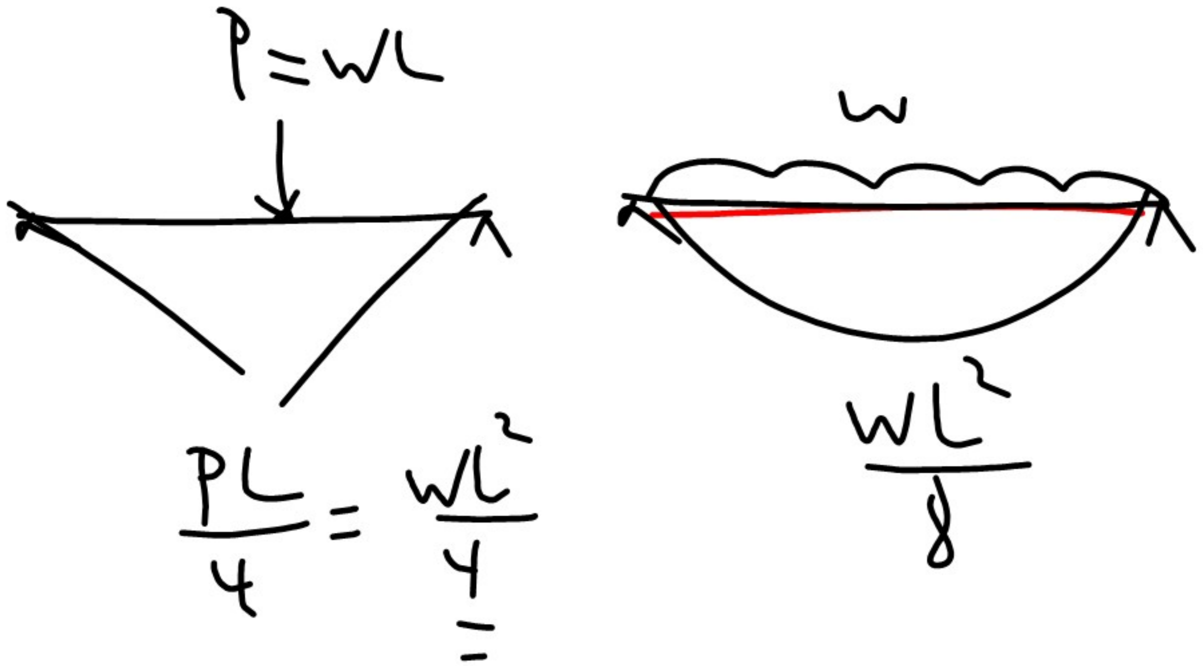

P = wL
w
PL/4 = wL²/4
wL²/8

5.1. Regular systems

5.2. Ribbed slab systems

5.3. Two way slab systems

If time permits

5.4. Systems without vertical continuity

5.5. General shape building systems

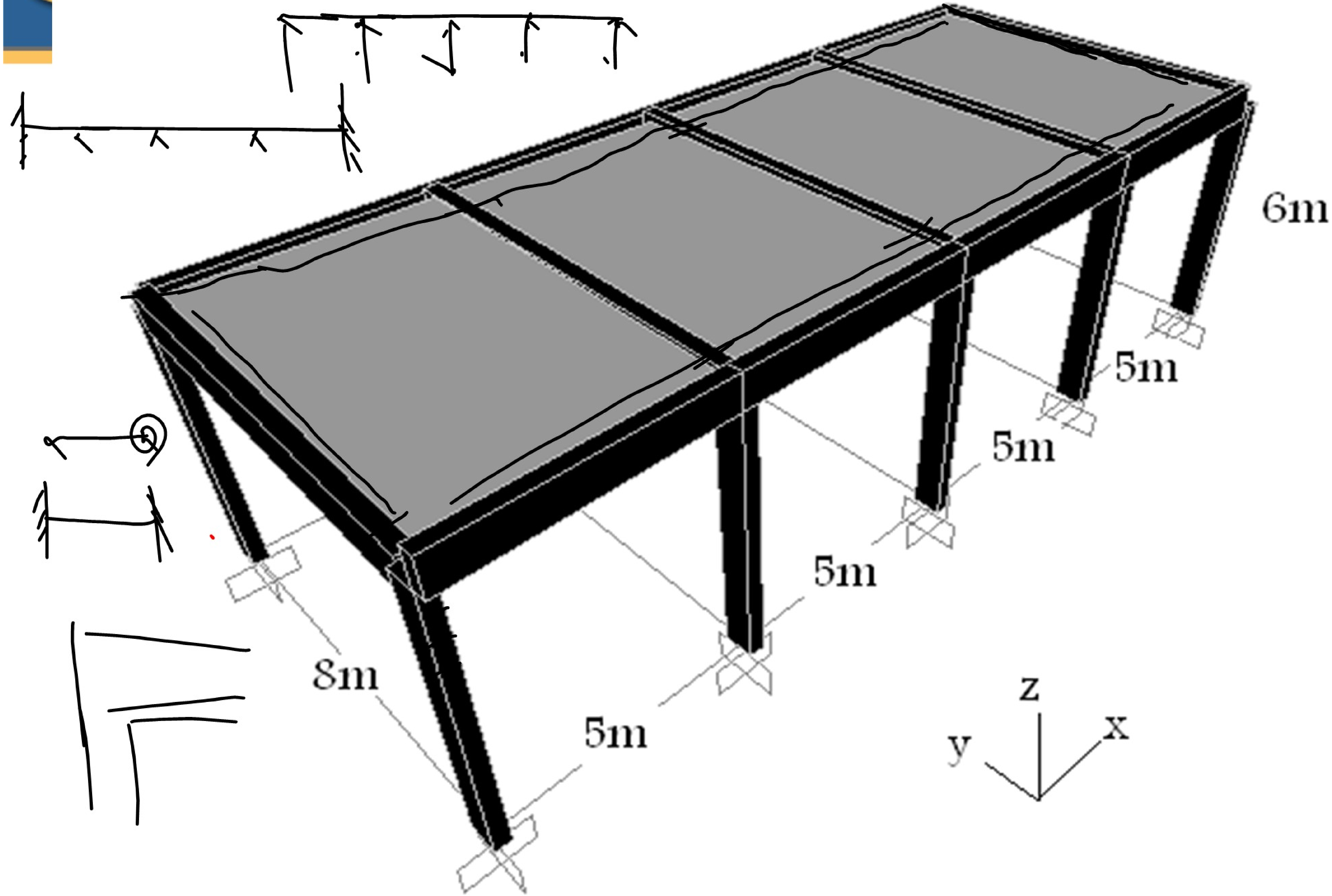
5.1 Regular systems

Regular systems are those which have one way solid slab and vertical continuity; i.e. load of slab is transferred to beams, from beams to columns and then to footings.

Analysis of all systems are done using either 1D, 2D or 3D modeling.

Regular systems: example

- 1-storey RC slab-beam factory structure shown next slide
- Fixed foundations, 4 spans 5m bays in x and a single 8m span in y, 6m elevation
- E=24GPa, μ=0.2, ρ=2.5t/m^3
- Cylinder concrete strength=25MPa, steel yield=420MPa
- superimposed loads=5kN/m^2, live load=9kN/m^2


6m
5m
5m
5m
5m
8m
z
y
x

Regular systems: example

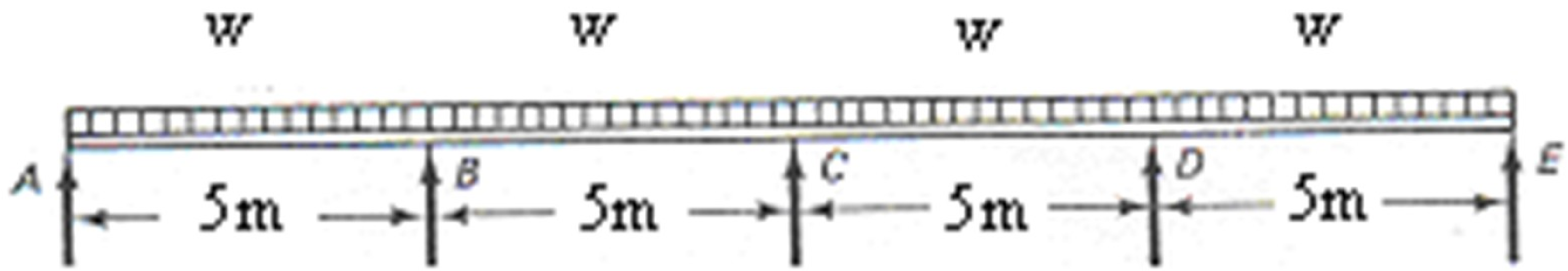
- Due to cracking of elements, use the following modifiers for gross inertia for 3D analysis (ACI R10.11.1):
  - Beam 0.35
  - Column 0.7
  - One way slab (0.35, 0.035)

Preliminary dimensioning

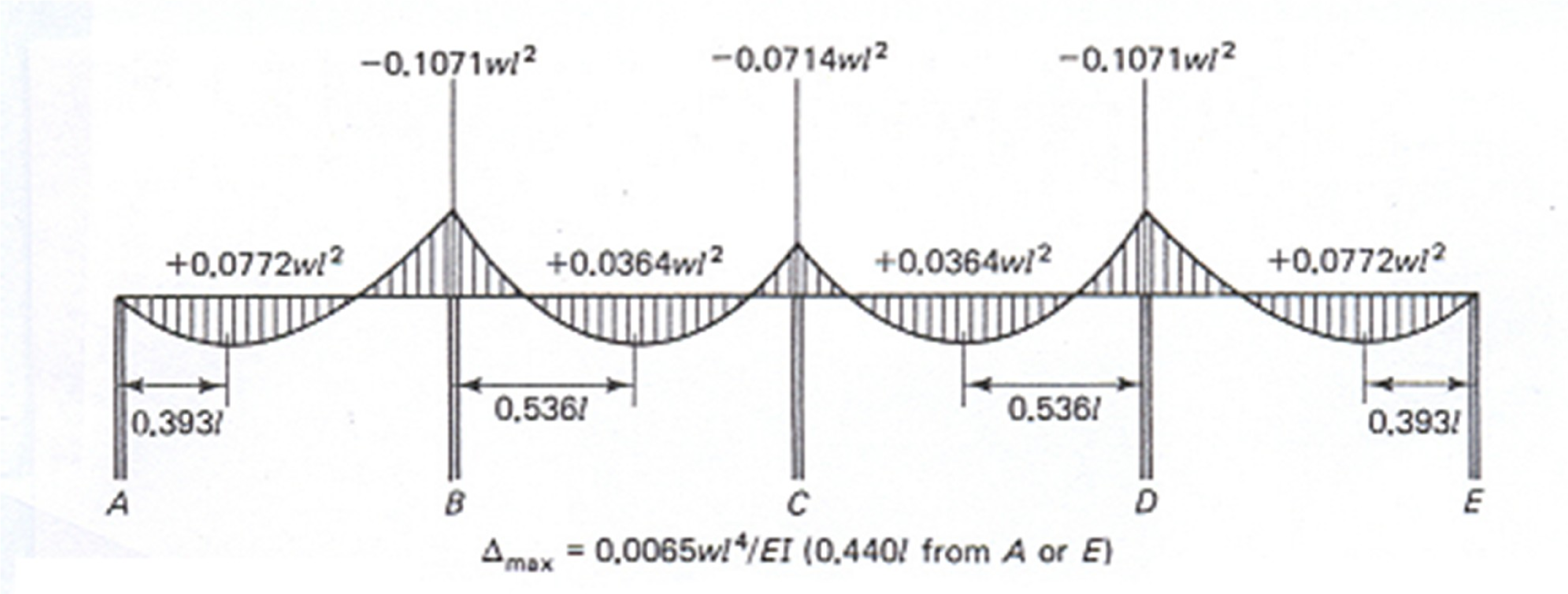
- Slab: According to ACI 9.5.2 thickness of slab=500/24=20.83cm, but considering that concentrated loads might be placed at middle of slab, use 25cm thickness
- Beam: 800/16=50cm, however beams fail by strength and not deflection, and because it is a factory use: drop beams 30cmX80cm (6cm cover)
- Columns: use 30X60cm reinforced on two faces (cover 4cm).

1D analysis and design: slab model

•



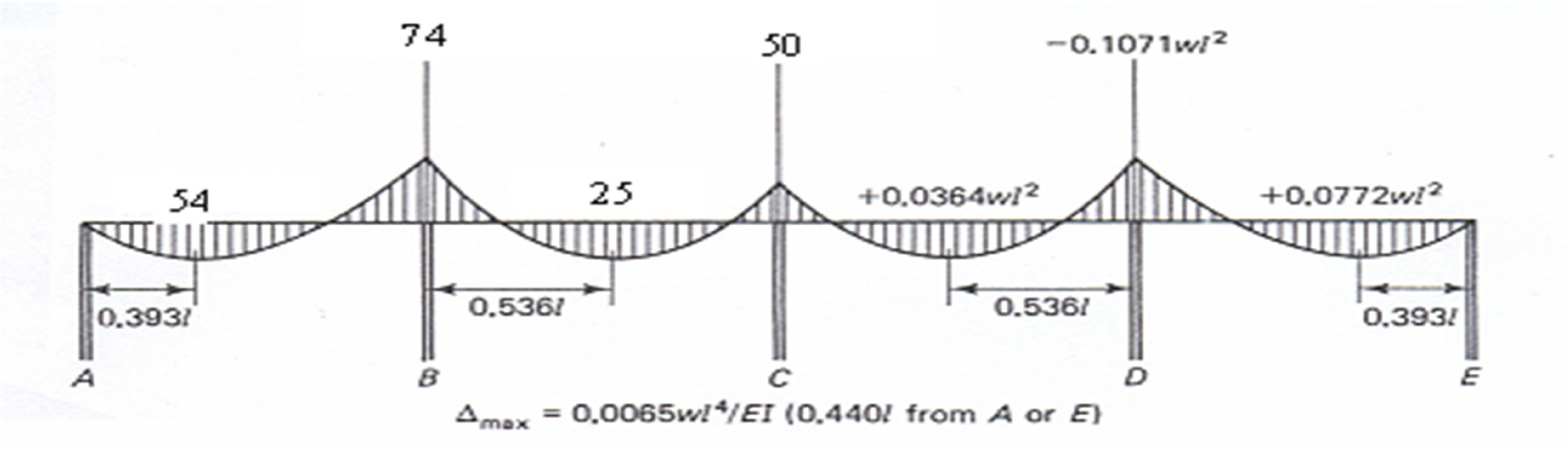
1D analysis and design: slab analysis

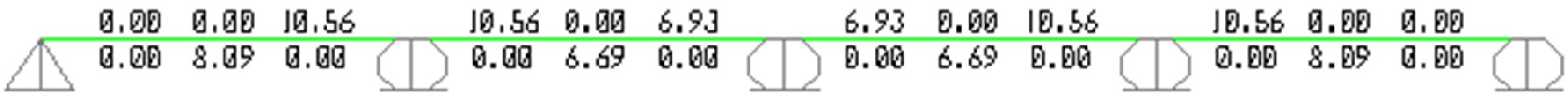


1D analysis and design: slab analysis

- $w_d=(.25*24.5+5)=11.125KN/m$
- $w_l=9KN/m$
- $w_u=1.2*11.125+1.6*9=27.75KN/m$

1D analysis and design: slab analysis, BM in KN.m, As in square cm

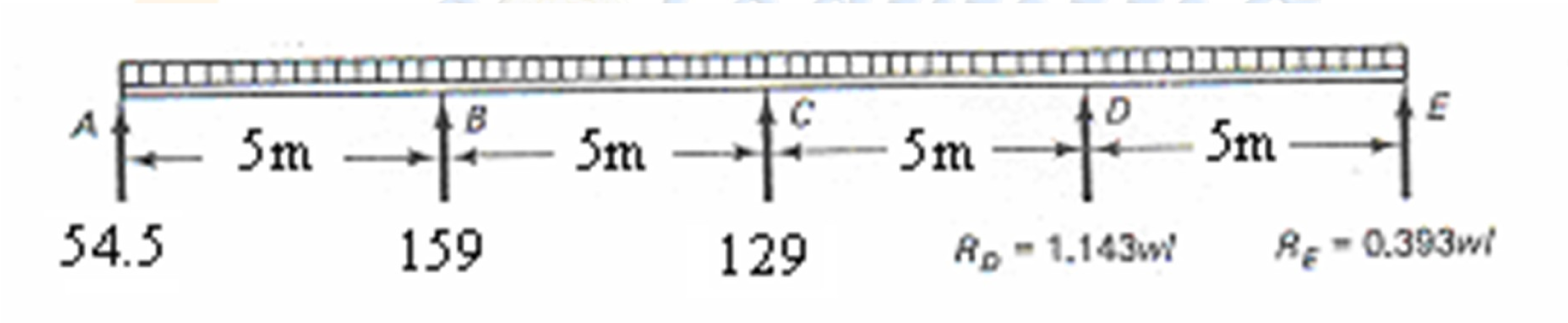




$$A_s \approx \frac{3M_u}{20} = 0.15M_u \geq \frac{1.4}{420}(100*20) = 6.67$$

1D analysis and design: slab analysis, values of reactions in KN

- Note: for slabs and footings of uniform thickness the minimum steel is that for temperature and shrinkage but with maximum spacing three times the thickness or 450mm. (ACI10.5.4)



1D analysis and design: beam analysis,

- Assume simply supported beam:
- Beam C, M_u=(129+1.2*0.3*.8*24.5)*8^2 /8=1088
- Beam B, M_u=(159+1.2*0.3*.8*24.5)*8^2 /8=1328
- Beam A, M_u=(54.5+1.2*0.3*.8*24.5)*8^2 /8=492

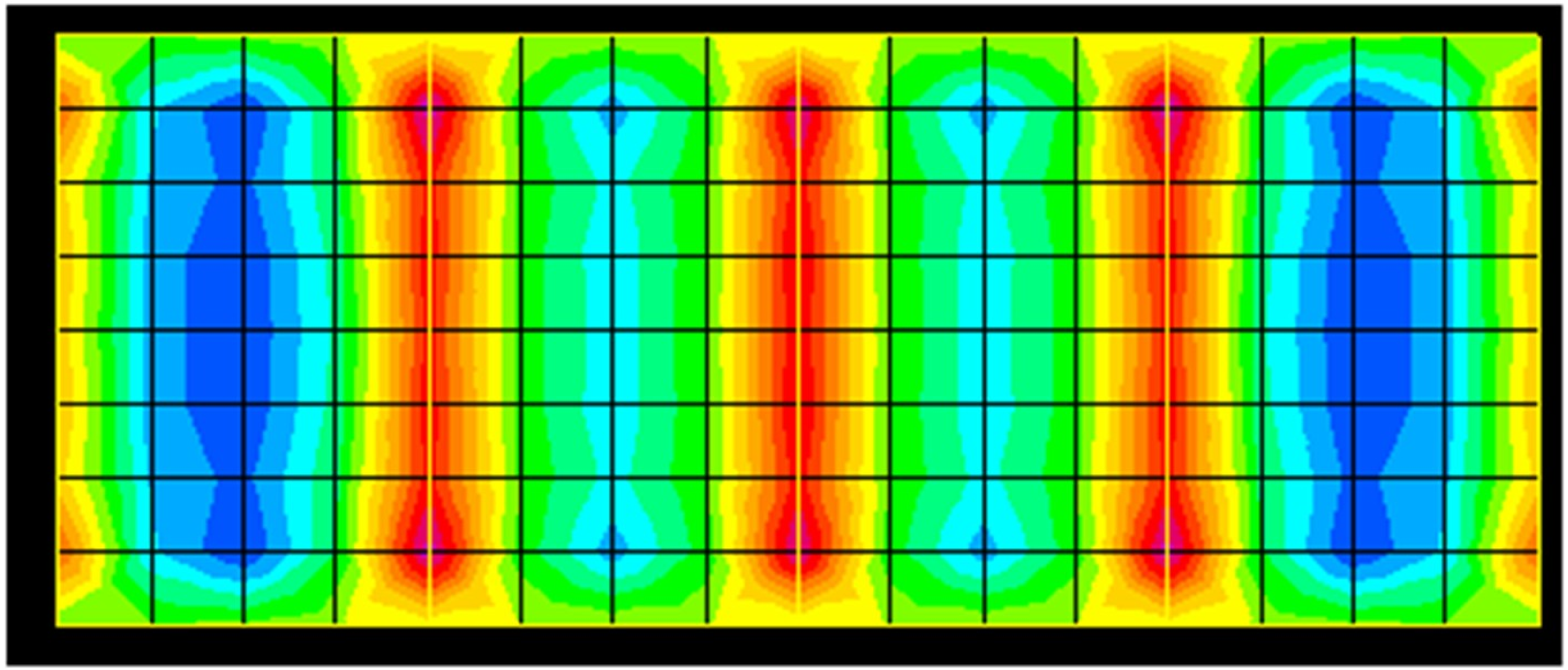
3D SAP: Gravity equilibrium checks

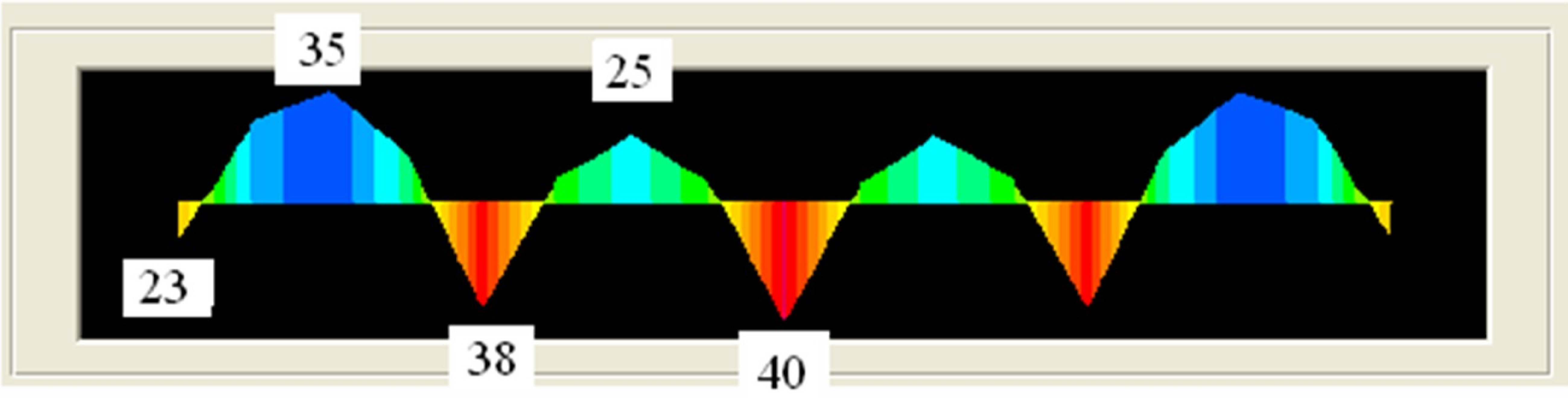
- D:
  - Slab=20X8X(0.25X24.5+5)=1780KN
  - Beams=(5X8+2X20)X.8X.3X24.5=470KN
  - Columns=10X6X.3X.6X24.5=264.6KN
  - Sum=2514.6KN
- L:
  - R =20X8X9=1440KN

Gravity equilibrium checks

- SAP results:

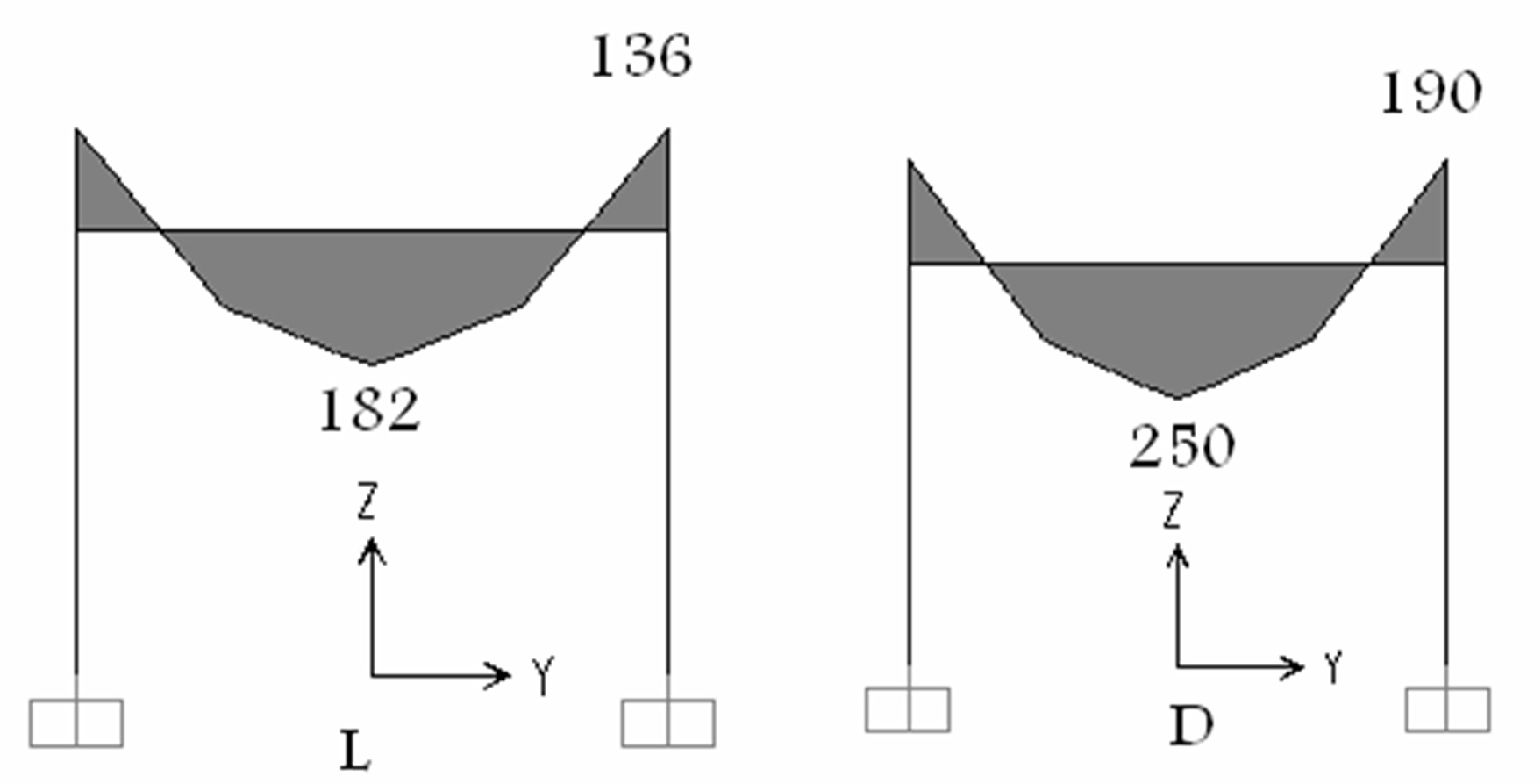
	OutputCase Text	CaseType Text	GlobalFX KN	GlobalFY KN	GlobalFZ KN	GlobalMX KN-m	GlobalMY KN-m	GlobalMZ KN-m
▶	DEAD	LinStatic	1.776E-15	0	2515	000000002615	000000004093	000000000151
	live	LinStatic	1.155E-14	-5.329E-14	1440	5.684E-14	000000008527	-5.658E-13





bending moment in slab KN.m

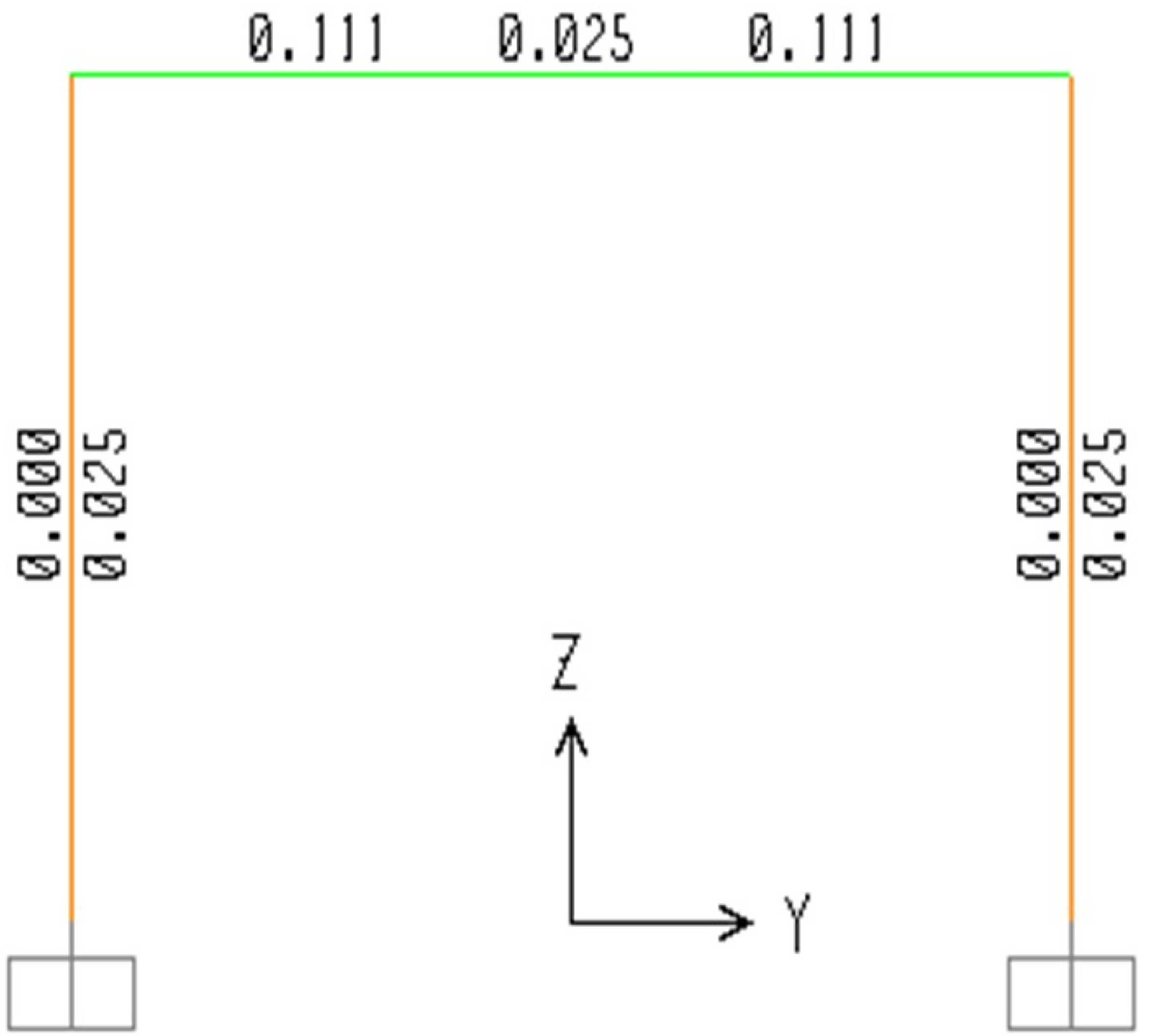
BM in beams in interior frame (KN.m)



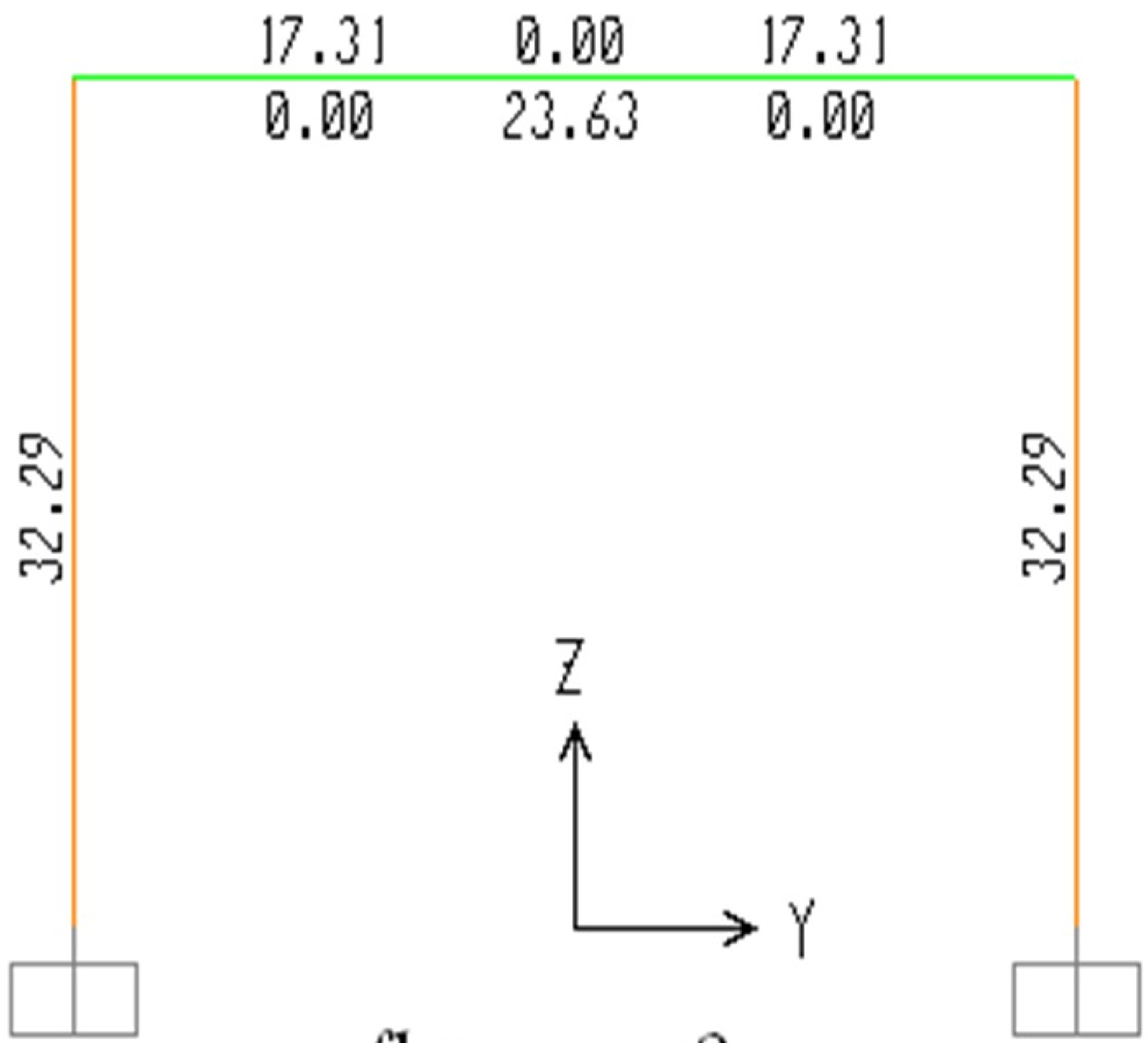
Design for D and L (1.2D+1.6L)

- Conceptual check for dead
  - W_d=(.25X24.5+5)X5=55.6KN/m
  - M_d=55.6X8^2 /8=445KN.m (compare with 250+190=440KN.m ok)
- Conceptual check for live
  - W_L=9X5=45KN/m
  - M_L=45X8^2 /8=360KN.m (compare with 182+136=318KN.m ok)
- Conceptual design for positive moment
  - M_u=1.2*250+1.6*182=591KN.m
  - A_s=3*591/74=24cm^2.

Reinforcement calculation



shear Av/s (cm)



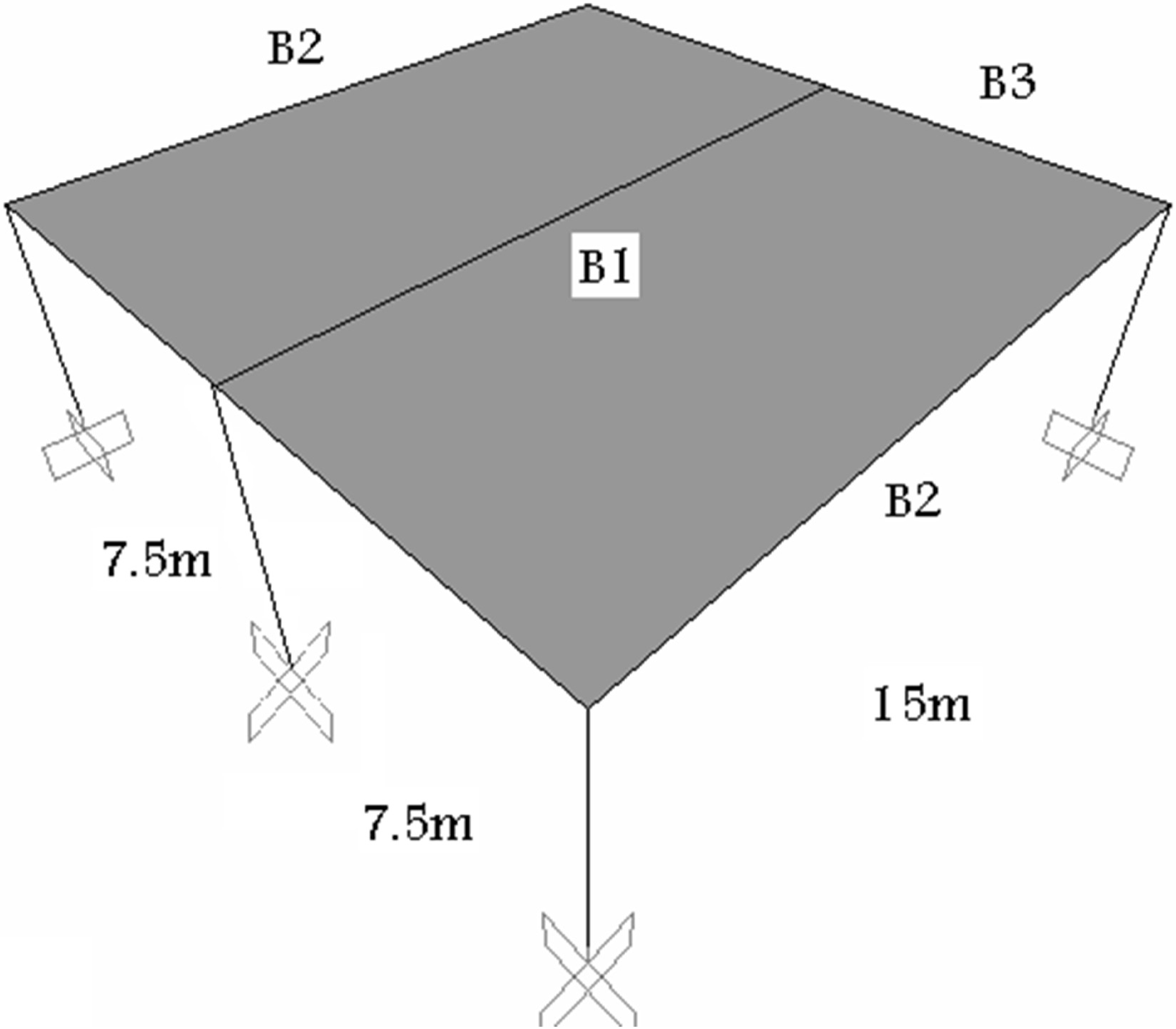
flexure cm2

Conclusion:

- If 3D analysis results are used conceptual understanding of edge beam is wrong, thus expect failure in torsion

Problem set #6

- Analyze and design a one story reinforced concrete structure (entertainment hall) made of one way solid slab sitting on drop beams supported on six square columns 50cm dimensions. The superimposed and live loads are $3KN/m^2$ and $4KN/m^2$ respectively.


B2
B3
B1
B2
7.5m
15m
7.5m

End of section 5.1

Let Learning Continue