# STAIRS

# Topics

- Definitions
- Proportioning of Stairs
- Requirements of Good stair
- Types of Stairs
- Numerical

# Definitions

1. **Stair & Stair case / Stairwell / Stairway**

    A building component which provides access from one floor to the other is called a stair. The space occupied by stairs in a building is called Stair case or Stairwell or Stairway.

2. **Flight**

    A series of steps without an intervening platform is called flight.

3. **Tread & Rise**

    The horizontal surface of a step is Tread. The vertical surface of a step is known as Riser. A step is a combination of Tread and Riser.

# Definitions

4. **Going or Run**

   The horizontal distance between any two adjacent risers is called Going or Run.

5. **Step**

   The combination of Tread & Rise is called a Step.

6. **Landing**

   The horizontal platform provided between two flights is called landing

# Definitions

7. **Balusters & Balustrade**

    The vertical members provided between steps and hand rail are called Balusters and the framework of handrail and balusters is called balustrade.

8. **Hand Rail**

    It is the Inclined member at convenient height (2'-9" to 3') providing safeguard to user.

9. **Newel or Newel post**

    The thicker baluster provided at start, turning and end of stair is called Newel or Newel post.

10. **Soffit**

    The under surface of stair is called soffit

# Definitions

## 11. Fliers & Winders

The steps of uniform width are called fliers

And steps of non-uniform width are called winders.

## 12. Pitch or slope

The inclination of line of nosing with respect to floor or landing is called pitch.

## 13. Waist slab

The concrete slab provided to support steps is called waist slab.

# Proportioning of Steps

The riser and tread of each step should be uniform dimensions throughout the length of the stair. The following are determined by arbitrary rules given as follows.

1. Rise + Going = 400 to 450 mm (16 to 18 in)

2. (2 x Rise) + (Going), in mm = 550 to 600 mm, 22 to 24 in.

3. Going x Rise, in mm = 40000 to 41000 sq.mm (64 to 66 sq.in)

# Proportioning of Steps

The following dimensions of Going and Rise are generally used for different buildings:

1.  Residential Buildings

    | | | |
    |---|---|---|
    | Going | 250mm to 300mm | (10" to 12") |
    | Rise | 150mm to 190mm | (6" to  7.5") |

2.  Industrial Building

    | | | |
    |---|---|---|
    | Going | 250mm to 270mm | (10" or 11") |
    | Rise | 175mm to 225mm | (7"  to  9") |

3.  Public Buildings

    | | | |
    |---|---|---|
    | Going | 275mm to 300mm | (11"  to 12") |
    | Rise | 150mm to 175mm | (6"   to   7") |

*( These are just guidelines, the final decision is made upon available space)*

# Guidelines for Stairs

Width of Stairs:

The width of a stair should be such that a person going up can pass a person coming down without any difficulty.

    Minimum Width of Stair for residential Building = 1m = 3'-6"

    Minimum Width of Stair for a Public Building = 1.5m = 5'-0"

Length of Flight:

The number of steps in a flight should not be more than 12 otherwise it becomes difficult to move up and down the flight.

Similarly the minimum number of steps in a flight should be 3.

# Guidelines for Stairs

Width of Landing:

The width of landing should not be less than the minimum recommended width of stair.

Head Room:

An adequate head room must be provided. It should not be less than 2.14m vertically or 1.5m at right angles to the line of nosing.

# Requirements of Good stair

A good stair should fulfill the following requirements

- It should be well proportionate.
- It should be centrally located in residential buildings and a no of stairs should be provided at corners of a commercial or educational building.
- Fliers should be used. Winders are discouraged.
- Pitch of stair should range between $25^o$ to $40^o$.
- Minimum width of stair is 3'-6" (1 m)
- No of steps should be 3 to 12 in one flight. There should be at-least one landing between two floors.
- Hand rail should be at convenient height i.e. 0.75 m to 0.85 m.
- Good material & workman ship should be used for construction.
- It should be ventilated and properly located.
- Circular and round stairs are usually not comfortable, so should be avoided.

# Types of Stairs

- Stairs can be classified as follows
- With respect to Layout
- With respect to Materials.

# Types of Stairs

**With respect to Layout**

Following are the types

1. Straight flight
2. Quarter turn
3. Half turn
4. Geometrical
5. Circular
6. Bifurcating
7. Spiral

# Types of Stairs

1. **Straight flight**

   This type of stairs run from one floor to other in one direction. Used for narrow staircases.

2. **Quarter turn**

   It turn through $90^o$ and used where width of staircase is more but length is limited.

3. **Half turn**

   It turns through $180^o$ it can be of three types

   i. Dog Legged Stair
   
   ii. Open well with half space landing
   
   iii. Open well with two quarter space landings

# Types of Stairs

Geometrical

 This stair in which a curved shape well is provided. Used for single or double story buildings.

Circular

 This stair is constructed in a circular shape Stair case. Used where limited space is available.

Bifurcating Stairs

 Bottom flight is divided into two relatively narrow flights.

 Used for assembly halls, railways foot bridges etc.

Spiral

 Stair with a central post to support winder shaped steps provided all around the post.

# Types of Stairs

**With respect to Materials**

- Wooden stairs

- Stone Stairs

- Metal Stairs

- RC Stairs

- Brick Stairs

# Stair



(a) Open String Stairs

(b) Closed String Stairs

# Spiral Stairs



Guard Rail Posts

Hand Rail Post

Floor

Holes for Hand Rail Post

Safety Tread
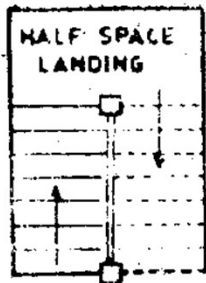
Hand Rail
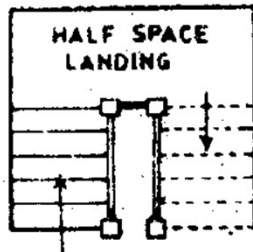
Detail of Step

Floor
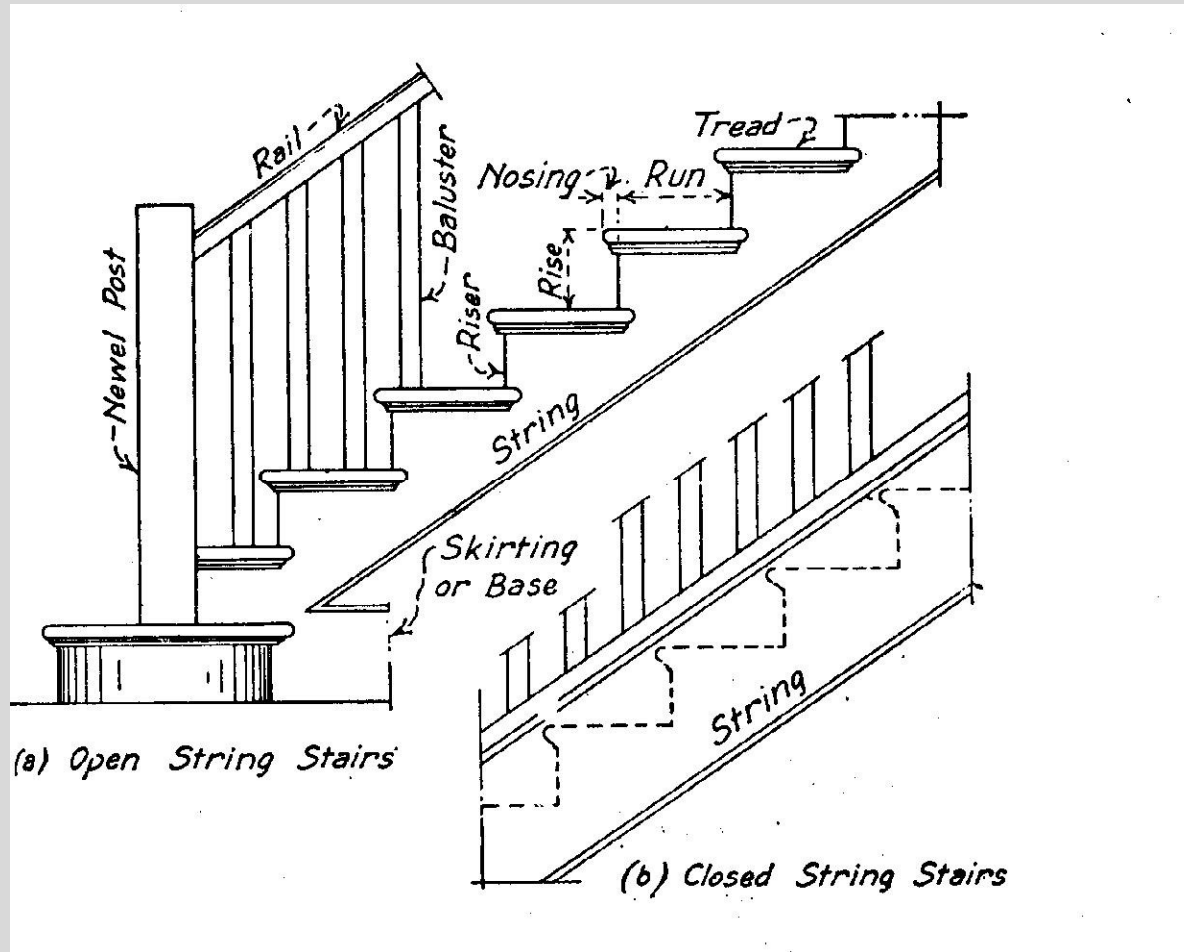
Spiral Stairs
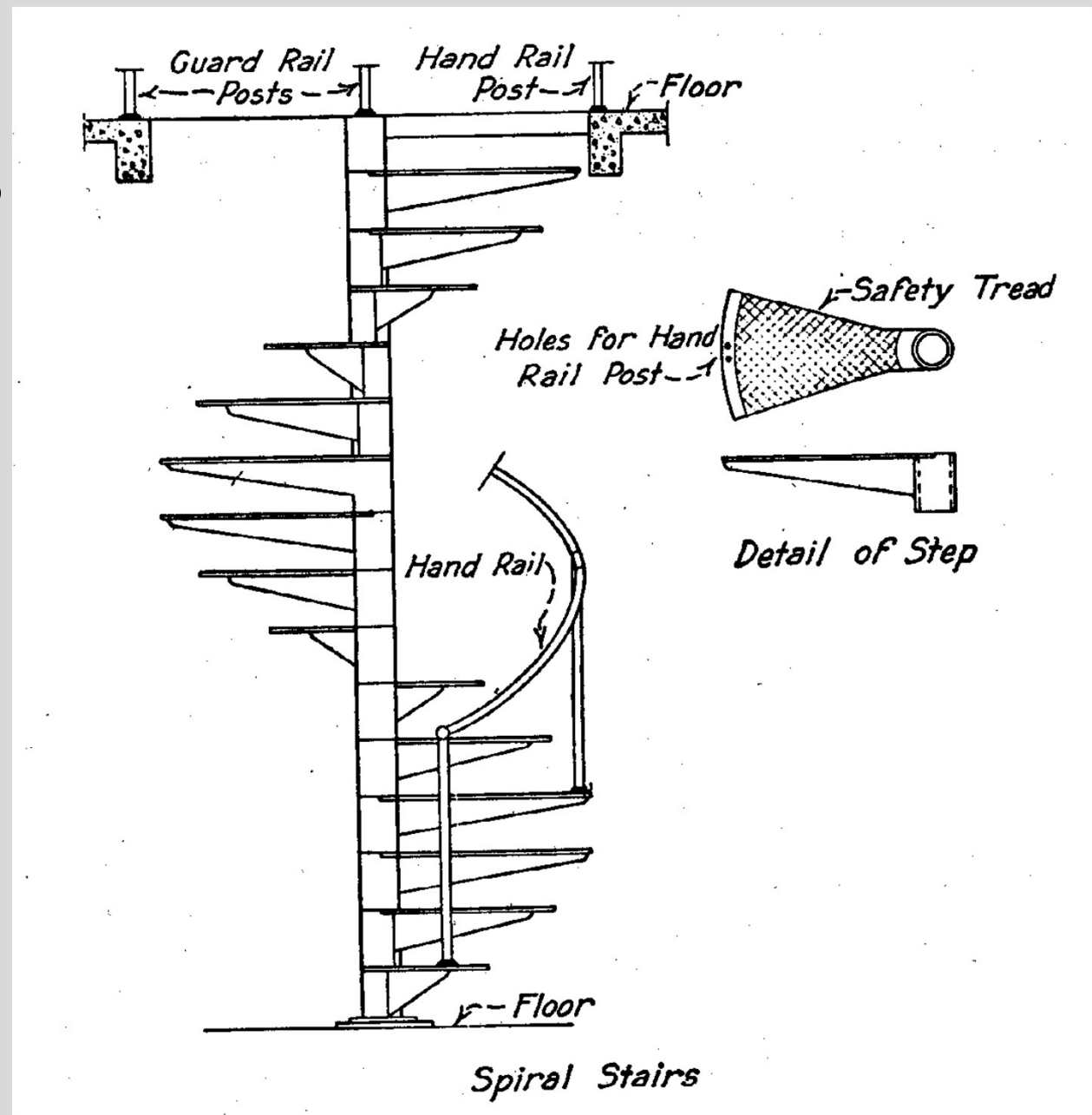
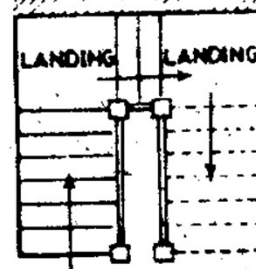(a) Straight Flight Stair    (b) Quarter Turn Stair (with winders)    (c) Quarter Turn Stair (with Quarter Space Landing)
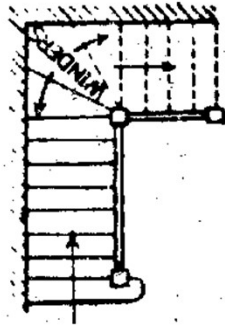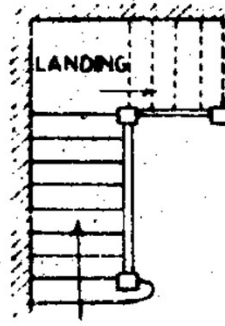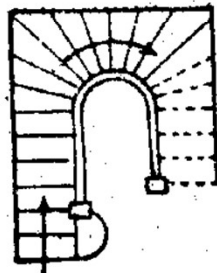
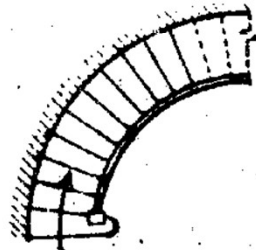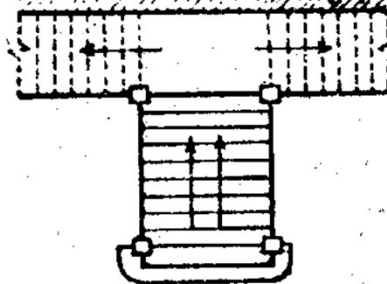(d) Dog-Legged Stair (Half Turn Stair)    (e) Open well or open Newel Stair (Half Turn Stair)    (f) Open Newel Stair with two Quarter Space Landings

(g) Geometrical Stair    (h) Circular Stair    (i) Bifurcating Stair

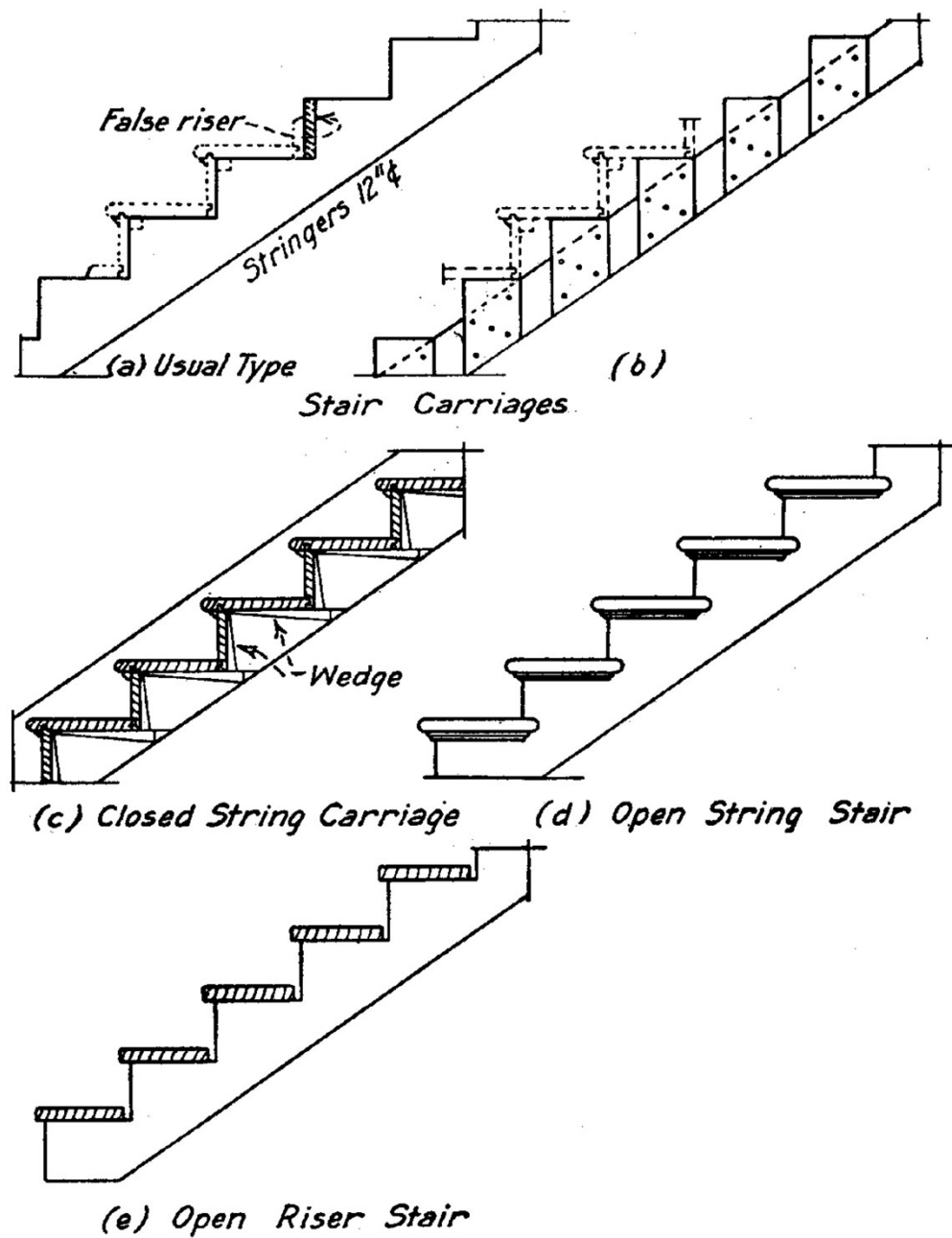Fig. 11.2. Different Types of Stairs According to their Layout.

# Wooden Stairs



False riser

Stringers 12"∮

(a) Usual Type  (b)

Stair Carriages

Wedge

(c) Closed String Carriage  (d) Open String Stair

(e) Open Riser Stair

Fig. 84-1. Types of wood stairs.

# Concrete Stairs

(a) Flight of Stairs

(b) Flight Ending at a Landing

Tie

Construction Joint

Note position of reinforcement at this section

(c) Flight Starting at a Landing

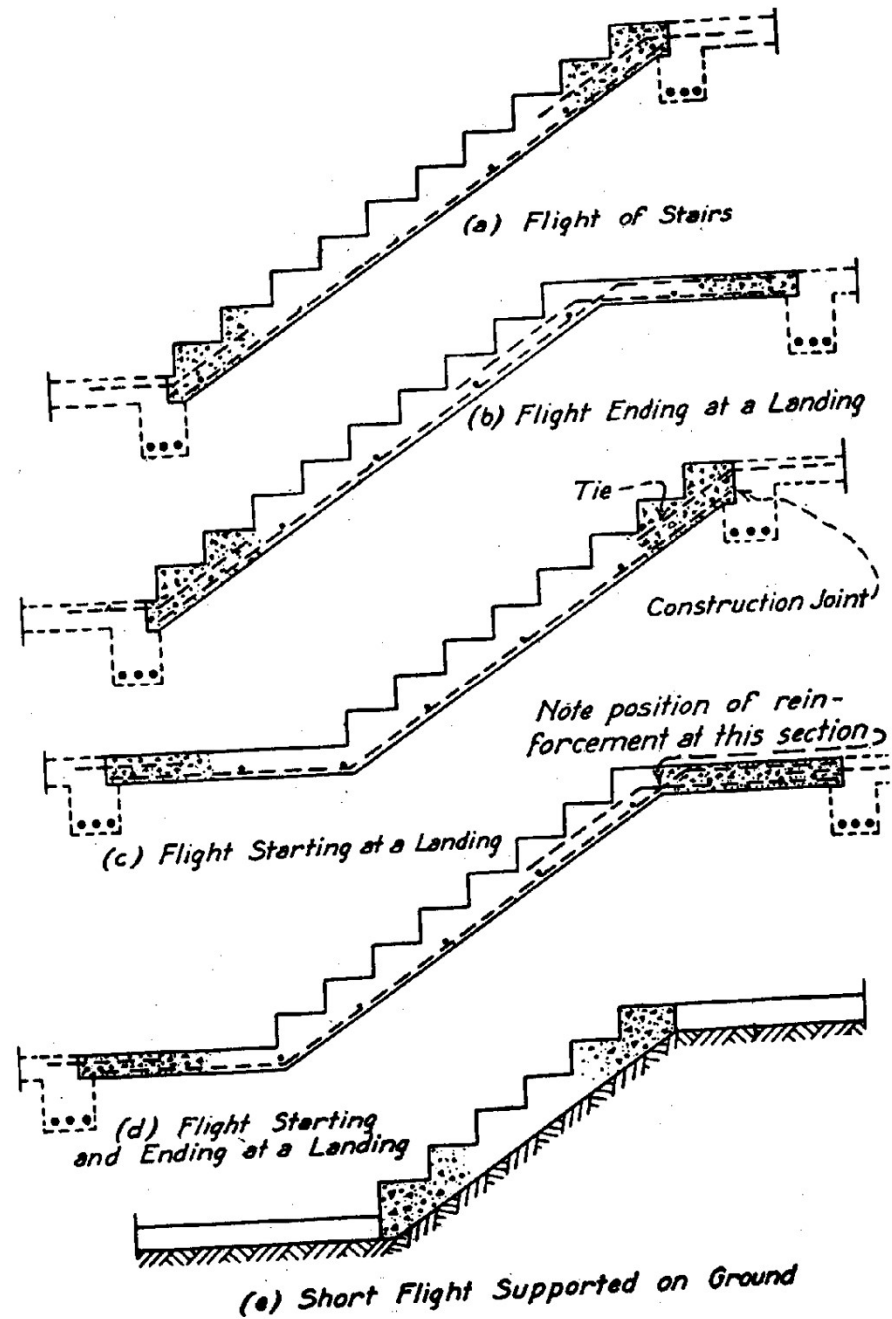(d) Flight Starting and Ending at a Landing

(e) Short Flight Supported on Ground

Fig. 85-1. Concrete stairs.

# Concrete Stairs
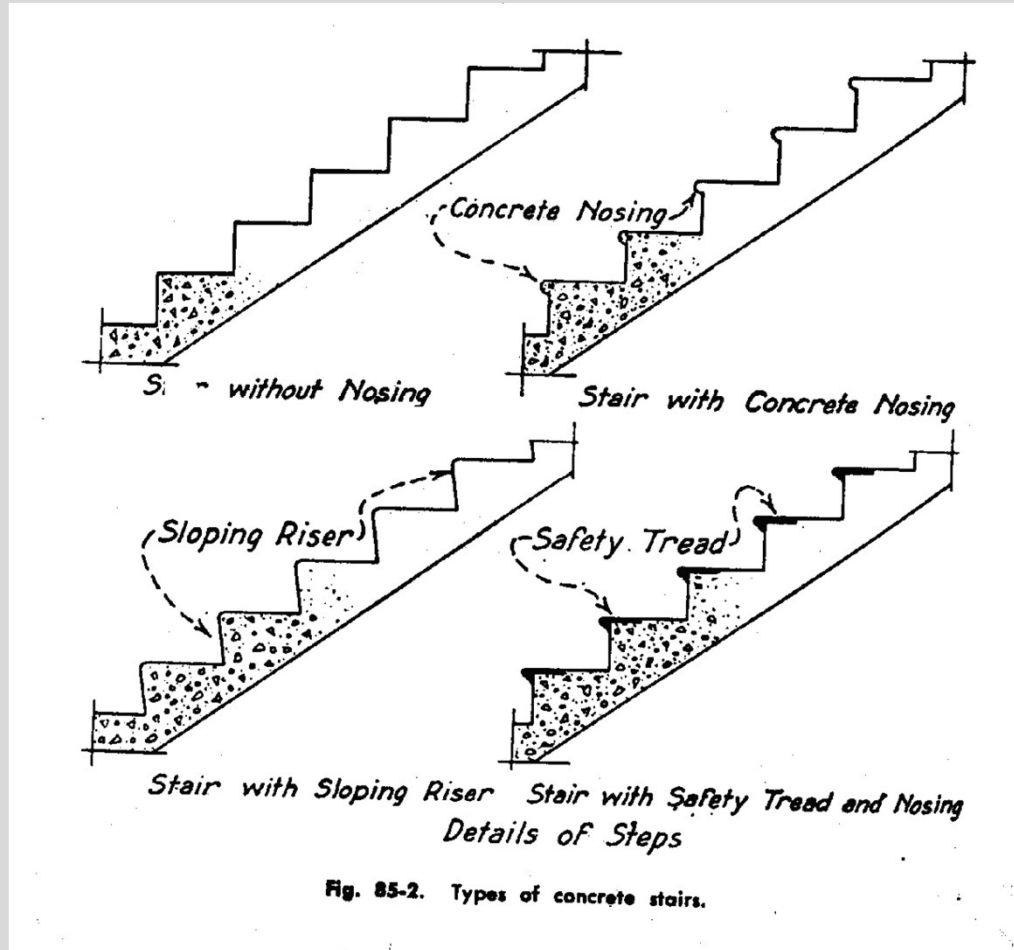


Fig. 85-2. Types of concrete stairs.

# Steel Stairs



Tread

Channel filled with Concrete

Special Cast-Iron Safety Tread

Steel Grating          Checkered Plate

(a) Types of Steel Stairs

Marble or Stone

Marble, Slate or Bluestone

Concrete or Composition

Checkered Plate
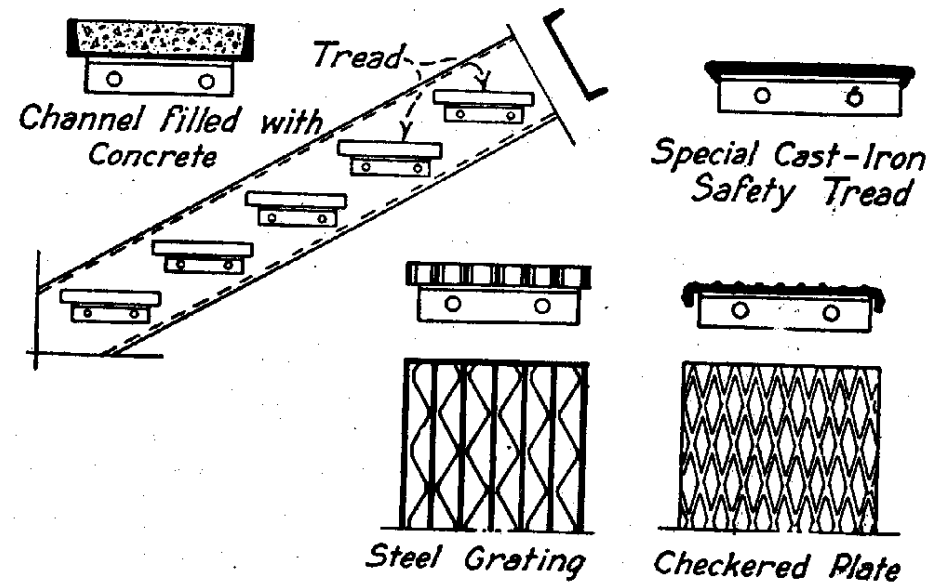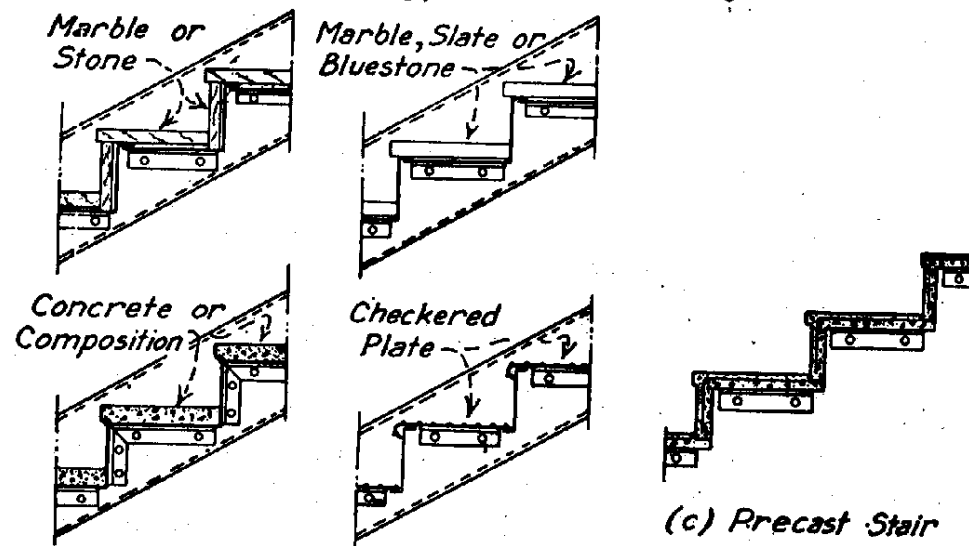
(c) Precast Stair
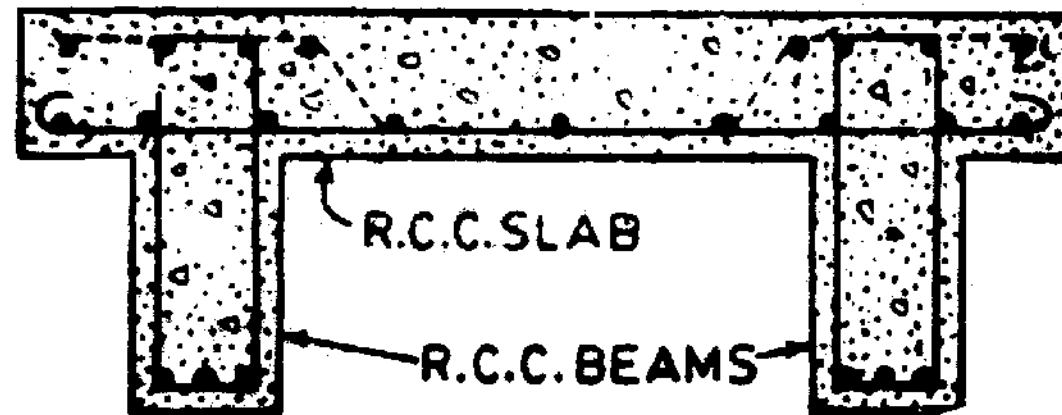
(b) Types of Steel Stairs

Fig. 86-1. Types of steel stairs.
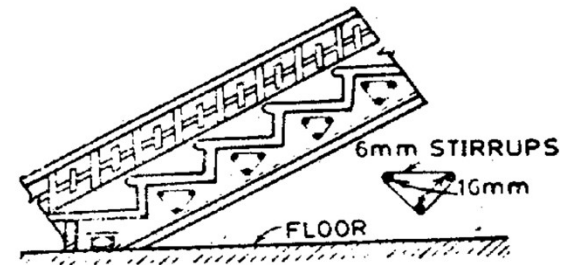
# RC Slab & Beam Type Stairs



R.C. Slab and Beam Type Stair.

# RC Slab & Beam Type Stairs



6mm STIRRUPS

16mm

FLOOR

R.C.C Cantilever Type Stair



1m

MAIN BARS
12mm φ @14 cm c/c

27cm

15 cm

22 cm

R.C. Slab Type Stair.



STEPS

LANDING

WALL

HEAD ROOM

A

12mm φ
@ 14 cm c/c

R.S.J. LANDING
BEAM

R.C.C. CONTINUOUS
SLAB

LANDING

6mm φ @
20 cm c/c

R.C.C. BEAM

WALL
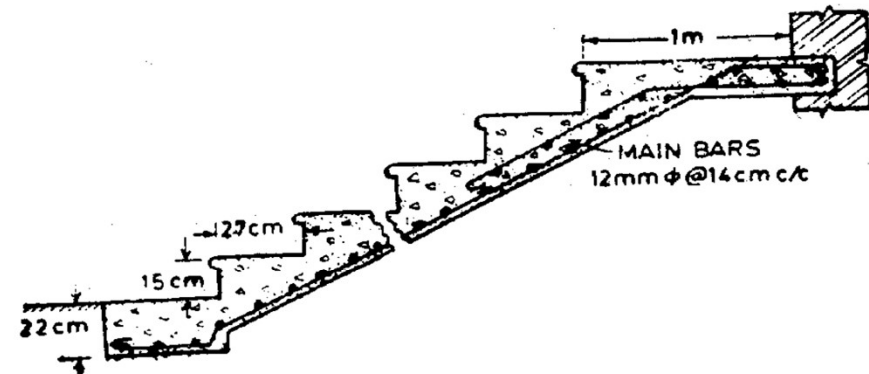
R.C. Continuous Slab Type Stair.
R.C. Slab Type Stairs

# Brick Stairs



Brick Stair.

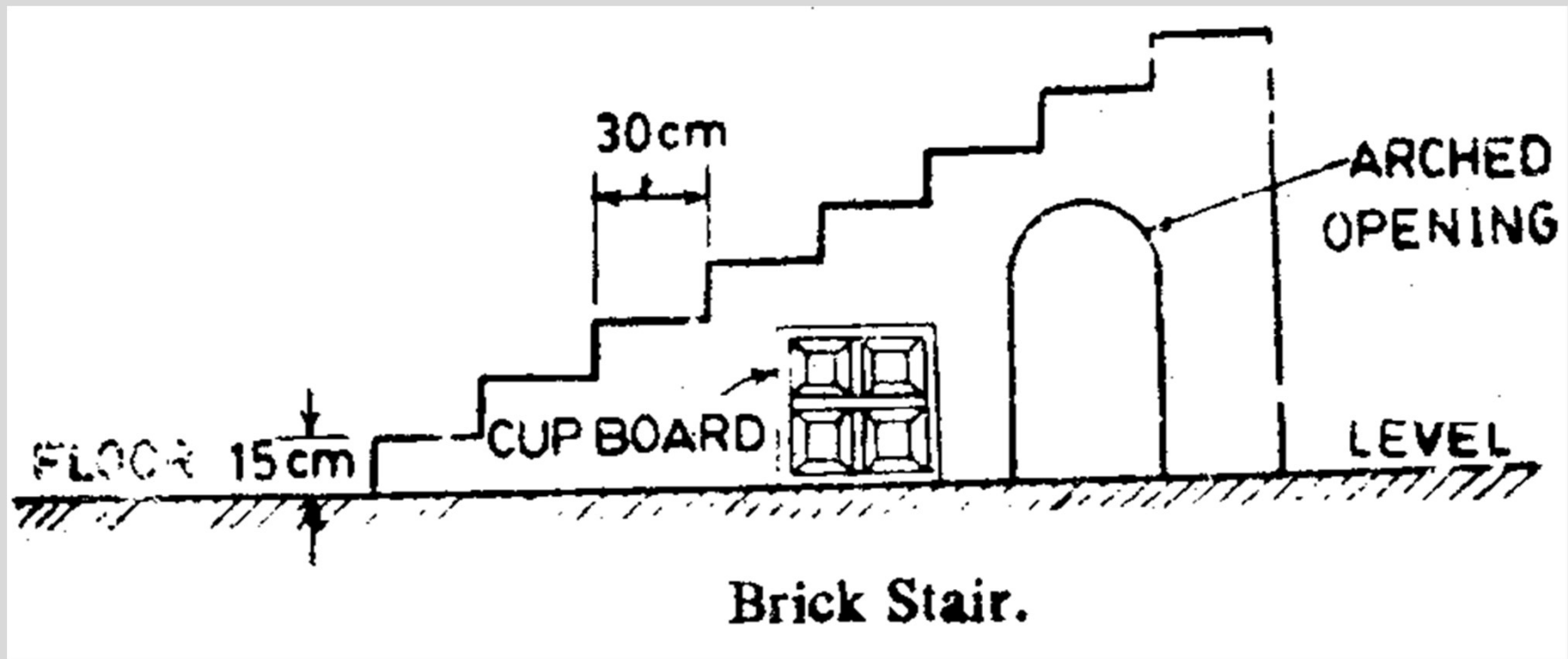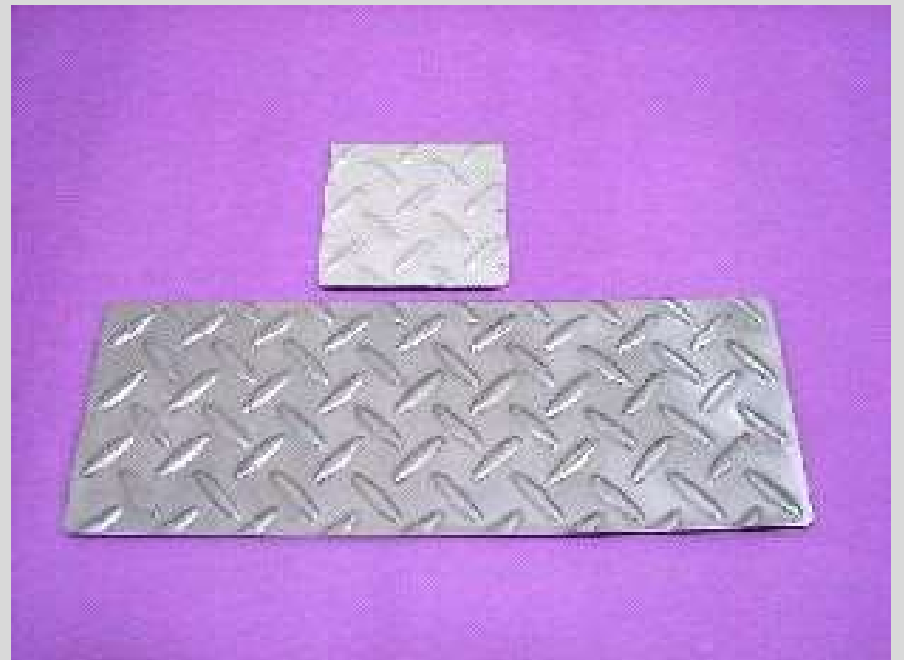# Checkered Plates (Non slippery plates)

# Spiral Stairs

# Spiral Stairs

# Bifurcating Stairs

# Spiral Stair

# Spiral Stairs

# WOODEN STAIRS

- It consists of
  - Stringers
  - Tread & Riser planks. (Fliers and Winders)
  - Balusters and newel posts.
  - Hand rail
  - landing
- Tongue & grove joints are provided between the tread & risers.
- Plank thickness for
  - Tread = 3.2 cm (1-1/4")
  - Riser = 1.6 cm (5/8")
- Projected nosing should not be greater than the thickness of tread.
- Ornamental molding or other finishes can be used for nosing.
- Use Straight flight, quarter turn, half turn or geometrical stairs

# Hand Rail & Balustrade



removable plastic
handrail cover

moulded and polished hardwood
handrail screwed from
underside of metal rail

8 mm dia.
set
screw

convex metal
handrail

metal
top
rail

metal standards
or baluster
section to design

8 mm dia.
set
screw

**Typical handrails**

metal rails slotted
to take standards
fillet welded on
underside

alternative
~ cover
plate

cover plate
welded to
standards

direct
screw or
bolt fixings

matching
cement
mortar
filling

run
lead or
cement
grout

ragged end

pocket formed in concrete

**Typical fixing methods**

**Handrails and balustrades**

# Stone Stairs

- It consists of dressed stone blocks or slabs.
- TYPES
- They are of three types.
  - Rectangular or square steps
  - Rectangular or square blocks or stones.
  - Built up steps
    5 cm (2") thick stone slabs are provided.
  - Spandrel steps
    rebated stone blocks of triangular shapes are provided, used for regular flight.

# Metal Stairs

PARTS
- Stringers
- Treads and risers
- Non slippery metal plates

TYPES

tread surface defines the types

1. Checkred plate tread stairs

non slippery plate provided as tread.

2. Stone slab tread stairs

stone slab is provided as tread

3. Concrete slab tread stairs

concrete steps with metal nosing are provided.

4. Spiral Stairs

It is provided as a central pipe newel and steps all arround.

USE

used where wear tear is more.

Fire proof construction is required

In factories, railway stations, power houses etc.

# CONCRETE STAIRS

- They can be of two types
    1. PCC stairs
    2. RC stairs
- PCC stairs are spandril type
- RC stairs are of three types.
    1. Slab & beam type
    2. Cantilever type
    3. Slab type

# Brick Stairs

- Stairs made of brick masonry are called brick stairs

- 1-1/2 brick wide treads are provided

- Use in ordinary buildings.

# Numerical

- Stair Proportioning

Given Data

Story height = 2.62 m

Total going  =  2.75 m

Find

No of flights

No. of steps

Width of landing (if any)

Sizes of riser and treads

Type of building = residential

# Solution

- For residential buildings trial size of step
-   25 cm x 16 cm

- No of risers = (Total story height)/Riser
-                   = (2.62)/0.16
-                   = 16.25 say 17
- As no of risers are more than 12 so
- No of flights = 2
- Steps in each flight = 8
- Riser value = 2.62/16       = 16.375 cm
- Tread width = 400/16.375 = 24.4 cm say 25 cm       As (tread x riser = 400)
- No of goings in each flight = No of risers -1  = 8-1 = 7
- Total going for steps= 0.25*7 = 1.75 m
- Width of landing = Total Going – total Going for steps
-                        = 2.75-1.75
-                         = 1 m
- CHECK
- As                 55 cm ≤ 2R+G ≤ 60 cm

- 2(16.375)  + 25 = 57.75 cm      ........**OK**