

## The HKIE Structural Examination – Written Examination 2023

### Section 2: Design Questions

Date: 28 November 2023 (Tuesday)

Time: 12:15 pm – 6:15 pm

(Duration: 6 hours)

**Question Paper**

Seat number:	
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**Answer ONE question only**

### NOTE

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## Question 1 Shopping Mall

### Client's Requirements

The following client's requirements must be met:

1. A three-storey shopping mall is proposed at an open coastal area with ground level +10mPD as shown in Figures.
2. The shopping mall shall be constructed in light weight material and enveloped by transparent glass wall.
3. A 120m x 30m skylight is proposed at roof level, key structural arrangement of the skylight should be integrated as part of the roof structure.
4. Zone A at ground floor is proposed to house superstore and /or for exhibition of heavy lifting machines, minimum centre to centre column spacing for this area should not be less than 20m. Other areas except Zone A at Ground floor, minimum column spacing shall be 10m from centre to centre.
5. The requirements of the proposed shopping mall are listed as follows:

Floor Mark	Usage	Floor to floor	Minimum clear head room (*)	Fire resistance Rating	Finishes & E&M Services Zone
Roof	Inaccessible		N/A	N/A	N/A
1/F & 2/F	Retail	7m	5m	2 hrs	0.7m
G/F	Retail	11m	8m	2 hrs	0.9 m

(\*) The minimum clear head room is the floor height clear of all structures, finishes & E&M Services Zone

6. Footprint of the shopping mall is 220m in length and 85m in width.
7. All voids are to be cleared from any structural element.
8. A column free zone measuring 5m around the edge of the voids is to be provided.
9. The maximum allowable height of the building to the main roof is 25m.
10. There is an additional 5m structural zone next to and above the building main roof to allow for discrete light weight steel structures such as steel post, stanchion, truss or cables.

### Imposed Loads

- |   |                      |
|---|----------------------|
| 11. Roof:                               | 2kN/m <sup>2</sup>   |
| Services on roof:                       | 0.5kN/m <sup>2</sup> |
| Retail:                                 | 5KN/m <sup>2</sup>   |
| Zone A at Ground floor:                 | 10kN/m <sup>2</sup>  |
| Finishes & E&M services (other floors): | 3KN/ m <sup>2</sup>  |

### Wind Loads

12. The wind loads shall be in accordance with the Code of Practice of Wind Effects in Hong Kong 2019.

### Site Conditions

- |                    |  |
|--------------------|--|
| 13. +10mPD to 0mPD | Loose fill, SPT N-value from <10   |
| 0m to -10mPD       | Medium Dense sand with SPT N-value from 10 to 50   |
| -10m to -40mPD     | Completely decomposed granite, SPT N-value >200  |
| Below -40mPD:      | Slightly to moderately decomposed moderately strong rock of material weathering grade III or better, with total core recovery greater than 85% |

Ground water is encountered at 5m below ground level

### Omit from Consideration

14. Detail design of staircase core
15. Second order and dynamic effects on the light weight roof

### Section A

- a. Prepare a design appraisal with appropriate sketches indicating two distinct and viable solutions for the proposed shopping mall including two viable foundation schemes. Clearly indicate the function framing, load transfer and stability aspects of each scheme to meet all client's requirements. Identify the solution you recommend and give reasons for your choice.

**(30 marks)**

- b. Explain how the structure will resist wind load including detailed description of the structural wind loads and design assumptions. Prepare detailed wind load calculations for the proposed shopping mall.

For the purpose of estimating Along Wind Force  $W_z$ ,  $Z_e$  can be taken as  $Z$  (effective height = actual height above ground level) and topographic adjustment not required. For the preliminary assessment of major direction wind induced deflection and / or stability check, the Along Wind Force could be multiplied by an overload factor of 1.4 to take into account of the combination of the two orthogonal directions and torsional loads. Torsional Force and Across Wind Base Moment could be ignored.

**(10 marks)**

## **Section B**

For the solution recommended in Section A:

- c. Prepare sufficient design calculations to establish the form and size of all the principal structural elements including the foundation. In calculation of wind load, considerations on torsional forces and cross-wind base moment and dynamic effect are not required.

**(20 marks)**

- d. Prepare foundation plan and framing plans for G/F, 1/F, 2/F and R/F with sufficient sections and elevations to show the key dimensions, layout and disposition of the structural elements and critical details for cost estimation purposes.

**(25 marks)**

- e. Prepare a detailed method statement covering essential activities for the safe construction of the shopping mall including foundation works.

**(10 marks)**

- f. Prepare a detailed construction programme covering essential activities from commencement of foundation to completion of structural works.

**(5 marks)**

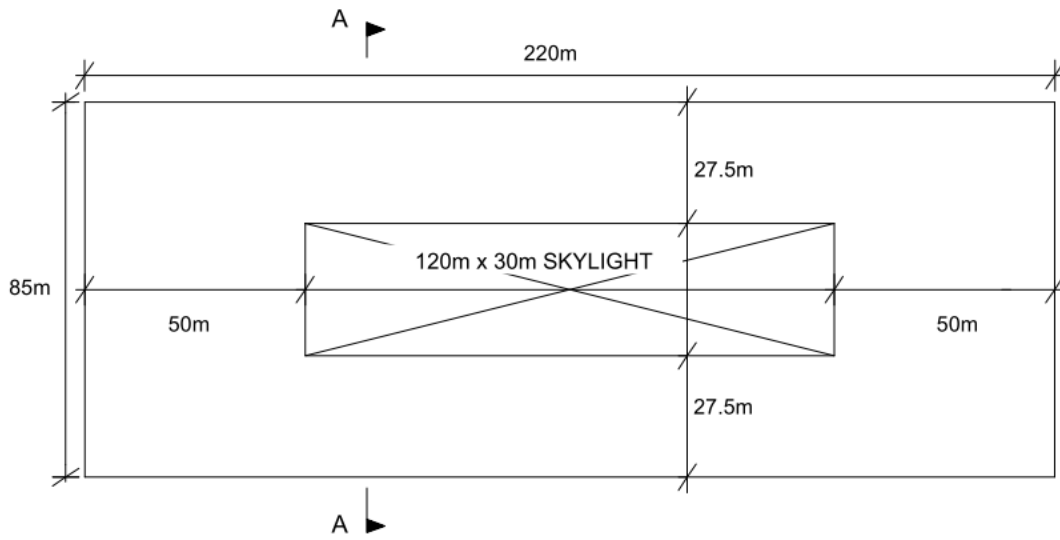


Figure 1 ROOF PLAN VIEW

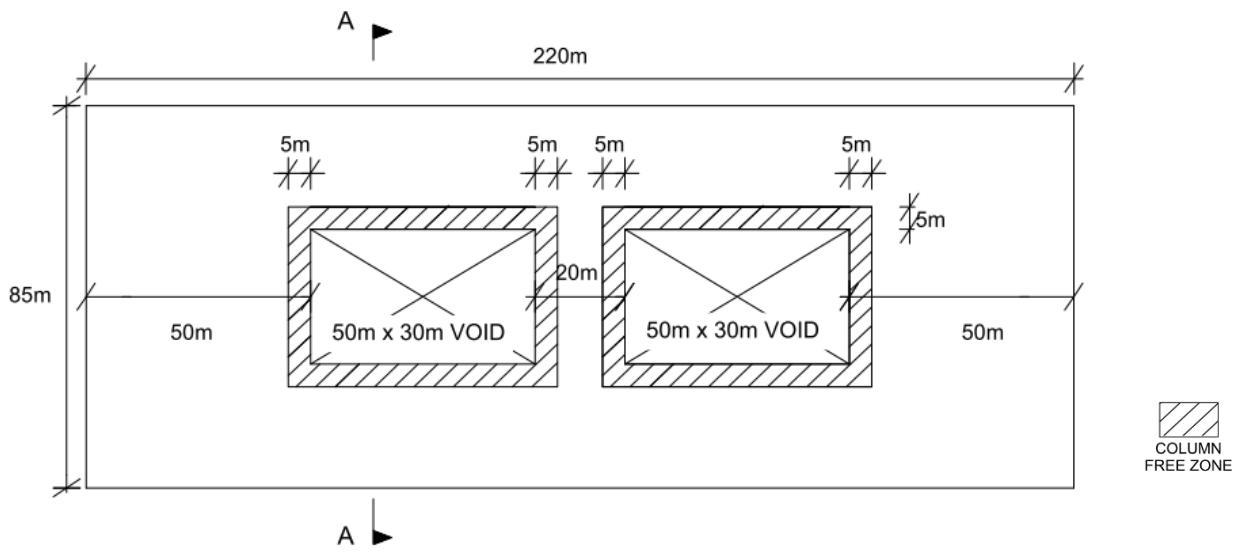


Figure 2 2F PLAN VIEW

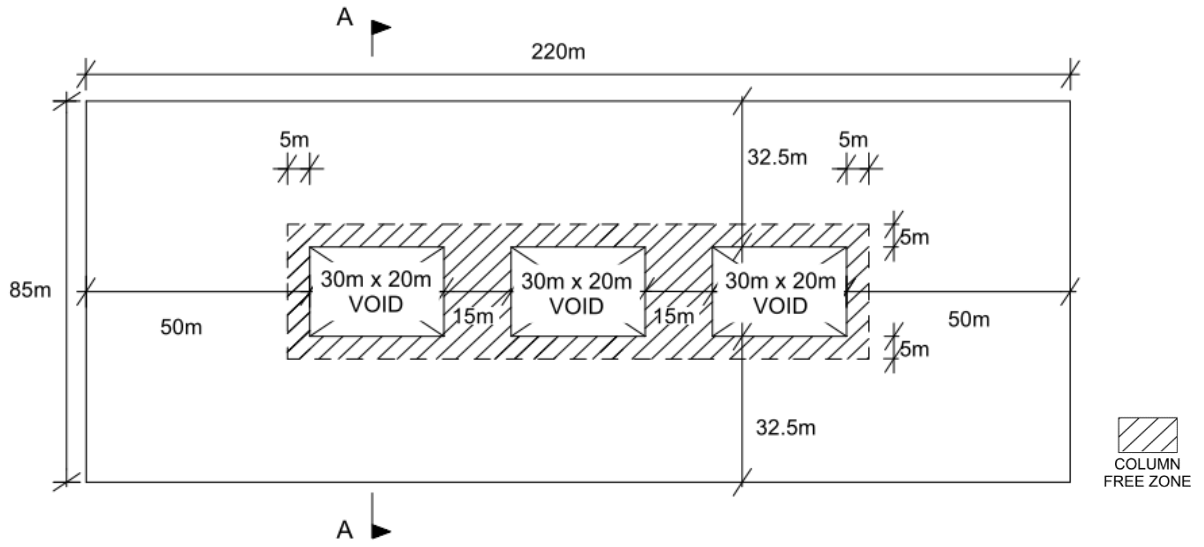


Figure 3 1F PLAN VIEW

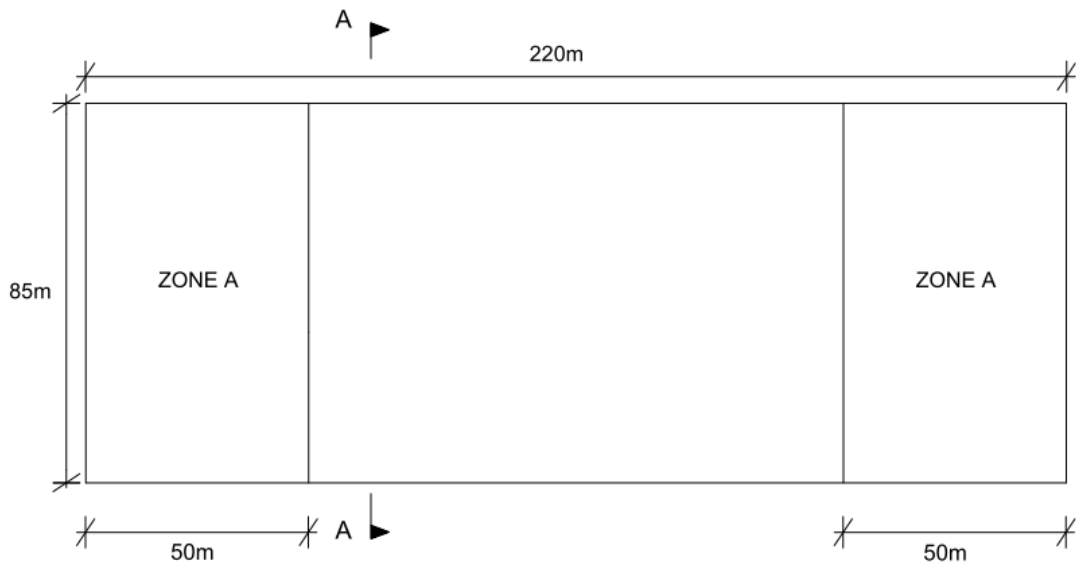


Figure 4 GF PLAN VIEW

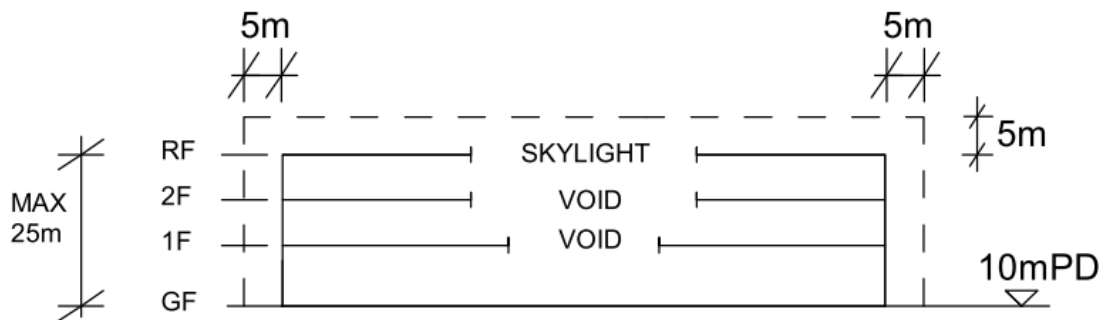


Figure 5 SECTION A-A

## Question 2 Library Building

### Client's Requirements

The following client's requirements must be met:

1. A multi-functional library building with double storey reading halls is to be constructed within the New Territories area of Hong Kong. See Figures 1 to 6.
2. The building has 8 storey and overall plan dimension of 58m x 62m. It is to be built over a two-level platform at +10mpd and +5mpd respectively. The two platforms are separated by a 5m high existing retaining wall which to be remained.
3. The proposed use of the library building with the minimum headroom requirements and fire resistance rating is listed as follows:

Floor Mark	Usage	Minimum Clear Headroom* (m)	Fire Resistance Rating	Finishes & E/M Services Zone (m)
Main Roof	Inaccessible	N/A	N/A	N/A
3/F – 7/F	Library	3.6	2 hours	0.5
2/F – 7/F	Reading Hall	8.0	2 hours	0.5
2-3/F	Terraced Reading Hall	Below +34 mPD	2 hours	0.5
1/F	Hall	5.0	2 hours	0.5
1/F	Gallery Hall	7.0	2 hours	0.0
G/F	Lobby/ Library	4.5	2 hours	0.5
LG1	Archives Office	3.6	2 hours	0.5

\* The minimum clear headroom is the floor height clear of all structures, finishes and building services.

4. The restrictions on the location of vertical structural elements are as follows:

Floor Mark	Area	Restrictions
G/F – 7/F	Library, Hall, Lobby	- Minimum columns centre to centre spacing is 9.0m.
2/F – 6/F	Reading Hall	- Minimum columns centre to centre spacing is 12.0m.
2-3/F	Terraced Reading Hall	- Minimum columns centre to centre spacing is 12.0m.
1/F	Gallery Hall	- Column Free Zone
LG1	Archives Office	- No restrictions.

\* No restriction on spacing between column and service core.

5. The main roof structure shall not be inverted.
6. For cantilever beam or structure (if any), maximum cantilever span to be less than 4.0m from face of support.

### **Imposed Loads**

7. The imposed loads shall be in accordance with the latest version of the Hong Kong Code of Practice for Dead and Imposed Loads.
8. The imposed load for Library and Archives Office shall be Class 5 according to table 3.2 of the Code of Practice for Dead and Imposed loads. Specific use shall be “Stack rooms in book stores and libraries”. Storage height can be taken as 3.6m.

### **Wind Loads**

9. The wind loads shall be in accordance with the Code of Practice on Wind Effects in Hong Kong 2019.

### **Site Conditions**

10. Existing 5m high masonry retaining wall within site to be remained.

11. Ground conditions:

From +10mPD to +5mPD	Lose Fill, SPT average N-value = 8 [Category 4(d)] <sup>Note 1</sup>
From +5mPD to -50mPD	Medium dense sand, SPT average N-value = 25 [Category 4(c)] <sup>Note 1</sup>
From -50mPD to -60mPD	Completely decomposed granite, SPT N-value > 200 [Category 3] <sup>Note 1</sup>
Below -60mPD	Moderately decomposed granite with total core recovery greater than 85% [Category 1(c) rock] <sup>Note 1</sup>

Note 1: Categories of soil/rock refer to Table 2.1 of Code of Practice for Foundation 2017.

12. The highest possible groundwater level is at existing ground surface

### **Omit from Consideration**

13. Detailed layout and design of the structure of the service core.
14. Stability of existing mass retaining wall.

## Section A

- a. Prepare a design appraisal with appropriate sketches including two distinct and viable solutions for the proposed library building including one viable foundation scheme. Indicate clearly the functional framing, load transfer and stability aspects of each scheme to meet all client's requirements. Identify the solution you recommend and give reasons for your choice.
- (30 marks)**
- b. Explain how the structure will resist wind load including detailed description of the structural wind loads and design assumptions. Prepare a detailed wind load calculation and stability checking for the proposed library building.

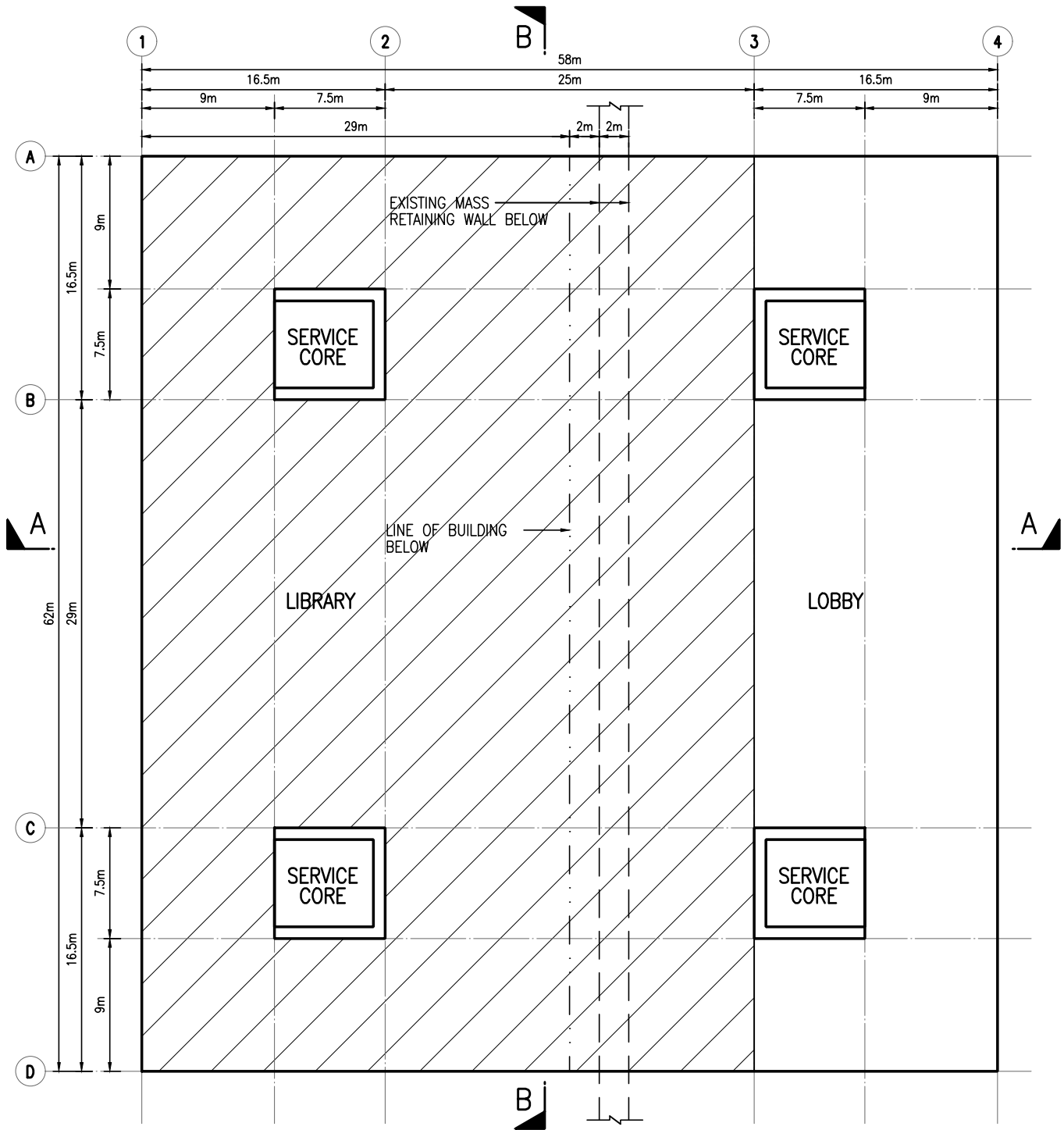
For the purpose of estimating Along Wind Force  $W_z$ ,  $Z_e$  can be taken as  $Z$  (effective height = actual height above ground level) and topographic adjustment not required. For the preliminary assessment of major direction wind induced deflection and/or stability check, the Along Wind Force could be multiplied by an overload factor of 1.4 to take into account of the combination of the two orthogonal directions and torsional loads. Torsional Force and Across Wind Base Moment could be ignored.

**(10 marks)**



## Section B

For the solution recommended in Section A:

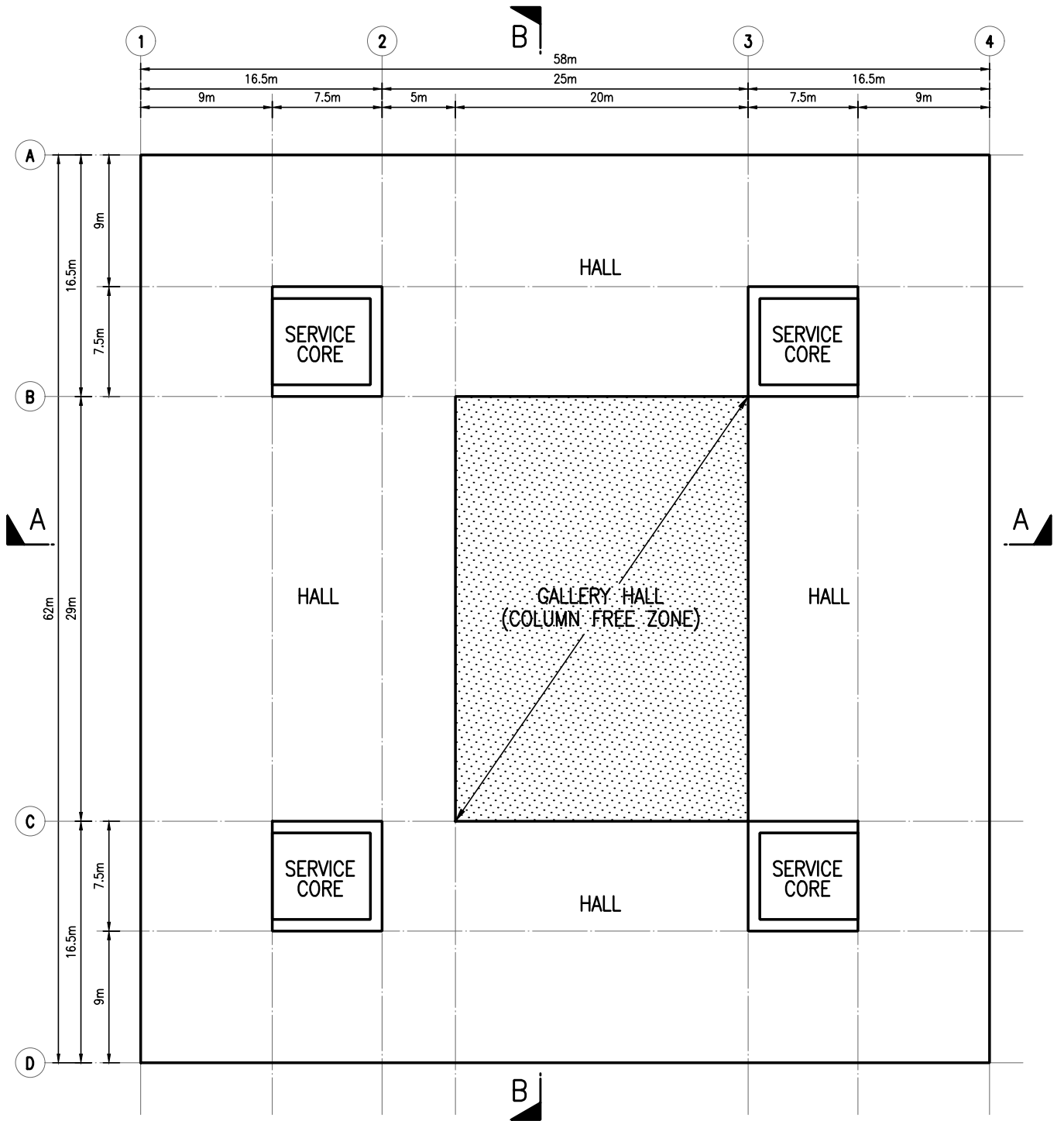
- c. Prepare design calculations to establish the form and size of all principal structural elements for superstructure from G/F to 4/F including transfer structures, and critical structures (if any).
- (15 marks)**
- d. Prepare full dimensional framing plans for each 1/F, 2-3/F, 4/F and levels with transfer and critical structures (if any).
- (20 marks)**
- e. Prepare structural details for the principal structural elements from G/F to 4/F including transfer and critical structures (if any), for cost estimation purpose.
- (10 marks)**
- f. Prepare the design calculation for the building foundation.
- (5 marks)**
- g. Prepare a preliminary foundation layout plan.
- (5 marks)**
- h. Prepare an outline construction program covering essential activities from commencement of foundation to the completion of structural works.
- (5 marks)**



**G/F PLAN**

-  LOBBY
-  LIBRARY

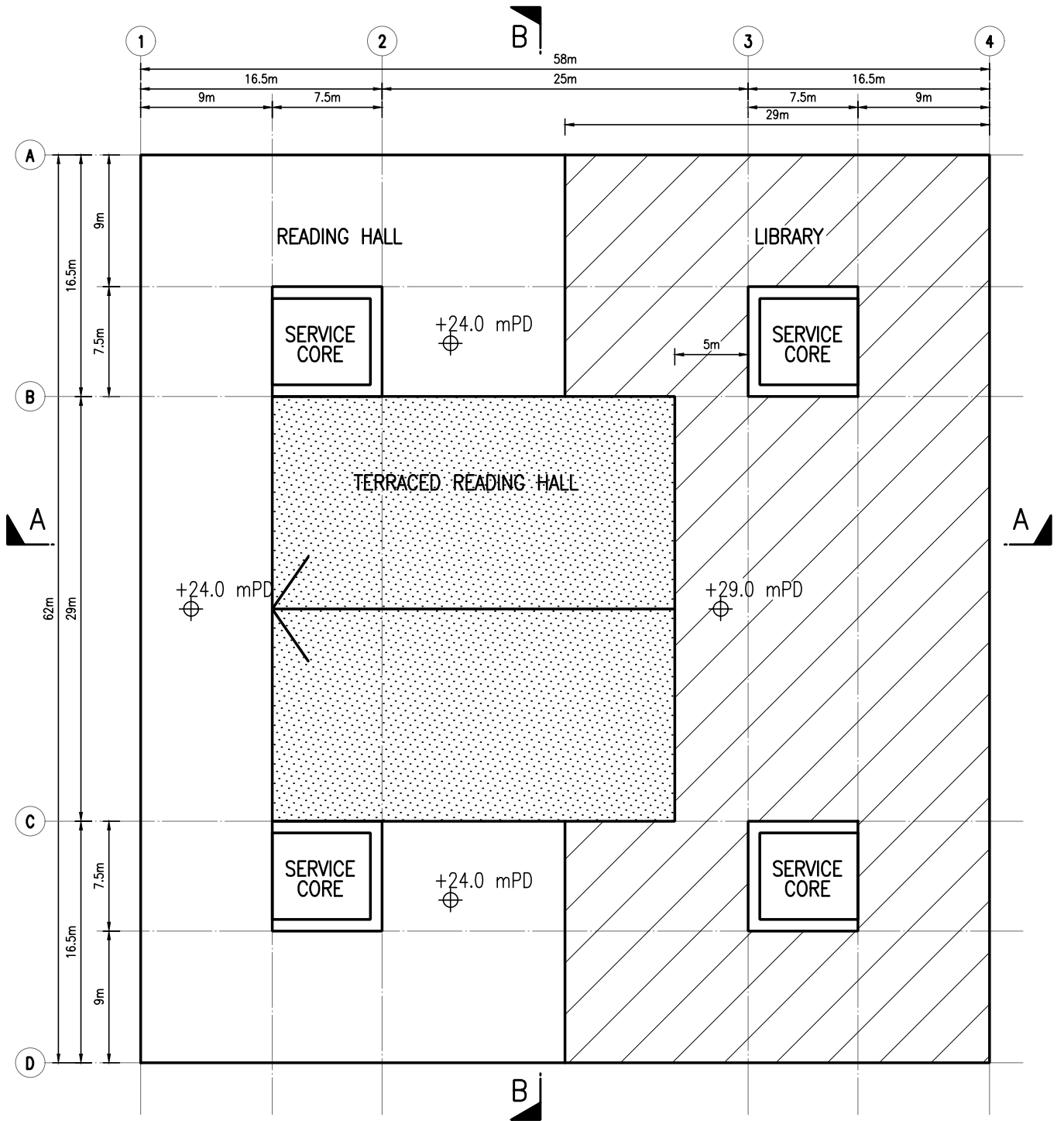
**Figure 1**



**1/F PLAN**

- HALL
- GALLERY HALL

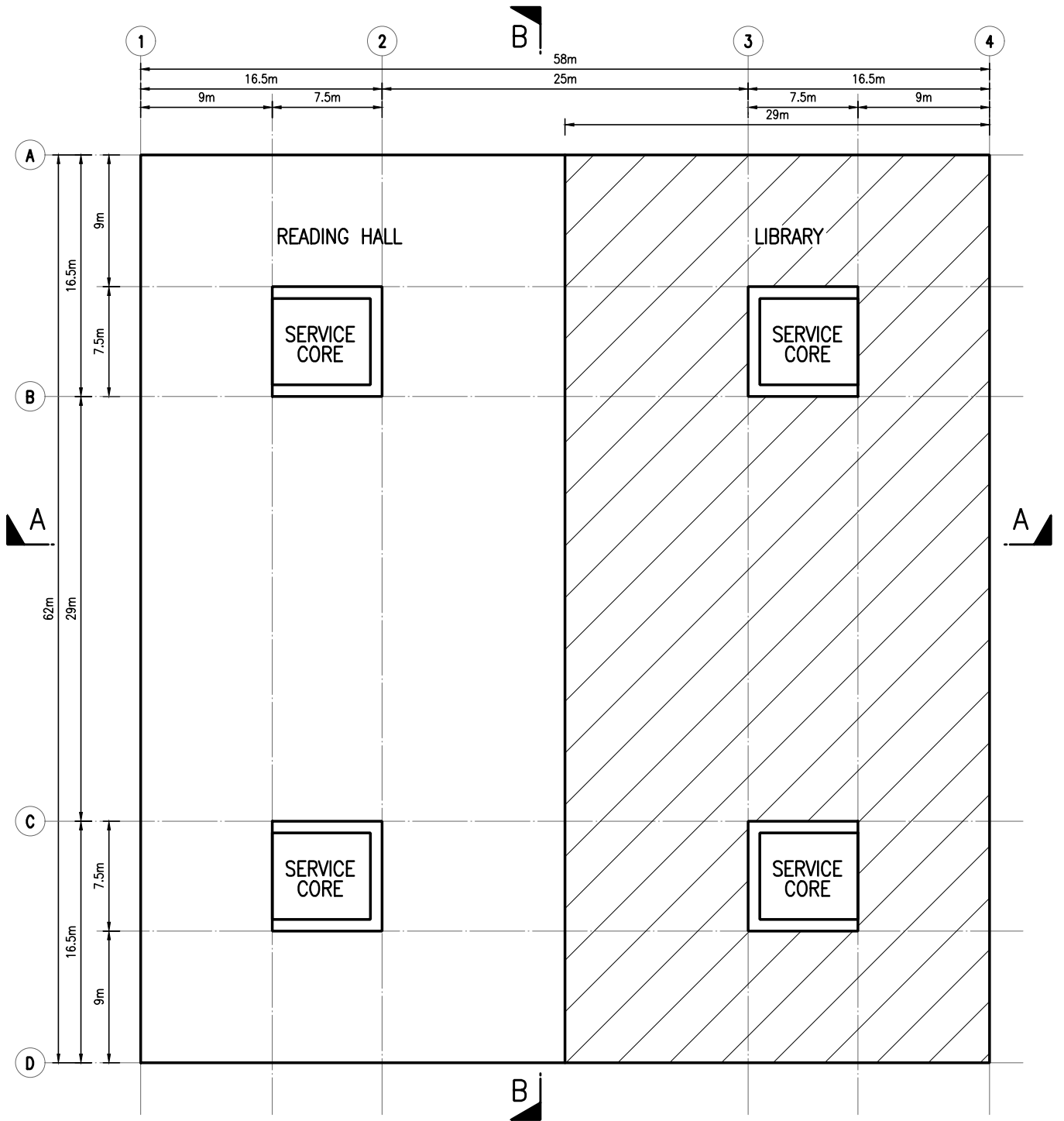
**Figure 2**



**2 ~ 3/F PLAN**

- READING HALL
- TERRACED READING HALL
- LIBRARY

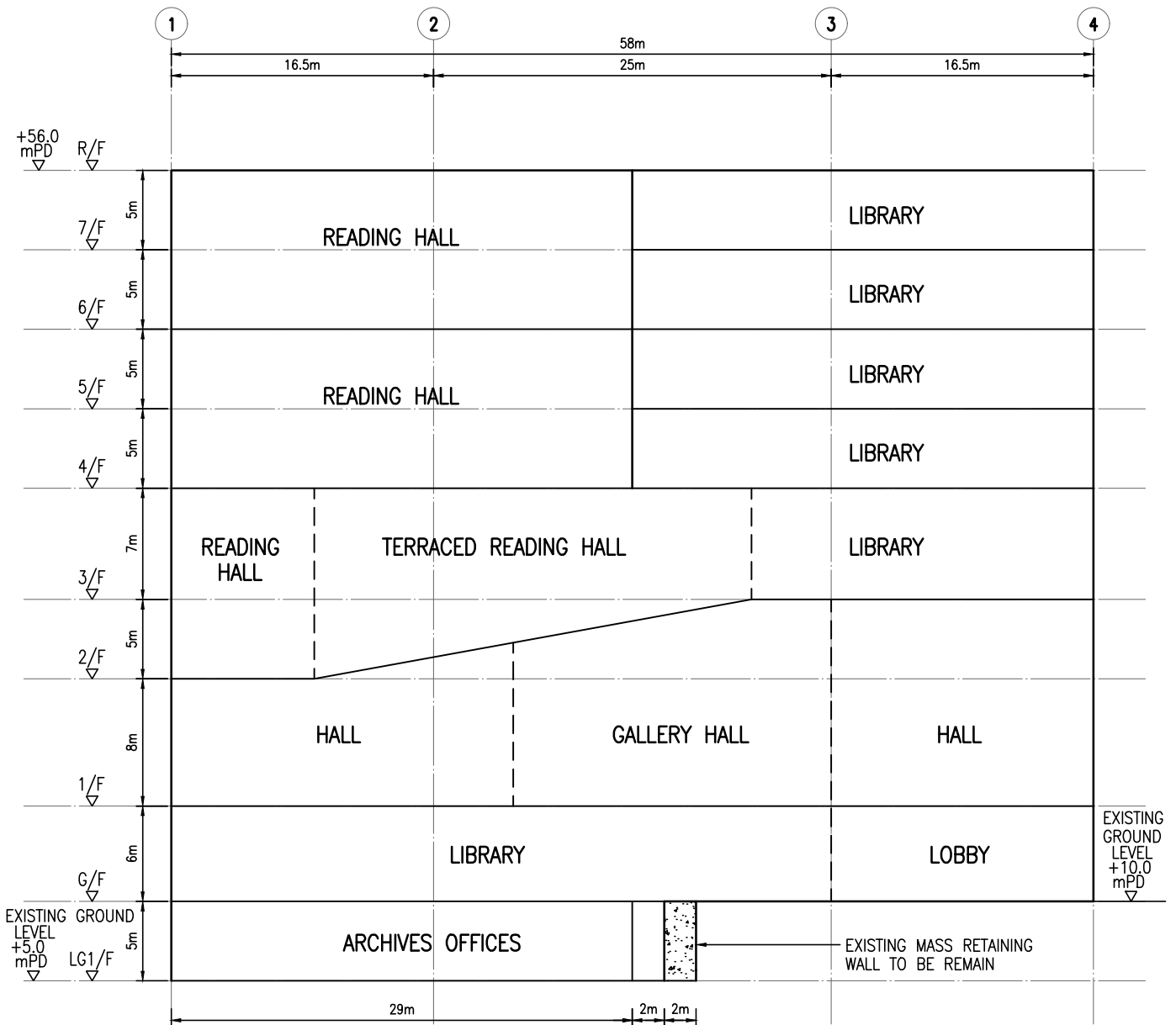
**Figure 3**



**4/F PLAN**

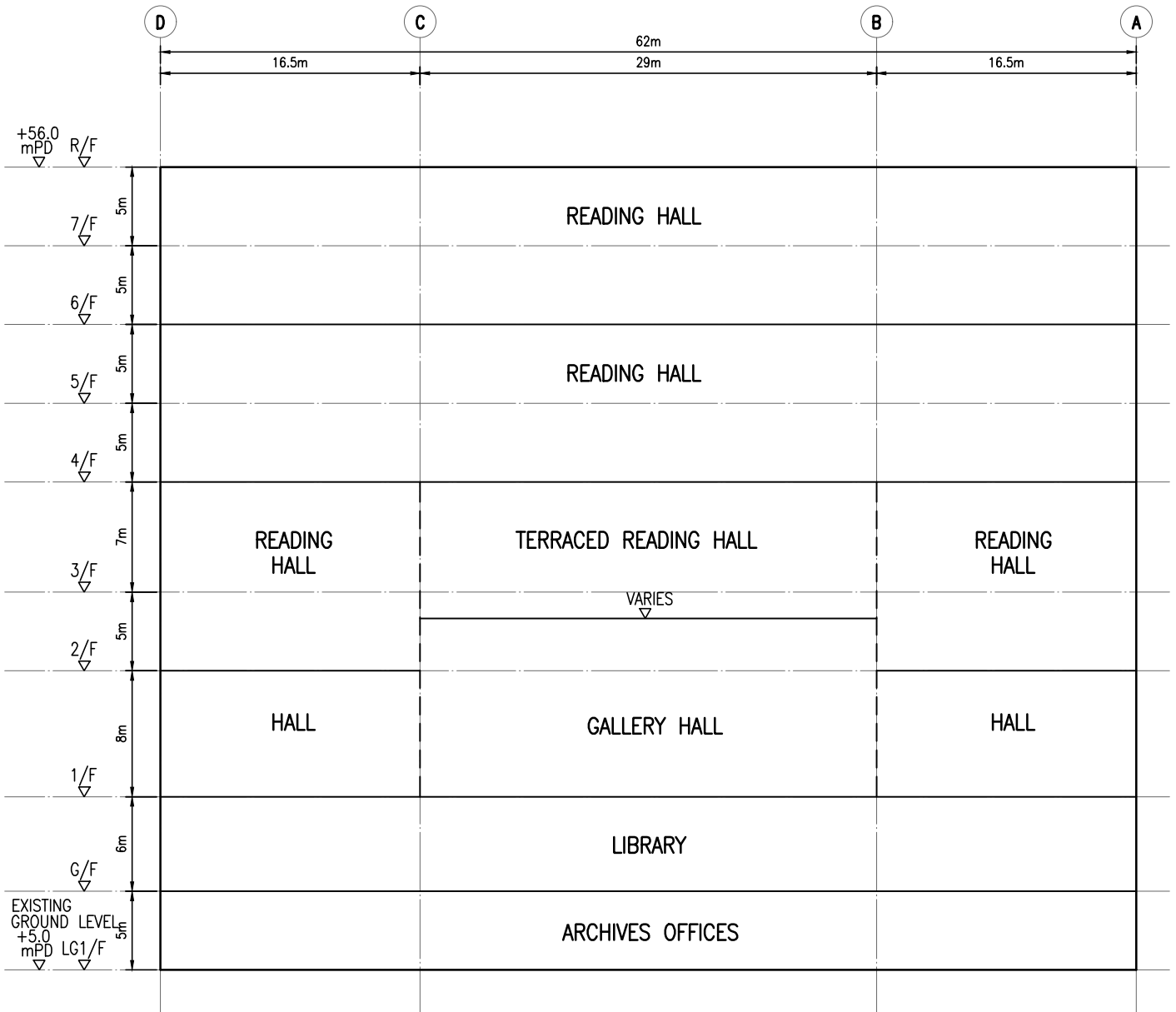
- READING HALL
- LIBRARY

**Figure 4**



SECTION A-A

Figure 5



SECTION B-B

Figure 6

## Question 3      Community and Sports Centre

### Client's Requirements

The following client's requirements must be met:

1. A new Community and Sports Centre is to be constructed in New Territories with a building footprint of 48m x 52m. Three sides of the proposed development are surrounded by public housing estates with a minimum height of 100m, whilst the northern boundary is facing open terrain.
2. A three-level of basement is to be provided for loading/unloading area, plant rooms and carparks. A ramp is located at the eastern boundary of the building.
3. The Community and Sports Centre provides two indoor basketball courts, a roof lawn bowl green and multi-function rooms, together with the associated ancillary facilities (offices, storage, café etc.).
4. Each basketball court measures 15m x 28m on plan, with a required clear headroom of 9m and a 4m space between them. A clear space (for clearance and passage) of 2m is also required along the outer lines of the courts. (See **Figure 1**)
5. A spectators stand measuring 3m wide is to be accommodated surrounding the two courts. No structures are permitted in and around the courts, including the clearance spaces, and in obstruction of the spectators stand. However raking structures are permitted from the 2nd floor as long as they do not violate the headroom requirement for the basketball courts. (also see **Figure 1**)
6. For the planning of the multi-function rooms and the underground carpark, a minimum centre to centre column spacing shall be 12m, except at the Entrance Hall on the ground floor where a column free space of 15 x 24 m is required. (see **Figure 2**)
7. Lift/stair cores will be provided for access at the perimeter of the building, which will also be used for housing the supporting utilities/facilities.
8. A vehicular ramp is to be provided at the Eastern boundary of the site (also see **Figure 2**).
9. A ventilation air duct with an overall dimension (size of the duct and insulation) of 2m x 4m is required along the perimeter of the sports hall in either a E-W or N-S direction. It should be accommodated within the depth of the SMEP zone of the roof structure (see **Figure 3**).

10. The height at each floor is also shown in **Figure 3**.
11. A clear floor to ceiling height for the basement is 4.8m and 3.0m for the basement 1 and basement 2 & 3 respectively while that for the ground and first floor are both 4.5m.
12. The following should be allowed for in the design of the Centre:

<u>Floor</u>	<u>Finishes</u>	<u>Building Services/ Ceiling</u>
1st Basement	50 mm	0.8m
2nd & 3rd Basement	15mm	0.4m
Ground	100 mm	0.6m
First Floor	150mm raised floor	0.6m
Second Floor	100mm	0.8m (over the hall)
Roof	150mm	Nil

### **Imposed Loads**

13. The following imposed loadings should be adopted in the design. Others not specified should be in accordance with the Hong Kong Code of Practice for Dead and Imposed Loads 2011.
  - Superimposed Dead Load – Basement (1.5KN/m<sup>2</sup>), Ground Floor (5.0KN/m<sup>2</sup>), Second Floor (2.0KN/m<sup>2</sup>) and Roof (5.0KN/m<sup>2</sup>)
  - Superimposed Live Load – First Basement (15.0KN/m<sup>2</sup>), 2<sup>nd</sup> and 3rd Basement (4.0KN/m<sup>2</sup>), Ground Floor (10.0KN/m<sup>2</sup>), Sports hall and Roof (5.0KN/m<sup>2</sup>)
14. The wind load should be in accordance with Hong Kong Wind CoP 2019.

For the purpose of estimating along Wind Force WZ, Ze can be taken as Z (effective height = actual height above ground level) and topographic adjustment not required.

For the preliminary assessment of major directional wind induced deflection and / or stability check, the Along Wind Force could be multiplied by an overload factor of 1.4 to take into account of the combination of the two orthogonal directions and torsional loads.

Torsional Force and Across Wind Base Moment could be ignored.

15. A deflection limit control of L/360 shall be maintained for the Live Load, whilst the limit can be relaxed to L/240 for total loads on both Second Floor and the Roof.
16. Assumptions / Exclusions
  - Design of lift / stair wells / 2M floor / basement floors

## Site Conditions

17. The generalised ground conditions are:

Depth	Stratum	Bulk Density	SPT'N' values
Ground level to 4m	Fill	18 kN/m <sup>3</sup>	10 to 15
4m to 15m	Completely Decomposed Granite (CDG)	20 kN/m <sup>3</sup>	30 to 200
15 to 30m	Completely Decomposed Granite (CDG) / Highly Decomposed Granite (HDG)	20 kN/m <sup>3</sup>	≥ 200
≥ 30m	Slightly to moderately decomposed moderately strong rock of material weathering grade III, with a total core recovery of more than 85% of the grade.	25 kN/m <sup>3</sup>	UCS values = 25 to 40MPa

The groundwater table is encountered at 2.0m below existing ground level.

### Section A

- a. Prepare a design appraisal with appropriate sketches including two distinct and viable solutions for the ground, first, and second floor and roof, plus two viable foundation systems. Clearly indicate the functional framings, load transfer and stability aspects of each scheme. Identify the solution you recommend and give reasons for your choice. **(30 marks)**
- b. Explain how the building structure will resist wind load including detailed description of the structural wind frame(s), design assumptions and how the uplift pressure, if any, in the basement is resisted. **(10 marks)**

### Section B

For the solution recommended in Section A:

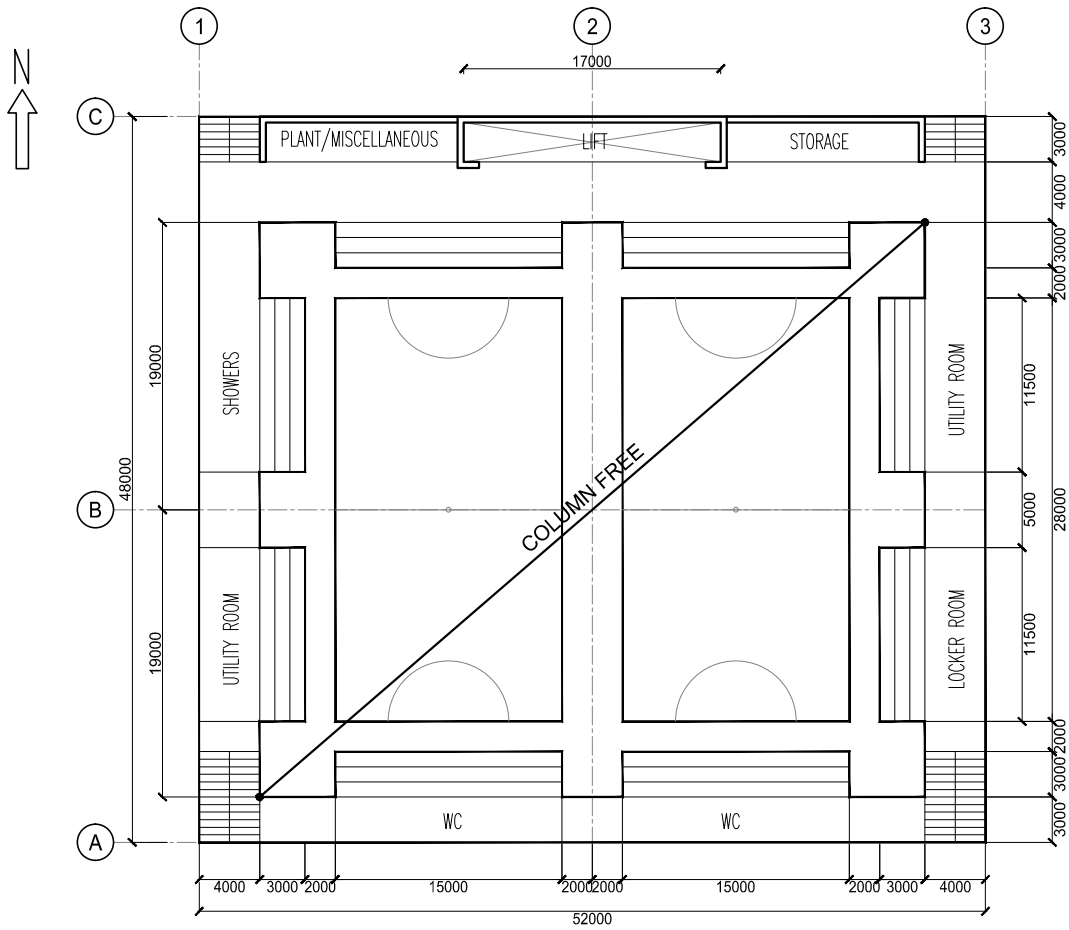
- c. Prepare sufficient design calculations to establish the form and size of all the principal structural elements including the foundations. **(20 marks)**
- d. Prepare general detailed structural framing plans (ground, first & second floor, roof and basement/foundation) to show the dimensions, layout, disposition of the structural elements. and critical structural details (including major beam penetrations, if any) for estimating purposes. **(25 marks)**

e. Prepare sufficient details of the critical elements (columns, beams, transfer etc.) and critical connections such as column/beam, column/slab connections etc.

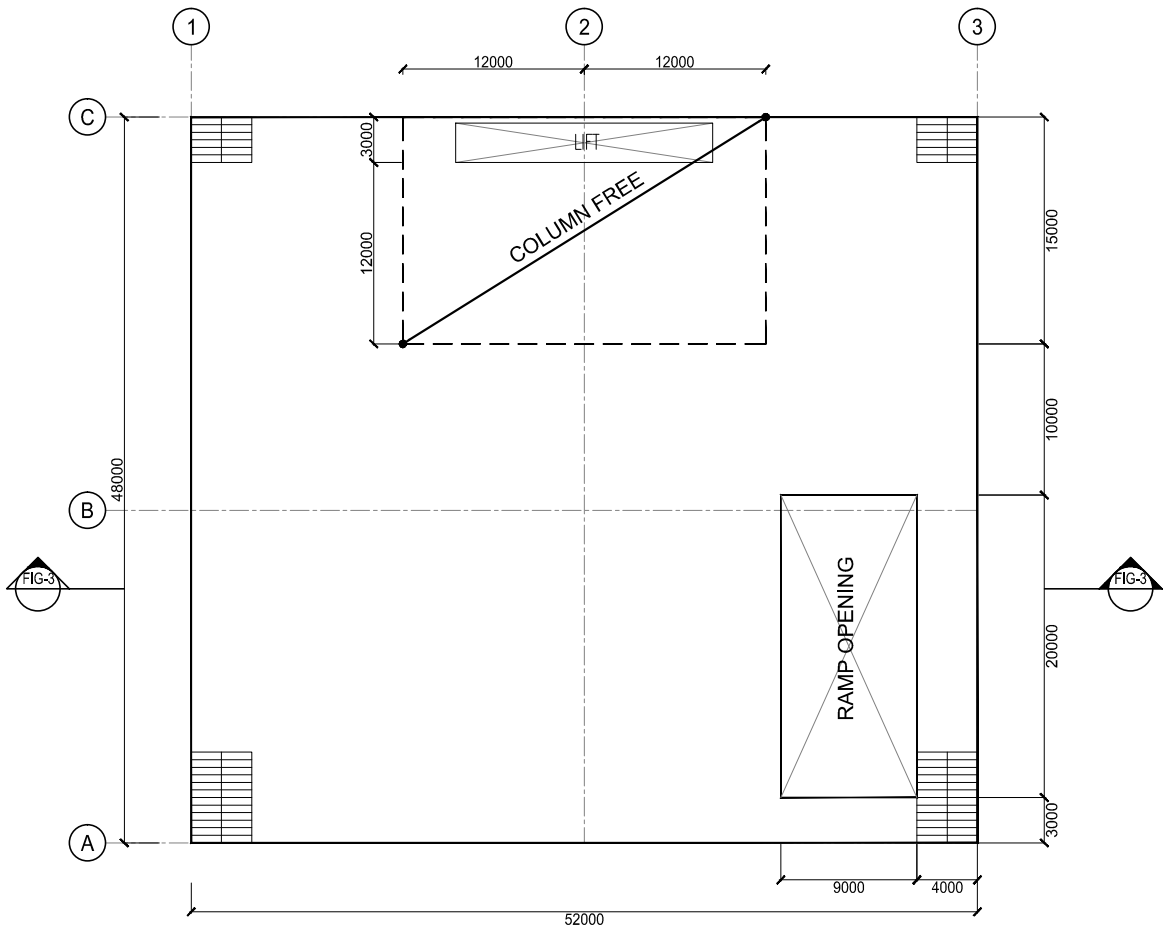
**(5 marks)**

f. Prepare a detailed method statement for the construction of the basement structure including any narratives, with emphasis on how ground movement and underground water are controlled during construction.

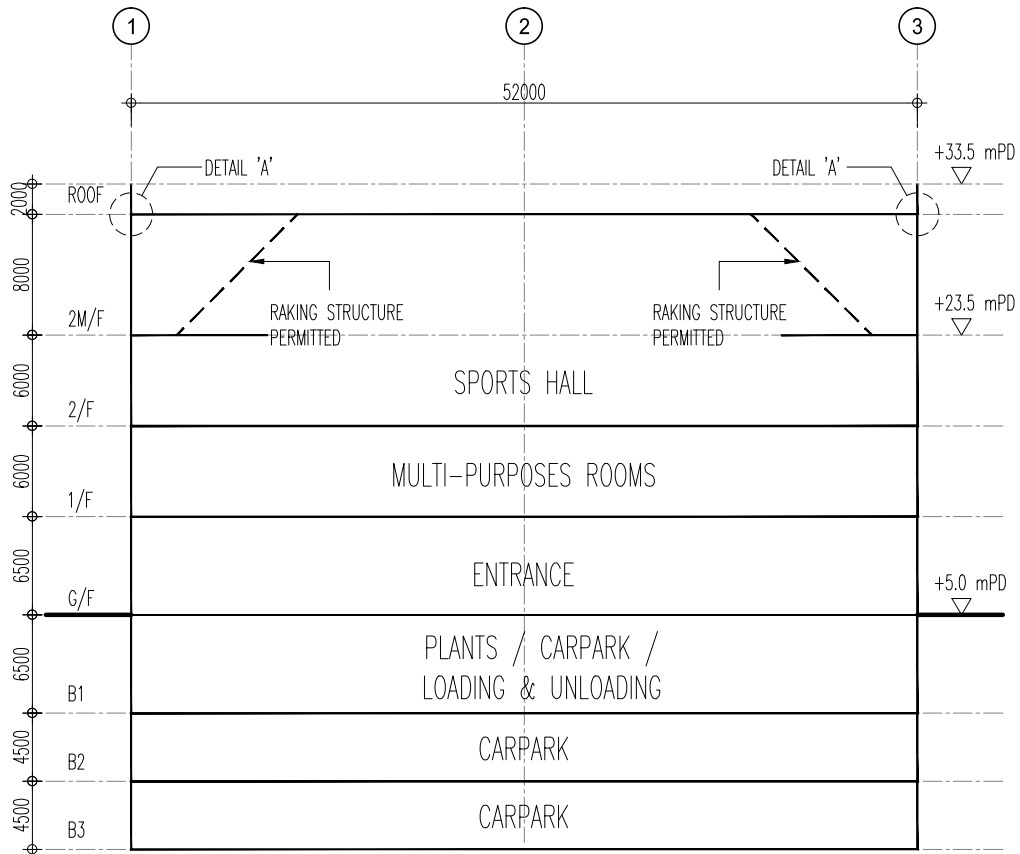
**(10 marks)**



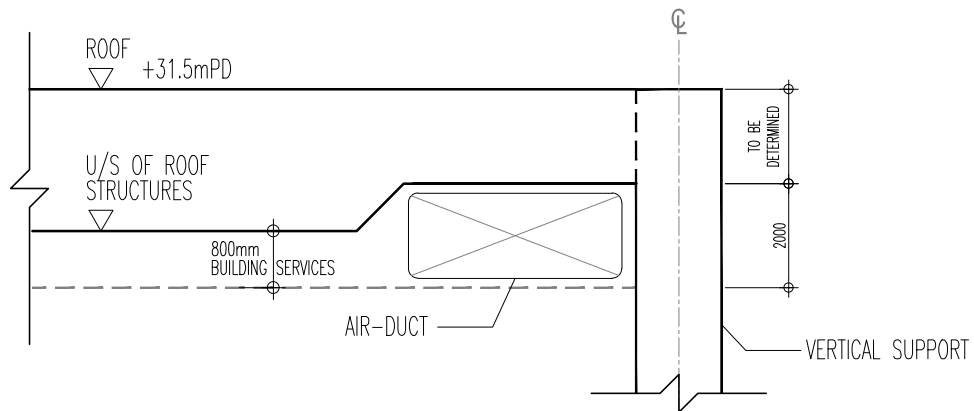
**FIGURE 1 - SECOND FLOOR LAYOUT**



**FIGURE 2 - GROUND FLOOR LAYOUT**



**FIGURE 3 - SECTION**



NOTE: INDICATIVE DETAILS FOR PROVISION OF AIR-DUCT OVER THE SPECTATORS STAND IN EITHER NORTH/SOUTH OR EAST/WEST DIRECTION

**FIGURE 4 - DETAIL 'A'**

## Question 4      Change of Use of an Existing Building

### Client's Requirements

The following client's requirements must be met:

1. It is proposed to change the usage of the top four floors (14/F to 17/F) of an existing office building from general use office to restaurant, and with other alterations on the lower floors (G/F to 3/F). The existing building is eighteen storeys building located in the urban of Hong Kong Island and constructed in 1990s. The framing plans and sections of the existing building is indicated on Figures 1-4 of Q4.
2. The existing building is to be vacant for construction.
3. The proposed new plans and sections as shown in Figures 5-7 of Q4 and with the following highlighted.
  - i) The top four floors (14/F – 17/F) is to be converted to three floors and the usage is changed from office to restaurant.
  - ii) The floor-to-floor height of the restaurant floors is increased (as shown on Figures 6 and 7) and the floor area is extended.
  - iii) The staircases and lift cores are to be relocated.
  - iv) Between gridlines 1 to 2, a vehicle access at ground floor of 6 m clear width and 4.5m clear headroom is required.
  - v) The existing transformer room at ground floor is to be relocated to 1/F (of the new plans).
  - vi) The new ground floor to first floor height is 6.5 m and with a minimum clear headroom of 4.5m.
  - vii) The façade of the building facing road C (along gridline A and between gridlines 1-5) is to be cladded with new curtain walls from 2/F and above.
  - viii) Except the existing columns of the existing building, no new internal column is allowed from 1/F and above. The existing columns and beams may be strengthened with suitable measures. New edge columns may be allowed but the column spacing should not smaller than the existing columns along the same direction.

4. The proposed use of the new building with the minimum clear headroom, finishes & E&M services zone and fire resistance rating is listed as follows:

Floor Mark	Usage	Minimum Clear Headroom * (m)	Finishes, & E&M Services zone (m)	Fire Resistance Rating
R/F	Accessible roof/ Signage			
13/F – 16/F	Restaurant	3.0	0.2	120 mins
2/F – 12/F	Office	2.5	N/A	120 mins
1/F	E&M Plant room and Transformer room, Restaurant	3.0 except 3.5 for transformer room	N/A	120 mins except 240 mins for transformer room
G/F	Access, Shop and Lobby	4.5	0.4	120 mins

\* The minimum clear headroom is the floor height clear of all structures, finishes, and E&M Services.

5. Information of the existing building are given as follows.

Floor Mark	Usage	Designed Imposed Load (kPa)	Designed Superimposed Dead Load (kPa)	Fire Resistance Rating
R/F	Inaccessible roof	0.75	2.0	120 mins
1/F – 17/F	Office	3.0	2.0	120 mins
G/F	Shops	5	3.0	120 mins

Foundation: Driven Steel H-Piles down to soil stratum with SPT N 200 and with a raft cap.

### Imposed Loads

6. The imposed loads shall be in accordance with the latest version of the Code of Practice for Dead and Imposed Loads in Hong Kong, unless specified.

### Wind Loads

7. The existing building was designed based on the Code of Practice on Wind Effects in Hong Kong 1983.

8. According to APP117 of Practice Notes for AP/RSE (PNAP), the structural adequacy of an existing building or part thereof, as may be affected by proposed A&A works may, subject to the following requirements, be checked according to the then prevailing Building Regulations and codes of practice to which they were designed:

(a) Wind Calculations

In the case of A&A works involving:

- i. partial or total removal of existing major wind resisting walls or frames, which would result in a reduction in their stiffness by 5% or more, or
- ii. the extension of building dimensions which would result in an increase of 10% or more of the wind exposure areas of a building, the structural adequacy of the building due to wind should be checked based on the current wind code (Code of Practice on Wind Effects in Hong Kong 2004 or 2019)

### Site Conditions

9. The site is located at Wan Chai Hong Kong and with flat ground level at +4.5mPD.
10. The site is a corner site bounded by two main roads on two opposite sides and a public garden and an existing office building on the other two opposite sides.

11. Ground conditions are:

From +4.5mPD – +0mPD	Loose Fill, SPT average N-value < 10
From +0mPD – -10mPD	Medium dense sand, SPT average N-value = 30
From -10mPD – -20mPD	Completely decomposed granite, SPT N-value > 200
Below -20mPD	Moderately decomposed granite with total core recovery greater than 85%

12. The highest measured groundwater level is at +3.0 mPD.

### Omit from Consideration

13. Design for staircases, cladding, window systems, façade, protective barrier, and roof top signboard is not required. However, the loading effect of these structures should be considered.
14. Detailed layout and design of the non-structural elements inside the service core.
15. Detail design of foundation and pile caps is not required. However, an assessment on the effect on the existing foundation is required.

## Section A

- a. Given a brief account on the required items of structural alterations and additions works. Prepare two distinct and viable solutions for the proposed alterations and additions works for G/F to 1/F and 13/F to R/F (new floor mark) including viable schemes for lateral and gravity loads stability and provide your key consideration. Clearly indicate the functional framing, load transfer and stability aspects of each scheme to meet all client's requirements. Identify the solution you recommend and give reasons for your choice.

**(30 marks)**

- b. Give a brief assessment on the effects of the proposed alterations and additions works and suggest strengthening solution if necessary for the following.
- 1) The relocation of existing transformer room.
  - 2) The existing foundation system with consideration of any changes of gravity loads and lateral wind loads.

**(10 marks)**

## Section B

For the solution recommended in Section A:

- c. Prepare sufficient design calculations to establish the form and size of all the principal structural elements for superstructure, including transfer (if any) and critical structures.

**(15 marks)**

- d. Prepare dimensional framing plans and sections for superstructure of G/F-1/F and 13/F-R/F (restaurant floors) to show the general arrangement of the structural elements including transfer (if any) and critical structures.

**(25 marks)**

- e. Prepare the structural details for the principal structural elements including transfer (if any) , and critical structures and the new curtain walls system for estimating purposes.

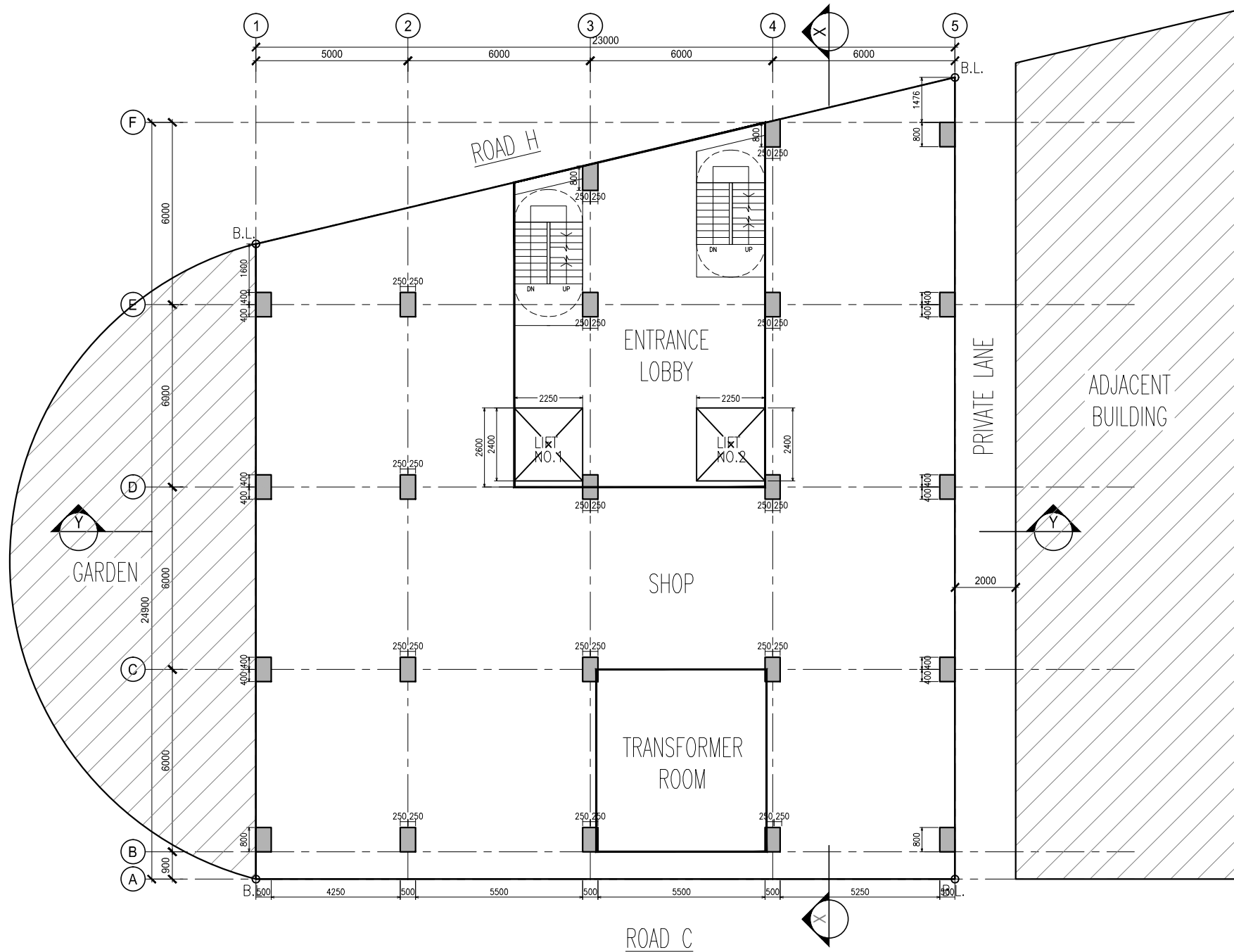
**(5 marks)**

- f. Prepare a detailed method statement for the construction of the A&A works including removal of the existing structures.

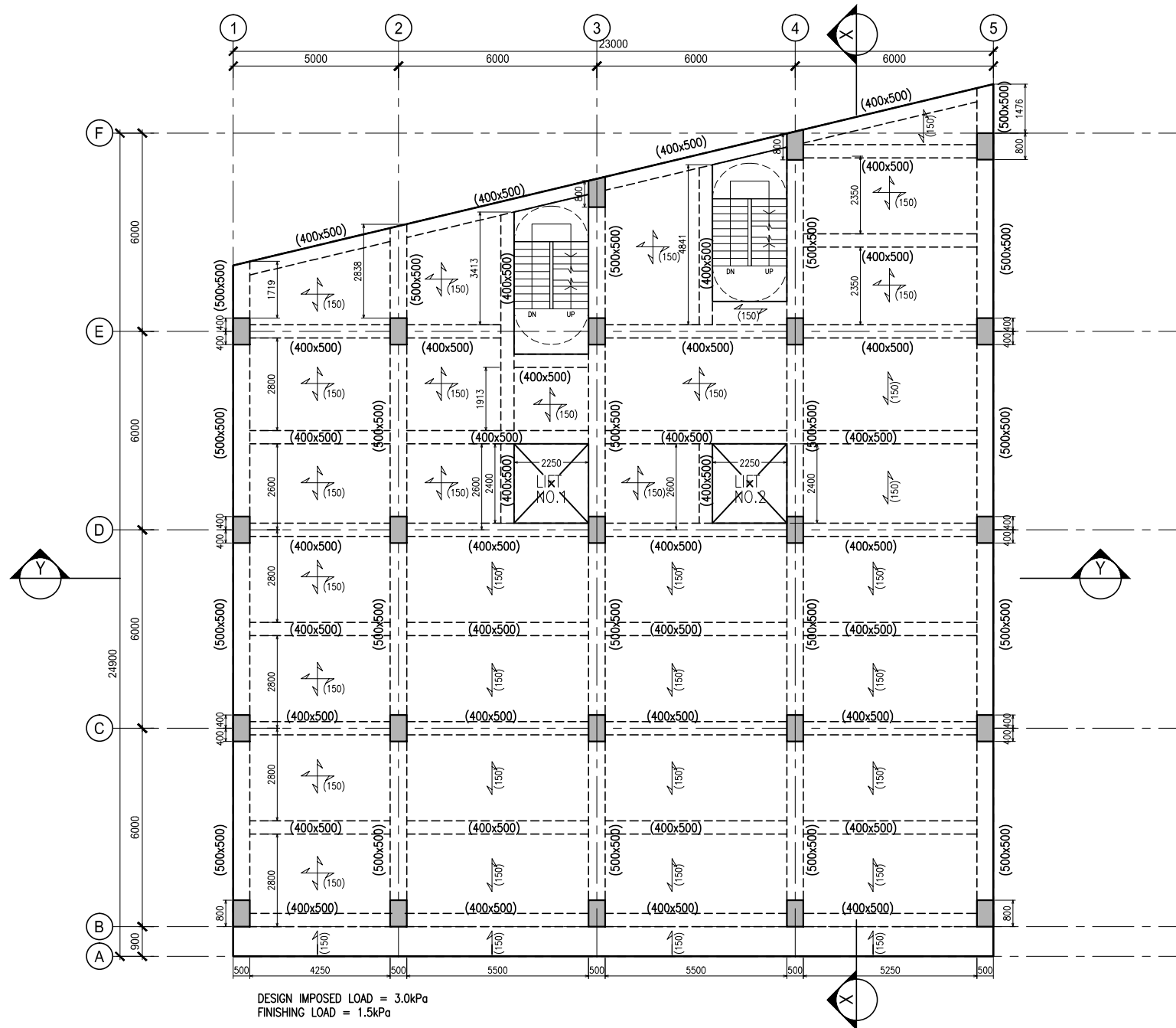
**(10 marks)**

- g. Prepare a detailed construction program covering essential activities from commencement of all protection and precaution measures to completion of structural works including the removal of the existing structures.

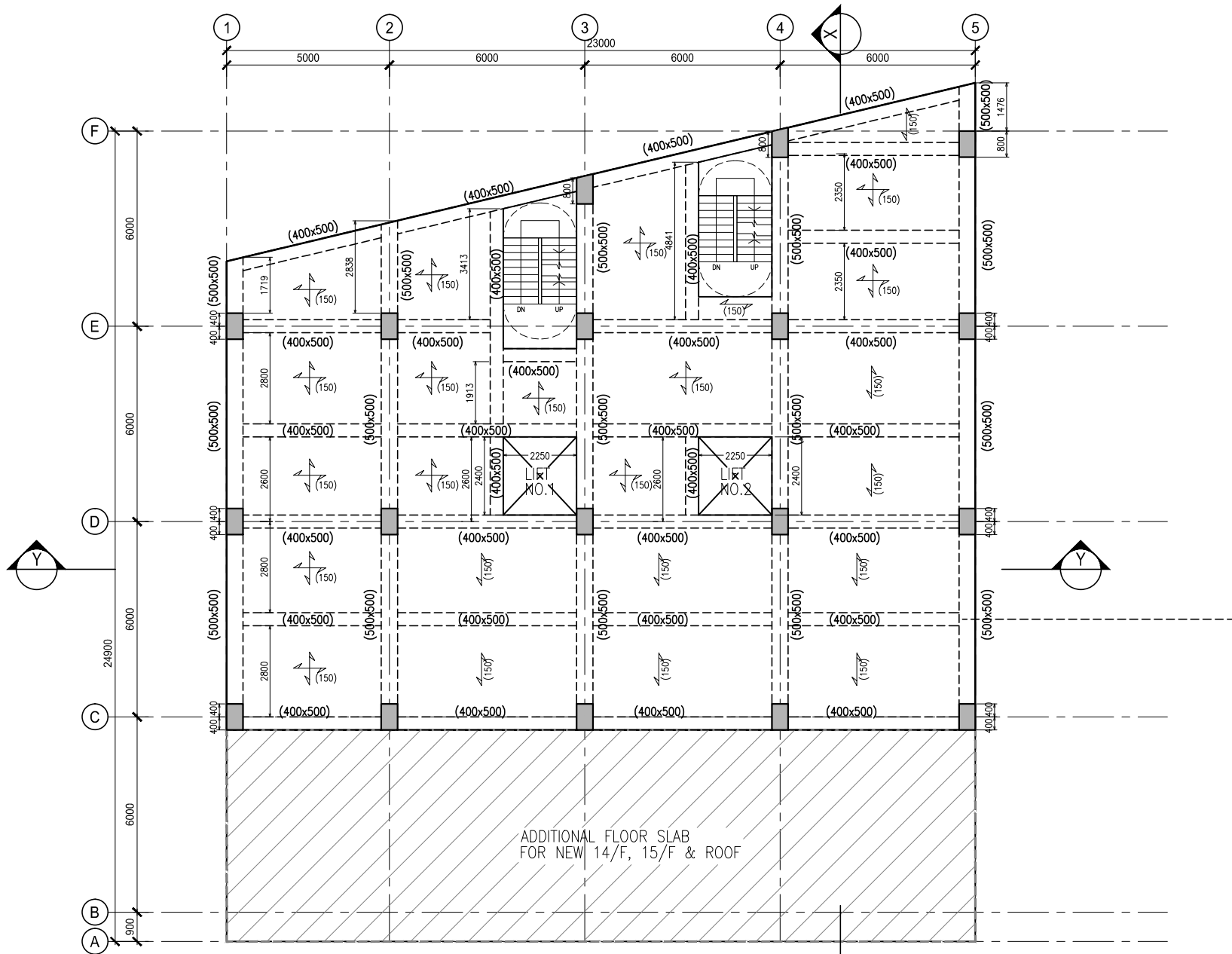
**(5 marks)**



**QUESTION Q4**  
**FIGURE 1 - EXISTING G/F LAYOUT PLAN**

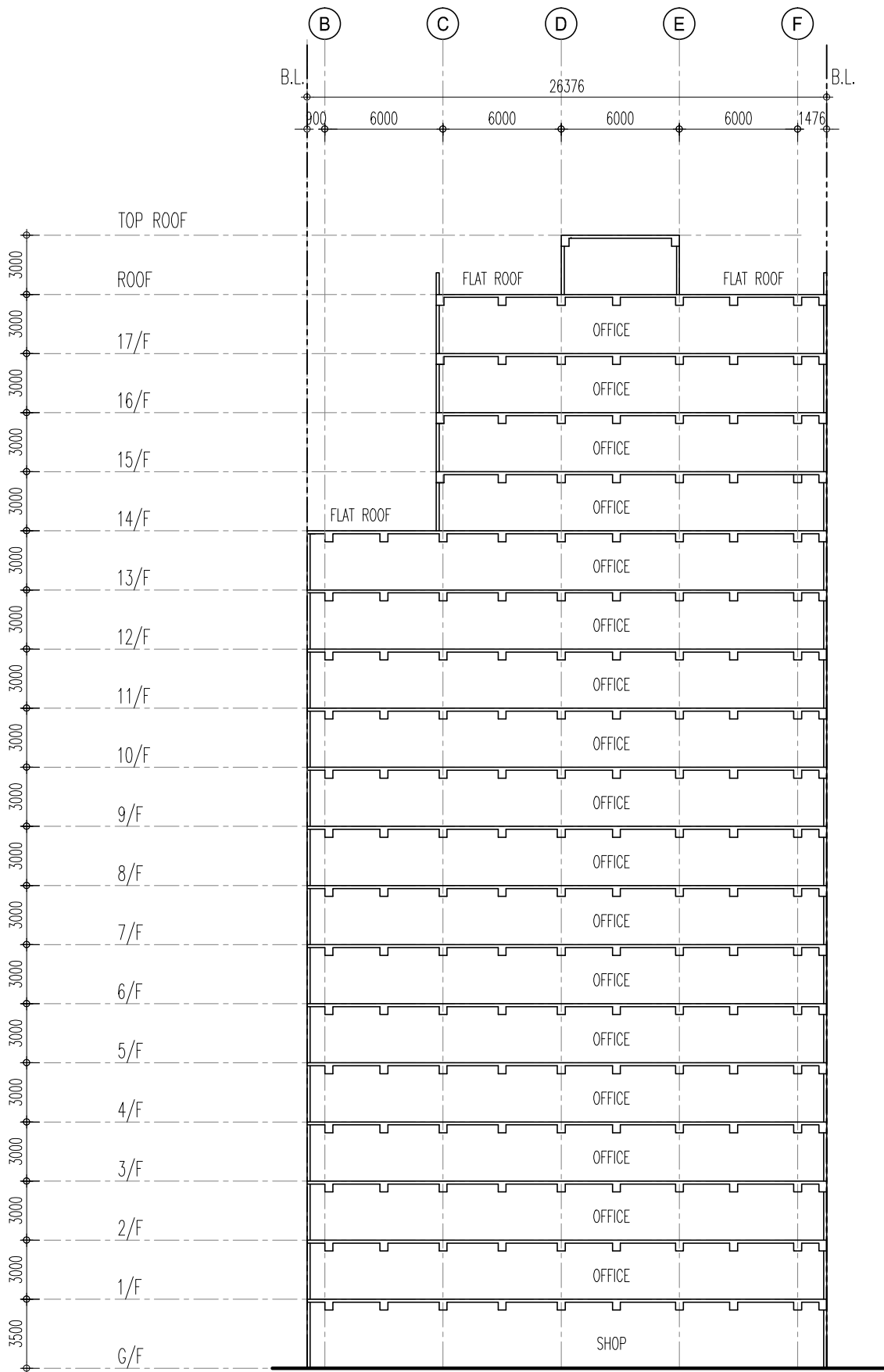


**QUESTION Q4**  
**FIGURE 2 - EXISTING TYPICAL FLOOR FRAMING PLAN (1/F-14/F)**

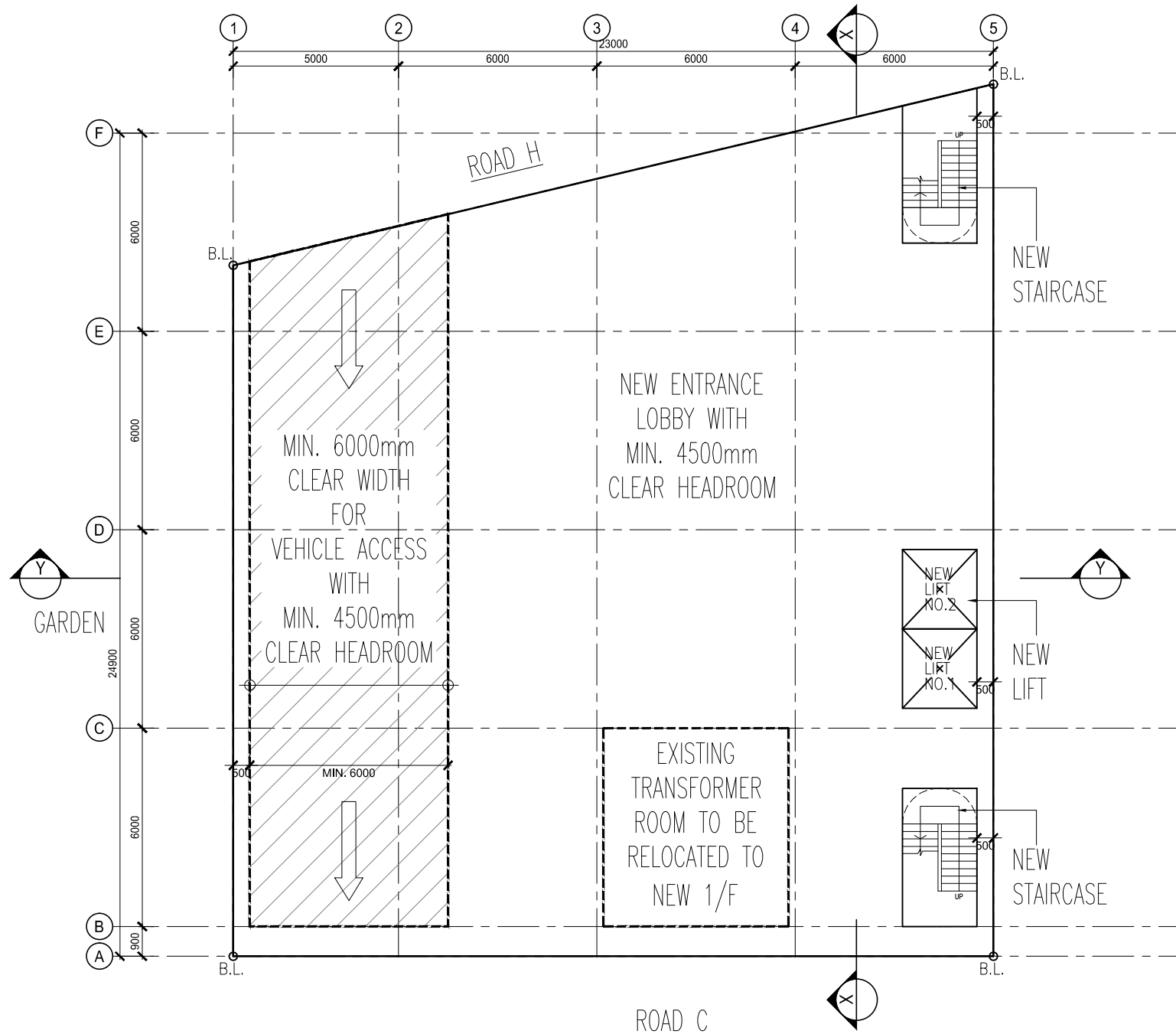


DESIGN IMPOSED LOAD = 3.0kPa  
 FINISHING LOAD = 1.5kPa

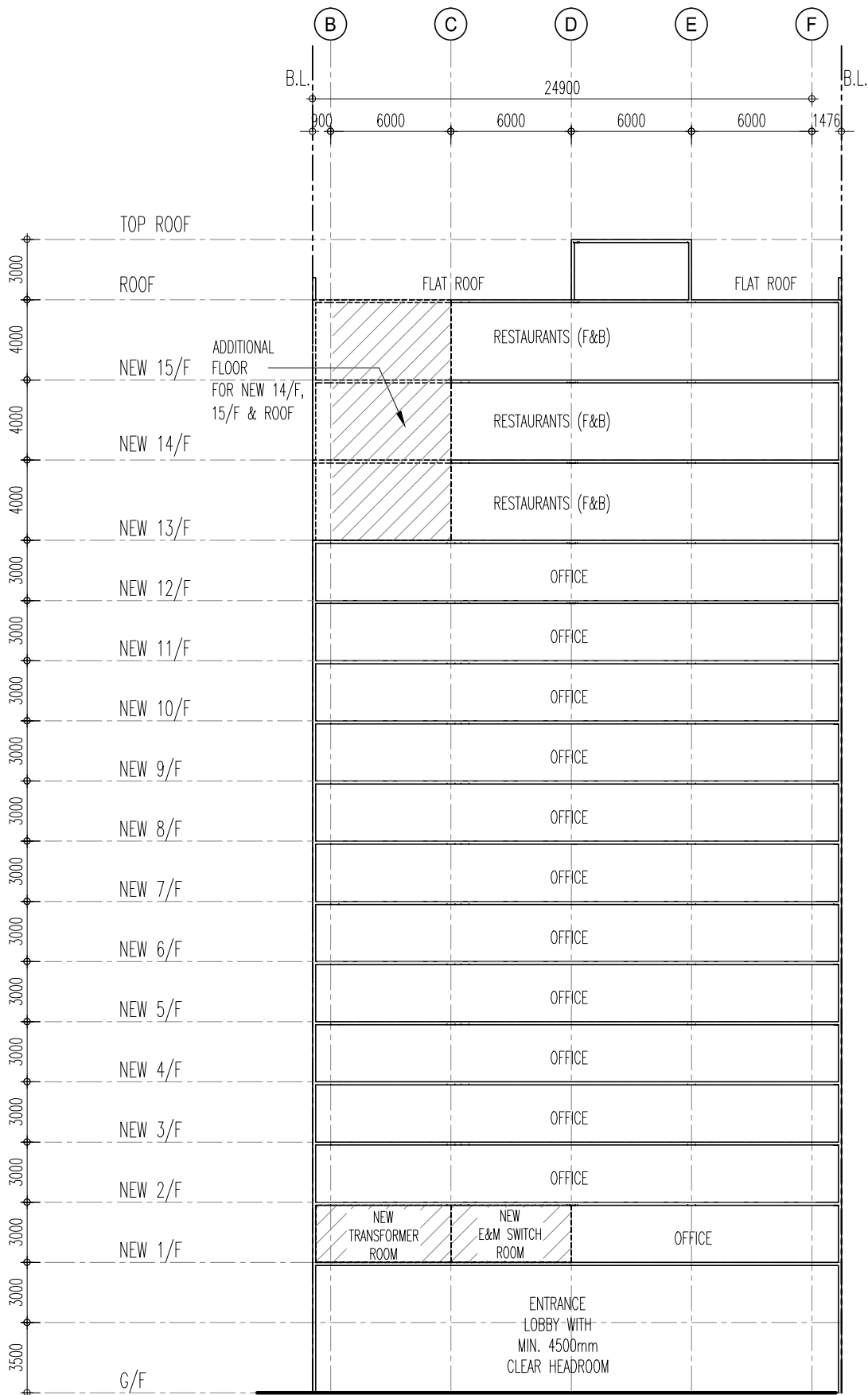
**QUESTION Q4**  
**FIGURE 3 - EXISTING TYPICAL FLOOR FRAMING PLAN (15/F-R/F)**



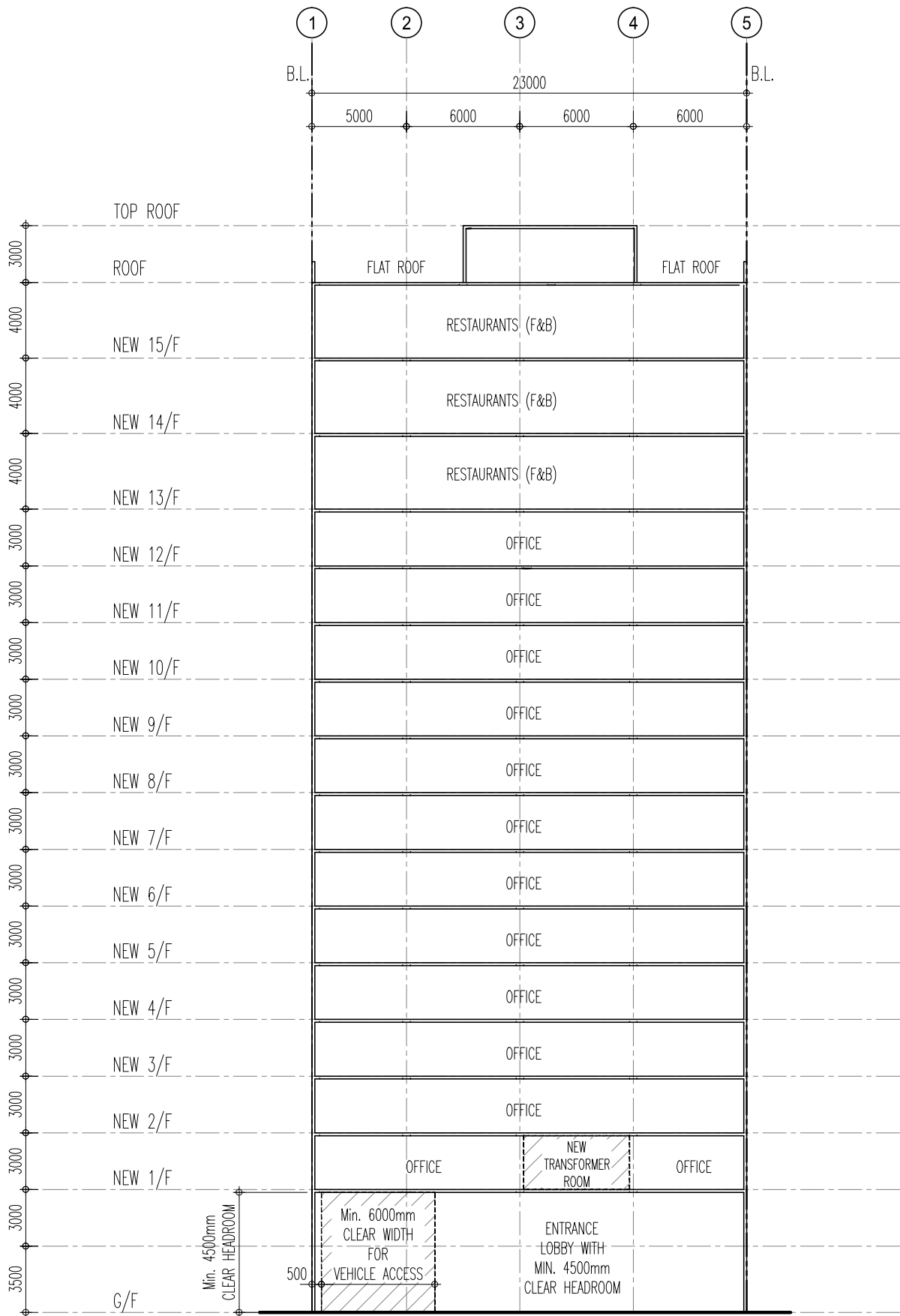
**QUESTION Q4**  
**FIGURE 4 - SECTION X-X (EXISTING)**



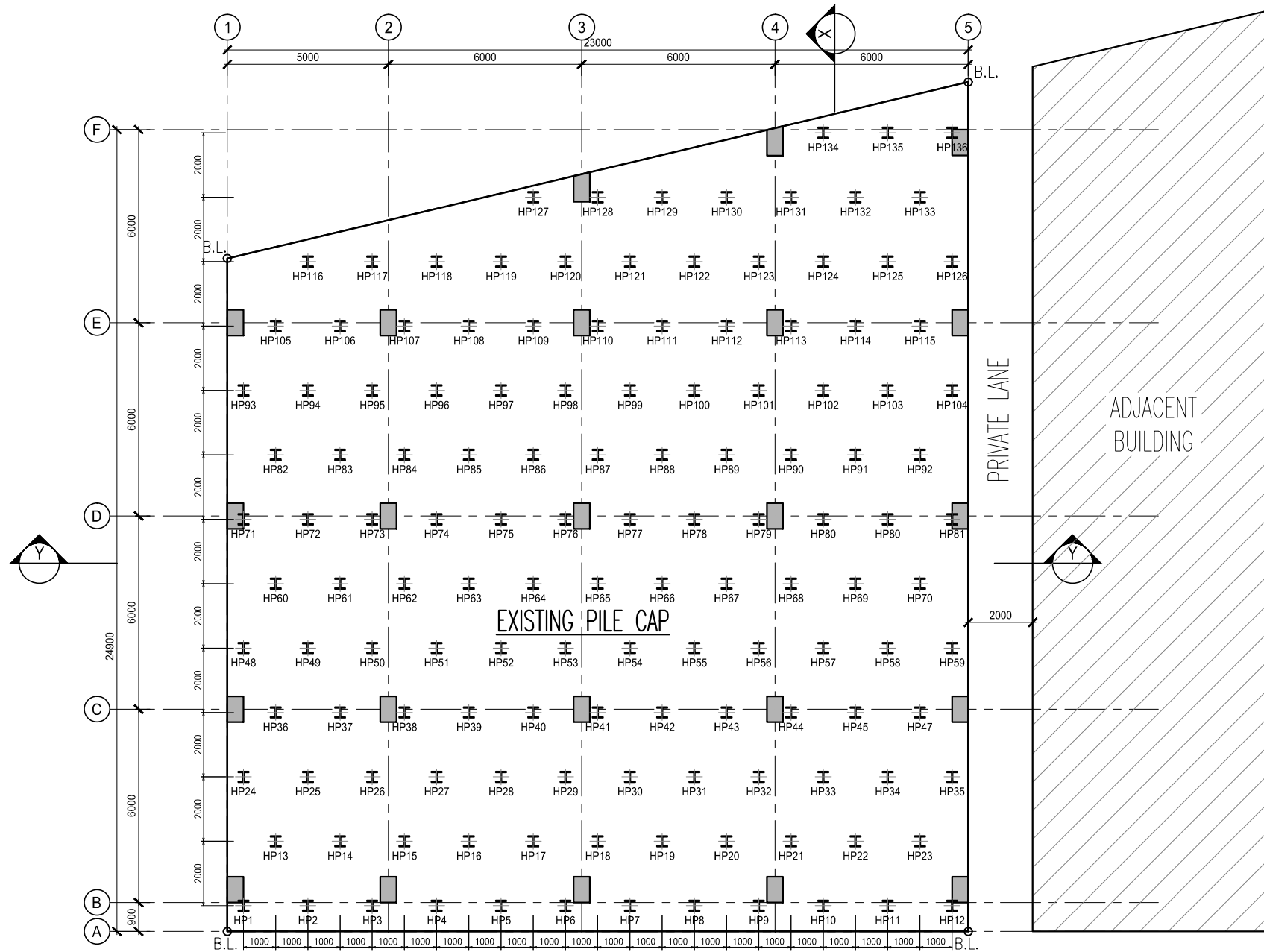
**QUESTION Q5**  
**FIGURE 5 - PROPOSED G/F LAYOUT PLAN (A&A)**



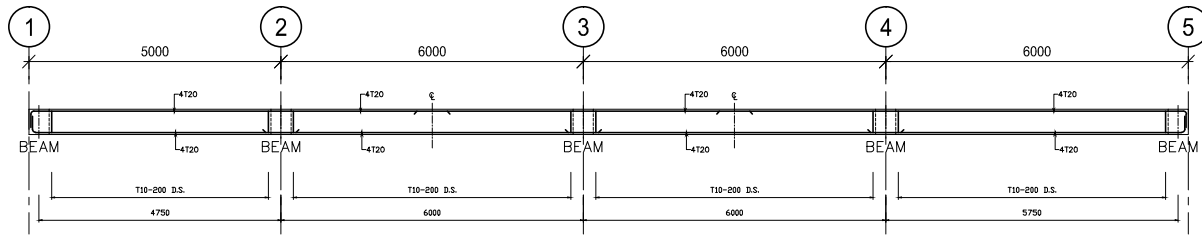
**QUESTION Q4**  
**FIGURE 6 - SECTION X-X (PROPOSED A&A)**



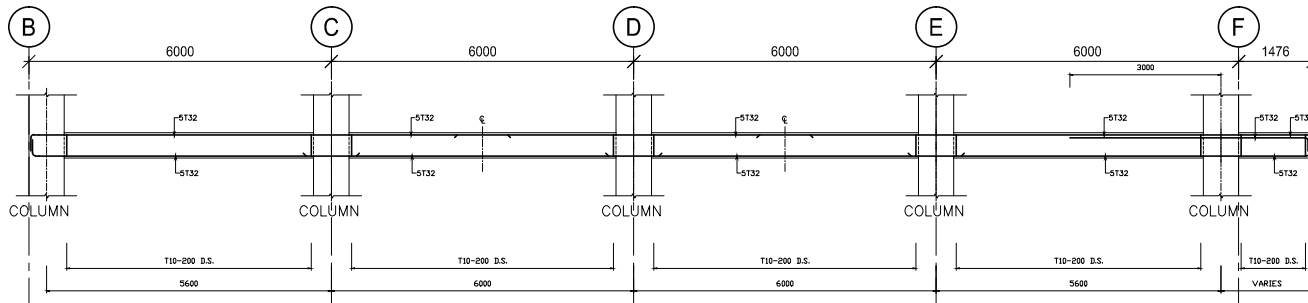
**QUESTION Q4**  
**FIGURE 7 - SECTION Y-Y (PROPOSED A&A)**



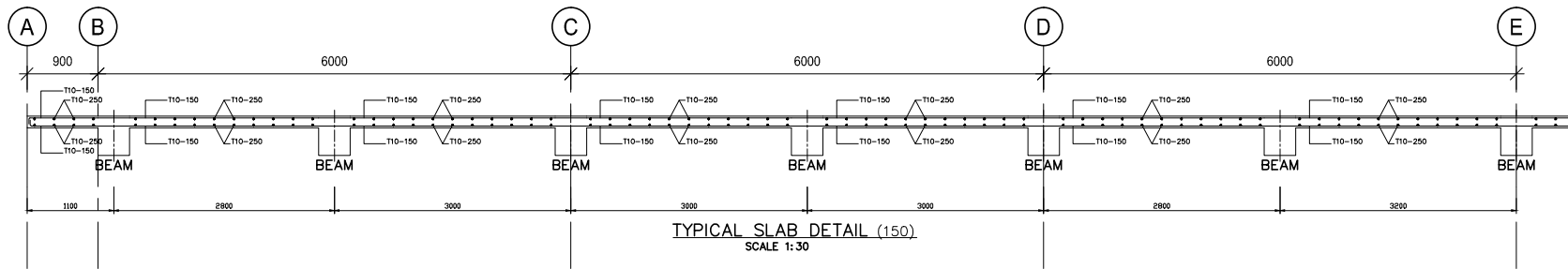
**QUESTION Q4**  
**FIGURE 8 - EXSITING PILING LAYOUT PLAN**  
**(FOR REFERENCE ONLY)**



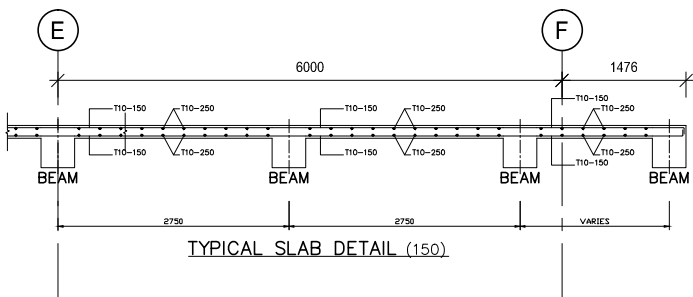
TYPICAL SECONDARY BEAM DETAIL (400x500)  
SCALE 1:50



TYPICAL MAIN BEAM DETAIL (500x500)



TYPICAL SLAB DETAIL (150)  
SCALE 1:30



TYPICAL SLAB DETAIL (150)

**QUESTION Q4**  
**FIGURE 9 - EXSITING RC BEAM/SLAB DETAILS**  
**(FOR REFERENCE ONLY)**

## Question 5      Footbridge

### Client's Requirements

The following client's requirements must be met:

1. A new naturally ventilated covered footbridge is proposed to run across an existing Drainage Channel to provide access to an existing Government Centre directly for local community from the east side of Drainage Channel. See Figure 1.
2. The footbridge is straight and will connect to an existing Government Centre at the west end. No loading is allowed to transfer from the footbridge to the existing Government Centre and an expansion joint is required at the interface. Lift and staircase will be required at the east end. There would be provision of a link bridge over the no column zone for future connection to the proposed commercial building.
3. Minimum clear headroom of footbridge is 3m, 300mm overhead services zone should be allowed for in the design. Maximum width of staircase is 2.4m. Landing of length of 1.5m shall be required for every 12 steps. Column supports to the footbridge are permitted only within amenity area and footpaths (excepted the No Column Zone).
4. The design of the structure should have a minimum and maximum longitudinal gradient of 1.0% and 1.5% fall respectively to allow for drainage.
5. The existing Drainage Channel have provision for future decking for playground use hence there is a restriction on footbridge soffit level. No column is allowed on top of any location of existing Drainage Channel except the 2m allowable column zone. However, temporary supports are allowed during dry days upon coordination with relevant Departments. The highest water level in the Drainage Channel can be flooded to 500mm below amenity areas (west side) in rainy and stormy days.
6. No columns should be located within 1.5m adjacent to the Drainage Channel nor within 0.6m adjacent to the road.
7. Closure of only one lane of road for construction is allowed each night between mid-night and 6:00am.
8. The minimum requirements on clear headroom over proposed playground, footpaths, and amenity area are as follows:

<u>Location</u>	<u>Minimum Clear Headroom (m)</u>
Footpaths/Cycle Track	4.0
Amenity area	4.5
Road	5.1

9. The construction is planned to complete in two and a half year.

### **Design Requirements**

10. The structural design shall be in accordance with the latest version of the Structures Design Manual for Highways and Railways published by the Highways Department of the HKSAR Government.

### **Imposed Loads**

11. The imposed loads shall be in accordance with the latest version of the Structures Design Manual for Highways and Railways published by the Highways Department of the HKSAR Government.

### **Wind Loads**

12. The imposed loads shall be in accordance with the latest version of the Structures Design Manual for Highways and Railways published by the Highways Department of the HKSAR Government.

### **Site Conditions**

13. The site is located at open area with Degree 3 of exposure to wind.
14. Ground conditions as revealed by the Ground investigation boreholes are:

From 0m to 2m	Loose Fill, SPT N-value = 0 – 10 [Category 4(d)] <sup>Note 1</sup>
From 2m to 12m	Medium dense soil, SPT N-value = 10 – 40 [Category 4(c)] <sup>Note 1</sup>
From 12m to 20m	Very dense soil, SPT N-value > 50 [Category 4(d)] <sup>Note 1</sup>
20m and below	Moderately decomposed granite with total core recovery >85% [Category 1(c)] <sup>Note 1</sup>

Groundwater is encountered at 5m below ground level (East Side).

Note 1: Categories of soil/rock refer to Table 2.1 of Code of Practice for Foundation 2017.

### **Omit from Consideration**

15. Design calculation of lift shaft, and railing.
16. EQ loading.

## Section A

- a. Prepare a design appraisal with appropriate sketches indicating two distinct and viable solutions for the span of the proposed footbridge over the Drainage Channel including two viable foundation schemes. Clearly indicate the function framing, load transfer and stability aspects of each scheme to meet all client's requirements. Identify the solution you recommend and give reasons for your choice.

**(30 Marks)**

- b. Explain how the structural will resist wind loading including detailed description of the structural wind loads and design assumptions. Prepare detailed wind load calculations for the proposed bridge.

**(10 Marks)**

## Section B

### For the solution recommended in Section A:

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

**(20 Marks)**

- d. Prepare foundation plans and details, framing plans (including articulation of bearings), sections, and elevations to show the dimensions, layout and disposition of the structural elements and critical details for cost estimating purposes.

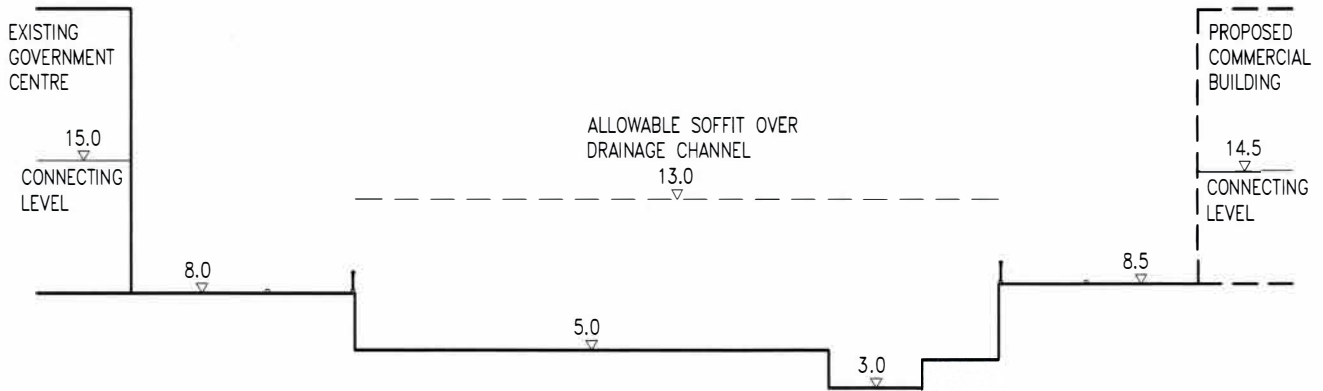
**(20 Marks)**

- e. Prepare a detailed method statement covering essential activities for the construction of the superstructure and sub structures of the footbridge including foundation works.

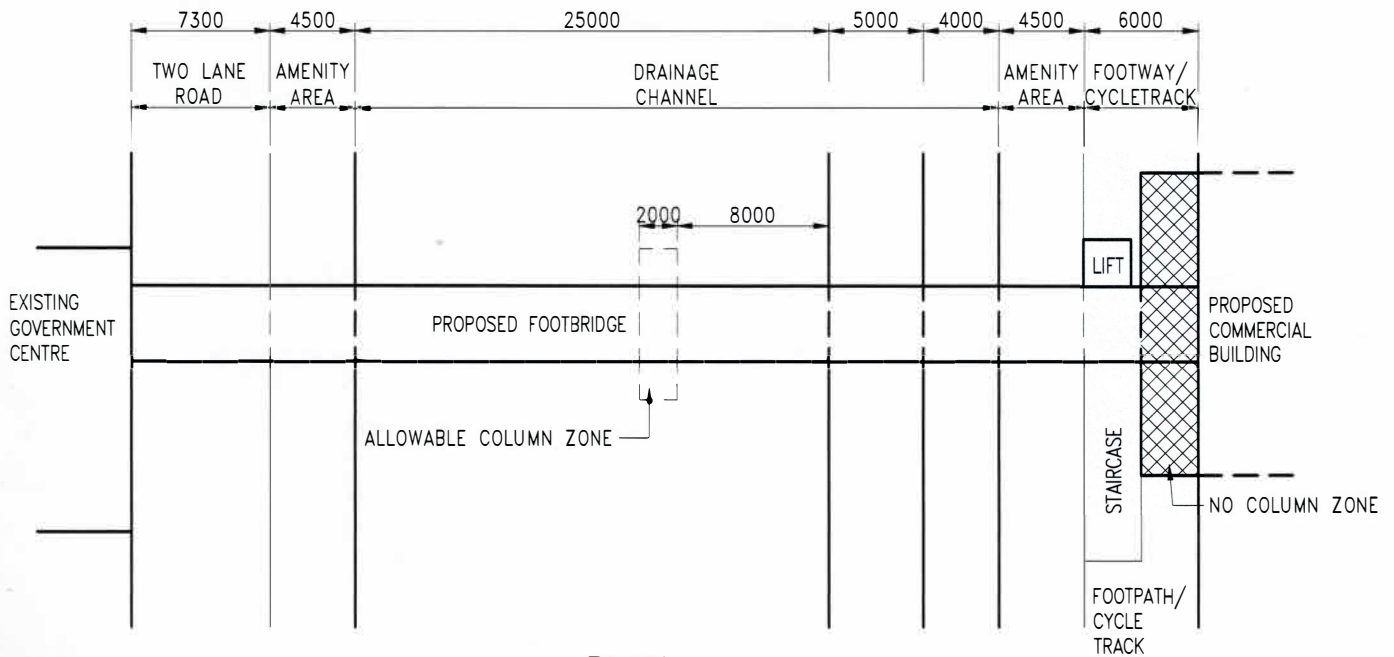
**(10 Marks)**

- f. Prepare a detailed construction programme covering essential activities from commencement of foundation to completion of structural works.

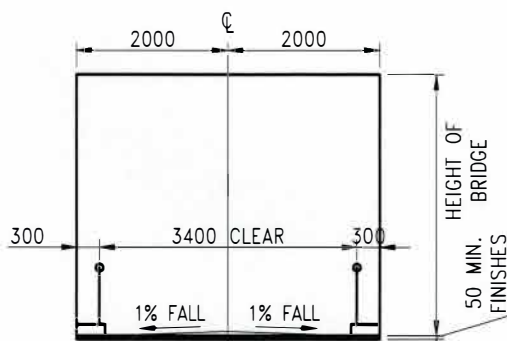
**(10 Marks)**



SECTION



PLAN



TYPICAL FOOTBRIDGE CROSS SECTION

\*ALL DIMENSION ARE SHOWN IN mm