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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	DESIGN OF PRECAST CONCRETE STRUCTURE
COURSE CODE	:	MFS 10303
PROGRAMME CODE	:	MFA
EXAMINATION DATE	:	JANUARY/FEBRUARY 2022
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL QUESTIONS** 2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK**

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 **Figure Q1(a)** shows part of the first floor plan of a double storey building. The floor of the building uses precast prestressed hollow core slabs. The cross section of the hollow core slab is shown in **Figure Q1(b)**. Given the following data:

Hollow core slab:		
Cross sectional area	=	175×10^3 mm^2
Unit weight of concrete	=	25 kN/m^3
Concrete topping and finishes	=	3.0 kN/m^2
Variable action	=	5.0 kN/m^2
Moment of inertia	=	1.56×10^9 mm^4
Prestressing tendon:		
Eccentricity of tendons above soffit	=	20 mm
Total short term loss (α)	=	10%
Total long term loss (β)	=	20%
Maximum allowable concrete stress at transfer	=	20 N/mm^2
Maximum allowable concrete stress at service	=	13.5 N/mm^2
Minimum allowable concrete stress at transfer	=	-1.0 N/mm^2
Minimum allowable concrete stress at service	=	0 N/mm^2
Area of 7-wire 12.5 mm helical strand (A_{ps})	=	94.2 mm^2
Maximum strength of tendon (f_{pu})	=	1750 N/mm^2

(a) Determine the suitable range of prestressing force for the hollow core slab.

(16 marks)

(b) Evaluate the minimum number of tendons required. Assume the initial prestressing force is taken as 70%.

(4 marks)

(c) If the floor is decided to use solid rectangular post-tensioned concrete slab, determine the minimum depth of slab required.

(16 marks)

(d) What is the precaution need to be taken for the storage of precast hollow core slab?

(4 marks)

Q2 A 10 m length precast concrete column has a square cross section of 750 mm x 750 mm is used for a factory building. The precast column will be lifted from the casting yard at the points of 0.2L from both ends as shown in **Figure Q2(a)**. At site, the precast column is pitching at a single point from the end of the column as shown in **Figure Q2(b)**. Given the following data:

Unit weight of concrete	=	25 kN/m^3
Strength of concrete, f_{ck}	=	35 N/mm^2
Strength of steel reinforcement, f_{yk}	=	500 N/mm^2
Nominal concrete cover	=	50 mm
Tensile strength of 16 mm diameter hook (R16)	=	250 N/mm^2

(a) Evaluate the structural capacity of the precast column during lifting process.

(15 marks)

(b) Determine the member force for the spreader beam.

(5 marks)

(c) Evaluate the tension capacity of the steel hook during pitching process. Use a partial safety factor 1.5 for the steel hook.

(10 marks)

Q3 **Figure Q3** shows part of the upper floor plan of a commercial building and the detail of the internal precast concrete beam (PCB 2). The floor system uses 150 mm thick precast concrete planks with a concrete topping of 90 mm and simply supported precast concrete beams. The precast concrete beams are to be semi-precast and unpropped during installation. Given the following data:

Unit weight of concrete	=	25 kN/m^3
Strength of concrete, f_{ck}	=	30 N/mm^2
Strength of steel reinforcement, f_{yk}	=	500 N/mm^2
Finishes & services	=	1.0 kN/m^2
Imposed load	=	5.0 kN/m^2
Imposed load during installation	=	1.5 kN/m^2
Nominal concrete cover	=	30 mm
Diameter of main reinforcement	=	32 mm
Diameter of shear reinforcement	=	10 mm

(a) Calculate the ultimate loading on precast concrete beam 2 (PCB 2) during installation stage and service stage.

(10 marks)

(b) Design the main reinforcement for PCB 2.

(20 marks)

-END OF QUESTIONS-

FINAL EXAMINATION

SEMESTER/SESSION : SEMESTER I 2021/2022
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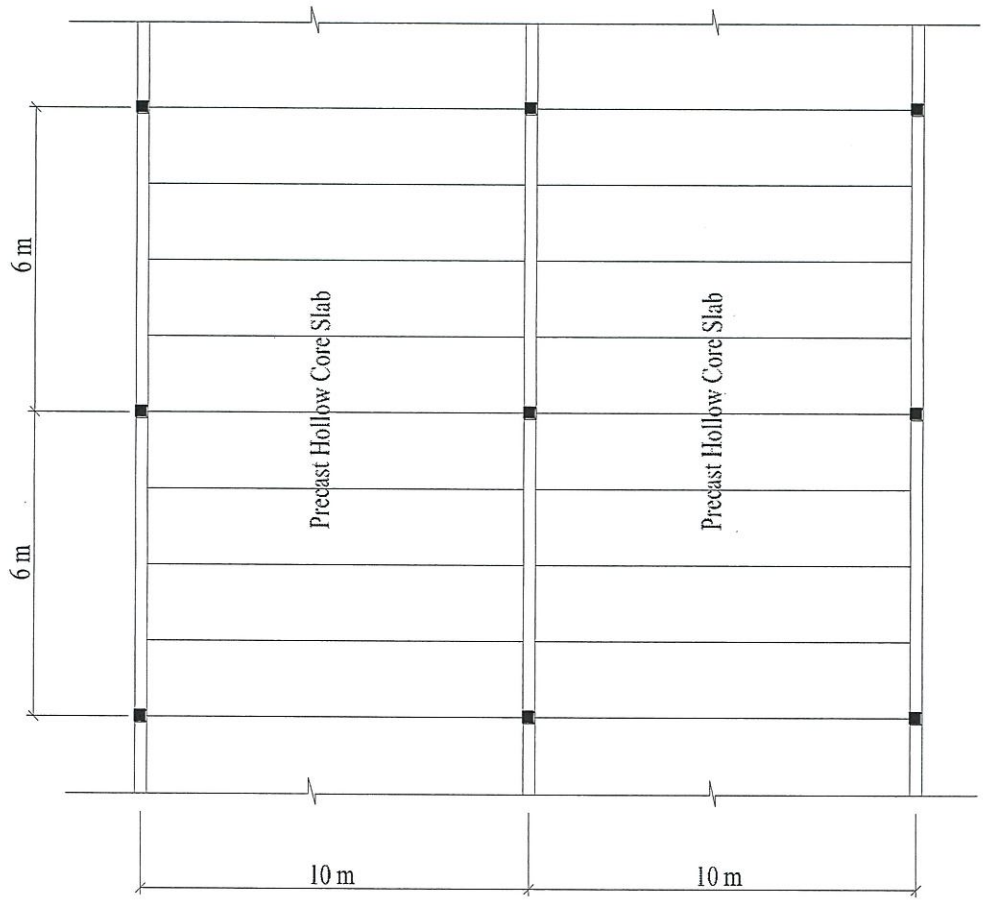

Figure Q1(a): First floor plan of a double storey building

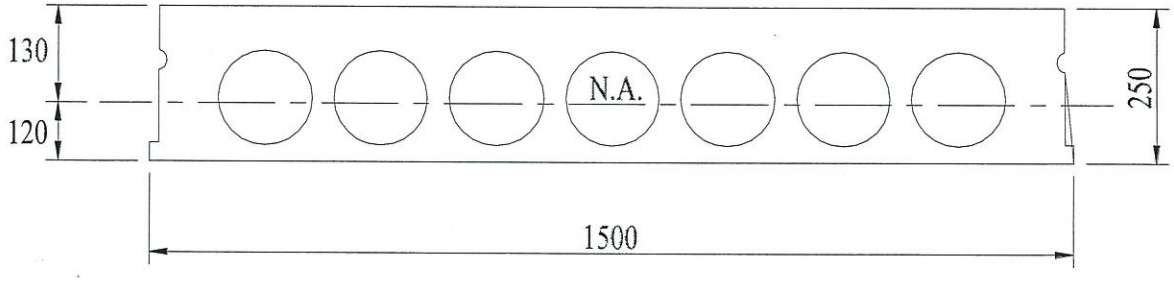

Figure Q1(b): Cross section of the hollow core slab

FINAL EXAMINATION

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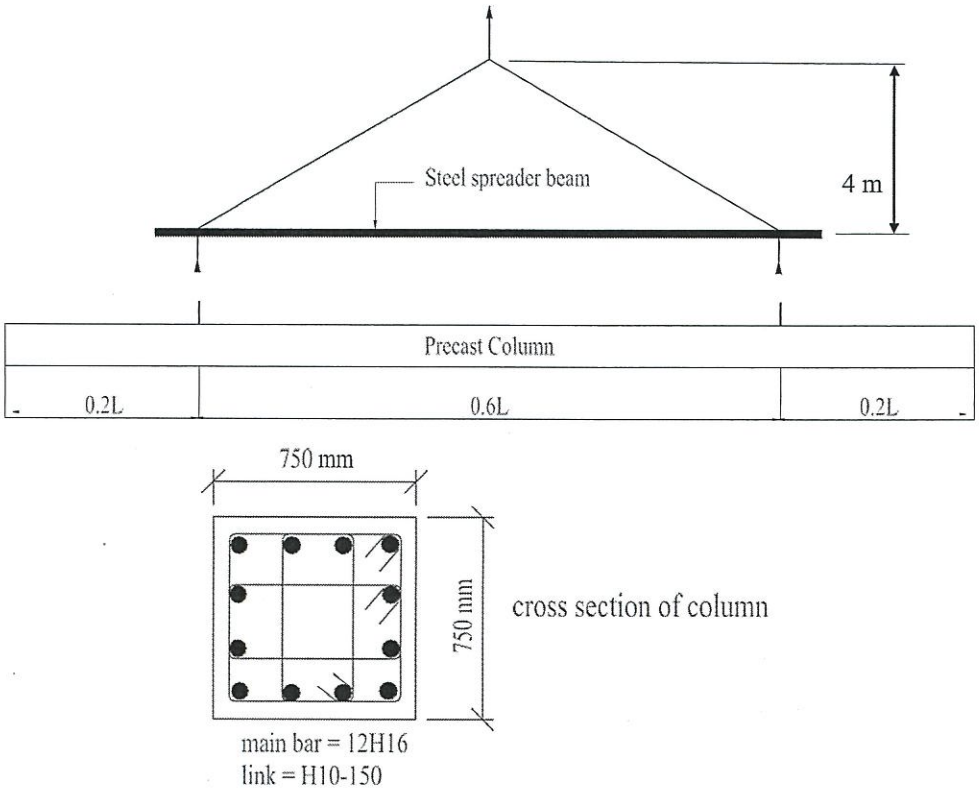

Figure Q2(a): Precast column lifting from the casting yard

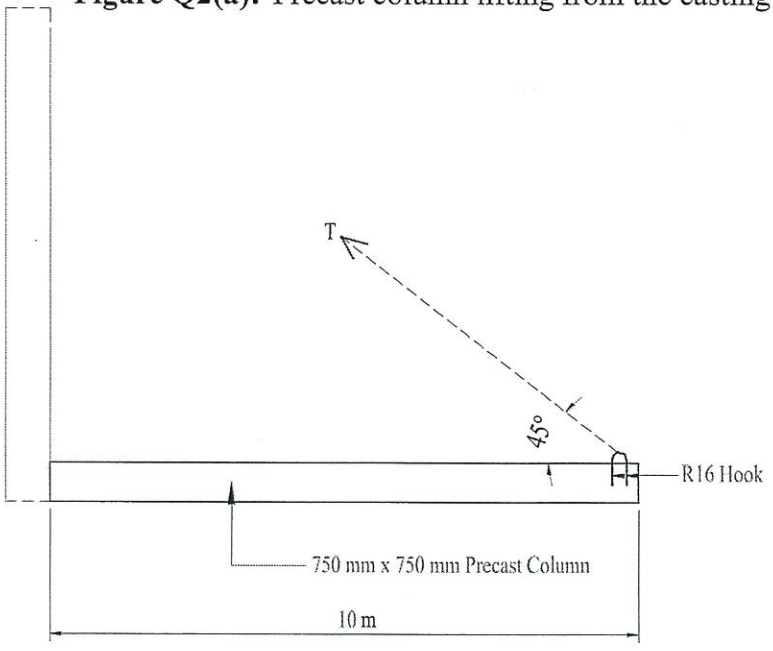

Figure Q2(b): Precast column condition

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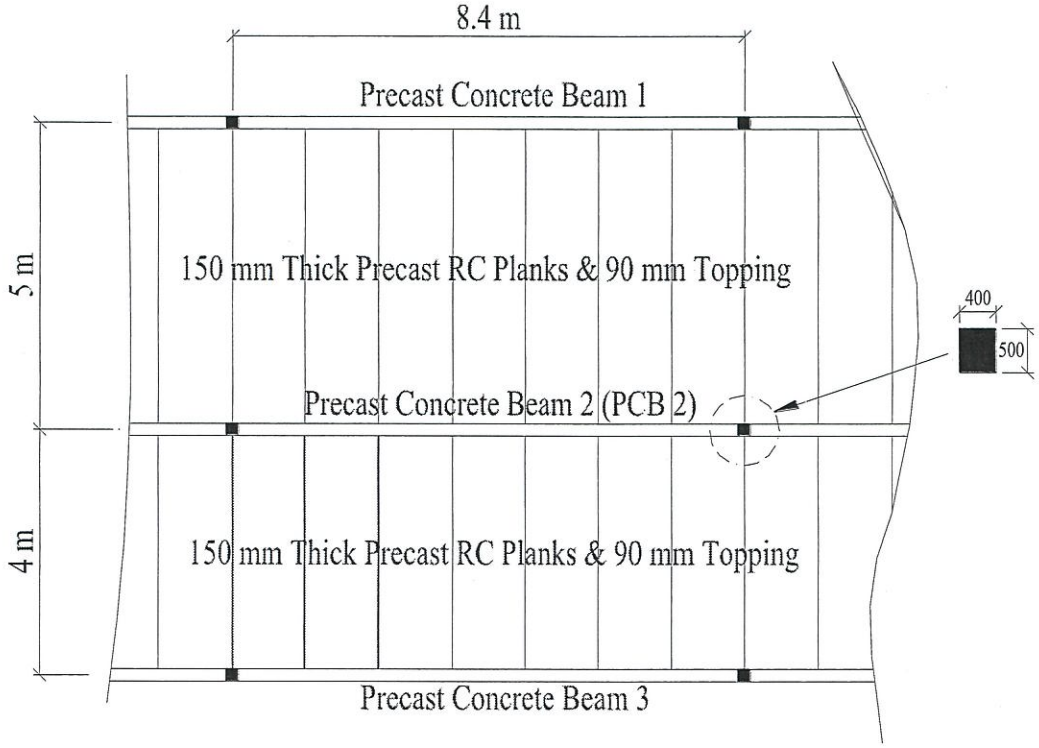

Upper Floor Plan

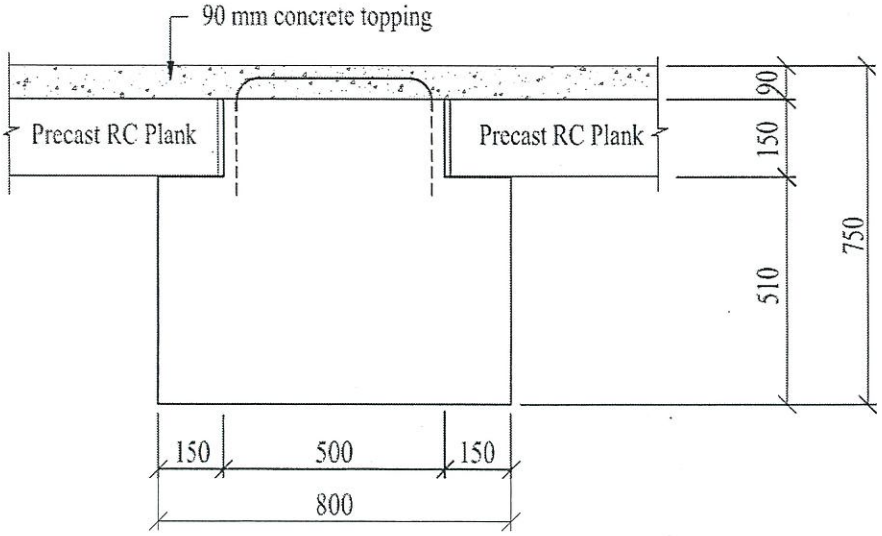

Figure Q3: Upper floor plan of the commercial building