Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2012

Construction Studies

Theory - Higher Level

(300 marks)

Friday, 15 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.*

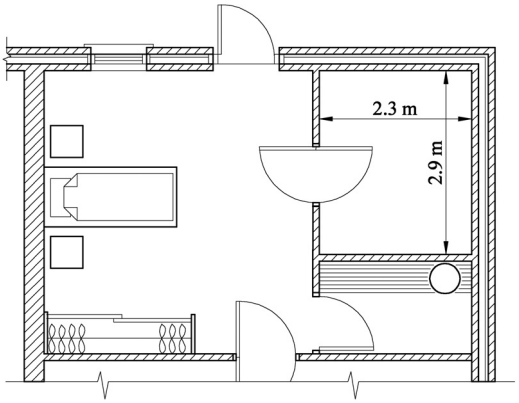
1. A triple-glazed bay window projects 1.5 metres from the external wall of a dwelling house, as shown in the accompanying sketch. The external wall is a 350 mm concrete block wall with an insulated cavity. The lean-to roof is an insulated slated roof and has a pitch of 30°. Insulated plasterboard is fixed to the underside of the rafters to form a sloped ceiling.

(a) To a scale of 1:5, draw a vertical section through the window, roof and front wall of the house. The section should show the typical construction details from 400 mm below the concrete lintels of the bay window, through the fixed frame of the window, wallplate and rafter to a level 400 mm above the abutment of the lean-to roof and the front wall of the house.

(b) Indicate on your drawing the design detailing that ensures moisture does not penetrate at the abutment of the roof and the wall of the house.

2. **(a)** Discuss in detail, using notes and freehand sketches, **two** functional requirements of a dwelling house designed for lifetime use. Refer in particular to the:

- main entrance **and**
- internal corridor layout.



(b) The layout of a bedroom and an adjoining bathroom, which is 2.3 m × 2.9 m, is shown in the accompanying drawing. The hot press is also shown.

Using notes and freehand sketches, show a preferred layout for the bathroom space to ensure that it is suitable for a person in a wheelchair. Indicate in your design sketches the location of the following:

window, shower area, toilet, wash hand basin and grab rails.

Include **three** typical dimensions.

(c) Discuss your preferred location for the bathroom items listed at **2(b)** above.

3. The drawing shows the elevation and plan of a semi-detached house with an adjoining storeroom. All external walls are of single leaf 215 mm hollow block construction and all roofs are slated. All internal walls are of solid block construction and the internal wall **A-A** is load-bearing. The storeroom wall **B-B** is south facing.
It has been decided to convert the storeroom in order to enlarge the living space.
In the conversion, you need to give consideration to:

- redesigning the ground floor layout to allow increased penetration of sunlight to the interior

and

- upgrading the thermal properties of the external walls.

(a) Show, using notes and freehand sketches, a revised design detailing for the dwelling house.

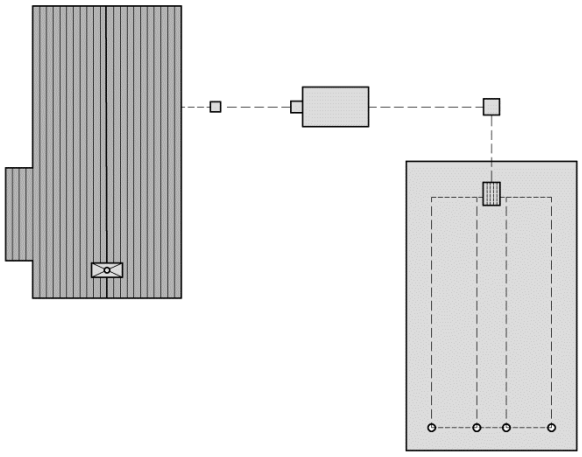
(b) For **each** of the above, discuss in detail the reasons for your proposed design choices.

4. The typical layout of an on-site wastewater treatment system suitable for a single house is shown in the accompanying drawing.

(a) Describe in detail, using notes and freehand sketches, the operating principles of a conventional septic tank system.

(b) Show, using notes and freehand sketches, the typical design detailing for the percolation area to ensure the safe treatment of waste from the septic tank. Include dimensions as appropriate.

(c) Discuss in detail **three** reasons why a proposed site for a dwelling house may be unsuitable for a conventional septic tank wastewater treatment system.



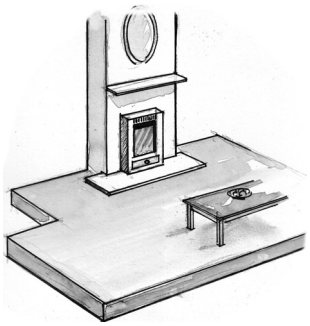
5. A house built in the 1970s has an un-insulated solid concrete ground floor with a sand/cement fine screed finish.

(a) Calculate the U-value of the concrete ground floor given the following data:

Sand/cement fine screed	thickness	60 mm
Concrete floor slab	thickness	100 mm
Damp proof membrane (DPM)	thickness	0.25 mm
Sand blinding	thickness	50 mm
Hardcore	thickness	225 mm
Subsoil	thickness	300 mm

Thermal data of concrete ground floor:

Resistance of internal surface	(R)	0.104	m^2	°C/W
Resistivity of fine screed	(r)	0.710	m	°C/W
Conductivity of concrete floor slab	(k)	0.160	W/m	°C
Conductivity of DPM	(k)	0.250	W/m	°C
Conductivity of sand blinding	(k)	0.160	W/m	°C
Conductivity of hardcore	(k)	1.330	W/m	°C
Conductivity of subsoil	(k)	1.800	W/m	°C

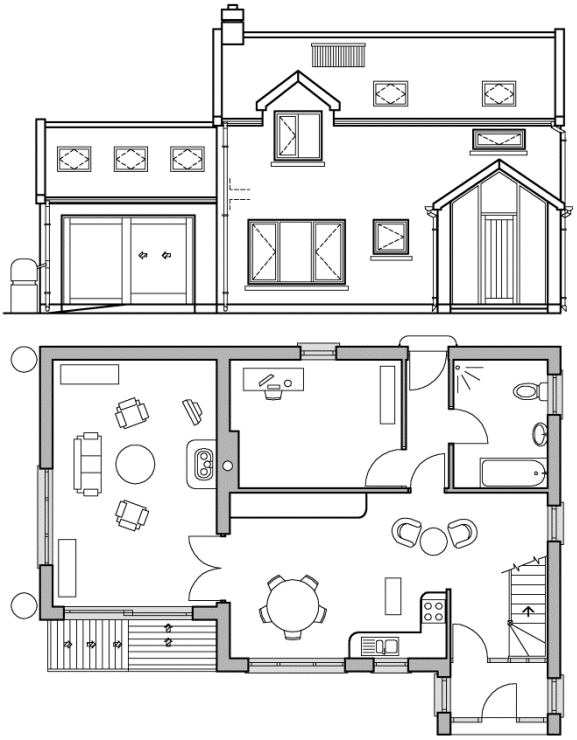


(b) Using the U-value of the concrete ground floor obtained at **5(a)** above and the following data, calculate the cost of heat lost annually through the un-insulated concrete floor slab:

Dimensions of floor	9.0 metres × 7.0 metres
Average internal temperature	20° C
Average external temperature of subsoil	5° C
Heating period	12 hours per day for 40 weeks per annum
Cost of oil	85 cent per litre
Calorific value of oil	37350 kJ per litre
1000 Watts	1 kJ per second.

(c) An insulated concrete ground floor is designed to prevent the penetration of radon gas through the floor and to meet the Passive House standard. Using notes and freehand sketches, show the typical design detailing for such a floor.

6. The elevation and ground floor plan of a house are shown. The house has a study / office as shown and also has three bedrooms and a bathroom upstairs.
The external wall is of timber frame construction with a concrete block outer leaf.
The house is designed to have low environmental impact, reflecting the sustainable ideal of doing more with less for longer.

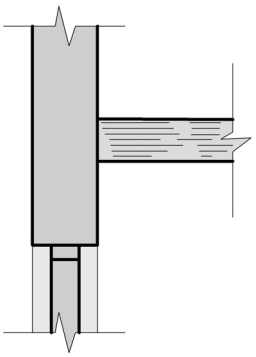


(a) With reference to the design shown, discuss in detail, using notes and freehand sketches, **three** features of the design that reflect the sustainable ideal of doing more with less for longer.

(b) Discuss in detail the importance of **each** of the following when designing an environmentally sustainable dwelling house:

- orientation of house
- flexibility of design
- sourcing of materials.

7. The main entrance door to a two storey dwelling house is a four-panel solid wooden door. The external wall in which the door is fitted is of timber frame construction with a rendered concrete block outer leaf. This wall supports the first floor joists, as shown in the accompanying outline drawing.



(a) To a scale of 1:5, draw a vertical section through a portion of the external wall, doorframe, door and first floor joists. The section should show the typical construction details from 400 mm below the top of the door to a level 500 mm above the first floor joists. Include typical dimensions.

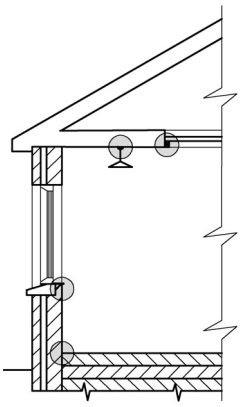
(b) Show clearly on your drawing the position of the vapour control layer to ensure an airtight structure.

8. **(a)** Show, using notes and freehand sketches, the correct wiring layout for **two** electrical sockets in a ring mains circuit for a domestic electrical installation. Indicate on your sketch the sizes and the colour coding of all electrical cables used in the circuit.

(b) Show, using notes and freehand sketches, **two** safety features that should be incorporated into the design of the above circuit to ensure that the circuit is safe for all users.

(c) Discuss in detail **two** strategies that would ensure the economical use of electricity in the home.

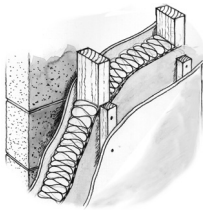
9. Designing for airtightness presents one of the most challenging aspects of contemporary house design.



(a) Discuss in detail the importance of careful design detailing in improving the airtightness performance of a dwelling house.

(b) The drawing shows an outline section through a portion of a single storey house of timber frame construction. The outer leaf is of rendered concrete block and the ground floor is an insulated solid concrete floor.
Select any **three** locations from those circled on the sketch and show, using notes and freehand sketches, the typical design detailing which will prevent air leakage at **each** of the locations selected.

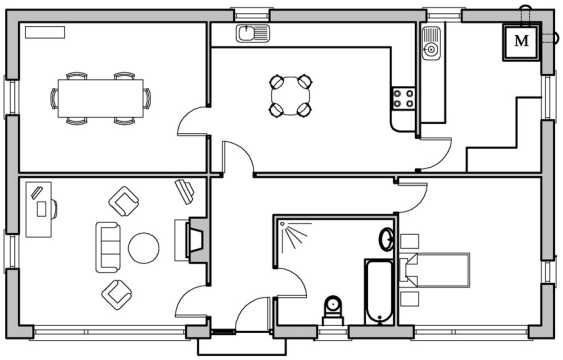
(c) Discuss the advantages of including a service cavity in an external wall of timber frame construction, as shown in the accompanying sketch.



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

- building form
- indoor environment
- energy performance.

(b) It is proposed to install a Mechanical Heat Recovery with Ventilation (MHRV) system for a Passive House, as shown in the drawing. The location of the MHRV unit - **M** - in the utility room is shown.
Draw a single line diagram of the given plan and show a typical design layout for the ducting to such a unit. Indicate clearly the direction of airflow in all the ducts and describe how a Mechanical Heat Recovery with Ventilation (MHRV) system works.



***Note**:*
While a plan of the room layout is required, it is not necessary to show the furniture.

(c) Discuss in detail **two** advantages and **two** disadvantages of Passive House construction.

OR

10. "A sustainable ethos in building will require the consideration of environmental implications associated with design, construction and operation of buildings and neighbourhoods; and greater emphasis on the improvement of existing buildings. Most buildings are used for several decades, and many survive for centuries. As the community's principal physical asset, getting good value requires that the building's full life cycle be considered, avoiding short-sighted attempts to merely minimise initial cost."

THE GREEN VITRUVIUS – PRINCIPLES AND PRACTICE OF SUSTAINABLE ARCHITECTURAL DESIGN (2011)
by Vivienne Brophy and J Owen Lewis (UCD). - *Earthscan Ltd, 14a St Cross Street, London ECIN 8XA, UK*

Discuss the above statement in detail and propose **three** guidelines that would promote the development of environmentally sustainable housing in Ireland.

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