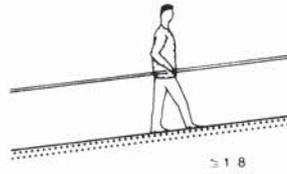
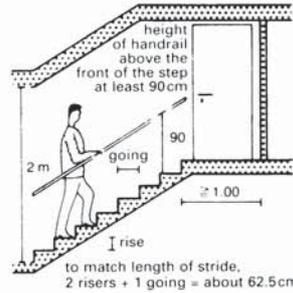


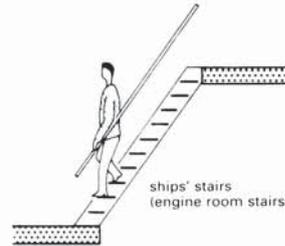
1 Standard stride of an adult on a horizontal plane



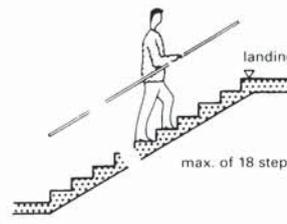
2 On a ramp the stride is reduced proportionately (desirable slope 1:10-1:8)



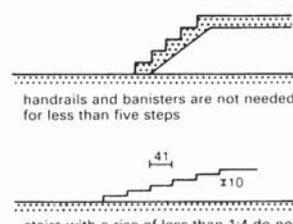
3 Optimum rise-to-tread ratio 17/29



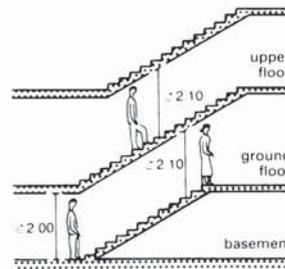
4 Ladder stairs with a handrail



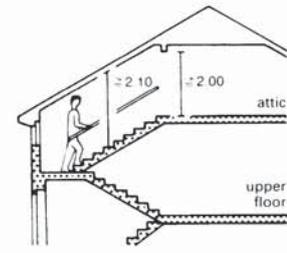
5 Normal stairs 17/29; landing after a max. of 18 steps



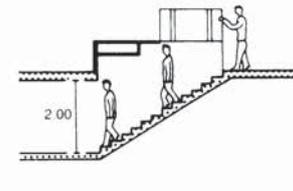
6 Steps without a handrail



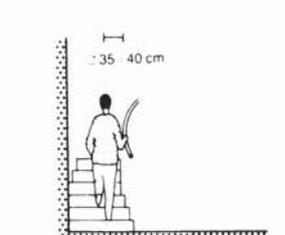
7 Superimposed stairs save space



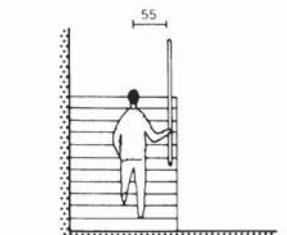
8 Laying the rafters and beams parallel to the stairs saves space and avoids the need for expensive alterations



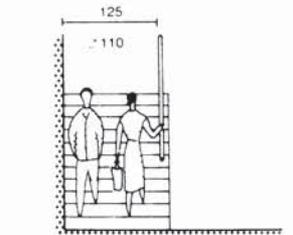
9 Covered entrances to cellars and trapdoors should be avoided. However, this combination has advantages and is safe



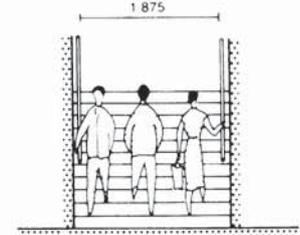
10 If stairs are narrow or curved the distance of the line of walk to the outer string should be 35-40cm



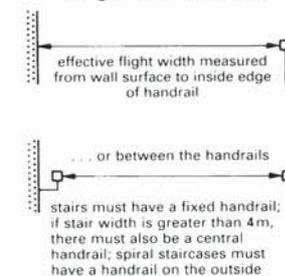
11 If stairs are straight and wide the distance of the line of walk to the handrails should be 55cm



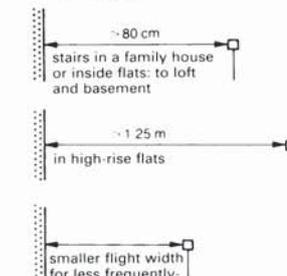
12 Stair width allowing two people to pass



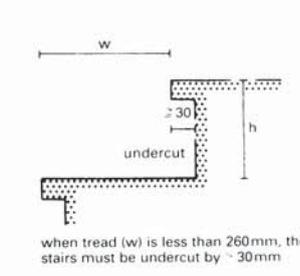
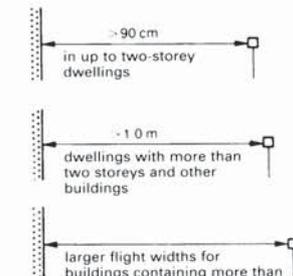
13 Stair width allowing three people to meet and pass



14 Minimum dimensions for stairs



15 Measuring the effective flight width



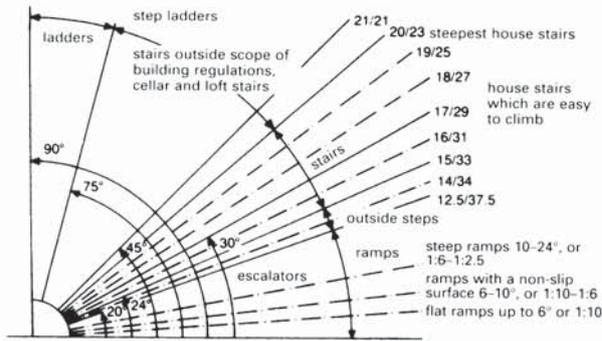
16 The proportions of the stair rises must not change as you go up

Calculations for the construction of stairs, ramps and guards are set out in various national building regulations. In the UK, British Standards and the Building Regulations should be consulted (see Approved Document K). The guidelines here are based on German standards.

Dwellings with no more than two flats must have an effective stair width of at least 0.80m and 17/29 rise-to-tread ratio. Stairs which are not strictly covered by building regulations may be as little as 0.50m wide and have a 21/21 ratio. Stairs governed by building regulations must have a width of 1.00m and a ratio of 17/28. In high rise flats they must be 1.25m wide. The length of stair runs from ≥ 3 steps up to ≤ 18 steps - ⑤. Landing length = n times the length of stride + 1 depth of step (e.g. with a rise-to-tread ratio of 17/29 = $1 \times 63 + 29 = 92$ cm or $2 \times 63 + 29 = 1.55$ m). Doors opening into the stairwell must not restrict the effective width.

The time required for complete evacuation must be calculated for stair widths in public buildings or theatres. Such staircases or front entrance steps are climbed slowly, so they can have a more gradual ascent. A staircase at a side entrance or emergency stairs should make a rapid descent easy.

STAIRS



height of storey	two-way stairs		single, triple width and stairs in buildings	
	steps, no.	steps, height	steps, no.	steps, height
a	b	c	f	g
2250	-	-	13	173.0
2500	14	178.5	15	166.6
2625	-	-	15	175.0
2750	16	171.8	-	-
3000	18	166.6	17	176.4

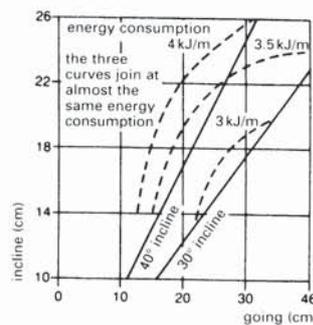
The experiences one has of ascending and descending stairs varies greatly with the stair design, for example there is a significant difference between an interior domestic design and a grand flight of entrance steps. Climbing stairs takes on average seven times as much energy as walking on the flat. From the physiological point of view, the best use of 'climbing effort' is with an angle of incline of 30° and a ratio of rise of:

1 Incline for ramps, outside stairs, house stairs, machinery access steps and ladders

2 Height of storey and step rise

type of building	type of stairs		effective width of stairs	rise, r ²¹	going, g ³¹
residential building with no more than two flats ¹¹	essential stairs (building regulations)	stairs leading to habitable rooms, cellar and loft steps which lead to non-habitable rooms	≥ 80	17 ± 3	28 ²² ₅
		stairs (additional) considered non-essential according to building regulations	≥ 50	≤ 21	≥ 21
		stairs (additional) considered non-essential according to building regulations (flats)	≥ 50	no stipulations	
other buildings	essential stairs according to building regulations		≥ 100	17 ²³ ₅	28 ²² ₅
	stairs (additional) considered non-essential according to building regulations		≥ 50	≤ 21	≥ 21

¹¹ Also includes maisonettes in buildings with more than two flats; ²¹ but not <14cm.; ³¹ but not >37cm = stipulation of the ratio of rise r/g

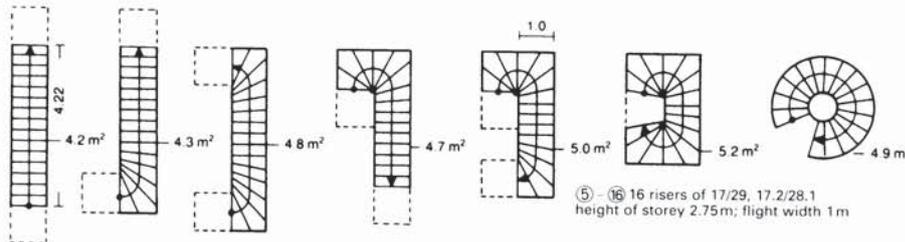


rise of step, $r = 17$
going of step, $g = 29$
The angle of rise is determined by the length of an adult's stride (about 61-64cm). To arrive at the optimum rise, which takes the least energy, the following formula can be applied:

$$2r + g = 63\text{cm (1 stride)}$$

3 Stairs in buildings

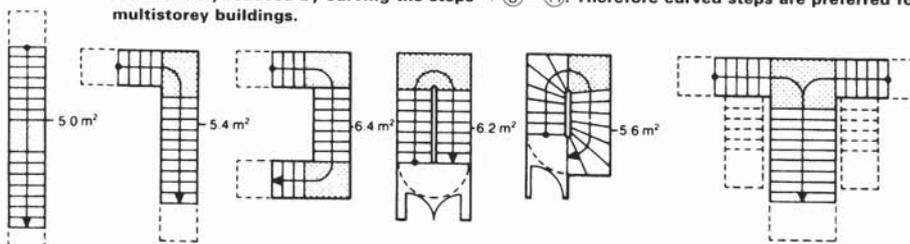
4 Energy consumption of an adult climbing stairs



In the dimensioning and design of flights of stairs, the function and purpose of the staircase is of primary importance, taking in the factors mentioned above.

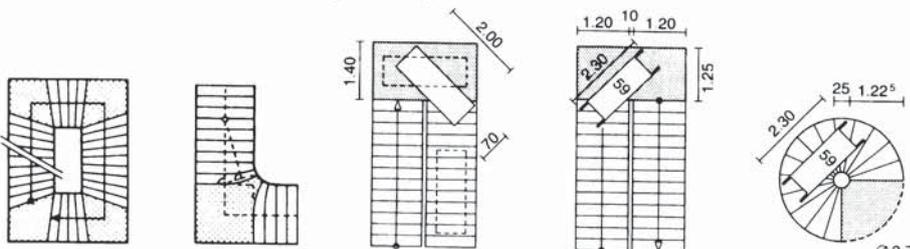
5 - 11 All stairs without landings, whatever the type, take up almost the same surface area. However, the distance from the top of the lower floor stairs to the foot of the next staircase can be considerably reduced by curving the steps → 6 - 11. Therefore curved steps are preferred for multistorey buildings.

Not only is the gaining of height important, but also the way that the height is gained. For front door steps in frequent use, low steps of 16 × 30cm are preferable. However, stairs in a workplace, or emergency stairs, should enable height to be gained rapidly. Every main staircase must be set in its own continuous stairwell, which together with its access routes and exit to the open air, should be designed and arranged so as to ensure its safe use as an emergency exit. The width of the exit should be ≥ the width of the staircase.



12 - 16 Stairs with landings take up the area of one flight of stairs + the surface area of landing - surface area of one step. For a height per storey of ≥ 2.75 m, stairs with landings are necessary. Width of landing ≥ stair flight width.

17 Three flight-width stairs are expensive and a waste of space



18 Winders save space

19 Curved steps at the landing on a narrow stairway save landing space

20 Minimum space required for moving furniture

21 Transporting a stretcher

22 On a spiral staircase

The stairwell of at least one of the emergency staircases or fire exits must be ≤ 35m from every part of a habitable room or basement. When several staircases are necessary, they must be placed so as to afford the shortest possible escape route. Stairwell openings to the basement, unconverted lofts, workshops, shops, storerooms and similar rooms must be fitted with self-closing fire doors with a fire rating of 30 minutes.