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:	$b_w = 200$ mm	$h_w = 250$ mm
in the y-direction:	$b_w = 250$ mm	$h_w = 400$ 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 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*

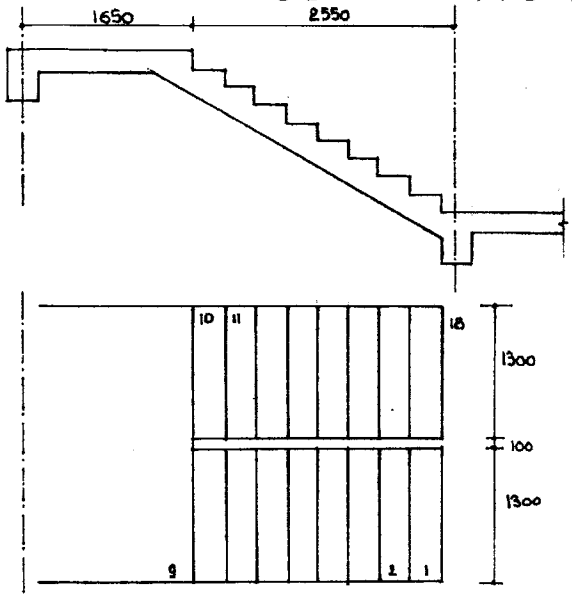

Figure 1

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 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: 90kN/m) in 2 different conditions (fig. 2):

(a) plain concrete footing (C16/20) with back-fill (18kN/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 3kN/m^2

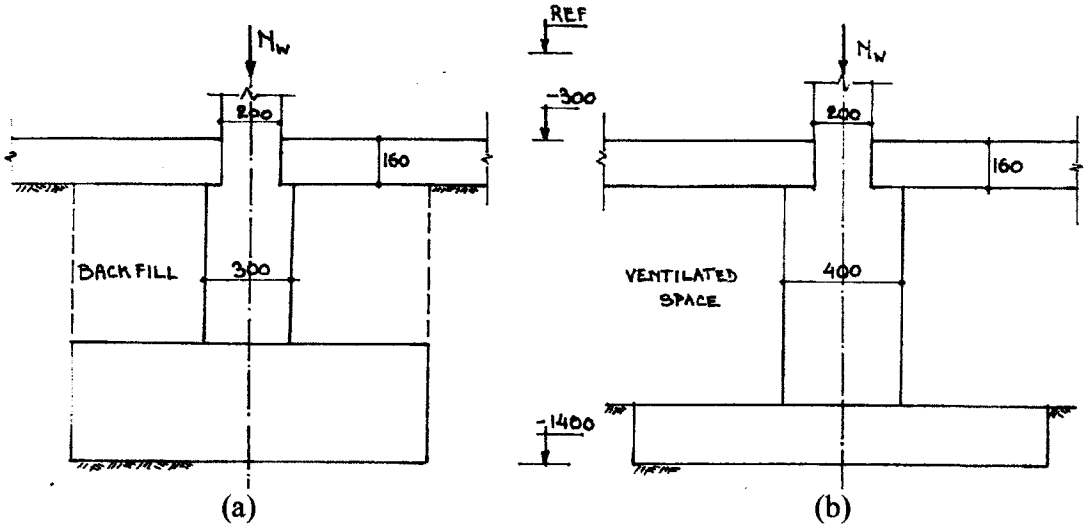

Figure 2

h_f: multiple of 50 mm b_f: multiple of 100 mm concrete cover: ≥ 50 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)