

Safe Stairs V. P. I. & S. U. LIBRARY Run, Rise, & Tread

DEC 9 1971

BLACKSBURG, VIRGINIA

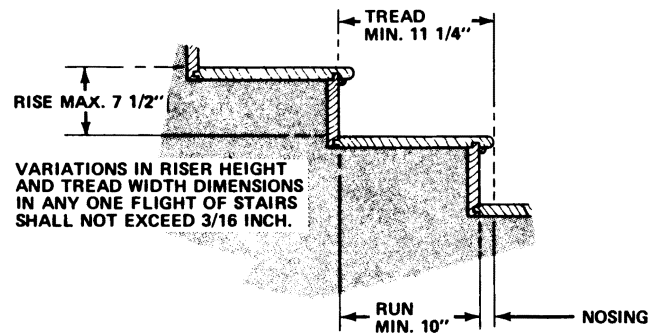
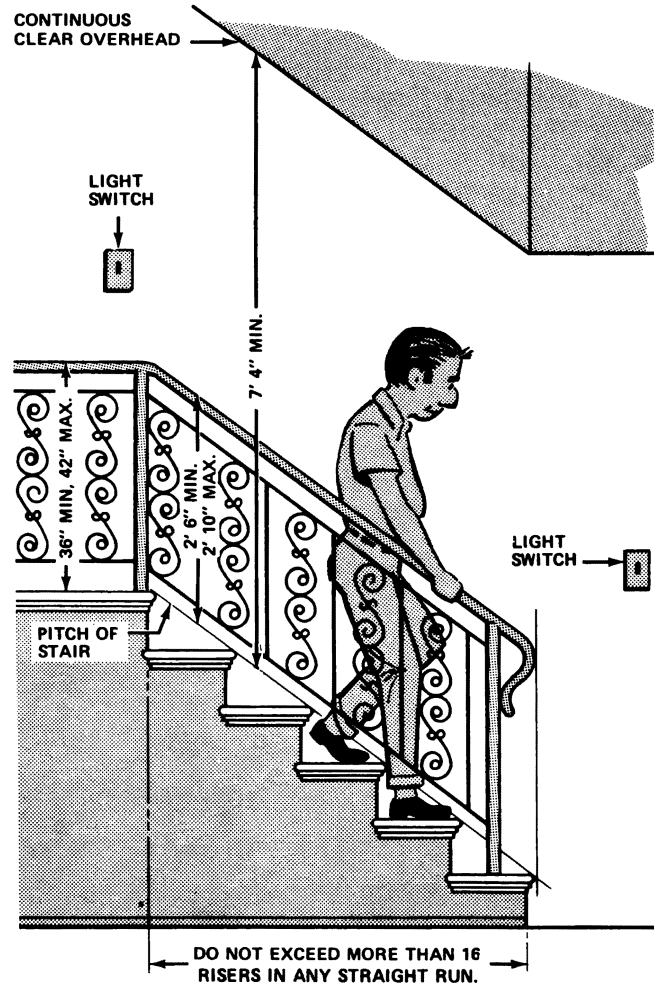
The run width, riser height, and tread width dictate the comfort and ease with which an individual may negotiate stairs. Improper dimensioning or installation of one of these elements alone or in combination can produce hazardous conditions.

The run-rise combination of stair design determines the degree of slope of the stairs. Extreme rise to run dimensioning produces steep stairs with high risers and narrow runs. The narrow run prescribes an equally narrow tread to avoid excessive nose overhang, which in itself can cause tripping. Narrow treads may also require a person to place his foot in a diagonal position on the tread for adequate support, thereby assuming an awkward, uncomfortable posture, which may precipitate an accidental fall. Ascending steep stairs is tiring and exposes the user to tripping, particularly those who are elderly or handicapped. The descending process is conducive to slipping over the nosing, is uncomfortable, and produces an unfavorable illusion of steepness which may create an unbalanced situation for the individual negotiating the stairs.

Many variations in the use of stair components may be considered in planning stairs from the safety standpoint. In determining dimensions, consideration should be given to commonly used finished floor to finished floor dimensions, dimensional variations in lumber, conservation of floor space, and the requirement to fit a set of stairs into a given space. Additional thought should be devoted to the type of stair layout best suited to the stated building constraints, which will also produce safe stairs. Standard variations include the straightrun, "L"-shaped, and "U"-shaped stair layouts. The use of spiral stairs in some instances is also an acceptable solution if properly designed and installed. Conventional construction practices and standard manufacturing dimensions should be clearly evaluated before finalizing the stair design.

Intensive engineering and human factors studies related to stair accidents have led to the formulation of certain conclusions and safety-oriented recommendations concerning the design and fabrication of stairs. Risers should measure no more than 7½ inches in height, runs no less than 10 inches in width, and stairway slope maintained within 30 to 35 degrees for the greatest comfort and safety in use. The 7½ and 10 inch dimensions mentioned above will produce a stair slope of more than 36 degrees, although there are values within those limitations which fall within the desired range of slope. The majority of the adult males

would experience adequate and safe foot contact on a minimum tread width of 11¼ inches.



STAIRWAY COMPONENT RELATIONSHIP

In many instances, the 7½ inch riser dimension may not provide an exact number of risers in a given space between finished floors. As an aid in determining the exact riser height dimension, the following method is presented:

- Determine the height from finished floor to finished floor in inches. Divide this number by 8. This usually gives a whole number and a fraction. The next largest whole number will be the total number of risers required.
- Divide the finished floor to finished floor height by the number of risers required to give the exact dimension of each riser. If this value exceeds 7½ inches, go to the next higher whole number.
- Knowing the riser height, the run can be determined by applying one or all of three proportioning rules:
 - ▲ 1 rise + 1 run = 17 - 18
 - ▲ 2 rise + 1 run = 24 - 25
 - ▲ 1 rise x 1 run = 70 - 75
 - ▲ Note: The number of runs is always one less than the number of risers.
- The data as presented in Table 2-1 may be used to check the approximate resultant slope of the stair using the selected dimensions.

TABLE 2-1. STAIRWAY SLOPE

		Run - Inches				
		10	10-1/4	10-1/2	10-3/4	11
Rise- Inches	7-1/2	36.8°	36.2°	35.5°	34.9°	34.4°
	7-1/4	35.9°	35.3°	34.6°	34°	33.4°
	7	35°	34.3°	33.7°	33.1°	32.5°

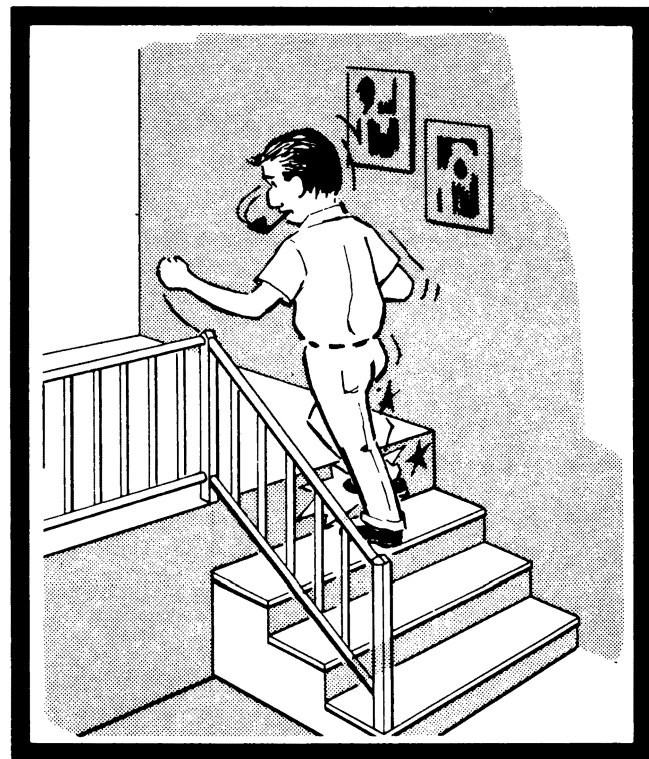
Table 2-2 shows the number of risers of a given height which can be placed in a given vertical space.

Exterior stair construction is not necessarily limited by tight space restrictions as in the case with interior stairs. Therefore, the design and construction of exterior stairs can

be expanded in the use of space to maintain a scale in keeping with the outdoor environment. Since exterior stairs may be used more frequently than interior stairs by individuals carrying bulky or heavy items, the lower risers and wider treads afforded by more ample space can reduce the likelihood that accidents will occur under these conditions.

Garden stairs are usually constructed in the ground and may frequently become covered with soil, lawn clippings, other outdoor debris, or growth, thereby reducing the effective tread area. Exterior stairs should provide ease of ascent and descent with a minimum of conscious attention to foot placement and balance.

Exterior stairs attached to a dwelling should incorporate a maximum riser height of 6 inches, a minimum run width of 11 inches, and a minimum tread width of 12 inches. Unattached exterior stairs should be constructed with a rise of not more than 5 inches and a run and tread of no less than 14 and 15 inches, respectively.



Dimensional variation in risers creates a tripping hazard.

Before building, consult the BOCA code.

Extension Division • Virginia Polytechnic Institute and State University • MI-153 • October 1977

Prepared by Helen L. Wells, Housing Specialist

Originally prepared for the Office of Research and Technology, U.S. Department of Housing and Urban Development, "A Design Guide for Home Safety" HUD-RT-17 January 1972

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. W. R. Van Dresser, Dean, Extension Division, Cooperative Extension Service, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.

The Virginia Cooperative Extension Service by law and purpose is dedicated to serve all people on an equal and nondiscriminatory basis. An Equal Opportunity/Affirmative Action Employer

RECOMMENDATIONS:

The design and construction of safe stairs for interior and exterior residential applications shall incorporate the following recommendations:

Interior Stairs:

- Maximum riser height - 7½ inches
- Minimum run width - 10 inches
- Minimum tread width - 11¼ inches
- Maximum nosing - 1¼ inches

Exterior Stairs - Attached to Dwelling:

- Maximum riser height - 6 inches
- Minimum run width - 11 inches
- Minimum tread width - 12 inches
- Maximum nosing - 1 inch

Exterior Stairs - Unattached:

- Maximum riser height - 5 inches
- Minimum run width - 14 inches

- Minimum tread width - 15 inches
- Maximum nosing - 1 inch

Once the riser height and tread width dimensions are determined, care must be observed in the fabrication process to hold variations in those dimensions to an absolute minimum. Many stair-related accidents can be attributed to non-uniform dimensions of risers and treads, although this condition is largely unrecognized as an accident cause. In 75 percent of stair-related accidents, as much as ½-inch variation existed in riser dimensions and tread dimensions, or both. Dimensional variations can break the natural rhythm set up by the individual in negotiating the stairs, causing him to trip and fall. Although zero tolerance is ideal, this requirement would be impractical. From the safety standpoint in the fabrication of stairs, a minimum tolerance range should be established and maintained. It is recommended that dimensional variations in stair risers and treads should not exceed 3/16 inch in any one flight of stairs.

RECOMMENDATION:

To reduce the incidence of accidents on stairs caused by tripping as a result of dimensional variations, the following recommendation is made:

- The variations in the height of risers and the width of treads in any one flight of stairs shall not exceed 3/16 inch.

TABLE 2-2. ASSEMBLED STAIR RISE SCALE

Height Of Riser	NUMBER OF RISERS							
	1	2	3	4	5	6	7	8
7	1- 2	1- 9	2- 4	2-11	3- 6	4- 1	4- 8-1/2	
7-1/16	1- 2-1/8	1- 9-3/16	2- 4-1/4	2-11-5/16	3- 6-3/8	4- 1-7/16	4- 8	
7-1/8	1- 2-1/4	1- 9-3/8	2- 4-1/2	2-11-5/8	3- 6-3/4	4- 1-7/8	4- 9	
7-3/16	1- 2-3/8	1- 9-9/16	2- 4-3/4	2-11-15/16	3- 7-1/8	4- 2-5/16	4- 9-1/2	
7-1/4	1- 2-1/2	1- 9-3/4	2- 5	3- 9-1/4	3- 7-1/2	4- 2-3/4	4-10	
7-5/16	1- 2-5/8	1- 9-5/16	2- 5-1/4	3- 0-9/16	3- 7-7/8	4- 3-3/16	4-10-1/2	
7-3/8	1- 2-3/4	1-10-1/8	2- 5-1/2	3- 0-7/8	3- 8-1/4	4- 3-5/8	4-11	
7-7/16	1- 2-7/8	1-10-5/16	2- 5-3/4	3- 1-3/16	3- 8-5/8	4- 4-1/16	4-11-1/2	
7-1/2	1- 3	1-10-1/2	2- 6	3- 1-1/2	3- 9	4- 4-1/2	5- 0	
7-9/16	1- 3-1/8	1-10-11/16	2- 6-1/4	3- 1-13/16	3- 9-3/8	4- 4-15/16	5- 0-1/2	
7-5/8	1- 3-1/4	1-10-7/8	2- 6-1/2	3- 2-1/8	3- 9-3/4	4- 5-3/8	5- 1	
7-11/16	1- 3-3/8	1-11-1/16	2- 6-3/4	3- 2-7/16	3-10-1/8	4- 5-13/16	5- 1-1/2	
7-3/4	1- 3-1/2	1-11-1/4	2- 7	3- 2-3/4	3-10-1/2	4- 6-1/4	5- 2	

Height Of Riser	NUMBER OF RISERS							
	9	10	11	12	13	14	15	16
7	5- 3	5-10	6- 5	7- 0	7- 7	8- 2	8- 9	9- 4
7-1/16	5- 3-7/16	5-10-5/8	6- 5-11/16	7- 0-3/4	7- 7-15/16	8- 2-7/8	8- 9-15/16	9- 5
7-1/8	5- 4-1/8	5-11-1/4	6- 6-3/8	7- 1-1/2	7- 8-5/8	8- 3-3/4	8-10-7/8	9- 6
7-3/16	5- 4-11/16	5-11-7/8	6- 7-1/16	7- 2-1/4	7- 9-7/16	8- 4-5/8	8-11-13/16	9- 7
7-1/4	5- 5-1/4	6- 0-1/2	6- 7-3/4	7- 3	7-10-1/4	8- 5-1/2	9- 0-3/4	9- 8
7-5/16	5- 5-13/16	6- 1-1/8	6- 8-7/16	7- 3-3/4	7-11-1/16	8- 6-3/8	9- 1-11/16	9- 9
7-3/8	5- 6-3/8	6- 1-3/4	6- 9-1/8	7- 4-1/2	7-11-7/8	8- 7-1/8	9- 2-5/8	9-10
7-7/16	5- 6-15/16	6- 2-3/8	6- 9-13/16	7- 5-1/4	8- 0-11/16	8- 8-1/8	9- 3-9/16	9-11
7-1/2	5- 7-1/2	6- 3	6-10-1/2	7- 6	8- 1-1/2	8- 9	9- 4-1/2	10- 0
7-9/16	5- 8-1/16	6- 3-5/8	6-11-3/16	7- 6-3/4	8- 2-5/16	8- 9-7/8	9- 5-7/16	10- 1
7-5/8	5- 8-5/8	6- 4-1/4	6-11-7/8	7- 7-1/2	8- 3-1/8	8-10-3/4	9- 6-3/8	10- 2
7-11/16	5- 9-3/16	6- 4-7/8	7- 0-9/16	7- 8-1/4	8- 3-15/16	8-11-5/8	9- 7-5/16	10- 3
7-3/4	5- 9-3/4	6- 5-1/2	7- 1-1/4	7- 9	8- 4-3/4	9- 0-1/2	9- 8-1/4	10- 4