BIRZEIT UNIVERSITY

جامعة بيرزيت

Reinforced Concrete Design I
ENCE 335

RC Beam Continuity

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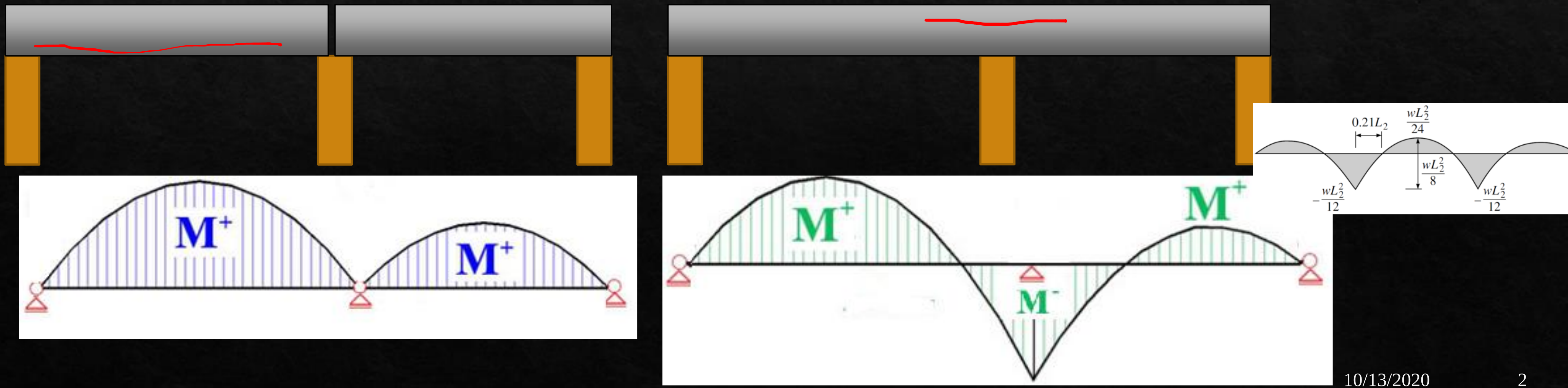
Continuous beams

- A continuous beam is meant to provide for more moment resistance at a greater length than a simple supported beam.
- Continuous Beams provide more redundancy in the structural system
- The resulting moments in a two adjacent simple beams are larger than one continuous beam with two spans

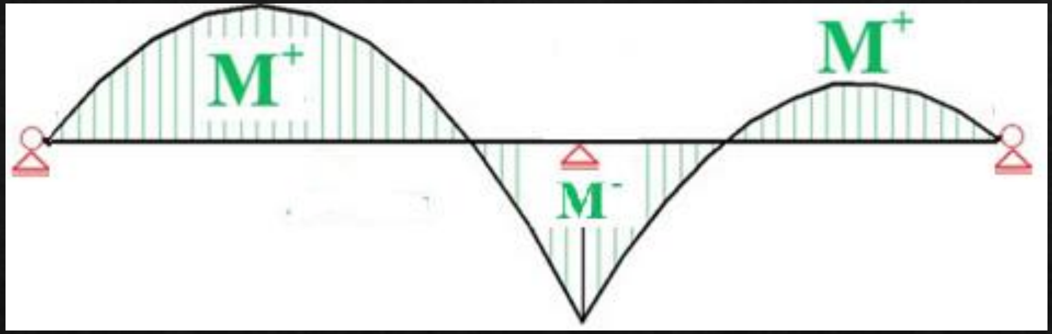


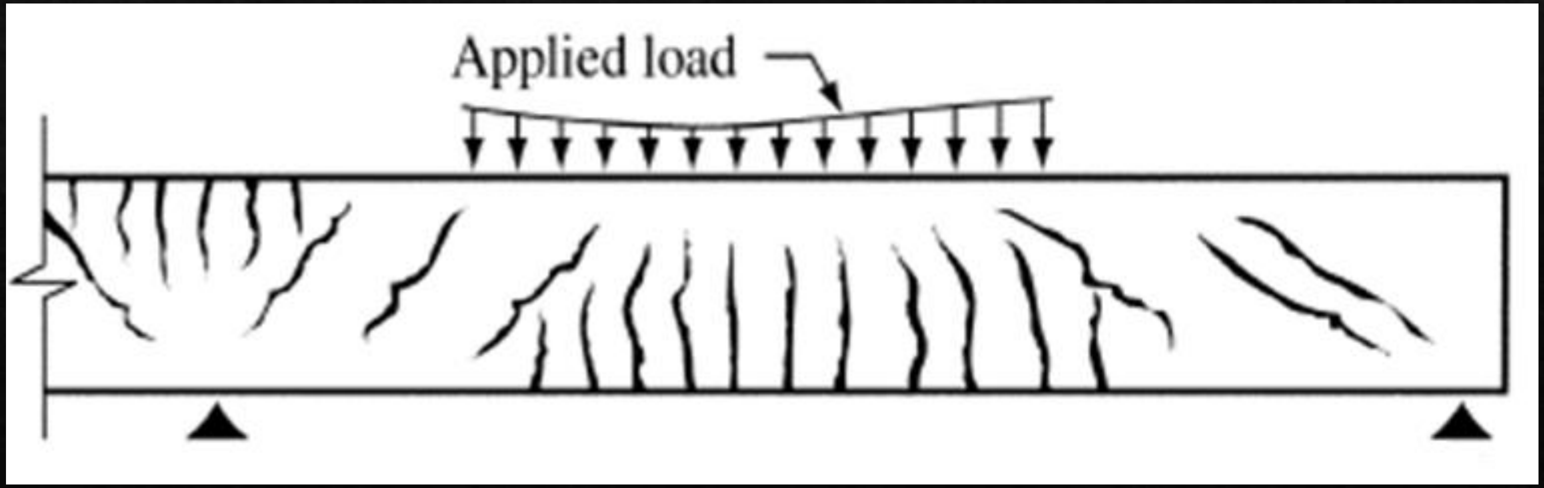
Continuous beams

- Loading and load cases:
  - Structural analysis for each member would involve determining the load position that causes the greatest force or stress in each member.
  - For that we use Influence Lines (graph of a response function (reaction, shear moment …etc.) of a structure as a function of the position of a downward unit load moving across the structure the structure).
  - Muller-Breslau Principle : The influence line for a response function is given by the deflected shape of the released structure due to a unit displacement (or rotation) at the location and in the direction of the response function.
    - Releases:
      - Support reaction – remove translational support restraint translational support restraint.
      - Internal shear - introduce an internal glide support to allow differential displacement movement.
      - Bending moment - introduce an internal hinge to allow differential rotation movement.

Continuity in RC beams

- Reinforcement is required where Tension forces are present in the RC beams
- Location of Reinforcement ??
- Extension of Reinforcement ??





Continuous Beams with uniform loading

- Using ACI coefficients to Analyze Continuous beams under uniform loading
  - Members are prismatic
  - Loads are uniformly distributed
  - Live load ≤ 3 Dead load
  - There are at least two spans
  - The longer of two adjacent spans does not exceed the shorter by more than 20 percent

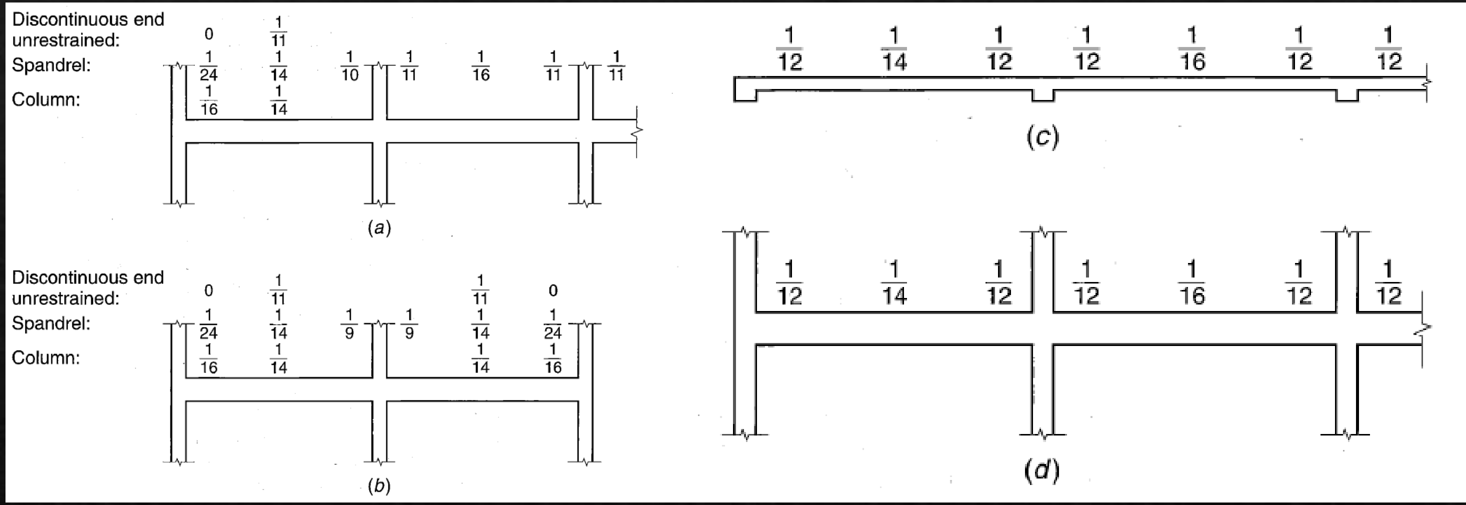


Table 6.5.4—Approximate shears for nonprestressed continuous beams and one-way slabs

Location	V_u
Exterior face of first interior support	$1.15w_u\ell_n/2$
Face of all other supports	$w_u\ell_n/2$

Which Chapter in ACI Code ???????

Continuous Beams with uniform loading

- Detailing of Continuous beams under uniform loading

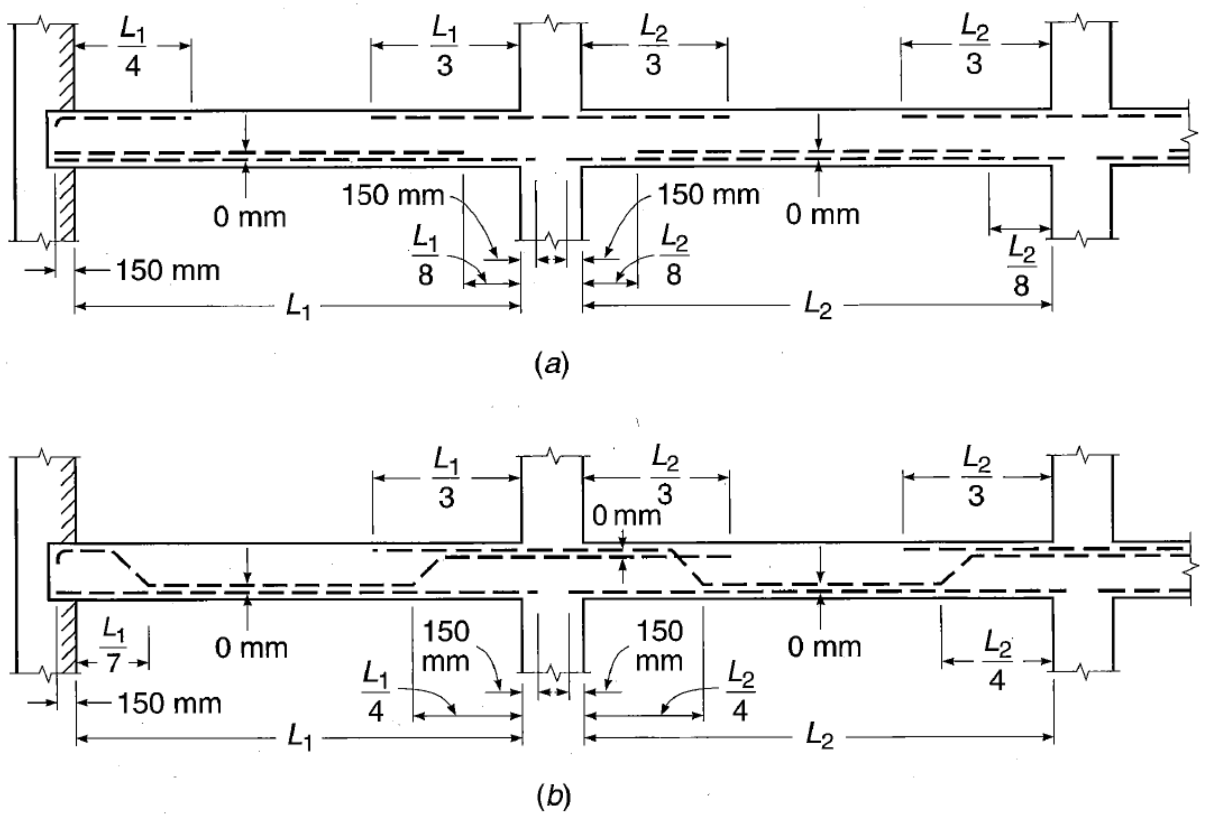


FIGURE 5.20 Cutoff or bend points for bars in approximately equal spans with uniformly distributed loads.

Continuous Beams with uniform loading

- Example: over-hang beam

The beam shown is supporting a uniform dead load of 50 kN/m and uniform live load of 70 kN/m, in addition to a concentrated live load of 100 kN . (B=350mm, H=600mm)

Determine load cases that maximizes the negative and positive moments

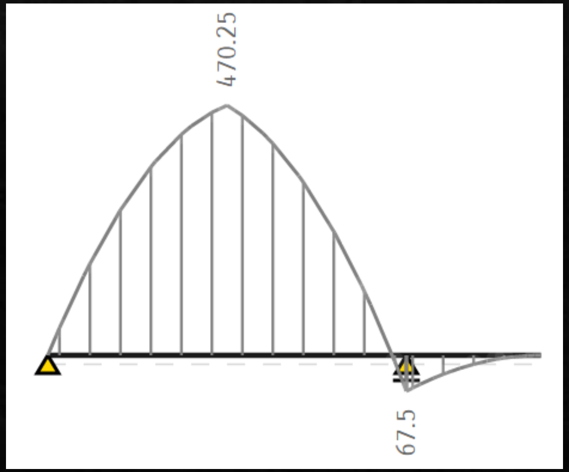
If 6φ25 are required for the maximum positive moment and 5φ25 are required for the maximum negative moment draw proper detailing for the beam.

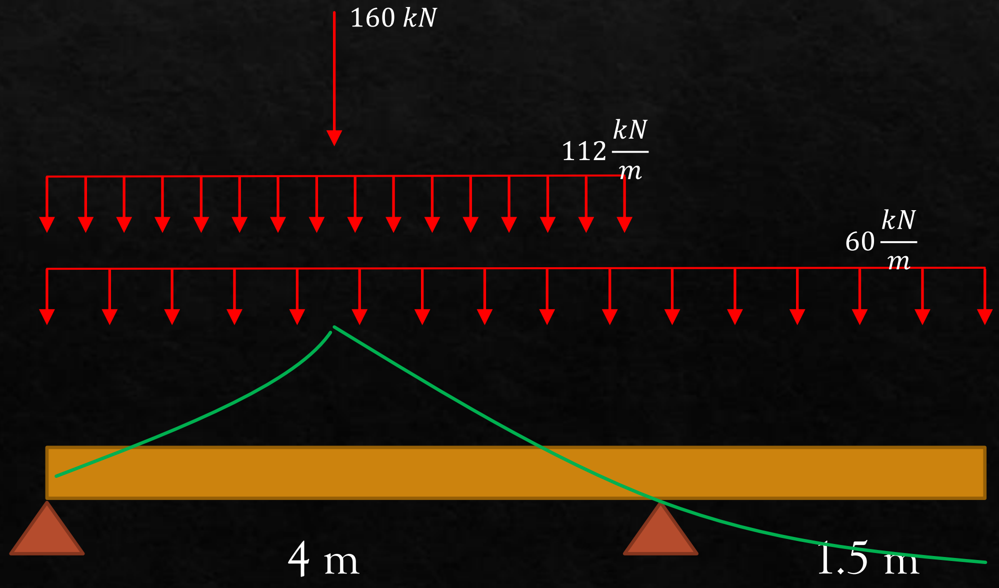
Solution: Looking at the IL of the positive moment at mid-span

Uniform dead load does not change and applied on the whole beam ($w_d = 1.2 * 50 = 60 \frac{kN}{m}$)

Uniform Live load should be applied on the whole span ($w_l = 1.6 * 70 = 112 \frac{kN}{m}$)

Concentrated live load should be applied at midspan ($P_l = 1.6 * 100 = 160\ kN$)





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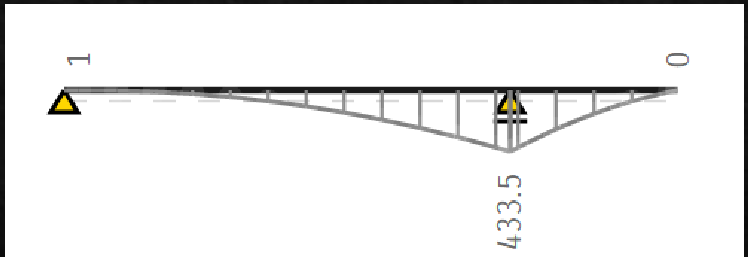
Determine load cases that maximizes the negative and positive moments

If 6φ25 are required for the maximum positive moment and 5φ25 are required for the maximum negative moment draw proper detailing for the beam.

Solution:

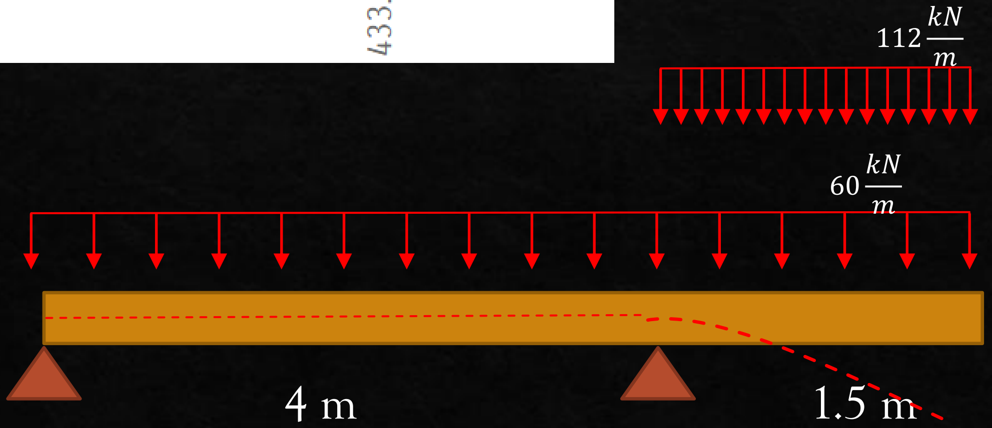
Looking at the IL of the negative moment at the interior support



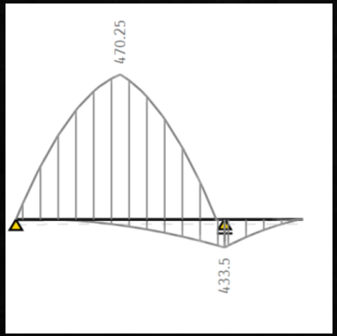
Uniform dead load does not change and applied on the whole beam ($w_d = 1.2 * 50 = 60 \frac{kN}{m}$)

Uniform Live load should be applied on the cantilever span ($w_l = 1.6 * 70 = 112 \frac{kN}{m}$)

Concentrated live load should be applied at the end of the cantilever ($P_l = 1.6 * 100 = 160\ kN$)



Now we can construct the moment envelope for the beam



Continuous Beams with uniform loading

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Determine load cases that maximizes the negative and positive moments

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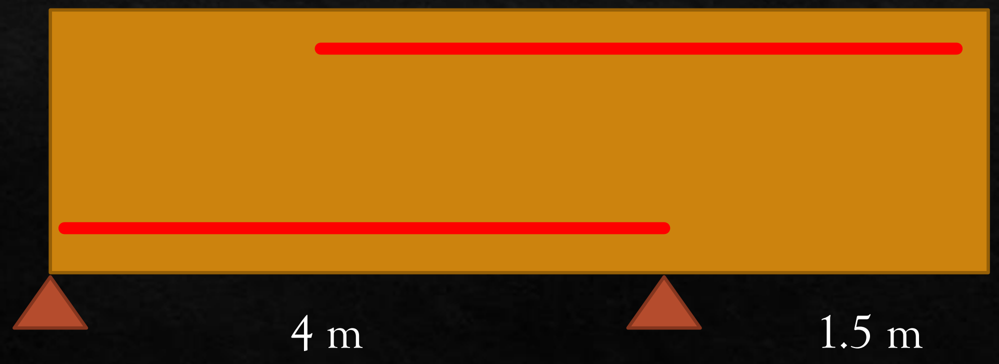
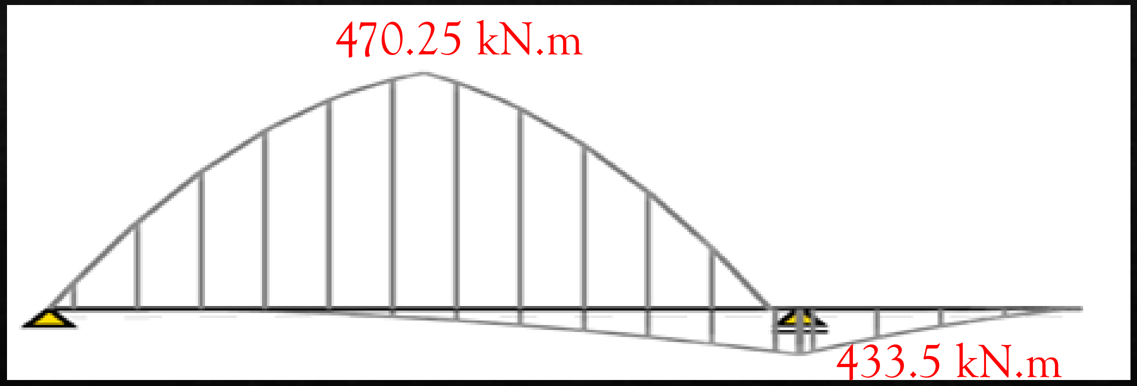
Solution:





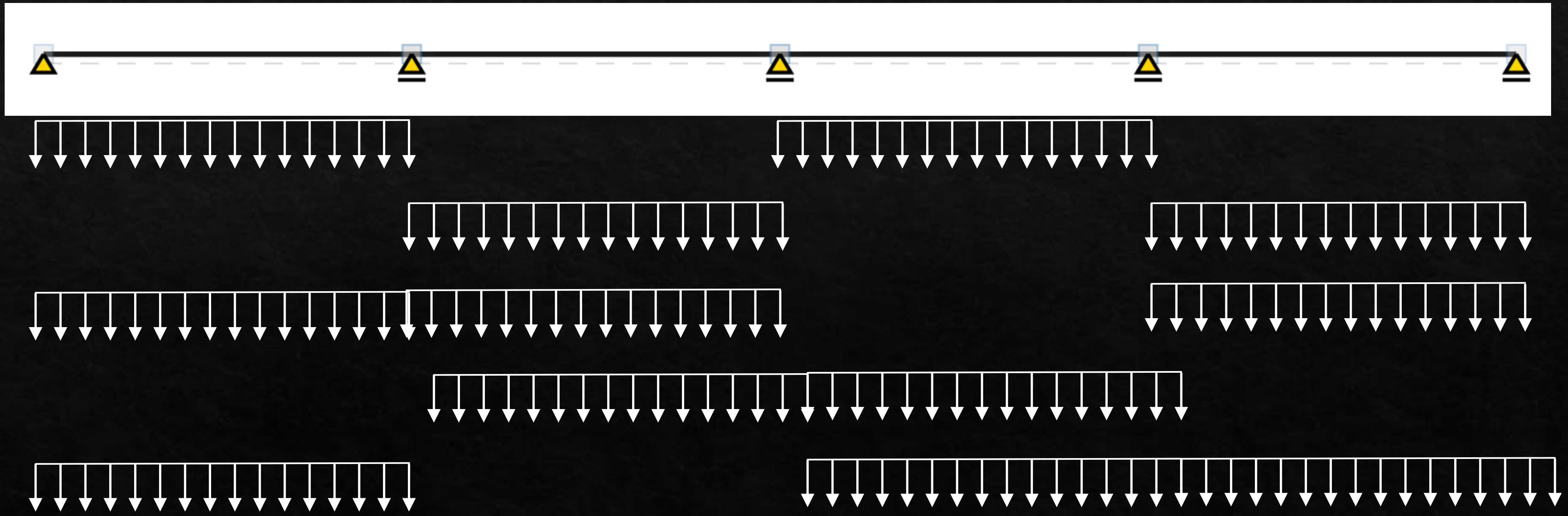
Continuous Beams with uniform loading

- Example: 4-span beam

A beam with 4 equal spans of 4m is supporting a uniform dead load of 90 kN/m and a uniform live load of 120 kN/m.

Draw load cases that maximizes the negative and positive moments

Use ACI Coefficients to draw shear and Moment diagrams



Max +M (1st &3rd spans)

Max +M (2nd &4th spans)

Max –M at 1st interior support

Max –M at 2nd interior support

Max –M at 3rd interior support

Continuous Beams with uniform loading

- Example: 4-span beam

A beam with 4 equal spans of 4m is supporting a uniform dead load of 90 kN/m and a uniform live load of 120 kN/m.

Use ACI Coefficients to draw shear and Moment diagrams

Ultimate uniform load → $U = 1.2\ D + 1.6\ L \ \rightarrow w_u = 1.2 * 90 + 1.6 * 120 = 300\frac{kN}{m}$