



UNIVERSITY OF RUHUNA

Faculty of Engineering

Semester 5 Examination in Engineering: August 2018

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 "Fibre Saturation Point" of timber? Briefly describe the variation of the percentage of strength and stiffness of timber with the variation of moisture content. [4.0 Marks]

Figure

- b) The nailed joint shown in Q1(b) is subjected to long-term tensile loading under service class 3 condition. The joint comprises six 3.8mm diameter and 100 mm long helical-threaded shank nails acting in double shear in a member of Imported Southern Pine (USA) timber.

- i. Determine the maximum load carrying capacity and joint slip of this timber connection. [8.0 Marks]

- ii. Determine the minimum nail spacings for this timber connection. [3.0 Marks]

- Q2. The cross-section of a suspended timber flooring system is shown in Figure Q2(a) & Q2(b). It consists of tongued and grooved (t & g) boarding with a self-weight of 0.15 kN/m<sup>2</sup> and carries a plasterboard ceiling of 0.2 kN/m<sup>2</sup>. The floor has an effective span of 4.0 m and is subjected to a domestic permanent imposed load of 1.5 kN/m<sup>2</sup>. It is proposed to use British grown larch SS grade timber in this flooring system. (assume dead load of a joist = 0.1 kN/m<sup>2</sup>).

- a) Design the timber floor joists under service class 3. [12.0 Marks]

Figure

- b) If the joists are to be notched at bearings with a 77mm deep notch as given in Q2(b), check whether the notched section is adequate to withstand under same loading conditions. [3.0 Marks]

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

[3.0 Marks]

b) State the purpose of a Damp Proof Course in structural masonry.

[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 ( $e_{xx} = 25\text{mm}$ ,  $e_{yy} = 25\text{mm}$ ) of P as shown in the Figure Q3. The designation of mortar is type II and the characteristic compression strength of standard format brick is 35.0 N/mm<sup>2</sup>. Assuming that the category of manufacturing control as "Special" and category of construction control as "Normal". Determine the maximum value of the load P.

category I

[9.0 Marks]

Q4. a) Figure Q4(a) 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 fixed at ground level while the top is supported by a reinforced concrete slab (Fig. Q4(b)). The characteristic loads which are acting on wall AA are:

- Ultimate vertical load from a column = 120 kN/m (kN)
- Characteristic vertical load on wall AA due to dead load of upper floor slab = 15 kN/m
- Characteristic vertical load on wall AA due to the dead load from upper floor walls = 5 kN/m
- Characteristic vertical load on wall AA due to imposed load on upper floor = 3 kN/m

The characteristic unit weight of the brick masonry is assumed to be 24.0 kN/mm<sup>3</sup>. The thickness of the wall is 210mm and height is 2800mm. 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 and hence, propose a suitable type of masonry (mortar designation and compressive strength of structural unit) for wall A-A.

[7.0 Marks]

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

[6.0 Marks]

- c) Check weather autoclaved aerated concrete blocks with 0.8 aspect ratio & unit compressive strength of  $3.6 \text{ N/mm}^2$  can be used with designation (ii) mortar instead of clay bricks for the wall.

[2.0 Marks]

**End of Question Paper**

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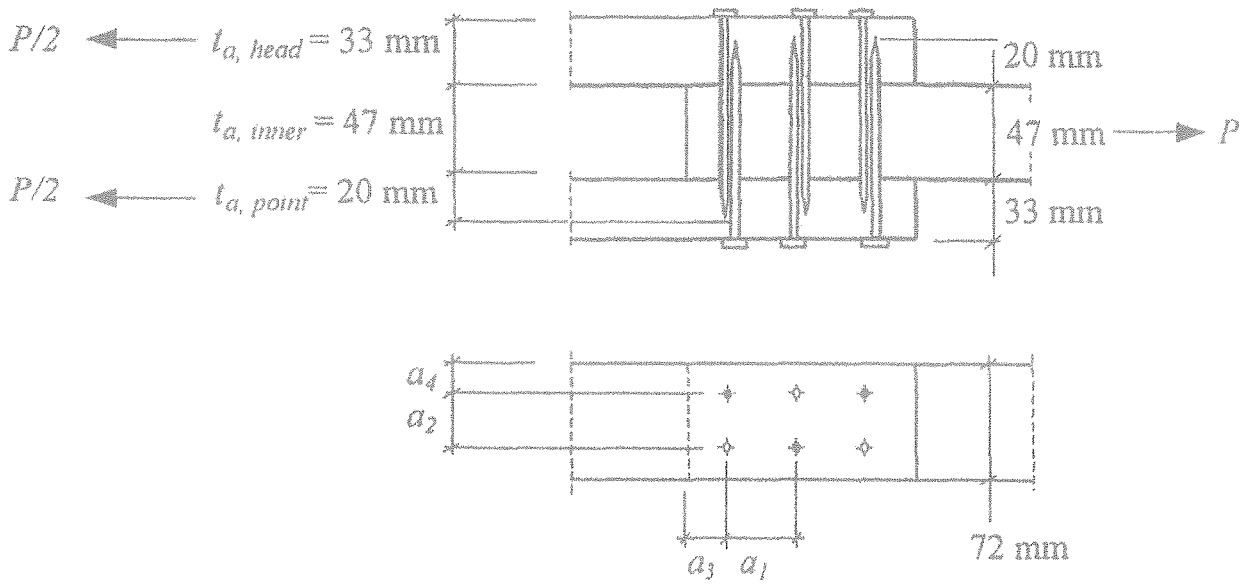


Figure Q1(b): Nailed Connection

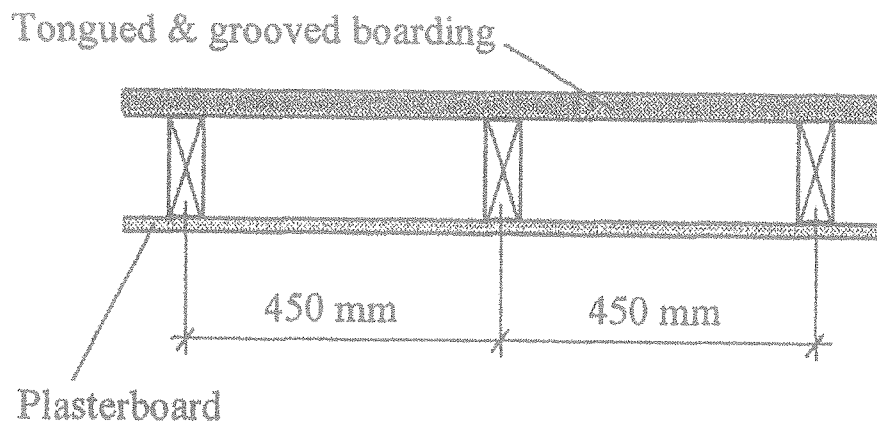


Figure Q2(a): Timber Flooring System

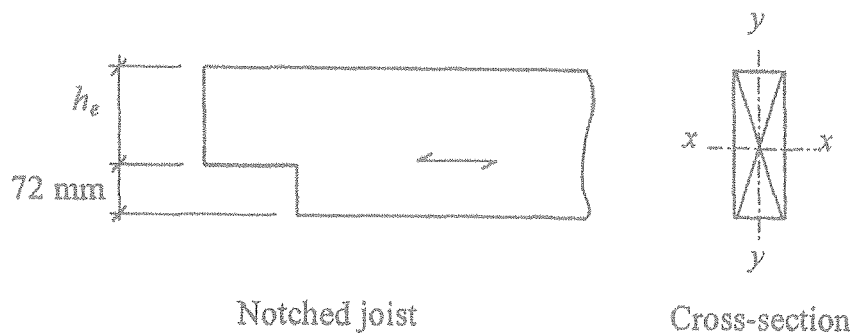


Figure Q2(b): Notched Supporting Beam

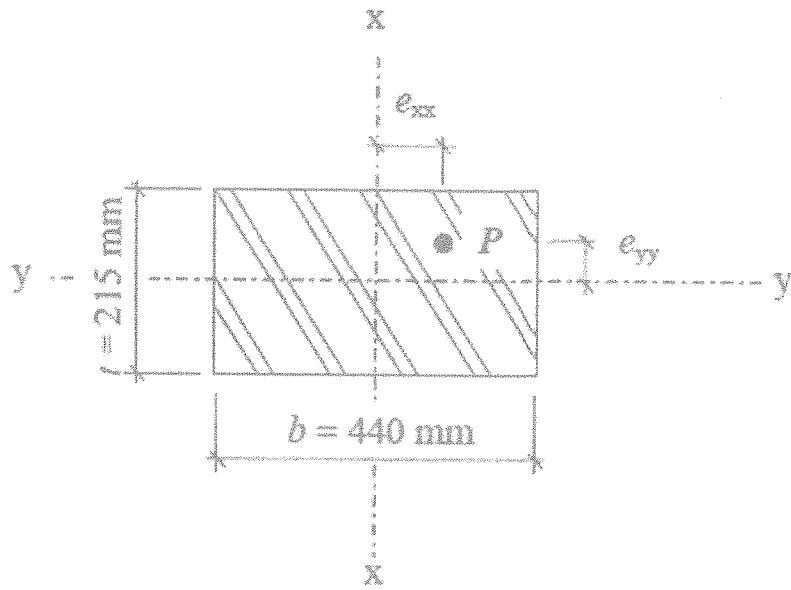


Figure Q3(d): Cross Section of the Masonry Column

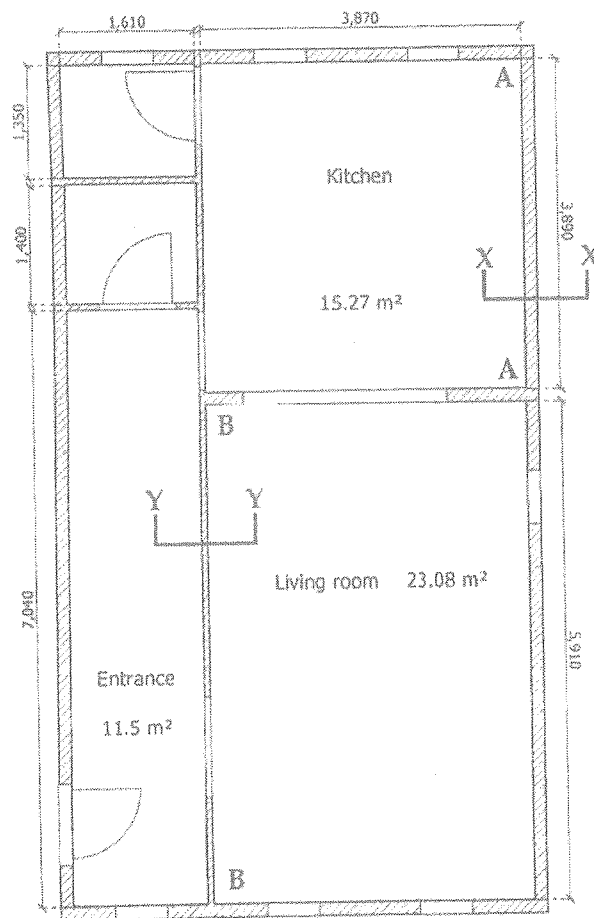


Figure Q4(a): Plan view of the building with wall A-A

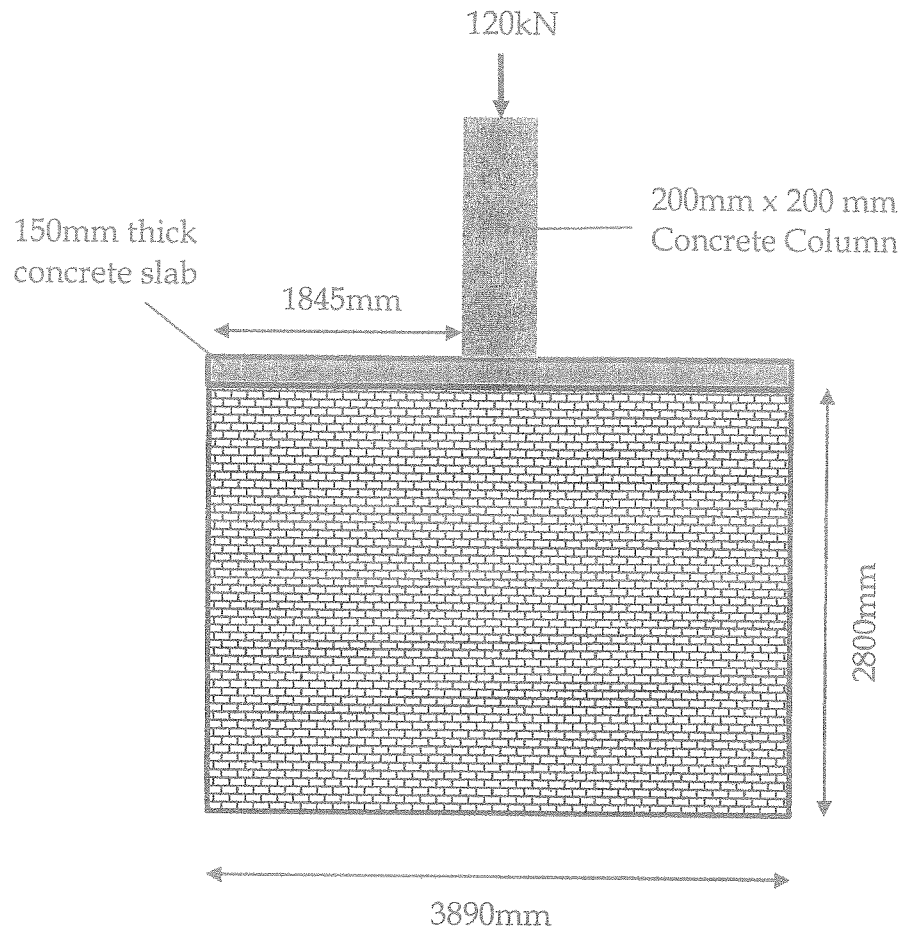


Figure Q4(b): Side View of Wall A-A