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**Subject:**

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[Ergonomically](#) and for [safety](#) reasons, stairs must have certain measurements so that people can comfortably use them. [Building codes](#) typically specify certain measurements so that the stairs are not too steep or narrow.

American building codes specify the following parameters: [\[5\]](#)[\[6\]](#)[\[7\]](#)

- Minimum tread length, typically 9 inches (229 mm) excluding the nosing for private residences. Some building codes also specify a minimum riser height, often 5 inches (127 mm).[\[8\]](#)
- Riser-Tread formula: Sometimes the stair parameters will be something like riser + tread equals 17–18 inches (432–457 mm);[\[9\]](#) another formula is 2 times riser + tread equals 24.6 inches (625 mm), the length of a stride.[\[3\]](#) Thus a 7 inches (178 mm) rise and a 10.6 inches (269 mm) tread exactly meets this code. If only a 2 inches (51 mm) rise is used then a 20.6 inches (523 mm) tread is required. This is based on the principle that a low rise is more like walking up a gentle incline and so the natural swing of the leg will be longer. This makes low rise stairs very expensive in terms of the space consumed. Such low rise stairs were built into the [Winchester Mystery House](#) to accommodate the infirmities of the owner, [Sarah Winchester](#), before the invention of the [elevator](#). These stairways, called "Easy Risers" consist of five flights wrapped into a multi-turn arrangement with a total width equal to more than four times the individual flight width and a depth roughly equal to one flight's run plus this width. The flights have varying numbers of steps.
- Slope: A value for the rise-to-tread ratio of  $17/29 \approx 0.59$  is considered optimal;[\[3\]](#) this corresponds to a pitch angle of about  $30^\circ$ .
- Variance on riser height and tread depth between steps on the same flight should be very low. Building codes require variances no larger than 0.1875 inches (4.76 mm) between depth of adjacent treads or the height of adjacent risers; within a flight, the tolerance between the largest and smallest riser or between the largest and smallest tread can not exceed 0.375 inches (9.5 mm).[\[10\]](#) The reason is that on a continuous flight of stairs, people get used to a regular step and may trip if there is a step that is different, especially at night. The general rule is that all steps on the same flight must be identical. Hence, stairs are typically custom made to fit the particular floor to floor height and horizontal space available. Special care must be taken on the first and last risers. Stairs must be supported directly by the subfloor. If thick flooring (e.g. thick hardwood planks) are added on top of the subfloor, it will cover part of the first riser, reducing the effective height of the first step. Likewise at the top step, if the top riser simply reaches the subfloor and thick flooring is added, the last rise at the top may be higher than the last riser. The first and last riser heights of the rough stairs are modified to adjust for the addition of the finished floor.
- Maximum nosing protrusion, typically 1.25 inches (32 mm) to prevent people from tripping on the nosing.
- Height of the handrail. This is typically between 34 and 38 inches (864 and 965 mm), measured to the nose of the tread. The minimum height of the handrail for landings may be different and is typically 36 inches (914 mm).
- Handrail diameter. The size has to be comfortable for grasping and is typically between 1.25 and 2.675 inches (32 and 67.9 mm).
- Maximum space between the balusters of the handrail. This is typically 4 inches (102 mm).
- Openings (if they exist) between the bottom rail and treads are typically no bigger than 6 inches (152 mm).
- Headroom: At least 83 inches (211 cm).[\[3\]](#)
- Maximum vertical height between floors or landings. This allows people to rest and limits the height of a fall.
- Mandate handrails if there is more than a certain number of steps (typically 2 risers)
- Minimum width of the stairway, with and without handrails

- Not allo

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