TAYLOR'S UNIVERSITY

Wisdom • Integrity • Excellence

BUILDING STRUCTURES [ARC 2523]

PROJECT 2:

EXTENSION OF A R.C STRUCTURE

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INTRODUCTION

DESIGN BRIEF

The existing house is a complete piece of architecture, however, some clients requested that the house to have extra spaces to occupy their family's large needs.

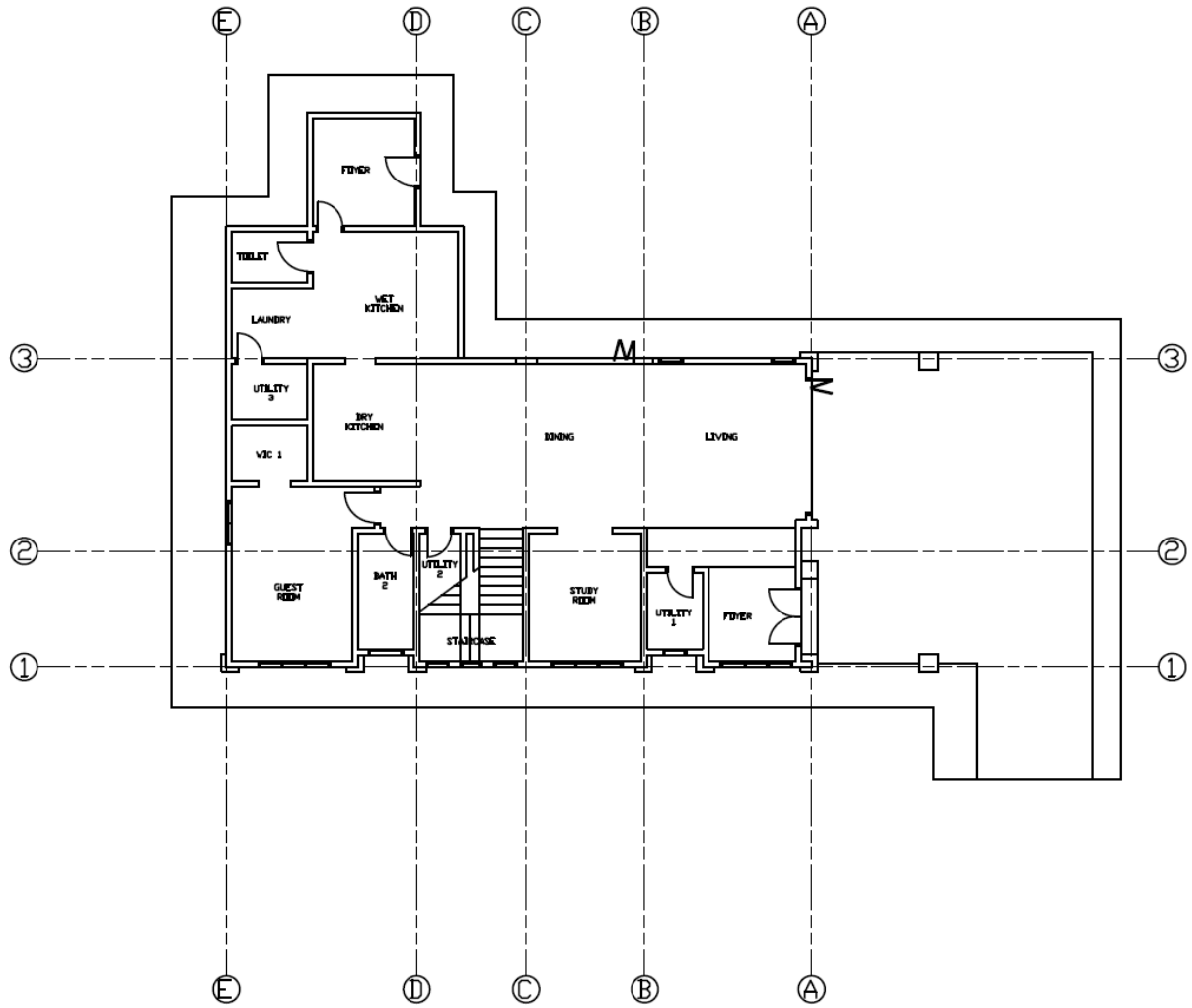
The ground floor has a limited space for kitchen activities in which it only has dry kitchen that could not sustain the needs of the client's family. Plus, a foyer is being positioned in a manner at the back of the house providing an entrance for the occupants to enter safely from the back through the proposed, wet kitchen.

The second bedroom at the first floor also needs a balcony and a bathroom size extension like the master bedroom, but, smaller in ways that the family has their wedded son and his wife, living there together to enjoy the morning air and sun as they also has their own marriage institution. Through my extension proposal, I address these issues.

EXTENSION PROPOSAL

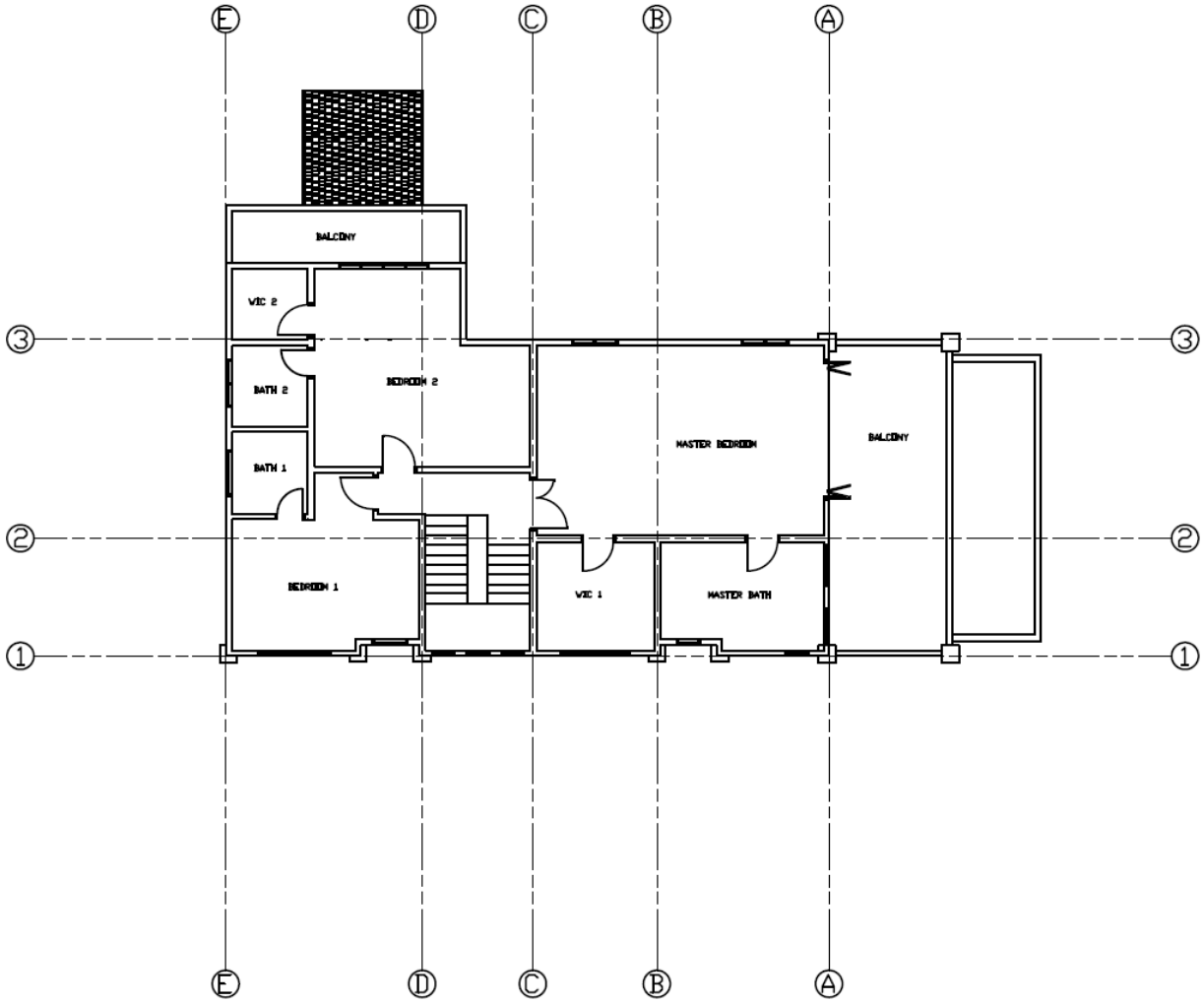
GROUND FLOOR PLAN

SCALE 1:200



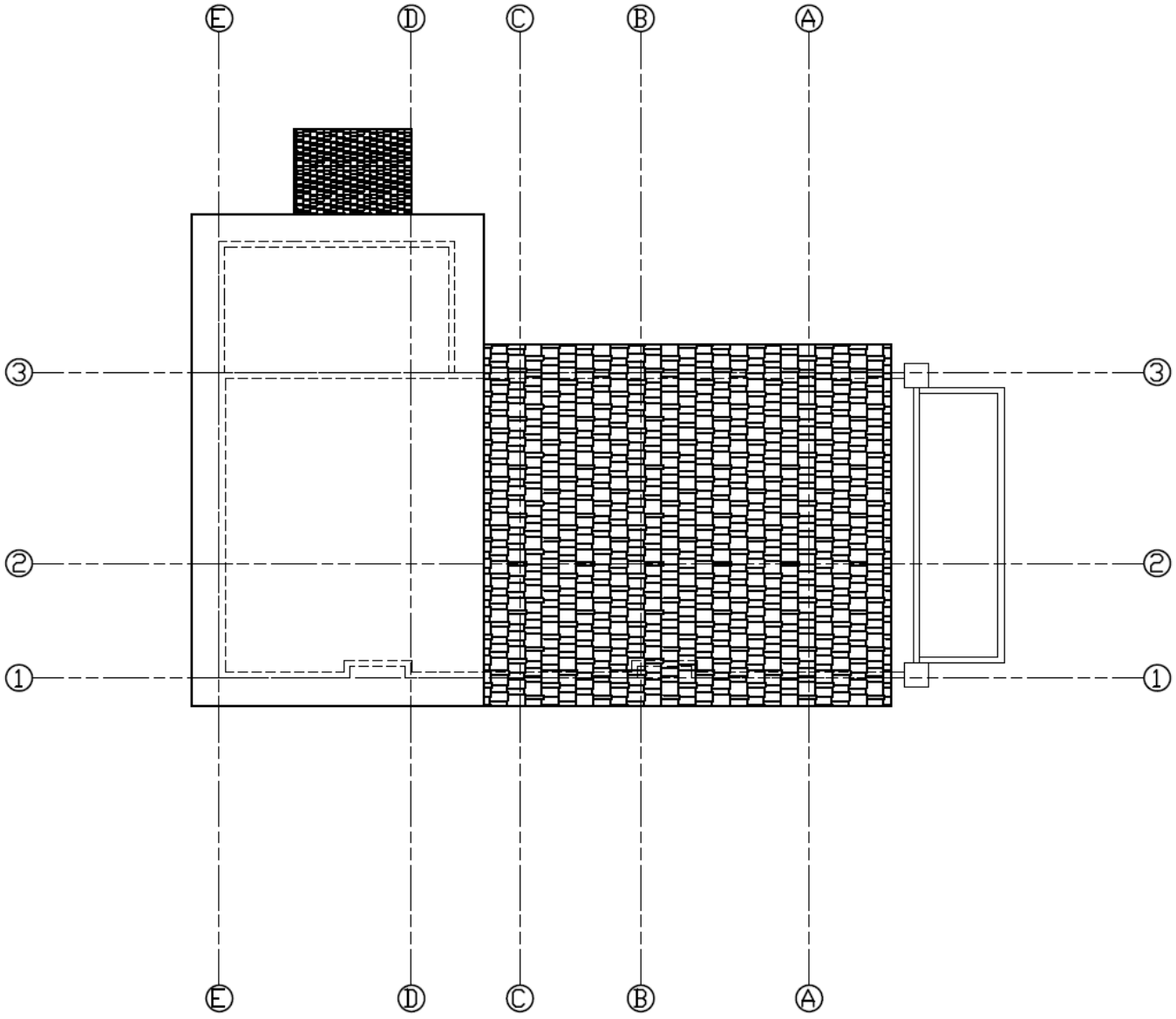
FIRST FLOOR PLAN

SCALE 1:200



ROOF PLAN

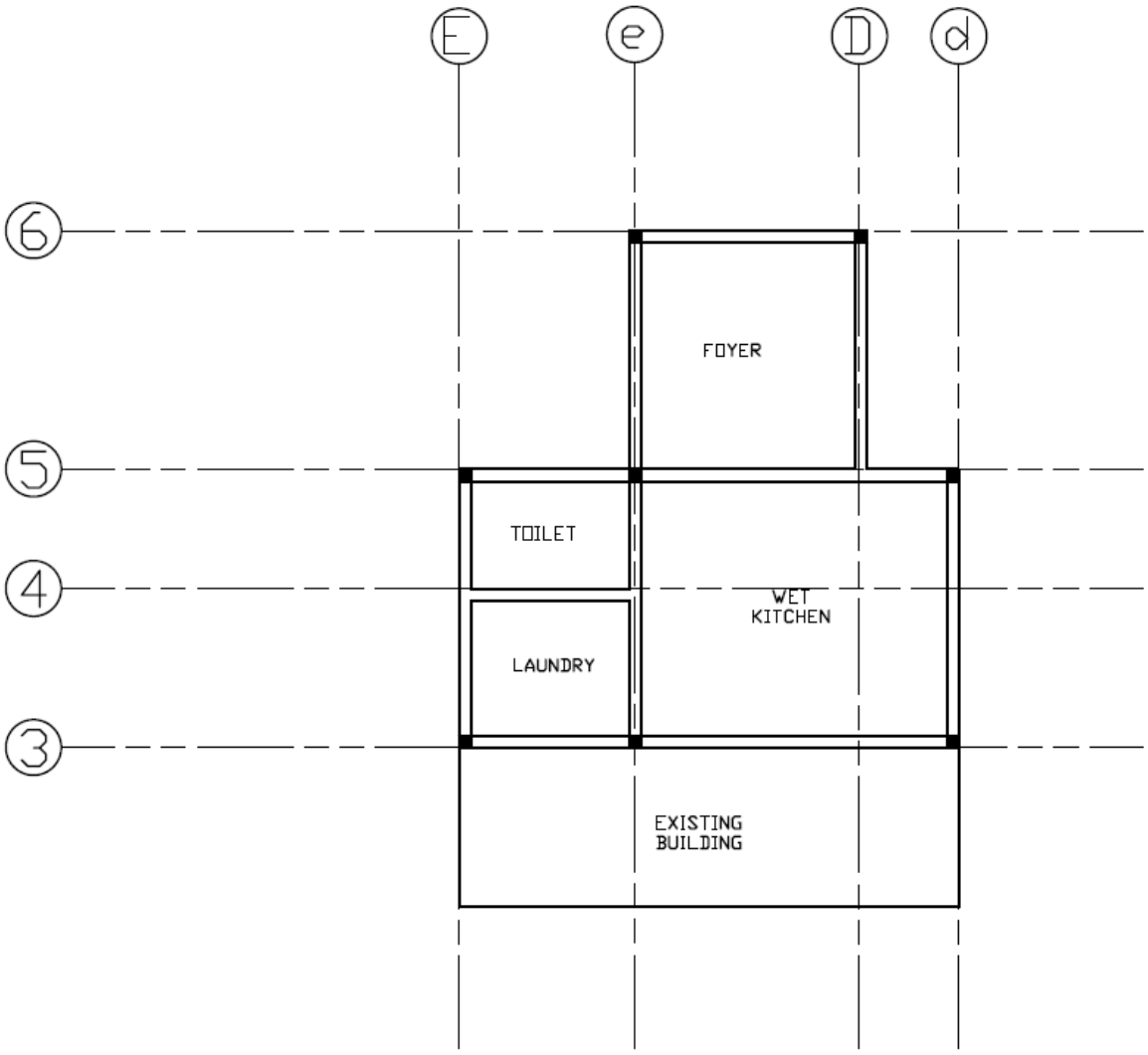
SCALE 1:200



STRUCTURAL PLANS

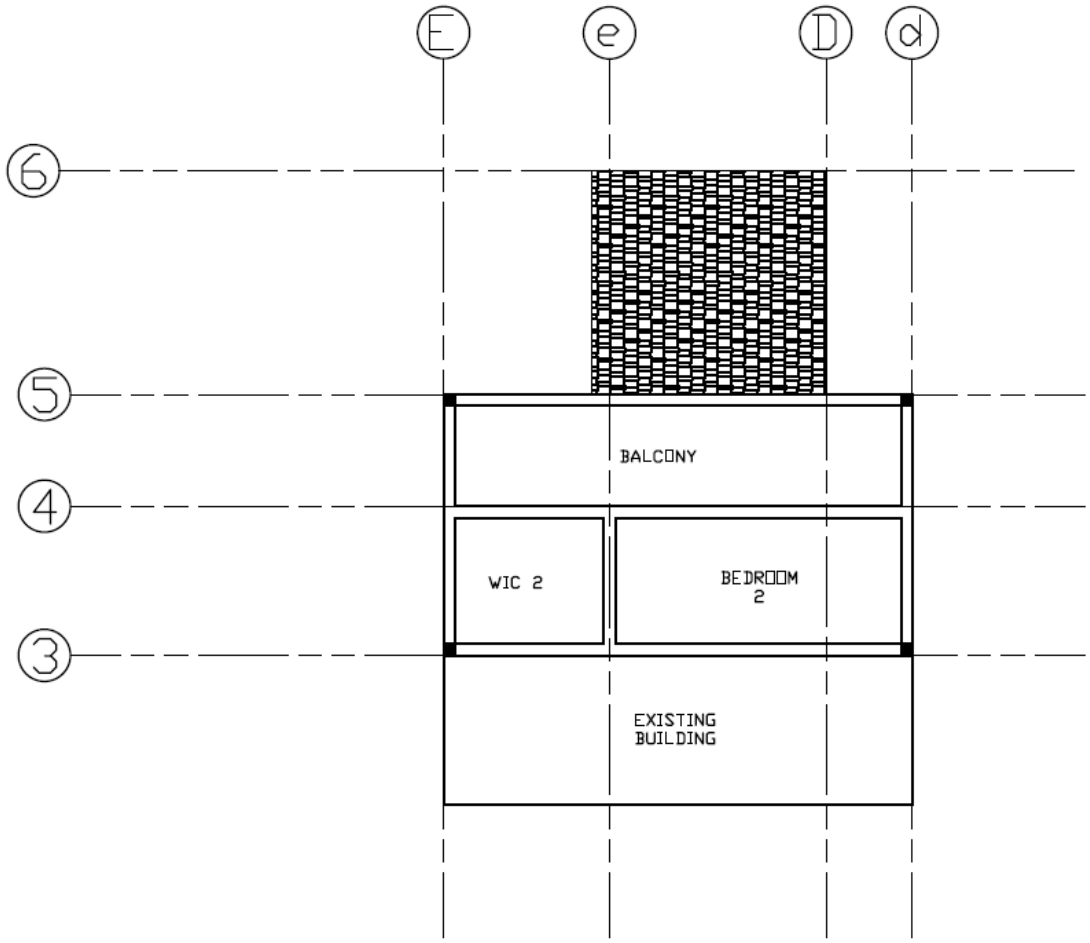
GROUND FLOOR PLAN

SCALE 1:100



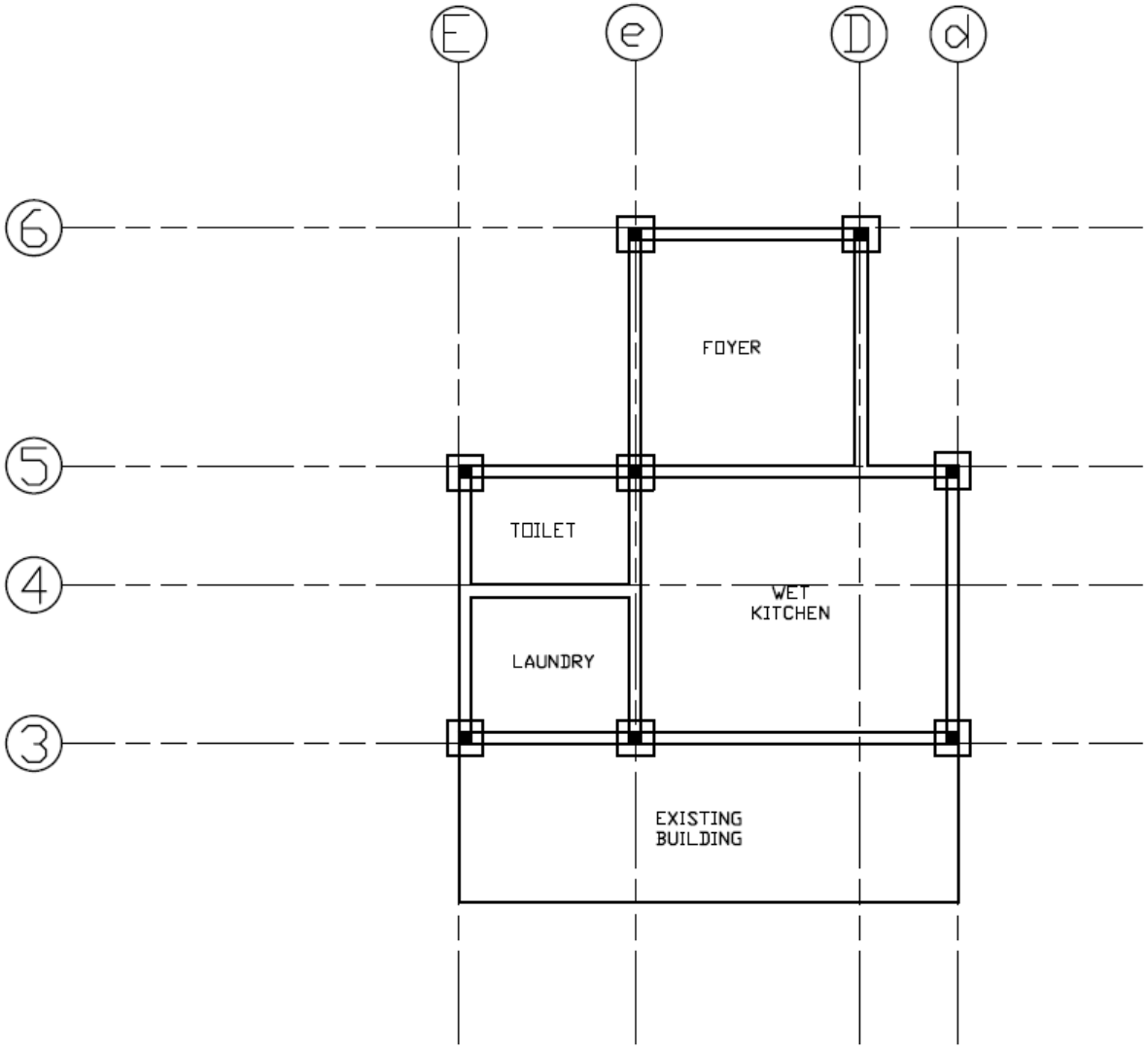
FIRST FLOOR PLAN

SCALE 1:100



FOUNDATION PLAN

SCALE 1:100



QUANTIFY DEAD LOADS AND LIVE LOADS ACTING ON STRUCTURE

DEAD LOADS

Ground Floor

Toilet:

Slab thickness: 150mm

Slab self-weight = 0.15m x 24kN/m^3

= 3.6 kN/m^2

Foyer:

Slab thickness: 150mm

Slab self-weight = 0.15m x 24kN/m^3

= 3.6 kN/m^2

Wet Kitchen:

Slab thickness: 150mm

Slab self-weight = 0.15m x 24kN/m^3

= 3.6 kN/m^2

Laundry:

Slab thickness: 150mm

Slab self-weight = 0.15m x 24kN/m^3

= 3.6 kN/m^2

First Floor

Bedroom 2:

Slab thickness: 150mm

Slab self-weight = 0.15m x 24kN/m^3

= 3.6kN/m^2

Walk-In Closet 2:

Slab thickness: 150mm

Slab self-weight = 0.15m x 24kN/m^3

= 3.6kN/m^2

Balcony:

Slab thickness: 150mm

Slab self-weight = 0.15m x 24kN/m^3

= 3.6kN/m^2

Brick wall:

= Wall Height x Thickness x Density

= 3.0m x 0.15m x 19kN/m^3

= 8.55kN/m

Beam Self-Weight:

Assume that initial beam size is 150mm x 300mm

= Beam size x Concrete density

= 0.5m x 0.15m x 24kN/m^3

= 1.8kN/m

LIVE LOADS

(According to Fourth schedule of UBBL for live load according to the function of the space)

Ground Floor

Wet Kitchen:

3.0kN/m^2

Foyer:

2.5kN/m^2

Laundry:

3.0kN/m^2

Toilet:

2.0kN/m^2

First Floor

Balcony:

1.5kN/m^2

Bedroom:

1.5kN/m^2

Walk-In Closet:

1.5kN/m^2

IDENTIFY ONE WAY OR TWO WAY SLAB

To identify whether a slab is acting in one-way or two-way, the following is used:

If Lx / Ly value is bigger than or equal to 2, then it is a one-way slab.

If Lx / Ly value is smaller than 2, then it is a two-way slab.

Lx = Longer length of slab

Ly = shorter length of slab

Ground Floor

Wet Kitchen:

= 4.0m / 3.5m

= 1.14 (two way slab)

Foyer:

= 3.0m / 3.0mm

= 1.0 (two way slab)

Laundry:

= 2.3m/ 2.0m

= 1.15 (two way slab)

Toilet:

= 2.3m / 1.5m

= 1.53 (two way slab)

First Floor

Balcony:

= 6.3m / 1.5m

= 4.2 (One-way slab)

Bedroom:

= 4.0m / 2.0m

= 2 (One-way slab)

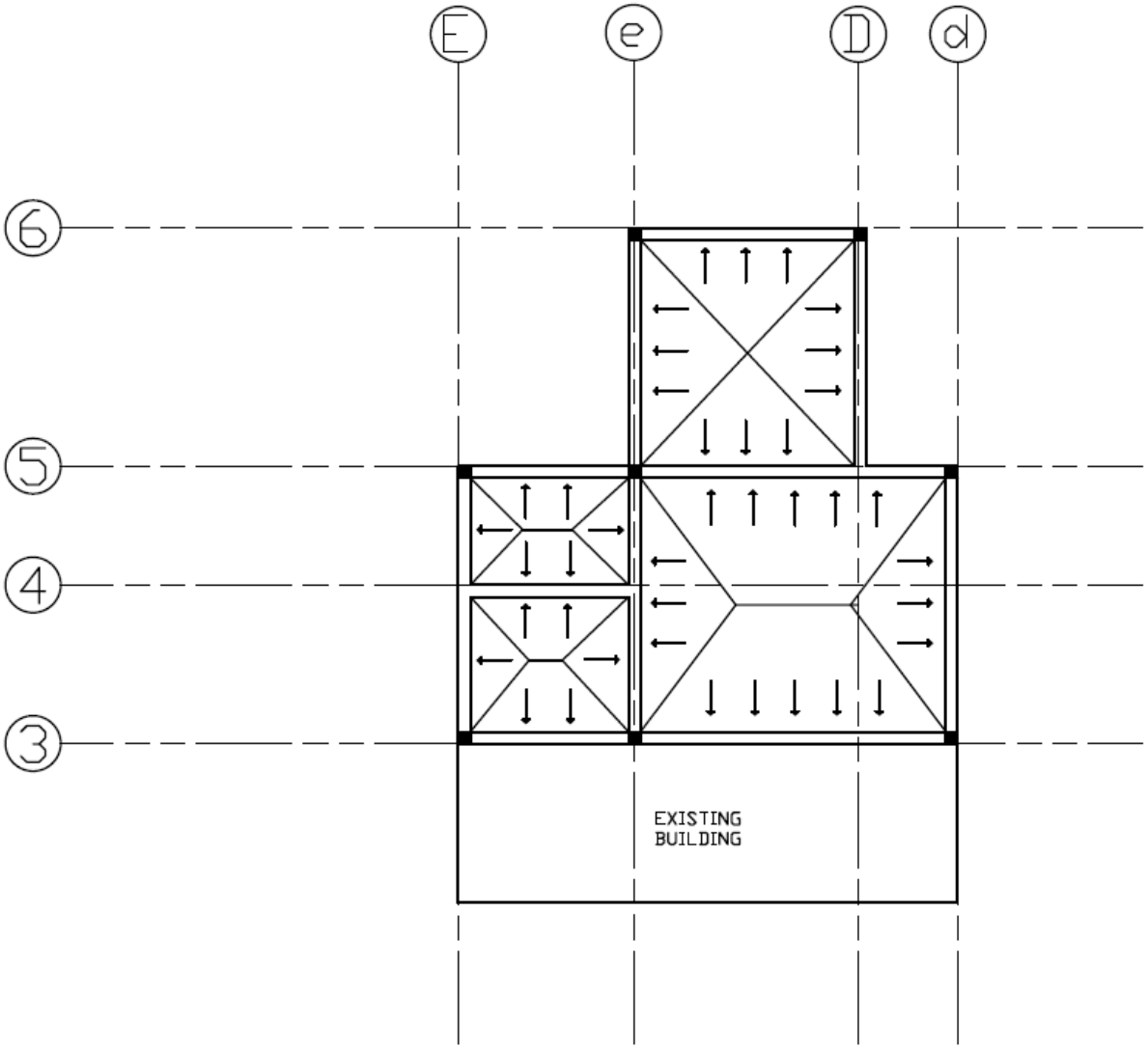
Walk-In Closet:

= 2.3m / 2.0m

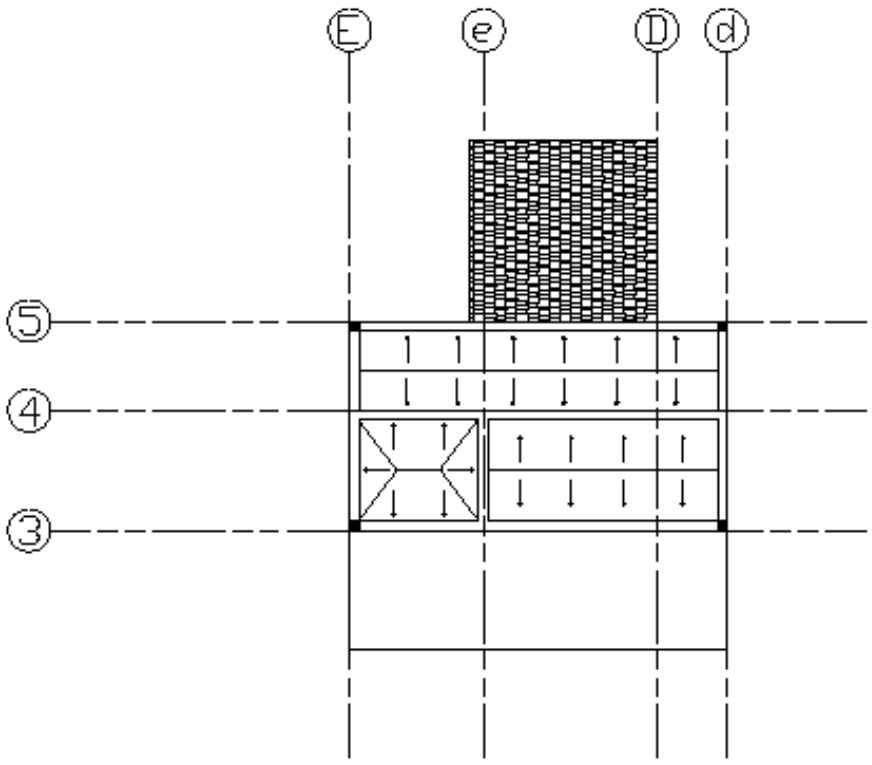
= 1.15 (Two-way slab)

LOAD DISTRIBUTION DIAGRAM

GROUND FLOOR PLAN



FIRST FLOOR PLAN



BEAM ANALYSIS CALCULATION

Ground Floor Beam, E / 3-5

1. Carries self-weight – Dead load
2. Slab dead load & live load
    a. 3-4 / E-e (Two-way slab)
    b. 4-5 / E-e (Two-way slab)
3. Brick wall – Dead load

Brick wall

= Wall Height x Thickness x Density

= 3.0m x 0.15m x 19kN/m^3

= 8.55kN/m

Beam Self-Weight:

Assume that initial beam size is 150mm x 300mm

= Beam size x Concrete density

= 0.5m x 0.15m x 24kN/m^3

= 1.8kN/m

Dead load transfer on slab 3-4 / E-e (two-way slab)

Load is transferred to beam E / 3-5 in a triangular form.

Dead load from slab = Dead load on slab x (Lx / 2)

= 3.6kN/m^2 x (2.0m / 2)

= 3.6kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Dead load from slab = 2/3 x 3.6kN/m

= 2.4kN/m

Dead load transfer on slab 4-5 / E-e (two-way slab)

Load is transferred to beam E / 3-5 in a triangular form.

Dead load from slab 4-5 / E-e = Dead load on slab x (Lx / 2)

= 3.6kN/m^2 x (1.5m / 2)

= 2.7kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Dead load from slab = 2/3 x 2.7kN/m

= 1.8kN/m

Total Dead Load

Total for 3-4

= 8.55kN/m + 1.8kN/m + 2.4kN/m

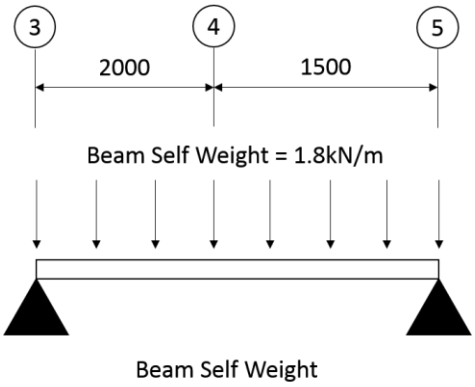
= 12.75kN/m

Total for 4-5

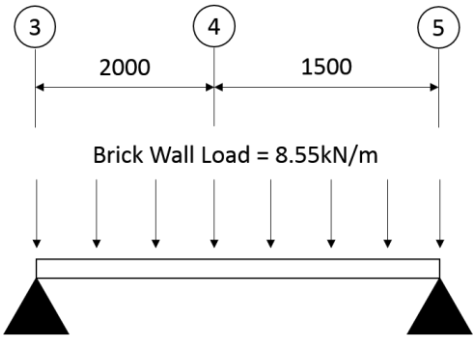
= 8.55kN/m + 1.8kN/m + 1.8kN/m

= 12.15 kN/m

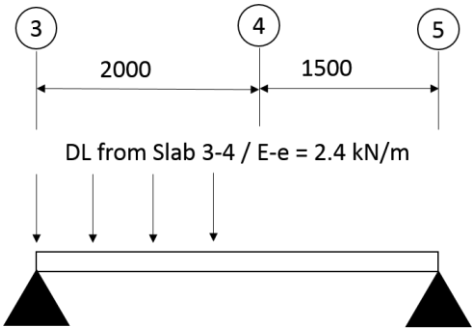
Total Dead Load Diagram



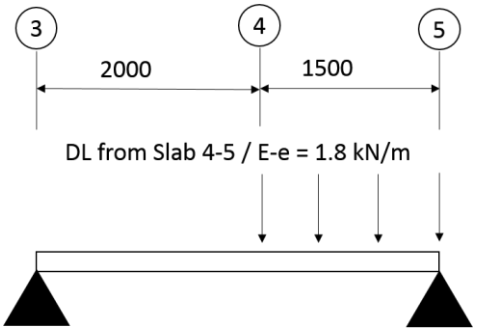
Beam Self Weight



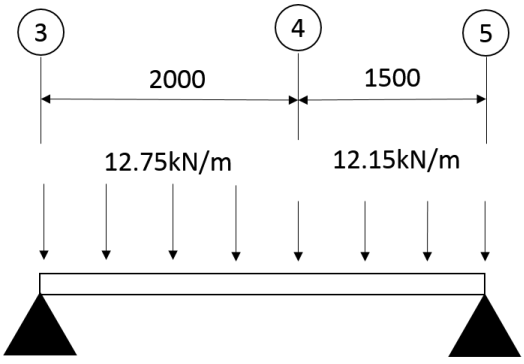
Brick Wall



Slab 3-4 / E-e



Slab 4-5 / E-e



Total

Live load transfer on slab 3-4 / E-e (two-way slab)

Load is transferred to beam E / 3-5 in a triangular form.

Live load from slab 3-4 / E-e = Live load on slab x (Lx / 2)

= 3.0kN/m^2 x (2.0m / 2)

= 3.0kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Dead load from slab = 2/3 x 3.0kN/m

= 2.0kN/m

Live load transfer on slab 4-5 / E-e (two-way slab)

Load is transferred to beam E / 3-5 in a triangular form.

Live load from slab 4-5 / E-d = Live load on slab x (Lx / 2)

= 2.0kN/m^2 x (1.5m / 2)

= 1.5kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Dead load from slab = 2/3 x 1.5kN/m

= 1.0kN/m

Total Live Load

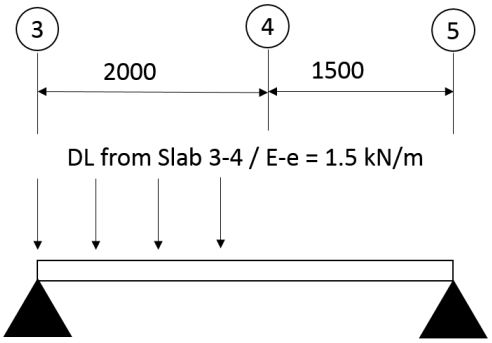
Total for 3-4

= 1.5kN/m

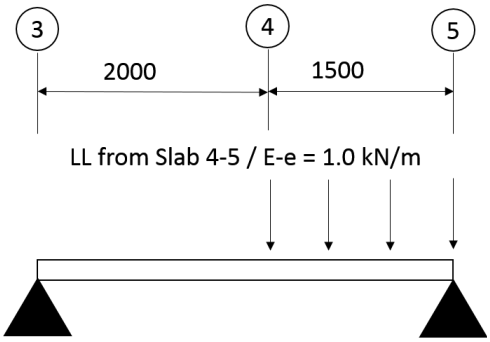
Total for 4-5

= 1.0kN/m

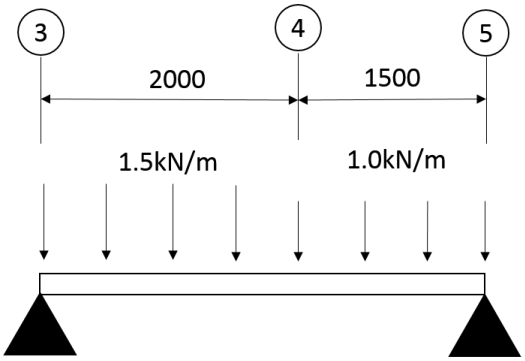
Total Live Load Diagram



Slab 3-4 / E-e



Slab 4-5 / E-e



Total

Ultimate Load

Apply factor 1.4 and 1.6 to dead load and live load respectively.

Dead load 3-4 = 12.75kN/m x 1.4 = 17.85kN/m

Dead load 4-5 = 12.15kN/m x 1.4 = 17.01kN/m

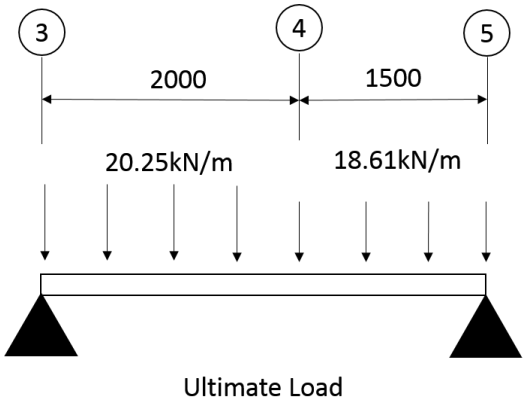
Live load 3-4 = 1.5kN/m x 1.6 = 2.4kN/m

Live load 4-5 = 1.0kN/m x 1.6 = 1.6kN/m

Ultimate load E-e = 17.85kN/m + 2.4kN/m = 20.25kN/m

Ultimate load e-d = 17.01kN/m + 1.6kN/m = 18.61kN/m

Ultimate Load Diagram



Ultimate Load

Reactions

$$\sum M_A = 0$$

$$= R_{3Y}(3.5) - 20.25(2.0)(2.5) - 18.61(1.5)(0.75)$$

$$= 3.5R_{3Y} - 101.25 - 20.94$$

$$R_{3Y} = 34.91kN$$

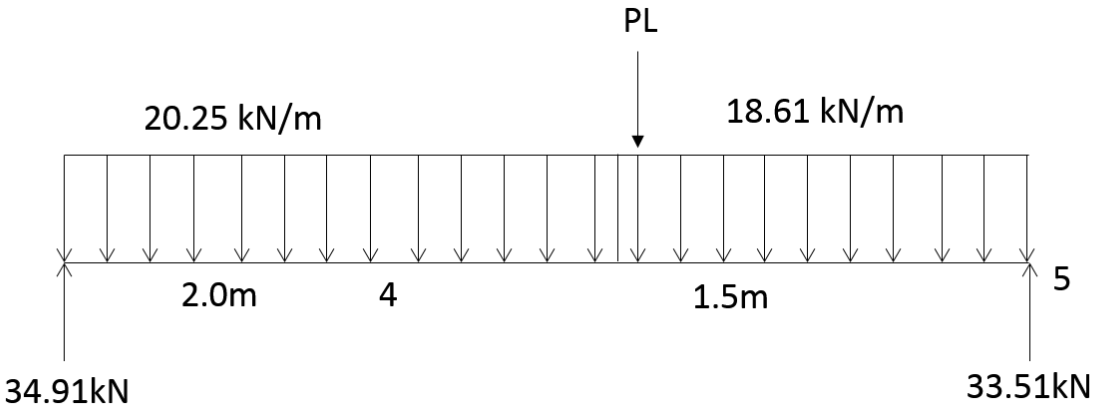
$$\sum F = 0$$

$$= R_{3Y} + R_{5Y} - 20.25(2.0) - 18.61(1.5)$$

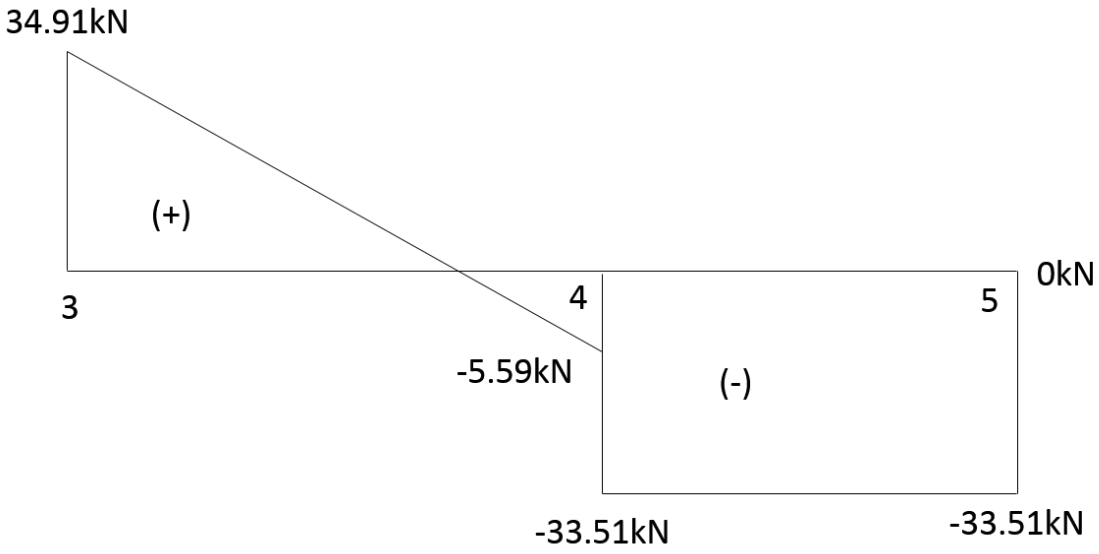
$$= 34.91 + R_{5Y} - 68.42$$

$$R_{5Y} = 33.51kN$$

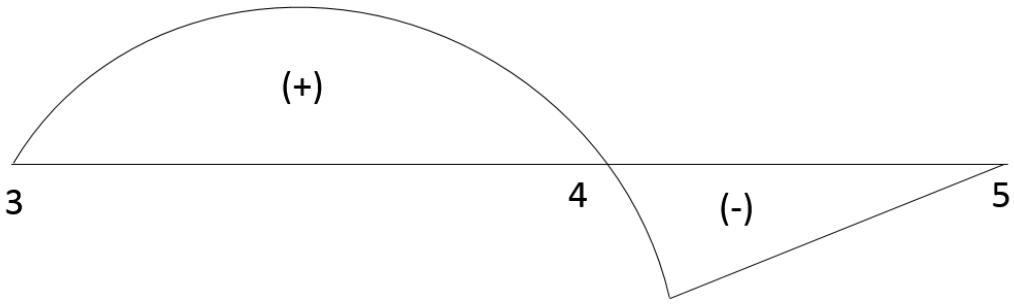
Load Diagram



Shear Force Diagram



Bending Moment Diagram



Ground Floor Beam, e / 3-6

1. Carries self-weight – Dead load
2. Slab dead load & live load
    a. 3-4 / E-e (Two-way slab)
    b. 4-5 / E-e (Two-way slab)
    c. 3-5 / e-d (Two-way slab)
    d. 5-6 / e-D (Two-way slab)
3. Brick wall – Dead load

Brick wall

= Wall Height x Thickness x Density

= 3.0m x 0.15m x 19kN/m^3

= 8.55kN/m

Beam Self-Weight:

Assume that initial beam size is 150mm x 300mm

= Beam size x Concrete density

= 0.5m x 0.15m x 24kN/m^3

= 1.8kN/m

Dead load transfer on slab 3-4 / E-e (two-way slab)

Load is transferred to beam e / 3-6 in a triangular form.

Dead load from slab = Dead load on slab x (Lx / 2)

= 3.6kN/m^2 x (2.0m / 2)

= 3.6kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Dead load from slab = 2/3 x 3.6kN/m

= 2.4kN/m

Dead load transfer on slab 4-5 / E-e (two-way slab)

Load is transferred to beam e / 3-6 in a triangular form.

Dead load from slab 4-5 / E-e = Dead load on slab x (Lx / 2)

= 3.6kN/m^2 x (1.5m / 2)

= 2.7kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Dead load from slab = 2/3 x 2.7kN/m

= 1.8kN/m

Dead load transfer on slab 3-5 / e-d (two-way slab)

Load is transferred to beam e / 3-6 in a triangular form.

Dead load from slab 3-5 / e-d = Dead load on slab x (Lx / 2)

= 3.6kN/m^2 x (3.5m / 2)

= 6.3kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Dead load from slab = 2/3 x 6.3kN/m

= 4.2kN/m

Dead load transfer on slab 5-6 / e-D (two-way slab)

Load is transferred to beam e / 3-6 in a triangular form.

Dead load from slab 5-6 / e-d = Dead load on slab x (Lx / 2)

= 3.6kN/m^2 x (3.0m / 2)

= 5.4kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Dead load from slab = 2/3 x 5.4kN/m

= 3.6kN/m

Total Dead Load

Total for 3-4

= 8.55kN/m + 1.8kN/m + 2.4kN/m + 4.2kN/m

= 16.95kN/m

Total for 4-5

= 8.55kN/m + 1.8kN/m + 1.8kN/m + 4.2kN/m

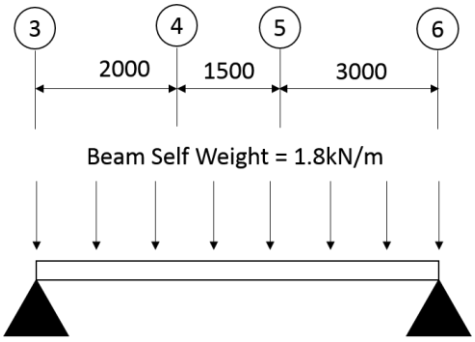
= 16.35kN/m

Total for 5-6

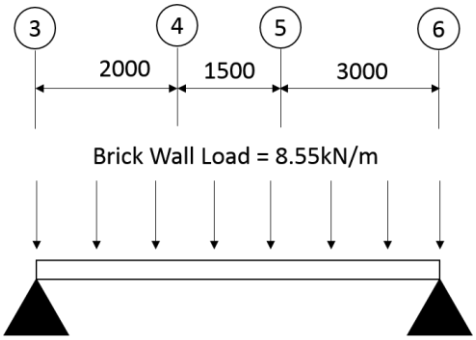
= 8.55kN/m + 1.8kN/m + 3.6kN/m

= 13.95kN/m

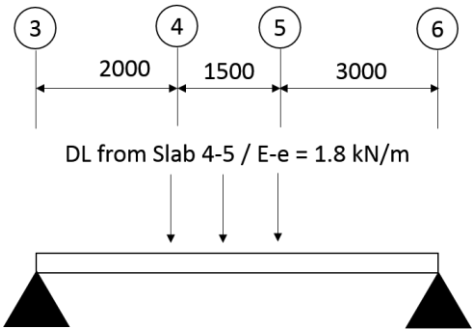
Total Dead Load Diagram



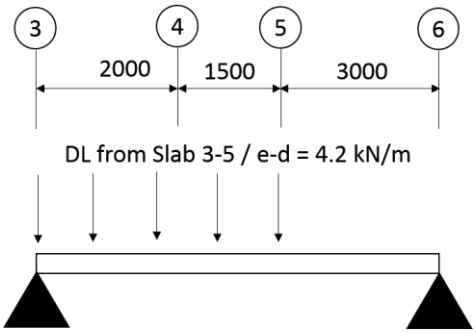
Beam Self Weight



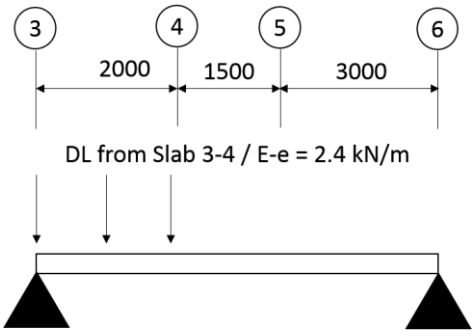
Brick Wall



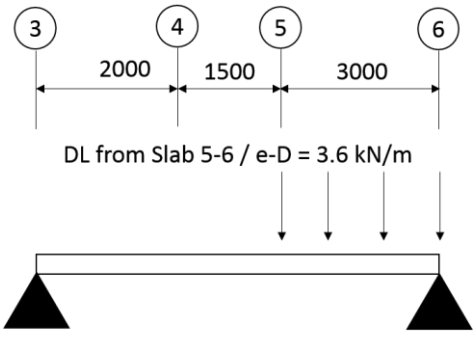
Slab 4-5 / E-e



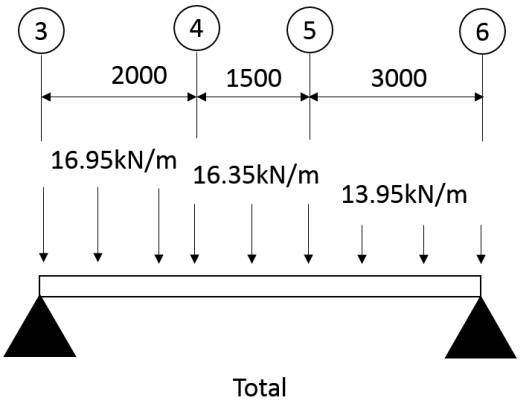
Slab 3-5 / e-d



Slab 3-4 / E-e



Slab 5-6 / e-D



Live load transfer on slab 3-4 / E-e (two-way slab)

Load is transferred to beam e / 3-6 in a triangular form.

Live load from slab = Live load on slab x (Lx / 2)

= 3.0kN/m^2 x (2.0m / 2)

= 3.0kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Live load from slab = 2/3 x 3.0kN/m

= 2.0kN/m

Live load transfer on slab 4-5 / E-e (two-way slab)

Load is transferred to beam e / 3-6 in a triangular form.

Live load from slab 4-5 / E-e = Live load on slab x (Lx / 2)

= 2.0kN/m^2 x (1.5m / 2)

= 1.5kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Live load from slab = 2/3 x 1.5kN/m

= 1.0kN/m

Live load transfer on slab 3-5 / e-d (two-way slab)

Load is transferred to beam e / 3-6 in a triangular form.

Live load from slab 3-5 / e-d = Live load on slab x (Lx / 2)

= 3.0kN/m^2 x (3.5m / 2)

= 5.25kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Live load from slab = 2/3 x 5.25kN/m

= 3.5kN/m

Live load transfer on slab 5-6 / e-D (two-way slab)

Load is transferred to beam e / 3-6 in a triangular form.

Live load from slab 5-6 / e-d = Live load on slab x (Lx / 2)

= 2.5kN/m^2 x (3.0m / 2)

= 3.75kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Live load from slab = 2/3 x 3.75kN/m

= 2.5kN/m

Total Live Load

Total for 3-4

= 2.0kN/m + 3.5kN/m

= 5.5kN/m

Total for 4-5

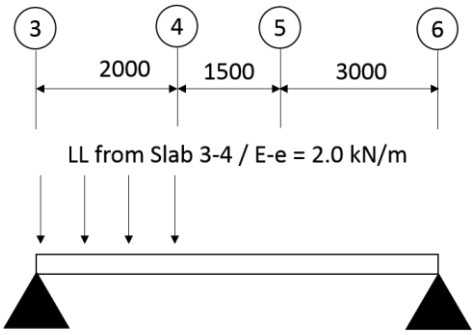
= 1.0kN/m + 3.5kN/m

= 4.5kN/m

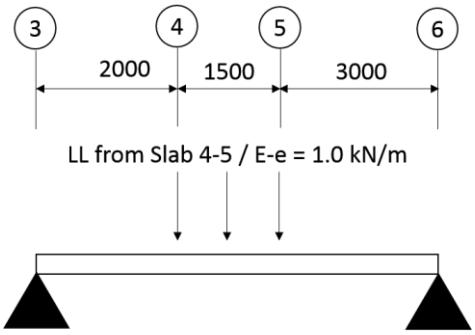
Total for 5-6

= 2.5kN/m

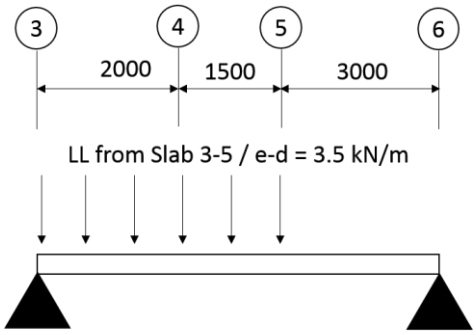
Total Live Load Diagram



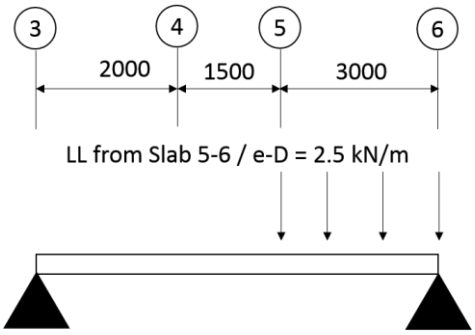
Slab 3-4 / E-e



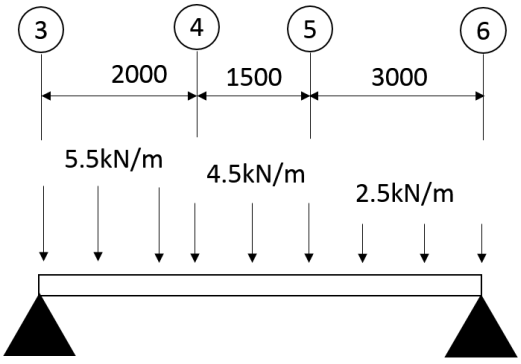
Slab 4-5 / E-e



Slab 3-5 / e-d



Slab 5-6 / e-D



Total

Ultimate Load

Apply factor 1.4 and 1.6 to dead load and live load respectively.

Dead load 3-4 = 16.95kN/m x 1.4 = 23.73kN/m

Dead load 4-5 = 16.35kN/m x 1.4 = 22.89kN/m

Dead load 5-6 = 13.95kN/m x 1.4 = 19.53kN/m

Live load 3-4 = 5.5kN/m x 1.6 = 8.8kN/m

Live load 4-5 = 4.5kN/m x 1.6 = 7.2kN/m

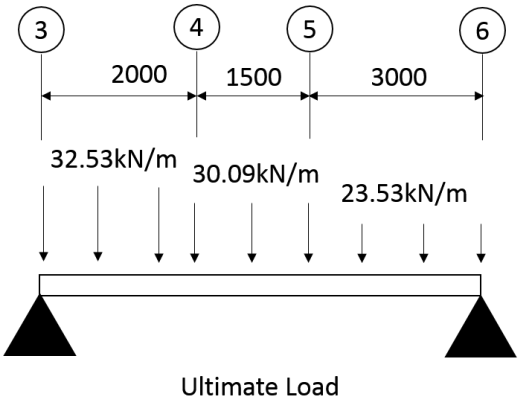
Live load 5-6 = 2.5kN/m x 1.6 = 4kN/m

Ultimate load 3-4 = 23.73kN/m + 8.8kN/m = 32.53kN/m

Ultimate load 4-5 = 22.89kN/m + 7.2kN/m = 30.09kN/m

Ultimate load 5-6 = 19.53kN/m + 4kN/m = 23.53kN/m

Ultimate Load Diagram



Ultimate Load

Reactions

$$\sum M_A = 0$$

$$= R_{3Y}(6.5) - 32.53(2.0)(5.5) - 30.09(1.5)(3.75) - 23.53(3.0)(1.5)$$

$$= 6.5R_{3Y} - 357.83 - 169.26 - 105.89$$

$$R_{3Y} = 97.38kN$$

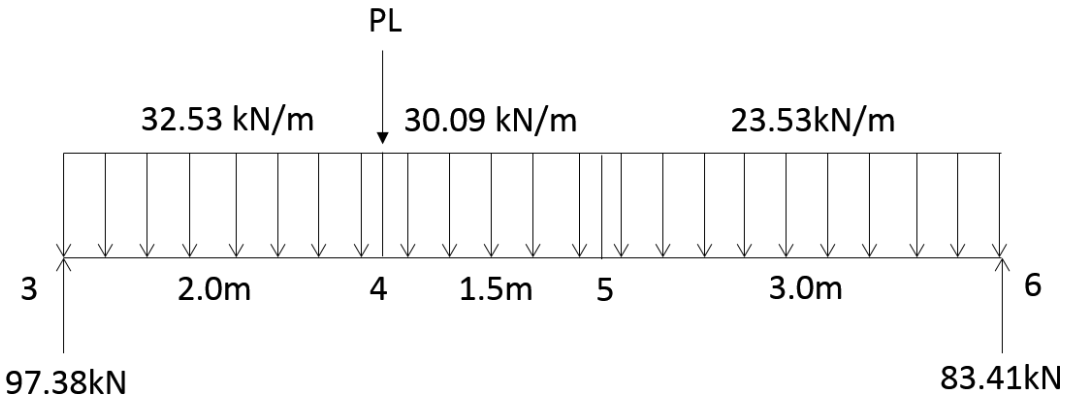
$$\sum F = 0$$

$$= R_{3Y} + R_{6Y} - 32.53(2.0) - 30.09(1.5) - 23.53(3.0)$$

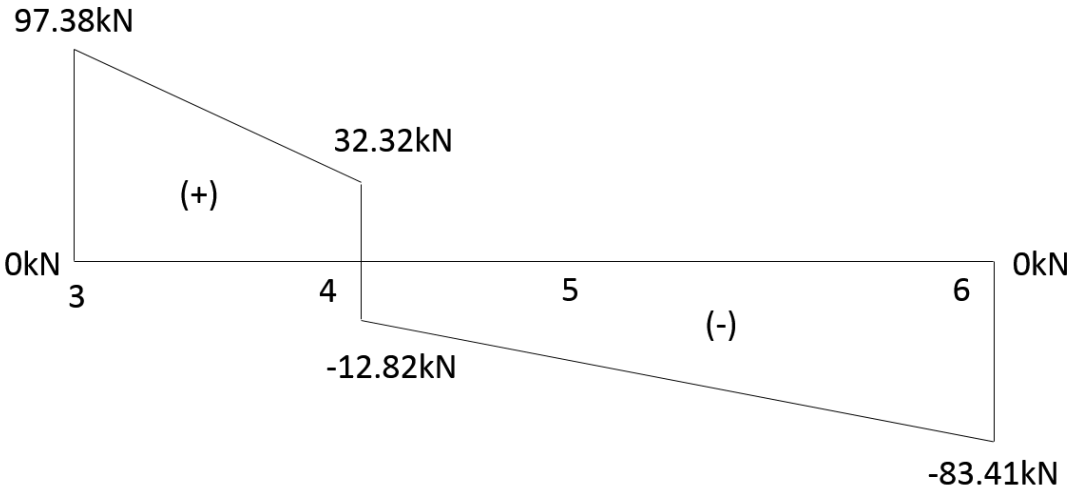
$$= 97.38 + R_{6Y} - 180.79$$

$$R_{6Y} = 83.41kN$$

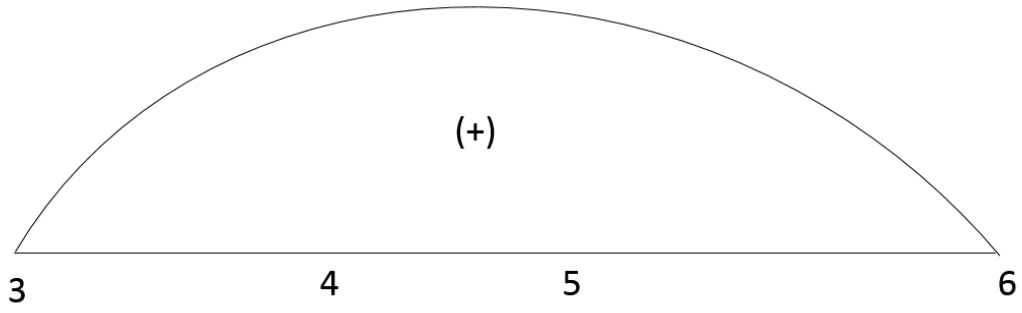
Load Diagram



Shear Force Diagram



Bending Moment Diagram



Ground Floor Beam, d / 3-5

1. Carries self-weight – Dead load
2. Slab dead load & live load
    a. 3-5 / e-d (Two-way slab)
3. Brick wall – Dead load

Brick wall

= Wall Height x Thickness x Density

= 3.0m x 0.15m x 19kN/m^3

= 8.55kN/m

Beam Self-Weight:

Assume that initial beam size is 150mm x 300mm

= Beam size x Concrete density

= 0.5m x 0.15m x 24kN/m^3

= 1.8kN/m

Dead load transfer on slab 3-5 / e-d (two-way slab)

Load is transferred to beam e / 3-6 in a triangular form.

Dead load from slab 3-5 / e-d = Dead load on slab x (Lx / 2)

= 3.6kN/m^2 x (3.5m / 2)

= 6.3kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Dead load from slab = 2/3 x 6.3kN/m

= 4.2kN/m

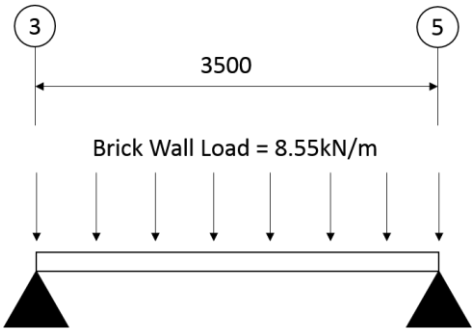
Total Dead Load

Total for 3-5

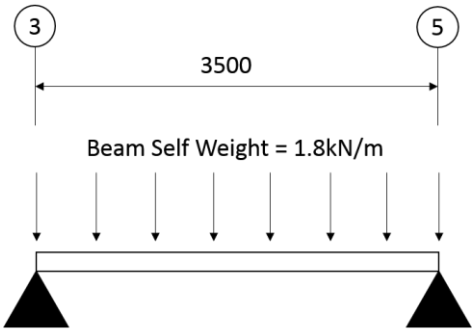
= 8.55kN/m + 1.8kN/m + 4.2kN/m

= 2.55kN/m

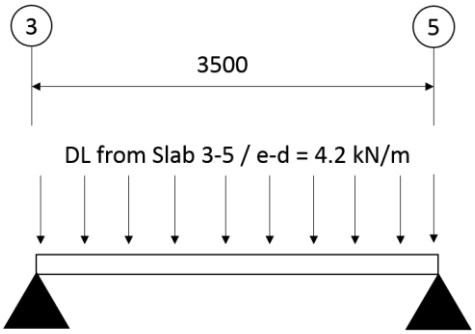
Total Dead Load Diagram



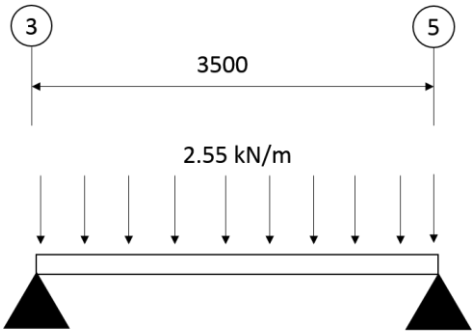
Brick Wall



Beam Self Weight



Slab 3-5 / e-d



Total

Live load transfer on slab 3-5 / e-d (two-way slab)

Load is transferred to beam e / 3-6 in a triangular form.

Live load from slab 3-5 / e-d = Live load on slab x (Lx / 2)

= 3.0kN/m^2 x (3.5m / 2)

= 5.25kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Live load from slab = 2/3 x 5.25kN/m

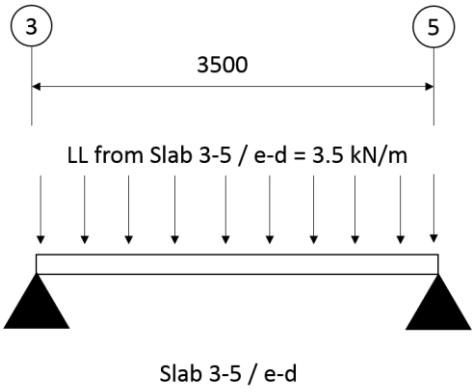
= 3.5kN/m

Total Live Load

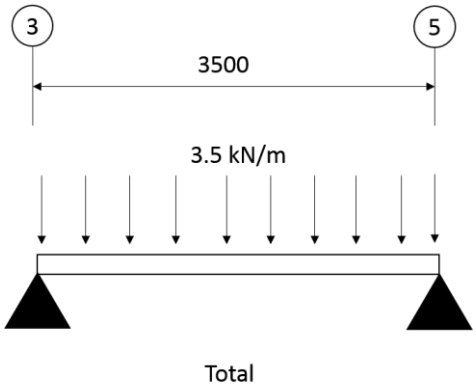
Total for 3-5

= 3.5kN/m

Total Live Load Diagram



Slab 3-5 / e-d



Total

Ultimate Load

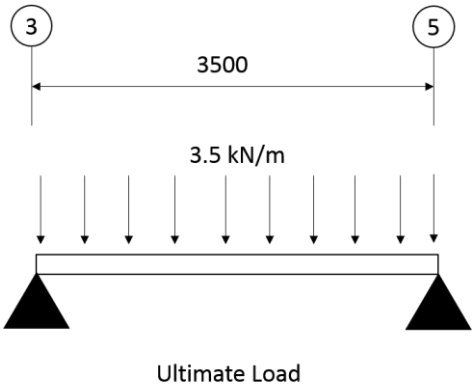
Apply factor 1.4 and 1.6 to dead load and live load respectively.

Dead load 3-5 = 2.55kN/m x 1.4 = 3.57kN/m

Live load 3-4 = 3.5kN/m x 1.6 = 5.6kN/m

Ultimate load 3-4 = 3.57kN/m + 5.6kN/m = 9.17kN/m

Ultimate Load Diagram



Ultimate Load

Reactions

$$\sum M_A = 0$$

$$= R_{3Y}(3.5) - 9.17(3.5)(1.75)$$

$$= 3.5R_{3Y} - 56.17$$

$$R_{3Y} = 16.05kN$$

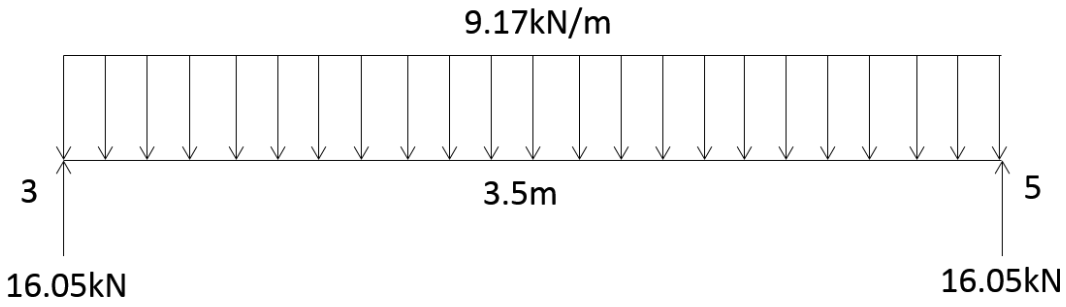
$$\sum F = 0$$

$$= R_{3Y} + R_{5Y} - 9.17(3.5)$$

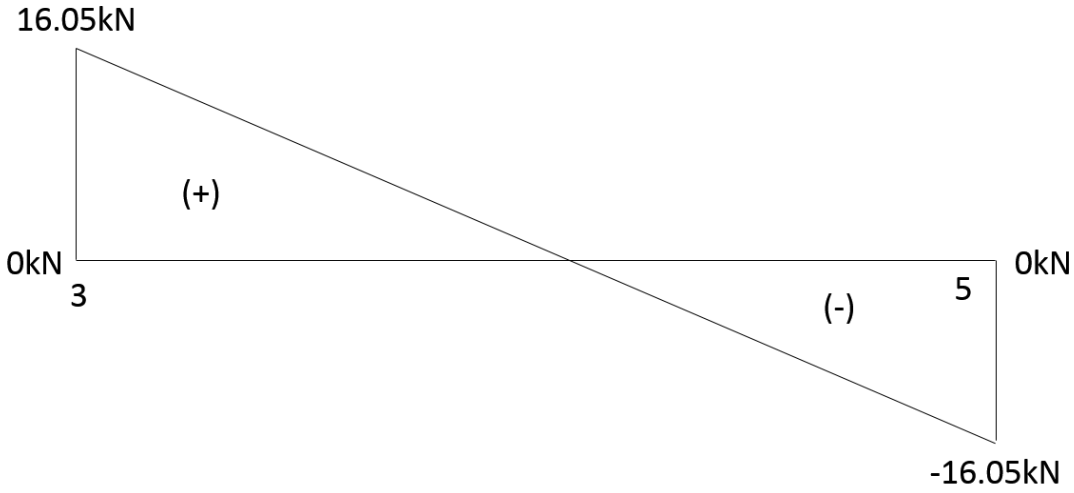
$$= 16.05 + R_{5Y} - 32.1$$

$$R_{5Y} = 16.05kN$$

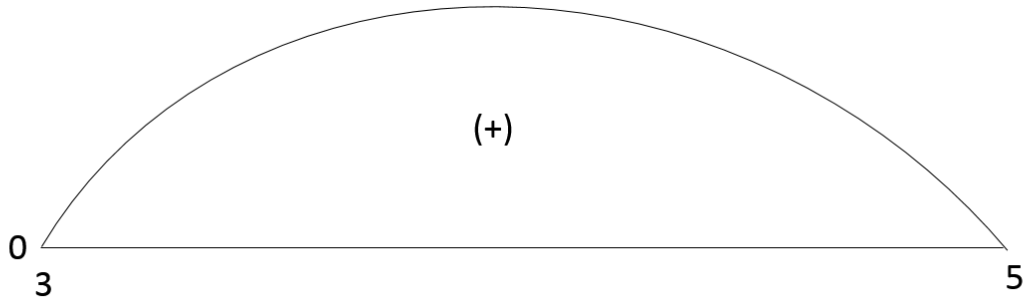
Load Diagram



Shear Force Diagram



Bending Moment Diagram



First Floor Beam, 4 / E-d

4. Carries self-weight – Dead load
5. Slab dead load & live load
    a. 3-4 / E-e (Two-way slab)
    b. 3-4 / e-d (One-way slab)
    c. 4-5 / E-d (One-way slab)
6. Brick wall – Dead load

Brick wall

= Wall Height x Thickness x Density

= 3.0m x 0.15m x 19kN/m^3

= 8.55kN/m

Beam Self-Weight:

Assume that initial beam size is 150mm x 300mm

= Beam size x Concrete density

= 0.5m x 0.15m x 24kN/m^3

= 1.8kN/m

Dead load transfer on slab 3-4 / E-e (two-way slab)

Load is transferred to beam 4 / E-d in a trapezoidal form. Convert the trapezoidal load into UDL.

Dead load from slab 3-4 / E-e = Dead load on slab x (Lx / 2)

= 3.6kN/m^2 x (2.0m / 2)

= 3.6kN/m

Dead load transfer on slab 3-4 / e-d (one-way slab)

Load is transferred to beam 4 / E-d in a UDL form.

Dead load from slab 3-4 / e-d = Dead load on slab x (Lx / 2)

= 3.6kN/m^2 x (2.0m / 2)

= 3.6kN/m

Dead load transfer on slab 4-5 / E-d (one-way slab)

Load is transferred to beam 4 / E-d in a UDL form.

Dead load from slab 4-5 / E-d = Dead load on slab x (Lx / 2)

= 3.6kN/m^2 x (1.5m / 2)

= 2.7kN/m

Total Dead Load

Total for E-e

= 8.55kN/m + 1.8kN/m + 3.6kN/m + 2.7kN/m

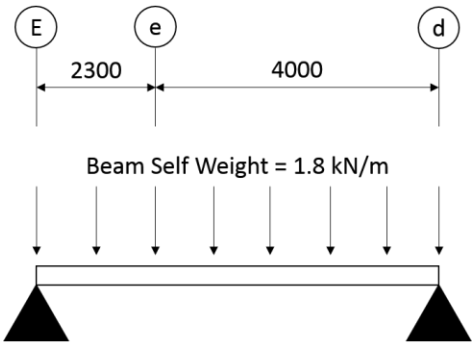
= 16.65 kN/m

Total for e-d

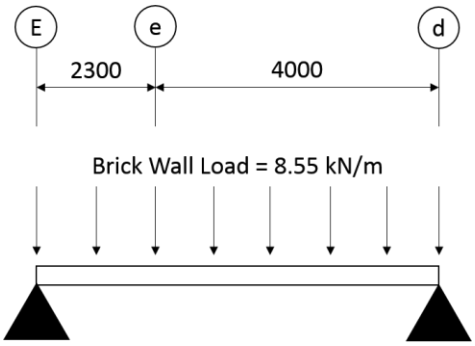
= 8.55kN/m + 1.8kN/m + 3.6kN/m + 2.7kN/m

= 16.65 kN/m

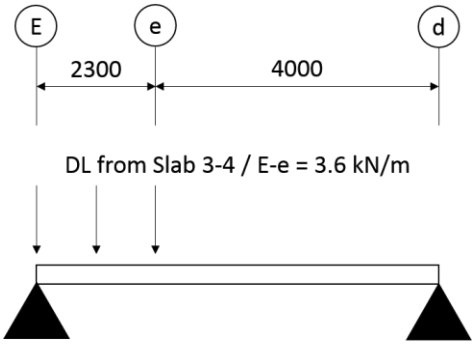
Total Dead Load Diagram



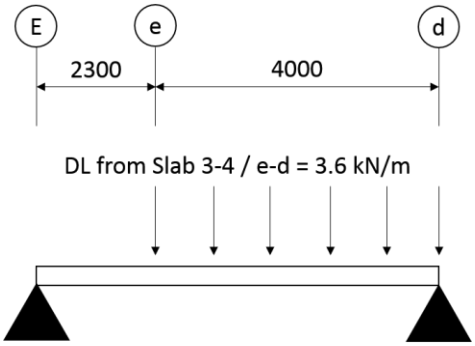
Beam Self Weight



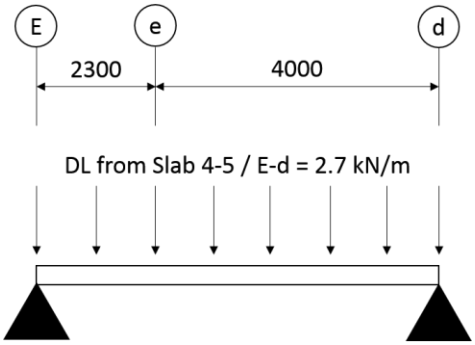
Brick Wall



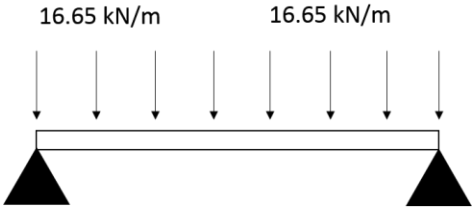
Slab 3-4 / E-e



Slab 3-4 / e-d



Slab 4-5 / E-d



Total

Live load transfer on slab 3-4 / E-e (two-way slab)

Load is transferred to beam 4 / E-d in a trapezoidal form. Convert the trapezoidal load into UDL.

Live load from slab 3-4 / E-e = Live load on slab x (Lx / 2)

= 1.5kN/m^2 x (2.0m / 2)

= 1.5kN/m

Live load transfer on slab 3-4 / e-d (one-way slab)

Load is transferred to beam 4 / E-d in a UDL form.

Live load from slab 3-4 / e-d = Live load on slab x (Lx / 2)

= 1.5kN/m^2 x (2.0m / 2)

= 1.5kN/m

Live load transfer on slab 4-5 / E-d (one-way slab)

Load is transferred to beam 4 / E-d in a UDL form.

Live load from slab 4-5 / E-d = Live load on slab x (Lx / 2)

= 1.5kN/m^2 x (1.5m / 2)

= 1.125kN/m

Total Live Load

Total for E-e

= 1.5kN/m + 1.125kN/m

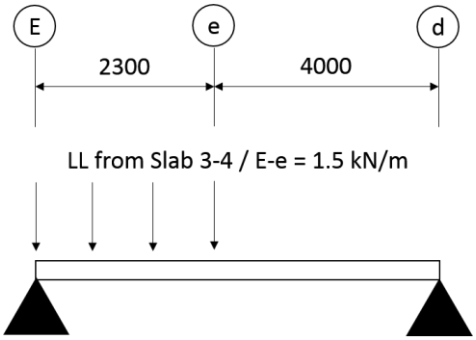
= 2.625kN/m

Total for e-d

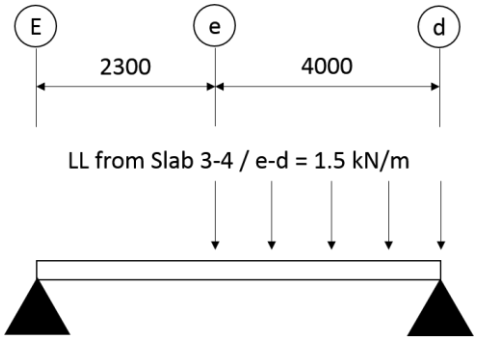
= 1.5kN/m + 1.125kN/m

= 2.625kN/m

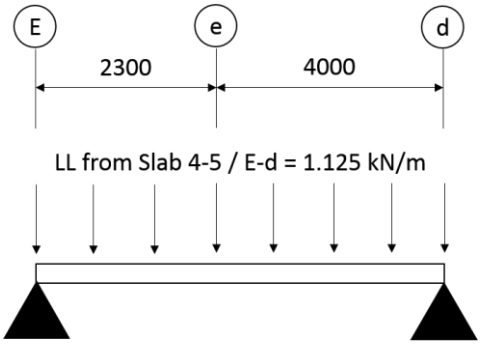
Total Live Load Diagram



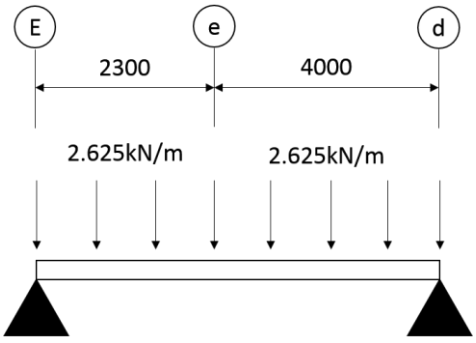
Slab 3-4 / E-e



Slab 3-4 / e-d



Slab 4-5 / E-d



Total

Ultimate Load

Apply factor 1.4 and 1.6 to dead load and live load respectively.

Dead load E-e = 16.65kN/m x 1.4 = 23.31kN/m

Dead load e-d = 16.65kN/m x 1.4 = 23.31kN/m

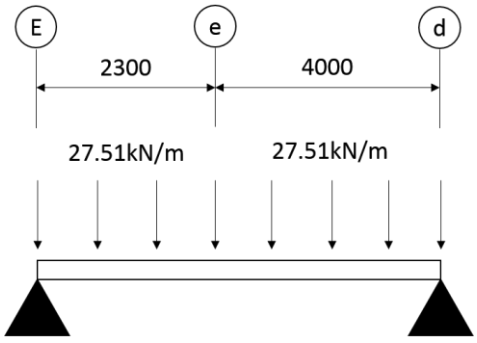
Live load E-e = 2.625kN/m x 1.6 = 4.2kN/m

Live load e-d = 2.625kN/m x 1.6 = 4.2kN/m

Ultimate load E-e = 23.31kN/m + 4.2kN/m = 27.51kN/m

Ultimate load e-d = 23.31kN/m + 4.2kN/m = 27.51kN/m

Ultimate Load Diagram



Ultimate Load

Reactions

$$\sum M_A = 0$$

$$= R_{EY}(6.3) - 27.51(2.3)(5.15) - 27.51(4)(2)$$

$$= 6.3R_{EY} - 325.86 - 220.08$$

$$R_{EY} = 86.65kN$$

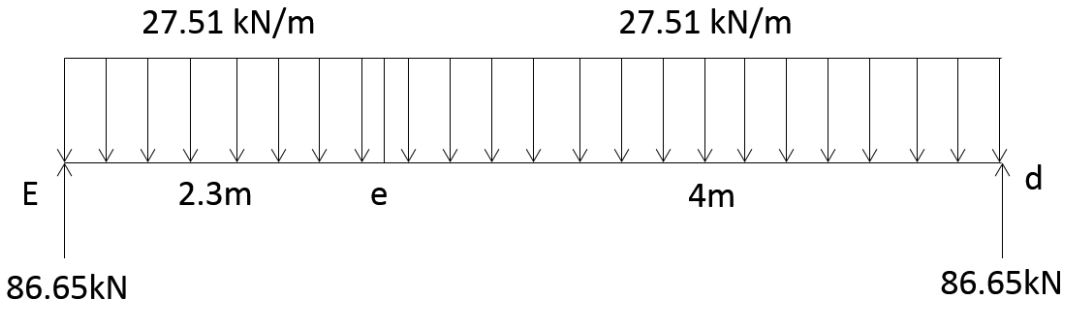
$$\sum F = 0$$

$$= R_{EY} + R_{dY} - 27.51(2.3) - 27.51(4)$$

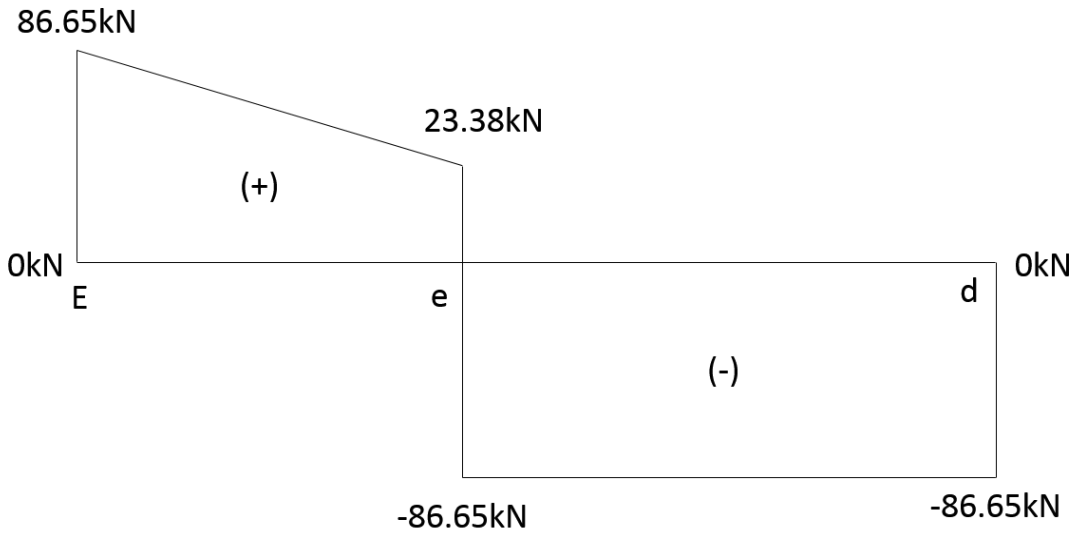
$$= 86.65 + R_{dY} - 173.3$$

$$R_{dY} = 86.65kN$$

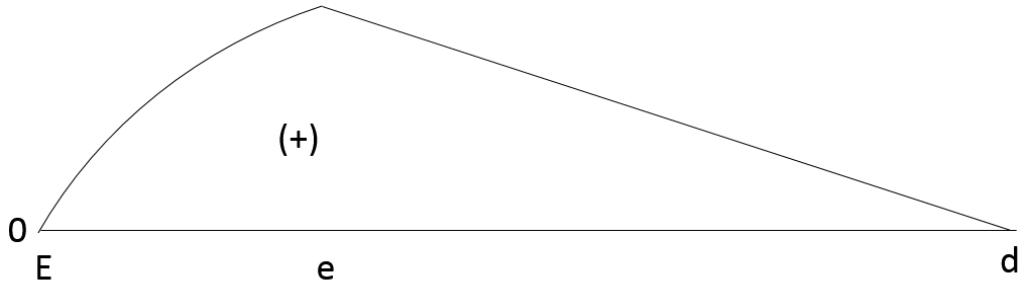
Load Diagram



Shear Force Diagram



Bending Moment Diagram



First Floor Beam, e / 3-4

1. Carries self-weight – Dead load
2. Slab dead load & live load
    a. 3-4 / E-e (Two-way slab)
3. Brick wall – Dead load

Brick wall

= Wall Height x Thickness x Density

= 3.0m x 0.15m x 19kN/m^3

= 8.55kN/m

Beam Self-Weight:

Assume that initial beam size is 150mm x 300mm

= Beam size x Concrete density

= 0.5m x 0.15m x 24kN/m^3

= 1.8kN/m

Dead load transfer on slab 3-4 / E-e (two-way slab)

Load is transferred to beam e / 3-4 in a triangular form.

Dead load from slab = Dead load on slab x (Lx / 2)

= 3.6kN/m^2 x (2.0m / 2)

= 3.6kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Dead load from slab = 2/3 x 3.6kN/m

= 2.4kN/m

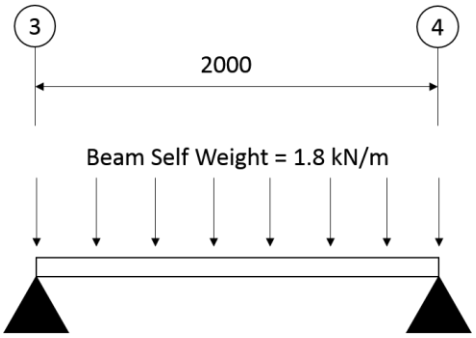
Total Dead Load

Total for 3-4

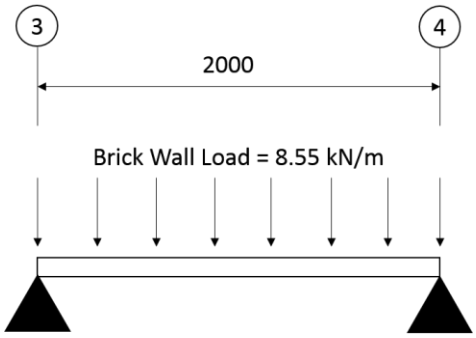
= 8.55kN/m + 1.8kN/m + 2.4kN/m

= 12.75kN/m

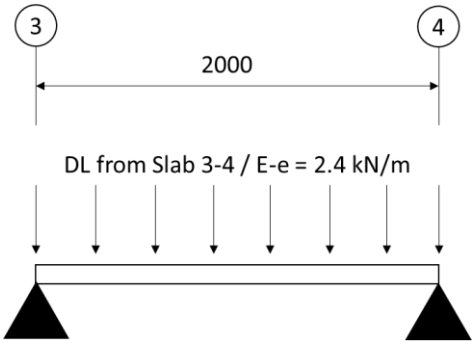
Total Dead Load Diagram



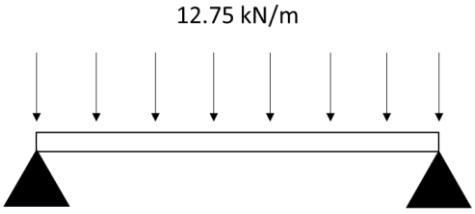
Beam Self Weight



Brick Wall



Slab 3-4 / E-e



Total

Live load transfer on slab 3-4 / E-e (two-way slab)

Load is transferred to beam e / 3-4 in a triangular form.

Live load from slab = Live load on slab x (Lx / 2)

= 1.5kN/m^2 x (2.0m / 2)

= 1.5kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

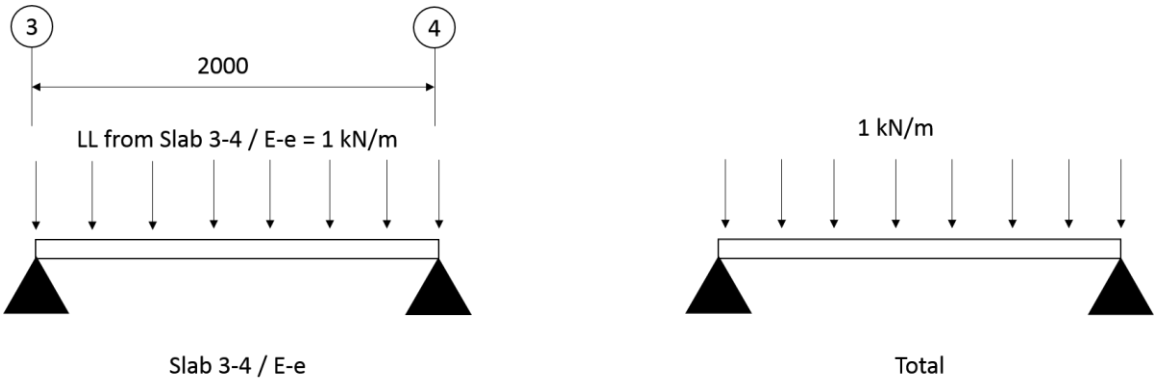
Live load from slab = 2/3 x 1.5kN/m

= 1kN/m

Total Live Load

Total live load for 3-4 = 1kN/m

Total Live Load Diagram



Ultimate Load

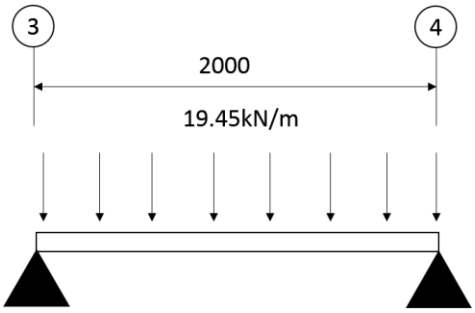
Apply factor 1.4 and 1.6 to dead load and live load respectively.

Dead load = 12.75kN/m x 1.4 = 17.85kN/m

Live Load = 1kN/m x 1.6 = 1.6kN/m

Ultimate Load = 17.85kN/m + 1.6kN/m = 19.45kN/m

Ultimate Load Diagram



Ultimate Load

Reactions

$$\sum M_A = 0$$

$$= R_{4Y}(2) - 19.45\,(2)(1)$$

$$= 2R_{4Y} - 38.9$$

$$R_{4Y} = 19.45kN$$

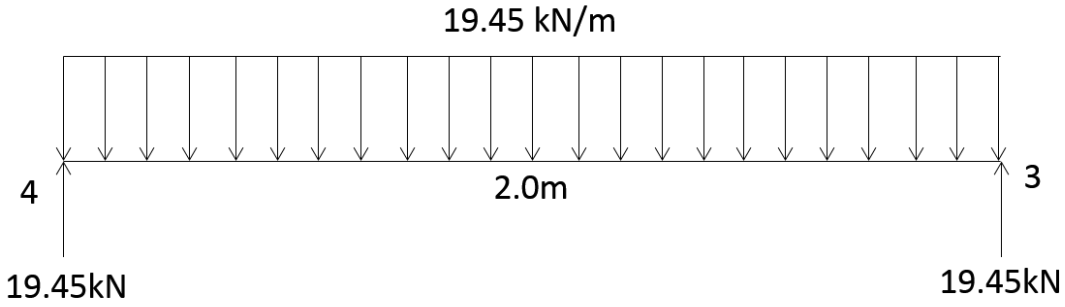
$$\sum F = 0$$

$$= R_{4Y} + R_{3Y} - 19.45\,(2)$$

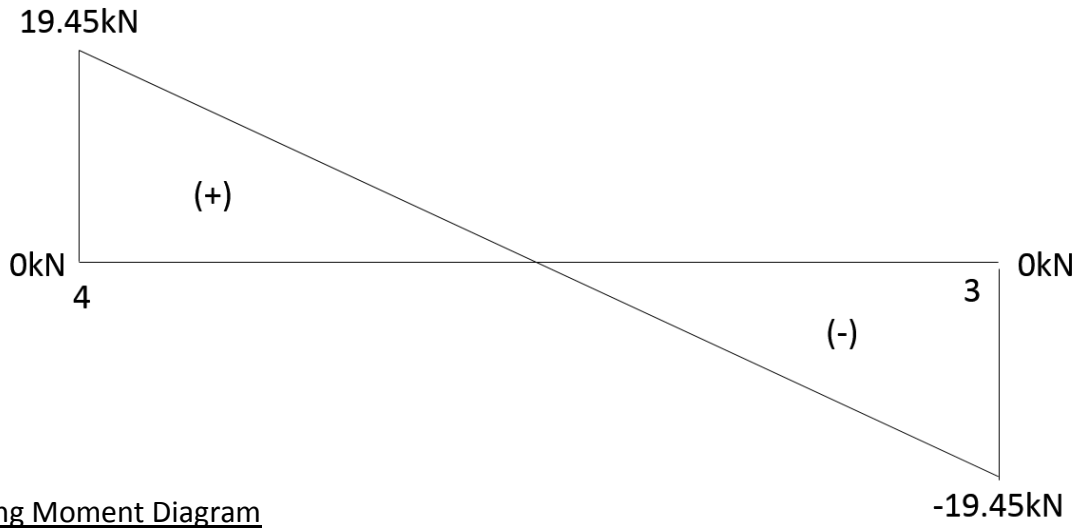
$$= 19.45 + R_{3Y} - 38.9$$

$$R_{3Y} = 19.45kN$$

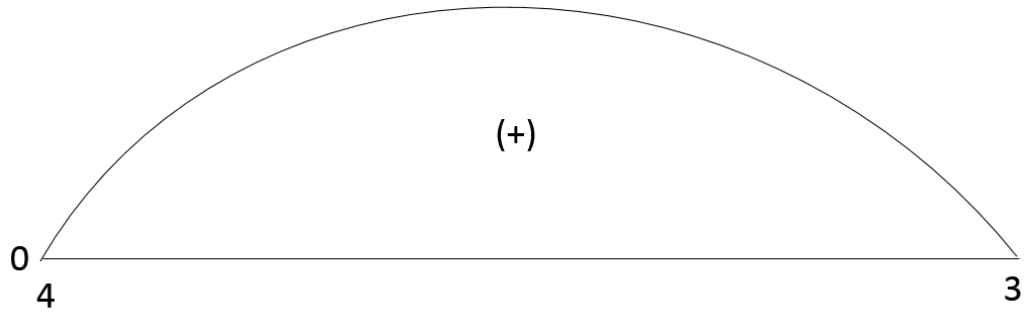
Load Diagram



Shear Force Diagram



Bending Moment Diagram



First Floor Beam, E / 3-5

4. Carries self-weight – Dead load
5. Slab dead load & live load
    a. 3-4 / E-e (Two-way slab)
6. Brick wall – Dead load

Brick wall

= Wall Height x Thickness x Density

= 3.0m x 0.15m x 19kN/m^3

= 8.55kN/m

Beam Self-Weight:

Assume that initial beam size is 150mm x 300mm

= Beam size x Concrete density

= 0.5m x 0.15m x 24kN/m^3

= 1.8kN/m

Dead load transfer on slab 3-4 / E-e (two-way slab)

Load is transferred to beam e / 3-4 in a triangular form.

Dead load from slab = Dead load on slab x (Lx / 2)

= 3.6kN/m^2 x (2.0m / 2)

= 3.6kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

Dead load from slab = 2/3 x 3.6kN/m

= 2.4kN/m

Total Dead Load

Total Dead Load for 3-4

= 8.55kN/m + 1.8kN/m + 2.4kN/m

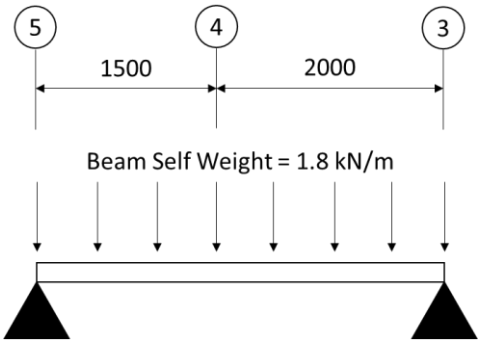
= 12.75kN/m

Total Dead Load for 4-5

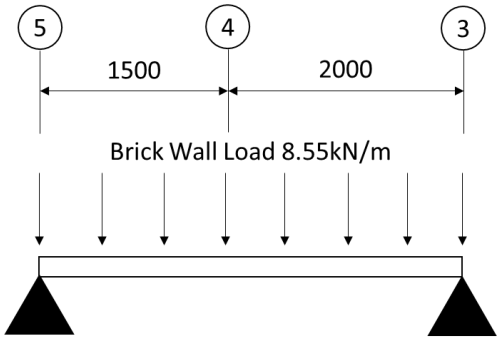
= 8.55kN/m + 1.8kN/m

= 10.35kN/m

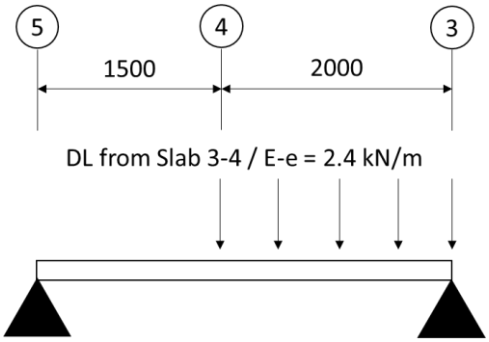
Total Dead Load Diagram



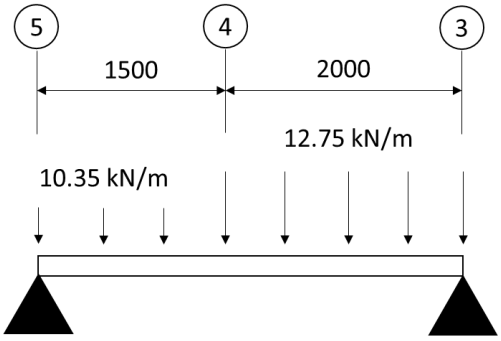
Beam Self Weight



Brick Wall



Slab 3-4 / E-e



Total

Live load transfer on slab 3-4 / E-e (two-way slab)

Load is transferred to beam e / 3-4 in a triangular form.

Live load from slab = Live load on slab x (Lx / 2)

= 1.5kN/m^2 x (2.0m / 2)

= 1.5kN/m

Convert the trapezoidal load into UDL by applying factor 2/3.

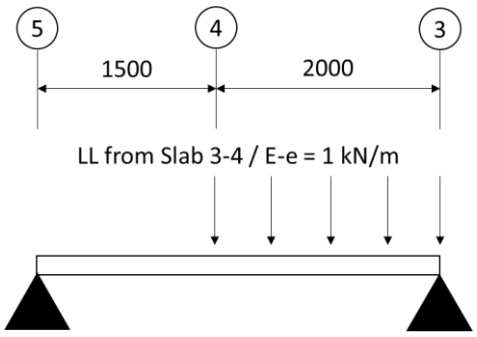
Live load from slab = 2/3 x 1.5kN/m

= 1kN/m

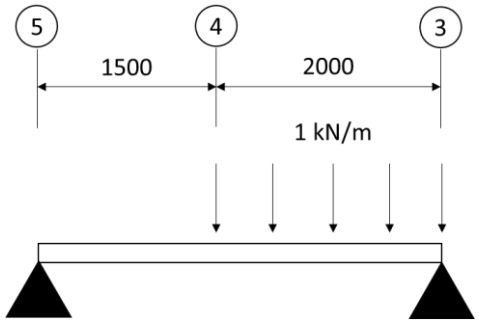
Total Live Load

Total live load for 3-4 = 1kN/m

Total Live Load Diagram



Slab 3-4 / E-e



Total

Ultimate Load

Apply factor 1.4 and 1.6 to dead load and live load respectively.

Dead load for 3-4 = 12.75kN/m x 1.4 = 17.85kN/m

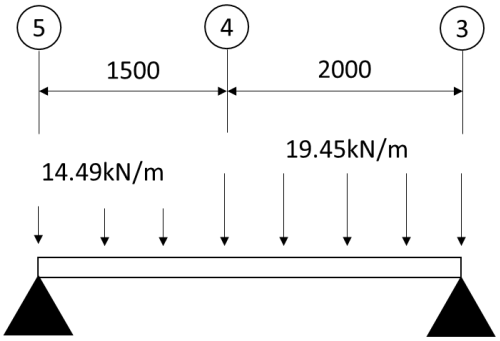
Dead load for 4-5 = 10.35kN/m x 1.4 = 14.49kN/m

Live Load for 3-4 = 1kN/m x 1.6 = 1.6kN/m

Ultimate Load 3-4 = 17.85kN/m + 1.6kN/m = 19.45kN/m

Ultimate Load 4-5 = 14.49kN/m

Ultimate Load Diagram



Ultimate Load

Reactions

$$\sum M_A = 0$$

$$= R_{5Y}(3.5) - 14.49\,(1.5)(2.75) - 19.45(2)(1)$$

$$= 3.5R_{5Y} - 59.77 - 38.9$$

$$= 3.5R_{5Y} - 98.67$$

$$R_{5Y} = 28.19kN$$

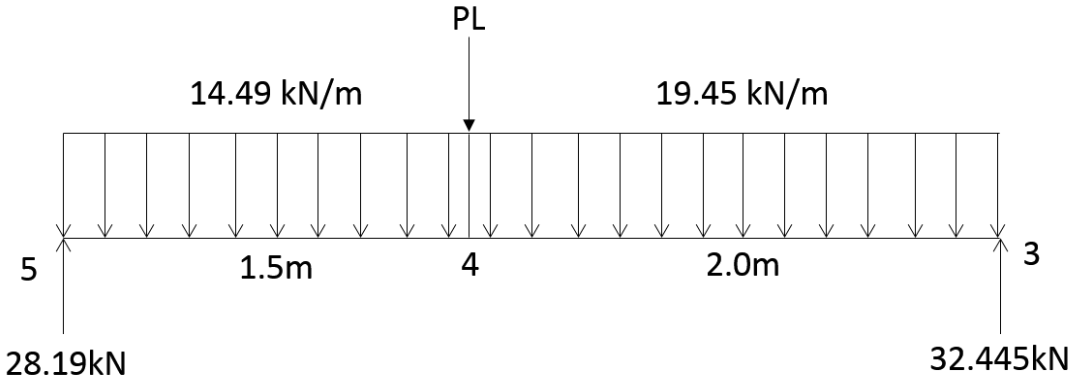
$$\sum F = 0$$

$$= R_{5Y} + R_{3Y} - 14.49\,(1.5) - 19.45(2)$$

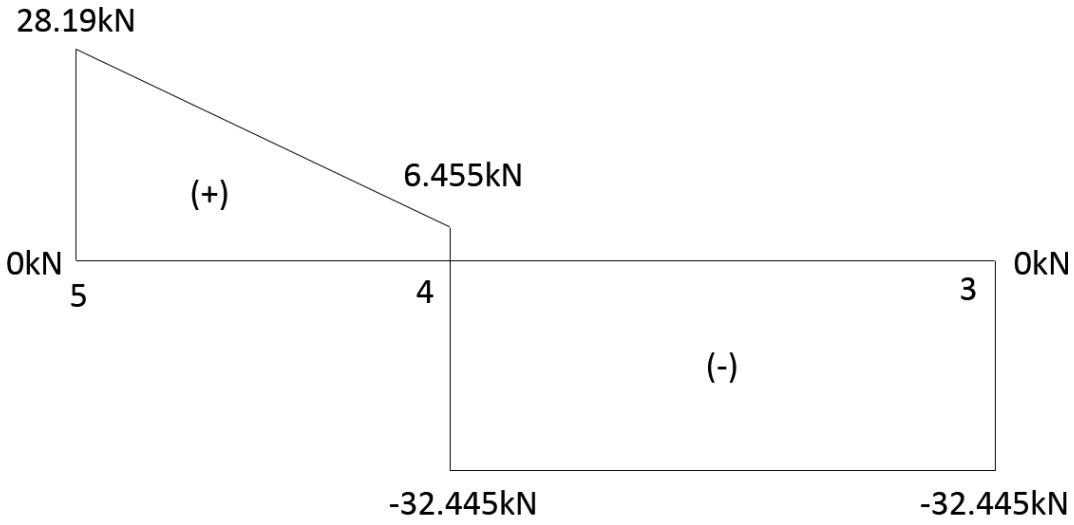
$$= 28.19 + R_{3Y} - 21.735 - 38.9$$

$$R_{3Y} = 32.445kN$$

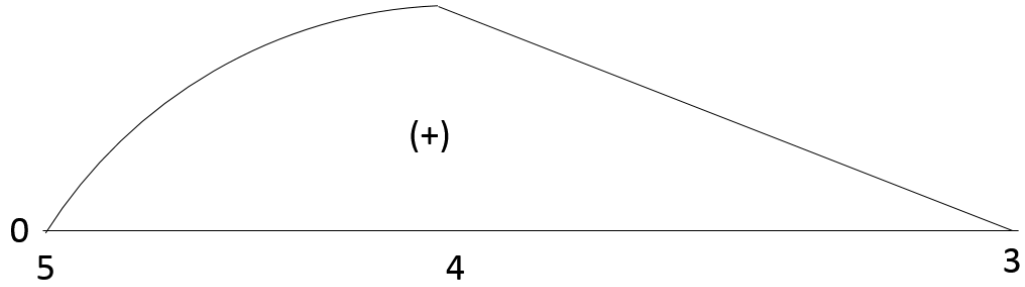
Load Diagram



Shear Force Diagram

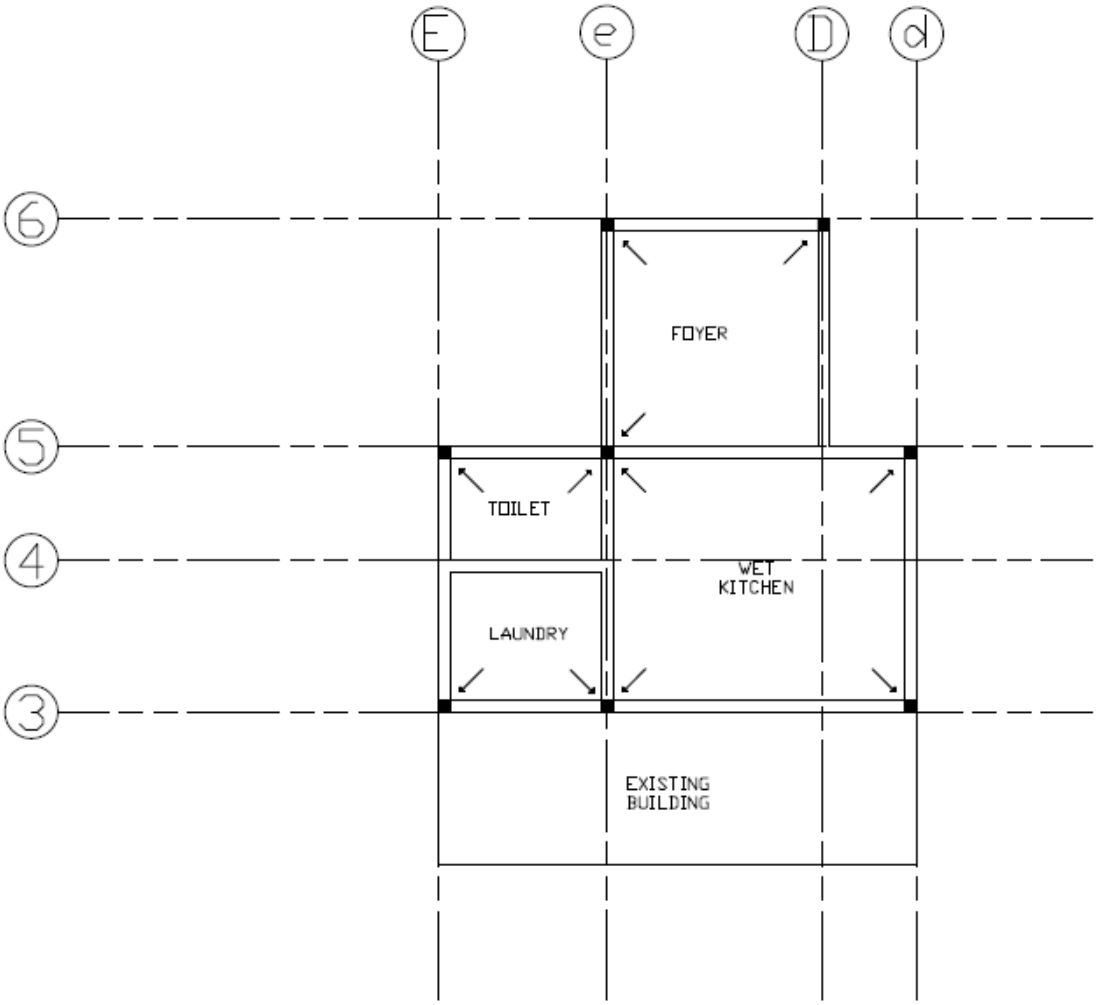


Bending Moment Diagram

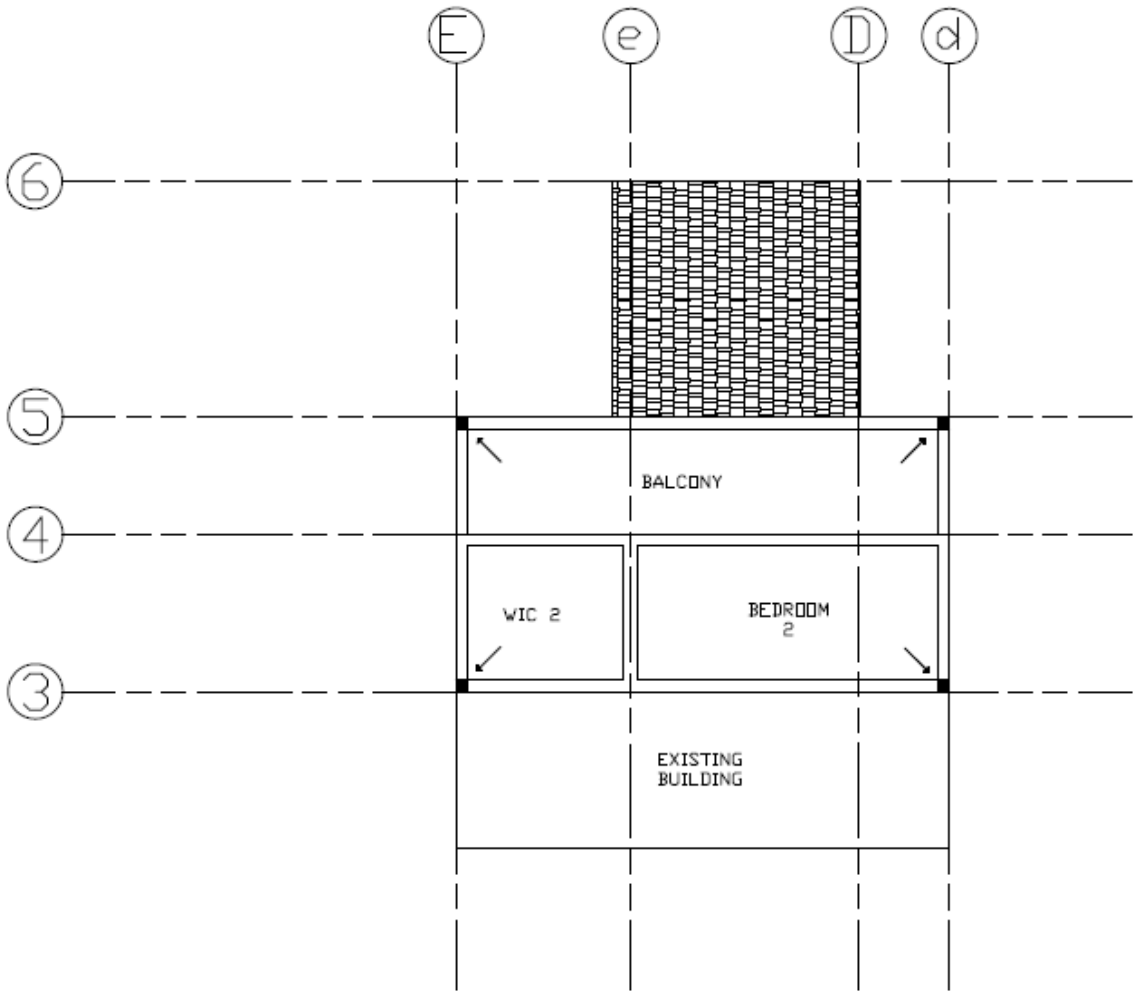


LOAD DISTRIBUTION DIAGRAM FOR COLUMNS

GROUND FLOOR PLAN



FIRST FLOOR PLAN



COLUMN ANALYSIS CALCULATION

Column 6 / e

Dead Load Calculations

Dead load of roof = 1.0kN/m^2

Dead load of slab = 3.6kN/m^2

Self -Weight of Beam = 1.8kN/m^2

Brick Wall Weight = 8.55kN/m^2

Roof

- Roof = 1.0kN/m^2 x 9m^2

  = 9kN

- Beams = 1.8kN/m^2 x (3.0m + 3.0m)

  = 10.8kN

Ground Floor

- Slab (Foyer) = 3.6kN/m^2 x 9m^2

  = 32.4kN
- Beams = 1.8kN/m^2 x (3.0m + 3.0m)

  = 10.8kN
- Brick wall = 8.55kN/m^2 x (3.0m + 3.0m)

  = 51.3kN

Total Dead Load

= 9kN + 10.8kN + 32.4kN + 10.8kN + 51.3kN

= 114.3kN

Live Load Calculations

Live load of roof = 0.5kN/m^2

Live load of foyer = 2.5kN/m^2

Roof

- Roof = 0.5kN/m^2 x 9m^2

  = 4.5kN

Ground Floor

- Slab (Foyer) = 2.5kN/m^2 x 9m^2

  = 22.5kN

Total Live Load

= 4.5kN + 22.5kN

= 27kN

Ultimate Load Calculation

= (1.4 x 114.3) + (1.6 x 27)

= 160.02kN + 43.2kN

= 203.22kN

Column size estimation

Assume

Fcu = 30N/mm^2

Fy (mild steel) = 250N/mm^2

Ac = (150mmx150mm) = 22500 mm^2

Asc = 22500 x 2% = 450 mm^2

F = (0.4 x 30 x 22500) + (0.8 x 450 x 250) N

= 360kN

This column is sufficient to carry the load of 203.22kN

Column 5 / E

Dead Load Calculations

Dead load of roof = 1.0kN/m^2

Dead load of slab = 3.6kN/m^2

Self -Weight of Beam = 1.8kN/m^2

Brick Wall Weight = 8.55kN/m^2

Roof

- Roof = 1.0kN/m^2 x (6.3x 3.5)m^2

  = 22.05kN

- Beams = 1.8kN/m^2 x (6.3m + 3.5m)

  = 17.64kN

Ground Floor

- Slab (Toilet) = 3.6kN/m^2 x (2.3 x 1.5)m^2

  = 12.42kN
- Slab (Laundry) = 3.6kN/m^2 x (2.3 x 2.0)m^2

  = 16.56kN
- Beams = 1.8kN/m^2 x (2.3m + 3.5m)

  = 10.44kN
- Brick wall = 8.55kN/m^2 x (2.3m + 3.5m)

  = 49.59kN

First Floor

- Slab (Balcony) = 3.6kN/m^2 x (6.3x 1.5)m^2
  = 34.02kN
- Slab (W.I.C.) = 3.6kN/m^2 x (2.3 x 2.0)m^2
  = 16.56kN
- Beams = 1.8kN/m^2 x (6.3m + 3.5m)
  = 17.64kN
- Brick wall = 8.55kN/m^2 x (6.3m + 3.5m)
  = 83.79Kn

Total Dead Load

= 22.05kN + 17.64kN + 12.42kN + 16.56kN + 10.44kN + 49.59kN + 34.02kN + 16.56kN + 17.64kN + 83.79Kn

= 280.71kN

Live Load Calculations

Live load of roof = 0.5kN/m^2

- Roof = 0.5kN/m^2 x 22.05m^2

  = 11.025kN

Ground Floor

- Slab (Toilet) = 2.0kN/m^2 x 3.45m^2
  = 6.9kN
- Slab (Laundry) = 3.0kN/m^2 x 4.6m^2
  = 13.8kN

First Floor

- Slab (Balcony) = 1.5kN/m^2 x 9.45m^2
  = 14.175kN
- Slab (W.I.C.) = 1.5kN/m^2 x 4.6m^2
  = 6.9kN

Total Live Load

= 11.025 + 13.8kN + 6.9kN + 14.175kN + 6.9kN

= 52.8kN

Ultimate Load Calculation

= (1.4 x 280.71) + (1.6 x 52.8)

= 393kN + 84.48kN

= 477.48kN

Column size estimation

Assume

Fcu = 30N/mm^2

Fy (mild steel) = 250N/mm^2

Ac = (250mmx250mm) = 62500 mm^2

Asc = 62500 x 2% = 1250 mm^2

F = (0.4 x 30 x 62500) + (0.8 x 1250 x 250) N

= 1000kN

This column is sufficient to carry the load of 477.48kN

Column 3 / d

Dead Load Calculations

Dead load of roof = 1.0kN/m^2

Dead load of slab = 3.6kN/m^2

Self -Weight of Beam = 1.8kN/m^2

Brick Wall Weight = 8.55kN/m^2

Roof

- Roof = 1.0kN/m^2 x (6.3x 3.5)m^2

  = 22.05kN

- Beams = 1.8kN/m^2 x (6.3m + 3.5m)

  = 17.64kN

Ground Floor

- Slab (Wet Kitchen) = 3.6kN/m^2 x (3.5 x 4)m^2

  = 50.4kN
- Beams = 1.8kN/m^2 x (3.5m + 4m)

  = 13.5kN
- Brick wall = 8.55kN/m^2 x (3.5m + 4m)

  = 64.125kN

First Floor

- Slab (Bedroom) = 3.6kN/m^2 x (4.0 x 2.0)m^2
  = 28.8kN
- Slab (Balcony) = 3.6kN/m^2 x (6.3x 1.5)m^2
  = 34.02kN
- Slab (W.I.C.) = 3.6kN/m^2 x (2.3 x 2.0)m^2
  = 16.56kN
- Beams = 1.8kN/m^2 x (6.3m + 3.5m)
  = 17.64kN
- Brick wall = 8.55kN/m^2 x (6.3m + 3.5m)
  = 83.79Kn

Total Dead Load

= 22.05kN + 17.64kN + 50.4kN + 13.5kN + 10.44kN + 64.125kN + 28.8kN + 34.02kN + 16.56kN + 17.64kN + 83.79kN

= 358.965kN

Live Load Calculations

Roof

Live load of roof = 0.5kN/m^2

- Roof = 0.5kN/m^2 x 22.05m^2

  = 11.025kN

Ground Floor

- Slab (Wet Kitchen) = 3.0kN/m^2 x 14m^2
  = 42kN

First Floor

- Slab (Bedroom) = 1.5kN/m^2 x 8m^2
  = 12kN
- Slab (Balcony) = 1.5kN/m^2 x 9.45m^2
  = 42kN

- Slab (W.I.C.) = 1.5kN/m^2 x 4.6m^2
  = 6.9kN

Total Live Load

= 11.025kN + 42kN + 12kN + 42kN + 6.9kN

= 113.925kN

Ultimate Load Calculation

= (1.4 x 358.965) + (1.6 x 113.925)

= 502.551kN + 182.28kN

= 684.83kN

Column size estimation

Assume

Fcu = 30N/mm^2

Fy (mild steel) = 250N/mm^2

Ac = (250mmx250mm) = 62500 mm^2

Asc = 62500 x 2% = 1250 mm^2

F = (0.4 x 30 x 62500) + (0.8 x 1250 x 250) N

= 1000kN

This column is sufficient to carry the load of 684.83kN