

[C021/SQP045]

Higher
Building and
Architectural Technology
Specimen Question Paper

Time: 3 hours

NATIONAL
QUALIFICATIONS

100 marks are allocated to this paper.

Answer **all** questions in Section A (40 marks).

Answer **three** questions from Section B (20 marks each).

Worksheets are provided for questions 7, 8 and 9.

Hand these in with your answer book.

An extract from BS 5328 : Part 1 : 1997 is also provided for use with question 7.

SECTION A

Marks

Attempt all the questions in this Section (total 40 marks)

1. (a) Briefly explain **three** reasons for carrying out a site investigation. 3
(b) State the **two** most common ways to carry out ground exploration. 1
(c) Describe an *in-situ* soil test which may be carried out during ground exploration. 4
(8)
2. Sketch and annotate a typical cross-section through **each** of the following foundation types:
(a) a pad foundation to support an *in-situ* concrete column; 4
(b) a raft foundation for a light commercial building. 4
(8)
3. The cavity wall for a new sports hall is to be constructed of two leaves of concrete blockwork. Internally the lightweight blockwork will be finished with a fair face.
(a) Explain why movement joints may be required in the masonry wall. 3
(b) State the maximum spacing at which vertical movement joints should be placed in the wall of the sports hall. 1
(c) Sketch and annotate a horizontal cross-section through a vertical movement joint in one leaf of the wall. 4
(8)
4. (a) Traditional cavity walling has changed over the last 25 years.
State the principal factor which has brought about this change. 1
(b) State **three** performance requirements of a traditional cavity wall. 3
(c) A new dwelling house is to be constructed on the west coast of Scotland.
Explain what materials and finishes you would specify for the external walls and windows giving clear justification for your choice. 4
(8)
5. An external render with a dry dash finish is to be applied to a background of clay bricks in a moderately exposed location.
(a) Prepare a list of suitable materials to be used for the undercoat render. 2
(b) State the mix proportions to be used for this situation. 2
(c) Explain the sequence of operations in applying the complete render. 4
(8)

SECTION B

Marks

Attempt any THREE questions in this Section (total 60 marks)

6. Twenty five new detached houses with access roads are to be constructed on a green field site.
- (a) State the temporary accommodation which will be required on the site. 6
 - (b) State **four** factors which should be taken into consideration when deciding where to locate the temporary accommodation. 4
 - (c) State the temporary services which will be required on site and what their main use will be. 2
 - (d) Select **four** of the following materials and explain how they should be correctly stored on site.
 - (i) Portland cement
 - (ii) Clay facing bricks
 - (iii) Aggregates
 - (iv) Trussed rafters
 - (v) Plasterboard
 - (vi) Paint8
- (20)**
-
7. (a) Explain the terms “designated” mix and “standard” mix as used in the specification of concrete. 6
- (b) **Worksheet Q7** indicates an incomplete detail drawing for a foundation and concrete floor slab in a domestic house. Using the **Worksheet**, complete the drawing with notes and critical dimensions to show how the requirements for compliance with current Building Standards (Scotland) Regulations can be achieved. 12
- (c) Using the extract from BS 5328 : Part 1 : 1997 which is provided with this paper (*Page five*), select a suitable concrete mix specification for the floor slab and the strip foundation. 2
- (20)**
-
8. (a) Explain, with the aid of annotated sketches, the difference between a “warm” roof and an “inverted” roof with reference to flat roof construction. 8
- (b) **Worksheet Q8** indicates an incomplete detail drawing for a flat roof with a parapet wall. The waterproof covering to the roof is mastic asphalt and the design is for a “warm” roof. Using the **Worksheet**, complete the drawing with notes and critical dimensions to ensure compliance with current standards. 12
- (20)**

9. **Worksheet Q9** shows an architect's detail for a private stair within a dwelling house serving three bedrooms and a bathroom. *Marks*
- (a) Define the following terms in relation to a stair:
- (i) pitch line;
 - (ii) headroom;
 - (iii) rise;
 - (iv) going. 4
- (b) Using the **Worksheet**, annotate it to identify the following component parts:
- (i) stringer;
 - (ii) tread;
 - (iii) landings;
 - (iv) newel posts;
 - (v) balustrade;
 - (vi) handrail. 6
- (c) Mark on the **Worksheet** the minimum permitted dimension for each of the following:
- (i) headroom;
 - (ii) height of handrail;
 - (iii) going;
 - (iv) width of stair. 4
- (d) State the regulation regarding the minimum permitted size of openings in a balustrade. 1
- (e) Using the dimensions given on the **Worksheet**, calculate the rise, going and pitch of the stair and state whether or not the stair complies with current standards. 5
- (20)**
-
10. (a) Explain the following terms with reference to timber frame wall construction:
- (i) cavity ventilation;
 - (ii) cavity barrier;
 - (iii) vapour barrier. 6
- (b) Explain, with the aid of an annotated sketch, the construction of the outer wall of a timber framed dwelling house. 6
- (c) Sketch an annotated horizontal section through a window jamb to an approximate scale of 1:5 to show the location and fixing of a timber window in a timber frame dwelling house. Surrounding finishes should be shown. 8
- (20)**

[END OF QUESTION PAPER]

Table 13. Guide to the selection of designated and standard mixes

Application	Designated mix	Standard mix	Recommended workability (nominal slump ¹⁾)
<i>Foundations</i>			
Blinding and mass concrete fill	GEN 1	ST2	75
Strip footings ²⁾	GEN 1	ST2	75
Mass concrete foundations ²⁾	GEN 1	ST2	75
Trench fill foundations ²⁾	GEN 1	ST2	125
Reinforced foundations ²⁾	RC 35	N/A	75
Foundations in Class 2 sulfate conditions	FND 2	N/A	75
Foundations in Class 3 sulfate conditions	FND 3	N/A	75
Foundations in Class 4A sulfate conditions	FND 4A	N/A	75
Foundations in Class 4B sulfate conditions	FND 4B	N/A	75
<i>General applications</i>			
Kerb bedding and backing	GEN 0	ST1	Very low (nominal 10)
Drainage works to give immediate support ²⁾	GEN 1	ST2	Very low (nominal 10)
Other drainage works ²⁾	GEN 1	ST2	50
Oversite below suspended slabs ²⁾	GEN 1	ST2	75
<i>Floors</i>			
House floors with no embedded metal (see note 1 of 5.3.3 of BS 5328 : Part 2 : 1997):			
– Permanent finish to be added, e.g. a screed or floating floor	GEN 1	ST2	75
– No permanent finish to be added, e.g. carpeted	GEN 2	ST3	75
Garage floors with no embedded metal	GEN 3	ST4	75
Wearing surface: light foot and trolley traffic	RC 30	ST4	50
Wearing surface: general industrial	RC 40	N/A	50
Wearing surface: heavy industrial	RC 50	N/A	50
<i>Paving</i>			
House drives, domestic parking and external parking	PAV 1	N/A	75
Heavy-duty external paving	PAV 2	N/A	50
<i>Other reinforced and prestressed concrete applications</i>			
Reinforced or prestressed concrete: mild exposure	RC 30	N/A	75
Reinforced or prestressed concrete: moderate exposure	RC 35	N/A	75
Reinforced or prestressed concrete: severe exposure	RC 40	N/A	75
Reinforced or prestressed concrete: most severe exposure	RC 50	N/A	75
¹⁾ Unless otherwise specified. ²⁾ In non-aggressive soils i.e. Class 1 sulfate conditions in table 7a. NOTE 1. Classes for sulfate conditions are given in table 7a. NOTE 2. Classes for exposure conditions are given in table 5. NOTE 3. Concrete containing embedded metal should be treated as reinforced. NOTE 4. For guidance on workability, see table 11.			

[C021/SQP045]

Higher
Building and
Architectural Technology
Specimen Marking Instructions

NATIONAL
QUALIFICATIONS

SECTION A

Marks

Question 1

- (a) Briefly explain **three** reasons for carrying out a site investigation.

Any three of the points listed below

To assess the general suitability of the site for the proposed works;

To enable an adequate and economic foundation design to be prepared;

To plan for any temporary works that may be required;

To plan the best method of construction and to foresee and provide against difficulties and delays which may arise during construction due to the ground conditions;

To investigate ground conditions where a failure has occurred.

3

- (b) State the **two** most common ways to carry out ground exploration.

Trial pits dug by mechanical excavator

Bore holes by light percussion drilling (shell and auger)

1

- (c) Describe an *in-situ* soil test which may be carried out during ground exploration.

Candidates may choose to describe any one of the following:

- Field Vane Test;
- Standard Penetration Test;
- Cone Penetration Test.

Standard Penetration Test.

This is the most commonly employed *in-situ* test carried out during light percussion drilling. It gives an *N* value of the soil which indicates its relative density.

The test itself is a dynamic penetration test in which a 50 mm diameter sampling tube is driven into the ground using a standard weight (65 kg) freely dropping a standard distance (760 mm).

The number of blows to drive the sampler a distance of 300 mm is recorded as the *N* value.

4

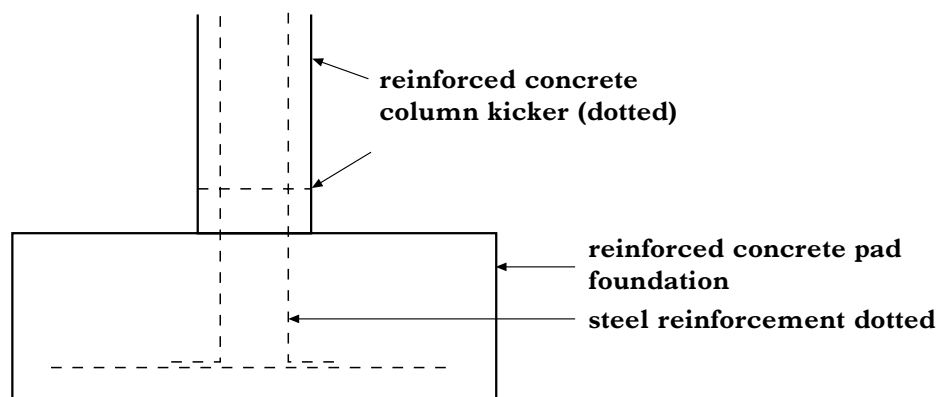
(8)

Question 2

Marks

Sketch and annotate a typical cross-section through **each** of the following foundation types:

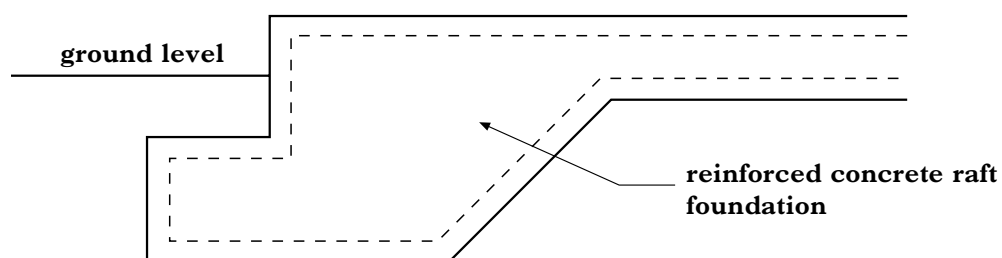
(a) a pad foundation to support an in-situ concrete column;



PAD FOUNDATION

4

(b) a raft foundation for a light commercial building.



RAFT FOUNDATION

4
(8)

Question 3

Marks

The cavity wall for a new sports hall is to be constructed of two leaves of concrete blockwork. Internally the lightweight blockwork will be finished with a fair-face.

- (a) Explain why movement joints may be required in the masonry wall.

All masonry is subject to movement. That is small dimensional changes which may be caused by one or more of the following factors:

- changes in temperature (thermal movement)
- changes in moisture content
- chemical action
- differential settlement

To accommodate movement it is necessary to build in movement joints to masonry walls at the required centres. Masonry units manufactured from different materials (eg clay bricks and concrete blocks) move at different rates.

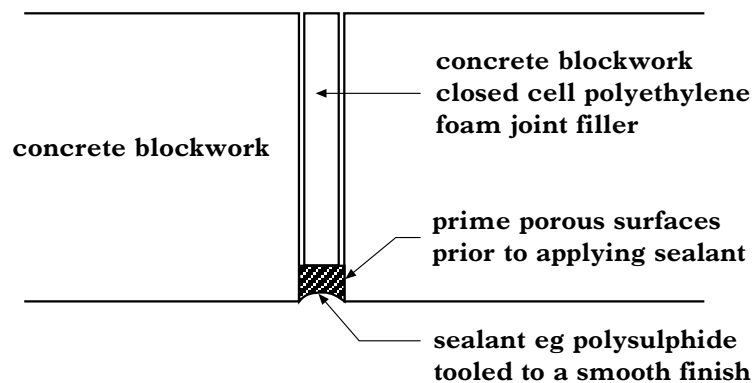
3

- (b) State the maximum spacing at which vertical movement joints should be placed in the wall of the sports hall.

6 metre

1

- (c) Sketch and annotate a horizontal cross section through a vertical movement joint in one leaf of the wall.



4

(8)

Question 4

Marks

- (a) *Traditional cavity walling has changed over the last 25 years. State the principal factor which has brought about this change.*

The principal factor has been the requirement to lower the U-value (thermal transmittance coefficient) of walls over the years due to government policy on energy conservation. This has led to the use of new materials and thicker insulation within the wall construction.

1

- (b) *State **three** performance requirements of traditional cavity wall.*

Any three from the following:

- Structure (to support the required loads)
- Weathertightness
- Durability
- Sound insulation
- Heat and moisture
- Fire
- Security

3

- (c) *A new dwelling house is to be constructed on the west coast of Scotland. Explain what materials and finishes you would specify for the external walls and windows giving clear justification for your choice.*

The west coast of Scotland is a geographical area of high wind speed and very severe exposure to driving rain.

Material selected for walling and windows should be able to withstand the climatic agents experienced in this part of the country.

For walls select masonry such as facing bricks which are durable eg engineering bricks with keyed joints. Alternatively, apply render to the walls to protect the masonry.

Windows should be high performance timber windows or alternatively PVCu windows which will require less maintenance. All windows should be double glazed.

4

(8)

Question 5

Marks

An external render with a dry dash finish is to be applied to a background of clay bricks in a moderately exposed location.

- (a) *Prepare a list of suitable materials to be used for the undercoat render.*

Any four from the following:

Portland cement

Hydrated lime powder

Washed building sand

Water clean and uncontaminated

Admixture (Proprietary waterproofer)

2

- (b) *State the mix proportions to be used for this situation.*

1 : 1 : 5 to 6

Portland cement : building lime : building sand

2

- (c) *Explain the sequence of operations in applying the complete render.*

The sequence of operations should include most of the following points.

- Preparation of the background by brushing down with a hard broom to remove dust and loose particles.
- Immediately before applying the undercoat check background for excessive suction. Dampen but do not soak backgrounds as appropriate.
- Apply the undercoat mix by laying on with a trowel to a thickness of between 8mm and 10mm. Trowel with pressure to remove air. Key the undercoat with a comb to scratch the surface. Cure the undercoat before applying the top coat.
- Apply butter coat of rendering to a uniform thickness of 8mm and while it is still plastic throw washed aggregate onto the surface to a uniform dense coverage. Immediately tamp the aggregate particles lightly into the butter coat to ensure a good bond is obtained.

4

(8)

SECTION B

Marks

Question 6

Twenty five new detached houses with access roads are to be constructed on a green field site.

- (a) *State the temporary accommodation which will be required on the site.*

There are regulations which set out the legal requirements for the minimum accommodation and facilities for site staff working on sites which has regard to the number of employees.

The following accommodation will be required:

- | | |
|--|------------|
| • Welfare facilities to include sanitary and washing facilities, canteen/rest facilities, facilities to change and store clothing; | 4×1 |
| • Office accommodation; | 1 |
| • Storage accommodation for tools and materials etc. | 1 |

- (b) *State **four** factors which should be taken into consideration when deciding where to locate the temporary accommodation.*

- | | |
|--|----------|
| Should be close to the site access | 1 |
| Near temporary services | 1 |
| Security of the site and accommodation | 1 |
| Vehicle parking for site personnel, visitors and materials delivery. | 1 |

- (c) *State the temporary services which will be required on site and what their main use will be.*

- | | |
|---|---------------|
| Water supply for temporary accommodation, cleaning and washing tools and mixing mortar or concrete. | $\frac{1}{2}$ |
| Electricity supply for lighting, heating and small tools. | $\frac{1}{2}$ |
| Telephone for communication including fax. | $\frac{1}{2}$ |
| Foul drainage for temporary sanitary facilities. | $\frac{1}{2}$ |

Question 6 (continued)*Marks*

(d) Select **four** of the following materials and explain how they should be correctly stored on site:

Portland cement; Clay facing bricks; Aggregates;
Trussed rafters; Plasterboard; Paint.

Bagged Portland cement

Portland cement must be stored in a dry weatherproof enclosed hut with a dry floor.

Store on a timber platform away from the walls and cover with polythene.

2***Clay facing bricks***

Bricks should stand on a firm, level, well drained base, not in contact with the soil. They must be wrapped in polythene to prevent them becoming wet or splashed by vehicles.

2***Aggregates***

Aggregates should be stored on a clean firm base to ensure no contamination. Different materials and grades must be kept separate.

2***Trussed rafters***

Must be stored either horizontally or vertically off the ground fully supported by battens below all joints to avoid damage to the joints by distortion. Must be protected from rain with a waterproof sheet secured all round.

2***Plasterboard***

Store horizontally on a dry level base consisting of a timber platform or by bearers at least 100mm wide laid across the width of the boards at centres not exceeding 400mm to prevent distortion of the boards. Do not stack boards to a height of more than 1000mm. Boards must be protected from the rain and rising damp with a waterproof sheet secured all round. Ideally they should be stored under cover.

2***Paint***

Should be stored in a lockable storage unit.

2**(20)**

Question 7

Marks

- (a) Explain the terms “designated” mix and “standard” mix as used in the specification of concrete.

A “designated” mix is one way to specify concrete by considering the site conditions and then identifying from Table 13 of the appropriate British Standard the application for which the concrete is to be used or the application that most closely resembles it and siting the corresponding designation.

The concrete must be ready-mixed from a quality assured plant.

3

A “standard” mix is another way to specify concrete for a limited number of applications. The mix, materials and mix proportions are selected from the British Standard.

Standard mixes are applicable for site batching of concrete.

3

- (b) **Worksheet Q7** indicates an incomplete detail drawing for a foundation and concrete floor slab in a domestic house. Using the **Worksheet**, complete the drawing with notes and critical dimensions to show how the requirements for compliance with current Building Standard (Scotland) Regulations can be achieved.

The attached worksheet indicates one solution.

Other solutions will be acceptable provided they comply with current standards.

Marks should be awarded as follows:

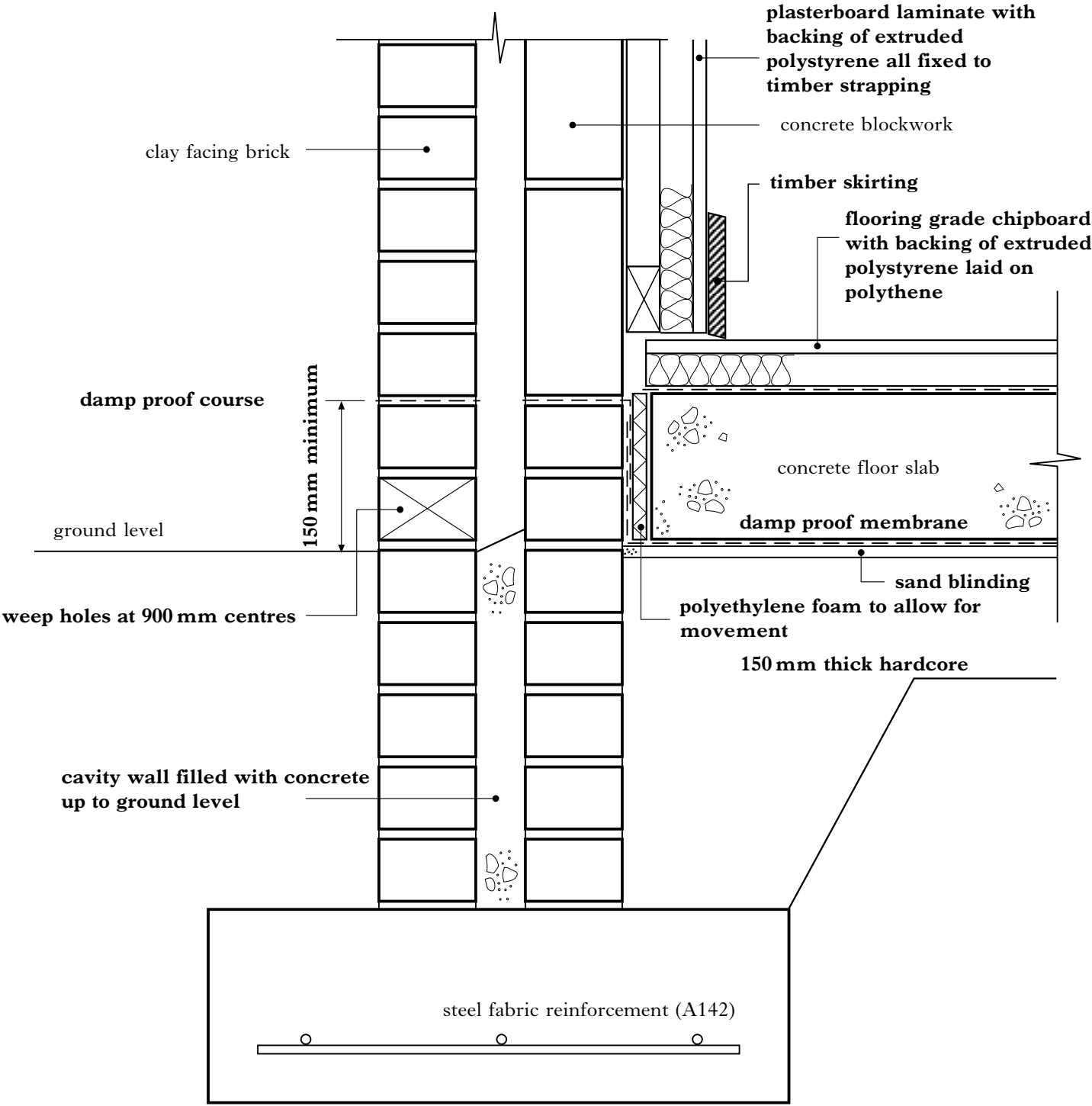
- Wall construction complete and the candidate has acknowledged that insulation is required. 2
- Floor construction complete and candidate has acknowledged that insulation is required in a floor. 2
- Damp proof course in the cavity wall at the correct location (150mm minimum above ground level). 2
- Cavity fill up to ground level. 1
- 150mm thick hardcore and blinding. 1
- Damp proof membrane in the floor lapped with the damp proof course in the wall. 2
- Weep holes in outer leaf. 1
- An allowance for movement in the floor slab. 1

- (c) Using the extract from BS 5328 : Part 1 : 1997 which is provided with this paper, select a suitable concrete mix specification for the floor slab and the strip foundation.

Refer to extract from BS 5328 : Part 1 : 1997

Concrete floor slab (unreinforced)	GEN 1	1
Reinforced concrete strip foundation	RC 35	1

(20)



SECTION

Question 8

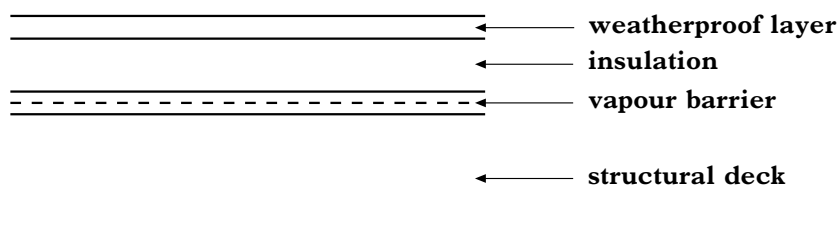
Marks

- (a) Explain with the aid of annotated sketches the difference between a “warm” roof and an “inverted” roof with reference to flat roof construction.

Warm roof

A flat roof system where insulation is laid below the weatherproof covering but above the structural deck. It is usually designed with a vapour barrier.

2

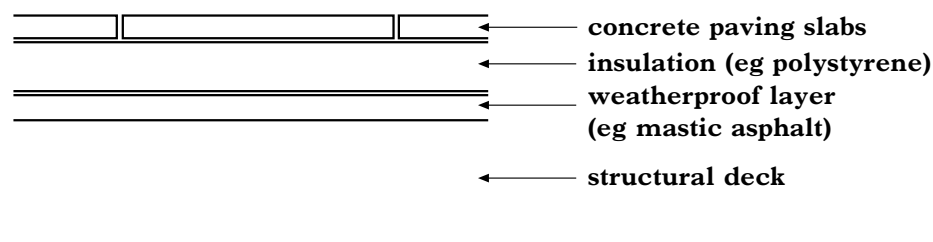


2

Inverted roof

A flat roof system where the insulation is laid above the weatherproof layer. The weatherproof covering also acts as the vapour barrier. The insulation has a protective layer of ballast in the form of paving slabs or cobbles.

2



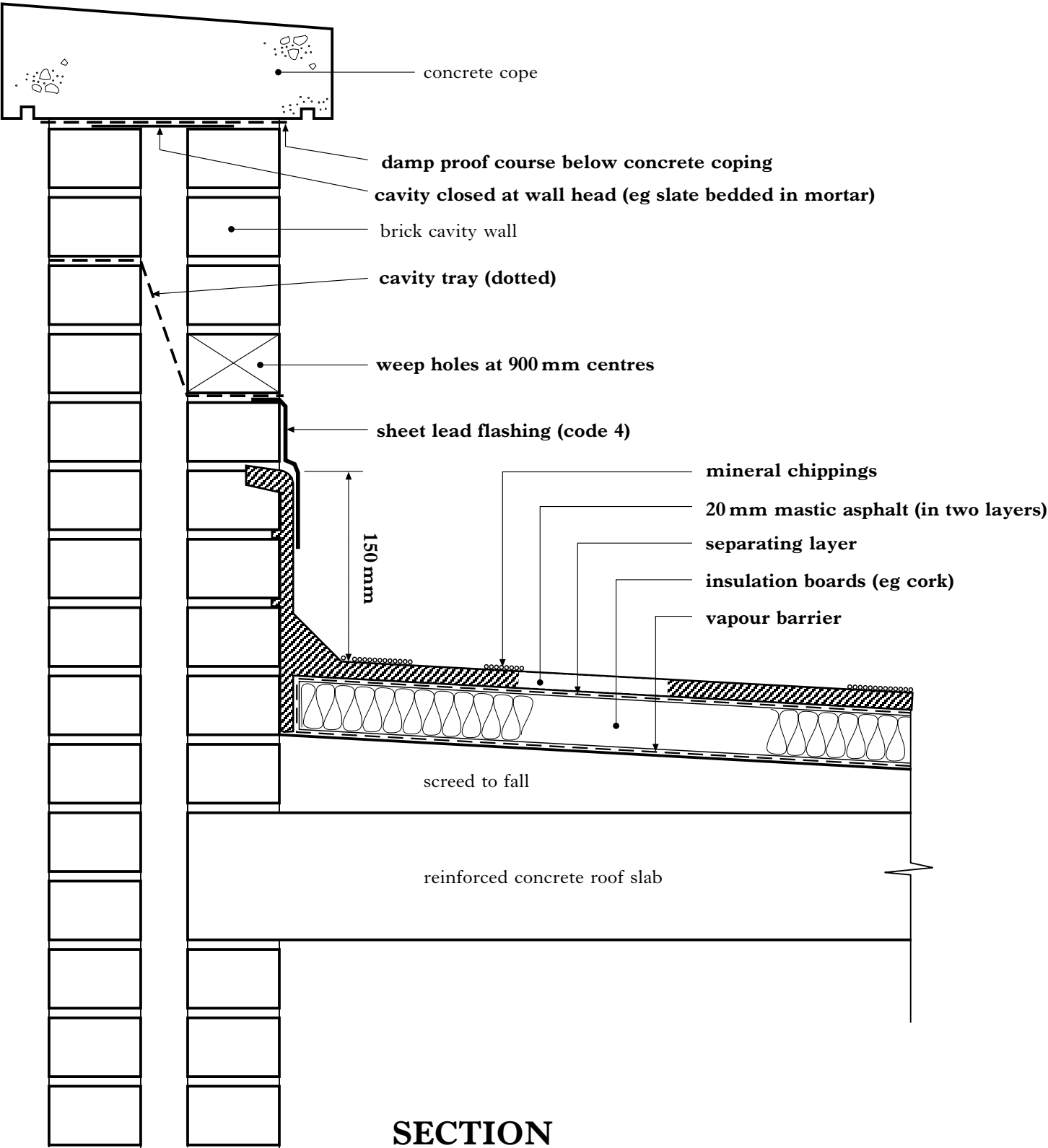
2

- (b) **Worksheet Q8** indicates an incomplete detail drawing for a flat roof with a parapet wall. The waterproof covering to the roof is mastic asphalt and the design is for a “warm” roof. Using the **Worksheet**, complete the drawing with notes and critical dimensions to ensure compliance with current standards.

The attached worksheet indicates a solution.

Marks should be awarded as follows:

- Damp proof course below cope; 1
 - Cavity closed at wall head; 1
 - Cavity tray in place; 2
 - Weep holes indicated; 1
 - Lead flashing in place; 1
 - Correct construction for the flat roof. 6
- (20)



Question 9

Marks

Worksheet Q9 shows an architect's detail for a private stair within a dwelling house serving three bedrooms and a bathroom.

- (a) Define the following terms in relation to a stair.

pitch line; headroom; rise; going.

Pitch line

A notional line drawn from the landing below a stairway to connect the nosings of all the treads in a flight of stairs.

1

Head room

The clear unobstructed height measured vertically from the pitch line to the soffit immediately above it.

1

Rise

The vertical distance between the upper surfaces of two consecutive treads.

1

Going

The horizontal distance between the faces of two consecutive risers.

1

- (b) Using the worksheet, annotate it to identify the following component parts:

*stringer; tread; landings;
newel posts; balustrade; handrail.*

See **Worksheet Q9** for answers.

One mark for correctly identifying each component part.

6×1

- (c) Mark on the worksheet the minimum permitted dimension for each of the following:

*headroom; height of handrail;
going; width of stair.*

Headroom 2000 mm

1

Height of handrail 840 mm

1

Going 225 mm

1

Width of stair 800 mm

1

- (c) State the regulation regarding the minimum permitted size of openings in a balustrade.

Openings must be small enough to prevent the passage of a 100 mm diameter sphere.

1

- (d) Using the dimensions given on the **Worksheet**, calculate the rise, going and pitch of the stair and state whether or not it complies with current standards.

rise $2665 \div 13 = 205$ mm

$\frac{1}{2}$

going $1350 \div 6 = 225$ mm

$\frac{1}{2}$

pitch – $\tan \angle = \text{opp} \div \text{adj}$

$\tan \angle = 205 \div 225 = 0.9111$

$\angle (\text{pitch}) = \text{inverse tan } 0.9111$

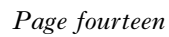
therefore pitch = 42.337 degrees

3

since the maximum pitch permitted for a private stair under current standards is 42.00 degrees the stair illustrated does not comply with current standards.

1

(20)



Question 10

Marks

- (a) Explain the following terms with reference to timber frame wall construction:

cavity ventilation; cavity barrier; vapour barrier.

Cavity ventilation

The cross ventilation of the external cavity between the timber frame and the brick cladding through open perpend in the brickwork. This is required to remove any water vapour which may escape from the building and which may otherwise build up in the cavity.

2

Cavity barrier

A device placed within the external cavity of timber frame and brick wall or between connecting elements of structure with the specific purpose of limiting the open area of cavity through which flame and smoke may spread.

2

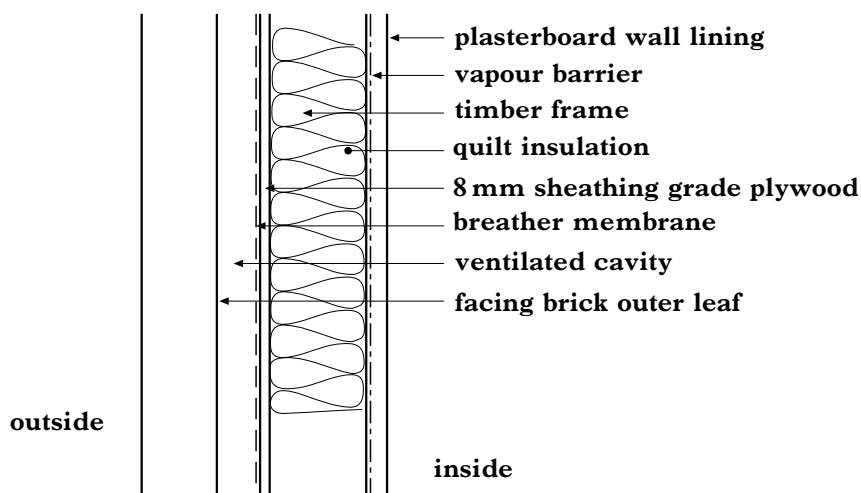
Vapour barrier

A vapour resistant sheet, usually polyethylene film, fixed to the inside face of the timber studs and on the warm side of the insulation. Its purpose is to minimise quantity of water vapour, generated in the building, that can permeate into the timber frame wall.

2

- (b) Explain with the aid of an annotated sketch, the construction of the outer wall of a timber framed dwelling house.

The sketch below indicates the construction of the outer wall. The timber framed wall is designed to carry all the vertical loads imposed by the building and transmit them to the foundation.



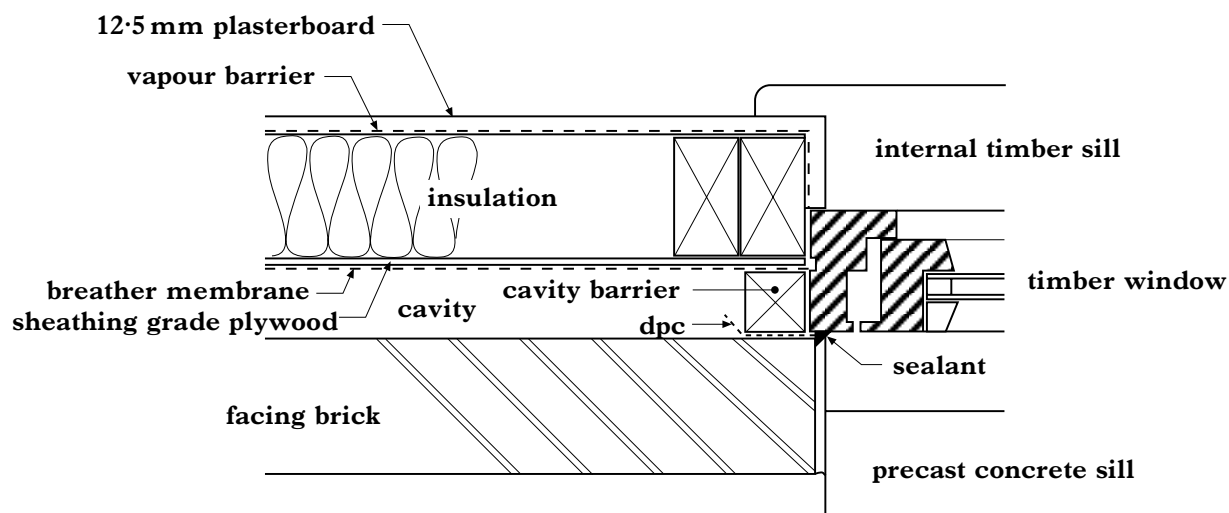
TIMBER FRAMED WALL CONSTRUCTION

6

Question 10 (continued)

Marks

- (c) Sketch an annotated horizontal section through a window jamb to an approximate scale of 1:5 to show the location and fixing of a timber window in a timber framed dwelling house. Surrounding finishes to be shown.



WINDOW JAMB

8
(20)

FOR OFFICIAL USE

Centre No.	Subject No.	Grade	Paper No.	Group No.	Marker's No.
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[C021/SQP045]

Higher
Building and
Architectural Technology

Time: 3 hours

NATIONAL
QUALIFICATIONS

Specimen Question Paper
Worksheets Q7, 8 and 9

Fill in these boxes and read what is printed below.

Full name of centre

Town

First name and initials

Surname

Date of birth

Day Month Year

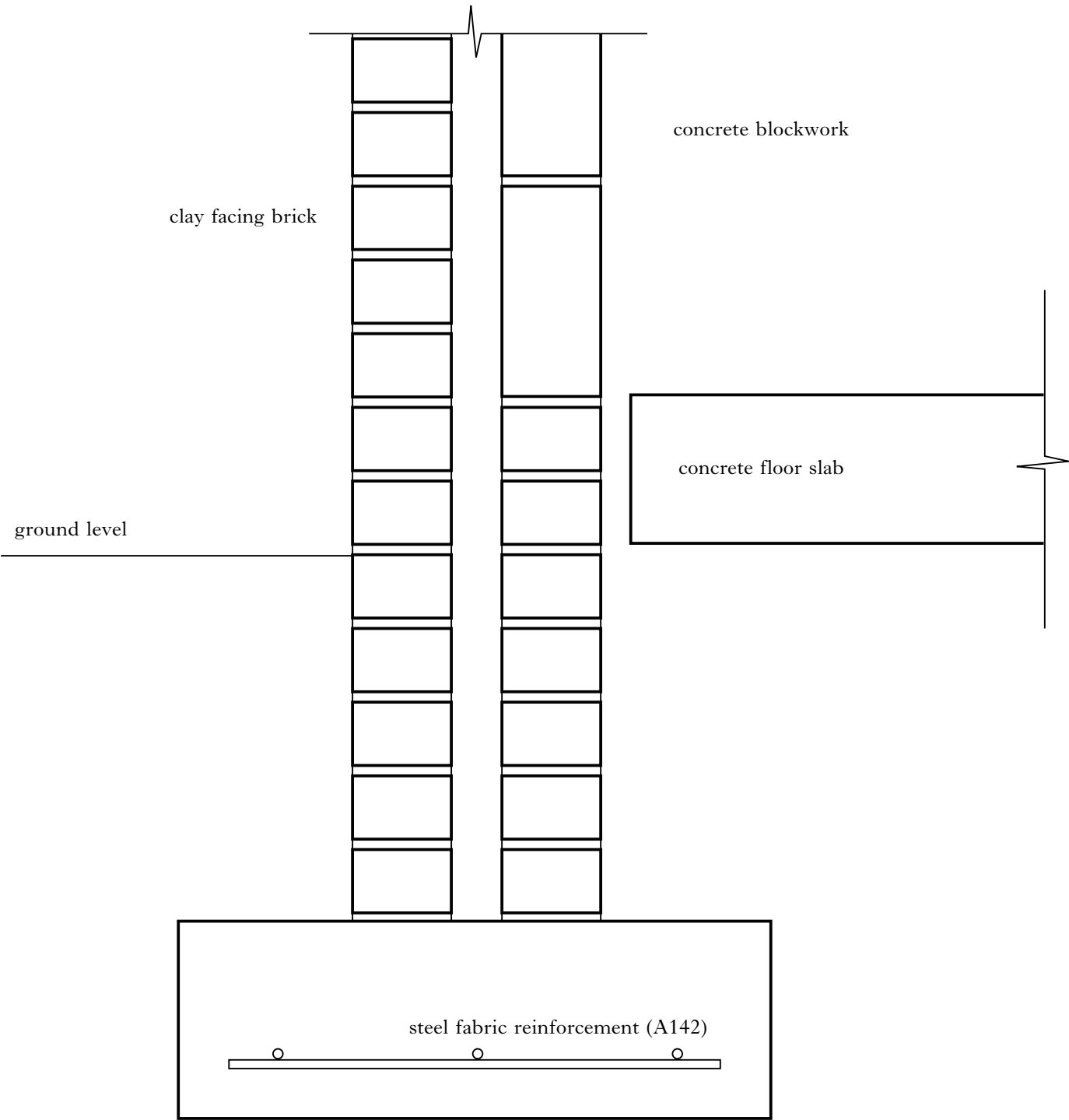
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Candidate number

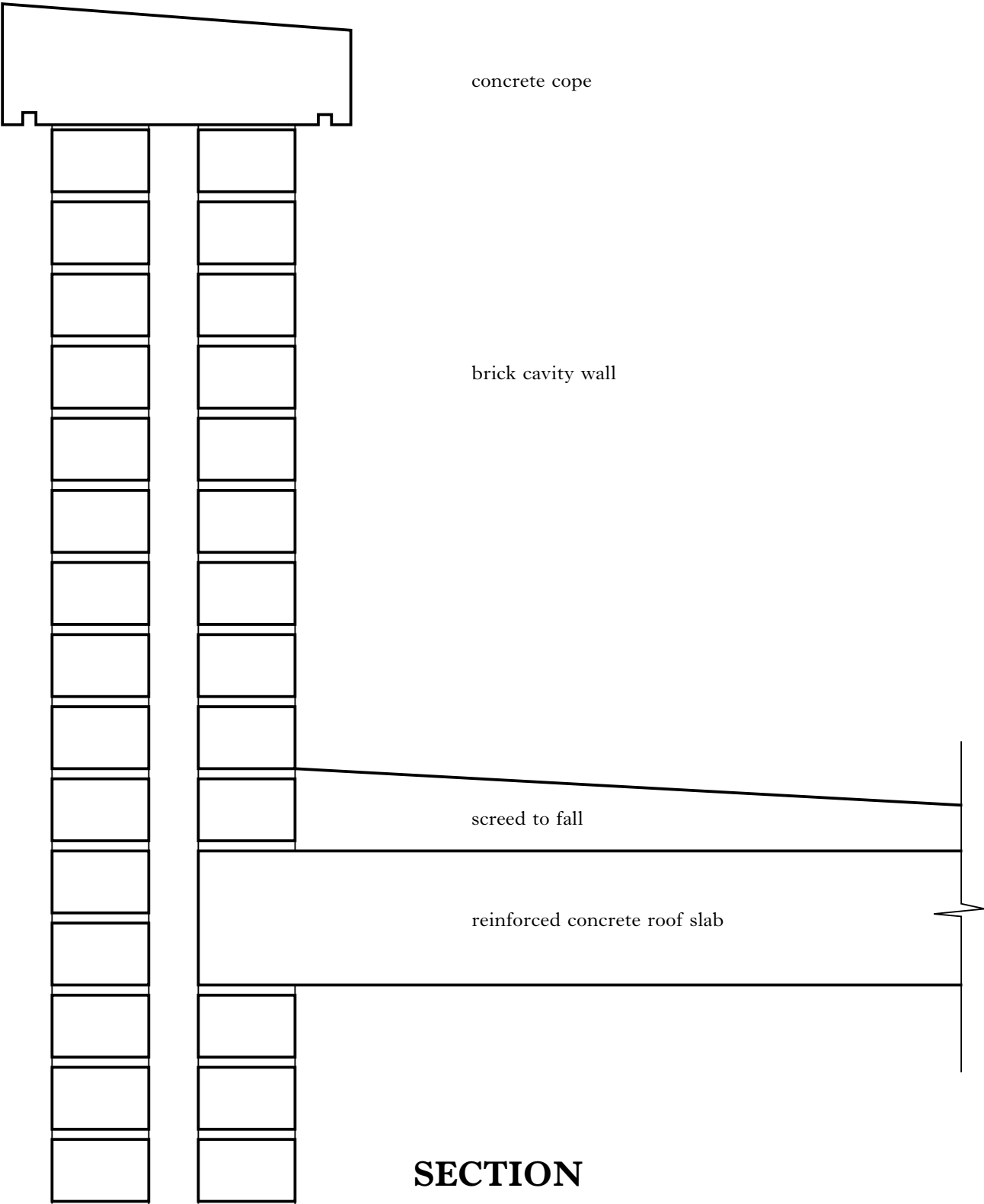
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Number of seat

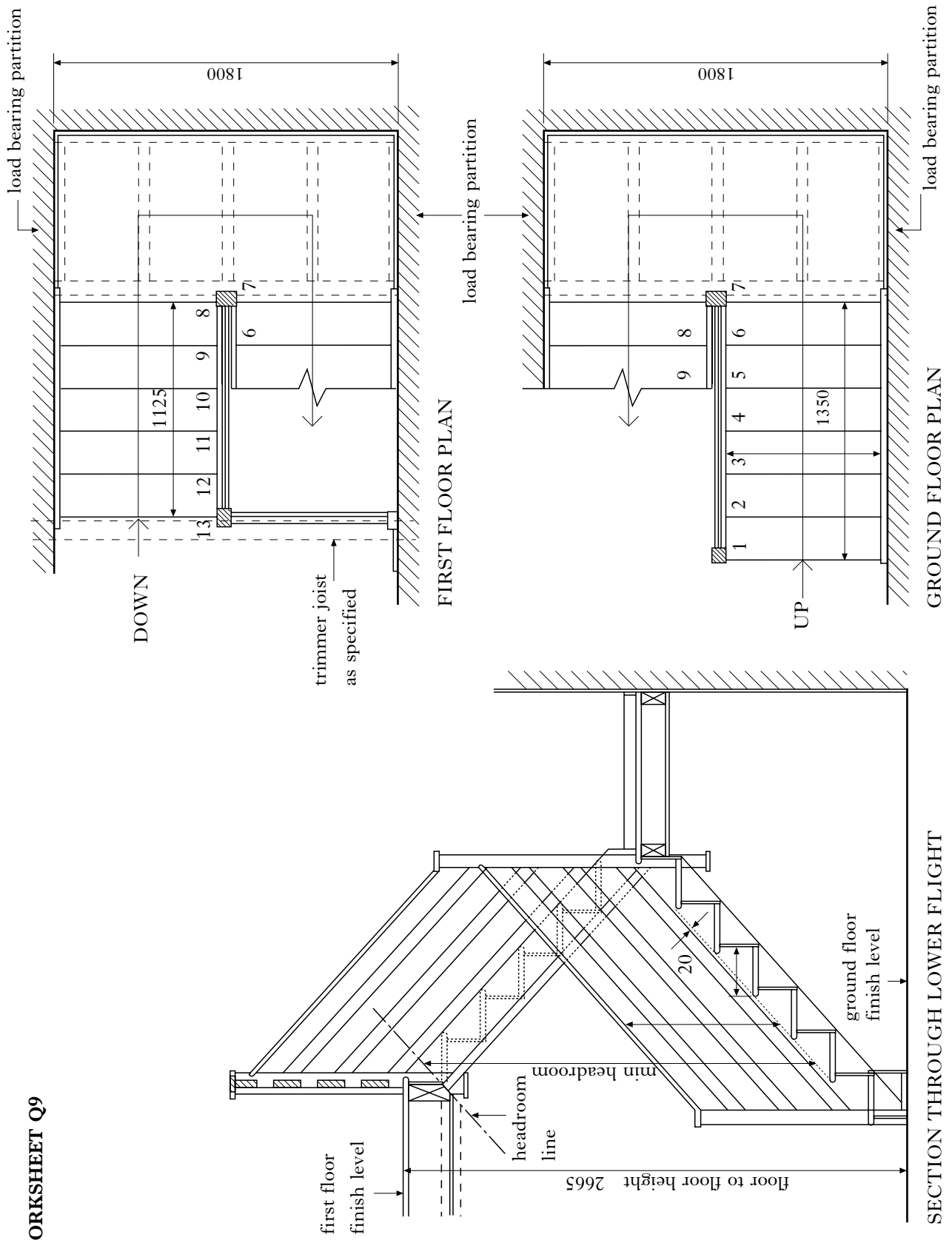
To be inserted inside the front cover of the candidate's answer book and returned with it.



SECTION



WORKSHEET Q9



[END OF WORKSHEET]