ASSIGNMENT 1

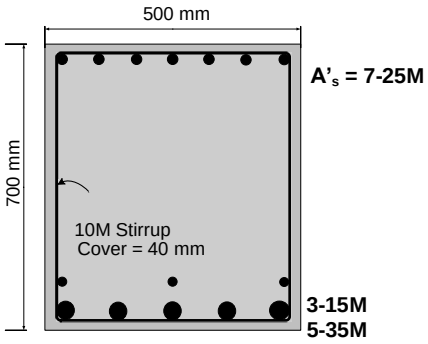
"Flexure"

Assigned:	May 2, 2022
Due:	TBD

Take f_y = 400 MPa for all questions. Use basic principles (not CAC design tables).

Problem 1

Determine the factored moment resistance, M_r, for the doubly-reinforced beam shown in Figure 1 (right) according to CSA A23.3-19. Use the bar spacing requirements of Clause A6.6.5 (Annex A) to determine *d*. Assume f'_c = 35MPa and a maximum coarse aggregate size of 19 mm. Round bar spacing to nearest acceptable multiple of 5 mm.



Problem 2

The plan view of the floor system for an industrial facility is shown in Figure 2. Determine the factored moment resistance, M_r, for Beams B1 and B2 based on the section details given.

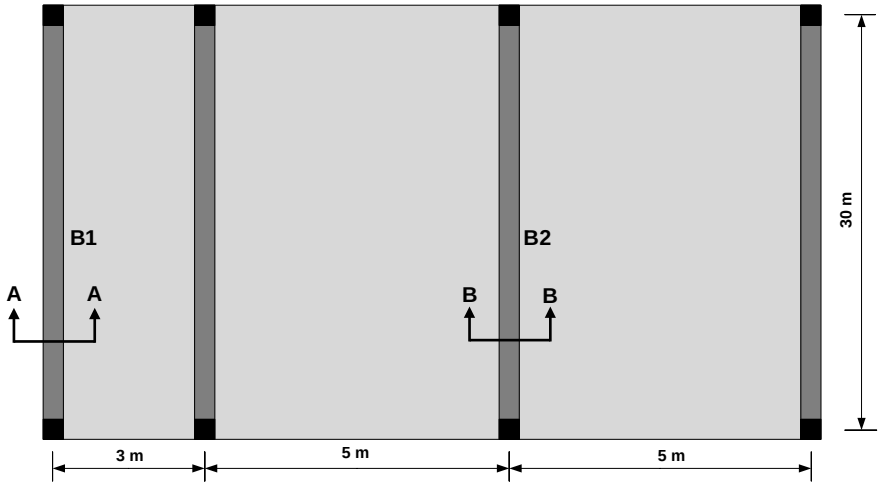
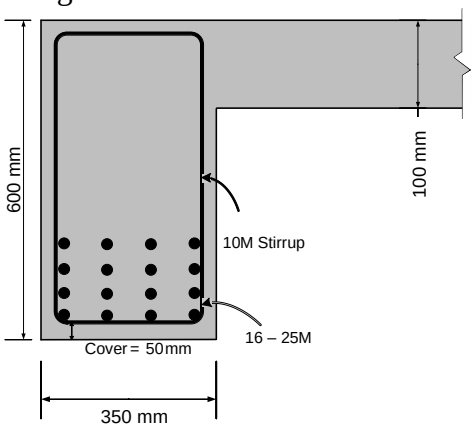
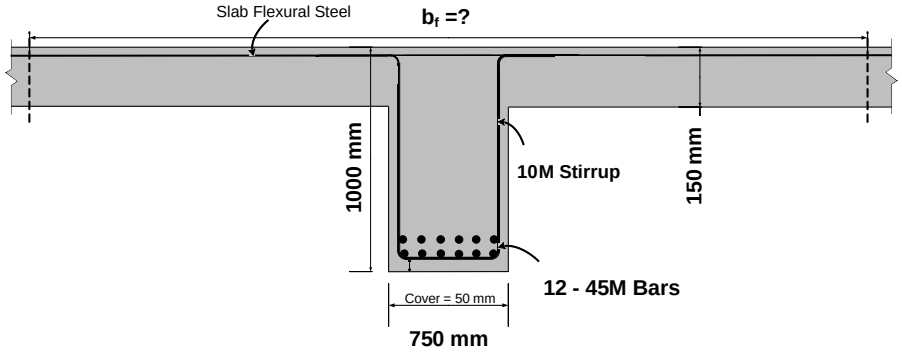


Figure 2 – Floor System Plan View



Section A-A – Beam B1



Section B-B – Beam B2

Notes:

- Determine the effective flange width of the beams according to CSA A23.3-19 Clause 10.3.3 or Clause 10.3.4 as applicable. Assume the beams are simply supported. Assume both edge beams have web widths of 350mm and both interior beams have web widths of 750mm.
- Use the bar spacing requirements of Clause A6.6.5 (Annex A) to determine *d*. Round to nearest acceptable multiple 5mm.

Assume f'_c = 45 MPa and a max. coarse aggregate size of 25 mm.

Problem 3

Figure 3 shows a plan view of the floor system for a multi-storey parking garage. The construction-type is continuous. The column locations shown have already been determined based on parking and traffic flow requirements, resulting in the beam framing and one-way slab span lengths indicated on Figure 3. Preliminary calculations indicate that 500x500 mm square columns are required. Beam B1 is an interior beam.

The design live load for the garage is 4.8 kPa, and a superimposed dead load of 0.75 kPa is assumed in addition to self-weight. *You may neglect wind, snow and seismic loading for the purposes of this assignment.*

Figure 3:
Floor System Plan View

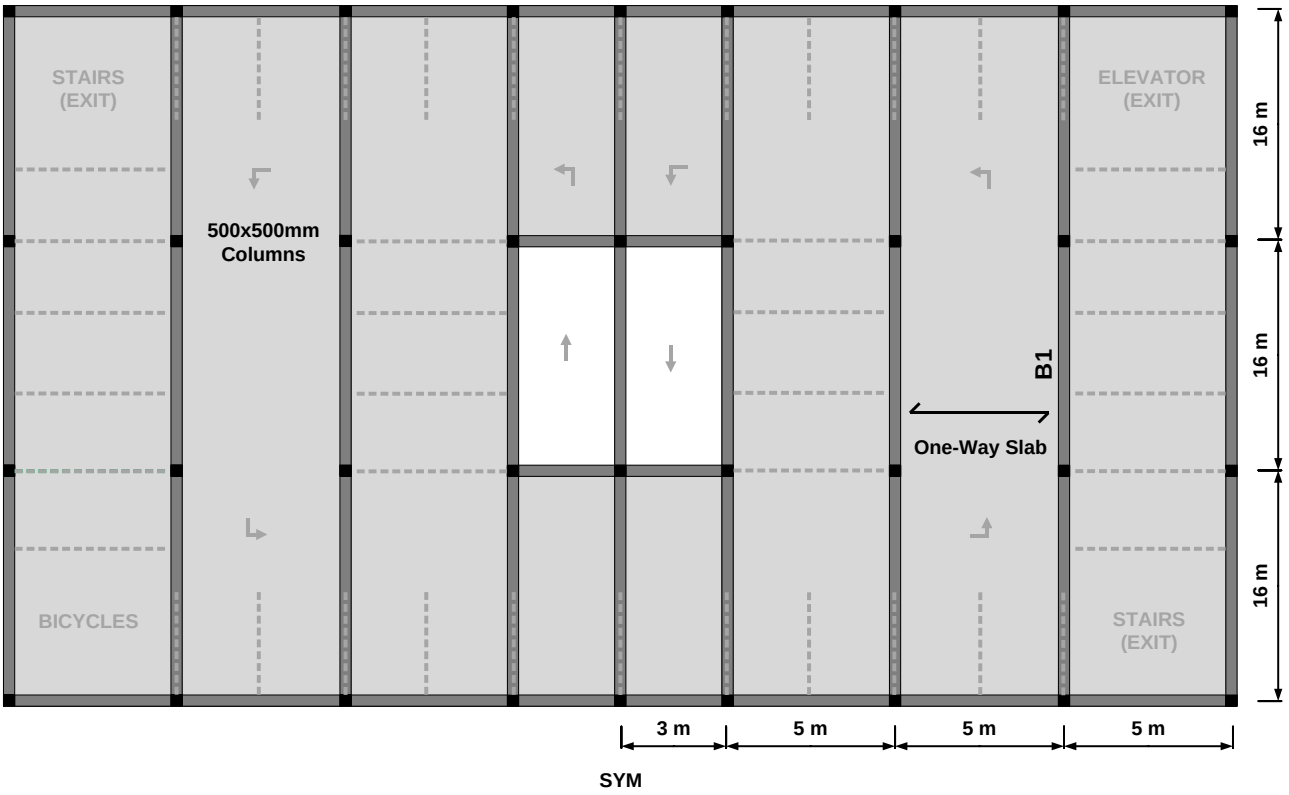
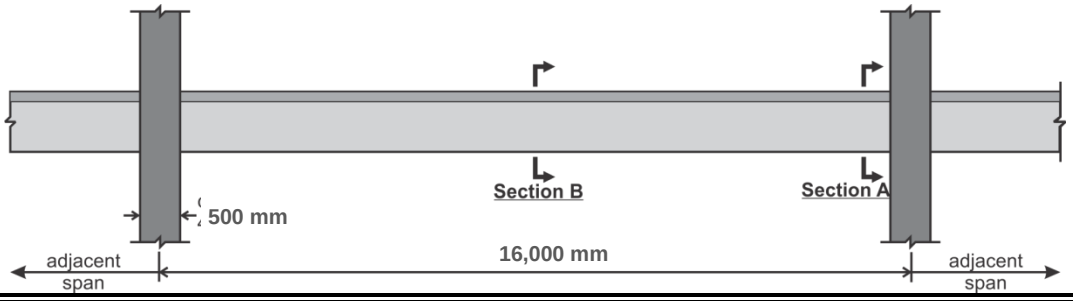


Figure 4:
Beam B1 Elevation View



Use f'_c = 50 MPa, γ_{conc} = 24.0 kN/m^3 and steel reinforcing bars (f_y = 400 MPa).
You may use CAC Design Handbook tables (K_r) for design.
Follow CSA A23.3-19 requirements.

3.1 Design the *midspan section* for the interior one-way slab adjacent to Beam B1 based on the requirements listed below.

- Use Clause 9.8.2.1 to determine the slab depth based on the slab clear span. Use a multiple of 10 mm for h.
- Use Clause 9.3.3 for your analysis of the continuous one-way slab midspan moment.
- Use the concrete cover requirements of CSA A23.3-19 Annex A. Assume that the parking garage is not enclosed, and is local.
- Verify that the requirements of Clauses 7.8, 10.5.1 and 10.5.2 are satisfied.
- Sketch the cross-section details for the slab. Show all dimensions.
- Sketch the slab temperature and shrinkage steel in both sections.

3.2 Design the beam cross-section and reinforcement at ***Section A (support)*** and ***Section B (span)*** of ***Beam B1,*** (see Figures 3, 4 and 5) based on the requirements listed below.

- Use Clause 9.8.2.1 to determine the beam depth based on the beam clear span. Use a multiple of 25 mm for h. *Due to architectural requirements, the beam depth, h, must not exceed 700 mm (even if this means that deflection must be checked according to Clause 9.8.2.1)* [Deflection checks not required for Assignment 1].
- Use the slab thickness from Question 3.1 as h_f.
- **The web width, b_w, must not exceed the column width (500 mm).**
- Use Clause 9.3.3 for your analysis of the continuous beam moments.
- Use Clause 10.3.3 to determine the beam effective flange width.
- Assume there is a 10M stirrup.
- Use the spacing and cover requirements of CSA A23.3-19 Annex A. Assume that the parking garage is not enclosed, and is local.
- Verify that the requirements of Clauses 10.5.1, 10.5.2 and 10.5.3.1 are satisfied.
- Sketch the cross-section details for the beam at both sections. Show all dimensions.

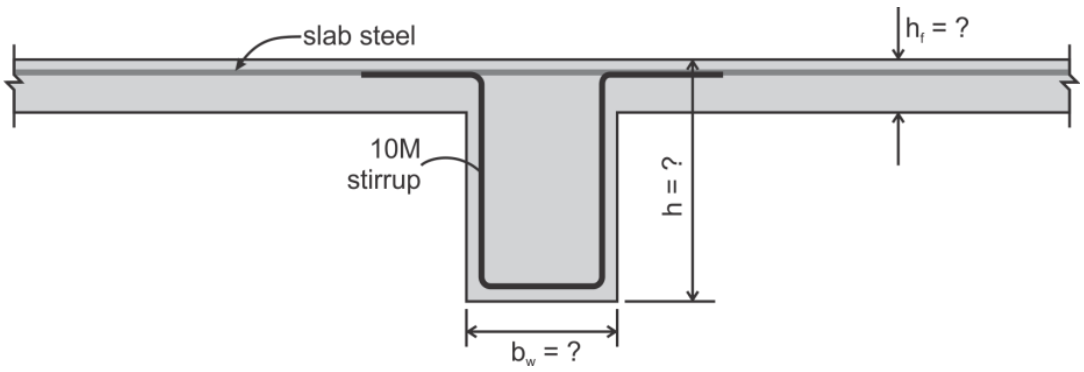


Figure 5: Typical Interior Beam Section