

UNIVERSITY OF RUHUNA

Faculty of Engineering

Semester 5 Examination in Engineering: July 2017

Module Number: CE5251

Module Name: Design of Timber and Masonry Structures

[Three Hours]

[Answer all questions. Each question carries EQUAL marks]

Code of Practice BS 5268 Part 2:2002 and BS 5628 Part1: 2005 are provided

Q1. a) What is meant by "Seasoning" of timber? Briefly explain the two methods of seasoning with at least one advantage and a disadvantage for each method. [4.0 Marks]

b) A roof tie beam of 100mm x 44mm is connected to a rafter (100mm x 33mm) using 4 nos of M8 steel bolts as shown in the Figure Q1(a). The section is made of tropical hardwood teak and its average moisture content exceeds 20%. The bolt holes are 2mm larger than the bolt diameters. The tie beam is subjected to a bending moment of 0.68kNm in both long and medium terms.

i. Determine the maximum tensile force the above roof tie can withstand in both long and medium term conditions. [6.0 Marks]

ii. Ignoring the effect of bending moment on bolt connections, check whether the given number of steel bolts are adequate to bear the long term shear load acting on bolts as a result of the maximum long term tensile force. [5.0 Marks]

Q2. A suspended timber floor system in a domestic building in which the joists at 500mm centers are simply supported on timber beams rested on load-bearing brickwork as shown in Figure Q2(a). The support beams are notched at the location of the wall as given in Figure Q2 (b).

Design Data

Center spacing of timber joists	500mm
Distance between the center lines of the brickwork wall	4.5m
Center to center of bearing span of joists	3.6m
Timber Species	British Grown Pine SS Grade
Dead Load due to floor boarding	0.08 kN/m ²
Dead Load due to self-weight of joists	0.1kN/m
Permanent Imposed Load	3.0 kN/m ²
Exposure Condition	Service Class 3
Wanes are permitted	

- It is planned to use 75mm × 200mm sections for the joists. Check the adequacy of the above section.
- a)

[7.0 Marks]

- b) Check the adequacy of 100mm × 475mm section for the support beam.

$$\delta_{\text{maximum}} = \frac{0.104M_{\text{maximum}}L^2}{E_{\text{minimum}}I}$$

[8.0 Marks]

- Q3. a) Why the masonry is known as a non-homogenous non-isotropic composite material?

[3.0 Marks]

- b) Write two structural forms of masonry that are being used in the construction industry

[1.0 Marks]

- c) What is the advantage of using reinforced brick walls over standard brick walls?

[2.0 Marks]

- d) A masonry column, having an effective height of 2500mm in y-y axis and 5000mm in x-x axis is subjected to an eccentric load ($e_{xx} = 20\text{mm}$, $e_{yy} = 25\text{mm}$) of P as shown in the Figure Q3. The designation of mortar is type II and the characteristic strength of standard format brick is 35.0 N/mm². Assuming that the category of manufacturing control as "Special" and category of construction control as "Normal" determine the maximum value of the load P.

[9.0 Marks]

- Q4. a) Figure Q4 shows a load bearing internal wall of a building (wall AA). The vertical edges of wall AA are supported by two intersecting brick walls. The bottom of wall AA is partially fixed at ground level while the top is supported by a reinforced concrete slab. The characteristic loads which are acting on wall AA are:

- Characteristic vertical load on wall AA due to dead load of upper wall roof and ceiling = 89.43 kN/m
- Characteristic vertical load on wall AA due to imposed load of upper wall, roof and ceiling = 9.92 kN/m
- Characteristic vertical load on wall AA due to dead load of upper floor slab (loads are symmetrically acting on wall AA) = 62.92 kN/m
- Characteristic vertical load on wall AA due to imposed load of upper

floor slab (loads are symmetrically acting on wall AA) = 21.12 kN/m

The density of considered brick masonry (excluding plaster) is 23 kN/m³ and the plaster weight 0.28 kN/m². The thickness of the wall is 210mm and height is 2500mm. Standard format bricks of clay having more than 25% and less than 35% of voids and water absorption is between 7% - 12% are provided. The category of manufacturing control is to be category I and that for construction is normal. It is also proposed to use designation ii or iii mortar for the construction.

a) Determine the design vertical load on the wall AA and hence, design the wall.

[7.0 Marks]

b) Calculate the maximum possible characteristic wind load the wall AA can withstand.

[6.0 Marks]

c) Check weather concrete blocks with 0.8 aspect ratio and unit compressive strength of 5.2 N/mm² can be used instead of clay bricks for the wall AA.

[3.0 Marks]

----- End of Question Paper-----

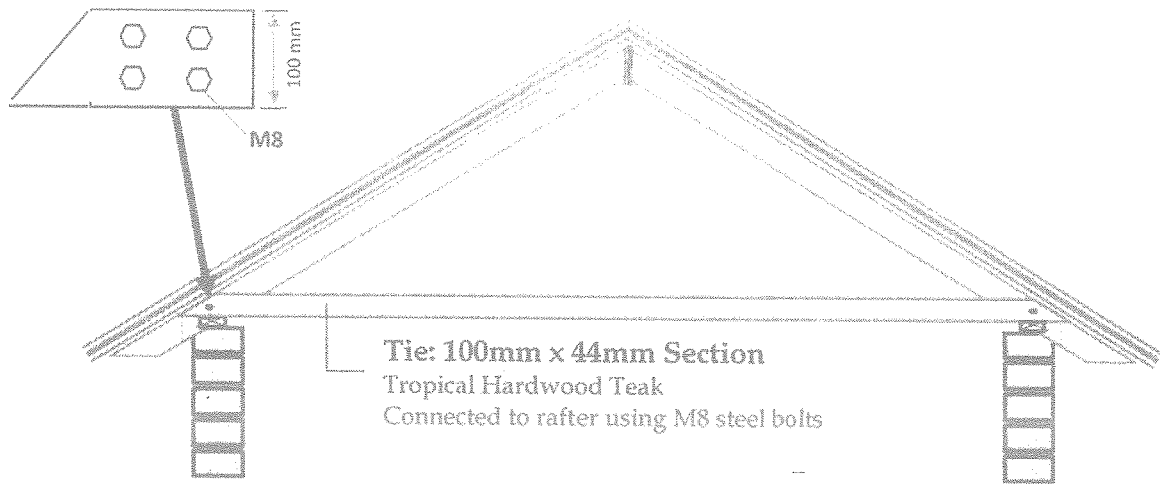


Figure Q1(a) - i :Roof Tie Beam

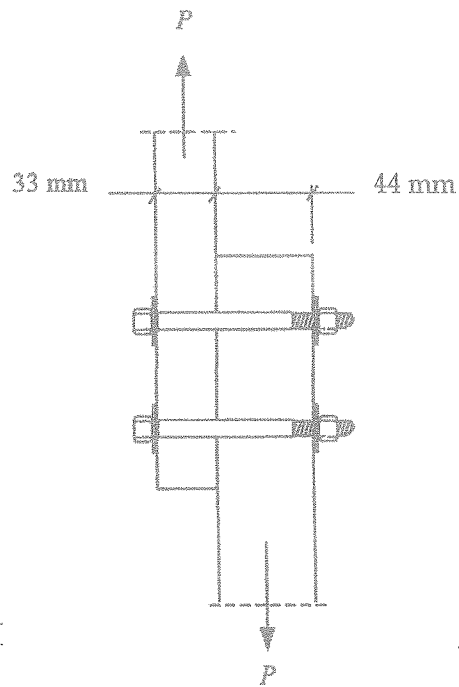


Figure Q1(b) - ii :Bolted Joint between Tie Beam and Rafter

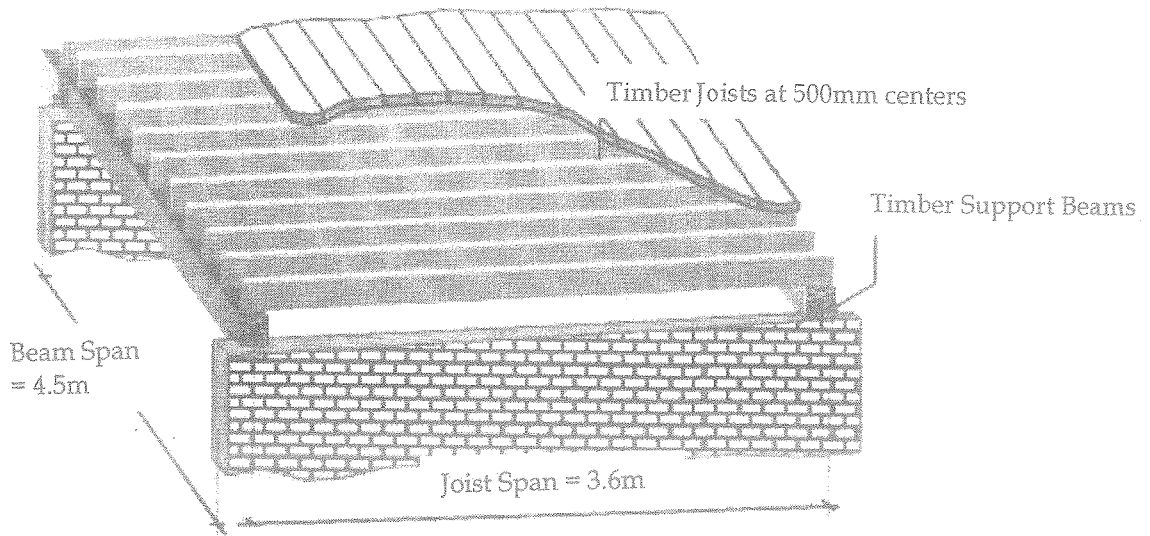


Figure Q2(a): Timber Flooring System

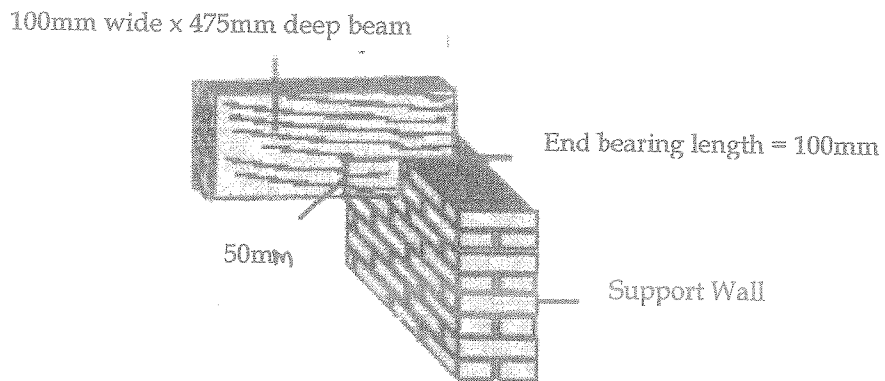


Figure Q2(b): Notched Supporting Beam

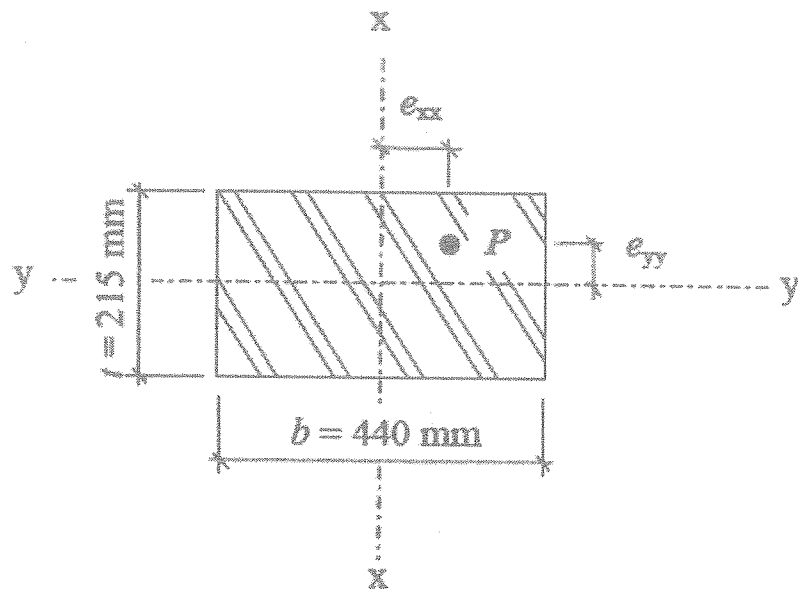


Figure Q3: Cross Section of the Masonry Column

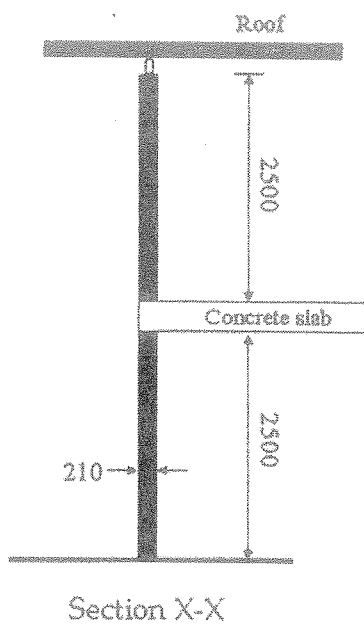
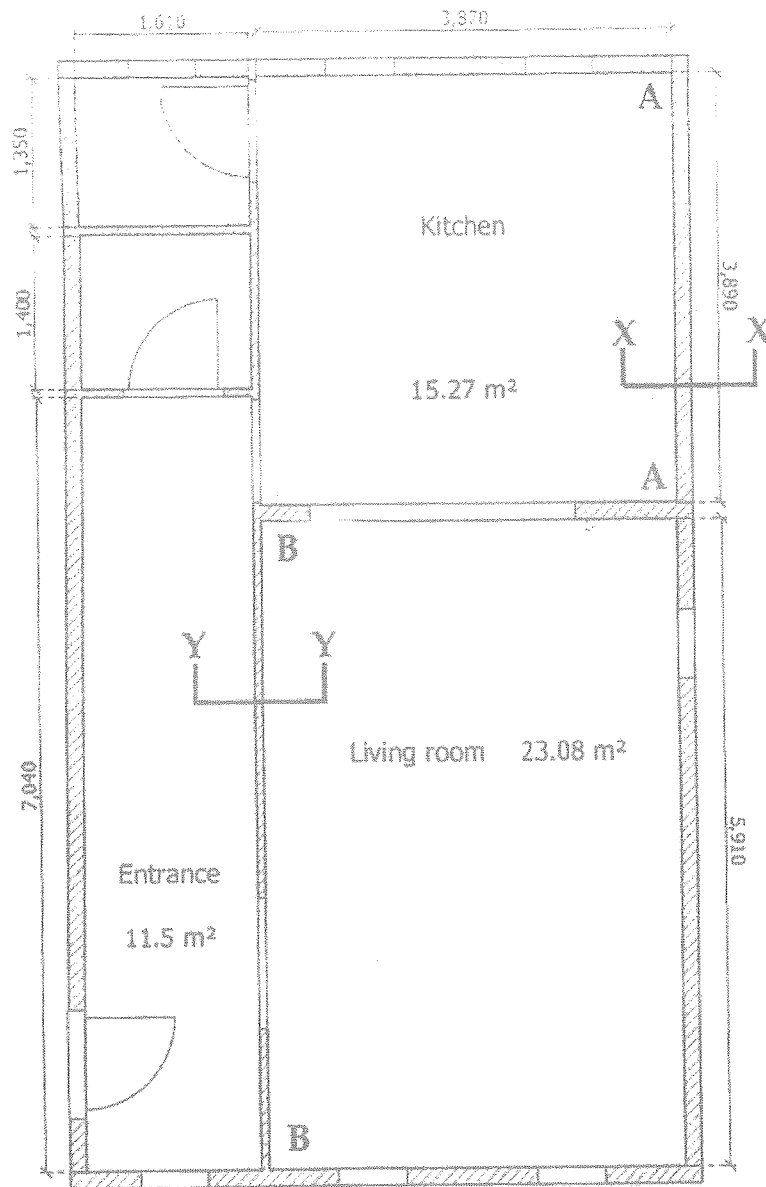


Figure Q4: Floor Plan and Vertical Section of the Wall