Module 9

Staircases

Lesson 20

Types and Design of Staircases

Version 2 CE IIT, Kharagpur

Instructional Objectives:

At the end of this lesson, the student should be able to:

- classify the different types of staircases based on geometrical configurations,
- name and identify the different elements of a typical flight,
- state the general guidelines while planning a staircase,
- determine the dimensions of trade, riser, depth of slab etc. of a staircase,
- classify the different staircases based on structural systems,
- explain the distribution of loadings and determination of effective spans of stairs,
- analyse different types of staircases including the free-standing staircases in a simplified manner,
- design the different types of staircases as per the stipulations of IS 456.

9.20.1 Introduction

Staircase is an important component of a building providing access to different floors and roof of the building. It consists of a flight of steps (stairs) and one or more intermediate landing slabs between the floor levels. Different types of staircases can be made by arranging stairs and landing slabs. Staircase, thus, is a structure enclosing a stair. The design of the main components of a staircase-stair, landing slabs and supporting beams or wall – are already covered in earlier lessons. The design of staircase, therefore, is the application of the designs of the different elements of the staircase.

9.20.2 Types of Staircases

Fig. 9.20.1(a): Single flight staircase

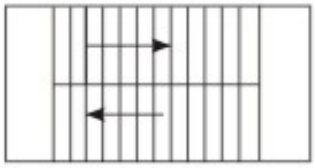

Fig. 9.20.1(b): Two flight staircase

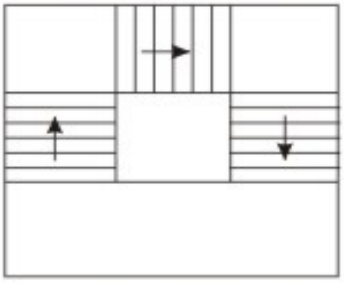

Fig. 9.20.1(c): Open-well staircase

Fig. 9.20.1: Types of staircases

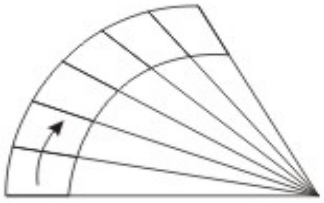

Fig. 9.20.1(e): Helicoidal staircase

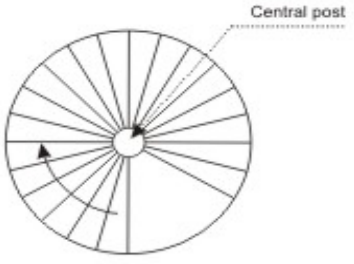

Fig. 9.20.1(d): Spiral staircase

Fig. 9.20.1: Types of staircases

Figures 9.20.1a to e present some of the common types of staircases based on geometrical configurations:

(a) Single flight staircase (Fig. 9.20.1a)

(b) Two flight staircase (Fig. 9.20.1b)
(c) Open-well staircase (Fig. 9.20.1c)
(d) Spiral staircase (Fig. 9.20.1d)
(e) Helicoidal staircase (Fig. 9.20.1e)

Architectural considerations involving aesthetics, structural feasibility and functional requirements are the major aspects to select a particular type of the staircase. Other influencing parameters of the selection are lighting, ventilation, comfort, accessibility, space etc.

9.20.3 A Typical Flight

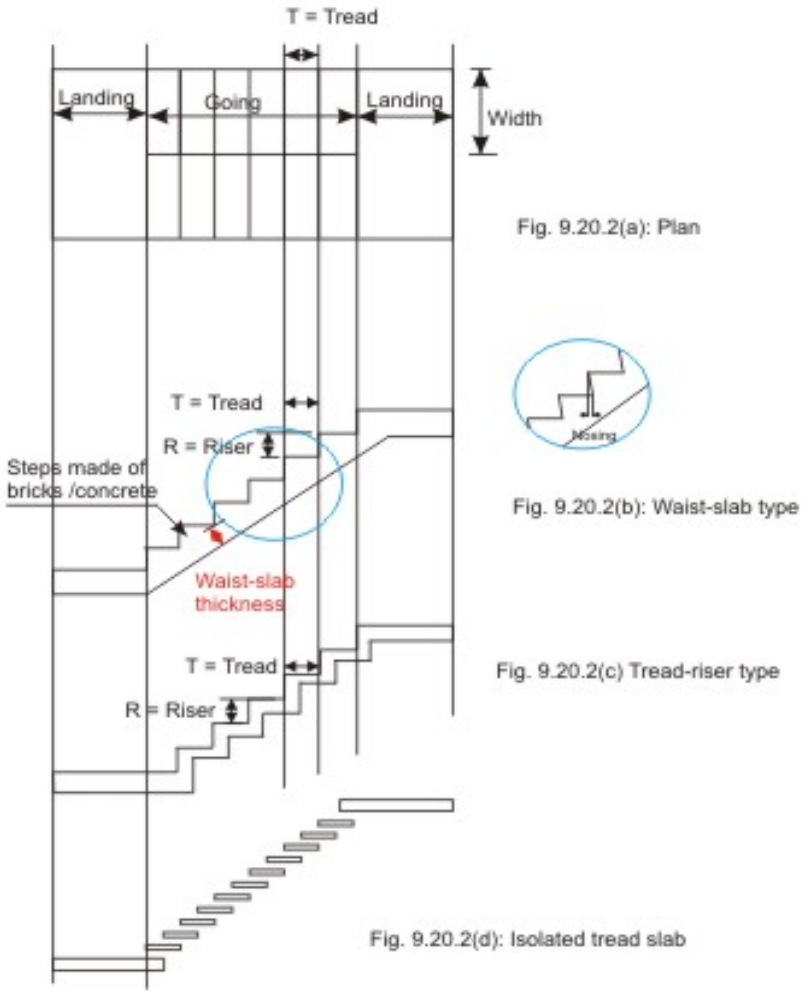

Fig. 9.20.2: A typical flight

Figures 9.20.2a to d present plans and sections of a typical flight of different possibilities. The different terminologies used in the staircase are given below:

(a) Tread: The horizontal top portion of a step where foot rests (Fig.9.20.2b) is known as tread. The dimension ranges from 270 mm for residential buildings and factories to 300 mm for public buildings where large number of persons use the staircase.

(b) Nosing: In some cases the tread is projected outward to increase the space. This projection is designated as nosing (Fig.9.20.2b).

(c) Riser: The vertical distance between two successive steps is termed as riser (Fig.9.20.2b). The dimension of the riser ranges from 150 mm for public buildings to 190 mm for residential buildings and factories.

(d) Waist: The thickness of the waist-slab on which steps are made is known as waist (Fig.9.20.2b). The depth (thickness) of the waist is the minimum thickness perpendicular to the soffit of the staircase (cl. 33.3 of IS 456). The steps of the staircase resting on waist-slab can be made of bricks or concrete.

(e) Going: Going is the horizontal projection between the first and the last riser of an inclined flight (Fig.9.20.2a).

The flight shown in Fig.9.20.2a has two landings and one going. Figures 9.2b to d present the three ways of arranging the flight as mentioned below:

(i) waist-slab type (Fig.9.20.2b),
(ii) tread-riser type (Fig.9.20.2c), or free-standing staircase, and
(iii) isolated tread type (Fig.9.20.2d).

9.20.4 General Guidelines

The following are some of the general guidelines to be considered while planning a staircase:

- The respective dimensions of tread and riser for all the parallel steps should be the same in consecutive floor of a building.
- The minimum vertical headroom above any step should be 2 m.
- Generally, the number of risers in a flight should be restricted to twelve.
- The minimum width of stair (Fig.9.20.2a) should be 850 mm, though it is desirable to have the width between 1.1 to 1.6 m. In public building, cinema halls etc., large widths of the stair should be provided.

9.20.5 Structural Systems

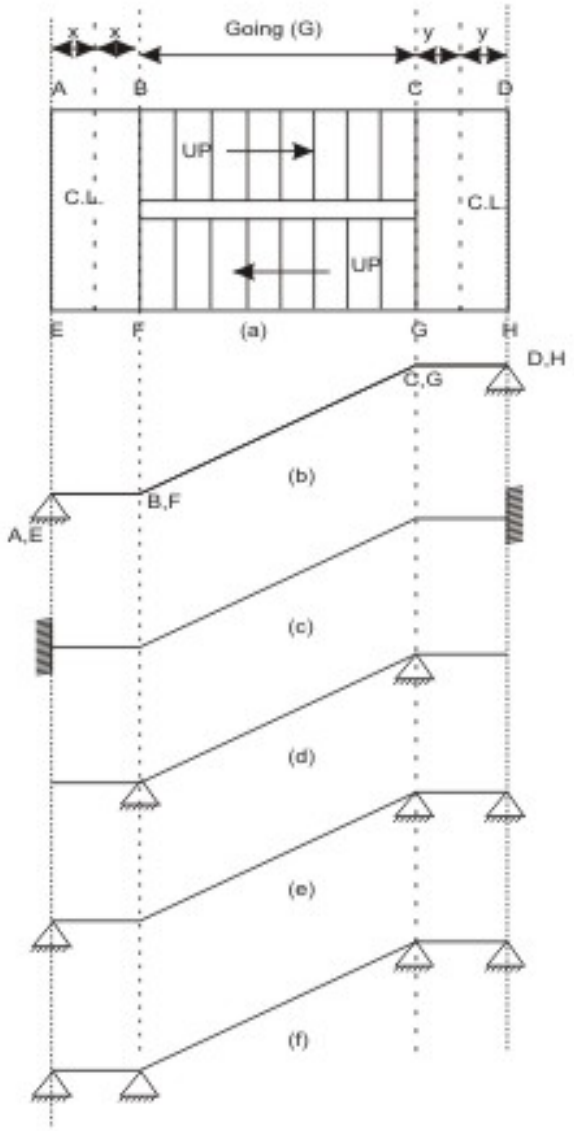

Fig. 9.20.3: Longitudinally spanning staircases

Different structural systems are possible for the staircase, shown in Fig. 9.20.3a, depending on the spanning direction. The slab component of the stair spans either in the direction of going i.e., longitudinally or in the direction of the steps, i.e., transversely. The systems are discussed below:

(A) Stair slab spanning longitudinally

Here, one or more supports are provided parallel to the riser for the slab bending longitudinally. Figures 9.20.3b to f show different support arrangements of a two flight stair of Fig.9.20.3a: