**Coimisiún na Scrúduithe Stáit**
***State Examinations Commission***

***Leaving Certificate Examination, 2015***

# *Construction Studies*

## *Theory - Higher Level*

***(300 marks)***

***Friday, 12 June***
***Afternoon, 2:00 to 5:00***

***(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 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.*

**1.** The main entrance to a dwelling house is designed to facilitate ease of access for everyone. The door shown is a high performance insulated wooden door with vertical sheeting on both sides. The door frame is 150 mm × 70 mm in cross-section and is fixed in the external wall.
The 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 finished floor, through the floor, the threshold, the external wall, the door and doorframe to a level 300 mm above the top of the door frame.

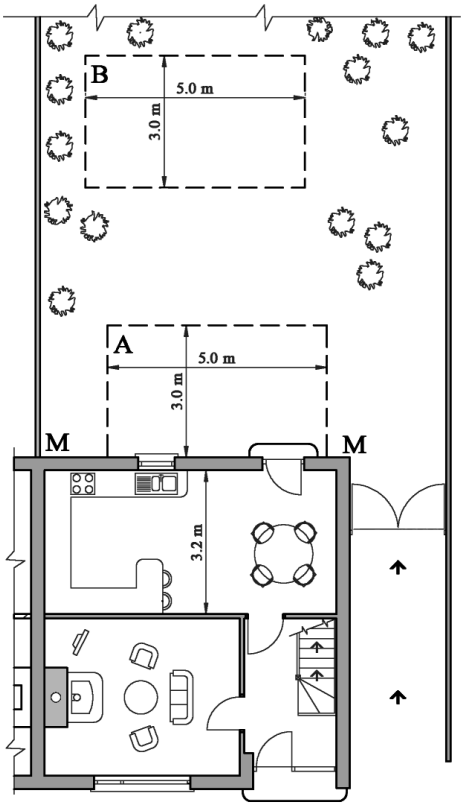
**(b)** On your drawing, show clearly the design detailing that ensures ease of access for all persons.

**2.** **(a)** Using notes and freehand sketches, discuss **three** functional requirements of an external wall for a new dwelling house.

**(b)** Using notes and freehand sketches, show the design detailing of **three** different, distinct external wall types suitable for a new dwelling house. For **each** wall type, specify the materials to be used and include typical dimensions.

**(c)** Evaluate the design of any **two** of the wall types at **2(b)** above. Recommend a preferred external wall type for a new house and justify your recommendation.

**3.** The drawing shows the ground floor plan of a two-storey semi-detached house and a portion of the rear garden. The external walls of the house are 400 mm concrete block walls with a full-fill insulated cavity.
The rear wall **M-M** is south facing.
The owners need an additional space for use as a study and occasionally as a family space. The space is to have internal dimensions of 5.0 metres × 3.0 metres as shown.




The following options are being considered:

(i) building a single-storey extension onto the rear of the house at **A**.

***or***

(ii) building a detached, free-standing space in the garden at **B**.

**(a)** Discuss in detail **two** advantages and **two** disadvantages of **each** option listed at (i) **and** (ii) above.

**(b)** Select **one** of the above options and, using notes and freehand sketches, show a proposed external design **and** internal layout for an attractive study/family space. Show in your design how the proposed space is to link with the surrounding rear garden.

**(c)** Discuss **two** advantages of designing a space that links with the rear garden.

**4**. **(a)** Discuss the importance of any **two** of the following in the eco-refurbishment of an old house built in the vernacular tradition:

- respect for local character
- breathable structure
- reuse of materials.

**(b)** A row of single-storey cottages is shown in the sketch. **One** of the cottages is in need of significant refurbishment.

A survey of the cottage reveals:

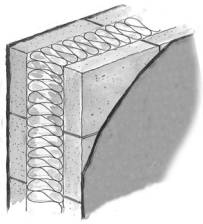
- un-insulated traditional cut roof with natural slates
- softwood windows, single-glazed with sliding sash
- un-insulated suspended timber floor.

Select any **two** of the areas at **4(b)** above and, using notes and freehand sketches, describe the steps involved in upgrading **each** area selected in a manner that respects the appearance and character of the original cottages.

**5.** **(a)** Using the following data, calculate the U-value of the external wall of a new dwelling house.
The wall is of concrete block construction, with a 250 mm cavity.
The cavity is a full-fill insulated cavity, with polystyrene bead insulation as shown.

***Specification of external wall:***

| | | |
|---|---|---|
| External render | thickness | 16 mm |
| Concrete block outer leaf | thickness | 100 mm |
| Cavity | width | 250 mm |
| Concrete block inner leaf | thickness | 100 mm |
| Internal plaster | thickness | 12 mm |



***Thermal data of external wall:***

| | | | | |
|---|---|---|---|---|
| Resistance of external surface | (R) | 0.048 | $m^2$ | °C/W |
| Conductivity of external render | (k) | 0.720 | W/m | °C |
| Conductivity of concrete blocks | (k) | 1.440 | W/m | °C |
| Conductivity of polystyrene bead | (k) | 0.031 | W/m | °C |
| Conductivity of internal plaster | (k) | 0.220 | W/m | °C |
| Resistance of internal surface | (R) | 0.122 | $m^2$ | °C/W |

**(b)** Using the U-value obtained at **5(a) and** the data given below, calculate the cost of heat lost annually through the external walls of **each** of the following:

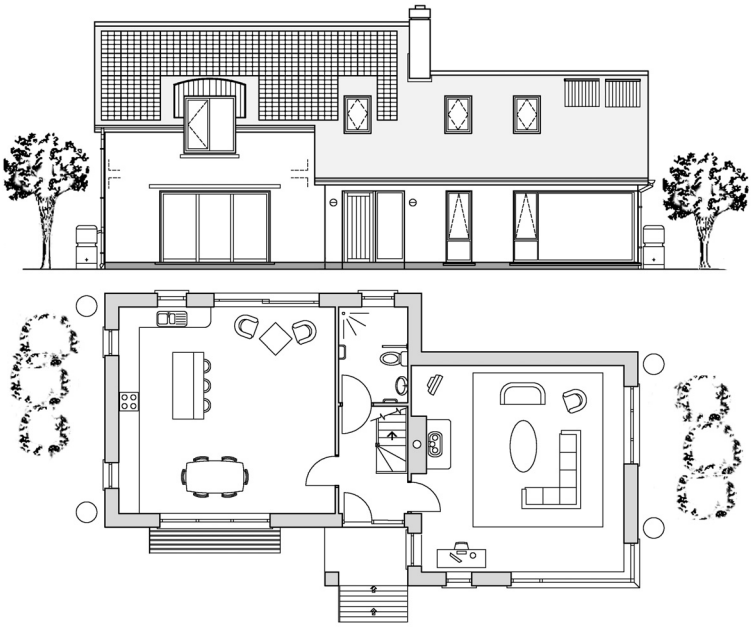
- the new house - as specified at **5(a)** above ***and***
- an existing house that complies with current Building Regulations, having a U-value of 0.21 $W/m^2$ °C for the walls.

***Data for both houses:***

| | |
|---|---|
| Area of external wall of each house | 150 $m^2$ |
| Average internal temperature | 20 °C |
| Average external temperature | 6 °C |
| Heating period | 8 hours per day, every day for 35 weeks per annum |
| Cost of oil | 95 cent per litre |
| Calorific value of oil | 37350 kJ per litre |
| 1000 watts | 1kJ per second. |

**(c)** Using notes and freehand sketches, show best practice design detailing to prevent the ingress of water at the window head in the wall of the new house specified at **5(a)** above.

**6.** The elevation and ground floor plan of a house are shown. The house has three bedrooms and a bathroom upstairs. The external walls are of timber frame construction with a rendered concrete block outer leaf. The house is designed to maximise solar energy, as shown, and to have low environmental impact.



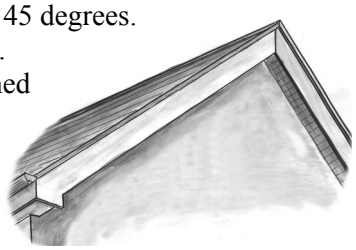
**(a)** Using notes and freehand sketches, discuss **three** features of the design that ensure that the house has low environmental impact.

**(b)** Using notes and freehand sketches, discuss the importance of any **two** of the following in designing a house to have low environmental impact:

- compact form
- flexible design
- low maintenance.

**(c)** Discuss in detail the importance of designing nearly zero energy buildings (NZEB) for the 21st century.

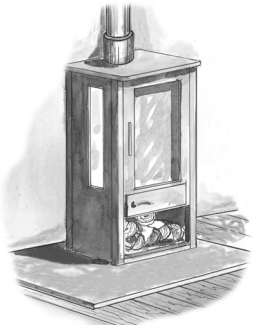
**7.** The roof of a new house, as shown, is a traditional cut roof and has a pitch of 45 degrees. The house has an internal width of 6.0 metres and the roof is highly insulated. Insulated plasterboard is also fixed to the underside of the rafters and is finished with a plaster skim coat. The external wall supporting the floor joists is a 400 mm concrete block wall with a full-fill insulated cavity. The 225 mm × 40 mm floor joists are supported centrally on 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 up to the ridge and include three courses of slate at eaves. Include **four** typical dimensions of the roof structure.

**(b)** Include on you drawing, best practice design detailing to ensure ventilation of the roof structure.

**8.** A wood-burning stove combined with a solar collector is to provide central heating and hot water for a three bedroom, two-storey dwelling house.

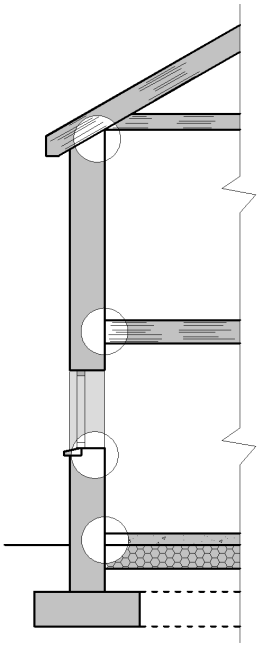


**(a)** Using notes and a single-line diagram, show a typical design layout for both the heating system **and** the hot water system. Show **two** independently controlled heating zones, one on each floor, and include **three** radiators on each floor. Indicate the location of the control valves and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

**(b)** Using notes and freehand sketches show a preferred location for a solar collector that will ensure its maximum efficiency.

**(c)** Using notes and freehand sketches, discuss **two** considerations that should be taken into account at the design stage of the house when selecting a location for **both** the chimney and the hot press. Justify your design choices.

**9.** It is proposed to design the external envelope of a dwelling house to be thermal bridge free. The drawing shows an outline section through a two-storey house having a 450 mm external concrete block wall with a 250 mm full-fill insulated cavity.
The roof is a traditional cut roof, the first floor has tongue-and-groove flooring on timber joists and the ground floor is an insulated solid concrete floor.

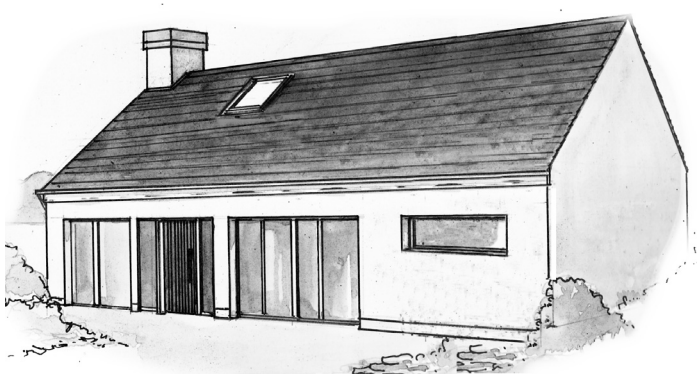


**(a)** Select any **three** locations from those circled on the drawing and, using notes and freehand sketches, show best practice design detailing that will prevent the formation of a thermal bridge at **each** location selected.

**(b)** Discuss the importance of designing a building envelope that is thermal bridge free.

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

- airtight building envelope
- space heating demand
- indoor air quality.



**(b)** Using notes and freehand sketches, discuss the importance of thermal mass in the design of a Passive House.

**(c)** Using notes and freehand sketches, discuss the function of carefully designed solar shading for the Passive House shown.

## OR

**10.** Light is what architecture is all about. It is as fundamental for the soul as air, fire, earth and water. Light has been one of the key elements of architecture since the Modern movement began (and glass technology improved) at the turn of the 20th century. Yet, light has traditionally been lacking in Irish homes. Many old cottages only have windows on the south side and none on the north. Now glass has improved and windows can be made with incredibly low U-values (meaning it doesn't let the cold through), so you can now have large glazed areas without heat loss. We need light and instinctively search for it. People move to the part of the room where there is natural light and children instinctively play in pools of light.

Adapted from *LOVE YOUR HOME Secrets to a Successful Space* by Dermot Bannon (2014)
Published by Gill & Macmillan. ISBN: 978 07171 6448 6

Discuss the above statement in detail and outline how advances in glazing technology have led to the increased use of glass in house design.
Recommend **three** best practice guidelines that would encourage better use of natural light in the design of contemporary dwelling houses.

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