# UNIVERSITY OF BOLTON

# OFF CAMPUS DIVISION

# WESTERN INTERNATIONAL COLLEGE FZE

# BENG(HONS) CIVIL ENGINEERING

# TRIMESTER TWO EXAMINATION 2021/2022

# STRUCTURAL ANALYSIS AND CONCEPTUAL DESIGN

# MODULE NO: CIE4023

**Date: Saturday 30th April 2022** **Time: 10:00am – 12:00pm**

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**INSTRUCTIONS TO CANDIDATES:**

**There are FOUR questions on this paper.**

**Answer ALL questions.**

**Marks for parts of questions are shown in the brackets.**

**This examination paper carries a total of 100 marks.**

**The necessary design aid data for and formula sheet for Section A will be provided at the examination hall.**

**All working must be shown. A numerical solution to a question obtained by programming an electronic calculator will not be accepted.**

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**Q1: Preliminary sizing**

Consider a room of a building of size 8m in length and 4m in width. **Figure 1** provides the plan view of a slab of span 4 m**.** The imposed load on slab is 4kN/m$^2$. With the aid of **Figure1 & Figure 2** prepare a set of preliminary sizing calculations for:

**(i)** The overall depth of slab

**(5 marks)**

**(ii)** The overall depth and width of beam

**(12 marks)**

**(iii)** The size of a square column

**(8 marks)**

**Total 25 marks**

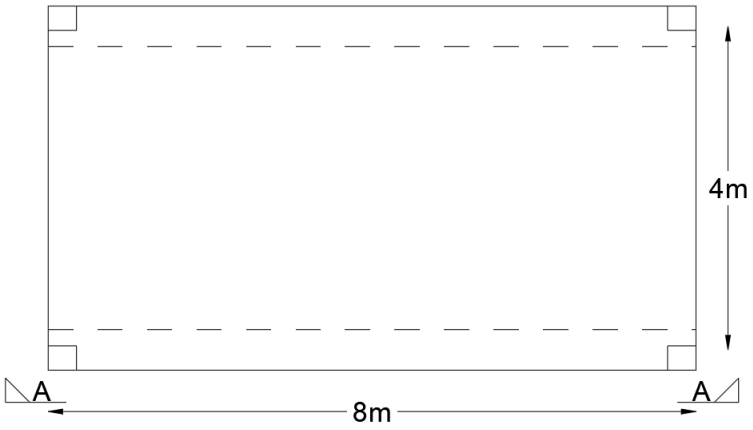


**Figure 1: Plan view of slab**

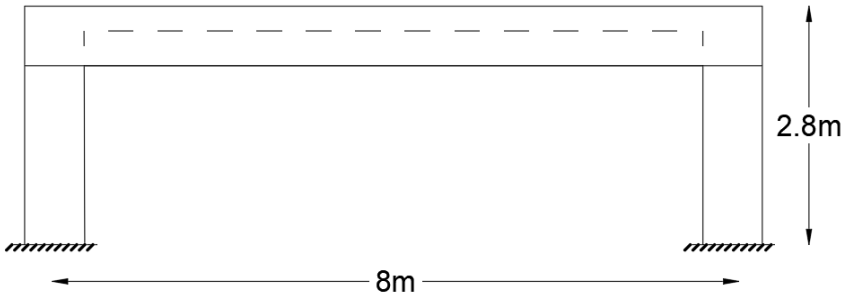


**Figure 2: Section A-A**

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**PLEASE TURN THE PAGE FOR GENERAL AID…**

**General Notes for aid**

1. The building is to be used for residential purposes.
2. Use concrete of grade C30/37 for all.
3. The nominal cover provided is 30mm for slab and beam.
4. Consider the self-weight of beam and slab.



**Q2. Design of SLAB**

**Figure 3** shows the plan view of first floor of a service block (Reinforced Concrete Structure). Consider the RC **slab spanning between grids 1 and 2 along BC** having a clear span of 5.5m as shown in **Figure 3**. The overall depth of the slab is 290mm. The slab is subjected to a live load of 5kN/m$^2$. Assume that H12 longitudinal bars are used.

**(i)** Show how the ultimate limit state (ULS) loading on the slab amounts to 17.287 kN/m and show how the maximum ultimate bending moment in the slab amounts to 73.94kNm. Make use of these values in all further calculations.

**(5 marks)**

**(ii)** Check the slab for bending

**(10 marks)**

**(iii)** Check the minimum reinforcement quantities.

**(10 marks)**

**Total 25 marks**

**Q3. Design of reinforced concrete BEAM**

The details of the RC **beam AB spanning on grid 1** in **Figure 3** are shown in **Figure 4**. The overall depth of the beam is 710mm and its width is 310mm. Assume H10 links and H25 main bars are used. The factored load and the maximum ultimate bending moment of the RC **beam AB spanning on grid 1** are 1428kN/m and 234.206kNm respectively.

**Q3 continued over the page**

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**Q3 Continued**

**(i)** Find the area of tensile steel required of the beam

**(10 marks)**

**(ii)** Design the beam for shear

**(10 marks)**

**(iii)** Check the deflection of the beam

**(5 marks)**

**Total 25 Marks**

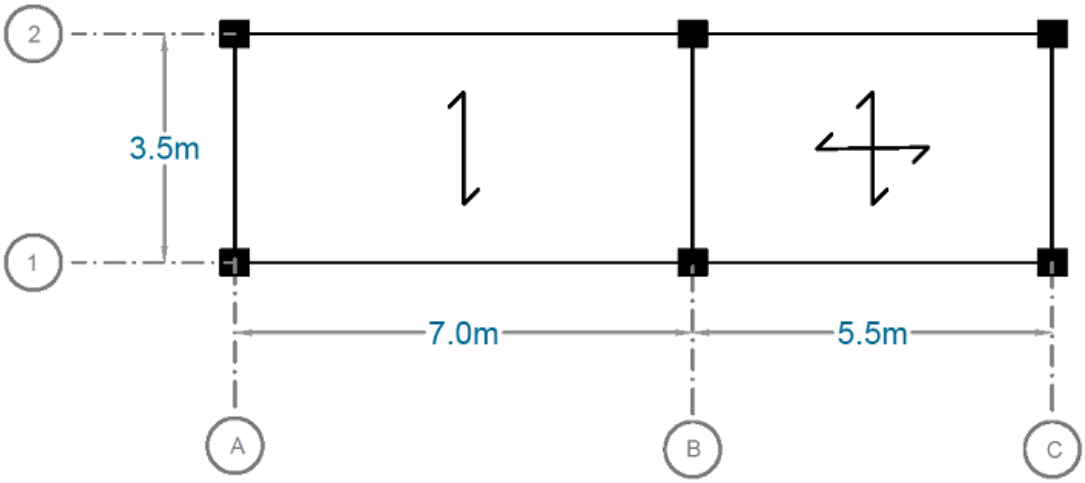


**Figure 3: Plan view of first floor of service block with RCC slabs, beams and columns**

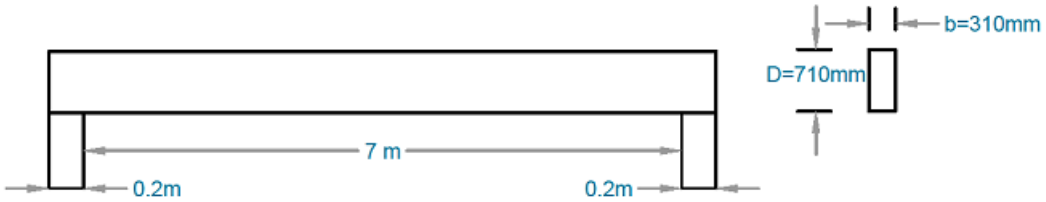


**Figure 4: Elevation and Cross sectional view of beam AB**

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**General Notes for aid**

1. The building is to be used for residential purposes.
2. Use concrete of grade C25/30 for all.
3. The nominal cover provided is 40mm for all.
4. The dead load must be calculated individually for beam and slab design.
5. Consider the slabs to have the same thickness and the beams to have the same cross-section throughout.
6. Steel Class H should be assumed for the reinforcement steel for all, which has a characteristic strength $f_{yk}$ = 500N/mm$^2$

**Q4: Steel Beam Design**

**Figure 5** provided below shows the plan view of the first floor of an office building. The ground floor and first floor of the buildings are of identical layouts. For the steel beam **BC** along the **grid line 3**,

**(i)** Calculate the load acting on the beam.

**(5 marks)**

**(ii)** Prepare a set of manual design check the moment capacity of the section.

**(12 marks)**

**(iii)** Sketch the cross-section of the chosen steel beam section

**(3 marks)**

**(iv)** Prepare the section classification for bending and compression.

**(5 marks)**

**Total 25 marks**

**PLEASE TURN THE PAGE FOR FIGURE AND GENERAL AID…..**

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**General Aid for Design**

1. The thickness of each slab is 220mm with 50mm thick screed(with a density of 24Kn/m²) over it
2. The slabs are subjected to a live load of 7.0Kn/m$^2$ each
3. Consider the loadings on the slabs to be the same on each floor
4. The self-weight of the steel beam is1.5Kn/m each
5. Assume the column is carrying axial force only and pinned at both ends.
6. The Young's modulus of steel should be taken as 210000N/mm²
7. Steel grade of S275 is considered for the whole structure
8. Suggested limit for vertical deflection in steel beams here is L/200

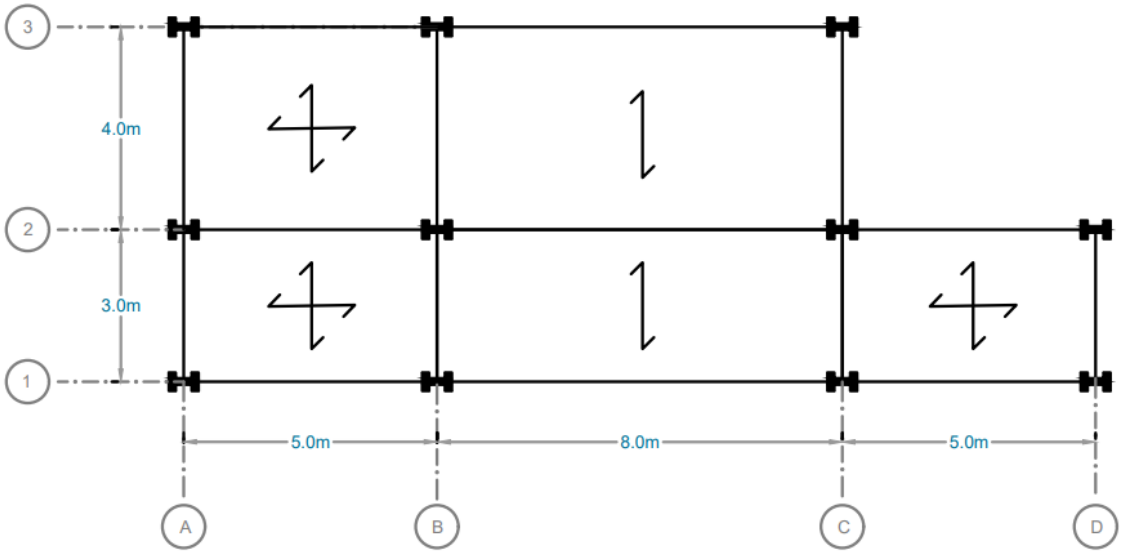


**Figure 5: Plan of the first floor of an office building**

**END OF QUESTIONS**

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**END OF PAPER**