The Institution of Structural Engineers

Membership Examination Part 3

5 APRIL 1991

Structural Engineering Design and Practice

9.30 a.m. – 1 p.m. and 1.30 – 5 p.m. (Discussion between individuals is not permitted during the luncheon period).

A period of fifteen minutes is provided for reading the question paper, immediately before the commencement of the examination. Candidates are not permitted to write in answer books, or on drawing paper or to use a calculator during this time.

Candidates must satisfy the Examiners in ONE question.

Important

The written answer to the question selected and any drawings must bear the candidate's index number and the question number in the bottom right-hand corner. Only the answer book(s) supplied by the Institution may be used. The candidate's name should not appear anywhere in the script.

Notes to Candidates

1. TO PASS THE EXAMINATION, CANDIDATES MUST SATISFY THE EXAMINERS IN BOTH PARTS OF THE QUESTION ATTEMPTED.
2. A fair proportion of marks will be awarded for the demonstration of an understanding of fundamental engineering concepts, as distinct from calculation of member forces and sizes.
   NOTE: In the calculation part of all questions, establishing "form and size" is taken to mean compliance with all relevant design criteria, ie bending, shear, deflection, etc.
3. In all questions 40 marks are allocated to Part 1 and 60 marks to Part 2.
4. The Examiners are looking for sound structural designs.
   It should also be remembered that aesthetics, economy and function are important in any competent engineering scheme.
   Candidates should read carefully the examiners' reminder on Page 3.
5. Any assumptions made and the design data and criteria adopted must be stated.
6. Portable battery calculators may be used but sufficient calculations must be submitted to substantiate the design, and these should be set out as in practice.
7. Good clear drawings and sketches are required; they should show all salient and structural features to suitable scales and should incorporate adequate details.
8. This paper is set in SI Units, together with an alternative set of numerical data in British Imperial Units in parentheses. Candidates may use either set of data and may work in either system of units but should note that the two sets of data do not necessarily correspond. This is in order to avoid complicated arithmetic in one set of units.

Now read 'Reminder' on Page 3 ☞

A Reminder from your Examiners

The work you are about to start has many features in common with other examinations which you have tackled successfully but it also has some which are unusual.

As in every examination you must follow carefully the NOTES FOR CANDIDATES set out for your guidance on the front cover of this paper; allocate the available time sensibly and set out your work in a clear and logical way.

The unusual requirement of the examination is that you must demonstrate the validity of the training and experience that you have acquired in recent years. The Institution must be satisfied that you are able to bring all the various skills you are expected to possess to the effective solution of a structural design problem – whether or not the problem is presented in terms that are within your actual experience.

A Chartered Structural Engineer must have an ability to design and a facility to communicate his design intentions. Where you are required to list and discuss possible structural solutions you must show by brief, clear, logical and systematic presentation that you understand the general structural engineering design principles involved.

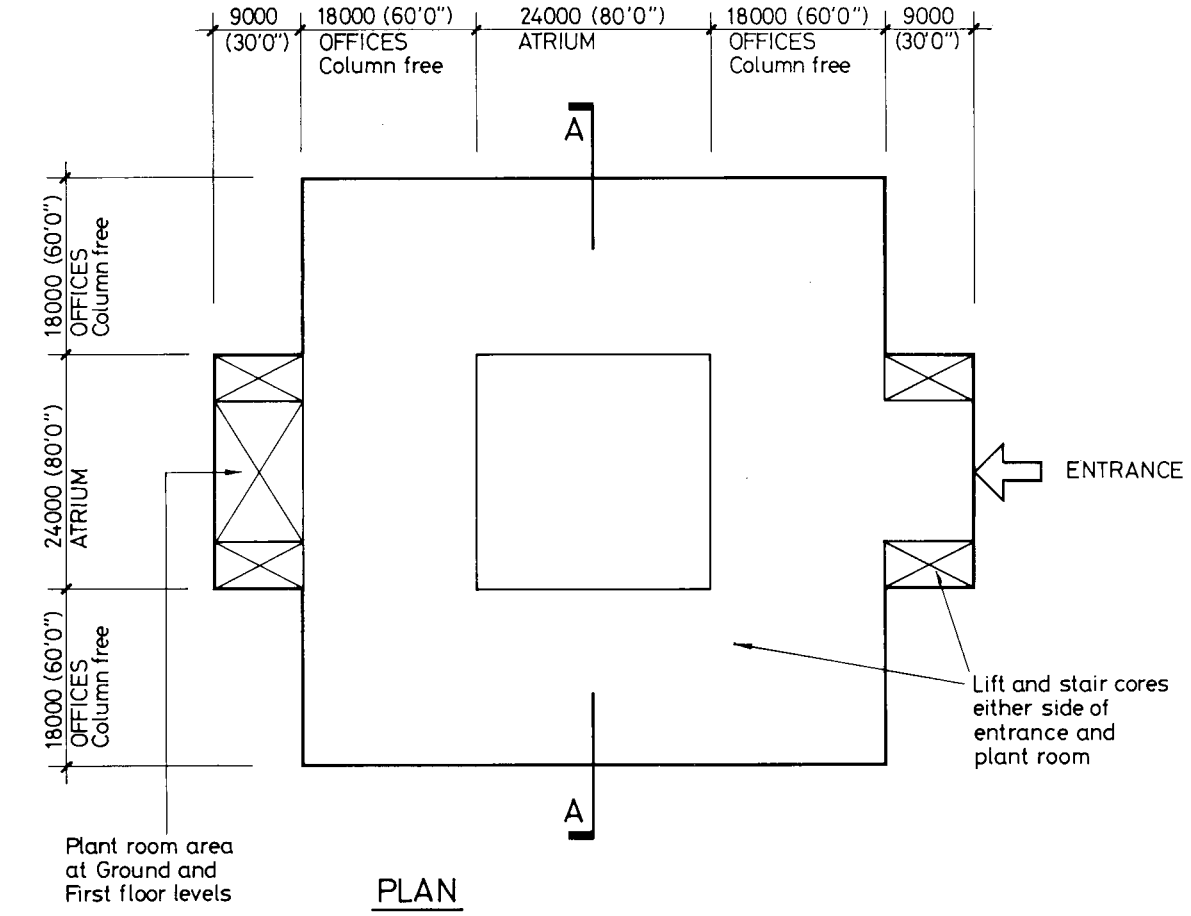
In selecting and developing your design you should also remember the guidance given in the Institution's report, 'Aims of Structural Design', and in particular:

(1) 'the structure must be safe',

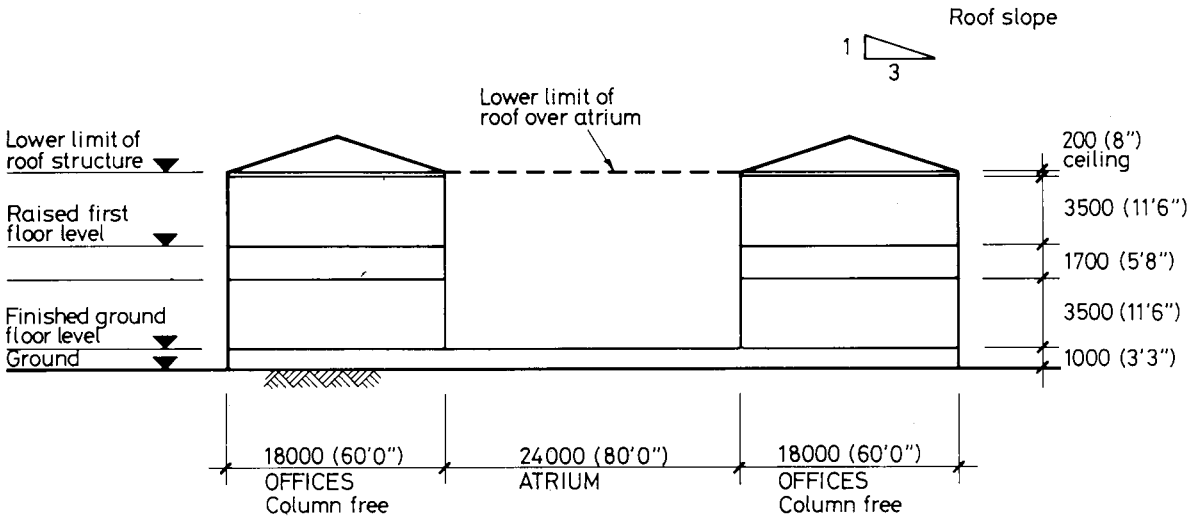
(2) 'a good design has certain typical features – simplicity, unity and necessity',

(3) 'the structure must fulfil its intended function'.

If you have difficulty in deciding the correct interpretation of a question, pay particular attention to point 5, Notes to Candidates, (overleaf). The examiners will take into account your interpretation – and the design you base on this – if this is clearly stated at the beginning of your answer.



PLAN



SECTION A-A (TYPICAL)

Note. Not to scale.
All dimensions are in millimetres (feet and inches).

FIGURE Q1

Question 1

Two storey offices/production building

Client's requirements

1. A two storey building suitable for use as offices or for light production set around a covered atrium. See Figure Q1
2. Ground floor to be screeded, with carpeting in office areas and wood block flooring in atrium.
3. The first floor construction depth of 1.7m (5′-8″) is to incorporate a 200mm (8″) deep raised floor and a 75mm (3″) deep false ceiling. The largest items of building services to be accommodated within the construction depth are circular ducts of 400mm (16″) diameter.
4. Roof over office areas to be clad in insulated decking suitable for a pitched roof. The roof over the atrium is to be 50% glazed and an aesthetically pleasing structure is required.
5. External walls to be concrete blockwork for 1.0m (3′-3″) up to ground floor level, with aluminium/glass curtain walling above.

Imposed loadings

6.

All roofs	0.75kN/m^2	(15lbf/ft^2)
offices/light production area floors (including partitions)	5.00kN/m^2	(100lbf/ft^2)
ceiling and services above office/light production areas	1.00kN/m^2	(20lbf/ft^2)
plant room floor	7.50kN/m^2	(150lbf/ft^2)
atrium floor	3.00kN/m^2	(60lbf/ft^2)

Site conditions

7. The building is situated on the outskirts of a large city. Basic wind speed is 46m/s (102 mile/h).
8. The ground comprises 1.0m (3′-3″) of loose fill over a thick layer of dense gravel with an allowable bearing pressure of 200kN/m^2 (2 tonf/ft^2). No ground water is present in the gravel.

Omit from consideration

9. Detailed design of lift and stair cores, although their contribution (if any) to overall stability and load transfer must be included in Part 1(a).
10. Roof construction over entrance and plant room areas.

Part 1 (40 marks)

a. Prepare an illustrated design appraisal indicating two distinct and viable structural solutions for the building. Identify clearly the functional framing, load transfer and stability aspects of each scheme. Identify the solution you recommend giving reasons for your choice.

b. After the design and details have been completed, the client proposes to add a first floor within the atrium for use as a staff restaurant with offices under at ground level. Prepare a letter to him explaining the structural implications of his proposal.

Part 2 (60 marks)

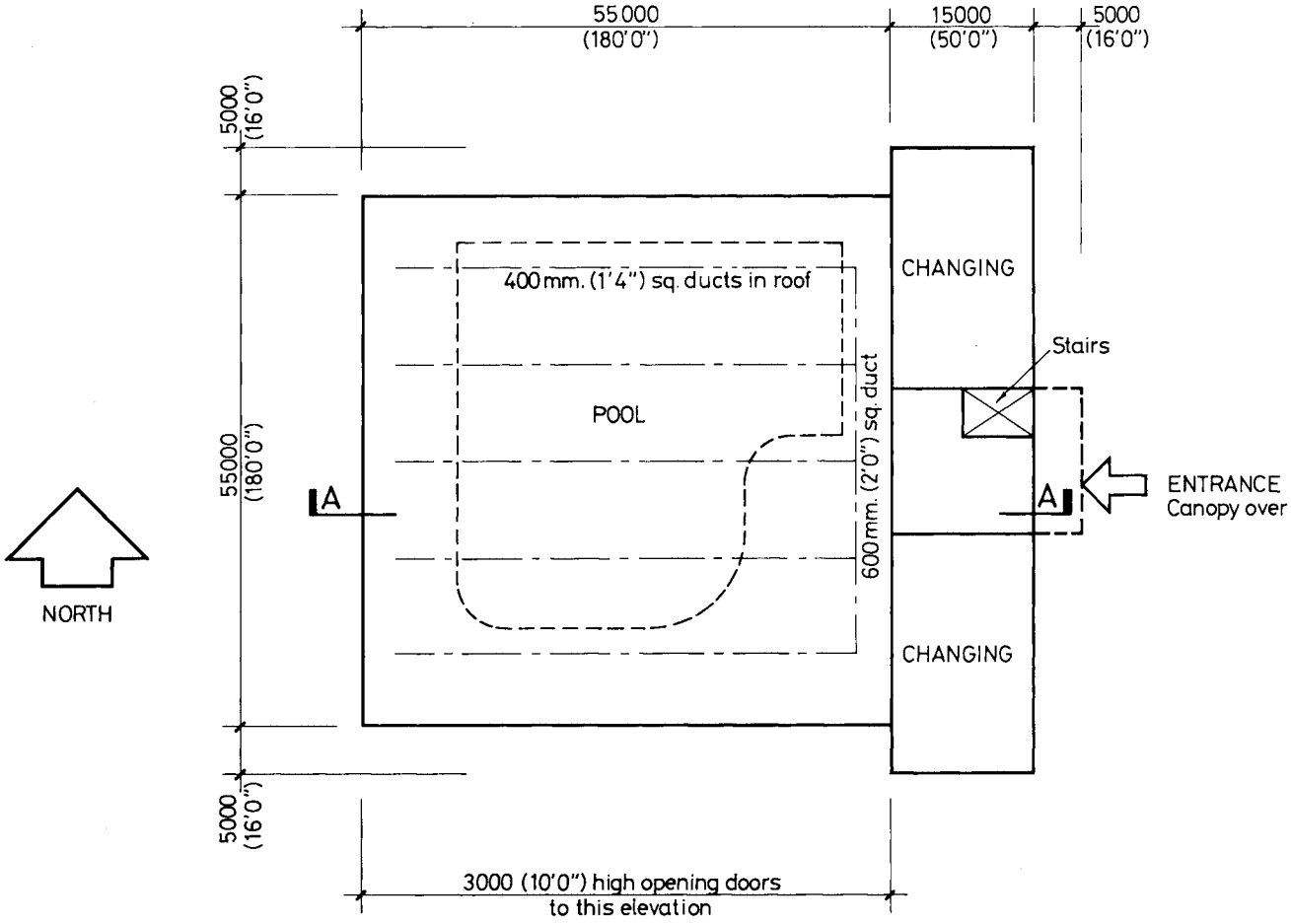
For the solution recommended in 1(a):

c. Prepare sufficient design calculations to establish the form and size of all principal structural elements including foundations and ground floor slabs.

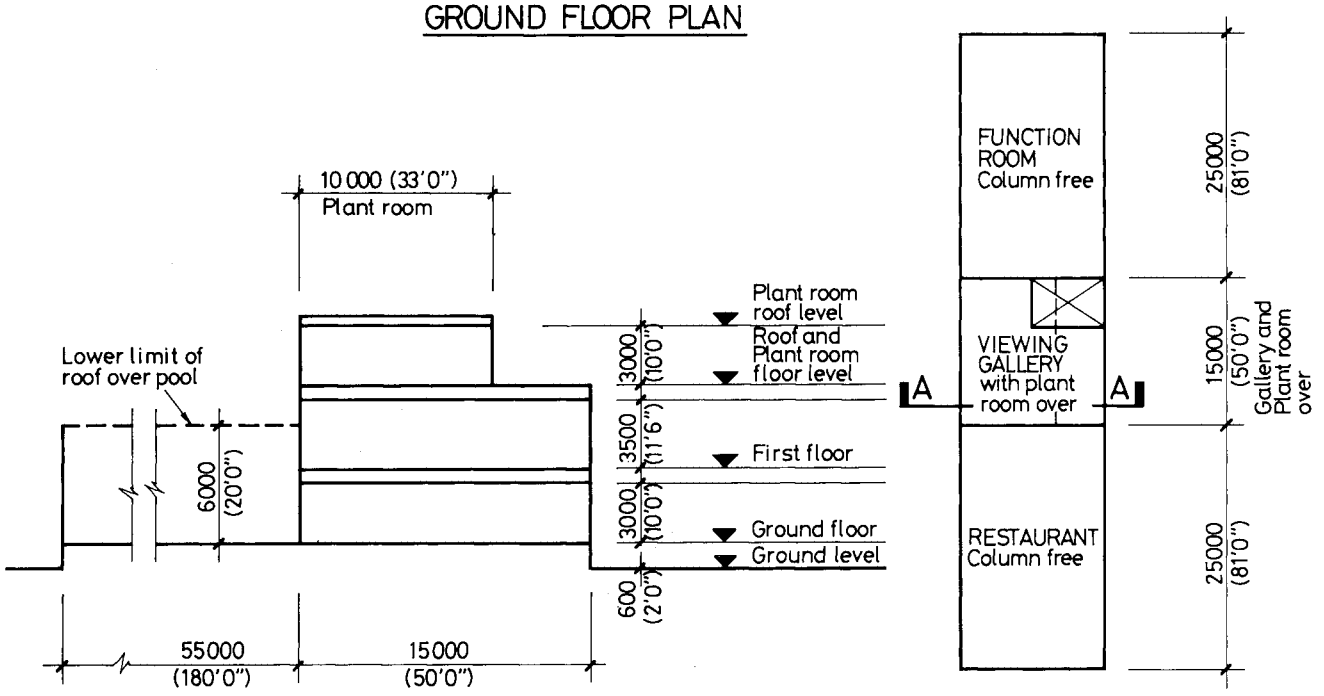
d. Prepare general arrangement plans, sections and elevations, giving the dimensions, layout, disposition and sizes of structural elements as required for estimating purposes.

e. Prepare clearly annotated sketches to illustrate details of:
   (i) Atrium roof/office junction.
   (ii) First floor construction.
   (iii) Column base/foundation connection.

f. Indicate methods of achieving adequate fire resistance for the various elements of the structure.



GROUND FLOOR PLAN



SECTION A-A

FIRST FLOOR PLAN

Note. All dimensions are in millimetres (feet and inches).

FIGURE Q2

Question 2

Building to house leisure pool and facilities

Client's requirements

1. A 55.0m (180′-0″) square clear span building to house a leisure pool adjacent to an ancillary building providing changing rooms and other facilities. (See Figure Q2).
2. The roof over the pool is to be suitably insulated with provision made for natural lighting over 30% of its area.
3. The roof structure is to be exposed and require minimum maintenance.
4. Service ducts are to be accommodated within the depth of the pool roof structure, with sizes and approximate positions as shown in Figure Q2. Precise positions of ducts may suit the structural layout.
5. Walls of the pool area to be predominantly glazed with continuous doors on one side to give access to a garden area. Columns are permitted on all four sides of the pool area.
6. The function room and restaurant located on the first floor of the ancillary building are to be free of internal columns.
7. The ancillary building to be clad in brick/blockwork cavity walls to incorporate traditional windows and parapets at roof levels.

Imposed loadings

8.

roofs	0.75kN/m^2 (15lbf/ft^2)
plant room floor	7.50kN/m^2 (150lbf/ft^2)
first floor (including partitions)	4.00kN/m^2 (80lbf/ft^2)
ground floor	3.00kN/m^2 (60lbf/ft^2)
ceiling and services within ancillary building	0.50kN/m^2 (10lbf/ft^2)
ducting and other services in pool roof	0.50kN/m^2 (10lbf/ft^2)

Site conditions

9. The building is in a city centre location in parkland. Basic wind speed is 44m/s (98 mile/h).
10. The ground comprises 1.0m (3′-3″) of loam over 2.0m (6′-6″) of soft clay over 2.0m (6′-6″) of peat over firm clay to a considerable depth. For soft clay average c = 25kN/m^2 (500lbf/ft^2) and for firm clay average c = 50kN/m^2 (1000lbf/ft^2).

Omit from consideration

11. Design of pool and surrounding floor.
12. Detailed design of stairs.

Part 1 (40 marks)

a. Prepare an illustrated design appraisal indicating two distinct and viable structural solutions for the building. Identify clearly the functional framing, load transfer and stability aspects of each scheme. Identify the solution you recommend giving reasons for your choice.

b. After work on foundations has started and fabrication of roof components is well advanced, the client requires the east-west dimension of the pool building to be increased to 70m (230′-0″) to accommodate a children's pool. Prepare a letter to him stating the effects that this change would have.

Part 2 (60 marks)

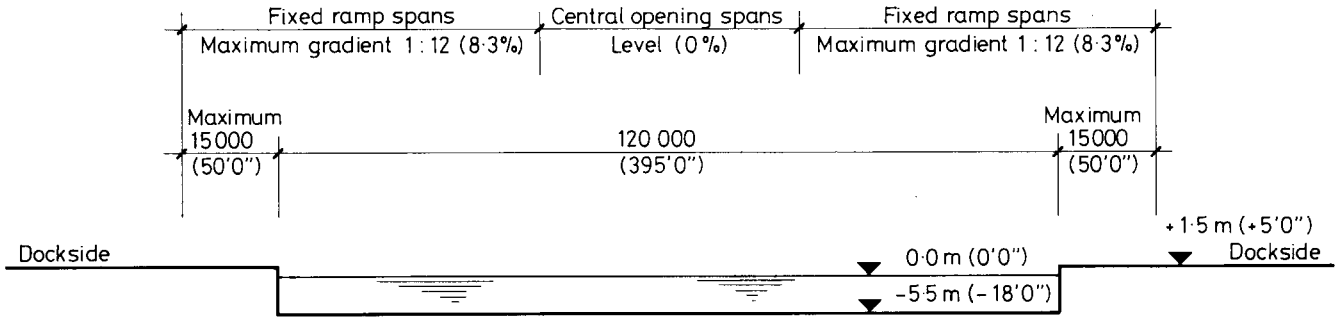
For the solution recommended in 1(a):

c. Prepare sufficient design calculations to establish the form and size of all principal structural elements including foundations.

d. Prepare general arrangement plans, sections and elevations, giving the dimensions, layout, disposition and sizes of structural elements as required for estimating purposes.

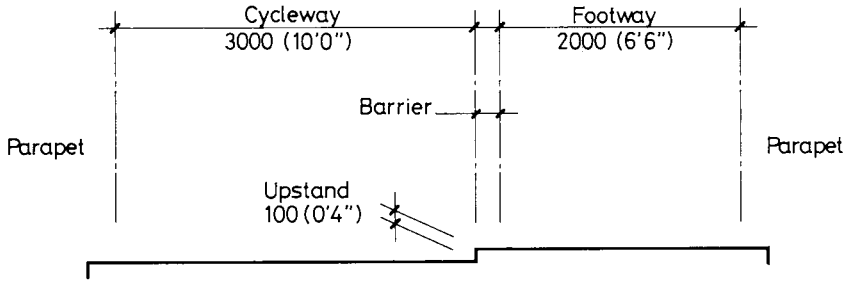
e. Prepare clearly annotated sketches to illustrate details of:
   (i) Typical joint in a main pool roof member.
   (ii) Junction between the pool roof and the ancillary building.
   (iii) Roof edge of ancillary building incorporating parapet and waterproofing.

f. Identify suitable protection systems to ensure a durable structure, making allowance for the various environments.

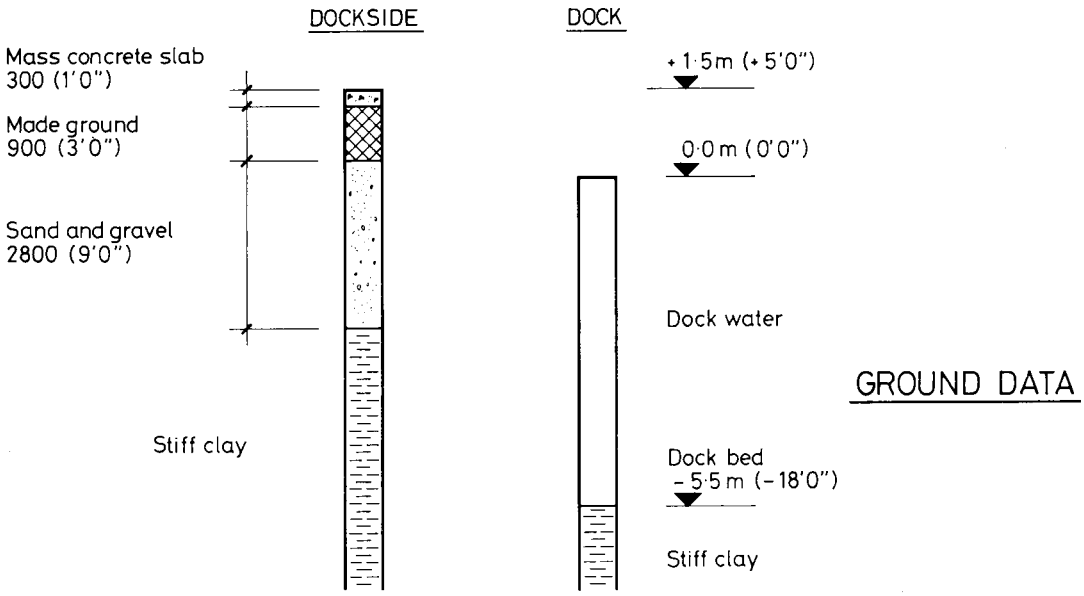


SECTION THROUGH DOCK

Note - Minimum clearance between water level and bridge soffit in Central opening spans to be 4500 (15'0")



TYPICAL CROSS SECTION



GROUND DATA

Note. All levels are in metres (feet and inches)
Other dimensions are in millimetres (feet and inches)

FIGURE Q3

Question 3
Opening footway/cycleway bridge

A new bridge, for pedestrians and cyclists only, is to be constructed over the still water of an existing dock and is to connect an existing highway with a new "High-tech" office complex on the other side of the dock. The Client is keen, therefore, to have an appropriate aesthetic form for the bridge, to conform with the image of the new office development.
The dock is used regularly by small privately owned craft and occasionally by larger vessels, which dictates that the bridge shall have an "opening" capability.

Client's requirements

1. Provision of an opening bridge across an existing dock as shown in Figure Q3. The footway shall be 2.0m (6′-6″) wide and the cycleway 3.0m (10′-0″) wide, with provision of a suitable barrier 1.0m (3′-3″) high between the footway and cycleway, and parapets of the same height at the edges of the deck.
2. The fixed ramp spans to have a maximum gradient of 1:12 (8.3%), and shall meet the existing dockside ground level within 15.0m (50′-0″) of the dock edge, due to external site constraints.
3. The central portion of the bridge shall be level (0% longitudinal gradient) and shall comprise two openings, each of which shall have a minimum clear width of 16.0m (50′-0″). The structures spanning these openings shall open and close simultaneously.
4. When the structures are open, passage of vessels with unrestricted mast height shall be accommodated. When closed a minimum clearance between water level and bridge soffit of 4.5m (15′-0″) shall be provided for the passage of small vessels.
5. During construction, the passage of small vessels shall be accommodated at all times. Provision for the passage of larger masted vessels should be made whenever possible during construction, but it is accepted that some periods of total closure to these vessels is inevitable.

Imposed loading

6. Cycleway and footway loading shall be 5kN/m^2 (100lbf/ft^2).

Site conditions

7. For ground data see Figure Q3.
   Sand and Gravel – N = 30.
   Stiff clay – undrained shear strength 75kN/m^2 (1500lbf/ft^2).
8. Design temperature range 50C°.
9. Wind loading 1.5kN/m^2 (30lbf/ft^2) on exposed area.

Omit from consideration

10. Accidental impact on bridge supports.
11. Detailed consideration of the mechanical/hydraulic means of opening/closing the bridge.

Part 1 (40 marks)

a. Prepare an illustrated design appraisal indicating two distinct and viable solutions for the bridge, to include the fixed approach ramps in addition to the central opening portion. Identify in each case the type and details of construction, the means of achieving overall stability and articulation, and the practical forms of the supporting structures and foundations.
   The means of satisfying the opening/closing requirements of the central portion should be highlighted in the appraisal.
   Identify the solution you recommend, giving reasons for your choice.

b. Before any design work is started, the Dock Authority asks the Client whether a single opening with a clear width of 25.0m (80′-0″) could be provided rather than the two smaller openings. Write a letter to the Client identifying the effects that this would have on your recommended solution.

Part 2 (60 marks)

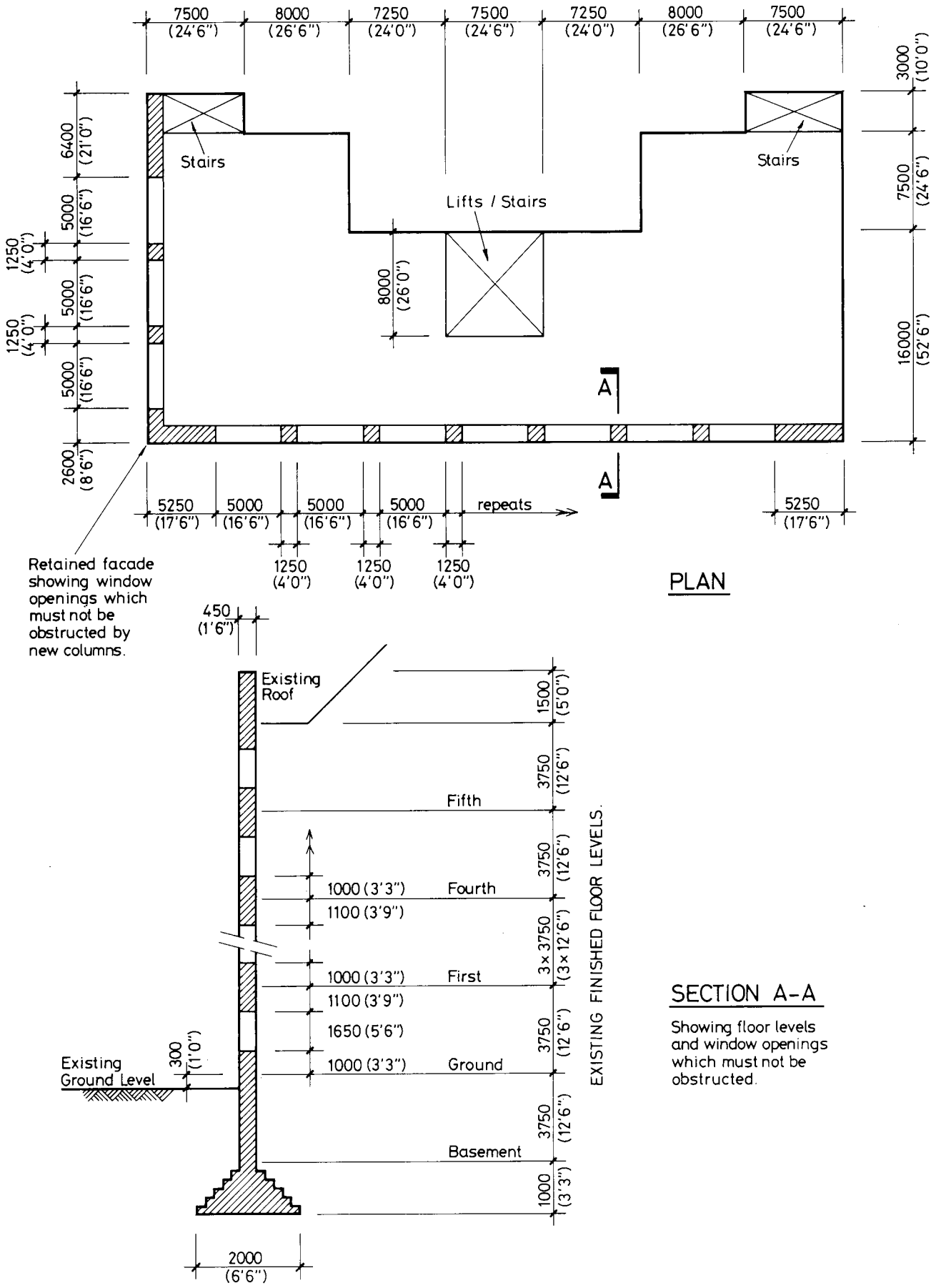
For the solution recommended in Part 1(a):

c. Prepare sufficient design calculations to establish the form and size of all principal structural elements including foundations.

d. Prepare general arrangement plans, sections and elevations, giving the dimensions, layout, disposition and sizes of structural elements as required for estimating purposes.

e. Prepare clearly annotated sketches to illustrate details of:
   (i) The supports to the opening spans, showing the form of bearings and means of accommodating the opening movements.
   (ii) The fixed ramp structure support where it meets the dock side.

f. Prepare a brief method statement for the structural site works.



Note. All dimensions are in millimetres (feet and inches)

FIGURE Q4

Question 4

New office block within retained facades

Client's requirements

1. A new six storey office building with basement is to be constructed within the retained masonry facades of two adjacent elevations of a period building. See Figure Q4. The two new elevations are to be constructed in curtain walling. The retained masonry facades are not to be used to support the new structure.
2. The column grid is to be not less than 6.0m (20′-0″) in each direction.
3. The new floor levels are to coincide with those of the existing building. An accessible raised floor, finished with carpet tiles, of 100mm (4″) overall construction thickness is to be provided. The false ceiling depth is to be 75mm (3″).
4. Full air conditioning is specified within a clear ceiling void of 450mm (1′-6″). The minimum finished floor to ceiling height is to be 2.7m (9′-0″).
5. The roof, which is to be flat, is to be mainly occupied by plant, enclosed in a lightweight soundproof housing.
6. Fire resistance to be 1½ hours.

Imposed loading

7. Plant room floor — 7.5kN/m^2 (150lbf/ft^2)
   Office floors (including partitions) — 6.0kN/m^2 (120lbf/ft^2)

Site conditions

8. A level site on the outskirts of a large city. Basic wind speed 40m/s (90 mile/h).
9. Ground conditions below existing basement level:
   0–0.5m (1′-8″) – Made Ground
   0.5m (1′-8″)–4.5m (14′-9″) – Loose becoming dense sandy gravel. SPT N values varying linearly from 6 to 16 with depth.
   Below 4.5m (14′-9″) – Stiff grey clay, average c = 150kN/m^2 (3000lbf/ft^2), ø = 0.
   Standing water was encountered 2.2m (7′-3″) below basement level.

Omit from consideration

10. Design of the plantroom superstructure.
11. Detailed design of the staircases and lift shafts, although their contribution, if any, to overall stability and load transfer must be stated in Part 1(a).

Part 1 (40 marks)

a. Prepare an illustrated design appraisal indicating two distinct and viable solutions for the construction of the building within the retained facades. Identify clearly the functional framing, stability and load transfer aspects of each scheme, together with the principles of the temporary and permanent works associated with the retained facades. Identify the solution you recommend giving reasons for your choice.

b. Prepare a letter to your client explaining the effect on your chosen solution of a proposal to lower the basement floor by 1.2m (4′-0″) to enable the basement to be used as a computer room.

Part 2 (60 marks)

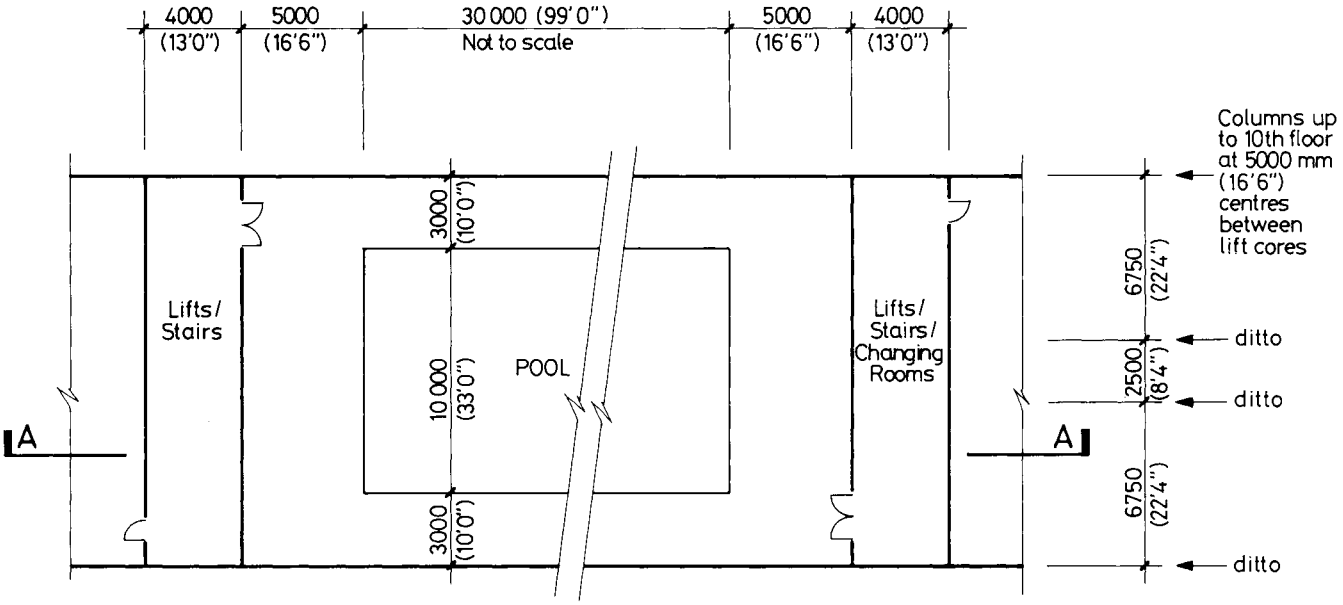
For the solution recommended in 1(a):

c. Prepare sufficient design calculations to establish the form and size of all principal structural elements including foundations and the works associated with the retained facades.

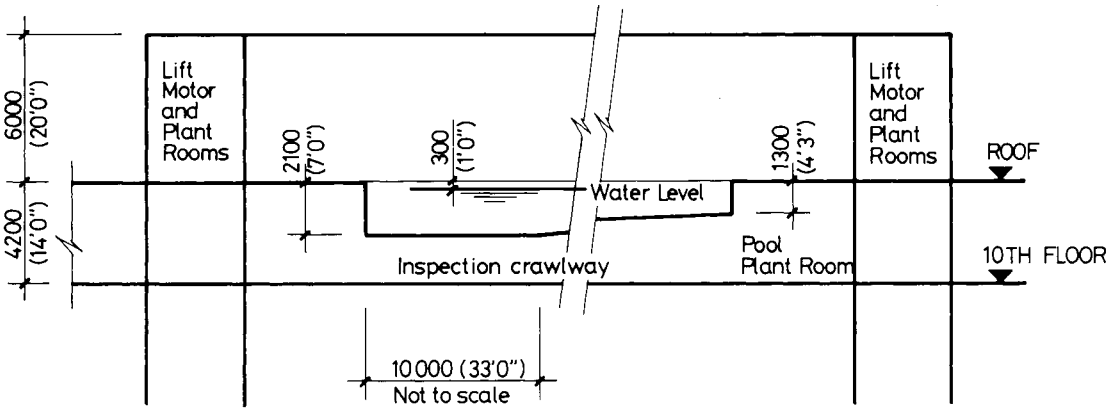
d. Prepare general arrangement plans, elevations and sections giving the dimensions, layout, disposition and sizes of the structural elements as required for estimating purposes.

e. Prepare clearly annotated sketches to illustrate details of:
   (i) New and existing foundations on a retained facade side.
   (ii) New floor to retained facade junction.
   (iii) Connection between retained facade and its temporary support structure.

f. Write a brief method statement outlining the sequence of operations from demolition of the existing building to the completion of the new structure.



PLAN



SECTION A-A

Note. All dimensions are in millimetres (feet and inches)

FIGURE Q5

Question 5
Rooftop swimming pool to a hotel

Client's requirements

1. A rooftop swimming pool is to be incorporated in the design of a ten storey hotel. See Figure Q5. The pool is to be 30.0m (98′-0″) × 10.0m (33′-0″) with a depth of water varying from 1.0m (3′-3″) to 1.8m (6′-0″). The pool is to be designed as a water retaining structure with a normal operating water temperature of 30°C.
2. The structure below 10th floor level comprises a concrete frame with beams and columns at 5m (16′-6″) centres between the lift cores.
3. The pool surround is to be finished in non-slip tiles, with the pool sides and base lined with glazed tiles.
4. The pool enclosure is to be a flat roofed structure level with the roof of the lift/stair cores. The side walls are to be panels of 200mm (8″) thick honeycombed concrete blockwork, (ie. concrete blocks laid with open 'perpends' 150mm (6″) wide). No major openings are required in the roof.

Imposed loading

5. Pool surround 3.0kN/m^2 (60lbf/ft^2)
   Pool roof 0.75kN/m^2 (15lbf/ft^2)

Site conditions

6. Sub-tropical coastal resort, level site. Basic wind speed 50m/s (112 mile/h). Frequent but short heavy rainfalls.

Omit from consideration

7. Details of scum channels, water circulation/drainage ducts, changing room accommodation and plant. Details of disposal of rainwater.
8. Structural framing, overall stability and load transfer of the structure below 10th floor level.

Part 1 (40 marks)

a. Prepare an illustrated design appraisal indicating two distinct and viable structural solutions for the pool and enclosing structure. Identify clearly the functional framing, stability, and load transfer aspects of each scheme. Identify the solution you recommend giving reasons for your choice.

b. Describe in a letter to the client the procedure for testing the watertightness of the pool and the remedial action to be taken should minor leaks become apparent.

Part 2 (60 marks)

For the solution recommended in 1(a):

c. Prepare sufficient design calculations to establish the form and size of all principal structural elements for the pool, its supports and its enclosure.

d. Prepare general arrangement plans, elevations and sections giving the dimensions, layout, disposition and sizes of the structural elements of the pool and enclosure as required for estimating purposes.

e. Prepare clearly annotated sketches to illustrate details of:
   (i) The junction between the pool floor and side walls.
   (ii) The junction between a pool supporting member and an external column.
   (iii) Means of stabilising the honeycombed enclosure wall.

f. Prepare a brief specification dealing with the relevant factors to ensure the construction of a watertight pool.

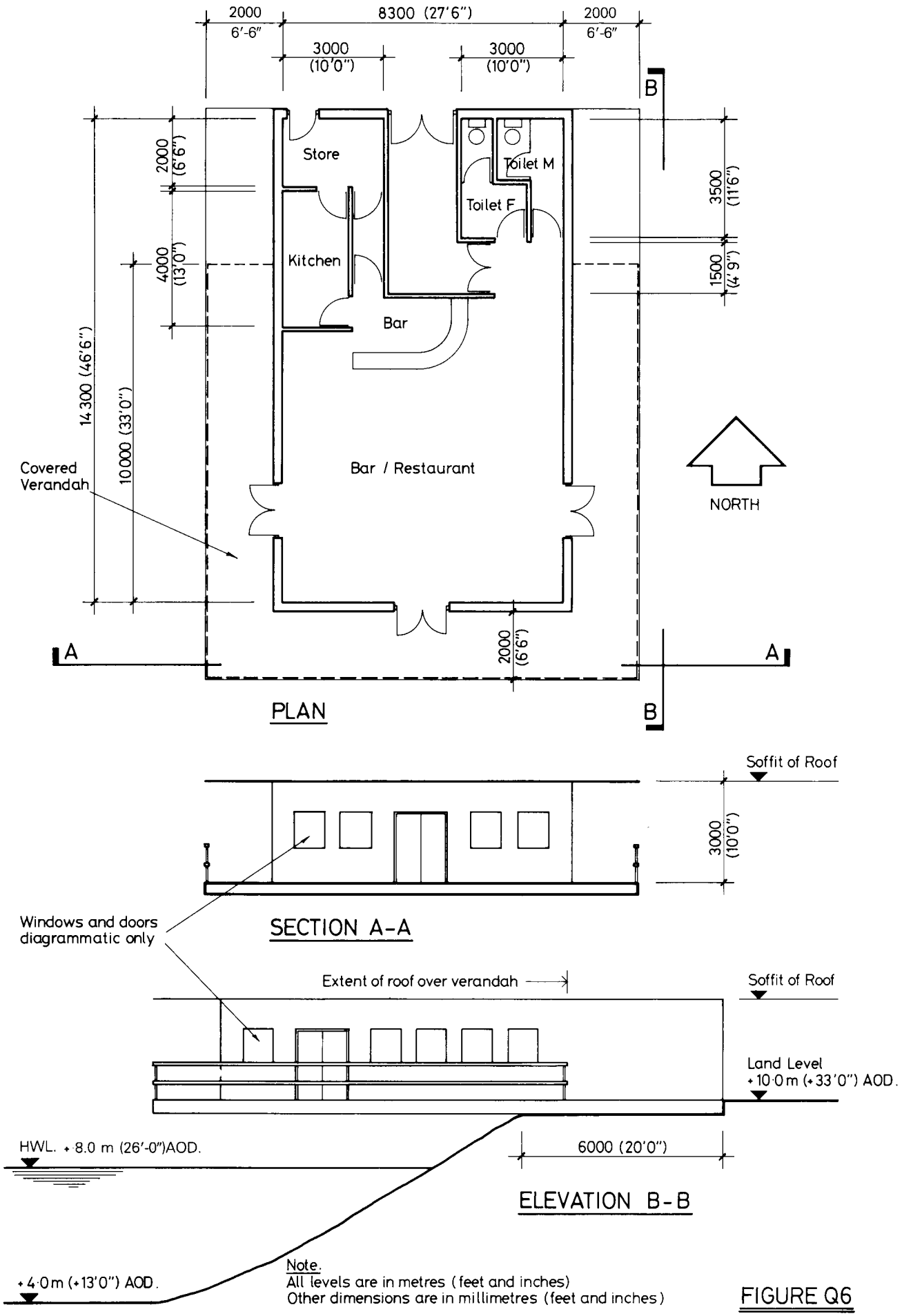

2000
6'-6"
8300 (27'6")
2000
6'-6"
3000
(10'0")
3000
(10'0")
B
2000
(6'6")
4000
(13'0")
14300 (46'6")
10000 (33'0")
Store
Toilet M
Toilet F
Kitchen
Bar
3500
(11'6")
1500
(4'9")
Covered
Verandah
Bar / Restaurant
NORTH
2000
(6'6")
A
A
B
PLAN
Soffit of Roof
3000
(10'0")
Windows and doors
diagrammatic only
SECTION A-A
Extent of roof over verandah
Soffit of Roof
Land Level
+10·0m (+33'0") AOD.
HWL. +8.0 m (26'-0")AOD.
6000 (20'0")
ELEVATION B-B
+4·0m (+13'0") AOD.
Note.
All levels are in metres (feet and inches)
Other dimensions are in millimetres (feet and inches)

FIGURE Q6

Question 6
Lakeside bar/restaurant

Client's requirements

1. The construction of a new lakeside bar-restaurant building, a portion of which is to be constructed in or over the lake. See Figure Q6.
2. A flat or pitched roof may be used to suit the materials and method of construction adopted.
3. External walls may be loadbearing or infill panel construction preferably involving the use of local masonry or timber.
4. Windows and doors to bar/restaurant area are to permit reasonable views of lake and provide access to covered verandah on three sides.
5. Verandah to have an open railed safety parapet 1.0m (3′-3″) high.

Imposed loadings

6.

Flat roof	1.50kN/m^2	(30lbf/ft^2)
Pitched roof	0.75kN/m^2	(15lbf/ft^2)
Floor (excluding all walls)	5.00kN/m^2	(100lbf/ft^2)
Parapet lineload	0.74kN/m	(50lbf/ft)

Site conditions

7. Lakeside site with difficult access from minor roads.
8. Ground conditions established from subsoil explorations on land are:

0–0.6m (2′-0″)	grass on top soil
0.6m (2′-0″)–8.0m (26′-0″)	loose gravel with water table at 2.0m (6′-6″) depth
Below 8.0m (26′-0″)	stiff grey clay, c = 150kN/m^2 (3,000lbf/ft^2), ø = 0

9. Lake water level varies seasonally between +7.0m (+23′-3″) AOD and +8.0m (+26′-0″) AOD with no significant current movement or scouring.
10. Basic wind speed 44m/s (98 mile/h).

Part 1 (40 marks)

a. Prepare an illustrated design appraisal indicating two distinct and viable structural solutions for the restaurant including the means of supporting the area to be constructed in or over the lake. Identify the solution you recommend giving reasons for your choice.

b. At an early design stage the client proposes to locate the building 6m (20′-0″) further north. Write a letter to him describing the effect that his proposal has on your recommended solution.

Part 2 (60 marks)

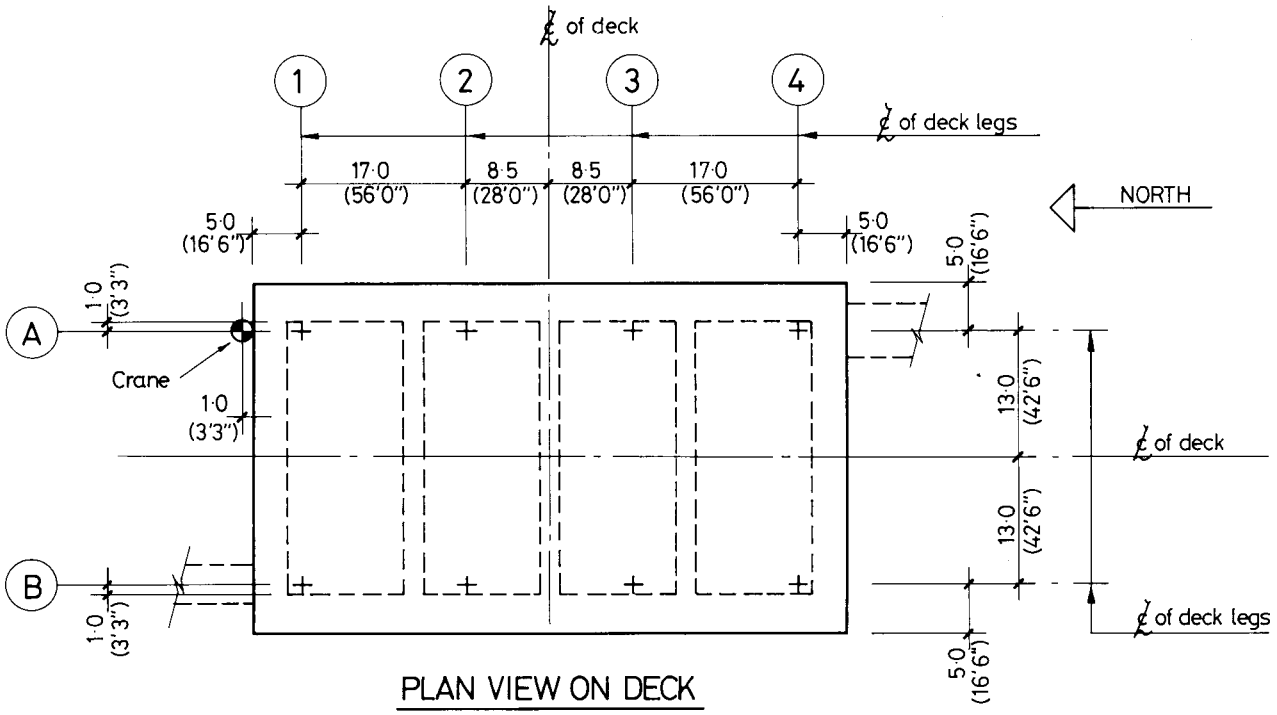
For the solution recommended in Part 1(a):

c. Prepare sufficient design calculations to establish the form and size of all principal structural elements including foundations.

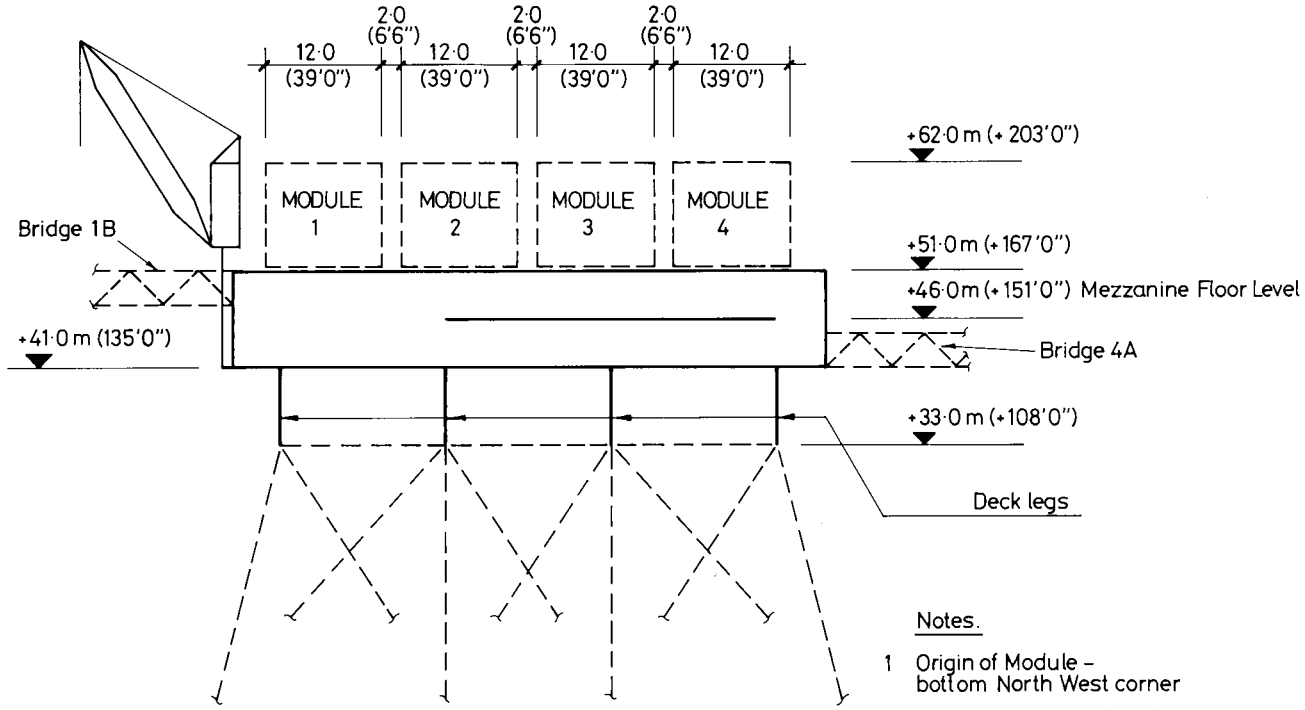
d. Prepare general arrangement plans, elevations and sections giving the dimensions, layout, disposition, sizes and materials of the structural elements as required for estimating purposes.

e. Prepare clearly annotated sketches to illustrate details of:
   (i) The roof/external wall junction.
   (ii) The external wall to the supporting floor structure.
   (iii) The connection of the parapet to the floor structure.

f. Describe the sequence and methods to be employed in constructing the building.



PLAN VIEW ON DECK



ELEVATION ON DECK

Notes.

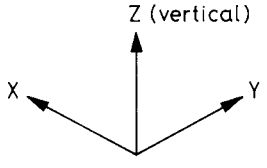
1 Origin of Module – bottom North West corner

2 All dimensions and levels are in metres (feet and inches)

3 ✳ indicates $\times 10^3$ tonnes ($\times 10^3$ tons)

Centre of Gravity Schedule (Operational Mode)

MODULE	X	Y	Z	W✳
1	14·3 (47'0")	6·0 (19'6")	5·2 (17'0")	1·0
2	14·5 (47'6")	5·8 (19'0")	4·7 (15'6")	1·3
3	13·5 (44'0")	6·3 (20'6")	4·8 (16'0")	1·4
4	15·2 (50'0")	5·3 (17'6")	4·1 (13'6")	1·6



Module Coordinates

FIGURE Q7

Question 7
Deck

Client's requirements

1. A deck structure for an eight legged jacket structure situated in the southern North Sea.
2. The deck and deck leg profile is shown in Figure Q7.
3. There are two access bridges to the deck which join the deck at different levels. The supports to the bridges at the deck ends are free to move in the direction of the bridge 300mm (1′-0″) and rotate plus or minus 10° about the axis perpendicular to the span direction of the bridge.
4. A mezzanine floor is to be situated between grid-lines 2,3,4, A and B at the +46.0m (+151′-0″) level.
5. A crane is to be located near the North East corner of the deck.
6. The deck is to be installed in a single lift offshore, maximum lift weight 2,500 tonnes (2,500 tonf).

Imposed loading

7. The deck is to support 4 modules, locations and centres of gravity as shown on Figure Q7.
8. Bridge 4A has a design support reaction of 40 tonnes (40tonf) vertical, 25 tonnes (25tonf) horizontal at +41.0m (+135′-0″) level. Bridge 1B has a design support reaction of 25 tonnes (25tonf) vertical, 15 tonnes (15tonf) horizontal at +51.0m (+167′-0″) level. Both horizontal reactions act at right-angles to the bridge spans.
9. The crane has a total self weight of 40 tonnes (40tonf) and a max safe working load of 30 tonnes (30tonf) including impact allowance.
10. (i) +41.0m (+135′-0″) level, north of grid line 2, S.W.L. = 20kN/m^2 (400lbf/ft^2)
    (ii) +41.0m (+135′-0″) level, south of grid line 2, S.W.L. = 10kN/m^2 (200lbf/ft^2)
    (iii) +46.0m (+151′-0″) level, mezzanine floor S.W.L. = 10kN/m^2 (200lbf/ft^2)
    (iv) +51.0m (+167′-0″) level, access ways around modules, S.W.L. = 10kN/m^2 (200lbf/ft^2)

Site conditions

11. Basic wind speed is 45m/s (100 mile/h).

Omit from consideration

12. Design of modules and crane.
13. Dynamic and fatigue checks.
14. Sea fastening.
15. Installation aids other than padeyes/padears.
16. Access between the +41.0m (+135′-0″) and +51.0m (167′-0″) level.

Part 1 (40 marks)

a. Prepare an illustrated design appraisal indicating two distinct and viable solutions for the proposed work including method of loadout and installation. Indicate clearly the functional framing, load transfer and stability aspects of each scheme.
Identify the solution you recommend, giving reasons for your choice.

b. In the early stages of the design, your client proposes to increase the weight of the modules by a factor of 2 in the operational mode. Write to him explaining the effects his suggestion is likely to have on your recommended solution.

Part 2 (60 marks)

For the solution recommended in 1(a):

c. Prepare sufficient design calcuations to establish the form and size of all principal elements for both temporary and permanent conditions.

d. Prepare general arrangement plans, elevations and sections giving the dimensions, layout, disposition and sizes of the structural elements and lifting points, as required for estimating purposes.

e. Prepare clearly annotated sketches to illustrate details of:
(i) Typical lifting points.
(ii) Typical jacket/jacket pile/deck leg connection (corner leg)
(iii) Deck leg/deck structure element.

f. Prepare a method statement outlining the installation and mating sequence of the jacket, jacket pile and deck.