Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2023

Construction Studies

Theory - Higher Level

(300 marks)

Friday, 16 June
Afternoon, 2:00 - 5:00

(a) *Answer **any five** questions.*

(b) *All questions carry equal marks.*

(c) *Answers must be written in ink.*

(d) *Drawings and sketches are to be made in pencil.*

(e) *Write the number of the question distinctly before each answer.*

(f) *Neat freehand sketches to illustrate written descriptions should be made.*

(g) *The name, sizes, dimensions and other necessary particulars of each material indicated must be noted on the drawings.*

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1. The sketch shows a dwelling house with a roof constructed using prefabricated trussed rafters. The tiled roof has a pitch of 30° and an internal span of 5.6 metres. The external wall is of timber frame construction with an external rendered concrete block leaf. The internal timber frame is 250 mm × 50 mm. A 50 mm service cavity is also provided at the internal surface. The roof is highly insulated at ceiling joist level.

(a) To a scale of 1:10, draw a vertical section through one half of the roof structure from eaves up to the ridge. Show one external wall and one rafter length. Include the typical construction details from 600 mm below the ceiling joist up to the ridge and include three courses of tiles at eaves.

(b) On your drawing, indicate the typical design detailing to ensure ventilation of the roof structure.

2. **(a)** Discuss in detail the importance of **each** of the following in maintaining a safe working environment on a construction site:

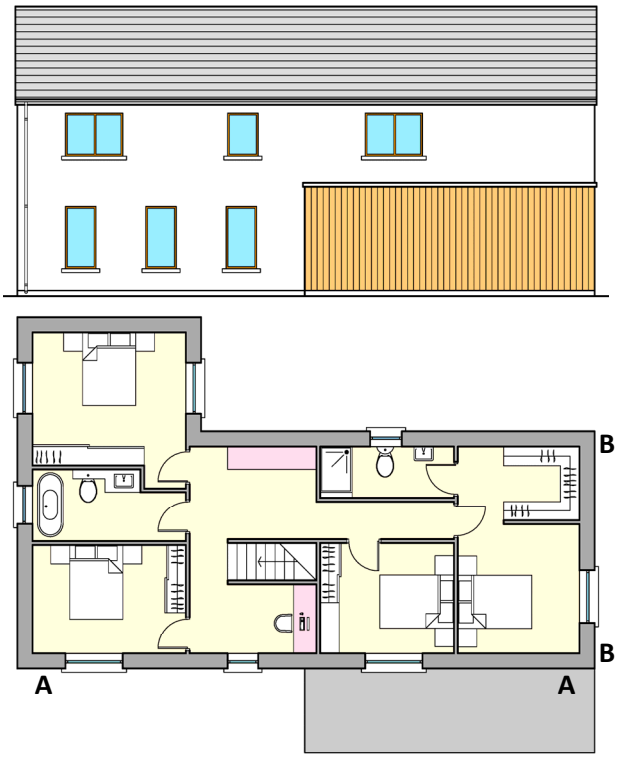
- communication
- supervision
- training.

(b) Using notes and freehand sketches, outline **two** specific best practice guidelines that should be observed for **each** of the following on a construction site:

- site access
- using a ladder.

(c) Discuss **two** reasons why all construction sites must have a safety statement.

3. The drawing shows the elevation and first floor plan of a two-storey house located by the coast. The front wall **A-A** is south facing and the wall **B-B** has views to the sea. The owners wish to relocate their kitchen/dining and living area to the first floor to take advantage of the orientation and sea views from their house. They intend to retain two bedrooms on the first floor and also retain the position of the stairs.

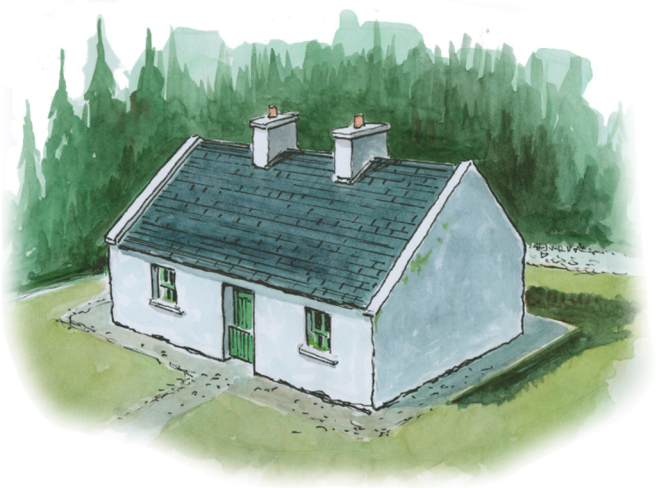


(a) Discuss in detail, **three** design considerations for the proposed new kitchen/dining and living area on the first floor.

(b) Using notes and freehand sketches, show a revised internal layout for the kitchen/dining and living area that incorporates **each** of the design considerations you outlined at **3(a)** above.
Justify your choices.

(c) Discuss **two** advantages and **two** disadvantages of locating a kitchen/dining and living area on the first floor of a dwelling house.

4. The sketch shows a vernacular Irish homestead built over 100 years ago. It was built in the vernacular tradition using local knowledge and skills which were related to its location and to the landscape. The owners wish to refurbish the cottage in a manner that respects the character of the original cottage.



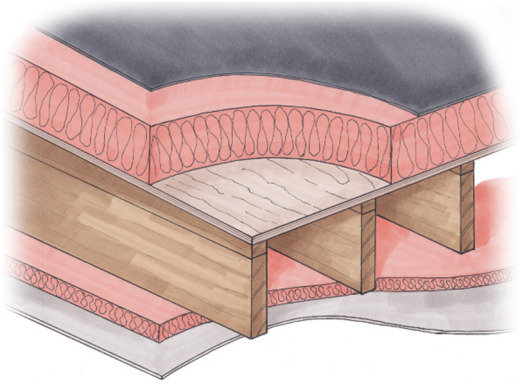
(a) Discuss in detail, using notes and freehand sketches, **three** features of vernacular Irish architecture evident in the cottage shown.

(b) Discuss the importance of any **two** of the following when carrying out a refurbishment of an old cottage built in the vernacular tradition:

- choice of materials
- craft skills
- respect for local character.

(c) Discuss **two** reasons to refurbish and maintain traditional Irish cottages.

5. An extension to a house has a highly insulated flat roof with a waterproof roof covering, as shown.



(a) Calculate the U-value of the roof, given the construction has the following sequence and data:

Waterproof covering	thickness	2 mm
Roof insulation	thickness	150 mm
Plywood decking	thickness	20 mm
Clear cavity between roof joists	thickness	200 mm
Ceiling insulation	thickness	50 mm
Plasterboard	thickness	12.5 mm

Thermal data of the flat roof:

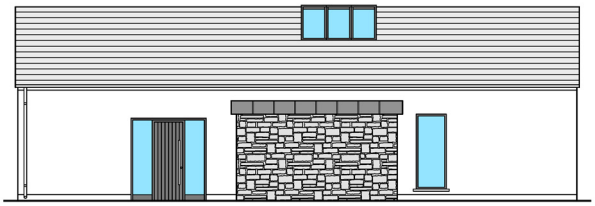
Resistance of external surface	(R)	0.048	m^2	°C/W
Resistivity of waterproof covering	(r)	6.250	m	°C/W
Conductivity of roof insulation	(k)	0.022	W/m	°C
Conductivity of plywood	(k)	0.130	W/m	°C
Resistance of clear cavity	(R)	0.170	m^2	°C/W
Conductivity of ceiling insulation	(k)	0.022	W/m	°C
Conductivity of plasterboard	(k)	0.250	W/m	°C
Resistance of internal surface	(R)	0.122	m^2	°C/W

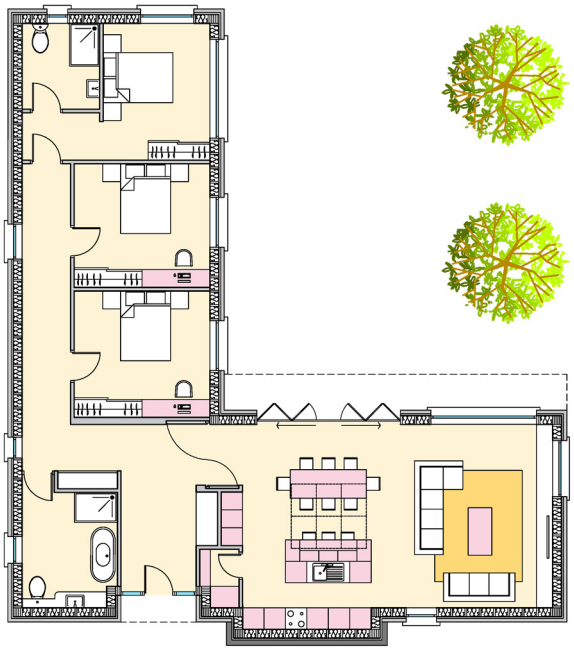
(b) Using the U-value of the roof obtained at **5(a)** above and the following data, calculate the cost of heat lost annually through this roof:

- dimensions of flat roof — 8.5 metres × 4.5 metres
- average internal temperature — 18 °C
- average external temperature — 5 °C
- heating period — 8 hours daily for 36 weeks per annum
- cost of oil — €1.25 per litre
- calorific value of oil — 37350 kJ per litre
- 1000 watts — 1 kJ per second.

(c) Using notes and a freehand sketch, show best practice design detailing that will prevent the formation of a thermal bridge at the abutment of the flat roof and external concrete block wall with a full-fill insulated cavity.

6. The elevation and ground floor plan of a house are shown. The external walls are of timber frame construction with a rendered concrete block and stone finish. The house is designed to have low environmental impact.





(a) With reference to the design shown, discuss using notes and freehand sketches, **three** features of the design that contribute to the house having a low environmental impact.

(b) Reducing operational energy demand is an important consideration in designing for low environmental impact. Using notes and freehand sketches, discuss in detail **each** of the following technologies and how each would further reduce the energy demand of the house:

- photovoltaic panels
- air-to-water heat pump
- evacuated tubes.

(c) Discuss in detail **two** advantages of reducing energy demand in the home.

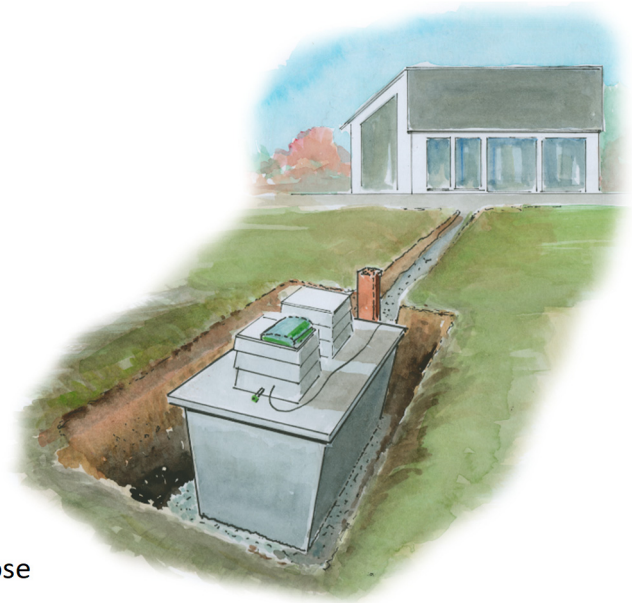
7. An external wooden door with vertical sheeting is the main entrance to a dwelling house, as shown. The thermally broken doorframe is 160 mm × 70 mm and the door is highly insulated. The 450 mm external wall of the house is of concrete block construction with a full-fill insulated cavity. The ground floor is a highly insulated solid concrete floor with a 20 mm tile finish.

(a) To a scale of 1:10, draw a vertical section through the centre of the door, external wall and ground floor. Show the typical construction details from a level 400 mm below the finished floor, through the door, up to a level 400 mm above the concrete lintels.

(b) On your drawing, show the typical design detailing that will prevent the ingress of moisture at the threshold.

8. **(a)** Discuss in detail, **three** functional requirements of a typical wastewater treatment system for a dwelling house.

(b) A wastewater treatment system is being installed for a dwelling house, as shown. Using notes and freehand sketches, show the typical design layout necessary for a wastewater treatment system and percolation area suitable for a house in a rural area.



Describe how the system works and include **four** typical dimensions.

(c) Discuss **two** reasons why it is important to properly treat and dispose of wastewater from a dwelling house.

9. The entry of light into rooms is a key consideration when designing a home.

(a) Discuss in detail, using notes and freehand sketches, **two** functional requirements of a modern glazing system for a dwelling house.

(b) The sketch shows a living room which measures 4.5 metres long by 4.2 metres wide. The living room has a vertical window and unobstructed views. An average illumination of 500 lux of daylight is required on the work plane.

Calculate using the degree of efficiency method, or any other suitable method, the appropriate area of glazing required to provide the stated illumination.
Assuming the illumination of a standard overcast sky to be 5000 lux.

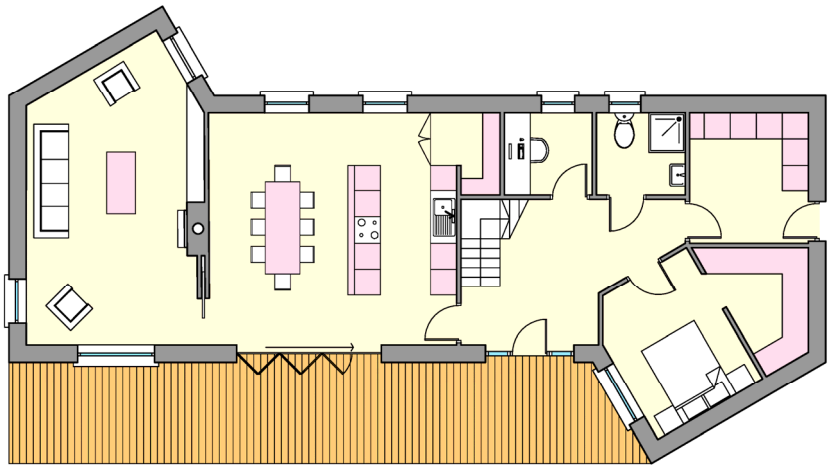
(c) Discuss **two** advantages and **two** disadvantages of installing triple glazing in a modern window framing system.

10. **(a)** Using notes and freehand sketches, discuss the importance of any **two** of the following in Passive House design:

- foundation design
- solar shading
- thermally efficient building envelope.

(b) The drawing shows the draft design of the ground floor plan for a new dwelling house. The engineer must design a Mechanical Ventilation with Heat Recovery (MVHR) system for this house.

Draw a line diagram of the given house plan. Show on your diagram the location of the MVHR unit and a typical design layout for the system ducting. Indicate clearly the direction of the airflow in the ducts.



Describe how the MVHR system works.

***Note**: It is not necessary to show the furniture.*

(c) Discuss in detail, **two** design considerations that need to be taken into account when deciding on the location of a MVHR unit in a dwelling house.

OR

10. "People regardless of age, size, ability or disability are positively contributing to the social, economic and cultural life of our communities. However, finding suitable and appropriate homes that can accommodate our changing needs over time can be difficult - whether for families with young children, a person with a temporary or permanent injury, someone with a disability, or an older person living independently. Universal Design can meet everyone's needs through flexible homes designed to adapt to lifecycle and lifestyle patterns of people over time."

Adapted from: **Universal Design Guidelines for Homes in Ireland**
Published by National Disability Authority

(a) Discuss the above statement in detail.

(b) Propose **three** best practice guidelines that would ensure all buildings are designed and constructed to be flexible to meet people's needs over their life.

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