جامعة الموصل – كلية الهندسة – قسم الهندسة المدنية

مواضيع مختاره في تصاميم الخرسانة

مقررات المرحلة الرابعة

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إعداد

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STAIRCASES

Introduction

- Staircases provide means of movement from one floor to another in a structure. Staircases consist of a number of steps with landings at suitable intervals to provide comfort and safety for the users. Some common types of stairs are shown in Figure 1.

- These include straight-flight stairs, quarter-turn stairs, half-turn stairs, branching stairs, and geometrical stairs.
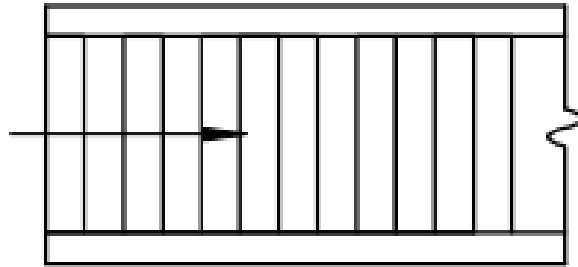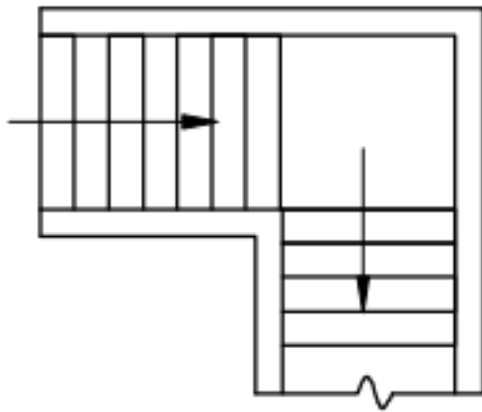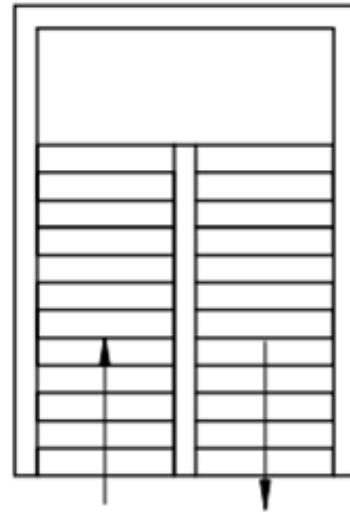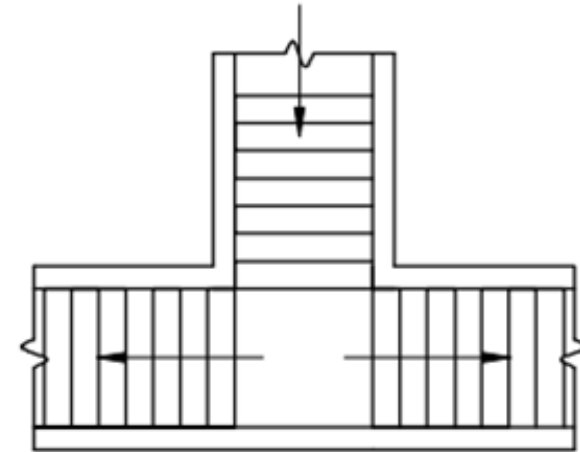
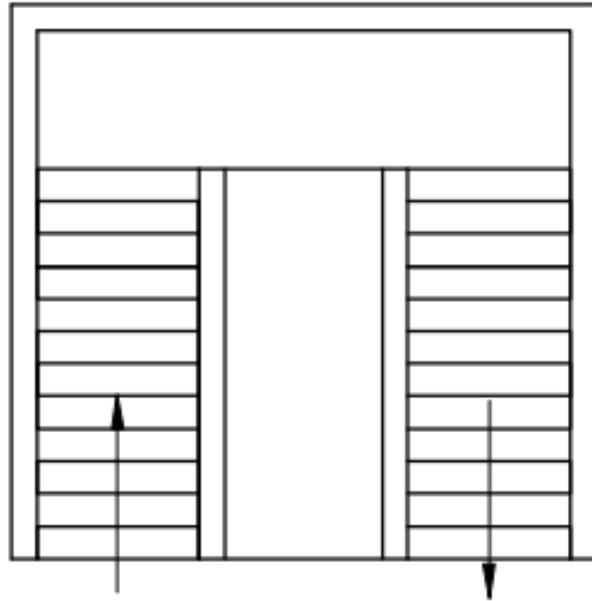# Introduction
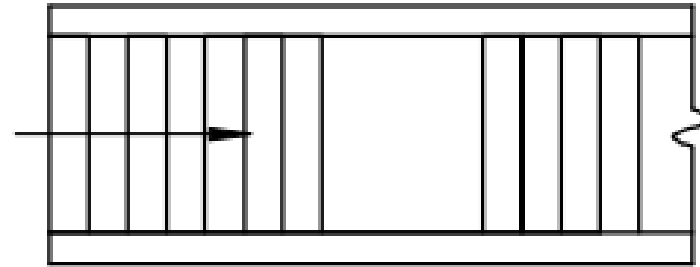
(a); (b) Straight flight stairs

Introduction
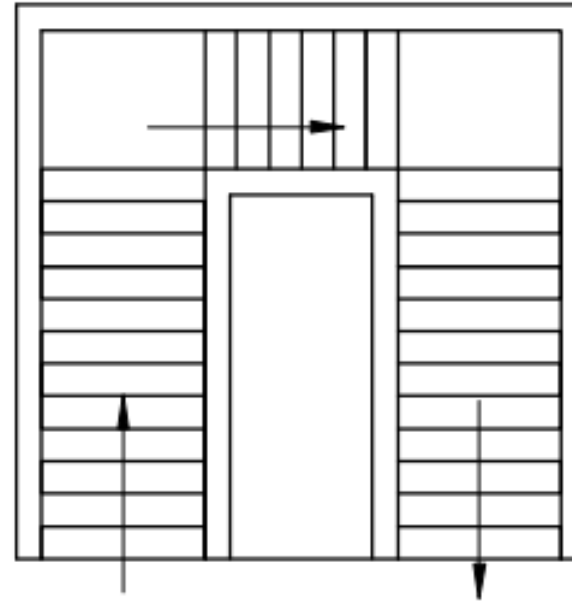

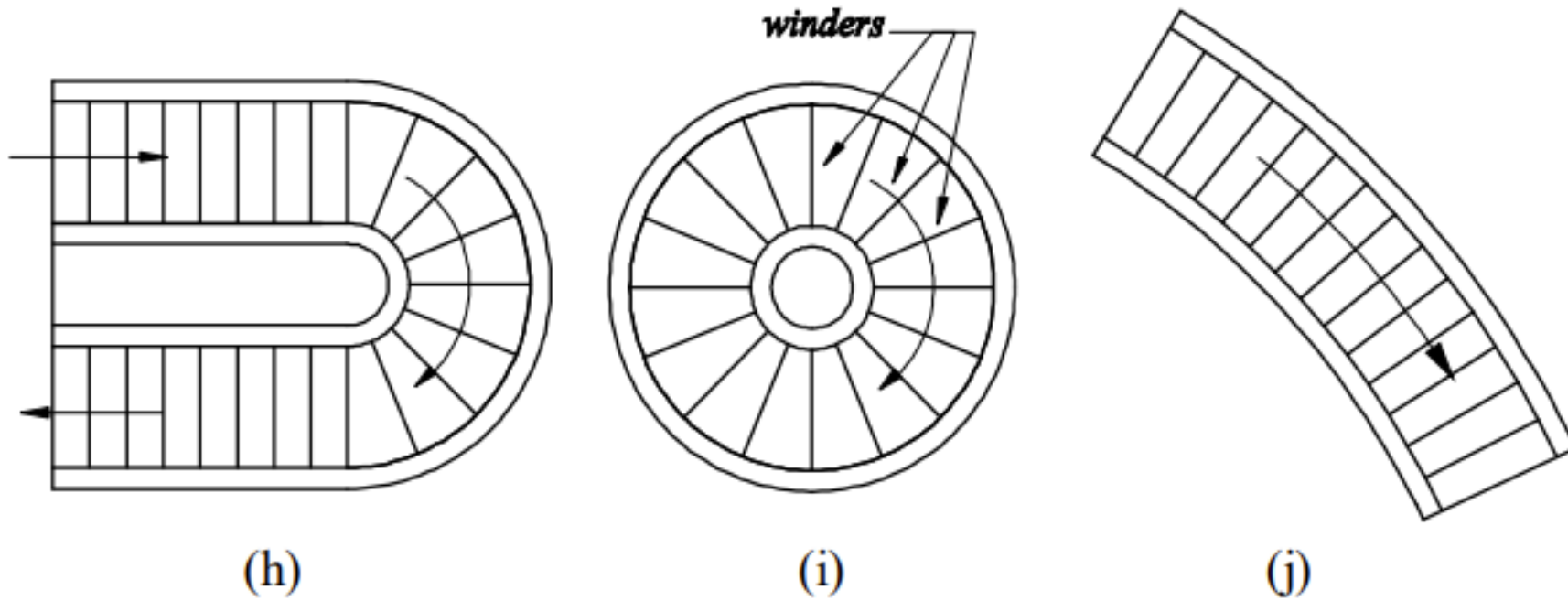(c) Quarter-turn stairs; (d) Half-turn stairs; (e) Branching stairs;

Introduction

(f) Open-well (half turn); (g) Open-well with quarter turn landing;

Introduction

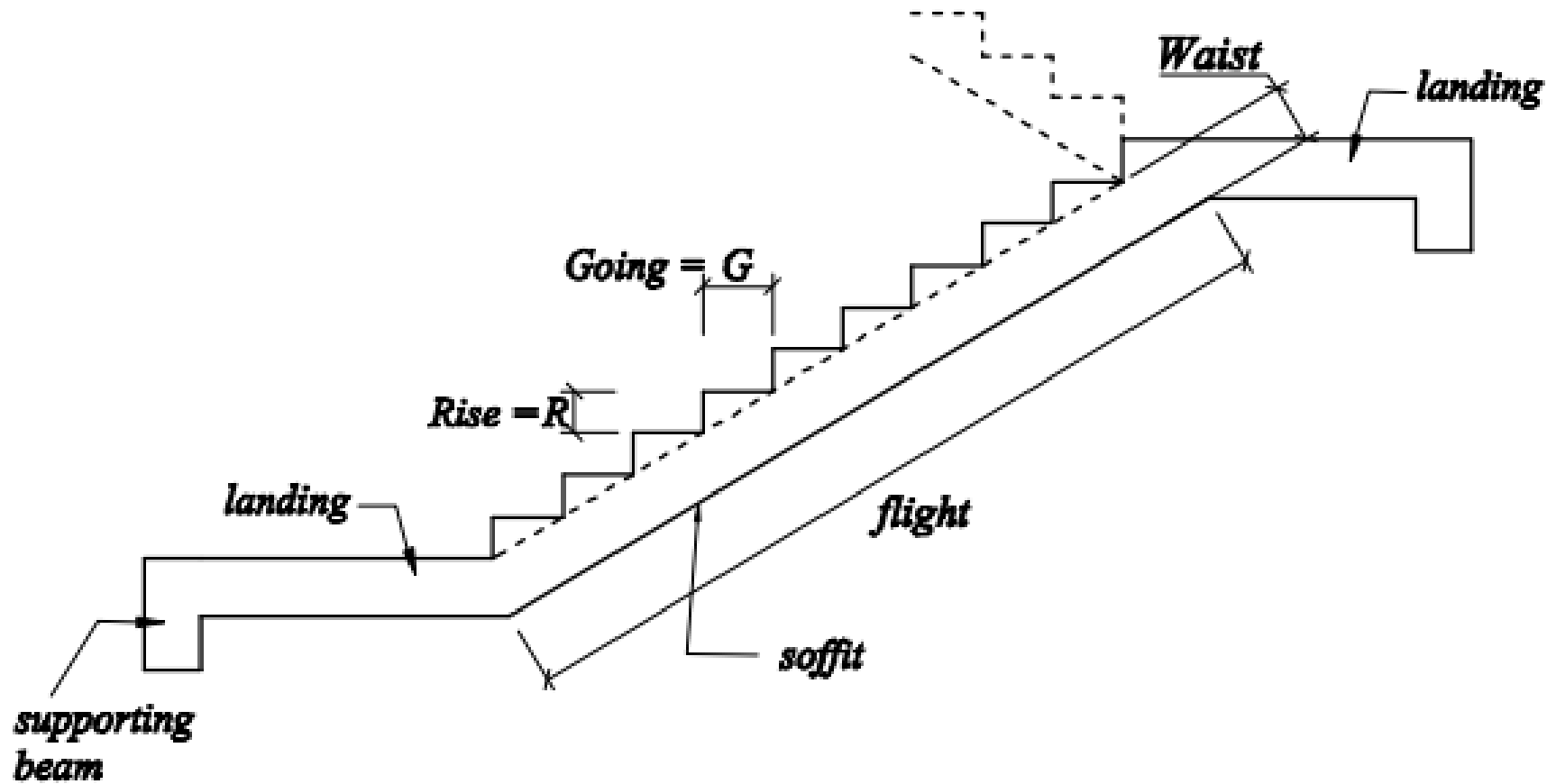(h); (i); (j) Geometrical stairs

Introduction

Figure 2 shows main technical terms associated with stairs design
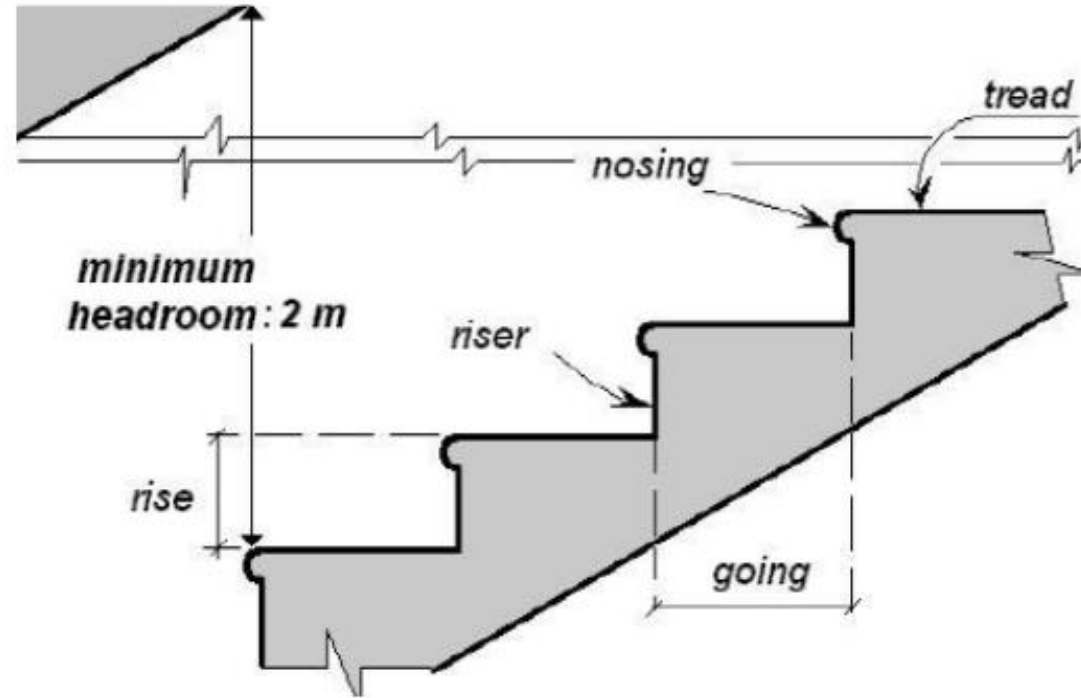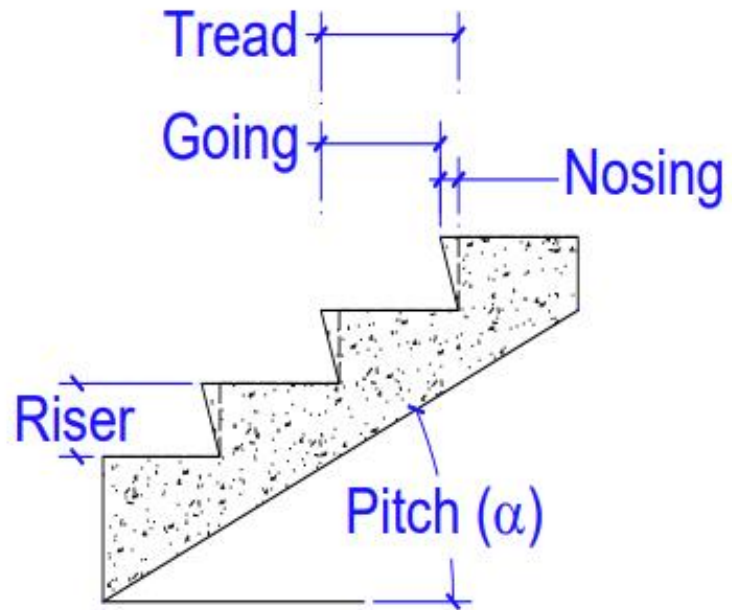
Introduction

Figure 2 shows main technical terms associated with stairs design

Introduction

Technical Terms

The definitions of some technical terms, which are used in connection with design of stairs, are given.

a. Tread or Going: horizontal upper portion of a step.

b. Riser: vertical portion of a step.

c. Rise: vertical distance between two consecutive treads.

d. Flight: a series of steps provided between two landings.

e. Landing: a horizontal slab provided between two flights.

f. Waist: the least thickness of a stair slab.

g. Winder: radiating or angular tapering steps.

h. Soffit: the bottom surface of a stair slab.

i. Nosing: the intersection of the tread and the riser.

j. Headroom: the vertical distance from a line connecting the nosings of all treads and the soffit above.

General Requirements:

G.R=420 – 450 mm

570 mm $\leq$ G+2R $\leq$ 630 mm

Where, G and R are in (mm).

| Item	Private	Common
Riser (R) (mm)	$\leq$ 220 mm	$\leq$ 190 mm
Going (G) (mm)	$\geq$ 220 mm	$\geq$ 230 mm
Pitch (α)	$\leq$ 42°	$\leq$ 38°
No. of Steps / Flight	$\leq$ 16 Steps / Flight	

Types of Stairs

For purpose of design, stairs are classified into two types; transversely, and longitudinally supported.

a- Transversely supported (transverse to the direction of movement):
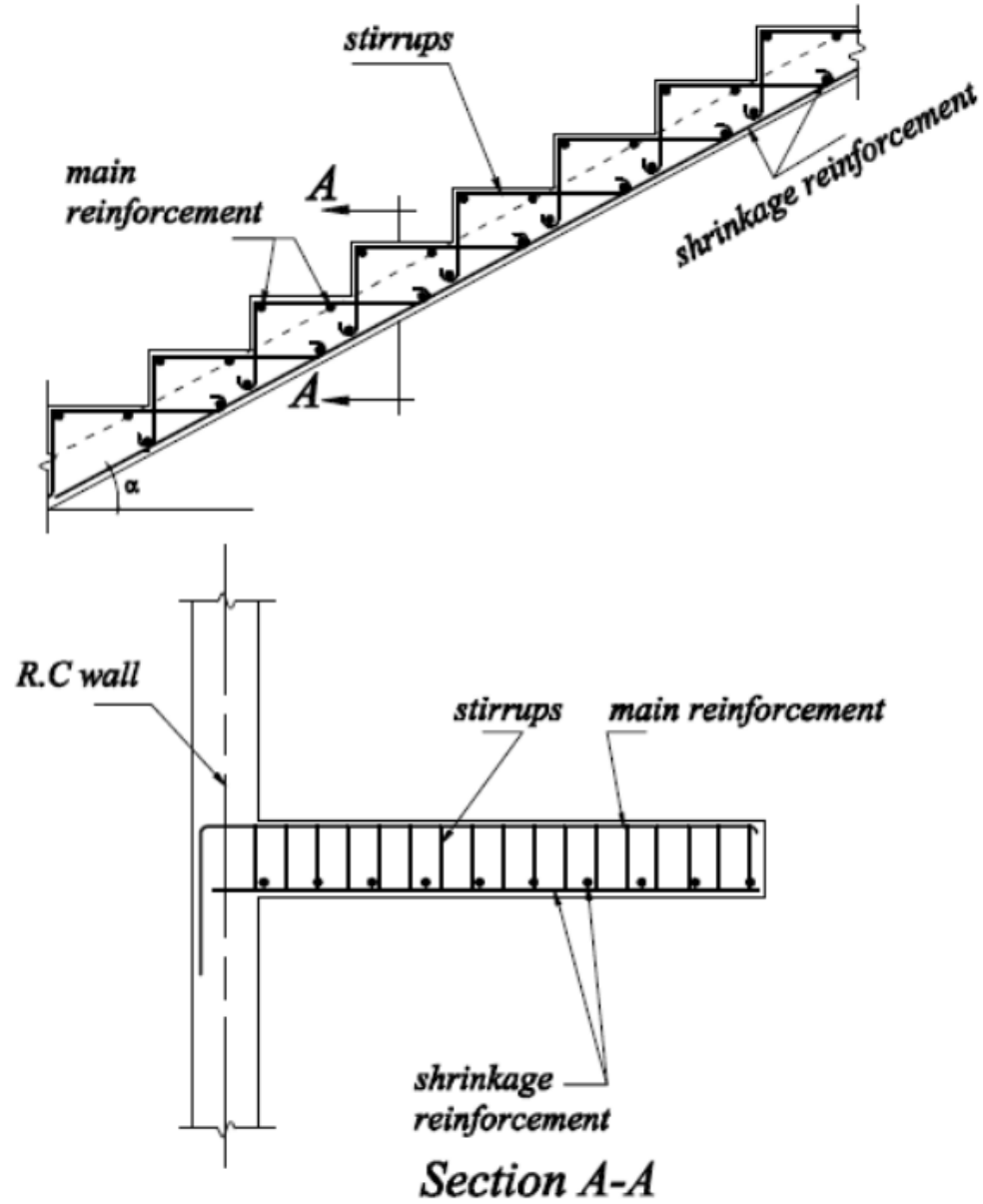
Transversely supported stairs include:

- Simply supported steps supported by two walls or beams or a combination of both.
- Steps cantilevering from a wall or a beam.
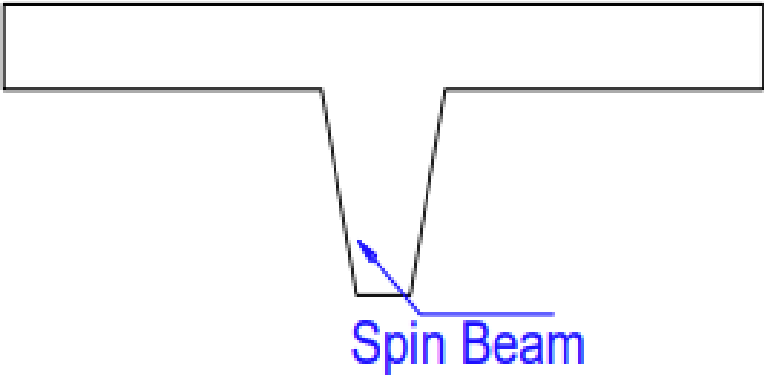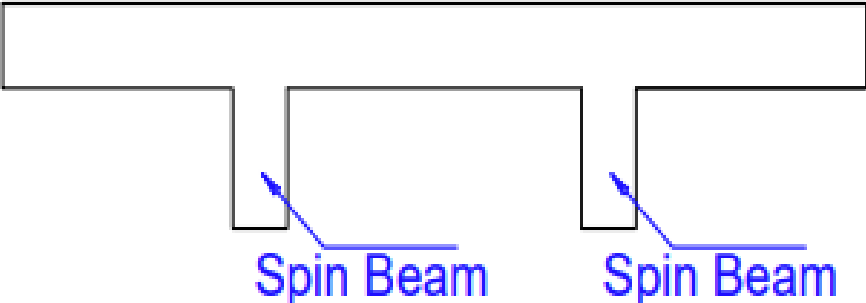- Stairs cantilevering from a central spine beam.
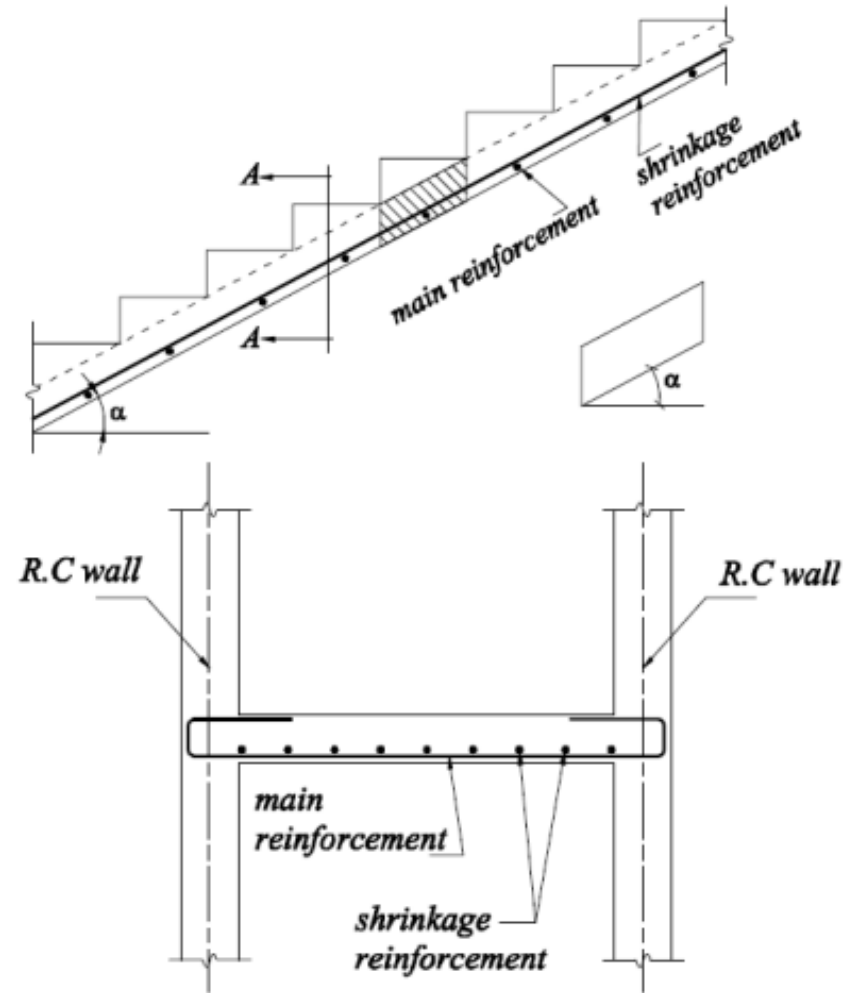
Section A-A

Figure shows a stair, simply supported on reinforced concrete walls.

- Steps cantilevering from a wall or a beam.

stirrups

main reinforcement

shrinkage reinforcement

A

A

α

R.C wall

stirrups   main reinforcement

shrinkage reinforcement

Section A-A

Stairs cantilevering from a central spine beam.


Spin Beam   Spin Beam

Spin Beam

b- Longitudinally supported (in the direction of movement):

These stairs span between supports at the top and bottom of a flight and unsupported at the sides. Longitudinally supported stairs may be supported in any of the following manners:
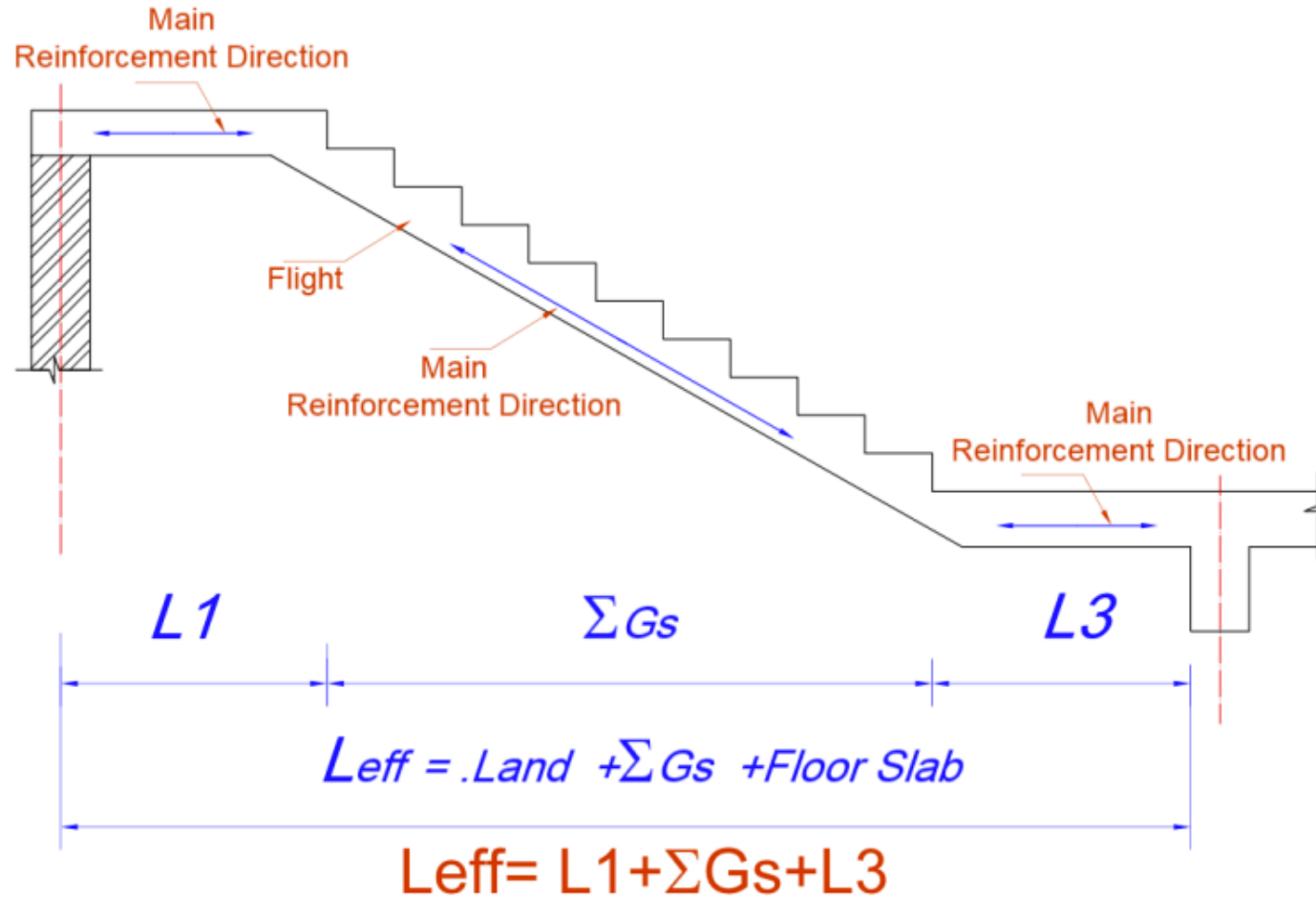
a. Beams or walls at the outside edges of the landings.

b. Internal beams at the ends of the flight in addition to beams or walls at the outside edges of the landings.

c. Landings which are supported by beams or walls running in the longitudinal direction.

d. A combination of (a) or (b), and (c).

e. Stairs with quarter landings associated with open-well stairs.

a. Stair flight may be spanning at both ends by beams or footing at base.
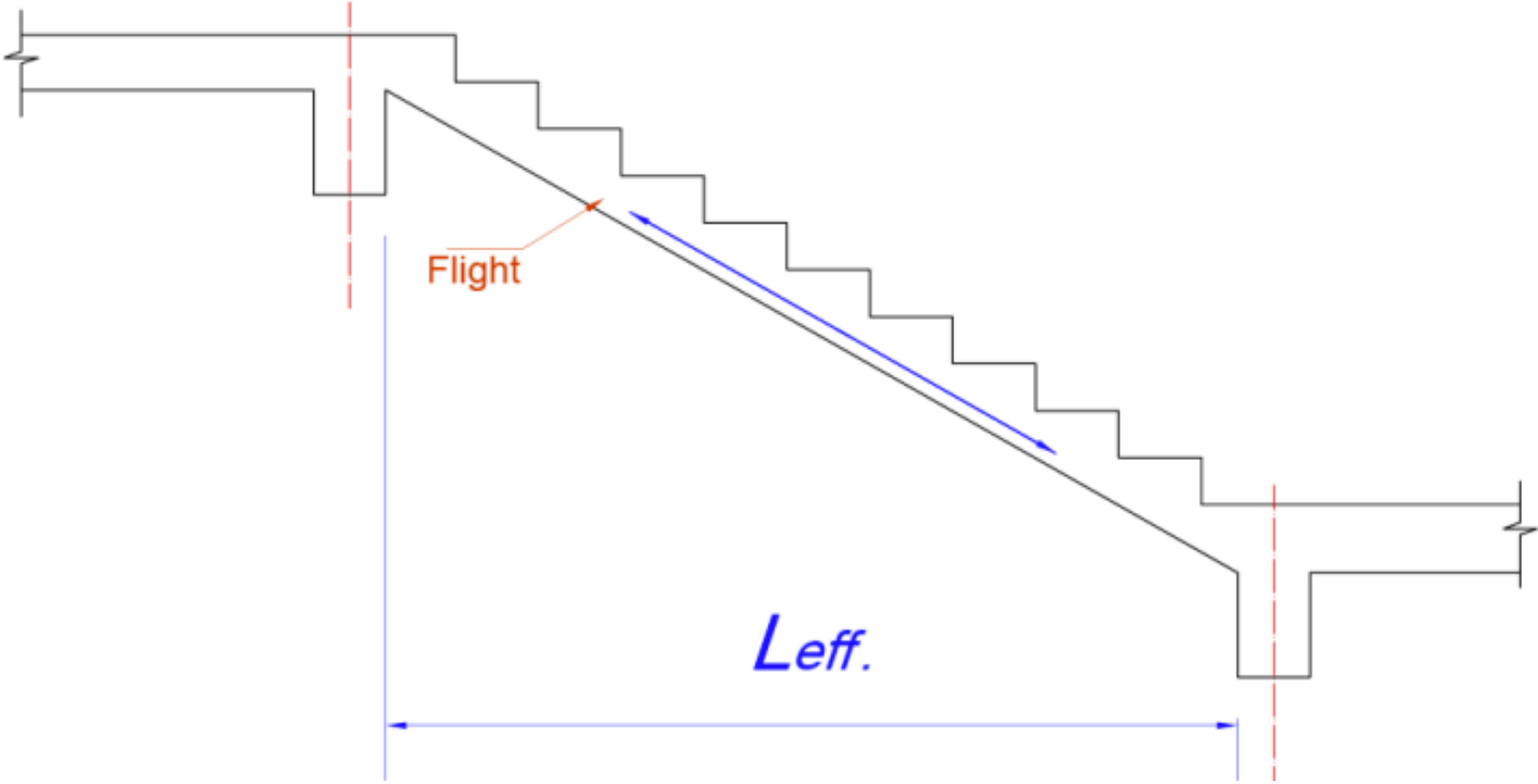

Flight

Leff.

Leff= Horizontal Projection of the flight between supports

b. Stair flight may be spanning between landing or floor slab having main reinforcement parallel to flight. The effective span is equal the sum of the distance between supports c/c.

Main Reinforcement Direction

Flight

Main Reinforcement Direction

Main Reinforcement Direction

$L1$

ΣGs

$L3$

$Leff = .Land + \Sigma Gs + Floor\ Slab$

$Leff = L1 + \Sigma Gs + L3$

c. When the flight is spanning between landing and floor slab and may have the main reinforcement perpendicular to flight.

Main
Reinforcement Direction

Flight

Main
Reinforcement Direction

Main
Reinforcement Direction

2X

ΣGs

2Y

$L_{eff.} = X + \Sigma Gs + Y$
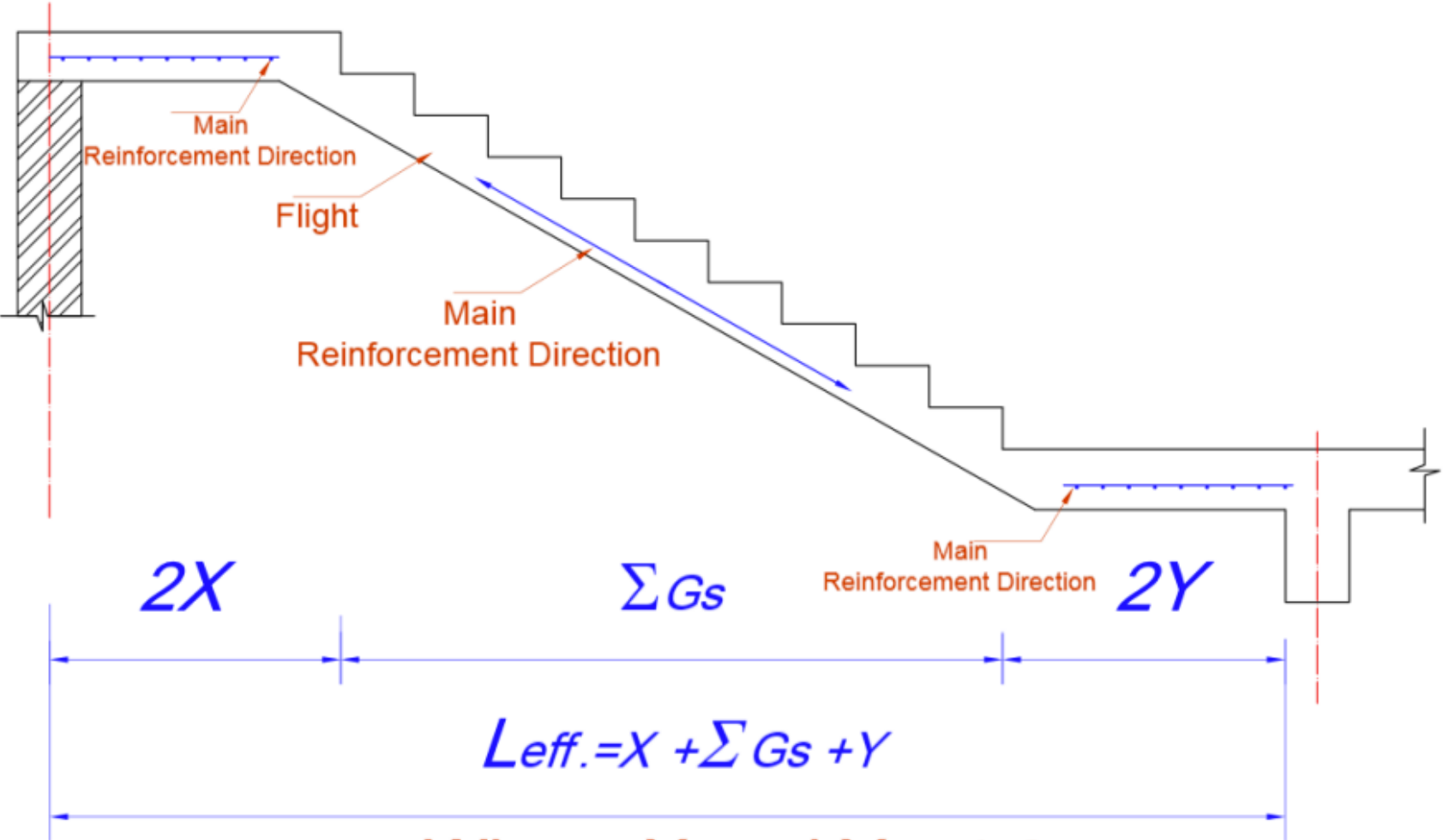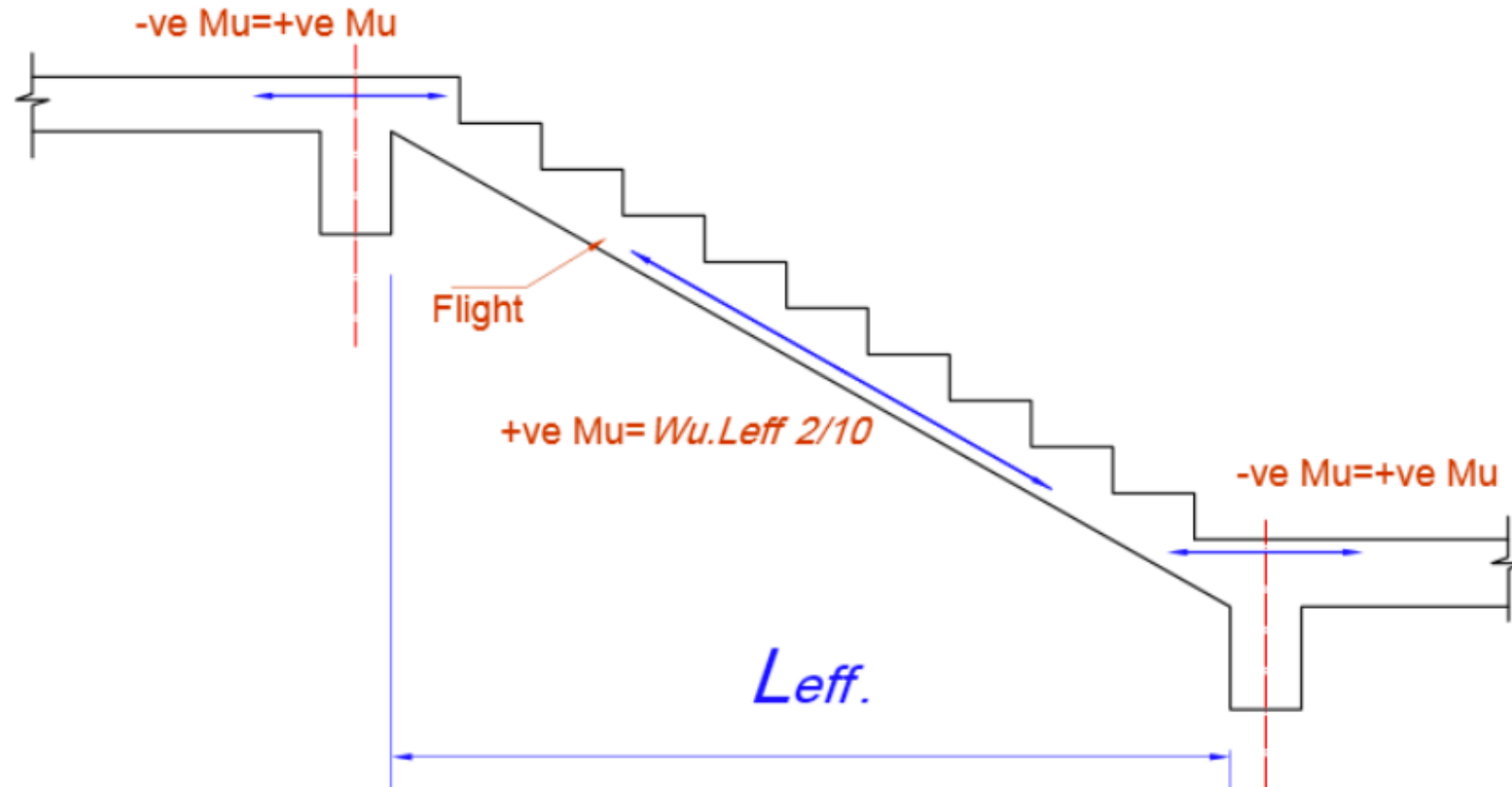
Where X and Y ≤ 1.0m

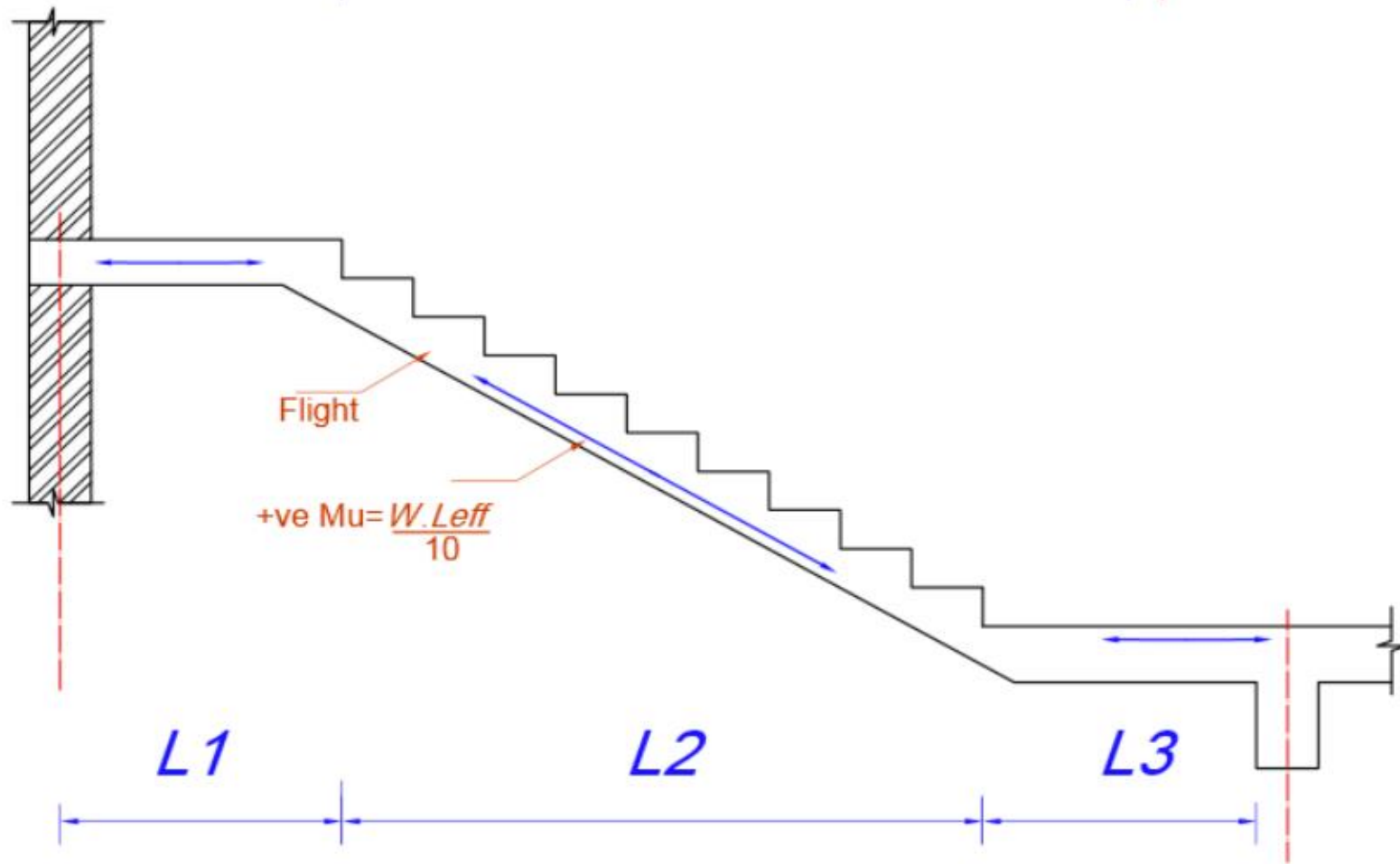- **Two methods of moment calculations can be used for stairs spanning in longitudinal directions:**

a) *Assume that the positive moment* $Mu^{+ve}=0.8\ Mu_{S.S.}$

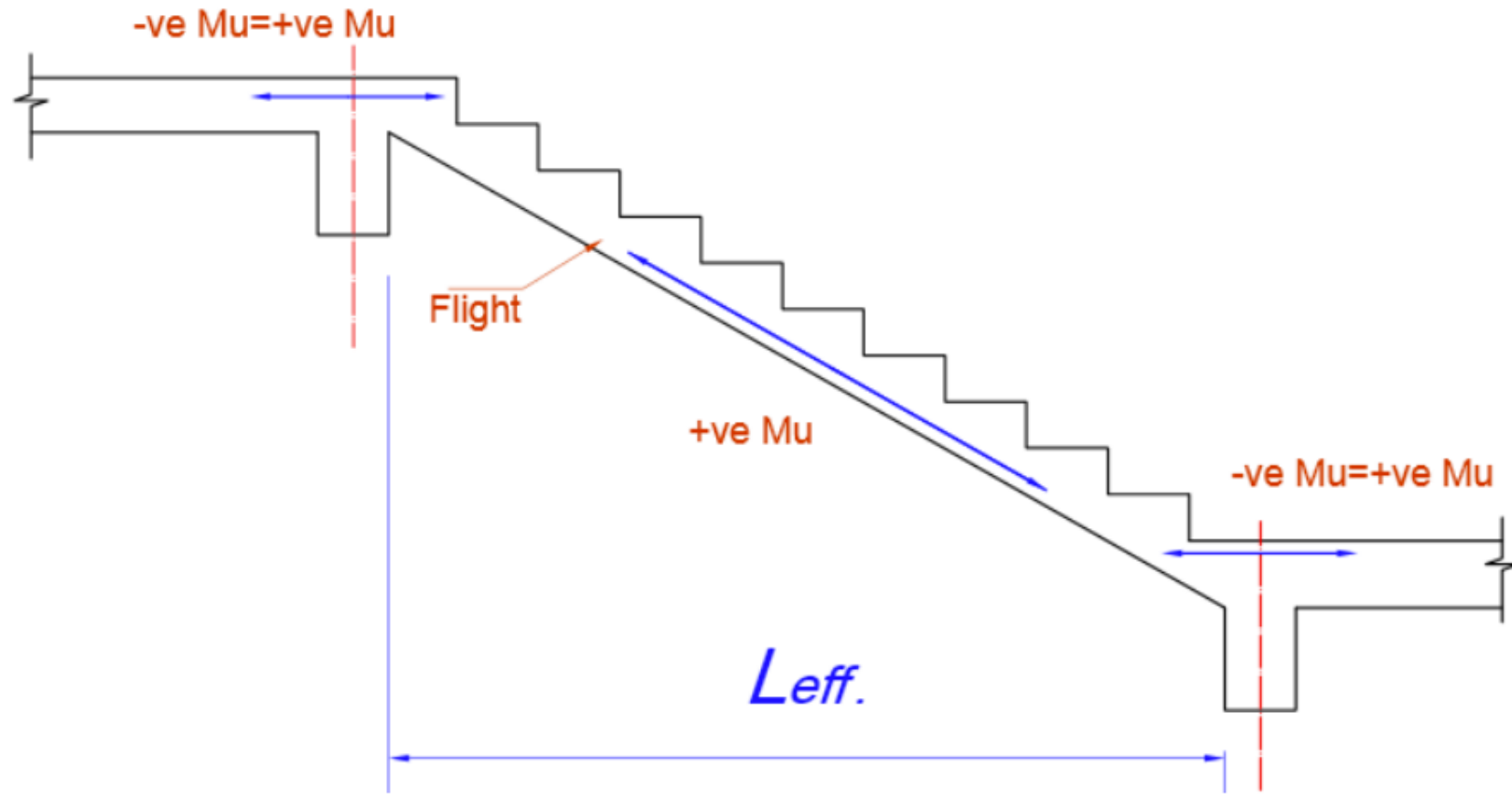b) *Assume that the positive moment* $Mu^{+ve}=Wu.L/10$
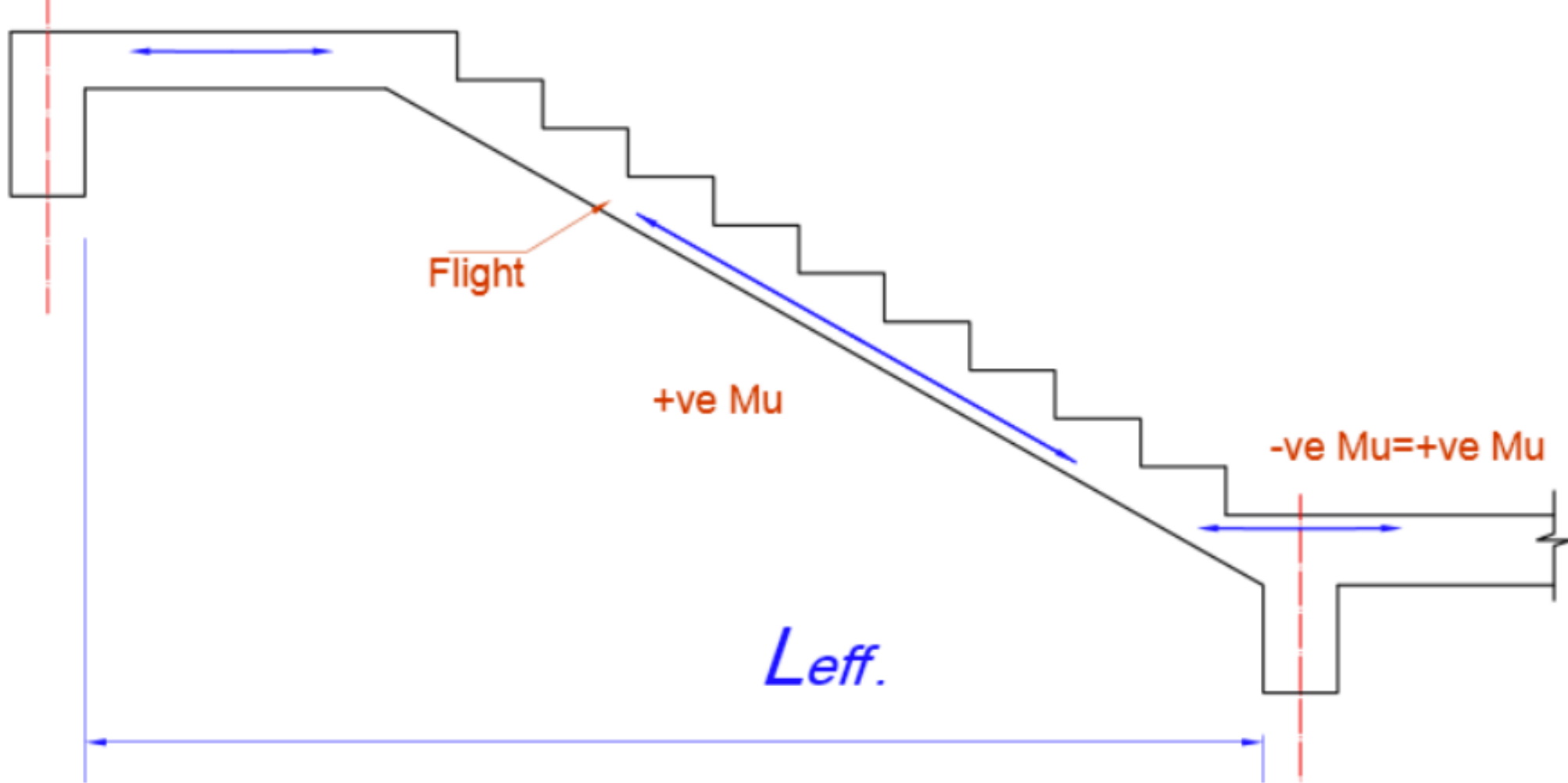
   Where :

   $Wu=wu_1.L1 + wu_2.\ L2$

-ve Mu=+ve Mu

Flight

+ve Mu= Wu.Leff 2/10

-ve Mu=+ve Mu

Leff.

Flight

$+\text{ve } Mu = \dfrac{W.Leff}{10}$

L1

L2

L3

$W = Wu1.L1 + Wu2.L2 + Wu3.L3$

- **_Positive and Negative moment distribution for stairs spanning in longitudinal directions:_**
1. _Two end continuous_

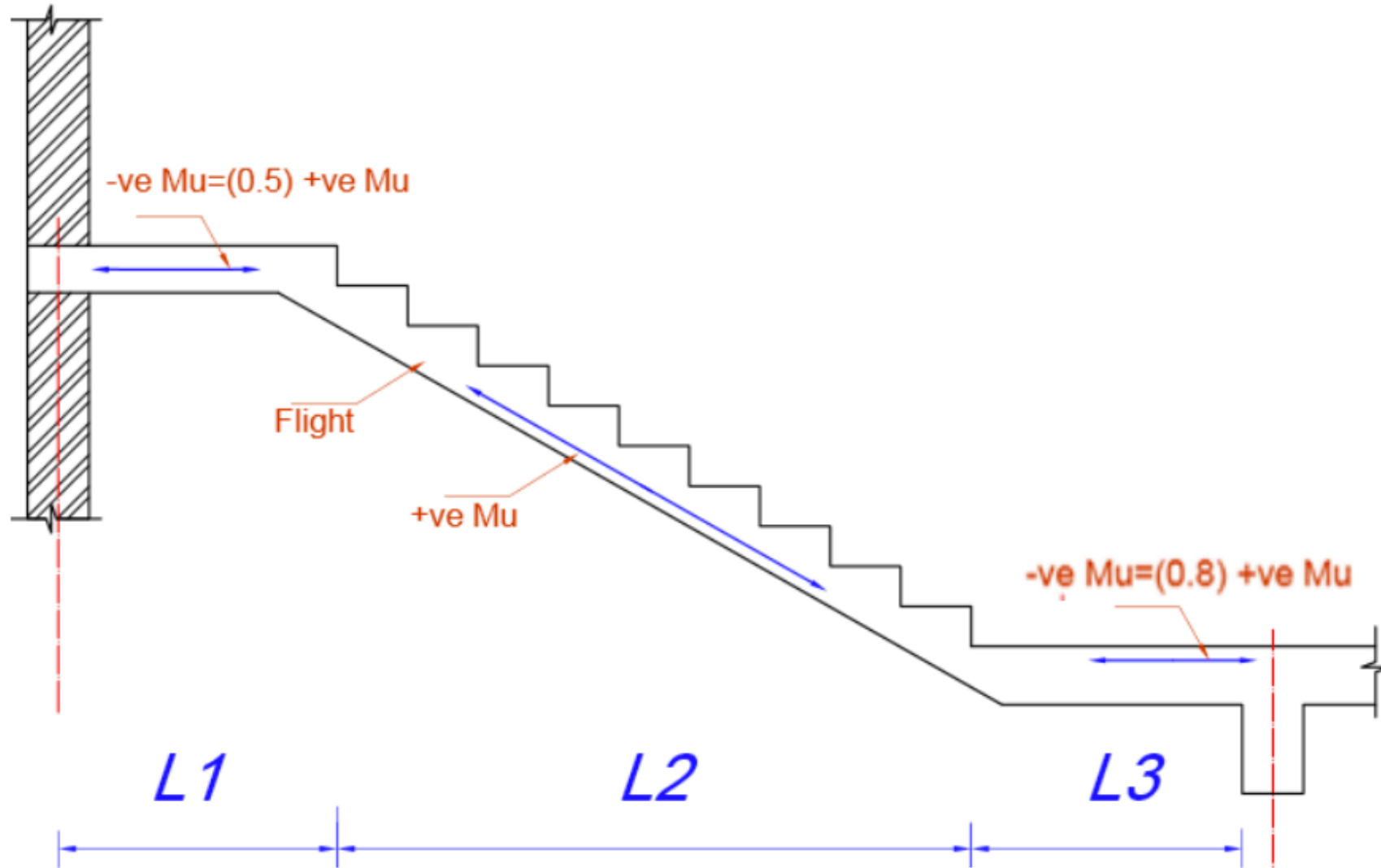## 2. One end continuous (Planning then beam)

-ve Mu=(0.8) +ve Mu

Flight

+ve Mu

-ve Mu=+ve Mu

L_{eff}.

3. One end continuous (Planning then Wall)

-ve Mu=(0.5) +ve Mu

Flight

+ve Mu

-ve Mu=(0.8) +ve Mu

L1 L2 L3

4. Simply Supported (Planning then Wall and Footing Base)

-ve Mu=(0.5) +ve Mu

Flight

+ve Mu

-ve Mu= (0.5) +ve Mu

Ground

L1

L2