Load Calculations

According to ASCE 7:

Minimum Uniformly distributed Live Loads for Building Design:

40 PSF for Residential dwellings, appartments, hotel rooms, school classrooms

50 PSF for Offices

60 PSF for Auditoriums with fixed seats

73 – 100 PSF for Retail Stores

(For others see ASCE 7)

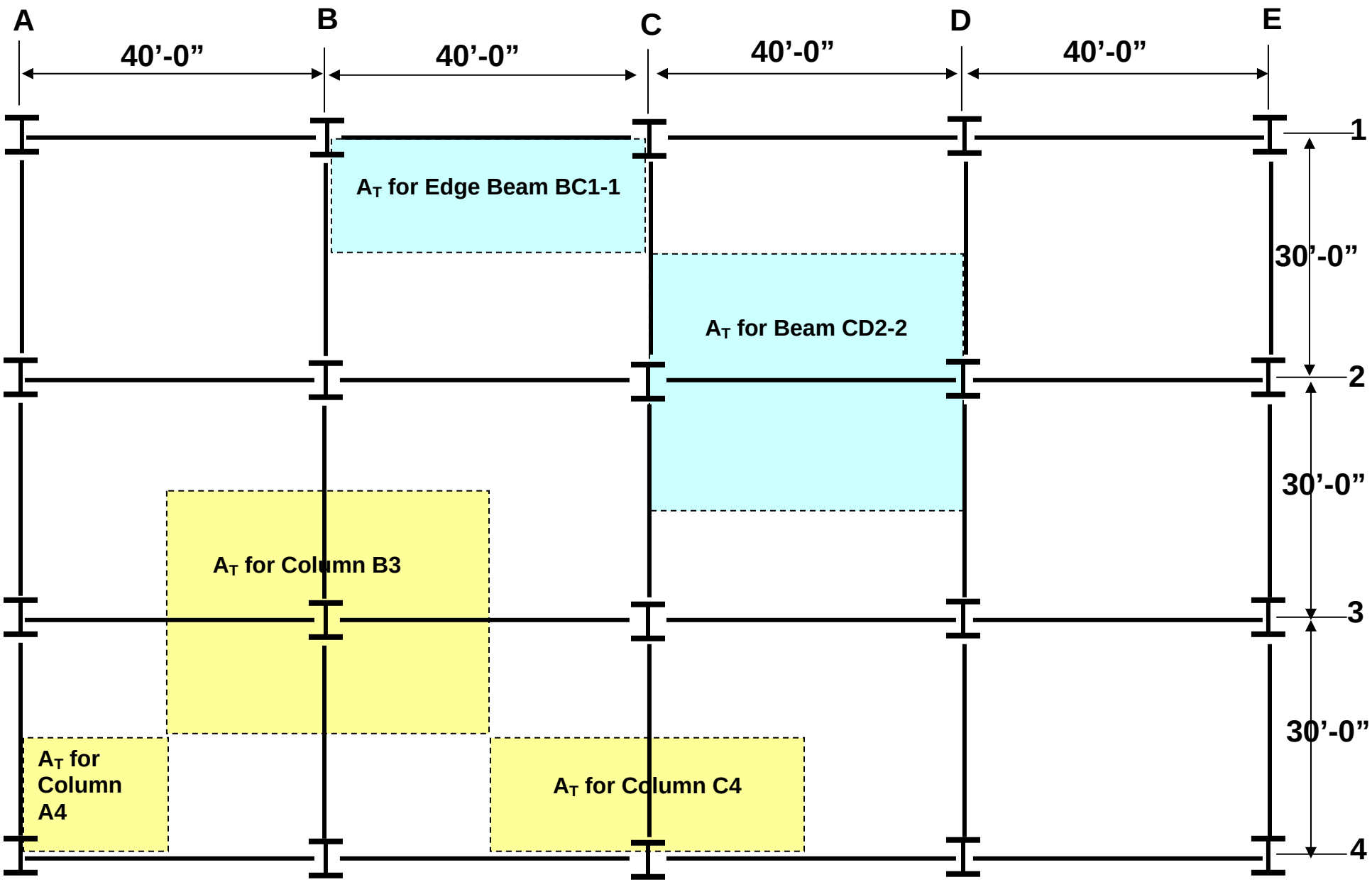
For influence area, A_I > 400 Sq.ft., the live load may be reduced according to the live load reduction equation:

$$L = L_o \{0.25 + (15 / \sqrt{A_I})\}$$

Where
L = Reduced Live Load
L_o = Code specified design live load
A_I =Influence Area =K_{LL} (A_T)
K_{LL} = Live Load Element Factor
(See Table)

Table – Live load element factor, K_{LL}

Element	K_{LL}
Interior columns	4
Exterior columns without cantilever slabs	4
Edge columns with cantilever slabs	3
Corner columns with cantilever slabs	2
Edge Beams without cantilever slabs	2
Interior Beams	2
All other members not identified above, including	1
Edge beams with cantilever slabs	
Cantilever beams	
One-way slabs	
Two-way slabs	



Floor Plan of High-rise Office Building

Given:

Live Load, L=50 psf

Dead Load, D= 70 psf

1. Girder BC 1-1

Tributary area, A_T = 40 x 15 = 600 sq ft

Influence area, $A_I = 2\ A_T$ = 2 x 600 = 1200 sq ft

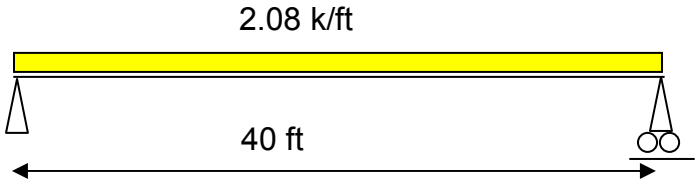
Live load reduction = 0.25 + [15 / √ (A_I)] = 0.25 + [15 / √ (1200)] = 0.25 + 0.433 =0.683

Amplified loads per linear foot:

Dead Load = 1.2 (70 psf) (15 ft) = 1260 plf

Live Load = 1.6 (0.683)(50 psf) (15 ft) = 819.6 plf

W_u = 1.2 D + 1.6 L = 1260 + 819.6 = 2079.6 plf = **2.08 k/ft**



Required Moment (LRFD), Mu = Wu L^2 /8 = 2.08 x 40^2 /8 = **416 k-ft**

2. <u>Girder CD 2-2</u>

Tributary area, A_T = 40 x 30 = 1200 sq ft

Influence area, A_I = 2 A_T = 2 x 1200 = 2400 sq ft

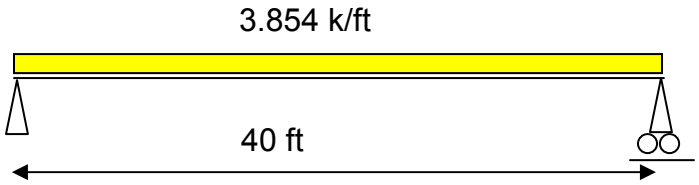
Live load reduction = 0.25 + [15 / √ (A_I)] = 0.25 + [15 / √ (2400)] = 0.25 + 0.306 =0.556

Amplified loads per linear foot:

Dead Load = 1.2 (70 psf) (30 ft) = 2520 plf

Live Load = 1.6 (0.556)(50 psf) (30 ft) = 1334.4 plf

W_u = 1.2 D + 1.6 L = 2520 + 1334.4 = 3854.4 plf = **<u>3.854 k/ft</u>**



Required Moment (LRFD), Mu = Wu L^2 /8 = 3.854 x 40^2 /8 = **<u>770.8 k-ft</u>**

3. Column A4

Tributary area, A_T = 20 x 15 = 300 sq ft
Corner column without cantilever slab,
Influence area, A_I = 1 A_T = 1x 300 = 300 sq ft < 400, No live load reduction permitted.

Amplified load:

Dead Load = 1.2 (70 psf) (300 sqft) = 25200 lbs

Live Load = 1.6 (1)(50 psf) (300 sqft) = 24000 lbs

W_u = 1.2 D + 1.6 L = 25200 + 24000 = 49200 lbs = **49.2 kips**

Required axial force (LRFD), Pu = **49.2 kips.**

4. Column C4

Tributary area, A_T = 40 x 15 = 600 sq ft

Influence area, A_I = 4 A_T = 4 x 600 = 2400 sq ft

Live load reduction = 0.25 + [15 / √ (A_I)] = 0.25 + [15 / √ (2400)] = 0.25 + 0..30618 =0.55618

Amplified load:

Dead Load = 1.2 (70 psf) (600 sqft) = 50400 lbs

Live Load = 1.6 (0.55618)(50 psf) (600 sqft) = 26697 lbs

W_u = 1.2 D + 1.6 L = 50400 + 26697 = 77097 lbs = **77.1 kips**

Required axial force (LRFD), Pu = **77.1 kips.**

5. Column B3

Tributary area, A_T = 40 x 30 = 1200 sq ft

Influence area, $A_I = 4\ A_T$ = 4 x 1200 = 4800 sq ft

Live load reduction = 0.25 + [15 / √ (A_I)] = 0.25 + [15 / √ (4800)] = 0.25 + 0.216506 =0.466506

Amplified load:

Dead Load = 1.2 (70 psf) (1200 sqft) = 100800 lbs

Live Load = 1.6 (0.466506)(50 psf) (1200 sqft) = 44784 lbs

W_u = 1.2 D + 1.6 L = 100800 + 44784 = 145584 lbs = **145.58 kips**

Required axial force (LRFD), Pu = **145.58 kips.**