Pre-Leaving Certificate Examination, 2020

Construction Studies

Theory - Higher Level

(300 marks)

Time: 3 Hours

(a) *Answer **Question 1** and **four** other 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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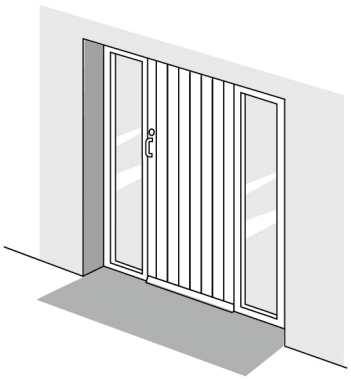
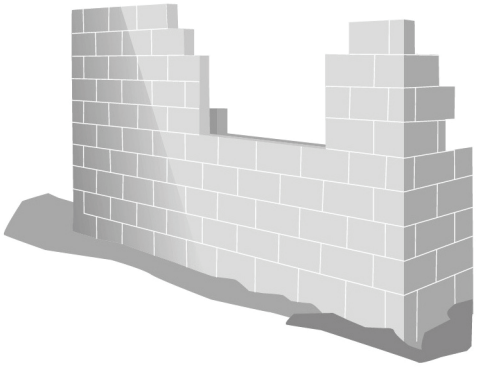
1. A high performance insulated wooden door with vertical sheeting on both sides is fitted in the external wall of a dwelling house. This entrance is designed to facilitate ease of access for everyone.
The fixed frame of the door is 150 mm × 70 mm in cross-section and is thermally broken. The external wall has a 100 mm concrete block outer leaf, a 200 mm timber frame inner leaf and a 60 mm insulated service cavity.
The ground floor is an insulated solid concrete floor with a 20 mm quarry tile finish.



(a) To a scale of 1:10, draw a vertical section through the centre of the door. Show the typical construction details from 500 mm below the finished floor, through the floor, the threshold, the external wall, the door and door frame, up to a level 300 mm above the concrete lintels over the door frame.
Include **four** typical dimensions.

(b) On your drawing, show clearly the design detailing that ensures ease of access for all persons.

2. **(a)** Discuss in detail, using notes and freehand sketches, **three** functional requirements of an external wall for a dwelling house.

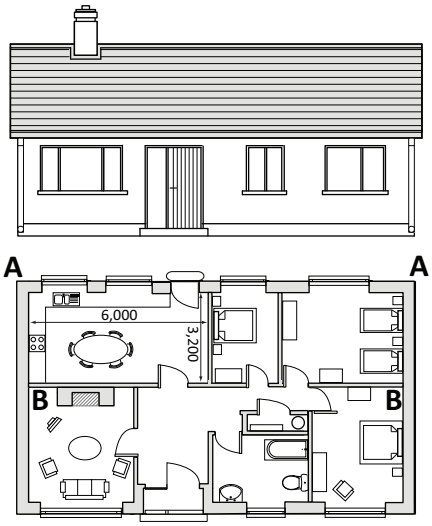


(b) Using notes and freehand sketches, show the design detailing of **two** different, distinct external wall types. Name the typical components of **each** wall type and include typical dimensions.

(c) Evaluate the design of **each** of the two wall types you have shown at **2(b)** under **each** of the following headings:

- ease of construction
- environmental considerations
- suitability for self-build.

3. The drawing shows the front elevation and ground floor plan of a bungalow built in the 1970s.
The rear wall **A-A** is south facing.
The house is of traditional construction with a slated cut roof and a 300 mm external cavity wall of concrete block construction. The internal walls are of 100 mm solid block construction and the internal wall **B-B** is a load-bearing wall.
The owners intend to build an extension, not greater than 18.0 m^2 in area, to the kitchen at the rear of the house.



(a) Using notes and freehand sketches, show a proposed design layout for the extension and the necessary modifications to the existing layout of the bungalow.

(b) Enhancing the health and wellbeing of the occupants is a critical consideration in the design of buildings.
Discuss **three** considerations that should be taken into account in the design of the extension to enhance the health and wellbeing of the occupants.

(c) Discuss **two** advantages of building an extension to the bungalow.

4. The sketch shows a row of terraced cottages built in the vernacular tradition. The owners of one of the cottages have decided to refurbish it and intend to self-build with the help of professional design and supervision.

(a) Discuss **two** advantages and **two** disadvantages of self-build as a method of refurbishment.

(b) A survey of the cottage reveals the following:

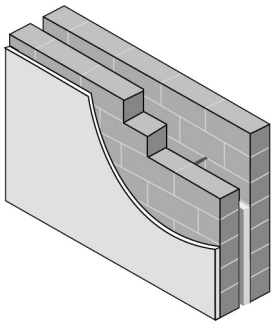
- softwood sliding sash windows with single-glazing
- uninsulated traditional cut roof with natural slates
- external random rubble walls with an internal and external lime render.

Select any **two** of the above areas and, using notes and sketches, describe in detail the steps involved in upgrading **each** area selected in a manner that respects the appearance and character of the original cottages.

5. A house built in the 1970s has an uninsulated external cavity wall, as shown.

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

External plaster	thickness	16 mm
Concrete block outer leaf	thickness	100 mm
Cavity (uninsulated)	width	100 mm
Concrete block inner leaf	thickness	100 mm
Internal plaster	thickness	13 mm



Thermal data of the external wall:

Resistance of external surface	(R)	0.048	m^2	°C/W
Conductivity of plaster	(k)	0.430	W/m	°C
Conductivity of concrete blockwork	(k)	1.440	W/m	°C
Resistance of cavity	(R)	0.170	m^2	°C/W
Resistance of internal surface	(R)	0.104	m^2	°C/W

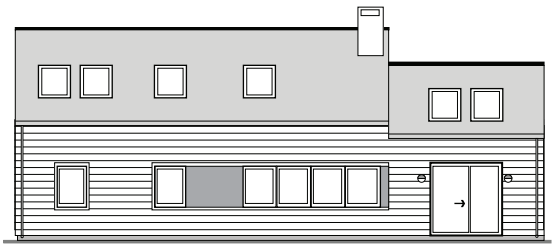
(b) Using the U-value of the wall obtained at **5(a)** above and the following data, calculate the cost of heat lost annually through this wall:

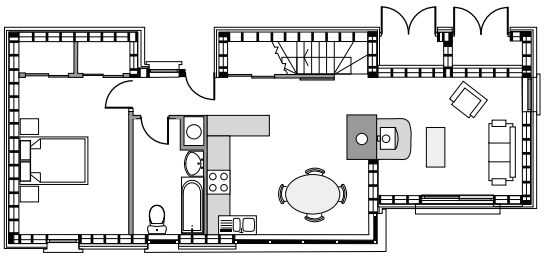
- area of external wall — 120 m^2
- average internal temperature — 17 °C
- average external temperature — 6 °C
- heating period — 8 hours daily for 38 weeks per annum
- cost of oil — 94 cent per litre
- calorific value of oil — 37350 kJ per litre
- 1000 Watts — 1 kJ per second.

(c) It is proposed to upgrade the thermal properties of the above wall, to meet the ***EnerPHit*** Passive House standard, by fixing expanded polystyrene to the external surface.

Given the thermal conductivity (k) of expanded polystyrene as 0.037 W/m°C, calculate the thickness of expanded polystyrene required to achieve a U-value of 0.15 W/m^2 °C.

6. The elevation and ground floor plan of a house are shown. The house also has two bedrooms and a bathroom upstairs. The external walls are of timber frame construction with an external rainscreen of native larch. The house is designed to have a low environmental impact.



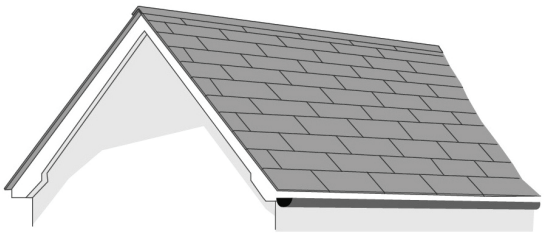


(a) With reference to the design shown, discuss using notes and freehand sketches, **three** features of the design that contribute to the house having a low environmental impact.

(b) Low operating costs are an important consideration when designing new eco-friendly homes. Using notes and freehand sketches, describe **two** other design features that could be included to further reduce the operating costs of the house.

(c) Discuss in detail **two** advantages of using local materials when building an eco-friendly house.

7. A single-storey house, with an internal span of 6.0 metres, has a traditional cut roof which is slated and has a pitch of 45 degrees. The roof is supported on a 400 mm external concrete block wall with a full-fill insulated cavity. Insulated plasterboard is fixed to the underside of the rafters and is finished with a skim coat.



The 225 mm × 40 mm floor joists are supported on the external wall and a 100 mm internal load-bearing concrete block wall. The attic floor is finished with 25 mm tongue-and-groove floor boards.

(a) To a scale of 1:10, draw a vertical section through one half of the roof structure from eaves up to ridge, showing one external wall and one rafter length. Show the typical construction details from 500 mm below the floor joists to the ridge and include **three** courses of slate at the eaves.

Include **four** typical dimensions of the roof structure.

(b) Indicate on your drawing design detailing to ensure the roof is ventilated.

8. A modern wood-burning stove as shown, combined with a solar collector, is used to provide central heating and hot water for a two-storey house.

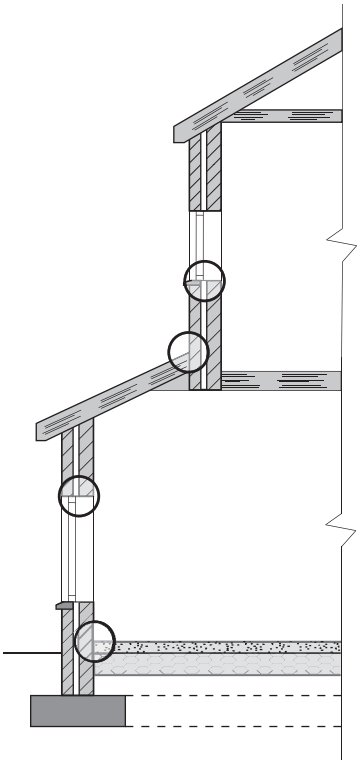
(a) Using notes and a single-line diagram, show a typical design layout for both the central heating **and** the hot water system. Show **two** independently controlled heating zones, one on each floor, and include **three** radiators on each floor. Indicate the location of the control valves and give the typical sizes of the pipework.

(b) Using notes and freehand sketches, describe **two** features that ensure that the system operates safely at all times. Discuss the importance of **each** safety feature outlined.

(c) Using notes and neat freehand sketches, show **two** design considerations that should be taken into account when selecting a preferred location for both the chimney and the stove. Discuss the importance of **each** consideration outlined.

9. The drawing shows an outline section through a two-storey house of timber frame construction with a rendered concrete block outer leaf. Both roofs are slated.

Careful design detailing is essential to prevent the penetration of dampness at the critical locations circled on the drawing.

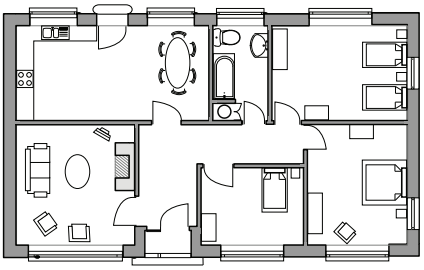


(a) Select any **three** locations from those circled on the drawing and, using notes and freehand sketches, show best practice design detailing that will prevent the penetration of dampness at **each** location.

(b) Discuss in detail the importance of ensuring moisture does not penetrate to the inner leaf of a wall of timber frame construction.

10. The elevation and plan of a house built in the 1980s are shown. The owners intend to carry out a deep retrofit upgrade of the house to meet the ***EnerPHit*** Passive House standard.

(a) Discuss **two** advantages of retrofitting an existing house to meet the ***EnerPHit*** Passive House standard.



(b) Using notes and freehand sketches, show the design detailing necessary to achieve the ***EnerPHit*** Passive House standard in **each** of the following areas:

- external wall
- windows and glazing
- airtightness.

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

- thermal bridging
- indoor air quality
- solar shading.

OR

10. "Buildings are directly responsible for 40% of energy use in Ireland and are major emitters of carbon. Upgrading our buildings so that they use less energy is one of the most cost-effective ways to reduce our greenhouse-gas emissions. Building renovation also yields other substantial benefits – environmental, economic and social. These co-benefits can accrue to the building users (e.g. increased comfort and better health) but also to society (e.g. job creation and energy security)."

Adapted from: **Introducing Minimum Energy Efficiency Performance Standards in the Rental Sector: A Review June 2019**
Irish Green Building Council

Discuss the above statement in detail and propose **three** best practice guidelines that would promote the environmentally sustainable refurbishment of existing buildings in Ireland.

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