

FACULTY OF THE BUILT ENVIRONMENT – YEAR 3
ENDS 3245: DESIGN AND CONSTRUCTION TECHNOLOGIES
(part: DESIGN OF STRUCTURES 2)
SPECIAL EXAM 2013.12.13 (open book – 4h00)

Q1. (marks: 40)

Consider a reinforced concrete slab consisting of 12 panels (x-direction: 3 spans of 4.5m; y-direction: 4 spans of 5.4m), supported by a beam grid. The supporting beams have following size:

in the x-direction: $b_w = 200 \text{ mm}$ $h_w = 250 \text{ mm}$
in the y-direction: $b_w = 250 \text{ mm}$ $h_w = 400 \text{ mm}$

Materials:

C25/30 & S400 (ribbed bars)

Concrete cover: 20 mm

Loads:

- self-weight (to be calculated)
- finishing: 0.5 kN/m^2
- live load $q = 5 \text{ kN/m}^2$

Determine :

- the slab thickness h (multiple of 10 mm) [.../2]
- the sizing moments in the edge panels along the x-axis, taking into account the influence of the adjacent panels and of the supporting beams [.../24]
- the practical value of the reaction along the first interior beams parallel to the y-axis [.../14]

Calculation: single panel method

Q2. (marks: 25)

Consider the stairs + adjacent landing for a small office building (public access) (fig. 1):
(in the section only the lower flight is represented)

- width: 1,30m
- run: 300mm
- rise: 175mm
- waist: 200mm
- height landing: 200mm
- beam width: 300mm

NOTE: the 3 sides of the landing (not adjacent to the flights), as well as the start (first) and end (second) of the flights are considered as simply supported

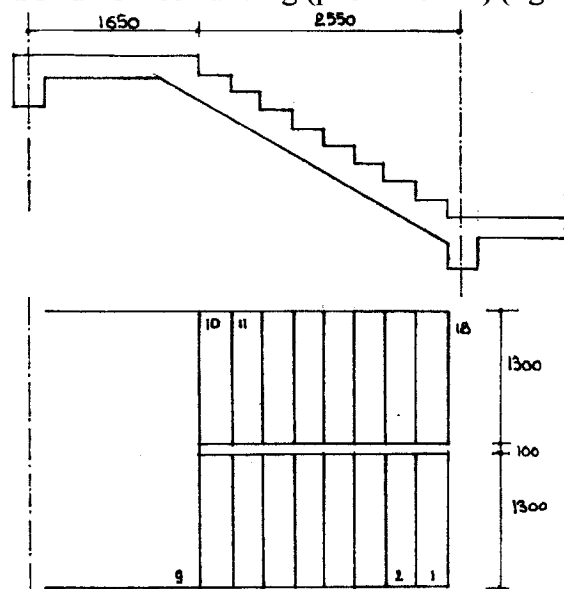


Figure 1

- 1° is the geometry of the stairs acceptable for this type of building? [.../3]
 2° calculate (for the first flight + landing) M_{\max} (approximate and exact value) [.../12]
 considering, in addition to the self-weight, the following loads:
 finishing: $0,5 \text{ kN/m}^2$ (horizontal area)
 live load: 5 kN/m^2 (horizontal area)
 3° check the size of the waist and determine the main reinforcement [.../8]
 4° make a sketch of the bottom reinforcement for the connection between the first flight
 and the landing [.../2]
 Materials: C25/30 & S400
 Concrete cover: 20mm

Q3. (marks: 35)

Determine the wall strip footing for a wall (thickness: 200mm; wall load at ground floor level: 90 kN/m) in 2 different conditions (fig. 2):

- (a) plain concrete footing (C16/20) with back-fill (18 kN/m^3) and a ground-slab
- (b) reinforced concrete footing (C20/25; S400 ribbed bars) with ventilated space

The self-supporting ground-floor slab (b) has – on either side – a span of 4.5m
 Both slabs have an industrial finish and the imposed load amounts to 3 kN/m^2

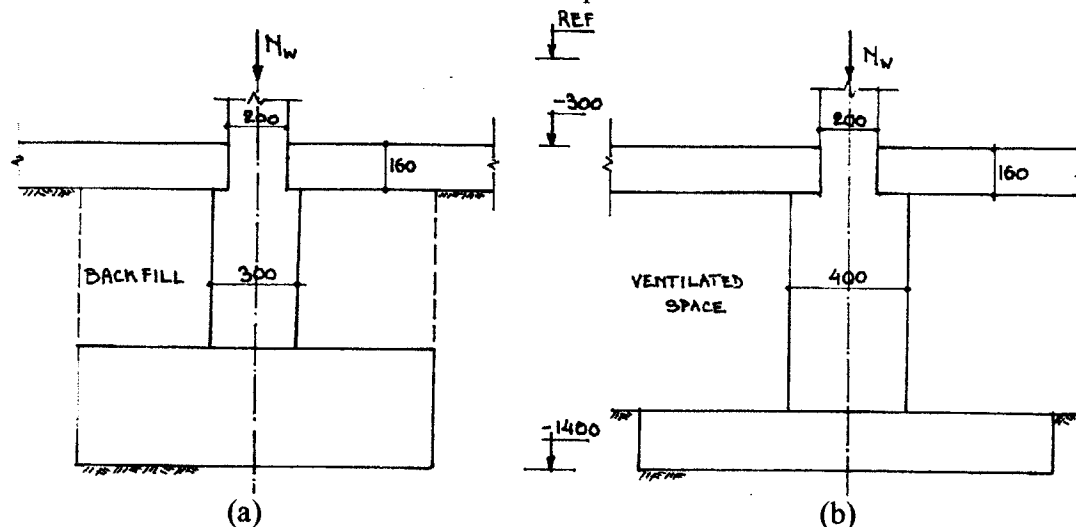


Figure 2

h_f : multiple of 50 mm

b_f : multiple of 100 mm

concrete cover: $\geq 50 \text{ mm}$

The calculation includes:

- for the plain concrete, the “all inclusive” calculation (soil & strength) [.../8]
- for the reinforced concrete footing:
 - the soil mechanics aspect: footing size and minimum height (stiffness of footing) [.../8]
 - the strength aspect: shear [.../7] (avoiding shear reinforcement) and bending [.../12] (check of the section depth – avoiding compressive reinforcement – and calculation of the reinforcement + curtailment if justified)