filigree. From the standpoint of safety, decorative metal stair railings should be free of sharp burrs, sharp edges, and sharp points, and should contain a minimum number of converging parts. In instances in which the ornamental feature of a handrail is designed primarily as a balustrade, sufficient grasping space should be provided between the handrail portion and the decorative portion so that hands and fingers will not normally become entangled in the decorative portion while an individual is negotiating the stairs.

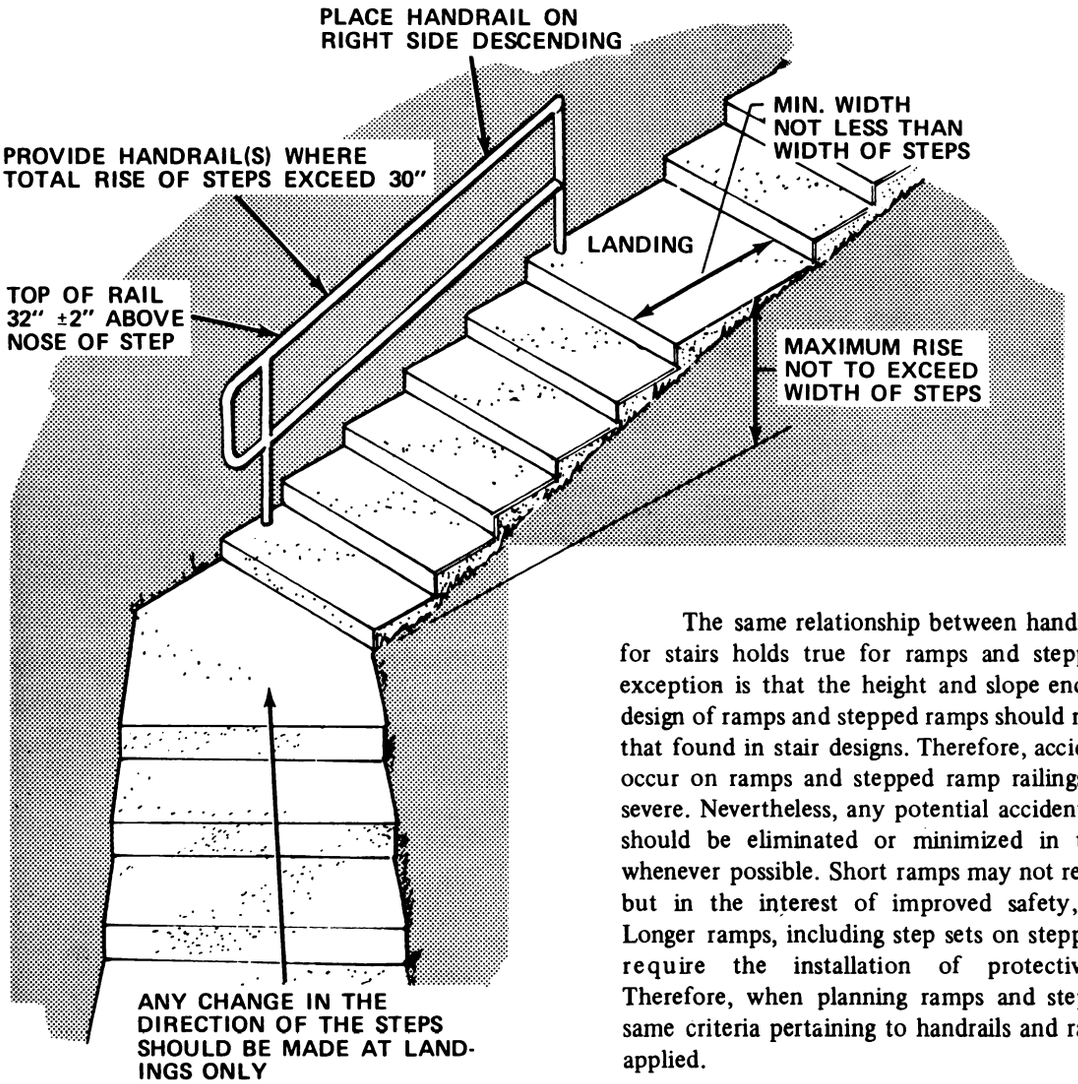
RECOMMENDATIONS:

To provide for the greatest degree of safety in the design of handrails and balustrades, including ornamental cast iron or wrought iron, the following safety criteria are recommended:

- **Ornamental metal balustrades and railings shall be free of all burrs, sharp edges, and sharp points.**

- **Ornamental metal balustrades shall be designed and fabricated with a minimum handrail grasping space of 2-1/2 inches between the handrail portion and the ornamental balustrade portion.**

Handrails and Railings on Ramps and Stepped Ramps



The same relationship between handrails and railings for stairs holds true for ramps and stepped ramps. One exception is that the height and slope encountered in the design of ramps and stepped ramps should not be as great as that found in stair designs. Therefore, accidents which may occur on ramps and stepped ramp railings may not be as severe. Nevertheless, any potential accident causing feature should be eliminated or minimized in the design stage whenever possible. Short ramps may not require a handrail, but in the interest of improved safety, it is desirable. Longer ramps, including step sets on stepped ramps, often require the installation of protective handrailings. Therefore, when planning ramps and stepped ramps, the same criteria pertaining to handrails and railings should be applied.

RECOMMENDATIONS:

Safety measures designed to reduce the potential accident hazards associated with the use of ramps and stepped ramps are stated below:

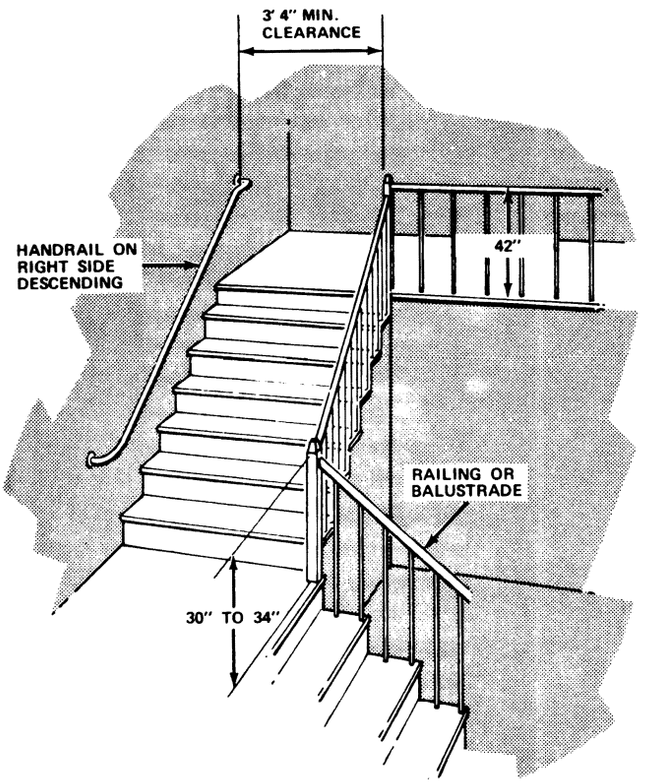
- **Handrails or railings shall be installed on all ramps and stepped ramps.**
- **Design criteria for handrails and railings shall be the same as those prescribed for handrails and railings intended for use on stairs (see page 2).**

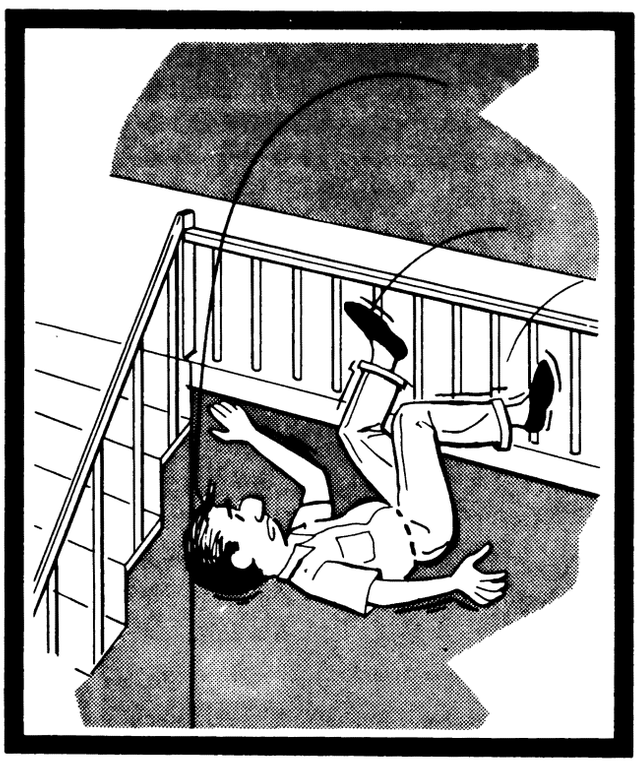
Railings for Balconies, Porches, Stair Landings, and Platforms

Railings are often designed and installed primarily as safeguards against falling from comparatively high elevations, to function aesthetically as room dividers, or for the dual purpose of protection and decor.

To perform satisfactorily as a safeguard, railings on balconies, porches, stair landings, and platforms should rise sufficiently above the walking level to call attention to the potential danger. Safety railings should also be high enough to avoid becoming a pivot hazard in the event a person collides with it, rather than contributing to an accidental fall over the railing. Safety railings should be designed, fabricated, and installed with sufficient strength to withstand the impact of a running child or the weight of a falling adult without complete failure. Railings designed primarily as decorative features need not necessarily have the strength characteristics required by safety railings, but they should be firmly constructed and anchored to withstand the usage normally expected, including that of adults sitting upon or leaning against the railing. Decorative railings should also rise above the floor to a height which will attract attention to their presence without providing a dangerous pivot point. No railing, decorative or otherwise, should be supported with a diagonal brace from the rail to the floor because of the tripping hazard a brace of this kind would present.

Other design, fabrication, and installation characteristics that should be considered for safety railings and decorative railings are the same as for handrails and balustrades designed for stairs. These characteristics include the aperture and grasp dimensions and the safety precautions noted in the use of cast iron and wrought iron railing components.





Railings on balconies, porches, and stair landings should be tall enough to direct attention to the potential danger.

RECOMMENDATIONS:

Decorative railings and railings intended for use on balconies, porches, platforms, and stair landings shall incorporate the following characteristics:

- Floor-to-Top-of-Railing Dimensions
  - ▲ Decorative railings and room dividers - minimum height - 30 inches.
  - ▲ Balconies and stairwells - minimum height - 42 inches.
  - ▲ Porches and platforms - minimum height - 30 inches.
- Railing Strength Criteria
  - ▲ Decorative railings shall be anchored securely to a wall and to the floor at a minimum of 3-foot intervals. Decorative railings shall withstand anticipated forces created by an adult male sitting or leaning against the railing at any point.
  - ▲ Design and installation of protective railings shall resist a minimum horizontal force, applied at the top, of 20 pounds per linear foot to 200 pounds, whichever is greater.
  - ▲ Use of diagonal bracing from the railing to the floor shall be avoided.
- Decorative Features
  - ▲ Use of oversize angular caps on railing corners and termination points shall be avoided.
  - ▲ Cast iron and wrought iron railings shall be free of burrs, sharp edges, and sharp points. Apertures in balustrades and between a railing and the floor shall not pass a spherical object larger than 5 inches in diameter.