

# Technology and Environment 1

## Construction Technology 1

Lecture 7

STAIRCASES - PRIVATE AND  
COMMON

# Learning Outcomes

## Aim

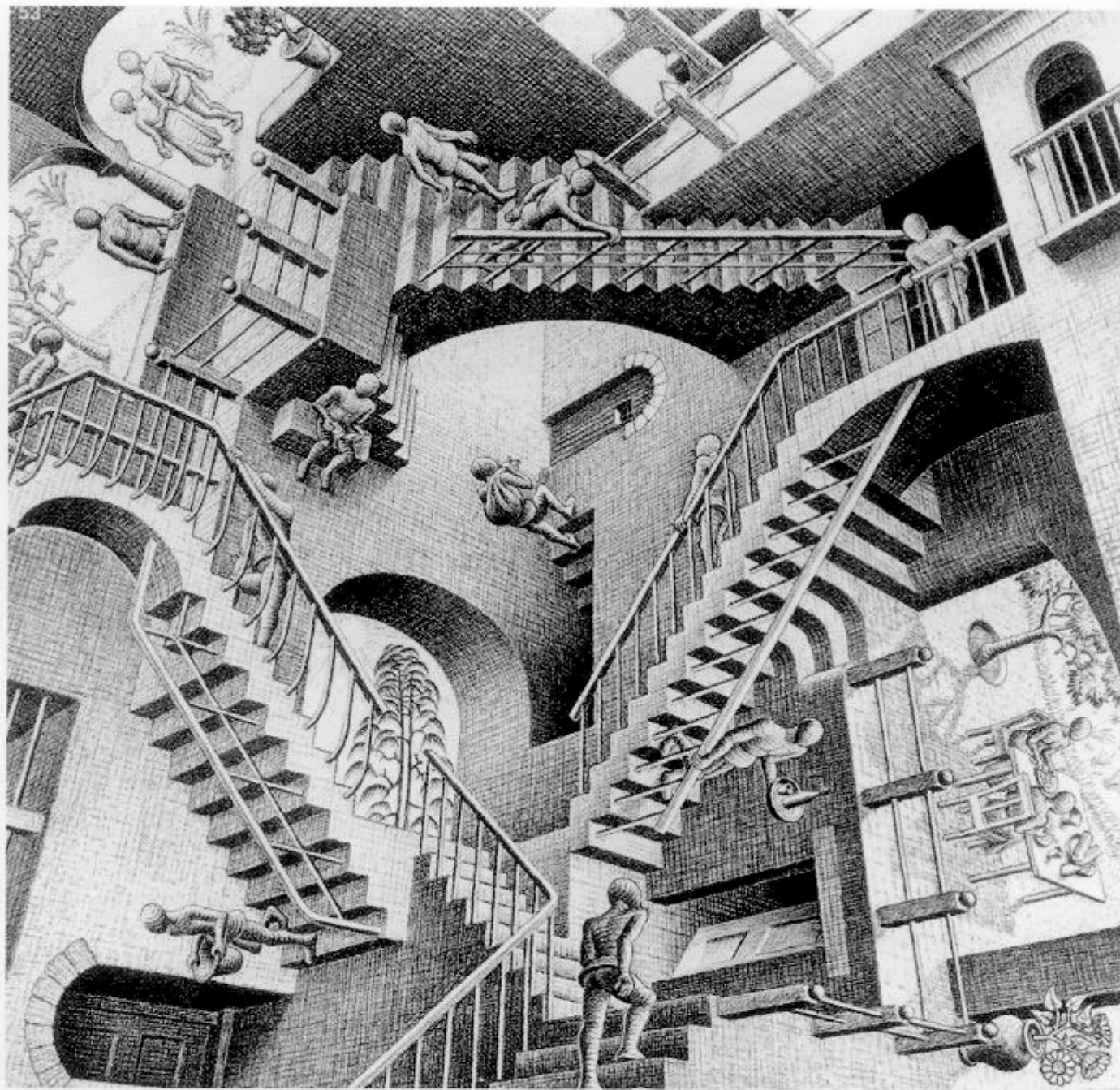
- To introduce the topic area of private and common staircases for low rise domestic buildings.
- Become familiar with the basic design requirements and potential of stairs

## Learning objectives

- Identify the basic design requirements of a stair: the difference between private and public stairs and apply the knowledge to the development of studio and / or course work

# STAIRCASES OVERVIEW

- Stairs have always served practical needs.
- The staircase has existed for one very specific purpose: to surmount gaps between different levels.
- Stairs have also contributed to creating dramatic spaces of great interest.



M.C. Escher's "Relativity" © 2002 Cordon  
Art B.V. - Baarn - Holland.

# STAIRCASES OVERVIEW

- Staircases became associated with religious practices an expression of the ascension of the spirit.
- Building on the role of stairs to sacred places, stairs can have a ceremonial role.
- This symbolism can be seen in the pyramids of the Mayas.

Maya  
Temple 1  
Tikal  
Guatemala



# STAIRCASES OVERVIEW

- Secular architecture developed features intended to convey political and economic power and the staircase became a compositional element that acquired an increasing importance in the overall visual impact of many buildings.



# STAIRCASES OVERVIEW

- Staircases often embody a set of values or an aspiration towards technical perfection.

# Timber stair



# DESIGN CONSIDERATIONS

- **Design Considerations**
- Stairs make it possible to pass from one level to another safely. Stairs, ladders and ramps shall offer safety to users moving between levels of the building.
- There are several types of stairs and the simplest is a straight flight consisting of a straight run of parallel steps.
- Stairs can also include a landing, winders and turning and can be circular (spiral).



# STAIRCASES

- TERMINOLOGY COMMON TERMS
- **FLIGHT** - The part of a stair or ramp between landings that has a continuous series of steps or a continuous slope.
- **GOING** - The horizontal dimension from front to back of a tread less any overlap with the next tread above.
- **RISE** - The height between consecutive treads.

# Concrete stair



# Glass and steel stair



# Spiral stair



# SAFETY

- In order for a stairs to be safe the following issues have to be considered and are set out in the Building Regulations Approved Document K.

# SAFETY

- Steepness - The steepness of overall stairs is measured as the angle of the stair pitch. Individual steps dimensions are also limited and all risers and goings of a staircase should have the same dimensions.
- Headroom - Enough space has to be allowed above a user's head to avoid clashes
- Balustrade - A balustrade is required at a height of 900 (see notes) above the pitch of the stairs, with a handrail at least on one side of the stairs

# SAFETY

- Children's safety (domestic stairs only) - avoid gaps larger than 100mm and horizontal balustrade elements that can be used to climb over stair edge
- Structural stability - The stairs including balustrades have to be built to take the necessary loadings

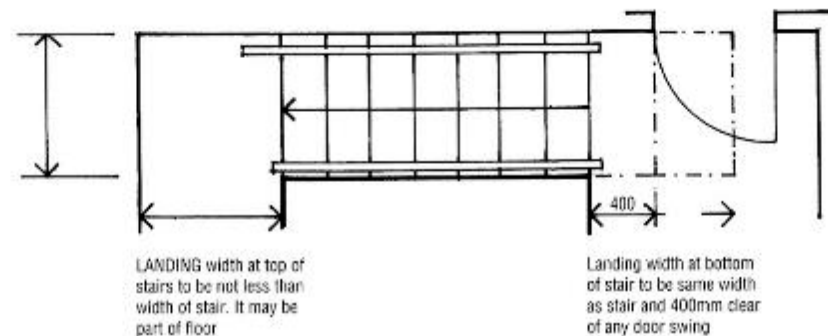
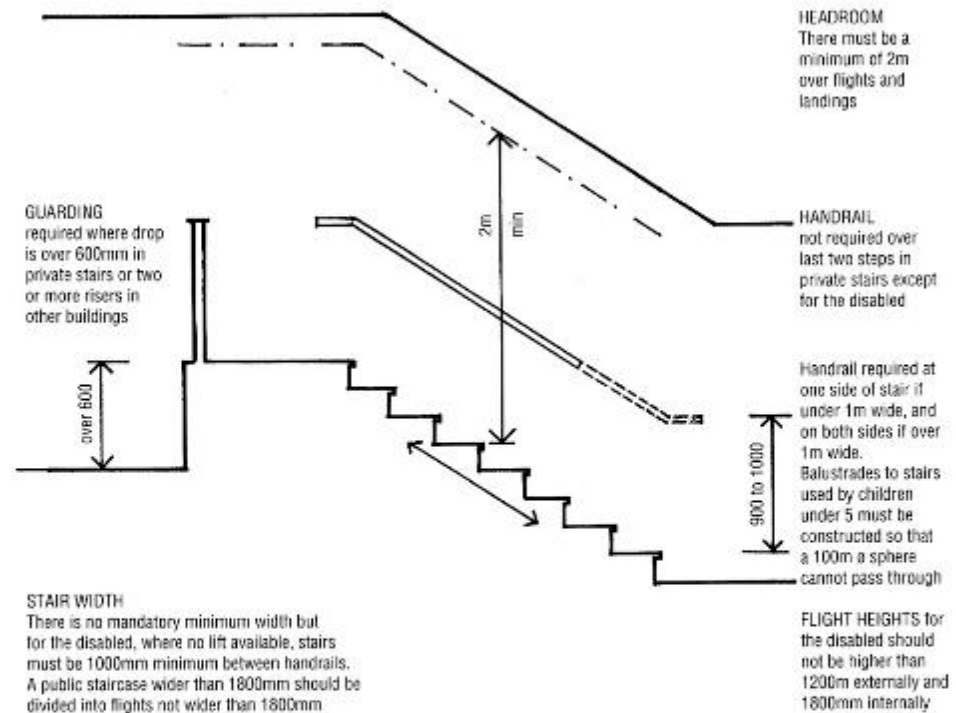
# DISABLED ACCESS

- Disability - Ambulant disabled, the elderly etc can be expected to use public stairs and their needs should be taken into account. Shallower stairs are needed in these cases. All public buildings have to have a ramped access for wheelchair access. Ramps are to be a maximum slope of 1:12 for ramps of 5 or less metres and 1 :15 for longer ramps.
- See also Building Regulations Part M

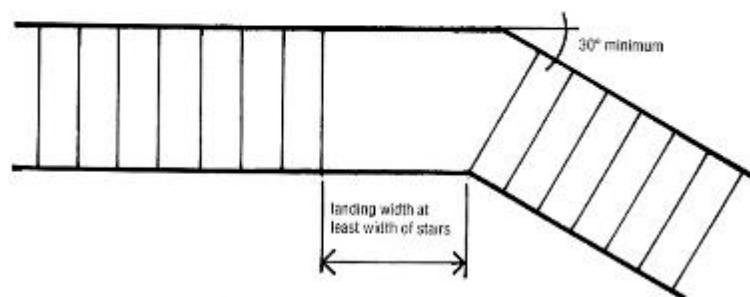
# Building Regulations

## Stairs

### Building Regulations requirements



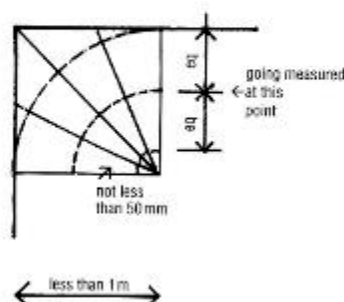
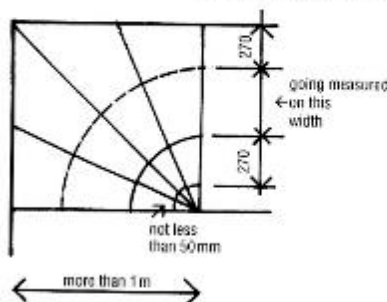
# Building Regulations requirements



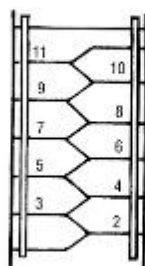
## LONG FLIGHTS

Stairs with more than 36 risers in consecutive flights should make at least one change of direction of not less than 30°. No more than 16 risers in any flight of stairs serving areas used as a shop or for assembly.

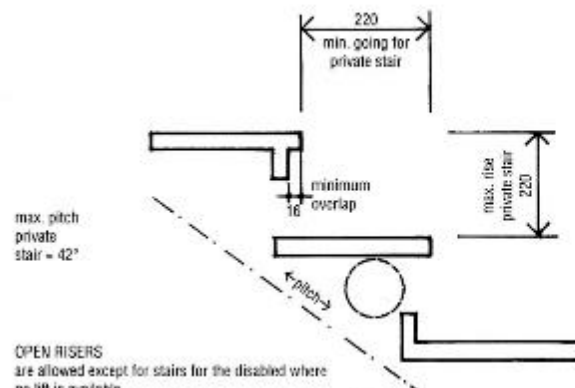
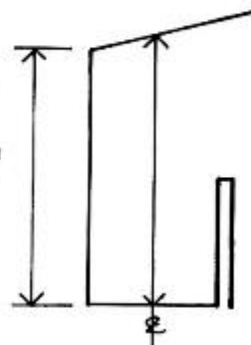
## TAPERED TREADS measurement of going



**ALTERNATING TREADS**  
may be permitted for loft conversions where there is no room for a proper staircase. They may only access one room and must have handrails both sides and non-slip surface to treads.



**LOFT CONVERSIONS**  
Headroom may be reduced if height at centre of stair is at least 1900mm and not less than 1800mm at side of stair



**OPEN RISERS**  
are allowed except for stairs for the disabled where no lift is available.  
Stairs used by children under 5 must have treads overlapping a minimum of 16mm and be constructed so that a 100mm sphere cannot pass through.

## SOURCES:

Building Regulations Approved Documents  
K Stairs, ramps and guards  
M Access for disabled people  
B Fire safety  
N Glazing (for glass balustrades)  
BS 6180: 1982 for strength of balustrades  
Spiral and helical stairs should be in accordance with BS 5395: Part 2: 1984

| RISE and GOING                        | max. rise | min. going |
|---------------------------------------|-----------|------------|
| Private stair                         | 220       | 220        |
| External stair for the disabled       | 150       | 280        |
| Internal stair for the disabled       | 170       | 250        |
| Institutional & Assembly stair        | 180       | 280        |
| Assembly building < 100m <sup>2</sup> | 180       | 250        |
| Other stair                           | 190       | 250        |

normal ratio: twice the rise plus going  
(2R + G) should be between 550mm and 700mm

## Gradients

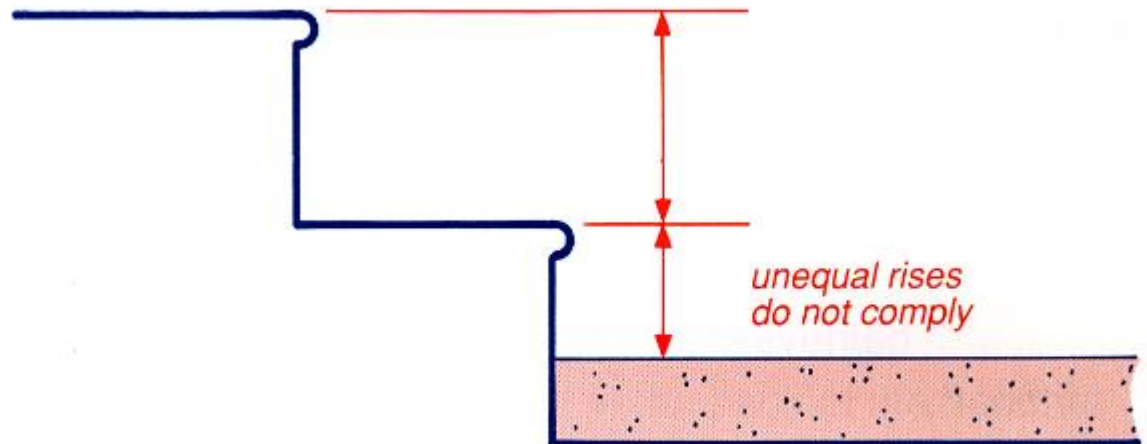
| %    | Slope  | Application                                                                                                                                    |
|------|--------|------------------------------------------------------------------------------------------------------------------------------------------------|
| 5%   | 1:20   | maximum uphill gradient preferred by cyclists<br>maximum outdoor slope for pedestrians                                                         |
| 6.5% | 1:15.4 | maximum downhill gradient preferred by cyclists                                                                                                |
| 6.7% | 1:15   | maximum wheelchair ramp for a maximum length of 10 m                                                                                           |
| 8.3% | 1:12   | maximum wheelchair ramp for a maximum length of 5 m                                                                                            |
| 8.5% | 1:11.8 | maximum indoor slope for pedestrians                                                                                                           |
| 10%  | 1:10   | maximum ramp for lorry loading bays and most car parking garages                                                                               |
| 12%  | 1:8.3  | any road steeper than this will be impassable in snow without snow tyres or chains<br>maximum for dropped pavement kerbs of less than 1 m long |
| 15%  | 1:6.7  | absolute maximum for multi-storey car parks                                                                                                    |

# Rise and Going

## **consistent rise and going**

In each flight of stairs all the steps should have the same rise and going.

The thicknesses of screeds and floor finishes should be taken into account.



# Rise and going dimensions

The dimensions for maximum rise and minimum going should be:

| Type of stairs               | Maximum rise [mm] | Minimum going [mm] |
|------------------------------|-------------------|--------------------|
| Private stairs               | 220               | 220                |
| Common stairs (not Scotland) | 190               | 240                |
| Access stairs (Scotland)     | not specified     | 250                |

The dimensions of the rise (R) and the going (G) should usually be related so that  $2R+G$  is between 550mm and 700mm.

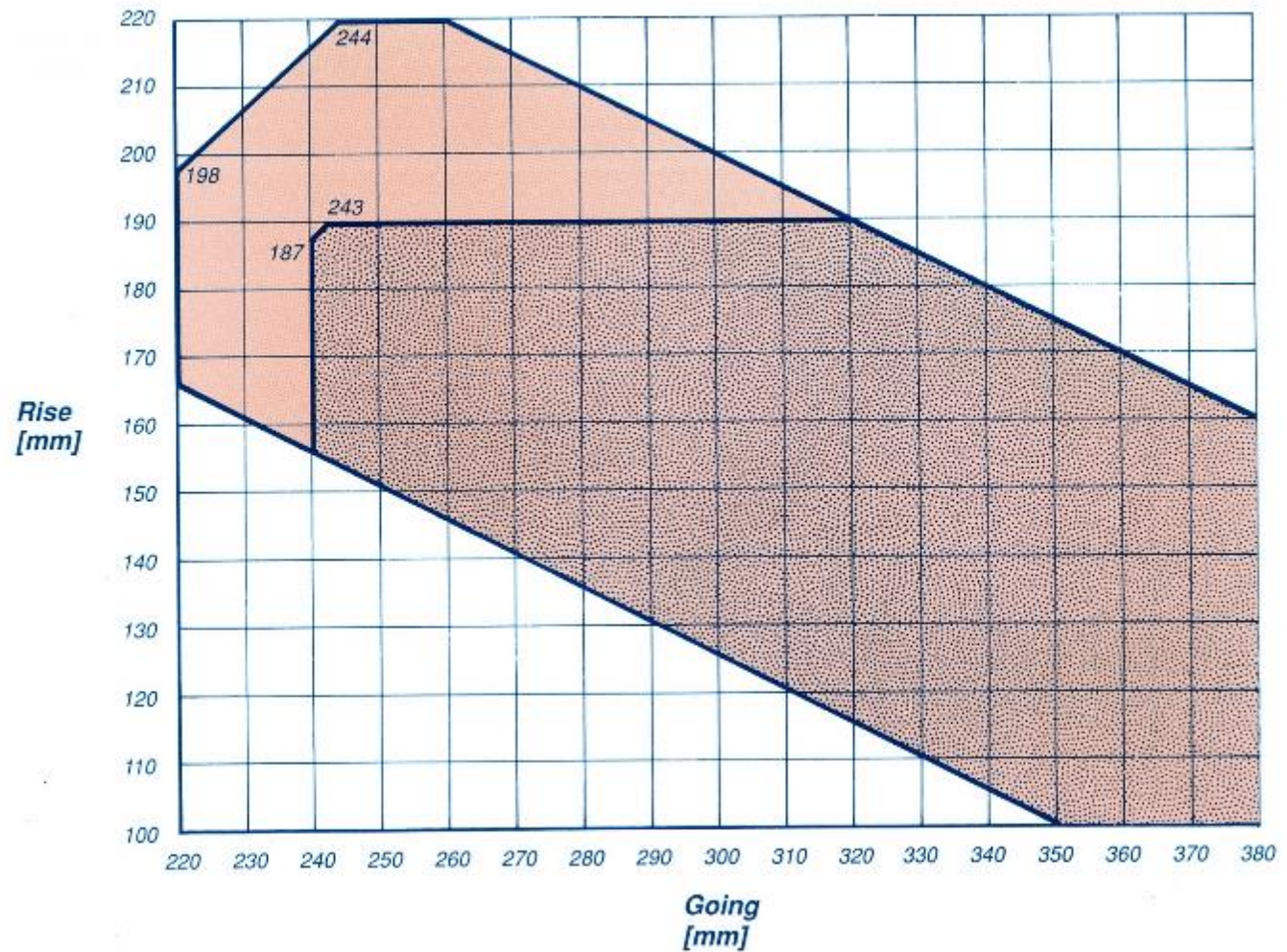
A design aid giving the relationship between rise and going is given in Appendix 6.6-B.

Further information on staircase design may be found in BS 5395 : Part 2.

# Design Aid

## Design aid for rise and going

Rise and going which intersect within the relevant shaded areas meet the criteria  $2R+G$  between 550mm and 700mm.



### Key

- Private stairs - whole of red shaded area
- Common stairs - textured area only

# DESIGN OF STEPS

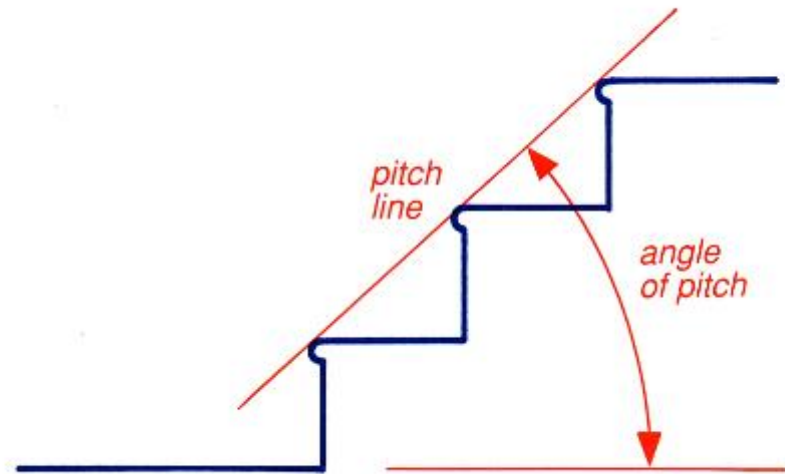
The design of steps shall allow safe use of the staircase

Items to be taken into account include:

## (a) pitch

The maximum angle of pitch of a stairway should not exceed:

- $42^\circ$  for private stairs
- $38^\circ$  for common or access stairs.

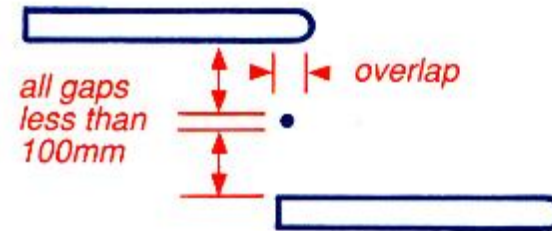


## DESIGN OF STEPS (continued)

### safe foothold

All steps should have level treads.

Stairs with open risers should have treads that overlap 15mm minimum.



Where stairs are open to the weather or may otherwise become wet, a non-slip finish or an insert to each tread should be specified.

# LANDINGS

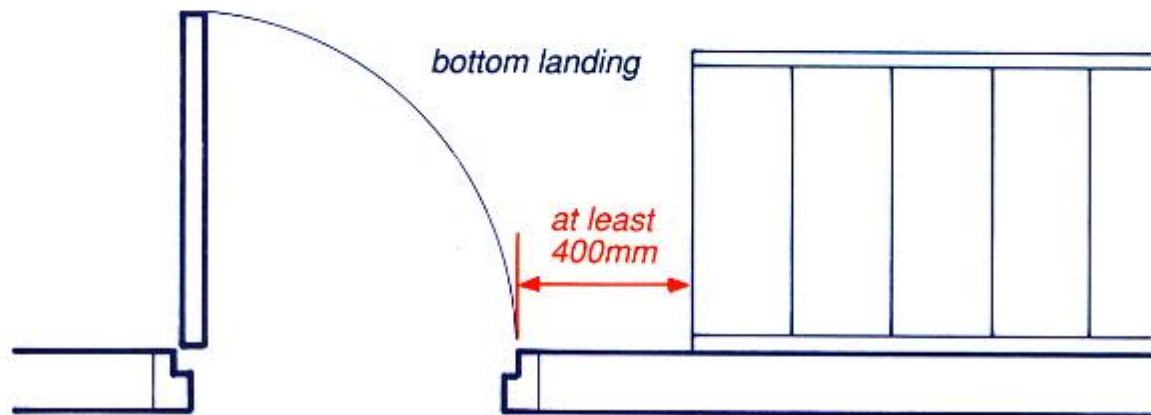
**Landings shall be designed to allow safe use of the staircase**

Landings should be provided at the top and bottom of every flight. The width and depth of landings should be at least the same as the width of the stair.

Landings should be properly framed to provide full support and secure fixings for flights, nosings, newels, etc.

Where pivot windows are being used, they should not obstruct the landing area or stair flight when in the open position.

Generally, door swings should not obstruct landings. However, a door may open across the bottom landing of a flight of private stairs if the swing is at least 400mm from the first tread and the dwelling is not over two storeys high.



# HANDRAILS

**Handrails shall be designed to provide an uninterrupted, safe handhold**

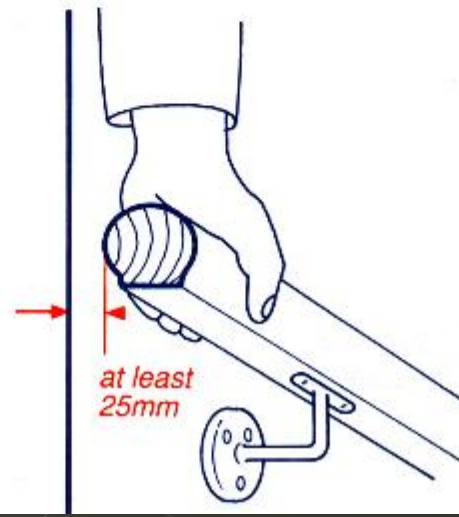
A continuous handrail is required to all flights of stairs that rise over 600mm.

Where winders are used, Building Regulations (Northern Ireland) and the Isle of Man Byelaws require a handrail to be fitted on the side where tapered treads have the greater going.

Handrails should be at a height between 840mm and 1000mm above the pitch line.

Design should ensure:

- a firm handhold
- that trapping or injuring the hand is prevented
- a minimum 25mm clearance at the back of the handrail
- secure fixing
- that handrail ends do not project to catch clothing, etc.

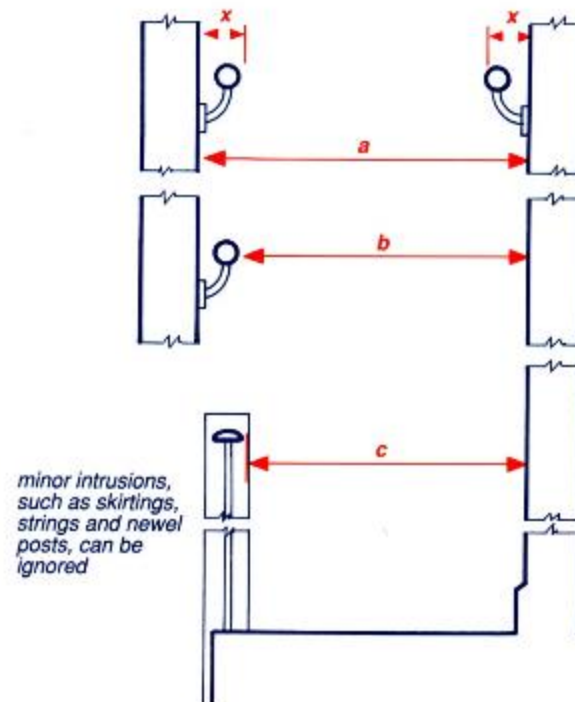


**minimum unobstructed width**

Generally, stairs within dwellings (private stairs) should have a minimum width of 800mm; stairs serving more than one property (common or access stairs) should be at least 900mm wide.

The following ways of measuring staircase width should be used:

| Staircases                                                            | Measurement                                         |
|-----------------------------------------------------------------------|-----------------------------------------------------|
| Private stairs                                                        | <b>b or c</b>                                       |
| Access and escape stairs in Scotland                                  | <b>a</b> (where <b>x</b> is not greater than 100mm) |
| Common stairs in England, Wales, Northern Ireland and the Isle of Man | <b>b or c</b>                                       |



# WIDTH OF FLIGHT

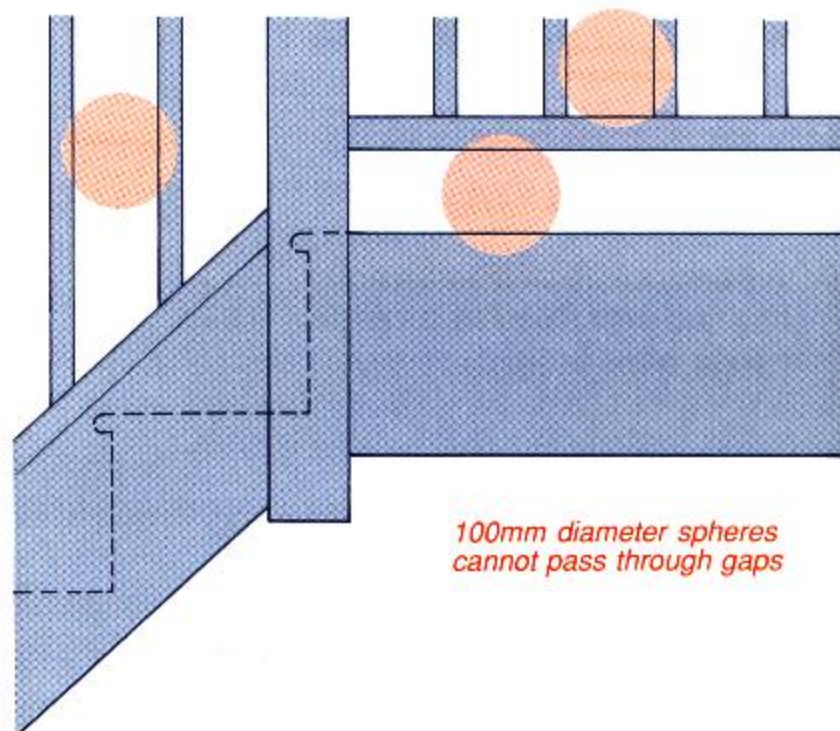
- You should bear in mind the requirements for stairs which:
  - a) Form part of a means of escape-see part B of the Building Regulations
  - b) Provide access for disabled people-see part M of the Building Regulations.

# HANDRAILS AND BALUSTRADES

**Balustrading shall be securely fixed and constructed to reduce the risk of it being climbed or fallen through**

Statutory regulations require that balustrading:

- is fixed securely
- cannot be easily climbed, and
- has no gaps which would allow a 100mm diameter sphere to pass through.



In concrete staircases, balustrading may be:

- grouted into pre-formed holes or pockets
- bolted or screwed into pre-drilled holes
- bolted to brackets cast into the concrete.

# GUARDING

**Guarding shall be designed to prevent accidents by falling**

Items to be taken into account include:

**resistance to loads**

Guarding should be:

- capable of resisting a horizontal force of  $0.36\text{kN/m}$  at its minimum required height
- a solid wall or balustrading.

Where guardrails or balustrades are long, the newel posts may not be sufficient to transfer horizontal forces to the structure and intermediate posts may be needed.

The method of fixing newels should be specified (eg through-bolted to joists).

Any glazing in the guarding should be toughened or laminated glass, or glass blocks. Wired glass is not regarded as safe for this purpose and should not be used.

# GUARDING

## dimensional requirements

Guarding should be provided along the full length of the open sides of all stairs and landings when the drop is more than 600mm at any point.

Guarding is not needed when the rise is less than 600mm and when the stair or landing is not a means of escape.

Balustrading should be designed so that it is not easily climbed by children.

No opening in the balustrade should be large enough for a 100mm diameter sphere to pass through.

| Type of stairs                                       | Minimum guarding height [mm] |          |
|------------------------------------------------------|------------------------------|----------|
|                                                      | flights                      | landings |
| Private stairs                                       | 840                          | 900      |
| Common stairs (Northern Ireland and the Isle of Man) | 900                          | 1100     |
| Common stairs (England and Wales)                    | 900                          | 1000     |
| Access stairs (Scotland)                             | 900                          | 1100     |

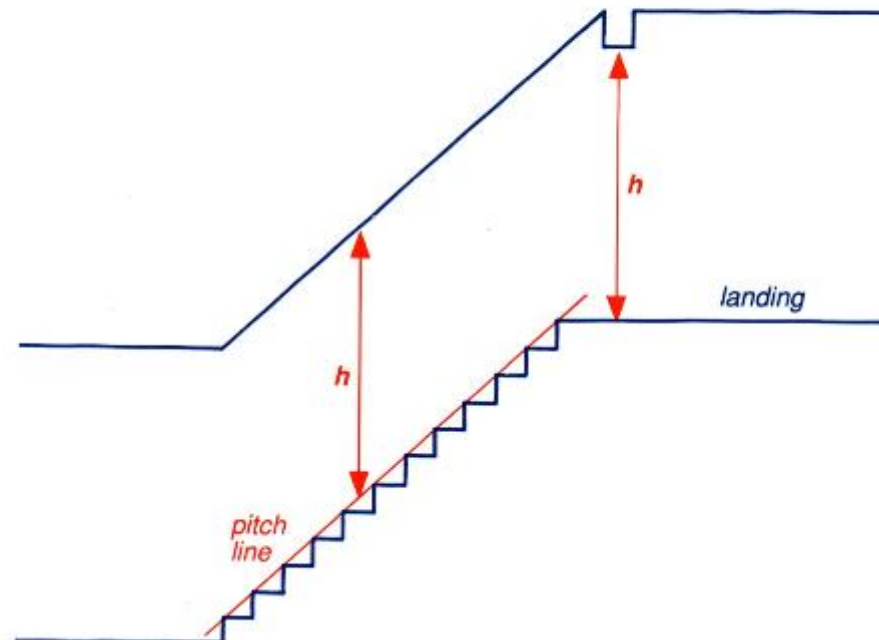
# STAIRCASE WIDTH AND HEADROOM

Staircase design shall ensure adequate provision for:

(a) headroom

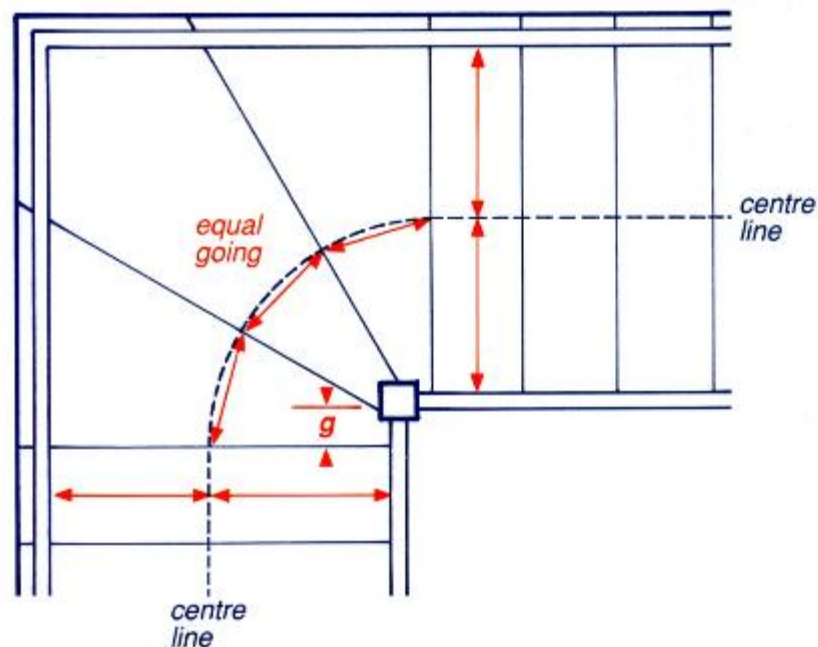
The minimum headroom above stairs should be measured vertically from the pitch line. The clear headroom over the entire length and width of a stairway, including landings, should be as follows:

| Location                             | Headroom ( $h$ ) |
|--------------------------------------|------------------|
| England and Wales                    | 2.0m             |
| Scotland                             | 2.05m            |
| Northern Ireland and the Isle of Man | 2.0m             |



## tapered treads and winders

The rise of tapered treads should be the same as that of adjacent parallel treads. The going should be uniform and not less than the going of the associated straight flight. The going should be measured from the centre line of the straight flight (as shown below).



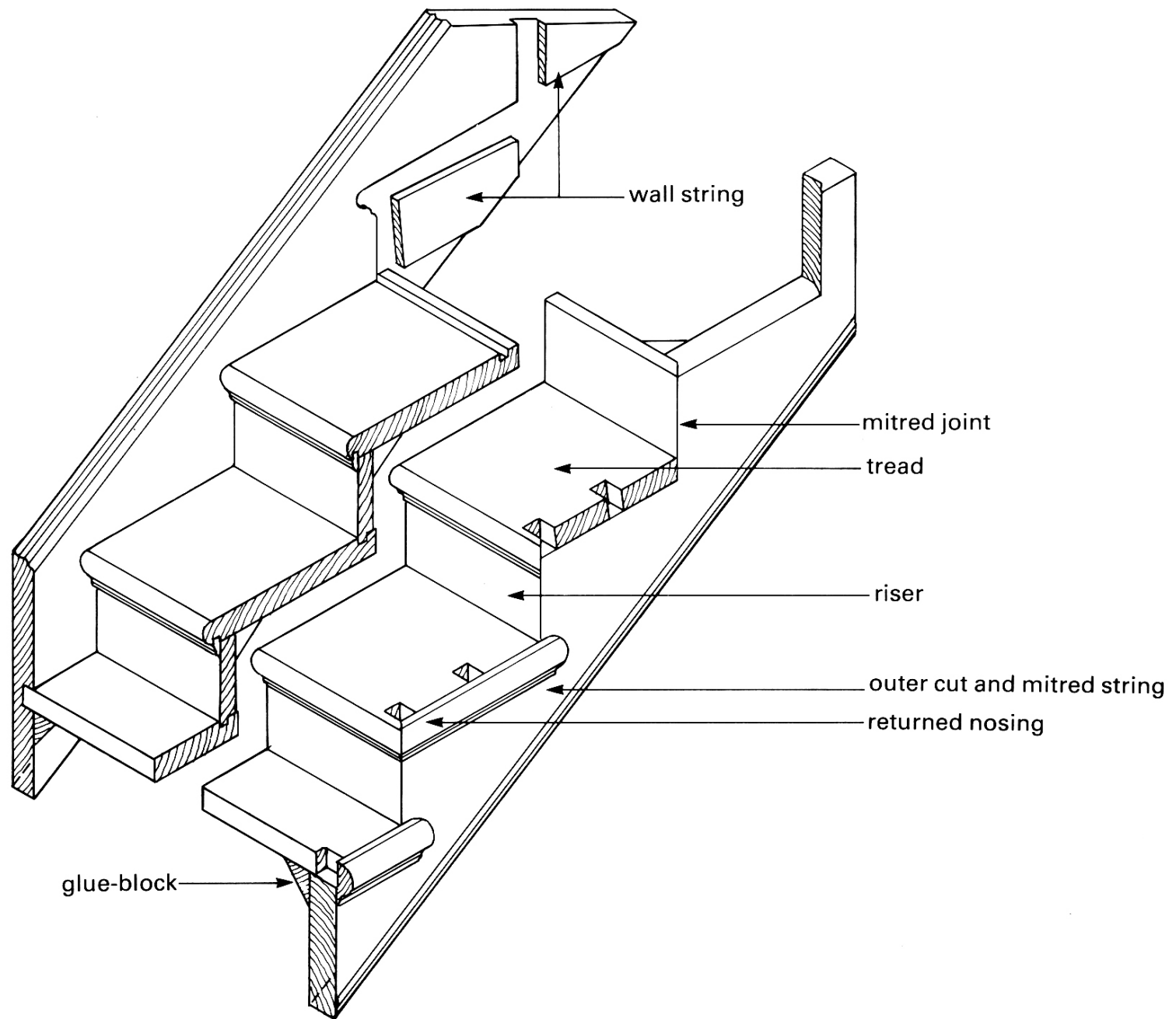
|                   | Minimum going (g) [mm] |
|-------------------|------------------------|
| England and Wales | 50                     |
| Scotland          | 75                     |
| Northern Ireland  | 50                     |
| Isle of Man       | 50                     |

# Standard Domestic Stair

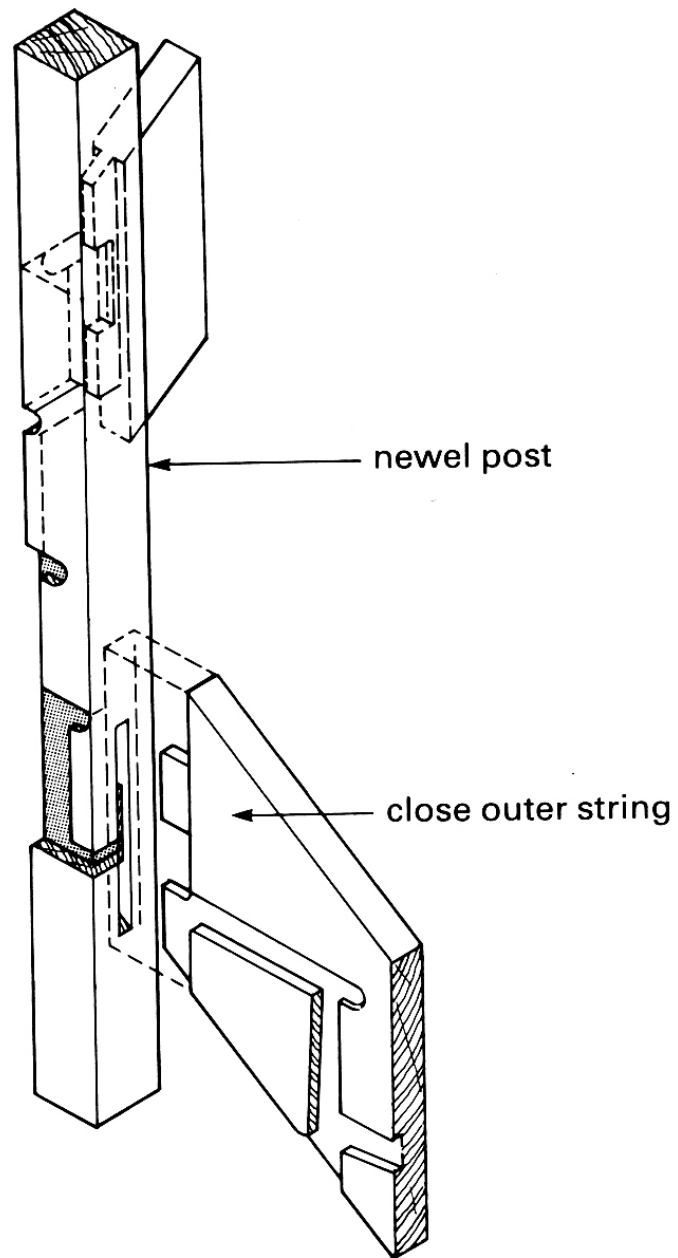
- Construction - Stairs can be supported in a number of ways. The most common way to support a stair is on a beam, either central beam or two side beams or strings. Stairs can also be hung or cantilevered.

# Stair Construction

- Beam support
- Typical timber stairs are often supported on beams situated under the steps or integrated within the string. The drawing below shows treads being supported on both sides by timber strings 225x45mm thick. The treads are further supported by a 25mm thick timber section (referred to as the part riser) which is slotted in the underside of the tread.
- Beam supports can be made of any material that can act as a beam, including steel, concrete and timber.



*Part of a flight of stairs, showing constructional details.*



**Newell post cut to receive strings, treads, risers etc**

# Stair with glass treads



# Stair with mesh panels



# Concrete stair



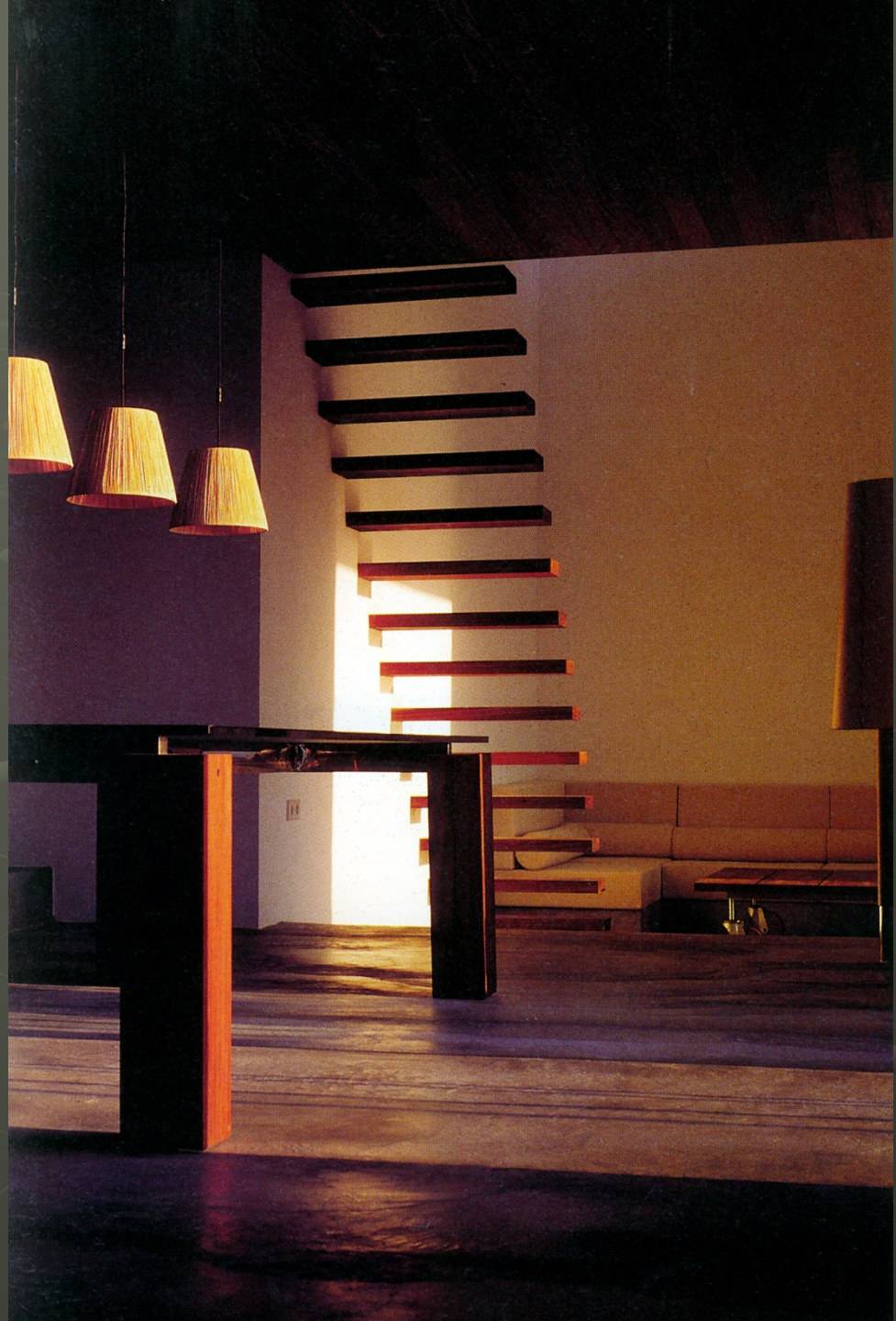
# Glass and steel stair



# Spiral stair



# Cantilevered timber stair



# Reading List & further info

- **Blanc (2001) *Stairs*, Architectural Press, London**
- **D Osbourn.** *Introduction to building*, in Mitchell's Building Series. Longman, Harlow 1993.
- **Jack Stroud Foster.** *Structure & fabric Part 1*, in Mitchell's Building series, 6<sup>th</sup> edition. Longman, Harlow 2000
- **W.B. McKay.** *Building Construction Volumes 1-4*. Longman.
- **The Building Regulations Part K and M –BS 5395 -1 :2000**  
Code of practice for the design, construction and maintenance of straight stairs and winders
- **BS 8300:2001** Code of practice/ Design of buildings and their approaches to meet the needs of disabled people.